DOMESTIC ECONOMY

DOMESTIC ECONOMY:

COMPRISING

THE LAWS OF HEALTH IN THEIR APPLICATION TO HOME LIFE AND WORK

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PREFACE

THE present work has been in large measure the outcome of a desire on the part of the authors to extend the study of the Laws of Health in schools. As yet, Hygiene does not form a definite subject of study in the majority of schools; but Domestic Economy, on the other hand, is widely taught in girls' schools, and is a compulsory subject of study for female pupil-teachers and students in training-colleges. The syllabus of Domestic Economy is an extensive one, embracing the various branches of **Domestic Hygiene**; hence the attempt in the present work to give a *scientific* and yet sufficiently popular exposition of its principles, while at the same time the problems of **Domestic Management** and **Thrift** receive full attention. No effort has been spared to state clearly the **Laws of Health** in their application to domestic life, while technicalities have been, as far as possible, avoided. It is hoped that the numerous illustrations throughout the work will further help to make it self-explanatory.

The rules of Domestic Hygiene have in no part of the book been stated without full consideration of the *principles underlying them.* As these principles are to a large extent physiological, it has been necessary to give the **Elements of Physiology** in some detail. It will, therefore, be found that throughout the book the functions of a given part of the body are first considered, and then the means of maintaining the integrity of these functions. Thus in connection with the study of respiration, the problems of ventilation are considered ; in connection with digestion, the varieties of food, methods of cooking, &c. ; and so on.

It is hoped that this interweaving of physiological facts and hygienic principles will conduce to that scientific and sound knowledge of the Laws of Health which, in our opinion, cannot otherwise be secured.

The work will be found to cover the entire syllabus in Domestic Economy for the Scholarship and First and Second Years' Certificate Examinations of the Privy Council on Education. It is hoped, however, that it will have a wider utility, and will not only lead to the rational teaching of the Laws of Health in schools by teachers who have learnt the subject scientifically, but will also be useful in increasing the healthfulness and comfort of many homes throughout the country.

A. N.
M. E. S.

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Part I.

PERSONAL AND DOMESTIC HYGIENE.

CHAPTER I.

INTRODUCTORY.

THE subjects to be treated of in subsequent chapters are of great practical importance to everyone in the community, and to none more than to the female pupil teachers and students, who will, in their future career as teachers, have large scope for influencing the healthfulness and economical administration of thousands of young families.

We have said 'subjects' rather than 'subject,' as domestic economy is simply a convenient name to embrace information of a very varied character, bearing on home life and work. The word **economy** is derived from two Greek words, which signify the law or management of the house. It includes the idea not only of *thrift*, but of *healthful* regulations and management. These are the two main branches of the subject, and it is fortunate that considerations of health are in every respect compatible with thrifty expenditure.

To the prime importance of personal health we are, perhaps, not sufficiently awake ; life without health becomes a burden, and spoils the individual power for utility. Hence **Domestic Hygiene** will occupy a very large share of our space in subsequent chapters.

But in order to understand the laws of the maintenance of personal health, it is necessary to know the rudiments of the structure and functions of the 'House we live in'; and in the first few chapters we shall therefore be occupied with the rudiments of Human Physiology. We cannot expect to understand how to avoid errors in food or clothing, or personal habits, if not familiar with the scientific basis of facts on which alone a rational knowledge can be built. All other knowledge is liable to fit loosely and to be soon lost; besides which it is mere 'rule of thumb' knowledge, and may easily be misapplied.

A most important requirement for health is **Food**, and many chapters will be devoted to the various kinds of food, their sources, methods of preparation and cooking, &c.

Water and other Beverages come under the head of Foods of an accessory kind, and they will require to be studied.

After food, the next important personal requirement is **Clothing**; and the relative merits of various kinds of clothing will be studied, as well as the means of cleansing and preserving clothes.

The importance of **fresh air**, and the means of providing it; also the **construction of our homes**, and the methods of **warming** and **lighting** them, will each be considered in turn.

If the laws of health as laid down in the following chapters are faithfully observed, the amount of sickness occurring at home will be very greatly decreased. Such sickness cannot, however, be kept for ever from the door, and we propose, therefore, to add chapters dealing with the **nursing of the sick**, and the duties of the sick room; with special details on the care required in cases of **infectious disease**; adding some details as to **sick-room cookery**, and the treatment of **minor ailments and accidents.**

When we add to the preceding list of subjects the questions of **general expenditure**, of **savings and investments**, *housework*, including methods of **washing** and **cooking**, it will seem that the subjects embraced within the book are so wide in scope as to cover most of the practical domestic life of wives and mothers; and we believe that a knowledge of the **science of home life** thus acquired will enhance the comfort and happiness of many thousands of families throughout the country.

CHAPTER II.

COMPOSITION OF THE BODY.

Elementary and Compound Substances.—Oxygen.—Nitrogen.—Hydrogen.—Carbonic Acid.—Chlorine.—Phosphorus.

The human body is a wonderful and complex organism; but, when analysed, its constituent elements are found to be comparatively few. Before we can understand much about the functions of the human body, it will be necessary to know something about these elements.

The whole of the substances which make up the mass of the earth, including its atmosphere and its inhabitants, are grouped into aggregates of greater or less stability, some being *solid*, some *liquid*, and some permanently *gaseous*. If we examine these various substances more carefully, we find that they are either simple or compound.

Simple or Elementary Substances are those which cannot be resolved into any simpler form of matter by analytical processes; *e.g.* gold (solid), mercury (liquid), or oxygen (gaseous). These have not as yet been shown to consist of more than *one* kind of matter, and are therefore called elements.

Compound Substances, on the other hand, are formed by the union of two or more elements into a substance, which differs from its constituents in physical properties, *e.g.* mercury and sulphur combine to form vermilion, which is a light red substance, entirely different from either component element. Similarly water, a liquid, results from the combination of the permanent gases oxygen and hydrogen.

The total number of elements known up to the present time are over 70, which are divisible into two great groups, known as *metallic* and *non-metallic* respectively. Of this number only about 14, whose names are given in the following list, enter into the composition of the human body.

ELEMENTARY SUBSTANCES PRESENT IN THE HUMAN BODY.

Non-Metallic.	*Metallic.*
Oxygen (O)	Calcium (Ca)
Carbon (C)	Sodium (Na)
Hydrogen (H)	Potassium (K)
Nitrogen (N)	Iron (Fe)
Phosphorus (P)	Magnesium (Mg)
Chlorine (Cl)	
Sulphur (S)	
Fluorine (F)	
Silicon (Si)	

It must be remembered that none of these elements are present in the body as such, but combined with each other as compound substances.

Of the above list, oxygen, hydrogen, nitrogen, and carbon are of primary importance, as, together with much smaller amounts of sulphur and phosphorus, they form the complex *organic* compounds found in the human frame. The *inorganic* or mineral constituents consist mainly of compounds of calcium and phosphorus, and of sodium and potassium with chlorine or phosphorus and oxygen.

We must know a little more about these elementary substances if we are to understand the true nature of foods and what becomes of them after they enter the body, the necessity of getting rid of the air breathed out of the lungs, and other problems in physiology, which are of the utmost importance to the maintenance of health.

Oxygen is one of the most important elements. It forms about one-fifth of the volume of atmospheric air. The burning of any substance is produced by the combination with it of some of the oxygen of the air, the phenomenon being known as *combustion* or *oxidation*. Thus, if a small piece of phosphorus be floated on a piece of cork, as shown in fig. 1, and then be set alight, the phosphorus combining with the oxygen of the air contained in the jar, at first burns brightly, but soon dies out, owing to the consumption of the oxygen. The oxide of phosphorus which has been produced dissolves in the water, and the water rises in the jar about one-fifth of its total height, showing that the volume of the enclosed air has been diminished by that amount. The gas remaining under the jar and forming four-fifths of the original bulk is **Nitrogen**, and a lighted

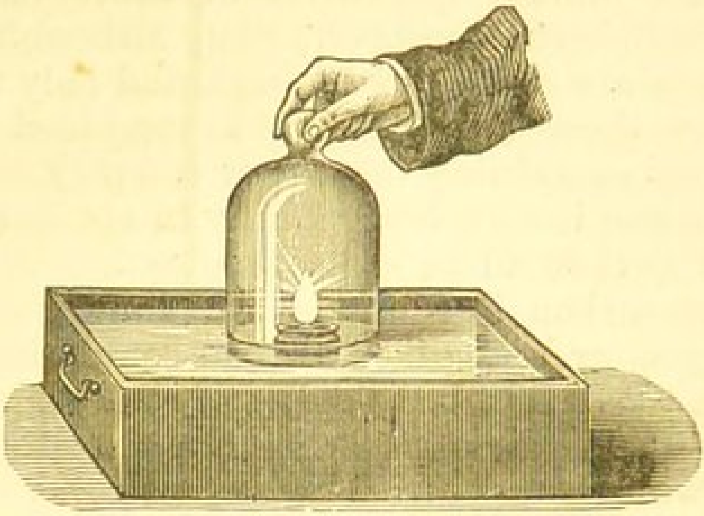

FIG. 1.—*Phosphorus Burning in a Closed Jar containing Air over Water.*

taper is extinguished in it. The gas which has disappeared was oxygen. Substances such as carbon and sulphur burn with great brilliancy in oxygen gas; and in the body, in every part of it, a similar but slower process of oxidation goes on, oxygen being carried from the lungs to every part of the system, there to combine with carbon and hydrogen, to form carbonic acid and water respectively.

Water consists of oxygen combined with another gas called **hydrogen**. When any substance containing hydrogen is burnt, water is produced by its combustion, *i.e.* by its union with the oxygen of the air. Thus, if a cold tumbler be held over a lighted candle, water will condense on the inside of the tumbler. Water from the combustion of hydrogen is produced similarly within the body. This is shown in the simple experiment of steaming a window by breathing upon it.

The three elements already named, together with **carbon**, form the great bulk of the solid constituents of the body. Hydrogen, oxygen, and nitrogen, in their separate condition, are gases; carbon is a solid. Carbon is the same substance as charcoal. That it forms a large part of all organic creation, whether vegetable or animal, is shown by the charcoal made from wood or from bones. Sugar and starch consist of carbon with hydrogen and oxygen in the same proportions as they exist to form water. Fats consist of the same three elements, but contain rather less oxygen. Meat contains these three elements, with the addition of nitrogen, and minute quantities of other elements. It must be remembered, however, that, although only four chief elements are contained in meat, and only three in fat or sugar, yet these elements are so combined as to make the substances containing them very complex.

When carbon is completely burnt in air, **Carbonic Acid** (also called **carbon dioxide**) is produced. This happens whether the carbon is contained in candle, oil, paraffin, coal, coal gas, or any other carbon-containing material. Similarly in the human body a sort of combustion occurs in every part of the system, resulting in the production of carbonic acid, which escapes from the body by way of the lungs.

Carbonic acid is heavier than air, and will not support combustion. A lighted taper placed in a jar containing the gas, is at once extinguished, just as in the case of nitrogen. Its presence is also evidenced by the milky appearance assumed by clear lime-water shaken up in a bottle into which some of the gas is introduced. Breathing into the bottle will produce this effect, as the air from the lungs contains carbonic acid.

Sulphur is well known as brimstone. When it is burnt in air, an oxide of sulphur is produced, which is a very pungent and irritating gas, valuable, however, as a disinfectant for rooms. Sulphur is present in the white of eggs, the flesh of animals, &c.

The blackening of a silver spoon produced on inserting it into an egg is due to the silver combining with the sulphur in the egg to form sulphide of silver. When an egg putrefies, the smell of rotten eggs is produced. This means that the changes undergone in putrefaction lead to the formation of a gas called sulphuretted hydrogen from the white of the egg.

Chlorine is a greenish yellow gas, possessing a very irritating smell. When combined with sodium it forms *chloride of sodium*, better known as table salt, an indispensable article of diet, of which we shall have more to say hereafter.

Phosphorus enters in minute quantities into the composition of the flesh, blood, brain, and other parts of animals. In the free state it is used chiefly for tipping matches, on account of the ease with which it takes fire. **Phosphate of Lime** (bone earth) forms the greater part of the earthy matter of bones, giving them stability and hardness. A minute quantity of *iron* is also present in our food, and it forms a very important part of the red corpuscles of the blood.

CHAPTER III.

STRUCTURE OF THE HUMAN BODY.

Organs and Tissues.—Build of the Body.—Thorax and Abdomen.—The Head.—Functions of the Body.

The elements named in the previous chapter as forming the human body do not exist there *in a free state.* They are combined in various *complex substances,* as fat, sugar, fibrin, myosin, gelatine. Thus the animal part of bone consists chiefly of a substance which becomes gelatine on boiling; this contains the five elements—carbon, hydrogen, oxygen, nitrogen, and sulphur.

These complex substances enter into the composition of the various tissues and organs of the body.

Organs and Tissues.—The body is made up of various **organs**, each devoted to its own special work or **function.** Thus the brain and spinal cord control the movements of the body, and the brain is the centre from which all voluntary action is started. The muscles are the organs by which the movements of the body are effected. The alimentary canal (including the mouth, gullet, stomach, intestines, and the liver and pancreas which are appended to them), is concerned with the digestion of foods, making them liquid so that they may be absorbed into the blood-vessels and lymphatics. The heart and blood-vessels circulate the blood to every part of the body; the lungs bring oxygen into the system from the air, and remove impure gases; while the kidneys and skin ged rid of other impurities from the system.

The various organs are made up of different textures or **tissues.** The chief tissues in the body are the epithelial, the muscular, the fibrous or connective tissues, the osseous or bony, the adipose or fatty, and the nervous tissues. Several of these may be combined to form what are sometimes called **compound tissues**. Thus (1) the *blood-vessels* consist of connective, muscular, and nervous tissues; (2) the *lymphatics* of connective and muscular tissues ; (3) the *skin* of connective, muscular, nervous, and epidermal tissues ; and (4) the *serous* and *mucous membranes* of connective, epithelial, nervous, and muscular tissues. The last-named membranes are called *mucous*, when they open on to the surface of the body, as the mouth and alimentary canal, and the lungs ; and *serous* when they form closed cavities, as in the case of the membranes covering the lungs (*pleura*), the heart (*pericardium*), and the outer surface of the alimentary canal (*peritoneum*).

The tissues of the body when examined by the microscope are found to consist of **cells**, greatly varying in shape and structure in different parts of the body, and transformed in connective tissue and muscular tissue into **fibres**, which were, however, originally cells. The cells, as they become modified in shape and structure, take on different functions. The cells of the salivary glands secrete saliva, the liver cells secrete bile, and so on throughout the body a *physiological division of labour* being thus secured.

Epithelium is a general name for cells covering a free surface of the body. The epithelium covering the skin is called the *Epidermis*, the outer layer of cells being hard and flat, the deeper cells softer and more rounded.

Thus far we have learnt that the body consists of various *organs*, each of which is composed of two or more *tissues* or textures ; that these tissues contain various *complex chemical substances* ; which are in their turn built up of *chemical elements*.

It will be convenient at this point to take a general view of the **build of the body** and of its functions. The body consists of head, trunk, and four extremities. The *trunk* is supported throughout its whole length by the **vertebral column**. This consists not of a single bone, but of twenty-six bones resting one on another, each one enclosing a central canal. The canal is continuous throughout the trunk and neck, and safely encloses the *spinal cord* or marrow (fig. 2).

Thorax and Abdomen.—The vertebral canal forms a long tube in the trunk, and we may regard the front portion of the body as another larger tube. This front tube is subdivided into two portions by the **diaphragm** or midriff, an arched muscle, attached *behind* to the front of the vertebral column, *in front* to the breast-bone, and on *each side* to the inner surface of the lower ribs. The part of the front tube above the diaphragm is called the chest, or **thorax.** It is encircled by twelve ribs on each side. These are fixed to

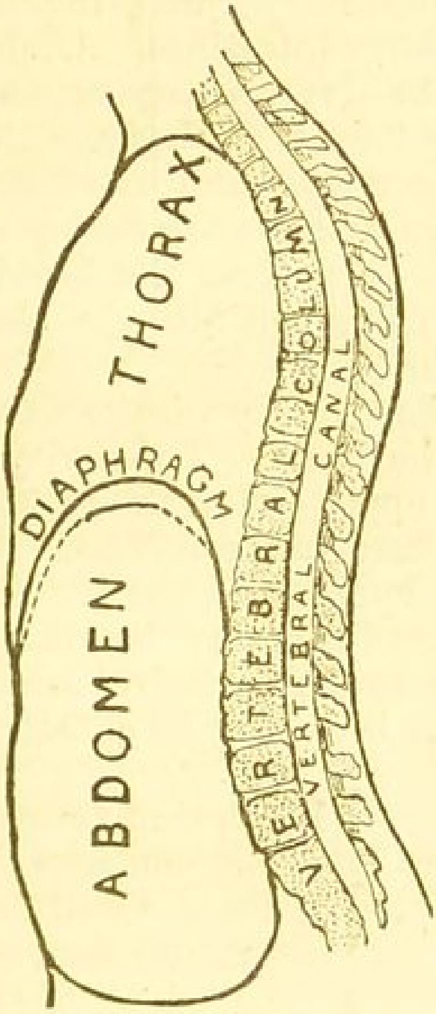

FIG. 2.—*Showing the three chief cavities of the Trunk,—Thorax, Abdomen, and Vertebral Canal. The continuous line shows the position of the Diaphragm in expiration, the dotted line its position in inspiration.*

the vertebræ behind, then arch forward, and all except the two lowest are connected by means of short pieces of cartilage (gristle) with the breast-bone (**sternum**) in front. Thus a somewhat conical cavity is formed, the base of the cone being formed by the diaphragm which is arched upwards, and the apex of the cone being incomplete at the root of the neck. At the latter point the windpipe (**trachea**) enters the thorax from the throat, and the gullet (**œsophagus**) passes behind the trachea along the back wall of the thorax and through the diaphragm, and, in addition, certain large vessels and other structures pass along the neck between the chest and the head.

The chief organs contained in the thorax are the heart and the two lungs.

The part of the front tube of the body below the diaphragm is called the **abdomen.** It contains the chief portions of the alimentary canal, including the stomach and the small and large intestines. Under the right side of the diaphragm is the **liver,** a large organ stretching across beyond the middle line of the body. The **spleen** is on the left side of the stomach, and the **pancreas** behind the stomach. The two **kidneys** are deeply seated in the loins, the urine formed in them from the blood being carried by two long tubes (**ureters**) down to the bladder, whence it is discharged from the body.

The head consists chiefly of the **Cranium** or skull, in which is lodged the brain. The cavity of the cranium is really an enlarged upper end to the vertebral canal, and the brain and spinal cord are continuous with each other by means of a large opening at the base of the skull. The front part of the head contains the mouth and nose, which form the entrances to the digestive and respiratory tracts.

The parts of the body may be classified as follows :—

- (*a*) THE HEAD, consisting of .
  - 1. Cranium (containing brain and its appendages the eyes and ears).
  - 2. Face Cavity (containing nose, mouth, and gullet).
- (*b*) THE TRUNK, consisting of . .
  - 1. Front Canal
    - 1. Thorax (containing heart, lungs, &c.).
    - 2. Abdomen (containing alimentary canal, liver, spleen, pancreas, kidneys bladder, &c.).
  - 2. Posterior Canal (containing spinal cord).
- (*c*) The LIMBS (*i.e.* arms and legs).

The organs contained in the chest and abdomen will be more fully described in later chapters.

The **Functions** of different parts of the body are very closely connected. None of them can be carried on for more than a very limited time without the supply of food. The food is dissolved and rendered fit for mixing with the blood by the organs of digestion. The blood forms the channel of conveyance between the different parts of the body. It carries all the liquid matters which have been absorbed from the digestive organs to every part of the body; each part acquiring and retaining the special constituents it requires for its own growth and nourishment. The heart is the chief propelling organ, which drives the blood about sixty times every minute to the most remote parts of the body. In addition to dissolved and elaborated food, the blood receives oxygen gas from the air in the lungs. The red corpuscles absorb this and take it with the nutrient material to the various tissues of the body. In these the processes of oxidation occur, which maintain the heat of the body.

Besides carrying nutriment and oxygen *to* the various tissues and organs of the body, the blood also brings back *from* them the effete or used up materials, the retention of which would soon poison the system. These are carried to the lungs, kidneys, and skin, and thence expelled (*excreted*) from the system.

We may classify the parts of the body hitherto considered as

(*a*) Organs concerned in manufacturing blood (the digestive organs).

(*b*) Organs concerned in circulating the blood (the heart and blood-vessels).

(*c*) Organs concerned in purifying the blood (lungs, skin, and kidneys).

In addition to these we have the **muscular system**, which renders movement possible. The proper development of the muscles we shall find is of great importance for health. Above all, and controlling all other parts of the body, is the **nervous system**. The control is exercised largely by means of sensory nerves, distributed to different parts of the body, which establish a sort of telegraphic communication with those parts; and by the special senses (sight, hearing, &c.), which put us in relation with the outside world.

It will be convenient to consider, first, the blood and its circulation.

CHAPTER IV.

THE BLOOD AND ITS CIRCULATION.

The Blood Corpuscles.—Uses of Blood.—Blood-Vessels.—Circulation of Blood.

The **Blood** is a red liquid thicker than water, owing in part to the solid particles it contains, and in part to the solids which are dissolved in it. That it is present in every part of the body is shown by the bleeding which follows a prick inflicted at any point. If a drop of blood obtained by this means be placed on a glass slide and examined under a microscope, innumerable biconcave circular discs (**red blood-corpuscles**) will be seen. The coagulation or clotting which occurs after blood has been shed is due to the formation of a delicate meshwork of fibrin, which did not exist as such in living blood.

The reason why fibrin forms in blood which has been removed from the body, and not in the blood-vessels under ordinary conditions, is still doubtful.

If a drop of blood is carefully examined under the microscope, one or two **white blood-corpuscles** will be seen, in addition to the red blood-corpuscles. These differ from the red corpuscles in the absence of colour and in the fact that they show a *nucleus* or denser part in the interior, whereas the red corpuscles appear to be uniform in structure throughout. There are about four or five hundred red corpuscles to every white corpuscle. The red corpuscles are probably formed from the white. The red corpuscles are about $\frac{1}{3000}$ part of an inch in width. They consist chiefly of a complex substance called **hæmoglobin.** This substance has the highly important property of combining loosely with oxygen when exposed to it, but readily giving it up again to the various tissues of the body.

From this review it is evident that blood is constituted as follows :—

<table>
<tr><td rowspan="4">Blood</td><td rowspan="2">Corpuscles</td><td>Red Corpuscles</td><td rowspan="3">Clot</td></tr>
<tr><td>White Corpuscles</td></tr>
<tr><td rowspan="2">Plasma</td><td>Fibrin</td></tr>
<tr><td>Serum</td><td></td></tr>
</table>

Fibrin is formed during the process of coagulation from substances which previously existed separately in the blood. The fluid blood before the formation of fibrin is known as **plasma.**

Serum is the fluid part of the blood remaining after the formation of clot. It contains a large amount of albumen and salts, with smaller quantities of other materials for the nutrition of the tissues.

In addition to the constituents already named, blood contains some **dissolved gases.** There is a small quantity of nitrogen, but oxygen and carbonic acid are the chief gases of the blood.

Hæmoglobin is of importance as an oxygen-carrier from the lungs to the tissues of every part of the body. The blood in the lungs is only separated from the air by a thin membrane, and the haemoglobin in the blood-corpuscles combines with the oxygen of air to form *oxy-hæmoglobin.* In the various tissues of the body the converse process is carried on ; the oxygen of oxy-hæmoglobin being given up to the tissues, and hæmoglobin returned to the heart and thence pumped into the lungs.

Dark purple blood is called **venous** ; bright scarlet blood is called **arterial blood,** because the blood brought from the tissues by the veins is generally purple, while that carried to the tissues by the arteries is bright scarlet. There is one exception to this rule, the arterial blood going to the lungs being dark purple, while the venous blood leaving the lungs is light scarlet.

Uses of Blood.—(1) The red corpuscles are oxygen-carriers from the lungs to every part of the body. (2) The fluid part of the blood carries albumen, sugar, and other substances required to nourish the different tissues and organs. (3) The blood brings away from every part of the body carbonic acid dissolved in it, and carries this to the lungs, whence it is eliminated. (4) The blood carries other impurities to the kidneys, skin, and liver, by means of which organs they are eliminated from the body. (5) The warmth of the blood maintains an equable temperature in every part of the body.

Circulation of Blood.—The best idea of the blood-circulation is to be obtained by watching the web of a frog's foot placed under the microscope. The blood corpuscles can be seen coursing from larger tubes (*arteries*) into *capillaries* which are so minute that they only admit the corpuscles in single file, and then issuing from the capillaries into *veins*, which carry the blood away from the web. In ourselves a similar process is going on throughout the body.

There are three kinds of blood-vessels—arteries, capillaries, and veins. The **arteries** are tubes with strong and elastic walls. The *aorta* is the trunk artery arising from the left ventricle, and the *pulmonary artery* the trunk artery from the right ventricle of the heart. The former distributes blood to every part of the body except the lungs; the latter to the lungs.

The smaller arteries contain muscular fibres, under the control of a part of the nervous system, which acts unconsciously. By this means the size of the arteries and consequently the amount of blood passing through them can be regulated. The larger arteries contain a large proportion of elastic tissue.

The **capillaries** are minute blood-vessels connecting the smallest arteries with the smallest veins, and varying in diameter from $\frac{1}{1500}$ to $\frac{1}{4000}$ inch. Their walls are extremely thin, consisting almost solely of a single layer of flattened cells. The thinness of the capillary walls allows free interchange between the blood and the tissues, which are everywhere permeated by capillaries. Take, for instance, a small muscular fibre. (1) Oxygen is given to the fibre from the red corpuscles, and fluid nourishment from the fluid part of the blood. (2) The muscular fibre gives up to the blood carbonic acid gas and other impurities. Consequently the blood entering the muscle is bright *red* (arterial), that leaving the muscle is dark *purple* (venous).

The **veins** have thinner and less elastic walls than the arteries. On their inner side they present *valves*, in the form of projecting flaps, usually in pairs. As will be seen from the following diagram, these valves allow the blood to flow in one direction (towards the heart), but prevent reflux in the opposite direction.

The **heart** is the central organ of the circulation. It is a hollow muscular organ contracting regularly from 60 to 70 times per minute, and driving the blood to every part of

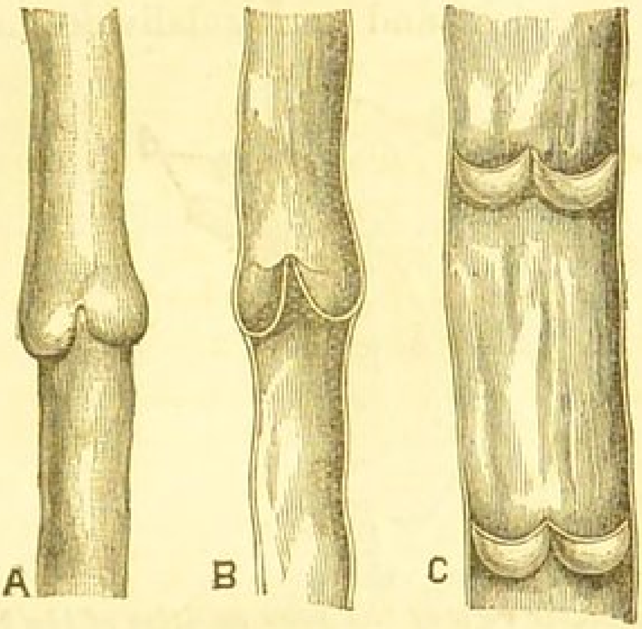

FIG. 3.

A. *A vein showing the knotted condition produced when obstruction to the onward flow of blood occurs.* B. *A section through the same vein, showing edges of valve in apposition to prevent reflux of blood.* C. *Vein cut open to show position of valves.*

the body. It lies in an oblique position in the chest, with the apex pointing downward and to the left. The apex-beat can be felt between the fifth and sixth ribs. The size of the heart is roughly that of the closed fist, and its weight from 9 to 10 ounces. It is covered without by a loose fibrous bag, called the *pericardium.*

The heart is divided by a fleshy longitudinal partition into a right and left half, and each half is subdivided into an upper cavity (*auricle*), and a lower cavity (*ventricle*) by a movable partition or valve. There are thus two upper cavities or auricles, and two lower cavities or ventricles. The right side of the heart is smaller and has thinner walls than the left side. The **right auricle** receives two large veins, the inferior vena cava and the superior vena cava (c and h, fig. 4). It communicates below with the **right ventricle**, the junction of the two being occupied by the *Tricuspid Valve*, which is formed of three pointed flaps attached to the wall of the heart. The under surfaces of these flaps are connected by fibrous cords with muscular projections on the inner surface of the ventricle. Thus when the right ventricle contracts, the flaps of the tricuspid valve are kept in contact and the blood is prevented from returning into the auricle. The pulmonary artery springs from the right ventricle, and soon subdivides into two, one

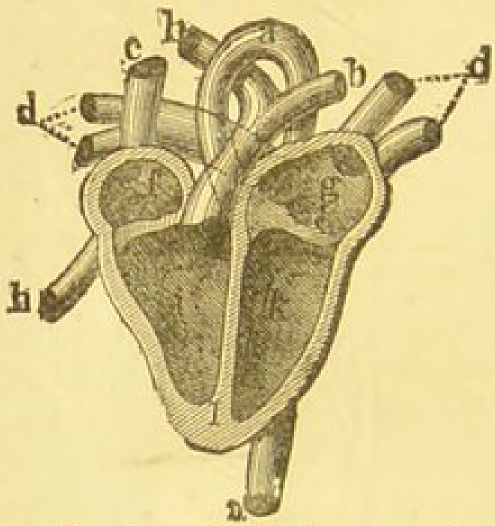

FIG. 4.—*Diagrammatic view of the four cavities of the heart, showing the main vessels entering and leaving it.*

(aa) *Aorta arching over from* k, *left ventricle;* (bb) *right and left pulmonary arteries, arising by a common trunk from* i, *the right ventricle;* (c) *superior vena cava;* (h) *inferior vena cava, entering* f, *right auricle;* (dd) *right and left pulmonary veins, entering* g, *left auricle;* (l) *septum or division between right and left auricle.*

going to each lung (bb, fig. 4). At its junction with the right ventricle is the *semilunar valve*, composed of three fibrous semicircular flaps, which allow the blood to pass freely from the ventricle into the pulmonary artery, but prevent any backward flow.

The **left auricle** has four pulmonary veins opening into it, which bring blood from the two lungs (dd, fig. 4). Below, it communicates with the left ventricle, which has much thicker walls and a larger cavity than the right ventricle. The *mitral* or *bicuspid* valve between the left auricle and ventricle is similar in structure and arrangement to the tricuspid valve on the right side of the heart, and prevents blood passing back from the ventricle to the auricle. The aorta (aa, fig. 4) springs from the left ventricle, and reflux of blood from it into the ventricle is prevented by semilunar valves as on the right side of the heart.

The **circulation of blood** is effected as follows:—The auricles contract and drive their contained blood into the ventricles. The ventricles immediately contract and force the blood onwards. It is prevented from passing back into the auricles by the tricuspid and mitral valves, and is therefore driven into the pulmonary artery and aorta. These arteries are however already full of blood; and in order to contain the additional blood their elastic walls become distended. As soon as the heart ceases to contract, the elastic walls of the arteries begin to recoil, just as a piece of india-rubber contracts after having been stretched. The blood, owing to the closure of the semilunar valves, cannot return into the heart. It is therefore forced onwards to every part of the body. Thus the blood is kept moving in the intervals between the contractions of the heart.

It is evident from what has been said that there must be a *double circulation*. 1. The **Lesser or Pulmonic Circulation.** From (*a*) the right auricle blood is driven into (*b*) the right ventricle; thence by (*c*) the pulmonary artery to the two lungs, passing through (*d*) the capillaries of the lungs to (*e*) the pulmonary veins, which bring the purified blood back to (*f*) the left auricle.

2. The **Greater or Systemic Circulation.** The purified blood from the lungs passes from (*a*) the left auricle to (*b*) the left ventricle, thence through (*c*) the aorta and branch arteries to (*d*) capillaries, which join together to form (*e*) veins. These join together to form two large veins called the superior and inferior vena cava, which finally end in (*f*) the right auricle of the heart. Any part of the blood leaving either side of the heart must complete both these circulations before it can return to the starting-point, with the exception of some minute blood-vessels supplying the substance of the heart itself.

2*a*. The **Portal Circulation** is a subdivision of the systemic circulation. The portal vein brings blood from the capillaries of the stomach and intestines, as well as from the pancreas and spleen. In the liver the portal vein, unlike other veins, breaks up again into capillaries between the cells of the liver, ultimately forming the hepatic vein which joins the inferior vena cava. The general course of the blood will be better understood from the diagram on the next page.

The main forces concerned in circulating the blood are :—

1. *The heart contracting at regular intervals.*—The amount of blood pumped out of the left ventricle at each

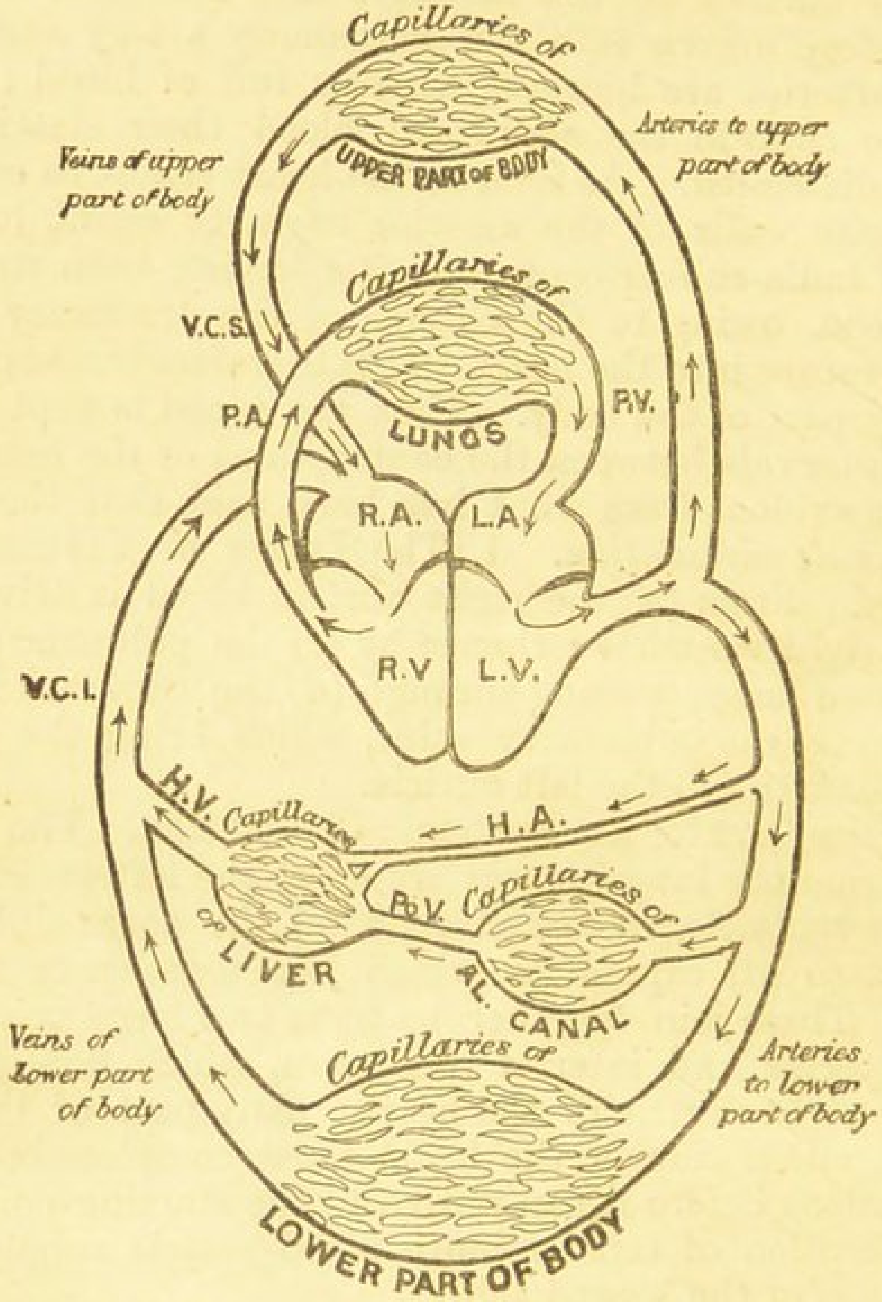

FIG. 5.—*Diagram of Course of Circulation of Blood.*

contraction is about 6 oz., each cardiac contraction occupying about 4½ tenths of a second. The beat of the heart is an automatic action, not directly controllable by the will, but regulated by certain important nerves and nerve-centres.

2. *The elastic recoil of the large arteries*, following immediately after the contraction of the heart, drives the blood on towards the capillaries

3. *The capillaries offer considerable resistance* to the passage of the blood, thus maintaining the blood-pressure in the arteries in the intervals of the contractions of the heart. The aorta is infinitely larger than each individual capillary, but all the capillaries together have a sectional area of 700 times as much as that of the aorta. It is well known that the shallower a stream, the more sluggish its current. Similarly in the capillaries the circulation is greatly decreased in rapidity, owing to the enormous increase of friction; and, consequently, interchanges between the blood and the tissues are helped.

4. *Muscular exercise helps* the onflow of blood in the veins, reflux being prevented by their valves. Every time a muscle contracts, it presses on the veins in its substance and around it, thus driving the blood on towards the heart. The chief forces, however, which propel the blood along the veins are the pressure of blood from behind, and

5. *The movements of respiration*, which exert a sucking or aspirating influence in the direction of the heart.

The **velocity of the bloodstream** diminishes from the heart to the capillaries. In the aorta it is probably one foot per second, in the capillaries only $\frac{1}{50}$ inch per second. In the veins the velocity is partially regained; but in the venæ cavæ it is only about half that in the aorta. The length of time required for blood to return from any one point to the same point will vary according to the length of the circuit, and will be diminished by exercise, but on an average it takes about twenty-three seconds.

CHAPTER V.

THE DIGESTION OF FOOD.

Mastication and Insalivation.—Deglutition.—Gastric Digestion.—Causes of Indigestion.

A fire will not continue to burn unless periodically replenished with fuel; and, similarly, the processes of oxidation within the body, which form the source of warmth and force, cannot continue unless food is supplied.

Varieties of Food.—The different varieties of food will be discussed in detail hereafter. For the present it is sufficient to know that they may be divided into two great classes, according as they contain nitrogen or not. The **nitrogenous foods** are typified by the lean of meat, white of egg, casein of milk, and gluten of bread. **Non-nitrogenous foods** are chiefly of four kinds :—(1) Starch and sugar, (2) fats and oils, (3) salts, especially chloride of sodium, and (4) water.

Mastication and Insalivation.—The alimentary canal forms a long and convoluted tube, passing right through the body. The food must be regarded as being still outside the body, until it has been dissolved and absorbed through the walls of the alimentary canal into the circulation of lymph and blood.

In the mouth food undergoes the first process of digestion. It is finely pounded by the teeth, and thoroughly mixed with the saliva.

The teeth in the healthy adult are 32 in number, viz., 4 central sharp *incisors*, 2 *canine* or pointed teeth, 4 *bicuspid* teeth, and 6 *molars*, or grinders, in each jaw. These form the second set of teeth. The first set of teeth in children under seven (so-called *milk teeth*) are only 20 in all.

In fig. 6 are shown the permanent teeth of the left half of the upper jaw. The figures attached give the age (in years) at which the teeth first appear.

The teeth are composed of a mixture of animal and earthy matter, somewhat harder than bone. Their free surfaces are covered by a very hard material called *enamel.* Any disorder of general health, and especially of the digestive organs, tends to produce decay of the teeth. On the other hand, digestion is often disordered by defective teeth, leading to the food being imperfectly masticated, and consequently more difficult to digest. In order to keep the teeth in good condition, they should be brushed daily. No particles of food should be allowed to remain between the teeth, as a tendency to acid fermentation is induced, and then the enamel is attacked. Nuts or hard sweets should not be cracked with the teeth ; and the general health should receive attention. Hollow teeth should be stopped by a competent dentist immediately they are discovered, in order to prevent the mischief from extending; and in children, if the teeth appear crowded or irregular, a dentist should be consulted, as crowded teeth are much more apt to decay than others.

The **saliva** is a thin glairy fluid, secreted (*i.e.* formed

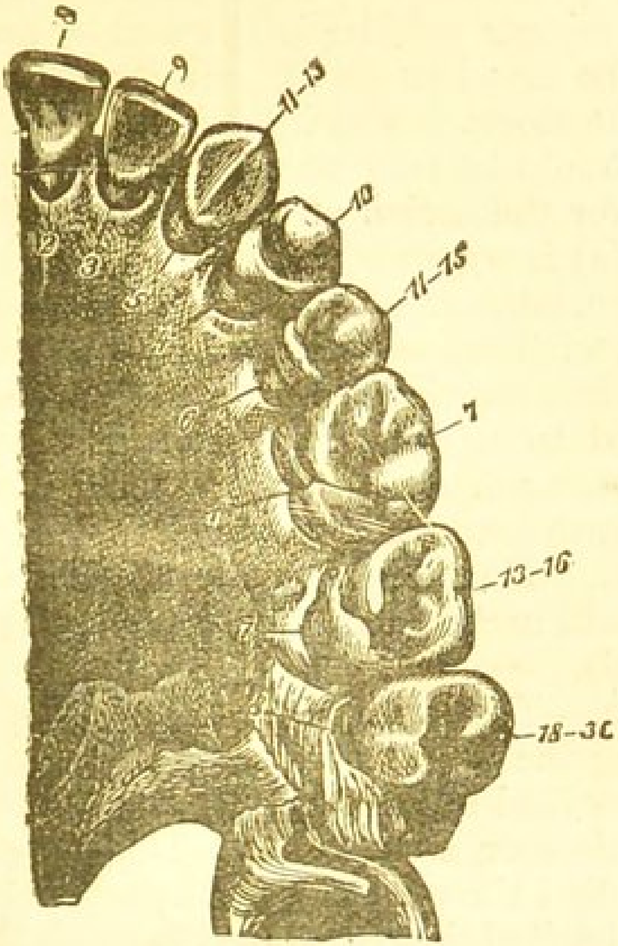

FIG. 6.—*Permanent Teeth of one half of Upper Jaw.*

from the blood) by six salivary glands, each about as large as a walnut, which pour their secretion along delicate tubes into the mouth. The secretion of saliva, like other secretions, is indirectly controlled by the nervous system, as evidenced by the 'watering of the mouth' produced by the sight, or even the thought, of appetising food. Mastication or chewing not only reduces the food to a fine mass, but mixes the saliva well with the food. It thus enables it to be swallowed. Dry food would stick in the throat; moist food easily passes down the gullet. Saliva has, however, a more important function. *Starch is converted into sugar* by the chemical action of the saliva upon starch.

Starch may be represented by the formula $C_6H_{10}O_5$ or some multiple of this. Saliva contains a ferment called ptyalin, which is able to convert starch into grape-sugar.

$$\text{Thus :—} \underset{\text{(starch)}}{C_6H_{10}O_5} + \underset{\text{(water)}}{H_2O} = \underset{\text{(grape-sugar)}}{C_6H_{12}O_6}$$

The saliva produces no effect on fatty or nitrogenous foods, but the minute subdivision caused by mastication enables these to be acted on much more readily by the digestive juices in the stomach and intestines.

The food should be well chewed or masticated, in order to allow time for the action of the saliva. Indigestion (also called *dyspepsia*) is commonly caused by sipping tea or other liquids during meals. The food should be moistened with saliva and not with tea or other liquids before being swallowed. Complete mastication is necessary also in order to reduce the food to minute particles, and thus enable the juices of the stomach and intestines to act on them, and convert them into a condition in which they can be absorbed into the system. Hard and large lumps of food are almost certain to remain undigested, and to give rise to discomfort of various kinds.

Deglutition.—The tongue and cheeks help in mastication by keeping the food between the teeth. The tongue next pushes the food back to the throat, and thus starts the act of deglutition or swallowing. The uppermost part of the gullet is called the **pharynx**; the part below this, which runs down the back of the thorax and through the diaphragm to join the stomach, is the **œsophagus.** As soon as the food reaches the upper part of the pharynx it is seized by the muscles in the wall of the tube and pushed down along the œsophagus. In its passage to the œsophagus the food has to cross over a sort of trap-door formed by the *epiglottis* (F, fig. 7), which, along with contraction of the muscles of the part, prevents food from dropping into the windpipe or trachea (G, fig. 7). The food does not *fall* into the stomach (as shown by the fact that a conjurer can swallow a tumblerful of water while standing on his head), but is propelled by wave-like contractions of the muscular fibres in the tube. Deglutition as soon as the food enters the pharynx is an involuntary act, and cannot be stopped by any effort of the will.

Gastric Digestion.—The stomach (fig. 7) is a large organ reaching across the upper part of the abdomen.

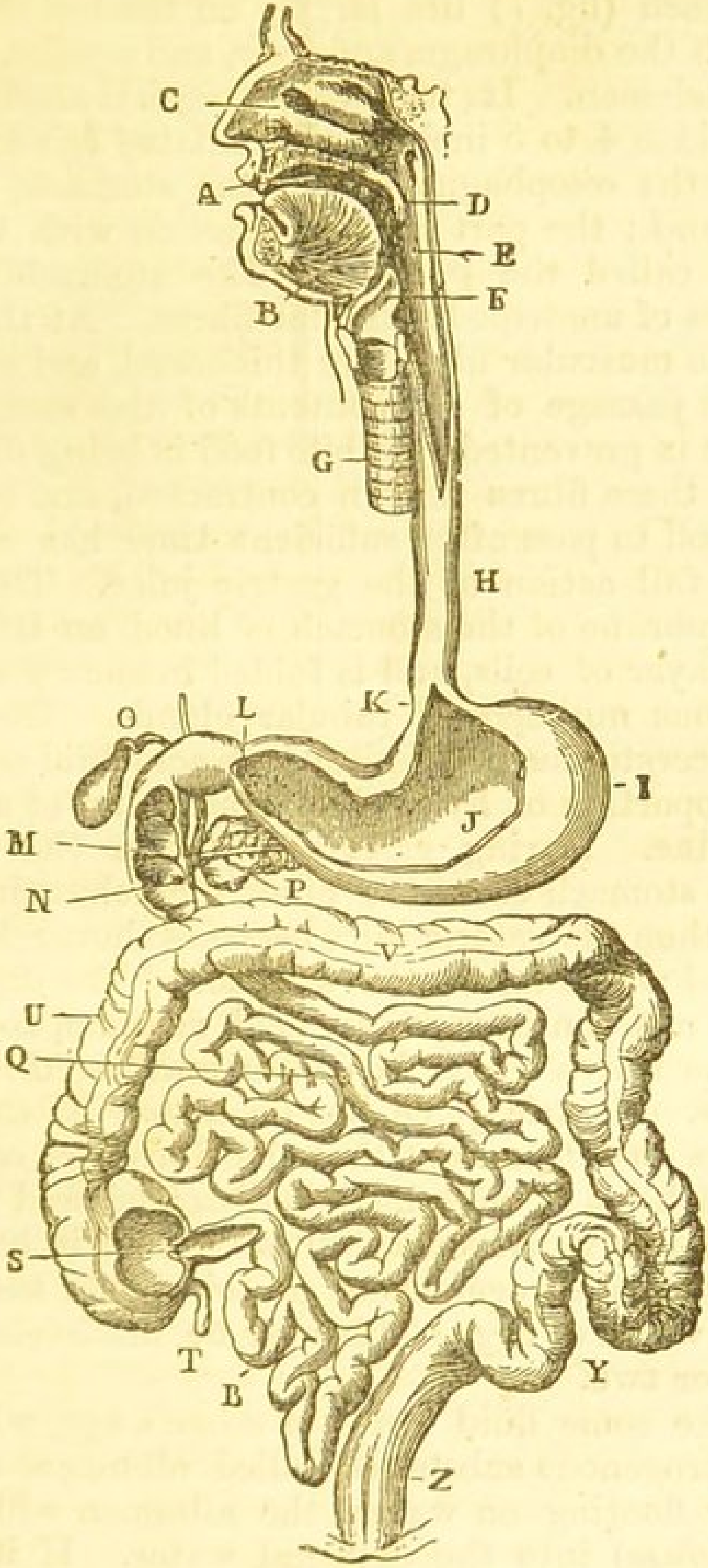

FIG. 7.—*View of the whole Alimentary Canal.*

A. *Cavity of mouth.* B. *Tongue.* C. *Nose-cavities.* D. *Tip of soft palate (uvula).* E. *Pharynx or gullet.* F. *Epiglottis.* G. *Trachea.* H. *Œsophagus.* K. *Cardiac orifice, and* (L) *pyloric orifice of stomach.* I. *Cardiac end of stomach.* J. *Interior of stomach.* M. *Duodenum.* N. *Point of entrance of ducts from liver and pancreas.* P. *Pancreas.* Q. *Coils of small intestine.* S. *Ileo-cæcal valve.* T. *Vermiform appendix.* U, V, X. *Ascending, transverse, and descending colon.* Y. *Sigmoid flexure of colon.* Z. *Rectum.*

The stomach (fig. 7) lies largely on the left side of the body beneath the diaphragm and liver, and against the front wall of the abdomen. Its transverse length is about 10 to 12 inches, its width 4 to 5 inches. Its dilated left extremity, near where the œsophagus enters the stomach, is called the *cardiac end*; the part at the junction with the small intestine is called the *pylorus*. The stomach contains several layers of unstriped muscular fibres. At the *pylorus* (L fig. 7) the muscular fibres are thickened, and when they contract, the passage of the contents of the stomach into the intestine is prevented. While food is being digested in the stomach these fibres remain contracted, and only relax and allow food to pass after sufficient time has elapsed to allow of the full action of the gastric juice. The *mucous* or inner membrane of the stomach is lined on its interior by a single layer of cells, and is folded in such a way as to form enormous numbers of tubular glands. The cells in these tubes secrete the **gastric juice**, an acid fluid containing a minute proportion of hydrochloric acid and of a ferment called **pepsine.** During gastric digestion the muscular fibres of the stomach contract, producing churning movements, and thus the gastric juice becomes thoroughly mixed with the food which enters the stomach. The digestion of starch does not continue in an acid medium, so that the action of the saliva which has been swallowed is stopped after a while. Gastric juice has *no action on starch.* It has *no action on fats,* except that the fibrous or connective tissue in which fat is contained is dissolved and the fat is set free in a finely-divided condition. But it has an important action on nitrogenous or proteid foods, such as lean meat or the white of egg. This may be made clear by an experiment or two.

If we take some fluid white of a hen's egg, which consists of a nitrogenous substance called albumen, and tie it in a bladder floating on water, the albumen will not pass through (*diffuse*) into the external water. If it were to pass through, the water would turn milky on being boiled. If however we take some white of egg, add to it a little acid solution of pepsine (which may be obtained from any intelligent chemist), and leave it in a warm place for a few hours, the resulting fluid will diffuse through the animal membrane formed by the bladder. This is exactly what happens to nitrogenous food in the stomach. *The nitrogenous or proteid food is converted into* **peptones** *which are able to diffuse through the walls of the stomach, and thus reach the minute blood-vessels and enter the circulation.*

After the food has remained two or three hours in the stomach, the muscular fibres at the pylorus relax, and allow what remains undigested and unabsorbed to pass on into the small intestine.

Gastric digestion consists in the conversion of proteids into peptones. The minute blood-vessels of the mucous membrane of the stomach absorb (1) not only these peptones, but also (2) the sugar produced by the conversion of starch into sugar, (3) the sugar taken as such in food (cane-sugar is converted into grape-sugar in the stomach), (4) a large proportion of the water drunk, and (5) the salts contained in food. All these pass into the circulation direct from the stomach.

Indigestion may arise from swallowing unmasticated lumps of food, the gastric juice not being able to reach their interior. The taking of very cold liquids or ices during meals tends to retard digestion, as does also the drinking of large quantities of any liquid. An interval of at least four hours should elapse between meals, in order to give the stomach sufficient time for getting rid of the last meal and for an interval of rest. Too frequent meals are a great mistake, and so likewise are very long intervals between meals. The best arrangement of meals is into breakfast, dinner, and supper, with an interval of five to six hours between each meal; though there is no harm in having tea between dinner and supper if it is not made a hearty meal.

Mental worry and overwork tend to produce indigestion. In such cases a rest before meals is advisable, and exercise should not be taken immediately after meals.

CHAPTER VI.

THE DIGESTION OF FOOD—*continued.*

Intestinal Digestion.—The Pancreas.—The Liver.—The Large Intestine.—Attention to Action of Bowels.

The soft pulpy material which leaves the stomach at the end of gastric digestion is known as **chyme.** It consists of (*a*) some nitrogenous food which has escaped the action of the gastric juice ; (*b*) some starch which has escaped the action of the saliva ; (*c*) fatty food, the fat of which has hitherto not been changed at all ; and (*d*) a quantity of material which is incapable of being digested, and which will have to be passed right through the alimentary canal. This chyme now enters the small intestine.

Intestinal Digestion.—The small intestine is a convoluted tube about 20 feet long, connected with the stomach at one extremity and with the large intestine at the other. Its inner or mucous membrane presents very numerous small ridges or projections on its inner surface, which greatly increase the extent of surface over which the chyme is exposed to the action of the digestive juices. Its internal surface has a velvety appearance, owing to the presence of several millions of conical projections called **villi**, each from $\frac{1}{50}$ to $\frac{1}{30}$ inch in length.

The first part of the small intestine near the stomach has a fine tube opening into it (fig. 8) which is formed by the junction of one tube from the liver bringing **bile** and another tube from the pancreas bringing **pancreatic juice** to the intestine.

The **pancreas** is about 6 to 8 inches long, by $1\frac{1}{2}$ inches broad, and weighs from 2 to 4 ounces (fig. 8). It lies behind the stomach, and in structure resembles a number of salivary glands aggregated together. Its ducts or tubes unite to form a common duct, which unites with the common bile-duct, and discharges its contents into the first part of the small intestine. The pancreas secretes an alkaline fluid, which, after being poured into the small intestine, has a threefold action :—(*a*) One ferment in it converts starch into sugar ; and (*b*) another ferment converts proteids into peptones. Thus both starchy and nitro-

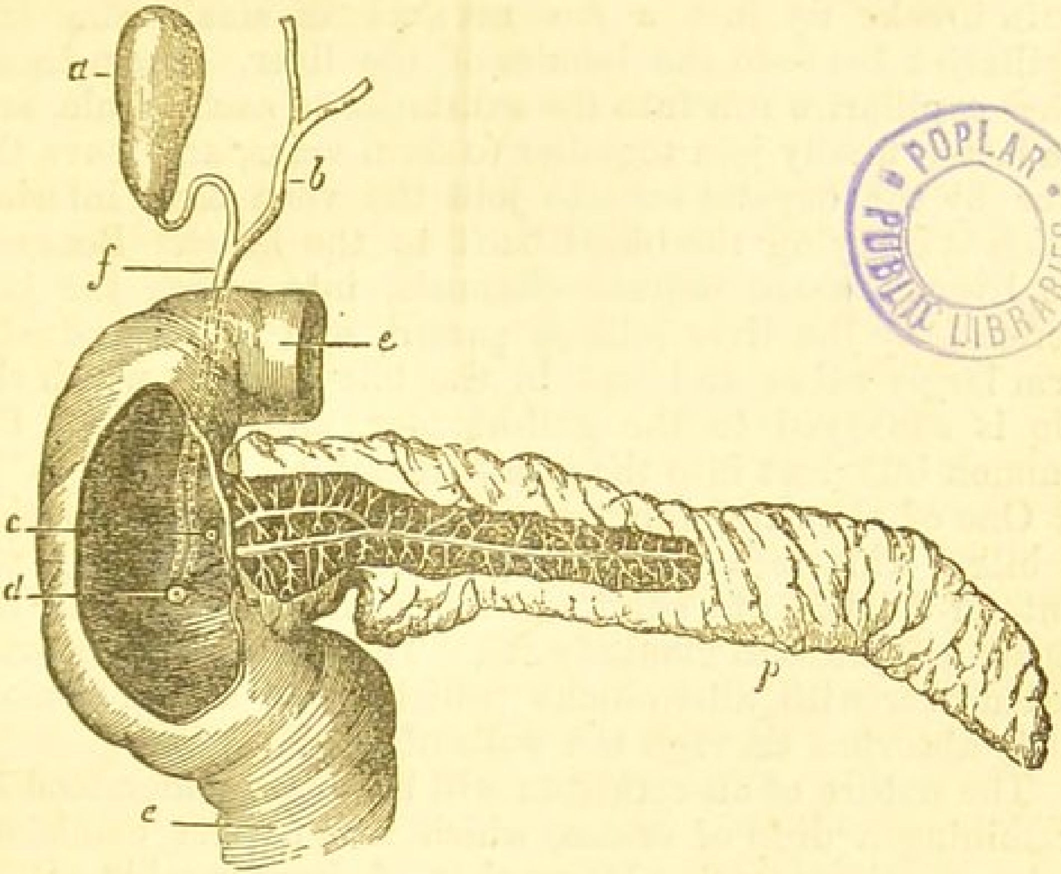

FIG. 8.—*Pancreas and Small Intestine.*

(p) *Pancreas ;* (e) *duodenum ;* (a) *gall-bladder ;* (b) *hepatic ducts from liver ;* (f) *common bile-duct ;* (c, d) *points of entry into intestine of ducts from liver and pancreas.*

genous foods which have eluded the action of the saliva and gastric juice, are subjected to a second similar action, so that little risk remains of digestible food passing through the intestines undigested. (*c*) The pancreatic juice acts on fats in two ways, emulsifying them and in part splitting them up into fatty acid and glycerine. Pancreatic juice being alkaline, part of the fatty acid is converted into a soap (*i.e.* an alkaline salt of the fatty acid), and the presence of this soap greatly aids the further emulsification of fats.

The **Liver** is the largest gland in the body, weighing from 50 to 60 ounces. It is divided into minute *lobules* from $\frac{1}{24}$ to $\frac{1}{12}$ inch in diameter, and each of these lobules contains numerous cells about $\frac{1}{1000}$ inch in diameter. The *portal vein* comes to the under surface of the liver, bringing the blood from the stomach and intestines and spleen, with the food which has been dissolved and absorbed into the circulation. As it passes through the liver, the portal vein again breaks up into a fine network of small veins and capillaries between the lobules of the liver. From these, other capillaries run into the substance of each lobule, and the latter finally join together to form veins, and leave the liver by the hepatic vein to join the vena cava inferior, which is carrying the blood back to the heart. Between the liver-cells are minute channels, into which the bile secreted by the liver-cells is passed, and these gradually form larger tubes and end in the bile-duct, by which the bile is conveyed to the gall-bladder, and thence by the common bile-duct into the small intestine.

One of the chief functions of the liver is the secretion of **bile.** This is a thick yellow fluid containing 14 per cent. of solids. Its chief use is, in conjunction with the pancreatic juice, to **emulsify fat.** The fat globules become coated over with albuminous pellicles, and are thus more easily absorbed through the walls of the intestine.

The nature of an **emulsion** will be better understood by examining a drop of cream, which is a perfect emulsion, under a microscope. It consists of innumerable oil or butter globules, covered with their coatings of albuminous matter. A similar but much coarser emulsion may be made by shaking up the glairy white of an egg with olive oil.

The fat in the intestine, by the combined action of bile and pancreatic juice, is thus emulsified and rendered cream-like. It then finds its way through the single layer of cells covering each villus into a minute vessel or tube in its interior, called a **lacteal vessel** (Latin *lac*, milk). The emulsified fat is thence carried to larger lacteal vessels, joining the lacteal vessels from other villi, and then passes along the **thoracic duct**, a vessel about the size of a crow's quill. The thoracic duct passes up along the back wall of the abdomen and thorax, and finally joins some great veins at the root of the neck, and thus the emulsified fat and other contents of the lacteal vessels (called **chyle**) become part and parcel of the blood.

From what has been said, it will be seen that (1) sugar, water, salts, and peptones enter the blood directly; while

(2) the chyle, with its contained fat, has to pass through a separate system of vessels and glands (part of the **lymphatic system**) before entering the blood. We shall shortly find that although most of the dissolved food enters directly into the blood, it is subjected to further changes in the liver before it is allowed to enter the general circulation.

Functions of the Liver.—The veins coming from the stomach and intestines, like veins in all other parts of the body, join together and form a trunk vein, called here the **portal vein**. This vein contains ordinary venous blood, and, in addition, the sugar, proteids, salts, and water absorbed from the alimentary canal. The peptone, as soon as it enters the blood-vessels, becomes reconverted into a non-diffusible proteid or albuminoid. The portal vein enters the substance of the liver, and, unlike any other vein (with one exception) in the body, breaks up again into capillaries which are distributed all over the substance of the liver. By this means the products of digestion are again acted on by the liver. We have already seen that the liver (1) *secretes the bile* which is poured into the small intestine. In addition (2) the cells of the liver seize on the sugar which is passing by them, and store it up as *animal starch* or *glycogen*, doling it out to the general system, as required, in the form of sugar. Sugar is one of the most important heat-giving foods ; and the liver, in virtue of this power of equalising the supply, prevents waste of material. (3) The liver undoubtedly has some other important functions. The liver contains about one-fourth of the whole blood of the body, and the *nitrogenous materials* passing through it are *partially broken down* and brought nearer to the condition in which they are finally eliminated (*i.e.* got rid of) by the kidneys. These chemical changes, like other chemical changes, mean that heat is produced ; and it is not surprising, therefore, to learn that a large portion of the heat of the body is produced in the liver.

The **large intestine** is five to six feet long, and, as seen in fig. 7, partially surrounds the margin of the coils of the small intestine. It is divided into three parts : the *cæcum*, where it joins the small intestine ; the *colon*, which is subdivided into ascending, transverse, and descending portions ; and the *rectum*, which forms the terminal part of the alimentary canal. The passage of the food through the large and small intestine is effected by wave-like contractions of the muscular fibres in the walls of the intestine. This wave-like contraction is termed *peristaltic action.*

As the chyme passes along the small intestine, more and more is absorbed in the ways already indicated, and when it enters the large intestine the fluid parts have been in large measure absorbed. The solid remainder consists chiefly of undigested food, and of portions of food incapable of digestion, with a little bile, &c. It is also known as the **fæces** or solid excreta, and averages about four ounces each day.

Attention to the action of the Bowels at a fixed time daily is a matter which is largely under the control of habit. When this is neglected, the condition of *constipation* results. Owing to the retention of the fæces in the intestines beyond the normal period, some of the products of putrefaction become absorbed into the circulation, and the complexion becomes earthy and the general health is deteriorated. Indigestion with flatulence (wind) is common in constipated persons, and piles frequently occur. The fæces may become impacted in the bowel and dangerous inflammation be produced. Purgative drugs should be carefully avoided in chronic constipation, unless under medical advice. As a rule they produce a temporary effect, but make matters worse afterwards.

A cure may usually be secured by alterations in diet.

The following articles of diet tend to obviate constipation :—(1) *Water*—taken last thing at night and in the early morning. (2) An increased use of common *table-salt* helps. (3) *Fats* lubricate the intestines and stimulate their peristaltic movements. (4) *Vegetables and fruits* are very serviceable. The cellulose and other indigestible materials of vegetable foods, as, for instance, the bran of brown bread, act as slight irritants, and thus hurry on the contents of the intestines. Such articles of diet as stewed prunes, pears, figs, olive oil, and brown bread are of great service ; and the cultivation of a regular habit is important above all the rest.

CHAPTER VII.

CLASSIFICATION AND USES OF FOOD.

Uses of Food.—Food-Stuffs.—Variations in Amount of Food required.—Construction of Dietary.—Vegetarianism.

Foods may be classified as *inorganic*, of which the chief example is table salt; and *organic*, which are derived either from *vegetables* or from *animals*.

For our purposes, however, a better classification of foods is into

1. **Nitrogenous foods.**
2. **Fats** (also called hydrocarbons).
3. **Carbohydrates**, including starch and sugar.
4. **Salts** (including the vegetable acids and their salts).
5. **Water.**

Uses of Food.—Food serves (1) *to build up the organs and tissues of the body*; (2) *to renew the composition of these parts*, as they become partially used up in the exercise of their functions (the amount required for this purpose is very much smaller than is commonly imagined); and (3) *to supply combustible material*, the oxidation of which is the source of the heat and force manifested within the body.

Thus all foods are either **tissue-producers** or **force-producers**, or both. There is no strict limiting-line between the two. The same food may be both. Sugar may be stored in the liver, or at once oxidised in the system; and fat similarly. On the other hand, the greater part of the nitrogenous foods which are taken, although sometimes erroneously regarded as only tissue-producers, *are broken down in the intestine and liver without entering into the composition of nitrogenous tissues.*

Salts, especially chloride of sodium (common table-salt), are essential foods, as they are found in all the tissues and fluids of the body. **Water** is necessary (1) to dissolve the food and enable it to be absorbed into the circulation; (2) to maintain the fluid condition of the blood and thus keep up its circulation; and (3) to enable the kidneys to separate injurious products from the blood.

Food-Stuffs.—Each important food contains a variable proportion of carbon, hydrogen, and oxygen, with or without nitrogen. These, then, are the chief elements out of which our foods are built. These elements are built **up** into **food-substances,** also called **food-stuffs** or **proximate-principles.** Thus albumen and gelatine are food-stuffs containing the four elements named above, with small amounts of sulphur and phosphorus.

Fats are food-stuffs containing carbon, hydrogen, and oxygen ; sugar and starch are food-stuffs containing the same elements, with a larger proportion of oxygen. The hydrogen and oxygen in sugar are in the same proportion as in water (*i.e.* as two atoms to one, or some multiple of this) ; in fats the oxygen is smaller in amount. It follows from this statement that in starch and sugar (carbohydrates) the hydrogen is already oxidised, *i.e.* it is in combination with oxygen in the same proportions as in water ; whereas in fats (so called hydrocarbons) the hydrogen is greater in amount than the oxygen in the fats can completely oxidise ; consequently some hydrogen still remains to be oxidised and form a source of heat. Hence fats are more concentrated foods than starch and sugar.

The following table gives the **chief food-stuffs** :—

FOOD-STUFFS

Nitrogenous foods	gelatine (in soup from bones, &c.)
	albumin (in white of egg, &c.)
	myosin (in flesh)
	casein (in cheese)
	legumin (in peas and beans)
	gluten (in bread)
Hydrocarbons or fats	olein, palmitin, stearin (in fats and oils)
	butyrin (in butter)
Carbohydrates	glucose (in grape sugar)
	sucrose (in cane sugar)
	lactose (sugar of milk)
	starch (in rice, potato, flour, &c.)

The ordinary **foods** which we take contain one or more of the food-stuffs enumerated above. Thus sugar consists of a single food-stuff. The fat in a piece of meat contains varying proportions of the three food-stuffs, stearin, olein, and palmitin. Bread contains starch, gluten, and smaller quantities of other food-stuffs. Milk contains casein, olein, and butyrin, lactose (sugar of milk), and a small quantity of albumen. It is evident, therefore, that most foods are composed of two or more food-stuffs, while milk contains representatives of them all.

The amount of each of these chief classes of food in some of our chief foods is shown in the following tabular statement:—

	In 100 Parts				
	Water	Albuminoids or Proteids	Fats	Carbohydrates	Salts
Uncooked meat, with little fat and no bone	74·4	20·5	3·5	—	1·6
White fish . .	78·0	18·1	2·9	—	1·0
White wheaten bread	40·0	8·0	1·5	49·2	1·3
Wheat flour . .	15·0	11·0	1·2	70·3	1·7
Oatmeal . . .	15·0	12·6	5·6	63·0	3·0
Butter . . .	8	2·0	88·0	—	variable
Egg (including shell)	67·2	12·5	10·3	—	10
Cow's milk . .	87·0	3·4	3·8	5·0	0·8

Variations in amount of Food required.—In order to maintain health, it is necessary that the dietary of every person, whether adult or child, should contain a due proportion of each of the five great classes of food (nitrogenous foods, fats, starches and sugars, salts, and water). In other words, the *dietary must be mixed.* A deficiency of fats is particularly injurious, increasing the tendency to consumption and other diseases. The absence of certain vegetable salts which are contained in fresh vegetable food, leads to scurvy, which in former days used to cause a very high mortality, especially on long sea-voyages.

The dietary will vary with season and climate.—The Esquimaux eats an amount of fat which would make us ill; and we eat more meat than is required in tropical climates.

The dietary will vary with occupation.—Persons engaged in heavy muscular work usually take much more meat than those of sedentary occupations, though the difference in amount of meat required is not so great as is usually supposed. There is, however, a greatly increased oxidation of fatty or saccharine material in the former, and therefore a need for increased food of these kinds.

The dietary will vary according to age.—Children under one year of age require little besides milk. Milk contains all the materials required for the increase in bulk and weight during the first year of life, which is relatively greater than in any subsequent year. Until growth has ceased it is evident that more food will be required in proportion to the present size of the body than after 25 years of age. For (1) not only have the ordinary processes of force-generation and repair of tissues to be carried on, but also (2) the rapid growth in all parts of the body has to be allowed for. If food is stinted during this period of life, then the present demands having to be met, it is evident that less material is left for growth, and stunted limbs and impaired powers must result.

As persons advance in years, the tendency is for them to take too much food.

Construction of Dietary.—An examination of the amount of material lost from the body by the lungs, kidneys, skin, and bowels; and an examination of the kinds and amount of food found to be sufficient for soldiers, and others living in public institutions, to keep them in good health, give the necessary data for stating the average amount of food required daily by each person. An adult engaged in moderate work requires—

$4\frac{1}{2}$	ozs. of	nitrogenous substances,
3	,,	fats,
$14\frac{1}{4}$	,,	carbohydrates, and
1	,,	salts,

Making a total of $22\frac{3}{4}$ ozs. of solid dry food.

But the ordinary foods we take contain about one-half their bulk of water. The above dietary is therefore equivalent to about $45\frac{1}{2}$ ounces of moist solid. To this must be added 2 to $2\frac{1}{2}$ pints of water.

The number of grains of nitrogen in the above dietary is about 300, of carbon about 4,800.

Now, meat contains an excess of nitrogen. If one attempted to live on lean meat alone, then 29 ozs. of uncooked lean meat would supply sufficient nitrogen, but 75 ozs. would be required to supply sufficient carbon.

Similarly bread contains an excess of carbon. If we attempted to live on bread alone, then 54½ ozs. would be required daily to supply enough nitrogen, and only 40 ozs. to supply enough carbon. It is evidently therefore *more economical to combine foods*, thus avoiding excess or deficiency of any one constituent.

Thus, 10·6 ozs. of lean uncooked meat and 34·6 ozs. of bread would give the 300 grains of nitrogen and 4,800 grains of carbon required daily by an adult engaged in moderate work.

A smaller amount of nitrogen suffices for those who lead an inactive life. It may be useful to give a few practical examples of dietaries worked out on the preceding lines.

Instances of Dietaries.—In **prisons**, for persons undergoing more than four months' imprisonment with hard labour, the dietary is as follows :—

Breakfast, Daily		Bread	8 ozs.
		Porridge	1 pt.
Dinner	Sun. and Wedn.	Bread	6 ozs.
		Potatoes	8 "
		Suet pudding	12 "
	Mon. and Friday	Bread	8 "
		Potatoes	12 "
		Cooked meat without bone	4 "
	Tues., Thursday, and Saturday.	Bread	8 "
		Potatoes	12 "
		Soup	1 pt.
Supper.	Daily	Bread	8 ozs.
		Porridge	1 pt.

The *soup* is made from the following ingredients in every pint :—4 ozs. of clod (or shoulder), cheek, neck, leg, or shin of beef ; 4 ozs. of split peas ; 2 ozs. fresh vegetables ; 1½ oz. onions ; pepper and salt.

Suet pudding.—Each pound contains 1½ oz. mutton suet, 8 ozs. flour, and about 6½ ozs. of water.

Porridge is made with 3 ozs. of coarse Scotch oatmeal to the pint, with salt.

The preceding diet is equal to about 270 grains of nitrogen and 4,300 of carbon.

It has been suggested that bacon and haricot beans should be substituted for beef in the Monday's dinner. This would be more nutritious and at the same time more economical. Thus :

4 ozs. of beef (cooked) without bone	costs	$3\frac{1}{2}d.$	$=5d.$
12 ,, potatoes	,,	$\frac{3}{4}d.$	
8 ,, bread	,,	$\frac{3}{4}d.$	

while

9 ozs. of cooked haricot beans	costs	$\frac{1}{2}d.$	$=2\frac{1}{2}d.$
1 ,, ,, fat bacon .	,,	$\frac{1}{2}d.$	
12 ,, ,, potatoes .	,,	$\frac{3}{4}d.$	
8 ,, bread . . .	,,	$\frac{3}{4}d.$	

being a saving of $2\frac{1}{2}d.$ on each dinner.

The **Soldiers' Dietary** consists of 12 ozs. of meat, of which $\frac{1}{4}$ part is bone, 24 ozs. of bread, 16 ozs. of potatoes, 8 ozs. of green or other vegetables, $3\frac{1}{4}$ oz. of milk, $1\frac{1}{3}$ oz. of sugar, $\frac{1}{4}$ oz. of salt, $\frac{1}{3}$ oz. of coffee, and $\frac{1}{6}$ oz. of tea. This is equivalent to 272 grains of nitrogen and 4,588 of carbon.

The following diet may be recommended for **brain workers**, being light, easily digestible, and quite sufficiently nutritious. It should contain about 20 ozs. of bread, 10 ozs. of fish, 16 ozs. of potatoes, 8 ozs. of other vegetables, $3\frac{1}{4}$ ozs. of milk, one egg, 1 oz. of butter, and $\frac{1}{2}$ oz. of sugar, or their equivalent in other foods, thus supplying about 300 grains of nitrogen and 4,640 grains of carbon. The diet may be varied to any extent, and many accessories included.

It is evident, however, that none of the preceding dietaries (with the possible exception of the prison dietary) would satisfy the **requirements of the working man**, having himself, his wife and family to support on 25*s.* to 30*s.* per week, on account of their expense.

For him the best money-value is perhaps obtainable from oatmeal. It is quite possible to meet all the requirements of a man engaged in laborious work, by supplying him daily with $1\frac{3}{4}$ lbs. of oatmeal and a quart of pure milk. This contains an abundant supply of nitrogenous material, fat, and carbohydrates, and at a cost which would not exceed 7*d.*

As variety is desirable, other foods may be introduced.

Thus, 20 ozs. of bread, $\frac{3}{4}$ lb. of lean bacon, 1 lb. of potatoes, $\frac{1}{2}$ oz. of butter, $\frac{1}{2}$ oz. of sugar, $3\frac{3}{4}$ ozs. of milk, 4 ozs. of oatmeal, would cost about $10\frac{1}{2}$*d.*, and would supply as much nutriment as the oatmeal and milk diet just named.

Suppose the labourer has a wife and four children, of whom one is an infant six months old, and the others, three, seven, and fourteen years of age respectively. The eldest child must be taken as requiring about as much food as his mother, and about two-thirds of the amount required by the father ; the two next children will require each about half the amount consumed by the father, and, unless the infant is nursed naturally by its mother (in which case her food would require to be increased), two pints of new milk must be allowed for it daily. Thus, leaving the infant out of the reckoning, if the family lived on oatmeal and milk the cost of food would be not quite 1*s.* 11*d.* *per diem* ; while if they lived on the more varied dietary we have mentioned, it would be 2*s.* 11*d.*

Numerous variations on the preceding dietaries may be devised without increasing expenditure. Bones may be utilised for making soup to which carrots and other vegetables form a nutritious addition. Peas or haricot beans may take the place of lean bacon once or twice a week, and cheese on other days if desired. But whatever plan is adopted, the labourer must evidently spend a large share of his earnings in food, leaving scant margin for rent and clothing.

Vegetarianism.—It is now much urged that only vegetable food should be taken by man. There can be no doubt (*a*) that all the food we require can be obtained from the vegetable world ; (*b*) that a large amount of suffering to animals would be prevented by the adoption of this system ; (*c*) that land feeds a larger number of people if devoted to producing corn instead of feeding cattle ; and (*d*), as shown by the experience of a large number of persons, health can be maintained for prolonged periods on vegetable foods alone.

On the other hand, there are the following strong reasons against an exclusively vegetable diet :—(*a*) The dietetic customs of nearly all races, and certainly of the most influential races, are in favour of a mixed dietary ; (*b*) with a purely vegetable diet the undigested refuse is greater than with an equal quantity of animal food; (*c*) the digestion of vegetable food is somewhat more complex and difficult than that of animal food, thus laying a greater strain upon the digestive organs. Animal food has a great advantage as regards convenience. Man requires food which is easily converted into the body substance, and this is supplied by the flesh of animals, milk, and eggs, with a due proportion of non-nitrogenous food. Sheep and oxen work up indigestible vegetable materials into easily assimilable mutton and beef. (*d*) The cooking of vegetable dishes requires more time and trouble than the cooking of meat, in order to secure a sufficiently nutritious and varied dietary.

There is, however, no reasonable doubt that at present an excess of animal food is taken. The consumption of meat has increased more than 40 per cent. in the last fifty years. This excess is probably absolutely harmful for town-livers, who do not get sufficient exercise in the open air.

If we include milk, cheese, and eggs in the vegetarian diet, the objections to it in a large measure disappear, and it would be well if it were much more widely known, especially among the poor, that on these, together with vegetables, health can be maintained with the addition of little or no meat.

CHAPTER VIII.

ANIMAL FOODS.

Gelatine.—Flesh Foods.—Varieties of Meat.—Meat unfit for Food.—Fish.—Eggs.

The most important foods derived from animals consist of their flesh, but **gelatine**, obtained by boiling the bones, is also a useful food. Gelatine possesses the well-known property of 'setting' when it becomes cool. It is obtained not only from bones, but also from meat. Beef-tea, as usually made, consists chiefly of the salts of meat and gelatine, extracted by boiling from the meat. The most nutritious part of the meat is left behind.

Isinglass obtained from the floating-bladder of the sturgeon is nearly pure gelatine; **glue** is an inferior sort made from bones and other refuse materials. The hides of animals consist largely of gelatine, and are converted into leather by soaking them in a liquid containing oak-bark. A hard compound is produced by the action of the tannin of oak-bark on gelatine. Strong tea contains a considerable amount of tannin, and for this reason it should not be drunk at meals where meat is taken.

The **flesh** of various animals forms an important source of both nitrogenous and fatty food. Meats are divided into (1) **red meat**, as beef, mutton, pork, game, wild-fowl, and salmon; and (2) **white meat**, as the common fowl and turkey, most fishes, rabbits, crustaceans (crab, lobster, &c.), and molluscs (oysters, mussels, &c.).

Generally white meats have finer fibres than red meats. They contain a smaller percentage of nitrogenous matter, and are in most cases more digestible than red meats. Tripe is the unstriped muscle of the first stomach of the cow. Its fibres are easily broken up during digestion, and therefore very digestible.

Changes in Muscle after Death.—When an animal dies its flesh remains flabby and relaxed for a few hours. After this the muscles become rigid and hard, a condition known as *rigor mortis*. This stage lasts on an average about two days, after which the flesh again becomes flabby and relaxed, and, if kept much longer, putrefaction sets in. During the state of rigidity meat is harder and less digestible than before or after this period. This explains why meat is so much more tender when it has been 'hung' for a couple of days.

How to purchase Meat.—Several facts should be known by the intending purchaser. The flesh of young animals is less nutritious than of more mature ones. A four-year-old ox yields the best beef, and a three-year-old sheep the best mutton. In ill-fed and old animals connective tissue is in excess and so the meat is tougher. Well-fed and fattened meat contains, for equal weights, about 40 per cent. more dry animal matter than non-fattened meat. The average proportion of fat in fat oxen is $\frac{1}{3}$, in fat sheep $\frac{1}{2}$, in calves $\frac{1}{6}$, lambs $\frac{1}{3}$, and fat pigs $\frac{1}{2}$.

