The Laws of health.

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THE LAWS OF HEALTH

D. Nabarro, M.D.

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THE

LAWS OF HEALTH

BY

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PREFACE

It has been my aim in this little book to place before the reader certain rules and suggestions for regulating his mode of living, so that by carrying them out he may maintain his body and his mind in a healthy condition. The book is intended primarily for the older pupils in Elementary Schools, but will, I venture to think, be of use to pupils in Secondary Schools and possibly to adults.

At the commencement of each chapter there is a very brief outline of the structure and working of the particular organs concerned. Details of structure of the various parts of the body have been omitted, and only so much has been included as is necessary to enable the reader to understand the general principles of the action of the different organs and how to keep them in good working order.

Certain subjects have been treated at some length; for example, the use and abuse of alcohol, the care of the teeth, the value of free ventilation and of exercise, the feeding of infants, the care of the eyes in childhood, tight clothes, smoking, diet, and the necessity for personal cleanliness; others, such as the details of cooking, are only lightly touched upon.

I am particularly indebted to Miss E. Abadi, B.A., Head-mistress of the Bell Lane School, London, for the

assistance she has given me in the preparation of this volume. Miss Abadi's experience in the teaching of children enabled her to give me many valuable suggestions throughout the work.

My thanks are also due to Dr. A. C. Stevenson, of University College, London, for drawing four of the figures (4, 8, 9, 11); the others have been borrowed from 'Physiology for Beginners,' by Dr. Leonard Hill, to whom and to Mr. Edward Arnold my thanks are due.

DAVID NABARRO.

HAMPSTEAD, N.W.

NOTE.—Teachers desiring an outline course for younger pupils who are not concerned with the physiological basis of the subject are recommended to use only the following parts of the book:

The whole of the first chapter.

Chapter II.: §§ 14, 15, 22-31 (without footnotes); Chapter III.: §§ 32, 33, 40-42, 44-53; Chapter V.: §§ 75, 85-91; Chapter VI.: §§ 102-117; Chapter VII.: §§ 122-126, 131-137; Chapter VIII.: §§ 148, 149; Chapter IX.: §§ 170, 171; Chapter X.: §§ 185-193; Chapter XI.: §§ 200, 202, 203; Chapter XII.: §§ 210, 213, 226, 228, 229, Conclusion.

The Summaries alone might be used for younger pupils, giving in a succinct and definite form all that is necessary for practical guidance.

CONTENTS

THE LAWS OF HEALTH

CHAPTER I

INTRODUCTORY

1. The human body is a machine like a steam-engine. Both consist of many parts and joints which require attention and care. Like a steam-engine, the human body can do work, but only when the necessary fuel is supplied to it. The fuel in the case of a steam-engine is coal; in the case of the human body it is food. Just as an engine will do most work when supplied with the best quality of coal, so the body will work best when fed upon the proper kinds of food. Then we find that in a steam-engine there are certain waste products which are got rid of, such as smoke from the funnel, ashes and clinkers from the furnace, and stale oil from the various joints. So the human body gets rid of waste materials from the lungs, from the skin, from the kidneys, and from the bowel.

2. The comparison may be carried still further. An engine requires a good draught—that is to say, a good current of air—to burn up the fuel completely. Just in the same way, a large supply of pure air is necessary

for human beings to keep their lungs and their bodies generally in good working order.

3. What happens to the coal a stoker puts into the fire of his steam-engine? With the help of the air it is burnt up and much heat is produced. This causes the water to boil in the boiler of the engine and changes it into steam. The steam is made to do work by turning round the wheels of the engine and so making it travel. The fuel, therefore, which is supplied to an engine in the form of coal produces heat. The heat changes water into steam, which does work. In exactly the same way we take in food as fuel, which produces heat and also gives us strength to work. If we had no food given us we should very soon have no strength left to do work; we should form little heat, and, in fact, should soon die from starvation.

4. Although the human body is like a steam-engine in many ways, yet there are also several important points of difference. In the first place, the human body is very much more complicated in its structure and more delicate in its working than any engine or machine made by man. As we shall see later, it is made up of millions upon millions of cells which are grouped together in different ways to form the tissues and organs of the body. These tissues and organs have their special duties to perform for the good of the body as a whole.

5. Secondly, an engine is made almost entirely of steel, whereas in the human body we find many different substances or tissues, such as bone, muscle or flesh, cartilage or gristle, binding or connective tissue, nerve tissue, and so on. In that respect the body may be com-

pared with a house in which we find different materials, such as wood, plaster, cement, bricks, metal, and glass.

6. Thirdly, you may have a small steam-engine or a large one, but the small one does not grow into a large one. Once the engine is made, it remains the same size as long as it lasts. On the other hand, a new-born baby is a complete human being, but does not remain the same size all through life. During the first twenty years of its existence it grows, so that, when it becomes a man or a woman, it is several times longer and much heavier than when it was born.

7. Fourthly, we have seen that an engine requires fuel, and fuel only, to enable it to do its work properly. On the other hand, the human body must be fed on something else besides fuel-forming food, so that it may go on working satisfactorily. It requires a substance called *nitrogen*, which is present in certain foods—especially meat, peas, and beans—to make up for the waste of the tissues which is always going on. Such foods are also required in great quantity by children who are growing, because they help to build up bone, flesh, and many of the important tissues of the body.

8. Lastly—and here we come to the most important difference between man and an engine—man not only works, but has the power of thinking and of acting accordingly. In order to think properly it is necessary for the body, and especially the brain, to be in a sound and healthy condition.

9. What, then, is meant by being healthy? In perfect health there is no pain in any part of the body, such as headache, toothache, stomach-ache, or any

other ache; nor are there any other unusual feelings anywhere, such as dryness or bad taste in the mouth, sickness, or 'pins and needles' in the hands or feet. There are no swellings or unusual appearances, but every part of the body looks sound and well formed. The appetite is good, we enjoy our food, and all the functions of the body are properly carried on. The skin acts well, and is of a good, healthy colour; the kidneys and the bowels, and all other parts of the body, do their work satisfactorily. We feel well, active, and ready to work both with the body and with the brain. Lastly, in perfect health we sleep well and soundly, and get up every morning refreshed and ready to do the day's work.

10. I think you will say that it is not often one meets anybody who enjoys all the blessings I have just mentioned, and that, therefore, very few people enjoy perfect health. That is quite true, and most people consider that they are healthy although they may have slight aches and pains, or unpleasant feelings sometimes. Well, then, although it may be very difficult for us to be and remain perfectly healthy, yet we should always try to be as healthy as we can, for there is no greater blessing than good health. We only find this out when we have lost it and are ill. Then we know how pleasant it is to be well and healthy—to be able to join in the work and the play of our fellow-creatures.

11. You cannot be expected to know, without being told, how to keep healthy, and it is the purpose of this little book to tell you how to live so as to keep your body and your mind in a state of good health. Here I shall give you a few general hints only.

12. In the first place, try to lead a regular life; eat regularly and not too quickly; work regularly, but do not overwork; take proper recreation, especially exercise in the open air, whenever possible, and give the brain rest by taking a proper amount of sleep. Secondly, let your food be plain, nourishing, and wholesome. Take sufficient of it, but not too much. Avoid harmful things, and, above all, avoid taking too much alcohol in the form of beer, wine, or spirits. Thirdly, breathe as much pure air as you can, and see to the proper ventilation of your rooms and houses. At the same time avoid draughts, chills, and getting wet. Fourthly, dress properly, according to the state of the weather and the season of the year. Fifthly, take proper care of your bodies, paying particular attention to personal cleanliness. Also see that your house is always kept in a sweet and clean condition. Avoid injuries to your bodies, for often a slight injury may lead to serious and lasting illness, and possibly deformity. Lastly, avoid too much of anything, for that is always harmful: too much eating, especially meat; too much drinking, especially beer, spirits, and tea; too much exercise and too much work; too much smoking; and, I would add, do not worry more than is necessary, for nothing makes a person old before his time quicker than worry.

13. An engine-driver, to keep his steam-engine working properly and at its best, must know something about the construction of his engine and how it works. Unless he does so, should any slight accident happen, he will be unable to set matters right. In the same way, before you can understand how to keep the body in a state of good health, you must be told something

about the wonderful construction and working of its different parts. I do not intend to tell you many details, because you can read them for yourselves in any book on physiology. I intend to tell you only just so much as is necessary for you to understand the various rules I recommend you to follow. If you carry out these rules carefully I am sure you will lead healthy and happy lives.

CHAPTER II

THE BONES OF THE BODY

14. When a big warehouse or shop is being built, strong iron beams called girders are put up and joined to one another. The bricks, wood, and other materials are added later to make the outside walls and the different rooms, doors, windows, and other parts of the building which help to make it complete. What is the use of these iron girders? In the first place, they give firmness and support to the whole building; secondly, they protect the rooms inside the building from injury such as might happen from wind; and, thirdly, the walls and floors of the different rooms are joined on to these girders, which may therefore be said to serve as points of attachment for the various parts inside the building; lastly, we may add that, when the building is finished, the girders are quite hidden though we know they are there.

15. We find much the same state of things in the human body. Inside the body, and quite hidden from view under ordinary conditions, we have a large number of bones all joined together to form what is called the *skeleton* of the body. These bones are very hard and strong, and have the same use as the girders in a build-

ing. They give firmness and support to the whole body, they protect the parts inside, and they serve as points of attachment for the various muscles of the body by which we move. There is one great difference between the girders of a building and the bones in our body. Girders are strongly fastened together so that no movement can take place between them. The bones of our body are also fastened together, only loosely, so that we can move one bone on the other; if it were not for this we should be unable to use the fingers, arms, hands, legs, or, indeed, any part of the body. The bands which tie bones together are known as *ligaments*. The ends of bones which are thus joined by ligaments are called *joints*. Sometimes in disease the bones become tightly fixed together at the joints in the fingers, wrists, arms, shoulders, legs, or back.

