MURBY'S SCIENCE SERIES

PRINCIPLES OF HYGIENE.

BY

ALBERT CAREY

MURBY'S "SCIENCE AND ART DEPARTMENT" SERIES OF TEXT BOOKS.

PRINCIPLES OF HYGIENE:

EXPRESSLY ADAPTED

TO

THE REQUIREMENTS OF THE SYLLABUS

OF THE

SCIENCE AND ART DEPARTMENT, SOUTH KENSINGTON.

BY ALBERT CAREY, F.R.G.S.,

Author of "Principles of Agriculture," &c.

Revised Edition.

London:

THOMAS MURBY,

7.2.85

3, LUDGATE CIRCUS BUILDINGS, E.C.

LONDON:
THOMAS G. JOHNSON PRINTER,
121, FLEET STREET E.C.

PREFACE.

THE *chief* design of this little work on *Hygiene* is to meet the requirements of the Syllabus of the Science and Art Department.

The Index consists of the Syllabus itself, the heads of which form corresponding divisions in the body of the work.

This arrangement has been adopted because the outlines of the Syllabus appear to be sufficiently comprehensive to embrace a good general knowledge of the rules designed for the promotion of health.

For this reason it is hoped that the work may be of interest to the public at large as well as to the student of Hygiene.

The Publisher takes the opportunity of acknowledging the receipt of some valuable hints from science teachers which will be found embodied in the present Edition.

With a view to the more logical arrangement of the subject matter than that suggested by the Syllabus, certain transpositions have been made, which, for the guidance of those using the former Edition, may be thus indicated: 1. The paragraphs on the comparative merits of Animal and Vegetable Food which formed the conclusion of Chapter IV., now appear at the end of Chapter II. 2. The order of Chapters XX. and XXI. has been transposed. 3. Sections in Chapters XXVI. and XXVII. have also been re-arranged.

It is hoped that the alterations alluded to may add to the value of the work, as already evinced by this early call for a Second Edition.

March, 1884.

CONTENTS.

DIVISION III.—Air.

DIVISION IV.—Removal of Waste and Impurities.

DIVISION V.—Shelter and Warming.

DIVISION VI.—Local Conditions.

DIVISION VII.—Personal Hygiene.

DIVISION VIII.—Treatment of Slight Wounds and Accidents.

HYGIENE.

INTRODUCTION.

The word *Hygiene* is derived from *Hygeia*, the fabled goddess of Health, daughter of Esculapius, the god of the healing art; and the term is understood to embrace that department of medical science which treats of the *preservation of health.*

It is consequently a subject of vital importance, intimately connected with the well-being of every individual from the beginning to the end of life.

The subject of *Hygiene* is not only vitally important, but of far-reaching extent, requiring for its complete mastery a study of several distinct and widely diversified branches of knowledge.

Thus it includes, in the first place, a knowledge of *Animal Physiology*, which treats of the functions of the various parts or organs of animal bodies; while to the departments of *Pathology* and *Anatomy* in medical science may be referred the treatment of wounds and accidents included under the special head of Personal Hygiene.

Hygiene also deals with those parts of *Physical Geography* relating to local conditions of soil, aspect, elevation, and prevailing winds, which are important factors in the life-tenure of every individual.

The construction of dwelling-houses, the manufacture of textile fabrics, and the preparation of food belong to the *industrial arts*, giving rise to our numerous gigantic industries.

To deal adequately with so many great subjects would require as many distinct treatises. But this is beyond our present purpose, which is simply to furnish the student with as much of the essentials as may be necessary to an intelligent study of the principles of Hygiene. To do this within the limits of so small a volume, without giving to our work the appearance of a *cram-book*, may not, at first sight, seem possible.

But by keeping well within the lines laid down in the Syllabus of the Science and Art Department, we have found it possible to present the leading features of the subject not only within the space at our disposal, but in a way that may possibly render the volume serviceable as well to the public at large as to the student preparing for examination.

Notwithstanding the vital importance of the study of Hygiene, it has only of late years commanded a degree of attention at all commensurate with its merits. The "Report of the Sanitary Condition of the Labouring Population of Great Britain," published in 1842, may be regarded as the starting point of modern sanitary science in this country.

By comparing the past with the present, we find that *both the value and duration of human life have increased;* statistics showing that in England men live two years longer and women three and a third longer than they did thirty years ago.

Taking a longer survey, the actual *strength and build* of men and women are also found to have increased. The stalwart Englishman of the present day can neither get into the armour nor be placed in the sarcophagus of the doughty heroes of olden times.

We find, moreover, in our comparative freedom from epidemics, and the more deadly of the zymotic diseases, and in the consequent lowered death-rate, that, speaking broadly, fevers, cholera, small-pox, and other deadly maladies exist at the present day but temporarily and, as it were, accidentally.

The important advances that have been made in "sanitary science" are also shown by the fact that pestilences have lost their virulence, gaol fever has disappeared, ague is seldom met with, and that fell destroyer, known as Black Death, is heard of no more, though a form of it still lingers perhaps in malignant typhus.

Let it not be understood, however, that all these scourges are entirely eradicated. Disease, and the danger of disease, are ever imminent, and, unless provided against, their devastations may again break out with their old fatality, and become agents of mortality under a system of accidental or perverse ignorance of the laws of health.

We know that death may lurk in the sub-soil, that a defect in an elaborate system of drainage may be more disastrous than no drainage at all, that the nose is an unsafe guide, and that we may be poisoned without knowing it till the dire effects assert themselves.

Should that happy time come when it shall be *practically* acknowledged that "cleanliness is next to godliness," *i.e.*, when sanitary science shall prevail, then shall disease be at its minimum throughout the length and breadth of Old England.

Division I.—Food, Diet, and Cooking.

CHAPTER I.

CLASSIFICATION OF FOOD SUBSTANCES.

In classifying the elements of food it is usual to arrange them in two divisions—the *inorganic* and the *organic*.

The *inorganic part*, termed the ash or mineral, is composed of earthy matters. Of these, phosphate of lime supplies material for bone ; salt and iron enter into the composition of the blood; while small proportions of carbon, potash, soda, magnesia, and other minerals enter into the juices of the animal frame.

The *organic portions* are divisible into two classes, the nitrogenous and the non-nitrogenous; the former mostly* entering into the composition of the animal tissues, and the latter chiefly maintaining the heat of the body.

TABLE OF FOOD SUBSTANCES.

ORGANIC.		INORGANIC.
* *NITROGENOUS.*	*NON-NITROGENOUS*	*MINERAL.*
Albumen Gluten Fibrin Syntonin Casein Gelatin Chondrin	Fats Amyloids Starch Dextrin Sugar Gum	Water and Saline Matters. Phosphate of Lime Salt Potash Soda, &c.

* It has been recently shown that each of these classes of food elements is capable of assisting to a slight extent in doing the work of the other.

The organic substances mentioned in the preceding table may be thus briefly described :—

I.—NITROGENOUS.

Albumen, a thick, viscous substance, forming a constituent part of both animal fluids and solids, existing nearly pure in the white of egg, and identical with the serum of the blood.

Gluten, a viscous, tenacious substance, found in wheat and other grains. It gives adhesiveness to flour, from which it may be separated by repeated washings.

Fibrin, the most important element in animal nutrition, a peculiar organic compound found in animals and vegetables. Pure fibrin is white, tough, elastic, and fibrous.

Syntonin is a kind of fibrin obtained by treating muscular tissue with dilute acid.

Casein is the curd of milk, which remains in solution while the milk is fresh, but coagulates when the milk is sour, or has an acid added to it. Casein very closely resembles albumen, and is abundant in the seeds of leguminous plants.

Gelatin, a kind of jelly extracted by boiling connective tissue, tendons, ligaments, bones, &c. Glue, size, and isinglass are different forms of this substance.

Chondrin, a substance obtained by boiling *cartilage*, and very much resembling gelatin.

II.—NON-NITROGENOUS SUBSTANCES.

The *Fats* contain a larger amount of carbon and hydrogen in proportion to oxygen. Of these there are several varieties, such as margarin, olein, stearin, and cholesterin.

The *Amyloids*, which include starch, dextrin, sugar, and gum, contain less carbon and hydrogen, in proportion to oxygen, than the Fats, the oxygen and hydrogen being in the proper proportions to form water.

CHAPTER II.

USE OF FOOD SUBSTANCES.

THE use of food is (1) *to replace the constant waste*, (2) *to maintain the animal heat*, and (3) *to supply material for building up the bodily frame*—in the case of young and growing animals.

1. *Constant Waste.*—The ordinary bodily movements may be intermittent or constant; these again may be perceptible or imperceptible, but in either case the performance of any function is invariably accompanied by a corresponding waste of tissue.

Whether we are in the active exercise of life's daily duties, or whether we are at rest—awake or asleep—waste of *some kind* goes on; for such movements as are connected with respiration, the beating of the heart, the circulation of the blood, and the processes of digestion and assimilation, are unceasing as long as life continues.

2. *The Maintenance of the Bodily Heat.*—The temperature of the body in man is remarkably constant, ranging from 98° to 100° Fahr., and it undergoes but little change under the opposite conditions of polar cold or tropical heat.

Just as the mechanical power of a steam engine is due to the heat-force generated by the *burning of the fuel in its furnace*, so, by the force evolved in a similar process of burning, but of course at a much lower temperature, are the various actions of the body accomplished. In the production of this force, some of the materials existing in the body undergo the chemical change known as *combustion*.

Respiratory, heat-forming, or, as it is sometimes called, carbonaceous or fuel food, abounds in carbon and hydrogen (see table, p. 10). It is the combustion of the carbon by means of the oxygen drawn into the lungs at every breath, which develops and maintains the animal heat.

The chief heat-formers, as already stated, are starch, sugar, and fats. In starch and sugar, the *carbon only* is burnt or oxidised; but in *fats*, the large excess of *hydrogen* is also oxidised, as well as the carbon. In consequence of this, the fatty substances in food contribute a much larger degree of heat than either starch or sugar.

While life remains, the body always preserves a certain amount of heat, and this is retained for a little while after death. The approach of this great change is generally indicated by a diminution of temperature; and when the spirit has fled, the heat of the lifeless body becomes rapidly dissipated, ultimately acquiring the same temperature as that of surrounding objects.

The connection of life with the preservation of animal heat is, therefore, an obvious fact, and the maintenance of this heat is an act of life brought about by means of the food we eat, and *constitutes* *an important source of waste of the tissues of the body.*

3. *Material supplied for building up the Animal Frame.* Young and growing animals have a third imperative demand upon their food, in addition to the two already mentioned.

Their growing bodies have to be built up and fully formed ; consequently an infant requires much more nitrogenous food than an adult in proportion to the weight of its body. We accordingly find them eating much and often.

The natural food of infancy is *milk*, which is a compound aliment, containing *casein*, a flesh-former, with certain *mineral* substances in its whey, and *fat*, a heat-giver, in its cream. Thus, in the mother's breast are collected from the animal, vegetable, and mineral kingdoms the various substances necessary for the support of infant existence. The proportions in which they are united in this perfect food evince the wisdom and care of the Creator, who regards the wants of the infant with the same tender adaptation of food to circumstances as those of the adult.

Later in life, when the formation of the teeth permits more solid nutriment to be taken, we learn to mix our foods, in order to obtain *all* the *requisite qualities* necessary to the support of the animal frame.

It has been estimated that a healthy man, of ordinary size, throws out of his system daily, as waste matter, about 4,600 grains of carbon and 300 grains of nitrogen. In order to keep such a man in health, his daily food should contain, in a convertible form, *at least* the same amount of carbon and nitrogen.

Now 1,000 grains of meat contain about 100 grains of carbon and 30 grains of nitrogen. In order, therefore, to obtain 4,600 grains of carbon, he would have to eat 46,000 grains of meat; but this would give 1,380 grains of nitrogen—more than four times the required quantity.

A diet consisting exclusively of animal food would not only furnish an over-supply of nitrogen, but throw an undue burden on the digestive organs.

The English are well known for their partiality to animal food, and eat much more of it than the system requires; a habit not only extravagant and wasteful, but which induces many ailments.

Many of our common articles of diet, as flour, potatoes, butter, &c., contain several of the requisite materials for a perfect food, but not in the proportions required by the system. It is on this account, though the reason may not always be known or understood, that certain *combinations* of food are in such general use, as "bread and butter," "ham and eggs," "pork and beans," "rice and sago pudding made with eggs and milk," &c.

All creatures, whether carnivorous, herbivorous, or frugivorous—bird, fish, or man—are provided by nature with food in endless variety of form and flavour, though similar in composition.

So far as mere subsistence is concerned, it signifies little whether our diet be plain and simple, or costly and luxurious. The poor man with his simple fare is furnished with as many of the elements necessary for his bodily sustenance as the wealthy epicure, for, strictly speaking, both require but a few essentials, which are as readily obtained from the coarser as from the costlier articles of diet; the ultimate needs in either case being merely such substances as best supply heat and nutriment.

This habit of mixing our food is due to something more than the mere calculation of how much of this or that substance is necessary to the support of our bodies; it is intimately connected with our tastes and higher instincts through which it exerts a powerful influence on nutrition. For, besides being grateful to stomach and palate, variety imparts a natural and healthy stimulus to the digestion and assimilation of food, and in this way becomes highly essential to the preservation of health.

While authorities are pretty well agreed as to the proximate dietetic principles necessary to sustain life, experience has also shown by numberless proofs that without *variety* in food, alimentary substances in accurate combinations and proportions sooner or later *fail*.

Uniformity in the matter of *time* and in the *characteristic features* of the respective meals is good, but absolute uniformity in their composition is bad. As Dr. Parkes says, "Sameness cloys; and with variety more food is taken and a larger amount of nutriment is introduced."

On comparing animal with vegetable food, it will be found that the former is much more concentrated and superior in nutritive qualities. It is also more easily assimilated to the uses of the body, but deficient in starchy matters, and sometimes of fat.

On the other hand, vegetable food contains carbonaceous matters in excess, while the elements of nutrition occasionally exist in each in such a condensed form as to be somewhat difficult of digestion.

A mixed diet of both animal and vegetable food is, therefore, not only convenient, but almost a necessity, which conclusion may be naturally deduced from the following points :—

(*a.*) Man's instinctive longing for a variety of food, including a flesh-diet.

(*b.*) The nauseating effect induced by the continued use of any one article of diet.

(*c.*) The formation of the human teeth and stomach.

(*d.*) The arrangement and length of the intestines.

Finally, appeal might be made to the Divine authority given to man at the beginning to use every living thing for food.

CHAPTER III.

ANIMAL FOOD.

THE food of man may be divided into animal and vegetable, each division being further divisible into solid and liquid.

Animal foods are supplied from the following sources :—

Mammalia—the ox, sheep, deer, pig, hare, rabbit, and many other animals.

Aves (birds)—the common fowl, pigeon, pheasant, partridge, turkey, goose, duck, and many kinds of wild fowl.

Reptilia (reptiles)—the green turtle and edible frog.

Pisces (fishes)—salmon, cod, mackerel, herring, eel, sprat, white-bait; flat-fish, as turbot, sole, plaice, &c.

Mollusca—the oyster, mussel, cockle, scallop, periwinkle, limpet, and whelk.

Crustacea—the lobster, crawfish, crab, prawn, shrimp, &c.

The parts of animals employed by man for food are the flesh, blood, viscera, bones, cartilages, ligaments and eggs. Thus every part of the animal is utilized, except the hair, teeth, and hoofs; and even from the latter, in the case of young animals, as the calf, we extract gelatine.

The flesh of animals is greatly influenced by their mode of life, the amount of exercise they take, and even by the manner in which they are killed to serve as food.

The flesh of wild animals is probably in a healthier state, and abounds more in the various nutritive principles, than that of domestic animals; at the same time the former is more fibrous and sinewy, and consequently tougher.

The toughness is somewhat modified by violent exercise just before death; and hence, when game is hunted, the quality of the meat is improved.

All kinds of flesh consist of two distinct portions, the fat and the lean, which vary very much in their nutritive qualities. The nitrogen of the lean promotes growth, while fat either produces heat, or becomes stored up in the fatty tissues of the body.

The constituents, whether of fat or lean, are the same in all kinds of meat, but the proportion of fat to lean varies considerably in different animals. This is important in determining the dietetic value of the meat, for on it greatly depend the flavour, strength, and digestibility of the different kinds.

The quality of the flesh of animals is determined by its tenderness and flavour, which vary according to breeding and feeding and age. The flavour depends largely on the feeding, the tenderness mostly on the age, but may be much improved by good feeding.

These two qualities have much value as promoters of the appetite, and of the relish for food.

One point is worthy of special notice: meat which contains a less quantity of blood and juices, and is less tender, contains a larger proportion of solid nutriment, and although it may be more difficult of digestion, it will prove the more valuable when it is digested.

This question is well exemplified by comparing well-fed Southdown mutton, and that of the hardy Welsh or Scotch mountain sheep; the former, a well-known variety deservedly noted for the excellence of its tender meat, but which, nevertheless, contains less nourishment than the muscular flesh of the latter.

DIFFERENT KINDS OF MEAT

Beef has the following advantages over other kinds of meat:—

1. It has stronger nutritive qualities, and a greater proportion of ozmazone—the peculiar substance on which the flavour depends.

2. Beef has a larger proportion of lean to fat, and the consequent proportion of nitrogen is higher.

3. The relative price of beef, compared with other kinds of meat, renders it the most economical.

Mutton is delicate in flavour, and very digestible, but inferior to beef in nourishment, as containing a larger proportion of fat; the greatest amount being in the Leicester sheep, the smallest in the Scotch and Welsh hardy mountain breeds.

Pork occupies a still lower position in the scale of nourishment, as it contains so much fat and bone compared to the lean. It is difficult of digestion, and therefore not fit for weak or delicate constitutions, and often causes diarrhœa even in strong people.

OTHER ANIMAL FOODS.

Chickens and *white fish* are nourishing and digestible foods for invalids.

Wild birds are more highly flavoured, and their flesh is usually preferred to that of domesticated fowls kept in yards or coops.

Fish, on the whole, is an excellent and wholesome food, and contains much nourishment, but not in such large proportion as other animal food.

Shell-fish, with the exception of the oyster, are not so nutritious, being mostly indigestible and sometimes positively pernicious.

Eggs are valuable as food, and easily assimilated when eaten raw or lightly cooked. They form a convenient, nourishing, and economical food when taken in milk, coffee, tea, or wine, for people who are not strong.

Milk.—The composition of milk is found on analysis to vary with the food, health, and age of the mother, and especially with the time which has elapsed since the birth of the offspring.

COMPOSITION OF MILK.

	Woman.		*Cow.*		*Ewe.*	*Goat.*	*Ass.*	*Mare.*
Butter ..	3·55	4·37	3·13	4·6	4·3	3·32	0·11	Trace
Caseine ..	1·52	1·54	4·48	4·0	4·5	4·02	1·82	1·62
Sugar ..	6·5	5·75	4·77	3·8	5·0	5·28	6·08	—
Salts ..	0·45	0·53	0·6	0·6	0·58	0·58	0·34	8·75
Water ..	87·98	87·81	87·02	87·0	85·62	86·8	91·65	89·63
	100	100	100	100	100	100	100	100

Cow's milk may be said to contain, on an average, 3½ lbs. of butter, 4 lbs. of caseine or cheesy matter, 4 lbs. of sugar, 9 or 10 oz. of mineral salts, and 87 or 88 lbs. of water in every 100 lbs. of milk.

Cheese is an important element in the dietary of some counties in England and Wales. As the essential element is the caseine of the milk, it ranks amongst the richest of all foods in nitrogen, and contains in addition some butter from the milk, and some salts from the whey which remain in it.

But, though nourishing, cheese is usually difficult of digestion, and consequently best suited to those who are robust and hard workers.

The amount of digestibility varies with its quality and age. When rich in fat, it is more digestible; when new, it is tough; and when old, often rancid and decayed.

There is, however, a certain degree of truth in the popular opinion that cheese favours the digestion of other foods—a fact which renders it a useful addition to every dietary containing a large amount of bread-stuffs.

One of the effects of food, and especially of animal food, is to stimulate the circulation, which is a strong reason why persons with feverish symptoms should refrain from meat, and why, in some complaints accompanied with inflammation, abstinence from solid food may be beneficial.

In hot countries the vital energies are unusually active, maturity being consequently attained at a much earlier age than with the people of temperate and colder countries. Stimulants being here less necessary, we find that animal food is sparingly used by persons residing in the tropics; the natives, taught by nature and experience, rarely touch any animal food except fish.

In cold countries, however, the retarded circulation, and the consequent tendency to torpor, have to be counteracted by the stimulus of animal food. The native of the dreary Arctic regions never feels the want of the fruits and of the vegetable productions which he is denied by the severity of the climate, but revels in an abundance of seal's flesh, or whale-blubber, consisting almost of pure oil, which affords a condensed, nourishing food to his stunted but hardy frame, maintaining him in health and strength throughout the rigour of the bitter Arctic winter.

CHAPTER IV.

VEGETABLE FOOD.

The mineral, vegetable, and animal kingdoms, at first sight, would appear to be widely separated. No one would mistake the sheep for the grass upon which it feeds, nor the grass for the soil that nourishes it. The sheep is animal, the grass vegetable, and the soil mineral. Nevertheless, sheep, grass, and soil are, for the most part, composed of the same materials; for the soil supplies food to the grass, and the grass to the sheep; in other words, the soil is by a certain process converted into grass, and the grass into sheep.

One of the distinctive features between animal and vegetable life is, that while vegetables derive their sustenance directly from the mineral kingdom, animals cannot, but require that the mineral matter must first be converted into living vegetable tissue before it can be assimilated into the animal frame.

The only exceptions to this among vegetables are some forms of *fungi* which can be nourished, like animals, only by living tissue.

A distinguishing feature between living matter, whether animal or vegetable, and mineral matter is the following. There is present in every living body a most important substance never found in the mineral world. This is *proteine* (Gr. *protos*, first), composed of carbon, hydrogen, oxygen, and nitrogen, with nearly always traces of sulphur and phosphorus, the precise quantity of each element being uncertain. However difficult it may be to determine whether or not a living body actually possesses this substance, its presence forms the only distinction that can be relied upon.

The grass makes proteine from the soil. The sheep requires proteine to nourish its frame. When we use the sheep for food, it is because *we* need proteine. Mutton is then converted into man, thus verifying the Scripture saying, "*All flesh is grass!*"

So long as life lasts proteine exists. When death takes place decomposition speedily sets in; under the influence of oxygen, now "the lord of the dead body," the complex proteine is resolved into simpler forms; atom by atom, the molecules become reduced into elementary substances; these return to the atmosphere and to the mineral world, until vegetation again seizes upon the wandering molecules and reconstructs them into proteine, and so the perpetual round goes on.