The most economical joint to buy is one having the least bone in proportion to the meat. A leg of mutton weighing 8 lbs. has bone weighing about 1 lb. Thus the price of its meat is raised from, say, $11\frac{1}{2}d.$ to $13d.$ per lb. Similarly a shoulder of 7 lbs. will have about 1 lb. of bone, and the apparent price, $10\frac{1}{2}d.$ per lb., is really $12\frac{1}{4}d.$; in a sirloin of beef weighing 40 lbs. 5 will be bone, and the apparent price being $10\frac{1}{2}d.$, the real price is 1*s.* It is evident, therefore, that steaks and small pieces without bone may not be so much more expensive than the ordinary joints as at first sight appears. We must not forget, however, that bones may be much more utilised among the poor than they are at present for making nutritious soup.

Good meat, whether beef or mutton, ought to have a marbled appearance, and should possess a medium colour, neither pale pink nor deep purple. Its texture should be firm, and it should not leave the impress of the finger after pressure. Its odour should be slight and pleasant (a clean skewer or knife thrust into the joint should give no unpleasant smell), the juice reddish and acid; the bundles of fibres should not be too coarse, and should be free from foreign particles embedded in them. Most important of all, the meat should not be the flesh of an animal that has recently calved, or has died in consequence of any accident or disease.

Beef is usually more lean than mutton or pork; it has a closer texture, and more nutritive material in a given bulk. It is also fullest of the red-blood juices, and possesses a richer flavour than the other two. It follows that the national preference of the English for beef is justified. The sirloin and ribs of beef are specially good for roasting; the brisket, the round, the aitch bone, and other parts may be boiled; the neck and the leg make excellent stock for soup. Meat is much more tender if hung for two or three days in a cool, well-ventilated larder, before being cooked. This is impracticable in hot weather.

Beef and mutton are now brought over from America and Australasia in refrigerating chambers in enormous quantities. There is little doubt that a large proportion of this is sold as English meat without the difference being detected. Such meat is undoubtedly quite wholesome, and there is absolutely no reason why it should not be eaten. Its cheapness forms an additional reason for its use by the working classes. American tinned beef also forms a good and cheap food, only, as it has already been overcooked, it must be eaten cold, or only warmed through.

Ox beef is the best kind of beef. It has a fine, smooth, open grain, tender texture, and red colour. Its fat is pale whitish yellow, and suet hard and white. When well fed, the flesh is marked or intergrained with fat. *Cow beef* has a closer grain than that of the ox, and its lean is a deeper red. *Bull beef* has a still closer grain, its fat is dark, its lean a deep coarse red, and its flavour strong.

Veal, the flesh of the calf, is paler than beef, and not so nutritious. In this country, owing to the immature age at which the calf is killed, the fibres are shreddy and difficult to masticate.

Mutton is generally considered to be more easy of digestion than beef, its fibres being shorter and more tender. Its fat is less digestible than that of beef. It varies much in quality, Welsh and Southdown mutton, which are very small, being considered particularly good. The leg is the best joint, the shoulder the next best; but nutritious dishes may be made from other parts by stewing or boiling.

Lamb, owing to its delicate flavour, makes an agreeable change from mutton; but it is more watery, and therefore less nutritious than mutton, and is consequently not an economical food.

Pork forms a much more important food for the labouring classes than mutton or beef, as in country places they can keep their own pigs, and pork is cheaper than butcher's meat. It can also be easily preserved by salting. It is the most difficult of meats to digest, owing to the large quantity of fat it contains.

Fresh pork is generally baked; pickled pork, boiled.

Bacon, cut in slices and broiled or toasted for breakfast, forms a universal English dish. The best quality of bacon or ham may be known by the rind being thin and the fat of a pinkish colour. It is more economical to buy the half of a large ham than a small ham, owing to the larger proportion of bone in the latter. The popular use of fat bacon with lean meats, such as veal, chicken, and rabbit, and with eggs, is founded on sound principles, as it serves to maintain the due proportions between nitrogenous and fatty food.

Brawn is a galantine made from pig's head, to which ox feet are sometimes added.

Meat unfit for Food.—Meat which has become tainted should be avoided, though, strange to say, game and venison are highly prized in this condition. The Esquimaux are said to bury their meat until it is putrid. The Chinese, again, are partial to rotten eggs.

Notwithstanding these exceptional instances, such foods should be rejected, as diarrhœa and other severe symptoms sometimes result from taking them.

Meat slightly tainted during hot weather may be restored by washing it with water just tinged with Condy's fluid. If the meat is then washed with clean cold water, all smell will be found to have disappeared. Meat may be kept for some time from tainting by pouring over it some of Barff's boro-glyceride. This is innocuous in small quantities, but the joint should be washed before being cooked.

Sausages, under certain conditions, and tinned meats to which air has gained access, are particularly dangerous, sometimes when no putrefactive smell can be perceived. In these cases a modified decomposition has occurred, accompanied by the formation of very poisonous chemical compounds called **ptomaines.**

Meat from animals which have died naturally or from accident and not been killed for food should be avoided. Meat derived from animals suffering from general tuberculous disease (consumption) is probably also dangerous. In fact, as a safe rule, it may be said that meat derived from animals suffering from any general or constitutional disease should be forbidden.

Certain parasites render meat very dangerous. Pork is sometimes (and beef less frequently) infested with minute cysts about the size of hemp-seeds, which, when swallowed in uncooked or imperfectly cooked meat, lead to the formation of long tape-worms in the intestines of the human body.

Another parasite (**trichina spiralis**), also often found in the pig, forms minute specks in the flesh (figs. 9 and 10), and, when swallowed in imperfectly cooked meat, multiplies rapidly in the alimentary canal, and produces a dangerous illness.

In order to avoid these dangers the meat purchased should be of good quality, and should always be thoroughly cooked

FIG. 9.—*Cysts of Trichina spiralis in a Muscle. Natural size.*

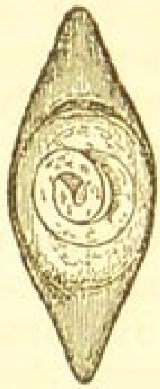

FIG. 10.—*A separate Cyst of Trichina spiralis, which is seen coiled up in the Muscle. Magnified* 200 *times.*

The **Flesh of Birds** contains very little fat. The muscular fibres are short and easily masticated, therefore forming a suitable food for invalids. This applies more particularly to the chicken. The flesh of ducks and geese, containing more fat, is less easy of digestion. *Game* should only be kept long enough to ensure tenderness. The flesh of the young *hare* and *rabbit* are both easily digested, resembling that of birds in general character. All these are alike in the deficiency of fat; hence the general use of fat bacon and melted butter with them.

It is important to be able to tell when fowls are young, and therefore tender. This may be known by the breastbone being soft like gristle, the spur being hardly formed, and by the feet and leg joints being larger in proportion to the body than in older birds. The flesh of wild-fowls is tougher and less digestible than of tame.

Fish forms a very important and too much neglected article of diet. It contains a larger proportion of water and less nitrogen, and is usually more easily digested than butcher's meat. There is considerable variation in the digestibility of fish, according to the distribution and amount of fat. We may divide fish into three classes: (1) Fish with *white flesh*, like whiting and sole; (2) fish with *red flesh*, like the salmon ; and (3) fish with *oily flesh*, like the eel. Under the first head, in addition to whiting and sole, we have turbot, brill, plaice, cod, flounder, &c., all these containing very little fat in their flesh. In the salmon there is considerable fat mixed up with the muscular fibres; and not only the eel, but also the pilchard, sprat, herring, and mackerel contain much fat mixed with their flesh, and are consequently not so suited for persons with delicate digestion as the white-fleshed fish.

Of the white-fleshed fish, whiting is the most digestible, the sole coming next. Cod and ling have close, firm fibres, and are not so easily digested as fresh haddock, brill, and plaice. Herrings form a cheap and nutritious dish, and can be preserved for eating when out of season. Haddocks, similarly, may be preserved by drying and smoking processes. Mackerel are cheap and wholesome when fresh ; but they rapidly become tainted, and should then be carefully avoided.

Fresh fish should be cooked as early as possible. Every hour that it is kept it deteriorates. The smell is the best test that a fish is fresh. The flesh should be firm, the gills bright pink, and the eyes full and bright. The quality of fish is always best when it is in season. During the spawning season it is to be avoided, though this rule does not apply to young fish before the spawning age. It is customary to speak of fish as a good 'brain food ;' but its reputation in this respect is probably owing to its ready digestibility.

Shell Fish—as lobster, crab, crayfish, shrimp, and prawn—are considered difficult of digestion. Occasionally they produce violent indigestion, followed by a red rash on the skin, called 'nettle-rash.' This is, however, exceptional, and shell-fish form a favourite article of diet among those who possess a strong digestion. The flesh of the lobster is more delicate and digestible than that of the crab. The flesh of the claws is more tender than that of the tail. The *oyster* is fairly nutritious, and, to most persons, easy of digestion. The soft part consists chiefly of the liver, which is almost self-digestive. The oyster is in season from September to April inclusive—*i.e.* in every month the name of which contains the letter *r*. The *mussel* is a larger and more nutritious mollusc than the oyster, but not so easy of digestion. It sometimes gives rise to very serious symptoms of poisoning. *Cockles* are allied molluscs somewhat less dangerous as a food than mussels.

Eggs.—Eggs form a concentrated food. The young chick is entirely developed out of the nutriment contained in the egg and its shell. The average weight of a hen's egg is about 2 ozs. In every 100 grains there are

10	grains of shell.	
22·8	„	albuminates and fat.
67·2	„	water.

An egg weighing two ounces would yield 110 grains of nitrogenous substance, 82 grains of fat, and 11 grains of saline matter. The *white* of the egg consists chiefly of albumen dissolved in water and enclosed in a delicate membrane. The *yolk* contains a very digestible oil, rich in phosphates, as well as a nitrogenous substance allied to albumen. Eggs lose weight when kept, owing to evaporation through the porous shell ; similarly air entering from without sets up decomposition.

To Preserve Eggs.—Eggs may be kept for an indefinite period (*a*) by smearing them over with lard or butter, so as to render them non-porous ; (*b*) by keeping them in a thin mixture of lime and water ; or (*c*) by keeping them in brine ; (*d*) in Scotland it is common to keep them by dipping them into boiling water.

To Test Eggs.—Fresh eggs appear clear when held up to the light, the centre being the clearest part ; stale eggs do not look clear. Make a brine of an ounce of common salt to half a pint of water ; fresh eggs sink in this solution, stale eggs float in it, and rotten eggs may even float in fresh water.

Ducks' eggs are larger and have a stronger flavour than hens' eggs. Plovers' eggs are considered a delicacy.

The common method of eating eggs illustrates the rational character of many of our dietetic customs. Bread and butter or bacon are taken with the egg, so as to compensate for the excess of nitrogenous matter in the egg. Salt, again, is taken to supply the requisite mineral food, and tea or some other liquid to furnish the necessary water

CHAPTER IX.

MILK AND ITS DERIVATIVES.

Cow's Milk.—Skim Milk.—Diseases from Polluted Milk.—Cream.—Butter.—Margarine.—Uses of Fat in Food.—Cheese.

Milk may be regarded as a *complete food*, inasmuch as the human infant sustains life for the greater part of the first year of life on milk alone, and during this year grows more rapidly than at any subsequent period of life. The proportion of nitrogenous to non-nitrogenous food (*i.e.* fats and sugar) in milk is about as 4 to 8·8. Such a proportion would be excessive for the adult, and the reason is not far to seek. The infant not only has to carry on the ordinary functions of the body, but has to build up its complex tissues, into the formation of which nitrogenous material largely enters.

Milk alone would form an extravagant dietary for an adult, and the excess of nitrogenous matter in it would be difficult to eliminate from the system. Every class of food is represented in milk. Thus in 100 parts of cow's milk there are 87 parts of water, 5 per cent. of sugar, 3·4 per cent. of casein (nitrogenous or proteid food), 3·8 per cent. of fat, and 0·8 per cent. of salts.

Milk varies in composition in different animals. Thus in every 100 parts by weight there are the following proportions in different species :—

	Water	Sugar (lactose)	Casein and extractives	Fat	Salts
Human . .	86·9	7·0	1·8	4·0	0·3
Cow . . .	87·0	5·0	3·4	3·8	0·8
Goat . . .	86·4	4·1	4·8	4·2	0·5
Ass . . .	89·0	7·1	2·1	1·5	0·3

The milk of the ass is nearest like human milk, and is much more easily digested by infants than cow's milk.

Goat's milk resembles cow's milk in chemical composition, but its casein does not form so stiff a clot, and it is therefore more easily digested. Ass's milk is very valuable for delicate infants; goat's milk for strong infants. By keeping a goat, the freshness and genuineness of the milk supplied to children can be guaranteed. The cost of keeping a goat is comparatively small, as hardly any animal will thrive on so many different foods as the goat, and the country cottager may add to his income by this means. The amount of milk supplied by a goat varies from one to four quarts a day.

Cow's Milk has a specific gravity of 1,032, as compared with water 1,000. This is ascertained by means of a *lactometer*. If allowed to stand in a narrow glass vessel, cream should occupy 10 to 12 parts out of every 100 parts of milk. The cream forms a natural emulsion consisting of minute globules of fat encased in albumen. If the proportion of cream is lower than the above, then the milk has been skimmed.

If the specific gravity is below 1,028, the milk has almost certainly been watered. The examination of milk by means of the lactometer and the estimation of the amount of cream will together enable us to form a good idea of the quality of a given milk, though neither of these is to be trusted alone. As cream is lighter than milk, its abstraction without watering would tend to increase the specific gravity. A low specific gravity, with a low percentage volume of cream, therefore, almost certainly indicates that the milk has been both skimmed and watered.

The chief products obtained from milk are cheese and butter.

Thus milk, *minus* fat of cream, *is called* **buttermilk.**
,, ,, ,, casein and fat, ,, **whey.**

Skim Milk is produced by abstracting the cream from milk. This is now done in large dairies by *centrifugal separators*, the revolutions of which cause the cream to be rapidly separated. Skim milk is highly nutritious; but when sold, as it frequently is in large towns, for *whole* milk, and at the same price as whole milk, it constitutes a serious fraud, as cream is more expensive than milk, and the cream of milk is a very valuable food for children.

Skim milk and potatoes form a very nourishing dish;

and with some dripping added to the potatoes to compensate for the cream which has been removed from the milk, we obtain a complete and yet very inexpensive meal. It is unfortunate that skim milk is not sold in large quantities in towns *as such*, for its food-value is very high.

Diseases from Contaminated Milk.—When any evil has followed the taking of milk it has been generally due either to (1) the mixing of tainted water with milk, or (2) the placing of milk where it could absorb noxious vapours from the air. The first of these is by far the most common; but milk is a very absorptive fluid, and it is important, therefore, to keep it covered over, and in a cool room where there are no decomposing matters, and no effluvia from drains, &c. Typhoid fever has been frequently traced to milk which has been mixed with sewage-polluted water, as, for instance, by washing cans with water contaminated from a cesspool. Scarlet fever has often been spread by the distribution of milk from a dairy where there were cases of scarlet fever. Contamination may also occur (3) from want of cleanliness in the vessels of the dairy. Milk in warm weather undergoes rapid fermentative changes, and during such changes various poisons are developed. Diarrhœa in children is frequently due to such a condition, or to the rapid decomposition of milk in a feeding-bottle which is not kept clean. Infantile diarrhœa is a very common and fatal summer-disease, its chief cause being the entrance of some poison into the infant's food, either from without or by putrefactive changes in the food itself. It has been shown that calves may be infected with tuberculosis (consumption) from the milk of tuberculous cows; and there is reason to think that children may in like manner acquire tubercular disease by drinking milk derived from consumptive cows.

For these reasons it is very desirable that in every house **milk should be boiled before being taken**, this precaution appearing to suffice to prevent infection. The best plan is to adopt the custom which prevails on the Continent, of boiling the milk as soon as it is brought into the house. Most of us would be revolted at the idea of eating raw meat. Milk is as much an animal product as meat; and there is probably greater danger in drinking uncooked milk than in eating raw flesh.

Preservation of Milk.—Everything about milk should be scrupulously clean, as it is very apt to decompose. Milk-pails, basins, jugs, and especially babies' feeding-bottles must be thoroughly scalded before milk is placed in them. Milk keeps much better after having been boiled, and, once the taste for boiled milk is acquired, it is liked as well as uncooked milk. Milk should be kept in covered vessels, in order that the dust of the pantry may not settle on it. Milk-jugs should be of such a shape that they can be thoroughly cleansed.

a *b*

FIG. 11.—*Milk Jugs of*
(a) *Proper shape*, (b) *improper shape.*

For remarks on condensed milk, see p. 82.

Cream, which rises to the top of milk after standing about twelve hours, consists chiefly of minute particles of butter fat. It is a most valuable food, especially for children. In towns there is reason to believe that a large amount of 'separated' or skim milk is sold as whole milk, and thus many children are deprived of an important part of their food.

Devonshire Cream is prepared from milk by allowing it to stand for about twelve hours in a metal pan, and then setting the pan over a slow fire, until its contents are heated to the point of simmering. At this point a scum is produced which *clots* the cream.

Butter forms $3\frac{1}{2}$ to $4\frac{1}{2}$ per cent. of cow's milk. It is separated from milk by churning, the oil particles being deprived by this means of their albuminous coats. The butter, when formed, is well washed and kneaded with water, so as to free it as completely as possible from casein and other constituents of milk. The more completely these are separated the better the butter keeps. It can be kept longer if salt is added, or in hot weather by keeping it under frequently changed water.

Butter, when fresh, is one of the most easily digested forms of fatty food, but if at all rancid it often disagrees. The fat in butter forms about 88 per cent. of its composition. It differs from all other fats in the presence of a special fat called *butyrin*, and can be distinguished by this means from artificial imitations of butter.

Other Fatty Foods.—This is a convenient opportunity for considering other fatty foods which are not derived from milk. They consist of varying proportions of three complex compounds called olein, palmitin, and stearin. Olein and palmitin occur in both the animal and the vegetable kingdom ; stearin is peculiar to animal fats. Stearin is the hardest kind of fat, and, owing to the large quantity of this compound, mutton fat is less digestible than beef fat. The more olein a fat contains the less solid it is. Olive oil consists almost entirely of olein. Cod-liver oil consists chiefly of olein, and is of great value both as a food and a medicine.

The temperature at which a fat becomes solid after cooking is a rough but fair guide to its digestibility. Thus mutton fat sets sooner than beef fat, and both of these sooner than bacon fat.

Margarine is made from beef fat. The fat is melted down, and the stearin (which solidifies at a higher temperature than the olein and margarine) is first separated. The remaining olein and margarine are coloured with annatto, and have some milk or butter incorporated with them, in order to impart some of the flavour of butter to the compound. The resulting compound, commercially known as *margarine* or *butterine*, forms a wholesome and cheap food, and may be recommended as a substitute for butter when economy is desired. It is an infringement of the law, incurring a maximum penalty of £20, to sell it for butter, though this fraud is still often attempted, especially in shops frequented by the poor. There is no certain means of detecting the fraud, except by careful chemical examination. As a rule, margarine has not the delicate aroma possessed by genuine butter.

Lard, the leaf fat of the pig, is used for frying purposes, and for making pastry. *Dripping*, derived from the fat parts of any kind of cooked meat, may be used for the same purposes, if well clarified.

Olive oil is a valuable food derived from the fleshy exterior of the fruit of the olive. It is often adulterated, cotton oil, and other cheap substitutes, being sold under the dubious names of 'lucca oil' or 'salad oil.' Cotton oil is quite wholesome, but commercially of much smaller value than olive oil.

Use of Oils and Fats for Food.—Hydrocarbons or fats form very important foods, being better heat-producers than carbohydrates (starch and sugar). This will be seen from the fact that 100 parts of

Starch	contain	45	parts	of carbon	and	6	parts	of hydrogen.
Sugar	"	43	"	"	"	6	"	"
Fat	"	79	"	"	"	11	"	"

Fat, in a healthy man, forms about one-thirteenth part of his total weight, and is thus a valuable reserve of food. Dr. Mantell tells of a pig which was buried for 160 days in its sty by the falling of a chalk cliff at Dover. At the time of its temporary interment it weighed about 160 lbs., when extricated only 40 lbs. No doubt the moisture in the chalk had helped to keep the pig alive. The camel's hump consists of fat, and forms a reservoir, varying in size with the state of its nutrition. After protracted marches it may almost disappear, the fat having been oxidised to maintain the heat of the body. During exposure to cold the possession of a sufficient layer of subcutaneous fat is an admirable help in keeping warm. *For children, a diet containing a considerable proportion of fat is of prime importance.* Deficiency of cream (contained in pure milk), or of other fatty foods, is one of the chief causes of *rickets*, a disease of children which not only produces great deformity of the bones, but also leads to many fatal diseases. The same cause also favours *consumptive diseases.* Some have even said that the *price of* butter has much to do with the amount of tubercular disease of the lungs (consumption). It is certainly true that those children who cannot take fat meat, &c., are most prone to this disease, and that the best way of treating and of preventing it is to give fat in various forms, including cod-liver oil.

For children who cannot take fat meat the fat may be given in other forms without disagreeing. If the digestion is very weak, butter should be given with the potatoes. In other cases we may put some suet into rice-pudding, or dissolve a little suet in milk by placing it in a warm oven. It should be remembered that fat when finely divided is more easily digested than when in lumps. Witness the difference between swallowing a lump of butter and thin bread-and-butter. Dripping and bread are enjoyed by children who could not have taken the dripping in the original joint. Dripping is a much more nutritious food when taken with bread than golden syrup or jam under the same circumstances.

In addition to the fatty foods named above, there are others among vegetables. Thus in 100 parts of oatmeal there are 5·6 parts of fat; in maize, 5 parts; and in wheat, 1·2 parts of fat.

Butter-milk contains all the constituents of milk except the butter. It is slightly sour to the taste. The casein in it is in a finely coagulated state, thus rendering it more digestible than whole milk. For this reason it is a valuable food for invalids and children, which is undeservedly neglected.

Cheese is prepared from milk by the action of rennet, an extract obtained from the mucous membrane of the fourth stomach of the calf. By its means the casein or nitrogenous part of the milk is converted into curd, which separates from the whey, carrying with it the cream and a large proportion of the salts of milk (especially phosphate of lime). The curd is subsequently pressed in moulds, a certain amount of salt being added. When new, cheese is tough; when old, its oil tends to become rancid; the best age is from nine to twenty months. It is probable that cheese in small amount helps the digestion of other foods, owing to its stimulant properties. Cheese is a very valuable and economical food, containing, weight for weight, twice as much nitrogenous material as meat. Thus a very complete and satisfying meal may be made of bread and cheese.

Being a concentrated food, it is itself rather difficult of digestion, and in considerable quantities is only suited for those leading active out-door lives. When toasted, cheese is proverbially indigestible.

There are many different kinds of cheese, the following being the more important varieties :—

(1) Cream cheese, consisting of the fresh curd only slightly pressed. It is more easily digested than ordinary cheese. It contains a large amount of butter fat. (2) Cheeses made with whole milk to which a certain amount of cream has been added, such as Stilton and double Glo'ster. (3) Cheeses made with unskimmed milk, as Cheshire and Cheddar. (4) Cheeses made of skimmed milk, as Suffolk, Parmesan, and Dutch cheeses. The last-mentioned cheeses keep best, but become hard and dry. The richer fatty cheeses are very prone to decomposition.

Cheese is adulterated, like butter, by the substitution of margarine for the butter fat. This can only be detected by careful chemical analysis.

Whey is the liquid remaining from milk after the cheese has been separated. It contains some soluble albumen and a little fat, together with the sugar and salts of milk. It is a useful drink in febrile diseases and for children who cannot digest whole milk.

CHAPTER X.

VEGETABLE AND MINERAL FOODS.

Cereal Foods.—Leguminous Foods.—Starchy Foods.—Other Vegetable Foods. — Fruits. —Sugar. — Condiments. — Mineral Foods.

With the exception of certain salts and water, our food is derived entirely from animals and vegetables. Some have asserted that a completely vegetable dietary is best, but this point has been already discussed (page 37).

Various parts of plants are used as food. In all kinds of grain it is the seed that is used ; in the turnip and beet it is the root; in the potato, a part of the underground stem called the tuber; in sago, another part of the stem is utilised; in asparagus, the young shoots; in cabbage and lettuce, the leaves; in cauliflower, the flowers; and in tomato and many others, the fruit.

Of all vegetable foods the corn-plants or **cereals** (also called *farinaceous seeds*) are the most important.

CEREAL FOODS.

Cereal foods contain a nitrogenous substance called **gluten**, which is peculiar to them. Gluten is to bread what myosin is to flesh, and casein to milk. If one takes a piece of dough made from wheat flour and holds it under a stream of water from the tap, a large part of it is washed away, while a sticky tenacious mass is left behind. This is gluten, and it is by virtue of the tenacity of gluten that bread can be made. If the fluid with which the dough was washed is collected, it will be found to contain a large quantity of starch (this turns blue on the addition of a few drops of tincture of iodine), and a small quantity of sugar, of albumen, and of certain salts. All cereals possess these constituents in various proportions (with a varying amount of fat). Good wheat-flour contains eight to eleven per cent. of gluten; oatmeal, barley, rice, and maize, very little. The other cereals, with the exception of rye, can only be made into bread when mixed with wheat-flour.

Wheat is the most largely consumed of all the cereal grains. The outer yellowish coat of the grain is known, when separated, as *bran*; the inner white part, as flour. To understand the exact nature of the products of wheat when ground we must examine the structure of the wheat-grain. It is really a fruit, consisting of a seed and its coverings. All the middle part of the grain is occupied by large thin cells (fig. 12, *d*), full of a powdery substance, which is chiefly starch. Outside this central starchy mass is a single row of squarish cells (fig. 12, *c*) filled with a yellowish nitrogenous substance. Beyond this are six thin coverings containing much mineral matter (fig. 12, *a b*). The outermost of these branny coats are very hard, and of no value as food for man.

In the ordinary English process of milling the wheatmeal is produced in one grinding, and then separated into several products. The following classification of the pro-

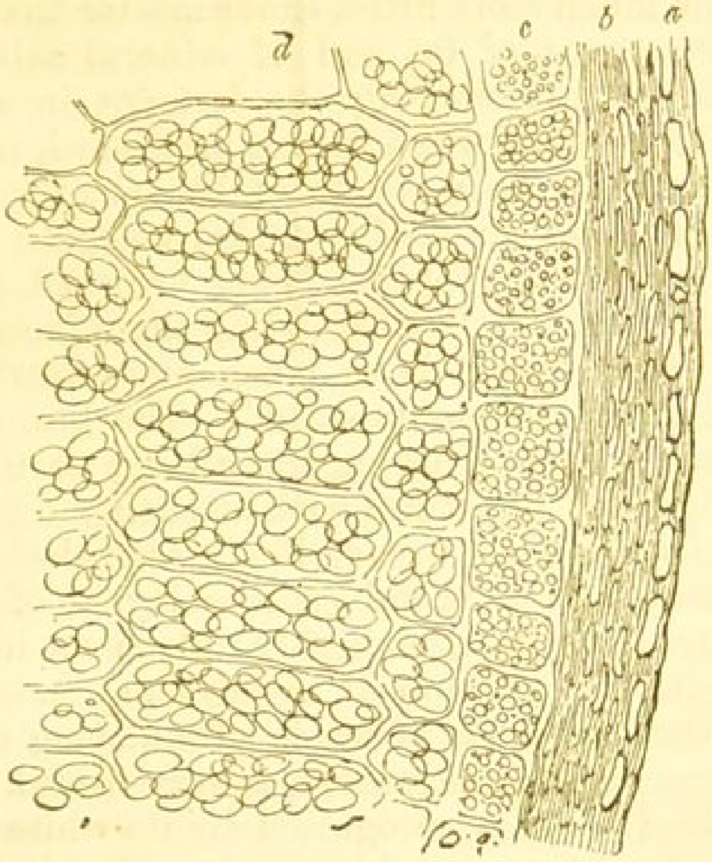

FIG. 12.—*Section of Grain of Wheat*[1] (*magnified* 200 *times*).
(a) *Cells of the bran;* (b) *cells of thin cuticle;* (c) *gluten cells;* (d) *starch cells.*

ducts is given by Church, with the average amount of each product obtained from 100 lbs. of good white wheat :—

		lbs.
Flour	1. Finest Flour	42
	2. Seconds Flour	18
	3. Biscuit Flour	9
	4. Tails or tailings	3
Bran	5. Middlings or fine sharps .	8
	6. Coarse sharps	3
	7. Fine pollard	3
	8. Coarse pollard	6
	9. Long bran	3

Thus about 72 per cent. of flour is obtained, 23 per cent. of bran, 5 per cent. being waste. These results are only approximations, and the names given to the different parts of the grain vary in different mills. The first three pro-

[1] From Landois' *Human Physiology*, 3rd edit., p. 851.

ducts are often sold as 'fine flour.' The middlings or fine sharps form a kind of link between flour and bran. The bran contains much more nitrogenous matter than the flour, also a larger amount of fat and of mineral salts. It also contains a ferment resembling the ferment in saliva, and having a similar effect, when flour is moistened, in changing starch into sugar. This is one of the chief reasons why bread made with brown meal is darker coloured than white bread, the sugar thus formed being browned during the process of cooking. Notwithstanding these facts, it is very doubtful if brown bread is so much more nutritious than white bread as is commonly stated. The branny matters are hard and difficult to digest, and a large portion of them passes through the intestines without being digested. In '*decorticated* whole-meal bread,' it is stated that the two or three outermost and more indigestible layers of bran have been separated, leaving the highly nutritious inner tunic. Even this kind of whole-meal bread sometimes disagrees, though in other cases its effect in stimulating the bowels, and thus preventing constipation, is very useful.

Good wheat flour is recognised by its white colour, by the absence of grittiness, and by the fact that it forms a coherent stringy dough. Under the microscope it should show the absence of any minute parasites, and of foreign starches, such as barley, maize, rice, and potato (these are known by the different shape of their starch-granules). Alum is occasionally added to flour to give a fictitious whiteness to it. Its presence may be detected by adding a fresh solution of logwood to the flour. This becomes permanently purplish blue if alum is present, but the colour soon fades if the flour is pure.

Semolina is a granular preparation of wheat made by a special method of grinding. It is made from hard-wheats containing much gluten. It is used for making puddings and for thickening soups.

Macaroni and **Vermicelli** are also prepared from wheats containing a large proportion of gluten. The dough is passed through moulds, thus forming long tubes.

Barley.—The meal of barley is very nutritious and is largely used for fattening animals. Most of the barley grown in this country is now converted into *malt* for making beer. *Pearl barley* is the grain deprived of husk and rounded and polished by a rasping or paring process. It is used for making barley-water for invalids and for adding to mutton broth, &c. Barley flour does not yield a light bread, but added in small quantity to wheat flour it helps to keep the bread moist and improves its flavour.

Malt consists of barley which has been made to germinate or sprout by means of heat and moisture and then dried in a kiln. During the process of germination a special ferment called 'diastase' is developed which possesses the power of converting starch into sugar on the addition of water. *Extract of Malt* is a treacly fluid obtained from malt. It is very nutritious, and, owing to the presence of diastase in it, helps in the digestion of other starchy foods. It is a valuable medicine (as well as a food) for patients with impaired digestion or debility.

Oatmeal is richer in nitrogenous, fatty, and mineral matters than any of the other cereals. It thus forms a highly nutritious food, and is particularly valuable for growing children. Scotch oatmeal is the best and richest, and, as porridge and oatmeal cake, it is very popular in the North. Like barley, oatmeal is apt to have a laxative effect, and in some persons it causes indigestion.

Groats is the grain freed from all husk ; when crushed it forms 'Embden groats,' used for making gruel.

Rye is rarely used in this country for making bread. In Russia and Germany it is made into 'black bread,' but its colour and sourish taste make it disagreeable, and it is laxative in its action. It is also liable to be attacked by a parasitic fungus (the ergot of rye), and if eaten in this condition produces a serious form of poisoning.

Maize or Indian Corn is very deficient in gluten, but, like oatmeal, contains a large amount of fat. It is now largely cultivated in Southern Europe, as well as in its native America, but it cannot be relied upon as a field-crop in England. In America the grains are cooked in the green and succulent state as a vegetable, like green peas. *Hominy* is a preparation of maize and contains all its nutriment. *Oswego flour* and *corn flour* are much less nourishing derivatives of maize, as they consist almost solely of starch. When taken with milk, however, they form light and nourishing dishes. Maize is largely used in America for making cakes. It is also used for horse-keep and for fattening poultry and other animals. On account of the large amount of fat contained in maize, it is apt, if kept long, to acquire an unpleasant rancid taste.

Rice is a native of India, though it is cultivated with success in Southern Europe. It is said to be the main food of one-third of the human race, and there is some truth in the statement that 'rice has ruined Bengal as the potato has ruined Ireland.' This is because too much dependence is placed upon the one crop; as if this fails the natives have nothing to fall back upon. There is a further analogy, as both the potato and rice consist chiefly of starch and contain very little nitrogenous matter or fat. They can both be usefully employed as food in combination with substances like meat, eggs, fat bacon, or peas, which supply the deficient proteid and fat.

The following table given by Parkes is useful for comparing the relative richness of the different cereals in their most important constituents, the richest being placed first:—

Nitrogenous Substances	Fat	Starch, &c.	Salts
Wheat	{ Maize	Rice	Barley
Barley	{ Oats	Maize	Oats
Rye	Barley	Wheat	Wheat
Oats	Rye	Rye	Rye
Maize	Wheat	Oats	Maize
Rice	Rice	Barley	Rice

LEGUMINOUS FOODS.

Vegetables which have their seeds enclosed in a pod are called leguminous plants. The chief seeds of this group are peas, beans, and lentils, which are known as **pulse**. They all contain a nitrogenous substance called *legumin*, which resembles the casein of milk in chemical composition, and has been called *vegetable casein*. In some parts of China cheeses are made from the seeds of peas and beans. Judged by the percentage amount of nitrogenous materials they contain, leguminous foods are of high value. Thus while in wheat-flour there is about 11 per cent., in meat 15 per cent., and in cheese over 30 per cent. of nitrogenous material, dried peas and beans contain about 22 per cent. of nitrogenous material. Chemical composition alone is not, however, a certain guide in matters of diet. The relative digestibility of various foods must also be taken into the reckoning. In this respect leguminous foods, unless very thoroughly cooked, are far behind the other foods just enumerated, with the possible exception of cheese. Their richness in nitrogenous substances makes leguminous foods the best substitute for animal food; and, even though it may not be desirable to substitute them permanently for meat, they may with advantage be given as a frequent change from meat. Combined with rice, leguminous plants form the staple food of many Indian races. To make this dietary completely satisfactory, some fatty food must be added. Beans and bacon form a most nutritious mixture.

Several varieties of **Beans** are used as food. The common horse-bean is grown in fields; the Windsor or broad bean in gardens. The haricot or French bean and the scarlet runner are both used when fresh as green vegetables, the seeds and pods being cooked together. *Haricot beans*, when dried, are largely consumed on the Continent, and, if carefully and thoroughly cooked, deserve to be much more extensively used in England. *Broad beans*, when young, form a wholesome food. They should not be too mature when eaten. They should be eaten before the point of attachment to the pod becomes dark coloured and while the skin bursts by boiling them. Under these conditions, with melted butter, they form a digestible and satisfying dinner.

Of **Peas** there are several varieties. The common field-pea is grown as food for cattle; the garden-pea is eaten both as a fresh vegetable, and ripe in the form of dried peas, split peas, and pea meal. Split peas have had the tough envelope of the seed removed.

Green peas contain a considerable amount of sugar, and their nitrogenous matter is much more digestible than that of dried peas. Dry ripe peas require long but slow cooking to render them fit for use. Like the other leguminous fruits, they are apt to cause flatulence and colicky indigestion. They contain sulphur, which is liberated as sulphuretted hydrogen in the intestines.

Lentils have of late years become a much more popular food in England. They are now largely imported from Egypt, as well as from the southern parts of Europe. They are, perhaps, the most nutritious of leguminous foods, and possess the additional advantage that the ash is very rich in iron, a most important element in our food. There is reason to think that the red blood corpuscles owe their power of conveying oxygen to the various tissues to the iron which they contain. Lentils contain little or no sulphur, and thus do not give rise to the unpleasant flatulence which follows the taking of peas and beans, especially the former. Lentil flour will undoubtedly take the place more and more of pea-flour for soups. *Revalenta arabica* is a patent food, consisting chiefly of lentil flour with barley flour or cornflour. It is sold at many times the value of the meals of which it is composed.

STARCHY FOODS.

All the preceding cereals and leguminous foods contain a large proportion of starch. The following gives approximately the percentage amount in some of the commonest foods :—

Wheat	66	Rice	79
Wheat bread	47	Peas	55
Barley flour	69	Potatoes	19
Oatmeal	58	Parsnips	9
Maize meal	65	Carrots	8
Rye meal	69	Turnips	5
Arrowroot	72		

The smallness of the percentage in potatoes is due to the large amount of water in their composition.

Some foods consist almost entirely of starch, the chief of these being sago, tapioca, and arrowroot. In all these plants starch occurs in minute *granules,* which are packed within the cells of the plant. Fig. 13 shows the starch granules of the potato very highly magnified. They vary in shape in different plants, and by microscopical examination the source of a given starch can thus be often detected. Starch is a useful and nutritious food, though not so valuable as fats. In order to enter the circulation it must be first dissolved. This is effected by means of the *ptyalin* of saliva and a similar pancreatic ferment, the starch being converted into a kind of sugar.

Dextrin has the same composition as starch, but is,

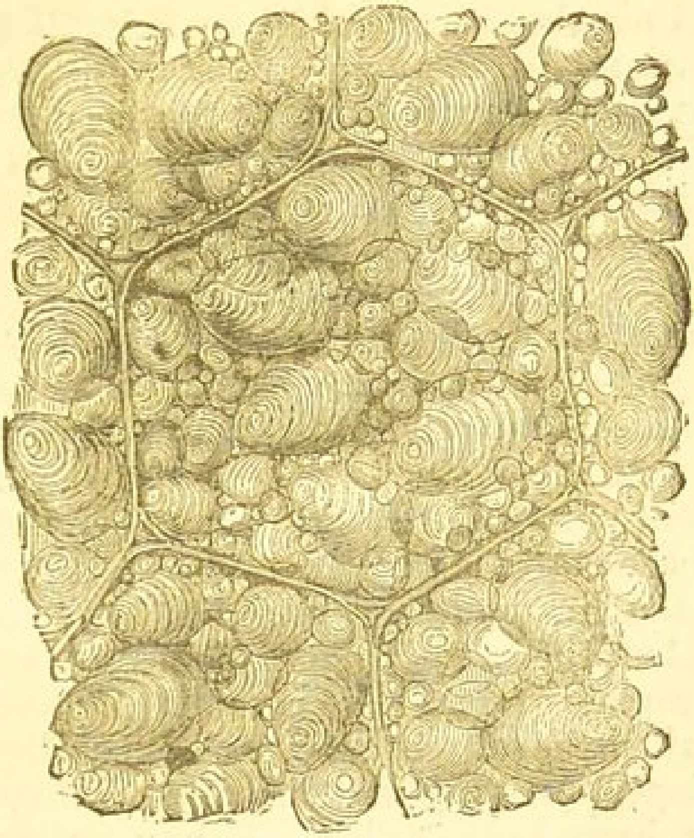

FIG. 13.—*Cells of Potatoes, showing Starch Granules, highly magnified.*

unlike the latter, soluble in cold water. It is made from starch by the action of heat or a dilute acid. It is then known as *British gum*, and as such is used for postage stamps. During digestion starch becomes dextrin before it is finally changed into sugar.

Sago is obtained from the pith of the stem of various species of palm ; a single tree may yield several hundred pounds. It is used for thickening soups and for making milk puddings. Boiled with milk, it forms a light, nutritious, and non-irritating food. Fictitious sagos are frequently made from potato and other starches.

Tapioca is obtained from the tuberous roots of the *Manihot utilissima*, cultivated in Africa, India, and other hot countries. The juice of the root contains prussic acid, which is separated by washing the grated roots, and allowing the starch granules to settle. It forms a useful addition to meat, soups, and broths, and makes nutritious puddings with milk. Tapioca is more soluble than sago, and so requires less time for cooking.

Arrowroot is derived from the tuber of the *Maranta arundinacea*, a native of the West Indies. It is easily digested, and non-irritating, and very suitable for invalids.

Cornflour and *oswego-flour* are starchy foods, already mentioned as being derived from Indian corn.

OTHER VEGETABLE FOODS.

The **potato**, from the tuber of the potato-plant, is a most useful food. Formerly scurvy was very prevalent and fatal in this country, and there is little doubt but that its present extreme rarity is due to the almost universal consumption of potatoes. It contains 26 solid parts in 100, of which 19 are starch and 2½ nitrogenous matter. Alone it contains too little nitrogenous and fatty materials to support life, but the addition of butter-milk and dripping make it a complete and nutritious food. Potatoes are most wholesome when the starch granules are healthy, as shown by the envelopes bursting and forming a floury mass after the potatoes have been boiled. Young potatoes contain immature cells, and are much less digestible and nutritious. Potatoes which have been frozen, or from any other cause have become waxy and watery, are unwholesome. Potatoes grown on a light dry soil are more mealy than those grown on a damp soil. They are easily cultivated by country cottagers, and form an admirable store-food for winter use.

Potatoes should not be boiled unless in their skins, as the salts they contain become dissolved in the water and thus lost. They are best steamed.

The **turnip** belongs to the cabbage tribe. Its nutritive value is small, but it introduces an agreeable variety into our food, and, like all fresh vegetable foods, is an admirable anti-scorbutic (preventive of scurvy). The **carrot**, like the turnip, contains no starch, and is used, like it, for soups and as a vegetable. The **parsnip** contains sugar, like the turnip and carrot, and some starch in addition.

Beetroot is extensively cultivated as food for cattle and for the extraction of sugar. It is largely used also in salads, and is a very useful food.

The **radish** somewhat resembles the turnip in composition, but is more pungent, and is rather apt to disagree, unless eaten young and fresh.

The **onion, garlic, leek,** and **shalot,** all members of the lily family, are used chiefly as condiments to improve the flavour of other foods. They contain an acrid volatile oil, which gives them their peculiar odour and flavour. By long boiling this is dissipated (as in the case of the Spanish onion), and the onion is then fairly digestible and nutritious.

Celery is formed of the leaf-stalks of the celery plant, bleached by being grown underground. It possesses a delicate flavour, due to an essential oil. It is eaten both raw and cooked ; in the latter form it is wholesome and digestible.

Only three **fungi** are, in this country, commonly regarded as safe—mushrooms, morels, and truffles ; but there are many others which, if their characters were but known, form nutritious and delicate foods. The difficulty lies in distinguishing the poisonous from the non-poisonous forms. Any fungus possessing an astringent taste and a disagreeable pungent odour should be avoided. In any doubtful case it is better to abstain. Mushrooms may be stewed, broiled, or pickled. They are also used for making ketchup, an agreeable sauce.

Green Vegetables contain comparatively little nutriment, but are none the less of great importance for the maintenance of health. Their main constituent is *cellulose,* which passes through the alimentary canal unchanged. Cellulose has the same percentage composition as starch, but except in the very young state cannot be digested by man, while starch can. Chemical composition alone is, therefore, not a certain test of the relative value of the food-materials. But although cellulose is not digested, it forms a useful stimulant to the alimentary canal, and thus tends to prevent constipation. *It is necessary for health that a certain amount of indigestible material should be taken as food,* and green vegetables are the best form in which to take this, inasmuch as they contain saline material which has valuable antiscorbutic properties. Concentrated nourishment can only be digested in a limited quantity ; every kind of natural food is bulky, thus giving the alimentary canal more mass to act upon.

Cabbage contains 92 per cent. of water and $2\frac{1}{2}$ per cent. of nitrogenous matter. Most of these green vegetables contain a considerable amount of sulphur, which sometimes causes flatulence.

Rhubarb and *sorrel* contain oxalates and tartrates of potash and lime, to which they owe their tartness. *Spinach* is cooling and laxative, like rhubarb, but not tart. *Sea-kale* and *asparagus* are wholesome and delicate vegetables. *Salads*, containing mustard and cress, watercress, endive, and the garden-lettuce, are very useful as anti-scorbutics.

FRUITS.

A great variety of fruits are consumed as articles of food, both in the fresh and dried state. The following are the chief varieties :—

1. The cucumber, vegetable marrow, melon.
2. The apple, pear, quince, pine-apple.
3. The orange, lemon, lime, and shaddock.
4. Stone fruits, as the plum, peach, apricot, cherry, olive, date.
5. The grape, gooseberry, currant, cranberry.
6. The strawberry, raspberry, blackberry, mulberry.
7. Nuts, as walnuts, filberts, almonds, chestnuts.

The grains of cereal plants are also fruits, but they have been fully considered.

The first six classes of fruits agree in the small amount of nitrogenous material which they contain, and the large proportion of water. Their chief food-value is due to the sugar which they contain. Thus the apple contains about 43 per cent. of sugar ; the cherry, 31 per cent. ; the raisin, 54 per cent., and the fig, 50 per cent. They also contain important vegetable salts (citrates, tartrates, malates), as well as some free vegetable acid, to which, and to certain essential oils and ethers, their agreeable taste is due. Malic acid is found in pears, apples, gooseberries, and currants ; tartaric acid in grapes ; citric acid in lemons, oranges, &c. They are more valuable as anti-scorbutics than as foods. They are cooling and refreshing, and tend to prevent constipation.

Cucumber and *vegetable marrow* are taken rather as vegetables than as fruits. Vegetable marrow is wholesome and agreeable, but not very nutritive. The rind of cucumber is very indigestible. In order not to produce indigestion, cucumber should be freshly cut and not pickled.

The *melon* is perhaps the most watery of the fruits, as it contains more than 95 per cent. of water. The *tomato* is largely used for salads, and for the preparation of soups and sauces. It is a refreshing and wholesome fruit.

The *apple*, *pear*, and *quince* are more digestible when cooked, and, speaking generally, all fruit not perfectly ripe should be cooked before eating. The presence of vegetable acids in fruit soon converts the cane-sugar used for sweetening into dextrose—a less sweet variety of sugar. It is, therefore, more economical to sweeten after than before cooking.

The *orange* is very valuable for allaying thirst. The peel is used as candied peel and also in orange marmalade. The *lemon* and its allies, the lime and shaddock, yield a useful anti-scorbutic juice, and give pungency and flavour to insipid foods.

Stone-fruits are unfit for food in the unripe state. When completely ripe the acids and astringent matter largely disappear. Dried plums (prunes) form a useful addition to the dietary. The *date* contains more than half its weight of sugar, and forms an important food in the East.

The *grape* is a very important fruit, on account of its richness in sugar, both in the fresh and dried form. Raisins are dried grapes, and the dried currants of the shops are very small raisins from a variety of the grape grown in the Ionian Isles.

The *gooseberry* is a wholesome fruit, especially when cooked, and makes a good preserve. The other berries in this group and of the strawberry group are useful varieties of food.

Figs contain about 50 per cent. of sugar. They are a useful food, especially when constipation exists.

The *chestnut* is very rich in starch, and contains little oil or fat. It is extensively used as a food in Italy and other countries, but it requires to be cooked to be digestible. Nearly all the other nuts contain a considerable amount of oil, sometimes as much as 50 per cent. They are, therefore, very rich foods, and, unless well masticated, are apt to disagree.

The *walnut* in the unripe state, when the shell is still soft, makes an excellent pickle. The kernel contains about 32 per cent. of an oil which is much used for food in Southern Europe.

The *hazel-nut*, the *filbert*, and the *cobnut* are produced by different varieties of one tree. The best hazel-nuts come from Spain (Barcelona nuts). Cobnuts and filberts are largely grown in Kent.

The *sweet almond*, when eaten unbleached, is apt to cause nettle-rash. The brown coat of the kernels should be removed by pouring boiling water over them and then peeling. The bitter almond, produced from a variety of the same tree, contains a peculiar principle called amygdalin, which, on the addition of water, breaks up into oil of bitter almonds and prussic acid. Oil of bitter almonds is sometimes used as a flavouring agent in cooking; it is very poisonous, and should not be employed for this purpose. A chemical compound called *nitro-benzol* is now commonly employed in its stead, which, although poisonous, is not so to the same dangerous extent as the essential oil of bitter almonds.

The white kernel of the *cocoa-nut* is rich in oil, which is expressed and used for many purposes. The spirit called 'arrack' is distilled from the fermented juice. The outer husk of the nut affords a strong fibre, from which mats, brushes, and cordage are made.

SUGAR.

Sugar is very like starch in composition, but is distinguished by its sweetness, and by the fact that it dissolves in cold water. Sugar being soluble in water, unlike starch, does not require any previous digestion, but the different varieties of sugar all become glucose before they are absorbed into the circulation. Sugar is a useful food, but in excess is apt to give rise to acidity and flatulence. *Cane-sugar*, or *sucrose*, is the best-known sort of sugar. Much of the sucrose now consumed in England is derived from the sugar-beet, though the oldest and best-known source of sugar is the sugar-cane, long cultivated in tropical and sub-tropical climates. The juice is expressed from the canes, and then clarified and boiled down. The first product is 'raw' or 'brown sugar, leaving molasses. By re-dissolving the raw sugar, purifying it by the aid of lime and charcoal, and re-crystallising, the purer and drier crystalline sugars are obtained. In these refining processes treacle and golden syrup are obtained, which contain about 65 per cent. of uncrystallisable sugar. Sugar candy is the purest form of sugar, white loaf-sugar comes next; after these the pale large-grained crystallised sugars, moist sugars being of inferior quality and sometimes infested by a small insect, the sugar-mite.

Many other grasses, besides the sugar-cane, yield large amounts of sugar. It is also derived from the sugar-maple, and from many kinds of palms.

Grape-sugar, or glucose, is found elsewhere than in the grape, just as cane-sugar occurs in many plants besides the sugar-cane. It may also be made from starch, dextrin, and cane-sugar by the action of weak acids; and starch and cane-sugar become converted into it before they enter the circulation. Cellulose, the compound which forms the main substance of paper, cotton, linen, and the structure of woods, can be changed into grape-sugar by the action of sulphuric acid.

Grape-sugar exists in three varieties. Two of these, *dextrose* and *lævulose*, form the main bulk of honey; the third, *maltose*, occurs in malt.

Milk-sugar, or lactose, occurs in milk. It is less soluble, and therefore less sweet, than the preceding sugars.

CONDIMENTS.

Condiments are taken with the object of improving the flavour of food, or of assisting its digestion. They are, in most cases, not foods themselves. *Taste* is usually a compound sensation, being shared by the nerves of taste (in the tongue) and of smell (in the nose). The flavour of meats is nearly entirely appreciated by the sense of smell. This is shown by their insipidity during a 'cold in the head.'

Excitation of the nerves of taste and smell results in the conveyance of a stimulus to the central system, which causes, by reflex action, an increased flow of the digestive juices. Such substances as cayenne and ginger also have a direct irritant effect on the mucous membrane, and are injurious in most cases. They are specially injurious for children, who should, as a rule, avoid every condiment except salt.

In the wide sense in which the term is here employed condiments include condiments proper, spices, flavouring agents, and acidulous substances.

(1) **Condiments** proper comprise mustard, pepper, cayenne, mint, capers, onions, morels, mushrooms, and truffles. The last five of these are also foods, but are more commonly used as condiments. *Mustard* is obtained from the seeds of the mustard plant, an English annual. Mustard is best prepared for the table by beating it up for several minutes with cold water, in order fully to liberate its essential oil. Mustard commonly has wheat-flour added to it, and there is no objection to this if it is sold as a mixture. *Pepper* is obtained from the seeds of an East Indian plant. Black pepper is prepared from the berries before they are ripe, white pepper from the ripe berries.

(2) **Spices** comprise cinnamon, cloves, ginger, and curry-powder and some others.

(3) **Flavouring Agents**, as vanilla, lemon-peel, oil of bitter almonds, are used to give a pleasant flavour to various dishes. The last-named is very poisonous.

(4) **Acidulous Substances**, of which vinegar and lemon-juice are the most important. *Vinegar* in small quantities is not unwholesome. With salads it is very valuable; also for pickling fish, &c., in warm weather. The best vinegar is made from wine, ordinary vinegar from malt or beer. *Lemon-juice* is very valuable for its refreshing qualities, and is also useful as an anti-scorbutic.

Oils, such as salad-oil, are rather foods than condiments, and the same may be said of **Common Salt.**

MINERAL FOODS.

Salts, and especially common salt (chloride of sodium), are necessary for the maintenance of health. *Chloride of sodium* is necessary for the formation of the hydrochloric acid in gastric juice, and for the supply of sodium in the salts of bile. Half the weight of the ash of blood consists of it, and it is found in every fluid and tissue of the body. Over 200 grains are excreted daily, chiefly in the urine. In the feeding of cattle it is well known that the addition of common salt to their food greatly improves their condition. It is obtained as rock salt from beds of salt deposited in some rock formations; also by evaporation of the water of brine-springs, as at Droitwich, Nantwich, &c., or salt-lakes, or sea-water. In Norway it is prepared by repeatedly freezing sea-water, the ice which is removed containing little or no salt.

Potassium salts are contained in milk, muscle, and blood corpuscles, as well as in other parts of the body. They are obtained from bread, milk, meat, fresh vegetables, and fruit. *Calcium* salts, especially calcium sulphate, form the earthy part of bone. Calcium phosphate is the most abundant salt in the body, as more than one-half the weight of our bones consists of this salt, with a smaller amount of calcium carbonate. Calcium salts are contained in most foods, and especially in milk, and its derivative, cheese. Liebig's beef extract contains the salts of meat, and among these a considerable amount of phosphates and a trace of iron. *Iron* in small quantities forms an essential part of the red blood-corpuscles, and is contained in minute proportions in nearly all our foods. *Magnesium* salts are also contained in foods and in the body.

Most of these salts are taken in other foods, the only exception being chloride of sodium. Certain salts contained in fresh fruits and vegetables (tartrates, citrates and acetates of potassium and sodium) become converted into carbonates in the body, and keep up the alkaline condition of the blood. These vegetable salts are essential to health, *scurvy* occurring when they are deficient or absent.

Adulterations of Foods.—For adulterations of milk, see page 47; of butter, page 50; of cheese, page 53; of flour, page 56; of sago, page 61; of coffee, page 73; of wines, page 76; of brandy, page 76.

CHAPTER XI.

BEVERAGES.

Water.—Aerated Water.—Tea, Coffee, and Cocoa.—Fermented Drinks.—Effects of Alcohol.—Useful Beverages during Hard Work.

Water forms the basis of all beverages, and is in itself a valuable food. It has been estimated that a man requires nearly half-an-ounce (*i.e.* a tablespoonful) of water for every pound weight of his body. Thus a man weighing 150 lbs. would require $3\frac{3}{4}$ pints of water, of which about one-third is taken in solid food, the remaining $2\frac{1}{2}$ pints being required as drink.

About two-thirds of the body-weight consists of water, and four-fifths of the blood. Water forms a large percentage of the composition of solid foods, as shown in the following instances:—

	Per cent. of Water.		Per cent. of Water.
Milk	$87\frac{1}{2}$	Peas	13
Fish	78	Potatoes	74
Lean uncooked meat	72	Cabbage	92
Lean cooked meat	54	Hen's eggs	70
Flour	12	Butter	6 to 12
Bread	38		

(*a*) Without water the food cannot become dissolved and gain entrance into the blood. The water thus dissolving the food comes from the blood in the form of the digestive secretions (saliva, gastric juice, pancreatic juice, &c.), and copious drinks during meals only hinder the process of digestion by checking the flow of the digestive juices and diluting those already secreted. (*b*) The water in the blood serves to carry nutrient materials to all the tissues; and by its circulation all over the system, equalises the bodily temperature, favours chemical changes, and moistens all the tissues. (*c*) By water, the effete matters which have been separated by the kidneys are washed out of its tubes.

For healthy persons, water is the best of all beverages;

and it is well known that starvation can be endured for a much longer period if water is supplied. All other beverages necessarily contain water as their basis.

Aerated Water.—*Soda-water* and *Potash-water* are prepared by dissolving small quantities of bicarbonate of soda or potash in water, and passing carbonic-acid gas into the water under pressure. Ordinary soda-water contains little or no bicarbonate of soda.

The carbonic acid in solution makes the water sharp and sparkling, and is a useful sedative to the stomach when indigestion exists.

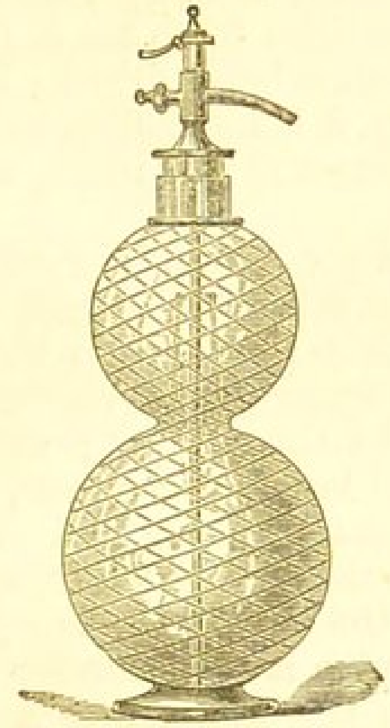

FIG. 14.—*Gazogene.*

Lemonade is generally made with weak sulphuric acid sweetened, flavoured with oil of lemons, and impregnated with carbonic-acid gas. It is more wholesome if made entirely from lemons and sugar, and mixed, just before drinking, with carbonic-acid water from a gazogene. *Apollinaris* and seltzer-water contain chiefly a little common salt and carbonate of soda, the water being charged with gas.

Non-Alcoholic Stimulant Beverages.—Tea is the leaf of an evergreen shrub grown in China, Ceylon, &c. The parts extracted by pouring boiling water over it are (1) a volatile oil, (2) an alkaloid called theine, and (3) tannin.

The *volatile oil* is more abundant in green than in black tea, and may cause headache and sleeplessness. *Theine* is the principle to which tea owes its wonderful restorative properties. It is an alkaloid allied to quinine in composition. It may amount to 3 or 4 per cent. in tea. The exact *rationale* of the operation of theine is not well understood, but it probably acts chiefly on the nervous system. It was formerly supposed that the waste or oxidation changes in the body were reduced by it, but this has been disproved. Tea contains 15 to 20 per cent. of tannin, and a large proportion is extracted by boiling water. Tannin is a powerful astringent, and tends to disorder digestion and cause constipation when taken in large quantities. It is extracted in much larger quantities when tea is allowed to 'brew' a considerable time before being drunk ; but as tannin is very soluble in hot water, it is impossible to avoid the extraction of a considerable amount of tannin, even by the shortest infusion.

In *making* tea a pot should be used which is quite dry in order to avoid mustiness ; a small quantity of boiling water should be first poured into the pot and then out again, so that the water poured on the tea-leaves may not be cooled down in heating the pot ; water actually boiling should be used ; and last, but not least, the tea should never be infused longer than five minutes. Longer infusion extracts too much of the soluble matters, and thus veils the delicate flavour of the beverage. For persons with a weak digestion, the best plan is to infuse for three minutes, then pour the tea, *minus* the leaves, into a second heated teapot, so as to prevent any further solution of tannin.

Soft water extracts more of the tea than hard water. If the water is hard, it should be boiled for ten minutes with a little carbonate of soda before making the tea.

Tea acts as a stimulant, removes fatigue, and promotes intellectual activity. The warmth of the infusion helps its stimulant action. It will often remove headache. Taken in excess it is apt to produce indigestion and palpitation of the heart, and in some cases sleeplessness. It retards digestion both in the mouth and stomach, chiefly owing to the tannin in it. 'High teas' and 'tea-dinners' are objectionable. Tea should not be made a hearty meal, except by those who have strong digestive powers. The practice of alternately eating solid food and sipping tea is very prejudicial to health, and children should not be allowed to acquire the habit. Children are better without tea, milk-and-water being a much more suitable beverage.

Coffee is prepared by roasting the seeds of the berry of the *Coffea arabica*. A powerful aromatic oil is developed during the process of roasting. In addition to this, coffee contains about $\frac{3}{4}$ to 1 per cent. of *caffeine*, which is practically identical in composition with theine, and possesses the same restorative properties. Boiling water poured on coffee dissolves a larger proportion of its constituents than the corresponding infusion of tea. For this reason, and owing to the fact that more coffee is generally used than tea in making the same amount of the two beverages, coffee is

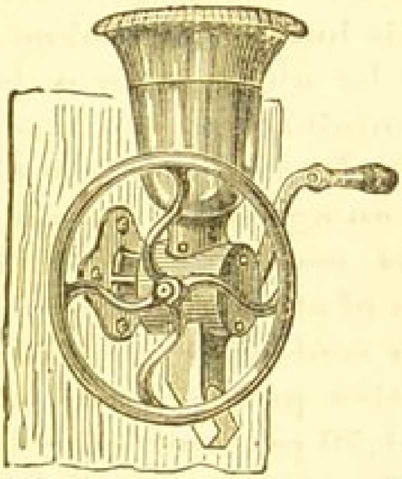

FIG. 15.—*Coffee-mill.*

more powerfully restorative than tea. Coffee has not the constipating effects of tea.

Coffee is largely adulterated with *chicory*, prepared from the root of the wild endive. As chicory is much cheaper than coffee, the most economical plan is to buy pure coffee, and add the chicory on one's own account. If coffee is bought as a mixture of coffee and chicory, the buyer has no check on the amount of chicory which the mixture may contain. Pure coffee sprinkled on the surface of a tumbler of water sinks slowly and hardly colours the water; chicory, similarly sprinkled, rapidly sinks and colours the water deeply. Chicory has not the aromatic smell nor the restorative properties possessed by coffee.

The beverage, coffee, is made, like tea, by pouring boiling water on the coffee, not by boiling the mixture. The coffee ought, if possible, to be freshly roasted, and should preferably be ground immediately before use. A coffee-pot arranged as a 'percolator' in which the clear infusion passes through into a lower receptacle, is very convenient. Coffee has stimulating effects like those of tea, but is a more powerful antidote in cases of poisoning by opium or alcohol. When taken with an equal quantity of hot milk it forms a valuable food as well as a stimulant.

Cocoa is obtained from the seeds of the *Theobroma Cacao.* It is grown in the West Indies, Mexico, and Central America. Its name, Theobroma, was given it by the naturalist Linnæus, and means 'the food of gods.' The fruit contains from twenty-five to thirty seeds, each about the size of an almond. *Cocoa-nibs* are the seeds roasted and deprived of their husks and broken to pieces. *Cocoa* is generally prepared by abstracting a large proportion of the natural fat contained in the seeds and substituting starch or sugar. As the seeds contain about 50 per cent. of this fat (which has an agreeable flavour and does not turn rancid), few people could digest whole cocoa, and the partial substitution of starch or sugar is justifiable. Cocoa contains about 2 per cent. of an alkaloid, *theobromine,* which has similar restorative properties to those of theine. It also contains about 20 per cent. of starch, and therefore, unlike tea and coffee, requires well boiling with milk or water to make a digestible beverage.

The purest form of cocoa is the *nibs.* When these are boiled in water, a brownish decoction is formed, with the fat as a scum on the top. If the scum is removed, a beverage very suitable for invalids with weak digestion is obtained. When starchy substances have been added to cocoa, to take the place of some of the fat (as shown by the fact that the beverage becomes thick on standing), the beverage requires boiling; if sugar only has been used, it can be prepared by the simple addition of boiling milk or water. The shells or husks possess the stimulant properties of cocoa, and may be boiled with water, thus forming a cheap restorative beverage. *Chocolate* is a preparation of cocoa in which sugar has been substituted for the fat and vanilla flavouring added.

FERMENTED DRINKS.

All fermented drinks agree in the one point that they contain alcohol. *Alcohol is produced by a process of fermentation from sugar*, the active agent in causing fermentation being a fungus contained in yeast and, in smaller quantities, floating about in the air. For this reason preserved fruits, and in fact any solution or moist substance containing sugar, will ferment if left exposed to the air.

The chief change in alcoholic fermentation is that grape-sugar is split up into alcohol and carbonic acid :—

$$C_6H_{12}O_6 = \begin{matrix} C_2H_6O \\ C_2H_6O \end{matrix} + \begin{matrix} CO_2 \\ CO_2 \end{matrix}$$

(One molecule of grape-sugar)	(Two molecules of alcohol)	(Two molecules of carbonic acid)

The process of fermentation may be watched in a flask containing a solution of sugar to which brewer's yeast has been added. Carbonic-acid gas is gradually evolved, which can be collected under a glass tube as shown in fig. 16.

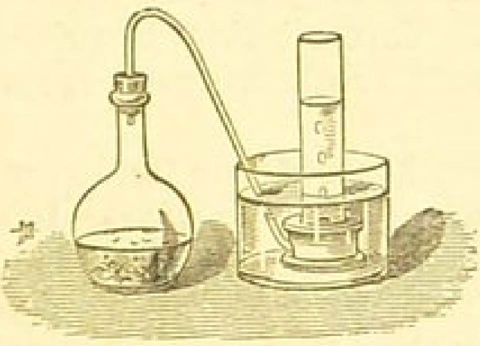

FIG. 16.—*Apparatus for watching Alcoholic Fermentation.*

That the gas evolved is carbonic acid may be shown by the facts that a lighted candle is extinguished in it and lime-water is turned milky by it.

Pure alcohol can only be prepared by repeated distillation of fermented liquids by special methods, so as to free the distillate which comes over from water. *Proof spirit* consists of about equal parts of water and alcohol. An impure form of alcohol, called methylated spirit, is used in the spirit-lamp.

Alcohol, when burnt, produces carbonic acid and water.

The fermented drinks containing alcohol may be classed as (1) malt liquors, (2) wines, (3) distilled spirits.

Beers, Ales, and Porters are prepared by the fermentation of malt, which is the germinating grain of barley, the hop-plant being added for its bitter tonic properties. The amount of alcohol in them varies from $1\frac{1}{2}$ per cent. in small beer to $8\frac{1}{2}$ in Burton ale.

Beer has a tendency to produce stoutness, and its continued use is often followed by gout. Those who indulge largely in beer, even though stout and strong in appearance, are decidedly unhealthy.

Wines are produced by the fermentation of the juice of the grape. Effervescent wines are bottled before fermentation is complete, carbonic acid gas being thus imprisoned. The stronger wines, as port and sherry, contain from 10 to 15 per cent. of alcohol. The presence of 14 per cent. of alcohol in a saccharine solution prevents further fermentation; so any wine containing more than this amount of alcohol must have had brandy added to it. This brandy is commonly of an impure kind, having been prepared from potatoes, and contains a higher alcohol known as amylic alcohol or fusel oil. The 'bouquet' of wines is chiefly due to volatile ethers. Tartaric acid is present in most wines. Some wines, as port, are astringent from the presence of tannin.

Wine, like beer, has a strong tendency to produce gout, especially the sweet and strong wines. It has not, however, the same tendency to produce corpulence.

Spirits differ from wine and beer, to begin with, in the amount of alcohol they contain. Thus, ales contain from 1 to 10 per cent., wines from 8 to 20, and all kinds of spirits from 40 to 58 per cent. Spirits are all prepared by the distillation of some previously fermented liquor. *Brandy* ought to be made by the distillation of wine, but a large amount of what is sold as brandy is really potato spirit. *Whisky* and *gin* are obtained from the wort of malt. When new they contain some fusel oil (amylic alcohol) in addition to the pure spirit (ethylic alcohol). Fusel oil produces more rapid intoxication and more headache than ordinary alcohol. The amount of fusel oil is always very small, and it is a mistake to suppose that the injurious effects often caused by whisky and other spirits are due to fusel oil, and not (as they really are) to the ethylic alcohol which they contain. Gin is flavoured with juniper berries. *Rum* is obtained by the distillation of fermented molasses.

Effects of Moderate Doses of Alcohol.—We may assume that a certain amount of alcohol is capable of being oxidised in the system without appearing in the urine or breath. The most trustworthy experiments place this amount at $1\frac{1}{2}$ ozs. of absolute alcohol, or slightly less than this. This would be equivalent to $1\frac{1}{2}$ pints of beer containing 5 per cent. of alcohol, and to about 6 tablespoonfuls of spirits.

This amount taken at intervals with food increases the flow of blood to the *stomach and liver.* It increases the force and rapidity of the *heart's action*, and causes a rapid dilatation of all the small blood-vessels, especially those of the skin. Consequently more blood is exposed in the capillaries of the skin, and as a result a slight *lowering of the body temperature* occurs, and the power of resistance to extreme cold is diminished. Even in small doses the effect on the *muscles* is not beneficial, and it is the reverse of helpful when muscular work is required. The same applies to the *nervous system.* The acuteness of all the senses is diminished ; and, though the rapidity of thought appears to be at first increased, most mental workers agree that alcohol is better left alone until work is done. Alcohol has a retarding effect on the *oxidation processes* within the body, and it thus tends to favour corpulence. This applies more, however, to beer and wine than to spirit drinking.

The effects of alcoholic drinks vary greatly with the circumstances under which they are taken. *Children* ought never to take alcohol in any form, except under the strictest medical supervision. Persons of *sedentary occupations* suffer more from the ill effects of alcohol than those engaged in active outdoor work. *Alcoholic drinks taken on an empty stomach or apart from meals are always pernicious.* Frequent drinks—'nips'—at intervals during each day are much more injurious to health than intoxicating doses taken at a single sitting, and perhaps only once or twice a week. The more *diluted* an alcoholic drink the less likely is it to produce injurious effects.

The advisability of Alcohol as an article of diet in health is a somewhat difficult point to decide dogmatically. Children and young persons are best without alcohol. Early habits are apt to grow and become serious when middle life is reached. In some cases wine or beer appears to stimulate a flagging appetite and weak digestion, and then undoubtedly is temporarily useful. It should be noted, also, that those who do not habitually resort to such an artificial stimulus are the more likely to benefit by it when circumstances call for its use. This is a strong argument against the habitual use of intoxicating drinks in moderate amount. Our own opinion is that alcohol should be regarded as a drug and only employed when prescribed by a doctor; and that the prescription should be used, like any other prescription, only while the symptoms remain for which it was originally demanded.

Excessive doses of Alcohol produce evil effects which are only too well known. The stomach and liver sometimes become acutely inflamed. The liver in some cases, especially in spirit-drinkers, becomes hardened, and the circulation of blood through it obstructed, dropsy and vomiting of blood resulting. The nervous system suffers not only by way of intoxication and delirium-tremens, but also by the production of various forms of paralysis, which have been traced to chronic alcoholism. Various degenerative diseases are caused by alcohol. The heart and arteries become prematurely old; gout occurs more particularly in beer and wine drinkers; old age creeps on before its time; and alcohol in many and various ways is undoubtedly the most potent disease and death-dealing agency with which medicine has to contend. We may hope that when this becomes more generally realised, and the principles of health are more generally understood, this gigantic amount of preventable disease and death will be greatly diminished.

Useful Beverages during Hard Work.—We have already stated that fermented drinks, even in small quantities, lessen muscular power and diminish the power to perform fatiguing work. In some laborious occupations in which free perspiration occurs, some beverage is absolutely necessary, beyond what is taken in the ordinary fashion with meals. The following drinks, recommended by the Church of England Temperance Society, may be safely drunk, though it is well to be cautious about taking cold drinks copiously when very heated through work or exercise. For men employed in furnaces, factories, and workshops, for railway men and navvies, and for agricultural labourers at the time of the hay and corn harvests, they are most useful, and do not diminish the power for useful work as alcoholic drinks do. They are pleasant to the taste, quench the thirst, increase, instead of diminishing, muscular strength, and at the same time are very cheap :—

(1) STOKOS is prepared thus :—Put from 4 to 6 ozs. of fresh oatmeal, ground as fine as flour, into a pan ; mix with a little cold water to the consistence of cream, then add about 5 or 6 ozs. of loaf sugar, and half a fresh lemon, cut in thin slices, with the pips taken out ; then add a gallon of boiling water. Stir thoroughly while the water is being poured on. Use hot, warm, or cold. The lemon may be omitted, or any other flavouring used instead. Costs 3*d.* a gallon.

(2) COKOS is a good nourishing drink, made as follows :—4 ozs. of good fine-ground oatmeal, 4 ozs. of cocoa, add a little cold water, and mix into a thin batter ; then add 4 ozs. of loaf sugar and a gallon of boiling water ; take to the field in a stone jar. Costs $1\frac{1}{2}$*d.* a quart.

(3) HOPKOS is a good harvest drink. Boil $\frac{3}{4}$ oz. of hops and $\frac{1}{2}$ oz. of ginger (bruised) in $1\frac{1}{2}$ gallons of water for 25 minutes, add 1 lb. of best brown sugar, and boil ten minutes more ; then strain, and bottle, or put into a cask while hot ; it will be ready for drinking when cold. Keep in a cold place. Dried horehound may be used instead of hops. Costs 3*d.* a gallon.

(4) An agreeable drink is made by pouring $\frac{1}{2}$ pint of boiling water on a teaspoonful of marmalade.

(5) Boiling water poured on a few slices of lemon, with a little loaf sugar, makes a very refreshing drink.

Butter-milk forms a wholesome and nutritious drink. Milk, coffee, cocoa, and tea, are all good drinks for hard workers.

By the 'Truck Amendment Act' it has been made illegal for farmers, as well as all other employers, to supply their men with beer, cider, or any other intoxicating drink as a remuneration for services. This is an admirable enactment, and removes a serious temptation from farm-labourers and others.

CHAPTER XII.

THE PRESERVATION OF FOOD.

Preservation of Meat.—Frozen Meat.—Dried and Tinned Meats.—Salted and Smoked Meats.—Other Preserved Foods.

All kinds of food tend rapidly to decompose and putrefy. Putrefaction only occurs when a comparatively warm and moist organic substance is exposed to the air. Food, therefore, may be preserved (1) by keeping it in a very low temperature, (2) by drying it, (3) by boiling it in some liquid, so as to drive out all air, and then fastening it in an air-tight case, or (4) by treating with antiseptic chemical agents.

Preservation of Meat.—By means of *refrigerating apparatus* large quantities of fresh meat are now weekly brought from the United States, Australia, and New Zealand. If the meat is frozen after the flesh has had time to cool down, but before the onset of post-mortem rigidity in the animal, it keeps nearly as well after thawing as English butcher's meat. It is said, however, to lose about 10 per cent. more in cooking than freshly killed meat, which must be borne in mind in comparing the relative price of frozen and fresh meat. The frozen meat is quite wholesome, and its supposed inferiority to home-killed meat has been greatly exaggerated.

Freezing arrests putrefaction if already begun, and may even veil its characteristic odour. Owing to this fact the bad condition of fish is often not discovered until after it is cooked, when the smell due to decomposition reappears.

Thousands of beasts are weekly imported alive into this country, and slaughtered in large *abattoirs* near the landing-stage. Thence the carcases are sent to various towns throughout the United Kingdom, having been first placed in a cooling-room where they are exposed to an atmosphere of about 35° Fahr. (the freezing-point of water being 32° Fahr.). This temperature does not freeze the meat, but cools it, makes it 'set' rapidly, and improves its keeping qualities.

Drying is a very ancient method of preserving slices of meat. It is a process which is best applicable to fish. Pemmican, largely used by Arctic voyagers, consists of a mixture of meat and fat, carefully dried and powdered, along with raisins and spices.

Tinned meats are prepared by first packing the cases with meat and filling up with gravy, and closing with a cover which is hermetically sealed, except at one point. The case is then heated to about 250° Fahr. in order to drive out all air and destroy any putrefactive germs present, and the open point is sealed while the gravy is still boiling, thus making the case completely air-tight. This method involves the meat being somewhat overcooked ; but it none the less forms an economical variety of animal food.

Tinned lobsters and crabs are best avoided. In all varieties of tinned meats, a good brand should be bought, and the meat must be eaten as early as possible after the tin is opened. Before opening the tin, see that the top is flat or depressed ; if this condition exists, no air has entered the tin. If the top has bulged out, then putrefaction has probably set in.

Meat is also preserved by *pressure*, as in corned beef ; but such meat has been deprived of its nutritive juices. Cooked meat may also be preserved by *covering with fat or gelatine*, care being taken that all air is excluded. This method is used for potted meats, tinned sardines, &c.

Of the *chemical agents* used for preserving meat, *salting* and *smoking* are the most common. Smoking is usually applied after salting, the creosote and other constituents of the smoke penetrating the flesh, and exercising a highly preservative action.

In salting a little saltpetre is usually added to the common salt in order to preserve the red colour of the flesh. The objections to salting are that (*a*) the brine dissolves out a large portion of the albuminous material and salts of the meat. Salt beef is of less than two-thirds the value of fresh beef. (*b*) The remaining meat is harder and more difficult of digestion than fresh meat ; while the flavour of the meat is altered, and the excessive amount of foreign salts is injurious. The flesh of the *hog* appears to be an exception to this rule, as it is rendered more wholesome and digestible by salting and smoking. Its fat does not disagree, like that of pork.

Boracic acid is largely used in England for the purpose of retarding the decomposition of milk, but its use is to be deprecated. *Boro-glyceride*, a compound of boracic acid and glycerine, is an admirable antiseptic, and in the proportion of one to forty parts of water is employed for preserving meat, fish, milk, and other food. *Salicylic acid* has also been employed for preserving foods, but its use is much more objectionable than that of boracic acid.

Preservation of other Foods.—**Milk** may be preserved for some time by boiling, and then completely filling a bottle which has been recently scalded out, and sealing the bottle. *Preserved Condensed Milk* is now largely sold in air-tight tins. It consists of milk deprived by evaporation of a large part of its water. It generally has a large amount of cane-sugar added to it, though there are some unsweetened brands. The latter are to be preferred when it is necessary to feed infants on condensed milk.

Condensed milk represents about three to four times its volume of fresh milk. The condensation which it has undergone leaves the casein in a form which is much more easily digested by infants than the casein of fresh cow's milk.

Milk has also been desiccated or dried, and when re-dissolved in water is said to form an excellent milk.

The tendency of **Butter** to become *rancid* in hot weather is well known. Salt is used largely in preserving it. It checks the decomposition of the small amount of casein in butter, which acts as a ferment, setting free the fatty acids of butter, and thus causing rancidity. The same end may be attained by washing the butter well with water, or by allowing it to stand immersed in water.

Fruits are largely preserved for food by drying, as raisins. They are also largely preserved by boiling with sugar in the ordinary domestic jams. Whole fruits, as pears, apricots, &c., are obtainable in tins or bottles imported from America, the fruit being preserved by boiling in a thin syrup, the tin being then sealed, as in the case of preserved meat. Such fruit (especially the kind in bottles) is wholesome, and preserves the flavour of the fresh fruit.

If it is bought in tins, the tins should be carefully examined, and only those showing an absence of bulging, and in which there is no internal lead-soldering, should be used.

CHAPTER XIII.

THE COOKING OF FOOD.

Objects of Cooking.—Methods of Cooking Flesh.—Soups and Broth.

Objects of Cooking.—Food, we have seen, is required for repairing the elements of the tissues, and for supplying combustible material to maintain the forces of the body. It may be taken in its crude and unprepared condition, or after it has undergone a preparatory process of cooking. Man is the only animal who cooks his food. Many foods taken by man, especially those derived from the vegetable kingdom, cannot be digested by him without such cooking. Cooking may, therefore, be regarded as a *preliminary process of digestion.*

Cooking as a preparatory help to the digestion of food is not equally required for all foods. Thus fruit and salads are usually taken uncooked. Milk, again, may be taken uncooked, though we have (p. 48) urged strong reasons against this practice. The oyster is the only animal which is eaten habitually in the uncooked condition, and there is a physiological reason for this, inasmuch as the liver of the oyster, which forms a large share of its bulk, contains a ferment which digests it, this ferment being destroyed by cooking. Water, which is a most important food, is commonly taken unboiled. Such a practice is usually safe in large towns, where a public company or the corporation is responsible for the purity of the water. It is, however, dangerous in villages and outlying places, where the water may be supplied from shallow wells or other sources liable to contamination. *In all doubtful cases water should be boiled before drinking.*

Cooking is intended (1) to partially break up the fibres and cells, and thus *to make the food softer*, and its mastication and digestion an easier task. In this sense, digestion may well be said to begin in the kitchen.

(2) *To produce certain chemical changes.* Thus, starch is partially changed into dextrine, gelatin is formed from the connective tissue of meat, &c.