16. The bones of the body forming the skeleton may be divided into three groups: (1) The skull, or bones of the head; (2) the bones of the body proper, or the trunk; and (3) the bones of the limbs (the arms and legs).

(1) The skull, or brain-box, is a strong box made up of twenty-two bones. It consists of two main parts. The larger, smooth, hollow part at the top and back contains that important structure, the brain. This part of the skull is very strong so as to protect the brain from injury. The lower and front part of the skull is called the *face*, and contains the holes for the eyes and nose and the two jaw-bones which carry the teeth. In a grown-up person all the bones of the skull are firmly joined together except the lower jaw-bone, which has a movable joint to enable us to eat and talk. In a young

child the skull-bones are softer, especially where they are joined together.

(2) In the body proper, or trunk, we have the 'backbone' or spine, which is made up of twenty-six bones, placed one above the other and joined together by strong ligaments. These bones can move a little on one another and allow us to bend or straighten the back. The skull is jointed on the top of the backbone so that we can move our head in almost any direction.

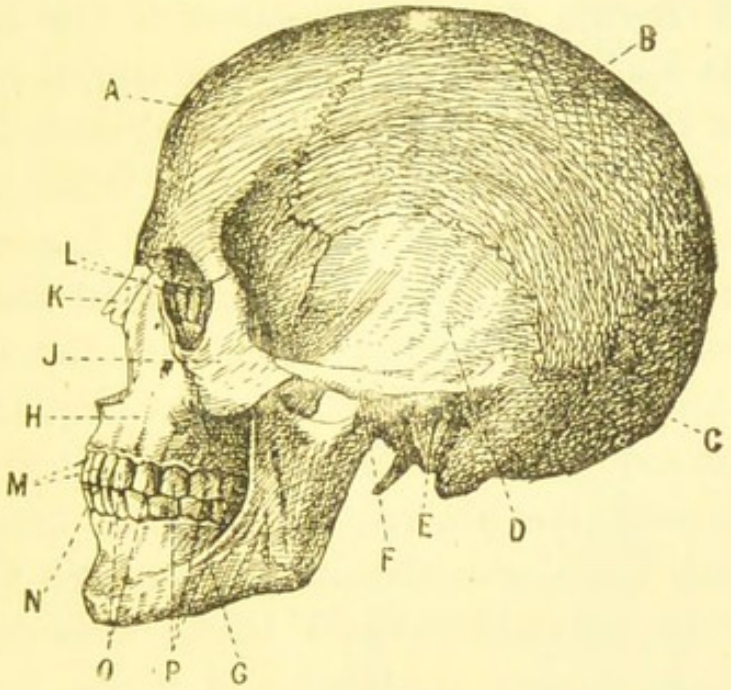

FIG. 1.—THE SKULL.

A, B, C, D, The part of the skull enclosing the brain; E, hole leading to drum of ear; F, joint of lower jaw-bone; G, H, lower and upper jaw-bones; J, cheek-bone; K, nose-bone; L, socket of eye; M, incisor teeth; N, canine; O, bicuspids; P, molars.

The upper part of the body is called the chest or *thorax*. In front there is the long flat breast-bone, and at the sides of the chest are twenty-four ribs, twelve on each side. The ribs are joined to the spine behind, and to the breast-bone in front. Some of the lower ribs do not quite reach the breast-bone, but hang loose. The bony cage of the chest, formed by the spine, ribs,

and breast-bone, protects the heart and lungs which are inside the chest.

(3) Let us now consider the bones of the limbs. Each arm is divided into the upper arm, forearm, wrist, hand, and fingers. In the upper arm there is one strong bone with a large knob-like end which is jointed to the shoulder-blade. This joint, the *shoulder-joint*, is a very free one, and allows the arm to be moved in any direction. In the forearm are two thinner bones, which are jointed to the upper-arm bone at the *elbow-joint*. The *wrist* is made up of a number of small bones. In the palm of the hand there are five long, thin bones, one for the thumb and one for each finger. Each finger has three small *finger-bones*; the thumb has only two. The arm is joined to the body by means of the *shoulder-girdle*. The shoulder-girdle consists of the *collar-bone* and the *shoulder-blade*. The collar-bones are the curved, rounded bones just above the ribs in front of the neck. The shoulder-blades are the flat bones at the back to which the arm-bones are jointed. Sit up straight and throw the shoulders well back; this brings the shoulder-blades nearer together and makes them stand out more from the body. Stand in front of a looking-glass and shrug the shoulders, you will then see the collar-bones more distinctly and will also be able to make out their shape.

Each leg is divided into the thigh, leg proper, ankle, heel, foot, and toes. In the thigh there is the long and very strong *thigh-bone*, the longest and strongest bone in the body. Above, it has a large round head which fits into a cup-like hollow in the hip-bone, to which it is loosely jointed by strong ligaments. The *hip-joint* is not so free as the shoulder-joint, but still it allows the

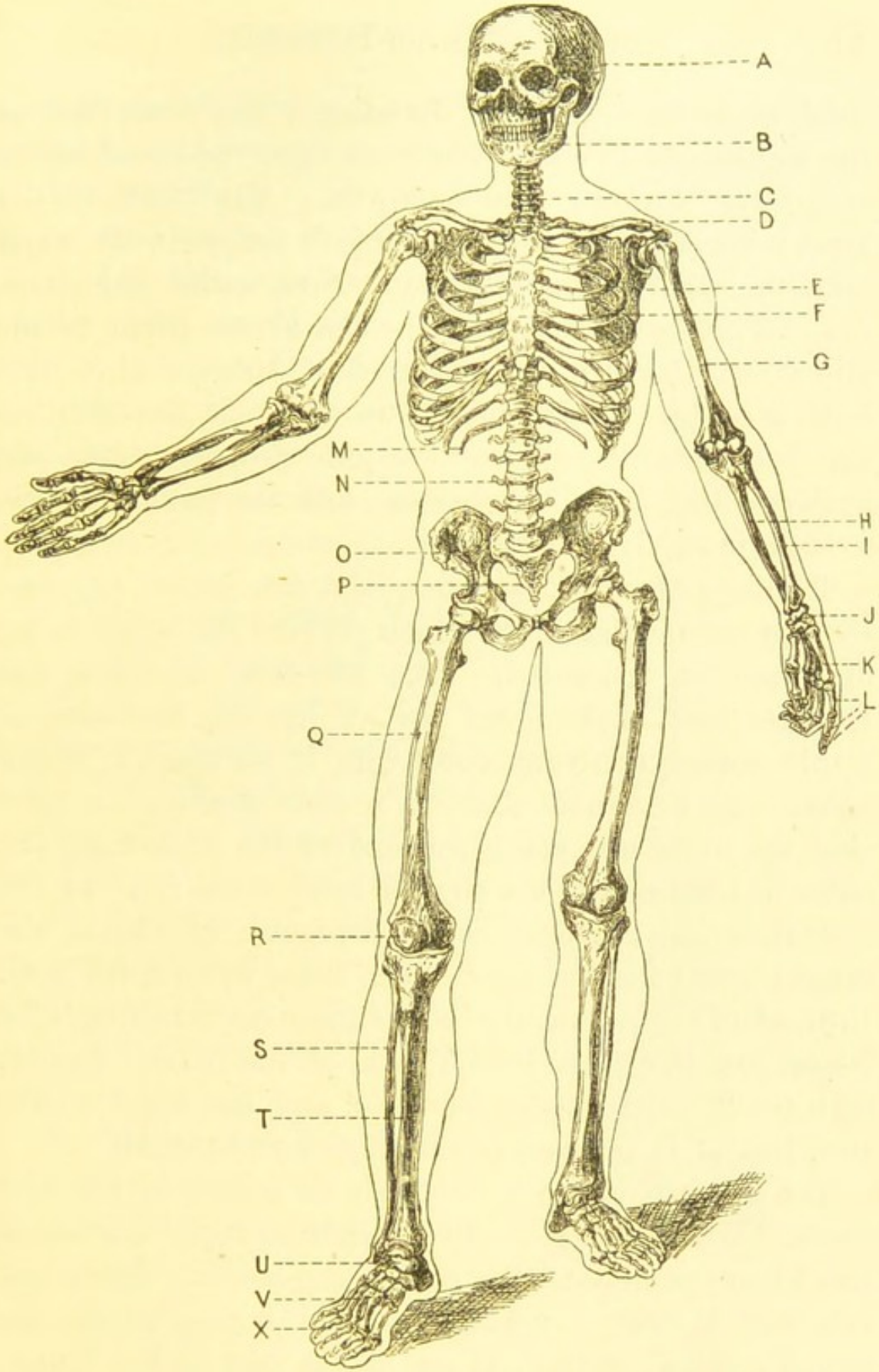

FIG. 2.—THE SKELETON.

A, Skull; B, lower jaw; C, N, P, bones of the spine; D, collar-bone; E, shoulder-blade; F, breast-bone; G, upper-arm bone; H, I, forearm-bones; J, wrist-bones; K, hand-bones; L, finger-bones; M, lowest ribs; O, hip-bone; Q, thigh-bone; R, knee-cap; S, T, leg-bones; U, ankle-bones; V, feet-bones; X, toe-bones.

thigh to be moved in any direction. The lower end of the thigh-bone is broad, and rests upon the broad top of shin-bone, forming the *knee-joint*. In front of the knee-joint, as you may easily feel for yourself when standing, there is a flat, round bone called the *knee-cap*. This bone sometimes snaps across when people slip down. It is a serious accident, because when this bone is broken we are unable to walk. If the parts of the broken knee-cap do not join properly after the accident, the leg will be useless, and the patient unable to walk properly ever after.