In the scope of this small work it would be useless to attempt more than an enumeration of the great variety of food substances derived from the vegetable kingdom.

Certain vegetable juices, either in a natural or prepared state, furnish pleasant beverages, while from others we get sugar, gum, and resins. Of plants, the roots, stems, pith, bark, leaves, leaf-stalks, buds, flowers, fruits, and seeds are all used, either raw or cooked, in the way of food or medicine.

The following elementary organic principles derived from plants are similar to those contained in animal food—viz., fibrin, albumen, casein, gluten, and oil; in addition, there are starch, gum, sugar, a substance called pectin, and certain organic acids.

The following list contains *most* of the varieties of vegetable productions in common use :—

EXOGENS OR DICOTYLEDONS.

Vegetables—potato, cabbage, turnip, peas, beans, carrot, parsnip, artichoke, lettuce, endive, spinach, beet, rhubarb, &c.

Fruits—orange, lemon, grape, strawberry, raspberry, currant, gooseberry, plum, peach, cherry, apple, pear, cucumber, melon, olive, fig, mulberry, &c.

Nuts—chestnut, hazel nut, and walnut, &c.

ENDOGENS OR MONOCOTYLEDONS.

Vegetables—onion, leek, asparagus, cereal grains or corn, &c.

Fruits—pine-apple, &c.

Nuts—cocoa-nut, &c.

CYPTOGAMIA.

Iceland moss, Sarragreen or Irish moss, Ceylon moss, laver, truffle, and the common mushroom.

* * * * * *

The liquid foods or drinks of man are extremely varied in their nature and composition, but may almost all be arranged under the following heads :—

Mucilaginous, farinaceous, or *saccharine drinks;* as toast-water, gruel, barley-water, &c.

Astringent or *aromatic drinks;* as tea, coffee, cocoa, chocolate, and chicory.

Acidulous drinks; as lemonade, ginger-beer, &c.

Animal broths; beef-tea, mutton-broth, &c.

Emulsive drinks; as milk, cream, &c.

Alcoholic drinks; beer, wine, spirits, &c.

CHAPTER V.

CONDIMENTS.

CONDIMENTS (Lat. *condio*, to preserve or pickle) are certain agents employed at table with which man has learnt, by nature and experience, to season his food and his drinks.

The principal condiments in common use are:—

Saline substances, as common salt.

Acidulous bodies, as acetic acid, or vinegar.

Oily condiments, as salad oil.

Saccharine bodies, as honey, &c.

Aromatic and *pungent condiments*, as nutmeg and other spices, mustard, pepper, and ginger.

It is questionable whether spices and condiments supply any nutriment to the system. As a class, they are mostly regarded rather as additions to food than in the strict sense of food itself. In a natural state of society it may certainly be said that such substances are not necessary, however agreeable they may be.

At the same time, if used in moderation, they are really conducive to health in the present state of society, in which there is so much that is artificial, and frequently such a total departure from the principles of simple nature.

Some of our highly dressed foods would probably be now not only indigestible, but most pernicious, were it not that their digestion is stimulated by the spices employed.

Their use, however, for such purposes is always attended with a degree of subsequent debility, and, if long continued, becomes a prolific source of all the miseries of intense dyspepsia. Spices and condiments are consequently salutary only when their employment is moderate, and their use occasional, but since they give a pleasant variety to food, they are not by any means to be despised.

Some of them have a slight medicinal value; thus, from cayenne pepper a *tincture* is made, from cloves an *essential oil*, while ginger and mustard are common appliances as medical auxiliaries in such cases as require them.

In all ages various spices and condiments have been much prized, and the earliest commercial intercourse of which we have any record was chiefly carried on for the sake of these commodities. They were sought after not solely as additions to food, but were also extensively used in religious rites and funeral ceremonies.

CHAPTER VI.

DIET: REQUISITES FOR MAINTENANCE.

In the exercise of his superior intelligence, man has discovered, as we have already shown, that all kinds of food, of whatever growth or clime, consist ultimately of *the same few elements.* The difference between the various food-stuffs is mainly due to the proportions, and to the peculiar mode in which those elements are combined. For instance, *sugar* differs but slightly in its component elements from *starch* and *woody fibre.* They all consist of carbon and the elements of water—hydrogen and oxygen.

It has also been stated that the great sources of the food of man are the *animal* and the *vegetable* kingdoms. With the simple exceptions of *water* and *salt*, we find scarcely any articles of food but what have once possessed either animal or vegetable life. One of the most important differences between animals and plants is, that while plants build up their tissues from such simple *inorganic* compounds as carbonic acid, ammonia, water, and saline matters, animals can only obtain nourishment from the *organic* compounds elaborated by plants. In other words, a *plant* absorbs the above simple organic compounds, and constructs from them the complex proteid and carbonaceous compounds of which its tissues are composed; while an *animal* eats either plants or animals which have fed upon plants, and thus derives its sustenance from the proteids, or flesh-forming substances which the plants or animals contain.

It is important to bear in mind the real use of food when considering the various forms in which it is presented for our consumption.

As shown in a former chapter, the term food or aliment may be applied to all those substances which, when introduced into the body, serve as materials for its growth, or for the repair of the losses which it is constantly sustaining.

All proper foods contain the three following principles:—

1. *Elements*, which build up and repair the waste of the body.

2. *Elements*, which keep up the animal heat.

3. *Mineral substances*, which supply minute quan-

tities of earthy and alkaline salts for the bones, blood, and muscles.

A certain amount of mineral matter is contained in ordinary *drinking water*, which forms about three-fourths of the weight of the body, and is both essentially necessary and mechanically useful to maintain, by its solvent properties, the flexibility, elasticity, and smoothness of the muscles and tissues.

The absolute quantity of food required for the maintenance of the human body in health varies with the age, sex, habits, and idiosyncracy of the individual, and with the circumstances in which he may be placed. It is, therefore, very difficult, if not impossible, to fix a standard for every case.

A leading principle observed in constructing dietary tables is to seek to obtain the largest amount of nourishment at the least cost.

The construction of such tables is therefore by no means a simple matter, for foods which are cheap are often inferior in real value to those which are dearer.

Again, a food which is nutritious and of small cost may be so *indigestible* as to be really dearer than a more digestible kind at a higher cost.

Finally, foods which are both nutritious and digestible may be so distasteful and even repulsive, that they are rejected by the appetite, and, as a consequence, are so imperfectly digested that a part of the nutritive material does not nourish at all, but is simply wasted.

A very fair average table of daily diet may be obtained by a consideration of the consumption of large communities of healthy men, such as our soldiers and sailors.

Such a dietary (No. 1) will represent the amount and quality of food required for men who must be in readiness for active exercise, involving great muscular strength and considerable power of enduring fatigue.

No. 1, DIET TABLE.—NAVY.

DAILY RATIONS.

Soft Bread or Biscuit, 1¼ lbs.; Spirits, 1 gill;
Sugar, 2 oz.; Chocolate, 1 oz.; Tea, ¼ oz.

When procurable	Fresh Meat, 1 lb.; Vegetables, ½ lb.
Otherwise, every other day....	Salt Pork, 1 lb.; Split Peas, ⅓ lb.*
On one alternate day........	Salt Beef, 1 lb.; Flour, 9 oz. Suet, ¾ oz,; Raisins, 1½ oz.
On the other alternate day ..	Preserved Meat, ¾ lb.; (1) Preserved Potato, 4 oz.; or (2) Rice, 4 oz.; or (3) Preserved Potato, 2 oz., and Rice, 2 oz.; or (4) Flour, 9 oz.; Suet, ¾ oz.; Raisins, 1½ oz.

Weekly.

Oatmeal, 3 oz.; Mustard, ½ oz.; Pepper, ¼ oz.; Vinegar, ¼ pint.

No. 2 represents, probably, a fair average diet for patients in a large well-established London hospital, and intended to recruit the powers of those who have been suffering from disease.

No. 2, DIET TABLE.

HOSPITAL PATIENTS.—FULL DIET.

Breakfast	Tea, 1 pint. Bread and Butter.
Dinner	½ lb. meat when dressed, ½ lb. Potatoes. Bread and Butter.
Tea	Tea, 1 pint. Bread and Butter.
Supper	Bread and Butter. Beer.
Daily allowance to each patient....	Bread, 14 oz. Beer, 2 pints (men), 1 pint (women). Butter, 1 oz.
Extras to be specially ordered...	Chops, Steaks, Beef Tea, Fish, Eggs, Puddings, Jelly, Ale, Porter, Wine, or Spirits.

---

* 1½ oz. of celery seeds to every 8 lbs. of split peas put in the coppers.

No 3.—PRISON DIET.

Male Convicts—Hard Labour.

	Breakfast.	*Dinner.*	*Supper.*
Sunday.	Oatmeal, 2 oz. Molasses, ½ oz. Bread.	Cheese, 4 oz. Bread.	Cocoa, ¾ pint, containing cocoa, ½ oz.; milk, 2 oz.; molasses, ½ oz. Bread.
Monday and Saturday.	As on Sunday.	Beef, 5 oz. (cooked), with its own liquor, containing onions, ½ oz.; flour, ⅛ oz.; pepper, ¾ oz. per hundred rations. Potatoes 1lb. Bread.	As on Sunday.
Tuesday and Friday.	As on Sunday.	1 pint good Beef Soup, containing pearl barley, vegetables (fresh), onions and flour. Potatoes, 1 lb. Bread.	As on Sunday.
Wednesday.	As on Sunday.	Mutton, 5 oz. (cooked) and flavoured as above. Potatoes 1lb. Bread.	As on Sunday.
Thursday.	As on Sunday.	Pudding, 1 lb., containing suet, 1½ oz.; flour, 8 oz.; water, 6½ oz. Potatoes, 1lb. Bread.	As on Sunday.

Bread, per week, 168 oz.—viz., 23 oz. each week day, and 30 oz. on Sunday.
Salt, ½ oz. per prisoner per day

ORDINARY WEEKLY AMOUNTS OF CERTAIN ARTICLES OF FOOD OF THE LABOURING CLASSES.

Extracted from Report to the Privy Council by DR. SMITH, *Medical Officer of Health to the Poor Law Board.*

County.	*Bread Stuffs.*	*Meat or Bacon*	*Milk.*	*Cheese*	*Tea.*
	lbs.	oz.	Fluid oz.	oz.	oz.
1. Bedfordshire	12	20	28	1·4	·37
2. Berks	10¼	17	20¼	1½	·5
3. Bucks	12¼	18¼	13½	4	·48
4. Cambridgeshire.. ..	14¼	17	9	1·3	·37
5. Cheshire	11	12½	50	3·	·7
6. Cornwall	9¼	22	58	—	·5
7. Cumberland	12¾	19	56½	8¼	·9
8. Derbyshire	12¾	13¾	37½	1½	·5
9. Devon	12	11½	57½	—	·4
10. Dorset	13	7¼	12	12½	·5
11. Durham	11½	29½	46½	1¾	·8
12. Essex	11¾	6½	10	4	·64
13. Gloucestershire.. ..	12½	8	¾	5¾	·4
14. Hants	11	9¼	8¼	3¼	·4
15. Herts	12½	14½	18	1½	·33
16. Huntingdon	11½	20	21¾	1½	·5
17. Kent	12¼	19	18	9¼	·7
18. Lancashire	11	26¾	80	4	·7
19. Leicestershire	12	17½	40	2	·44
20. Lincolnshire	12¼	21	45	·8	·35
21. Norfolk	12½	7	40	1¼	·25
22. Northampton	11½	28¼	18	1¼	·54
23. Northumberland ..	15¼	35	89	4	·7
24. Notts	13¼	24	54	·9	·43
25. Oxford	11	16	20	1¾	·5
26. Rutland	11¾	17¼	28	1½	·7
27. Salop	15½	5½	49	·3	·5
28. Somerset	10½	6¾	10½	4¼	·4
29. Staffordshire	11	16¾	16¼	4	·5
30. Suffolk	13	14	26¾	4	·45
31. Surrey	12¼	26¼	2	8¼	·9
32. Sussex	12¾	12½	12·7	5½	·8
33. Warwickshire	11½	8½	25½	4½	·52
34. Westmoreland	12½	21½	120	2	1·0
35. Wilts	12½	7	15½	5	·55
36. Worcestershire	12	17½	53	2¼	·6
37. Yorkshire	12¾	26	74·7	—	·6
38. Anglesey	18¾	10¾	150¾	—	1·0
39. North Wales	14¾	15¼	178	1·8	·8
40. South Wales	13	7¼	66	14·	·4

If, now, we compare with these a dietary which has been found sufficient for the support of health in a state of more or less confinement, with a moderate amount of daily labour, we may fairly infer that the proper allowance for persons not engaged in active manual labour lies somewhere between these extremes.

CHAPTER VII.

COOKING.

A REMARKABLE point of distinction between man and the inferior animals is that while the latter confine themselves, in their several species, to a tolerably definite kind of food, man, in his various stages of civilization, eats of almost every kind. He is carnivorous, herbivorous, graminivorous. He feeds on the beasts of the field, the fowls of the air, the fishes of the waters, and the fruits of the earth. If any kind of food be found too coarse or too tough, too strongly or too weakly flavoured, for his refined palate, he will boil, roast, pickle, salt, or preserve—in short, so disguise it by the help of heat, condiments, and chemical action, that its ultimate effects both on the palate and on the animal economy become almost entirely changed. In fact, so universal is this custom of preparing food before eating it, that man, "the lord of creation," is distinguished from the lower orders of creation as the "cooking animal."

Speaking broadly, the food of man is procured in four different ways. First, by hunting, snaring, or otherwise catching wild animals; secondly, by rearing tame animals; thirdly, by gathering wild fruits and plants; and fourthly, by cultivating those species which require constant attention from the hand of man.

When taken into the human system food passes through several processes, all of which, except the first, are beyond the control of the will.

On entering the *mouth*, it is submitted to the process of *mastication* by the teeth. This process, though of an automatic character, is capable of being controlled and directed by the will. It is greatly assisted by the beneficent provision of nature which provides for every class of animal the kind of teeth best adapted to the class of food on which it subsists.

Thus the action of the teeth of herbivorous animals is similar in effect to a powerful grinding apparatus. In flesh-eating animals, the food is cut rather than ground down; in man, the shape of the teeth, consisting partly of cutting forms and partly of grinding surfaces, indicates the mixed character of his diet.

The condition of food after mastication requires to be such that, on its introduction into the stomach, it will be acted upon with the greatest rapidity and facility by the gastric juice.

Mastication is followed by the act of *deglutition*, or swallowing, which is of a purely reflex nature, "being the result of a nervous influence in which neither the will nor sensation is concerned."

The next process is that of *digestion*, under the influence of the gastric juice of the stomach. By this operation, the useless or innutritious portions are rendered capable of separation from the useful or nutritious constituents of the food.

Both the stomach and the intestines assist in the work of digestion, the nutritive portions being utilized in the processes of *absorption* and *assimilation*, by means of which the digested food is first taken up into the blood and then appropriated or applied to its legitimate uses in the animal economy.

The question of what to eat is pre-eminently one to be determined by individual experience, as "one man's meat may be another man's poison." Many of the vexed questions in diet can best be solved by the intelligent study by individuals of what is most easily digested by themselves.

In feeding soldiers, the inmates of hospitals, workhouses, and gaols, the good resulting from frequent changes in diet has been repeatedly demonstrated; while *an increased variety in the cooking of their food* has been found to be the means of marked improvement in the health of the scholars in schools of every grade.

Where it is difficult to give any great variety to the composition of meals, much of the good of dietetic change may be secured in giving an *artificial variety* to foods by a judicious use of the different modes of cooking, the sole objects of which are (1) *to improve the flavour of food*, and (2) *to facilitate its digestion.*

In the hands of an expert cook alimentary substances are made to change almost entirely their nature, form, consistence, odour, savour, colour, and chemical composition; and although everything may be so modified that it becomes impossible to identify the basis of a given dish, the end attained by the greatest triumph of the culinary art consists in making the preparation *agreeable to the senses, and easy of digestion.*

Since cookery and digestion are so nearly allied, the culinary operations of a household must have a direct individual effect on its inmates, and a visit to the kitchens of great families, hotels, and club-houses will show what a highly important post is that of head cook, while the estimation in which his services are held may be known by the large salary attached to the office.

Taking a still broader view, it is certain that the amount of skill displayed by the people of any nation in preparing food for the table may be taken as a measure of their knowledge, wealth, and refinement.

TABLE SHOWING THE TIME

REQUIRED FOR THE DIGESTION OF VARIOUS FOODS.

Articles of Diet.	*Mode of Preparation.*	*Time required for Digestion.*
Rice	boiled	1 hour.
Sago	,, ...	1¾ hours
Tapioca and Milk	,, ...	2 ,,
Turkey	roasted	2½ ,,
Goose & Sucking Pig ..	,, ...	2½ ,,
Chicken, full grown ..	fricassee	2¾ ,,
Eggs, fresh	hard-boiled or fried	3½ ,,
,, ,, ...	soft-boiled	3 ,,
,, ,, ...	roasted	2¼ ,,
,, ,, ...	raw	2 ,,
Beef, fresh, lean	roasted	3 ,,
,, old, hard salted ..	boiled	4¼ ,,
Pork, fat and lean ..	roasted	5¼ ,,
Mutton, fresh	,, ...	3¼ ,,
Veal, fresh	broiled	4 ,,
Fowl	boiled	4 ,,
Butter	melted	3½ ,,
Cheese, old, strong ..	raw	3½ ,,
Beef Soup & Vegetables ..	boiled	4 ,,

CHAPTER VIII.

ROASTING AND BOILING.

All the various forms of cookery may be reduced to two—viz., *roasting* and *boiling*.

Roasting, in its widest sense, may be considered to include baking, broiling or grilling, and all other processes which consist essentially in the exposure of food to the action of heat, without the presence of any fluid excepting its own natural juices.

In roasting, this simple and common-sense rule should be observed: Place the meat *at first* sufficiently near a brisk fire, so that the albumen on the surface may be rapidly coagulated, and thus retain the internal juices. This in most instances is effected in about fifteen minutes, after which the joint should be removed to a greater distance from the fire, and allowed to cook slowly. The evaporation of the internal juices is still further prevented by dredging the meat with flour.

The loss of weight in roasting is greater than that in boiling, and is due to the evaporation of water, and the melting out of the fat, leaving the nutritive matter in an easily digestible form in the interior.

As to the *time* required for roasting a given joint, the usual rule is to allow a quarter of an hour for every pound, and some minutes over, according to taste. There are, however, exceptional circumstances to be taken into account, such as the strength of the fire and the nearness of the meat to it; also the size of the joint. For instance, ten pounds of beef will require two hours and a-half, but twenty pounds will take three hours and three-quarters; while a leg of pork or of lamb would require full twenty minutes to the pound.

Unless the roasting is continued long enough, the parts nearest the centre do not become sufficiently hot to allow the albuminous matters to coagulate ; hence they appear juicy, red, and underdone.

Salting meat before it is put to roast draws out the gravy; consequently a joint should not be sprinkled with salt until almost done.

Meat from full-grown animals requires less dressing than the flesh of young animals; not because it is sooner cooked, but because it can be eaten with more of the juices in it.

Time, *distance*, *frequent basting*, and *a clear fire of proper size* for the purpose required, are essential points to perfection in roasting.

Boiling.—When heat is applied to a vessel containing water, the temperature gradually increases, and vapour rises silently from the surface. As the temperature increases, *steam* begins to be formed in small explosive bursts at the bottom, and, rising in bubbles to the surface, throws it into a state of ebullition. The temperature is now found to be 212° Fahr., which is, therefore, called the boiling point of water.

Every other liquid, oil, for instance, in frying, has its own boiling point, which is constant as a rule, but liable to be altered by various circumstances.

Allowing the steam to freely escape, *water* gets no hotter than 212° Fahr., however great may be the heat of the fire.

This point is very important in cookery; for a stronger fire than is just sufficient to keep water boiling will not only evaporate the water uselessly in steam, but harden the outside of the meat, so that the interior will scarcely be reached by the heat.

It is usual to wash meat before cooking it, but long soaking in cold or tepid water causes much of its albumen and nutritive juices to be wasted.

For the preservation of these juices, it is a good plan to plunge the meat into boiling water for a minute, in order to coagulate the albumen, and then to reduce the water to a tepid state, and allow it to rise gradually to a degree slightly *under* boiling point, usually called simmering.

The water should remain in this state till the meat is sufficiently cooked, all scum being carefully skimmed off as it rises to the surface.

The foregoing particulars are more especially applicable to the cooking of fresh meat, which should be allowed twenty minutes for each pound in weight. *Salted* and *dried* meat should be thoroughly washed, soaked for two hours in cold water, dried, and placed in cold water, which should then be brought gradually to the boiling point and kept simmering for a space of time proportioned to the weight of the meat.

Tongues, hams, &c., which are to be eaten cold, should be allowed to remain till cold in the water in which they were boiled, and will then be found much more juicy than if taken out to cool.

Stewing may be defined as a method of cooking which *draws out* the full flavour and juices of the meat, the fibres of which are at the same time rendered tender and digestible.

It is often confounded with a process of slow boiling, which, however gentle, requires nevertheless a temperature of 212°, while *proper stewing* requires that the heat should never exceed 180° Fahr.

By stewing, if sufficient time be allowed, rough joints may be rendered extremely tender, and a means afforded of obtaining a savoury and wholesome dish at a minimum cost.

CHAPTER IX.

ADVANTAGEOUS PREPARATION OF FOOD. COOKING APPARATUS.

A PERSON who lives upon cold food, even for a single day, will feel more or less spiritless and depressed, his energies will flag, and outward circumstances look gloomy and sad. A good meal of warm, wholesome food will often dispel these feelings by raising, at one and the same time, both the bodily temperature and the flagging spirits.

The reason is, that *cooking* warms the food, and thus adds to its heat-producing qualities, whereas by taking cold food into the stomach, part of the vital heat of the system is used up in work which might be better done in the kitchen.

Much of the craving for stimulants, especially among the working classes, is perhaps due to the want of warm food properly cooked. The effect of insufficient nourishment is felt in lack of *strength* to work, and also in want of *will* or energy.

The same evils follow when a person is badly nourished, either through taking an insufficiency of food, or food of a wrong kind.

Badly fed persons are also more predisposed to disease, and become the first victims of prevalent epidemics, to which they often succumb for want of vital stamina.

The fatty portions of the body serve as a reserve of nourishment from which, in an emergency, supplies can be drawn. Hybernating animals betake themselves to their winter quarters full of fat, by which they are nourished till the spring, when they wake up thin and ravenous. Thus a starving sheep is, for the time being, as much a carnivorous animal as the lion.

Too much fat, however, in ordinary diet produces loss of appetite and derangement of the system; while an insufficiency, particularly in cold weather, not only lowers the temperature of the body, but makes an undue call on the *starchy* portions of the food to keep up the necessary supply of animal heat.