(3) *To destroy any noxious parasite* present in the food, and to postpone *putrefactive changes.* We know, for instance, that the trichinæ in diseased pork can only be killed by thorough cooking.

(4) *To make the food more pleasant* to the eye and agreeable to the palate. The improved savour of cooked meat, for instance, has a very appetising effect, and consequently makes digestion much easier. *Variety* can be obtained by various methods of cooking. Cookery may be described as a moral agent. 'A hungry man is an angry man.' Badly cooked food, monotonous in kind, tends to a lowered state of health, and often leads to the taking of alcoholic stimulants.

In ordinary cooking the chief agent used is **heat**, and the art of cooking consists, in a large measure, in the skilful application of heat. Heat is applied in cooking in two ways: (*a*) by *radiation*, as in roasting, grilling, toasting, baking; and (*b*) by *direct contact*, as in boiling, frying, stewing.

THE COOKING OF FLESH.

The following classification by Priestley gives the different methods of cooking meat :—

A. The whole mass of meat to be cooked and eaten.

(a) Heat applied by exposure to radiant heat	1. Roasting. 2. Grilling. 3. Baking.
(b) Heat applied by contact with hot water	4. Boiling.
(c) Heat applied by contact with hot oil	5. Frying.
(d) Heat applied by contact with steam....................	6. Steaming.

B. The soluble parts to be dissolved out in water and the rest rejected	7. Broths, soups, and teas.
C. The soluble parts to be dissolved out, and the rest rendered suitable for eating .... (A combination of A and B.)	8. Stewing.

Roasting is the name applied to the process of cooking meat before an open fire. No other form of cooking meat causes it to retain so large a share of the juices of the meat, and exalts its flavour so much. The joint, after having been washed with clean water, dried, and dredged with a little flour, is placed on a roasting-jack and hung before the fire, a dripping-pan being placed under the joint, with a long-handled spoon, to allow of frequent basting. A clear bright fire is necessary for roasting, the fire having been well made up before beginning. At first the meat should be placed near the fire, so that the albumen on its surface may be coagulated, and the juices retained by this means in the interior of the joint. After about ten minutes the joint ought to be removed somewhat further from the fire (about one foot), and allowed to cook slowly. It should be frequently basted with the gravy and fat which has dropped into the dripping-pan, in order to prevent the surface from charring, and to develope the full flavour of the meat. Care must be taken also to keep up the fire, and after the roasting is completed the joint should be sent to the table on a hot dish, all other dishes and plates having been also warmed ready for the dinner.

The pleasant flavour of roast beef is due to a substance called *osmazome*, which is developed during cooking, and, by its appetising influence, doubtless helps the digestion of food. As regards time for cooking, the rule is to allow a quarter of an hour for every pound of meat, and one quarter of an hour over. Veal and pork require a few additional minutes to ensure the absence of redness. To ascertain if the meat is done, press the fleshy part with a spoon : if it remains depressed, it is done ; if not done, it retains its elasticity.

The **Baking** of meat in a closed oven does not produce so delicately flavoured a joint as roasting before an open fire.

With a good oven, however, from which the smell of burning fat produced during the cooking is rapidly removed by

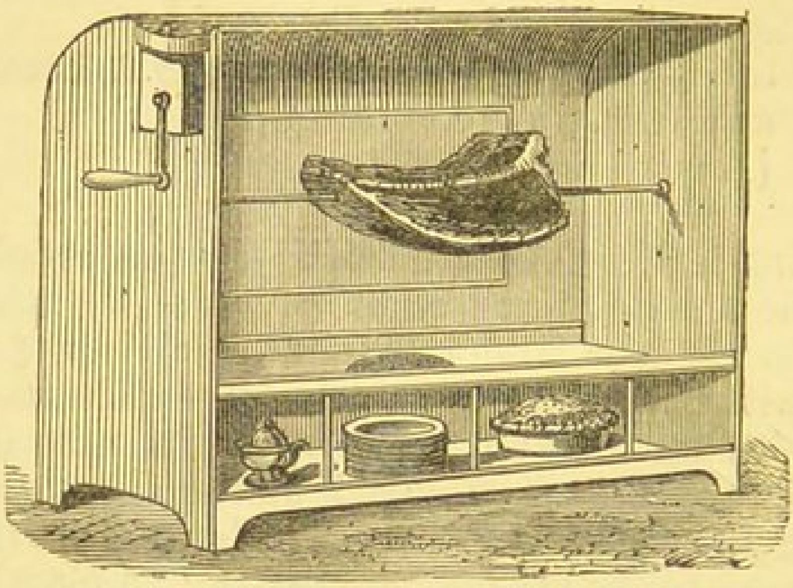

FIG. 17.—*Cooking-screen.*

proper ventilation, the result may nearly approach in perfection that obtained by roasting. The meat should be put into the hottest part of the oven for the first ten minutes, and then removed to a cooler part, that it may cook more slowly. Basting, in order to prevent charring and dryness of the joint, is as important as in roasting. Pork, being very fat, does not require to be basted so often; but it must be cooked *slowly*, and not allowed to char. Note that the oven should be *very hot* when the meat is placed in it; after a few minutes, push in the dampers, so as to moderate the temperature.

Grilling is really a process of roasting applied to a small portion of meat. The *chop* to be grilled must not be pricked, or the juices will escape during cooking. The fire must be very hot, and quite clear. The gridiron must be put on the fire to warm before the chop is put on to it, or the raw meat would stick to the cold iron bars. Turn the chop every two minutes with the flat blade of a knife and a spoon. A large chop will then be well cooked in twelve minutes, a thin one in about ten minutes. A *beef-steak* is cooked in the same way.

Boiling of meat requires the same time as roasting. With many cooks 'to boil is to spoil'; and if this result is to be avoided, the following rules must be followed;—

The joint should be plunged first into *boiling* water, preferably soft water, and allowed to boil fast for five minutes, so as to form a covering of albumen to the joint. Then the saucepan must be drawn to the side of the fire, and allowed to simmer gently (at 180° Fahr.). If there is no thermometer to guide the cooking, then, after the preliminary boiling for five minutes, add three pints of cold water to each gallon of boiling water, and retain at the same temperature for the rest of the process.

The use of *soft water* for cooking purposes is always advisable; otherwise a rather longer time is required. A preliminary boiling for a few minutes renders water much softer, and the addition of a little carbonate of soda has the same effect

When meat is placed in water at a temperature below its boiling-point, the juices are gradually extracted, while the meat is left a mass of hard, indigestible strings, equally wasted whether eaten or not. A nourishing soup is produced, but the meat is almost valueless. With every precaution to keep in the goodness of the meat in boiling, a certain proportion escapes. For this reason the liquor in which fresh meat is boiled should always be kept as stock for soup.

Fish is boiled in a fish-kettle (fig. 18) or saucepan.

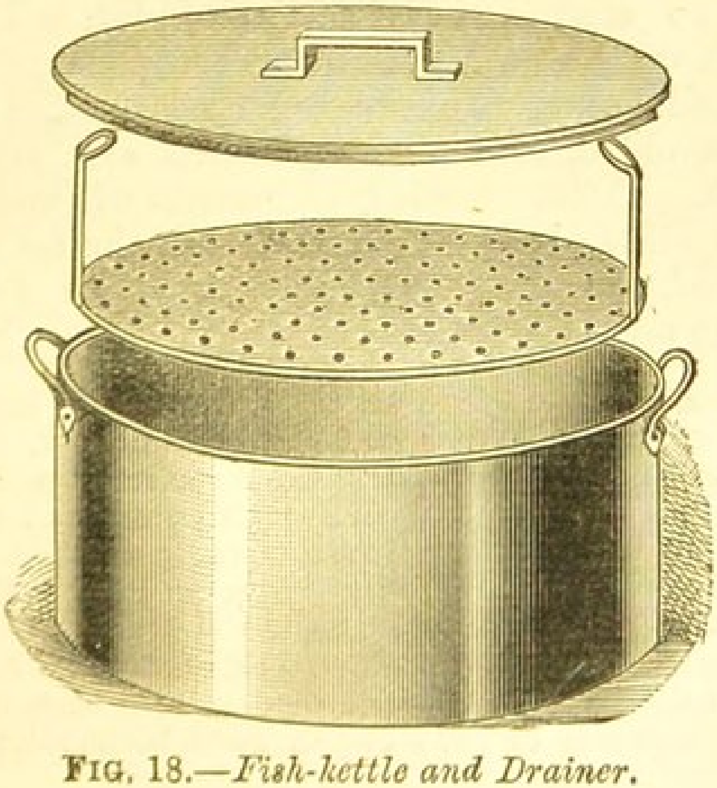

FIG. 18.—*Fish-kettle and Drainer.*

For salmon the water must be boiling to begin with; for all other fish it should only be warm water. The water is allowed to simmer gently for from twenty minutes to three-quarters of an hour, according to the size of the fish. When the skin of the fish is cracking, we know that it is sufficiently boiled.

Stewing is a process intermediate between boiling and baking, and is a most economical process, inasmuch as by

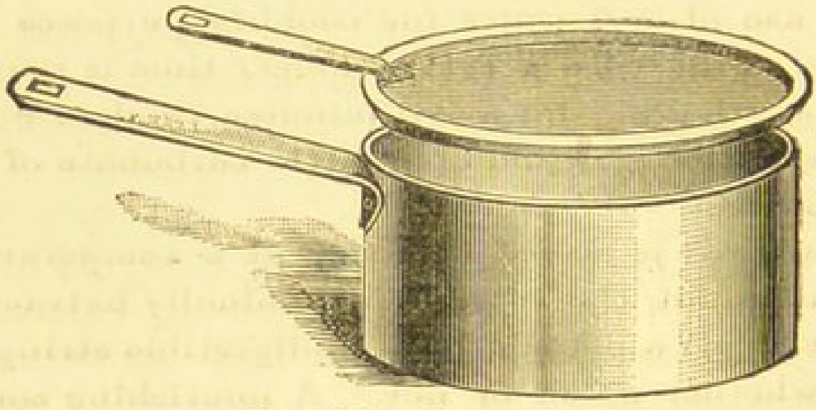

FIG. 19.—*Stewpan.*

its means tough and sinewy pieces, which would otherwise be wasted, can be made into palatable and nutritious dishes. The substitution of the stewpan for the frying-pan in the homes of the poorer class would ensure a very great economy. It possesses the advantages over baking that there is no charring and no burnt fat. The stewpan should always be at hand to receive parings from joints and crushed bones. In stewing no large fire is required, waste is avoided, and savoury meals are produced at a small cost. After stewing fragments of meat, the stew should be allowed to get cold, so that the fat may set and be removed. Then vegetables should be added, before serving the meat for food.

To Stew a Steak.—Take 1 lb. of rump steak, 1½ inches in thickness. Cut off all the skin and fat from the steak. Take 1 carrot and 1 turnip, and, having scraped the former and peeled the latter, cut them into small pieces. Peel 2 small onions and cut them into quarters. Put ½ oz. of butter into a frying-pan, place it on the fire, and then put the steak in to fry brown on both sides. Next put the steak, with the vegetables, into the stewpan. Next add to the stewpan ½ pint of water, into which ½ oz. of flour, half a teaspoonful of salt, and the same quantity of pepper have been mixed. After stirring the contents of the stewpan until boiling occurs, let them simmer for an hour. When the steak is sufficiently stewed, place it on a hot dish, and serve.

Hashing is a process of stewing applied to meat which has been previously cooked. The consequence of this double cooking is that the meat becomes tough and leathery. A modified hash, in which the meat is simply well warmed throughout, is very preferable. By this means cold meat may be conveniently used up, and, if properly managed, an appetising dish may be produced.

To properly Hash Meat.—First cut off all the meat carefully from the remains of the joint in nice thin slices and put them between two plates in a warm place, after having removed all skin and gristle. The latter, with the bone chopped up, should be put in a saucepan, covered with cold water, and boiled for two hours. Next slice a large onion and fry it of a rich brown colour in a frying-pan with a little dripping. Add 1 oz. of flour to the onion, and mix well; then add a tablespoonful of vinegar and of ketchup, and ½ pint of stock from the bones. Cover closely and simmer gently for a quarter of an hour. Now add the warm meat. Let it stand for a few minutes, but not be heated any further, or the meat will be hardened; then serve on a hot dish, with sauce poured over, and pieces of toast or sippets around the dish. The sippets are prepared by frying slices of bread in boiling fat in the oven or over the fire.

Frying, unless carefully done, renders meat difficult of digestion, each fibre becoming coated with fat. The art is to 'fry lightly'—that is, burn quickly and evenly, so that no charring is produced. Two methods of frying are in use: (1) The substance to be fried is placed with a little fat or oil in a frying-pan. This plan should only be employed for pancakes, omelettes, and small pieces of fish. (2) The substance to be fried is immersed in fat, a frying-basket being required for the purpose. In each case the fat must be heated before the meat is added, so that the juices of the latter may be imprisoned in its interior. Good frying depends on the fat being properly heated. Its temperature should rise to 345° Fahr. for ordinary frying and 400° for whitebait. If a thermometer is not available, the heat of the fat may be determined by the facts that (*a*) the fat becomes quite still and begins to smoke when it is very hot, and (*b*) a crumb of bread thrown into the fat turns almost immediately a light brown, indicating that the fat is ready for use. When a sole is fried in a bath of fat, the inner part is really being steamed, as the moisture from the fish cannot escape. Although more fat is required for frying in a proper frying-basket than in a frying-pan, there is really less waste of fat, as in the former case the fat can be used over again, whereas the fat in a frying-pan becomes wasted through the spluttering which occurs and the charring of fat on the heated metal. The great secrets of successful frying are : (1) to have sufficient fat, and (2) to have it hot enough ; (3) to use only clarified fat. Bacon is best prepared by toasting rashers before the fire. Fried bacon is less wholesome.

To Clarify Fat.—Small pieces of fat from mutton, cold meat, breakfast bacon, soups, &c., are placed in an old but clean saucepan, just enough cold water to cover them being added. Keep the saucepan on the fire for about an hour, stirring occasionally to prevent burning or sticking to the bottom of the saucepan. When the water has evaporated, pour the melted fat through an old sieve into a basin. *Dripping* may be clarified by putting it in a saucepan on the fire to boil, then pouring it into a basin in which there is half a pint of cold water. When the dripping is cold it can be cut out as a cake, taking care to scrape off all the sediment on the bottom of the cake and to wipe it dry with a cloth.

STOCK-MAKING.

Much economy may be effected by the establishment and maintenance of a proper stock-pot, as stock is the foundation of all soups and gravies. Good stock cannot be made in an iron saucepan unless it is well tinned inside, and it should not be left in a saucepan all night. An economical housekeeper will never need to buy either meat or bones for the stock-pot, but will use the trimmings of meat, crushed bones from ordinary joints, with any pieces of vegetables that may be at hand. All liquor in which meat is boiled should be put into the stock-pot. The contents of the pot may be kept stewing (but never allowed to boil) from morning till night, but should be strained off at night. If allowed to remain in the pot all night with the lid on, the contents turn sour. The addition of vegetables, such as a carrot, turnip, and onion, improves the stock.

SOUP.

Soup forms a much-neglected article of diet in this country, which is to be regretted, as soup is nutritious, easily digested, and serves to utilise food which would otherwise be wasted. The most nutritious and wholesome soups are those which contain vegetable material as well as gravy derived from the stock-pot. It must be remembered that good soup and good cooked meat cannot be prepared by the same process. If boiled meat is required, the process described on page 87 must be adopted. If good broth or soup is desired, the meat should be cooked slowly, so that the temperature never exceeds 160° Fahr.

To Make Mutton Broth.—Take 3 lbs. of scrag-end of neck of mutton, remove all fat as far as possible, pour 4 quarts of cold water into a clean pan, put in the mutton, add a teaspoonful of Scotch barley (which has been previously well washed). Put the pan on the fire to simmer gently for two and a half hours, but do not allow boiling to occur. Add 2 carrots, 1 turnip, 1 onion, and half a stick of celery after the meat has been simmering for half an hour. Add pepper and salt just before serving.

For pea-soup, see page 101.
For beef-tea, see page 307.

To Make a Plain Soup.—Take the bones left after all the meat from a joint has been used up; crush them, and put into a saucepan with water sufficient to cover them and 1 quart over. Put on the fire, and when boiling occurs add a tablespoonful of salt; this will cause the scum to rise, which must be skimmed off. Next peel and cut up 1 turnip, 2 carrots, and 2 onions. Add these to the soup; put the saucepan to simmer beside the fire for two and a half hours. The soup may be thickened by adding two tablespoonfuls of tapioca, which has been previously soaked for half an hour in ½ pint of cold water. The previous soaking prevents the tapioca from sticking to the bottom of the pan. Flour or semolina may also be used for thickening soup.

To Make Milk Soup.—Put 2 quarts of water to boil on the fire in a saucepan. Take 2 lbs. of potatoes and one onion; wash and peel, cut in slices, and add them to the water when it boils, with sufficient pepper and salt. Let them boil gently until thoroughly mashed. Then strain the soup through a colander, rubbing the vegetables through with a wooden spoon. Return the soup to the saucepan, add to it a pint of milk, and put on the fire until it boils. Serve in a hot tureen. Stock may be used for this soup instead of water.

CHAPTER XIV.

THE COOKING OF ANIMAL FOODS.

Cooking of Eggs.—Milk.—Cheese.

The Cooking of Eggs.—According to the form in which they are taken, eggs are among the most easily digested of foods—*e.g.*, when lightly boiled—or the most difficult of digestion—*e.g.*, when fried or baked in a milk pudding. In the case of a young Canadian, Alexis St. Martin, who, in consequence of a bullet-wound, had an artificial opening through his abdominal wall into the stomach, the time required for the digestion of various foods could be observed. In his case an egg whipped and diluted with water required $1\frac{1}{2}$ hours;

fresh, raw, and undiluted, 2 hours;
soft-boiled or poached, 3 hours;
hard-boiled, $3\frac{1}{2}$ hours;
fried, $3\frac{1}{2}$ hours.

The reason is not far to seek. The white of egg consists chiefly of albumen. This begins to be slightly opaque when heated to 134° Fahr.; at 160° it ceases to be liquid, but still is a jelly and trembling in consistence. On heating to 212° (the boiling-point of water) it becomes quite opaque, and if kept at this temperature becomes hard. If heated beyond this, it is very hard. (A good cement for broken china is to smear the broken surfaces with white of egg, put them together, and heat in an oven.) A similar effect is produced by stewing a beef-steak in boiling water. It ceases to be meat and becomes more like gutta-percha.

To Cook an Egg without Boiling it.—Put a pan of water on the fire to boil. As soon as it really boils, remove the pan, and instantly place a fresh egg in the water, cover the pan with a lid to keep in the steam, and put the pan on the fender. After about five minutes take out the egg, when the white will be found in a creamy condition. This is practically the same process as *poaching an egg*—*i.e.*, cooking it without the shell. The egg, which has been previously broken into a cup, is slipped into boiling water as before, and allowed to stand about the same time. By this means eggs may be cooked without any exact calculation of time, the only necessary condition being that the lid of the pan must be on.

To Make a Savoury Omelette.—It is essential to have an absolutely clean frying-pan. Chop up a small piece of onion and parsley with a pinch of sweet herbs. Break 3 eggs into a basin and beat them up till they froth; add a saltspoonful of salt, half this quantity of pepper, and the chopped onion and parsley, &c. Melt 2 ozs. of butter in the frying-pan, pour in the beaten eggs, &c., and stir quickly, scraping the bottom of the frying-pan with the spoon to prevent the mixture sticking and burning. As soon as the mixture begins to set, scrape it up into a semi-circular shape; slacken the heat, and as soon as the mixture ceases to run, take the pan off the fire, and hold it in front of the fire, with the pan sloped. This will make the omelette lighter.

To Make a Baked Custard.—Put 1 pint of milk into a pie-dish; add to it 2 eggs which have been previously well whisked, a little sugar, and seasoning to taste. Bake gently in the oven for half an hour.

To Make a Boiled Custard.—Prepare the custard as in the last recipe. Butter a small basin that will exactly hold it, put in the custard, and tie a floured cloth over it; plunge it into boiling water, float it about for a few minutes, boil it slowly for half an hour, turn it out, and serve.

To Make a Cup Custard.—Take 1 quart of milk, 6 eggs, and the rind of 1 lemon. Boil the milk and lemon-rind, and allow it to cool in a pitcher. Add the eggs, previously thoroughly whisked, to the milk, stand the pitcher in a saucepan of boiling water, and stir it until the custard thickens. It must not be allowed to boil. Add sugar and flavour to taste.

The Cooking of Milk.—We have already dwelt on the importance of cooking all milk brought into the house, to preclude the possibility of its being the medium for the reception of the germs of some specific disease, such as typhoid or scarlet fever or tuberculosis. Milk is also rendered more digestible by being cooked, and many agreeable dishes may be made from it. Its use in custards and milk puddings is elsewhere considered.

To Make Junket.—To 1 pint of milk, heated till it is lukewarm, add 1 teaspoonful of concentrated essence of rennet (which can be bought at grocers' shops), and 1 small teaspoonful of pounded white sugar; pour it into a bowl or mould, cover with a napkin, and put it aside to cool, when it is ready for use.

To Make Milk Jelly.—Dissolve a little isinglass in water, mix it well with ½ pint of milk, then boil the milk, and serve with or without sugar, as preferred.

To Keep Milk from Turning Sour.—Fifteen grains of bicarbonate of soda to 1 quart of milk hinders its turning sour. Boiling milk while it is fresh also retards souring.

Cheese.—Toasted cheese is most indigestible, the casein being converted into a tenacious insoluble mass. Cheese may, however, be utilised in cookery as follows :—

To Prepare Macaroni with Cheese.—Take 2 ozs. of macaroni, break into pieces about 4 inches long, and put them into a saucepan of boiling water, with a little salt. Place the pan where the macaroni can simmer, and cook gently. When it is quite tender, take it out, spread on a flat dish, add a little liquid butter with pepper and salt, grate 2 ozs. of cheese all over the top, and put it in front of the fire to brown.

Dry pieces of cheese may be utilised by grating them, and then serving with biscuits. Or, after being grated, add a little vinegar, salt, and mustard, and eat with bread

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CHAPTER XV.

THE COOKING OF VEGETABLE FOODS.

Bread-making.—Pastry.—Puddings.—Porridge.—Potatoes, &c.—Vegetable Soups.

Bread-making.—The art of bread-making consists in converting flour into a *porous* firm mass, which can be readily masticated, and which is not moist or sticky. It is most important that the bread should be porous. This is usually secured by the process of *fermentation* of some of the sugar of the flour, the sugar being split up into alcohol and carbonic-acid gas. The alcohol thus produced is evaporated during the process of baking, while the carbonic acid in its attempt to escape renders the dough porous. The fermentation is set in action by yeast. Yeast contains a plant which, under favouring conditions of warmth and moisture and the presence of sugar, grows rapidly. This plant is composed of cells, and is so minute that 30,000 of the cells would be required to cover a square inch. As the plant grows, it splits up sugar into alcohol and carbonic-acid gas. The process is known as *alcoholic fer-*

mentation, and it occurs not only in bread-making but also in the manufacture of wines, beer, and other fermented drinks. In the latter cases, however, the alcohol is retained in the beverage, while in the case of bread the minute amount of alcohol produced is dissipated by the heat. The fact that this process of fermentation must go on in order that dough may rise will explain why, after the dough has been well mixed, it must be left for an hour or two in a warm place, so that sufficient gas may be produced to swell the dough. The heat of the oven stops any further fermentation by killing the yeast-plant, but at the same time the heat causes expansion of each minute vesicle of gas contained within the pores of the dough, thus rendering it still more porous.

To Make Bread.—(*a*). Take 7 lbs. of flour and put it into a clean earthenware pan, and mix 1 tablespoonful of salt well into the flour. (*b*). Next put 2 ozs. of German yeast into a basin, and mix with it a gill of lukewarm water. (*c*). Make a hollow in the centre of the flour, pour the barm (yeast and water) into it, and then gradually incorporate the barm with the flour, adding more lukewarm water until a stiff paste is produced. The yeast and water must be added *slowly*, and after it has been all mixed with the flour, kneading must be continued for ten or fifteen minutes. It is almost impossible to knead the dough too much. When none of the dough sticks to the hands, kneading may be stopped. (*d*). Cover the top of the basin with a clean cloth and put it near the fire. After about an hour the top of the dough will begin to separate and look like a honeycomb. (*e*). It should then be well kneaded again, made into loaves, and put into the oven to bake. It should be put into a hot oven, and the heat gradually reduced to about 300° Fahr. The loaves should be left in the oven nearly two hours, taking care that the temperature is gradually lessened during the last hour.

Potatoes are not uncommonly added to flour for making bread, having been first boiled, well mashed, and rubbed through a colander. As much as ½ lb. of potatoes to 3 lbs. of flour may be used. The addition of milk to the dough greatly improves the quality of the bread.

Entire wheatmeal does not make good light bread so readily as the white flour. Its use may, however, be advocated for labourers and others who do not get meat-food. For the purpose of bread-making the meal should not be so coarsely ground as that commonly sold as 'wholemeal.' The best form in which to bake it is as a flat cake, which is lighter and less hard than a loaf made from the same flour. The following recipe is highly recommended by Sir Henry Thompson :—

To Make Whole-meal Bread.—To 2 lbs. of coarsely-ground or crushed whole wheat-meal, add $\frac{1}{2}$ lb. of fine flour and a sufficient quantity of baking-powder and salt. When these are well mixed, rub in about 2 ozs. of butter, and make into dough with half milk and water, with skimmed milk (warm), or with milk, if preferred. Make into flat cakes like 'tea-cakes,' and bake without delay in a quick oven, leaving them afterwards to finish thoroughly at a lower temperature.

For the $\frac{1}{2}$lb. of flour ordered above, the same quantity of medium fine Scotch oatmeal may be substituted. This change adds to the brittleness and lightness of the cakes.

One pound of the best white flour costs about 2*d.*; bread of at least equal nutritive quality may be made from seconds flour, a darker variety, which costs only about $1\frac{1}{2}$*d.* per lb.

A hot oven is necessary for good baking. The temperature inside the oven should be 410° Fahr. when the dough is put in. In the best bakeries thermometers are used to test the temperature. If a thermometer is not available, the temperature of the interior of the oven may be tested as follows :—Sprinkle a pinch of flour on the bottom of the oven : if it becomes black the oven is too hot ; if it becomes a nice brown colour in a minute, the oven is just at the right heat ; and if it does not brown, the oven is not hot enough. In order to know whether the loaf is sufficiently cooked, push a skewer into it. If the skewer comes out clean, the bread is sufficiently baked ; if the skewer is sticky, then the bread is underdone.

We have assumed hitherto that the use of yeast is necessary to make bread porous. The same result may, however, be attained by Dr. Dauglish's plan of making the dough with water containing carbonic acid dissolved in it under pressure. The gas escapes in the substance of the dough, and on baking expands as in the ordinary method of making bread. Bread made in this manner is called **aerated bread.** In Nevill's bread, a solution of carbonate of ammonia is incorporated with the dough, which volatilises when heated, thus making the bread porous. Both these varieties of bread are sweeter than the bread made by fermentation, none of the sugar having been used up to form alcohol and carbonic-acid gas. The amount used for the latter purpose is, however, very small, and the difference in nutritive quality of these varieties of bread is but slight. Bread may be also rendered porous by means of baking-powder (page 99).

New bread is not so digestible as stale bread. It is moister than stale bread, and more coherent; it is therefore not so easily or completely masticated as stale bread, and the saliva does not penetrate it so thoroughly.

Badly made bread also causes indigestion. This may be owing to the use of bad yeast, making the bread heavy and comparatively non-porous. Bread made from the coarser meals is heavier and less easily digested than the bread from white flour, probably owing in large measure to its less porous character.

Rusks may be made by cutting a loaf of bread into slices and baking in a slow oven until they are brown. The ordinary bought rusks are made from a rather richer dough, like that used for making tea-cakes. **Pulled bread** is simply ordinary dough, pulled into stick-like pieces, and baked hard in the oven. Both these forms of bread are most useful for dyspeptics who suffer from flatulence, &c., after taking ordinary bread.

Bread may be further cooked by being **toasted.** This causes a further drying and scorching of the surfaces. Bread should be toasted in slices thin enough to be crisp right through. If made too thick, it is tough, and the inner part is soft like new bread. Thin toast and pulled bread ought to be eaten in preference to ordinary bread by persons inclined to stoutness.

Biscuits, as the name indicates, are made of dough which is baked much longer and is harder and drier than ordinary bread. They can therefore be preserved for a long time. They are made without the use of yeast, and are, therefore, a form of unfermented or unleavened bread. In the history of civilisation, unleavened bread was undoubtedly first made. The yeast-plant is constantly present in the atmosphere; and probably the discovery of fermented bread was accidental, some dough having been left and fermentation having spontaneously occurred. Next came the practice of leaving a little dough over, with which to 'leaven' the next baking; and finally came the adoption of brewer's and German yeast instead of the leaven. Now non-aerated bread is scarcely eaten, except by Jews at the Passover feast, and in the form of biscuits.

Pastry is made from wheat-flour to which is added butter or dripping and some baking-powder. It is not so easily digested as ordinary bread. The lard or dripping which has been added renders the product more flaky and less easily pulverised by the teeth ; also the fat appears to coat over the starch-cells of the baked flour, thus impeding the action of saliva upon them. Boiled puddings made with suet are more digestible than baked pastry. Pastry made according to the following recipe may be taken and digested by persons who are obliged to avoid ordinary pastry :—

To Make German Pastry.—Take 1 lb. of flour, add to it 1 dessert-spoonful of baking-powder ; then rub in ½ lb. of butter. Take 4 eggs, whisk them well, and add them to the flour. Three eggs will suffice if a little milk is used as well. Dripping may be substituted for the butter if well beaten.

A cool hand and light touch are required to make good pastry. Dripping may be generally substituted for lard, if it has been well clarified (p. 90) and beaten into a cream. When rubbing fat into flour it must be touched only with the tips of the fingers.

To Make Pastry for Pies, &c.—Put 1 lb. of flour into a basin. Take ½ lb. of lard or butter, and rub half of it lightly into the flour ; then add 2 teaspoonfuls of baking-powder, ½ teaspoonful of salt, and sufficient cold water or milk to make a firm paste. After mixing, roll on a floured paste-board or slab. Take half of the remaining lard, place it over the paste in little pats, sprinkle it with flour, fold it over and roll. Repeat this process with the last portion of lard ; and then, when folded, put it away to cool for an hour, preferably on a marble slab. This paste may be used for fruit or meat pies.

For puddings the paste must be made as follows :—

To Make Suet Paste.—Take ¼ lb. of suet, remove the skin, and chop it finely. Add it to 1 lb. of flour, with ¼ teaspoonful of salt and sufficient cold water to form a firm paste. A teaspoonful of baking-powder makes the paste lighter.

Suet puddings must have plenty of time to boil. They must be put into *boiling* water, and be kept boiling fast the whole time. Puddings boiled in a basin should not be covered with water, but should have plenty of water around them. Pudding-cloths should not be touched with soap, but washed with hot water and soda and then thoroughly dried in the open air.

To Make a Bread-and-Butter Pudding.—Take 6 slices of bread and butter them. Butter the inside of a pie-dish, and place the slices of bread in layers, sprinkling each layer with currants, finely-chopped suet, and a little sugar. Take 2 eggs, whisk them, and add 1 pint of milk to them; pour this over the pudding, and bake for about an hour.

Bread pudding may be made for using up odd pieces of bread. It is made by first soaking the bread in a little milk or water, then adding to it ¼ lb. of currants, 1 egg, and sugar, with about ½ pint of milk. This can be either boiled or baked.

Baking-powders are used in making pastry, cakes, &c. They are all composed essentially of two substances, which while dry do not interact, but when moist enter into chemical combination, carbonic acid being then evolved into the substance of the dough. Borwick's baking-powder consists of a mixture of carbonate of soda, tartaric acid, and rice-powder; MacDougall's, of acid phosphate of lime and carbonate of potass. The bread made by these means is not so wholesome and digestible as that made by fermentation, and the process is only used for small baking operations.

To Make Baking-powder.—Take ½ lb. of ground rice, ¼ lb. of carbonate of soda, and 3 ozs. of tartaric acid. Dry these ingredients well, and pass them all together through a sieve or colander. Put into a dry bottle or canister until required.

Other Cereals are chiefly used for making milk puddings, with the exception of oatmeal. Rice pudding may be taken as an example.

To Make a Rice Pudding.—Take 2 tablespoonfuls of rice, wash it well. Grease the inside of a pie-dish, put in the rice, add ½ pint of water, ½ pint of milk, 1 teaspoonful of chopped suet, and 1 tablespoonful of moist sugar; mix all well together, and bake very slowly for two hours.

The pudding is improved by adding pure milk instead of milk and water. The suet increases the nutritive value of the rice pudding, and is particularly valuable for children. Eggs added to milk puddings make them much less digestible.

Tapioca and sago puddings are similarly made.

To Make Oatmeal Porridge.—Boil 1 pint of water in a clean saucepan, and add a little salt. With the left hand sprinkle in gradually two large tablespoonfuls of the best Scotch oatmeal, and, by means of a wooden porridge-stick in the right hand, carefully mix it in the boiling water, preventing lumps. Keep stirring for a few minutes, and then allow it to simmer for an hour, stirring at frequent intervals.

It is a good plan to cook oatmeal overnight when intended for breakfast, and then heat it again in the morning before serving. Oatmeal can hardly be cooked too much. Some persons prefer to use a double saucepan for making porridge, as this ensures that it shall be slowly cooked, without risk of burning.

Potatoes, when boiled, ought to be placed in boiling water. If put into cold water, without their jackets, and then the temperature gradually raised, much of the starch is changed into a gelatinous condition, and mixes with the water. At the same time, some of the vegetable salts of the potato are dissolved out, unless the outermost layer is quickly hardened by boiling water. When starch-cells, whether in potato, bread, or any other food, are heated to the boiling-point of water, the capsule of the cell bursts and liberates the starch-granules in the interior, thus rendering them capable of being acted on by saliva. This is the chief object of cooking starchy foods.

It is most economical to boil or bake potatoes in their skins. If peeled, the skin should be taken off as thinly as possible.

Potatoes ought to be steamed rather than boiled, on account of the possible loss of some starch in the latter process. Potatoes are more digestible when mashed; when underdone they are very objectionable. If potatoes are boiled, let them boil slowly, as fast boiling makes them knock against each other, thus risking the loss of some nutritive material. Steaming is the best process, especially for old potatoes. The time required for boiling potatoes varies from twenty minutes for small new potatoes to three-quarters of an hour for good-sized old potatoes.

To Boil Green Vegetables.—Wash them first in cold water, then soak in salt and water for half an hour, in order to rid them of insects, and put them into boiling water with a little salt, and cook with the lid off until they are tender.

All **green vegetables** require thorough and prolonged cooking. This renders their tissues softer and more easily attacked in digestion. Soft water should preferably be used. Spinach is the easiest digested of all green vegetables, becoming a pulp by boiling. Asparagus should be tied in bundles and placed upright with the green heads out of water, so that they may not be overdone.

Vegetables of the cabbage tribe give a peculiarly strong and disagreeable odour to the 'green-water' in which they are boiled. They must, therefore, be boiled alone. Do not allow the green-water to be poured down the sink, or the smell will be perceived all over the house. It should be emptied over a gully-trap in the yard.

Fresh **peas** and **beans** require from twelve to thirty minutes for boiling. **Dried peas** are of great value as food, if subjected to prolonged cooking. They should first be soaked in cold water for at least twelve hours, then crushed and stewed.

To Make Pea-Soup.—Put 1 quart of split peas into a basin with cold water to cover them, and let them soak for twelve hours. This should be done overnight. Put 2 quarts of cold water, or the liquor from boiled meat, and the split peas into a saucepan, and put it on the fire to boil. Wash and peel 2 onions and 1 turnip, and cut them in halves; wash and scrape 1 carrot, and a head of celery, and when the water in the saucepan is boiling, put in all the vegetables. If no meat-liquor is available, take some bones and add them to the saucepan, with sufficient salt and pepper. Boil slowly for two hours, skimming occasionally. Next take the bones out of the saucepan, place a colander over a basin, and rub the contents of the saucepan through into the basin with a wooden spoon. Powdered dried mint and toasted bread cut into small pieces should be served with the soup.

In the cooking of **mixed dishes** it is important to remember that the different components may require a longer or shorter time for cooking. A soup containing vegetables as well as meat juices should be prepared in two parts. The vegetables require prolonged boiling; gravy is spoilt by this. Similarly if the jam be placed in a tart before baking, it loses its proper fruity flavour. Spices if mixed with a dish before it is boiled, lose nearly all their flavouring power, while they remain irritating.

CHAPTER XVI.

THE TEACHING OF COOKERY IN ELEMENTARY SCHOOLS.

Preliminary Teaching.—Direct Teaching.—Cooking of Vegetables.—Re-cooking Cold Meat.—List of Utensils required for a Cookery Class.—Stoves.—Mincing-machine.—Syllabus of Lessons.—Disposal of Dishes.

Cookery is a subject which should be taught practically and upon scientific principles in every girls' school. It will prove of the greatest value in increasing the health and comfort of the homes of the poorer classes. The Education Code includes cookery in its schedules, and some valuable hints which are embodied in this chapter have been drawn up by the authorities of the Education Department for the use of teachers of cookery. In order that the lessons may prove of the highest practical value to the girls they must be given upon some systematic plan, arranging for *definite* and *progressive* instruction. Throughout the whole of the teaching the children should be made to realise the importance of the subject.

Preliminary Teaching.—The children should first be taught what cookery is—viz., the art of preparing food so as to render it more palatable, more digestible, and more nutritious than in its raw condition. Lessons should be given in the management of stoves, lighting a fire, economy of fuel, and cleaning of flues.

In certain districts special stoves and appliances are in common use. Where this is the case the teaching should be given so as to utilise these as far as possible. The children should be made to think over the food-resources of their own neighbourhood, and the prices of the various articles.

Direct Teaching.—This includes the six primary methods of cookery, as specified by the Education Department, what meat should be roasted or baked, what boiled, what stewed, &c., and the reasons for employing the different methods for different kinds of meat. The lessons are expected to include instruction in the following subjects, according to the district, whether inland or near the coast :—

I. (1) Boiling meat or fish.
(2) Stewing meat.
(3) Baking meat or fish.
(4) Broiling meat or fish.
(5) Roasting meat (when it can be conveniently managed).
(6) Frying meat or fish.
(7) The re-cooking of cold meat.

II. (1) The cooking of potatoes and other root vegetables.
(2) The cooking of green vegetables.
(3) The making of stocks and vegetable soups.
(4) The art of pastry-making.
(5) Puddings.
(6) Bread-making.
(7) Sick-room cookery.

At each of the practice lessons at the commencement of the course it is well to let one recipe be illustrative of one of the primary operations, the *principles* being always brought under the notice of the children. The *recipes* should be chosen in accordance with the *food-resources* and *wages* of the neighbourhood. It would be obviously unwise to use materials beyond the means of the parents of the girls. The *re-cooking of cold meat* should be specially considered. Thus, instead of eating cold meat for two or three consecutive days, a savoury stock may be made from the bones of the joint, to which some fresh vegetables have been added, and this served up with the meat, which has been previously cut into slices and allowed to warm through in the gravy before serving. Economy of *time*, *labour*, and *fuel* should be borne in mind, as well as economy of *materials for cooking*. Every girl ought to have practice in actually preparing the dishes and in *cooking* them. The teacher must, of course, exercise sufficient supervision to prevent the dishes being wasted or spoilt. It is better to arrange for a number of small dishes to be cooked, allowing the girls to work in couples, than for a large number to work together in preparing one large dish. In order to make the girls exact, they should *weigh* the ingredients, and, as they may not always have scales and weights at home, they should be taught to *measure* them accurately in ordinary cups and basins, spoons, &c. They should be trained to perform all their cooking operations in the most delicate, cleanly manner, and they should be required to present a scrupulously clean personal appearance before entering the cooking kitchen. The hands and arms should be freshly washed, the nails short and clean, and the hair neatly arranged; large clean white aprons and sleeves must be worn. After the lesson the cooking utensils should be properly cleaned and put in their places. Good methods and attention to all these small details train the girls to those habits which characterise all good domestic servants and housekeepers.

During the whole course the lessons should be made as interesting as possible, and the girls should be encouraged to look upon their cookery classes as a privilege and as the most pleasant work of the week. A lawful ambition to excel may be excited by a few words of judicious praise from the teacher whenever a girl, by special care, produces really good results in her cookery, such as a well-made loaf of bread.

List of Utensils, &c., required for furnishing a small Cooking Kitchen suitable for a Practice Class.

Utensils.

	£	s.	d.
2 Tin saucepans, 2 quarts each, 2*s*.	0	4	0
2 " " 3 pints " 1*s*. 6*d*.	0	3	0
3 " " 1 pint " 6*d*.	0	1	6
1 Frying-pan	0	0	7
1 Fish-kettle	0	3	6
1 Colander	0	0	9
1 Strainer	0	1	6
1 Set of measures	0	0	6
1 Scales and weights (about)	0	7	6
2 Roasting-pans	0	2	0
1 Grater	0	0	6
6 Wooden spoons	0	1	0
6 Iron "	0	1	0
6 Tea "	0	0	6
2 Cake-tins	0	1	0
12 Knives	0	6	0
Carried forward	1	14	10

	£	s.	d.
Brought forward	1	14	10
4 Vegetable-knives	0	1	4
6 Forks	0	1	6
2 Chopping-boards and pastry-board	0	6	0
2 Rolling-pins	0	1	0
1 Knife-board	0	1	0
1 Hand-bowl	0	0	9
1 Bucket	0	1	3
1 Galvanised tub	0	2	0
1 Kettle	0	2	0
1 Wire sieve	0	2	0
2 Scrubbing-brushes	0	2	0
1 Sink-brush and 1 pot-brush	0	1	0
1 Set blacklead-brushes	0	2	6
Salt-box and spice-tins	0	2	0
Flour-dredge	0	0	6
Egg-whisk	0	0	4
Fish-slice and egg-slice	0	0	8
Skewers	0	0	3
	3	2	11

Crockery.

	s.	d.
6 Large bowls	6	0
6 Basins	2	0
12 Cups	1	0
18 Plates	2	0
3 Jugs	1	0
6 Pie-dishes	1	6
	13	6

Linen.

	s.	d.
6 Kitchen cloths	3	0
2 Roller towels	2	6
3 Dish-cloths	0	6
2 Knife-cloths	0	2
	6	2

Sundries to last for Ten Lessons.

	s.	d.
House-flannels		
Soap and soda		
Blacklead	3	0

Total.

	£	s.	d.
Utensils	3	2	11
Crockery	0	13	6
Linen	0	6	2
Sundries	0	3	0
	4	5	7

The price of the stove will vary, according to the kind used, from 3*l.* upwards. Gas-stoves are often used, and they may be hired from a gas company at a cost of from 2*s.* 6*d.* to 5*s.* per quarter. Teaching with an ordinary cooking-stove is, however, of more practical value to the girls, as few use gas in their own homes.

The above-mentioned articles are only for simple cookery; more advanced work would require moulds, omelette-pans, &c. It is a good plan to teach children to employ such a homely means of cooking as a Dutch oven (fig. 20), which is much used among the poor.

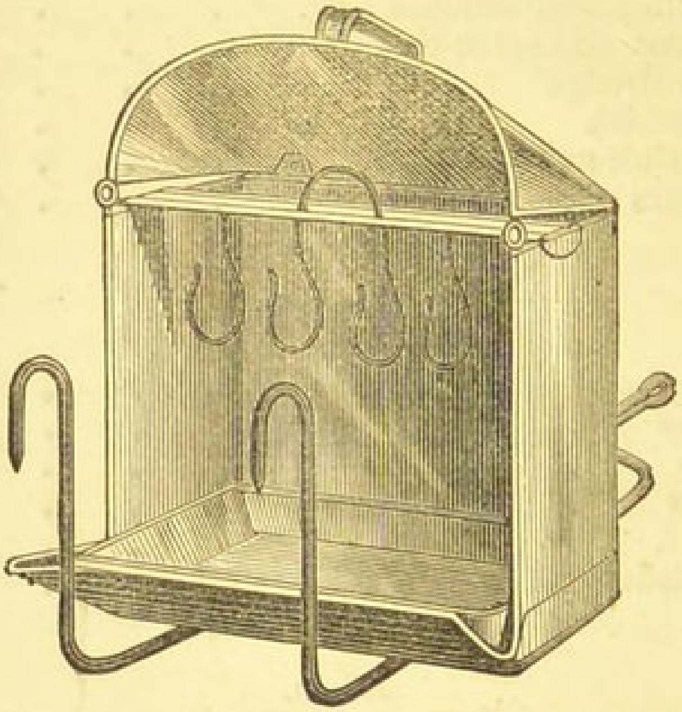


FIG. 20.—*Diagram of Dutch Oven.*

In districts where oil is used, in addition to the management of a large oil-stove, it would be of value to the girls to learn the management of a small oil-stove (fig. 21), such as they might have in their own homes.

A mincing-machine (fig. 22), which is of great use in preparing cold meat for re-cooking, should be in every kitchen.

This machine requires careful cleansing. After being washed, it should be dried by the fire, and then have a piece of bread passed through it. It can also be cleaned immediately after use for mincing meat by passing stale bread through it.

Rissoles can be readily made with a few slices of lean cold meat, minced and mixed with half the weight of the meat in breadcrumbs, pepper and salt, a few savoury herbs

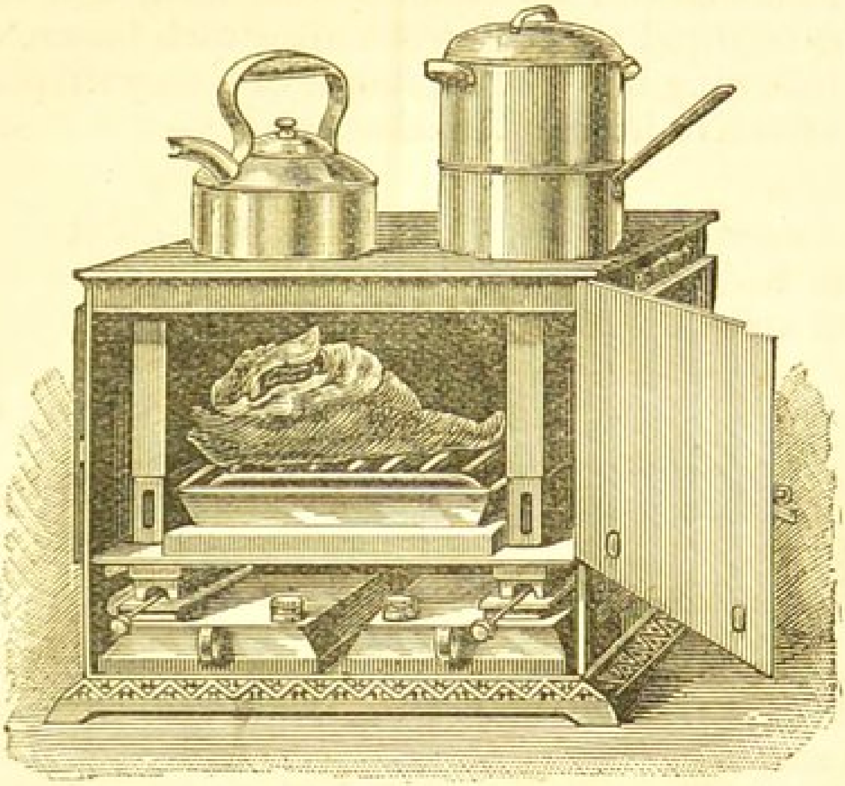


FIG. 21.—*Diagram of small Oil-stove.*

chopped fine, and the whole bound well together by being mixed with one or two eggs. It should also be explained

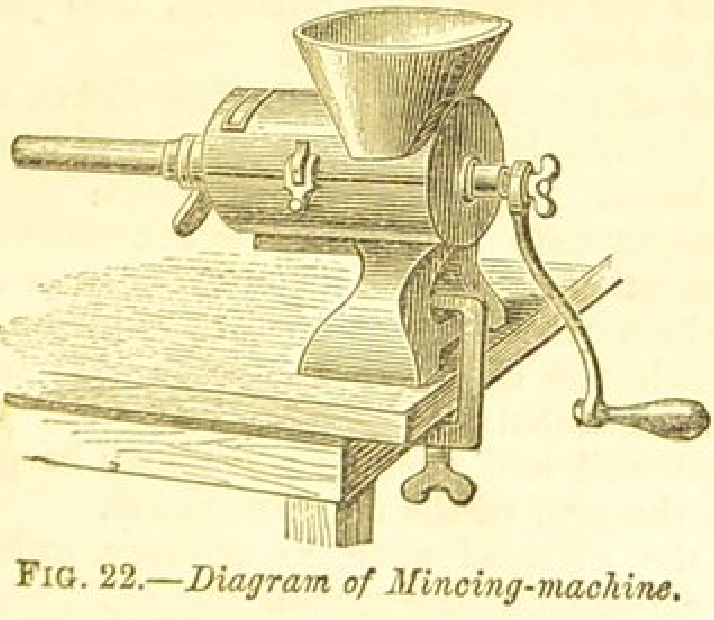


FIG. 22.—*Diagram of Mincing-machine.*

to the girls that minced meat, requiring little mastication, is a useful food for invalids and persons who have lost their teeth, as well as for young children, who often dislike cold meat and 'bolt' it unchewed.

The tables should be of unpainted deal, and the girls should be required to scrub them after each lesson.

The following is a short syllabus of a very simple course of demonstrative lessons for school-girls :—

Lentil Soup	Fried Fish
Spanish Onions	Stewed Rabbit
Imitation Kidney Soup	Meat Pies
Macaroni and Cheese	Fruit Tarts
Sea Pie	Roly-poly Pudding
Leek Soup	Scones and Short Cakes
Boiling Vegetables	Plum Pudding
Haricot Mutton	Plain Cake
Baked Fish	Treacle Tart
Steak Pie or Meat Pudding	Pancakes

Much more extensive work can be done where apparatus and materials can be obtained. In large schools, where there is ample means for the sale or disposal of the cooked food, large joints are often cooked ; but the real aim of the teacher of cookery should be to teach the children to make articles of food which are well within their reach, and to use to the best advantage scraps and small things which are often wasted, turning them, by their knowledge of cookery and the exercise of patience, into palatable and nourishing dishes.

Disposal of Cooked Food.—1. The dishes may be purchased by the children at the cost price of the ingredients and taken home.

2. Arrangements may be made for some of the children to dine at the school at the cost of 1*d.* or 1½*d.* each.

3. Teachers who live at a distance from the school may, through the cookery classes, be able to dine comfortably at the school.

4. Soups well and cheaply made may be given in cold weather to the poor of the neighbourhood.

5. As the girls advance in cookery, orders may be taken and executed at the school.

In country villages where no other means could be obtained for the teaching of cookery, a kitchen in a private house has been sometimes lent by ladies in order that the girls of the neighbourhood might receive some training in economical and nutritious cookery. In other cases ladies have gone to the cottages of the poor to teach. It is to be hoped that in time the systematic teaching of cookery will be universal throughout the country. Some County Councils, in their desire to carry out the spirit of the Technical Education Act, are at the present time making arrangements for the teaching of cottage cookery by visiting teachers in the homes of the poor in country villages.

CHAPTER XVII.

INCOME AND EXPENDITURE OF THE BODY.

Sources of Loss and Gain.—Production of Heat.—The Excretory Organs.

In preceding chapters we have seen how, by the process of *digestion*, food is broken up and dissolved, until it is capable of being *absorbed* into the system. Absorption is either (*a*) directly into the minute blood-vessels in the walls of the stomach and intestines, or (*b*) first into lacteal vessels, which take up the emulsified and liquid fat, and pass it eventually into the veins near the root of the neck. In both cases the destination of the assimilated food is the same. It becomes part and parcel of the blood, and is circulated all over the body with that complex fluid. Even in the case of the food directly absorbed into capillaries and veins, the course into the general circulation is not an unobstructed one. The absorbed nitrogenous material and sugar are carried by the portal vein into the liver. Owing to the almost unique fact that the portal vein breaks up once more into capillaries in the substance of the liver, the absorbed food is subjected to further changes by the minute cells of the liver. These seize on the sugar in the food, store a considerable proportion of it in their interior, having first in some marvellous way converted it into glycogen, a form of animal starch. From the liver the glycogen is only given up again, as sugar, in such quantities as suffice to meet the requirements of the general system. Eventually all the assimilated food reaches the general mass of the blood, and is *circulated* to every part of the body, at intervals of not longer than one second. The mechanism of this circulation we have already described (p. 18).

To every remote part of the body goes a minute artery, which breaks up into microscopic channels called capillaries. From the same part comes a minute vein, which joins with other veins to take the blood back to the heart, and thence to the lungs to be purified. The blood in these veins thus returning from the various tissues and organs differs from the blood going to them in the arteries in several particulars. (1) Venous blood is as a rule slightly warmer than arterial blood. The reason of this we shall see shortly. (2) Venous blood is darker coloured than arterial blood. This is due chiefly to the oxy-hæmoglobin, which is the chief constituent of the red corpuscles of the blood, having given up its oxygen to the tissues, which it leaves as reduced hæmoglobin. (3) Venous blood is less pure than arterial blood. It has lost a certain amount of oxygen. In addition it contains a certain amount of carbonic acid, which will be carried to the lungs and thence be eliminated from the body. It also contains certain other impurities, the result of the functional activity of the various tissues, which are subsequently eliminated by means of the kidneys and the skin.

Income and Expenditure.—The food carried by the blood to every part of the body is not immediately expended. A certain share is stored up for emergencies. Fat is stored under the skin (**subcutaneous tissues**) and in other parts. Glycogen, as already stated, is stored in the liver. Albumen and other materials are doubtless stored beyond the immediate requirements of the system in the blood and various tissues.

The daily income for a healthy adult is equal to nearly $1\frac{1}{2}$ lbs. of dry food, and 2 to 3 pints of water, taken as ordinary meals, and about $1\frac{1}{2}$ lbs. of oxygen, which is brought from the lungs by the red blood corpuscles to every part of the body.

The losses of the body are represented by (1) the heat which is lost in the expired breath and in the excreta (*i.e.*, urine and fæces), and in warming the food taken, in addition to the still greater amount of heat which is lost from the general surface of the body ; (2) about 20 ozs. of water on the average are daily eliminated from the skin, 50 ozs. from the kidneys, and 9 to 10 ozs. from the lungs; (3) about 14·4 cubic feet of carbonic gas are daily eliminated from the lungs; (4) about 500 grains of urea are eliminated from the kidneys, with smaller quantities of other impurities; and (5) about 4 ozs. of solid excreta (fæces) are excreted from the large intestines. In a healthy man there is a balance between the loss and gain in the human organism. If too much food is taken, then an excessive accumulation occurs within the body, or the system is disordered; if too little food is taken wasting and weakness result—in fact, chronic starvation supervenes.

Income.	*Expenditure.*	*Loss.*
Foods of various kinds, including water.	In maintaining warmth.	Water from kidneys, skin, and lungs.
Oxygen.	In muscular movements.	Carbonic acid from lungs.
	In various other kinds of physiological work, including brain-work.	Urea from kidneys.
		Solid excreta.
		Heat lost from skin, &c.

Production of Heat.—It is difficult to understand that *there is fire in the body*, when the smoke and flame which we usually associate with the idea of a fire are absent. It is, however, none the less true that *oxidation* or *combustion* is constantly going on within the human system. The temperature of the skin is maintained constantly at about 98·6° Fahr., and of the blood at about 100° Fahr., whether it be a cold wintry or a hot sultry day. Evidently there must be some internal fire, and some apparatus regulating the amount of oxidation, to enable us thus to maintain a uniform heat.

It was formerly supposed that this oxidation occurred solely in the lungs. It was thought that the oxidisable materials in the blood combined with oxygen while passing through the lungs, and that the lungs were in this sense comparable not only to the bellows in a smith's forge, but also to the fire itself. But *oxidation produces heat*, and this old theory is at once disposed of by the fact that *the blood leaving the lungs is cooler than that entering them.* If all the oxidation occurring in the body were carried on in the lungs, the heat produced would almost suffice to char them. The lungs act as bellows, bringing oxygen to the system. The red corpuscles combine with this oxygen and carry it all over the body. Oxidation occurs in every tissue in every part of the body; arterial blood supplying the oxygen, and venous blood removing the products of oxidation. Chemical action within the body involves the production of heat, just as does the burning of coal on a fire. Thus heat is being produced in every part of the body which is being exercised, whether it be the brain or muscles or other parts. The heat thus produced is uniformly diffused throughout the body, in consequence of the fact that blood is being carried to and brought away from every part of the body 60 or 70 times per minute. So far as substances containing carbon and hydrogen are concerned, the *ultimate products* of oxidation are carbonic acid and water.

Thus	C (carbon)	+	O_2 (oxygen)	=	CO_2 (carbonic acid).
	H_2 (hydrogen)	+	O_2 (oxygen)	=	H_2O (water).

The carbonic acid is eliminated almost solely by the lungs; water is eliminated by the kidneys, skin, and lungs.

Nitrogenous substances do not undergo such complete oxidation as non-nitrogenous substances, and the final product of their oxidation, **urea**, although a much simpler body than the albuminoid or proteid food which is its original source, is still a comparatively complex body.

Perhaps the complexity of the changes undergone in the body may be better appreciated by a glance at the following schematic statement, which only gives an approximation to the truth :—

Hypothetical albuminoid.	Typical fat (stearin).	Starch.	Grape-sugar.
$C_{72}H_{112}N_{18}SO_{22}$.	$C_3H_5\ (C_{18}H_{35}O_2)_3$.	$x(C_6H_{10}O_5)$.	$(C_6H_{12}O_6)$.

Various intermediate products, which are finally broken down into and eliminated as

Urea, CH_4N_2O.	Carbonic acid, CO_2.	Water, H_2O_2.

The final products produced by oxidation (more correctly termed **metabolism**) are eliminated by the **excretory organs**—viz., the kidneys, skin, and lungs. One point is common to these : nothing can be eliminated from them except by *passing through the blood.* The excretory organs select and filter from the blood various impurities. Health cannot be maintained unless the excretory organs, and especially the lungs and kidneys, are constantly at work We should be speedily poisoned by the products of our own activity, unless these organs were constantly engaged in eliminating and purifying, just in the same way as a fire would speedily go out if it were allowed to remain clogged with ashes, and if the chimney were blocked up.

The **kidneys** lie deeply in the loins. They are supplied with blood by a branch of the abdominal aorta (3, fig. 23) and the blood returning from them is carried into the inferior vena cava (4, fig. 23). The blood-vessels penetrate into the substance of the kidney, and come into very close contact with the minute tubes of which the kidney chiefly consists. The tubes of the kidney end in its substance in minute sacs (called *Malpighian bodies*), about $\frac{1}{120}$ inch in diameter, and the tubes themselves are four or five times smaller than this. They are lined throughout by minute epithelial cells, and the solid part of the urine (especially urea and uric acid) appears to be separated from the blood by these cells. But these solids require to be dissolved and washed down by some liquid from above. This is supplied from the Malpighian bodies, each of which receives a minute artery, which forms a loose tuft of capillaries in the interior of the sac. From the capillary tuft water is constantly filtered, and as it flows down the tube it dissolves and washes away the urea and uric acid formed in the tube. All the tubes in each kidney combine to form the **ureter** (5, fig. 23), which, with the ureter from the opposite kidney, empties its contents into the bladder. The urine is constantly being formed drop by drop, though it is only discharged from the bladder at intervals.

From 45 to 50 fluid ounces of urine are formed in the twenty-four hours. The chief solid constituent is urea, which is present in solution to the amount of about 2·3 per cent. We have seen that the daily solid excreta (fæces) amount to about 4 ozs. The weight of the solid matter in the daily liquid excreta (urine) is about one-third more than that of the daily fæces; and this solid matter is even

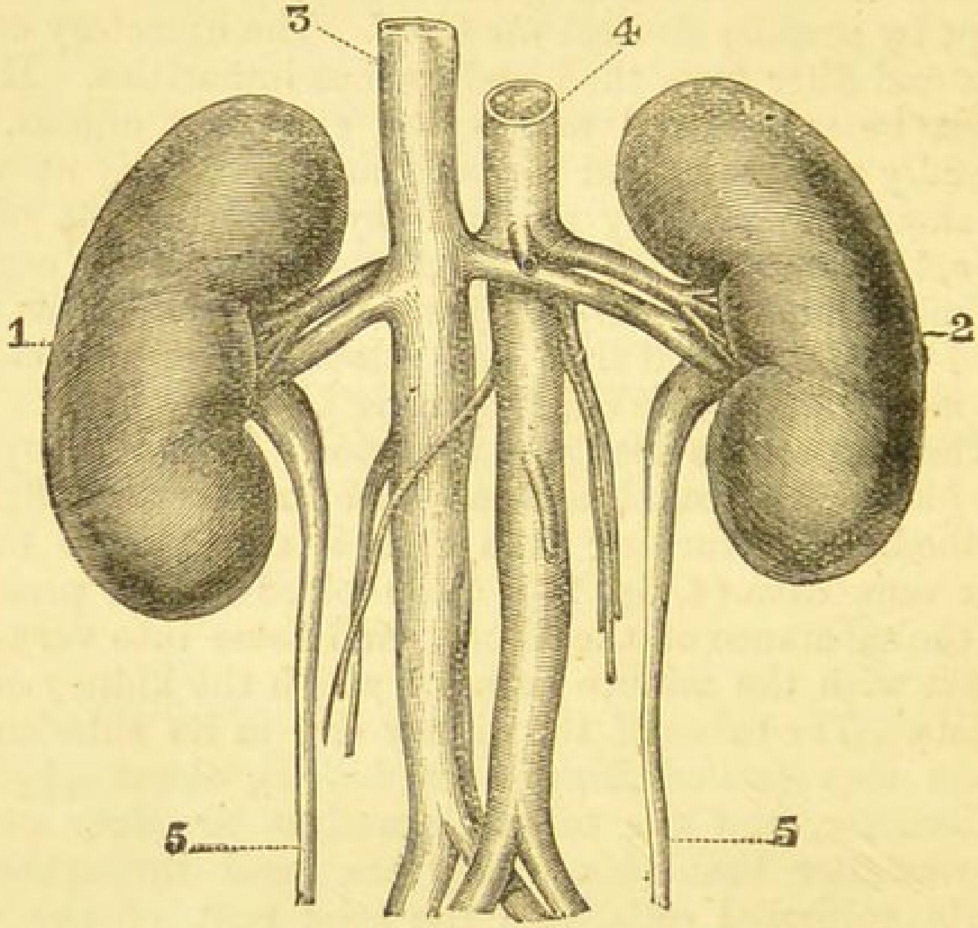


FIG. 23.—*The Kidneys, &c.*

1. *Right.* 2. *Left kidney.* 5, 5. *Ureter from each kidney leading down to bladder.* 3. *Abdominal aorta.* 4. *Inferior vena cava.*

more prone to putrefaction than that in fæces. The proper removal from houses of urine is, therefore, quite as important as that of fæces.

The two other excretory organs, the skin and the lungs, will be described in the following chapters.

CHAPTER XVIII.

THE SKIN AND CLEANLINESS.

Functions of the Skin.—Uncleanliness.—Uses of Soap.—Uses of Baths.—Geysers.—Personal Cleanliness.—General Cleanliness.

The Skin consists of two layers—an upper, called the *epidermis*, and a deeper, called the true skin or *dermis*. The epidermis consists of a number of layers of minute cells.

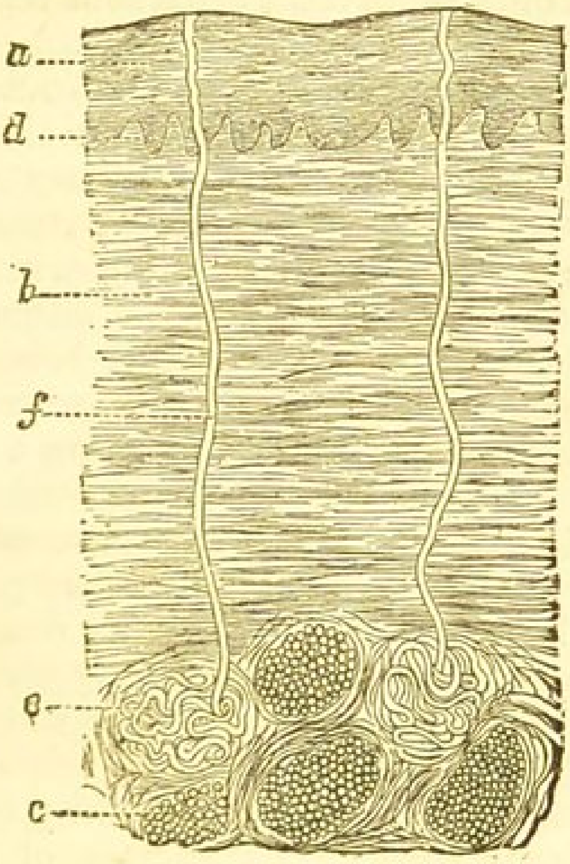


FIG. 24.—*Section of the Skin.*

Showing (a) *epidermis;* (b) *dermis;* (c) *fat-cells in subcutaneous tissues;* (d) *papillæ;* (e) *coiled-up end of perspiration-tube;* (f) *perspiration-tube.*

The upper layers are horny, and are composed of cells which have become horny and modified to form scales; in the deeper layers the cells are more rounded and softer. The colour of the negro's skin is due to the deposition of pigment granules in the deepest part of the epidermis. The uppermost cells form minute flakes, which are every day being shed as 'scurf,' or can be scraped off the surface of the skin. Hairs and nails are composed of modified and hardened epidermal cells. The epidermis is insensitive, and can be pricked without producing pain. The dermis is not only sensitive but also very vascular. The epidermis, when seen under a magnifying glass, shows ridges and depressions arranged in a regular order. These are due to minute conical upward projections of the dermis, termed *papillæ*, each about $\frac{1}{100}$ inch long. These papillæ contain the endings of minute nerves, and it is by their means that we possess the sense of touch. The papillæ are more closely set in the more sensitive parts. The epidermis is perforated by the tubes of two kinds of glands, sebaceous and sudoriparous (perspiration glands).

The *sebaceous glands* are short and branched, and commonly end alongside the hairs lower than the point of emergence of the latter from the skin. They secrete an oily material which serves the purpose of a natural pomade, and renders any artificial hair-oil in most cases unnecessary. The sebaceous secretion also keeps the surface of the skin unctuous and supple, and prevents it becoming dry and harsh. In persons who perspire freely, were it not for the sebaceous secretion, the skin would have a macerated appearance, somewhat like the hands of a washerwoman. The smell of the sebaceous secretion is unpleasant, especially in closed parts of the body, as under the armpits. Frequent washing of such parts is, therefore, very desirable.

The *sudoriparous* or sweat-secreting *glands* are longer than the sebaceous glands. Each tube when straightened out is about $\frac{1}{4}$ inch long. It ends below in the subcutaneous tissue in a coiled-up extremity (*e*, fig. 24). It opens by a minute pore on the surface of the skin. As many as 3,000 of such pores have been counted on a square inch of the palm of the hand. It has been estimated that in an adult the length of all the sweat-tubes put together would be nearly twenty-eight miles!

The sudoriparous glands secrete the perspiration. This is constantly evaporating from the surface of the body, though to a much greater extent in hot weather and during severe exertion. It is very important that the pores of these glands should be kept open in order that the secretion of sweat may not be hindered. Animals have been killed by covering their skin with varnish, and so preventing the escape of perspiration. The amount of water given off from the body by the skin varies with the external temperature and with other circumstances ; but it is about double the amount passing out from the lungs.

The greater part of it escapes as *insensible perspiration*, passing off as invisible aqueous vapour. When it appears as drops on the skin it is known as *sensible perspiration*. Perspiration contains about 1 per cent. of solids, the chief one being common salt. A minute amount of carbonic acid is given off by the skin, about $\frac{1}{200}$ of that eliminated by the lungs.

The skin has other functions, besides the secretion of perspiration and sebaceous matter. (1) It is the end-organ of the *sense of touch*, and thus forms one of the media by which we come into conscious communication with the external world. (2) It serves as a *protection* to the deeper parts of the body. (3) By its means the *temperature of the body is regulated*. This will be explained hereafter (page 146) in the chapter on clothing.

The results of uncleanliness may almost be gathered from a study of the preceding physiological considerations.

Uncleanliness leads to (1) obstruction of the sweat and sebaceous ducts of the skin, and (2) accumulation of débris on the general surface of the body.

(1) *Obstruction of the sweat-pores* of the skin interferes with the free elimination of waste-products by the perspiration, so that more work is thrown upon the kidneys and lungs, and the balance of health is destroyed.

(2) *Obstruction of the sebaceous pores* causes an accumulation of oily secretion in the ducts. The black spots so commonly seen on the nose are blocked-up orifices of sebaceous ducts, and tiny threads of fatty matter may be pressed out by squeezing the nose. Pimples result from inattention to such obstructions, and if these pimples become inflamed the condition called acne is produced, which may permanently disfigure the face.

(3) *Accumulation of impure matters* on the skin occurs if the skin is not frequently washed. The outer part of the epidermis is constantly being shed as 'scurf'; and, in the absence of frequent washing, the sebaceous secretion tends

to mat these scales together. The saline matters of the perspiration tend also to accumulate, and these, by attracting moisture, keep the skin clammy and cold.

(4) The skin contains numerous nerves and blood-vessels. When the papillæ are covered with dirt *the sensibility of the skin is dulled.* Now, the sensations received by the skin are important in regulating the temperature of the body. A cold external temperature should cause a reflex contraction of the small arteries bringing blood to the skin, while a warm external temperature should cause these arteries to dilate and send more blood to the skin. In the first case, undue loss of heat is prevented; in the second, the balance of temperature is maintained by a greater loss of heat. But if the sensibility of the skin is dulled by dirt, this reflex nervous mechanism is impaired, and the dangers from sudden changes of temperature are greatly increased. *Consequently, the tendency to chills* is increased.

When uncleanliness is protracted, various *skin-diseases* may be produced.

Uses of Soap.—Soap is produced by the action of an alkali on a fat or oil. Fat is a compound of fatty acids with glycerine. The alkali combines with the fatty acid to form soap, while glycerine is liberated. Thus :—

Stearin + soda = stearate of soda + glycerine.
(mutton fat)

Soft soap is stearate of potass; hard soap, stearate of soda. Most soaps contain an excess of alkali, but if the excess is great, the soap is irritating to delicate skins. Soap forms an insoluble compound with lime-salts, and is, therefore, wasted in considerable amount when one washes in hard water. Thus :—

$$\underset{\text{Chalk}}{\begin{Bmatrix}\text{Calcium}\\\text{Carbonate}\end{Bmatrix}} + \underset{\text{Soap}}{\begin{Bmatrix}\text{Sodium}\\\text{Stearate}\end{Bmatrix}} = \underset{\text{Insoluble}}{\begin{Bmatrix}\text{Calcium}\\\text{Stearate}\end{Bmatrix}} + \begin{Bmatrix}\text{Sodium}\\\text{Carbonate}\end{Bmatrix}$$

In washing the skin, the water used washes away a certain amount of scurf and saline matters which have accumulated. But the sebaceous oily secretion and water will no more mix than will any other oil with water; and as the sebaceous secretion is the most ill-smelling part about the skin, something more than water is required to ensure cleanliness. This is provided by soap. The alkali in soap combines with the oily matter to form an emulsion, which carries away with it the particles of dirt blocking up the pores of the sebaceous ducts. When the skin is subsequently rubbed by the towel, the softened epithelium, and with it any remaining dirt, is rubbed off. Thus (*a*) water, (*b*) soap, (*c*) the towel, and (*d*) abundant friction at each stage, are required to ensure thorough cleansing of the skin.

Uses of Baths.—(1). The first object of bathing is cleanliness, and, by its means, the maintenance of health. For this purpose the warm bath is the most efficient, combined with the free use of soap and friction. A warm bath at 95° Fahr., as it tends to relax the skin and may be followed by a chill, should always be taken at night. This increased sensibility to cold after a warm bath may be obviated by immediately afterwards sponging over the body with cold water, and then drying quickly.

(2). The cold bath, if taken with due precautions, forms an admirable *tonic to the system.* It should be taken rapidly; and if it is found that a feeling of cold and chilliness remains afterwards, the bath has done more harm than good. During winter the temperature of the water used may be raised to 60° by the addition of warm water, without interfering with its tonic effects ; and for weakly persons this is much to be preferred to the greater shock given by water, at, say 40°. Cold baths increase the tone of the skin, and render it less susceptible to changes of temperature, thus diminishing the tendency to 'catch cold.'

The *Turkish bath* consists in spending a longer or shorter time in rooms which vary in temperature from 80° to 160° or even more, free perspiration being thus induced. The body is then thoroughly cleansed by friction and soap, and subsequently cooled by a spray of cold water, or a cold plunge ; the last stage being one of rest in a cool apartment to allow the skin to become thoroughly braced. This bath is of great value where there is deficient elimination, and for persons who lead a sedentary indoor life. Persons with heart-disease should avoid the Turkish bath.

Swimming is a very valuable combination of bathing and exercise. The exercise accompanying it usually suffices to counteract the depressing action of the cold water. It is important, however, (*a*) that the immersion should not be too prolonged; (*b*) that the body should be warm at the time of entering the water; (*c*) that the bath should not be taken until about two hours after a meal, nor (*d*) after prolonged fasting, as before breakfast.

Classification of Baths.—Baths are considered *cold* below 70° Fahr., *tepid* between 70° and 85°, *warm* from 85° to 97°, and *hot* above this temperature.

A complete **bath-room** should have an open fireplace. The bath should be sufficiently large to allow of submersion of the whole body. It should have an abundant supply of both hot and cold water, and the waste-pipe should be sufficiently large to carry off the water expeditiously. An overflow pipe must be provided in case of accidental filling of the bath. The waste-pipe and overflow-pipe should be made to discharge over a gully-trap in the yard, or over the open head of a rain-water pipe, and the waste-pipe should, in addition, be provided with a syphon bend under the bath to prevent smells rising into the bath-room from decomposition of soap or other foul matters along its course. A leaden tray, called a *safe*, is usually placed under the bath to catch any accidental spillings of water. The small waste-pipe from this is often connected with the soil-pipe—a most dangerous practice. It should discharge into the open air. Non-attention to these rules may make the bath-room a source of danger to the occupants of a house, especially as it is commonly placed close to a bedroom.

Where there is no circulating system of hot-water supply for the bath-room, **Geysers** are now frequently employed in heating water for baths. In these the water is made to flow over a large heating surface furnished by the combustion of coal-gas, and with the best varieties a hot bath (at 98° Fahr.) can be supplied in from five to ten minutes. As a rule, no provision is made in these apparatus for the proper escape of the fumes, and the consequences in some cases have been very serious and even fatal. The bath-room is usually very small, and most commonly has no open fireplace. Consequently the poisonous products of the combustion of gas are apt to be present in very considerable quantity. These are chiefly carbonic acid, which is produced in large amount; but the more poisonous carbonic oxide may also be produced in minute quantities.

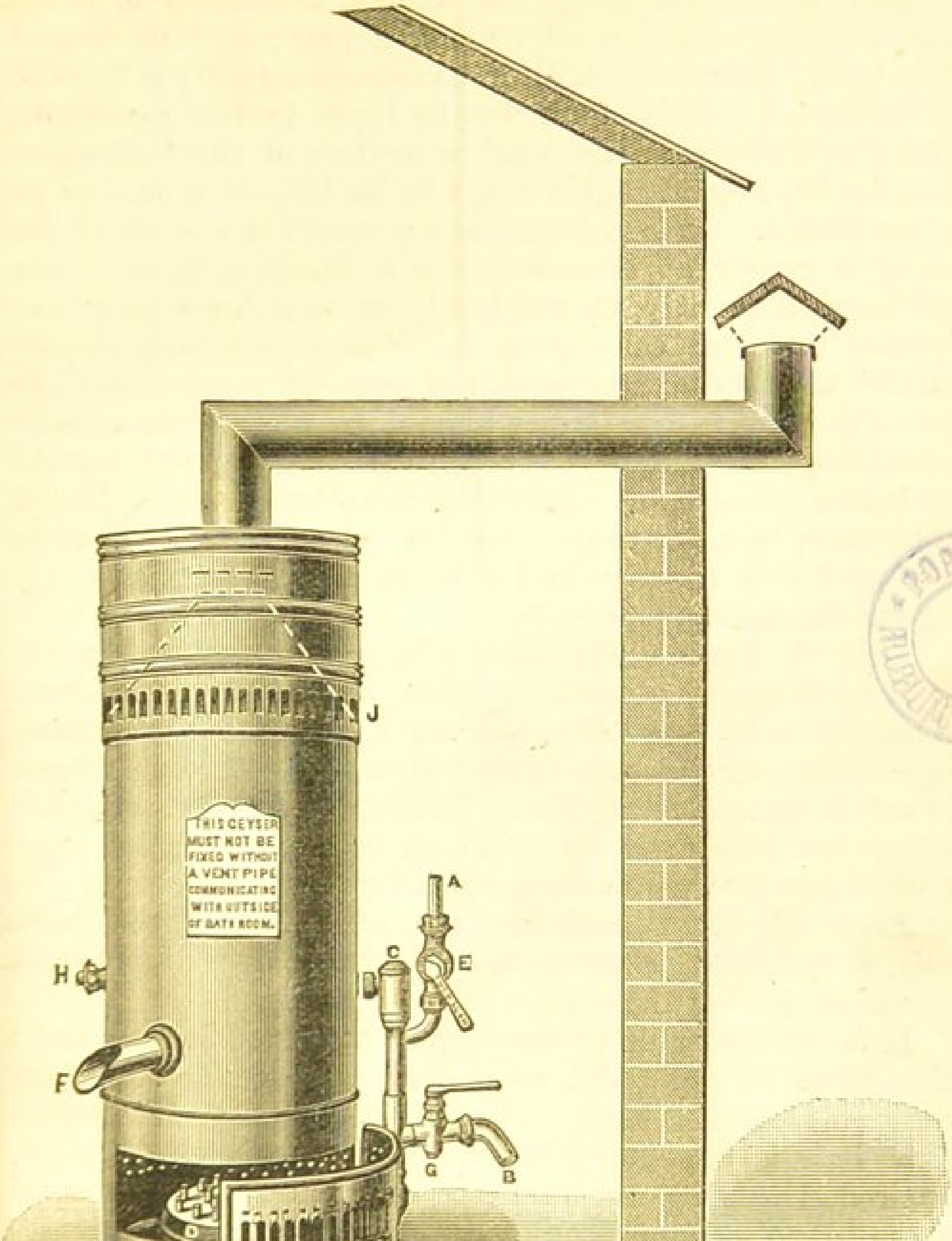


FIG. 25.—*Geyser Apparatus with proper Ventilating Arrangements.*

A. *Entrance of cold water.* B. *Entrance for coal-gas.* C. *Dual-valve, so arranged that immediately the water is turned off or the supply fails from any cause, the supply of gas is also cut off.* F. *Point of issue of hot water after passing through the various chambers in the geyser.* G. *Separate gas-tap, which can be used as a regulator or to entirely cut off supply of gas, if only cold water is required. If the taps are required on the other side of geyser, they can be fixed to the union* H. J. *Baffle to prevent down-draught in the flue-pipe (sometimes better inserted in the pipe under the ceiling).*

Hence it is not infrequent for violent headaches to occur after a warm bath derived from a geyser; and in several cases both adults and children have been actually suffocated by the fumes. It is of no use to trust to the verbal instruction that either the window or door of the bath-room must be kept open. This is apt to be forgotten or may be inconvenient. It is not a valid argument in favour of the use of a geyser apparatus *minus* a flue-pipe, to say, as is said very frequently, that it has been used for a long time without any evil consequences. The geyser may at any time be used by inexperienced or careless persons and life be endangered. No geyser should be allowed in a house unless a special flue-pipe is connected with it, and carried out into a passage, or, preferably, into the open air. In the latter case, in order to prevent down-draught, a cowl must be placed over the pipe and a baffle arranged (as at J, fig. 25) for the same purpose.