The bones forming the knee-joint are joined together by very strong ligaments which prevent the bones being displaced or dislocated. The *shin-bone* is much the stronger bone in the lower part of the leg, but there is a thin bone which runs down with it all the way to the ankle. At the *ankle* there is a bony swelling on each side, the inner one being the end of the shin-bone, the outer one the end of the slender bone of the leg. In the foot there are several bones, irregular in shape, the largest being the *heel-bone*, which helps to form the heel. In front of these irregular bones there are five long, thin bones, just like those in the palm of the hand. Lastly, each toe has three small *toe-bones*, and the big toe only two, just as in the case of the fingers and thumb.

The legs are joined to the body by means of the *hip-bones*. When you place the 'hands on hips,' the hands rest upon the upper edge of the hip-bones. These are two very strong, irregularly-shaped bones, which are joined together in front at the lowest part of the trunk. Behind, they are very firmly bound to the spine by means of strong ligaments. The two hip-bones and the spine-bone to which they are joined, together form the

pelvic girdle, which is very strong as it has to bear the whole weight of the body above. The thigh-bones are jointed to the hip-bones, but the legs cannot be moved about so freely as the arms. That is because the pelvic girdle is firmly fixed to the trunk, whereas the shoulder-blades can slide up and down and so enable us to move the arms about freely.

17. The long bones of the body, such as the thigh-bones, consist of a very hard, dense substance arranged like a hollow tube. Inside this tube is a fatty substance called the *marrow* At the ends, where they become broader to form the joints, the bones are no longer like a hollow tube nor so hard, but spongy inside with a thin shell of hard bone outside.

The smaller flat bones, such as the ribs, breast-bone, etc., are like the spongy ends of the long bones in structure.

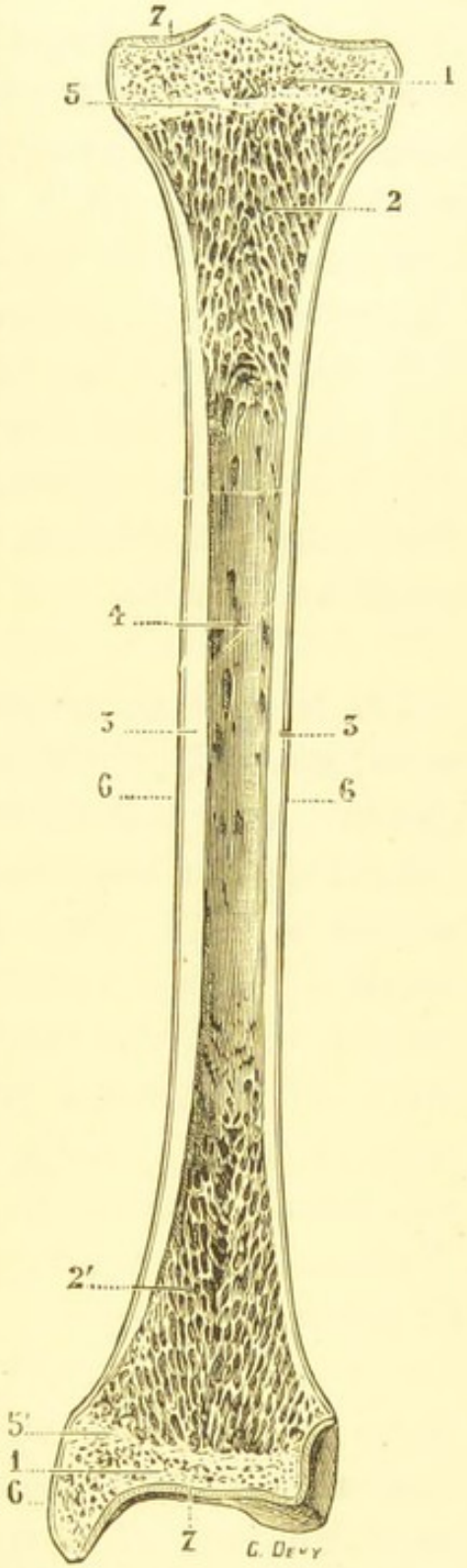

FIG. 3.—SHIN-BONE SAWN IN HALF.

1, 2, Spongy bone; 3, hard, dense bone; 4, marrow cavity; 5, layer of gristle at the growing part of the bone; 7, gristle covering the joint surface of the bone.

18. Bone is made up of one part of animal matter and two parts of mineral matter. This can be proved by means of two simple experiments. Take a

piece of fresh bone and weigh it carefully. Put it in a jar of weak acid ('spirits of salts' and water), and leave it in for a fortnight or more. At the end of that time remove the bone, wash it in water, dry it and weigh again. The bone will have lost two-thirds of its weight, because all the mineral matter is dissolved out by the acid. The mineral matter gives to bone its hardness, and therefore the animal matter, which is left after dissolving out the mineral matter, is quite soft and easily bent. The animal matter is like gristle and makes the bone tough and elastic.

19. Next, take another piece of fresh bone, weigh it as before, and hold it over a bright red fire in an iron spoon. After a time the bone turns quite white: all the animal matter has been burnt away and only the mineral matter is left. After letting the bone-ash cool down, weigh it. The bone will have lost only one-third of its weight, which was that of the animal matter in it at the start. The mineral matter of bone consists chiefly of salts of lime. Children's bones have more animal and less mineral matter in them than the bones of adults. This makes them tougher and less brittle than the bones of grown-up people. In cases of accident, when the bones of older people would be broken right across, those of children often only bend or are partially broken. Thus if you try to bend a piece of wood or dried twig of a tree it will snap and break right across; if you do the same to a fresh, green twig it will bend and then break partly but not right across. The bones of children generally break in this way, and it is known as a 'greenstick' break or fracture.

20. A child during its growth requires in proportion more food than does a grown-up person. Like an adult, a child has to supply fuel to keep up the heat of the body and to do work, as well as to replace the wear and tear of the tissues. But in addition to this, the child's body grows and gets bigger every day, and therefore requires an extra supply of food. To build up good, sound, strong bones a healthy, growing infant requires a liberal supply of nitrogen-containing or proteid food, of mineral food, and of fat. It requires also a certain amount of sugar during the first year of its life, but less than it does later on.* If an infant is fed on too little proteid and mineral food its bones will not be strong and healthy. There will be too little mineral matter in the bones, which are therefore softer than they should be. A little later, when the child begins to stand and to toddle about, the weight of its body will make the bones bend, and the legs will become crooked. It will then get all the signs of the disease called *rickets*. Not only the legs but also the bones of the arms, chest, and

* Sugar and starchy food are known as *carbohydrate* food, because they contain the elements carbon, hydrogen, and oxygen. Such foods are fuel, like the coal used for the steam-engine, and are *work-producers*. During its first year a child does very little work because it sleeps most of the day and night. A baby, therefore, does not want so much of these foods in proportion as an adult.

The most important *mineral foods* a baby requires are phosphate of lime and phosphate of potash. The phosphate of lime is necessary for the proper growth and hardness of the bones and teeth. The phosphate of potash is necessary for the formation of good healthy muscles and blood. These mineral foods are present in meat and milk in a form which is easily absorbed by the blood. Therefore, by feeding a child on good milk and, as it grows older, also on meat, it gets not only the necessary proteid or nitrogenous food, but also the necessary mineral salts.

head may be soft and become bent. It is a serious thing if the ribs become soft in rickets, because they bend inwards and make the chest out of shape. If the child should get a slight cold on its chest, it would always be liable to get serious lung disease which might even cause death.

21. Human (mother's) milk is the natural and only necessary food for a baby until it is nine or ten months old. It contains all these foods (proteid, mineral, fat, and sugar) in the proper quantities for the healthy growth of the baby's bones and other tissues. Cow's milk, prepared as we shall learn later, will do almost as well.

22. We have seen that children's bones are softer than those of grown-up people. We must, therefore, take care that the bones do not get bent, otherwise they may remain bent all through life. Rickets, which is caused by bad feeding, may lead to bending of the bones and so give rise to crooked legs and arms and badly-formed chests in children. These can all be prevented by giving babies a proper and sufficient supply of food. The head-bones of children are always soft, and particularly so in rickets. A child's head must, therefore, be well protected from injuries, such as blows or falls. Young girls and boys should not be allowed to carry a baby, large parcels, or other heavy weights. Children who constantly carry heavy weights may become deformed owing to the spine becoming curved. Violence to any part of the body may cause the bones to break. If the bone in a limb is broken, the limb is altered in shape and cannot be moved or used until the bone is 'set' and properly joined.

23. People of all ages should avoid prolonged and undue pressure on any of the bones, as this may lead to serious results. (1) The organs, if pressed upon, cannot do their work properly; and (2) prolonged pressure leads to loss of proper shape of the body. Thus, girls should never press in their chests by the use of tight stays. Stays do a great deal of harm to children as well as to grown-up women, especially if they are drawn in too tightly about the waist. Tight stays prevent proper movement of the ribs during breathing. People who wear tight stays never get enough air into the lungs, which is so necessary for good health.

24. Tight lacing also presses the lungs, heart, liver, and stomach out of their proper position, and so interferes with the working of those organs. The result is pain, discomfort after eating, bad circulation of the blood through the heart and lungs, and indigestion of food. Tight bands round the neck or wrists and tight braces and garters should also be avoided, as they all interfere with the circulation and with the proper working of various parts of the body.

25. Particular attention must be given to the feet. Tight, 'smart-looking' boots with pointed toes and high heels should never be worn. Boots should always be comfortably loose (but not too large), with broad toes and low heels; the feet will then keep their proper shape, which nowadays we see only in the case of little babies who have never worn boots or shoes. By wearing properly-shaped boots or shoes the toes will not be pressed over one another, and there will be no blisters, corns or bunions on the feet.