It is pretty generally acknowledged that the French, as a nation, are superior to us in the culinary art, and there is no denying that the French cook is an artist in his way. A great difference between English and French cookery consists in the fact that the French cook their meat much longer than we do, by which means it becomes more digestible. They are also famous for the variety of their dishes, obtained by altering the natural taste of the meat by means of various zests or flavours. Their superiority in this direction is pretty freely acknowledged amongst us, French dishes being commonly admitted to our tables as graceful and welcome additions to our more substantial English fare.

In the matter of economy, too, the French evince a decided superiority. To a French cook "kitchen waste" is unknown, for he throws nothing away;

trimmings, skimmings, and drippings are alike utilized, and, like a true workman, he produces great results from small means. Our shortcomings in this respect are due, in great part, to the common English practice of cooking pieces of meat too large to be consumed while hot.

The ordinary kitchen utensils are the *gridiron*, *frying-pan*, *spit*, *Dutch-oven*, *saucepan*, and *stewpan*.

The *gridiron*, though somewhat primitive in construction, is not to be despised, and popular taste in this direction is shown by the present flourishing condition of the numerous "grill-rooms" in our large centres of population. When the gridiron is used, the following are points essential to success:—A clear fire, clean hot bars; chops or steaks not too thin or too thick—from half to three-quarters of an inch; turn by means of proper tongs, or, at least, never pierce the meat by a fork; when ready, serve hot.

The *frying-pan*—a much-abused servant of the kitchen—has its useful points, though it is probable that the *worst cooking* and the *greatest household waste* in this country are due to its use by people entirely ignorant of the first principles of the culinary art. The essence of frying is *boiling* and *browning in fat*. How many attempts at frying result in *burning*, and *blackening*, and *spoiling!*

The *spit* is the common implement in use for roasting large joints, and has the great advantage over the *oven* that the watery vapours pass entirely away, leaving the essence of the meat in its primest condition. The process of roasting is perfectly sound in its chemical effects on food, and has the advantage of being always under the eye of the cook, whose fault it must be should any mistake arise.

The *Dutch-oven* is of great utility for small dishes of various kinds, which the spit would spoil or the oven destroy by the severity of its heat. It combines the advantages of roasting and baking; it is easily heated, and its use involves scarcely any extra expenditure of fuel.

The *saucepan.* In order of merit probably all other cooking implements must yield precedence to its claims. In its operations, whether in the form of the large boiler, the stewpan, or the saucepan proper, it more resembles the human stomach than any other culinary utensil.

In the operations of cooking by means of the saucepan, nothing is lost. That which escapes from the meat is retained in the form of broth; fat rises to the surface, and may be skimmed off; while the fragrance and the delicacy of flavour due to good cookery are by its use promoted in the highest degree.

A *digester* is a strong closed vessel in which bones or other substances may be subjected, usually in boiling water, to a temperature far above that of boiling point. By the use of Papin's digester, the hardest bones of mutton, and even beef, have been made as soft as cheese, without water or other liquor.

Cooking Ranges.—In ranges for cooking purposes immense improvements have been made of late years.

The open cottage range or fire-place, showing the cheerful blaze, is most in accordance with the ordinary Englishman's idea of fireside comfort; the "household hearth," with all its family associations, being almost an object of worship. This kind of fire-place, however, has some serious drawbacks, which may be summed up briefly thus: (1) *Waste of fuel*, (2) *unequal heating at different distances from the fire*, (3) *cold draughts*, (4) *cold to the feet*, (5) *bad ventilation*, (6) *smoke and dust*, (7) *loss of time*, (8) *danger to person and property*.

It has been found that in a common English fire-place, of the heat produced from the fuel seven-eighths ascend the chimney, and are absolutely lost. This loss is distributed thus: *One-half* of the heat of the fuel is carried off in the smoke from the burning mass; *one-quarter* is carried off by the current of the warmed air of the room, which is constantly entering the chimney and mixing with the smoke; lastly, *one-eighth* of the combustible matter is supposed to form the black and visible part of the smoke in an unconsumed state. Some have even estimated the loss at fourteen-fifteenths of the whole. The object of late years has been not so much, perhaps, to do away with the system of the open fire-place, as to improve it.

The success of *American ranges*, with their various appliances and multifarious uses, has done much to stimulate English makers. These so-called American cooking ranges, now made in many parts of this country, have a side oven, fitted up for baking, and most of them a hot-water boiler, which should be kept well supplied with water, as, when heated, it is liable to crack if cold water be poured in, and being usually constructed of cast-iron, it cannot be repaired.

Ranges of this kind, under various names, are now quite common, most of the various patterns being constructed on similar principles. They are extremely economical in the matter of fuel (the combustion of which is regulated by means of ventilators), and are capable of being used for all the usual cooking operations.

Gas-ranges or cooking-stoves are rapidly growing in favour for heating and for cooking, and where the price admits of gas being used for these purposes, there is every reason to believe that the demand for it will continue, in spite of the growing use of electricity for lighting purposes.

The cleanliness and intense heating power of gas, and its capability of the most careful regulation, have been turned to excellent use by the makers of gas-stoves for both heating and culinary purposes.

All the operations of roasting, baking, frying, grilling, boiling, and steaming can be carried on at the same time, if required, by the use of these convenient ranges heated by gas.

In most of our large towns the gas companies are sufficiently alive to their own interests to offer to supply gas-stoves on hire at a merely nominal figure, looking for their remuneration in the extra consumption of gas by their customers.

Division II.—Water and other Beverages.

CHAPTER X.

WATER.

WATER is one of the primary wants of human life, not less essential than air and food; hence the strong and religious interest that has always been attached to the means of its supply.

Some of our earliest Biblical recollections refer to the digging of wells, and to the anxiety manifested respecting their possession.

The "Pools of Solomon" near Bethlehem, nearly as perfect now as when first constructed, were connected with a scheme for supplying Jerusalem with water. Other nations of antiquity, such as the Assyrians, Persians, Egyptians, Chinese, and even the Incas of Peru and the Mexicans, have left evidence of the existence of gigantic works connected with their water-supply; and, if we except the supply to New York from the Croton river, and that of Glasgow from Loch Katrine, the modern efforts to supply cities dwindle down to comparative insignificance compared with those of the Romans.

The care they bestowed upon the provision of pure water—with which is connected the celebrated name of Frontinus as "Curator Aquarum"—and their elaborate system of drainage, prove that they had correct ideas on some of the fundamental principles of hygiene.

Water is most abundantly distributed in nature, nearly two-thirds of the earth's surface being covered with it, while it forms by far the greater proportion of the structure of all plants and animals, and it is a constituent of many minerals. Three-fourths of the human body consist of water, and by its aid all nourishment is rendered soluble and fit to be absorbed into the system.

Inasmuch as all the actions of the living body are performed by the movement of its fluid particles, the presence of an abundant supply of water becomes an absolute necessity, and its freedom from impurity a matter of extreme importance.

Water presents itself in three distinct forms: first, in a state of vapour or steam; secondly, in its liquid state; and lastly, in its frozen or solidified condition.

In the form of vapour it is ever present in the atmosphere, while as snow it always covers the tops of the highest mountains, and as ice it forms vast fields in the polar regions.

Properties of Water.—Water is a tasteless, inodorous liquid, transparent, and colourless when seen in small depths, but of a bluish-green when viewed in great depths.

At a temperature of 32° Fahr. (or 0° C.) water solidifies into ice, which is a crystalline, transparent substance of a slightly greenish-blue tint when seen in great thicknesses. In passing from the liquid to the solid state it expands by nearly one-eleventh of its volume—that is to say, one volume of water becomes about $1\frac{1}{11}$th volume of ice.

The force of this expansion is almost irresistible; by it a strong iron bottle filled with water and frozen bursts into fragments. The bursting of water-pipes during a frost is due to the expansion of the water during the process of freezing.

Since ice occupies more space than the water from which it is produced, it follows that ice is *lighter* than water; its *specific gravity*—that is, its weight compared with an equal volume of water—is 0·92, the weight of the volume of water being 1.

At all temperatures water is constantly evaporating; even ice and snow gradually waste away by evaporation.

Under the ordinary atmospheric pressure, water at a temperature of 212° Fahr. (or 100° C.) enters into ebullition, or boils, and becomes converted into steam, which is a transparent and colourless vapour.

The white cloud seen escaping from boiling water is not true steam, but minute particles of water suspended in the air, and produced by the condensation of the true steam which is invisible.

In passing from the liquid to the vaporous condition, water undergoes enormous expansion, one volume of water at 32° Fahr. becoming 1,698 volumes of steam at 212° Fahr.

The boiling point of water is much lowered when the pressure of the atmosphere is reduced. Conversely, the boiling point is raised when the atmospheric pressure is increased.

Water is 770 times heavier than an equal bulk of atmospheric air; one cubic foot of water weighs 1,000 oz., and one gallon 10 lbs.

The *physical* properties of water have a most important bearing in the economy of nature. The great specific and latent heat of water, as well as its wonderful power of *contracting*, when raised from 32°

to 39° Fahr., play a very important part in nature's processes; a knowledge of these physical properties being necessary to understand the formation of dew, rain, snow, hail, and other meteorological phenomena.

In conclusion, it may be stated that water is a compound composed of the elements, hydrogen and oxygen, in the relative proportions by weight of 1 to 8; and that it may be resolved into its elements, or component parts, by the action of *heat* and *electricity*.

CHAPTER XI.

DIFFERENT KINDS OF WATER; ITS SOURCES.

On account of its powerful solvent properties, both upon solids and gaseous matters, water never occurs in nature in a state of purity but always contains some substances in solution, either gaseous or mineral, or both. *Rain* is the purest form in which it can be found, but even this is contaminated to a certain extent by dissolved impurities.

When freely exposed, water absorbs a large quantity of air—enough to support the life of fish and other aquatic animals.

The amount of gas that water will dissolve depends largely on the pressure and on the temperature, the quantity decreasing as the temperature of the water rises.

A gallon of ordinary drinking water contains from 5 to 7 cubic inches of carbonic acid, 6 of oxygen, and from 2 to 3 inches of hydrogen. The last is much less readily absorbed than carbonic acid and oxygen, the gases which impart that sparkle and freshness so much and so worthily prized by the cold-water drinker.

These gases contained in water may be expelled by the process of boiling, the liquid, when cold, being flat and insipid.

Water is also a great absorbent of the odours from putrescent animal and vegetable matters. It is also the most universal solvent with which we are acquainted, its operations in this respect being apparent, although on very different scales, both on the crust of the earth and in the laboratory of the chemist. It may be freed from solid impurities by boiling it in a retort, which is a vessel constructed so as to permit the steam to be condensed as it escapes—a process of purification called distillation.

Other natural waters besides rain-water may be included under the heads of *Spring-water*, *River-water*, and *Sea-water*.

Spring-water.—If we trace water from the moment it assumes the liquid condition in the atmosphere to that in which it issues from the earth in the form of springs, we find it gradually accumulating impurities of various kinds. In percolating through strata more or less soluble, and more or less pervious, it is conveyed long distances by subterranean channels, and in certain instances only appears after having found its way deep into the crust of the earth, thereby to become heated and charged with various substances before it is forced back again to the surface.

The amount of impurity in spring-water varies from 5 to 50 grains per gallon. When the latter quantity is exceeded it imparts a decided taste, and the water may be regarded as *abnormal*.

Sea-water and mineral springs are in this condition.

In their passage through various mineral masses, springs become impregnated with *gaseous, aline,* or *metallic* admixtures—such as carbonic acid gas, sulphuretted hydrogen gas, nitrogen, muriate of soda, sulphate of lime, carbonate of lime, carbonate of iron, &c.

When these foreign ingredients have medicinal properties, the springs are known as *mineral waters* while those whose waters are of a high temperature are called *thermal springs.* Instances of the latter in this country are found at *Matlock* (66° Fahr.), and *Buxton* (82°), in Derbyshire; *Bath* (117°), in Somerset; and *Clifton* (76°), in Gloucestershire.

For practical purposes mineral springs may be classed as follows :—

1. *Saline aperient springs*—some hot, some cold. The chief are those of *Cheltenham, Leamington,* and *Harrogate,* in England; *Dunblane, Pitcaithly,* in Scotland; *Carlsbad, Kissengen, Wiesbaden, Baden-Baden, Seidlitz,* in Germany.

2. *Alkaline waters: Harrogate, Scarborough,* and other Yorkshire springs, *Cheltenham, Leamington, Bath,* and others, in England; *Carlsbad, Kissengen, Marienbad, Pullna, Ems,* and *Wiesbaden,* in Germany; *Vichy* and *Mont d'Or,* in France.

3. *Chalybeate waters,* with which acidulous waters are often reckoned, the iron being often associated with much free carbonic acid gas. Some of the chief are at *Tunbridge Wells, Harrogate,* and *Brighton,* in England; *Peterhead,* in Scotland; *Pyrmont* and *Marienbad,* in Germany.

4. *Sulphurous waters* are found at *Harrogate* and *Askern*, in Yorkshire; *Moffatt* and *Strathpeffer*, in Scotland—all cold; while at *Aix-la-Chapelle*, *Baregas*, and other Pyrenean springs, the waters are hot.

Of late years, other substances have been detected in spring-water, notably iodine and bromine; while some springs have been proved to contain certain *organic* matters of a somewhat obscure character.

A large trade is done in this country in connection with foreign mineral waters, but they all suffer some deterioration by time, and many artificial imitations are made, some of them very valuable, but always inferior in efficacy to the waters drunk at the springs.

River-water.—Notwithstanding several defects, it happens that in many places surface-water is the best that can be had.

River-water is supplied partly from surface-water and partly from springs, either shallow or deep. In either case, in addition to mineral matters dissolved from the rocks and strata of the river-basin, the water must certainly contain inorganic impurities from mud, decayed vegetable substances, the exuviæ of fish and other matters in suspension.

But the grave sources of pollution are those arising from sewage, manufacturing wastes, and the washings from manured lands. So prevalent are these sources of impurity, that few rivers are now left whose lower courses could supply water fit for domestic purposes.

Sea-water.—The waters of the ocean cover about 146,000,000 of square miles, as compared with 51,000,000 of land.

The saltness and bitterness of sea-water are due to the soluble matters contained in it, amounting to about 3½ per cent. This saltness is fairly uniform, the effects of evaporation and freezing being counteracted by tides, currents, and waves.

The substances which, in respect of quantity, play the principal part in the composition of sea-water are chlorine, sulphuric acid, soda, potash, lime, and magnesia. Smaller but determinable quantities are found of the following substances: Silica, phosphoric acid, carbonic acid, and oxide of iron.

As the grand reservoir into which rivers finally empty themselves, the ocean is continually receiving the mineral matters carried from the land, *not one particle of which is ever lost* in the constant process of evaporation.

CHAPTER XII.

GOOD DRINKING-WATER.

The purest water is that which falls after heavy rains have washed away the floating impurities of the atmosphere.

Water springing from a green-sand formation holds very little solid matter in solution, the strata being very pervious, and its particles not readily soluble.

Water passing over the *surface* of land which is hard and insoluble, becomes but slightly contaminated with mineral matters. The waters of Loch Katrine, for instance, contain only 2½ grains of solid matter per gallon; and the water which issues from lakes is always comparatively clear, the grosser impurities being precipitated. Thus the muddy waters of the Rhone, entering the Lake of Geneva, issue therefrom a pure and sparkling stream.

The Dee at Aberdeen has 4 grs. and the Tay at Perth 5 grs. of solid matter per gallon.

The improvements lately effected in the practical details of civilized life have given rise to so great a demand for a copious domestic supply of water, that hydraulic engineering has now assumed a high degree of importance. The daily consumption of water is usually calculated at from thirty to forty gallons per head of the population.

A good and cheap water-supply is indispensable for comfort, cleanliness, and safety; and the state of the water-supply of a town is a sure index of its sanitary condition, and partly of the physical character of its inhabitants.

In all questions of water-supply, a primary inquiry is the *locality* from which it is to be obtained. With respect to the proper *quality*, the point appears to hinge chiefly on the *hardness* or *softness* of the waters, and, consequently, upon the presence in them of the salts of lime. On the score of economy, it is seldom found that a supply is rejected if conveniently near at hand, and free from peculiar properties and impurities.

Quoting a well-known authority, the qualities indispensable in water for town supply are that "it should be fresh, limpid, and without smell; that its flavour should be hardly perceptible; that it be neither disagreeable, flat, brackish, nor sweet; that it should contain little foreign matter, but a sufficient quantity of air in dissolution; that it should dissolve soap without leaving curds, and should cook vegetables easily."

Hardness in water is liable to develop certain forms of disease (as gout and calculi), and the presence of carbonic acid, though increasing its wholesomeness, enables the water to take up an additional quantity of salts of lime. Ice-water and snow-water, though usually pure, are considered unfitted, from their deficiency in certain elements, to maintain the human frame in health.

Water contaminated by organic matter is the most objectionable for domestic purposes. Both chronic and acute diseases, among which are typhoid fever, cholera, dysentery, diphtheria, diarrhœa, ulcerated throat, &c., may be traced to the use of water containing such impurities, either in suspension or solution.

Spring-water loses much of its natural impurity if allowed to flow in the open air in a clear channel.

Aëration improves the quality of water: a direct argument in favour of river-water as compared with that from wells, which may occasionally become stagnant. The same objection applies, though perhaps with less force, to the water of reservoirs, ponds, and lakes. Water stored in reservoirs must, of necessity, be exposed, especially in hot weather, to all the deleterious effects resulting from the development in it of animal and vegetable life, under the influence of light and heat. Agricultural and peat lands, and those which give off mineral or earthy salts in abundance, are those which most contaminate the streams flowing through them, while the crystalline rocks and silicious sands are the least hurtful.

CHAPTER XIII.

SOURCES OF CONTAMINATION OF WATER, AND ITS DELETERIOUS EFFECTS.

Where water is obtained from a well, it is absolutely necessary that no cess-pools, manure-heaps, drains, or ditches should be near, as these are common sources of contamination, more especially to shallow wells.

Drainage and sewage matter, with its foul impurities, may soak through the soil for a considerable distance, and ultimately find its way into the well. Water thus poisoned, though apparently pure, may be a positive cause of typhoid fever, cholera, and other bowel complaints, particularly where there exists a predisposition to the outbreak of these diseases.

Defective sanitary arrangements caused the great plague in London, in 1665, when 100,000 persons died out of a total of 450,000 inhabitants.

It was a comparatively simple case of diarrhœa in a child, that, by polluting a well, killed 500 persons in St. James's, Westminster, in 1854.

The reports on the epidemics in England teem with proofs of the terrible influence of polluted water-supplies.

To draw drinking-water from a cistern in immediate communication with the water-closet may be as dangerous as to drink water from a churchyard.

The organic impurities are particularly dangerous in *hot weather*, on account of their liability to set up fermentation. Water in daily use may absorb noxious gases and still appear perfectly clear and sparkling to the eye. This form of pollution has probably been more destructive of human life than any other.

The solubility of gases in water is extremely various, and the more easily a gas is condensable by cold and pressure, the more soluble it is in water.

A frequent cause of the formation of deleterious gases in water is the common practice of storing it for domestic purposes in water-butts and cisterns. Wherever it is possible, these should be abandoned in favour of a service of pipes *with the water always turned on*—what is known as the "constant supply" system.

Sewage matter in river-water renders it quite unfit for drinking purposes, the poisonous elements being too minute to be affected by filtration, which removes only the *grosser* particles in suspension; the soluble matters require chemical treatment—a process which has so far proved too expensive to be of any practical service.

Water from deep wells is usually free from organic impurities, and, although often too "hard" for washing and cooking purposes, is usually very acceptable as a beverage.

Rain-water falling in, or near, large towns becomes contaminated by soot and other impurities, but at a distance from them it is remarkably free from impurity.

It should be stored in cisterns of slate, cement, or metal, rather than in wooden butts; as the latter favour the growth of green vegetable matter.

Cisterns made of *lead* are dangerous, as the rain-water is apt to dissolve the metal to a poisonous degree.

A very interesting report on the "composition and quality of daily samples of water supplied to the metropolis" during the year 1882, gives a statement of the London water-supply, under the following heads: *Colour of the Water*, *Clearness*, *Amount of Free Oxygen*, *Ammonia and Organic Matter*, *Nitrogen and Chlorine*, *Wholesomeness*.

The examinations were made at the joint expense of the Water Companies, and of the 2,110 samples which were tested monthly throughout the year, about equal proportions were taken from the mains of the New River Company, the East London Company, the Chelsea, West Middlesex, Lambeth, Grand Junction, and the Southwark and Vauxhall Water Companies, taking their supply from the Thames and the Lea.

Colour of the Water.—By means of an instrument called a *colour-meter* it has been shown that there exists close connection between the brown colour of the metropolitan waters and the amount of contained organic carbon.

Taking this amount to be a measure of the organic matter present, a very fair estimate of the purity of water in this respect may be made by mere optical examination.

Clearness.—A summary of the results of the examination of 2,110 samples of London water is thus given under this head: "40 samples 'very slightly turbid,' 10 'slightly turbid,' and 1 'turbid;' leaving 2,059 samples entirely free (so far as unaided vision could determine) from suspended matters."

It may be noticed, in connection with this subject, that of the 51 samples not entirely free from suspended matter, 35 were coincident with, and dependent on, the occurrence of periods of violent rain-fall.

Free Oxygen.—The quantity of free oxygen in the water ranged from $1\frac{3}{4}$ to $2\frac{1}{4}$ cubic inches per gallon, the amount varying inversely with the temperature, in accordance with the law of the variation of gas-solubility with temperature.

This quantity being a mean result of about 200 determinations, is practical proof that the water-supply for the whole year was fully aërated or oxygenated. The statement is also important as demonstrating the high character of the water in respect to its freedom from putrescent matter.

Ammonia and Organic Matter.—It is worthy of notice that out of 252 samples examined, $\frac{1}{500}$th of a grain of ammonia per gallon was the maximum amount found, and this on twelve occasions only. On sixty-eight occasions only $\frac{1}{1000}$th of a grain per gallon was recorded; whilst 192 examinations revealed no trace whatever.

In a summary of a professional report on the London water-supply the following statements appear:—

"It is interesting to note the actual quantities of organic matter met with in the river-derived water supplied to London during the past six months" (ending June 30th, 1883).

"The mean amount of organic carbon, as deduced from our 156 determinations, comes to 0·175 part in 100,000 parts of water. . . . .

"In four samples only, out of the 156 samples examined, was the organic matter found to exceed, and that by very little, *half a grain per gallon*—a proportion falling considerably short of *the thousandth part of one per cent. of the water.*"

Nitrogen and Chlorine.—The amount of nitrogen in daily samples of water supplied to the metropolis ranged from 1¼-tenths of a grain to 2¼-tenths of a grain per imperial gallon of 70,00C grains. Of chlorine the average quantity is stated at about one-tenth of a grain per gallon.