This vital point has hitherto been unrecognised by the majority of manufacturers of geysers, and we have, therefore, no hesitation in departing from our usual rule and mentioning with honour the name of the only manufacturers (Messrs. Ewart & Son, Euston Road, London) who place on each geyser manufactured by them an emphatic caution that it must not be used without a vent-pipe.

Personal Cleanliness includes attention to the hair, nails, mouth, and other parts of the body, as well as to the general surface of the skin.

It is not desirable to use soap as often to the *hair* as to other parts of the body, as it washes away the sebaceous secretion from the hairs and renders them dry and brittle. If the hair is kept fairly short, artificial pomades are not required, though pomades made of purified lard, or equal parts of lanoline and vaseline, can do no harm. The *finger-nails* should be kept scrupulously clean, and the same applies to the *mouth* and all other mucous orifices. A fœtid breath is often due to the discharges from decayed teeth, or to the decomposition of food which has been allowed to accumulate between the teeth. It is important that the *teeth* should be regularly cleansed, and that all decayed teeth should be 'stopped' at an early period.

General Cleanliness is next in importance to cleanliness of the skin. It is unfortunate that less regard is sometimes paid to the cleanliness of under-clothing than to that of outer garments.

The tendency to disregard cleanliness of *apparel* is shown also by the usual preference for colours 'that do not show the dirt,' the fact that the dirt is still there, although not seen, being ignored. It is always well to hang one's clothes at night where they may be well ventilated and purified by the oxygen of the air.

Bedclothes should be scrupulously clean. The organic matters given off from the lungs, skin, &c., hang about the bed-linen, and cause the 'close smell' which can be appreciated on entering a bedroom in the morning from the open air. Beds should not be made directly after being left, but the clothes thrown over the bottom of the bed, the bolster and mattress well shaken, and the window widely opened so that every part may be exposed to a free current of air for an hour or two before re-arranging the clothes.

The house should also be kept clean. Dust is deposited in obscure corners and attracts to itself organic matters, thus making the room stuffy, even though free ventilation be secured. Carpets should be easily movable, and should not extend to the walls of the room, so that they may be easily swept and kept free from dust. The walls should also be kept clean, and a new wall-paper should not be allowed to be pasted over an old one, as is too often the case, thus preserving the dirt of years in the room.

CHAPTER XIX.

THE LUNGS AND RESPIRATION.

Structure of the Lungs.—Mechanism of Respiration.—Changes in Blood by Respiration.

The organs concerned in respiration are the lungs, which fill the greater part of the thorax or chest. At the root of the tongue, in front of the œsophagus, is an orifice which leads into the *larynx*, or voice-box. The larynx opens below into the trachea, or wind-pipe (fig. 7).

The **trachea** is about $4\frac{1}{2}$ inches long, and is kept open by 16 to 20 incomplete rings of cartilage (gristle). Between the rings, the trachea consists largely of elastic tissue, but contains also some involuntary muscular fibres. The mucous membrane of the trachea and its branches is lined by smooth columnar epithelial cells presenting *cilia* or hair-like projections about $\frac{1}{3000}$ inch long on their free surface. The trachea passes down the neck in front of the œsophagus, and as it enters the thorax divides into two **bronchi**, one to each lung. Each bronchus divides in a forked manner in the substance of the lung, the smallest branches, or *bronchioles*, having no cartilage in their structure, and terminating in sac-like pear-shaped expansions called *infundibula.* Each infundibulum, with its corresponding bronchiole, constitutes a *lobule* of the lung, and the different lobules are bound together by connective tissue. The infundibula have sac-like walls, each division of the sac being called an *air-cell* or *alveolus.* The walls of the air-cells consist of a delicate layer of connective tissue lined by a single layer of flattened cells. In the wall of each air-cell is a fine network of blood-capillaries, only separated from the air in the interior of the air-cell by the epithelial cells. The outer surface of each lung is pressed closely against the inner surface of the walls of the chest, and closely follows its movements. The two surfaces are, however, not in contact, but separated by the smooth *pleural* membrane.

Mechanism of Respiration.—The walls of the thorax are formed by the vertebral column behind, the curved ribs on either side, and the breast-bone and costal cartilages in front. The ribs slant forwards and downwards, and the only joint at which they can move freely is at their attachment to the vertebræ behind. Between the ribs are short *intercostal muscles*, and the contraction of these muscles pulls the ribs up, at the same time making them more horizontal, and thus increasing the transverse dimensions of the chest-cavity. The base of the thorax is formed by the **diaphragm.** This is a large muscle attached all round to the inner wall of the lower part of the thorax, to the sternum (breast-bone) in front, the inside of the six lower ribs on each side, and the vertebral column behind. It has three openings, through which pass the œsophagus, the aorta, and the inferior vena cava. Within its attachments the diaphragm forms an arched vault (fig. 2), rising up so as to make the central part of the thorax shallower than its margins. On the upper convex surface of the diaphragm the lungs and heart rest, while the liver, stomach, and spleen fit into its concave under-surface.

The *respiratory act* consists of two parts : (1) a breath-

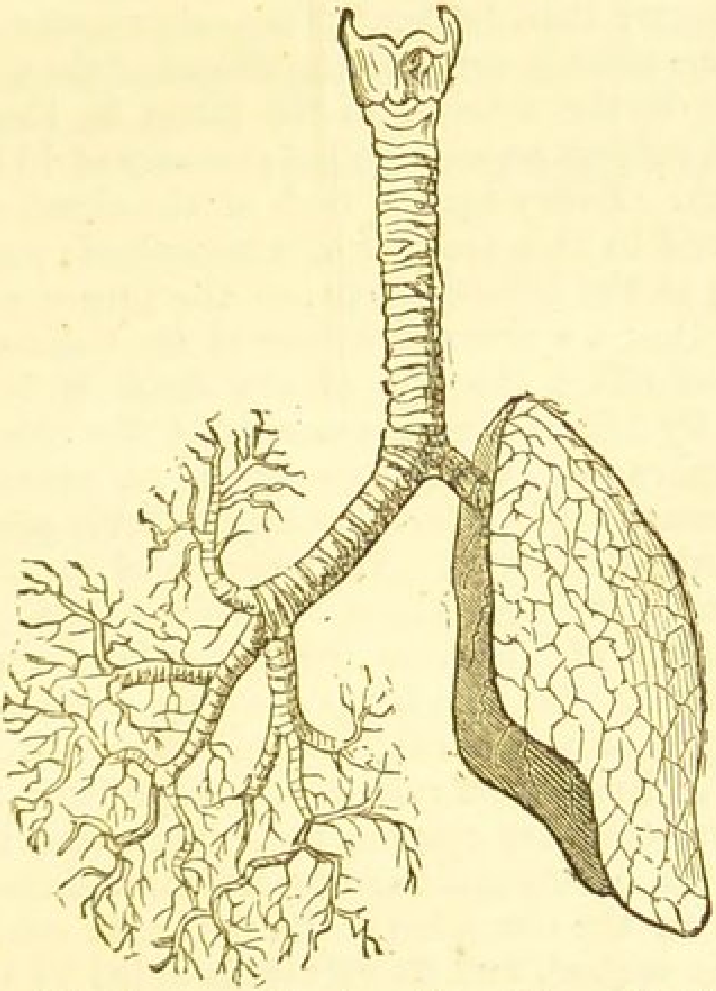


FIG. 26.—*The Larynx, Trachea, Bronchi, and Left Lung.*

The right lung has been removed to show the method of branching of the bronchi.

ing-in, or inspiration, followed by (2) a breathing-out, or expiration, with a pause between the two. In the adult the respiratory act occurs about 17 times per minute.

Inspiration is brought about by muscular action, a large number of muscles contracting in unison. Ordinary inspiration is *effected by descent of the diaphragm, and elevation and eversion of the ribs.* The elevation of the ribs is effected by the action of intercostal muscles, assisted by some other muscles. It is evident that as the ribs move on a pivot at their hinder attachment, when they are raised they must also be pushed out or everted, thus increasing the size of the chest from front to back and from side to side.

Descent of the diaphragm occurs when its muscular fibres contract. When a muscle contracts, its fibres become shorter, and in the case of an arched muscle like the diaphragm this must imply that the muscle descends and becomes flatter than before. Thus contraction of the diaphragm increases the vertical dimensions of the thorax (fig. 2).

The air in the interior of the lungs is, like air everywhere else, subject to an average pressure of 15 lbs. to every square inch. Every square inch of the chest-wall is similarly exposed to this amount of atmospheric pressure; and it is owing to the balance between the pressure in different directions that we are not aware of its existence. When by muscular effort the size of the chest is increased, the lungs exactly follow the movements of the chest-walls and of the diaphragm. Consequently the air contained in the lungs becomes rarefied, and the atmospheric pressure forces more air into the lungs. The volume of air thus inspired at each breath averages about 30 cubic inches.

Expiration of air from the lungs is a comparatively passive process. (*a*) The lungs are very elastic and tend to recoil as soon as the muscular effort of inspiration ceases. (*b*) The ribs have been raised into a position of unstable equilibrium, and they resume their more slanting position as soon as the intercostal muscles become relaxed. (*c*) The diaphragm on the cessation of its muscular contraction becomes again arched, and its return is aided by the pressure of the liver and other abdominal organs which have been somewhat displaced during inspiration. It is only during forced expiration that the abdominal and other muscles are brought into play.

The complicated act of breathing is effected by the co-operation of many muscles supplied by different nerves. We cannot voluntarily stop breathing for more than a few seconds, and during sleep respiration continues perfectly. It is an automatic act, controlled and regulated by a special part of the nervous system.

The **changes** produced in air by passing through the lungs will be described on page 130.

Changes in Blood.—The blood entering and passing through the lungs has been derived from the veins of every part of the body, having been pumped from the right ventricle of the heart through the pulmonary arteries into the lungs. This blood is purple, while that leaving the lungs is scarlet, a difference which is due to the absorption in the lungs of oxygen by the hæmoglobin of red corpuscles. In passing through the lungs the blood loses some carbonic acid and gains some oxygen. By means of the mercurial air-pump 60 volumes of gas can be extracted from 100 volumes of blood.

This gas differs in composition in arterial and in venous blood. Thus—

From 100 volumes of

		ARTERIAL BLOOD.	VENOUS BLOOD.
may be obtained	Oxygen .	20 vols.	8 to 12 vols.
	Carbonic acid	39 „	46 „
	Nitrogen	1 to 2 „	1 to 2 „

CHAPTER XX.

THE AIR WE BREATHE.

Properties of Air.—Composition of Air.—Composition of Expired Air.

The importance of an abundant and pure supply of air can scarcely be exaggerated. Death follows in a few minutes after total deprivation of air; while abstinence from solid food and even from water may be borne for several weeks before a fatal result occurs.

Properties of Air.—We cannot see the air, but its existence is clearly shown when on windy days it is in active movement. Like other substances, it is possessed of weight, and, in consequence of its weight, exerts pressure uniformly in all directions. This pressure is equal to about

15 lbs. on every square inch, or about 14 or 15 tons on the body of a man of average size. The pressure is equal in all directions. Thus there is pressure outwards by the air in the lungs, as well as pressure inwards by the external air ; so that under ordinary circumstances we are unaware of its existence.

The atmospheric pressure is ordinarily measured by the **barometer.** In this instrument a long glass tube, 1 inch in diameter, is filled with quicksilver, and then, the thumb being placed over the open end, the tube is inverted in a vessel containing quicksilver. The quicksilver in the tube does not sink to the level of the quicksilver in the vessel, but remains about 30 inches higher, and the weight of this column of quicksilver is equivalent to the atmospheric pressure on one square inch of surface at the time of the experiment. Cold air is heavier than warm air, and dry air is heavier than moist air. Hence the barometer gene-

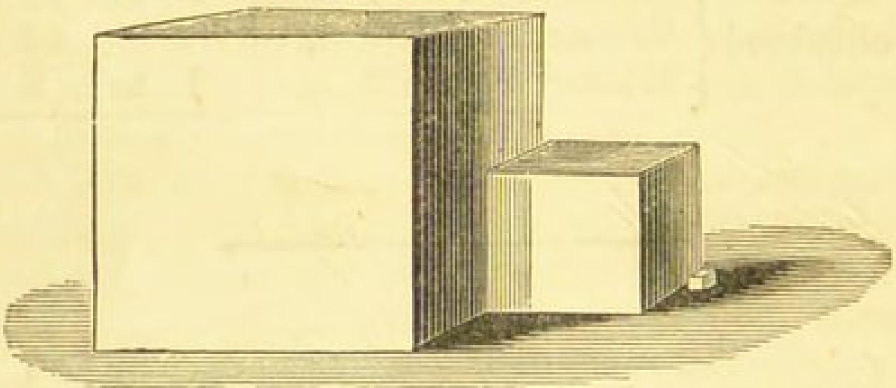


FIG. 27.—*Proportions of Nitrogen, Oxygen, and Carbonic Acid in Air.*

rally stands higher when the air is dry and cold than when it is moist and warm.

Composition of Air.—Air consists of a mixture of 20·9 volumes of oxygen to 79·1 of nitrogen, with a very much smaller amount of carbonic acid, aqueous vapour, and other constituents. In the above figure the large cube represents the bulk of nitrogen, the next in size the bulk of oxygen, and the very small cube the bulk of carbonic acid in the air.

The nitrogen and oxygen are not chemically combined, but only mixed in the air. The nitrogen serves the purpose of a diluting agent ; the oxygen is necessary for life, and is absorbed from the lungs into the blood at each breath.

Ozone is a more concentrated form of oxygen, in which three volumes of oxygen are condensed so as to occupy two volumes. In this condensed form it possesses powerful oxidising properties. Many putrefying matters when thus oxidised become harmless; hence ozone has been called *the scavenger of the air.* Ozone is only present in very pure air, as at the seaside, or in mountainous or rural districts. It is generally absent from dwelling-houses and in towns. It may be produced on a small scale by hanging a piece of moist phosphorus in a room.

Aqueous Vapour is always present in air, though the amount varies greatly. When condensed it becomes visible, as cloud or fog, rain, snow, hail, or dew. If the air contains as much moisture as it can take up, it is said to be *saturated.* The higher the temperature the more water can be evaporated before the point of saturation is reached.

The amount of aqueous vapour present in air varies greatly, but forms on an average about $1\frac{1}{2}$ per cent. of its total volume. It is derived from the evaporation of water from the surface of rivers, seas, and other large surfaces of water; and from the aqueous vapour exhaled from the soil, from plants, from all processes of burning and decay, and from the breathing of animals.

Carbonic Acid is generally present in the air in the proportion of about 4 volumes in 10,000 of air (·04 per cent.); in impure air it may be present in much larger amount. In country places it may not exceed 3·36 parts in 10,000 of air; but in the streets of busy towns may be 5 or even 6 parts in 10,000 of air. It is a heavy gas, and does not support combustion. In all animals a process of combustion or oxidation goes on, so that the presence of a large amount of carbonic acid in air which has to be breathed is detrimental to health, and, in still larger amount, may be fatal.

Carbonic acid is produced by the oxidation of all substances containing carbon, as in the burning of candles, coal-gas, coal, &c. It is also formed when organic bodies ferment or putrefy, and is breathed out from the lungs of animals as the result of the oxidation occurring in their tissues.

The air in the soil contains much more carbonic acid than that above the surface of the ground, often 8 per cent. or even more, derived from the decomposition of organic matters. From the same cause the air at the bottom of old disused wells has been known to poison men who have incautiously descended. The safest plan in descending such a well is to carry a lighted candle, holding it as low as possible. If the flame becomes faint, and, still more, if it goes out, further descent will be unsafe. The carbonic acid in such a well may be got rid of by throwing burning straw or shavings into it. The burning shavings heat the carbonic acid, and thus make it lighter. It escapes from the top of the well, while fresh air from above takes its place.

Use of Plants.—Plants keep the carbonic acid in air down to the amount found in pure external air. Their green parts under the influence of bright sunlight decompose carbonic acid, fixing its carbon, which goes to form nearly one-half of their structure, while the oxygen is liberated. Thus carbonic acid is split up into carbon *plus* oxygen; or

$$CO_2 = C + O_2.$$

A small amount of carbonic acid is given off by plants, especially by flowers and ripening fruits, but this does not prevent plants from acting on the whole as great purifiers of the air. At night plants do not give off oxygen, so it is not advisable to keep them in bedrooms.

The atmosphere contains about one part of ammonia in a million of air, also traces of nitrous and nitric acids. These form important plant-foods when washed down by rain.

Expired Air.—The act of breathing is repeated by man about 17 times per minute, each time about 30 cubic inches of air being inspired, and a nearly equal amount of vitiated air expired. The expired air differs from the inspired in the following particulars :—

(1) It is *heated.* In its passage through the lungs it has acquired a temperature closely approaching that of the blood (99° to 100° Fahr.).

(2) It is *moister* than the external air. This is easily demonstrated by breathing on a cold surface of glass. At least half a pint of water is given off from the lungs in the form of vapour each day.

(3) The proportions of oxygen and carbonic acid are altered. Thus in every 100 parts by volume

	Oxygen.	Nitrogen.	Carbonic Acid.
Inspired air contains	20·86	79·1	·04
Expired " "	16·12	79·5	4·38

The oxygen is greatly diminished and the carbonic acid is greatly increased. The amount of carbonic acid given off is greatly increased by work of any kind, so that more air is required when at work than when at rest. The average amount given out by a healthy adult is 0·6 cubic foot per hour, or 14·4 cubic feet per day.

(4) Expired air contains *organic impurities,* partly gaseous and partly minute particles. These impurities give the air of an unventilated room occupied by a number of persons a close or foul smell, and they are much more dangerous to health than carbonic acid.

CHAPTER XXI.

IMPURITIES OF AIR.

Suspended Impurities of Air.—Gaseous Impurities.—Products of Combustion.—Products of Respiration.—Effluvia from Sewers, &c.

The impurities commonly present in air may be classed under two heads—*solid* and *gaseous.*

The number and variety of **suspended particles** can be appreciated by noting the innumerable particles to be seen floating in the air of a room across which the sunlight streams. Light itself is invisible, and the course of the rays of light is only rendered visible by the particles from which light is reflected.

If we close the shutters of a room, only leaving a small round aperture through which bright sunlight can enter, the track of this beam of light is shown by innumerable suspended particles. If we next place a lighted spirit-lamp under the course of the beam of light near the middle of the room, the particles of suspended matter are destroyed at this point, and the beam of light appears to be interrupted by a black patch in its middle.

Suspended Impurities of Air.—The suspended matters in the air are either *inorganic* or *organic*. Of **inorganic suspended matters** the most abundant are common salt, sand, clay, dried mud, coal, soot, and similar substances. In certain occupations, such dusty matter has given rise to serious diseases. Thus potters, stone-masons, needle- and knife-grinders, and workers in lead and phosphorus may suffer severely unless proper precautions are taken.

Of **organic suspended matters** the most abundant are minute fragments of wood and straw, the spores and other parts of plants, and minute fragments of insects and other animal matters. Particles from the skin and lungs are found in the air of rooms. In hospitals various forms of blood-poisoning have been caused by impure particles being carried in the air from one patient to another. The antiseptic treatment of wounds is founded on the principle of filtering the air which is allowed to reach the wounds. By this means they can be kept perfectly 'sweet,' and healing is promoted. The air itself is not dangerous, but only the particles of septic matter suspended in it.

Gaseous Impurities of Air.—Gaseous impurities of the air are very commonly associated with suspended matters, and it is sometimes impossible to separate the effects of the two.

Carbonic Acid is the most frequent gaseous impurity of the air. It forms about ·04 per cent. of the volume of pure air. When it amounts to more than ·06 per cent. the air is reckoned to be impure. A much larger proportion may be borne, unless the carbonic acid is associated with other impurities of a still more poisonous character. But in dwelling-rooms carbonic acid and organic pollutions usually increase in the air in about equal proportions, so that, if we have a simple method of determining the amount of carbonic acid in a given air, we obtain a fairly correct estimate of its total impurity. This test is furnished by the fact that lime-water is turned milky by carbonic-acid gas.

If, after blowing some of the air of the room to be examined into a half-pint bottle, then adding a tablespoonful of clear lime-water and shaking the bottle, no milkiness is produced, we may conclude that the carbonic acid does not amount to 6 parts in 10,000 of air, and that the air is therefore pure.

Carbonic Oxide is a much more dangerous poison than carbonic acid, and fatal consequences have followed when it was present in air in the proportion of less than $\frac{1}{2}$ per cent. We have seen that oxygen enters into combination with the hæmoglobin of blood-corpuscles. Carbonic oxide forms a much more stable compound with hæmoglobin, displacing oxygen from the red corpuscles and thus acting as a deadly poison. It forms the most poisonous gas present in coal-gas. It is also given off where charcoal stoves are used, and such stoves without flues are always dangerous.

Coal-gas is a mixture of various gases, produced by the distillation of coal. It owes its illuminating properties to compounds of carbon with hydrogen. Coal-gas may be dangerous when allowed to escape (*a*) through forming an explosive mixture with air; (*b*) through the poisonous character of the gases contained in it. Even in small quantities the inhalation of coal-gas produces headache and other symptoms. When inhaled in larger quantities, persons have been poisoned in their sleep. When an escape of coal-gas is detected, it is important to avoid lighting a match or candle, as fatal explosions have been caused by this indiscretion. The proper plan is to turn off the gas at the meter, and then open the windows and investigate the cause of the escape. Sometimes it is simply due to evaporation of water from the chandelier. If it is due to leaky pipes, considerable skill and patience may be required before the point of escape is detected. (*c*) The products of combustion of coal-gas are also injurious. One cubic foot of coal-gas produces on combustion about two cubic feet of carbonic acid. A medium-sized gas-burner burns about three cubic feet of gas per hour, and therefore produces six cubic feet of carbonic acid per hour, or ten times the average amount produced by a healthy man in the same time. Some *sulphurous acid* is also produced by the combustion of coal-gas. It is on this account that plants do not thrive where gas is burnt. Pictures, the bindings of books, and the colours of various fabrics are also injuriously affected by sulphurous acid.

The **Products of Combustion of Candles and Lamps** are similar to those of coal-gas, with the important exception that no sulphur enters into their composition, and therefore no sulphurous acid escapes into the room. For equal illuminating power candles give more carbonic acid to the air than gas; but in practice we are contented with a smaller and more localised light from candles or lamps than from gas.

It is most important that all products of combustion should be carried directly out of the room. The re-breathing of these products causes general ill-health, accompanied

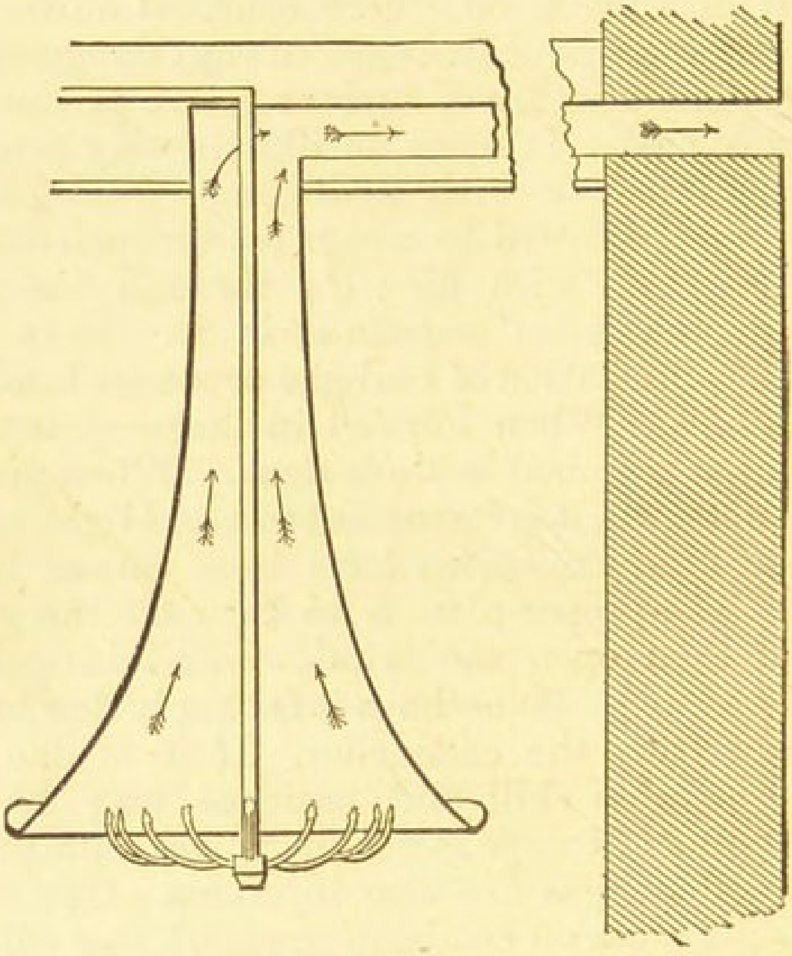


FIG. 28.—*Ventilating Gas-pendant.*

by pallor, loss of appetite, and a feeling of unfitness for work. Fig. 28 shows a simple arrangement for carrying the products of combustion into the open air.

The Products of Respiration are similar to those of combustion of coal-gas, lamps, and candles, with the addition of organic matters which render them much more dangerous. These organic matters can be smelt, and are the cause of the 'closeness,' going on to 'foulness,' that characterises the air of rooms which have been occupied for some time without free ventilation. Carbonic acid cannot be smelt, but as its amount is commonly proportionate to the amount of organic matter, it is found that the air of a room becomes distinctly close when the carbonic acid reaches 6 parts in 10,000 of air (or ·06 per cent.), and when it reaches ·1 per cent. the air is extremely close.

(*a*) When a room not sufficiently ventilated is occupied *for a few hours*, headache, languor, drowsiness, and a tendency to yawning occur. (*b*) When such exposure to foul air is *prolonged from day to day* the general strength and vigour become lowered, and the complexion becomes pale and pasty, contrasting unfavourably with the ruddy complexion of the outdoor labourer. The tendency to '**colds**' is greatly increased by living in foul air. **Consumption** has been shown to be aggravated, if not actually produced, by overcrowding and the breathing of a vitiated atmosphere, and infectious diseases spread more rapidly under similar circumstances. In hospitals and other places occupied by the sick the products of respiration are even more dangerous, and the necessity for thorough ventilation is increased. (*c*) When the products of respiration are breathed *in a concentrated condition* rapid poisoning results. In the Black Hole of Calcutta 146 persons were confined in a room 18 feet every way, with two small windows on one side. During the night 123 died, and the remaining 23 were seriously ill.

Effluvia from Decomposing Matters vitiate the air. The gases and volatile particles given off from privies and cesspools are very dangerous. Similarly when the contents of drains and sewers are not rapidly carried to their outfall, putrefaction occurs, and so-called '**sewer gas**' is evolved. This contains not only sulphuretted hydrogen and other foul-smelling gases, but also volatile putrefying particles, which, under certain circumstances, may cause serious disease. Typhoid fever, diphtheria, and other diseases have been traced to such causes.

CHAPTER XXII.

GENERAL PRINCIPLES OF VENTILATION.

Natural Forces Purifying the Air.—Winds.—Amount of Air Required.—Inlets and Outlets.

Before considering the means of ventilation employed for removing the impurities from the air of occupied rooms we may examine briefly the **natural forces** at work for the same purpose. These are—

1. Plants.
2. The fall of rain.
3. The natural movements of the air.
4. Certain constituents of the air.

Plants under the influence of sunlight absorb carbonic acid from the atmosphere and give out pure oxygen, thus maintaining the purity of the air. The active agent in this change is the chlorophyll in the green parts of plants. Plants also by their roots absorb ammonia and nitrous and nitric acid which have been washed down by rain.

The Fall of Rain clears the atmosphere of solid particles, and carries down with it sulphurous and other acids which may be contained in the air of towns.

Oxygen is *the* purifying constituent of the atmosphere, especially when present in the form of ozone. Oxidation of decomposing and putrefying matters is constantly going on, harmless products being formed.

Movements of Air are constantly being effected everywhere. The physical causes at work producing these movements are three—

1. Diffusion.
2. Differences of temperature in neighbouring masses of air.
3. Winds.

Winds are only an example on a large scale of currents of air due to differences of temperature.

Diffusion produces the rapid mixture of gases placed near each other. Air diffuses rapidly through chinks and openings in the walls and doors and windows of rooms. Bricks, and even plastered walls, allow a certain amount of air to pass through them, but papered walls only very little air.

Differences of temperature between the external and internal air are the most active cause of natural ventilation. As a rule, the air of rooms is warmer than the external air in this country. Warm air is lighter than cold air. It tends, therefore, to ascend the chimney or other means of exit; while cold air, in accordance with natural laws, is forced in to take its place. The smell of cooking in an underground kitchen is frequently perceptible in bedrooms, the warm gases being carried upwards.

Winds are caused by movements between large masses of air of unequal temperature, and consequently of unequal density. Winds are somewhat uncertain in their action. At one time the air may be nearly stagnant, at another time may blow a hurricane. The average velocity of air-movements in this country is 10 feet per second, or about 7 miles an hour. Air moving at the rate of 2 miles an hour is hardly perceptible. If we assume a man to present 9 square feet of surface to the air, and that the air travels at the rate of 10 feet per second, it follows that in the open air 324,000 cubic feet of air would flow over him in an hour. An allowance of 3,000 cubic feet of air per head per hour is considered very liberal in a living room; and yet this does not equal one hundredth part of the allowance out of doors. It is evident, therefore, that in the interest of health as much time as possible should be spent out of doors.

Winds act as purifying and ventilating agents in two ways: (*a*) by *propulsion*, driving impure air before them, or freely mixing with it; and (*b*) by *aspiration*, drawing impure air along with them.

Wind blowing horizontally over the top of a chimney causes an upward current in the chimney. When we ventilate a room by throwing wide open doors and windows, both actions of the wind are brought into play, but in particular the flushing action of the wind, foul air being driven out in front of the current of fresh air. It is evident that winds will have comparatively little effect in purifying the air of houses if the houses are situated in crowded courts surrounded by higher buildings. In such cases the houses are not freely swept by the winds, and the air is comparatively stagnant. In addition, therefore, to ventilating appliances in a house, it is necessary to supply clear space around the house in order to allow natural forces to have full play.

Amount of Air required.—We have already said that when the carbonic acid in a given air exceeds 6 parts per 10,000 of air, the air begins to be perfectly stuffy, the stuffiness being due to the organic pollutions resulting from respiration which usually accompany carbonic acid. If this standard be accepted, then carbonic acid must not be more than 2 parts per 10,000 (·02 per cent.) in excess of what is present in external air.

The problem to solve is, how much external air (having ·04 per cent. of carbonic acid) must be supplied per hour to each person in a room in order that the carbonic acid may never exceed ·06 per cent.? Now, an average adult expires ·6 cubic foot of carbonic acid per hour. The following statement in proportion will, therefore, give the amount of fresh air required by an adult per hour in order to keep the carbonic acid in the room down to ·06 per cent. :—

$$\cdot 02 : \cdot 6 :: 100 : x.$$
$$x = 3{,}000 \text{ cubic feet.}$$

In the above calculation we have assumed that carbonic acid is usually proportional in amount to the more important organic pollutions of the air; and this assumption is commonly correct. We have assumed also that ·6 cubic foot is the average amount of carbonic acid given out by each adult per hour. As a matter of fact, persons engaged in active muscular work give out much more than this; hence the importance of free ventilation in workshops, rooms for gymnastics, &c. It is usually assumed that children under 10 years of age only require half the amount of space allotted to adults, but this assumption is quite arbitrary.

Air in relation to Cubic Space of Room.—It is evident that 3,000 cubic feet of air might be supplied per hour, either by having (*a*) a small cubic space with frequent changes of air, or (*b*) a large cubic space with less frequent changes of air. If 1,000 cubic feet of space are allotted to each person—*i.e.*, 10 feet in every direction—then the air must be changed three times per hour. In schools the Education Department requires 80 cubic feet as the minimum space per scholar, and 8 square feet as the minimum floor-space allowable. In common lodging-houses 300 to 350 cubic feet per head are usually enforced; in barracks 600 cubic feet; in prisons about 800 cubic feet; and in hospitals 1,000 to 1,500 cubic feet.

It is evident that the smaller the space allowed per head, the more frequent must be the interchange of air, if it is to maintain the required standard. Hence there is an increased danger of draughts. Where the space allowed is larger, a threefold advantage is gained: (*a*) The rate of entry of air is decreased and draughts are therefore minimised; (*b*) the occupants of the room are further removed from the points of entry of air and therefore less likely to perceive any draughts; (*c*) owing to the larger air-space to begin with, a little longer time is required, even without ventilation, before the air becomes polluted.

A lofty ceiling will not diminish the necessity for sufficient floor-space, as air is apt to become stagnant in the upper parts of a room. It is very important that a room should have *a large floor-space*. The height of a room above 12 feet should be disregarded for ventilating purposes.

It must also be remembered that a room full of furniture has less air-space than an empty room.

Inlets and Outlets.—In order that the supply of air to a room may be steady and uninterrupted, an inlet for fresh air must be supplied and an outlet for foul air; and neither of these can be dispensed with.

The ordinary open fire-place forms an admirable outlet for foul air, but fresh air must also be admitted. In chimneys, down-draught may be due to the non-provision of inlets for fresh air in the room; and many a smoky chimney might be cured by simply arranging for a freer entry of fresh air into the room.

Assuming that air enters a room at the rate of 5 feet per second (half the average velocity of the wind in this country), then in one hour 3,000 cubic feet of air would enter through an aperture measuring 24 square inches; and this is the usual allowance for inlet and outlet openings for each individual, making 48 square inches altogether.

It should be noted that a number of small openings are collectively not as efficient for ventilating purposes as one large opening having the same area, owing to the increased friction in the former case.

Position of Inlet and Outlet.—The best position theoretically for **inlets** of fresh air is the floor, but this leads to cold currents along the floor of an unpleasant character. It is advisable, therefore, to admit air along the wall a little more than six feet from the floor, the current of air being directed upwards by some contrivance. The staircase in most houses forms an important inlet for fresh air. The staircase window may be kept open when an open window in the dining-room could not be tolerated. The staircase should be cut off from air communication with the basement of the house, and care should be taken that the window of the water-closet is not the only open window in the house, or the ventilation of the house will be derived from this source.

Outlets are generally best placed near the ceiling of a room, and should as far as possible be enclosed within walls. The escape of impure air is greatly helped by keeping it as warm as possible, and as warm impure gases from the combustion of gas and from human respiration tend to hang about the ceiling, this is the most economical point of outlet.

CHAPTER XXIII.

METHODS OF VENTILATION.

Natural and Artificial Ventilation.—Ventilation by Window, by Walls, by Ceiling, by Chimney.

Whatever methods of ventilation are adopted, two points must be borne in mind. (1) However well a room is

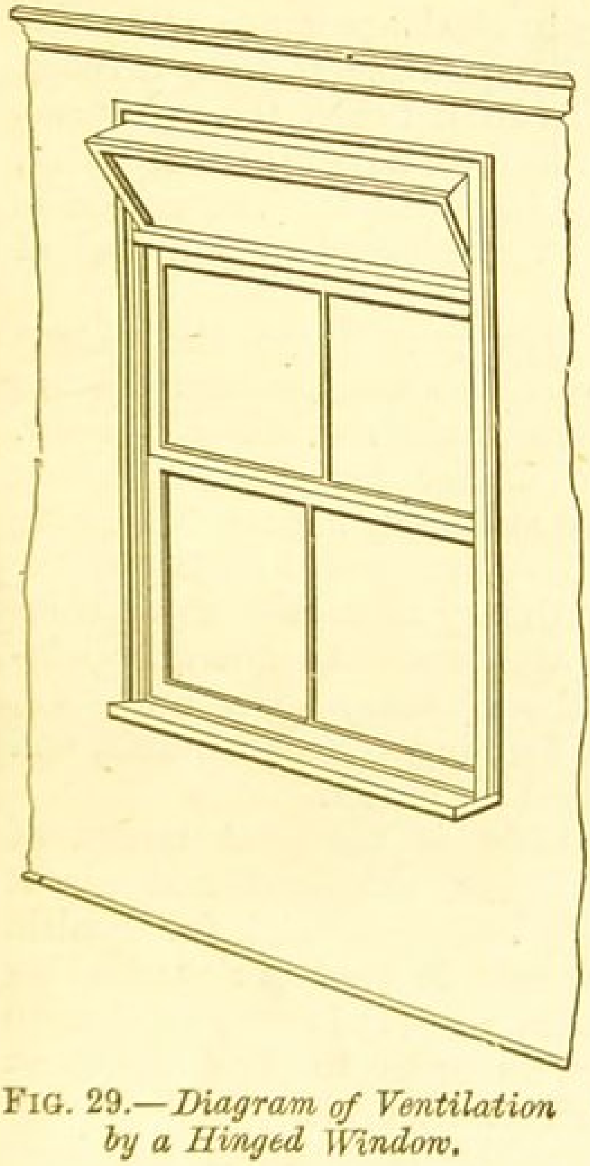


FIG. 29.—*Diagram of Ventilation by a Hinged Window.*

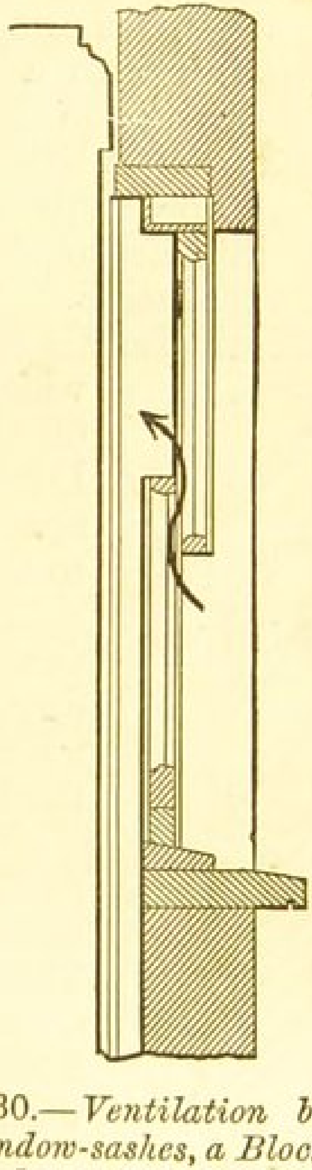


FIG. 30.—*Ventilation between Window-sashes, a Block being fitted under the Lower Sash.*

ventilated, it will still smell 'stuffy' if not kept clean. Dirty carpets or curtains, walls or ceilings which have not been cleansed for years, and furniture or clothing in a dusty or foul condition will make the best ventilated room unwholesome. (2) In addition to the ordinary means of ventilation, it is necessary to *flush each room with fresh air*, by throwing windows and doors wide open whenever it is left unoccupied. By this means solid particles floating in the air, as well as foul gases, are swept out of the room.

Two kinds of ventilation are usually described—natural and artificial. **Natural Ventilation** is produced by the ordinary interchange of air when windows or doors or other ventilating openings are allowed to remain open. **Artificial Ventilation** is that produced by the help of heating apparatus or some mechanical appliance, either for propelling air into a room or aspirating it from a room. No rigid distinction can be drawn between the two forms of ventilation. A lighted fire forms an admirable ventilator, but as no apparatus specially intended for ventilation is brought into action, it may be considered as a means of natural ventilation.

Natural Ventilation is only possible to the extent which is desirable when the temperature of the external air reaches 55° Fahr. During the winter months ventilating apertures are commonly kept closed, owing to the cold draughts caused by them.

FIG. 31.—*Louvre Ventilators.*

In an ordinary room, the three chief ventilating agents are the door, the window, and the chimney; the first two, when open, forming fresh-air inlets, and the last, a foul-air outlet.

The Window is the best means of purifying a room, the light and air it admits being both essential for health. The window may be used as a ventilating agent as follows:—(1) It may be thrown widely open, in order to *flush the room* with fresh air at intervals.

(2) The upper segment of the window may be made to **work on a hinge**, triangular pieces of glass being placed at the two sides of the window to prevent down-draught. By this means the current of air is directed upwards.

(3) A **block of wood**, two or three inches wide, may be inserted at the bottom of the window-sash, and then the window pulled down on this. Air is then admitted between the two sashes, the current of air being directed upwards.

(4) The top sash of the window may be lowered, and some **zinc gauze** fastened across the open part. Thus air is admitted between the two sashes and through the gauze. But the amount of air entering through a number of minute openings is very much less than through a single

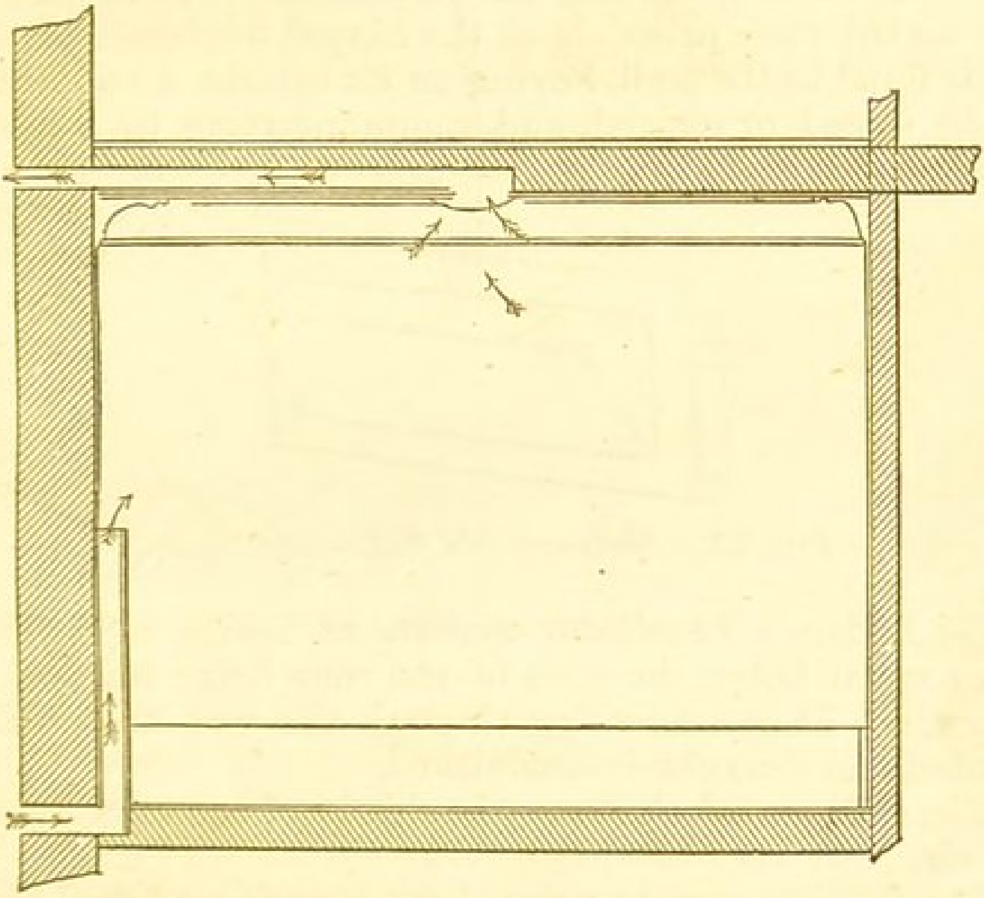


FIG. 32.—*Diagram showing Inlet Ventilation by Tobin's Tube, and an Outlet-shaft leading from Centre-flower of Ceiling.*

opening having the same area as the aggregate of the small openings.

(5) In **Louvre Ventilators** parallel pieces of glass are substituted for a single pane of glass, and the current of air may be directed upwards by inclining the pieces of glass in an upward direction.

The **Walls** of a room may be utilised for ventilating purposes: (1) by **Tobin's Tubes**. In these a grating communicating with the external air is inserted in the wall near the floor. It is connected inside the wall with a vertical tube, by which a vertical direction is given to the incoming air.

In order to prevent particles of dust and soot entering the room through the tube, cotton-wool or gauze is sometimes stretched across the tube. This, however, to some extent diminishes the current of air.

(2) **Sheringham's Valve** is a more convenient way of ventilating through the wall, and, the channel being shorter than that of Tobin's tube, the ventilation is more efficient. It is on the same principle as the hinged window. An iron box is fixed in the wall, having on its interior a valve which can be closed or opened, and communicating by a grating with the external air.

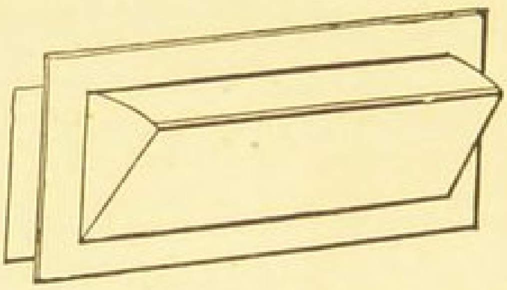


FIG. 33.—*Sheringham's Valve-ventilator.*

(3) **Ellison's Ventilator** consists of bricks, each pierced with conical holes, the apex of the cone being towards the outer air. Thus air coming through the wall becomes distributed and draught is diminished.

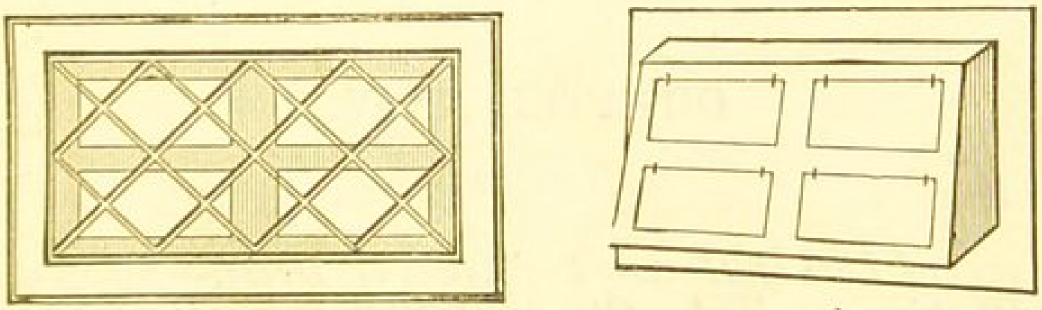
The ceiling and chimney are chiefly of use as outlets for foul air.

The Ceiling may be utilised for carrying off foul air as shown in fig. 32. It is very desirable also that the products of combustion of gas should be carried out of the room as they are produced. This is done by enclosing the gaslight in a cylinder, which communicates either with the external air or the chimney-flue. By this means it forms a valuable aid to ventilation, as shown in fig. 28.

In large buildings **cowls** are commonly placed on the roof, communicating with the interior. These cowls act in the same manner as chimneys, allowing the escape of foul gases and tending to increase the up-current of air.

The Chimney forms the best means of escape for foul air. No room should be built without an open fireplace, and in bedrooms the chimney should not be allowed to be boarded up or the register closed. Even when no fire is burning there is, as a rule, an up-current of air. When a fire is burning, from 5,000 to 15,000 cubic feet of air pass up a chimney per hour. It is evident, therefore, that it forms a very powerful extraction shaft.

The impure products of combustion of gas, &c., and of respiration, being warm, tend to accumulate near the ceiling. It is therefore important to allow their escape into the chimney-flue at a higher point than the fireplace. (1) **Dr. Arnott** first devised a valve for this purpose. An iron box was placed in the wall, having a light metal valve capable of swinging towards the chimney-flue, but not towards the room. This apparatus has been found to be objectionable, because it makes noisy clicks, and it admits blacks from the chimney when out of order.



a b

FIG. 34.—*Boyle's Mica-flap Ventilator.*
a, *View from room;* b, *View from chimney.*

(2) In **Boyle's Valve** thin talc plates take the place of the iron valve, as shown in fig. 34.

It would be very useful if a **separate smaller flue** were built alongside every chimney, not communicating with the chimney, but having an inlet from a room on each storey at a point near the ceiling. The chimney-flue would keep the smaller flue warm, and cause an up-current, and thus draw the foul air out of each room in succession.

Artificial Ventilation is not much used in private dwelling-houses. In large buildings, such as schools, it is almost indispensable, the most common plan being to combine ventilation and heating by one process. Thus fresh air is admitted over hot-water or steam pipes, and by this means warmed at the same time. Some of the means of warming incoming air for private houses will be described hereafter (page 181). When in large buildings hot-water or steam pipes are carried around the room or arranged in coils without any provision for admitting cold external air over them, it is evident that the vitiated air of the room will be warmed over and over again. Such a system is most pernicious. Windows are not opened, as cold draughts immediately arise; consequently the air is very impure. The only method by means of which during wintry weather ventilation can be secured without draughts is to warm the incoming air by passing it over the pipes or other source of heat as it enters.

CHAPTER XXIV.

CLOTHING.

Sources of Loss of Heat.—Requisites of Dress.—Amount of Clothing required.—Children's Clothing.—Materials for Clothing.

The average temperature of the surface of the body in man is about 98·6° Fahr.; and, whatever may be the external temperature, the bodily heat never varies more than about one degree. The maintenance of a tolerably uniform temperature is an essential condition of life.

This temperature is regulated by the maintenance of an equilibrium between—

1. The amount of heat produced and
2. The amount of heat lost

If more heat is lost, more has to be generated. The source of body-heat is the oxidation of nutritive material within the body. This nutritive material is derived from the food, consequently more food is required in winter than in summer. But even apart from changes in the temperature of the air, there are variations in the amount of heat lost, and therefore in the amount of food required, according to the amount of exercise taken and the amount of clothing worn.

Heat is lost (1) by the *skin*; (2) in *respiration*, the expired air having been heated during its stay in the lungs; (3) with the *food and drink* taken, if these are taken cool; (4) with the *excreta*; and (5) by transformation of heat into *mechanical motion* during exercise. Of the whole loss by these different channels, probably 80 to 90 per cent. is through the skin.

The **Loss of Heat by the Skin** is in three different ways—(1) by *conduction*, as when the skin comes in contact with anything colder than itself; (2) by *radiation* into space; and (3) by *evaporation* of the perspiration. Even when the perspiration is not sufficiently great in amount to be visible, it causes a considerable lowering of temperature.

The relative amount of these three methods of loss of heat by the skin varies under different circumstances; when one is increased another is diminished by way of compensation. Evaporation is greatest in hot weather, while in cold weather radiation and conduction of heat are increased, and evaporation diminishes, thus counterbalancing the increased loss from the two other sources. More heat is conducted away from the body in damp than in dry weather, moisture being a good conductor of heat. If one were to sit clad in a bath of water at 60°, it would be uncomfortably cold, but air at the same temperature is fairly warm. The greater the difference between the temperature of the body and that of surrounding objects the greater is the amount of radiation. In a hot room one naturally fans, as in such a room the loss by radiation is small, and the act of fanning increases the evaporation and conduction of heat.

The loss of heat is greatly diminished by the use of clothing, and this diminution of loss of heat is the chief object of clothing. The protection afforded by houses and the radiation of heat from fires, &c., also economise the loss of heat from the body. These will be considered in Chapters XXVII. and XXVIII.

In addition to (1) maintaining *warmth*, clothing (2) affords *protection* to certain parts of the body (as the feet) from injury ; (3) it is used for purposes of *ornament* ; and (4) by all civilised nations for the sake of *propriety*.

It should be noted that no clothing is *warm* or *cool*, in virtue of its own properties. It is only warm if it retains the heat of the body ; and cool if it allows this to escape. A cold stone wrapped in a blanket will remain cold ; but a hot brick similarly encased will remain hot much longer than if left exposed to the external air.

Requisites of Dress.—1. The first and most important requirement is that *clothing should maintain a uniform and equable temperature in all parts of the body.*

In hot climates clothes are required in order to protect the body from external heat. In this country they are chiefly required to prevent the too rapid escape of heat from the body. For both these purposes dress must be of a *non-conducting material*. The loss of heat by the skin may be prevented by interfering with radiation or conduction of heat, or with evaporation from its surface. Radiation of heat from the skin is prevented by clothing, the dress taking the place of the skin as a radiating surface. Hence, if the dress material is a bad conductor of heat, loss of heat by radiation will also be greatly diminished. Woollen goods are much warmer than linen, largely because of their poorer conducting power for heat (if linen = 100, wool = 50 to 70).

The *colour of dress* has no influence in regulating the loss of heat except in the case of outer clothing. Thus, red flannel, contrary to the old superstition, has no superiority over white flannel of the same quality and thickness ; but a black coat absorbs more heat than a light-coloured one. Hence a person dressed in black feels much warmer in the sun than if dressed in white materials of the same texture and substance.

In order to maintain an even temperature, *clothing should be evenly distributed* all over the body. Very commonly the middle part of the body is overladen with clothing, while the limbs and the root of the neck are insufficiently covered. Children, in particular, should have the limbs covered and the neck protected well above the level of the collar-bones. The apex of each lung rises a little diztance above each collar-bone. This is the part of the lung most prone to be attacked by consumption (tubercular disease), and it is therefore very important that it should be well protected by clothing. The low-necked dresses of children and women are contrary to all the rules of health.

In female attire the method of clothing is very unhygienic. The trunk, especially below the waist, is overladen with layers of apparel, while the neck and upper part of the chest are left comparatively bare, and the legs are but imperfectly protected. The adoption of 'combination' under-garments for women, and of sleeves and leggings for young children, is a most desirable reform. It would ensure a more uniform distribution of heat, and would doubtless greatly diminish the diseases resulting from exposure to cold.

2. *Clothing should not interfere with perspiration.* Those materials which soon become wetted by perspiration are cold as compared with others which are able to absorb moisture easily without their surface becoming wetted, because water or any moist material is a good conductor of heat. Thus, with a flannel vest the liability to chill is much less than with a cotton vest, and still less than with a linen vest. Although woollen materials diminish the risk of chills, they do not remove it entirely, especially when the perspiration is excessive. After exercise in which free perspiration has occurred, it is important not to sit in a cold room or exposed to a draught, and, if possible, to rub the chest with a rough towel so as to free it from perspiration.

Waterproof clothing, being non-porous, prevents the escape of perspiration, and is therefore injurious when worn for a long time, unless provision is made for free ventilation under the waterproof material. The body becomes enveloped in a vapour bath composed of its own perspiration. For a similar reason indiarubber boots are objectionable, except for short periods : they make the feet damp, and even sodden. Sealskin jackets are objectionable for walking, not only because of their weight, but because they are not porous.

3. *The clothing should not be tight;* and this for three reasons :—

(*a*) *Loose clothing is warmer than tight,* as everyone has experienced in the case of gloves. It is a very mistaken notion to suppose that clothing is an apparatus to keep the air out. Those textures are the warmest which are the most permeable to air. Air is a bad conductor of heat; the tighter the clothing, the less air it contains in its meshes, and consequently the cooler it is. The imprisonment of air in the meshes of the material largely explains the warmth of eider-down quilts, furs, and flannels as contrasted with linen.

(*b*) Clothing should not be tight, in order *to avoid interference with the action of muscles.* Tight *sleeves* prevent the muscles of the arms and chest from being exercised. Tightly laced *corsets* similarly imprison the trunk muscles, prevent their free exercise, and so lead to muscular weakness and occasionally spinal curvature. So-called lateral curvature of the spine (fig. 35) occurs chiefly in girls from sixteen to twenty years old. It is in large measure due to sitting at badly arranged desks and seats, and to weakness of the muscles of the back. The latter is caused by the imprisonment of the trunk in corsets, preventing their free exercise. They consequently become weak, and are unable to support the spinal column in its proper vertical position.

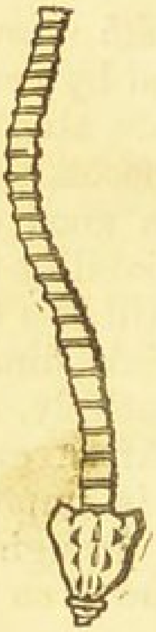


FIG. 35.—*Showing Lateral Curvature of the Spine towards the Left, in the Dorsal Region.*

Tight *skirts* prevent free play of the lower limbs, leading to a halting gait, a diminished amount of exercise, and all the evils following deficient exercise. Tight clothing is, however, not confined to one sex, and in all cases is injurious to health.

Tight boots and shoes are injurious (1) because they destroy the natural elasticity of the movements, and confine them within narrow limits, thus acting to some extent the part of splints; and (2) because they produce various deformities. During childhood they are very apt to produce permanently weak ankles. Moreover, by interfering with the circulation of blood through the feet, they cause cold feet, and not uncommonly chilblains. When being measured

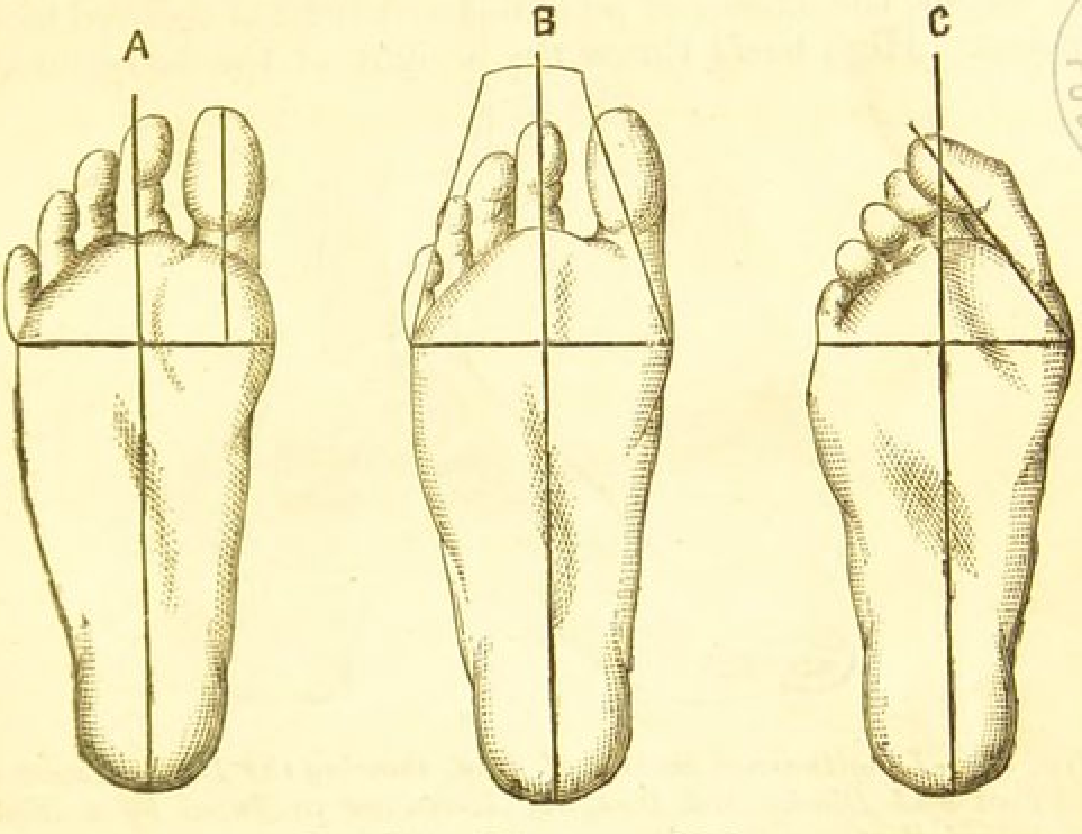


FIG. 36.—*Diagrams of Foot.*

A, *Normal foot;* B, *Normal foot, showing the lack of adaptation of the ordinary-shaped ready-made boot to it;* C, *Deformed foot, the result of such a boot.*

for boots, it is advisable to insist on the outline of the foot being taken on a piece of paper, while standing with the whole weight of the body on the foot in question. This ensures that full allowance will be made in the width and shape of the boot, for the spreading out of the foot which occurs when walking. It is particularly important that sufficient width should be allowed between the ball of the great toe and the little toe. Again, the outline of the boot should be a straight line forward from the ball of the great toe to its tip. If the boot curves towards the centre of the foot as shown at B (fig. 36), the great toe gets deviated from its normal position (C, fig. 36), and the foot becomes deformed. Corns and bunions are commonly also induced.

High-heeled boots are extremely injurious, as they do not allow the natural elasticity of the foot to come into action. This accounts for the uncertain and ungraceful gait of many ladies. Supposing the heel of the foot can rise 6 inches from the ground in walking, if the boot-heel props it up $1\frac{1}{2}$ inches, the extent of possible movement is reduced to $4\frac{1}{2}$ inches. High heels throw the weight of the body on the

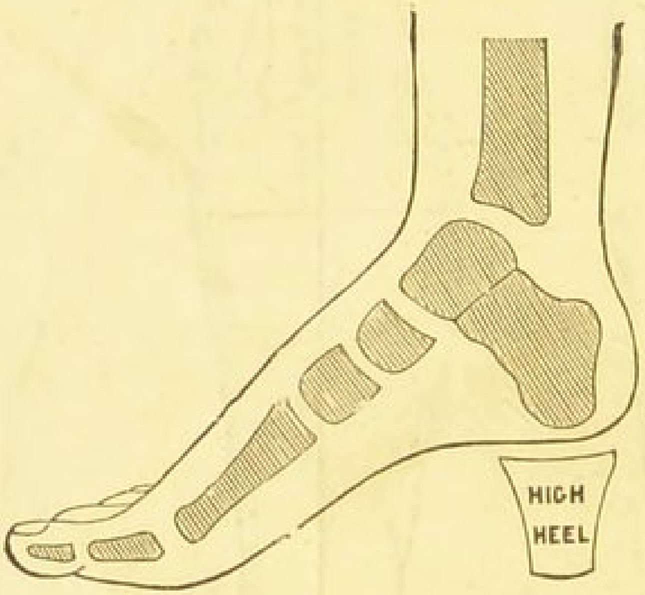


FIG. 37.—*Longitudinal Section of Foot, showing the Displacement of Foot and Diminished Range of Movement produced by a High-heeled Boot.*

front part of the foot; consequently the balance of the body is disturbed, and more strain is thrown on the muscles of the back. This may in extreme cases lead to spinal curvature, while corns and bunions are common consequences.

Thinly soled boots are very objectionable. They tire the feet after walking much more than a stout sole, and they are liable to admit moisture. There is a great sympathy between the feet and the throat and lungs, and sore throats and chest-affections are frequently due to damp and cold feet.

(*c*) Tight clothing tends *to impede the functions of circulation, respiration, and digestion.* No fashion interferes to such an enormous extent with important functions of the body as tight lacing.

This produces (i.) *compression* of the lower lobes of the lungs and of the liver and stomach, and at the same time the two latter organs are *displaced* downwards. Indigestion is a frequent result. Not only are the important functions of the liver impeded, but discomfort occurs after a sufficient meal has been taken, there being no room left for the necessary expansion of the stomach. This leads to the taking of an insufficient amount of food. The pressure

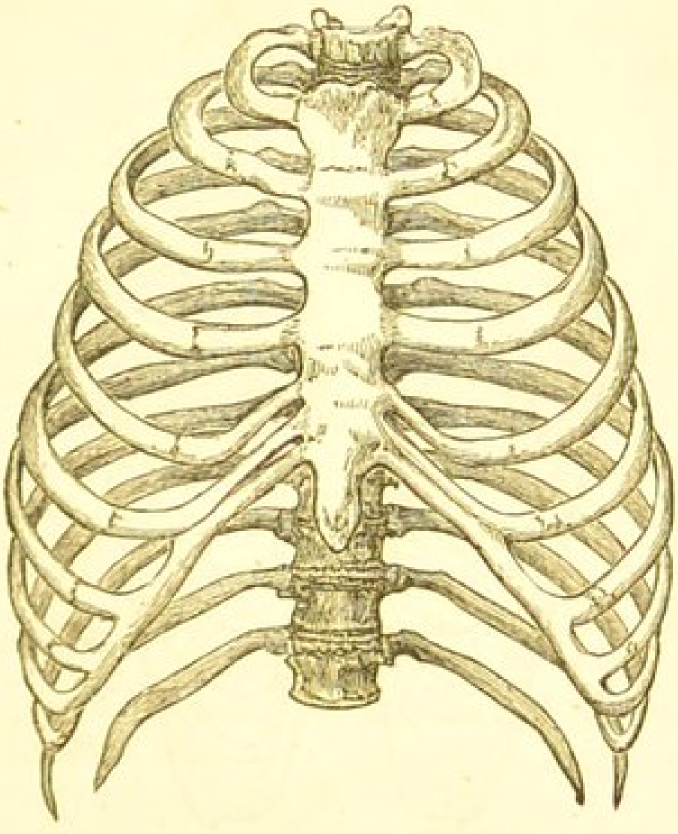


FIG. 38.—*Normal Chest.*

also produces a sense of oppression, for which stimulants are often taken, thus in some cases leading to the habit of tippling. (ii.) *Respiration* is interfered with. Not only is full expansion of the lower part of the lungs rendered impracticable, but as the compression occurs around the points of attachment of the diaphragm, the contraction of this muscle is hampered, and respiration is imperfectly performed. If a young woman, in the absence of serious disease, cannot walk quickly without getting out of breath, and cannot mount stairs without panting, there is strong presumptive evidence that she is laced too tightly, however much she may protest to the contrary. No one guilty of this pernicious practice will acknowledge the fact. (iii.) If, in addition, the nose shows a bluish tint near its tip, the evidence of tight-lacing is strengthened. This is owing to some obstruction of circulation, in addition to interference with the proper aeration of the blood. (iv.) The muscles of the trunk, being tightly encased, are incapable of movement, and consequently tend to waste. (v.) The general outline of the trunk is altered: instead of the waist being elliptical, as it naturally is, it becomes nearly

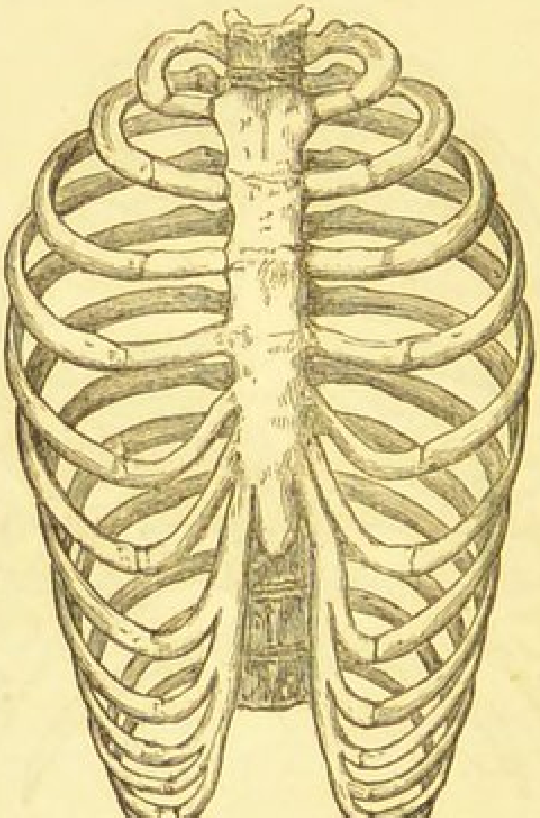


FIG. 39.—*Chest Deformed by Tight Lacing.*

circular; a disfigurement which emphasises the statement that 'the girdle of beauty is not a stay-lace.' No adult woman's waist should measure under 24 inches in circumference, and this is only permissible to slender women. The rule of beauty is that the waist should have a circumference twice that of the throat. The celebrated statue of Venus de Medici, which is the acknowledged type of beauty, has a waist of 27 inches, the height of the figure being 5 ft. 2 in. Compare this with some fashionable modern waists, which measure as little as 18 inches, and in their wasp-like proportions are as destructive to beauty as they are to health.

Garters are another constricting agency to be carefully avoided. They may cause varicose veins of the legs (as may also tight-lacing) by impeding the circulation, and for a similar reason cold feet are not infrequently due to them. Stockings are best supported by suspenders from above.

4. *The weight of the clothing should be properly distributed.* The shoulders and hips should share in the suspension of clothing, and the waist should be relieved from the weight of clothes. Supporting the skirts from the waist alone is injurious, as important organs are displaced and compressed; this effect is not entirely prevented by fastening them over the corset. The clothes should be as light as possible, consistently with warmth. If made to fit each limb separately, the amount of material required is diminished. Petticoats afford but a poor protection against cold. A much smaller quantity of clothing fitted to each individual limb is equally warm.

5. *Elegance of dress*, though not so important as utility, is not to be neglected, and the two are perfectly compatible. In fact, the two commonly go together; for a dress which obstructs the movements of the body produces a gait which is far from elegant; and a sudden constriction, such as is seen in a very tight waist, is not only hygienically bad, but is also ugly.

The **Amount of Clothing required** varies with circumstances.

1. *Healthy persons* require less than the feeble. It should be remembered that within certain limits, if heat is preserved by clothing, less food is required, and that *a distinct saving of food is effected by warm clothes.* Warm clothes are the equivalent of so much food that would have been required to keep up the temperature of the body, if the clothing had not been worn. Thinly clad persons, when undergoing starvation, die much more quickly than those who are better protected.

2. *Climate and season* necessitate the adaptation of clothing to varying temperatures. Clothing in our variable English climate ought not to be changed according to the month of the year, but according to the actual weather. The sudden changes of temperature in spring and autumn

can only be safely guarded against by wearing woollen underclothing.

There is considerable danger in assuming summer clothing too early in the spring and continuing it too far into the autumn. The statement of one authority, that winter clothing should be put off on Midsummer Day and resumed the day after, is simply an exaggeration of a caution that needs to be emphasised.

3. **Age** affects greatly the power of resisting cold, which is least at the two extremes of life.

Aged persons have a feeble circulation, their power of production of heat is small, and it is important that they should be well clad in woollen garments, the extremities especially requiring full protection from cold. In cold weather aged persons and young children die in numbers altogether out of proportion to those at intermediate ages. A degree of cold that would act as a useful tonic to the robust and middle-aged produces serious and even fatal depression of the vital powers in young children and aged people. For the same reason it is inadvisable to continue the use of cold baths as age advances.

Infants require careful protection from external cold, and young children should not be allowed to go about in cold weather with bare arms and legs, and ofttimes bare shoulders. It is a great mistake to think that children ought to be 'hardened' to the influences of cold, and that too much clothing 'makes them tender'; though when children are actively playing about, some of the outer garments should be removed to prevent overheating. When children's arms and legs and a large portion of the neck are exposed, a great amount of heat is lost from these bare surfaces. There is thus (1) *danger of chill*, resulting in sore throat, or rheumatism, or bronchitis, or other chest-affection, according to the particular weakness of the child. (2) *A larger amount of food is required* to compensate for this excessive loss of heat, and to maintain the bodily temperature. Now, children not only (*a*) have to maintain a uniform temperature, but also (*b*) have to build up their rapidly-growing tissues and organs. It follows, then, that with equal amounts of food, those whose bodies are unnecessarily exposed to cold will be more stunted in growth than others who have abundant clothing. If the food taken is expended in preserving the warmth of the unprotected body, it cannot be utilised for the purpose of growth. Gutter children are often pointed to as demonstrating the utility of the hardening process. It is forgotten, however, how many of these poor children have perished under the hardening system, and that the good health of those remaining in spite of the hardening is really due to the survival of the fittest.

Young children should wear flannel night-gowns, as well as flannel or woollen during the day, and weakly adults should wear woollen under-garments throughout the whole year, as they can now be obtained of any thickness to suit different seasons of the year.

There is another important reason why children require more clothing than adults. *The younger a child the larger its surface as compared with its bulk*, and therefore the larger the surface from which heat may escape. Thus, a cube 1 inch each side has 6 square inches of surface to 1 cubic inch of bulk ; while a cube 10 inches each side has 600 square inches of surface to 1,000 cubic inches of bulk. The relationship between surface area and cubic contents varies with the shape of the body. Speaking generally, the volumes of bodies similar to each other in shape, increase more rapidly than their surfaces.

In the accompanying diagram another illustration is

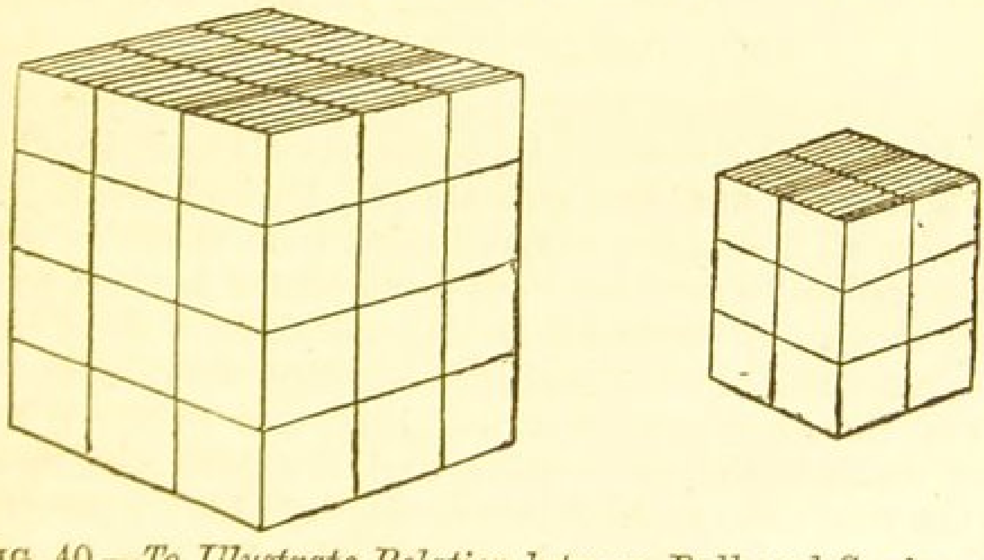


FIG. 40.—*To Illustrate Relation between Bulk and Surface Area.*

given. The smaller block, containing 12 cubic feet, has a surface area of 32 square feet. The larger block of 36 cubic feet has a surface area of 66 square feet. Thus, while the cubic contents of the first block are one-third those of the second, its surface area is nearly one-half that of the second.

Materials for Clothing.—The materials used are derived partly from the vegetable world, as hemp, flax, cotton; and partly from the animal world, as silk, wool, hair, feathers. The most important materials are wool, silk, cotton, and flax.

CLASSIFICATION OF PRINCIPAL CLOTHING MATERIALS.

I.—Animal:—

1. Wool, the hair of sheep, goat, alpaca, or vicuna.
2. Hair, of horse, camel, &c.
3. Silk, from cocoon of silkworms.
4. Furs, the dried skins of animals with hair left on.
5. Feathers, used chiefly as ornaments.
6. Leather, the tanned skin of animals.

II.—Vegetable:—

1. Cotton, the lining of pod of cotton-plant.
2. Linen, from fibres of stem of flax-plant.
3. Hemp }
4. Jute } Fibres of plants, used for mixing with flax and silk in manufacturing certain coarse fabrics.
5. India-rubber, hardened juice of tree used in waterproof goods.

Several varieties of **wool** are employed for clothing.

1. *Wool from the sheep* is a soft elastic hair, its fibres being 3 to 8 inches long, and about $\frac{1}{1000}$ inch thick. Its fibres, like all hairs, are covered with minute scales overlapping each other. This causes the outer surface to be slightly rough and irritating to delicate skins. Wool is by far the most useful and healthful clothing we possess. It is one of the worst conductors of heat, and does not soon become moist with perspiration, and for these reasons ensures the wearer more certainly against chill after perspiration than any other material. *Flannel* is a woollen fabric of open make, and is most valuable for underclothing.

2. *Cashmere* is made from the very fine hair of the Thibet goat.

3. *Alpaca* is obtained from the fleece of the llama, alpaca,

and vicuna. It has soft, long fibres capable of taking a high finish.

4. *Mohair* is obtained from the hair of an Asiatic goat, and is used for making plush, braid, &c.

Merino for vests should consist of wool, but usually contains a considerable admixture of cotton, which renders it a much less perfect article of dress for wearing next to the skin. Knitted vests made of fine wool with coarse needles are very good for winter wear, and home-knitted stockings of woollen material form the best protection for the feet.

Leather is prepared from the skin of animals (the hairs and epidermis having been previously removed) by sub-

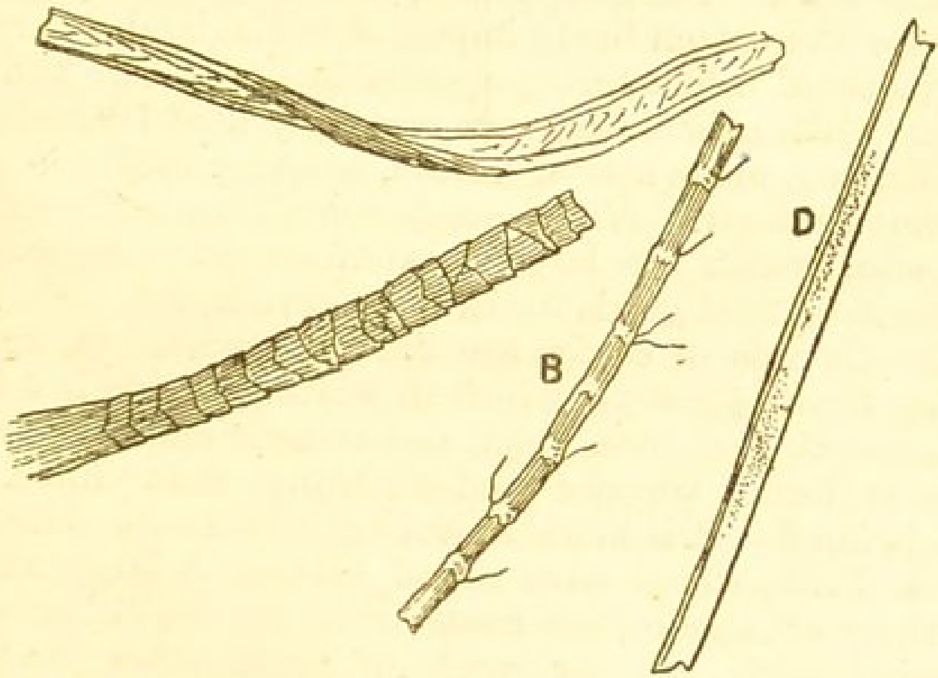


FIG. 41.—*Fibres of Cotton, Wool, Linen, and Silk, magnified about 800 times.*

A, *Cotton;* B, *Linen;* C, *Wool;* D, *Silk.*

jecting it to the action of tannin—as, for instance, by steeping hides in a strong solution derived from oak-bark. It forms a sort of natural felt, which is impervious to moisture.

Silk is the thread spun by the silkworm to form its cocoon. It is composed of minute round fibres, each about $\frac{1}{2000}$ inch wide, softer and somewhat smaller than the round fibre of linen. Satin, velvet, and crape are prepared from silk, but they often contain a considerable proportion of cotton.

Silk is manufactured in various parts of England, as at

Spitalfields, Derby, Macclesfield, Bradford. French silks are also largely used. *Satin* is silk so prepared as to form a smooth, polished surface ; but there are many cheap imitations. *Velvet* is a silk fabric, the pile of which is due to the insertion of short pieces of silk thread under the weft or cross-thread. Cheaper kinds contain a considerable proportion of cotton. *Crape* is made of raw silk gummed and twisted to form a gauze-like fabric. Moire, brocade, and plush are made of silk alone, or are mixed with cotton.

Cotton consists of the downy hairs derived from the pods of the gossypium-plant. The seeds are embedded in this soft coat. The gossypium-plant is grown in tropical countries, the cotton being imported to England, where it is manufactured into wearing apparel in Lancashire and elsewhere. Calico sheets are now generally used for beds, and print dresses, made also of cotton, are very cool and clean for summer wear. *Mixed goods* containing cotton mixed with wool or silk are largely manufactured. Alpacas are serviceable mixed goods for dress materials, &c.

The threads of cotton are flat and twisted (A, fig. 41), varying from $\frac{1}{800}$ to $\frac{1}{2000}$ inch in width. Cotton is a worse conductor of heat than linen, and absorbs moisture better ; hence it forms warmer underclothing than linen. Its fibres being flat it is more irritating to delicate skins than linen and silk, which have round fibres. A large number of articles of apparel are made from cotton, either alone, or mixed with silk, or wool, or some other material. Calico, fustian, jean, velveteen, corduroy, and muslin are perhaps the most important of the many fabrics made from cotton.