26. You should always remember to sit up straight, with the shoulders well back and the head erect, especially at school in your desk. When writing, do not press the chest against the desk, or sit crooked or bend the body forward over the desk. If you often sit crooked, or stand with 'round shoulders' or with the weight of the body on one leg, by which the pelvic girdle is lowered on that side, the spine and back may become bent and you may remain crooked for life.

27. Our bones may be joined together in one of three ways: First, they may be tightly fixed by parts of one bone dove-tailing into the other bone, as in the case of the bones of the skull; secondly, the bones may be joined together, but not quite tightly, so that they can move a little. This is seen best in the bones which make up the spine or backbone. Each bone in the spine can move a little on the bone above and below it. Through this movement we are able to bend the neck forwards or backwards or from side to side, also to bend the back, as in playing leap-frog; thirdly, the bones may be joined so loosely that we are able to move them a great deal. The shoulder, elbow, wrist, hip, knee, ankle and finger joints are all examples of this kind of joint.

28. When bones are joined so that some movement is possible between them, the ends of the bones are covered with *gristle* or *cartilage*. The bones themselves are joined together by strong bands called *ligaments*. When two bones have gristle between them and are joined together by ligaments, we call the connection a *joint*. Gristle or cartilage is a tough, pearly-white, glassy

substance, best seen at the end of a long bone such as the thigh-bone.*

29. In health the gristle at the ends of the bones is quite smooth; the joints are kept well greased or oiled by a fluid which is always present in small amount in the joint. In old people the gristle at the end of the bones very often becomes rough. Sometimes this happens also in young people suffering from rheumatism. Exposure to damp and cold often causes rheumatism. We must always take care to protect the joints, especially the knees and ankles, from wet. If the feet or legs get wet through walking in water or in the rain, we should always take off the wet clothes, boots, and stockings, as soon as possible. The joints should then be dried and rubbed hard with a rough towel till the skin over them feels nice and hot. Sleeping in a damp bed often brings on rheumatism. Sheets should always be well *aired*—that is, hung up in front of a fire after they come home from the laundry, to make sure that they are dry. If on getting into a bed the sheets feel damp, the safest thing is to take them away altogether and to sleep between the blankets. Clean underclothes should also be aired before being worn.

* In children the spongy ends of the long bones (see Fig. 3) are joined on to the hollow part or *shaft* of the bone by a layer of gristle. This layer of gristle is the place where a bone grows in length. At about the age of twenty, when young people have stopped growing, this layer of gristle is changed into bone, and then all the parts of the long bone become one solid piece. It is important that this layer of gristle should not be damaged or diseased in children. If it should, then the bone will not grow at that level any more, and the child's arm or leg, as the case may be, will remain shorter than the other.

30. The joints must be protected from injury as much as possible. Children should never be dragged along the streets or pulled up or swung round by the arms, in case the spongy end of any bone be separated altogether from the body or shaft of the bone. Blows, knocks, falls, even slight strains, may all damage a joint. An injured joint becomes swollen, hot, painful to move, and tender to the touch. Such a joint is said to be *inflamed*. It is wise to rest an inflamed joint for some time, so as to allow the swelling to go down. Very often an inflamed joint may get stiff later on, through the gristle at the end of the bones becoming rough and the bones sticking together. After a sprained ankle the foot may become stiff; it is well, therefore, always to see a doctor if there is any pain or swelling in the joints.*

31. If we live well and take a fair amount of exercise the joints will keep in good condition. Too much exercise or too violent exercise, such as running or jumping, may cause the joints to swell and become diseased. If we do not use a joint for a long time, it is apt to become stiff owing to the ends of the bones in the joint becoming stuck together. This is sometimes seen in the knee or ankle joints of people who have to remain in bed for weeks or months through illness. It should always be prevented by the doctor or nurse moving the joints about and working them every day.

* A very violent injury to an arm or leg often causes *dislocation* of a joint. In dislocation the ends of the bones forming the joint get pushed out of place away from each other. The ligaments around the joint are torn at the same time. When a joint is dislocated, it cannot be used till the bones have been replaced in their proper position. In children dislocation does not often happen, but the spongy end usually breaks off from the shaft of the bone at the layer of gristle between them. That is a serious thing, because the bone will not grow any more after that accident.

CHAPTER III

THE MUSCLES

32. Muscle is the red flesh of our bodies. Meat which you see in the butcher's shop is the flesh or muscle of the bullock, sheep, or pig. Flesh or muscle forms a large part of a man's body. About two-fifths—that is, nearly one-half—of the weight of a man is muscle. If we examine any fleshy part of the body or a piece of meat, such as a leg of mutton, we find that it is made up of many separate muscles of different sizes and shapes. Each muscle is wrapped round by a layer of binding or *connective tissue*, which separates it from the muscle next to it. The muscle itself is seen to be made up of bundles of strings or *fibres*, placed side by side, with a little fat between them.

33. All muscles are supplied with nerves, along which messages are sent to the muscles from the brain. At the two ends of a muscle are tough whitish bands or strings, like the ligaments which bind the bones together. These white bands are called leaders or *tendons*.

Bend your elbow. The swelling which appears inside the upper arm is a muscle. With the forearm still bent, run your fingers over the space just in front of the elbow-joint; you will then feel the tendon or leader of this muscle. Stand on tip-toe. You can then see and

feel the leader behind the heel. These tendons or leaders join the muscles to the bones. Leaders are very strong and are very firmly joined to the bones. Most muscles start from one bone, pass over a joint, and end in another bone. Some small muscles are not joined to bones at all, but to the skin or other soft parts. This is the case with some of the muscles of the tongue, eye, and face.

34. The bones cannot move themselves, but are moved by the muscles. When muscles act they get shorter or contract, and at the same time they get thicker and harder. When a muscle shortens it draws together the two bones to which it is attached. In that way bones are moved at a joint by the contraction of a muscle, joining the one bone to the other. Bend the elbow again. The muscle in the upper arm gets shorter and thicker, and so draws together the bones of the forearm and upper arm. Contraction of muscles usually takes place through the *will*. We wish or desire to lift the arm or leg, and we do so. For this reason all these muscles are called *voluntary* muscles because they are under the control of the will. We shall see later that there are other muscles in the heart, stomach, blood-vessels, etc., which are not under the control of the will. They are known as *involuntary* muscles for that reason. An electric battery can also make muscles act. Sometimes in disease a battery can make a muscle act when the will cannot.

35. When a muscle acts and gets shorter and harder, changes take place inside it. These changes are chemical in nature, and are very much like those which take place when coal is put into a steam-engine. The coal

gets burnt up and gives out heat and force. In the same way, when a muscle contracts food is burnt up in the muscle. You must not imagine that when a muscle contracts a piece of meat or bread from a previous meal gets into the muscle and is burnt up. The meat or bread we eat becomes altered by digestion (as we shall see later), and then gets into the blood, and so is taken to the muscles to be used up as fuel when they contract. Heat and force are the result. The heat helps to keep the body warm. After much contraction of muscles, as in running, you know how nice and hot you feel on a winter's day. The force produced in the muscle goes to do work.

36. When the muscles act under the influence of the will, a visible shortening or contraction usually occurs. When the muscles seem to be at rest, however, they are really slightly contracted. This slight contraction is under the control of the brain, but not of the will. As a result, the muscles are never quite loose or *relaxed*, except when the brain is out of action and we are *unconscious*. This is the case when we are asleep or in a faint, or after a severe blow on the head or under chloroform. As you know, we are unable to stand under any of those conditions, but ' fall all of a heap.'

37. Our bodies are so well made and so nicely balanced that very little *active* muscular effort is required to stand upright. The head is balanced on the spine, and the trunk on the legs mainly by the tightening of the various ligaments which join the bones together, and by the slight constant *unconscious* action of the muscles. Standing, therefore, cannot be looked upon as a form of exercise or as beneficial to the body. It is

indeed harmful to stand much, because it may cause serious leg troubles, such as swollen veins, swelling of the ankles, chilblains, and 'flat-foot.'

38. Flat-foot is produced by the stretching of the ligaments which join the bones of the foot together. This is likely to occur in rickety children and in young women and men who stand much, such as shop assistants. When not actually attending to customers, shop assistants should therefore be allowed to sit down. When standing for a short time, children should assume the attitude of 'attention' at drill. Standing for any length of time is fatiguing, especially for children. They then usually stand with the weight of the body on one foot and bend the spine and hip-bone towards the other side, which may lead eventually to spinal curvature. The best attitude for prolonged standing is an erect position of the body with the head well balanced on the spine. The weight of the body should be borne by the two feet equally. In this way the spine and pelvic girdle will be kept straight. The feet should point 'half right and left,' and be separated by a few inches at the heels with one foot a little in front of the other. To avoid fatigue, the right and left foot should be in front alternately. A smart and correct attitude of the body indicates an alert and active condition of the mind.

39. Walking is a healthy form of moderate exercise, in which the muscles of the legs especially are called into play. Running is also healthy in moderation, but is rather a violent form of exercise. In running, the leg muscles act much more powerfully and rapidly than in walking, so that we get tired more quickly from running than we do from walking. Swimming is one

of the most useful forms of exercise, because it brings into use nearly all the muscles of the body. In addition to this, a person who can swim well may be the means of saving the life of some unfortunate fellow-creature who has fallen into the water and is in danger of being drowned. In swimming, most of the leg muscles are used, especially those of the thigh and buttocks. The neck, arm, chest, and back muscles are also used. In fact, nearly every muscle of the body is exercised when we swim.

40. Good healthy muscle feels firm, particularly when contracted. All muscles have some fat between their fibres and on the surface. In fat, flabby people much more fat is present in the muscles. Often in such cases there may be more fat than flesh in muscles. Babies who are fed on too much sugary food and too little proteid and mineral food also get fat and flabby. Healthy muscles depend upon a healthy brain and nervous system. In certain diseases the muscles become unhealthy and changed into fatty material. This also happens when the nervous system is diseased. People with unhealthy muscles cannot use their muscles much. They cannot do much work and also soon get tired.