Hardness.—The mineral matter held in solution consists mainly of the carbonates of the alkaline earths, with a small quantity of sulphates, nitrates, and chlorides.

The presence of these salts is not only unprejudicial to health, but actually useful to the animal economy, as supplying constituents required for the bodily functions.

Wholesomeness.—The wholesomeness of water for drinking purposes must always remain a point of vital importance, for serious cases of the outbreak and spread of zymotic disease are known to be the direct consequences of the distribution and consumption of impure water—more especially water contaminated with excremental matter.

The opinion of the Royal Commission in 1869 as to the quality of the London water-supply, is contained in the following extract from their report :—

"Having carefully considered all the information we have been able to collect, we see no evidence to lead us to believe that the water now supplied by the Companies is not generally good and wholesome."

On the score of "organic impurity," the Thames-derived water, as supplied by the London Water Companies, compares most favourably with the much-vaunted Loch Katrine water-supply to the city of Glasgow.

CHAPTER XIV.

CISTERNS AND WELLS.

A CISTERN is a tank for holding water. Where the supply is intermittent, or where rain-water is used, cisterns, or small reservoirs of some kind, become a matter of necessity.

They are variously constructed, both in shape and material; cast-iron, wrought-iron, zinc, slate, brick and cement, and wood lined with lead, are in common use for this purpose.

When very large cisterns are required, they are sometimes constructed in a cylindrical shape, in which case the heavy pressure acts at all points equally from the centre.

Water-butts often abound in impurities, such as mud and decaying organic substances, which, though gradually precipitated, are liable to be stirred up again, more or less, every time the water comes in.

Whenever these receptacles must be used, they should be covered from dust and dirt, and removed from the neighbourhood of closets, dust-bins, manure-heaps, or any such unpleasant accumulations, the deleterious gases from which may be taken up and absorbed by the water.

It is a matter for regret that *cisterns* are *often* the cause of great deterioration in the quality of the water supplied for daily use. Notwithstanding the precautions which the law enjoins, together with the scientific knowledge brought to bear upon the question by the various Water Companies, the wholesome filtered supply delivered for domestic purposes is frequently deteriorated after leaving the Companies' mains by the dirty state of the receptacles on the premises of consumers.

Many of the cisterns, tanks, and butts for storing water are in a shocking state. Cisterns may be seen without lids, full of rank and decaying vegetation, which on closer examination would show more or less organic deposit, and, under the microscope, would be found to abound in infusorial life.

In many instances cisterns and water-butts are left open, and regularly receive the drippings from roofs and gutters; they are often in close proximity to the dust-bins and other deposits of filth and garbage; while children amuse themselves by throwing all sorts of dirty rubbish into the water. The purest water in England would be poisoned by such a storage.

Even in the better class of houses, and in many public buildings, the cleansing of cisterns and tanks (often placed in positions extremely difficult of access) is frequently neglected for months, and in some cases *years* are permitted to pass without any examination or cleansing taking place; exemplifying the old adage, "Out of sight, out of mind."

All cisterns and other receptacles should be frequently cleaned out, and every care taken to prevent the contamination of the domestic supply.

When, on a forced examination, kitchen boilers have been found half full of black-beetles, with a cricket here and there, by way of variety; when pigeons, sparrows, and other birds; rats, mice, and even cats, have been found in cisterns, to say nothing of branches of creeping plants and dead leaves,—the necessity of proper covers and frequent attention is evident.

A London resident who took alarm from the advice given in a health-lecture, had his cistern examined, and the following items were found: "Fine mud, $2\frac{1}{2}$ inches; small red worms, any amount; the bones of mice, numerous; a small live eel, one specimen; fragments of slate (from the roof), several; a piece of a leather shoe, from the water-pipe, possibly; drowned insects, a few; iron nails, six; and one or two pieces of coal."

After these interesting geological, zoological, and other revelations, the gentleman has naturally given orders that the cistern shall be systematically flushed every month.

The contamination of water by the gases generated from sewage, is of far more frequent occurrence than is generally supposed.

Where *waste-pipes* from cisterns are in direct communication with the sewers, the gases from the latter are conveyed back into the cisterns, and become absorbed by the water. To prevent this, the overflow or waste pipe should be carried *outside* the house, and the end left exposed to the air. By the adoption of this plan, the poisonous effluvia and gases from the drains will be got rid of. These would otherwise ascend through the pipe, and not only be partly absorbed by the water in the cisterns, but be mixed with the air in the houses, thereby becoming a cause of fever and disease.

The importance of this precaution has been recognized by the Legislature, and the following clause of the Board of Trade Regulations, 1872, relative to waste-pipes, is intended to prevent this contamination of the water from the gases generated by sewage.

Regulation No. 14.—"No overflow or waste pipe, other than a 'warning pipe,' shall be attached to any cistern supplied with water by the Company, and every such overflow or waste pipe existing at the time when these regulations come into operation, shall be removed, or, at the option of the consumer, converted into a 'warning pipe' within two calendar months next after the Company shall have given notice to the occupier thereof, or left at the premises in which such cistern is situate, a notice in writing requiring such alteration to be made."

It is recommended that, in very hot weather, drinking-water should be *boiled*, and that the use of water from pumps and surface wells be discontinued; also that closets, drains, and sinks of houses should be frequently flushed, and efficiently trapped and kept in good order. It is a useful precaution to use carbolic powder, chloride of lime, Condy's Fluid, or some other antiseptic, as a disinfectant, in dust-bins, water-closets, and similar places.

Wells.—The water from wells is popularly considered to be the most wholesome that can be obtained; but this is not always the case.

Well-water supplied from deep springs is almost invariably pure, but there always exists the possibility of contamination by leakage from the surrounding strata.

It sometimes happens that, when a fresh well is sunk, springs are tapped which supply water to adjacent wells, and these accordingly afford a diminished supply. What is the inference? It must be perfectly obvious that a subterranean connection exists between the springs. And herein lies the possibility of danger; for a porous soil saturated in any spot with sewage matter may affect the drinking-water of the nearest well by a poisonous solution.

Deep wells should invariably be covered and carefully protected from the infiltration of superficial ooze. The situation of pump-wells is often unfortunate in this respect.

Whole generations may drink of the water from a well, and the thought of examining the source of supply never enter the head of any one of them. But, on the other hand, should sickness come, and sanitarians insist on an examination of the well and an analysis of the drinking-water, what a consternation sets in; and often, alas! what startling revelations are made! Many a village draw-well has never been examined within the memory of the oldest inhabitant—the museum of curiosities at the bottom never exhibited!

Artesian Wells are perpendicular borings into the ground, through which water rises above the surface of the soil from depths which vary according to circumstances.

The possibility of obtaining water in this way depends on the geological structure of the particular district.

Many artesian wells exist in London and the vicinity. A well of this class, sunk into the upper chalk to a depth of 393 feet, supplies the water to the ornamental fountains in Trafalgar Square.

CHAPTER XV.

TEA, COFFEE, AND COCOA: PREPARATION AND EFFECTS.

THE above-named vegetable substances used in the preparation of drinks form a very important part of the food of man.

It is worthy of notice that mankind, by the instincts of a common nature, have been led to select in them a class of substances which philosophy teaches to be the best adapted to the bodily wants.

These substances are not heat-formers, neither do they resemble wine or alcoholic liquors, which merely excite the circulation, and are, therefore, considered unsuitable for constant use as a beverage. None of these stimulants are to be compared with *tea*, *coffee*, or *cocoa*, as liquids adapted to the daily needs of mankind in every clime.

Professor Liebig says : "We shall never, certainly, be able to discover how men were led to the use of the hot infusion of the leaves of a certain shrub (tea), or the decoction of certain roasted seeds (coffee). Some cause there must be, which would explain how the practice has become a necessity of life to whole nations. But it is surely still more remarkable that the beneficial effects of both plants on the health must be ascribed to one and the same substance, the presence of which in two vegetables belonging to different natural families, and the produce of different quarters of the globe, could hardly have presented itself to the boldest imagination. Yet recent researches have shown in such a manner as to exclude all doubt, that *caffeine*, the peculiar principle of coffee, and *theine*, that of tea, are in all respects identical." most

Tea is the leaf of a small evergreen shrub which grows chiefly in China, but is cultivated also in Japan, Assam, on the slopes of the Himalayas, and other parts.

Its cultivation appears to be somewhat simple. The plants are raised from seeds, and either left in the places where they are to remain, or else transplanted, yielding their first crop of leaves in about three years.

The preparation of the leaf involves some amount of labour, much care being bestowed on the various processes of picking, heating, drying, and packing it for the market. The best kinds of tea are called Mandarin teas, which are very expensive even in China, and being but slightly fired, and rather damp, when in the fittest state for use, will neither bear transport nor keeping.

There are many varieties of tea which enter largely into the English trade.

Black and green teas are both made from the same variety of plants; the difference in appearance, when the latter is not artificially coloured, depending entirely on manipulation and the age of the leaf.

The *flavour* of tea depends very largely on the nature of the soil and situation, the time of the year when the leaves are gathered, and the mode of preparing the crop for market.

There are, however, peculiarities of soil and culture which restrict its cultivation within much narrower limits than those of its botanical or natural area.

The leaves of the tea-plant are gathered in spring, summer, and autumn, and on some occasions there are four crops in a year. The spring leaves have the most delicate colour and the best flavour; the leaves of the second crop are of a dull green colour, and are less valuable; the third crop produces leaves inferior in all respects to the other two.

The following points should be observed in making tea: A thoroughly dry tea-pot (damp causes a musty flavour and smell); *boiling* and, if possible, *soft* water; sufficient time to draw out the flavour and aroma, but not the coarse, bitter, tannic principle.

It is necessary to remember that some of the effects of tea are due to the plants which are sometimes mixed with the real tea, some of which are powerful stimulants; in other instances, deleterious chemical compounds are used to convert damaged black teas into saleable green tea.

The effect of tea on the system has been a subject of much discussion, but it is known that the action of very strong tea is more powerful than that of anything not used as a medicine, except alcohol and tobacco.

That it should not suit all constitutions or all ages is not remarkable. For young children it is extremely improper, producing a morbid state of the brain and nervous system, and in all cases it is less suited for young persons than for adults. Taken in moderation, tea pleasantly excites the nervous system, promotes the action of the skin, and assists the duties of the digestive organs.

Strong tea is an antidote in case of poisoning by opium, arsenic, and tartarised antimony. Its use is beneficial in the case of the corpulent and over-fed, and for those of sedentary habits. The nitrogenous part of tea also helps to form bile; in this sense tea may be partly a substitute in badly-fed persons for the nitrogen in animal food.

"Tea and coffee were originally met with among nations whose diet is chiefly vegetable" (Liebig).

People of an irritable nature should not drink it, and being best taken some hours after a heavy meal, it is unsuitable as a breakfast beverage.

When used in excess, tea causes disturbances of a very distressing nature in the system, and its injurious effects on the health are sometimes seen very strongly marked.

CHAPTER XVI.

TEA, COFFEE, AND COCOA. *(Continued)*

COFFEE is the seed of a tree belonging to the genus *Coffæa Arabica*, a native of Abyssinia and Arabia, but now naturalised in many tropical countries colonised by Europeans.

The flowers, which grow in clusters at the root of the leaves, close to the branches, are pure white and very fragrant. The fruit contains two cells, with a seed or so-called "berry" in each.

As the coffee-tree continues in flower for eight months, its fruits are of very unequal ripeness; and in the West Indies and Brazil, three gatherings are made annually. The seeds, after being sun-dried, are divested of their covering by means of rollers, winnowed from their impurities, and packed in bags for exportation.

The following kinds are best known in commerce:

Mocha—small, grey berries, slightly green;

Java, or *East Indian*—large, yellow berries;

Jamaica—somewhat smaller and greenish;

Surinam—the largest of all; and

Bourbon—the berries of which are pale-yellow, or almost white in colour.

The coffee berries or beans are *roasted* till they assume a reddish-brown colour, losing in the process 15 per cent. by weight, and gaining 30 per cent. in bulk; if roasted till they become chestnut-brown, they lose more, and if the heating continue till they become dark brown, they lose 25 per cent. in weight, and acquire 50 per cent. in bulk.

The beans should never be heated beyond a light-brown colour, which is sufficient to bring out the aroma and other qualities; when the operation is carried farther, more or less charring is the result, and the aroma is overcome by a disagreeable burned smell.

Coffee owes its exhilarating and refreshing properties to the presence of three substances: (1) *Caffeine*, which exists in the roasted bean to the extent of $\frac{3}{4}$ to 1 per cent.; (2) a *volatile oil*, which is not present in the raw bean, but is developed during the roasting process to the extent of about one part in 50,000 of the roasted coffee; (3) *astringent acids*, resembling tannic acids, but called caffeo-tannic and caffeic acids.

In its effects coffee is more stimulating than tea; it aids digestion, but accelerates the action of the heart.

Coffee does not usually retard the action of the bowels as strong effusions of tea do, having less of the astringent principle, and because of its aromatic oil, which is aperient in its action.

Its most important functions are to allay the sensation of hunger, to produce a refreshing effect, and to diminish the bodily waste.

Taken strong, it produces watchfulness, which sometimes lasts for hours; it is consequently administered in cases of lethargy, to counteract the action of narcotics.

Coffee grounds contain much legumin, and some Eastern nations use these as well as the infusion.

In other respects coffee possesses similar properties to tea.

Preparation of Coffee.—The chief object is to obtain the liquor free from all sediment, for which purpose an endless variety of apparatus have been contrived, some of them of great complexity. The simplest and cheapest of these is the well-known percolating coffee-pot.

An easy and perhaps as satisfactory a way as any of preparing coffee, is to put two ounces of *fresh-roasted* and *fresh-ground* coffee into a common coffee-pot, pour over it a pint of boiling water, and let it stand closely covered near the fire for five minutes, but not to boil. The liquor may then be simply strained, and returned to the coffee-pot (previously rinsed out) and warmed.

Soyer, the celebrated French cook, recommended that before the boiling water is poured in, the coffee-pot, or *saucepan*, should be set on the fire, and the powder stirred till quite hot, but not in the least burned.

In France, a pint of boiling milk is added to a pint of coffee, forming the well-known *café-au-lait*.

Chicory, produced from the roasted, powdered, carrot-like root of a plant growing in most European countries, is sometimes mixed with coffee, but does not supply the animal economy with any useful ingredient, beyond a certain per-centage of sugar which it contains. Its principal effect is to impart a deep brown colour and an appearance of strength to the mixture. When largely used, it has a tendency to produce diarrhœa.

Cocoa, or Cacao, is the product of a tree called by botanists *Theobroma*. Several species are cultivated, all being natives of the tropical parts of America, the seeds yielding more or less of the cocoa of commerce.

It is extensively grown in America and the West Indies, and has been successfully introduced into some parts of Asia and Africa.

The fruit is shaped like a cucumber, six or eight inches in length, containing the cocoa beans of commerce, which are very numerous. The thin, reddish-brown, fragile skin covers a dark brown, oily, aromatic, bitter kernel. These kernels, when decorticated, are bruised into small pieces, known as *cocoa-nibs*.

The cocoa-tree yields two principal crops in a year, and attains its full vigour in seven or eight years. The fruit is gathered and fermented for five days, then opened by hand, and dried by fire or the sun.

Cocoa contains from 45 to 49 per cent. of butter, or oil, about 22 per cent. of starch, gum, mucilage, &c., and 17 per cent. of gluten and albumen, and is consequently very nutritious.

The beans contain, in addition, a crystallisable principle, called Theobromine, which is identical with Caffeine.

Preparation.—For dietetic purposes cocoa is prepared in several ways.

Chocolate is made from the seed after the husk is removed, and is mixed with vanilla, an exquisite perfume and aromatic.

Soluble cocoa, rock cocoa, and common cocoa are various forms in which the unshelled beans are powdered and mixed with various substances—honey, sugar, and *starch*.

It is prepared in various solid forms as sweet-meats.

The large quantity of oily matter it contains makes the ordinary preparation of cocoa too thick and heavy for persons of delicate constitutions. Some manufacturers have prepared a superior form of the article from which the oily matter has been extracted.

The best and purest beverage is prepared from cocoa-nibs, this being lighter and more palatable than any other infusion of cocoa.

In countries where the cocoa-tree is indigenous, the natives sometimes eat the pulp of the fruit, and also obtain a kind of spirit from it by fermentation and distillation.

CHAPTER XVII.

FERMENTED DRINKS.

Fermentation.—In certain organic nitrogenous compounds, some of animal, others of vegetable origin, the different constituents are held together by affinities so feeble that *spontaneous changes* are liable to take place when they are exposed to favourable conditions of air, moisture, and warmth. Albumen, casein, fibrin, and gluten are bodies of this class, which when removed from vital influence, are very liable to enter into slow chemical decomposition or fermentation, the final products of which are *carbonic acid*, *ammonia*, and *water*.

Bodies which undergo this change in themselves have also the power of setting up a similar action in other and more stable bodies with which they come in contact. They are hence called *ferments*, as *yeast* in bread-making and brewing.

Three well known kinds of fermentation are the *vinous*, producing alcohol; the *acetous*, producing vinegar; the *putrefactive*, which is unaccompanied with the production of alcohol or acetic acid, being the spontaneous decay and decomposition of animal and vegetable matter, giving rise to various fœtid products.

The various fermented drinks prepared from vegetable substances may be conveniently discussed under the heads of *Malt Liquors, Wines, or Vinous Drinks*, and *Distilled Spirits.*

Malt liquors, known as ale, beer, and porter, are produced by fermentation from malted barley or other grain.

Malt may be described as grain in which a portion of the starch has become changed into sugar and dextrine by an artificially excited germination, which is suddenly checked by the application of heat, when the young root of the germinating grain has been sufficiently developed.

In the process of drying in the kiln, the malt may be made to take various tints, pale brown, or high dried; and the colour of the beer is light or dark according to the quality of the malt from which it is brewed.

The *bitter* quality is imparted as required by the introduction of hops

In the process of brewing, the sugar is extracted from the crushed malt by infusing it in water heated to a temperature ranging from 170° to 190° Fahr.

The liquor, after being boiled with the desired amount of hops, is run off to cool, and the process of fermentation is started by the addition of a little of the ferment yeast.

At a certain stage the fermentation is arrested, lest it should pass on to the *acetous stage.*

When the fermentation ceases, the liquor is run off from the fermenting vat into smaller casks, where it is allowed to *fine itself*, carbonic acid escaping through the open bung-hole.

Wines, and analogous drinks, such as cider and perry, are all produced from the juices of fruits.

The wines from France are generally admitted to be the finest, though much is made in Spain, Portugal, Madeira, the Cape of Good Hope, the Rhine Provinces, Hungary, Sicily, and Greece; and all from the fruit of the grape vine.

The principle of wine-making is everywhere the same. The grapes are crushed in a large vat; fermentation is set up; and the saccharine matters, which consist of oxygen, hydrogen, and carbon—under the process of fermentation and the loss of carbonic acid—become changed into *alcohol*, which is also a combination of oxygen, hydrogen, and carbon *in altered proportions*.

The remaining operations consist of refining, bottling, storing, &c.

In very hot countries, more sugar is produced in the grape than can be converted into alcohol during the process of fermentation; consequently, wines from such grapes contain not only much alcohol, but a considerable amount of unconverted saccharine matter in solution, making them *fiery* and *sweet*.

In Champagne, Burgundy, and the Orléannois country, the wines containing little sugar are liable to turn sour from acetous fermentation, unless the *marc—i.e.*, the skins and stalks of the fruit—are left floating on the liquor during fermentation, when the alcohol extracts from the refuse a principle which retards the acetous fermentation and makes the wine keep.

Fruits in colder countries not only ripen imperfectly, but contain an insufficiency of saccharine matter; consequently, sugar is added to their juices as a source of alcohol, as in our *home-made wines*.

The *flavour of wine* depends partly on a volatile oil secreted in the skin of the fruit.

The *colour* is imparted by a resinous product likewise resident in the skin. This colouring matter is only soluble in alcohol; so that by abstracting the *marc* during fermentation, the wines are white, however dark the grape may be. White champagne, for example, is made from grapes of a deep purple colour; and port from the same vineyard may be either red or colourless, according as the skins of the fruit have been allowed to remain in the *must* during fermentation, or have been removed.

The following substances exist in the grape: *tartaric acid*, *malic acid*, *potash*, and *lime*.

The tartaric acid unites with the potash and forms a white crystalline mass, called *cream of tartar*.

When the wines are racked off, the fermentation is again renewed, but gradually subsides, and the casks are then closely corked. A period of from one to ten years should elapse before the wine is ready for bottling.

Wine improves with age, especially when kept in the wood (casks), as some of the water passes off, leaving a higher proportion of alcohol.

Electricity is now used in California for fining and mellowing new wines; the effects of *years of time* being produced by this means in forty-eight hours.

The process of making cider and perry from apples and pears respectively, after the crushing of the fruit, resembles wine-making in all essential particulars.

In the making of cider and perry, the fermentation is not so long continued as in that of grape-juice, as these liquors are not usually prized so much for the amount of their contained alcohol as for their brisk, acidulous, but sweet and pleasant flavour, which would be lost if the saccharine matters were entirely converted into spirit.

CHAPTER XVIII.

FERMENTED DRINKS: EFFECTS. *(Continued)*

Ardent spirits are produced from fermented liquors by the further process of *distillation.*

Distillation consists essentially in converting a fermented liquor into a vapour in a close vessel, by means of heat, and then conveying the vapour into another cool vessel, to be condensed again into a liquid. The Spirit is produced by fermentation, distillation merely separating it from the mixture in which it may be contained.

Spirits were first distilled from wine, and were hence called spirits of wine; but the term, as usually understood, means alcohol in its potable condition, of which there are numerous varieties, each deriving its special characteristics from the substance used in its production.

Brandy is a spirit only obtainable from wine. *Rum* is manufactured from the products of the sugar-cane, mostly molasses. *Gin* and *whiskey* are made from malt and various cereals. *Hollands* is a Dutch spirit, made from corn, and flavoured with juniper berries. (From the French name of the berry "genièvre" come *geneva* and *gin.*)

Sugar is the direct source of alcohol, inasmuch as by its decomposition during the process of fermentation alcohol and carbonic acid are produced. For this reason, any vegetable products containing sugar, such as sugar-cane, beetroot, the sap of the maple and birch, grapes, and sweet fruits, are used in the manufacture of spirits. Hence, in addition to the spirits before mentioned, we have cherry-brandy, peach-brandy, and cider-spirit.

Starch is another, though indirect, source of alcohol, being easily convertible into sugar under the influence of diastase. For this reason, potatoes and other starchy substances, containing little or no free sugar, are capable of yielding alcoholic spirits of an inferior kind.