Linen is obtained from the fibres of the flax-plant. Cambric and lawn are very fine and thin linen materials. Damask is a variety of linen containing figured patterns, and much used for table-linen. The fibres of linen are round and smooth ; hence linen feels much more agreeable to the skin than cotton, with its sharp flat fibres. Linen is a better conductor of heat, and becomes wetter with perspiration than cotton, and still more than silk or wool ; hence 'it feels cold' to the skin, and there is more danger of chill after perspiration than with the other fabrics named. Linen is very durable, and has, therefore, been much used for sheeting; also for table-linen, collars, and shirt-fronts, because it can be made to take a more glossy appearance than cotton.

Flax is cultivated in Ireland, and to a less extent in England and Scotland. Belgium also is famous for the growth of flax.

The points of resemblance and difference between the four most important clothing materials may be gathered from the following tabular statement:—

—	Wool	Silk	Cotton	Linen
1. Shape and width of fibres	Round, $\frac{1}{1000}$ inch	Round, $\frac{1}{5000}$ inch	Flat, twisted, $\frac{1}{500}-\frac{1}{2000}$ inch	Round, $\frac{1}{2000}$ inch
2. Surface	Rough . .	Smooth . .	Rough . . .	Smooth
3. Heat-conducting quality	Very low .	Low . . .	Greater. . .	Greatest
4. Power of absorbing moisture without becoming wet (hygroscopic quality)	Great . .	Rather less	Little . . .	Very little

CHAPTER XXV.

EXERCISE.

The Muscular System.—Muscular Exercise.—Effects of Exercise on Health.—Effects of Defective and Excessive Exercise.

Our review of the functions of the body, so far as they are connected with the maintenance of personal health, has been confined hitherto to the functions of digestion, circulation of blood, and excretion of impurities from the lungs, kidneys, and skin.

It is necessary that we should now extend our examination of the functions of the body to the muscular and nervous systems, in order to obtain a view of individual life sufficiently complete for our purposes.

The Muscular System.—The bones of the body are connected with one another by joints, or **articulations,**

allowing the limbs and other parts of the body to be bent in various directions. The bones of themselves are, however, quite incapable of movement, the motive power being furnished by the muscles which cover them. The red flesh of animals is formed by a number of muscles. Each muscle has a definite arrangement, and is usually fixed at its extremities to two bones with a joint between.

When a muscle contracts, its fibres become shorter, thicker, and harder, and important chemical changes occur in its substance. Carbonic-acid gas is produced, and the blood which leaves the muscle is dark venous, while that entering the muscle is bright arterial blood. The chemical changes in the muscle produce an elevation in the temperature of the blood leaving it, and consequently muscular contraction is one of the chief agents in maintaining the body-temperature.

Each muscle consists of a number of delicate fibres freely supplied with blood from minute vessels. In the rabbit one-fourth of the whole blood of the body is contained in the muscles of the body, and probably a somewhat similar proportion holds good for ourselves. The importance of the muscles in relation to health is further indicated by the fact that in a healthy human being they form two-fifths of the body by weight, as well as by the fact that by their contractions all the movements of the body and of its parts are produced.

Each muscle has a motor nerve connected with it. If this nerve were divided the muscle would be paralysed, and, however much we wished, this particular muscle could not be voluntarily brought into action.

In addition to the red muscles of the body, there are paler 'unstriped' muscles, contained in the coats of the stomach and intestines, the bladder, blood-vessels, and some other parts. These muscles are regulated by a portion of the nervous system known as the **ganglionic or sympathetic system**, and are not under the direct control of the will. In other words, movements of the stomach and other similar parts go on without our being conscious of them.

The heart, although composed of red striped muscle similar to that in the limbs, goes on contracting at regular intervals, without being controllable by any efforts of the individual. The muscles carrying on the movements concerned in breathing may be stopped for about a minute by a violent effort, but then, whether we will or not, we are obliged to resume breathing.

Muscular Exercise.—In the strict sense of the word, *exercise* signifies the performance of its function by any organ of the body; thus digestion is exercise of the stomach, respiration of the lungs, and so on. The term is now commonly employed to signify muscular exercise, and more particularly exercise of the voluntary muscles. Muscular exercise is always going on in the involuntary muscles of the body—as, for instance, the heart, the muscles of respiration, and the unstriped muscles of the stomach and intestines and other parts. In addition to this there is voluntary exercise, as in walking or any definite work involving use of the muscles of the body which are under the control of the will. Such exercise is essential to health, as it is in the muscles that a large proportion of the oxidation processes of the body occur, on which the maintenance of the bodily temperature depends.

Exercise has important effects on health. (1) The *muscles* themselves become *larger and harder*, and more readily under the control of the will. (2) The *action of the lungs is increased* by exercise. Thus (*a*) the *air inspired is increased.* While resting a man inspires about 500 cubic inches of air per minute; if he walks at the rate of four miles an hour he inspires 2,400 cubic inches; if at the rate of six miles an hour, 3,260 cubic inches. (*b*) The amount of *carbonic acid expired is increased*, the amount varying exactly with the amount of exercise taken. For this reason it is important that work should, as far as possible, be done out of doors or in well-ventilated rooms, so that the carbonic acid given off may be removed. Otherwise work is inefficiently done, and fatigue occurs at a much earlier period. (*c*) The size of the lungs is increased, and their *vital capacity* (*i.e.*, the amount of air capable of being expired after a forced inspiration) is considerably increased.

(3) *The action of the skin is increased*, the evaporation of moisture being greater than when at rest. Owing to this increased evaporation

(4) The *temperature of the body* is rendered more equable, though not raised by exercise, the circulation being improved.

(5) The *heart's action* is increased in frequency and force, and the pulse becomes correspondingly more rapid.

(6) *Digestion* is aided indirectly by an improvement in appetite and digestive powers. Thus outdoor exercise is valuable in the treatment of indigestion. Digestion may, however, be impeded if active exercise is taken directly after meals. For persons with what is known as a 'torpid liver' exercise is of great value.

(7) Exercise does not involve any deterioration of *intellect*. In fact, a certain amount of exercise is essential for a healthy mind. Where athletes are poor scholars, it is rather because no time is devoted to mental culture, than because exercise in itself has any ill effect on the brain.

(8) The *elimination of urea* by the urine is not increased to a perceptible extent unless the muscular work has been very excessive.

Excessive Muscular Exercise produces muscular exhaustion. If a group of muscles are over-exerted for a long period, local palsy may be produced, as in the curious cramp of the hand from which clerks occasionally suffer. Persons of sedentary habits often do themselves great harm by undertaking a walking or rowing trip without preliminary training. *Competitive exercise* often overstrains the strength; and heart-disease has sometimes been produced.

Deficient Muscular Exercise leads to enfeeblement and wasting of the muscles. Oxidation processes are diminished, and the temperature of the body is not well maintained. Cold feet and chilblains occur chiefly among those who have deficient exercise, or deficient clothing, or both. Many diseases are favoured by deficient exercise, and especially so as deficient exercise generally implies living indoors in a comparatively impure air.

Drooping shoulders in children may be due to shoulder straps confining the muscles; and curvature of the spine may be due to weakness of the muscles of the back from being confined in corsets (fig. 35).

The **Amount of Exercise** taken daily by a man engaged in outdoor manual labour is estimated to be equal to the work involved in lifting 250 to 350 tons one foot high. A walk of 20 miles on a level road is equivalent to about 350 tons lifted one foot.

In taking exercise it is desirable that the clothing should not be excessive, wool being the best material. The exercise should be systematic and regular, and its amount should be regulated by individual fitness. Excessive gymnastic exercises are always harmful, and especially for rapidly-growing lads.

Exercise should be varied, every part of the body being, as far as possible, brought into action. Additional clothing should be put on when resting after exercise, to prevent chill.

Of all the **Forms of Exercise**, walking is the most generally practised and perhaps the most useful, as it brings into play most of the muscles of the body. Horse exercise and cycling are very valuable, and enable a larger amount of exercise to be taken in a given time than walking does. Rowing, cricket, and football are also very useful, if practised with discretion. Lawn-tennis and swimming are valuable forms of exercise, as the muscles of every part of the body are brought into play. Singing and reading aloud are excellent exercises for strengthening the voice and lungs.

Gymnastics can be employed to train various groups of muscles, and are useful in supplementing the more recreative forms of exercise.

CHAPTER XXVI.

PERSONAL HEALTH.

The Nervous System.—Rest and Sleep.—Habits.—Conditions necessary for Personal Health.

The muscles and all other parts of the body are under the control of the nervous system; and it is through the nervous system and the special senses, which are part of its mechanism, that we come into conscious relationship with the external world.

The Nervous System consists chiefly of a central *cerebro-spinal axis* (brain and spinal cord) from which nerves pass to every part of the body. The *sympathetic system* of nerves and ganglia is only indirectly connected with the cerebro-spinal system, and controls the organic functions of life, which are carried on apart from consciousness.

The brain and spinal cord consist of an aggregation of nerve-cells and nerve-fibres. The nerve-fibres pass outwards from the brain and spinal cord, and have two chief extremities—(1) in the muscles which control movement: these are the *motor nerves*; (2) in sensory organs, as the skin and other parts: these are the *sensory nerves*. The nerve-cells receive the impressions brought by the sensory nerves from peripheral parts of the body, and as the result of these impressions either reflex muscular contractions are produced, or consciousness and intelligence are brought into action. The organs of taste, smell, sight, and hearing are instances of a further physiological division of labour, as they serve to transmit to the brain, not the impressions of common sensation, but sensations which lead to the appreciation of taste or smell, or some external object or source of sound.

Rest and Sleep.—The exercise of any part of the body is necessarily followed by a period of repose. This period of repose is necessary in order that (*a*) the oxidised products formed during functional activity of any organ of the body may be removed by the blood and carried off by the skin, lungs, and kidneys, and (*b*) fresh nutritive material may be supplied to the organ to make good the losses sustained. Even the heart, which appears to be constantly at work, rests between each beat, the total period of its rest amounting to thirteen hours in the twenty-four. Not only for the muscles, but also as regards the brain, and the digestive and other organs, the same law of alternate rest and activity holds good.

This rest may be *partial* or *general*.

When a student takes a walk in the open air, or uses methodical gymnastic exercises, he is resting the intellectual part of his brain, and exercising his muscles. Thus partial rest is secured by *change of occupation*.

Sleep is the only form of complete and general rest; and even during sleep the heart and lungs continue their activity, the peristaltic movements of the alimentary canal do not stop, and the organs and tissues of the body are nourished and reconstructed at leisure.

During sleep oxidation is less active in the tissues, and consequently the body-temperature tends to fall. Also assimilation is very active; and therefore it is even more necessary to have the air of bedrooms sweet and pure than the air breathed during the day.

The **Amount of Sleep** required varies in different persons. Many persons accustom themselves to more sleep than is necessary. Seven or eight hours form a sufficient allowance for most adults.

Infants naturally spend the larger part of their existence in sleep. Children over two or three years old require sleep only at night; but it should be of longer duration than that for adults.

The average amount of sleep required at 4 years old is 12 hours; at 7 years old, 11 hours; 9 years, $10\frac{1}{2}$ hours; 12 to 14 years, 9 to 10 hours; and at 14 to 21 years, 9 hours per day.

Children require more sleep than adults because (1) their tissue-changes are more active than those of adults. (2) They are rapidly building up new tissues and adding to their present bulk, as well as maintaining the healthy condition of their present tissues. For both these reasons more time is required for the assimilation of fresh nutritive materials by the tissues, a process which is most active during rest.

Food should not be taken just before retiring to rest, but hunger is by no means helpful to sleep. The best plan is to allow about two hours between the last meal of the day and sleep, and this especially if animal food has been taken.

The habit of keeping late hours does not tend to longevity. Sleep during the day is not so beneficial as during the night. About one or two hours after midnight the heart's action is lower than at any other time in the twenty-four hours, indicating the necessity for rest at this time. Another objection to late hours is the fact that vitiated air is generally breathed in rooms which are artificially lit. Persons who have attained old age have generally been early risers.

Sleeplessness occurs chiefly among persons engaged in harassing occupations of a sedentary character. Thus increased exercise in the open air is one of the most important points in preventing and treating sleeplessness. Tea or coffee taken late in the evening may cause sleeplessness. Cold feet and a stuffy room are also apt to cause sleeplessness. The habit of taking drugs to induce sleep is most pernicious, and not infrequently leads to fatal results. Short of the danger of poisoning, the health is ruined and the power of the will destroyed by this habit.

The maintenance of health depends upon the normal performance of the various functions of the body, which have been already described. But health may vary in degree even when there is no actual disease, depending on differences in **constitution**. Differences of constitution are partly *acquired* and partly *inherited*. The tendency to gout, scrofula, consumption, and various nervous diseases may be inherited, though in such cases the disease may remain undeveloped if the individual lives under conditions favourable to health, and may even be entirely eradicated by living a wholesome regular life.

Habits are very potent factors in regulating health. We all know 'how use doth breed a habit in a man,' how acts become almost automatic which are frequently repeated, and how habits, although easily formed, are not easily broken. The habit of swallowing food without proper mastication leads to indigestion and other troubles. The craving for stimulants, which results in certain persons from frequent indulgence in a moderate amount of alcoholic drinks, is an instance of the dire results which may follow when the habit is allowed to overcome the will-power. Smoking is another habit which, if begun before manhood, frequently leads to a species of bondage from which the victim finds it harder to escape than the victim of alcoholic excess. In excess, smoking interferes with the appetite, diminishes bodily activity, and may lead to partial blindness.

The importance of attention to the regular action of the bowels has been already emphasised (p. 30).

It may be convenient before concluding the subject of personal health to summarise *the main conditions necessary for health.*

1. The house inhabited, and if possible the soil on which the house is built, must be dry and clean.

2. There must be no effluvia from defective drains or other sources of putrid poisoning.

3. Every room of the house must be efficiently and constantly ventilated.

4. An equable bodily temperature must be maintained by proper warmth of the house, comfortable apparel, and regular daily exercise.

5. The food should be wholesome, varied, and sufficient in quantity. Excess should be avoided. A healthy person is better without stimulants.

6. Meals should be at regular intervals, and the food should be well masticated.

7. An abundant supply of pure water should be available, both for drinking purposes and for baths.

8. Sleep should be regularly taken, and not postponed until late at night. Worry should, as far as possible, be avoided.

These points by no means exhaust the subject. Other points may be gathered by a careful perusal of this book.

CHAPTER XXVII.

THE DWELLING.

Neighbourhood.—Varieties of Soil.—Constituents of Soil.—Ground Air.—Ground Water.—Dangers to House from Soil.—Construction of House.—Means of Avoiding Dampness.—Paints and Wall-papers.—Walls and Roof.

In **choosing a house** many important points require consideration. These may be classified as follows :—

1. Site of the house.

2. Construction, with special reference to *dryness* of the house, and to its efficient *lighting*.

3. Warming arrangements of the house.

4. Water-supply.

5. Arrangements for removal of impurities, including house-refuse and sewage.

The arrangements for ventilation have been already considered (p. 141), and the cleansing of the house will receive attention hereafter.

In choosing a site for a house, where choice is possible, the *neighbourhood* should be carefully selected. This is determined largely by considerations of *rent*, and of *nearness* to the daily work of the bread-winner. In towns the latter consideration is diminishing in importance, as, owing to the large number of cheap workmen's trains, it is now possible to have daily work in the heart of a great city and yet live in a pretty cottage in a semi-rural district. Where it is necessary to live in a crowded district there is danger of the overcrowding of a family in rooms forming part of an insanitary house. Under these circumstances it is much better to live in a self-contained suite of rooms in a block dwelling, such as are provided by the Peabody Trust. Care should be taken, however, to ensure that the rooms to be occupied are not overshadowed by other rooms, and that sunlight and air have free access. For the sake of the children it is desirable that the home should not be too remote from a school, or the journey to school may be too long, especially in inclement weather. The aspect of a house should be such as to allow free access of light and air. The house should not be hemmed in closely by surrounding houses, walls, or trees. A southerly or south-westerly aspect receives most sunshine. The north aspect is the best for larders, where coolness is desirable. An easterly aspect should be avoided for bedrooms, especially for invalids.

The nature of the soil on which houses are built has considerable influence on the health of the people living in them. So also have the slope of the soil and its altitude in relation to surrounding parts.

Speaking generally, *the driest soils are the healthiest*, and therefore porous soils, which allow moisture to pass easily through them, are healthier than the non-porous. We may therefore, from a sanitary standpoint, classify soils as (1) **Porous or Permeable**, including gravels and loose sands, sandstone, and chalk; (2) **Impermeable**, including dense clays and limestones, granites, and metamorphic rocks. There are all stages of gradation between these.

Shallow low-lying gravels may contain an excess of moisture, especially when near rivers; and a house built on such a soil might not be as dry as one standing on an impervious but sloping clay.

'**Made Soils**' are to be carefully avoided as sites of houses. Such soils are commonly found in towns where previously brick-fields or other excavations existed, the cavity having been filled up with the refuse from dust-bins or the sweepings from streets. These materials contain organic matter in a state of gradual putrefaction, and no house should be built on such a site for many years.

The **slope** of a soil is of importance in relation to health. A clay soil on the side of a hill and with a southern exposure might be as dry and more healthy than a gravel soil at the bottom of the valley.

Constituents of Soil.—The soil consists chiefly of (*a*) *mineral* matter, but generally contains also a certain amount of (*b*) *vegetable* and *animal* matters. A certain amount of (*c*) *air* is contained in its interstices, and (*d*) *water*, which exists in the form of moisture and of a definite stratum of water called ground or subsoil water.

Thus the soil contains :—

1. Mineral matter in large quantity.
2. Organic matter { 1. Vegetable, 2. Animal, } in variable quantities.
3. Ground air.
4. Water { 1. Moisture, 2. Ground or subsoil water.

The soil is being constantly purified and freed from dangerous impurities by (1) processes of oxidation, and (2) the influence of growing plants. Animal matters gradually become decomposed in the soil; the nitrogenous matter is converted into nitrates, large beds of saltpetre (nitrate of potassium) being formed in India and elsewhere by this means. Ammonia, nitrates, and carbonic acid, and other ultimate products of the decomposition of organic matter, are absorbed and assimilated by plants; and thus a process of purification of the soil is being constantly carried on.

The **Air in the Soil** is much less pure than that above ground, though there is a constant interchange between the two. If a *fall of rain* occurs, the moisture percolating through the soil *drives out a certain amount of ground-air.* Similarly a fall in the barometer, or a rise in the temperature above ground, will cause movements of ground-air. A house which is artificially warmed will, unless there is free ventilation by legitimate channels, and unless the ground floors are made impervious, suck up the ground-air under the house ; and in this way foul gases from leaky drains or other impure sources have been brought into the house. Coal-gas from leaky gas-mains has been known to travel as far as twenty feet under ground, and then pass through foundations and floors into the house.

The ground-air contains a large excess of carbonic acid, often 8 per cent., or even more, and it is owing to this excess that water passing through the soil is able to dissolve a considerable amount of chalk out of it.

The **Water in the Soil** is present as moisture in the more superficial parts, and as a definite sheet of water at a deeper level.

Permeable soils, like chalk or gravel, allow the rain to percolate through to deeper strata. Impermeable soils, like clay, retain the moisture near the surface, and houses built upon them, unless specially protected, are much more liable to damp than those built on permeable soils.

The **ground-water** (or subsoil-water) forms a sheet of water at varying depths, which is in constant motion towards the outfall, into a river or sea. It is evident that the ground-water would rise if either (1) there were an increased rainfall, or (2) the outflow were blocked in some way, as by constructing a mill-dam or when a river is swollen. Similarly the level of the ground-water will fall (1) when there is a dry season, or (2) when the subsoil is artificially drained.

The ground-water slopes towards its outfall into the nearest river or sea ; and in choosing a house, a site should preferably be selected in which the basement-floor will be at least three feet higher than the highest level of the ground-water. This may be ascertained by testing the height of the water in the nearest well.

The temperature of the soil depends largely on the amount of moisture it contains. Damp soils are colder than dry soils, and so less desirable for building upon. A damp soil may be rendered drier by laying agricultural porous drain-pipes, at a certain depth, to carry off the ground water. Such drainage of the soil is particularly necessary in heavy clay soils, and in low-lying lands below the level of the nearest river. Even a clay soil may be rendered comparatively dry and warm by this means.

Surface drains should be provided to carry off rain as far as possible, so as to prevent the soil from becoming damp by percolation of water.

Vegetation, by causing rapid evaporation, tends to diminish dampness of soil, and the eucalyptus plant and sunflower appear to be particularly efficient in this direction.

Dangers to House from Soil.—Various poisons may be drawn by a heated house from the subjacent soil. Thus if the drains under a house are leaky, the poisons of diphtheria or typhoid fever may be inhaled. Damp soils have from long experience been found to favour the development of *rheumatism*, and it has been clearly proved that *consumption* (phthisis) is more prevalent on damp than on dry soils. *It is essential to health that the house should be dry.* Bricks are very porous, each one being capable of holding about a pint of water ; and if the ground is damp, the moisture may rise from brick to brick.

Thus, take eight lumps of sugar, and arrange as in the diagram. If some water is spilt on the table and allowed to touch No. 1, it will be seen to rapidly mount to No. 8.

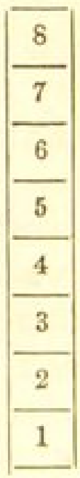


FIG. 42.

The rise of moisture from the soil is prevented in properly constructed houses by several measures.

(1) The foundation is built of *a solid bed of concrete* projecting beyond the outer edge of the walls, thus cutting off ground moisture and, to a large extent, ground air. In some cases the same end has been attained by building the basement on open arches.

(2) *A dry area*—*i.e.*, a closed chamber lined with stone or cement, is constructed around the four walls of the house below the ground level (fig. 43).

(3) *A damp-proof course* is inserted in the part of the wall nearest the foundation, being carried through the

whole thickness of the wall just above the ground-level. This is formed of perforated glazed tiles, or roofing-slate set in cement, or other materials.

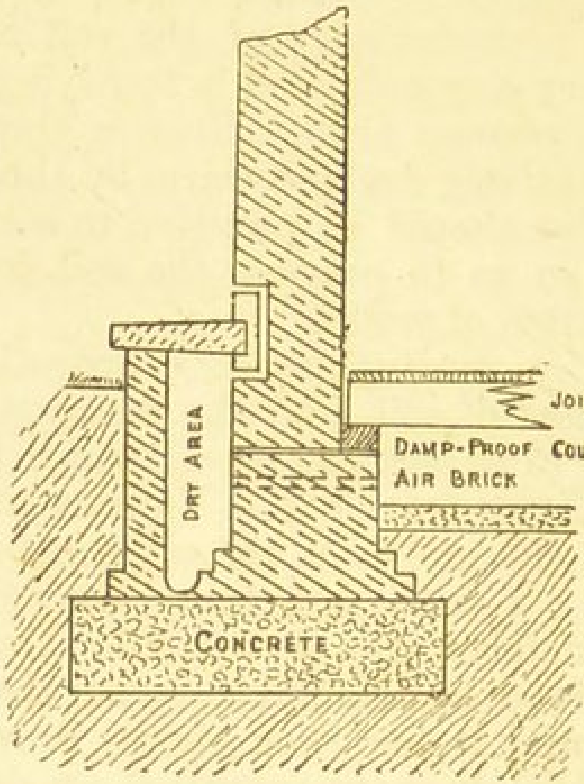


FIG. 43.—*Concrete Foundation, Dry Area, Damp-proof Course, and Ventilation under Floor.*

Construction of the House.—*Bricks* are the material most commonly used in building houses, and if well made they are probably the best material for this purpose. What is required is a substance which will, in virtue of its poor conducting power for heat, prevent the internal warmth of the house from escaping during winter, and for the same reason prevent the heat of summer from penetrating into the house through the walls. In this respect brick is superior to stone, and is therefore a warmer material for house-building. This is to some extent counterbalanced by the fact that stone walls are commonly built thicker than brick walls.

Bricks, again, are very *porous*, and thus allow a certain amount of air to pass through them. For the same reason they will absorb 10 to 20 per cent. of their weight of water; and it is important, therefore, that the arrangements described on page 173 should be made to prevent moisture rising in the walls from below, to avoid wetting of the brick wall from dripping roofs, &c., and where the wall is much exposed to driving rains, to cover it with some impervious material.

Mortar should consist of clean sharp sand and slaked lime. Many builders use inferior mortar, in which other materials such as 'road-scrapings' are substituted for sand. Such mortar does not bind the walls permanently together and admits moisture, thus making the house damp. *Concrete* formed of gravel or broken stones mixed with lime is used to make the foundations of a properly constructed house. It may also be used to make each floor of the house fire-proof. Its use for the foundations is unfortunately often neglected, the concrete being only placed under the wall itself and not over the space under the floors. This, however, does not suffice, as it is extremely important to cut off the ground-air from the house.

We have seen how damp may be prevented from rising up the walls from the ground (p. 173). It is necessary also that the walls above the level of the ground should, as far as possible, be kept free from damp. With this object in view several points require attention.

(*a*) The *windows-sills should project* beyond the walls, otherwise rain falling on the window-sills runs down them, making them damp.

(*b*) *Cornices and other projecting portions* of the wall should be especially sloped and protected, parapet walls, gables, &c., should be properly covered with coping, and the mortar joints should be specially good.

(*c*) *Rain-water roof-gutters and pipes* should be kept clear of deposit, and in good repair. The guttering and pipes should not lie close to the wall of the house, as then any leak necessarily causes dampness.

(*d*) *Rain beating against the walls* as a rule does no great harm if the walls are well constructed, but if this is not sufficient a much-exposed wall may be coated with Portland cement or with slate.

We have emphasised the evils arising from damp houses. Such evils can be avoided in every new house by proper methods of construction. In an old house they are much more difficult to remove. If possible avoid taking any house which, on first entering it, has a peculiar mouldy smell, and in which the wall-papers are discoloured or hang loose, and in which you cannot see any gratings outside the house, near the ground-level, to allow of ventilation under the ground floor.

Not only are damp walls unhealthy, they are also very uneconomical. As each brick is capable of holding about a pint of water, the evaporation of this moisture uses up a very large share of the heat produced by fires, and thus involves larger and more expensive fires for comfort than in a dry house. A well-ventilated house is always less damp than one kept closed up; hence one means of avoiding the ill effects of damp in the walls of a house is free ventilation through the house.

The **internal walls** of a house are generally either painted or papered. It is dangerous to sleep in a newly-painted room. Colic, and other complaints due to lead-poisoning, have been produced by this means.

Paper is more commonly used than paint for covering the walls of rooms. Light-coloured papers should be chosen, as they are more cheerful and are not so likely to harbour dust. For kitchens, bath-rooms and closets, if tiled walls cannot be afforded, varnished papers, which can be washed, should be used. Good *size* and *paste* should be employed in hanging wall-papers. The smell of decomposing glue is most obnoxious. *Never allow a new paper to be pasted over an old one.* Paper when moist is liable to decompose, and, in addition, by this practice the dirt of years is allowed to accumulate on the walls. Bedroom papers should be renewed oftener than the papers of sitting-rooms. Until recently a considerable amount of *arsenic* was employed in manufacturing the colours for wall-papers, and there are still some of these in the market. The arsenic gradually volatilises into the atmosphere, and prolonged ill-health may be caused by this. Such symptoms as nausea, abdominal pains, griping, headache, and loss of appetite are the most common. Arsenic has been most frequently used for green-coloured papers, but is by no means confined to papers of that colour.

Arsenic may be detected by the following test:—

Take a piece of the suspected paper about two inches square, cut into small pieces and place in a good-sized test-tube; add water to fill about one-fourth of the tube, and then a dessertspoonful of *pure* hydrochloric acid and a small piece of pure bright copper foil. Next, heat the test-tube over a spirit-lamp. If arsenic is present a black coating will be formed on the copper foil. A mere tarnish of the copper must not be accepted as evidence of the presence of arsenic, but an almost complete veiling of the colour of the copper. This test may be confirmed by taking the copper covered with arsenic, drying it, and then heating in a perfectly dry test-tube. Eight-sided crystals of white arsenic are deposited higher up the tube, and can be detected under the microscope.

The **Roof** of a house should be quite impenetrable to rain. It is usually made of tiles or slates, and should be built inside with close boards covered with felt, which diminishes loss of heat through the roof in winter, and excessive penetration of heat in summer.

CHAPTER XXVIII.

LIGHTING AND WARMING OF THE HOUSE.

Effects of Light.—Dangers of Artificial Lighting.—Modes of Carriage of Heat.—The Open Fireplace.—Open Gas-fires.—Closed Stoves.—Central Systems of Heating.—Lighting of Houses.

Light is essential for health almost equally with fresh air; in fact, the two usually go together. If a house is dark, it is almost certain to be ill-ventilated, and probably also uncleanly. We all know the depressing effects of a dull cloudy day, which largely depend on the absence of direct sunlight; and there is no doubt that the depressing effect of such a day on the mind is accompanied by similar effects on the bodily functions. Plants grown in the dark are weakly and white, and similarly human beings who do not obtain sufficient light and air, living perhaps in basements or in rooms overshadowed by other houses, become pale and comparatively bloodless. 'Where the light cannot come, the doctor must,' is a proverb expressing this truth in a pithy form.

Small windows, though they may look picturesque, are not conducive to health, and if they are in a large measure covered by green creeping plants, light is still further impeded in its entrance into the room. We have seen that the carbonic acid given out by animals can only be seized on by the green parts of plants, the carbon fixed and oxygen liberated, *under the influence of bright sunlight.* Persons who work in a dim imperfect light are very apt to become near-sighted, owing to the strain upon their eyes. It is evident, therefore, that (1) windows should be large enough to ensure that every corner of each room in the house receives direct daylight, and is not in the shade;[1] (2) the window-area should not be diminished by curtains or blinds, or creeping plants. Blinds are only allowable when bright sunshine prevents the carrying on of work in a room, or at night, when there is no sunlight to be kept out. It is unfortunate that the usual method of fixing blinds at the top of each window generally leads to a certain length of blind being left down at the part where the window would otherwise allow the most valuable light—viz., that direct from the sky—to enter.

Natural Light has a most beneficent effect on health. The same cannot be said of artificial lights, which, with the single exception of the electric light, add impurities to the air, and thus increase the vitiation arising from our own exhalations. For this, if for no other, reason, it is advisable to avoid working by artificial light as far as possible. 'Early to bed' conduces to health, among other reasons, by preventing the breathing of air polluted by the products of the combustion of artificial lights.

Of **Artificial Lights**, candles, lamps, and coal-gas are the most important. It is the carbon in all these sources of light that makes the flame luminous. A *candle* is made of tallow, sperm, wax, or some similar substance, composed chiefly of carbon and hydrogen. The *oils* used in *lamps* are the colza oil, obtained from rape-seed, or the so-called mineral oils, of which paraffin is the basis. Only good mineral oils should be used. When imperfectly purified, they may contain paraffins which are explosive at a comparatively low temperature. When good paraffin is employed, accidents can only occur as the result of carelessness. The

[1] The Model By-laws state that every inhabited room shall have the area of its windows, clear of window-sashes, equal to at least one-tenth of the floor-space of the room. This is hardly sufficient in narrow streets and high houses.

lamps should be 'safety-lamps,' so constructed that when tilted, or overturned, the light is spontaneously extinguished. Such lamps can now be obtained at a price within the reach of all, so there is no excuse for the use of lamps not constructed with the safety arrangement. The receptacle of lamps should be made of metal rather than glass or earthenware, and the lamp should be placed where it is not in danger of being overturned. If a lamp is overturned and the paraffin gets on fire, it is useless to throw water on the flame. It continues to burn floating on the water. Anything at hand, as a coat or hearth-rug, should be thrown over the flame, so as to extinguish it by stopping the supply of air. Do not throw the windows open, or the flame will rapidly spread.

Coal-gas is manufactured from coal, and owes its luminosity to the presence of compounds of carbon and hydrogen. It gives more light than either candles or lamps for the same amount of money; but this economy of gas is rather apparent than real, as with a lamp we are content to have a light less diffused all over the room than with gas. Gas produces not only carbonic-acid gas and steam by its combustion, as paraffin and candles do, but also a certain amount of sulphurous acid. This is injurious to pictures and books, and to living plants. The products of combustion of gas should, where possible, be carried away through the ceiling (page 143, fig. 32), or into the chimney-breast (page 134, fig. 28). *It is always dangerous to leave a feeble glimmer of gas in the bedroom* during the night. Not only do the products of combustion vitiate the air, but there is a tendency with a low light for some unconsumed coal-gas to escape into the room, and, in addition, a sudden whiff of air may blow out the light, and the occupants may be poisoned in their sleep.

It is a good practice to turn off the gas at the meter each night; but *do not turn the gas off at the meter until every burner in the house has been turned off*, or a serious escape of coal-gas may occur during the next evening.

WARMING OF HOUSES.

It has been explained that the warmth of our bodies is maintained by the processes of oxidation constantly going on in the system. The loss of heat from the surface of the body is economised by warm clothing; and the artificial warming of houses has a similar action to clothing.

The **temperature** at which living-rooms should be kept will vary with circumstances. For delicate children and old people a room may be kept at 65° Fahr.; for healthy adults any temperature between 55° and 60° will be comfortable. It is well to have a *thermometer* placed in some convenient part of the room, remote from the fire, and not exposed to direct draughts from the door or windows, so that the temperature may be accurately gauged. The *sensations are not good guides as to temperature.* A room may be complained of as very hot, when it is only 'close' from imperfect ventilation; and the best remedy in such a case would be to open the window or door, and *at the same time* lay more coals on the fire, so as to ensure a rapid escape of air up the chimney.

Now, warmth in rooms is supplied by two methods—direct radiation and convection. **Radiation** of heat is the process by which heat passes straight from a fire or other source of heat until it meets with solid bodies, not heating the air as it passes through it, except indirectly, when the furniture, &c., which has been heated heats the surrounding air. In **convection** air or water is employed to actually carry the heat from one part to another. Radiant heat is the most pleasant and healthy form of heat, but it is expensive and somewhat unequal in its distribution. The open fireplace is the usual method by which it is obtained, and it still retains its popularity notwithstanding that it is the most extravagant source of heat.

The Open Fireplace not only furnishes a cheerful warmth, but is likewise a valuable purifier of the atmosphere of a room, as from 5,000 to 15,000 cubic feet of air pass up an ordinary chimney each hour. The chief disadvantages of the open fireplace are the following:—(1) The heat is unequally distributed, being, for instance, nine times as great at a distance of one foot from the fire as it is at a distance of three feet. (2) Currents of cold air are produced along the floor in order to supply the place of the air which is rushing up the chimney. (3) There is the trouble of frequently replenishing the fire. (4) Dust and smoke are produced.

The great loss of heat necessarily involved in an open fireplace has led to the use of chambers behind the fireplace, by which external air is warmed as it enters the room. In such stoves there is an air-chamber at the back communicating with the external air and communicating above the fireplace with the interior of the room.

Air admitted through this opening has been warmed by coming in contact with the fire-clay which separates the air-channel from the smoke-flue.

Apart from the admission of warm air, an open fireplace may be much improved by other means. (1) Do not allow the fireplace to be too far included in the wall, and never on an outside wall, or heat will be lost. (2) Have as little iron and as much fire-clay in its composition as possible. With an ordinary fireplace it is estimated that one-half of the heat obtainable is lost with the smoke, one-fourth with the warm air which ascends the chimney, and one-eighth as unconsumed smoke, making a total loss of seven-eighths of the heat obtainable from coal under the best conditions. (3) The width of the back of the grate should be only one-third that of the front, and the distance between the back and front of the grate should be equal to the width of the back.

Gas is sometimes employed instead of coal for fires.

No gas-stove should be allowed in which provision is not made for carrying off all the products of combustion A chimney or pipe for carrying away the gases produced is even more necessary than in the case of a coal-fire, for in the latter case the smoke produced would necessitate a recourse to open windows or other means of ventilation, while in the former the deleterious products are invisible. Gas is only suitable as a means of heating small rooms, owing to its greater expense. Fletcher's stoves are convenient and thoroughly sanitary; they are placed in an open fireplace with a flue-pipe attached. For bedrooms the Calorigen stove is a valuable means of supplying warm and pure air. Its arrangement is shown in fig. 44. A spiral tube communicates below with the external air, and opens at its upper end into the room. A small gas-flame is kept burning below the spiral tube, the products of combustion from which are carried directly out of doors. The heat thus produced warms the air which is passing along the spiral tube and causes a constant rapid entry of warm air into the room.

Closed Stoves possess the advantage over an open fire-place that there is a smaller consumption of fuel, and that the combustion can be more effectually regulated. Commonly, however, they make the air of a room dry, and produce a peculiar close smell, probably owing to the charring of minute organic particles on the outside of the stove. It is found also that carbonic oxide may pass through cracks,

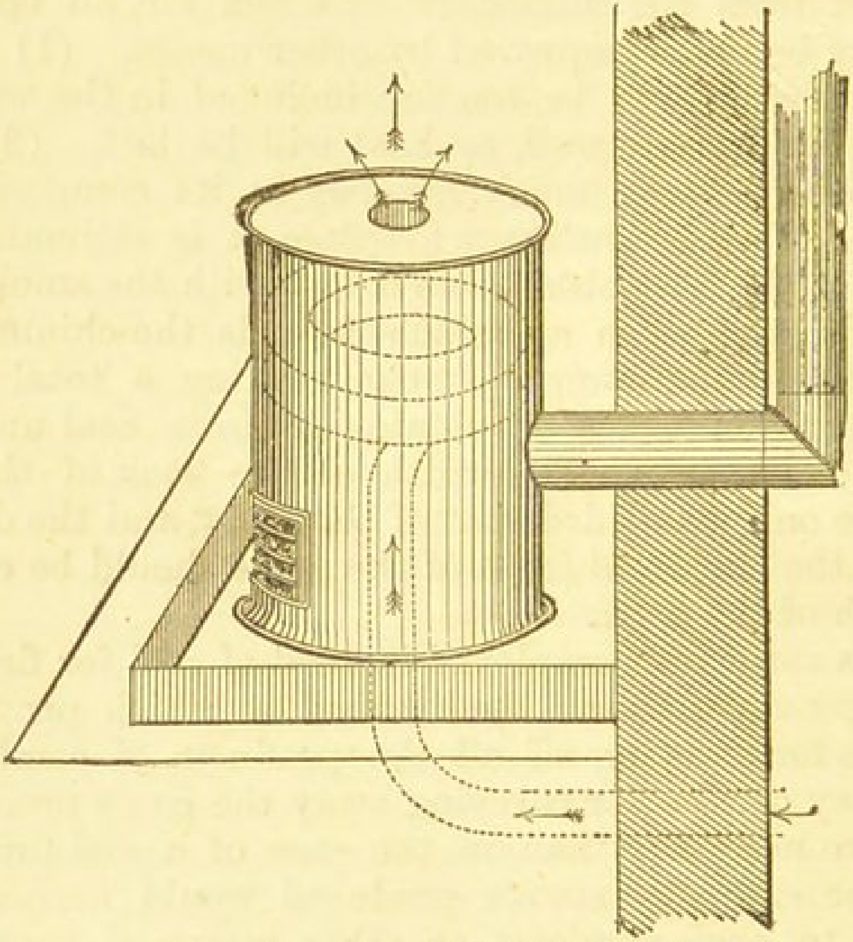


FIG. 44.—*The Calorigen Stove.*

or even through the substance of iron stoves when they are red-hot. When stoves are employed, firebrick should be in contact with the fire at all points, and the stove should never be allowed to become red-hot. There should be as few joints as possible, and these should be horizontal and not vertical. The supply of air to the stove should never be cut off, nor should the escape of the products of combustion be prevented by dampers, or by admitting air between the stove and the chimney.

We are strongly of opinion that stoves should only be allowed in combination with some provision for warming the incoming air. This may be secured by having a sheet iron or zinc cylinder, considerably wider than the stove-pipe, placed round it and fastened to the floor below. A good-sized pipe is then carried through the floor and out to the external wall of the room. In this way a large supply of warmed air is drawn into the room (fig. 45).

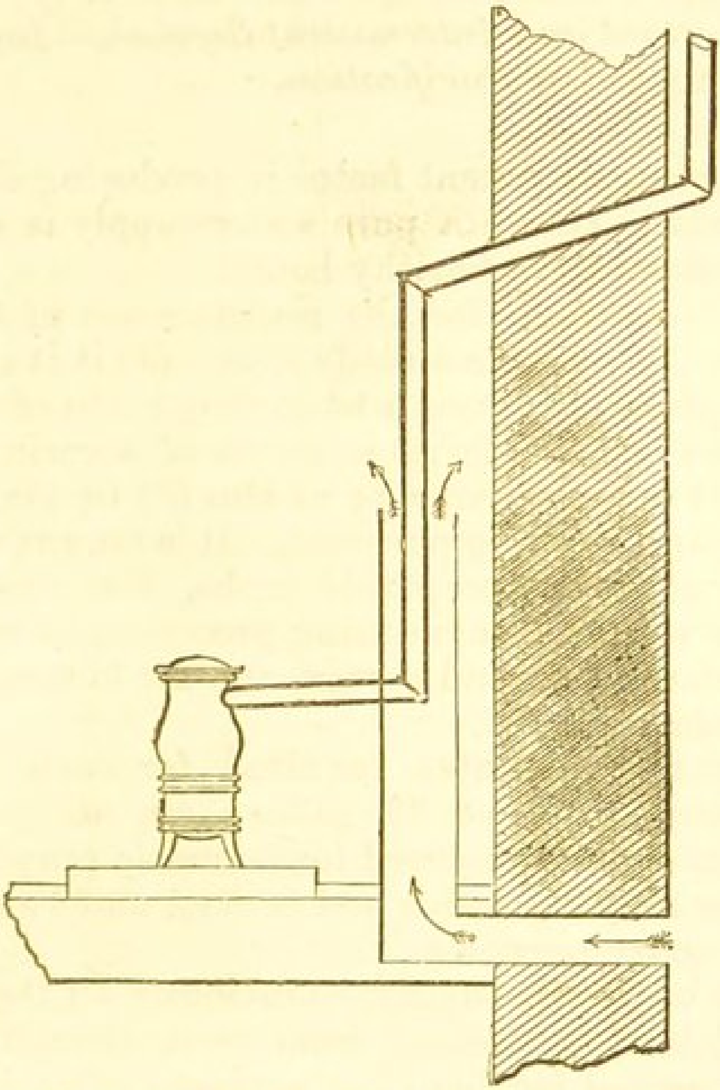


FIG. 45.—*Closed Stove arranged to Warm incoming Fresh Air.*

Central Systems of Heating are in use in large establishments, but are not applicable for small private houses. The air is warmed by hot-water or steam pipes, or hot air warmed by passing over the flue of a furnace is admitted. The system of warming by hot water is probably the best, *if it is combined with ventilation.* The proper plan is to have coils of hot-water pipes, and admit fresh air over these, so that it is warmed as it enters the room.

CHAPTER XXIX.

THE WATER WE DRINK.

Uses of Water.—Amount required.—Sources of Water-supply.—Constant and Intermittent Services.—Impurities of Water.—Method of Purification.

There is no more potent factor in producing disease than polluted water. Hence a pure water-supply is one of the prime necessities for a healthy home.

Water is essential for the maintenance of health and even of life. As we have already seen—(1) it is an essential part of our *food*, and forms a large proportion of each of the tissues of the body. (2) As a means of securing *personal cleanliness* it is indispensable; as also (3) *in the household* for cooking and washing purposes. It is required (4) by *the community at large* for public baths, for cleansing the streets, for many manufacturing processes, as well as for flushing water-closets and sewers, and for horses and other domestic animals.

The **amount of water required** for each individual averages roughly about 30 gallons per day, of which about 12 gallons are required for domestic purposes, about 8 gallons for flushing drains and sewers, and 10 gallons for trade and sundry purposes.

Sources of Water-supply.—Obviously all the water we drink is ultimately derived from *rain*, though it is very often only secured for drinking purposes after it has percolated through considerable depths of soil (from *springs* and *wells*), or after it has formed *rivers*.

In towns, and in many large villages, water is now generally supplied by the local Sanitary Authority or by some Water Company, and such water may be generally depended upon as being fairly pure without any further filtration. The water supplied from such central sources is usually derived from rivers, or from collecting-grounds at the foot of hills in moorland districts, or from deep wells. In remote country villages, however, individual householders often have to make their own arrangements for water-supply, and for them the following hints may be useful.

Rain-water may form a valuable source of drinking-water under proper safeguards. It is very soft, and therefore economical for washing purposes, and is always well aerated. It may be contaminated, however, (*a*) by washing down soot and various noxious gases from the air; (*b*) by running over dirty roofs and carrying with it the excrement of birds and other impurities, as well as possibly dissolving lead from lead pipes; and (*c*) by being kept in foul water-butts. Appliances are sold (as Roberts Percolator) by which the first, and therefore the dirtiest, portion of rain-water from roofs is rejected, and only the clean rain-water which follows is collected for future use. Cemented tanks should be used for storing rain-water, and they should be supplied with filters. If it is also ensured that no lead has come in contact with the water, rain-water forms a useful source of drinking-water, and is much preferable to the water found in shallow wells.

Springs supply water which has percolated through the soil until it reaches clay or other impervious stratum, and is then brought to the surface where the impervious stratum crops out. This water in its course through the soil dissolves mineral salts and is therefore generally hard. It is also well aerated, and is much cooler than river or rain water. It is consequently a very pleasant water to drink. Many springs become dry in the summer months.

Surface Wells are dug down to catch the subsoil-water or ground-water, which percolates into them from the surrounding soil. They are generally not more than 15 or 20 feet deep. If a cesspool or privy is near, this may simply drain into the well, as shown in fig. 46. Such soakage is much more apt to occur when a fall of rain tends to wash the contents of the privy or cesspool towards the well.

The subsoil-water, we have seen, is a subterranean stream produced by rain penetrating into a porous soil. This stream forms an inclined plane, the water gradually falling until it reaches the nearest river or the sea.

The chances of contamination for the water in a well will depend on the relative position of cesspool and well. Thus in fig. 46 the ground-water is passing from left to right, and the cesspool A can only contaminate the well by soakage from the former descending to the ordinary or low-water level. But after heavy rain the ground-water rises and sewage may be carried direct from the cesspool to the well. The cesspool B is comparatively harmless so far as this particular well is concerned, because the flow of subsoil-water is in the opposite direction.

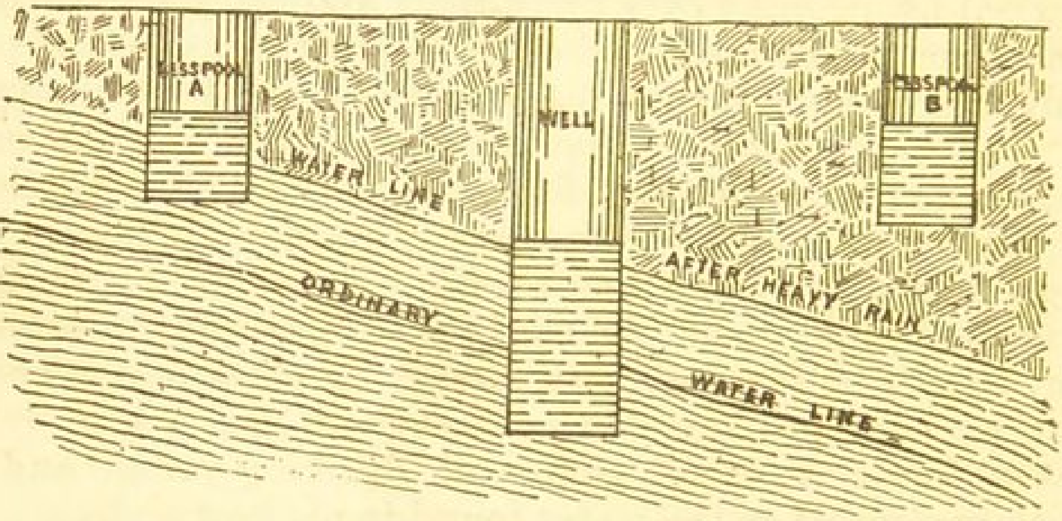


FIG. 46.—*Shallow Well and Cesspools.*

Deep Wells are made to exclude the subsoil-water which enters shallow wells. A shallow well is first dug, and is lined with brickwork thoroughly set in hydraulic cement, and then the bottom of the well is bored through until a water-bearing stratum is reached.

Occasionally even deep wells have been contaminated from cesspools, when cracks or fissures exist in the strata of soil. If much pumping is done, a well may drain the soil from distances amounting in some instances to a mile.

Where shallow wells must be used, the water should only be admitted from the lowest point of the well, the walls of the well being made water-tight. No cesspools should be allowed within twenty or thirty yards of the well (it is doubtful if this limit is sufficient), and the water should always be boiled before drinking.

Rivers form a frequent source of water-supply. Nearly the whole of London is supplied with water from the rivers Thames and Lea. River-water is well aerated, usually not so hard as spring and deep-well water, but is not so cool in summer as these two. The Thames above the point from which comes the chief London water-supply, receives the sewage from various houses and villages. It is urged, however, that a process of natural self-purification goes on. The water is subsequently filtered through elaborate filter-beds, and doubtless a large proportion of its impurities is thus got rid of. It is, however, contrary to good principles to take comparatively impure water and then proceed to purify it for drinking purposes, instead of selecting water which is so pure as not to require this treatment.

For the supply of large communities water is stored in reservoirs, and thence distributed to each house. The service-pipes to each house are generally made of lead, the convenience of which lies in the ease with which it can be bent and curved. Soft waters are very apt to attack lead pipes, dissolving an injurious amount of the metal.

Some supplies of water are **constant**, others **intermittent**. In the intermittent system the water is turned off at certain hours each day. The pipes then become empty, and water has to be stored in butts or cisterns. This system of water-supply is regarded as more economical by water companies ; but it is doubtful whether any waste of water is really prevented. It is most objectionable, from a sanitary standpoint, because (1) foul air, and even foul liquids, may get into the empty pipes from the soil in the neighbourhood. It must be remembered that drains and gas-pipes are necessarily not very remote from water-pipes; and instances in which coal-gas, and even solid matters from foul closets, have been sucked into empty water-pipes are on record. (2) In case of fire, there is greater danger to property with an intermittent supply. (3) The **cistern** rendered necessary by an intermittent supply is in itself a source of danger. The water stored in it during the summer months becomes unpleasantly warm. Dirt accumulates in the cistern, and sometimes birds, mice, and other animals are drowned in it. The comparatively inaccessible position in which the cistern is commonly placed, renders it probable that its polluted condition will escape detection. Occasionally the overflow pipe of the cistern has been directly connected with the soil-pipe or water-closet, as in fig. 47, thus bringing foul gases into the cistern. Not uncommonly the drinking-water cistern is made also to supply the water-closet, as in fig. 47. If a cistern is necessary, then (*a*) it should be made of galvanised iron, not of lead or timber. (*b*) It should have a well-fitting lid. (*c*) It should be easy of access, for periodical cleansing. (*d*) The overflow-pipe should discharge into the open air. (*e*) The water-closet should have a separate supply-cistern.

When the water has to be turned off to allow of the execution of necessary repairs, some of the evils of the intermittent system may arise in connection with the con-

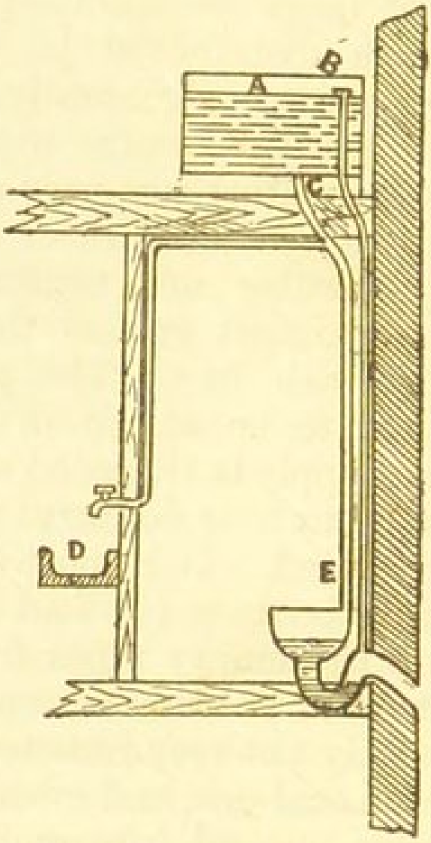


Fig. 47.—*To illustrate Insanitary Arrangement of Drinking-water Cistern.*

A, *Cistern.* B, *Overflow-pipe directly connected with soil-pipe.* C, *Supply-pipe from cistern, one branch of which supplies drinking-water at* D, *the housemaid's sink, and the other,* E, *supplies water for flushing closet.*

stant system. To prevent any mischief from this cause—(*a*) *each closet should have a supply-cistern.* Where the water-pipe to the closet is directly connected with the main, instances have occurred in which foul matters have been sucked from the closet-pan into the water-main. (*b*) The hot-water boiler should have a large cistern for its supply. When the mains have been emptied for repairs, accidents have arisen from boilers becoming dry and red-hot, and cold water suddenly entering the boiler while in this condition.

Pure Water is (1) *colourless* or deep blue when seen in a mass. A yellow tinge is always suspicious. (2) It is quite *free from odour*, even though kept for some time. (3) Its *taste* should be pleasant and sparkling. The presence of bitterness or saltness is very suspicious. (4) When rubbed between the hands it should be fairly soft to the *touch*, and should dissolve soap easily. (5) It should be *clear*, and contain no suspended matters.

Water which has passed through the soil always contains a certain amount of mineral matter.

The most common mineral impurities are *calcium salts*, especially calcium carbonate (*i.e.*, chalk) and calcium sulphate (*i.e.*, gypsum). These two salts are the chief cause of the **hardness of water.**

The air contained in the crevices of the soil contains 200 to 250 times as much carbonic acid as natural air, and calcium carbonate is rendered soluble in water by this carbonic acid; a compound of calcium carbonate and carbonic acid (called **calcium bicarbonate**) being produced, which more easily dissolves in water than calcium carbonate.

Hardness is either (1) temporary or (2) permanent. **Temporary hardness** is removed by boiling the water; permanent hardness remains after boiling. *Temporary hardness is due chiefly to calcium bicarbonate*, and when the water containing this salt is boiled, the carbonic acid escapes, the calcium carbonate remaining being thrown down to the bottom of the vessel. This explains the thick fur on the inside of kettles in districts supplied with hard water.

Temporary hardness may be partially removed (1) by boiling the water; (2) by adding milk of lime—*i.e.*, quick-lime mixed and partly dissolved in water—to the hard water in definite proportions. This method is carried out on a large scale at various waterworks, as at Caterham. The lime combines with some of the carbonic acid in the bicarbonate, producing calcium carbonate, which is carried down to the bottom of the water. Thus

Calcium bicarbonate + calcium oxide (lime) = calcium carbonate + calcium carbonate.

Permanent hardness of water is due chiefly to calcium sulphate, and cannot be removed by boiling; but boiling with washing soda removes some of it.

Hard water is objectionable *commercially*, but from a *sanitary* standpoint it is harmless unless the amount of hardness is very excessive.

Much soap is wasted by the use of hard water. Every degree of hardness (corresponding to one grain of chalk in a gallon of water) implies a waste of eight or nine grains of soap for each gallon of water, if the hardness is completely neutralised by soap, so that the amount wasted by each family per annum must be very considerable. As a matter of fact, however, in washing, the waste is not so great as appears, owing to the fact that the soap is applied to the clothes rather than dissolved in the water. Not only does soft water require less soap, but it is much more economical for making tea and soup, and for boiling meat and vegetables, both time and fuel being saved. Kettles with a thick fur inside are bad conductors of heat, so cooking is slower with hard than with soft water.

Lead may be dissolved by soft waters from lead pipes or from cisterns either made of lead or slate cisterns having red lead inserted at the joints. Hard water is nearly always free from the danger of contamination by lead. Soft water, especially rain-water and the water derived from moorlands, may dissolve lead. The solvent action of water on lead may be prevented by adding pieces of limestone to it.

As little as $\frac{1}{10}$ grain of lead in one gallon of water may produce the symptoms of **lead-poisoning**.

Organic Impurities of Water may be derived from either plants or animals. The most important are those from sewage, by soakage from drains or cesspools into wells or water-pipes, or by absorption of foul gases in drinking-water cisterns.

Contamination of water with sewage or other animal matters may give rise to **Diarrhœa.** When the sewage-contamination contains the specific poison of the disease, **Enteric** or **Typhoid Fever** has been frequently traced to polluted water. We have already seen that milk sometimes produces typhoid fever owing to the addition of polluted water. This water may have been derived from a surface well situated in a farm-yard which also contains a large manure-heap and a privy whose contents soak towards the well, especially after a heavy fall of rain. In large villages or towns, where the refuse matters are kept in midden-heaps or privies, or in cesspools dug in the ground, which allow of soakage in every direction, if wells are dug in the neighbouring soil the danger of the contaminated water causing typhoid fever is greatly increased.

Cholera, when introduced from abroad, has been rapidly spread in this country by polluted water.

A simple test for the presence of organic matter in water is made as follows :—

Take a tall glass vessel, fill it with the water to be examined, and add a few drops of Condy's fluid (solution of permanganate of potassium). Place the liquid in a position facing the light, and by its side another glass vessel full of distilled water to which the same amount of Condy's fluid has been added. If the first becomes rapidly discoloured, probably organic matter is present in considerable amount.

PURIFICATION OF WATER.

After what has been said it will be understood that *drinking-water ought to require no purification.* It should be of such a character that it can be drunk without any preliminary treatment. The water from deep wells, for instance, is deteriorated by being filtered, and should be drunk as it comes from the tap. But sometimes there is no choice. The water supplied is impure, and no other is available. Then one of the following means of purification may be used :—

Distillation. Boiling. Filtration.

The distillation of water renders it absolutely pure, as no other method can ; and the distilled water can be made palatable by aerating it. This method is, however, scarcely practicable under ordinary circumstances, though it is largely used on board large steamers.

The boiling of water not only gets rid of much of the hardness which may be present, but also of a considerable amount of organic matter (of animal or vegetable origin). *The longer the boiling is continued the more absolute the protection from danger.* Water from the most polluted source, if boiled for not less than half an hour on three successive days, might be drunk with impunity. Milk should always be boiled before drinking, and water should also be boiled whenever we cannot vouch for its purity.

Filtration is carried out on a large scale by water companies or corporations supplying water, and on a domestic scale by individual householders. We must repeat that the very fact that such filtration is necessary indicates that the water is derived from an undesirable source. The only exception to this rule is in the case of soft waters derived from moorland districts. Such water may be deprived of the lead it is apt to dissolve by filtering through spongy iron or silicated carbon.

The London water derived from the river is filtered through beds of sand and gravel about 4 feet thick, the filtration being carried on at intervals, so that these filtering beds may be freely exposed to the oxygen of the air in the intervals of filtration. As the result of such filtration some of the organic matter in the water becomes oxidised, while the largest part of it is mechanically stopped by the filtering medium.

In **domestic filters** the chief materials used are animal charcoal, spongy iron, and silicated carbon.

Charcoal presents an enormous surface to the water as it passes through, and it undoubtedly oxidises a large proportion of the organic matter in water. The filtering material, however, must be comparatively fresh in order to do its work. Animal charcoal contains a large amount of phosphates (being derived from bones), and this probably explains the fact that it favours the growth of bacteria and other forms of lowly organised life. Inasmuch as the chief object of a filter is to prevent the infection of such diseases as typhoid fever being received into the system, charcoal cannot be said to be certainly efficacious. In Maignen's filter, a mixture containing charcoal and lime is employed, which softens the water as well as filtering it.

Spongy Iron filters not only remove organic matter from water, but also reduce its hardness, and the filtered water does not develop bacteria (low forms of organisms, only visible under high powers of the microscope), as in the case of charcoal.

Silicated carbon is said to be as efficacious as spongy iron in removing organic matters, and it removes lead from the water filtered through it.

The *Pasteur-Chamberland filter* consists of a cylinder of unglazed porcelain, which effectually prevents the passage through it of bacteria.

The cylinder is screwed on to the tap, and the water forced through its pores is completely freed from all living impurities, which are the most dangerous. This is the only completely effectual way of purifying impure water.

Sponges and sand should never be used in domestic filters, as they speedily become foul. If filters of any kind are employed they should be periodically cleaned, by washing and brushing the surface of the filtering material and allowing it to stand dry in the open air.

CHAPTER XXX.

REMOVAL OF WASTE AND IMPURITIES.

Varieties of House-refuse.—Kitchen-refuse.—Sewage Systems.—Dry Methods.—Water-carriage System.

The carrying-on of the functions of life involves the production of certain effete matters, which must be got rid of in order that health may be maintained. These are—

1. Carbonic acid from the lungs and in minute quantities from the skin.

2. Organic *débris*, including volatile particles from the lungs and shreds of epithelium and other matters from the skin.

3. Urea and other solid matters dissolved in water from the kidneys.

4. Fæces or solid excreta from the bowels.

Water also is eliminated from the lungs and skin in comparatively small quantities, but its only evil effect, when a large concourse of persons occurs, is to render the atmosphere too moist. The water eliminated in the urine, and the solid excreta, are removed as sewage. Carbonic acid and volatile organic particles are removed by efficient ventilation; other *débris* from the skin by personal cleanliness.

In addition to urine and fæces, certain other impurities connected with human habitations require to be systematically removed in order that disease may not follow on the accumulation of filth.

These are—

1. *Slop-water*, containing waste matters from cooking, baths, laundries, and house-cleaning.

2. *Kitchen-refuse*, under which are classed the varying contents of the domestic dust-bin.

In large towns it is also necessary to get rid of *rain-water*, either by admitting it into the sewers or by having a separate system of drains provided for it.

It will be convenient to take first the disposal of kitchen-refuse.

Kitchen-refuse consists chiefly of the ashes from fires, with a certain proportion of cinders when the ashes have not been properly sifted. But the dust-bin is also a favourite refuge for various animal and vegetable matters, as well as for broken pots and tins.

If the dust-bin is not to give rise to nuisance, the following rules should be adopted :—

1. The dust-bin should be at least six feet from the wall of the house. It should be of small size in order to ensure periodical emptying, and it should be protected from the rain, as moisture favours decomposition.

2. The best form of dust-bin is a zinc pail or box, which can be removed by the dustman and thoroughly emptied, thus ensuring that no dust is allowed to accumulate about the premises.

3. Cabbage-leaves, potato-peelings, and all other vegetable and animal refuse should be burnt in the fire after having been dried by placing them under the range or kitchener, or on the dying embers of the fire at night. No wet refuse should ever be put into the dust-bin.

4. The dust-bin should be emptied at least once a week, preferably twice a week, and daily where the amount of house-refuse is great.

Sewage Systems.—There are two chief methods of removing excreta from the house.

1. Dry methods, also called **conservancy systems.**

2. The **water-carriage method.**

In dry methods of removing refuse, (*a*) the dust or house-refuse is commonly added to the excreta, and the two removed together. This forms the **midden system.** (*b*) Where fixed receptacles are used, but no house-refuse is added to the excreta, we have what is known as the **privy system.** (*c*) Or the excreta may be kept in **pails** and periodically removed. (*d*) Or the excreta may be sprinkled with **dry earth,** and thus deodorised each time the closet is used. Where privies or middens are used, they should not be situated within six feet of a house. The receptacle should be above the ground-level and easy access for cleaning provided at the back. It should be frequently emptied, and the floor should be of concrete, so that soakage into the soil is prevented. In all these plans the foul water from the house, and to a large extent the urine, remain to be dealt with and require special drains for their removal. This fluid is almost as offensive as if it contained also the solid excreta ; and it is certain that, at any rate in the case of towns and large villages, the combined system of removing solid and liquid impurities together (*i.e.*, the water-carriage system) is by far the best.

In the **water-carriage system** a house-drain is provided which communicates with the sewer in the road. The house-drain must have a proper fall so as to ensure rapid emptying into the sewer. Its joints must be water-tight ; and it must be cut off from aerial communication with the sewer by a syphon or U-shaped bend. The water contained in this bend acts as a trap and prevents the sewer-air from coming towards the house. The soil-pipe carries the contents of the water-closets into the drain. It should be continued upwards above the roof with its end wide open in order to ventilate the soil-pipe and drain ; and, with the same object, there should be an inlet opening to the drain in front of the house.

The water-closet should be one of the patterns known as the Valve, or Wash-out, or Short Hopper. Its junction with the soil-pipe should be securely jointed, and the closet should be flushed by means of a cistern specially devoted to this one purpose.

The rule in regard to all other waste-pipes than the soil-pipe is, that *they must not be directly connected with the drain.*

Thus waste and overflow pipes from baths and sinks, and rain-water pipes, should open over a gully-trap in the yard which is connected with the drain. Bell-traps should not be allowed, as they have an insufficient seal of water, and the bell is frequently removed.

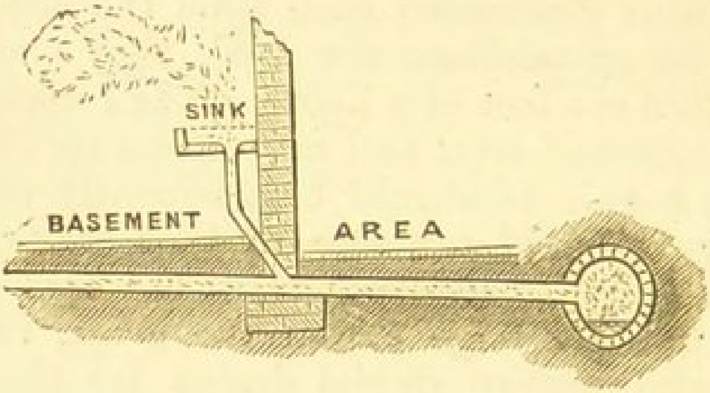


FIG. 48.—*Insanitary Arrangement of Sink.*

Insanitary Arrangements.—In many houses the waste pipe from the sink, or from lavatories, &c., is carried direct into the drain. Fig. 48 shows an extreme instance of this. The waste-pipe from the sink goes straight into the house-drain, and the latter is connected with the sewer without any disconnection by means of a U-bend in the drain.

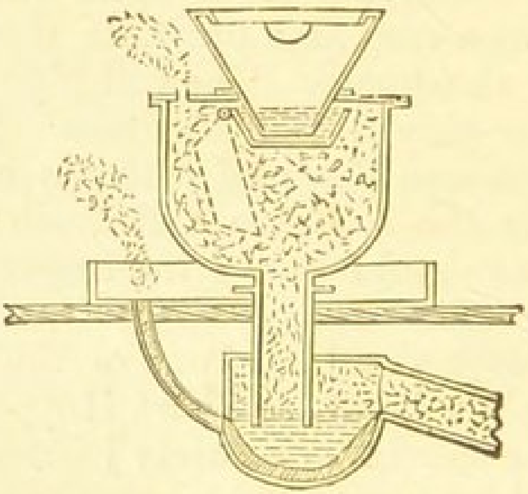


FIG 49.—*Insanitary Double-pan Closet.*

Of closets, the foulest and yet the one most commonly used, is the double-pan closet (fig. 49). The one shown in the figure illustrates several bad arrangements. The small waste-pipe from the tray under the closet is connected with the D trap, instead of being made to discharge into the open air. The foul inner container shows leaky joints, and the D-shaped trap below this has corners which allow offensive matter to accumulate and decompose.

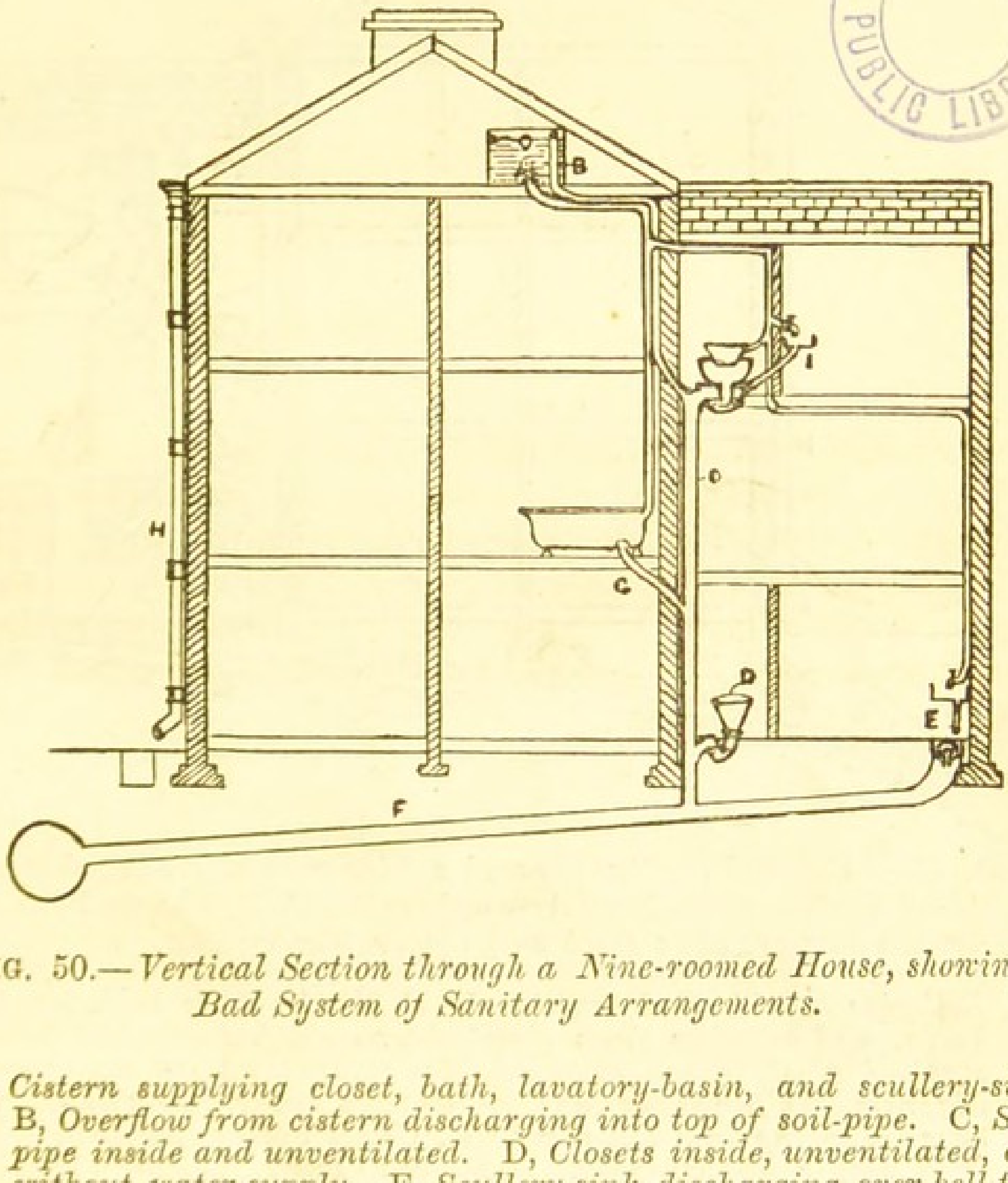


FIG. 50.—*Vertical Section through a Nine-roomed House, showing a Bad System of Sanitary Arrangements.*

A, *Cistern supplying closet, bath, lavatory-basin, and scullery-sink.* B, *Overflow from cistern discharging into top of soil-pipe.* C, *Soil-pipe inside and unventilated.* D, *Closets inside, unventilated, and without water-supply.* E, *Scullery-sink discharging over bell-trap under same.* F, *Drain to sewer without intercepting-trap, and unventilated.* G, *Waste from bath connected to soil-pipe and untrapped.* H, *Rain-water pipe discharging into soakage-hole.* I, *Waste from lavatory-basin connected to D-trap under double-pan closet.*

A study of figs. 50 and 51 will enable a person of average ability to detect many of the insanitary arrangements found in dwelling-houses. Fig. 50 is an epitome of bad arrangements, fig. 51 of good arrangements.

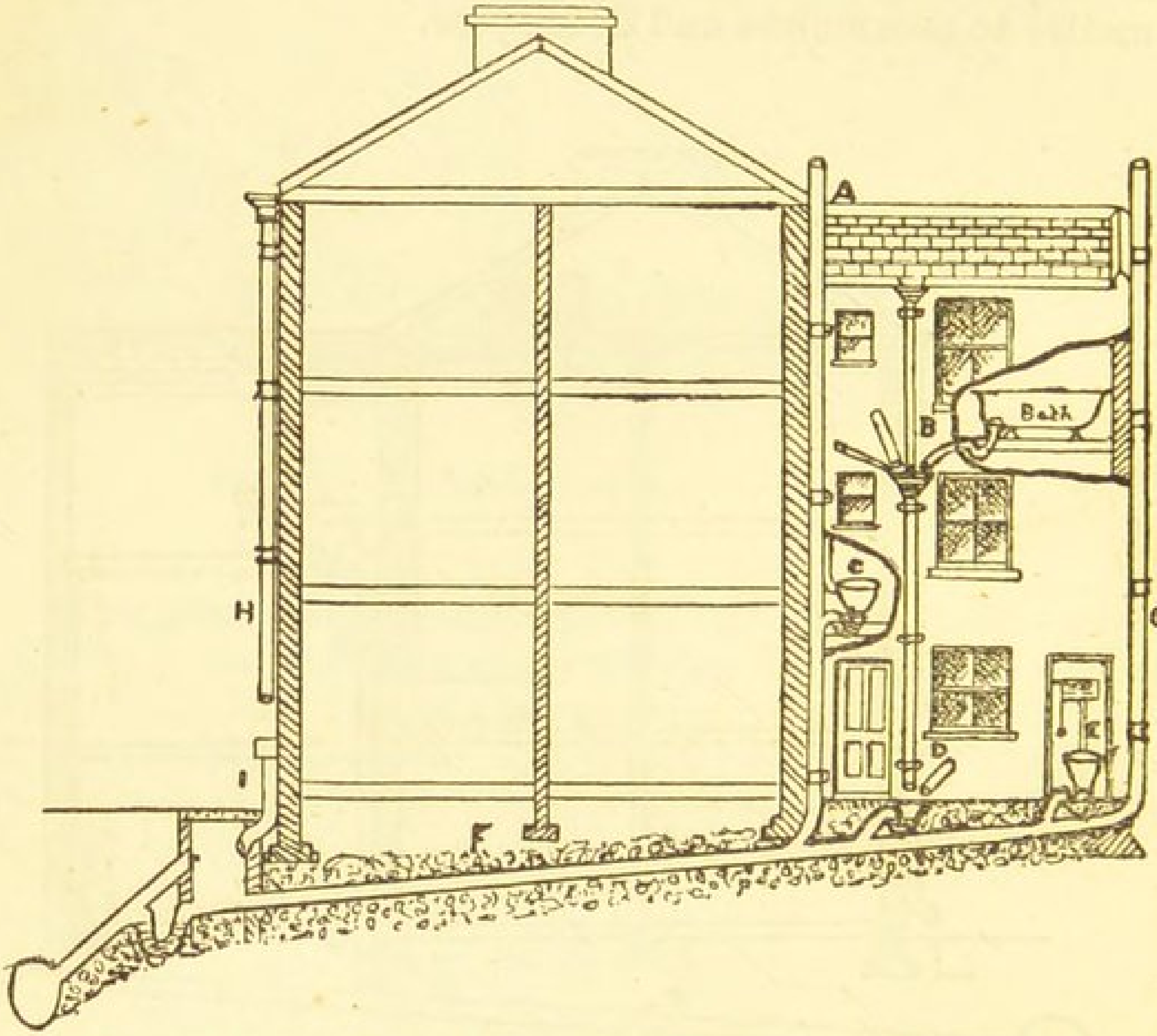


FIG. 51.—*Vertical Section through a Nine-roomed House, showing a Good System of Sanitary Arrangements. N.B. The wall has been broken away to show Bath and Upper Water-closet.*

A, *Soil-pipe outside and ventilated.* B, *Wastes from bath, lavatory-basin, and overflow from closet-cistern discharging into head of stack-pipe.* C, *Closets supplied from separate cistern, not shown in diagram.* D, *Stack-pipe and waste from scullery-sink discharging over gully-trap into outer air.* E, *Closet outside, ventilated, and with proper water-supply.* F, *Drain to sewer, jointed in Portland cement, bedded in concrete, with intercepting-trap and inspection-chamber, and ventilated by inlet and outlet pipes.* G, *4-inch vent-pipe from highest part of drain carried above the roof, and opening above and away from all windows.* H, *Rain-water pipe discharging over gully-trap.* I, *Fresh-air inlet to drain.*

Part II.

DOMESTIC MANAGEMENT.

CHAPTER XXXI.

THE HOME AND WOMAN'S WORK.

The importance of choosing a house in accordance with such conditions of soil, aspect, drainage, and water-supply as are most conducive to health having been considered (page 169), it is now necessary to examine those details which deal with the home. It is not possible for everyone to choose a dwelling of just the kind and in just the place which would seem the most desirable. Only the more highly favoured among us can do that; for we are all more or less creatures of circumstance, and must live where our work calls us. Given, however, that all the conditions of the house are good, the health of the family still largely depends upon the internal arrangements and cleanliness. These are the particular province of the woman at the helm, whose duty it should be to spare no trouble in order that those dependent upon her knowledge of household duties and the laws of health may enjoy health and comfort.

The Duty of Teachers.—Teachers who have large numbers of girls under them would do well to remember that the nation's future health lies largely in the charge of those girls who will be the future wives and mothers of the English race. Remembering this, surely they will see the wisdom of giving them direct instruction in domestic economy, and of helping them to acquire those habits of observation, attention to details, and thoughtfulness, which will be of so much value to them when they leave school and enter upon the more serious work of their lives.

Frequent complaints are heard from ladies that 'there are no good servants nowadays,' and the Education Code has been censured as being the cause of this dearth of domestic servants. The encouragement, however, now given by the Government to the teaching of cookery and laundry work, in addition to domestic economy, in those schools where proper arrangements are made for practical instruction, may help to create a desire among girls to excel in the performance of household duties. An educated housekeeper or servant should intelligently know 'the reason why,' rather than act by the 'rule of thumb,' by which mistakes are often made, entailing much expense and trouble. Details of cleaning and household work should be familiar to *all* women. If ladies would only learn how work should be done they could often teach young servants and correct those who had learned bad methods. Careless servants will be less able to impose upon a mistress who possesses a thorough knowledge of household routine and economy. Ladies who know well the details of these matters usually have much better servants than those who, through ignorance, are obliged to depend upon the very indifferent knowledge of their servants. It is the duty, too, of mothers to do their utmost to train their girls to habits of neatness, cleanliness, and thrift in their home by actual practice and by example.

Teachers should, when possible, advise mothers to encourage their daughters to become good domestic servants in preference to entering upon indifferent callings which frequently entail late hours, injury to health, and exposure to temptation.

CHAPTER XXXII.

DOMESTIC SERVANTS.

Personal Qualities of servants.—The General Servant.—The Nursemaid.—The Housemaid.—The Cook.—Care of Servant's Health.

The Personal Qualities which should characterise a good servant, briefly stated, are as follows :—

1. An intelligent knowledge of her work.
2. Cleanliness.
3. Neatness in appearance and work.
4. Good temper.
5. Readiness to oblige and to obey orders.
6. Quickness and punctuality.
7. Straightforwardness in word and deed.
8. Faithfulness to the interests of her employers.

The General Servant.—A really good general servant is a very valued person in a household where the income only admits of one servant being kept. Her duties will be multifarious, and much tact and judgment in arranging work will be necessary in order that all her duties may be efficiently carried out. Early rising is indispensable. At six o'clock the lower windows or doors of the house should be opened; then the kitchen fire should be lighted, kettles put on, and the kitchen swept and dusted. The hall mats should be shaken, the hall swept, the front steps cleaned, the brasses and knocker polished, the hall furniture dusted, and mats put down. The breakfast-room fire should next be lighted, the room swept and dusted, an old silk handkerchief being used for polished articles and a feather brush for the picture-frames. The inside of the windows should not be forgotten. The table should be laid for breakfast, and breakfast at once prepared. If there are children, the mistress has probably been dressing them in the meantime.

Whilst the family are at breakfast, and after the servant has had her own breakfast, she should see that all bedroom windows are open top and bottom, all beds stripped, so that the bedclothes may be thoroughly aired, the slops removed, and the washstand utensils washed with hot water, rinsed with cold water, and dried with a cloth. After removing and washing the breakfast things, the beds should be made and the bedrooms dusted.