41. In order to keep our muscles in good condition, three things must be remembered. In the first place, to eat a sufficient quantity of proper food; secondly, to take a sufficient amount of exercise so as to prevent the muscles getting flabby and soft from want of use; and thirdly, not to overtax some of the smaller muscles, such as those of the hand and eyes. We should also avoid sitting in a draught, otherwise we may get cold in the

muscles, leading to the painful conditions called muscular rheumatism and 'wry-neck.'

42. The muscles of the hand, which are used in carrying out fine movements, such as writing, piano-playing, sewing, etc., and of the eyes, which are used in looking at near objects, as in reading, writing, sewing, etc., should not be constantly overtaxed, especially in young children. It may lead to 'cramp' or 'spasm' in the different muscles, and to want of control over them. For this reason children should be taught to hold the pen properly. The pen in writing must not be held too tightly nor pressed too heavily upon the paper. The hand should be moved from the elbow or just below it, and not from the wrist. Overstrain of the eye muscles in children is avoided by not allowing any book or work to be brought nearer than 10 inches to the eyes. The effects of overstrain of the eye muscles we shall see later (see Chapter XI., p. 132).

43. Two kinds of food are required by the muscles: (1) Flesh-forming or *nitrogenous* food, which builds up the muscle substance and repairs the waste; (2) force-producing or *carbonaceous* food. The first may be called the building material, and is provided in milk, meat, fish, eggs, etc. The second is the fuel for the muscles and is contained in bread, sugar, potatoes, fat, etc. Exactly the same thing is seen in the steam-engine. When any part of the engine gets worn out from long use, it is replaced by a similar part made of steel. That corresponds to the nitrogenous food which repairs the broken-down parts of the muscle substance. The fuel which enables the engine to do work is coal. In the same way, the fuel which enables the muscles to

contract is the carbonaceous food which gets burnt up in them.

44. An infant which lies in its cradle asleep nearly all day does not exercise its muscles much. All the time, however, it is growing rapidly and its muscles are increasing in size. A young baby, therefore, requires much more building material but less fuel, in proportion, than an adult. In other words, a baby requires a larger proportion of nitrogenous and mineral food, but a smaller proportion of sugar. This is exactly what is found in a baby's natural food—namely, milk.

45. Older children, whose muscles are constantly growing and who are always exercising their muscles by running about, require a large supply both of nitrogenous building material and of carbonaceous fuel. The former is best supplied in milk, chicken, fish, eggs, porridge, and underdone meat; the latter in jam, honey, sugar, cream, and fat. A child brought up on tea and bread and jam alone will never have healthy muscles.

46. In adults the muscles are no longer growing much, so that only a little building material is required to repair the waste of the muscle substance. On the other hand, anyone doing hard work requires much fuel or carbonaceous food, such as bread, sugar, potatoes, and fat. Much more of these fuel foods will be required when hard work is being done than when we are not working hard.

47. Exercise is necessary for all healthy people, young and old. As people get old they tend to take less exercise, but it is just then that exercise is so

important to keep the body in good condition. Moderate exercise is of great value to the muscles as well as to the general health of the body. During exercise more blood is carried to the muscles, which makes them grow bigger and stronger. The muscles of a swimmer, the legs of a cyclist or runner, are bigger than those of a person who does not take much exercise.

48. When we have taken much exercise we feel tired. That is because the waste materials formed by the muscles have not had time to get out of the muscles and blood. A hot bath after exercise is a good thing. It helps us to get rid of these waste materials, and so lessens the feeling of tiredness. It also washes away from the skin the perspiration which exercise produces. **Exercise should always be taken regularly and in moderate amount, and, as much as possible, in the open air.** It is not good to sit still all the week and then to take violent exercise, such as a long bicycle ride or playing in a football match, on Saturday afternoon.

49. In different forms of exercise different muscles are used. We should so arrange our games and forms of exercise that most of our muscles are used. Different people like different kinds of sport and exercise. Swimming is one of the best and healthiest, because it brings into action nearly all the muscles of the body. Gymnastics of all kinds are valuable, if not overdone. Rope-climbing, parallel-bars, the vaulting-horse, and skipping are all very good, as they bring into play many of the body muscles. Dumb-bells, clubs, the horizontal ladder, ball-throwing, and tennis are good for the arm and trunk muscles. Walking, running, cycling, horse-riding, football, and many games of that kind, help to develop

the muscles of the legs. Drilling, especially in the open air, is an excellent training both for the body and for the mind. Weak children, who are unable to join in the more vigorous games of their playmates, will derive pleasure and plenty of fresh air from gardening. Very little children should be allowed to play out in the open air as much as possible. They should not be worried too much with gymnastics and drilling exercises, but allowed to do almost what they please in the playground.

50. It is very important to be properly dressed when taking exercise, especially when doing gymnastics. There should be nothing tight round the waist or legs or over the shoulders. During gymnastics we should be able to breathe as freely and deeply as possible. We cannot do that if we have tight braces over the shoulders or a tight pair of stays round the waist. It is very important for girls to remember this. Dress worn during gymnastic exercises should be quite loose, so as to allow full play for all movements.

51. We have seen how necessary and important exercise is for the proper growth and health of the body. Still, we can have too much even of a good thing. Exercise improves the circulation of the blood. At the same time, it makes the heart beat faster and so gives it more work to do. If we take too much or too violent exercise, such as racing, it puts too much strain on the heart and may soon make it unhealthy or diseased.

Too much exercise, especially just before a meal, may make us so tired that we have no appetite to eat; or it may so tire the body that the stomach cannot digest the

food we take. Exercise immediately after meals is also injurious.

52. We have seen that when muscles contract, they use up extra fuel or food. If we do a lot of hard work or take very much exercise we want more food. If this is not supplied, the body will get thin and we shall be more likely to get all kinds of diseases. When muscles are not used they get smaller and waste. They also become diseased and changed partly into fat. In people who are paralysed and cannot use a limb, the muscles are much smaller than in the sound limbs. People who are ill in bed for a long time also suffer in this way. When they get up again, the muscles are much smaller than usual and very soft and flabby. After a time, however, as the person gets stronger, so the muscles become stronger and bigger. A child healthy when born, if properly fed and looked after, will grow up to be a tall, healthy man or woman. As we have seen, this will only be the case if the child is given a sufficient quantity of good food, takes plenty of exercise in the open air and leads a healthy life generally.

53. In an earlier part of this chapter, we learnt what foods a growing child requires for the healthy growth of its body. Then, **healthy children should never be given alcohol** in the shape of beer, wine or spirits. Alcohol is quite unnecessary for children in health—it is not only unnecessary, but positively harmful. Lastly, as to *smoking*. **Smoking certainly seems to stop the growth of people.** Boys under twenty should never be allowed to smoke. Smoking not only delays the growth of the body, but, as we shall see later, has also a bad effect upon the nerves, the heart, the eyes, and the appetite in many cases, especially in young people.

CHAPTER IV

THE CHIEF ORGANS OF THE BODY

54. The *head* is the most important part of the body, for it contains the *brain*, which controls all our movements and feelings and enables us to think and reason. The brain likewise controls the working of all the other organs in the body. From the brain fine threads, called *nerves*, run all over the body. Along these threads messages are constantly sent to and from the brain, just as messages are sent along telegraph wires to and from a central office. The brain, being an all-important organ, is well protected from injury. It is contained in the large space at the top and back of the skull and is quite surrounded by bone. It is continued down the back of the body by a long nerve organ called the *spinal cord*. The spinal cord is well protected from injury, because it runs in a bony tunnel nearly to the bottom of the spine. Nerves run from the spinal cord to all parts of the body. Besides the brain, the head contains the eyes, the ears, and the nose, which are called *organs of sense*. These sense organs teach us a great deal about the things around us. We see them with the eyes, hear them with the ears and smell them with the nose. The mouth contains the tongue and the teeth. The tongue is used in speaking and in tasting

food. It also helps in chewing and in swallowing the food. The teeth are used in chewing and grinding up food before it is swallowed.

55. In front of the neck is the voice-box or *larynx*. This can easily be felt by putting two fingers at the top of the neck in front and then swallowing some water. The voice-box will be felt to move upwards during swallowing. In men sometimes the voice-box sticks out very much and is then known as 'Adam's apple.' Running down from the voice-box into the chest is the windpipe or *trachea*, and behind this is the food-pipe or *gullet*.

56. Most diseases are caused by *germs* or *microbes* which get into the body from the air or with our food. Microbes are so very small that they cannot be seen with the naked eye, but only when examined under a microscope which magnifies them very much. Microbes are found everywhere and occur in large numbers in the mouth, in the air we breathe, and in the food we eat and drink. Many of the microbes of the air and food are harmless, but some of them, when they get into the body, produce diseases such as consumption, diphtheria, and typhoid fever. In different parts of the body there are small fleshy organs called *glands*. The glands act as filters and keep back any microbes of disease which may get into the body. Sometimes when the glands have filtered very many germs they become swollen and inflamed. Thus, when we have a poisoned finger, it is due to a large number of microbes getting into the wound. These microbes are carried up the arm and are filtered off by the glands in the armpit, which become swollen and painful. The glands at the

sides of the neck often become swollen and diseased through filtering too many microbes from the mouth and throat. They may then be dangerous to health, and you should always consult a doctor about swollen glands.

57. The *trunk* is that part of the body left after taking away the head and neck, the arms and legs. It is divided into two parts by a fleshy partition called the midriff or *diaphragm*. The upper compartment is known as the chest or *thorax*, the lower as the belly or *abdomen*. People often call the abdomen, the stomach. That is wrong, for the stomach is the name of only one organ in the abdomen.