In addition to the alcohol, certain essential oils extracted from the raw material impart to the spirit their own particular flavour, and though repeated distillation will rectify the spirit to a considerable extent, the peculiar flavour of each will remain.

Some of these essential oils are disagreeable and positively noxious. The effect of age is to dispose of these by spontaneous decomposition; hence, in comparison with new spirit, which is always more or less disagreeably fiery and unwholesome, old spirit is pure and mellow.

The amount of alcohol in distilled spirits is, on an average, about 49 per cent. by weight, but is sometimes more.

The effects produced by drinking spirits habitually are—(1) *indigestion*, (2) *disordered liver*, (3) *dropsy*, (4) *diseased kidneys*.

1. *Indigestion* is produced by an alteration in the mucous membrane of the stomach, which weakens its solvent action, prevents the proper digestion of the food, and causes a deficient nutrition of the blood.

2. *Disordered liver.* The fibrous structures of the liver become overgrown; this produces a compression

of the substance of the liver proper, and prevents the due performance of its functions. In addition to this, the fibrous substance impedes the proper flow of the blood from the portal vein through the liver.

The structure of the liver is so much affected by the use of ardent spirits, that the alteration is recognized by the physicians of different countries under the name of the spirit in common use there.

It is known in England by the name of "the gin-drinker's liver."

3. *Dropsy.* The free passage of the blood through the liver being impeded, an extra pressure is naturally exerted on the capillaries. This causes the serum of the blood, or "water," as it is commonly called, to collect between the walls of the abdomen and the membrane enclosing the intestines, which is called the peritoneum.

The walls of the abdomen become distended; the diaphragm, and other organs, become impeded in their action; respiration is rendered difficult, and the action of the heart is interfered with; while the tissues, one and all, degenerate from want of proper nourishment.

4. *Diseased kidneys.* That this often follows the use of spirits is proved from the fact that it is far more prevalent among drinkers of alcoholic liquors than amongst those who are not.

Other effects may be noticed in addition to the foregoing.

Spirits are especially dangerous in hot countries. A depression of the system follows their use in cold countries, and spirit-drinkers do less work than others.

The effect of wines and fermented liquors on the constitution, as compared with ardent spirits, is only a question of degree, as the former contain a smaller proportion of alcohol. The alcohol contained in the stronger wines, however, such as port and sherry, is usually increased by the addition of brandy to the amount of from 10 to 14 or 15 per cent.

Strong wines and malt liquors do not produce so marked an effect on the liver as the drinking of spirits, but when taken in excess, the blood becomes impure from deficient oxidation, the kidneys become diseased, and from the nitrogenous substances uric acid is deposited in the tissues instead of being excreted as urea.

Uric acid thus produced gives rise to gout, the severity of which is increased by excess in animal food, and the use of strong liquors taken at the same time, as the presence of alcohol in the stomach, prevents the proper digestion of food.

Very little indeed can be advanced *against* the principles of total abstinence from intoxicating drinks, for, though alcohol, as well as other stimulants, may be useful in many forms of disease, it is not by any means an essential to healthy life.

Light wines and the lighter varieties of beer, taken in strict moderation, may in some instances stimulate the appetite and promote digestion, and may in other ways be beneficial; but those who are unable to avoid the *abuse* of intoxicants, even in this mild form, had far better join the safe side of the total abstainers.

Division III.—Air.

CHAPTER XIX.

MOVEMENT AND COMPOSITION OF AIR.

THE existence of an atmosphere is to us a matter of vital importance, for to its influence we owe the possibility of both animal and vegetable life, the modification and retention of the heat of the sun, the transmission of sound, the gradual fading of day into night, the disintegration of rocks to form soils, and the various phenomena connected with the weather.

In common with all other gaseous bodies, the particles of the atmosphere repel each other, and can only be held in proximity by external force; hence it follows that air, being highly elastic, is pressed by its own weight into a less bulk, so that the stratum of air nearest the earth is denser than strată in the upper regions, where it becomes thinner or more attenuated, in consequence of the greater freedom afforded for the exercise of the repulsive force of its particles.

So elastic is the air that at the height of 18,000 feet its density is only one-half, and at 36,000 feet, or nearly 7 miles, it is only one-fourth of what it is at the sea-level.

The exact height of the atmosphere has not been determined, but from the observation of luminous meteors, it is inferred that it reaches at least an altitude of 100 miles, and that, in a form extremely attenuated, it may reach at least 300 miles from the earth.

The *pressure* of the atmosphere is one of its most important qualities.

A column of mercury 30 inches in height, and one square inch in section, weighs about 15 lbs. (14·7), which gives the equivalent weight of a column of atmospheric air of the same section, or 26,345,088 tons on every square mile.

The atmosphere encircling the whole of the globe is capable of considerable motion, caused primarily by the rarefaction or expansion of its particles by heat.

Dry air admits of the passage through it of the heat-giving solar rays without becoming sensibly warmed. The air can, however, be heated by *conduction ;* that is to say, the earth being heated, communicates its warmth to the air above, which in its turn warms the air immediately overlying. During this process, however, a part of the heat is destroyed, so that the heated earth cannot make the overlying air as hot as itself, and the higher the position above the earth, the lower will be the temperature, the decrease being generally about 1° Fahr. for every 300 feet of altitude.

Any alteration in the *temperature* of the atmosphere causes a change in its *density*, and as density can only be affected by the movement of its particles, we arrive at the conclusion that all atmospheric movements result from variations in the temperature, thus offering a simple explanation as to the origin of winds.

A *storm* is simply the effort of a disturbed atmosphere to restore its equilibrium, and the barometer is the instrument which indicates the existence of the disturbed condition.

The sun's vertical rays, beating upon the torrid zone with intense fervour, heat and rarefy the air in those tropical regions. This heating process causes the air to expand, and being then lighter than the colder air above, it rises and forms an ascending current. Meanwhile the colder, heavier air of the polar regions gradually descends nearer to the surface, and flows in towards the equator, and thus the equilibrium is maintained.

The same general principles apply to movements of the air on every part of the earth's surface.

COMPOSITION OF AIR.

One hundred volumes of dry air, under ordinary circumstances, contain the following bodies, mechanically mixed but not chemically combined :—

Nitrogen	79·02
Oxygen	20·94
Carbonic Acid	·04
Ammonia, Carburetted Hydrogen, etc.	Traces
	100·00

As atmospheric air is never found dry, we must add to the above constituents, for ordinary air, a certain quantity of *watery vapour*, the amount of which is constantly changing, according to locality, wind, and temperature.

CHAPTER XX.

AMOUNT OF AIR NECESSARY FOR EACH PERSON.

Air, as we have already stated, is necessary for the maintenance of animal and vegetable life. For animals it is the *oxygen* of the air that is required, nitrogen alone being unable to support animal life.

One use of the latter gas in the atmosphere appears to be to dilute the oxygen and render it less active and exciting to the system, for by oxygen alone the vital activities are increased to an unnatural extent.

There is a free communication between the external air and the minute air-cells of the lungs through the trachea, or wind-pipe, and the bronchial tubes.

The blood circulating in the capillaries of the lungs is separated from the air-cells by only a very delicate membrane, through which there is a constant interchange of gases. Part of the oxygen of the inhaled air is absorbed by the blood, while the carbonic acid of the blood passes outward with the exhaled air. In this way the venous or impure blood becomes arterialised, or made pure.

Notwithstanding this free communication with the external air, that which is in the cells of the lungs would soon become deprived of too much of its oxygen, and charged with too much carbonic acid, to allow the necessary exchange of gases to take place, unless a constant supply of fresh air is maintained by breathing or respiration.

Inspiration, the act of drawing air into the lungs, and *expiration*, the act of forcing it out again, are accomplished in ordinary breathing chiefly by the intercostal muscles, the diaphragm, and the elasticity of the ribs.

From twenty to thirty cubic inches of air are ordinarily inspired and expired by each respiratory act, and in quiet breathing the number of respirations in a healthy adult varies from about 14 to 18 per minute.

In quick walking, the number of respirations rises to 25 or 30 per minute; and in running, the number may reach as high as 70, or even more.

Respired air may be distinguished by the following terms :—

1. *Tidal* or *breathing air* or that which passes in and out of the lungs at each ordinary respiratory act.

2. *Complemental air* or the extra amount taken in by a deep inspiration.

3. *Supplemental air* or that which may be driven out of the lungs by a forcible expiration.

4. *Residual air* or that from which the lungs can never be entirely freed.

TOTAL CAPACITY OF LUNGS.

Tidal Air	30 cubic inches.
Complemental Air	100 ,, ,,
Supplemental Air	100 ,, ,,
Residual Air	100 ,, ,,
	330 cubic inches.

It will be seen, therefore, that during quietude between 400 and 500 cubic inches of tidal air pass in and out of the lungs every minute, about 16 or 17 cubic feet per hour, or, in round numbers, 400 cubic feet in every 24 hours; the weight of this quantity being considerably more than the food and drink which is taken in during the same period.

It has been stated as a homely illustration that a full-grown man spoils or vitiates in 24 hours as much fresh air as would fill 17 three-bushel sacks.

Whatever may be the amount of moisture contained in the outer air, that which is exhaled is perfectly saturated with moisture, the amount of water given off by the lungs daily being from 14 to 20 ounces, and the weight of carbon given off in the carbonic acid being about 8 ounces.

COMPOSITION OF EXHALED AIR.

Nitrogen*	79·3
Oxygen	15·4
Carbonic Acid	4·3
Loss	1·0
	100·0

Expired air thus differs from the air *inspired* (p. 84) in having less oxygen, nearly 120 times as much carbonic acid, more watery vapour, and a temperature raised to about 98° or 100° Fahr.

Carbonic acid exists in the atmosphere, in a general way, to the extent of about 4 parts in 10,000, but in any large proportion it is extremely injurious.

Air containing 1,000th part of its bulk of carbonic acid is exceedingly depressing; although in crowded assemblies, and even in close rooms of private houses, it often reaches ·2 or ·3 per cent. Air of this

* The amount of nitrogen in expired air is sometimes a little more and sometimes a little less than in air which has not been inspired, but these variations may be looked upon as exceptional.

quality will rapidly produce lassitude, headache, and incapacity for active exertion, either mental or bodily. Four per cent. of carbonic acid in the air will rapidly enfeeble the pulse, and hasten the breathing to an alarming extent, while a higher amount produces insensibility, asphyxia, and death.

In cases of strangling, drowning, or choking, the cause of death is the same—viz., a want of fresh air to arterialise the blood.

Whether air is prevented altogether from entering the lungs, or whether that which is breathed has too little oxygen or too much carbonic acid, the result is the same—the blood does not become arterialised, and asphyxia ensues.

The direct effect of want of oxygen is to retard and eventually stop the flow of blood in the capillaries of the lungs, and a lack of arterial blood soon causes the heart and other organs to cease to act.

Vitiated air causes the organs of the body to lose their vigour, and to become more liable to disease; consequently a *sufficient* and *constant* supply of pure air is absolutely necessary to the maintenance of health.

It must not be forgotten that an ordinary room, as usually built, is in effect *a closed box*, which, when the doors and windows are shut, has merely accidental communication, so to speak, with the outer air through cracks and crevices, the key-hole, and the fire-place.

Wherever lights are burned, a further necessity exists for the constant renewal of fresh air, especially as they are burned where the products must of necessity mingle with the air of the room.

One pound of oil in burning consumes the oxygen of 130 cubic feet of air, and produces much watery vapour and carbonic acid.

One pound of coal, in burning, consumes 31 cubic feet of oxygen—as much as is contained in 150 cubic feet of air.

One cubic foot of coal-gas consumes the oxygen of 10 feet of air, forms at least one foot of carbonic acid, besides watery vapour, and sometimes sulphurous fumes.

A single candle burning renders nearly as much air impure as the breathing of a child.

To counteract these common sources of pollution, and to maintain the wholesome condition of the air in apartments where several people are breathing, it has been found in practice that 30 cubic feet of fresh air per minute must be supplied *for each individual.*

According to *Dr. Parkes*, the amount of fresh air which ought to be supplied *per hour* for *each person* should amount to 2,082 *cubic feet*, in order "to dilute the products of respiration and transpiration," or, in other words, to keep the air wholesomely pure.

In barracks the amount should not be less than 1,059 cubic feet by day, and 2,118 by night; in workshops, prisons, and theatres, 2,118 cubic feet; in schools, 1,059 cubic feet; in hospitals, 2,825 cubic feet; but during "dressing time," 4,236 cubic feet; in mines, 6,000 cubic feet.

Two thousand cubic feet of fresh air per head per hour are considered necessary to keep the carbonic acid in an apartment down to ·5 or ·6 in 1,000 volumes, and to purify the air from the *odor humanus*, or the result of personal exhalation of organic matters.

CHAPTER XXI.

IMPURITIES OF AIR: DELETERIOUS EFFECTS.

The impurities in air may be conveniently treated of under the heads of (*a*) *Suspended Matters*, (*b*) *Gaseous Substances*, and (*c*) *Special Impurities*.

(*a*) Amongst *suspended matters* are numerous and universal germs of organic beings, both animal and vegetable; pollen, and spores of fungi of various kinds, together with numerous particles of metallic and mineral matters.

The presence of minute solid substances in the atmosphere in a state of extremely fine subdivision, is revealed to a certain extent in the sunbeam; the quantity, and sometimes even the presence, of these foreign matters is affected by local and meteorological causes.

Minute particles of inorganic matter are often taken up by currents of air, and remain in suspension; while the various industries of man produce an enormous amount of atmospheric impurities, of which particles of coal and half-burnt carbon (smuts) are the best-known examples.

In the air of badly kept hospital-wards epithelial cells and pus cells are often to be discovered; and it is now generally accepted that specific poisons of small-pox, scarlet fever, and measles, derived from the skin and mucous membranes, pass into the air as molecular organic matter, although, so far, these minute organisms have escaped actual detection.

The same remark applies to the so-called *germs* of typhoid fever and cholera, which are thrown off by the mucous membrane of the intestines, and may subsequently become dried and capable of suspension in the air.

Whatever the extent of our actual knowledge may be, this much is certain—viz., that these specific poisons differ very much in the readiness with which they are *oxidised* and rendered harmless.

The poisons of typhus and of Oriental plagues are readily destroyed; those of small-pox and scarlatina spread in defiance of free ventilation, and retain their virulence for weeks, and even months.

There are suspended matters which are known to occasion disease in various trades, in numerous instances the workmen being injuriously affected by the *dust*, &c., arising from their work.

The following is a classification of these :—

Metallic Dust.—Tool-grinders, file-makers, lithographers, engravers, moulders, watchmakers, &c.

Lead-poisoning is not uncommon in the case of lead-miners, painters, plumbers, and workers in white lead. It produces various forms of paralysis, such as lead-palsy, painters' colic, and wrist-drop.

Mineral Dust.—Grindstone-makers, flint-cutters, glass-polishers, and stone-cutters.

Vegetable Dust.—Cigar-makers, tobacco and snuff workers, weavers, workers in "hackling," "carding," "sorting," and "dressing" hemp and flax; millers, bakers, and flock-dressers.

Animal Dust. — Brush - makers, hair - dressers, skinners, tanners, and hatters; button, harness, and cloth makers; feather-dressers, and shoddy-grinders.

In order to change the character of these unhealthy occupations, it is necessary to free the air inspired from any such dust or other foreign bodies. This is sought to be effected by the use of magnetized wire-gauze respirators by steel-grinders, and other special forms of respirators by stone-cutters and millstone-grinders.

For the use of the London Fire Brigade, Professor Tyndal devised a respirator of cotton wool moistened with glycerine and mixed with pieces of charcoal.

There are some trades in which irritant vapours are associated with floating particles in causing disease. Thus brass-founders suffer from asthma, bronchitis, and brass-founder's ague; plumbers and painters are liable to colic, or lead-poisoning; workers in mercury suffer from mercurial tremor; and symptoms of chronic poisoning are seen occasionally among those employed in making artificial flowers, green wall-papers, and other arsenical compounds.

Chemical vapours may be rendered comparatively harmless when inhaled through cotton, and the effects of the vapour of mercury are mitigated by sprinkling the floor of the workshop with ammonia.

In the case of those whose work brings them in *personal contact* with poisonous metals, the hands and mouth should always be washed before eating, and a daily bath should be taken.

Water acidulated with sulphuric acid should be freely imbibed by those who work among lead.

All ordinary domestic waste matters, whether offensive or inoffensive, when first produced, become offensive to about the same degree when putrefied. They also become equally dangerous, save that some may carry specific germs of disease which are absent from others.

It is important not only to consider the removal of the bulk of the offensive matters, but to guard against evils arising from the decomposition of the adhering particles which mark the course it has followed in the process of removal.

The effect of putrefactive fermentation is to resolve the decaying matter into its constituent elements.

(*b*) Among *gaseous matters* which pass into the atmosphere from natural causes or from manufactories, are various compounds of carbon, sulphur, chlorine, nitrogen, and phosphorus. Straw-hat makers suffer from exposure to sulphurous acid fumes, and bleachers from the action of chlorine gas and alkaline fumes.

There are, in addition, the organic vapours arising from decomposing animal matters, and from sewers. The gases emanating from volcanoes and other subterranean cavities may be also mentioned.

We may here observe that some gaseous bodies are of the highest importance, as connected not only with the well-being, but even the existence, of animals. Two of them, oxygen and nitrogen, form the atmosphere; hydrogen and oxygen constitute water; oxygen united with silicon and various other metals, forms the greater part of the crust of the globe; and chlorine is one of the elements of that great preservative, common salt.

(*c*) *Special impurities* are caused by cutaneous exhalations and by respiration. The latter process not only increases largely the proportion of carbonic acid in the air, but is accompanied by the exhalation of organic matters of a poisonous character from the lungs.

Division IV.—Removal of Waste and Impurities.

CHAPTER XXII.

PRINCIPLES OF VENTILATION.

In temperate and cold climates, the bodily heat, if allowed to escape freely, would be dissipated faster than it is produced; and as the vital powers are invariably weakened if the temperature of the body be allowed to continue depressed below its normal state, there arises the necessity of houses, clothing, and other means of retarding its escape.

The warmth of a living body is lost in two ways: the layer of colder air that touches it receives part of its heat by conduction, and rising up, makes room for another layer or film to do the same; in this way, in cooling, a moderately heated body loses about one half of its heat. The other half is given off in rays which pass through the air and impinge upon surrounding objects. These radiate back heat in their turn, but as their temperature is low, the return is small, and the warmer body is colder by the difference.

Consequently we are chilled by a cold body without touching it, though the air between may be comparatively warm; the abstraction of heat from the warm body continuing till its surroundings are of a similar temperature to itself.

Extra clothing is used in some countries as a resource against cold, *both indoors as well as out;* but whenever fuel can be had, it is always preferred for keeping up, and for preventing the loss of bodily heat, by maintaining an artificial temperature somewhere near summer heat.

To maintain, artificially, a temperature most congenial to the human constitution is comparatively easy, but when to this we add the condition that the air must be also *pure*, a difficulty at once arises, inasmuch *as warming and ventilating are in some degree antagonistic operations.*

In spaces more or less confined, the necessity for ventilation is due to the fact *that air becomes vitiated by breathing*, the amount of its carbonic acid being *increased* and that of its oxygen *decreased* at a very rapid rate as we have shown (Chap. xx.).

The undue amount of watery vapour contained in expired air combines with the minute quantities of animal matter, also held in suspension, and forms on walls and furniture a clammy deposit, which, on putrefying, become organic poison.

Ventilation consists of two operations—the removal of the foul air, and the introduction of fresh. This is sought to be effected in a variety of ways, some *natural* and some *artificial*.

Natural Ventilation.—The agent employed in *natural ventilation* is the same as that by which nature, on a grander scale, effects the ventilation of the earth—viz., the draught of ascending currents produced by changes of temperature, and the consequent inflow of the surrounding air to fill the partial vacuum and maintain the equilibrium.

In ordinary dwelling-houses natural ventilation is effected by means of doors and windows, chimneys and fire-places.

Windows.—When properly constructed, to open at top and bottom, and suitably placed, windows offer the most convenient means of natural ventilation.

A simple but very excellent plan is to lift the lower window sash and rest it on a piece of board about two inches deep, fitted tightly across the bottom of the window frame.

By this simple arrangement a constant current of fresh air passes into the room through the open space between the two sashes, and being directed upwards, all perceptible draught is prevented.

Chimneys.—When a fire is lighted in a room, the lower stratum of air is set in motion, and a current established towards the chimney from every crevice communicating with the colder air outside. This, of course, carries much of the vitiated air up the open chimney. A large part of it, however, rises *above* the opening into the chimney, and, for perfect ventilation, provision should be made for the escape of this, which might be done by a ventilator through the wall into the chimney.*

When there is no fire burning, the process of ventilation is less effective; but all apartments—especially bed-rooms—are far less healthy if without open fire-places.

Artificial ventilation consists in rendering the existing natural means more efficient by mechanical contrivances, such as *fans*, *pumps*, *screws*, and *propellers*.

Furnaces and *stoves*, or other means for producing artificial heat, are also utilized by a variety of contrivances, for withdrawing or forcing air into the apartment.

* These ventilating valves are apt to cause an emission of smoke into the room, owing generally to an insufficient draught in the chimney.

Ventilation by means of the window may be further improved by means of such expedients as perforated panes of glass, zinc, tin, &c., and by what are known as louverts.

With all these possible appliances, however, it is unwise in the highest degree, in the construction of dwelling-houses, to dispense with any arrangement that can be introduced for ventilation by natural means.

The air which becomes heated and impure by the action of breathing, or by the burning of candles, lamps, gas, or the fire, rises to the top of the apartment, its place being supplied by the cold air which rushes in through every possible opening in the room.

It follows, therefore, that for thorough ventilation there must be in any apartment at least two openings —one above, for the escape of the impure air; the other below, for the supply of pure air.

It is a mistake to suppose that the carbonic acid of the breath, from its greater weight, must be chiefly at the bottom of the room. The heated breath, on leaving the lungs, instantly ascends, and the carbonic acid gas, with which it is charged, in obedience to the law of the diffusion of gases, seeks to spread itself all over the room.

CHAPTER XXIII.

WASHING AND SOAP: REMOVAL OF IMPURITIES.

As the process of washing, or cleansing by means of water, is usually assisted by the solvent action of soap on the impurities to be removed, the considera-tion of one of these processes naturally involves that of the other.

Soap originally meant the compounds derived from the union of *fatty bodies* with the *alkalies*, potash and soda. The name is still usually thus limited in its meaning, but has nevertheless been extended to compounds of fatty bodies with either *earthy* or *metallic* bases, having but few properties in common with soap, properly so called. These are mostly used in pharmacy and medicine, and need not therefore be considered further in this place.

Both animal and vegetable fats are used in soap-making.

Animal fat consists mostly of two parts: a hard part known as *stearine*, formed of stearic acid and glycerine, and a soft part known as *oleine*, composed of oleic acid and glycerine.