Some special work should be allotted to each day, so that every part of the house may be thoroughly cleaned at least once a week without any serious disarrangement of the household routine, such as occurs when nearly all the cleaning is left to the end of the week. This special work should occupy from ten to twelve o'clock. The mistress, probably, does part of the cooking. From twelve to one o'clock the servant will assist her in the kitchen and will lay the dinner-table. After dinner the sitting-room fire should be made up and the room tidied, the dinner-things washed, knives cleaned, saucepans and all cooking-utensils cleaned inside and outside, and the kitchen made quite neat. As a rule, the heavy work of the day should now be over, and the servant should change her dress, and be ready to do needlework or to attend to any light duties.

If the washing is done at home it should be commenced on Monday, and all linen be ironed and put away by Wednesday afternoon. One or two bedrooms should be cleaned on Thursday, one bedroom and one sitting-room on Friday, and the silver and tins in the afternoon, the other sitting-room, kitchen, staircase, and hall on Saturday.

It is impossible to lay out an exact plan for distributing the work of a house, as it is obvious that it will differ according to the size of the house, and the assistance given by the mistress, or any adult members of the family. Where there are children many extra duties will arise, but much work will be saved if the children are trained when young to be helpful, punctual, orderly, cleanly, and to do as much as possible for themselves.

The following forms an example of an average *weekly routine of special work* for a general servant in a seven-roomed house. It does not include the ordinary daily household work :

Monday : Washing flannels and preparing soiled linen to be sent to laundry. Or, with help, washing all clothes at home.

Tuesday : Cleaning mistress's bedroom in the morning, ironing clothes in afternoon if washing is done at home.

Wednesday : Cleaning two or three other bedrooms.

Thursday : Cleaning dining-room and staircase.

Friday : Cleaning drawing-room and hall in morning ; cleaning silver, tins, &c., in the afternoon.

Saturday : Cleaning kitchen and pantry.

The Nursemaid.—Perhaps of all situations which a girl can undertake, that of a nursemaid is the most responsible. Even where the mother takes the chief share in the duties of the nursery, the post is still one of great importance, and demands the possession of many good qualities on the part of the girl who aspires to become a nurse. Good temper, cheerfulness, patience, and exact truthfulness are indispensable qualities. She must be gentle, yet possess the power of making children obedient.

Daily Work of the Nursemaid.—This will include the care of the children, and of the rooms occupied by them. Most houses have a night nursery and a day nursery, and it will not be difficult to ensure thorough cleanliness and plenty of fresh air if the nurse has the welfare of the children at heart. The day nursery should be swept and dusted early in the morning, the fire lighted, and all arrangements made for the children's baths before they are allowed to get up.

The baths should never be omitted ; the skin must be carefully dried, and in the case of very young children it should be rubbed gently with the hand in order that the circulation may be thoroughly restored.

The nurse should be very careful in dressing the children not to put on any garment so as to cause undue pressure upon or constriction of any part of the body. It will also be her duty at meal-times to watch the children carefully, to check and correct any defects of manner, which, if left unnoticed, would soon become habits difficult to eradicate. The children's beds and bedding should be well aired every day. In fine weather the bedclothes may be spread out near an open window, in order to allow a current of fresh air to pass through them.

Daily outdoor exercise should be taken, except when the children are ill or the weather is unsuitable. Perfect cleanliness is essential in the nursery. Children are easily trained to habits of cleanliness and neatness, and simple rules for putting away playthings, &c., should be enforced by the nurse. It is well to keep the children employed as much as possible. An intelligent cheerful nurse will readily invent means by which children can be amused or taught to employ themselves, thus training them early to habits of self-dependence.

Symptoms of illness should be at once reported to the mistress. A young inexperienced nurse must on no account give medicines or sleeping-draughts, except when ordered to do so.

After the children have been bathed and put to bed, it is the nurse's duty to examine and repair all articles of clothing worn during the day. Buttons and tapes should be replaced, socks darned, &c. A nurse ought to be a good needlewoman, and she will be a much more valued servant if she can cut out and make little garments. Children's underlinen must be frequently changed, and the nurse must be careful to see that it is well aired.

The Housemaid.—In households where a cook and housemaid are kept, the housemaid has the care of nearly all the rooms, excepting the kitchen, dining-room and hall, which are generally in charge of the cook. Much of the housemaid's downstair work should be done in the early morning, before the family breakfast; early rising is, therefore, most necessary. Her early duties will include the sweeping and dusting of the breakfast-room, also dusting of the library and the drawing-room. In winter-time there may be several fires to light before breakfast.

The cloth having been laid for breakfast, and the breakfast served, the housemaid should proceed to the bedrooms, open windows, strip beds, and follow out the same directions as to the bedroom work of a general servant (page 203). The stairs should be swept and dusted daily, the polished hand-rails well rubbed, and all ledges and window-sills left free from dust. Working by rule, the housemaid, subject to her mistress's directions, should divide her work methodically, so as to prevent any part of the house being neglected. Some division of work similar to the weekly routine of a general servant will be arranged. On Saturday the clean linen should be looked out and aired.

It will be the housemaid's duty to answer all inside house-bells during the day, and all outside door-bells after luncheon or middle-day dinner (the cook answers outside door-bells during the morning). Even when doing dirty work she should be neat in appearance. A large working-apron can then be worn over her white waiting-apron, and is easily slipped off. By wearing gloves in her rougher work she may keep her hands in nice order. She will have to take the entire waiting at table. The china and glass will be in her charge, and will need careful washing; and for the mending and airing of linen she will also be responsible.

The Cook.—The cook holds a most important position in every household, for, to a large extent, the health and comfort of the family depend upon her. Where several servants are kept, including kitchen-maid and scullery-maid, the cook's duties will necessarily differ much from those in a house where only two servants are kept. In the former case she will devote her time almost entirely to cooking, in the latter case she will be required to perform certain house duties besides her own kitchen work. A cook must be clean in person, and punctual, methodical, neat and orderly in her work. Cleanliness in the kitchen and in cooking are absolutely essential to health, economy, and successful cookery. In a house where cook and housemaid are kept, the cook generally has charge of the dining-room, the hall, the doorsteps, and the pantries, as well as the kitchen. Early rising is indispensable. Her first morning duty will be to attend to the kitchen fireplace. A cook should make herself thoroughly acquainted with the particular cooking-stove that is in her kitchen, in order that she may keep the flues clean, and understand the best way to regulate the heat for the ovens, &c. Much waste of fuel, uncertain results in cooking, and trial of temper may be spared if this point be attended to. Having cleaned the fireplace and lighted the fire, rinsed and filled the kettles, she will clean the hall and doorsteps, sweep the kitchen and pantry, before preparing breakfast. In some houses the cook clears away the breakfast-things whilst the housemaid is still upstairs in the bedrooms. She has also to answer the morning outside bells. The kitchen should be quite neat, and all utensils of cookery clean and in their places when the mistress goes down to give her orders for the day. There must be no waste of food through neglect or forgetfulness, and nothing that can be turned to account should be thrown away. The stock-pot should be emptied and cleaned out every day. No gravies or soups should be allowed to remain in it all night. The bread-pans should be wiped out daily, and care taken to prevent the accumulation of pieces of stale bread. The refuse from vegetables, and all decaying organic matter should be burned. Nothing that may have begun to turn bad should be allowed to remain in the kitchen or pantry, as the bad gases from it will affect other food. Kitchen utensils should be carefully cleansed (page 215), and, when there is any appearance of the tin wearing off the inside of copper utensils, it is the cook's duty to have them immediately repaired, as there is danger of poisoning if this is neglected. Pudding-cloths, jelly-bags, &c., should be scalded and scrubbed if necessary, but no soda, and, if possible, no soap should be used in washing them. Before being put away they should be well dried and aired to prevent a musty smell being imparted to the puddings, &c., next time they are used. The cook must be particularly careful of the sinks and drains. She should never pour cabbage-water down the sink *inside* the house if she can possibly carry it outside, and, in either case, she should immediately pour down plenty of clean water after it.

The smell of water in which green vegetables have been boiled is most unpleasant; it permeates the whole house, and is not unfrequently mistaken for the smell of drains. Every day, after washing up, a large can of very hot water and soda should be poured down the sink, to prevent a stoppage in the pipes which might be caused through an accumulation of grease. A *grease-trap* requires very special care; it should be emptied and cleaned out at least once a week. If not kept clean the contents become putrid, and may cause very bad smells in the house.

In the cook's actual work—viz., cooking—there must be no hurry; proper time must be allowed for all the preparations for the meals, and all the cooking operations must be timed in order to prevent any course or dish being either over-cooked or partially cold when served up. A skilful cook will have some knowledge of the constituents of food and of the purposes served by them, and she will endeavour to bring this knowledge to bear intelligently upon her daily work of preparing food, not only so as to render it palatable, but also as nourishing as possible. A conscientious person will have regard for the interests of her employers, and will use to the best advantage many little things which are often thrown or given away or are sold by the cook as 'perquisites.'

Care of the Health.—*The Servant's Health* should be considered by her mistress as well as by herself. Opportunities for getting fresh air and exercise should be given, and times for meals arranged. The servant on her part must not neglect to take advantage of these arrangements. She should remember that personal cleanliness is absolutely necessary to ensure a healthy condition of the body. A warm bath with soap should be taken at least once a week, and plenty of soap and water used daily to keep the pores of the skin free from retained perspiration and dirt. The teeth must not be neglected, and the hair should be well brushed night and morning, kept neatly arranged, and without a 'fringe.' Clothing suitable to the work to be done should be worn, and underlinen be frequently changed. Cotton dresses are best for morning wear, as they are washable. Black stuff dresses should be worn in the afternoon.

CHAPTER XXXIII.

DOMESTIC WORK.

Hints for Housemaids and General Servants.

How to Make a Bed.—The servant's hands should be clean, and a large clean white apron worn. The bed should be stripped and exposed to the air for at least an hour before it is made. If there is a feather bed it should be turned, well shaken so as to separate the feathers, and the bed spread out and smoothed to the size of the bedstead. If mattresses are used they should be turned, not only over from side to side, but from top to bottom. The palliasse should be removed, and the bedstead dusted once a week. Where spring mattresses are used, the top one should be turned every day. The under-blanket should be put smoothly on the mattress, and tucked in all round, care being taken not to disarrange the shape of the bed if it be of feathers. The under-sheet should then be put on and tucked in at the bottom. The bolster is well shaken, and placed at the head of the bed on the top of the sheet, which is then rolled round it, unless a bolster-case be used. The sheet is then tucked in at the head, the pillows put on, and the upper sheet and remaining bedclothes smoothly and carefully arranged. In placing the upper sheet, leave sufficient margin at the top to allow of its being turned down over the upper blanket. A quilt or coverlet should be so put on as to hang down equally all round, the centre pattern being in the middle of the bed. Curtains are not healthy appendages, but if these are provided, they should be drawn back and folded gracefully across the pillows. The pillows are sometimes put in pillow-shams or day covers, and laid on the outside of the bed. At night the bedclothes should be turned down smoothly to the lower margin of the pillows.

How to Sweep a Carpeted Room.—For a carpeted room a long-handled hair broom, a short brush, and a dust-pan are required. Carry out the movable articles of furniture into the passage or landing, or, if this is not practicable, cover all articles, such as lounges, chairs, &c., with large dusting-sheets, and remove or carefully cover any small articles likely to spoil. Remove the furniture to the middle of the room, so as to allow of the corners and sides being swept. Carefully strew clean prepared tea-leaves on the carpet all round the room, and sweep towards the fireplace or open window. The only purpose of damp tea-leaves is to prevent the dust rising, but unless they are thoroughly washed with cold water in a clean colander, and then well squeezed to extract the extra moisture, they will stain and do more harm than good. In America newspaper is torn up into small pieces, sprinkled with water enough to damp it, and used instead of tea-leaves. In Australia the custom is to use fresh cut grass for the same purpose. Having swept all round the room, replace the furniture near the walls and so leave the middle of the room clear for being swept. Take up the tea-leaves, paper, or grass and dust in the dust-pan with the short brush. Old carpets may, after sweeping, be brightened up if rubbed with a damp cloth wrung out of cold water containing a little borax.

How to Take Grease-spots out of Carpets.—Where candles are carried up to bedrooms it not unfrequently happens that the grease guttering from them is dropped upon the stair-carpets, where it hardens and is trodden in. The best way to remove it is to scrape off all that lies on the surface with a spoon; a knife is not so good, as it is apt to cut the pile of the carpet. Then take a piece of thick blotting-paper folded double, place over the stain, and with the point of a hot flat iron rub lightly over the grease-spot, move the blotting-paper immediately, and repeat two or three times, each time taking a clean part of the paper. Repeat the process until no grease-stain appears on the paper and no mark is left on the carpet.

For an *oil-stain* it is better to use a paste of fuller's earth mixed with water; leave it on for a day or two, taking care not to walk on it, and brush off when dry. Or French chalk—*steatite*—may be scraped and left dry upon the stain for a day or two, and then brushed off.

How to Take Ink-stains out of Carpets.—*Ink-stains* are best treated with fresh milk. Soak up the ink quickly with blotting-paper, then pour milk on the stain, and rub with a clean flannel. Repeat this until the stain disappears, which it is sure to do. This is also very useful for woollen table-cloths should the inkstand be upset.

How to Clean a Grate.—Remove the hearthrug and lay down a kneeling-cloth or piece of old carpet, or some newspapers to prevent soiling the carpet of the room. Place the housemaid's box on this. This box contains gloves, brushes, blacklead, turpentine, emery-cloth, a rough duster, and a division for cinders. Put on the cleaning-gloves, remove the cinders and ashes, and put them in the sifter of the cinder-pail. Proceed to blacklead the grate. The blacklead may be mixed with a little water, but turpentine is preferable. It should be put on lightly with a brush, the grate having first been rubbed with a cloth to remove all dust. This will prevent the white appearance often noticeable in a badly cleaned grate. Brush the blacklead off briskly with a hard brush before it becomes quite dry, and polish the stove with a soft brush. Nothing spoils the look of a room more than smeared mantel-sides; if any smears have been made on the marble, clean it as directed ('How to Clean Marble,' page 217).

How to Dust a Room.—After the fireplace has been cleaned, and the carpet swept, the room should be left for a short time with the windows open for the dust to settle. Two dusters, a feather brush, and an old silk handkerchief will be required. The large articles of furniture are to be dusted first, the dust being gathered or *gently wiped* up in one of the dusters, and not allowed to fly about the room. 'Whisking' over the articles will not remove the dust. All carved work, such as the back and pedestals of sideboards, will require extra care. A very soft hair brush will be found useful in removing the dust from carved work. When dusting chairs, one duster should be used to hold the chair, whilst the other is used to remove the dust. Little spaces in the woodwork will require a corner of the duster to be drawn through them, and rims and joints should not be neglected. If the seats can be removed they should be brushed in the open air; if of velvet or silk and immovable, they should be carefully brushed with a velvet or a feather brush, and rubbed lightly with a clean silk duster kept for the purpose. The picture-frames should be lightly dusted with a feather brush and the glass rubbed with a duster.

The mantelpiece ornaments should be placed on a cloth or newspaper on the table, each one being dusted with the silk handkerchief as it is removed. The mantelpiece should be dusted on the top and down the sides with a brush and duster, and the ornaments replaced. If the mantelpiece is marble, wash it with soap and water, and dry with a clean cloth, then polish it. ('To Clean Marble,' see page 217.) China should be lightly dusted and occasionally washed. The covers of books must not be rubbed, but dusted with the feather brush.

The legs of tables, skirting-boards, all ledges, window-sills, panelling, and doors must be dusted thoroughly, so as to remove every possible speck of dust from the room, and the framework of the door as well as the top edge of the door, where dust gathers very thickly. Polished articles, such as tables, &c., should, in addition, be well *rubbed* with the silk handkerchief. Glass doors of bookcases and insides of windows should be cleaned with a damp wash-leather and polished with a clean duster. When all is finished, the hearthrug, which has previously been hung over a line, beaten with a smooth stick, and then brushed, should be laid down, and table-covers, &c., replaced, having been first well shaken out in the open air. Fur and hair rugs should be shaken only.

How to Clean a Steel Grate.—Rub the bars which have become blackened daily with fine emery-paper. Polish every part of the grate, and also the fender and irons, with a leather. When through neglect rust-spots appear, apply a paste made of sweet oil and rotten-stone. This should remain on for some hours, then be rubbed off with a piece of flannel, and the steel polished with a chamois leather and a little unslaked lime. Take care to avoid its getting into the eyes.

For regular cleaning of steel fenders and fireirons, the following is admirable :—

Have a saucer full of finely-scraped Bath brick, make it into a paste with equal parts of methylated spirit and water, dip a thick flannel or piece of soft broadcloth into this, and rub the irons well. Polish with leather.

How to Clean Brass and Tin Ware.—When these articles are regularly cleaned, and care is taken to prevent discoloration, a simple paste made of precipitated whiting will be all that is needed. Rub the paste on the articles with a piece of soft flannel, and, when dry, rub it off with a fresh flannel and plate-brush, polishing with a chamois leather. When brass and tin ware have become very discoloured the following mixture may be used :—1 oz. of rotten-stone, 1 oz. of soft soap, 1 oz. of spirit of hartshorn. Mix these, and keep closely corked in a stone bottle. Various patent articles, such as Sapolio and Monkey Brand Soap, clean brass beautifully.

How to Clean Copper Kettles, &c.—Utensils made of copper may be cleaned in the same way as brass and tin ware, but when they have been neglected they will need something stronger. Mix 1 oz. of oxalic acid with ¼ pint of warm water, rub this on with a soft flannel and polish with a soft cloth or leather. The oxalic acid is very poisonous, and the solution made as above should be labelled 'Poison,' and kept where it cannot be taken by mistake instead of medicine.

How to Preserve Brasses, Steel Fireirons, &c., from Rust when not in Use.—Rub over them a paste made of fresh lime and water. A brush should be used and all the ornamental work well covered with the paste. Articles so treated will keep free from rust for many months.

How to Clean Stone Steps.—Sweep all dust from the steps, wash each step thoroughly with house-flannel and water, then wet and rub horizontally with ordinary rough hearthstone, which can be purchased at any oil-shop at the rate of two or three pieces for a penny. Wring out the flannel and finish off the step by rubbing it horizontally and evenly so as to prevent a patchy appearance when dry. The sides and fronts of the steps must not be omitted. A superior kind of stone or pipe-clay may be purchased for stone stairs inside houses. Care must be taken to rub evenly from side to side and not in curves, or the marks will show when dry. Milk-stains on a doorstep are as bad as grease, and must be treated in the same way—viz., by covering them with a paste made of fuller's earth and water. Leave this on for twenty-four hours, then wash off and repeat if necessary. Cleaning in the usual way with hearthstone and water is not sufficient to remove the stain.

How to Clean Windows.—Rub the windows well with a dry duster inside and outside, then wash them with slightly warm water and a wash-leather. Dry them with a cloth, and polish quickly with a linen duster.

Another plan is to rub a little moist whiting over each pane. This is to be rubbed off with a cloth when nearly dry and the windows polished with a wash-leather. Windows may also be well cleaned by using a leather only for washing and polishing, and perhaps this is the quickest way of all. Rub the window thoroughly with a dry duster, then wash each pane with a rather wet leather. Now wash out the leather in the cleaning pail, wring the leather as dry as possible and polish with it. When done, the window should be quite dry and bright.

How to Clean Glass Decanters, &c.—Mix some crushed eggshells with salt and warm water. Use this to remove stains. Chips of raw potato, or bits of brown paper well soaped and rolled up, may also be used, being put into each decanter with warm water and well shaken for a few minutes. Rinse with clean cold water several times. A little silver sand in the water will help to brighten the glass, but it takes a great deal of rinsing to get quite rid of the sand. Wipe the outside with a dry cloth, and turn the decanter upside down in a jug to drain, if there is no bottle-rack. A mixture of salt and vinegar will remove obstinate port-wine stains.

How to Wash China Tea-things, &c.—Prepare a large bowl of warm water, a clean, soft dish-cloth or flannel, and a small brush. Empty all dregs from cups and saucers into the slop-basin. Wash all the articles thoroughly with the flannel, using the brush for the handles of the cups if necessary, put them on a tray to drain, and dry them with a soft cloth.

How to Wash Dinner-things.—Prepare a large bowl of hot water containing a piece of soda, a bowl of cold water, two dish-cloths, and a large cloth for drying. Remove all pieces from plates and dishes. Wash the plates, &c., singly in the hot water, using one of the dish-cloths. Dip each article as washed into the bowl of cold water and leave it to drain. For wiping, first use the other dish-cloth, and finish off with the dry cloth. The use of two dish-cloths will save using large drying-cloths. Where there is a plate-rack over the sink, the final drying is not required, as the plates dry quickly after being rinsed in cold water and placed in the rack.

How to Wash Saucepans and Kitchen Utensils.—Use plenty of hot water and soda, and wash the saucepans and other metal utensils used in cooking inside and outside. It is useless trying to remove the grease without soda. A small twig hand-broom and a good-sized cloth for the purpose should be used. After being thoroughly cleansed, rinsed, and wiped inside and outside, all black being removed, they should be allowed to stand for a few minutes on the closed stove or kitchener, or in front of an open range, in order to get thoroughly dry before being put away. This will prevent all danger of rust.

How to Clean Plate.—Wash and dry all articles thoroughly, make a paste of precipitated whiting and rub it all over them with a piece of soft rag or flannel. When dry rub it off with a soft plate-brush, and polish with a chamois leather. Two brushes may be used: a small fine one for the ornamental work, the other, larger, for large surfaces. Great care must be taken not to leave any whiting in prongs of forks, round handles of teapots, &c.

Another Method.—Make a paste of hartshorn-powder and water, or, if the plate be very discoloured, with spirit of wine instead of water. Rub this lightly over the plate with a soft cotton rag, and, when quite dry, brush and polish as above. This method will produce a very good polish, lasting longer than if cleaned with whiting or various plate-powders. Many plate-powders contain quicksilver, and this, in time, has an injurious effect, making silver brittle and liable to be easily broken.

How to Precipitate Whiting.—Ordinary whiting, as purchased in lumps, contains many little specks of grit and dirt which, if the whiting be used without precipitation, will cause scratches on silver. The simple way to precipitate whiting is to scrape a quantity into a piece of fine muslin, place it over the top of a jug of water, letting the part of the muslin containing the whiting be suspended in the water. Let it stand for some time, when it will be found that the whiting has passed through the muslin to the bottom of the jug, whilst the grit remains in the muslin. Pour off the water gently, to disturb the sediment as little as possible. Let the whiting dry, and keep it in a box for use.

How to Clean Knives.—Wash the blades and wipe the handles, so as to remove all grease. Never put the handles of knives into hot water, which will discolour ivory and loosen the blades. These are fastened in with resin, upon which heat readily acts. Rub a little Bath brick on a knife-board covered with indiarubber, or a little prepared knife-powder may be used. Clean the knives on both sides, holding them flat, and rubbing horizontally. Do not hold them sideways, nor rub the edges, or they will be blunted. Rubbing the knives on a piece of board covered with soft carpet will give them a high polish and make them look like new. Knife-machines save time and labour, but they wear out the knives quickly.

How to Clean Floorcloth.—Floorcloth should be washed as seldom as possible, to avoid rotting. It may be kept bright and fresh by careful sweeping, and rubbing with a dry cloth. When really soiled it should be washed with warm water (soft water if possible), soap and flannel, and dried thoroughly. Then, if rubbed over with a flannel wrung out of milk, it will look like new. Rubbing with a little beeswax and turpentine puts a high polish on it, but renders it dangerously slippery, and is a frequent cause of accidents.

How to Clean Papered Walls.—Tie a large duster over the head of a long-handled sweeping-brush, and thoroughly sweep every part of the walls, changing the duster as often as necessary. Paper may be considerably freshened in appearance by being rubbed with dry dough, made by kneading together a little flour and water. The paper, however, soils very quickly after this process.

How to Clean Paint.—Use warm soft water, a little dissolved soap, and a piece of soft flannel. If soft water is not obtainable, boil the water and dissolve the soap in it. Have a second pail of clear cold water and a large clean sponge. In cleaning a large surface—such as a door—wipe it well all over with a *dry* duster first; then squeeze out the sponge and thoroughly wet the surface all over, *beginning* *at the bottom*; this will prevent the soap and water from running into streaks, and will preserve the paint. Rub the paint as gently as possible with the soapy flannel, rinse the dirt out of the flannel, go gently over it again, and rub dry with a soft cloth.

How to Scrub a Room.—Roll up and remove the carpets, and clear the room of as much furniture as convenient. Sweep the room thoroughly towards the fireplace, door, or open window. The articles required are a kneeling-mat, a piece of mottled soap, a scrubbing-brush, a woollen floor-cloth or house-flannel, a dry rubber, and a pail of warm water containing a little soft soap. Begin at the part farthest from the door, wet a small portion of the boards as far as the arm can conveniently reach. Rub a little soap on the scrubbing-brush, and scrub the piece thoroughly, taking care to scrub in the direction of the grain of the wood. Wipe up all the dirty water and soap with the woollen floorcloth. Use the dry rubber for wiping the part dry. Do not wet or slop the boards more than is really necessary to make them clean. Change the water frequently, or the boards will have a dirty, streaky appearance when dry. Do not choose a damp day for scrubbing bedrooms or rooms constantly used as sitting-rooms. Let a good current of air pass through the room after scrubbing, and it will soon dry on a fine day. In winter it is well to light a fire if the room is required for use very quickly. If any part of the flooring is much discoloured, put a little sand over it before scrubbing.

How to Remove Grease-spots from Boards.—Make a paste of fuller's earth and hot water. When cold spread it thickly over the grease-spots and allow it to remain there for a day or two. Then scrub the place in the way already described. Repeat until the grease-spot disappears.

How to Clean Marble.—Take 1 oz. of powdered chalk, 1 oz. powdered pumice-stone, 2 ozs. soda, and, after passing them through a fine sieve, make them into a paste with water. Rub this paste over the marble, afterwards washing it with soap and water. Any stains will be removed, and a good polish produced. Sapolio and Brooke's Monkey Brand Soap are probably similar in composition, and will be found to effectually cleanse.

Another Method.—Make a paste of $\frac{1}{3}$ pint of turpentine, $\frac{1}{4}$ pint of soap lees, equal parts of powdered pumice-stone and pipe-clay, and a little bullock's gall. Spread the paste over the marble, and let it remain for two or three days until dry, when it should be rubbed off with a soft duster. If the marble has been much neglected it may be necessary to repeat the process two or three times.

How to Polish Furniture.—Make a furniture-polish of the following ingredients :—$\frac{1}{2}$ pint of turpentine, $\frac{1}{2}$ pint of linseed oil, $\frac{1}{4}$ pint of vinegar, $\frac{1}{4}$ pint of methylated spirit. Shake these well together, and rub some of the mixture on the furniture with a soft linen rag. Polish with a duster. A piece of clean old chamois leather is useful to finish off with. When furniture has been much neglected it is a good plan to rub it well over with linseed oil, and let the oil remain on it for some hours. This will loosen dirt and prepare the wood to receive the furniture-polish. Precipitated brick-dust powder may be shaken over the oiled parts through a muslin bag, but this should be done very carefully, and never with valuable furniture, as even with care scratching may occur. The old-fashioned furniture-paste, consisting of beeswax and turpentine, is very good, but needs a great deal of hard rubbing. Labour may be saved by the addition of a little methylated spirit.

French-polished furniture only requires the use of furniture-polish three or four times a year, but it should be well rubbed daily with an old silk handkerchief—not merely dusted. The polish should not be put on in excess, or in daubs or smears, but should be rubbed evenly up and down, according to the grain of the wood.

How to Light a Fire.—First sweep down the soot hanging about the register ; next clean the grate, and lay a few cinders on the bottom of the grate, and over these a few pieces of paper slightly crumpled. Upon the latter place several pieces of firewood lightly across each other, with spaces between. Next put on a few more cinders and several small pieces of coal, taking care not to lay them too closely together, as that will prevent the air from passing through the grate, and without air there can be no fire.

The fire should be lighted from below with a match applied to the paper. If carefully laid, and not overcrowded with wood and coals, it will burn up very quickly.

How to Wait at Table.—Waiting at table is the duty of the parlourmaid, assisted by the housemaid, or, if only two servants are kept, the housemaid does it alone.

Appearance of the Servant.—The maid who waits at table must be scrupulously clean in person, her hair neatly arranged; her attire should be a plain, close-fitting black dress, white muslin apron with bib, clean white collar and cuffs, and fresh white muslin cap. A slow, heavy servant should never be chosen to wait at table. It requires a bright, quick-sighted girl, soft of foot, and ready to act. If the number at table be large, several waiters or waitresses will be required; but in a small household, or where there are only one or two guests, the housemaid is able to do all the waiting required. She will learn from the cook what dishes are to be served up at dinner, and having laid the table in accordance, with spoons, knives, forks, &c., required for each course, she will, when the family are seated, commence her waiting by going to the left hand of the carver, and removing the cover of the dish in front of him.

Soup is generally served first, and the waitress should take a plateful to each person, commencing with the lady on the right of the carver, or, if there are no guests, commencing with the lady of the house. It should be placed in front of her from the left side. As each person's plate is finished with, it should be quietly removed and placed on or near the sideboard, conveniently for removal from the room.

In some houses zinc-lined baskets are used in the dining-room as receptacles for dirty plates. Spoons, forks, knives, &c., should be placed in baskets, each one having a cloth at the bottom to avoid noise. Care must be taken not to scratch the silver in putting it into the baskets. Everything must be done quickly and quietly. There must be no sound of rattling of plates, silver, or cutlery.

Fish is handed round in the same way as the soup, but the waitress also carries in her left hand the sauce-tureen, holding it for each person to help himself. Plates, &c., are removed as before.

The joint is next brought in, and the plates with meat are taken round, the maid at the same time carrying one vegetable-tureen Each course should be served in a similar way, but entrées are handed round, not placed on the table in front of the carver.

If wine or beer be taken, the maid will pour it into the glasses as desired.

Where only two servants are kept, the cook will carry the hot plates and dishes to the dining-room door, outside which should be a stand with a large butler's tray, upon which they should be placed in readiness for the housemaid to carry in.

Cheese having been handed round, and dinner being over, the crumbs should be deftly swept off the cloth with the crumb-brush and tray.

Dessert is usually placed on the table when the cloth is laid, but where this is not the custom the waitress should remove the dessert from the sideboard and arrange the dishes on the table.

Having placed a dessert-plate, on which is laid a fruit knife and fork, in front of each person, also finger-glasses, if they are used, her active duties of waiting are over, and, removing any dishes, &c., that are remaining on the sideboard, she leaves the dining-room until it is vacated by the company, when she returns to clear the table.

CHAPTER XXXIV.

PUBLIC LAUNDRIES.

The subject of laundry-work is one which has come under notice in a remarkable way during the last few years. Numerous public companies have established large laundries in various parts of the country, and in these institutions washing and the getting-up of linen are carried on by those who understand the scientific principles underlying the successful performance of such work.

Machinery is largely used in the various processes of cleansing, ironing, &c., and this fact is sometimes urged as an argument against public laundries, machinery being supposed to weaken the fibres of the materials and to tear the articles. Great improvements in laundry machinery have, however, been recently made, and this danger is now reduced to a minimum.

The technical education of the country now includes laundry-work for girls, and the instruction is given by special teachers who are theoretically and practically qualified to judge the quality of the materials to be used in washing and to superintend the actual work.

Educated ladies, finding that new and superior methods of performing laundry-work require a higher grade of intelligent knowledge than that generally possessed by ordinary workwomen, have taken posts of supervision in laundries; whilst many, having obtained the requisite technical knowledge, have undertaken in their own homes the getting-up of fine linen, cleaning of real lace, washing and starching of delicate muslins, &c.

Public laundries under efficient management are without doubt an inestimable boon to the well-to-do residents of large towns.

The vans carry away the soiled linen at the beginning of the week, and return with it clean at the end of the week. There are, however, thousands of families in which, on the ground of economy, the washing must be done at home.

Public Washhouses have been built in some thickly populated districts to supply a want keenly felt by the poorer classes. The limited amount of space in the houses of the poor, and the absence of good drying accommodation, make the efficient cleansing of linen almost an impossibility.

The Advantages of Public Washhouses to those living in small city homes are :—

1. The discomfort of 'washing-day' at home does not exist. The small house is not rendered distasteful to husband and children by a steamy atmosphere, wet floors, and clothes hanging about.

2. The expense is very small, generally about three-halfpence per hour.

3. There is in the public washhouse plenty of space for working.

4. There is an abundance of hot and cold water.

5. There is free use of tubs and coppers.

6. The use of public washhouses carries with it excellent drying arrangements on rails in thoroughly ventilated hot-air cupboards. Free use of mangles is also allowed.

Women who desire to take their linen to the public washhouses can book their time the day before, so as to

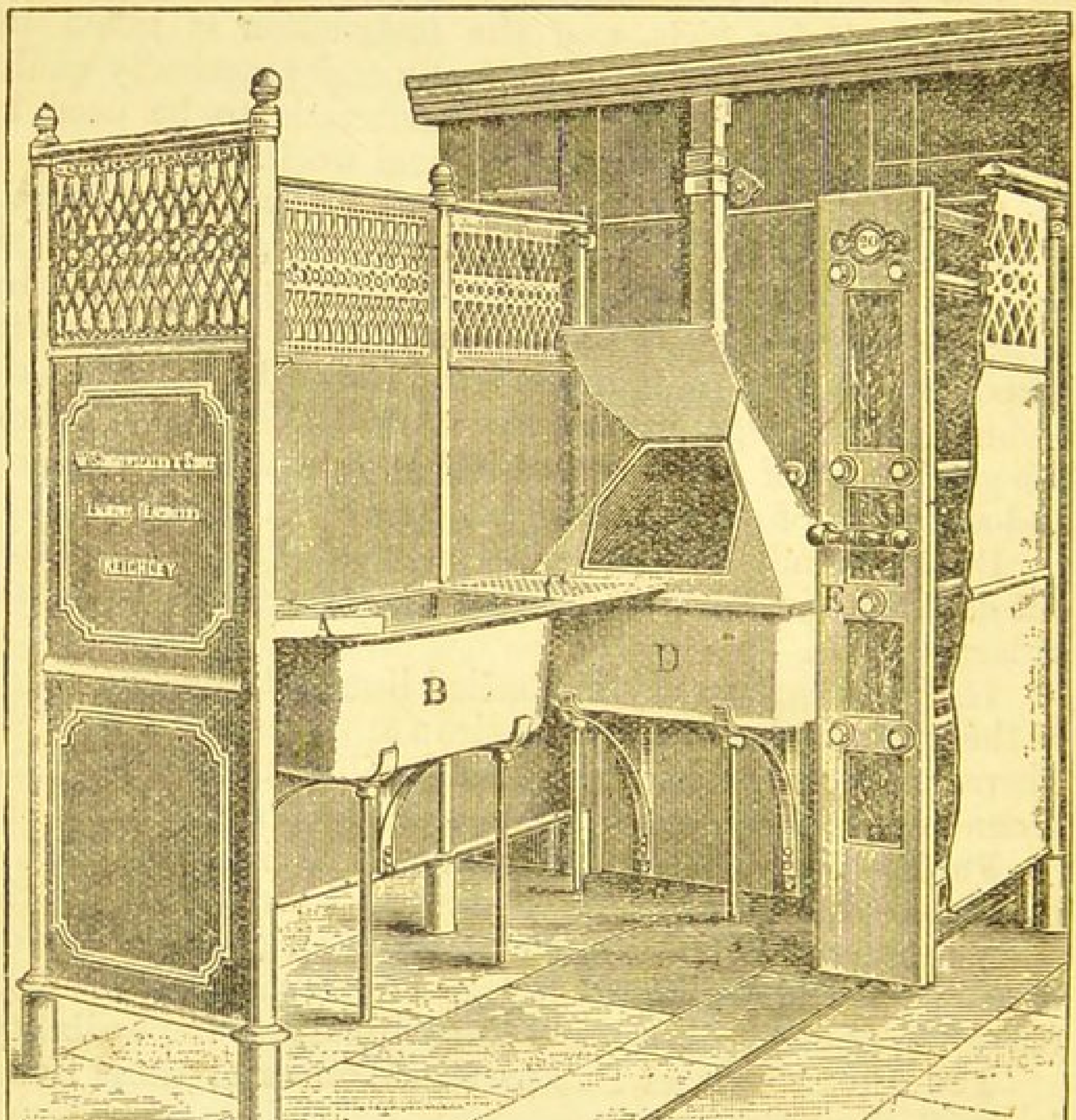


FIG. 52.—*Compartment of Public Washhouse.*

A, *Rubbing-board.* B, *Washing-trough.* C, *Drainer.* D, *Boiling-trough.* E, *Drying-horse.*

prevent being kept waiting for their turn. It is sometimes difficult, perhaps, for a mother to leave her home for several hours at a time, but kindly-disposed neighbours will often arrange to help each other by attending to little home-matters in turn.

In some of the most recently designed public washhouses each woman is provided with a separate washing-stall, containing a separate accommodation for washing, boiling, and drying (fig. 52 and fig. 53). There is by this system no opportunity for women to take away the wrong linen.

It has been stated that there is danger of infection,

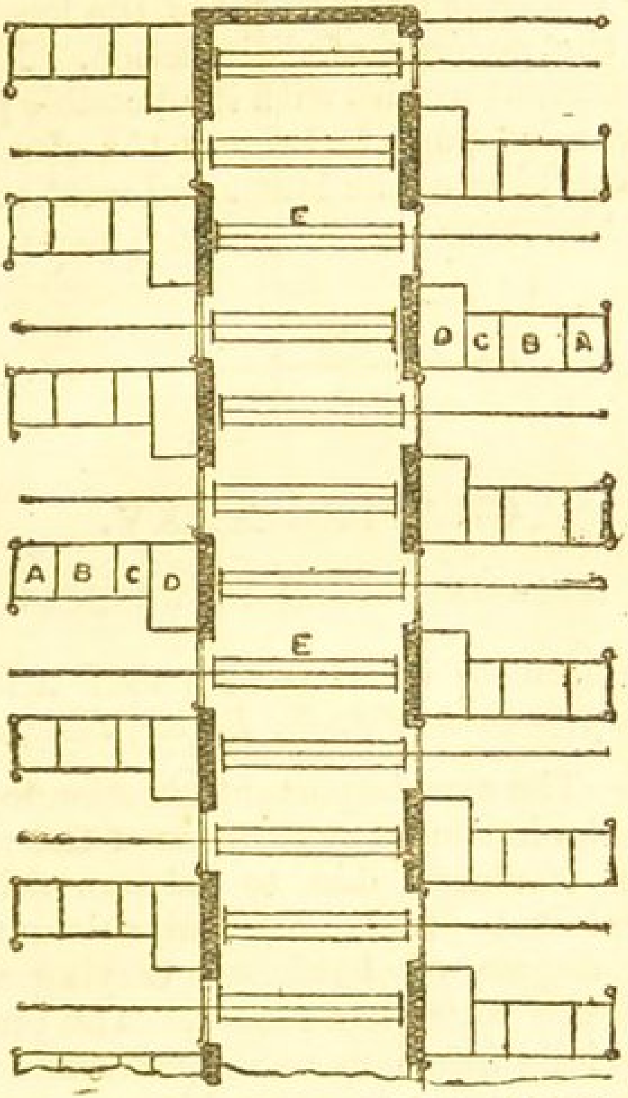


FIG. 53.—*Ground Plan of Public Washhouse.*

A, *Rubbing-board.* B, *Washing-trough.* C, *Drainer.* D, *Boiling-trough.* E, *Drying-horse.*

owing to linen having been brought from an infected house. This is now highly improbable in most towns, as the sanitary officials are, under the Infectious Diseases (Notification) Act, cognisant of each case of infectious disease (with the exception, perhaps, of measles and whooping-cough), and any Sanitary Inspector who allowed infected articles to go to a laundry without previous thorough disinfection would be guilty of culpable negligence of his official duties.

One section of the Infectious Diseases Prevention Act, which came into force in the Metropolis in December, 1890, and has also been largely adopted throughout the country, requires the owner of any clothing or other articles which have been exposed to the infection of any infectious disease, to hand over the same to an officer of the local authority for removal for the purpose of disinfection. Non-compliance with this enactment carries with it a possible penalty of £10.

The diagram on page 222 shows the *elevation*, and that on page 223 the *plan* of the latest and most convenient form of public washhouses.

CHAPTER XXXV.

MATERIALS USED IN WASHING.

Methods of Softening Water.—Uses and Adulterations of Soap.—Uses of Soda, Borax, Blue, &c.

I. Water.—The most important question to be considered in washing is the hardness or softness of the water. Hardness of water is chiefly due to calcium salts, especially chalk (*i.e.*, calcium carbonate) and calcium sulphate, or gypsum, the degree of hardness varying with the soil through which the water has passed. The presence of iron in water is specially injurious to the materials to be washed.

Hard water wastes a considerable amount of soap, as a lather is not produced until all the lime-salts have been neutralised by the added soap. Soft water is not only economical of soap, but also of labour. It is therefore desirable, where possible, to wash with soft water. Where the tap-water is hard, rain-water may be collected for washing purposes, taking care to secure it in a clean condition by filtering or otherwise.

If only hard water is obtainable, means must be taken to soften it, so as to secure economical and efficient cleansing of clothes.

1. *Boiling* gets rid of a considerable proportion of the hardness of water. The calcium carbonate in water is in the form of a bicarbonate, from which carbonic acid is driven off by heat, and the remaining carbonate is precipitated. This accounts for the 'fur' on the inside of kettles and boilers. All boilers should be periodically cleaned out. The 'fur' forms a thick internal coating which retards the heating of the water, and, in addition, the pipes leading to and from the boiler may, unless attended to, become blocked up. It is not, however, always convenient to employ water which has been previously boiled and the calcareous matter allowed to settle. Most persons, therefore, have recourse to the use of

2. *Soda and Borax.*—These throw down a considerable proportion of the lime-salts, and thus diminish the amount of soap required for washing purposes.

3. Water for washing and other domestic purposes may be deprived of the greater part of its hardness by adding *milk of lime* in definite proportions, taking care to avoid an excess. The amount required will vary with the degree of hardness of the water. Thus, if a given quantity of water contains 1 lb. of chalk in solution, it requires to be thoroughly mixed with 9 ozs. of quicklime which has been previously made into a milky solution. The lime combines with the carbonic acid, which kept the chalk in solution, and if time is allowed, nearly the whole of the chalk settles to the bottom. By this means if a gallon of water contains $17\frac{1}{2}$ grains of chalk, 16 will be deposited, and only $1\frac{1}{2}$ grains remain. Time must be allowed for settlement before the clear soft water is removed. The amount of lime which will be required may be gathered from the fact that the drinking-water in London, which is chiefly derived from the rivers Thames and Lea, and is hard, contains between 14 and 15 grains per gallon of the minerals producing hardness.

II. Soap consists of some purified fat or oil, saponified by the addition of an alkali—*i.e.*, soda or potash (page 118). Formerly animal fats only were utilised in the manufacture of soap, but vegetable fats and oils are now largely used. Good soap is invariably the most economical for washing linen.

Soap Adulterations.—Cheap inferior soaps are often adulterated. (1) *They may contain too large a percentage of water*, which the customer in purchasing pays for at the rate of pure soap. The amount of water-adulteration may be tested by weighing and cutting up a piece of soap into thin slices and drying them slowly in an oven. If upon weighing again the loss of weight be above 3 per cent. the difference will show the quantity of fraudulently added water.

(2) *They may contain an excess of alkali.* The alkali when united with fats in proper proportion assists in cleansing, but injures the linen when it is present uncombined with the fat.

(3) *The presence of unsaponified fats.*—These are fats upon which the alkali has not acted. In washing this fat escapes, clings to the linen and the sides of the tub, causing a greasy scum on the top of the water, and effectually preventing the proper cleansing of the articles.

III. Soda.—Most of the ordinary soda used in washing is manufactured from chloride of sodium or common salt. Briefly stated, the process is as follows :—Sulphuric acid is added to common salt, sulphate of sodium and hydrochloric acid being formed. Heat is then applied to the solution, evaporating the hydrochloric acid, and leaving the sulphate of sodium. This is roasted with carbonate of lime and charcoal, giving a mixture of sulphide of lime and carbonate of soda, commonly known as black ash. This ash is then thrown into water, which dissolves out the carbonate of soda, and leaves behind the insoluble sulphide of calcium. The solution is again evaporated to dryness, yielding **crude** carbonate of soda. This is roasted with sawdust to convert any caustic soda resulting from the action of the lime on the carbonate into normal carbonate. The product is known as soda ash. Dissolved again, and crystallised out, it constitutes the ordinary soda used for laundry purposes.

Owing to the large amount of water in the composition of soda, it deteriorates when exposed to the air, and therefore it should be kept in glazed earthenware jars with close-fitting lids. A wet hand should never be put into the jar, as some of the soda will be damped, and in this case it may form a mass, and it will be necessary to dissolve the whole in order to get out a part.

Uses of Soda.—(1) It softens hard water. (2) It acts as a solvent of fatty acids, loosening them and allowing them and other accumulated dirt to be readily washed out.

Soda used in excess is very destructive to materials weakening the fibres, and causing discoloration. It should never be used for washing delicate articles, muslins, lace, or coloured prints, as it acts chemically upon the dye, causing the colour to fade or to run.

IV. Borax.—This is a saline substance found in its crude state in many of the salt lakes of Asia, and also in North and South America. These lakes are supplied by springs, the water containing common salt and borax. Large deposits of these compounds are constantly forming in the bottom and on the borders of the lakes. By a process of evaporation impurities are removed, and borax crystals readily soluble in water are formed.

Uses of Borax.—(1) It has a powerful effect in softening water. (2) It dissolves fats, starches, &c., and loosens dirt in a marvellous way, so that it can be easily washed out. (3) It does not attack and weaken fabrics as soda often does, and it may be used in washing cotton, linen, woollen, or silk ; neither does it affect the dye. (4) It saves much labour and soap.

V. Washing-powders, &c.—These consist of preparations of soda, chloride of lime, and borax. Cheap washing-powders invariably spoil the fabrics with which they are used. The real basis of most "soap-powders" and "soap-substitutes" is almost invariably chloride of lime, and although, when properly used, chloride of lime is a valuable and necessary means for bleaching raw fibres and new materials, yet the constant use of such a powerful chemical agent can only produce a most detrimental effect upon the linen. Manufactured strong sodas, potash lyes, bleaching fluids and powders should all be avoided by the amateur laundress.

VI. Bleaching-powder.—A simple bleaching-bath may be made with boiling water and soda or borax. For one gallon of water use two tablespoonfuls of either soda or borax. This may be diluted as required. It is suitable for bleaching grey calico.

VII. Blues.—These may be obtained in solid or liquid form. Liquid solutions of blue are very strong, and do not readily dissolve in cold water. Even when warm water is used a deposit may often be found at the bottom of the water, if allowed to stand. On the whole, they are not so satisfactory as the solid forms of blue. These should be firm in the bulk, but should readily crumble to a fine powder free from grit. **Indigo blue** is much used, but requires care to mix it uniformly. If used with discoloured linen, indigo gives them a greenish tinge. **Prussian blue**, so called because first manufactured in Berlin, is of a dense hue, and somewhat troublesome to mix, often precipitating spots and streaks upon the linen. It is frequently much adulterated. **Ultramarine blue** is often sold in liquid form, but, when properly manufactured and carefully used, it is a valuable form of solid blue.

Aniline blues are largely used. If purchased from firms with good reputation they may be relied upon not to injure the linen or to give uncertain results.

VIII. Paraffin.—By an accident the use of paraffin as a detergent in washing was discovered. The dirty linen, without any previous soaking, is placed directly into a copper of boiling water containing a solution of soap and paraffin in the proportion of two tablespoonfuls of paraffin to half a pound of yellow soap for an average-sized copper half filled with water. The linen is allowed to remain in the water from 20 to 30 minutes, being occasionally stirred with a stick. After being wrung out, rinsed in warm water, blued, and dried, it is found to be quite clean and of a good colour.

The objections to the use of paraffin are :—That (1) there is danger of its bursting into flame if too much paraffin is used and a light brought near it. (2) The water sometimes overflows, and the paraffin carried with it makes a mess, even if it does not catch fire. (3) It forms a greasy scum with the soapsuds, and this, if not carefully skimmed off, clings to the sides of the copper. If it should get rubbed into the linen it is most difficult to remove. (4) Unless very carefully and thoroughly rinsed, the smell of paraffin remains in the linen.

IX. Soap Jelly.—This is most valuable for washing flannels and woollen materials. Shred one pound of good yellow soap into a saucepan with three quarts of water. Stand it by the fire until the soap is quite dissolved. When cold the mixture becomes a stiff jelly, a portion of which can be melted as required for use.

CHAPTER XXXVI.

WASHING.

Utensils Required.—Washing-machines.—Processes of Washing.—Order of Washing.

Utensils Required for Washing.—The number required will vary with the size of the household. In an ordinary house where the washing is done at home, the following will be needed:—(1) Two large washing-tubs and one smaller one. Washing-troughs of an oblong shape, and provided with a ledge at one end for soap, are more convenient than round tubs. One or two large earthenware pans are very useful for rinsing. In hot weather it will be often necessary to fill the tubs with cold water in order to prevent them from leaking. (2) A copper or large boiler. (3) A linen-stick for stirring and lifting the clothes out of the copper. Brushes in the case of hand-labour. For *drying*, lines, props, pegs, and a wicker clothes-basket will be required.

Washing-machines.—In laundries and establishments where washing is carried out on a large scale, machinery is indispensable, and, owing to numerous inventions and improvements, this kind of labour-saving apparatus has reached almost to perfection. Economy of time and labour is a great consideration in the home, and a machine, although small and of the most elementary character, substantially shortens the operations of washing and probably wringing, whilst reducing the amount of actual labour. Machines are a decided improvement upon the ordinary washing in tubs and using brushes to scrub the linen, thus wearing it out. The same objection has been raised to washing-machines, but, if carefully used, the work may be done without any harm to the materials.

When purchasing a washing-machine, care should be taken to select one that effects the cleansing of the linen most thoroughly with the least expenditure of strength, and with as few complications of machinery as possible.

Among the many kinds of washing-machines in use may be mentioned—

(1) **Upright Barrels and Dollies.**—These are largely

used in the North of England and in manufacturing districts where the clothing is often very rough and much soiled, but many are not suitable for more delicate work.

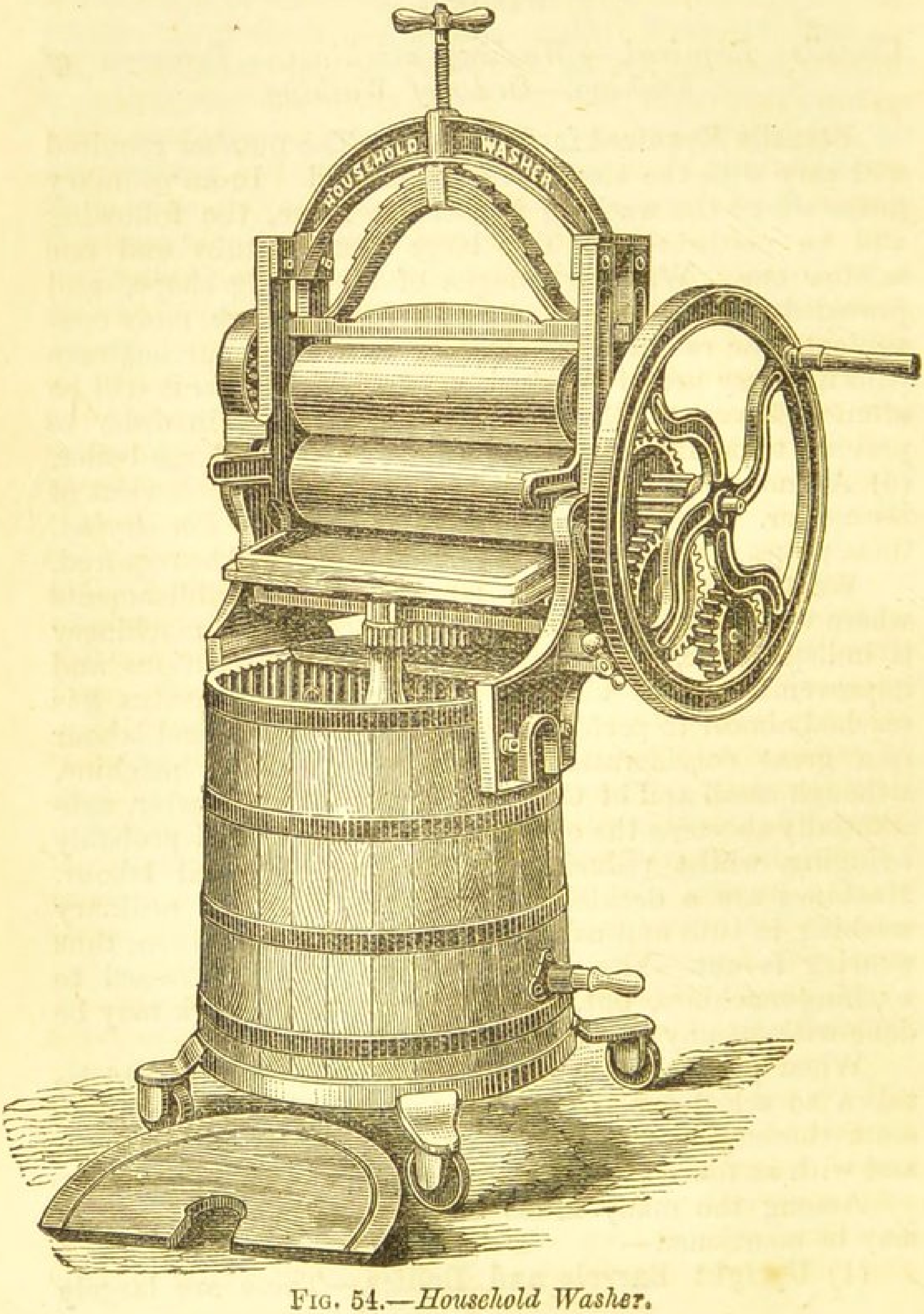


FIG. 54.—*Household Washer.*

(2) **Summerscales' Household Washer.**—This machine is suitable for washing any kind of fabric. It consists of a cylindrical barrel fitted with rollers above, and in the centre with a dolly which has a reversible action, so that the clothes cannot get twisted into lumps. The whole of the work is done with one handle, the motion being easily altered, by an eccentric, from washing to wringing or mangling. The prices vary from about £3 18s. to about £5. (Fig. 54.)

(3) **The Canadian Prize.**—The clothes are forced over two small rollers and under a large fluted one by the application of pressure caused by turning a crank-handle, and in this way the dirt is rubbed and squeezed out. By means of a small thumb-screw on the left side of the roller, the bottom may be increased or decreased so as to fit into tubs of various sizes. Price from 30s.

(4) **Bradford's Patent Vowel Machine** is simple in construction, and is easily kept clean. It consists of a cylindrical barrel capable of rapid motion by turning a crank-handle. It is fitted with rollers, which serve to wring and mangle the clothes. The price of a 'Family Washer' of medium size is from six to seven guineas.

Preparation of Clothes for Washing.—*Sorting.*—The sorting of linen is a necessary preliminary to washing. There should be separate heaps made of (1) fine muslins, nets, and lace; (2) collars and cuffs; (3) white body-linen; (4) table-linen; (5) bed-linen; (6) coarse household-linen; (7) coloured articles; (8) flannels; (9) stockings; (10) pocket-handkerchiefs. Coloured and white flannels should be washed separately; also cotton and woollen stockings.

Stains.—These should be removed before articles are washed, because soap combined with boiling or hot water makes most stains permanent. (For removal of stains see pages 245–6.)

Soaking.—This process is absolutely necessary to successful washing. The linen should be soaked in cold or tepid water for several hours before being washed. It is best to put the linen in soak the night before, keeping the various kinds of articles separate in different vessels. The water used for soaking should be soft. It is a good plan, in the case of very dirty linen, to add a little good soap lathered, or, better still, a little dissolved borax. The tepid water and detergent agent combined loosen the dirt, and materially simplify the after-operation of washing. Very soiled parts of the linen, such as wristbands and collars of shirts, may be rubbed with soap.

The First Washing.—The linen must be slightly wrung from the soaking-water, and the tubs well rinsed for the washing. For this the water should be warm, but not too hot. When a machine is used a washing-liquor should be previously prepared by dissolving chipped soap and a little soda in warm water. Whether the linen be washed by machinery or by hand the guiding principle should be the same—viz., to expel by means of friction, with the aid of soap, the dirt which has been loosened by the previous soaking

In the case of hand-labour the soap is rubbed on each article, and generally a scrubbing board and brush are used. As already stated, the scrubbing process wears out the linen. After all the articles are thoroughly rubbed,

The Second Washing should be done in another tub, with fresh water, after which they will be ready for

Boiling.—For this the linen should be wrung out and cleared of soap-suds as much as possible. The water for the copper must be previously prepared by some softening process, such as already described, or the linen may be slightly discoloured by the deposit of mineral matter from the hard water released in boiling. Some soap chips should be cut into the copper, which should be about a quarter full of water. This should be allowed to boil, and then the copper should be filled up with cold soft water before the linen is put in. It is usual to place the linen in large bags, made either of calico or strong twine netting. Different kinds of linen must be kept separate in boiling. The bags of linen should be placed in the copper, the water being only moderately warm, plenty of room being allowed. The fire is then made up, and the water brought up to boiling-point, the linen being allowed to boil for ten or fifteen minutes, and moved about occasionally with the stick. Prolonged boiling is not good, as the linen will thus acquire a yellow tinge. In some laundries it is the custom to put the dirty linen at once into boiling water, but this practice cannot be recommended for home washing. After the boiling the linen should be lifted out with the stick, removed from the bags, and placed in large pans for

Rinsing.—This is a very important process, if linen is to be kept of a good colour. It is a mistake to plunge the linen straight from the boiling water of the copper into *cold* water. This method of rinsing, though commonly pursued in home washing, is one of the causes of linen being a bad colour and acquiring a grey or yellow streaky appearance. This appearance is due to the sudden hardening of the warm soap in the tissues of the material. The first rinsing should be done in clean *warm* water, and all traces of soap should be thoroughly removed before the second rinsing of cold water is given. Thorough rinsing will help to prevent the black spots which so often appear on linen when being ironed, and which betray faulty work either in soaking or rinsing. A handful of salt should be put into the rinsing-water for coloured prints and muslins (see page 235.)

Blueing.—The tub or pan in which this is done should be washed perfectly free from soap-suds. For small home washing experience generally teaches the amount of blue necessary in order that the correct tint of the blueing-water may be gauged. One article may be dipped into the blue-water to test it, and when held up to the light the colour should be of a pure sky-blue. The blueing process helps to neutralise the yellow tint which may be left by soda, but the articles must not be allowed to remain in the blue-water, or the blue will settle on the folds in streaks or patches. They should be quickly rinsed through and wrung out.

Wringing.—This may seem a very simple process, but careless wringing helps to destroy the linen. Some people wring *anyhow*, but there is a right and a wrong way. The water should be expelled by pressure as much as possible, rather than by twisting and wrenching, which causes unnecessary strain upon the fibres of the tissue. When wringing by machinery, every article must be shaken and folded selvedgewise before being placed between the rollers. When wringing by hand the articles should be twisted according to the selvedge. In laundries hydro-extractors are used, which, by a rapid rotary movement draw out nearly all the water without submitting the linen to any wringing process whatever. Delicate muslins, &c., should be squeezed and then folded in towels and very gently wrung.

Drying.—Linen should be dried with the wrong side outwards. Wherever possible, drying in the open air is undoubtedly the best plan. In crowded towns this is impossible. When linen is obliged to be dried indoors it should be done in a well-ventilated room. The method of drying differs according to the material. Linen and cotton articles should be hung on lines and fastened securely by wooden clothes-pegs. They should be hung out to dry as soon as possible after washing, as the colour is spoilt and the material rotted if they are allowed to remain too long wet in heaps.

Coloured articles, prints, and muslins require very rapid drying, and should not be hung in the sun or be exposed to great heat or they will fade. If not required to be starched, they should be ironed whilst still damp. Woollen goods and flannels should be well shaken and slightly stretched in all directions. They should be dried rapidly, but not before the fire. Woollen stockings dry best when drawn over a wooden stocking-stretcher cut exactly to the shape of a stocking.

Linen-lines must be kept clean and dry or they will mark the clothes. Props should be used to raise the lines and keep the clothes from dragging on the ground. Linen-pegs should be made of wood; metal will cause ironmould. Clothes should never be tied to the line by the tapes. Plenty of pegs will save mending. The latter should always be clean.

Order of Washing.—Those articles which require no boiling and which must be quickly dried should be washed first. The order of washing generally found most convenient is (1) flannels, woollen articles, and coloured things; (2) muslins, fine things, and laces; (3) shirts, collars, and cuffs; (4) underclothing and bed-linen; (5) table-linen; (6) coarse things.

(1) *Washing Flannels.*—A lather of soap should be made in hot water. This should be allowed to cool, and when only just warm the flannels should be put in and moved about in the water, backwards and forwards, without being rubbed, until they are quite clean. They should then be rinsed in *warm* water, twice over if necessary. Well-washed flannels should feel soft to the touch. Neither *hot* nor *cold* water should be used for flannels; either will cause sudden shrinking, discoloration, and hardness. As a general rule flannels should not be rubbed, neither should

soap be rubbed on them. Sometimes, however, when they are very dirty, this rule must be broken, but the flannels in time shrink and become discoloured in consequence. They should be thoroughly shaken and quickly dried in the air if possible.

To Shrink New Flannels.—Soak the flannel in warm water for ten minutes; rub soap over every part of it, or spread a gelatinous soap-mixture made of chipped soap and a little borax dissolved in boiling water over it. Dip it up and down in the water and knead it for several minutes. Thoroughly rinse in warm water, wring carefully, shake well, pulling the selvedges into shape, and dry slowly—in the air if possible, but, if indoors, not near a fire.

Coloured Prints, Calico, and Light-coloured Cottons.—A lather should be made as for flannels, but the prints must not be put in until the water has become tepid. Avoid rubbing them with soap as much as possible, and no soap-powder or washing-powder should be used. They should be washed, rinsed, and dried very quickly to prevent the colours from fading. Hard water should be used for rinsing coloured prints, and a little salt or alum added to it will help to prevent the risk of fading.

(2) *Muslins, Fine Things, and Laces.*—These should also be washed in a lather of good soap, and the temperature of the water should be moderately warm. Rubbing should be avoided, but if absolutely necessary should be done with great care and each article rubbed separately. The soapy water should be squeezed out and plenty of warm, soft water used for rinsing. It is better to scald—that is, to pour boiling water over them—than to boil them. They should be laid in a cloth and wrung gently.

(3) *Shirts, Collars, and Cuffs*; (4) *White Underclothing and Bed-linen.*—These should be put through the processes of first washing, second washing, and boiling as already described on page 232.

(5) *Table-linen* should be washed separately in perfectly clean water, the water in the copper having been changed before they are put in. This is done by emptying the copper, putting in two or three pailfuls of cold water with some soap chips, and when boiling filling up with cold water. This second water will also do for boiling the coarse kitchen towels, aprons, rubbers, dusters, &c.

CHAPTER XXXVII

FOLDING, STARCHING, AND IRONING.

Folding.—Mangling.—Starching and Starches.—Ironing. —Linen from Infectious Patients.—Duties of Laundry-maid.

Folding.—For this the linen which has been dried with the wrong side outward should be turned to the right side. In folding, the edges should be placed together, selvedges made to meet, and the articles pulled gently into their proper shapes, or they will present a very uneven appearance in every direction. If they have become quite dry they should be slightly sprinkled with clean cold water before they are passed through the mangle or ironed. A large table covered with a white cloth, or a clean board, is necessary, in order that the articles can be well spread out. Large sheets and table-cloths require two persons to fold them. They should first be folded exactly double, with a crease down the centre, wrong side outwards, the corners and hems being made to meet. They should be folded together again, and creased down the middle. One of the folds should then be turned back, so making the centre crease lie between the two long selvedges. The right side will now lie outwards, and it will only be necessary to halve the length and double into small folds. In folding for the mangle, buttons and tapes of body-linen, &c., should be protected by being covered by the folds of calico. Not only may buttons be broken, but damage done to the linen if this be neglected.

Mangling.—Sometimes mangling is done at home, and it should be remembered that the operation requires to be very carefully performed in order that too much strain is not put on the linen. Sheets, counterpanes, linen aprons, towels, &c., should be mangled quite damp. If they have become dry, damp the articles, stretch them till as smooth as possible, and place them smoothly and selvedgewise between the rollers. If two persons are able to do the work together, one may hold and smooth the linen as it passes through the mangle, thus helping to prevent creases and pleats and the twisting or straining of the material.

Heavy articles should be mangled by themselves apart from small ones. Good mangling is a saving of time and labour in the ironing process.

Starching.—This work in good laundries and in establishments for 'clear starching' has been brought up to a state approaching perfection. Home starching, as a rule, is not so well done, probably often owing to the starch being either inferior in quality or of an unsuitable kind for the purpose, or to its being badly made.

Starch is often largely adulterated, mixtures of good and inferior qualities being sold as pure starch, some of them being prepared with common flour, various powders, and wax, the latter in order to save the trouble of glazing. These substitutes for pure starch are rarely satisfactory, and may help to destroy the fibres of the tissues. Formerly *wheat starch* was almost exclusively used, but it was found to cause patches on the linen after ironing. The best work is now done with *rice starch*, although a very good starch is made from a mixture of *rice* and *maize* or *potato* starch. Other starches are produced from buckwheat, rye, oats, acorns, barley, arrowroot, and tapioca. In large laundries each of these is used for particular purposes, in accordance with the necessity for modifying the stiffening process, or the nature of the fabric. Collars, cuffs, shirts, &c., require strong starch ; muslins, laces, &c., only a very weak solution. Table-linen looks better and keeps clean longer if slightly starched. At the same time, the starch prevents stains such as fruit, wine, or grease from thoroughly soaking into the fibres of the linen.

To Make Starch.—(1) *The Hot Process.*—The water used should be previously filtered if possible. The starch should be made in a perfectly clean earthen or tin pan. The quantity required should be considered, also the kind of linen to be starched. As a general rule, one quarter of a pound of starch blended with four tablespoonfuls of cold water requires two quarts of boiling water to be poured over it, stirring it all the time. The blending and stirring should be done with a flat piece of wood. A little paraffin, a lump of sugar, or a pinch of borax stirred in, will help to prevent the irons from sticking, and will cause a gloss on the linen. A little pure wax, or a common tallow or paraffin candle stirred in it will do as well. Another method is to use cold water, and then to *boil* the starch, which is said to bring out its full stiffening powers. In (2) the *Cold Process* cold water, instead of boiling water, is poured gradually upon the blended starch, stirring all the time. The water should be previously softened. Hard water may cause streaks on the linen. When prepared starches are purchased it is not necessary to add a glaze.

To Starch Linen.—The articles should be placed one by one into lukewarm starch, collars, cuffs, and shirts being done first, table-linen, skirts, &c., afterwards. Body-linen requires to have the starch well rubbed in; table-linen merely requires dipping. They should be squeezed, pulled level, and wrung in a cloth as dry as possible. Muslins, laces, cambrics, &c., should be well shaken and clapped between the hands before being rolled in a cloth. This will cause the starch to be removed from the interstices of the material and render it transparent. For very delicate fabrics a weak solution of isinglass made with soft water is often used.

To Starch a Shirt.—Gather the front of the shirt together with the left hand, dip it into the starch, and rub the starch well in with the right hand, taking care that none touches the other parts of the shirt. Squeeze it, and lay a clean handkerchief over the front. Roll it up until ironed. The collar and cuffs should be dipped into the starch and treated similarly.

Ironing.—Upon this finishing process much of the beauty of the linen depends. Good washing, drying, starching, and preliminary mangling will all be useless if the ironing be carelessly or imperfectly done. The table should be placed in a good light, and covered with two or three thicknesses of flannel (old blankets serve this purpose very nicely), upon which should be laid a clean white cloth. But, even for very simple ironing, *ironing-boards* are best. They should be of plain smooth wood, free from knots, and should be covered with flannel and calico sewn on smoothly and tightly, so that there are no wrinkles.

Where there is a large amount of ironing to be done it will be found most convenient and economical to have an *ironing-stove.* The best ironing-stoves are made of thick plate metal, slanting gently inwards and in an upward direction, and are provided with flanges upon which the irons rest. Sometimes the smoke is carried off by a flue under the flooring, sometimes upwards by a chimney. Such stoves should be lighted with wood and coal, after which the fire may be kept up with coke, which is more economical than coal and not likely to cause smuts.

The Irons may be either (1) *box-irons*, or (2) *flat-irons.* (1) The heaters should not be placed in the box-irons at too high a temperature, and, after putting the heater in, the end should be securely fastened down. One box-iron and at least two heaters are required. The box-iron has the

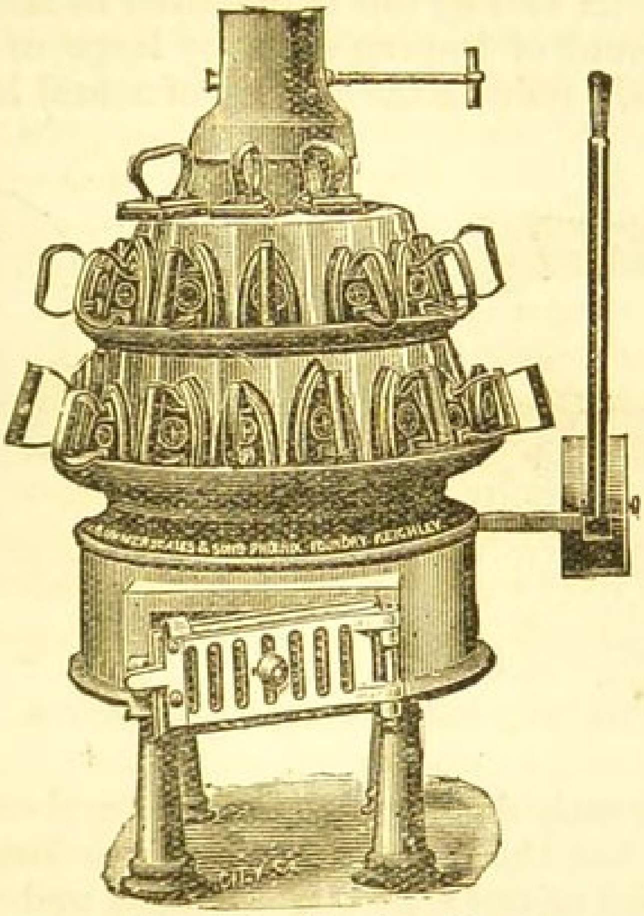


FIG. 55.—*Ironing-stove.*

advantage of being always clean. (2) Flat-irons, when taken from the fire, should be rubbed up and down on a little finely-powdered Bath brick, spread out on a pad of several thicknesses of brown paper, and should be wiped with a rough cloth. An *ironing-stand* should be placed on the right side of the ironer, and a *holder* of substantial flannel or cloth sewn in folds for holding the iron should be provided. A basin of clean cold water and a piece of linen rag should be in readiness to remove any speck of dirt or starch blemish that may be found. Before commencing, a *clothes-horse* should be ready to receive the ironed linen, in order that it may be aired by the fire before being put away, and a large dish or tray to receive the collars and cuffs when ironed.

Charcoal-irons are much used on the Continent. The charcoal is put inside the ironing-box and there is a tube for the escape of the fumes. This is economical as regards fuel and time, as the iron once heated keeps hot during the whole process of ironing, but the fumes are unhealthy. *Ironing by steam* and by *gas* is practised in large laundries. The large amount of ironing done by large rollers worked by steam greatly reduces the amount of actual hand-ironing.

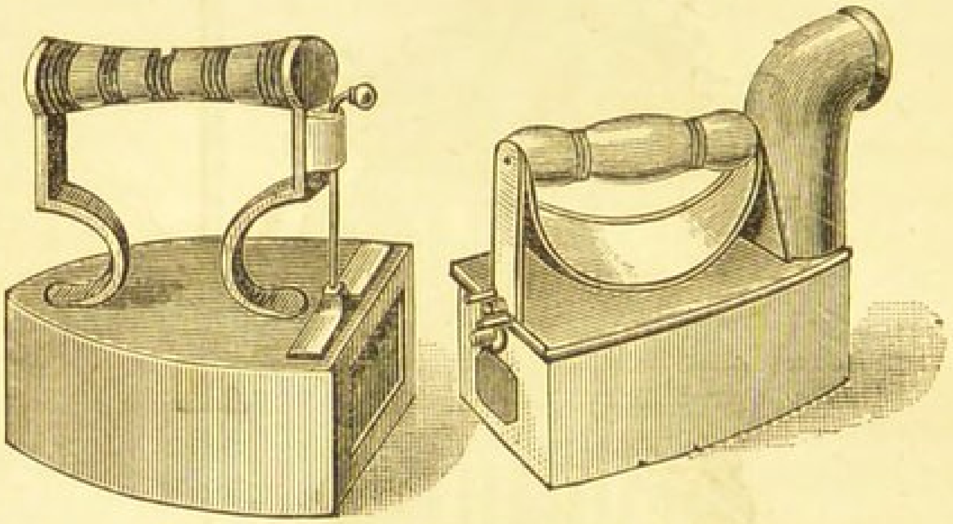


FIG. 56.—*Box-iron and Charcoal-iron.*

The latter is mostly done by gas, the heat and smell of which are injurious, but these disadvantages are largely reduced by the gas being mixed with air. The gas and air tubes are supported on stands, and run parallel to the large ironing-boards. The proportion of air to gas is nine-tenths air and one tenth gas, this amount of gas being found to sufficiently heat the irons. Each woman has her own iron attached to the upper tubes by a long flexible tube. The iron is heated by a number of little gas-jets inside the iron, and each woman regulates her own iron by a separate gas-tap. This method is cleanly and economical of time. When stoves are used for heating the irons, much time is wasted in going backwards and forwards, waiting turns, and in cleaning the irons, whilst even the best-managed fires cause dirt and dust in the laundry. Special arrangements are required for ventilating a laundry where gas is used. Simple gas-stoves or gas-stands can be arranged for home-work at a very trifling cost, and, in summer especially, are a great comfort, as there will be no necessity for the ironer to be exposed to the heat of a large fire. Several flat-irons can be heated at once by being placed on a sheet of iron or tin over the gas-stove, and this is quite a cleanly arrangement.

In domestic laundry-work the *shirts* should first be ironed ; then the collars and cuffs, muslins, cambrics, and laces, the rest of the under-linen, and pocket-handkerchiefs ; then print dresses and aprons. Girls should be taught to iron by being allowed to assist their mothers. Small articles, such as pocket-handkerchiefs, should be given to them first, and as they gain experience by practice they will be able to do some of the more important work.

Ironing a Shirt.—Lay the shirt, front downwards, parallel to the length of the ironing-board, the collar being to the left hand of the ironer. Flatten the *yoke* into shape and iron it, pressing very firmly. Next double the *back* in two, and iron each half of the back, being careful to prevent a crease down the centre, but making two small pleats on each half from the yoke downwards. These pleats make the shirt a better shape for folding. Iron the *cuffs* next lightly on the wrong side first, and then heavily on the right side, the *neckband*, which follows, being done in the same way. Iron the *sleeves* next, first opened out and then flattened into shape with pleats. Turn the shirt over and give a finishing press to the pleats at the back, before commencing the front. Stretch the shirt, front upwards, and place a piece of flannel or a small ironing-board under the upper half of the starched front. Commencing at the neck-band, iron firmly up and down until this half stands up quite stiffly, then iron the other half of the front. Place the two halves into shape and press firmly the narrow band across the bottom of the front. With a small rounded polishing-iron a beautiful gloss may be obtained on front and cuffs. Take out the flannel or board, pull the remaining part of the shirt well into shape, and finish ironing it, making a box pleat from the band at the bottom of the front downwards. *Folding* is now done. Lift the shirt carefully, and place it, front downwards, lengthways on the board. Lightly fold over each side towards the middle of the back of the shirt. Fold back the sleeves at full length parallel to the fold of the shirt, and then double them in two, the cuffs being upward. Lastly, fold the shirt in two or three folds according to length, always allowing the front to be uppermost. *Airing* should be done at once, to prevent the starched parts from becoming soft.

Collars and Cuffs should be taken one at a time from the cloth, and the starch should not be too dry. Iron the wrong side lightly first, and finish on the right side with firm, even pressure. The small polishing-iron will give a good gloss. A light touch with the left hand will bend them into a curved shape. This should be done before they stiffen, or the fibres are weakened. They should be aired at once, to fix the starch.

Muslins, Cambrics, and Laces.—These should be ironed on the wrong side. Very fine materials should be ironed quite damp, and should be covered with a cloth, as they should not be touched by the iron. There should be no gloss upon them, and the pattern should stand out in relief. Should they have a clouded appearance when finished, this is due to bad starching.

Handkerchiefs and Small Things.—All these should be ironed parallel to the selvedges, care being taken to gently pull them into shape without straining the material. Commence on the wrong side and finish off on the right side. Fold in two halves by the selvedge, wrong side outwards; double each half back again, the right sides being out. Halve the length, press with the iron, and fold back again, each handkerchief when finished forming a perfect square with the name uppermost.

Print Dresses, White Skirts, &c.—First iron the bodice and sleeves. Iron the skirt on a well-covered ironing-board resting on trestles. The board should be slipped inside the skirt, the waist being on the left-hand side, and the ironing done strip by strip, from the hem to the waist, the ironed part being passed away from the ironer as finished. The point of the iron should be used for pleats and gathers which require care.

Precautions in Cases of Sickness.—All linen used by persons suffering from infectious diseases must be washed separately. It is most culpable to run the risk of other persons taking disease in any way, and the mixture of infected with non-infected linen is a very ready means of conveying infection. Persons exposing infected clothing so as to endanger the health of other persons make themselves liable to a heavy penalty. In laundry-work quicklime and hydrochloric acid are sometimes used, but these, though effectual disinfectants, are very destructive to the materials. Carbolic soap, though expensive, is a good disinfectant. Jeyes' fluid, Sanitas or borax may be used. In some laundries it is the rule to pass *all* linen through a disinfectant bath, or to place them in a chamber or tank allowing them to be exposed to hot dry air or to steam. Ordinary washing in itself is an admirable disinfectant, and articles which have been boiled in water and then exposed in the open air to dry may be regarded as absolutely free from infection.

Care of Laundry Utensils.—Wash out the copper and wipe it perfectly dry. Keep washing-tubs in a cool and shady place, to prevent the wood from shrinking and so causing them to leak. Leaking may be prevented by occasionally filling the tubs with water, which will cause the wood to swell. Scrub the linen-pegs occasionally, and keep them in a bag when not in use. Wash the clothes-line, and when thoroughly dry roll it, and keep it in the peg-bag: it will rot if allowed to remain wet. Keep the wicker baskets and airing-horses quite clean. Put irons away in a dry place, and see that the ironing blanket and cloths are kept in a place quite free from dust.

Duties of the Laundry-maid.—In large houses, especially in the country, it is often the custom to keep a laundry-maid who is responsible for the washing and getting-up of all the linen of the family. If the family be large she is generally allowed to have a woman to help her, and by this arrangement the work can be done much more effectively and with great economy of time.

Her work will be, on a small scale, much the same as that in a large laundry. On Monday morning she receives the linen, and after sorting and examining the articles she should enter them in the laundry-book, keeping separate lists for the family and for the servants. The family list should be subdivided into shirts, body-linen, bed-linen, fine things, woollens, &c. The kitchen cloths, &c., should be kept quite separate.

Before washing, all stains, grease-spots, &c., should be removed.

The soaking should now be commenced, and the tubs allowed to remain all night. Everything should be put in readiness to commence washing next morning. On Tuesday morning the work should be begun very early. The first and second washing should be done, and the white linen boiled, rinsed, and dried in the same day, if possible ; but where there are large quantities this will not be possible. Flannels, woollens, greasy cloths, silken materials, all require separate washing. After the work is done the floors of the washhouse, the coppers, tubs, and all utensils should be cleaned, and everything left neat and orderly. If washing-machines, wringers, &c., are provided, they must be washed and thoroughly dried, to prevent rust of the metal and rotting of the wood. On Thursday and Friday the folding, mangling, starching, ironing and airing should be done, and on Saturday morning the articles, sorted and arranged according to the lists, should be returned to the house.