58. The *chest* consists of a bony framework or cage which protects the vital organs, the heart and lungs. The bony cage of the chest is formed by the spine at the back, the breast-bone in front, and the ribs at the sides. The floor of the chest is formed by the midriff. Inside the chest is the *heart*, which lies in front, just behind the breast-bone. The heart is not exactly in the middle of the chest, but lies a little to the left of the middle. At the top of the heart are the large blood-vessels by which blood leaves the heart and returns to it again. The lungs lie on each side of the heart, and overlap it in front to a large extent. In Fig. 4, the lungs have been pulled aside a little to show the heart more fully. The heart and lungs fill the chest and lie on the midriff.

59. Covering the inner surface of the chest and the outer surface of the lungs there is a very smooth membrane called the *pleura* or chest membrane. This allows the parts to slide over one another easily in

breathing. When this membrane becomes inflamed and diseased the condition is called *pleurisy*, and there is then pain on breathing, because the surfaces are no longer smooth. The heart is also covered with a smooth membrane and is enclosed in a strong fibrous bag called the *pericardium*, which is lined by the same smooth membrane.

60. The *windpipe* runs down from the throat and joins the two lungs. The *gullet* runs down the back of the chest from the back of the mouth and passes through the midriff into the abdomen.

61. In the *abdomen* are the various organs which are used in the digestion of food. On the left side, just under the midriff, is the *stomach*. In a healthy person a large part of the stomach is protected by the bony cage of the chest. The stomach is a large hollow bag, roughly pear-shaped, with its narrow end towards the right. At its upper end the stomach is joined by the food-pipe. At the other end it is continued into a long, hollow tube called the bowel or *intestine*. The bowel is about 26 feet long, so in order to pack these 8 or 9 yards of tubing in the abdomen it forms many twists and turns. The first 21 feet of the intestine are narrower than the rest, and are called the *small intestine*. The last 5 feet are wider and straighter and are called the *large intestine*.

62. Where the small and large intestines join, near the bottom of the abdomen on the right side, is a small part of the bowel called the *appendix*. It is about three inches long and closed at one end like the finger of a glove. When this little organ becomes inflamed it gives rise to a painful and sometimes dangerous illness called

appendicitis. On the right side of the abdomen, just below the midriff, is the large, solid, fleshy *liver*. Like the stomach, the liver is, in a healthy body, almost

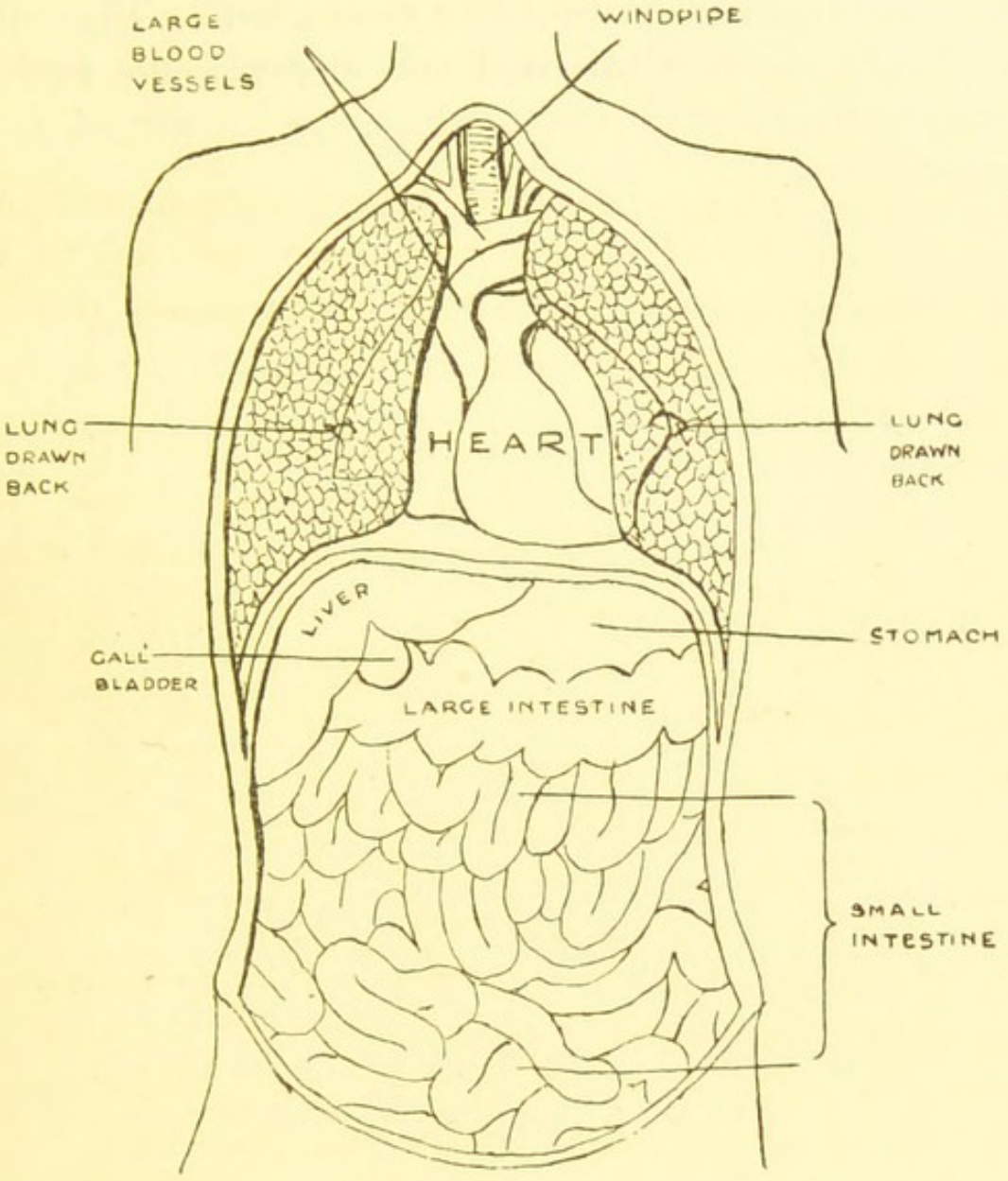

FIG. 4.—THE CHIEF ORGANS OF THE BODY.

entirely protected by the bony cage of the chest. On the under side of the liver is a small, pear-shaped bag called the *gall-bladder*. The abdomen also contains the *sweetbread*, the two *kidneys*, the *bladder*, and the *spleen*

or *milt*. The whole of the interior of the abdomen is lined with a smooth membrane called the *peritoneum*, or abdomen membrane. Nearly all the organs in the abdomen are quite covered with this membrane, so that the intestines can move easily over them. When the membrane becomes inflamed and diseased, the surface becomes rough, and the condition is known as *peritonitis*.

CHAPTER V

THE HEART AND BLOOD-VESSELS

63. Whenever we cut or prick ourselves, no matter in what part of the body it may be, one or more drops of a bright red liquid will escape from the injured part. That bright red liquid is the blood which, during life, is found in every part of the body. Every organ and every tissue of the body has blood supplied to it, just as every house in a street has its supply of fresh water. The blood carries to the tissues and organs all the food and other nourishments they require to do their work properly. It also brings away from the tissues the waste substances they want to get rid of. The blood also distributes evenly over the body the heat produced by the muscles and liver. The organs do not contain blood as a sponge holds water, but the blood runs all over the body in a system of pipes called *blood-vessels*, just like the water or gas pipes in a house.

64. Blood as it escapes from a cut or wound is usually bright red in colour and opaque—that is to say, it is impossible to see through it. Blood is opaque because it has in it a very large number of exceedingly small bodies called blood cells or *corpuscles*. These corpuscles are so small that over three thousand of them placed side by side would measure only 1 inch. Being

so small they cannot be seen with the naked eye but only on examining the blood under a microscope. There are two kinds of blood-corpuscles, the red and the white, the red being far more numerous than the white. These blood cells float in a clear, colourless liquid which is like thin white of egg in its composition.

65. In the body of a healthy person the blood is always liquid. When any part of the body is pricked or cut, blood runs out just as water does from a burst pipe. Very soon after blood escapes from the body it congeals or *clots*. If you collected some blood in a glass vessel you would find that, after a few minutes, the blood could no longer be poured out of the vessel, as it had become like a jelly. After some hours this jelly becomes altered in appearance. There is a firm, solid, red part or *clot*, floating in a clear, pale-yellow liquid. The clot contains all the cells (red and white) of the blood entangled in a stringy substance called *fibrin*. The clear liquid in which the clot floats is almost the same as the blood liquid as it exists in the body. As we shall see later, clotting is Nature's way of stopping bleeding. If it were not for this clotting power of the blood we should bleed to death, even from slight cuts and wounds.

66. We have already seen that the blood has to carry food and nourishment to the various organs and also to bring the waste substances away from them. You would therefore expect that the blood found in different parts of the body would not be exactly the same in composition, and that is really the case. In order to understand what is meant by good and bad blood, we must learn first the uses of the different parts of the blood.

67. The blood liquid carries food nourishment to all the tissues of the body to enable them to perform their duties. It also brings away from the tissues the waste materials which are no longer of any use. The two most important of these are (*a*) *carbonic acid gas* (CO_2), and (*b*) a chemical substance called *urea*. All the tissues of the body are constantly forming these waste materials, which they send into the blood to be got rid of. The carbonic acid gas is removed from the blood by the lungs during breathing. The urea is removed by the kidneys and passes from the body in the urine.