In the manufacture of soap, an alkali (soda, for example) is heated along with oil or tallow. The soda gradually combining with the stearic and oleic acids, forms soap, and yields up in this process of *saponification* a clear, viscid, sweet liquid known as *glycerine*.

Having an alkaline base, soaps are soluble in water and in alcohol.

The materials used in making common soap are tallow, kitchen-grease, soda, water, and a little salt. The alkali formerly used was obtained from kelp and barilla, but the carbonate of soda obtained from common salt is now almost exclusively used. The finer kinds of hard soaps are made with soda and the purer vegetable oils. For the inferior soaps, animal oils or the coarser vegetable oils are used.

The varieties of soap usually made are known as mottled soap, curd or white soap, yellow soap, soft soap, and fancy soap.

The mottling in *mottled soap* is due to a sprinkling of ley or caustic soda on the boiling liquid soap when near completion; this sinks slowly through the mass, leaving dark-coloured veins in its track.

Curd or *white soap* is manufactured nearly in the same way as mottled, but with more care and with specially selected ingredients.

Yellow soap has its colour imparted to it by the use of large quantities of palm-oil in the manufacture, the oil being partially bleached by a chemical process.

Soft soap is made chiefly of oil and potash. Any oil may be used, as seal, whale, olive, or linseed, a small quantity of tallow being added to increase the stiffness of the mixture.

Fancy soaps are usually made of good white soap which is remelted and perfumed.

Soap formed of cocoa-nut oil is soluble in salt water, and can therefore be used at sea.

Of late years many varieties of soap have been introduced, containing substances having antiseptic, detergent, or other specific qualities, such as coal-tar, sulphur, vaseline, iodine, and some others.

Hardness in water is of two kinds, *temporary* and *permanent*. *Temporary hardness* is occasioned by the presence of carbonates of lime and magnesia, which decompose soap, and form an insoluble curd, and no lather can be obtained till the whole of the lime and magnesia in the water has been precipitated in the curd thus formed.

This temporary hardness, which is the cause of the formation of the earthy incrustations or "fur" on the insides of kettles and steam boilers, may be removed from water by boiling.

Permanent hardness in water is due to the presence of *sulphate* of lime or *sulphate* of magnesia, and cannot be removed by boiling.

The degree of hardness in water is estimated by the amount of soap which it destroys or renders valueless. For instance, when *twelve pounds of soap* are required to produce a permanent lather in *one hundred thousand lbs. of water* (10,000 gals.), the water is said to have one degree (1°) of hardness. Water containing two lbs. of carbonate of lime in ten thousand gallons will, of course, require *twenty-four lbs.* of soap to produce a permanent lather. Such water is therefore said to have 2° of hardness.

These proportions show that the degrees of hardness of water coincide with the number of grains of carbonate of lime contained in each gallon. Thus water having *one grain* of carbonate of lime per gallon is said to have *one degree* of hardness; *two grains*, *two degrees*, and so on.

As showing the variations in hardness in water of different localities, we may mention that the water of Loch Katrine supplied to the people of Glasgow has 0·9° of hardness, while that of the Thames above Hampton contains from 20° to 24° of hardness.

Hard water may be rendered soft in many ways. The best, perhaps, is that known as Dr. Clarke's Process, which consists of the addition of one ounce of quicklime to one thousand gallons of water for each degree of hardness. This will render the water clear and soft and fit for drinking purposes in a period of twelve hours.

In comparing the cost of this process, Dr. Clarke shows that the action of 1 cwt. of quicklime costing, with labour, say, 3s., will be equal in effect to $4\frac{3}{4}$ cwt. of carbonate of soda costing £2 17s. 9d., or of $20\frac{1}{4}$ cwt. of soap costing £47 1s. 8d.

These figures show the enormous waste of soap entailed by the use of very hard water.

Although some people prefer hard water for drinking purposes, others, on the contrary, have a special liking for soft water.

For washing purposes soft water is certainly superior, on account of its solvent action on greasy and sticky impurities, as it effects a saving of soap, fuel, time, and labour.

For cooking purposes, the advantages of using soft water are noticeable in making tea, soup, bread, and boiling meat and vegetables. Ten ounces of tea used with soft water will be equal in strength to eighteen ounces with hard water. When hard water is used more meat is required in making soup; meat requires longer time to boil, and is harder in the fibre; green vegetables in cooking acquire a slightly yellow colour, and bread is not so light.

Various mechanical appliances are in common use for washing purposes, but the ulterior object is the same in all washing machines—viz., the removal of dirt from textile fabrics with as little damage as possible to the fabric.

The soap, by its chemical action, dissolves the greasy impurities of the fabric; friction assists the work, and after the article is rinsed in clean water, the operation usually understood as *washing* is virtually complete.

CHAPTER XXIV.

REMOVAL OF PARASITES.

The word "parasite," from the Greek *para*, beside, and *sitos*, food, means literally one who eats with, or at the expense of another.

Parasitic animals are somewhat numerous. They belong to different classes, and even to different divisions of the animal kingdom, but all are invertebrata.

Some live in the interior, others on the surface, of the animals from which they derive their nourishment. The former are termed *Entozoa*, the latter *Epizoa*.

Entozoa are found either in the natural cavities of the body, as the intestinal canal; or in the solid tissues, as the liver. They have also been discovered in the kidney, in the bladder, in voluntary muscles, in the eye, in the portal vein, in the sub-cutaneous tissues, and even in the gall-bladder.

Twenty distinct species of intestinal worms have been found in man, but comparatively few of them give rise to dangerous or severe symptoms.

It would, indeed, seem to be an obvious and necessary condition of parasitism that the parasites must not destroy the creature from which they obtain their support. In most cases it is not the animal that the parasite attacks so much as its superabundant products.

Intestinal worms are most rapidly propagated in debilitated persons, and in children living in damp and cold situations. The use of raw or imperfectly cooked meat, unripe fruits, and impure water exercises a considerable influence on their development.

Epizoa derive their nourishment from the skin of the animals on which they live.

Human parasites of this class, to which we shall now confine our attention, may be divided into two groups: (1) those which live *on* the skin, and (2) those which live *in* the skin.

Fleas, lice, bugs, &c., belong to the first group; the itch-insect (Sarcopetes), the pimple-mite, and possibly some other species of the Acaridæ, belong to the second.

Of fleas there are several species—all, however, very similar to the common flea, which is plentiful in all parts of the world, and lives by sucking the blood of man, and of some kinds of quadrupeds and birds.

Wherever *cleanliness* is neglected there fleas abound, especially where dirt and dust are allowed to accumulate in the chinks of floors and walls. The nests of swallows, pigeons, and poultry are particularly favourable to their propagation.

The abundance of fleas in some countries is a perfect nuisance, both to travellers and residents, especially in dry, warm climates, like Australia, where housewives, with all their precautionary measures, are almost powerless to cope with these bloodsuckers.

The two sexes are very similar to each other, but the female is rather the larger of the two.

Fleas are propagated by means of eggs, of which the female lays about a dozen, of a white colour and slightly viscous or sticky. When the egg is hatched, a lively little worm appears, white at first, afterwards reddish, and destitute of feet.

Before changing into the pupa state, it encloses itself in a tiny silk cocoon, from which it emerges in a perfect state, seeking whom it may devour.

Where careful attention and cleanliness are insufficient, as in some climates, and in dwellings with much wood-work with gaping joints, strongly aromatic plants are employed, whose odours are detestable to them; of these fleabane and wormwood are well-known instances.

> "Where chamber be sweeped and wormwoode is strown,
> No flea, for his life, dare abide to be known."—TUSSER.

The dog, fox, mole, and other animals have each their particular species of fleas.

The Jigger, or Chigoe, of the West Indies, which infests man, is the most troublesome species.

The louse (*pediculus*) is the type of a numerous family which forms the order *Parasita*. The species are small, and live parasitically on human beings, mammalia, and birds.

The following is a general description: body flattened, and almost transparent; mouth small and tubular, enclosing a sucker; legs short, terminating in a claw, by which the animal affixes itself to hair or feathers; eyes simple, and one or two on each side of the head.

They multiply with astonishing rapidity, and reach maturity in about eighteen days, during which time the skin is cast several times. The female lays in all about fifty eggs, which are fixed by a glutinous substance.

The same species is rarely found on different species of animals, unless very nearly allied, though some animals are infested by more than one parasite.

The variety infesting the human head may be destroyed by combing, and by using either the Persian insect-powder, or white precipitate ointment; the latter being the common remedy in this country.

Other effective measures are the following:—

(1) Cut the hair short, if practicable;

(2) Wash the head with soft soap every day; and

(3) Bathe the head with a lotion of weak vinegar and water once or twice a week, which hastens the process by destroying the nits.

The *body-louse* is similar to the head-louse, but of larger size.

A third kind, the *crab-louse*, is, fortunately, seldom met with, or even known. Mostly found in the pubic region of the body, it has a broader body, and other characters considerably different from the two foregoing kinds.

The word *bug* is a name applied to a large family of insects, some of which are known as land-bugs, others as water-bugs.

The annoying and disgusting house or bed bug is perhaps better known, unfortunately, than any other kind.

Its body is flat, somewhat oval, of a dirty rust colour, and about three-sixteenths of an inch in length, and emits a disagreeable odour.

The mouth, formed for suction only, is furnished with a three-jointed sort of proboscis, which forms a sheath for the three suckers.

This insect lurks by day in crevices of walls, bedsteads, and other furniture, but is sufficiently active during the night.

Scrupulous attention to cleanliness is the best preventive of bugs in a house; but where the nuisance exists it is not easily removed.

A good and safe remedy is thorough washing with spirits of turpentine, and a solution of corrosive sublimate has been tried with success. A wash made of vinegar and carbolic acid painted over the crevices in which the pest is lodged is also most efficient.

One species of bug sucks the blood of bats, pigeons, swallows, and other birds ; but the greater number of this family live on the juices of vegetables.

Itch, or *scabies*, is a contagious vesicular disease of the skin, due to the presence of a minute *acarus*—the *itch-mite*.

The itch insect burrows within the epidermis, and excites cutaneous irritation, causing the affected parts to itch with great intensity, especially when warm in bed, or after partaking of stimulating drinks or exciting condiments.

The *itch-mite*, in the case of the female, is about one-fifth of a line in length, and one-seventh in breadth, and is visible to the naked eye as a greyish white corpuscle, not unlike a starch granule. The male is considerably smaller.

Once fairly buried, it burrows and forms tortuous galleries within the skin. At certain intervals these galleries are pierced with minute openings, sometimes resembling small dots, through which the young escape.

Some species infest the lower animals ; one of them produces *mange* in dogs; horses, oxen, and sheep are also subject to their attacks.

The itch disease may be communicated by contact, or through articles of clothing. In some cases, the itch insect is conveyed in its perfect form ; in others, only the ova suspended in the fluid of the vessels may be the mode of transmission.

In cold and temperate climates the disease never gives rise to serious injury to the health. The great remedy is sulphur, which may be regarded as a specific. Four ounces of sulphur ointment rubbed into the affected part, before the fire, morning and evening, for two days, and wearing the same flannel shirt the whole of the time, with a warm bath on the morning of the third day, will in most cases bring about a perfect cure.

There are several cutaneous disorders much resembling itch, such as *eczema*, *prurigo*, and *lichen;* but these may be distinguished, on a close examination, from the somewhat disreputable affection we have just described.

Eczema forms rounded, and not conical vesicles, and causes a sensation more like pricking than itching. Prurigo and lichen are not accompanied with vesicles, and none of these diseases are contagious.

Ringworm is a popular term for several distinct forms of skin-disease, which occur in patches of circular or annular form on the body, and especially on the scalp.

A species of Lichen and two of Herpes are often mistaken for ringworm.

True ringworm, however, is a disease dependent on the presence of a special vegetable, fungous parasite, known commonly as the hair-plant *(Tricophyton tonsurans).*

The three varieties of true ringworm are:

(1) Ringworm of the body;

(2) Ringworm of the scalp; and

(3) Ringworm of the beard.

The essential treatment of ringworm is to apply a preparation which will destroy the fungus, to do which, the hair must be removed, if this has not already been effected by the disease.

Lint dipped in a solution of sulphurous acid, and continuously applied, will be found efficacious, sulphurous acid being probably the most energetic parasiticide at present known. A solution of one part of corrosive sublimate to 250 of water has also been found of service.

The general health should also be improved, to which end the internal use of cod-liver oil is often conducive.

Ringworm in the lower animals is of a similar nature to that in man, and is decidedly contagious, being communicable from one animal to another, and also to man.

Generally speaking, says Dr. Aitkin, "Wherever the normal chemical processes of nutrition are impaired, and the incessant changes between solids and fluids slacken, then, if the parts can furnish a proper soil, the cryptogamic parasites will appear."

CHAPTER XXV.

DANGER OF DIRT.

Dirt has been happily defined as "matter in the wrong place," and whenever it is permitted to exist for any length of time it invariably becomes the parent of a numerous progeny of diseases and other misfortunes.

The subject has a moral as well as sanitary aspect, but it is to the latter that we propose to confine our attention.

For this purpose it may be considered under the heads of (1) *Dwelling-houses and Surroundings*, (2) *Clothing*, and (3) *Bodily Uncleanness.*

1. *Dwellings and their Surroundings.*—An offence against sanitation in the matter of personal surroundings is a *public offence*, inasmuch as every dirty house is a source of danger to the neighbourhood in which it stands.

Sanitary inspection has been the means of removing much that was wrong, and consequently much that was dangerous; but as action from this source usually applies to the more flagrant violations of sanitary law, its effect is perhaps more deterrent than remedial.

At any rate, less attention is generally paid to the matter of cleanliness in personal surroundings than the gravity of the case would warrant.

Many a heap of rubbish, fermenting under the influence of sun and rain, many an open gutter, many a leaky sewage pipe, with all their deleterious odours and gases and contaminating soakage, are allowed to remain, producing their dire effects in the shape of low fevers or other epidemics.

The bad effects of dirt are intensified and concentrated to an extent exceedingly dangerous when it is allowed to exist in dwelling-houses. No refreshing breezes sweep through to dilute the pestiferous atmosphere, no drenching rains can carry off the impurities; even the blessed sunlight finds its way with difficulty into the abode of uncleanness, for sunlight and dirt are always opposed to each other.

Wretchedness, squalor, discomfort, and waste are the hand-maidens of dirt in the dwelling-house; and we all know how the moral nature of the dwellers in such an abode is gradually narrowed, biassed, and warped by such enervating and degrading surroundings.

The following conditions are requisite to insure healthy habitations, on whatever scale they may be constructed: (1) A dry site, and not malarious, with an aspect imparting light and cheerfulness; (2) a construction which will insure perfect dryness of foundation, walls, and roof; (3) sufficient ventilation to carry off respiratory contaminations of the air; (4) a system of immediate and perfect sewage removal.

Dirty clothing and *bodily uncleanness* are necessarily inseparable, and follow in natural sequence to dirty surroundings and filthy dwelling-houses. Can a man handle pitch, and not be defiled?

The state of the skin is of great importance from a hygienic point of view. The perspiration and the sebaceous, unctuous matters from the glands which are naturally poured out upon the surface of the body, become intermingled with detached scales of epidermis, dust, and fragments of fibre from the clothing, and, if not soon removed, they will interfere materially with the proper excretory action of the skin.

The daily use of the cold bath—almost unheard of fifty years ago—has greatly contributed to harden the system against attacks of cold, rheumatism, &c. In winter the cold water may often be advantageously raised to its summer temperature.

Division V.—Shelter and Warming.

CHAPTER XXVI.

CLOTHING FOR INFANTS AND ADULTS.

By means of suitable clothing, man is enabled to become an inhabitant of every clime.

In the tropics, the main use of clothing is to screen the skin from the intense heat of the solar rays, to permit a free circulation of air, and to assist in the escape of perspiration. For this purpose, light, loose, thin garments are used, the material chosen being a good conductor and reflector of heat.

In cold countries, the bodily heat is prevented from escaping by warm garments of wool and fur, which are bad conductors of heat.

In a changeable climate such as ours, great care is necessary to keep pace in our clothing with the weather, and neglect in this respect is a fruitful source of illness.

Sufficiency of Clothing.—In the case of infants, the first great danger to life is from external cold.

In common with all other young animals, infants produce a large amount of animal heat, on account of the quick circulation, rapid respiration, and the consequent extensive oxidation going on in the blood.

But, as the rule holds that the smaller a body is, the larger is its surface in proportion to its contents, infants lose heat a great deal faster, and so get chilled more easily, than adults.

The normal temperature of the body is from 98°

to 100° Fahr., and if an infant gets chilled a few degrees below this, death quickly follows.

But what happens far more frequently is that they catch cold, which gives rise to inflammation of the lungs or bronchitis, with all their dangers.

The effect of cold on the body is to chill the skin. This causes a determination of blood to the internal organs; perspiration and other necessary functions of the skin become checked, and ill-health results.

Although in our changeable climate no particular rule can be laid down as to the clothing that should be worn, it is strictly necessary that all persons should have such an amount as shall prevent the feeling of habitual chilliness.

It is especially essential that *infants*, *young children*, and *aged persons* should be warmly clothed.

During the period of youth and middle age this is a matter of somewhat less importance, but the chest should in all cases be well covered.

The neck should either be well covered, or not at all; hence it is not always a good plan to wear a thick comforter round the neck, as this tends to make the part very sensitive, and sore throats often follow.

An upright position either in walking or sitting is very advantageous, facilitating the action of the vital organs by the freedom of movement conferred through the due expansion of the chest.

Tight lacing injuriously affects the organs of the chest and of the abdomen.

Tight boots give rise to corns, and deform the shape of the foot by cramping the toes.

High heels throw the weight of the body forward to an unnatural degree, and are apt to produce permanent injury to the muscles of the feet.

These fashions are thoroughly objectionable and dangerous, and the wonder is that the discomforts arising therefrom do not cause a discontinuance of such absurd practices.

CHAPTER XXVII.

MATERIALS FOR CLOTHING.

The common materials for clothing are cotton, woollen, linen, and silk. Of these, cotton and linen are of vegetable origin, while woollens and silk are products of the animal kingdom.

Cotton is an important vegetable fibre, extensively cultivated in various parts of the globe within the 35th parallels of latitude. Although the cotton plant is a native of the tropical parts of Asia, Africa, and America, its cultivation has extended far into the temperate zones.

The origin of the cotton trade of the Continent dates as far back as the tenth century, when the staple was introduced into Spain by the Mohammedans. Since that time the manufacture has continued to increase, until it has arrived at its present gigantic proportions. The progress of the trade was, however, very slow till within the past hundred years.

Muslins and *laces* are made of the finer kinds of yarn, spun from Sea Island and long-stapled Egyptian cotton. *Sea Island* cotton is grown exclusively on the islands and a portion of the mainland of

Georgia, South Carolina, and Florida; the saline ingredients of the soil and atmosphere of those regions being indispensable elements of its growth.

Cambrics, *calicoes*, *shirtings*, and *sheetings* are made from the better classes of short-stapled American and Brazil cottons.

Fustians and some other heavy fabrics are made from inferior qualities of American and Surat cottons.

Cotton is also combined with wool in the manufacture of many beautiful and useful fabrics.

In the manufacture of some other fabrics cotton is also used in combination with linen, silk, and alpaca. Since the "cotton famine," or scarcity of raw material for this important industry—which resulted from the American Civil War in 1861-2—increased supplies have been obtained from India and other sources.

Wool is the most important of all animal substances used in manufactures, and ranks next to cotton as a raw material for textile fabrics.

Its use as a material for clothing is almost universal in the temperate regions of the globe.

Previous to 1791, British woollen cloths were made almost wholly of native grown wools. After this time Merino wool from Spain began to displace them in the finer kinds of goods. Before 1820 German wool had begun to supersede the Spanish, and was largely imported till 1841. After that, the cheaper wool of the British Colonies to a great extent took the place of the German, and the latter is now chiefly used for only the finest cloths.

The value of wool varies with the particular breed of the sheep which yields it, also with the nature of the soil, food, shelter, and climate.

In wool of prime quality the fibres are fine, sound, soft, elastic, of good colour, and free from troublesome impurities; the commercial value of any sample will therefore depend upon the extent to which it possesses these qualities.

In composition wool is nearly identical with that of hair or fur. When burned it leaves only from 1 to 2 per cent. of ash. In a natural state, wool contains a variable amount of oily and fatty matter, and a large proportion of sulphur, with about 10 per cent. of moisture.

According to the *Bulletin Association of Wool Manufactures*, there is perhaps no defect which renders wool, and otherwise good wool too, so absolutely useless for manufacturing, and especially for combing purposes, as tenderness or breechiness.

Good fleeces should have, as near as possible, a uniformity of character,—that is, as regards fineness, length of staple, density, and softness.

Wool is always more or less waved, and, when viewed under the microscope, is seen to be covered with minute scales, overlapping each other, and projecting wherever a bend occurs in the fibre. These projecting points of the scales hook into each other, and hold the fibres in close contact.

These scales give to wool the quality of *felting*, and the deeper these fit into each other, the closer becomes the structure of the thread, and consequently of the cloth made of it.

Other varieties of wool, or woolly hair, for manufacturing purposes, are obtained from the Angora goat (mohair), the camel, bullock, and the common goat.

In some instances, furs are also used to some extent for manufacturing purposes.

Woollen stuffs are usually classified according to the materials of which they are composed. Where *carded wool* is employed, the goods are called "*woollen fabrics;*" where *combed wool* is used, the goods are called "*worsted fabrics.*"

Shoddy is a very inferior kind of cloth, worked up from waste wool.

Woollen cloths include broad cloths and narrow cloths.

Under the name of broad cloth there are many varieties, having more or less finished surfaces, such as meltons, beavers, pilots, lustres, India cloths, elastics, and unions, which have cotton warps and woollen wefts.

Narrow cloths (about 27 inches wide) include cassimeres, doeskin, Tweeds, and many other special kinds.

Blankets, flannels, and some kind of shawls are included in woollen goods.

Worsted stuffs are very various, and they are not only used alone, but also mixed with other fabrics. The following are some of the varieties :—

1. *Fabrics entirely of wool*—merinoes, shalloons, serges, buntings, moreen, damasks, reps, camlets, &c.

2. *Fabrics composed of cotton and wool*—Coburg, Orleans cloth, winceys, &c.

3. *Fabrics of wool and silk*—poplins, tabrinets, Paramatta, Canton cloth, &c.

4. *Fabrics composed of wool, silk, and cotton*—mixed goods, including peculiar kinds, such as vestings, linings, cravats, shawls, scarves, quiltings, boot and shoe cloths, &c.

5. *Fabrics composed of alpaca and mohair, mixed with*

cotton or silk. These include alpacas, lustres, and mixtures—plain, figured, and twilled—umbrella and parasol cloth, glacés, barèges, &c.