CHAPTER XXXVIII.

THE CARE OF CLOTHING.

Care of Clothing.—Garments made of different fabrics require different treatment in order that they may be preserved and present a fresh and bright appearance after being worn from time to time. **Woollen garments** when taken off should never be put away without being well shaken and brushed. **Silk dresses** should be spread out on a table, and wiped all over with a clean, soft cloth before being put away. Both silk and woollen dresses should be hung with the wrong side out, and be protected with a covering from dust. **Cotton** and other **starched materials** should not be hung, as they lose their freshness and become limp. They should always be loosely folded when not being worn, and should be rough-dried without starch when put away for the winter. In summer-time woollen garments and winter clothes require special care to preserve them from becoming moth-eaten. Nothing should be put away dirty. Cashmeres and woollens should be repaired, well brushed, and washed if necessary, before being packed. They look much better, after being packed, if all folds, drapery, and gathers are taken out before they are washed. During the summer months, moths attack woollens, velvets, furs, as well as blankets, rugs, &c., and these should be examined occasionally, and hung either in the open air or in a draught for several hours.

To Keep Moths from Clothing, &c.—Put lumps of camphor into linen bags and keep one in each drawer or box where the clothes are packed. Aromatic herbs will do as well.

To Destroy Moths.—When clothes chests and cupboards have become infested with moths the woodwork or walls should be rubbed with a strong decoction of tobacco, or sprinkled with spirits of camphor. Freshly ground pepper sprinkled among clothing will destroy moth. Various patent powders are sold for the same purpose.

To Clean Black Cashmeres, Merinos, &c.—These should be well brushed, and all dust first removed. Superior woollen materials may be made to look almost new when carefully cleaned. They should be washed very quickly in warm water in which soap has been lathered. A good quantity of ammonia should be put into the water. There should be as little rubbing as possible. The rinsing should be done in blued water containing a handful of common salt. Soap should never be rubbed on. **Serge** should be passed quickly through well-lathered cold water and rinsed in warm water.

To Remove Mildew from Linen.—Rub the part well with soap, scrape fine chalk, and rub it well into the fabric. Hang it in the sun or open air, or lay it on the grass if possible; as it dries repeat the operation. The mildew will come out after two or three applications.

To Remove Mildew from Silk and Glazed Materials.—Rub the surface with a soft silk handkerchief, and finish off by rubbing with a hard polished cold surface such as a flat-iron. Refractory mildew or water-stains may be removed by being quickly sponged with pure alcohol, diluted with cold water, after which the material should be ironed on the wrong side, being protected by a damp cloth.

General Treatment of Stains.—Describe a circle with the cleaning preparation round the stained part at some little distance from it. This is to prevent the stain from spreading. As little liquid as possible should be used. It should be dried with flannel or linen. If the material will not bear much rubbing, stale bread-crumbs may be used to absorb the moisture, and fine linen or flannel to finish off with.

Grease-stains on Clothes or Carpets.—Diluted benzine collas should be used to remove grease-stains caused by fats, butter, and oils. Treat as above. Should the colour appear spoiled it may be improved by the application of a weak solution of borax or ammonia. Water mixed with bullock's gall may be used for washing large patches of grease. Wax and candle-grease stains may generally be removed with a hot iron and blotting-paper.

Rust-stains.—Lay the stained part upon a cold surface, such as a plate or marble slab (not wood or iron), and rapidly rub the stain with a solution of oxalic acid on a piece of flannel or linen, but remove the acid as quickly as possible.

The acid does not destroy the tissues of the fabric, but it attacks both natural and chemical dyes. Salts of lemon will remove rust from linen and cotton.

Sugar-stains.—These may be removed by the application of pure alcohol, but, if the material or colour is very delicate, it may be diluted with water before being used.

Paint-stains.—Mix equal portions of turpentine and pure alcohol, and rub the stains as before described. This softens hard paint and allows it to be easily rubbed off. The grease that is left behind after the colouring matter is removed should be treated with benzine. Fresh paint or varnish stains may be rubbed first with a little good butter instead of turpentine and alcohol. The grease may then be removed with benzine or chloroform. Paraffin or turpentine rubbed immediately on paint-stains, when wet, will remove them from woollen garments.

Fruit and Wine Stains.—These are mostly true dyes, and should receive immediate attention or they may become permanent. Washing in pure soft cold water may remove them at once. The stained part should be stretched out tightly over a cup and the water poured through the material. This will prevent the stain from spreading. Fabrics very decidedly stained should be spread over a basin, and salts of lemon well rubbed into the fabric, after which boiling water should be poured through until the stain either disappears or becomes very faint. In the case of wine-stains common salt may be used instead of salts of lemon.

Ink-stains are removed when quite fresh by pouring hot water over them. When the ink has dried in, the parts should be stretched over a basin, and salts of sorrel (also known as essential salts of lemon) should be well rubbed in. Rinse thoroughly with tepid water. **Iron-mould** may be similarly treated.

CHAPTER XXXIX.

THE CHOICE OF CLOTHING.

Purchase of Clothing.—Quality of Materials.—Estimate for Outfit.

In nearly every class of society a woman is more or less judged by the style of her dress, and it is the duty of every woman to endeavour to look as nice as she possibly can at all times, no matter what her occupation or position may be. A cottager's wife at work in her small home, a woman at work in a laundry, a domestic servant at her daily work, may, by their neatness and cleanliness and dress suited to their work, present quite as pleasant an appearance in their own position as the more expensively dressed lady of the wealthier classes does in hers. Suitability of dress to the work and the occasion is one of the points to be remembered by women when purchasing materials for clothing. The amount spent upon it should be consistent with the income, and its choice in accordance with the daily work or the social position. The essence of good dressing on small means is to avoid dowdiness, peculiarities, and all extremes of fashion. Whilst not despising fashion, it is wise to let the prevailing mode be subservient to that which suits the individual's style, age, and appearance. Careful, tasteful, and consistent dressing induces a feeling of self-respect.

The Purchase of Clothing.—It is well to arrange, as far as the means will allow, the purchase of clothing at fixed periods. This will tend to deter a woman from buying at odd times of the year so-called 'bargains.' The numerous bargains so frequently advertised are often very unsatisfactory after being purchased. Everything has its market value, and, as a rule, articles that appear to be marked below their normal price are defective either in material or manufacture.

Really reliable shopkeepers cannot possibly sell good things except at a good price, and it is far more economical in the end to purchase one superior dress at its proper value than two or three of inferior quality for the same price.

It is well to have a thorough knowledge of the signs by which the quality of the various fabrics may be judged, and of the value of the different articles. **Calicoes** may be judged very easily. Good qualities have little lime-dressing, and this may be judged by tearing a piece across or by rubbing a corner of the calico ; the selvedge is even, and the threads fine and close without flaws. **Flannels and Woollens** should be of pure wool. Sometimes cotton is mixed with the wool, but this can be detected by fraying out a piece, when, if cotton be present, it will not break between the thumb and finger-nails as readily as wool, whilst in appearance the threads are smooth and flat. (See fig. 41.)

Dress Materials.—These are so very numerous that only a few can be mentioned. Cashmeres, merinoes and other pure woollen materials are most serviceable and can be readily cleaned. Good alpaca always wears well, tweeds are useful for hard wear, but are very heavy for dresses. Light, warm materials are best for dresses. Heavy cloth is not so suitable, and causes fatigue. **Washing-materials** are also numerous. Light muslins, cambrics, and prints may be purchased for a very small sum, but they are not economical on account of the expense or trouble of washing. Printed cottons are very pretty and inexpensive dresses for summer wear. Holland is a more expensive material, but it is very durable.

Silks.—Glacé silks are not durable. Heavy, thick-ribbed silks, owing to some constituent in the dye, often present a greasy appearance after having been worn for a short time. Other silks crack or drop to pieces, this also being attributable to the dyeing process. In buying silks care must be taken that the material is of pure silk and not a mixture. Good silks should be firm and strong. Some of the best-wearing pure silks are so soft that their quality can be judged by the touch. Good black silks generally have a handsome, bright-coloured selvedge. Silks should only be purchased from a really reliable tradesman, to whose interest it would be to sell only good materials.

Mixed Materials, with but few exceptions, such as Irish poplins, are unsatisfactory purchases, owing to their want of durability. They consist of cotton and wool mixed, or cotton and silk, or wool and silk. They are quickly spoiled by damp, which causes them to shrink and lose their attractive appearance.

Stockings are an expensive item in a family unless home-made. In every economical house the knitting-basket should be an institution, and all the girls should be taught to knit. Knitted woollen stockings are not only more durable than bought stockings, but they promote the circulation better, and so are a preventive of cold feet and chilblains.

Boots and Shoes are a most important consideration in the expenditure of the dress-allowance. There is no economy in buying cheap, inferior, ill-made boots, the health so greatly depends upon the feet being well clad. Many cases of serious illness trace their origin to 'getting the feet wet.' Hand-sewn boots are the best, though the most expensive. Patent leather should be avoided. Good plain leather, calf or kid, is the most durable.

Accessories.—The minor details of dress, if carefully chosen and in character with the style of dress, will often compensate for a dress coarse in texture, provided that its make and colour suit the occasion and the appearance of the person wearing it.

A neat collar and cuffs are far preferable to ribbons and laces worn indiscriminately. Flowers, feathers, and similar ornaments should only be worn if very good. If the income does not warrant the purchase of a superior quality it is far better to substitute a simple bow of ribbon than to wear common articles.

Underclothing should be prepared in sets, not too large in quantity, and the stock should be systematically kept up by a few new garments being made each year. The new garments should not be washed until required for use, as even the first washing process somewhat weakens the fibres, and the soda used may cause discoloration while the articles are lying by unused. Mending and patching should be done as neatly as possible and, as a rule, before the garments are washed. Patches should be put on evenly by a thread, and the selvedge of the new material should run in the same direction as the selvedge of the garment. If the hole or tear be near the edge or close to a seam, it is neater to open the seam and *let in* the patch, so that its edge will form part of the seam of the garment. Neatness of work and care in matching material and pattern will make even a mended garment almost as good as a new one. Shirts made of good calico should have new collars, cuffs, and fronts inserted when these parts are worn.

Darning should be done with thread or wool of the same quality and colour as the material. Small holes in table-linen, well darned, will scarcely show; but it is a waste of time to attempt to darn large holes in anything: a carefully inserted patch would be better. Darns should lie quite flat when finished. It is more satisfactory to mend knitted stockings by cutting out the weak part and re-knitting it.

Estimate of an Outfit for a Girl Going to Service for the First Time.—So much of the expense of an outfit for a girl depends upon what her stock already consists of, and the ingenuity of herself and her mother in contriving to mend old things and to make new ones, that only an estimate of the *requirements* can be given, and this, as far as actual outlay goes, will probably differ in almost every case. A girl who can knit and sew well will probably have prepared her own stockings as well as much of her underlinen. Again, the expense will vary according to the amount of flannel worn by the girl. Knitted vests are economical and wear well.

1. *Underclothing.*

	£	s.	d.
3 sets combinations, 10½ yds. calico at 5*d.* per yd.	0	4	4½
3 Night-dresses, 10½ yds. at 5*d.* per yd. .	0	4	4½
2 Flannel petticoats, 5 yds. at 10½*d.* per yd.	0	4	4½
2 " vests, 3 " 10½*d.* "	0	2	7½
4 pairs stockings (or wool for knitting) .	0	4	0
2 Petticoats, 6 yds. serge at 8*d.* per yd. .	0	4	0
Carry forward . . .	1	3	9

	£	s.	d.
Brought forward . . .	1	3	9
2. *Dresses, Aprons, &c.*			
3 Print dresses, 24 yds. print at 6*d.* per yd. .	0	12	0
Linings, 6 yds. at 4*d.* per yd. . . .	0	2	0
1 Black dress for afternoons, 8 yds. at 1*s.* per yd.	0	8	0
Linings, braid, and buttons . . .	0	1	3
6 White aprons, 6 yds. cambric at 6*d.* per yd.	0	3	0
4 Working-aprons, 6 yds. linen at 8*d.* per yd.	0	4	0
2 Large coarse aprons, 4½ yds. blue-checked linen at 6*d.* per yd.	0	2	3
2 yds. muslin for caps	0	1	0
4 sets collars and cuffs	0	2	0
1 pair house-shoes	0	2	6
3. *Outdoor Clothing.*			
Hat and bonnet	0	5	6
Jacket	0	10	0
Cloak or waterproof	0	10	0
Gloves	0	1	0
1 pair strong outdoor boots	0	8	6
	4	16	9

The above appears a large sum for working people to spend on a girl's outfit for service, and, as we have already stated, only the requirements in clothing are mentioned; it would rarely happen, however, that the outlay would need to be so great. Beside the above, a box for clothing, comb and brush, pocket-handkerchiefs, and many small things might be added. A careful mother should warn her daughter who is leaving her home for the first time not to spend her wages indiscriminately, and she should arrange to go with and advise her for the first year or two when purchasing clothing. The importance of paying ready money for everything, and of avoiding tallymen, should be impressed upon her, as well as the duty of saving a small sum every year.

CHAPTER XL.

NEEDLEWORK.

The Teaching of Needlework.—Kinds of Stitches.—Cutting-out.—Repairs.

A great share of the comfort of a home depends upon the capacity for needlework possessed by the female members of the family. The mother specially has great need for ability in contriving, making, and mending garments. With careful contrivance neat little articles of clothing for children may be made out of the better parts of her own old dresses, cut down and tastefully arranged. Recently a prize scheme was instituted by some ladies in London for giving prizes to poor women in their district who could make a little boy's suit of clothes out of a pair of old trousers. A large number of these women were by their ingenuity able to compete, and many tidy little suits were sent in.

Needlework in Elementary Schools.—This is taught very satisfactorily according to a progressive system. Much may be done by the teachers to induce the children to take a pleasure in their work, by making the lessons interesting, and encouraging a desire to excel. The girls may be made to feel that the opportunities for learning whilst they are at school will not occur again when they are women, and that it is undignified in a woman not to be able to mend and to make well.

Habits Cultivated by Needlework.—In addition to the practical benefits of making the girls useful at home, and good needlewomen in the future, they are, by means of the lessons in cutting-out and needlework skilfully and intelligently given, trained to habits of cleanliness, neatness, industry, thoughtfulness, contrivance, economy, good taste in arranging, and in general carefulness.

Stitches Required in Making an Ordinary Garment.—Hemming, sewing, running, felling, stitching, gathering, setting-in, and buttonholing.

In every case teaching must be given *by illustration.*

Diagrams are very useful, and in the case of a teacher in charge of a large class much time and labour may be saved by the use of a stand upon which can be fixed in a framework a sufficiently large piece of material for demonstrating the stitch to the whole class at once.

Hemming, being the easiest stitch, is generally taught first. The faults to be avoided are the improper holding of the material, over two fingers instead of one; upright stitches, caused by holding the needle almost perpendicularly to the body, instead of pointing towards the left thumb; letting the needle only pass through the top or the bottom of the hem instead of catching both top and bottom; straight horizontal stitches having the appearance of running, which at once draw up like gathering if the thread be pulled tightly. The material used for teaching should be of a coarse kind, canvas or coarse calico at first, after which strips of finer calico may be given. It is a mistake to let children practise too long upon strips. A towel, handkerchief, pinafore, or duster will furnish a much greater incentive to excel, whilst strips joined together may make little petticoats.

Sewing or Seaming.—The chief difficulties to be overcome in teaching this are holding the material wrongly, irregularity of stitches, and a tendency to pucker. The children must be taught to take only one thread deep into both edges of the seam, and to point the needle at right angles towards the body.

Fastening on and off require special care. The ends of both the finished and the fresh needleful of cotton should be sewn over on the top of the seam, care being taken not to form a ridge.

Felling is the flat hemming done on the wrong side of a 'sew-and-fell' joining. A fell should always be narrow, and it should be carefully flattened out before being hemmed down. Care must be taken in the fixing to turn down all the edges evenly, so that there will be no irregularity in the width of the fell. This is one of the difficulties to be overcome in teaching children to fix a sew-and-fell. Children who have overcome the difficulties of hemming will generally fell well.

Running and felling is not such strong work as sewing and felling. It is sometimes adopted because it is considered to save time, but, if well done, it takes nearly as long as seaming. The stitches in the running must be placed very closely together, two threads being taken on the needle, and two left. It is undesirable to allow children to run-and-fell any part of a garment upon which there is any strain.

Stitching is used for strengthening the doubled edges of material and for bands, also for ornament. It is always done on double material, and, where possible, a thread is drawn for guidance. The general rule for teaching the stitch is :—Put the needle in two threads to the right of the cotton, and take it out two threads to the left of the cotton. The children should be made to notice that when the stitch is taken there are four threads on the needle, and that the cotton has two threads on each side. The stitch is best learned on coarse canvas, and practised on holland before calico is given. Care must be taken not to let the children draw their cotton too tightly or the regularity and beauty of the stitching will be destroyed.

Gathering is used for drawing the fulness of a garment into a narrow compass in order that the material may be fitted into a band. Before commencing the gathering the width of the material as well as the band should be halved and quartered, and these divisions marked with a stitch of coloured cotton, so that there may be a guide for the even distribution of fulness into the band. The material should be doubled down and creased so as to mark a straight line upon which the gathering is to be done. The general rule for gathering is :—Take two threads and leave four. The thread is then drawn up not quite tight, and is twisted two or three times round a pin stuck in the material. The gathers are then made level by the process of 'stroking-down' with a strong needle. Each gather is stroked and gently pushed between the left thumb and first finger. Great care must be taken in teaching this, as children are so apt to weaken or even to tear the material. No scratching sound must be allowed. Both above and below the gathering thread the material should be stroked.

Setting-in is the arranging of the gathers to fit into the band and attaching them to the band by the 'setting-in' stitch. This stitch, unlike hemming, is upright. The band should just cover the gathering thread, and one gather at a time should be set in ; no gathers should be missed. The wrong side should be afterwards fixed and set in, the stitches not being allowed to show through to the right side. Care should be taken that the back edge of the band is not allowed to be lower than the front edge.

Buttonholing is perhaps the most difficult part of the teaching of needlework. It must be taught collectively by demonstration, but also individually. The stitch should be taught on canvas, working from left to right, and counting the threads in order that the stitches may be of equal depth. Four threads deep are usually taken. The needle should be pointed perpendicularly towards the body, the double part of the thread coming from the eye of the needle being taken, and put round the point of the needle from left to right. The needle should then be drawn out away from the worker and it will be found that a pretty purled edge has been formed. The **ends** of the buttonhole may be either square or round, or one may be square and the other round. The ends should be taught as separate lessons. The **round end** consists of nine stitches, three slanting to the left, three straight, and three slanting to the right. The **square** end consists of nine stitches worked at right angles to the buttonhole, the stitches being of the same depth as those of the sides of the buttonhole. It is not correct to work a loop at the square end, as it does not strengthen the button-hole.

Sewing-on Buttons.—Large buttons are best sewn on by stitching in the form of a little ring round the middle of the button. A guide for stitching should be given to children. A small circle may be impressed upon the button with a key-barrel, or, if the button be sewn on with a cross or star, the point of the needle may be used to indicate the places where the stitches are to be made. An essential point to be remembered is the necessity for twisting the cotton several times round the button before fastening off, in order to prevent friction from wearing away the stitches, and also to prevent the button from lying too closely to the material.

Sewing-on of Tape.—As a rule children should be taught to regulate the distance at which the tape is to be placed from the edge by the **width of the tape.** The tape should be turned under, hemmed neatly on three sides, then turned back and seamed where the tape meets the edge of the garment. The ends of the tape should be hemmed.

Herringboning is used for flannel. It is easily taught on canvas, and children generally like this stitch. The teacher will find the frame the best means for demonstrating. The children should be made to notice and count the threads, so that the little crosses are in regular lines and equally distant from each other. Two threads should be taken for each stitch and two threads left between, and there should be four threads between the top and bottom rows.

Marking is also a favourite stitch with children, and is quickly learnt by means of the frame demonstrations, which are imitated by the children on canvas. Cross-stitch is usually taught in schools, though there are various ornamental stitches used for marking. The back of the marking must be quite neat, there must be no loops or cottons left hanging, and each letter must be fastened off before commencing the next.

Cutting-out is an art which should be learned by every girl. It cannot be taught by means of books only. Practical teaching must be given; and observation, much practice, and the exercise of common sense in contriving, are required before a girl can be classed as a good cutter-out. The mechanical aids for teaching proportions are chequered blackboards and chequered paper. Sketches of the parts of the pattern garments are made by the teacher upon the blackboard, and the girls, whose papers are ruled similar to the blackboard but on a smaller scale, copy the pattern with their lead-pencils, carefully counting the squares. The importance of perfect accuracy in counting and in sketching must be explained by the teacher. It can readily be shown that an apparently small mistake in measurement upon their papers would represent a very serious mistake in the full-sized garment, entailing probably a misfit, and certainly waste of material. Newspapers do very well for practising cutting-out, and girls may be trained to take a pride in cutting-out a garment at home without the teacher's help. Another very useful exercise is to teach the girls to sketch the parts of several small garments upon one sheet of chequered paper. The girls should be taught to judge the right and the wrong side of calico, flannel, &c., the meaning of the *right way* and the *wrong way* of the stuff; and that a general rule to be remembered is that the selvedge or *right* way of the material goes the long way of the garment. Little girls may obtain practice in holding their scissors by being allowed to cut geometrical figures out of old copy-book leaves. The scissors should always be held with the larger blade downwards.

Mending and Utilisation of Worn Articles.—The actual needlework of the poor, perhaps, consists more of *mending* than of *making*; hence the importance of teaching girls to mend and to turn old things about. It is one of the means by which thrift and economy can be inculcated. It is a good plan to allow the girls occasionally to bring mending from their homes to the schools. Valuable lessons may be given upon repairing the old garments. Half-worn sheets, table-cloths, &c., may be cut in two down the centre, and the sides sewn together to form the middle of the articles; these, when hemmed, are quite tidy, and will last for some time longer. Large sheets, when much worn, may be cut down into small sheets for cots and children's beds, or, if not good enough for this purpose, they may be made into dusting-sheets or dusters. Table-cloths, if worn round the edges, may be cut into smaller ones. Good damask, used and washed with care, lasts for many years, and when worn may be cut down into sideboard-cloths, tray-cloths, fish napkins, or even into table-napkins. Common table-cloths may be cut down into tea-cloths. The best parts of old print skirts may be turned into aprons. We have seen a little jersey for a child of eighteen months made out of a pair of old stockings. Indeed, there are numerous ways in which old garments and household linen may be utilised, and teachers who have the real welfare of their girls at heart will not neglect this very practical means of teaching an important branch of domestic economy.

The value of a sewing-machine is great in a household. It is a most useful means of saving time and expense if dressmaking be done at home. Young girls should not be allowed to work a treadle-machine. We have seen the use of a hand sewing-machine very successfully taught to the senior girls in several schools as a reward for individual excellence in plain needlework. Always remembering that hand-work is of the greater importance, there is no reason why girls should not be also taught to work a hand sewing-machine at school if circumstances permit.

CHAPTER XLI.

THE HOME AND ITS FURNITURE

An Artisan's Home.—The Furniture.—Second-hand Furniture.—The Kitchen.—The Stove.—The Bedrooms.—Estimate of Furniture for Three Rooms.

When money is plentiful, the furnishing of a home is more a matter of taste than of economy of outlay. There is no necessity in these pages to devote space to the furniture required for the homes of the wealthy, but rather to consider the possibility of combining both economy and taste in furnishing even the most humble home.

An Artisan's Home.—In a country town or village the furnishing will differ very considerably from what is necessary in a largely populated city. In the former, the artisan will probably obtain a neat cottage or small house for a much lower rent than he will pay in the latter for two or three rooms. If possible three rooms should be the minimum number in such a home. The *rent* will be an important consideration, but there is no economy in saving a trifle weekly by taking a house or rooms in an unhealthy neighbourhood because the rent is low. As a general rule, the rent in a town should not exceed one-fifth of the income, whilst in the country it may be less.

The Furniture.—This must depend upon the amount saved by the man who is desirous of having a home; and the probably limited means at command necessitates very serious consideration, and cautious examination of each article to be purchased, in order that unwise expenditure may be avoided. It should be remembered that common wooden painted furniture is not durable and requires to be replaced after a very few years. Therefore it is more economical to choose a few articles of really well-seasoned material and of good manufacture than a quantity of showy cheap furniture. The style known as 'sets of furniture' should be avoided in furnishing a simple home. Very good 'sets' are expensive and only suitable for larger houses.

Unless very good, the upholstering quickly becomes shabby, the wood warped, and the veneering cracked. All kinds of cheap imitations should be passed by.

Second-hand Furniture.—Well-kept, clean second-hand furniture may often be bought for a less price than common new articles. Care should be taken in the selection; it is not advisable to purchase second-hand bedding, carpets, &c., as infection and vermin are sometimes carried by them. Mahogany tables, bookcases, chests of drawers, &c., in good condition, may be chosen without much danger; but they should be examined to see if dry rot has set in.

The Kitchen.—So much of the comfort of the home, whether of the rich or poor, depends upon the kitchen that its furniture and fittings are of great importance. In many small homes the kitchen is also the room in which the meals are taken, and so it is necessary that it should be comfortably furnished.

The Stove is, perhaps, the most important matter in the kitchen; so much of the health of the family depends upon well-cooked food. Those who are so fortunate as to be able to choose their own stove or range should remember that the principal points to be considered in its choice are durability, efficiency, and economy of fuel. The lowest-priced ranges are not necessarily the cheapest. They are often made of very light metal which soon wears out, are of faulty construction, and cause much waste of fuel. A good range should be so constructed that it can be used both as a close range and an open fireplace. The fire-box should be of such a size that the fire is sufficient to heat all the surfaces of roaster and boiler, but not so large as to waste fuel by sending superfluous heat up the flues. The flues should go *round* the roaster and boiler and should not be connected with each other. In cheap ranges this is sometimes neglected, and the cooking suffers in consequence. The flue-pipe should have a cleaning-door, giving easy access to the flues. By shutting the damper of the roaster when the latter is not in use, the draught, and consequently the consumption of fuel, is greatly decreased. The parts of the range immediately in contact with the fire—such as the cheeks, bottom-grate, fire-cover, &c.—should all be movable, so that they can easily be replaced by new ones when worn out. The boiler should be of heavy metal thoroughly welded, and in some of the best ranges it is arranged so that it can be lifted out. One of the best examples of a good range, combining all the good points of the well-known American cooking-stove with all that is useful in the

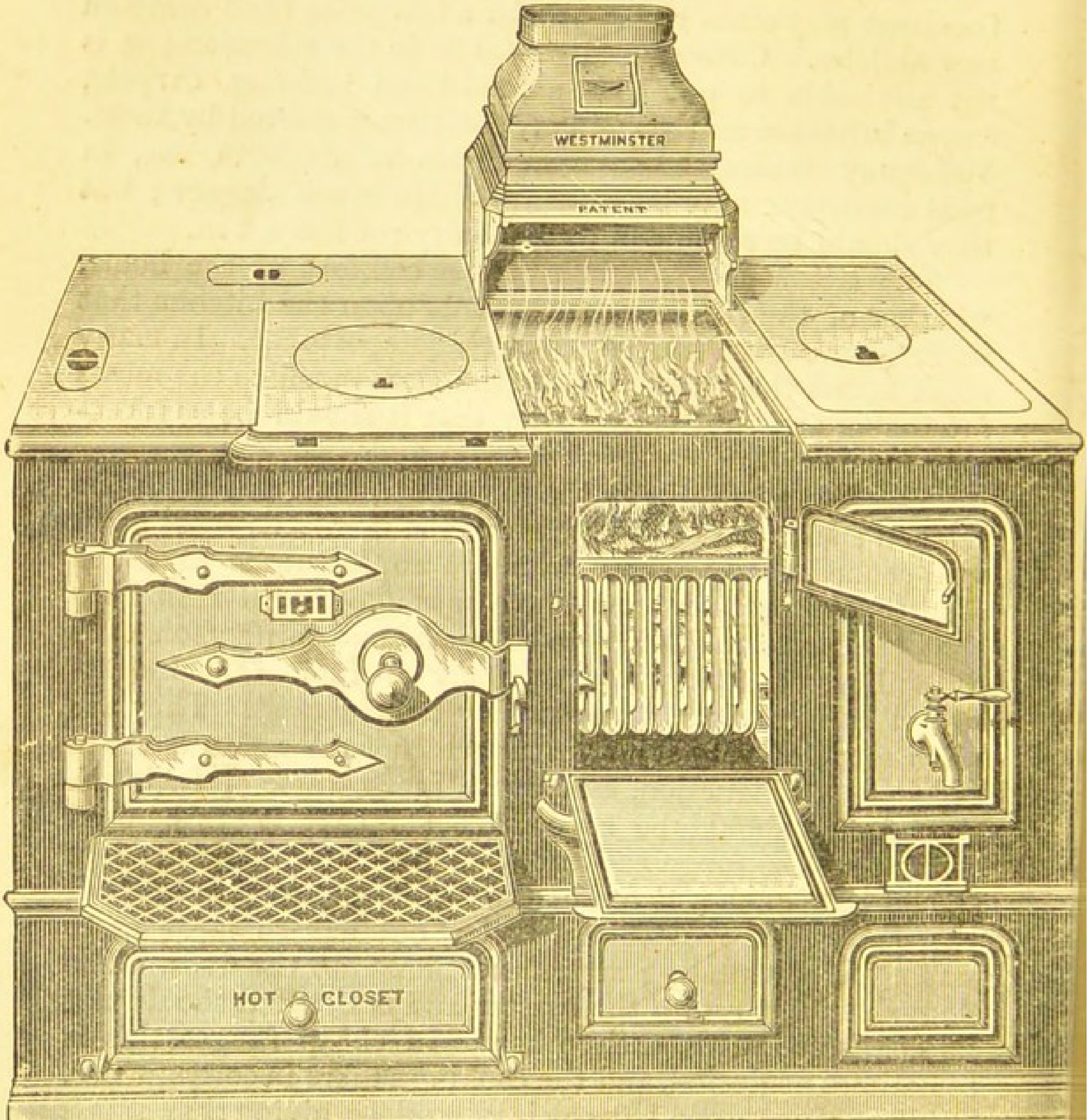


FIG. 57.—*Stevens's 'Westminster' Range*
(*Combining Close Range and Open Fireplace*).

English close-fire range, is Stevens's 'Westminster' range (fig. 57). This is a movable range, so constructed that a very small amount of fuel is required to heat both oven and boiler, whilst a good supply of hot water, which is so constantly required for household purposes, can be supplied within half an hour after the fire has been lighted. The hot closet under the oven is for warming plates. The prices of this range are from 3*l*. 5*s*. 6*d*. to 5*l*.

The **Dresser**, nicely kept, adds much to the appearance of the kitchen, and it is an index to the character of the housekeeper. The **furniture** required will vary with the size of the kitchen and the number of persons in the family. It should be of a kind that can easily be kept clean, and there should be no curtains or draperies in which dust can be harboured.

The Bedrooms.—When there are several children in the family and the means are limited, it is best to dispense with a sitting-room, and, in the interest of the health and morals of the children, have an additional bedroom. The bedrooms should be simply furnished with none but necessary articles. As much air as possible is required in bedrooms, and overcrowding of furniture not only causes inconvenience but diminishes the amount of air in the rooms. **Bedsteads** should be of iron of good quality. Wooden bedsteads should be avoided. Spring mattresses are healthier than feather-beds, and metal chain-work frames than palliasses. The covering of bedding should be preserved from rust-stain by laying a few sheets of brown paper on the iron laths if palliasses are used. The sides of mattresses should be covered with strips of strong unbleached calico, which can be taken off and washed occasionally. Bed-hangings are not desirable, unless they are necessary as a protection against a direct draught.

Blankets should be warm and light; if mixed with cotton they will be heavier than if of pure wool.

Cotton **sheets** are generally preferable to linen, though by many persons the latter are preferred. Young children, old persons, and those suffering from rheumatism should not sleep in linen sheets.

Counterpanes may be used as coverings for the beds in the daytime, but it is wise to remove them, if at all heavy, at night.

Furniture of hard polished wood is the most durable and is easily kept clean. Washstands of painted wood should be covered with oil-cloth to preserve the paint and to prevent rotting of the wood through the moisture. Dressing-tables may be of plain deal, covered with glazed calico, over which white muslin may be draped. Where it is very necessary to economise space and outlay, a small chest of drawers may serve the purpose of a dressing-table.

Carpets should not cover the floor under the beds or near the wall. They should be so arranged as to be easily taken up every week and shaken. A strip of oil-cloth or Indian matting should be laid in front of the washstand to preserve the carpet. Brussels carpets are the most durable in texture, but as soon as the surface is worn the beauty is quite gone. Printed tapestry, cut pile carpets, and Kidderminster, if good, last for many years. The staining of the pattern of these carpets should come through to the reverse side. Kidderminster carpets are the best for bedrooms. Hard stiff carpets do not, as a rule, wear well, the threads being made of hemp and hard wool mixed. Such carpets possess no elasticity, and when used as stair-carpets may crack. Sometimes odd pieces of very good carpet may be purchased at a low cost in large warehouses, and these, neatly bound or fringed, often make pretty rugs and are very useful additions to the carpets of a house. Small neat patterns with as few tints as possible should be chosen for small rooms. **Floorcloth** if good should not be too soft. In a good quality the paint will slightly crack when the cloth is bent backward. Linoleum is durable, but unsuitable for a sitting-room.

When about to furnish a house it is best to buy first only what is really necessary. It is unwise to spend all the money saved. Often many things are purchased which are not really required, merely because there seems to be a little money to spare. It is much wiser to avoid spending all the money saved, as, when the actual experience of housekeeping begins, many little things which would add to the comfort of the home can be purchased. As the income increases it is easy to add to the comfort and beauty of the home, though neither depends largely upon outlay, but rather upon tastefulness, neatness, suitability of the home to the position of the owner, and good sense in the management of the furniture and the income.

Estimate of the Furniture Required for Three Rooms or Small Cottage.—In making out this estimate, only the really necessary articles are mentioned. Many little additions may be easily made by those anxious to make their home comfortable and pretty. An artisan will probably fit up book-shelves in recesses, put up window-blinds, arrange poles for curtains, make picture-frames, flower-boxes for windows, &c. It will be his wife's duty to provide a fair stock of household linen, in purchasing which she should remember that the best is always cheapest in the end. She will also probably have many pretty little things for ornamenting her home (page 265).

Kitchen Furniture.

	£	s.	d.
Deal table, with leaf	0	10	0
4 Windsor chairs	0	10	0
1 Elbow Windsor chair	0	4	6
Flour-trough, well made, so as to act as side-table	0	10	0
Cocoa-nut matting or square of good floor-cloth	0	6	6
Fender and fireirons	0	5	0
Coal-scuttle	0	2	6
Door-mat	0	2	0
Muslin for short blind	0	0	9
	2	11	3

Sitting-room.

	£	s.	d.
Carpet, bordered square	1	5	0
Hearthrug	0	6	6
6 Chairs	1	1	0
1 Armchair	0	7	6
Table	1	0	0
Small couch	1	10	0
Fender and fireirons	0	7	6
1 Small round table	0	1	6
Table-cloth	0	2	6
Coal-scuttle	0	3	6
Muslin curtains	0	3	6
	6	8	6

Bedroom.

	£	s.	d.
Iron bedstead	0	15	0
Chain palliasse	0	18	0
Wool mattress	0	18	0
Bolster	0	5	0
Feather pillows	0	7	6
2 pairs Blankets, 12*s.* 6*d.* and 9*s.*	1	1	6
1 Counterpane	0	6	0
Carried forward	4	11	0

	£	s.	d.
Brought forward	4	11	0
Deal dressing-table, to be draped with muslin	0	3	6
Washstand	0	7	6
Chest of drawers	1	5	0
Dressing-glass	0	5	6
Two chairs	0	4	0
Carpet (6 yards wide Dutch)	0	6	0
Toilet-set	0	5	6
Footbath and can	0	5	6
Curtains	0	5	0
Fender	0	2	0
	8	0	6

Kitchen and Household Utensils.

	£	s.	d.
4 Saucepans, 2*s.* 6*d.*, 2*s.*, 1*s.*, 6*d.*	0	6	0
1 Boiling-pot	0	4	0
1 Stewpan	0	2	0
1 Kettle	0	2	6
2 Baking-tins, 8*d.*, 4*d.*	0	1	0
Gridiron	0	0	9
Frying-pan	0	0	9
Iron spoon	0	0	3
Dripping-pan & stand	0	2	6
Chopping-board	0	1	0
Rolling-pin	0	0	4
Chopper	0	1	0
Coal-shovel	0	1	0
2 Flat-irons	0	2	0
Iron-rest	0	0	6
House-pail	0	2	0
Slop-pail	0	1	0
1 Washing-tub	0	3	6
1 smaller Washing-tub	0	2	6
Scrubbing-brush	0	1	0
3 Shoe-brushes	0	2	6
Stove "	0	2	0
Long brush	0	2	6
Carpet-brush	0	1	9
Short hearth-brush	0	0	9
Dust-pan	0	0	6
2 Trays	0	2	6
Salt-box	0	1	0
½ doz. knives & forks	0	5	6
Carvers	0	2	6
4 Table-spoons	0	2	0
6 Teaspoons	0	1	6
1 Cruet-stand	0	2	6
Coffee-pot	0	0	9
Oil-can	0	0	6
Candlestick	0	0	4
	3	4	8

China, Glass, &c.

	£	s.	d.
3 Breakfast cups and saucers	0	1	6
6 Tea " " "	0	1	9
6 Plates	0	1	3
Cream-jug and sugar-basin	0	0	6
2 Jugs	0	1	6
2 Salt-cellars	0	0	4
Teapot (earthenware)	0	1	0
6 Dinner-plates	0	1	6
6 Smaller plates	0	1	0
3 Meat-dishes, 8*d.*, 6*d.*, 4*d.*	0	1	6
2 Vegetable-dishes	0	2	0
Carried forward	0	13	10

	£	s.	d.
Brought forward	0	13	10
3 Basins	0	0	9
2 Pudding-basins	0	0	8
3 Pie-dishes, 4*d*., 3*d*., 2*d*.	0	0	9
Bread-pan	0	1	0
Washing-up pan	0	0	6
Lamp	0	2	6
	1	0	0

Total.

	£	s.	d.
Kitchen	2	11	3
Sitting-room	6	8	6
Bedroom	8	0	6
Kitchen utensils	3	4	8
China, glass, &c.	1	0	0
	21	4	11

CHAPTER XLII.

THE DECORATION OF THE HOME.

Order and Cleanliness.—The Walls of the Room.—The Windows.—The Furniture.—Beauty and Utility.

In writing upon this subject we reiterate what we have already stated—that our remarks are not intended to apply to those who have plenty of money at their disposal. Rich and poor alike instinctively love the beautiful, and it is not unnatural that the prevailing idea among the poor is that, on the ground of expense, beauty in their homes is far above their reach. But where there is no wealth to expend either in furnishing or decorating, the home may still be made beautiful by the exercise of good taste and the avoidance of whatever is vulgar. Order is Heaven's first law and cleanliness is next to godliness. Trifles make the sum of human life, and trifles make the comfort of a home. Order, cleanliness, and comfort are absolute essentials of beauty in the home, and all three are attainable in every home, however simple. It is only intended here to offer a few simple suggestions.

The Walls of the Rooms.—Wall-paper is now so cheap, and at the same time made in such pretty designs, that there is no excuse for walls being either dirty or covered with unsightly paper. Common sense as well as good taste must be exercised in the choice of paper for the walls of different rooms. Much of the style and prettiness depends upon the suitability of the paper. Dark papers should never be chosen for small rooms. They are only suitable for lofty, spacious rooms, with abundance of light. Gloomy greens, browns, and dark crimson should be avoided, whilst blues rarely look well. Papers for sunny bright rooms should be of cool-looking pale tints. In rooms having a northern aspect the paper should not be entirely white, grey, drab, or stone-colour, but the light ground should be brightened up with some pretty trailing design, such as jessamine. A pink-tinted ground to the paper would have the effect of giving a slightly sunny flush to the room.

The Windows.—It is scarcely necessary to mention that even prettily-furnished rooms may be much marred by negligence in attending to the windows. The glass should be always bright, and the curtains fresh and clean. The latter should be so arranged as not to obstruct the current of air. Long lace curtains in summer are always cool and pretty, and, for those who cannot afford to purchase the ordinary poles and rings, very good substitutes may be made of stout laths obtained from a carpenter. These should be covered with white calico, and they can be easily fixed upon hooks at each end of the top of the woodwork of the windows. Common brass rings will do for hanging the curtains, and the bare appearance caused by the absence of the poles may be taken off by white muslin frills nicely arranged along the laths. Art muslins are cheap and pretty, but do not always wash well. Plain white muslin blinds are most suitable for bedrooms. Laths covered with white calico, and used instead of tape, prevent the blinds from drooping in the centre. The indispensable long roller-blinds should be of the same colour and pattern in all the rooms facing in the same direction. These should always be kept in good order, and if of glazed material should be dusted weekly with a brush or a duster tied to the top of the brush.

For winter curtains, mixed fabrics of silk and wool, or cotton and wool, should be avoided. Woollen damask is the best and most durable material, and will wash well in cold water without soap.

The Furniture.—Large heavy furniture is out of place in small rooms. We have said before that in choosing furniture 'sets' should not be purchased by persons of small means.

Art muslins and draperies of all kinds for furnishing should be used in great moderation. Where furniture is covered, calendered or shiny chintz is much preferable to cheap cretonne or any other material which soon fades. Cretonne washes deplorably. Chintz, if really good, wears well; and, if washed with care, looks well to the last shred.

The colour of the carpet and rug must harmonise with the colouring of the walls ; indeed, harmony of colouring must occur throughout the room. When it is impossible to match well it is best to arrange a good contrast. It is desirable, if possible, to break the bareness of the walls by pictures of some kind. Imitations of oil-paintings should as a rule be avoided ; but some oleographs are pleasing and inexpensive. Large pictures, unless very good, never look well. Wide common gilded frames are in bad taste. Simple water-colours and engravings in unpretentious narrow gilded or oaken frames are the most suitable for very limited means. The frames may be made at home if the husband is gifted with mechanical ingenuity.

Besides the furniture actually required, such additions as a pretty work-table, a writing-stand, books, an artistically shaped chair or two, will give an air of refinement to the room. A few prettily-carved brackets, and ornaments judiciously chosen and placed, cushions covered with soft delicately-tinted muslin, made for use and not merely for ornament, will all contribute in the same direction. Knick-knacks should not be so numerous as to require hours to be spent in dusting them. Plants and fresh fragrant flowers are a natural, beautiful addition to a pretty room.

Simplicity should mark the adornments of bedrooms. Hangings should be of white dimity or muslins, which, when washed, always look new. There should be no superfluous furniture. In no other room is overcrowding of furniture so out of place as in bedrooms. Old bedroom furniture, such as painted chairs, washstands, &c., may be made to look as good as new by careful enamelling, which can be done at home.

Much more might be said upon this subject, but the canons of beauty and elegance can only be learned in a very general way, if at all, from books. It is obvious that so much must depend upon the particular circumstances of the home and the taste of individuals. A home in its true sense is 'where the heart is,' and a woman's ingenuity will invent numerous adornments and comforts for the home of those she loves. She will combine beauty with *utility*. All her adornments will have a practical value in the economy of the home, and nothing will be too good for daily use. In her desire to make the home the abode of happiness and contentment—the spot to which all her family turn their thoughts as to a haven of rest when wearied with toil, or when in need of comfort in time of trouble—she will not spare herself. There will be no neglect of duty, no remission of labour—and her personal influence, and the remembrance and influence of her pretty bright home, will live long after her active work ceases. Of such a woman we can give no better description than that given by Solomon: 'Strength and honour are her clothing; and she shall rejoice in the time to come. She openeth her mouth with wisdom; and in her tongue is the law of kindness. She looketh well to the ways of her household and eateth not the bread of idleness. Her children arise up and call her blessed; her husband also, and he praiseth her."

CHAPTER XLIII.

INCOME AND EXPENDITURE.

Value of Money.—Expenses.—Reserve Fund.—Distribution of Expenses.—Expenditure of a Schoolmistress.—Teachers' Provident Society.

Value of Money.—One of the important lessons which young people should be taught is the value of money. From their early childhood they should be trained to habits of general carefulness in the treatment of clothing, books, &c., provided for their use; of consideration and respect for the property of other persons; and they should be guided in the judicious expenditure of any money which may be given to them. Anything approaching parsimony should be deprecated, whilst a tendency to reckless spending should be checked. They should be trained to keep a little account of all their small sums of money, and to balance the amount. At the same time, any tendency to over-estimate money merely because it is money must be avoided. What is habit in youth becomes nature in old age, and a constant habit of checking expenditure will do much to insure relief from money-troubles when the business of life begins.

Current expenses are those running on from day to day. They include rent, taxes, food, fuel, clothing, education, wages of servants, all items connected with keeping the home clean and in good order, and possibly travelling to and from work.

Occasional expenses are those which occur beyond the current expenditure for the daily necessaries of life—*e.g.*, a yearly holiday at the seaside, or any incidental exceptional purchase, &c.

Contingent expenses are those which arise through some sudden emergency, creating an imperative need for ready money.

Reserve Fund.—When a contingency arises, such as the sudden or prolonged illness of a member of the family, loss of employment, or any accident, the trouble is much increased by the want of money. This should be provided against by a reserve fund. However small the wages may be, an effort should be made, by self-denial in times of health, to effect some little saving. The idea that a small sum is not worth saving is fallacious, and should not be entertained. 'Many a mickle makes a muckle.'

Distribution of Expenses.—Much of the happiness, comfort, and health of the home depends upon the way the money is spent, rather than upon the amount spent. As a rule, the wife has much to do with the distribution of the greater part of her husband's earnings, and a man who finds his wife capable and judicious in the management of the home, will gladly rely upon her judgment as to the wise expenditure of his income. The practice of keeping exact household accounts is absolutely necessary in order to ensure that the current expenses shall be less than the income, so that some provision may be made for occasional and contingent expenses. A division of the income should be made according to the neighbourhood and needs of the family; and this division, when found to answer well, should be adhered to. It is impossible to lay down any absolute rules for this division; each housekeeper must arrange for her own particular case. As an example, divide the income into twentieths, allotting three for rent, ten for food and fuel, three for clothing, one for repairs and cleaning materials, one for education or books, two for clubs and reserve fund.

Ready Money should be paid for everything. It will always command the best articles at the lowest price if expended with judgment. Shopkeepers who act fairly prefer it. Those who are anxious to give credit should be avoided. A valuable maxim to be remembered is, *Buy nothing that cannot be paid for at the time*; and again, when the income is small and the expenses many, *Buy nothing that is not really necessary.* Sydney Smith's advice was, 'When you are going to buy anything, first ask yourself whether you want it, then whether you can do without it.'

FORM OF ACCOUNT SHOWING WEEKLY EXPENDITURE.

——	Mon.	Tues.	Wed.	Thur.	Fri.	Sat.	Total
Rent							
Reserve fund, &c. .							
Flour and bread .							
Meat . . .							
Tea and groceries .							
Butter . . .							
Milk . . .							
Vegetables . .							
Fuel and light .							
Cleaning materials .							
Clothing . . .							

In country villages, expenses are less than in a town. The rent, as already stated, is very low in comparison, ranging from 1*s.* 6*d.* to 3*s.* per week, and the majority of cottages have a garden. Generally an allotment at 10*s.* per rood per annum can be rented. This provides vegetables and often fruit, whilst the waste and smaller vegetables, together with acorns, will help to keep a pig. Wood is cheap, skim-milk can be purchased in some parts at the rate of two or three pints for a penny. If a few hens are kept, they may be a source of profit. In harvest-time, gleaning provides a small addition to the supply of flour.

TABLE SHOWING WEEKLY EXPENDITURE FOR A COUNTRY LABOURER, WIFE, AND THREE CHILDREN—INCOME 15*s.* 6*d.* PER WEEK.

	s.	*d.*
Rent	2	0
Club and reserve fund	1	6
Flour	3	6
Meat	1	6
Suet	0	4
Tea and sugar	1	0
Cheese	0	6
Butter	0	6
Split peas, haricot beans, pearl barley, or rice	0	4
Milk	0	6
Salt, pepper, &c.	0	1
Cleaning materials	0	6
Coal and candles	1	0
Clothing	2	3
Total	15	6

The vegetables, &c., to be grown in the garden should include potatoes, cabbages, broccoli, artichokes, onions, lettuces, radishes, cress, celery, rhubarb, fruit-bushes, &c. A carefully-kept garden will not only provide these for the family, but may be made a source of income by the sale of part of the produce. A small plot of ground should be given to the children to train them to care for the garden, and they may be made useful in picking weeds, hoeing potatoes, and keeping the paths tidy. Occasionally a small addition to the weekly income is earned by the children

TABLE SHOWING WEEKLY EXPENDITURE FOR AN ARTISAN, WIFE, AND THREE CHILDREN IN TOWN.—INCOME 30*s.* PER WEEK.

The requirements for this family are the same as those of the country labourer, but the conditions are so different that a larger amount in proportion must be spent on rent, fuel, and physical necessaries.

	£	s.	d.
Rent	0	6	0
Reserve fund	0	3	0
Bread and flour	0	3	4
Meat	0	4	0
Suet	0	0	4
Bones for soup	0	0	2
Tea and sugar	0	0	9
Cheese	0	0	6
Butter	0	0	8
Peas, beans, rice, &c.	0	0	4
Milk	0	1	0
Salt, pepper, &c.	0	0	1
Vegetables	0	1	0
Fruit or currants	0	0	3
Fuel	0	2	0
Oil and candles	0	0	6
Books, &c.	0	0	6
Clothing	0	4	6
Cleaning materials and repairs	0	0	9
Sundries	0	0	4
Total	1	10	0

Expenditure of a Schoolmistress.—Under the most favourable circumstances the work of a really conscientious teacher entails much physical wear and tear. In order that she may carry on the work of education and perform all her numerous duties thoroughly, she must not neglect herself, or a breakdown in health will certainly result. It is necessary that she should have a comfortable home and regular meals. When able to reside at home with her own relatives the difficulty of securing home-comfort probably does not exist. When, however, she is at a distance from friends, it is far wiser to arrange for boarding with a respectable family than to take apartments and endeavour to board herself. By this means she will not have the discomfort of preparing meals when tired and worn after many hours at school. Neither will there be so much inclination to neglect meals altogether. In a large town it is sometimes possible for two or three young teachers to reside together. This has been found to be a good plan on the grounds of economy, comfort, and society. Sometimes a school residence and furniture are provided, in which case special arrangements have to be made by the teacher for boarding herself.

Duty of Saving.—With the teacher, as with everyone, it is a duty to have a reserve fund for contingencies such as illness, but she should also make some provision for old age or for infirmity that may incapacitate her from teaching. Neither of these can be done unless there is a careful arrangement of the expenditure, which should be portioned out in accordance with the amount earned.

ANNUAL EXPENDITURE OF A TEACHER EARNING £75 PER ANNUM, NO SCHOOL RESIDENCE BEING PROVIDED.

	£	s.	d.
Board and residence with family, 15*s.* weekly	39	0	0
Washing	2	12	0
Clothing	10	0	0
Gloves, boots and shoes	3	0	0
Travelling and holidays	5	10	0
Books, lectures, &c.	2	0	0
Sundry expenses, gifts, &c.	1	8	0
Contributions to charities	1	10	0
Savings bank, insurance, &c. . . .	10	0	0
Total . .	75	0	0

Such a table can only be a guide as to the distribution of the income when the teacher is living quite by herself and has no one dependent upon her. She may exercise economy in her expenditure for clothing by judicious forethought, by making and altering dresses, trimming bonnets, &c., for herself. She should choose such clothing as is suited to the climate and district, urban or rural, in which her work lies. In former times clear starching, ironing muslin, laces, and fine linen, were among the duties performed by high-born ladies. Such work may be done by a teacher, as one of the means of economising in small expenses. For investments suitable for small sums, see page 275.

The Teachers' Provident Society.—This society for the benefit of teachers was founded in 1878 by the National Union of Teachers. It is based upon very sound principles and is duly registered under the Friendly Societies Act of 1875. By it easy opportunities are offered for making provision for times of sickness, for old age, and for investing small savings. The affairs of the society are managed by teachers, and it thus gives to its members a professional interest and security not to be found in a general provident society. The Deposit Fund affords to young teachers excellent opportunities for practising the habit of thrift, and of thus laying the foundation of future comfort and independence. The confidence induced by a knowledge that provision is made against the contingencies of life will undoubtedly increase the personal comfort of teachers, fit them better for the performance of their professional duties, and give them an increased sense of honourable independence which they could not otherwise possess.

A member joining at twenty-one years of age can, by the payment of 2*s.* 1*d.* per month, secure 1*l.* per week in the event of sickness. This is reduced to 10*s.* per week after a continued sickness of six months, and to 5*s.* per week after a year's sickness. The arrangements for the payment of pensions are based upon the lowest figures compatible with security.

CHAPTER XLIV.

SAVINGS AND INVESTMENTS.

Post Office Savings Bank.—Stocks, Consols, &c.—Annuities.—Life Insurance.—Infantile Insurance.—Building Societies.—Friendly Societies.—Co-operative Societies.—Penny Banks-—Medical Clubs.—Old Age Insurance.

It was not until after the commencement of the present century that a proper place of deposit for the small savings of the working classes was provided. Benevolent persons, anxious to raise the condition of the lower classes and to encourage thrift among them, established institutions of the nature of banks in which the very smallest savings could be deposited. Interest was paid upon sums thus invested, and many thousands availed themselves of the opportunity given for saving. In time millions of pounds were deposited, and at length the Government felt that the movement required greater security than private support could guarantee. The outcome of the inquiry made was the institution of a Government Savings Bank, the security of the nation itself being given for the funds deposited.

I. The Post Office Savings Bank.—This Government bank is so called because its business is transacted through the medium of the Post Office. It is, perhaps, the best and most convenient means of deposit for small sums of money. The lowest sum which can be deposited is one 1*s.* : odd pence are not received. As much as 50*l.* may be deposited in one year, and 200*l.* is the highest total amount received from one person. Interest at the rate of two-and-a-half per cent. is paid upon every complete pound standing to a depositor's credit. After the sum of 200*l.* has been deposited no further ordinary deposits may be made, and the interest may be used to purchase Government stock. Special arrangements are made for those who wish to purchase Government stock. Deposits may be made by persons of full age, by married women, by children over 7 years old, by guardians of children under 7 and of insane persons, by two persons jointly on their own behalf, by trustees and treasurers of societies, by corporations, companies, and vicars of parishes on behalf of parish charities, &c.

Among the benefits granted by the Post Office Savings Bank may be mentioned—

(1) *Its Perfect Safety.*—The Government itself guarantees the return of the capital and its interest. This safety more than compensates for the low rate of interest.

(2) *Its Convenience for Deposit and Withdrawal.*—Money may be deposited and withdrawn at any post office in the United Kingdom where the depositor may happen to reside.

(3) *Its Correspondence.*—Correspondence respecting the bank business may be carried on without costing the depositor anything, and books and special withdrawal forms are provided free by the Government.

(4) *Its Legal Arrangements are Simple.*—In case of the death of the depositor without a will, payment is made to the administrator of the estate upon the production of the letters of administration ; or, if no letters of administration are taken out, payment is made to the widow or nearest relative who satisfies the Postmaster-General that his claim is legal.

(5) *Its Strict Secrecy.*—Strict secrecy is enjoined upon all officers of the Postmaster-General in connection with

the subject of the Savings Bank accounts of the depositors.

The Post Office Savings Bank offers encouragement to children to save their pennies. Slips of paper marked with twelve divisions for postage-stamps may be obtained at any post office, and when twelve stamps have been pasted on the paper it can be handed in to the bank as a shilling deposit. Teachers in public elementary schools have opportunities for bringing this under the notice of their pupils.

II. Government Stocks, Consols, and Public Funds.—Depositors can always rely upon these as perfectly safe investments. They form part of the National Debt of the country, a debt formed by the Government when requiring money at different times for great national undertakings. Private individuals are the creditors, who lend their money on the understanding that, although the interest will be regularly paid by the Government, the capital can only be realised through the ordinary channels of the money market. *The right to receive the interest* upon the amount of stock held can be sold. Depositors can become holders of Government stock through the medium of the Post Office Savings Bank.

The minimum amount of stock which may be purchased or sold is one shilling, and not more than 200*l.* stock can be credited to an account in any year, or 500*l.* in all. Investments may be made in Consolidated two-and-three-quarter per cents. or in the Two-and-a-half per cents., or in the Local Loans three per cent. stock. The Government negotiates the sale of stock for their depositors, buying and selling at the *current price* of the day in the money market. A commission of one-eighth per cent. is charged upon the sale and purchase. The advantages of this mode of investment are similar to those of the Post Office Savings Bank. The largest sum which can be saved in one year through the medium of the Post Office is 200*l.* stock and 50*l.* deposit = 250*l.*

III. Annuities.—These are of two kinds: (1) *Immediate* and (2) *Deferred Annuities.* The Government undertakes the payment of annuities through the Post Office. They may be purchased on the life of any person over five years of age.

(1) *Immediate Life Annuities* are obtained by the pay-

ment of a sum down, the amount to be paid varying with the age and sex of the annuitant. A few items taken from the Government tables are here given as examples of the amount to be paid in order that an immediate life annuity may be received :—

Age in years, at the time of purchase, of the person upon whose life the annuity is to depend	Males			Females		
	Cost of an immediate annuity of £1			Cost of an immediate annuity of £1		
	£	s.	d.	£	s.	d.
If 20 and under 21 . .	22	15	10	24	16	6
„ 25 „ „ 26 . .	21	12	11	23	15	0
„ 30 „ „ 31 . .	20	9	1	22	11	8
„ 35 „ „ 36 . .	19	4	1	21	6	2
„ 40 „ „ 41 . .	17	17	10	19	18	0

The above sums give the cost of an immediate annuity for 1*l.* *only*, and an annuity of a larger amount costs a larger sum down in exact proportion—*e.g.*, a man aged 25 who desires to purchase an annuity of 50*l.* would be required to pay down 21*l.* 12*s.* 11*d.* × 50 = 1,082*l.* 5*s.* 10*d.*; a man aged 40 who desires to receive an annuity of 50*l.* would be required to pay down 17*l.* 17*s.* 10*d.* × 50 = 894*l.* 11*s.* 8*d.*

(2) *Deferred Life Annuities* are obtained by paying a certain sum of money either down, or yearly, to the Government for a certain number of years, at the end of which period these payments cease, and the annuity commences.

The premium to be paid yearly varies according to the number of years before the annuity commences, and to the conditions of the contract between the applicant and the Postmaster-General as to the return or non-return of the whole or part of the purchase-money in the event of death before the annuity was due to commence. The 'Post Office Guide,' published quarterly, gives full information upon annuities and their varying terms of purchase. The great *advantage* of the Government annuities is their perfect security. The *disadvantage* is that illness or trouble may prevent the annual payment of the premium being maintained, in which event the sum already paid is lost.

TABLE GIVING EXAMPLES OF THE YEARLY SUM OR THE SINGLE PAYMENT FOR WHICH A DEFERRED LIFE ANNUITY OF £1 WILL BE GRANTED. IN THIS CLASS OF ANNUITIES THE PURCHASE MONEY WILL BE RETURNED UPON APPLICATION, OR ON THE DEATH OF THE NOMINEE IF AN INSTALMENT OF THE ANNUITY SHALL NOT HAVE BECOME DUE.

Age in years, at the time of purchase, of the person upon whose life the annuity is to depend	Cost of an annuity of £1, payable after the expiration of ten years			
	MALES		FEMALES	
	In 11 yearly sums of	In one sum at time of purchase	In 11 yearly sums of	In one sum at time of purchase
Deferred Life Annuities—Money Returnable.				
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
If 20 and under 21	1 12 10	15 19 7	1 16 3	17 12 10
,, 25 ,, ,, 26	1 10 10	15 0 0	1 14 2	16 12 11
,, 30 ,, ,, 31	1 8 8	13 19 6	1 11 11	15 10 11
,, 35 ,, ,, 36	1 6 6	12 17 9	1 9 5	14 6 6
,, 40 ,, ,, 41	1 4 1	11 14 4	1 6 7	12 19 2
Deferred Life Annuities—Money not Returnable in any Event.				
If 20 and under 21	1 10 8	14 6 8	1 14 5	16 5 6
,, 25 ,, ,, 26	1 8 6	13 4 10	1 12 4	15 4 6
,, 30 ,, ,, 31	1 6 3	12 2 3	1 10 0	14 1 9
,, 35 ,, ,, 36	1 3 11	10 18 9	1 7 6	12 16 11
,, 40 ,, ,, 41	1 1 6	9 14 2	1 4 8	11 9 7

All the above rates are given as the cost of an annuity of 1*l*. only, and they vary in exact proportion to the amount of the annuity desired to be purchased, as already explained on page 277.

IV. Life Insurance is effected by an immediate payment or an annual payment extending over a number of years. By this means the head of a family can secure to those dependent upon him a specified sum to be paid to them at his death. The age and sex of the assurer and the amount for which the insurance is taken determine the amount of the annual premium. The Government offers advantageous terms and perfect security. At the age of 25 a man can insure his life for 100*l*. by the payment of the annual premium of 2*l*. 0*s*. 6*d*. through life; or of 2*l*. 12*s*., payment to cease at the age of 60.

Infantile Insurance.—We may here mention the subject of the insurances taken on infant lives. It is the duty of all adults who can afford the annual payment, and who have others dependent upon them for whom they find it difficult to save a sufficient sum, to insure their own lives. There is, however, not the same reason for taking out an insurance policy on the life of infants and young children, and yet thousands of parents are induced to insure their children, on the pretext that this is a variety of thrift. The maximum amount which is legally payable on the death of a child under 5 years is 5*l*.; the maximum amount in the case of a child under 10 years old is 10*l*. It is evident that these sums can only furnish enough for funeral expenses and for the purchase of mourning clothes.

Such insurances are pernicious for various reasons. (1) In the case of some careless and improvident mothers, the children thus insured have been neglected, and their chances of life diminished. (2) In a much smaller number of cases there has been strong reason to suspect that children have been wilfully neglected and their death hastened for the sake of the insurance money which would then become due. (3) The benefits derived from these insurances can only be obtained if the insured dies during the early years of life. If the child lives beyond a certain age, the benefit ceases, and no repayment is made of the weekly sums paid or even of a portion of them.

(4) The societies dealing in the insurance of infants are managed on a system of canvassing, involving heavy working expenses. On an average 50 per cent. of the premiums paid are spent in their collection, the money being collected in weekly payments of 1*d*. and upwards. It is evident, therefore, that the full benefits of insurance are not secured. A payment at the rate of 1*d*. weekly into the Post Office Savings Bank would probably produce as good a financial result, and would not be open to the objection which holds good against infantile insurance, that no benefit can be received unless the child dies within 5 or 10 years.

V. Building Societies.—These take the form of (1) *Proprietary Companies*, who aim at providing cheap and suitable accommodation for the poorer classes according to the Labourers' Dwelling Act of 1855, in which regulations as to the building of these dwellings are laid down. The Housing of the Working Classes Act, 1890, demands that such building companies shall satisfy the local authorities from time to time that the houses are not overcrowded, and that the sanitation, ventilation, water-supply, and state of repair are such as to render the houses fit for human habitation.

(2) *Benefit Building Societies.*—These are established for the purpose of raising funds by subscription to enable the members to build or purchase dwelling-houses or other heritable property, either freehold or leasehold, by loans granted by the society. The debt to the society is secured by mortgage upon the property until the sum borrowed, with interest, &c., is paid. Every member is entitled to a loan equal to the value of his share, but interest is payable at a stated rate. An *appropriation* is made occasionally, when the funds of the society permit. It consists of a sum of money lent by the society to one of its members, *without interest*, for a number of years—generally 12½. The member to receive this benefit is decided by ballot, and only those who have fully paid up their subscriptions are eligible. Building societies are also a convenient means of investment for those who do not join with the intention of purchasing houses, but who merely invest their money in what appears a safe and profitable undertaking. Building societies, when well conducted on economical principles, are a valuable inducement to thrift; but cases of insolvency through careless management, fraudulent treasurers, &c., have at times greatly shaken the public confidence in them. Hence the necessity for very careful investigation before joining or investing in them. Building societies may be either Permanent or Terminable.

(i) A *Permanent Society* is one which, when formed, has no fixed date limiting the period of its existence. Its board of management consists of a number of directors or trustees, who are generally qualified for their office by holding shares, and three auditors.

(ii) A *Terminable Society* is one which, by the rules of the society, ends at a fixed date. Its management is similar to that of a Permanent Society, but the number of its members is limited and each receives a loan. After the repayment of all these loans, the society comes to an end. The advances are made sometimes by ballot, sometimes by lot, sometimes by sale. A member selected to receive a loan may sell his privilege for a certain sum—say, 50*l.*—to any other member. The *rate of interest* received annually by the members depends upon the profits realised.

1. *Advantages of Building Societies.*—(*a*) They enable persons to buy land and houses by small periodical payments, instead of paying direct rent, and they help builders of little capital. (*b*) They form a good means of investment, and the interest is generally good.

2. *Disadvantages.*—(*a*) There is a risk of loss through the unfortunate speculations or dishonesty of the directors. (*b*) There may be a delay of three months or longer when members desire to withdraw their capital.

VI. Benefit or Friendly Societies.—These are established on a co-operative principle for working men. There have been numerous societies of this kind, but many have been delusive in the terms they have offered to their members. At their first institution they are generally composed of members in the prime of life; there is, therefore, little sickness and comparatively little claim made upon the funds, which rapidly accumulate in consequence. The directors are then tempted to raise the amount of allowance to those occasionally incapacitated. But it has not infrequently happened that (*a*) the subscriptions of the members decline, while (*b*) the expenditure for sick-pay increases owing to the fact that with advancing years the average amount of sickness is greater. The society is liable then to become bankrupt, leaving the older members whose regular subscriptions have contributed to its early success destitute of all relief at a time when they most need it.

The chief points of a good Benefit Society are that—

(1) It provides not only a Government certificate that the rules are according to the legal arrangements of the Friendly Societies Act, 1875, but also an actuary's certificate to the effect that the contribution tables are arranged at a sufficiently high rate to secure the benefits they promise, thus vouching for the solvency of the society.

(2) It provides a pension for old age.

(3) It has a distinct rate of payment for persons enter-

ing at different ages, so that the younger members enter at a lower rate than older members.

(4) It is not connected with any trade organisation disagreement with which involves expulsion and consequent loss of sick-pay and pension.

(5) It does not, if possible, hold its meetings at public-houses.

Among the most largely patronised of working men's societies are—The Manchester Unity of Oddfellows, The Foresters, and the Mutual Provident Alliance. The last-mentioned works entirely from its headquarters in London, but the others have branches and members in nearly every town and village throughout the country.

VII. Co-operative Societies and Stores.—These are associations of individuals generally belonging to the working classes who combine for mutual assistance. The most common forms of co-operative societies are—(1) Associations of men belonging to any particular trade or industry for the purpose of carrying it on entirely by their own efforts. No intermediate profit having to be paid, the members of the association thus secure the full profit of their work for themselves. (2) Associations which undertake to provide their members and customers with all kinds of food, clothing, and household necessaries directly from the producers. The chief source of the success of most of these societies lies in the fact that all business, whether of purchase or sale, is done with *ready money*. The co-operative system is successfully carried out in the north of England. At Keighley in Yorkshire the Industrial Co-operative Society at the present time numbers nearly 5,000 members out of a population of about 30,000. The capital involved in co-operative societies, in Lancashire and Yorkshire only, amounts to many millions.

Membership is constituted by the payment of a small yearly subscription, which entitles a person, upon showing his ticket of membership, to the privilege of purchasing at the stores. All the articles are of the best quality and the prices are similar to those of ordinary shops. At the end of stated periods calculations as to profit are made after all rents, wages, &c., are paid, and the members then receive back a small dividend from the profits, varying in amount with the amount of cash they have individually expended during the period. Only members are eligible to become shareholders, and the value of shares which each person may hold is limited, thus preventing speculation. Members often allow their small dividends to accumulate until they have a sufficient sum standing to their credit with which to purchase shares.

VIII. Shares in companies such as railway, tramcar, or omnibus companies, gas and water, fire and life insurance companies, are all means of investment; but in every case careful examination of the balance-sheets is necessary before an investment is made. It is always advisable also to take the advice of a person skilled in finance before making such investments. Balance-sheets are ofttimes difficult to interpret, and may even be misleading. *Any investment promising a high rate of interest should*, as a rule, *be regarded with the most profound suspicion.* A high rate of interest is rarely compatible with safety of capital. It is wiser to obtain a small rate of interest than to risk the whole capital in the endeavour to obtain a high interest.

IX. Local Inducements to Thrift.—(1) *Penny Banks* for school-children, well carried out, are a valuable aid in training children to carefulness with small sums. In many instances a small interest is given upon every completed sum—*e.g.*, 10*s.*—in the year. The money is taken weekly, and each sum paid in is entered upon the child's bank-card. The full sum taken is placed in the Post Office Savings Bank, in the name of the club, the trustees, or treasurer of the club. Parents are sometimes allowed to join these penny banks. Money can be drawn out by giving a week's notice.

(2) *Clothing and Boot Clubs.*—These are managed similarly to penny banks, but instead of having the money returned to them, the members receive an order-ticket, upon which is stated the amount of their subscription, together with the interest or bonus given upon it. Certain shops undertake to supply the clothing or boots on favourable terms, and the shopkeepers receive their money direct from the trustees of the Club. Such clubs are a valuable inducement to the exercise of carefulness and thrift.

(3) *Medical Clubs and Dispensaries* have been founded chiefly in connection with the Oddfellows, Foresters, and other friendly societies. The usual contribution is about

1*d*. per week, and this entitles each adult male to free medical attendance in case of sickness, and his relatives to an allowance at his death for funeral expenses. The principle of thus providing for the contingencies of sickness and death is an admirable one.

X. Insurance for Old-Age Pensions.—For the last fourteen years Canon Blackley has advocated a system of compulsory insurance for old age. This appears to be likely to come shortly within the range of practical politics, or, at any rate, a system of *voluntary* insurance for old age, the results of which, we hope, will be so satisfactory as to prevent opposition to a subsequent general *compulsory* scheme. At present the outdoor relief given by the guardians of the poor is practically a pension which is given without any corresponding previous payment in the shape of insurance premiums by its recipient. Canon Blackley's present proposal is that every young man and young woman between the ages of 18 and 21 shall contribute the sum of 10*l*., and that in return for this the State shall guarantee to pay 5*s*. a week so long as such person shall live beyond the age of 65. This can be done in consequence (i.) of the accumulated compound interest for 44 years, and (ii.) the death of about one-half of the insured before they reach 65. In the case of the wage-earning class, it is proposed that the payment should be reduced to 5*l*., the State contributing the other half. It is proposed also that, in the case of persons dying before reaching the specified age, the sum contributed should be returned to the nearest relative without interest. That some such scheme as this will be ultimately adopted appears fairly certain. The community would receive an abundant return for its help towards the scheme by the practical abolition of the burden of poor-law relief. At present the actual number of persons above 65 in receipt of poor-law relief is equivalent to one out of every six of those above this age; and it is highly probable, as stated by Canon Blackley, that every other person in the wage-earning class before he dies will at some part of his after-life be in receipt of parish relief.

CHAPTER XLV.

STORAGE OF FOOD

Laying in of Stores.—Storage of Vegetables and Fruits.—Times when Foods are in Season.

Advantageous Times for Laying in Stores.—It is well known that things purchased in small quantities are in proportion dearer than when purchased in large quantities. Those having very limited incomes are obliged to submit to this evil to a great extent; but, as there is with most articles of consumption a cheap season and a dear one, an attempt should be made to take advantage of the cheap season. This can only be done by securing a little reserve sum in advance by extra carefulness in all the departments of domestic expenditure. *In storing* care must be taken not to put such articles as tea and coffee, soap and cheese near each other, as the flavour and smell may be imparted from one to the other. Air-tight tin canisters, glass bottles with close-fitting covers, and earthenware jars are useful for the store cupboard.

Vegetables and Fruits.—*Potatoes* may be purchased cheaply for storing about August. In the country they are stored in the ground. A deep hole is dug and lined with straw; the potatoes are put in, covered with straw, and banked up with earth. In the house they should be kept in a dry, dark cellar, covered with straw to protect them from frost. They should be examined two or three times during the winter; any showing signs of decay should be immediately removed, and little sprouts should be broken off. *Artichokes* may be similarly stored. *Cabbages* may be preserved in pits dug in the earth. Their appearance is white but their flavour is good, and they are useful for soup, &c. *Turnips* will keep for some weeks on the floor of a dry, dark cellar. *Carrots* and *parsnips* may be preserved by being kept in damp sand in a dark cellar. *Onions* should be tied by the stalks into long strings, and dried in the sun. They will keep good for many months hung in a dry place. They can be purchased very cheaply in autumn. Herbs for flavouring and soups should be dried in the sun, the leaves rubbed to powder, and kept in air-tight bottles. *Apples* should be laid on straw in a dry place, such as wooden shelves or a floor. They are best kept apart from other stores, and should not be allowed to touch each other. Apples with rough skins, such as russets, keep best. *Gooseberries, raspberries, strawberries, currants,* &c., may best be preserved as jam ; but green gooseberries and red currants may be preserved whole in bottles for pies and puddings in winter. *Flour* and *oatmeal* should be kept in a dry place. They must be kept in a wooden box or bin. The flour-bin should not be allowed to stand upon the floor, if of stone, but upon raised wooden rests. The bin should be divided into two parts, one for oatmeal and one for flour. It should be air-tight, as flour readily absorbs moisture, and any damp will cause mustiness, and the whole quantity may be spoilt. Bought by the sack, a considerable saving is effected. Flour is generally cheapest shortly after harvest, but this depends upon the season and foreign markets.

To Bottle Fresh Fruit.—Choose full-grown but not over-ripe fruit. Let them be gathered in dry weather, as, if gathered damp, they will mould. Pick them off the stalks and examine carefully to avoid any blemished fruit. Use wide-mouthed glass bottles, and first exhaust the air in them by holding a lighted match inside before putting in the fruit. Cork them gently with new soft corks, and put the bottles into a very slow oven (one from which bread has been recently drawn would be best). Let them stand until the fruit has shrunk about one quarter. Then take them out, and fill up from another bottle, beat in the corks, cut them off level with the tops, and seal them with melted resin or sealing-wax. Fruit so bottled will keep good for many months, if stored in a *dry* place.

General Rules for Pickling.—Use glazed stoneware jars, as salt and vinegar will penetrate through common earthenware. Use the best vinegar, pepper, ginger, and cloves. Never use a metal spoon for taking pickles out of a jar ; keep a wooden one for the purpose. Always keep the jars securely covered, so as to be air-tight. Store them in a dry place, and never in proximity to a gas-burner.

To Pickle Red Cabbage.—Choose a firm cabbage, with curly leaves. Hang it up to dry for a few days. Remove the outside leaves and hard stalk, cut it across in very thin slices ; lay them on a large dish, and sprinkle them well with salt; cover them over with another dish, and let them stand for twenty-four hours. Drain them in a colander or in a clean cloth. Boil vinegar with spices, 1 oz. of whole black pepper, ½ oz. of well-bruised ginger, and a few cloves, to one quart of vinegar. Put the cabbage into the jars, and pour the vinegar, &c., over when cold. A little cochineal boiled with the vinegar will give a bright red appearance to the cabbage. Tie down the jars with bladder, and store in a dry place.

To Pickle Onions.—Gather the onions when quite ripe and dry. Peel off the outside skin, putting them into a bowl containing salt and water. Strain them through a colander, and dry them with a soft cloth. Put them into jars or bottles. Pour over them cold vinegar, with ½ oz. of whole black pepper and ½ oz. of bruised ginger to a quart of vinegar. Tie them down, and keep them in a cool, dry place. They will be fit to eat in four or five weeks.

To Pickle Walnuts.—Let the walnuts be young. Test them by seeing if they can be readily pricked through with a darning-needle; if the inside seems hard they are woody, and will not make a good pickle. Lay them to soak for nine days in strong salt and water, stirring them gently occasionally. Change the water every third day. Drain them and spread them out on dishes or a board in the sun for two or three days until they become quite black. Put the walnuts into dry stone jars, but do not quite fill the jars. Boil the vinegar with 2 oz. of whole black pepper, 1 oz. bruised ginger, 1 oz. allspice, ½ oz. of cloves, to each quart of vinegar, and pour the mixture, whilst nearly boiling, over the walnuts, quite covering them. When cold, tie them down closely, and keep them in a dry place. They will be ready for use in four or five weeks.

Pork may be purchased fresh in large quantities at a low price. It is best to lay in a stock in November for the winter. It should be pickled or cured to preserve it.

To Pickle Pork.—Rub the pieces of pork well with salt, and put a layer of salt into a tub or glazed earthenware pan. Pack the pieces of pork closely together in the tub with a layer of salt over each layer of pork, and strew salt on the top. Cover the tub with a coarse cloth and a tight-fitting lid. Place a heavy weight on the top to keep the pork down in the brine which will be formed as the salt melts. When a piece of pork is taken out, the tub must always be again closely covered. Pork well pickled will keep good for two years. One-third saltpetre and two-thirds salt is sometimes used, but many persons prefer using salt only.

To Cure Bacon.—Examine the meat carefully to see if it be fresh and good; wipe it with a cloth, sprinkle it with salt, and leave it to drain for several hours, in order that it may be thoroughly cleansed, which will prevent it from turning bad or having a strong taste. Pound and mix 1 lb. of saltpetre, 1 lb. of bay salt, 1 gallon of coarse salt, 1 lb. of coarse sugar, and 1 lb. of sal-prunella. Rub all the hams, cheeks, and sides with the mixture, and put them into the brine. Rub and turn them every day for a week, afterwards every second day for a fortnight or three weeks, according to the size of the parts. After taking them out of pickle, they should be allowed to drain for an hour or two. They are *cured* by being hung in a smoke-house exposed to the smoke arising from the slow combustion of sawdust of oak or other hard wood, from which is produced creosote, a volatile oil which is an antiseptic. In country farmhouses bacon is sometimes cured by being hung in the kitchen chimney for two or three weeks, during which time wood only is burned. Rooms heated by stoves are also used as curing-rooms. The best mode of curing, however, is that first mentioned, the process also producing a thin covering of resinous varnish, which, entirely excluding the air from the muscle and fat, prevents the meat from becoming rusted.

Fresh Butter may be purchased cheaply in summer in a large quantity, and preserved by being packed in layers sprinkled with salt in earthenware jars covered over to exclude the air. If too salt when used the salt may be removed by well kneading the butter in cold water.

To Preserve Eggs.—See page 45.

Herrings may be bought at a low price in October, and will keep for many weeks if well cured. They are best kept by being hung up on a rod, not being allowed to touch each other.

Soap is best bought in bars. It should be cut into pieces with twine and put upon a shelf to dry. Dry soap is much more economical than moist.

Candles last longer if kept till they harden. They should be kept in a tin box in a cool dry place.

Coal is always cheaper in summer than at any period of winter. It should be bought in summer and stored ; quite one-third of the cost may often be saved by this means.

Times when Foods are in Season.

January, February, and March.

Fish : Herrings, haddocks, sturgeon, soles, carp, crabs, crayfish, dace, eels, barbel, brill, oysters, lobsters, lampreys, turbot, whiting, flounders, smelts, skate, shrimps, prawns, sprats ; also cod in January.

Meat : Beef, mutton, veal, house-lamb, pork ; venison in January.

Poultry and Game : Capons, fowls, pigeons, turkeys ; chickens and ducklings in February and March ; grouse, partridges, hares, rabbits, pheasants, snipe, woodcock.

Vegetables : Cabbages, broccoli, sprouts, carrots, parsnips, potatoes, lettuces, savoys, turnips, spinach.

Fruits : Apples, pears, grapes, oranges, nuts, dried fruits, medlars.

April, May, June.

Fish : Salmon, turbot, tench, soles, lobsters, mullet, prawns ; trout in May and June ; mackerel in June.

Meat : Beef, mutton, lamb, veal ; venison in June.