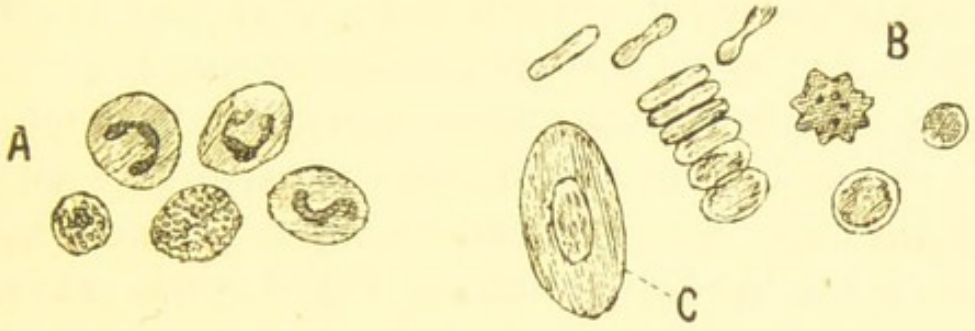

FIG. 5.—THE CORPUSCLES OF THE BLOOD.

A, White corpuscles; B, red corpuscles of man (some are seen on the flat, others edgewise); C, nucleated red corpuscle of frog.

68. The red corpuscles have the power of taking up into their substance the gas called *oxygen* which they carry to all parts of the body. Without oxygen we cannot live. Our muscles and other tissues require oxygen to burn up the fuel brought to them by the blood, just as a steam-engine requires air to burn up the coal in its fire. The white corpuscles of the blood act as the dustmen of the body. They can kill and destroy the microbes of disease which may get into the body. They can also destroy any dirt particles. These germs and particles of dirt are usually taken by the white corpuscles to the filtering glands which exist in

the neck, armpits, and elsewhere in the body. The white corpuscles also help to heal injuries such as cuts, ulcers, and even broken bones.

69. To sum up, then, we may say that the blood-liquid (1) takes food nourishment to all the tissues, and (2) brings away the waste materials, carbonic acid gas and urea, from them. The red blood-corpuscles act as carriers of fresh air or oxygen to all parts of the body. The white corpuscles help to destroy the microbes of disease and to heal injuries.

70. The blood going to the tissues contains much food nourishment and much oxygen, and is therefore *good blood*. The blood coming from the tissues contains little food nourishment and oxygen, but much of the waste substances, urea and carbonic acid gas, and is therefore *bad blood*. Good blood, containing much oxygen, is bright red in colour. Bad blood, containing much carbonic acid gas, is dark purple in colour. Bad blood is purified in the lungs during breathing, so we find that the blood going to the lungs is dark purple in colour, while the blood coming from the lungs is bright red. You see that even in health there is always bad blood in some parts of the body, but it is being constantly purified in its passage through the lungs and kidneys.

71. In many diseases the blood is bad in all parts of the body. The blood may contain too few red cells, and is then very pale in colour. Such a condition is called *anæmia*, or poorness of blood. When the lungs or heart are badly diseased, the blood always contains too much carbonic acid gas, and is therefore darker in colour than usual. When the kidneys are diseased, the waste

substance—urea—is not properly removed from the blood and accumulates in the body. In many diseases —such as consumption, typhoid fever, etc.—the microbes or germs of the disease are present in the blood and may be carried by it all over the body.

72. When blood is bad from the presence of too much carbonic acid gas and too little oxygen in it, all the organs of the body are affected. The brain is less active than usual, which makes us less inclined to study and think; food is not properly digested; the muscles cannot work as well as they should, and headaches are frequent. People whose blood constantly contains too much carbonic acid gas through not breathing pure air, become pale and unhealthy-looking and are liable to catch serious diseases, especially of the lungs.

The way to avoid all these bad effects is: (1) **To let as much fresh air as possible into your houses,** and especially into the bedrooms at night; (2) **to breathe deeply** as often as you can, so as to get as much pure air as possible into your lungs; (3) **to take plenty of exercise** in the open air, so that the blood may flow freely to the lungs to be purified, and then be carried to all the organs of the body.

73. When there is too much of the waste substance urea in the blood, headache, giddiness, and other unpleasant sensations are produced. When we eat too much nitrogenous food, such as meat, we get a great deal of urea in the blood. This can be avoided by taking plenty of exercise or by doing hard manual labour. When we cannot take much exercise we should never eat too much meat. Except when working very hard, most people require meat only once a day.

74. The same food which makes good flesh and bone in babies makes good blood. Such food must contain plenty of nitrogenous or flesh-forming and of mineral matter. The substances required are all present in the natural food for babies—namely, milk. Older children and grown-up people require the same foods to make good blood, only they take them in a different form. The nitrogenous and mineral matter are best taken in the form of eggs, fish, chicken, and meat. Oatmeal, peas, beans, and lentils are also good. Fruit and vegetables contain much mineral matter (especially phosphate of potash) which is necessary to make good blood. Children and adults should, therefore, always take plenty of fruit and vegetables. Young girls often live chiefly on tea and bread-and-butter. Such food does not contain enough nitrogenous and mineral matter, and consequently their blood becomes poor and watery.

75. To sum up, then, we may say that to make the blood good and to keep it good, we should:

(1) Eat plenty of the necessary foods mentioned above, but avoid too much meat.

(2) Breathe as much pure air as possible.

(3) Take plenty of exercise, especially in the open air.

76. We have already learnt that in the body the blood flows in pipes or tubes called the blood-vessels. The heart, by its beat, keeps the blood always moving forward. This is what is meant by the *circulation of the blood*. The blood-vessels through which the blood flows are not the same all over the body. The blood comes out of the heart through two large pipes called *arteries*. These pipes split up like the trunk of a tree into smaller and smaller branches, until at last there are so many

fine pipes that they are found all over the body. These very fine pipes are much thinner than a hair so that they cannot be seen with the naked eye. They are called *capillaries* and are so plentiful and so close together, that no matter where we may prick or cut ourselves blood always flows from them. The capillaries gradually join together again to form larger and

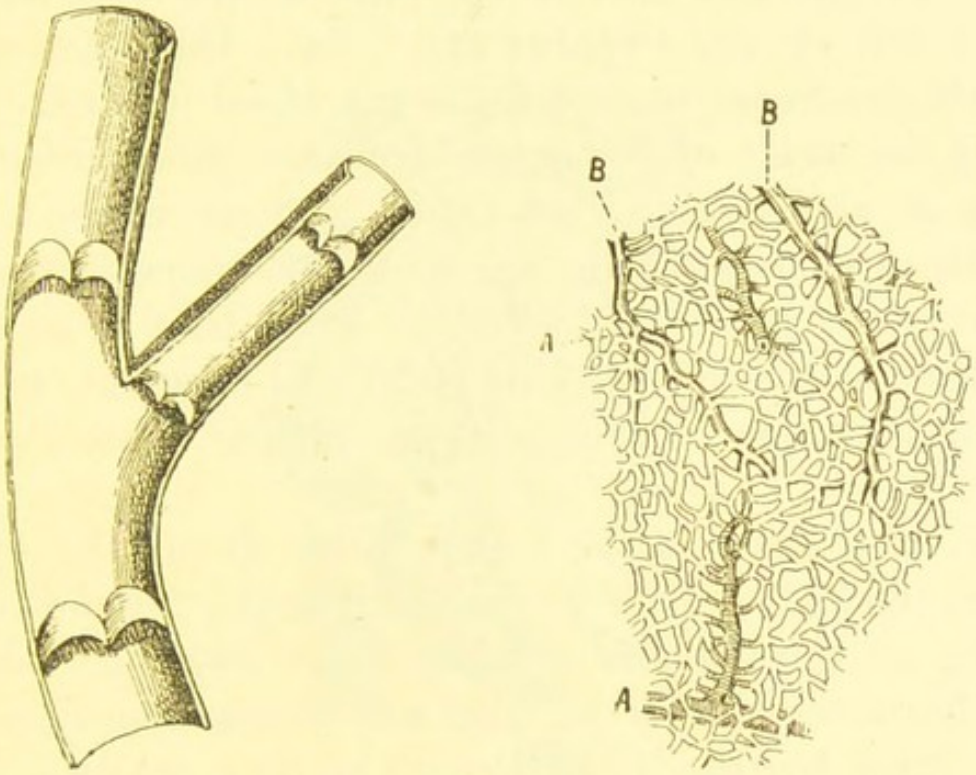

FIG. 6.—VEIN CUT OPEN TO SHOW THE VALVES. DIAGRAM OF A NETWORK OF CAPILLARIES.

A, Artery; B, vein.

larger pipes through which the blood runs back to the heart. These blood-vessels which carry the blood back to the heart are called *veins*.

77. The arteries have thick, strong walls made up of *fleshy* substance (muscle) and a substance like india-rubber called *elastic tissue*. The walls of the capillaries are extremely thin, consisting only of one layer of cells —thinner than the finest tissue paper. All the organs

are full of these fine capillaries, so that nourishment, such as food and oxygen, can pass out of these fine pipes into the tissues. At the same time the waste materials from the tissues, such as carbonic acid gas, pass into the capillaries and so get carried into the veins and back to the heart. The veins have thinner walls than the arteries and are made up chiefly of supporting or *connective tissue*. The bluish lines at the back of the hand and up the forearm are veins. Their thin walls enable you to see the colour of the blood in them. All along the inside of the veins there are little pockets or flaps of membrane called *valves*. These valves allow the blood to flow only in one direction—namely, onward towards the heart. Directly the blood tries to go back the little valves fill up with blood and open out, and so prevent the blood getting back any further. (See Fig. 6.)

78. The heart is the pump which drives the blood round the body. It is a wonderful organ because it is acting all through life whether we are awake or asleep. If it beats very feebly, we faint and become unconscious. If it stops beating for any length of time, we die. The heart is a fleshy or muscular organ much like the muscles by which we move the bones. It is a hollow bag divided into four compartments. The two upper compartments are called the *auricles*, the two lower compartments the *ventricles*. The auricle and ventricle on the right side of the heart are completely separated from the left auricle and ventricle by means of a fleshy partition. In the floor of each auricle there is a hole through which the blood flows down into the ventricle of the same side. At each hole there is a valve which fills out, like the valves in the veins, directly the

blood tries to flow back from the lower into the upper compartment. All four compartments of the heart have blood-vessels leading from them, by which the blood comes into and leaves the heart.