Linen (Lat. *linum*) is manufactured wholly from flax. It is one of the earliest manufactures of which we have any account, and formed part of the dress of the Hebrew and Egyptian.

The cerecloth in which the most ancient mummies are wrapped proves its early and extensive use among the Egyptians; and its durability is evidenced by the almost perfect condition in which the linen is sometimes met with under such circumstances.

The development of the cotton trade checked the demand for linen for a time, but it has now fully regained, if not exceeded, its former proportions as one of our great staple manufactures.

Stimulated by the necessity of fine yarns for lace-making, the linen produced in France and Belgium is the best in the world in fineness of fibre.

The following list includes the best known and most valuable linen fabrics :—

Lace of various kinds ; *Lawn*, formerly exclusively a French production, but now made largely in Belfast, Armagh, and Warringstown ; *Cambric*, *Damask*, and *Diaper*.

Sheeting and *Towelling* are plainer linen fabrics ; *Ducks*, *Huckabacks*, *Osnaburghs*, *Crash*, and *Tick* are very coarse heavy materials, some bleached, and some unbleached, or nearly so.

A few varieties of *velvet* and *velveteen* are also made of flax, and much linen yarn is used as a warp for other fabrics.

Silk, which is manufactured from the cocoon of the silkworm, does not appear to have been well known to the ancient nations of Europe, but its cultivation in China is of the highest antiquity.

It was first cultivated in Europe in A.D. 550, and has ever since been an important branch of industry in Italy, Turkey, and Greece; while it has been cultivated to a large extent in France and Portugal.

The silk manufactures in Britain are chiefly in Manchester, Macclesfield, Coventry, Derby, and at Bethnal Green and Spitalfields districts of London.

Considerable quantities of silk goods are received from India to be printed with English patterns. These consist chiefly of bandana pocket-handkerchiefs, and Indian waist and turban scarves.

The quantity of silk raised in the whole world is enormous; and when we reflect that it requires 1,600 worms to produce a single pound of the raw material—the produce of one cocoon averaging 300 yards—we get some idea of the importance to mankind of this humble minister to our wants.

Its value to Great Britain alone is calculated at upwards of £16,000,000.

Cotton, wool, linen, and silk have their distinct and definite qualities as articles of clothing.

Cotton is light, and, in temperate climates, is usually employed for under-garments, for which its warmth renders it very suitable.

Wool is a non-conductor of heat, and in our variable climate very essential in cold weather. The warmth and the slight stimulating effect on the skin arising from its roughness when worn next the body render the wearing of flannel very beneficial to health.

Linen is not so warm, and is rather heavy, but it is more durable, and keeps its colour better than cotton. It is also far more expensive.

Silk in a *pure* state is really seldom met with in materials for clothing, being too expensive, though much used to mix with and beautify the commoner materials.

It is somewhat heavy and fairly durable, but is apt to retard healthy evaporation when worn in close-fitting garments.

Division VI.—Local Conditions.

CHAPTER XXVIII.

SOIL AND ITS DRAINAGE: ASPECT, ELEVATION.

Drainage consists in freeing the land from superfluous moisture.

In a general way, it may be considered that the primary cause of wetness in land is the rain-fall.

Wherever land is naturally wet, or wherever the flow of water is intercepted in its passage through the soil, to the detriment of animal or vegetable life, there drainage becomes necessary.

Drainage is effected by making in the land channels and water-courses, down which the water may escape to a lower level.

In addition to the many agricultural advantages to be derived from drainage, the following are most important from a sanitary point of view:

1. The temperature of the soil is raised, as the sun's rays are *absorbed* by the land, instead of being used in evaporating the moisture.

2. The health of man (and beast) ceases to be exposed to those humid conditions which are so specially productive of disease.

Although there are many accepted systems of drainage, no single one may be said to be capable of uniform application to all classes of localities and soils; and before commencing the general work of draining an estate, farm, or even a field or building site, it is advisable that the depth, distance, and fall of drains should first be settled by very careful calculations.

With respect to drainage, soils may be classed in two great divisions: (1) light and free soils, and sub-soils, and (2) clay soils and sub-soils.

Although *drainage* may improve the condition of even a bad site, and dryness be secured by thoroughly draining a locality which is damp, a *naturally* dry soil will always be found more suitable for the erection of buildings than one which is retentive of moisture.

Gravel and clay are the two extremes. Gravelly soils are unquestionably the most healthy, and next to these are sandy soils, which are necessarily dry and warm.

Houses embosomed in tall trees are unhealthy, also those which stand *near* a loose, damp soil. Care should be taken respecting the surface *near* the dwelling, as well as in the choice of the actual site.

Whatever may be the kind of soil chosen for a building site, every precaution should be observed in constructing the necessary drains and sewers. Not only should ample provision be made for draining the soil, but also for ordinary surface drainage and the surplus fluid from the house.

It is specially important that the *fall be sufficient* to guard against the possibility of choking, that there be a *sufficiency of water* for flushing purposes, and that the *traps* and *masonry* in connection with the drains should be *well finished and cemented*, to prevent the leakage of sewage matter and the escape of sewer gas.

One valuable modern improvement is the use of glazed earthenware pipes or tubes, which should, however, be kept as much as possible outside the building.

By reason of their value for manurial purposes, waste substances, and especially solid and fluid excreta, have been collected with a view of turning them to account. The various methods by which this is sought to be done are included under the name of the "Conservancy Systems." Instances are still, unfortunately, met with of midden-heaps and cesspools in immediate proximity to dwellings.

When situated under basement floors, these receptacles have proved the fertile cause of sickness and death, especially in days gone by. *Recent* inquiries into this matter has shown that the evil still exists in many large houses, not of modern construction, both in the metropolis and other large towns, and also in country districts. Not only cesspools, but defective drains, in such situations cause the ground around them to become sodden with fœtid matter.

The subtle emanations of gas therefrom diffuse themselves through the whole dwelling, and their baleful but insidious influence is ultimately felt, more particularly when the atmospheric conditions are favourable to an outbreak of cholera, fever, or other epidemic.

The "dry earth system" in various forms is of modern invention, and has been found a very convenient method of dealing with excretal matters in villages, asylums, prisons, schools, &c., as well as for temporary assemblages, such as fairs, race-meetings, and camps, provided a responsible person is told off to keep the necessary arrangements in thorough working order.

But in large communities, the safest and best plan is that of the "water-carriage system," in which, by means of specially constructed drains and sewers, the solid excretal matters are *cheaply* and *quickly removed* by gravitation.

With regard to *aspect*, there is in every locality a certain point from which, owing to local peculiarities, storms arise more frequently than from any other.

A south-east aspect in this country is usually found not only to be most sheltered from high winds and driving rains, but also most open to the genial influences of sun, light, and air.

Slope or *inclination*, too, exercises a very material effect, by regulating the drainage of any locality, and also in determining the amount and intensity of the solar rays which fall upon it.

High and dry situations, with a free circulation, of air are proverbially healthy; while those which are low and damp, and surrounded by confined air, are the opposite.

Ague, dysentery, and fevers prevail in wet and insufficiently drained localities, as well as in the neighbourhood of accumulations of decomposing organic substances.

Dampness of locality induces a condition of mental depression, bodily debility, and a consequent craving for stimulants.

The inhabitants of the deep valleys of Switzerland are subject to several serious ailments from which the people who live on the mountains are wholly exempt.

Children born and reared in the low, damp ground-floor of a house have suffered sad consequences, while others reared in the floor above have been perfectly healthy.

CHAPTER XXIX.

HILL, PLAIN, AND VALLEY; WINDS.

Character of Surface.—The land and water composing the surface of the earth are very unequal in their proportions, and the former presents an extremely irregular surface. As a consequence, the movement of the atmosphere in passing over the land is so broken up and complicated, that winds and rains, heat and cold, are incidents extremely variable.

Highlands, hills, and mountain-chains influence the rain-fall by their condensing action on watery vapour. They also form barriers to winds, and thus induce important alterations in temperature as well as humidity, for by intercepting moist winds they may favour the production of *rain* on their windward side, and droughts on their leeward side.

Lofty and continuous mountain-chains not only determine the physical outline of the great land-masses of the globe, but constitute in some cases important lines of demarcation in the fauna and flora of entire continents. They also determine the direction of many rivers, and thus indirectly influence the situation of towns.

Elevation, or height above the sea-level, causes a decrease of temperature in Great Britain to the extent of about 1° Fahr. for every 270 feet in altitude.

At the same time, even a comparatively slight elevation will often confer on a site immunity from the unwholesome influences of mists and fogs, to which a district lying nearer the level of the sea may be subject.

Distance from the Sea.—Large masses of water maintain a more equable temperature than land. Proximity to the sea consequently gives a more uniform temperature than is conferred on localities inland.

There is also a certain proportion of saline matter in the air near the ocean, the degree of which is largely dependent on the prevailing winds.

Influence of Surrounding Objects.—1. *Forests*, by their leaves, condense the vapour of the atmosphere, and, by precipitating it, help to feed *springs*. They also give shelter from winds, especially when situated on high grounds, and the slopes and crests of hills.

2. *Marshes* and *lakes* act unfavourably on climate by augmenting fogs and mists, as well as by noxious emanations inimical both to man and beast.

3. *Ocean currents* may bring warmth and moisture, and raise the temperature of the countries which they wash—the Gulf Stream, for instance—or they may temper the summer climate by their comparatively low temperature; as is the effect of the Arctic current on the eastern shores of North America.

4. *The direction of river-plains and valleys* may open out to favourable winds and warm ocean currents.

5. *Cultivation* has a marked effect on the climate of a country. The felling of forests, the draining of lakes, marshes, and swamps, tend to greater dryness and warmth, and general amenity of climate.

Nature of the Soil.—On its texture and composition will depend its power to withstand drought, absorb and retain heat, and generally to modify, favourably or otherwise, the extremes of climate.

Even *colour* has its influence; a dark coloured soil absorbing more heat rays than one of a lighter hue.

Manufactories may adversely affect the health of a neighbourhood, by means of the smoke and soot from their chimneys, or the poisonous effluvia arising from the chemical preparations in use.

Tan-yards, glue-works, smelting and blast furnaces, and similar places, must also be looked upon as active sources of impurity in their respective localities.

Winds have an effect according to their nature and direction.

In this country, those from the north and east are cold and dry, and on the whole unfavourable; while those from the south and west are mild and genial in their influence.

Where winds sweep over a large expanse of water, they become charged with aqueous vapour, which is deposited on the land in the form of rain, or some other meteorological phenomenon.

When winds sweep across burning deserts, or extensive arid districts, they lose their moisture, and acquire a blighting, withering influence, which in most instances is absolutely pernicious, and sometimes deadly.

In fact, so sensitive is the atmosphere to the influence of both heat and moisture, that on its currents (or winds) depend in a great measure the essentials of climatic diversity.

Winds may be *constant*, *periodical*, or *variable*. They may be hot, dry, cool, or moist, invigorating or relaxing in character ; and with regard to their speed and power, they may float softly as a zephyr, or, as a hurricane sweeping along, level a whole forest in the exercise of their devastating power.

Division VII.—Personal Hygiene.

CHAPTER XXX.

HABITS, EXERCISE, REST, AND SLEEP.

Individual habits result from the ordinary routine of life, and are consequently gradually and almost unconsciously acquired.

Habits formed during the period of bodily growth are apt to become established and strengthened to such an extent that, whether beneficial or pernicious to health, they are usually difficult to give up, to modify, or even to control.

Much, of course, depends on individual temperament, and on hereditary tendencies, and perhaps more on mental character and strength of mind. These again may be very materially influenced by position in the social scale of life. Another great factor is that of *health;* freshness and vigour in the bodily system being conditions largely regulating the formation and growth of habit.

Habits may be intellectual or moral or otherwise in their tendency, but an enlargement on these would be out of place in the present work. Our object is to deal with the subject merely as it affects the bodily functions in a hygienic sense.

Under the heads of *Exercise, Rest and Sleep, Cleanliness*, and *Attention to the Action of the Skin and Bowels,* many of the bodily habits and functions may be included, the ordinary duties of eating and drinking having already been considered in the chapters relating to diet, water, and beverages.

Exercise.—It is pretty generally known in the present day that, by judicious exercise, the muscles are strengthened, and the bodily powers improved and kept in proper working order. As the blood passes through the body, it collects the decayed and effete particles in the shape of carbonic acid and ammonia. These are conveyed to the lungs to be oxidized by exposure to the air, and this cleansing process of the blood and the system generally is more rapidly performed during muscular exertion. The *blood* is freed from superfluous moisture and the ordinary products of waste, the *fat* is reduced to a healthy minimum, and the *flesh* rendered hard, firm, and muscular. If to these conditions we add a proper scale of diet, with a sound and healthy constitution, it may be fairly assumed that the bodily necessities are satisfactorily supplied, if the sanitary surroundings are what they should be.

People of a phlegmatic temperament who complain of inability to take exercise, are often not too *weak*, but too *indolent* to do so.

Rest and sleep naturally follow exercise and labour. The food taken into the body restores the natural, constant *waste;* but the feeling of weariness and muscular fatigue can only be removed by rest and sleep.

As the world is periodically shrouded in the silence and darkness of night, so man, the "lord of creation," who works while it is day, is intended by his Creator to rest at night from his labours of mind and body, and to recruit his failing energies by "gentle sleep—Nature's soft nurse."

The time which may be profitably devoted to sleep is a matter which varies much in different people.

Some are satisfied with as little as four or five hours, some with six, but, as a rule, the adult body requires from six to eight hours to repair the wear and tear of the remainder of the twenty-four.

The brain contains less blood during sleep than when a person is awake.

Extreme heat or cold creates drowsiness, and a morbid disposition to sleep is often the precursor of apoplexy; while prolonged sleeplessness, on the other hand, is a frequent symptom of insanity. Sleeplessness may also be caused by over-stimulation, mental anxiety, indigestion, and partaking of strong tea or coffee.

Depriving a criminal of sleep is a frequent mode of execution in China; it is fearfully painful, and death occurs in eighteen or twenty days.

The *position* in which the body lies during sleep is not an unimportant matter, and bad habits can be contracted in this respect as well as in others apparently more important.

Whatever the habitual attitude may be, the respiratory organs should work freely and without restraint. The proper beating of the heart might be partially impeded by assuming a cramped and awkward position; sleeping on the back is bad, as the stomach is apt to compress the surrounding organs, especially if the former is loaded with food.

Night-mare and bad dreams are a common consequence of indigestion, resulting from heavy suppers and a position during sleep which impedes the proper exercise of the digestive and respiratory functions.

The position of the body with respect to the points of the compass has also been discussed, and a general direction of north and south has been advised, in accordance with the flow of the terrestrial magnetic currents; but on this obscure point we prefer to reserve our opinion.

A position which will permit of the full exercise of the vital functions will be always found to be most conducive to comfort and healthy sleep.

Children are apt to fall asleep in most uncomfortable and even dangerous postures, and many disasters have resulted from indifference on this point on the part of those in charge of them.

The indifference shown by so many, otherwise sensible, people as to the supply of fresh air in sleeping apartments is certainly surprising.

Windows are carefully fastened, the doors shut, and the fire-place—the last chance—stopped up! And in this closed box the hours of the night are passed!

Is there any wonder, with such slow suffocation, that the morning brings with it a feeling of stuffiness, weariness, and general depression, which is only relieved by breathing the pure fresh outer air?

CHAPTER XXXI.

CLEANLINESS: ATTENTION TO THE ACTION OF THE SKIN AND BOWELS.

Cleanliness.—Even in an abstract point of view, cleanliness must recommend itself to all well-balanced and intelligent minds.

Dirt in any form is unnatural and degrading.

The birds wash themselves and plume their feathers, and all the lower animals do their best to rid themselves from parasites and dirt. Many of them, in fact, appear to be particularly careful, and sometimes fastidious, on the score of cleanliness.

Even the proverbially "dirty pig" is maligned in this respect, for when "wallowing in the mire" it is using one of Nature's remedies for a restlessness engendered by its unnatural condition as a domesticated animal.

Looking at the subject, however, from a physiological point of view, the lessons connected with cleanliness present themselves to our understandings in a far higher light; natural instincts being here supplemented by the teaching of scientific truths.

Physiology teaches us that the constant waste of the body must be got rid of, or the delicate excretory organs—the lungs, the kidneys, and the skin—will become clogged by the waste material.

The *lungs* separate from the blood both water and carbonic acid; the amount of carbon expired in the latter being about eight ounces in twenty-four hours. The effect of *dirt on the person* is here somewhat indirect, but as personal dirt is usually accompanied by dirty home surroundings, the air inhaled is contaminated and impure, and the excretory action of the lungs consequently rendered imperfect: a state of things always productive of disease.

The *kidneys* purify the blood by taking up urea, uric acid, saline substances, and animal matters, together with small proportions of carbonic acid, oxygen and nitrogen, all of which pass out of the body after collecting in the bladder.

Action of the Skin.—The skin consists of two portions: an outer, termed the epidermis; and an inner, called the dermis, or true skin.

The latter is richly supplied with nerves and *blood-vessels.*

Embedded in the innermost portions of the dermis, or true skin, and surrounded by numerous capillaries (minute blood-vessels), are a number of coiled tubes, called *sudoriparous*, or *sweat glands*. The ducts from these glands pass through both dermis and epidermis, and open upon the *surface* of the skin, the apertures being somewhat oblique and valve-like.

These sweat glands are found upon the whole surface of the body, and are especially numerous upon the palms of the hands.

It has been calculated that if the whole of the sweat glands of the body were uncoiled, they would extend to a length of twenty-eight miles.

The skin also possesses a certain power of absorption.

Besides the *sweat glands* there are others called *sebaceous glands*. These are also found over the whole surface of the body, and secrete a fatty substance from the blood.

The moisture deposited by these glands on the surface of the body is known as *perspiration*. Ordinarily the perspiration does not collect upon the skin, but evaporates as fast as it is formed. It is then termed *insensible* perspiration.

When the secretions are poured out faster than they can evaporate, and hence collect in drops upon the surface of the body, it is called *sensible* perspiration or *sweat*.

The most important materials got rid of by the skin are carbonic acid and water.

About twice as much water passes off from the skin as from the lungs, but the amount of carbonic acid is only about one-thirtieth or one-fortieth part as much.

To the perspiration must be added another kind of excretion, from the outer or scarf skin—viz., the waste cells of the epidermis, which wear away in small particles as they are pushed upwards and flattened by the growth of the deeper cells.

A consideration of the foregoing statements will show that *dirt on the skin must clog the pores and prevent the excretory action of the glands.*

As a result of this, the body is not properly freed from the waste matters which every act of life entails, and the health must be impaired.

The excretory actions of the lungs and kidneys are beyond our direct control, but a knowledge of the proper functions of the skin may be a means of promoting bodily health to a very important extent.

The Action of the Bowels.—When food passes into the stomach, a nervous action is set up, which causes the blood-vessels to become more distended with blood, and the gastric juice is then secreted and commences to act upon the food.

The result is that the various constituents of the food become more or less completely dissolved, and reduced to a thin pulp, called *chyme*.

Part of the fluid of the chyme is absorbed by the walls of the stomach, and the remainder passes on through the pyloric opening into the duodenum, where *intestinal digestion* commences.

Here the chyme becomes mixed with (1) the *bile* from the *liver*, (2) the *pancreatic juice* from the pancreas, and (3) certain juices secreted by the glands in the intestines.

Under the action of these secretions the fatty matters in the chyme become emulsified, and fit for absorption, the acid of the gastric juice mixed with the chyme becomes neutralized, and any starchy matters which remain are converted into sugar.

These changes convert chyme into what is known as *chyle*.

The peristaltic movements of the intestine cause the chyle to move towards the lower parts of the bowel; those portions of the food which have been properly digested being absorbed—the *fatty* matters into the lacteal vessels, the *nitrogenous* and *saccharine* constituents into the blood capillaries of the small intestine.

The parts of the food which cannot be so absorbed pass out of the alimentary canal as useless excrementitious matter.

From this brief outline, it will be apparent that the proper action of the bowels will depend on the due performance of several different organs. The saliva, the gastric juice, the bile, and the pancreatic juice, all have their several uses in the great work of maintaining the healthy action of the intestinal canal.

If the bowels are irregular in their action, this condition can often be remedied by attention to diet or to habits. But if medicines are necessary, some one of the following will generally be found efficacious: Castor oil, Hunyadi Janos Water, Compound Liquorice Powder, Confection of Senna, &c.

There is abundance of wisdom and practical application of knowledge in the old recommendation to "keep the head cool, the feet warm, and the bowels open."

Division VIII.—Treatment of Slight Wounds and Accidents.

CHAPTER XXXII.

WOUNDS, CUTS, BURNS AND SCALDS, BLEEDING, FITS.

The treatment of wounds depends in a general way on the nature and extent of the injury.

Coolness and presence of mind even in unskilled hands will often prevent serious consequences, and even save life in cases of accidents.

The exercise of common sense and a knowledge of ordinary appliances are sometimes of vital importance while awaiting medical assistance.

A bruise is such as would be caused by a violent blow, the skin remaining unbroken.

A contused wound is an injury where the skin is broken, and where, in addition, the parts are *bruised*.

A "punctured wound" is such as would be made by a sword or bayonet.

A "lacerated wound" is where the parts are torn.

Cuts.—In what is called a clean cut, if not serious, the edges or lips of the wound should be brought carefully and evenly together, and bound or strapped up in the blood.

The sides of the wound, if the health and constitution be sound, will usually heal by the "first intention," as it is called.

Jagged and lacerated wounds are always troublesome, and suppurate, owing to the injured parts being more or less destroyed or killed.

Granulation, or the growth of new flesh, will restore these parts, leaving more or less of a seam or scar.

Proud flesh, popularly believed to be dangerous, is simply an *excess* of granulation, and requires to be kept down by the application of caustic.

Bruised or contused wounds, and cuts made with a dirty knife, are liable to cause great pain, throbbing, tenderness, and feverishness.

Such injuries might be cleansed by means of poultices and carbolic oil.

The latter is made by boiling one part of carbolic acid with five parts of linseed oil. Its antiseptic and healing properties have brought it into common use in cases of cuts, bruises, burns, &c.

Burns and *scalds* are more fatal to children than to those of adult age. The blisters arising from such injuries should on no account be opened.

A burn affecting an extensive surface is more to be dreaded than one which is deeper, but less extensive; and a fatal result may be expected from a burn or scald which extends over one-third of the body.

As a remedy for *burns*, the parts should be at once covered with oil and dusted with flour or scraped potato, if nothing better is at hand. Sheets of oiled wadding are also used, but the best application is equal parts of linseed-oil and lime-water.

In *scalds*, cold water should be applied for some hours to allay the inflammation, the parts then to be covered and treated as in the case of burns.