Poultry and Game : Fowls, chickens, ducklings, rabbits ; pigeons and hares in April.

Vegetables : Broccoli, asparagus, seakale, cauliflowers, lettuces, early potatoes, radishes, salads ; peas in June.

Fruits : Apples ; forced fruits in April and May ; green gooseberries, rhubarb ; strawberries, and currants for tarts in June.

July, August, September.

Fish : Herrings, salmon, flounders, lobsters ; sturgeon and pike in July and August ; plaice, shrimps, prawns, soles, trout, skate, carp ; mackerel in July ; oysters and cod in September.

Meat : Beef, mutton, lamb, veal ; venison in July and August ; pork in September.

Poultry and Game: Fowls, chickens, ducklings, geese, pigeons, grouse, blackcock, hares, rabbits; also partridges and pheasants in September.

Vegetables: Asparagus, artichokes, cauliflowers, beans, mushrooms, cabbages, onions, celery, lettuces, seakale, tomatoes, cress, vegetable marrows, turnips.

Fruits: Cherries, currants, raspberries, strawberries, and apricots in July; gooseberries and plums in July and August; filberts, bullaces, damsons, mulberries, apples, and pears in September; pineapples.

October, November, December.

Fish: Brill, barbel, cod, gudgeons, haddocks, herrings, crabs, eels, turbot, oysters, soles, lobsters, whiting, skate, tench, pike.

Meat: Beef, mutton, pork, veal, venison.

Poultry and Game: Capons, fowls, chickens, pigeons, geese, turkeys, wild ducks, hares, rabbits, pheasants, partridges, snipe, woodcock, widgeons, teal.

Vegetables: Artichokes and turnips in October; potatoes, cabbages, carrots, celery, onions, sprouts, spinach, turnips, Scotch kale, vegetable marrows and beetroot in October and November.

Fruits: Apples, pears, filberts, grapes, walnuts, medlars; bullaces in October and November.

Part III

HOME NURSING

CHAPTER XLVI.

THE CARE OF INFANTS AND CHILDREN.

Requirements for Healthy Childhood.—Infants' Food.—Use of Cow's Milk and Condensed Milk.—Origin of Rickets and Scurvy.—Children's Food.—Attention to the Teeth.

No part of domestic hygiene is so little understood as the proper care of young children. And yet during the first five years of life physical growth and development are more rapid than at any subsequent period of life, and the care exercised and *regimen* adopted during this period are therefore of greater importance than at any other time of life.

The most important requirements for a healthy childhood are :—

1. An abundant supply of easily digested and nutritious *food.*

2. A sufficient amount of woollen *clothing.*

3. Free *exercise* of every part of the body, with alternations of *rest.*

4. Absolute *cleanliness* of body and apparel and surroundings.

5. Abundance of *light* and *fresh air.*

Most of these have been already considered, but the question of food requires further discussion.

Infants' Food.—The natural and complete food for the first nine or ten months of life is milk supplied by the mother. Other foods are not required, and not only are not required but are *absolutely injurious.* The statement so frequently made that the baby 'does not seem satisfied with milk' is founded on a complete misapprehension, and any mother who gives her infant bread-pap or artificial foods of any kind so long as it continues to thrive on milk alone is guilty of a serious offence against the child's health and welfare. Starchy foods cannot be digested by an infant until its teeth appear, as before this time the saliva is deficient in the ferment which turns starch into sugar.

If the mother is strong and healthy, she should allow nothing to prevent her from feeding her child. It is a mistake to feed the baby whenever it cries. The crying may be due to 'wind' and indigestion, in which event giving more milk will only make matters worse. To soothe the child in such a case, rub the abdomen gently, and give a small quantity of dill-water or peppermint-water. Soothing-syrups should be carefully avoided. The following are the proper intervals of feeding :—

For the first three months	Every two hours during the day, and every three hours during the night ; the total daily amount being about 1 pint for the first, $1\frac{1}{4}$ pints for the second, and $1\frac{1}{2}$ pints for the third month.
For the next six or eight months	Every three hours through the day, and every four hours during the night, gradually increasing the interval ; the total daily amount being $1\frac{1}{2}$ to 3 pints.

Where the mother's milk fails, it is generally necessary to resort to cow's milk as a substitute.

The best plan is to begin with one part of cow's milk to two parts of water for a child under one month old. Such a mixture, however, is much poorer than undiluted human milk in all the three chief constituents — nitrogenous (casein), fatty (cream), and carbohydrate (sugar). Even half cow's milk and half water is below the standard of human milk, and it is only when it reaches the proportion of two parts of cow's milk to one of water that the necessary standard is approached. The deficiency of sugar can be made up by adding a little sugar to the bottle. The deficiency of fat can be made up by adding a teaspoonful of good cream to each bottle for the infant.

The *casein* of cow's milk is much more difficult to digest than the casein of human milk. As soon as any kind of milk is swallowed it becomes clotted, and, after thus becoming solid, is digested by the gastric juice. But cow's milk forms heavy thick clots, while mother's milk forms fine and small clots, which are not so apt to disagree with the child. Hence the deficiency of casein in a mixture of one part cow's milk to two of water is for a short time advantageous. Gradually more milk may be used, until by the time the infant is three or four months old he may be taking equal parts of milk and water, and at six months old two parts of milk and one of water. But always remember to add a little sugar and cream (the latter taken from a separate sample of milk) to each bottle. This for three reasons—(*a*) cow's milk when diluted is much poorer than human milk ; (*b*) cow's milk as bought has frequently had some of the cream already fraudulently abstracted ; and (*c*) deficiency of fatty food is one of the chief causes of rickets.

Some infants seem to be unable to digest cow's milk, even when diluted with water. Then (*a*) a little lime-water may be added to each bottle, about one part in twelve ; but the best plan is (*b*) to use clear barley-water instead of water with the milk. The barley-water is nutritious ; at the same time, when mixed with the milk, it prevents it from clotting in heavy lumps. There are very few infants who cannot be successfully reared on cow's milk and barley-water. Do not be led away by any delusive statements of old nurses that this food is not sufficiently nourishing. Whether the infant is thriving on it or not can easily be tested, as a healthy infant should increase in weight from two to four ounces weekly.

Always boil cow's milk before using it for food. One frequently hears the statement that boiled milk is constipating. It would be much more accurate to say that it is less laxative than unboiled milk. Nurses often resist the orders to boil the milk, but it is most desirable, inasmuch as (1) boiled milk is more easily digested than unboiled milk ; and (2) the danger of disease being imparted with the milk is avoided.

The bottles used for infants' food *should be thoroughly cleansed.* The best for use are long flat ones with an indiarubber teat, and *no long tube.* Long tubes cannot be kept perfectly clean. Two bottles should be in use, one being washed in warm water and then soaked in water containing a few drops of Condy's fluid, while the other is in use. Once a day each bottle should be washed in strong soda and water. Before using the bottle in soak, it should be rinsed out with clean water. If there is any sour smell about a bottle, the food is sure to be unwholesome and do harm.

Condensed milk should only be very exceptionally used for infants. It possesses only one advantage : its casein is much more easily digested than that of fresh cow's milk ; but although infants fed on condensed milk become very fat, they are generally unhealthy and weak on their legs. There is a large excess of sugar in condensed milk, and sometimes a deficiency of cream. Infants fed solely on condensed milk have been known to develop symptoms of scurvy just as do adults who take no potatoes or other fresh vegetables.

Patent Foods may be added to the cow's milk with which an infant is fed, after it is seven or nine months old. Among the best of these is Mellin's food, as it contains no unaltered starch. Benger's and Savory and Moore's are also very good. Most other artificial foods are to be avoided, and even those mentioned do not take the place of cream and milk, but should be added to them.

For the first six months of an infant's life avoid all artificial patent foods, unless under medical advice.

The diseases to which infants are most prone are traceable almost entirely to *improper feeding.* Many thousands of infants are annually sacrificed to the ignorance or carelessness or prejudice of their parents as regards food. These diseases may be classed as :—

(1) Diseases due to *irritation of the alimentary canal.* Thrush, indigestion, and diarrhœa are the commonest of these. Infants are also very liable to convulsions, sometimes fatal, and the most common cause of convulsions is improper food, which, by its irritant effect, sets up reflex convulsive movements.

Many of the symptoms for which *teething* is supposed to be responsible are really due to the taking of unsuitable food, either stale or fermented, or of a kind not appropriate to the age of the infant.

(2) Diseases due to *defective nutrition.* Of these, anæmia and wasting, rickets, and scurvy are the most frequent, and these also are due to improper feeding.

Rickets is probably due chiefly to deficiency in fatty food. It can be cured best by adding cream to the food or giving cod-liver oil. It is a mistake to suppose that it is due to deficiency of lime-salts. In this disease the bones remain soft and become bent and distorted. Hence the bow-legged limbs so often seen. The ribs are similarly affected, and, the ribs falling in, the chest becomes 'pigeon-breasted,' and insufficient room is left for the lungs to expand. Rickety children are very prone to have bronchitis and inflammation of the lungs as well as convulsions, and from one or other of these causes show a very high rate of mortality. If they survive to adult life, they are generally undergrown, and the bones of the pelvis, as well as of other parts, are seriously deformed. All these evils may be almost certainly escaped by careful and intelligent feeding of infants.

Scurvy seldom occurs in infants fed on fresh milk. Fresh milk has antiscorbutic properties, similar to those possessed by fresh vegetables. Condensed milk does not share these important properties, nor do the patent foods for infants.

In cases of extreme weakness, or where milk cannot be digested by an infant, *raw meat juice* is most valuable. It is the most easily digested and restorative of all animal foods, and forms a splendid substitute for the casein of milk.

It is prepared by mincing finely a piece of best rump steak, then adding cold water in the proportion of one part of water to four of meat. Next stir the two well together, and allow to soak for half an hour cold. The juice is now forcibly expelled through muslin by twisting it.

The juice thus obtained is much richer than ordinary beef-tea, as shown by the following table from Dr. Cheadle:

—	Beef-tea made in the ordinary way	Beef-tea made by soaking beef one hour in cold water, then stewing down 1 lb. to make 1 pint of beef-tea	Raw-meat juice
Proteids . .	·82	1·02	5·1
Nitrogenous extractives .	2·09	1·82	3·1
Salts . .	0·78	0·88	0·7
Water . .	96·31	96·28	—

It shares the antiscorbutic properties of fresh milk. An infant may have 2 to 3 ozs. of this juice in the twenty-four hours, instead of the casein of milk.

Children's Food.—At twelve months old a little broth may be given as well as milk, and the child may be allowed to bite at a crust of bread. A little custard or milk pudding may also be given. No meat should be given until the child is two years old, but mashed potatoes with gravy are allowable. The chief food should still be boiled cow's milk. No child should be suckled beyond the age of eleven months. After this age the diet may be gradually increased in variety, but it is a mistake to press meat on a child in preference tc milk or eggs. Tea and coffee are not good for children, and alcoholic drinks should be strictly forbidden.

Attention to the Teeth.—The teeth are frequently neglected in young children, with serious results to future health; and we strongly recommend that they should receive early and systematic attention. The *milk-teeth* are usually left alone if they become carious and hollow, the supposition being that, as they will be later on replaced by the permanent set, the temporary inconvenience may be ignored. This is a very short-sighted policy on the part of parents. Sound teeth are as essential for mastication before as after seven years of age. The due performance of the digestive functions, and consequently the nutrition and growth of the whole body, are in a large measure dependent on the proper mastication of food. Hence the necessity for sound teeth, competent to thoroughly masticate the food. But as the body grows during the six years ending with the end of the seventh year of life at a rate which is never equalled in after life, it is evident that indigestion at this period of life, with its resultant imperfect nutrition, is more likely to be followed by stunted growth and other evil results than at any subsequent period. For these reasons it is of great importance to the health of children that, if their temporary teeth become carious, they should be properly stopped by a dentist.

At seven years of age the milk-teeth begin to be shed, and their place supplied by the permanent teeth. At this period and for the next few years the child's mouth should be *periodically inspected* by a competent dentist. Regular supervision of the mouth between seven and ten years of age, with correction of irregularities if required, will often prevent much subsequent trouble. It may be hoped that as the importance of this matter becomes better recognised, the governing bodies of public institutions for the young will secure the services of a properly qualified dentist as a matter of routine, just as they now employ a medical adviser.

CHAPTER XLVII.

MANAGEMENT OF THE SICK-ROOM.

Personal Qualifications of a Nurse.—Ventilation and Warming of Sick-room.—Fireplace.—Absence of Noise.—Light.—Cleanliness.—Linen.—Administration of Medicines.—Temperature Observations.

If the information given in preceding chapters be acted upon, it may reasonably be hoped that sickness will long be absent from the household. Sooner or later, however, sickness comes, and it is important to know how to cope with it to the best advantage.

We shall first treat of the personal qualifications of the nurse. In many households a trained nurse cannot be afforded; but the remarks made about the nurse will apply, with obvious modifications, to mothers and others who may undertake the duties of a nurse.

Qualifications of the Nurse.—Nursing is an art, and requires to be learnt like any other art. No amount of affection will compensate for the absence of the requisite knowledge and tact. In fact, affection often forms a drawback in the nursing of the sick by their relatives; as the necessary firmness and attention to rules are difficult to obtain from the latter. The sick will often take food from and allow the necessary applications to be made by a strange nurse, when a parent would be unable to ensure compliance with the doctor's directions. At the same time, nothing can compensate for the absence of kindness on the part of the nurse evidencing itself in every little detail. What is required is a judicious combination of *kindness with firmness*. If the nurse cannot succeed in getting her patient to allow, for instance, hot poultices to be applied, or to take possibly nauseous medicines, she had better resign her post. Relatives could only fail in this manner. In securing this end, much *tact* is often required, as well as firmness.

A *cheerful* nurse is a godsend. She inspirits the patient, and does much to ensure his speedy recovery. At the same time, she should *not be too loquacious*, as too much talking is very fatiguing to a patient who is seriously ill.

The nurse should never be so destitute of tact as to ask a patient 'what he would like.' A small quantity of food should be brought and offered in as dainty a manner as possible, thus tempting the patient to eat. A nurse who is a good tactician will in this way induce patients to take food where others have failed.

Strict *obedience* to the instructions given by the doctor is an essential condition to successful nursing. It is 'hers not to reason why,' but to obey. Many nurses do great harm by criticising details of treatment in the absence of the doctor. This is impertinence on their part, as they have had no medical training; and it is directly harmful to the patient, for if he loses heart and hope in the treatment which is being carried out, so great is the effect of the mind upon the body that the chances of recovery become greatly diminished.

Attention to every little detail is essential for the successful nursing of a serious case of illness. The *symptoms* should be carefully *noted*, so as to make a trustworthy report to the doctor at the time of his visit. The doctor will then give directions for the further conduct of the case. If the doctor has given a grave view of the case, the nurse should not allow her face to betray this, as patients are very apt to take the cue from the nurse. Even more important is continued cheerfulness on the part of the nurse. She should be most careful to avoid describing other cases she has attended, especially when they have had serious complications. A nurse who thus details the sufferings of other patients does her patient immense harm.

The nurse should be attentive to the *requirements of her own health*, in the patient's interest as well as in her own. She must have a sufficient allowance of daily sleep and of outdoor exercise. A nurse who states that she 'has not had her clothes off for many nights' is not to be commended for this, unless under very exceptional circumstances. She cannot be clean and fresh and in a condition fit to attend on a sick person, unless she has slept without her day-apparel. In addition to a due amount of sleep and fresh air, *regular meals* are necessary for successful working. Good substantial meals should be taken, and not mere 'snatches' at irregular intervals. The nurse's meals should not be taken in the sick-room. This is bad for both the nurse and the patient. The nurse should avoid onions, or any other food the odour of which might be objectionable to the patient. She should be strictly *temperate* in her habits, total abstinence from alcoholic drinks being preferable in most cases. Nurses have a great tendency to take tea at every meal. This is inadvisable, and is apt to produce dyspepsia and sleeplessness.

The nurse should be *neatly and quietly dressed.* Print dresses are best, especially for infectious cases. The dress should not be of a material which will rustle, and it should not be long enough to sweep along the floor. She should always wear woollen underclothing. The hands should be kept clean, especial care being taken to cleanse them thoroughly after dressing any wound and after the use of the bed-pan, &c.

In addition to the above general qualifications of a nurse, a skilled nurse has certain additional *technical qualifications.* She is acquainted with the laws of health and their application to the sick-room, and has had practical instruction and experience in the mysteries of bedmaking, the washing, dressing, and feeding of patients, the dressing of wounds, administration of medicines and of enemata, and many other details.

Ventilation and Warming of Sick-room.—When an invalid is confined to one room for the whole of the twenty-four hours, the maintenance of a pure atmosphere is even more important than when rooms can be changed. Never be afraid of open windows in a bedroom. *People do not catch cold in bed,* unless exposed to a direct draught. It is easy to arrange for a direct current of fresh air to pass between the window and fireplace without impinging on the patient's head and neck. With proper bedclothes and a hot bottle to the feet, a patient may, if necessary, be kept warm in bed, and yet have the sick-room thoroughly flushed with fresh air. *It is not sufficient to open the windows for a few minutes once or twice a day.* Keep one window constantly open, using a screen, if necessary, to guard the patient from direct draught.

But while free ventilation of the sick-room is essential in order that the patient may make a good recovery, it is equally important that a proper temperature should be maintained; usually from 60° to 65° Fahr. is the best temperature. *It is most pernicious to secure this temperature by shutting the windows.* Keep the windows slightly open, and at the same time increase the fire; and, if necessary, put hot bottles in the bed. Nurses very commonly confuse between cold and ventilation. If the nurse finds a room close, she will let out the fire, thereby making the room closer, instead of increasing the fire and at the same time opening the window. Or she will open the door instead of the window, thus bringing air of doubtful purity from other rooms. This is done more particularly at night, from some absurd notion that 'night air is injurious.' The night air in towns is commonly purer than the day air; and in any case it is better to have out-of-doors night air than night air from a neighbouring room.

In order to keep the air of the sick-room pure, there ought to be *nothing in the room*, except the patient himself, *that can give off effluvia or moisture.* Even damp towels are preferably kept out of the room. Nothing ought to be aired in the patient's room, and, if possible, nothing cooked there. The effluvia from excreta are very detrimental to health; and yet how often are utensils concealed behind the valance to the bed, it being apparently assumed that the effluvia will not rise up and poison the air of the room. All *chamber utensils* for sick-rooms should be provided *with lids.*

A slop-pail should never be brought into a sick-room. The utensil should preferably be taken direct to the water-closet, emptied there, rinsed there, and brought back clean. In well-arranged closets there is usually a tap for this purpose. Never depend on fumigation by disinfectants to purify the air of a sick-room. Remove the offensive material, and the smell will disappear.

Management of the Fireplace.—An even temperature should be maintained, and for this purpose reliance should not be placed by the nurse upon her sensations, but upon a thermometer hung against the outer wall.

The fire should not be allowed to get too low, or it may smoke when replenished. If it is necessary to make up the fire when the patient is asleep, place separate knobs of coal, previously wrapped in paper, on the fire with the fingers, so as to avoid noise.

Unnecessary noise of every kind should be avoided. Never allow a patient to be waked out of his first sleep, unless distinctly ordered by the doctor to do so, in order to administer food or medicines. Whispered conversations in the sick-room strain the patient's attention in his effort to hear what is going on. Walking on tip-toe is generally irritating to patients. What is required is a light, quick step, and a clear but soft voice, not lowered into a whisper nor unduly loud.

The sick-room should be well-lit, as light undoubtedly aids recovery. Patients naturally turn towards the window. If they can see out of two windows instead of one, so much the better.

The greater part of nursing consists in preserving cleanliness. No ventilation can effectually freshen a sick-room where the most scrupulous cleanliness is not observed. If possible the patient should occupy another room while his own is being thoroughly cleansed. When this is not practicable, the room must be kept as clean as possible.

The patient himself should, if possible, have a warm bath at least once a week. He should have his hands and face washed twice a day; and a good wash of the body at night, in addition, will often help to secure a night's rest.

To wash the patient in bed, place a blanket under him, and cover with another blanket. Then, having removed the body-linen, place the patient on one side, and proceed to wash the upper side under the blanket, without exposure. The patient is turned on his other side, to wash the opposite half of the body.

The best bed for sick persons is, in most cases, a well-stuffed hair mattress, about six inches thick. The under-sheet should receive great attention, in order to keep it smooth and free from crumbs or other irritating particles. Each day the patient's bed should be stripped off, and thoroughly aired in front of a fire, if possible in another room, the patient meantime being covered with a couple of spare blankets. In *changing sheets* for helpless patients avoid chill and unnecessary exposure, and take care to disturb the patient as little as possible.

The body-linen of patients confined to bed should be changed at least once a week, and if possible twice a week. The nurse should take care not to begin changing until everything is ready, to see that no draught falls directly on the patient, that the fresh linen is properly aired and warmed beforehand, and to avoid allowing the patient to help himself too much.

The **administration of medicines** is an important part of a nurse's duty. These should be given at exact intervals as ordered, and the exact quantity prescribed must be measured and administered. The teaspoons, dessert-spoons, and table-spoons in common use do not represent with certainty and uniformity the quantity which is ordered under these names. Medicines ought, therefore, to be always measured in a proper medicine-glass (fig. 58), which can be obtained at a small cost.

It is important that the nurse should be able to take the patient's **temperature** accurately. This is usually taken with a small *clinical thermometer* under the armpit or in the mouth. When taken in the mouth, the mercurial end

FIG. 58.—*Medicine-glasses.*

of the thermometer is placed under the tongue, and the lips held tightly together for about four minutes. This is too fatiguing for patients seriously ill, and the best plan is to place the mercurial end of the thermometer in the hollow of the armpit, draw the arm tightly into contact with the chest, taking care that the clothes are well out of the way, and leave the thermometer in this position for five minutes. After the thermometer has been read, the column of mercury should be shaken down a little below the arrow indicating the normal temperature, 98·6°, so as to be ready for the next time.

The nurse should keep a *careful record* of each temperature observation, and in serious cases it is advisable for her to record details as to the action of the bowels, the quantity of food taken, &c., so that the doctor, on his visit, may have accurate information of what has happened during his absence.

CHAPTER XLVIII.

FOOD AND REMEDIES FOR THE SICK.

General Rules.—Common Errors as to Food.—Preparation of Beef-tea, Milk, &c.—Invalids' Drinks.—Poultices and Fomentations.

General Rules.—The proper feeding of sick persons is so important as to demand a separate chapter. It must be remembered that, in serious illness, the amount and kind of food will be determined by the doctor, and any nurse who gives other food than that ordered may be responsible for serious, and sometimes even fatal, results. This is particularly the case in typhoid fever, in which disease ulcers of the intestines occur. Towards the end of the illness the patient becomes hungry and tired of his monotonous diet of milk and beef-tea. He begs for solid food, and if the relative or nurse weakly consents, a serious relapse is likely to occur, accompanied by danger of perforation through the bowels.

Apart from the general principle that the food must be such, and such only, as is allowed by the medical adviser, the feeding of the patient is the special province of the nurse.

Tact and perseverance are necessary in serious cases to ensure that the patient takes the requisite *amount* of nourishment. And in this particular the professional nurse generally succeeds better than the relative of the sick person, for she is generally able to exert more authority than the anxious relative.

Where the patient's stomach rejects a teacupful of some article of food which has been ordered every three hours, a nurse who possesses the necessary tact will give a table-spoonful every half-hour, and probably this amount will be retained.

Untasted food should never be left by the patient's side from meal to meal. There is no surer way of making a patient disgusted with all food than to have something always standing by him. The food should be brought as a surprise, and, if possible, should not be seen or smelt beforehand.

Punctuality in giving food should also be observed. A patient's appetite is capricious, and if kept waiting too long he may be unable to take the food which is finally brought.

Everything that is used for feeding should be perfectly *clean.*

Common Errors as to Food.—Perhaps the most prevalent is that *beef-tea* is the most nutritive of all foods. This is very far from being the case. If half a pint of ordinary beef-tea be evaporated down, there is barely a teaspoonful of solid matter left. The table on p. 297 has shown that raw beef juice contains three times as much nourishment as beef-tea made in the ordinary way. *Beef-tea* is a valuable stimulant and restorative, but its *food-value is grossly exaggerated* in the popular mind. The person who had to feed on it alone would fare very badly indeed!

Jelly is a standard article in great favour for the sick. It is useful to some extent, but exaggerated notions are entertained as to its importance in feeding an invalid. A quarter of an ounce of isinglass or gelatine bought at a shop would furnish as much gelatine as an invalid could conveniently take in a day, and yet the amount of nutritive material in it is extremely small. A tablespoonful of sugar dissolved in water, or, still better, the same amount of cream, would be of much greater food-value.

Eggs, again, are a great resort in sickness. Three or four are often given to an invalid in a single day, it being forgotten that eggs form a somewhat concentrated food, and that the same number of eggs taken by the same person when in good health might not improbably bring on a 'bilious attack.'

Arrowroot is a stock article of food for the sick. It is certainly a palatable and non-irritating food, especially in diarrhœa. Let it not be taken, however, under the impression that it is superlatively nutritious. It is simply starch; the same weight of flour would be much more nutritious as a food.

Milk is rightly the sheet-anchor in most cases of dangerous illness. Milk, however, is a somewhat concentrated food, and is difficult for infants to digest. Invalids must be treated like infants in this respect. Let their milk be somewhat diluted. It is well to remember that—(1) milk that has been boiled is more easily digested than uncooked milk ; (2) hot milk is more easily digested than cold milk ; (3) milk is more easily digested if a biscuit or some other solid food is taken with it; (4) if solid food is not allowed, the milk is more easily digested if some baked flour is thoroughly mixed with it. It is evident that these last two devices prevent the casein from clotting in large heavy lumps in the stomach.

Milk for the sick should be of the freshest. In summer-time, if it must be stored, it should be surrounded with ice until required.

How to Prepare Invalids' Foods.—*Beef-tea* is an important article in sick dietary if it is properly prepared. When prepared in the usual manner, by stewing meat at the boiling-point of water, it possesses only slight nutritive properties, though an exaggerated notion of its value is widely prevalent. Beef-tea thus prepared will commonly set to a jelly when it becomes cool, and this fact is pointed out by the nurse or anxious mother as demonstration of the high nutritive value of the preparation. This 'setting' is due to gelatine which the process of boiling has abstracted from the meat. Gelatine is a useful food, but the more valuable albuminous or proteid portions of the meat have been coagulated by the process of boiling or stewing, and left behind in the shreddy meat, the beef-tea containing chiefly gelatine and the salts of meat, which have a comparatively small nutritive value. The same remarks apply to *Liebig's Extract of Meat.* This contains the salts and extractives of meat with a little gelatine. It is an admirable restorative stimulant, but the food-value of a teacupful of beef-tea prepared from it is probably no greater than that of the two lumps of sugar in a cup of tea.

To Make Whole-beef Tea.—By the following plan beef-tea may be prepared which will contain most of the nutriment of the meat :—

Take ¾ lb. of lean gravy beef, remove all skin and gristle, cut into pieces an inch square, place in a basin with a gill of cold water, add a little salt, and leave for an hour, so as to allow the water to draw out all the juices of the meat. Next take the pieces of meat out of this water, put them into a jar with a pint of cold water, and put the jar into a pan of boiling water for two hours. After removing the jar, pour the gill of cold juice into the hot beef-tea; remove the pieces of meat and pound well in a wooden bowl with the end of a rolling-pin, adding any liquor which exudes to the beef-tea. The tea may be flavoured with salt, and a stalk of celery and a few cloves may be added, if preferred.

The beef-tea thus prepared is much more nutritious than that prepared by slow heating of the whole mass in the oven or in a saucepan of boiling water on the fire. If heat is used in the preparation of beef-tea, the temperature must not be allowed to rise above 150° Fahr., in order to avoid solidifying the nitrogenous constituents of the beef.

Raw-meat Juice is an even more valuable preparation of meat, especially for infants (p. 297).

Veal-broth is another nutritious invalids' food, and forms a pleasant change from beef-tea.

In this case the object is rather to obtain the gelatine out of the meat and bones, which exists in veal in large proportions. The knuckle of a leg or shoulder is soaked in water and then boiled in water for several hours, salt and flavouring being added to taste. **Chicken-broth** may be similarly prepared, and forms also an agreeable change from beef-tea.

Eggs are of great value for invalids when they can be taken without disagreeing. The most digestible form is beaten up with a little hot milk and water, sugar being added if preferred. They may be added to a light broth or clear soup, care being taken that the liquid is not too hot when the egg is mixed with it. In cases where the white of egg cannot be tolerated, the yolk of egg may be beaten up with hot milk and water, or with a little hot weak tea, sweetened with sugar.

The yolk of egg is sometimes a useful addition to infants' food, especially when cream cannot be obtained, to add to each bottle of food. It supplies the fatty matter which is deficient in most artificial infants' foods.

Milk forms an important part of the dietary of nearly all invalids. The different ways in which it may be taken have been already described (page 93; see also page 309). Even when most other foods are rejected by the stomach, equal parts of milk and soda water are generally retained with ease. *Milk-diet* is commonly ordered for invalids. Thus, at St. Thomas's Hospital the milk-diet for an adult consists of $1\frac{1}{2}$ pints milk, 12 ozs. bread, $\frac{3}{4}$ oz. butter, $\frac{1}{2}$ lb. rice or bread pudding, and $1\frac{1}{2}$ pints tea, with milk and sugar. The *Fever diet* consists of 2 to 3 pints of milk and 1 pint of beef-tea.

In cases of wasting diseases, especially tubercular consumption, the addition of fat to milk makes it a very valuable food.

To Prepare Milk and Suet.—Chop finely 1 oz. of suet, boil it with a quarter of a pint of water for ten minutes, and press through linen. Next add 1 oz. of sugar and three-quarters of a pint of milk. A little bruised cinnamon may also be added if desired. Boil again for ten minutes and strain. A wineglassful or two at a time.

To Prepare Rice-milk.—Soak 1 oz. of rice for twelve hours, having first washed it quite clean. Add the soaked rice to a pint of boiling milk, with half a teaspoonful of salt and of sugar. Stir well and cook slowly for an hour. Rub through a hair sieve. Sago or tapioca may be substituted for rice.

To Prepare Whey.—Boil a pint of milk with a teaspoonful or two of lemon-juice, then strain through muslin and press all the fluid from the curd. If the curd is well broken up and the fluid thoroughly pressed out of it, much of the cream will pass into the whey, thus increasing its nutritive properties.

Whey may also be prepared by mixing a large teaspoonful of cream of tartar with a little hot water and then adding it to a pint of boiling milk. It is strained after being allowed to stand till cool. It may also be prepared by the use of rennet.

Whey is a slightly nutritious liquid, containing the salts and sugar of milk and a little albumen and fat. It is valuable for infants who reject whole milk. Its nutritive qualities may be improved by adding a little cream.

Peptonised Milk is sometimes ordered for invalids or infants when the digestive powers are very weak and a food capable of easy absorption is required.

To Peptonise Milk.—Into a clean quart bottle pour a pint of milk, add a quarter of a pint of water, and a tube of Fairchild's peptonising powder (consisting of pancreatic extract and bicarbonate of soda); shake them together. Put the bottle into water as hot as the hand can bear (about 150° Fahr.) and let it stand for half an hour; then boil for two or three minutes. It is now ready for use. The boiling permanently arrests the ferment, the continued action of which would render the milk bitter. Milk thus prepared is practically predigested, and can be retained and assimilated by patients who would not be able to digest ordinary cow's milk with its heavy clots of casein.

Invalids' Drinks.—Thirst is one of the most common symptoms in illness. The following drinks will be found generally useful :—

Toast-water.—Take a slice of stale bread, toast it quite brown on both sides, put it in a jug, and pour over it boiling water; let it stand to cool.

Barley-water.—Take 2 ozs. of pearl barley, and, having twice washed it in cold water, boil for twenty minutes in $1\frac{1}{2}$ pints of water; strain, and flavour with lemon-peel, sugar, &c., to taste.

Rice-water.—Wash 1 oz. of rice in a strainer with cold water; then put the washed rice, with an inch of cinnamon stick, into a stewpan with a pint of water; boil for an hour; then strain and sweeten to taste.

Lemonade.—Pare a lemon very thin, and remove as much as possible of the white pulpy material underneath; then cut it into thin slices and put them, with the thin rind, into a jug with some white sugar; add a pint of boiling water; let it stand till cold, then strain.

Linseed-tea.—Put $\frac{1}{2}$ oz. of unbruised linseed and a drachm of liquorice into a covered jar, adding a pint of boiling water; let the infusion stand on the hob or near the fire for three or four hours; strain, and flavour to taste.

External Remedies may be mentioned here, though they do not come under the head of dietary. The most important of them are poultices, fomentations, and the wet pack.

A *bread poultice* is best made by first grating a sufficient quantity of stale bread-crumbs, and then adding them to a little boiling water in a basin, carefully stirring all the time, until the proper consistence is obtained. The resulting mass is poured on muslin, without being pressed in any way.

A *linseed-meal poultice* is prepared by pouring some boiling water into a previously warmed basin, and then adding gradually a sufficient quantity of linseed meal to form a thick paste, stirring thoroughly all the time. The mass is then spread, by means of a knife which has been dipped into hot water (to prevent the linseed sticking), on muslin or tow. It is advisable next to pour a few drops of olive oil on to the poultice to avoid its sticking to the skin.

A *mustard poultice* is made of varying strength according to the directions given. Boiling water should not be used for this poultice, as it diminishes the activity of the mustard. A paste is prepared either of the pure mustard or of mustard and linseed meal. This is spread as a thin layer on brown paper, and covered with muslin on the side to be applied to the skin.

Fomentations are generally used to allay pain.

Simple fomentations are most easily prepared by enclosing the flannels to be applied within a double layer of towelling, allowing a sufficient excess of length to permit of wringing. Boiling water is poured over the flannels, and the greater part of the excess of water can be squeezed out without scalding the nurse's hands. The flannel when applied should be covered with a piece of macintosh or oiled silk to keep in the heat. A *turpentine fomentation* is prepared by sprinkling about a tablespoonful of turpentine on the flannel prepared as above.

Wet packing is a most valuable remedy, especially for children who appear to be very feverish, and it may be safely employed by the mother before a doctor is fetched.

Place two large blankets on the bed under the patient, dip a sheet in tepid water, wring it, fold three or four times and apply along the back; then turn the patient over, and apply a sheet similarly over the front of the body; finally turn over the blankets, previously left overlapping, and wrap the patient in them. The patient should remain in the pack about thirty minutes, or until free perspiration is induced. The skin is then dried with hot towels and the patient placed on a dry blanket in bed.

CHAPTER XLIX.

COMMON AILMENTS AND ACCIDENTS.

Treatment of Common Ailments.—Cuts.—Hæmorrhage.—Accidents from Fires.—Fits.—Unconsciousness.—Suffocation.—Drowning.—Poisoning.—Stings and Bites.

There are many minor ailments for which a doctor's aid is not usually requested, and it is desirable, therefore, that a few general rules should be given for such cases. Speaking generally, *drug-treatment should be carefully eschewed by amateurs.* Most of the common complaints which are treated without a doctor may be successfully treated without the use of drugs.

For a Severe Cold, keep in one room at an equable temperature. Put the feet in hot mustard and water, take some hot gruel, and lie between the blankets in bed. If perspiration does not occur, foster it by copious drinks of hot water.

If **Cough** accompanies the cold it is even more important to stop in one room at the early stages. Drink linseed-tea freely, take warm drinks, and suck gum arabic to allay the tickling cough. By these means a cure may generally be effected in a few days.

Constipation may be cured by increasing the amount of vegetable food, especially whole-meal bread, by taking a dessert-spoonful of olive oil night and morning, and by the encouragement of a regular habit. Drugs are but seldom really necessary. (See also page 30.)

Headache is a frequent complaint, especially among those who lead a sedentary life. It may require medical treatment, but may frequently be cured without. Let the events of the two or three days preceding the headache be critically examined, with a view to ascertaining the particular in which the laws of health have been disregarded. Most commonly it will be found that indigestion or constipation is the cause of the headache, in which case careful attention to diet (sometimes abstinence) will effect a cure. Or the cause may be living in a vitiated air, or a too sedentary occupation, or overstrain of mental work—the appropriate remedy in each case being obvious.

Convulsions are a very serious, and sometimes fatal, symptom in children. The child should be at once placed in a hot bath, some mustard being added to the bath, and a doctor sent for. Keep the child in the bath for a few minutes, and then roll in a hot blanket. A dose of castor oil may remove the irritating food to which convulsions are often due.

Croup is a name given to an affection of the larynx, accompanied by difficult breathing, and caused by diphtheria or simple inflammation from a cold. In either case, have a doctor at once, and in the meantime apply hot linseed poultices to the throat, and get ready a steam-kettle in the room.

Sleeplessness is frequently caused by excessive mental work or worry, by over-fatigue, or indigestion. To avoid it, retire at regular hours, take exercise late, but avoid a late supper. Drink some warm soup or gruel and put the feet in hot water before getting into bed.

Cuts or Wounds are of varying severity and danger, according to the parts affected and to the size of the blood-vessels injured. In all such cases it is important (1) to remove all coverings from the wound, so as to ascertain its exact condition, and then wash carefully so as to remove dirt and other foreign matters. (2) Bleeding must be stopped, if possible. This may be effected by carefully bringing the edges of the wound together, and fixing them by narrow strips of sticking-plaster applied transversely to the direction of the cut. If this is not successful, then other means, shortly to be described, must be adopted.

After strapping the edges of the wound together, a strip of linen soaked in clean water, or, better still, in a solution of carbolic acid (about 1 to 80 of water) is applied over it, and the part bandaged up.

Bleeding is due to the rupture of a blood-vessel, and may be caused by a wound or by some internal disease. It may occur externally or into the interior of some organ, as the lungs or stomach, whence the blood may be coughed or vomited up.

Just as there are three kinds of blood-vessels, there may be three kinds of bleeding—(1) capillary, (2) arterial, and (3) venous hæmorrhage.

Capillary hæmorrhage is never serious in amount, only producing a general oozing, which is easily stopped by a pad of lint over the bleeding part.

Arterial hæmorrhage (*a*) occurs in intermittent jets, and (*b*) the blood lost is of a bright scarlet colour. It is much more dangerous than any other form of bleeding. In the interval before a medical man arrives, one must be prepared to adopt the necessary measures, or life may be endangered.

After exposing and washing the wound, the next thing is to attempt to stop the bleeding by means of *pressure.* This may be applied (*a*) *over the wound itself* by pressing with the two thumbs over the point in the wound from which blood is seen to be issuing in spurts, or by making a pad of linen into a firm roll, and then tying it tightly over the bleeding-point by means of a bandage round the limb or other part involved. (*b*) The flow of blood in the arteries being from the trunk-arteries to their branches, pressure may be applied to the main artery higher up the limb *on the side of the bleeding-point nearest the heart.* Bleeding from a lower part of the same artery, or from a branch, may be thus controlled by compressing an artery at a higher point. Thus, if there is severe bleeding from a cut in the palm of the hand, this may be controlled by pressing the artery on the inside of the arm midway between the elbow and shoulder against the bone. Compression of the trunk-artery higher up than the wounded point may be effected by pressing one thumb over another at a point where the beating of the artery can be felt near some bone. Or a tourniquet may be fastened round the limb. An imitation of a tourniquet may be improvised by wrapping a large cork or a piece of wood in a handkerchief, and then placing it over the artery above the bleeding-point, tying it firmly in its place by means of a bandage round the limb.

If the foot or hand is wounded, flexing the knee or elbow as far as possible diminishes the arterial flow of blood by pressure at the bend of the joint, and so diminishes the hæmorrhage. If the bleeding part is elevated, the flow of blood through it is similarly diminished.

Venous hæmorrhage is (*a*) in a continuous stream, and (*b*) of a dark purple hue. *The circulation in veins is towards the heart* : hence pressure on the trunk-vein higher up the limb than the wounded point would tend to increase bleeding by retarding the flow of blood from the wound. The most serious form of venous hæmorrhage is that occurring from varicose (dilated) veins of the legs, and this is sometimes fatal. It may, however, be easily stopped. The limb must be well elevated, so as to diminish the flow of blood ; then a pad of lint must be tightly bound *over the wound* by means of a bandage, and perfect rest must be enjoined.

Bleeding from the nose is often difficult to stop. Syringing out the nose with a strong solution of alum in iced water is often useful ; or, failing this, tannin in powder may be blown into the nostrils through a quill. Occasionally troublesome hæmorrhage occurs an hour or two after the extraction of a *tooth.* This may be stopped by clearing out the clot and carefully pushing a small plug of cotton wool down into the socket of the gum, and then, by means of an additional plug, keeping up pressure from the opposite jaw. Hæmorrhage from the *lungs or stomach* is very dangerous. The patient should be kept absolutely quiet, and should have ice to suck. A teaspoonful of vinegar may be given in a little water every five minutes if the bleeding is severe ; but medical advice should be obtained as quickly as possible. In cases of bleeding, the patient sometimes becomes very pallid, and may faint. It is not, however, advisable to give stimulants, as they tend to make the hæmorrhage recur.

Burns and Scalds vary in severity according to their depth and the extent of surface of the body involved. It should be remembered that dangerous collapse may occur after such accidents, hence it is important to obtain early medical help. In the local treatment (1) cut off the burnt clothes at once as gently as possible, so as to avoid pulling off the skin with them. (2) Apply to the injured parts strips of linen soaked in a saturated solution of bicarbonate of soda in water, or in a mixture of olive oil and lime-water (carron oil), covering the whole with a sheet of cotton wool.

In **Accidents from Fire,** presence of mind and prompt action are very necessary. Where a woman's or child's clothes have caught fire, the first thing to do is to wrap the sufferer in a woollen shawl or blanket or rug, and place her on the ground, leaving only the head out of the covering. Thus air is prevented from reaching the flame, and it is at once extinguished. Next, the clothes must be carefully removed, so as to avoid further injury to the patient.

In **Accidents** from being run over, or falls from a height or other causes, it is necessary to adopt certain measures until the aid of a doctor can be obtained. If there is serious bleeding it should be treated as already described. If bones are *fractured*, as indicated by inability to use the affected limb, and shortening and alteration of its shape, the limb should be secured in splints before moving the patient. Splints may be improvised by taking long pieces of flat wood, or two umbrellas, and tying them on opposite sides of the limb, so as firmly to fix the injured part. A stretcher on which to carry the patient may be improvised from a window-shutter, and the patient ought not to be moved unless the injured parts can be kept completely at rest.

Dislocations are sometimes mistaken for fractures. Any attempt to replace the dislocated bone by an unskilled person may be dangerous. *Sprains*, if not carefully treated by keeping the joint fixed for some time, may be very troublesome.

Fits may be either (1) epileptic fits, or (2) hysterical fits, or (3) fainting fits. Young children are very liable to convulsions, resembling epileptic attacks, which occur about the time of teething, and are most commonly due to improper feeding.

The immediate treatment of **Epileptic Fits** resolves itself into preventing the patient from doing himself harm during unconsciousness by falling into the fire, or knocking against furniture, or by biting his tongue. All tight clothing should be undone, especially about the neck. A piece of cork, or, failing this, the handle of a spoon, covered with part of a handkerchief, should be held between the teeth to prevent injury to the tongue. Persons subject to fits should be carefully watched, lest they fall into the fire or into water during the attacks.

Epileptic fits are occasionally *feigned* by beggars. Such impostors generally overact the convulsions, and if the eye-ball is touched with the finger, flinching occurs, while in a true epileptic attack the eye-balls are quite insensitive.

Hysterical Fits generally occur in emotional women. The patient is sure not to fall so as to hurt herself; she sobs considerably, and, as a rule, is not quite unconscious. Little treatment is required during the attack, but the application of cold water to the face, or, better still, a good shock from a galvanic battery, will usually cause a rapid recovery.

Fainting Fits differ from the last two in the absence of convulsive movements and in the extreme pallor of the face. The patient should be laid on his back, with his head low; tight clothing should be removed from the neck; and persons should not be allowed to crowd round, thus obstructing the free current of air. Half a teaspoonful of sal-volatile may be given in water as soon as the patient is sufficiently conscious to swallow it.

Unconsciousness may be due to various causes in addition to the three just named. Persons are sometimes found insensible in the street and taken to the police-station on the supposition that they are dead-drunk. The fact that a person's breath smells of alcoholic drink by no means proves that the unconsciousness is not due to a much more serious condition than drunkenness.

The chief causes of unconsciousness are (1) drunkenness; (2) apoplexy; (3) epilepsy; (4) fainting; (5) injuries to the brain, as concussion, fracture of skull, &c.; (6) blood-poisoning from kidney-disease ; (7) poisoning by opium or other narcotic drugs. It is often very difficult, even for a medical man, to distinguish between the different forms of unconsciousness. Practically, for the present purpose, it suffices to remember that a person apparently dead drunk may in reality be dying.

Suffocation, whatever its cause, means a serious interference with respiration, and the indications for treatment are (1) to remove the impediments to breathing, and (2) to carry on artificial respiration until the natural process is fully established.

When a person is found **hanging**, the first thing is to cut him down and thus stop the process of suffocation. Many a life has been lost by the finder of the suicide first running for help. Next remove the cord from the neck and persevere with artificial respiration, as described under 'Apparent Drowning.'

Suffocation is occasionally produced by some **foreign body** in the throat, as a marble or cherry-stone, which has been held in the mouth and then suddenly sucked down into the larynx. This is always a serious accident, and may necessitate the operation of tracheotomy (opening the wind-pipe below the point of obstruction). The only safe remedy until a doctor arrives is to put the finger to the back of the throat, in the hope that the foreign body may be reached ; or, failing this, to try to excite vomiting.

Poisonous Gases sometimes cause suffocation, as in the case of carbonic acid at the bottom of brewing-vats or near lime-kilns, or the escape of coal-gas into bedrooms. The patients should be at once removed into the open air, artificial respiration should be steadily performed, and, at the same time, the patient should be wrapped in a blanket and hot bottles applied to his extremities.

Apparent Drowning is the most important instance of suffocation, and it is advisable that all should be familiar with those measures which must be applied promptly in order to be successful. No time should be wasted in running for help, and hanging up by the heels and all other rough methods are to be strongly condemned. The following line of treatment should be adopted :—(1) Cleanse the mouth and nostrils rapidly from any foreign matters ; draw forward the tongue (so as to keep open the entrance to the lungs), and, if possible, let someone hold it forward. (2) Place the patient on his back, with a firm cushion or folded coat under his head and shoulders to give steady support.

(3) Perform artificial respiration. Several methods of doing this are in use, all depending for their efficacy on an imitation of the natural movements of inspiration and expiration. The one usually practised is *Silvester's method.* This will be understood from the two following diagrams. (*a*) The patient's arms are grasped just behind the elbows (fig. 59), and are drawn steadily over above

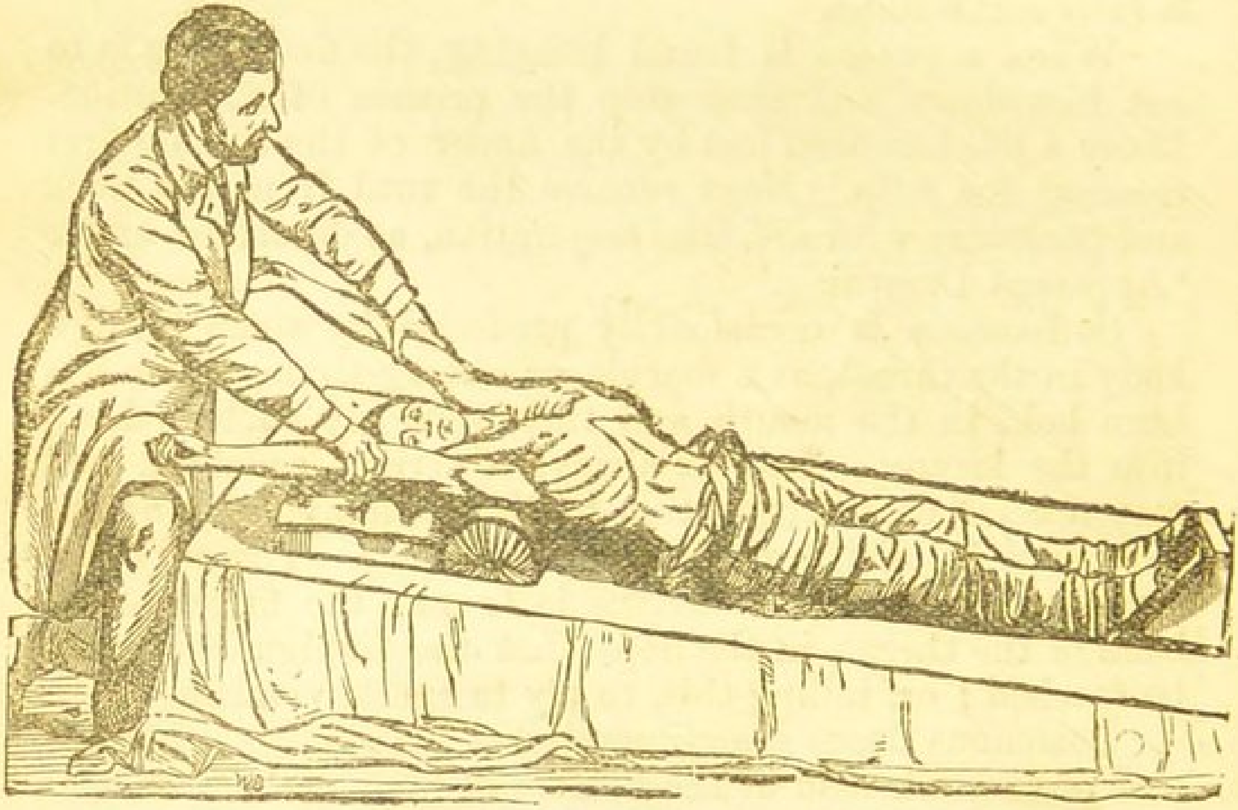


FIG. 59.—*The Inspiratory Movement in Artificial Respiration.*

the head. (*b*) In two or three seconds they are again lowered (fig. 60) and pressed steadily and firmly against the sides of the chest. The first movement pulls on the muscles of inspiration, and thus expands the chest and causes suction of air into the lungs. The second movement, by pressing on the chest, imitates the natural movements of expiration. These alternate movements are repeated at regular intervals about fifteen times every minute, taking care not to perform them hurriedly. They should be persevered in until natural attempts at breathing occur, or for at least half an hour even when there is no apparent return to life.

(4) While artificial respiration is going on, helpers may be engaged in rubbing the legs to assist the circulation, and in tickling the throat with a feather, or applying smelling-salts to the nostrils in the hope of exciting respiration. But none of these things should be allowed to interfere with the all-important artificial respiration. When the patient begins to breathe, a warm bath is useful, and, as soon as the patient can swallow, a cup of strong coffee may be given.

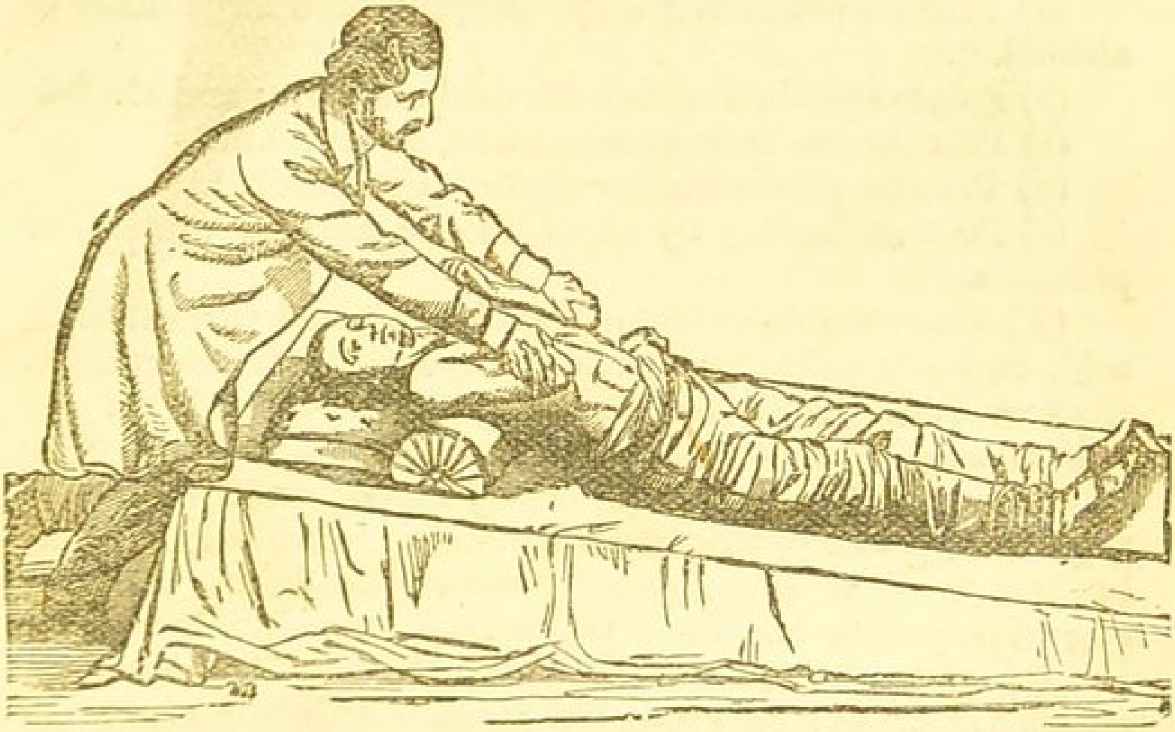


FIG. 60.—*The Expiratory Movement in Artificial Respiration.*

Poisoning may be suspected, though its occurrence is not proved, (*a*) when there is a *sudden onset of serious symptoms* in a person previously healthy. It must be remembered, however, that certain diseases also have a sudden onset.

(*b*) The symptoms are commonly noticed *after taking a certain medicine or food.* On this point it must be remembered that tinned meats and sausages sometimes cause symptoms very like those of an irritant poison.

(*c*) *If more than one has partaken* of the suspected food they will suffer from similar symptoms, and this may help in identifying the cause.

Poisons are classified as (1) *corrosive*, like the strong mineral acids, oxalic acid, corrosive sublimate, and chloride of zinc (in Burnett's disinfecting fluid). These destroy the mucous membrane of the gullet and stomach, and generally produce rapid collapse and death. (2) *Irritant poisons*, like arsenic, copper, and other metallic salts, produce a less extreme degree of damage than corrosive poisons. They cause vomiting, abdominal pain, diarrhœa, and, later on, inflammation.

(3) Poisons acting on the general system, or some other part than the alimentary canal. Thus we have—

(*a*) Poisons producing *sleep*, as opium and large doses of alcohol.

(*b*) Poisons producing *delirium*, as belladonna and alcohol

(*c*) Poisons producing *convulsions*, as strychnia.

(*d*) Poisons producing *paralysis*, as hemlock.

(*e*) Poisons killing by *shock* to the nervous system, as prussic acid.

(*f*) Poisons producing *suffocation*, as coal-gas, carbonic acid, carbonic oxide, sulphuretted hydrogen, sewer-gas, &c.

The Indications for Treatment are to (1) *get the poison out of the system as quickly as possible.* This is done in the event of acute poisoning by emetics and the use of the stomach-pump, the latter of course being only possible by the medical attendant. Emetics do harm where a corrosive poison has been taken, the straining increasing the injury to the walls of the stomach. In all other cases an emetic should be promptly given. Sulphate of zinc in doses of thirty grains is the best emetic ; but a domestic emetic may be quickly prepared by mixing a dessert-spoonful of mustard with a teacupful of warm water, or by giving copious drinks of salt water. These may be helped by tickling the back of the throat.

(2) *Neutralise the effect of any remaining poison* by giving antidotes. There are three kinds of antidotes, of which only the first two can be used by the unskilled. (*a*) *Mechanical antidotes*, such as flour and water, milk, magnesia, and such like substances, tend to prevent the irritating action of the poison, and so give time for the application of other remedies. (*b*) *Chemical antidotes*, which neutralise the poison and produce a compound insoluble in water, and, if possible, insoluble in the digestive

juices. For acids, chalk and magnesia are the best antidotes. Thus, for oxalic-acid poisoning, chalk and magnesia are the best antidotes, as insoluble oxalates of lime or magnesia are produced. For corrosive-sublimate (perchloride-of-mercury) poisoning, the white of egg (albumen) is the best antidote, an insoluble albuminate of mercury being formed.

(c) *Physiological antidotes* are given by doctors in the shape of drugs which have opposite effects on the system to the poison already taken. Thus, belladonna is a partial antidote to opium.

(3) The final indication for treatment is to *combat the individual symptoms that may arise.* Stimulants are required if the patient is collapsed ; strong coffee counteracts to some extent the drowsiness produced by morphia, the active principle of opium. Opium may be required where there is great pain, under the direction of a medical man.

The following tabular statement gives the treatment for the chief poisons. We have not described the symptoms produced by each poison, as no practical good would be done by this. The treatment of poisoning in non-medical hands must necessarily be confined to those cases in which the nature of the poison is rendered evident by the confession of the would-be suicide, or by the presence of the bottle or packet from which the poison was taken, or, in accidental cases, by the discovery of the nature of the accident. In connection with this point, we may emphasise the importance of having poisons intended for domestic use distinctly labelled and kept in a blue-ribbed bottle, which cannot be mistaken for a medicine-bottle. They should, preferably, be kept under lock and key.

Poison.	Treatment.
Sulphuric, Muriatic (Hydrochloric), and Nitric Acids.	Do not give emetic. Give chalk or magnesia freely, mixed with water. If these are not available, whiting or plaster off the walls or soapsuds may be given.
Oxalic Acid.	Same treatment as last.
Caustic Potash, Soda, or Lime.	No emetic. Give weak vinegar and water or lemon-juice freely ; afterwards olive oil and milk.

Poison.	Treatment.
Corrosive Sublimate.	The vomiting which occurs may be encouraged by warm water. Then give white of egg beaten up in plenty of milk.
Antimony (especially Tartar Emetic).	The vomiting which occurs may be encouraged. Then give anything containing tannin, as strong boiled tea or nutgalls, followed by draughts of milk.
Arsenic.	Induce vomiting at once. Then hydrated peroxide of iron (iron rust) is the best antidote; or, failing this, white of egg beaten up in milk.
Salts of Copper.	Vomiting occurs. Give eggs beaten up in milk, followed by a dose of castor oil.
Salts of Lead.	Give an emetic, and follow this with a dose of Epsom salts.
Phosphorus (Matches, Rat-Poison, &c.)	Give an emetic, then large doses of magnesia or chalk in water. Turpentine is also valuable. Oils and fats should be avoided.
Prussic Acid.	No time for emetics or possible antidotes. Dash cold water over head and face; rub the extremities. Try artificial respiration if breathing stops. Hold strong smelling-salts to nostrils.
Carbolic Acid.	Give emetics at once, then uncooked eggs, followed by olive oil and magnesia. Stimulants are necessary to avert collapse.
Chloral Hydrate.	If detected early, give emetic. Later, give stimulants freely, and perform artificial respiration if breathing fails.
Opium or Morphia.	Give emetic at once. Then give a cold douche to head and neck, to rouse the patient. Keep

POISON.	TREATMENT.
	him walking about, to prevent sleep, and give strong coffee. If he cannot be roused, use galvanic battery, and, if breathing fails, perform artificial respiration.
Strychnia.	Give emetic at once, followed by a large dose of animal charcoal. In the absence of a doctor, it would be justifiable to inject into the bowels a little brandy and milk containing a small teaspoonful of laudanum or of syrup of chloral hydrate.
Poisonous Gases (Chloroform, Coal-gas, &c.)	Carry the patient into the open air, and perform artificial respiration for at least half an hour, if natural breathing is not resumed.

The **Stings of Insects**, as of bees, wasps, and mosquitoes, seldom produce any serious trouble, though occasionally serious symptoms have been produced. In the case of wasps or bees, the sting should be first extracted. This may be effected by pressing the hollow part of a watch-key over the affected part. A weak alkaline lotion of soda or ammonia will then allay the irritation. The irritation from **Nettle-stings**, which is due to formic acid, may be similarly relieved by an alkaline lotion.

Snake-bites are but little known in England. The only venomous snake is the adder, and its bite is only dangerous for weakly persons. The treatment is to carefully wash the wound, encourage it to bleed, and inject Condy's fluid into it.

Bites of Dogs are only serious if one has reason to believe that the dog is suffering from rabies, and that its bite may therefore produce hydrophobia, the corresponding disease in man. Such a danger only arises when the skin is cracked ; but where a crack or sore exists, hydrophobia has been caused by a dog, suffering from the earlier stage of rabies, licking its master's hand or face. On the other hand, only a very small proportion of the bites of rabid animals produce hydrophobia, owing to the fact that the legs are usually bitten and the poisonous saliva gets wiped off the teeth before the latter penetrate the skin.

It is wise to treat every bite as though it came from a rabid animal. A ligature should be tied round the limb at a higher point to obstruct the venous circulation; then bleeding should be encouraged by friction and bathing the wound with warm water. Subsequently strong carbolic acid should be inserted in the wound. This is better than lunar caustic (nitrate of silver), which only forms a superficial film over the wound.

CHAPTER L.

INFECTIOUS DISEASES.

Means of Infection.—Symptoms of Onset of Infectious Diseases.—Duration of Infection.—Popular Errors as to Infectious Diseases.

The most prevalent infectious diseases in this country are Measles, Whooping-cough, Scarlet Fever, Diphtheria, Chicken-pox, Mumps, Small-pox, and Typhoid or Enteric Fever.

These diseases possess the common feature that they *can be conveyed from one individual to another by a process of infection.* For this reason they are called **infectious diseases.** Sometimes they are also called **contagious diseases,** *contagion* implying the conveyance of disease by means of actual contact, and *infection* the conveyance of disease through the air, or by other indirect means. As there is considerable confusion on this point, it is better to use only the term *infectious* disease, implying thereby a disease which is conveyed either by direct contact or otherwise.

The **means of infection** vary in different diseases. (*a*) Some, as, for instance, hydrophobia, can only be propagated by *inoculation—i.e.*, the introduction of the poison through the broken skin; (*b*) most of them may be carried for at least a short distance through the *atmosphere,* as Measles, Small-pox, Scarlet Fever. Thus a healthy person might possibly acquire these diseases by standing some feet away from the patient in a sick-room, without coming into actual contact with him. Much more common methods of infection are (*c*) by handling *clothes*, books, &c., which have belonged to the patient; or (*d*) by the *drinking of water or milk* which has been fouled by discharges from infectious patients. Typhoid Fever, Cholera, and Diarrhœa are most often produced by the last method. Woollen articles harbour and convey infection more readily than calico. The infection may hang about the clothes of a patient for months, or even years, if they are kept in a drawer or box, unless they have been thoroughly disinfected.

Each infectious disease is due to a specific poison or virus, which is a living micro-organism, multiplying rapidly in the system, and given off from the skin, or breath, or excreta.

Onset of Infectious Diseases.—In each infectious disease an interval elapses between the reception of the specific poison and the development of the earliest symptoms, known as the *period of incubation*, or hatching. During this time the patient may be in fair health and is *not infectious*.

With the onset of the earliest symptoms, he becomes a centre of infection, though usually not so dangerously as a few days later. The period of incubation of the various fevers is shown in the following table :—

Disease	Begins usually on the	But may possibly be at any period between
Scarlet Fever . .	4th day.	1 & 7 days.
Diphtheria . . .	2nd "	2 & 5 "
Small-pox. . . .	12th "	1 & 14 "
Chicken-pox . . .	14th "	10 & 18 "
Typhus Fever . .	12th "	1 & 21 "
Typhoid Fever . .	21st "	1 & 28 "
Measles	12th-14th "	10 & 14 "
Rötheln (German Measles) . . .	14th "	12 & 18 "
Mumps	19th "	16 & 24 "
Whooping-cough .	14th "	7 & 14 "

Following the period of incubation, come the premonitory symptoms, which are usually somewhat sudden in onset.

In **Scarlet Fever** the child, as a rule, vomits and becomes extremely feverish, at the same time complaining of sore throat. His skin is hot and dry. Within 24 hours a punctiform red rash appears on the chest, soon becoming a scarlet blush, and spreading to other parts. Some cases are so slight that they may go to school throughout, and only be discovered in consequence of the occurrence of peeling, or dropsy due to chill affecting the kidneys, which is especially liable to occur after these mild cases.

In **Diphtheria**, after a day or two of languor and sore throat, white patches appear on the tonsils and contiguous parts, which in severe cases join together to form a continuous membrane. Smaller white patches, due to the condition called ulcerated throat (follicular tonsillitis), are often confused with the much more severe disease, diphtheria. Both, however, are extremely contagious by inhalation of the breath, and it is essential, therefore, that the patient should be isolated in one room.

Small-pox comes on with severe pain in the loins, sickness, and shivering. At the end of 48 hours, a hard, pimply rash appears, followed by the formation of vesicles, which gradually become pustular and leave the skin pitted. The modified small-pox, which occurs in those partially protected by vaccination, is a much milder complaint, and in one case known to the writer, a boy attended school with it, being supposed to have a 'spring rash.' In such a case small-pox would be likely to spread among those who had been imperfectly or unsuccessfully vaccinated.

Chicken-pox may come on with hardly any premonitory symptoms, except slight feverishness. The rash comes out in 24 hours—at first pimples, but speedily becoming clear vesicles. There may be some difficulty in distinguishing it from modified small-pox, though the rash in the latter seldom or never appears on the scalp, as it does in chicken-pox.

Measles comes on with all the symptoms of a severe cold in the head, with an unusual amount of fever. At the end of 72 hours, red blotchy spots appear on the face, hands, and other parts, and rapidly spread, tending to assume crescentic arrangements.

Rötheln, or German Measles, has a rash somewhat like that of measles. There is no nasal catarrh, however, and always a sore throat, similar to, but less severe than, that of scarlet fever. It is always a slight complaint, but as it is very infectious, strict isolation must be enforced.

Mumps comes on with feverishness and pain near the ear, followed by enlargement of the parotid salivary gland. This causes bulging out at the side of the neck and in *front of the ear*, by which means it can be distinguished from glandular enlargement due to other causes.

As a rule both sides are affected, but occasionally only one.

Whooping-cough is a disease in which the characteristic cough does not come on for a week or two, but the cough appears to be simply due to bronchial catarrh. It is unfortunate that during this unrecognisable stage (unless by the history of infection) the disease can be communicated to others. At the end of 7 to 14 days the patient begins to cough till he is out of breath, and then draws in his breath with a peculiar crowing noise or whoop. Every mother should be familiar with this whoop, and isolate any child who has it, or who, even without it, has *a cough severe enough to make him sick.*

Duration of Infection.—It is important to know at what period, after the onset of an infectious disease, isolation may be relaxed, and the patient allowed to mix with others. This information is given in the following tabular statement. In the last column is given also the period which must elapse before a child who has been exposed to infection may, in the absence of symptoms, be allowed to return to school, assuming that in the interval he has been completely isolated from any source of infection. We have allowed a margin beyond the longest period of incubation of each disease for the symptoms, if coming on, to become fully developed.

It must be clearly borne in mind that the date of cessation of the *patient's* infection is stated in the following table. It is assumed that all wearing-apparel has been disinfected, and likewise the room occupied by the child. Sometimes a child is taken ill in a particular dress, and resumes this on returning to school, or otherwise mixing with healthy children, thus carrying the infection with him.

Disease	Duration of Infection	Duration of Quarantine of Children exposed to Infection
Scarlet Fever .	From 5 to 8 weeks; ceases when all peeling of the skin has been completed.	14 days.
Diphtheria . .	From 14 to 21 days, if there is no sore throat or discharge from nose, eyes, ears, &c.	12 days.
Small-pox and Chicken-pox	About 4 to 5 weeks.	18 days.
Measles . . .	From 2 to 4 weeks, when all cough and branny shedding of skin has ceased. It is best to allow 3 weeks.	16 days.
Rötheln . . .	14 days.	16 days.
Mumps . . .	14 to 21 days from the beginning	24 days.
Whooping-cough . .	6 weeks from the beginning of whooping, or when the cough has quite ceased.	21 days.
Typhus and Typhoid Fevers	4 to 5 weeks.	28 days.

Popular Errors as to Infectious Diseases.—No notion is more prevalent than that it is *necessary for children to have infectious diseases,* more especially measles, whooping-cough, and scarlet fever. Some parents even go so far as wilfully to expose their children to infection; if one has caught an infectious disease, they straightway put their other children in the same room, 'to have it all over at one trouble'! Such conduct is most injurious not only to the children involved, but also to the whole community. (1) Measles and whooping-cough, the so-called slight children's ailments, annually cause a larger number of deaths than all the other infectious diseases put together. One slight case in a house does not necessarily imply that subsequent cases in the same house will not be virulent in type. (2) Every additional case forms a new centre of infection, thus preventing these diseases from being stamped out. (3) Every additional year that a child lives without having an infectious disease, diminishes his risk of ultimately getting it. The tendency to these diseases appears to diminish with advancing years. Considering, then, how many children die from these diseases, how many others are permanently maimed by them, it is surely wise to take every possible precaution against them.

Infectious diseases, again, *do not arise without cause.* In most instances the cause is a pre-existing case of the same infectious disease; in a few cases, local insanitary conditions—*e.g.*, the effluvia from foul privies, cesspits, or drains—may cause diphtheria, or sore throat, or typhoid fever, though even in the latter cases it is much more usual for the disease to be acquired by infection from a preceding case.

CHAPTER LI.

ISOLATION AND DISINFECTION.

Isolation.—Legal Penalties for Exposing Patients.—Details of Isolation.—Disinfectants.—Vaccination.

Isolation is the most important of all measures for the prevention of the spread of infectious diseases. It is now commonly maintained in scarlet fever and small-pox, though it is too often neglected for whooping-cough and measles.

Isolation should be maintained in every case, until the absence of infection is ensured. Epidemics of infectious diseases are not infrequently caused by sending children to school who are just convalescent from these diseases, but still infectious to others. Mild cases of diphtheria may be unrecognised, and lead to the infection of other children by kissing, &c. Similarly, children who still have a slight whoop from whooping-cough, or, more rarely, children who have not finished peeling from scarlet fever, are allowed to mix with other children.

Certain **legal penalties** are incurred by wilful disregard of necessary precautions. Ignorance of the necessity for these precautions is not a legal defence. If a person suffering from an infectious disorder, or in charge of such a person, allows him to enter a cab or other public conveyance without informing the driver, he is liable to a penalty not exceeding 5*l.* Similarly, exposure in any street, school, or other public place renders the offender liable to the same penalty. A penalty is incurred by letting a house or part of a house after an infectious disease without previous disinfection; and for giving, lending, selling, or exposing, without previous disinfection, any bedding, clothing, &c., which have been exposed to infection.

Details of Isolation.—When a child is taken ill with an infectious disease—*e.g.*, scarlet fever—he should only be kept at home (*a*) if a room is available for absolute isolation, (*b*) and if the mother or responsible nurse can also remain entirely separated from the rest of the household. If it is impossible to secure these two conditions, it is wiser to allow the child to be removed to a hospital for such diseases, which is now provided in most districts. The prejudice against these hospitals is rapidly dying out. As a rule, such removal is better both for patient and parent. It enables the mother to attend without interruption to her usual domestic duties, whereas if the patient had been kept at home, it would have been necessary for her to remain isolated with the patient during the whole period of infection; and at the same time the child is able to command more skilled attention than at home.

The *nurse* should dress in a cotton dress. No visitors should be allowed in the room, and the nurse should confine her duties to the sick-room, avoiding contact with any other members of the household.

No *food* brought up from the kitchen should be allowed to return to it. All cups, plates, &c., leaving the room must be dipped in weak Condy's fluid.

The *bed* and *body linen* must be disinfected in the room. This is best accomplished by putting them in boiling water to which has been added carbolic acid in the proportion of

1 in 60. Towels and pocket-handkerchiefs must be similarly treated; and rags which can be burnt after use are preferable to handkerchiefs. After being thus disinfected, the linen should not be sent to a public laundry, but washed separately from other linen.

The *sick-room* should be freely ventilated, though the patient must be protected from direct draught. All unnecessary furniture, curtains, bed-hangings, and carpets should be removed from the room at the commencement of the illness. The floor of the bedroom should be washed frequently with water containing some disinfectant.

Disinfectants are substances capable of destroying the poison of the various fevers. The word *germicide* expresses the same meaning. *Deodorants* are substances used to destroy bad smells. Charcoal is an admirable deodorant, and so is freshly-ground coffee, though probably they have no power to destroy the germs of disease. Some deodorants, however, as carbolic acid and sulphurous acid, are also disinfectants. *Fresh air* is of all means the most efficient disinfectant, combined with thorough *cleanliness*. Thorough scrubbing of the floors of a room, combined with stripping off the wall-paper and lime-washing the ceiling and walls, is one of the best means for destroying infection.

The only certain means of destroying the germs of disease which may have penetrated into mattresses, &c., is by the application of *great heat*. The most efficient form of heat is *superheated steam*. By this means bedding and mattresses can be raised to a temperature of about 240° to 260° Fahr., without any danger of scorching. This is usually carried out at some central establishment by the local Authority. By recent legislation, it has become an acknowledged principle that disinfection cannot be efficiently performed by the householder, who is obliged, under pain of a penalty, to have it done by the inspector of the local authority. If the bedding is not valuable, it is a good plan to have it *burnt* after a serious case of infectious disease.

The sick-room does not require to have its atmosphere disinfected during the time it is occupied by the patient. The saucers of Condy's fluid which are commonly placed about in sick-rooms, under the bed, &c., are absolutely useless. *Condy's fluid* is not a volatile disinfectant; it only affects matter with which it comes into actual contact. Even carbolic acid, chloride of lime, and other disinfectants, which may partially volatilise in the sick-room, are of very doubtful utility. These disinfectants, to be of sufficient strength to kill the germs of disease, must be so concentrated as also to kill the patient. It is better to leave *disinfection of the sick-room* until the patient has left it, trusting in the meantime to absolute isolation. When the patient has ceased to be infectious he is thoroughly washed in an adjoining room, and then puts on entirely clean clothing which has not been exposed to infection. Then the room may be disinfected as follows :—Having closed all windows, shut down the fire-register, and spread out the bedding, &c., in the room, an iron saucepan or shovel is taken and supported on a pair of tongs over a bucket of water in the middle of the room. Then from one to two pounds of sulphur are placed in the saucepan and set on fire, the room is hastily left, and the margins of the door and the keyhole are pasted over with paper and paste previously prepared. The room should be left until the next morning. Then the windows may be thrown widely open and the room and its contents thoroughly cleansed. The bedding is removed to a central establishment to be stoved. The bed-linen is placed in disinfecting fluid to be subsequently washed. The paper is stripped off the walls and burnt. The walls and ceiling are thoroughly lime-washed, the woodwork, the bedstead, and floor are scrubbed with soft soap and water, and the room is allowed to remain unoccupied with widely open windows for a few days.

During occupation of the sick-room the linen must be carefully disinfected. The *excreta* must also be disinfected before leaving the room. A solution of *corrosive sublimate* (1 in 1,000) is the best for this purpose; but *Burnett's fluid*, a solution of chloride of zinc, and *Tuson's fluid*, a solution of chloride of zinc containing also sulphurous acid, are very useful for this purpose. These should be added to the utensils before they are used as well as afterwards. If disagreeable smells occur in the bedroom, sanitas or eucalyptus is useful, though these must be regarded more as deodorants than disinfectants. Jeyes' fluid is useful for the same purpose.

When a case of infectious disease occurs in a household it is now compulsory, in most parts of England and Wales, for the head of the household to **notify** the fact to the medical officer of health of the district or town in which the house is situate. Any householder neglecting to comply promptly with this requirement renders himself liable to a penalty. The same duty rests on the doctor who is called in to attend the case.

The diseases which are to be thus notified are Scarlet Fever (or Scarlatina), Small-pox, Diphtheria, Enteric or Typhoid Fever, Typhus Fever, Puerperal Fever, and Erysipelas. In some towns Measles is also included in the list. It is evident that, by having complete information of all cases of infectious diseases, the sanitary authorities will be able much more efficiently to cope with and prevent the spread of epidemics.

In the case of Small-pox, **vaccination** is compulsory for all infants before the age of three months. Vaccination by lymph, which is ultimately derived from the cow, means the inoculation of the virus of small-pox which has been modified and mitigated in virulence by passing through the system of the cow. Vaccination furnishes an efficient protection against small-pox, but the protection tends to die out, and it is well, therefore, to be re-vaccinated when about twelve or fourteen years old.

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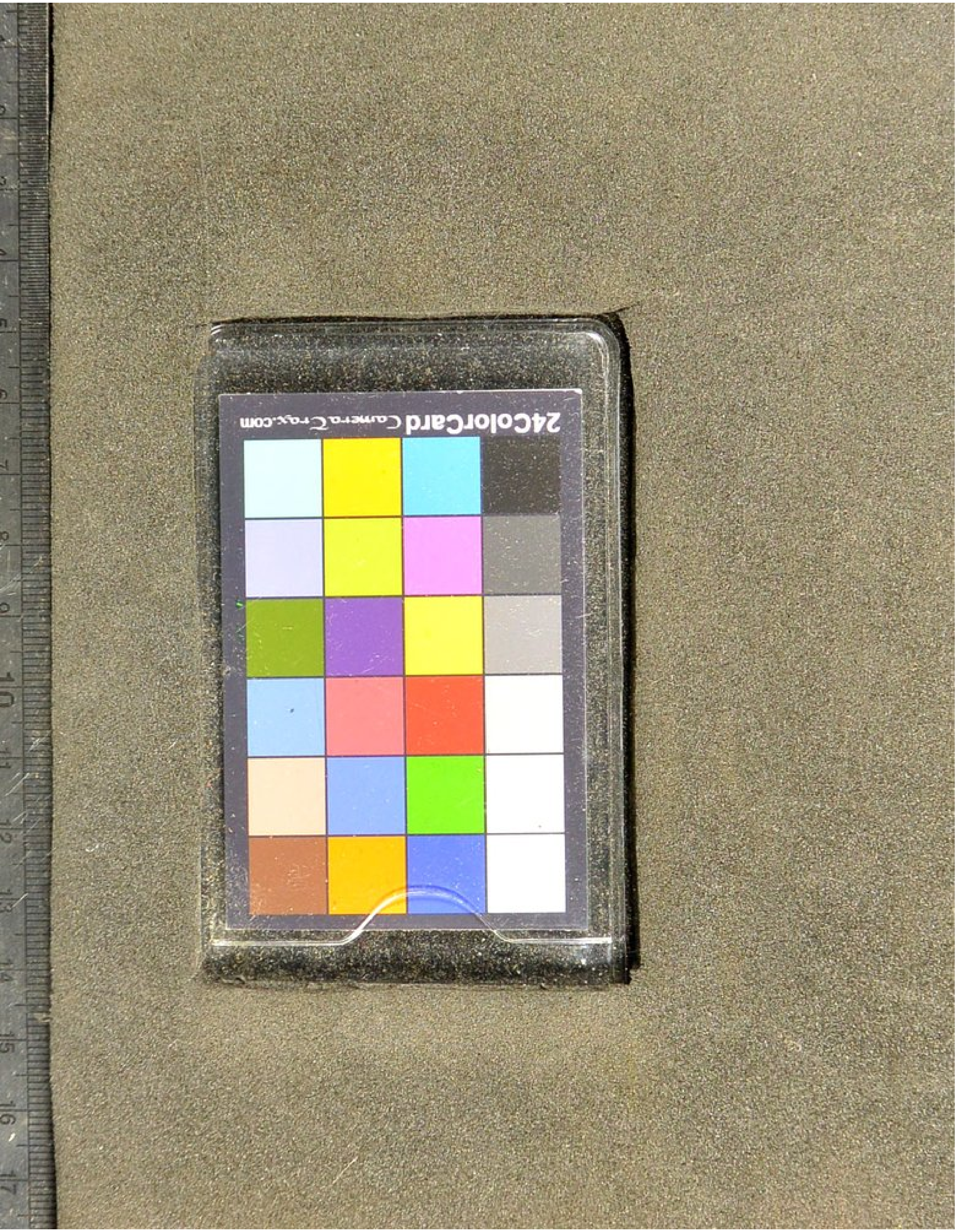
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