Where there is much suppuration or discharge, the patient should be supported by nourishing diet; and when, owing to the shock, in severe cases no pain is felt, brandy should be administered at once.

Bleeding.—In a severe cut, with very free bleeding, a small pad should be placed on the wound, and a bandage tied tightly round it.

Should a *vein* be cut, the blood will ooze in an even, dark-purple stream, and can be stopped by pressure just *below* the wound, and by a pad upon it, steeped in some astringent matter or styptic—cold or iced water, for instance (the blood in the veins is flowing *to* the heart).

If an *artery* has been cut, the blood (which is on its way *from* the heart) is propelled in jets of a bright-red colour. In such cases a very firm pressure *above* the wound will be required to arrest the flow or hemorrhage, and medical assistance should be sought at once.

The two thumbs pressed tightly into the flesh will be of temporary use, or a tourniquet can be hastily improvised by wrapping a narrow bandage round the injured part, and twisting it very tightly to compress the artery by means of a stick, or even a clothes-peg, passed underneath.

Celerity and prompt action are indispensable, for a spurt of blood from the artery follows each pulsation of the heart, and faintness, or even death, may ensue if the flow continue even a comparatively short time.

Faintness, however, is Nature's remedy, as in this condition a clot of blood may form and become a natural plug in the wounded vessel.

Fits.—The word fit, in its widest sense, is applied to any physical or mental condition which *comes on suddenly, lasts for a short time*, and when it recurs, does so *at irregular intervals.* Thus in ordinary speech we hear of a "fit of laughter," "a fit of madness," &c. We have also the word *fitful*, and the expression, "fits and starts."

In its narrower sense, the word is applied to various morbid conditions, all of which, however, are marked more or less by the *suddenness* of their attack, their *shortness* of duration, and the *irregularity* of their recurrence. The following may be described as among the most important kinds of fits :—

(1.) *Epileptic Fits.*—When a person is seized with a fit of this kind he falls down suddenly, as if he had been shot, lies motionless and pale for a second or two, and then becomes livid and convulsed—the twitchings being often confined to one side of the body. There may be foaming at the mouth, and the tongue may be bitten.

Treatment.—But little can be done for a person in an epileptic fit. The dress about the neck should be loosened, and he should be placed in as easy a position as possible. A pad may be placed between the teeth to prevent biting of the tongue. To dash cold water on the face and head, or to give stimulants, is useless.

(2.) *Fainting fits* may arise from various causes, such as sudden emotions, pain, or loss of blood, or from disease of some internal organ. In a fit of this kind the patient becomes pallid, and the lips are blanched. He feels giddy, staggers, and either tries to save himself from falling, or else lies or sits down. After being placed in the horizontal position, he generally lies still, although occasionally there may be slight twitchings. The skin becomes cold, and often breaks into a perspiration.

Treatment.—The patient should be placed in the horizontal posture as soon as possible, with the head low. The dress should be loosed at the neck and elsewhere, while a current of fresh air should be allowed to blow over him. Restoratives may be employed, such as smelling salts. The face may be bathed, and, if possible, stimulants (as brandy or wine, &c.) may be given.

(3.) *Hysterical Fits.*—A fit of this kind often bears a general resemblance to an epileptic seizure. It may, however, be distinguished by attention to the following points: The person is always a woman; the convulsions affect *both* sides of the body, which is thrown into all sorts of contortions; and the countenance is not livid. The patient is noisy, and laughs, or cries, or screams. She is not *wholly* unconscious, and however much she may throw herself about, she does not hurt herself.

Treatment.—To pour or dash cold water over her face is perhaps the best course to pursue; or the face may be slapped gently but briskly with the corner of a towel wetted in cold water. She will soon show that she knows what is going on by beginning to resist, but the treatment must be continued until she is quite recovered, and must be repeated if the attack recurs, as it often will. Above all, she must not be *pitied* or made a fuss of. Sympathising friends should be banished from the room.

(4.) *Infantile Convulsions.*—Fits or convulsions are common in children, and generally depend on some disturbance in the general health. While the child is in the fit it is usual to place him in a hot bath, bathing the head at the same time with cold water. The after-treatment must depend upon the cause of the fit.

(5.) *Apoplexy.*—In a case of apoplexy, the patient lies motionless, is wholly or partially unconscious; the breathing is generally slow, and the face flushed, and one or other of the arms, if raised, will mostly fall down as if dead. The treatment of such cases belongs to the physician. Drunkenness may be mistaken for apoplexy, and *vice versâ.*

CHAPTER XXXIII.

DROWNING.

A PERSON unable to swim, on falling into deep water, rises and sinks two or three times before finally disappearing, the specific gravity of the body being increased as the air is expelled from the lungs.

Life *may* be restored even after the body has been in the water eight minutes, and death may occur within *one minute.* Generally, death takes place in from four to five minutes.

On recovering a body from the water, medical assistance, dry clothing, blankets, hot water, and heated bricks should be promptly procured. In the meantime active measures should be taken, securing as much fresh air as possible.

The essential points to be aimed at are (1) *the restoration of breathing*, and (2) *the promotion of warmth and circulation.*

Treatment.—Turn the body on the face, place the arm under the forehead, to dislodge the fluid from mouth and throat.

Then lay the body on the back, cleanse the mouth and nostrils, open the mouth, and draw and *keep forward* the tongue, to admit a free passage of air to the wind-pipe; tight clothing and pressure having been previously removed from the chest.

The body should be placed on a flat surface, the head and shoulders resting on a small cushion, or a folded garment, placed under the shoulder-blades. Meanwhile the face and chest should be quickly rubbed with hand or towels. Turn the body *on the side; inspiration* will then take place.

Again turn the body on the face, and *expiration* will follow.

Or, inspiration and expiration may be caused by keeping the body on the back, grasping the arms gently, just above the elbows, and drawing them steadily upwards till they meet above the head. After two seconds, press gently down against the sides of the chest; a little pressure on the breast-bone at the same time will assist expiration.

These movements should be perseveringly continued for a quarter of an hour.

When signs of life appear, and spontaneous respiration ensues, the efforts in this direction should be followed by a warm bath for five or six minutes, smelling salts should be applied to the nostrils, and cold water dashed agaist the chest and face, to promote stronger breathing.

The after-treatment is intended to promote and assist *circulation*, and includes gentle friction of the limbs in an upward direction *under* hot blankets, or *over* dry clothing; heated bricks and bladders or bottles of hot water being applied meanwhile to the soles of the feet, the inside of the thighs, and the arm-pits.

When circulation and respiration are restored, and the patient can swallow, wine, brandy, or coffee should be administered in small quantities, and a disposition to sleep encouraged.

Mustard plasters between the shoulders and on the chest will relieve the distressed breathing which usually follows.

The efforts to restore life should be continued for at least an hour, though pulse and respiration have apparently ceased to act.

Suffocation, or asphyxia, is produced by an accumulation of carbonic acid in the blood, vitality being suspended, but life not extinct.

The result is the same, whether air is altogether *prevented from entering the lungs*, or whether that which is breathed has *too little oxygen* or *too much carbonic acid.* In either case, whether by strangling, choking, or suffocation in wells or beer-vats, or otherwise, the blood does not become *arterialised*, and asphyxia ensues.

Want of oxygen appears to be the most *potent* cause of asphyxia, for air containing 15 or 20 per cent. of carbonic acid may be breathed without producing an immediate ill-effect, *if the amount of oxygen be also increased.*

The direct effect of want of oxygen is to retard the flow of blood in the capillaries of the lungs; the right ventricle, the right auricle, and the veins consequently become gorged with dark venous blood, while the left side of the heart and the arteries become empty.

As ashes choke the fire of a furnace, so the excess of venous blood soon causes the heart and other organs of the body to cease to act, and, if not relieved, death soon takes place.

The means to be adopted in cases of suffocation will therefore be such as should restore *respiration* and *circulation*, and will correspond with the treatment recommended for the recovery of persons apparently drowned.

CHAPTER XXXIV.

POISONING.

The term "poison" is generally understood to include any substance which, when taken into the system, destroys life.

This definition is, however, very incomplete, inasmuch as the same substance may be a *poison* at one time and a *medicine* at another, according to the amount which is administered. Thus the powerful poisons, strychnia, prussic acid, corrosive sublimate, and arsenic, become valuable remedies when taken in small doses; and certain common medicines, as quinine, when taken in large doses, become poisons.

Poisons may be classified under the heads of (1) Irritants, (2) Narcotics, (3) Narcotico-Irritants, (4) Poisonous Infectious Germs, and (5) Poisonous Vapours and Gases.

The first three divisions form the usual classification, based on the direct and immediate effects of such poisons on the animal system.

The last two can scarcely be excluded from any classification of deadly agencies, considering the terrible nature of their effects, of which epidemic diseases in the one case, and the fatal results of choke-damp in mines in the other, are, unfortunately, too common instances.

1. *Irritant Poisons.*—The following are the chief :—

(*a.*) *Mineral acids*—sulphuric, nitric, and hydrochloric acids.

(*b.*) *Vegetable acids and other salts*—oxalic acid, binoxalate of potash, and tartaric acid (in doses of half an ounce or more).

(*c.*) *The alkalies*—pearl-ash (carbonate of potash), soap-lees (carbonate of soda), ammonia and its sesqui-carbonate.

(*d.*) *Metallic compounds*—white and yellow arsenic, acetate of lead (sugar of lead) in doses of an ounce or more, carbonate of lead (white lead), sulphate of copper (blue vitriol), subacetate of copper (verdigris), arsenic of copper, or emerald green (known as extract of spinach, and used to colour confectionery), tartarised antimony, chloride of antimony (butter of antimony), chloride of zinc, nitrate of silver (lunar caustic), sulphate of iron (green vitriol), and bichromate of potash.

(*e.*) *Vegetable substances*—colocynth and gamboge (in large doses), savin, croton oil, leaves and flowers of common elder, &c.

(*f.*) *Animal substances*, such as cantharides (Spanish fly), and certain fish and molluscs, which, though usually innocuous, sometimes act as irritant poisons.

Taken in ordinary doses, irritant poisons occasion intense vomiting and purging, with severe pain in the abdomen. They irritate, inflame, and sometimes corrode the stomach and intestines, frequently producing ulceration, perforation, and gangrene.

Strong mineral acids, caustic alkaloids, and corrosive sublimate are particularly destructive to the tissues. Others, such as arsenic, cantharides, and carbonate of lead, do not affect the tissues.

2. *Narcotic Poisons.*—These include opium, hydrocyanic (or prussic) acid, oil of bitter almonds, cyanide of potassium, henbane, camphor, alcohol, ether, and chloroform.

Narcotic poisons act specially on the brain and the spinal cord, and produce headache, giddiness, stupor, loss of power in the voluntary muscles, convulsions, and finally coma, or insensibility.

3. The *narcotico-irritant poisons* are—nux vomica, meadow saffron (Colchicum), white hellebore, foxglove, water hemlock, hemlock, water dropwort, fool's parsley, thorn apple, monk's hood or wolf's bane, deadly nightshade, tobacco, Indian tobacco, the bark and seeds of the common laburnum, berries and leaves of the yew-tree, and certain kinds of fungi.

Narcotico-irritant poisons, as their name implies have a *mixed* action. They give rise *at first* to vomiting and purging, with irritation of the intestinal canal, and *finally* produce stupor, coma, and paralysis owing to their effect on the brain and spinal cord.

Some poisons are intensely bitter in taste, as nux vomica, and its alkaloid, strychnia ; others are hot and acid in taste, as monkshood and the poisonous fungi ; and arsenic has a sweetish taste.

Antidotes.—Only a few substances are qualified to neutralize chemically the action of poison.

In all cases of poisoning, whether by accident or otherwise, vomiting should be excited as soon as possible, and where the nature of the poison is unknown, the use of sulphate of zinc, or a mustard emetic, for this purpose is a safe course.

One table-spoonful of mustard in half a pint of warm water is a good emetic within the reach of everybody. The vomiting should be continued by further emetics, till the contents of the stomach are discharged, after which milk should be given freely.

The poisons which may affect the body by direct introduction into the blood through a puncture or abrasion, may be derived from either the *animal*, the *vegetable*, or the *mineral* kingdom.

Those derived from the *vegetable* and *mineral* kingdoms, with a few exceptions, are as active, when introduced directly into the blood, as when taken into the stomach.

Animal poisons, on the other hand, act only by direct contact with the blood, and some may be even swallowed with impunity.

POISONS AND ANTIDOTES—MORE OR LESS EFFECTIVE.

POISONS.	*ANTIDOTES.*
Mineral Acids	Chalk or Magnesia in water; Carbonate of Soda; Milk.
Alkalies, & their Carbonates	Vinegar and water; or Lemon-juice and water; Milk.
Oxalic Acid	Chalk and Magnesia in water.
Arsenic	Hydrated Peroxide of Iron—(doubtful), Magnesia, Flour, and Milk, or water.
Corrosive Sublimate..	White of Egg, Flour and water.
Nitrate of Silver..	Salt and water.
Tartarised Antimony	Decoction of Bark, or Gall-nuts, Tannin.
Acetate of Lead	Sulphate of Magnesia.

CHAPTER XXXV.

VENOMOUS BITES AND STINGS.

UNDER this head are included the wounds inflicted by animals, which, by their bites or stings, introduce poisonous or irritating matter into the bodies of their victims.

In this country the subject is comparatively unimportant, the adder, or common viper, being the only venomous creature whose bite is likely to prove fatal; but in warm countries it demands the serious attention of the surgeon.

Injuries inflicted by the teeth of animals, usually considered as non-poisonous, occasionally produce serious, if not fatal, consequences, from the *virus* on the teeth poisoning the wound.

Virus differs from *venom*, the latter being a secretion natural to certain animals, whilst the former is always the result of a morbid process, a morbid poison. This is the case with dogs suffering from rabies. The bites of cats, and other creatures, when excited to extreme fury, often have a decidedly poisonous effect, the wounds inflicted being dangerous, and very difficult to heal.

Treatment of the Bite of a Mad Dog.—Destroy the part, as quickly as may be, by excision, or cutting out the bitten part, when possible.

If from the situation of the wound it cannot be cut, it should be cauterized, or burnt by a stout wire heated to whiteness.

The extreme heat instantly destroys the tissues, and may prevent absorption of the poison.

There are various modern theories on the medical treatment of hydrophobia, but no definite course appears to be generally agreed on, and the result is almost always fatal and attended with intense suffering.

A dog which has bitten a person, and which is suspected to be suffering from rabies, should be secured and supplied with water and food. If it recover, the fear of hydrophobia in the sufferer is removed, but if the animal is at once destroyed, the dread of this fearful malady may remain for months.

1. *Bites from Poisonous Reptiles.*—The venom is described, when fresh, as a yellow or greenish, viscid, neutral fluid, somewhat resembling saliva in its physical character.

When introduced into the system by its natural channel, the poison-fang, its effects rapidly produce a general shock to the nervous system, followed by faintness, tremor, great depression, and sometimes by stupor, loss of sight, vomiting, lock-jaw, and general insensibility. Usually, intense local pain is set up, with great swelling.

The symptoms vary with the comparative sizes of the reptile and its victim, and also the quantity of the secretion present at the time in the sac at the root of the poison-fang. In the case of serpent bites, the effects differ also in character and intensity, according to the kind of serpent; but the ordinary effects of their bites have a general resemblance.

Local Treatment.—Immediate application of a ligature above the wound, to prevent absorption, where possible; excision of the bitten part; bathing with warm water; sucking the wound, or, better still, cupping it.

Where excision cannot be resorted to, apply nitric acid, to destroy the tissues.

General Treatment.—Free administration of stimulants—whiskey, or brandy—and ammonia, also olive oil.

For the bite of the rattle-snake, the popular treatment is to make the patient drunk with whiskey—a process known as the Western Cure.

Other so-called specific remedies are—decoction of Virginian snake-root, guaco, and the Tanjore pill, whose chief ingredient is arsenic.

2. *Stings of Insects.*—The sting consists of two fine, sharp darts, enclosed in a tubular sheath, at the base of which is a poison sac, whose contents are injected into the wound made by the darts, which are usually jagged or barbed.

The usual consequences are well known, and need not be detailed. They seldom produce serious effects, unless the insect is swallowed in a cavity of ripe fruit, or in the act of drinking, when a sting on the fauces or the throat may give rise to severe and even fatal inflammation.

Remedies.—Extract the barbed sting by pressure over the wound with a watch-key, and the use of small tweezers, or forceps.

Apply ammonia, or sal-volatile.

Common domestic remedies are vinegar, oil, spirits, Eau-de-Cologne, and the common indigo blue-ball, used by washerwomen.

GLOSSARY OF TERMS.

Aliment (Lat. *alere*, to feed), that which nourishes; food.

alkaline (Egypt. *kali*, a marine plant), having properties of alkali.

asphyxia (Gr. *asphúxia*, from *a*, without, and *sphúzein*, to throb) apparent death, or suspended animation.

assimilate (Lat. *similare*, to make like), to convert into a like substance.

astringent (Lat. *astringere*, to draw tight, to strain), a medicine that has the property of causing contraction in the organic textures.

Barilla, a maritime plant from the ashes of which soda is made.

Chalybeate (Lat. *chalybs*, iron), impregnated with some salt of iron.

combustion (Lat. *combustio*, a burning up), in chemistry, a process in which, by the aid of heat, a substance unites with oxygen, or chlorin.

Deleterious (Lat. *delere*, to destroy), having the quality of destroying or extinguishing life.

Detergent (Lat. *detergere*, to rub or wipe off), cleansing, purging.

Effluvia (Lat. *efflus*, to flow out), noxious exhalations from decaying substances, usually detected by the sense of smell.

emulsive (Lat. *emulgere*, to milk out), softening, milk-like.

Farinaceous (Lat. *farina*, flour), yielding farina, or flour.

fauna (Lat. *fauni*, rural deities among the Romans), in zoology, the various kinds of animals peculiar to a country.

flora (Lat. *flos*, a flower), the complete system of vegetable species native in a given locality, region, or period.

fungi (Lat. *fungus*, mushroom), pertaining to the mushroom family.

Gland (Lat. *glans*, an acorn), an organ of the body in which secretion is carried on.

Kelp, a kind of sea-weed, the ashes of which are used in making glass.

Louvert, or louver (Fr. *l'ouvert*, the opening), an opening in a roof, wall, or window, with a series of sloping slabs of board or strips of glass (sometimes made to open and close on each other), and so arranged as to admit the air, but exclude the rain.

Malarious (Lat. *mal.*, bad, and *aer*, air), pertaining to, or infecting the air.

mange (Fr. *manger*, to eat), the scab, or itch, in cattle, dogs, and other beasts.

meteorological (Gr. *meteora*, things in the air), relating to the atmosphere and its phenomena.

molecules (Lat.), minute particles which constitute matter.

mucilaginous (Lat. *mucus*, slime), containing a solution of gum, or mucilage,

Organic (Gr. *organon*, a part), consisting of organs, or pertaining to them.

osmazone (Gr. *osme*, smell, and *zomos*, broth), a brownish-yellow animal substance, obtained by digesting cold water on muscular fibre and then treating it with pure alcohol.

pharmacy (Gr. *pharmakon*, a drug), the art of preparing medicines.

potable (Lat. *potare*, to drink), that which is fit to be drunk.

protein (Gr. *protos*, first), the gelatinous semi-transparent substance obtained from albumen. fibrin, or casein.

Rectification (Lat. *rectus*, straight, and *facere*, to make), the process of refining or purifying by repeated distillation.

Saccharine (Lat. *saccharum*, sugar), having the qualities of sugar.

saponification (Lat. *saponis*, soap), the act of converting into soap.

stimulus (Lat. *stimulare*, to goad or incite), in medicine, that which produces an increase of vital activity.

Thermal (Gr. *therme*, heat), a term applied to springs having a temperature above 60 deg. Fahr.

Uric acid (Lat. *urina*), an acid obtained from urinary calculi, a stony substance sometimes formed in the bladder.

Virus (Lat. *poison*), the agent for transmitting infectious diseases.

INDEX.

Adopted by the School Board for London.

"EXCELLENT!" | "UNEXCELLED!"

MURBY'S IMPERIAL COPY BOOKS.

Price 2d. each.

These Copies are acknowledged by numerous practical teachers and School Inspectors to be the very best of their kind. The style of the writing is CLEAR and BOLD, without being vulgar and inelegant, like some of the series in vogue.

THE SERIES CONSISTS OF SIXTEEN BOOKS.

STAND. I.	Book 1.	HALF TEXT—Lines, curves, easy letters and easy words.
	,, 2.	HALF TEXT—More difficult letters and more difficult words.
,, II.	,, 3.	HALF TEXT—Difficult letters, words, and figures.
	,, 3½.	LARGE & HALF TEXT—Short words.
	,, 4.	HALF TEXT—Geography, grammar.
,, III.	,, 5.	SMALL TEXT—Capitals, figures, &c.
	,, 5½.	LARGE & SMALL HAND—Capitals and figures. Geography.
	,, 6.	SMALL HAND—Geography, grammar, and figures.
	,, 6½.	DOUBLE SMALL—Narratives and poetry.
,, IV.	,, 7.	SMALL HAND—On single line. History.
	,, 7½.	THREE HANDS—Proverbs, &c.
	,, 8.	SMALL HAND—On single line. No division marks between the words. Grammar.
,, V.	,, 9.	SMALL HAND—Three copies on page, no division or space between lines, proverbs, extracts, &c.
	,, 10.	SMALL HAND—History extracts, &c.
,, VI.	,, 11.	SMALL HAND—History, geography, literature, and arithmetic.
	,, 12.	SMALL HAND — Business forms, letters, addresses, themes, &c.
	,, 12½.	LADIES' HAND—Poetical extracts.

*** Books 3½ (Large and Half Text), 5½ (Large and Small Hand), and 12½ (Ladies' Hand) have lately been added, in accordance with the Code requirements.

LARGE POST EDITION.

Very superior paper, stiff nonpareil covers. Price 6d. each.

No. 1. Easy letters and words.
,, 2. Easy capitals and words.
,, 3. Capitals.
,, 4. Small Hand.
,, 5. Text, Round and Small.
No. 6. Small Hand. History.
,, 7. Small Hand. History and Geography.
,, 8. Letters.

I esteem it at once a duty and a pleasure to call the attention of my fellow-teachers, public and private, to the above series of Copy Books. I have carefully examined almost every set which has appeared during the last fifteen years, and I know of no others by means of which a clear, rapid, and elegant style of penmanship may be so easily acquired by the pupil with so little supervision on the part of the teacher. The quality of paper is excellent, and the printing is done in the most finished manner. I shall certainly adopt them in preference to any other, and recommend them to my friends.

WILLIAM DODDS,
Author of the "Complete Guide to Matriculation," &c.

LONDON: THOMAS MURBY, 3, LUDGATE CIRCUS BUILDINGS, E.C.