79. The circulation of the blood is rather difficult to follow, but by carefully reading the account of it and

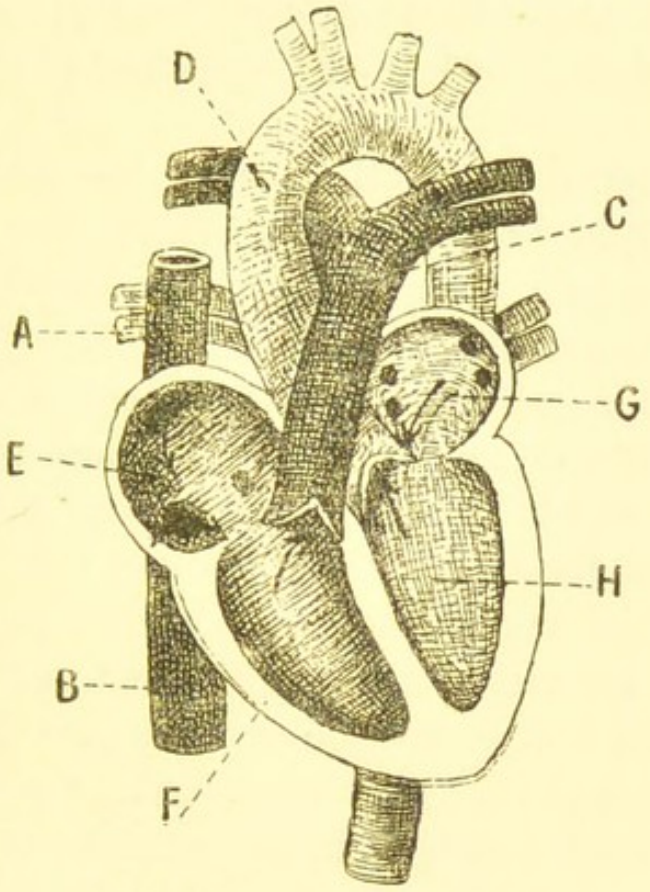

FIG. 7.—DIAGRAM OF THE HEART.

A, Superior vena cava; B, inferior vena cava; C, pulmonary artery; D, aorta; E, right auricle; F, right ventricle; G, left auricle; H, left ventricle.

tracing it out on the diagram much of the difficulty will, I hope, disappear. The blood in the left side of the heart is good blood, so this will be a good starting-point. The left ventricle drives the good blood into one very large artery called the *aorta*. This artery, by means of the smaller arteries into which it divides, carries good

blood (containing much oxygen and food nourishment) to the brain, muscles, stomach and every part of the body *except the lungs*. On its way through these tissues (brain, muscles, etc.) the blood gives up oxygen and nourishment to the tissues, and receives in exchange CO_2 and other waste substances from the tissues. The blood as it passes through the walls of the stomach and intestines receives digested food which it carries to the heart to be distributed to all the organs of the body.

80. The blood from all parts of the body *except the lungs* is carried back to the heart by two large veins, called the *superior vena cava* and the *inferior vena cava*, which open into the *right auricle*. The blood in the right auricle is good blood because it contains much food nourishment, but it is also bad blood because it contains much CO_2, which it has collected from all the organs and tissues of the body. On account of the large amount of CO_2 and the small amount of oxygen in it, the blood in the right auricle is dark purplish-red in colour. From the right auricle this dark blood flows into the right ventricle. The next time the heart beats, the blood, which cannot flow back into the auricle on account of the valve at the opening, leaves the ventricle by the *pulmonary artery* which goes to the lungs. In the lungs this artery divides into smaller and smaller branches, and finally into capillaries. Through the very thin walls of these capillaries the CO_2 passes out of the blood which receives oxygen in exchange. In this way the dark impure blood, which was carried to the lungs from the right side of the heart, is changed to bright red pure blood. This pure blood is carried from the lungs by the *pulmonary veins* to the *left auricle*. From the left auricle

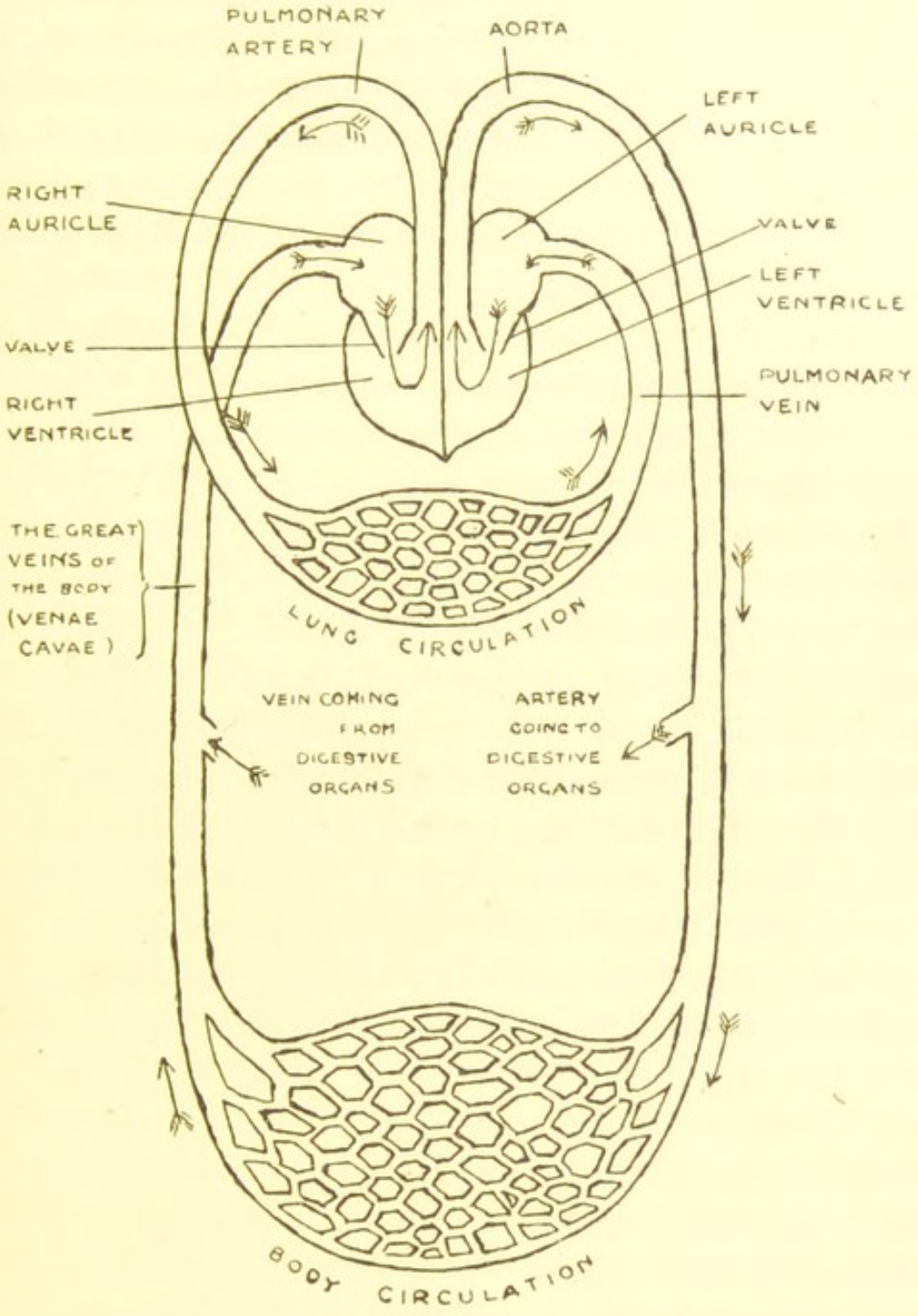

FIG. 8.—DIAGRAM OF THE CIRCULATION.

The arrows indicate the direction in which the blood flows. Note the valve between the auricle and ventricle on each side of the heart, which prevents the blood flowing back from ventricle to auricle.

the blood flows into the left ventricle, which was the place from which we started. The blood in the left auricle and ventricle is the purest and best blood, because it contains much oxygen and little CO_2 (having just been purified in the lungs) and very much food nourishment, which was brought to the right auricle from the digestive organs.

81. You will see from this account of the circulation that there is really a double circulation going on the whole time. Every time the heart beats, blood is driven (1) by the left ventricle all round the body (except the lungs), and (2) by the right ventricle through the lungs. The first is called the *body* or *systemic circulation*, the second the *lung* or *pulmonary circulation*. The heart beats in this way sixty or seventy times a minute in a healthy adult, and so makes the blood flow rapidly round the body. The flow of blood is kept up in the arteries by the force of the heart and the elastic nature of the arterial walls. By the time the blood reaches the veins —having then passed through the very fine capillaries— the force of the heart-beat is lost, so that it can no longer drive the blood on. The flow of blood in the veins is kept up chiefly by the movements of the muscles and by the act of breathing. We now see why plenty of exercise and deep breathing are so necessary to keep up a good circulation of the blood. The valves present inside the veins also help to drive the blood on towards the heart.

82. The action of the heart is under the control of the brain, but not of the will. We cannot 'will' to make the heart beat faster or more slowly, as we can 'will' to

make the muscles of our arm contract. When we are nervous or excited, however, the brain can make the heart beat more quickly. When this is very marked we may even feel the heart knocking against the chest-wall, which is known as 'palpitation.' In the same way the arteries can, under the influence of the brain, become wider or narrower when necessary. Thus when any organ is doing more work than usual, its arteries become wider so that more blood can come to it. In that way the organ gets more nourishment (food and oxygen), and its waste substances are carried away more quickly. A good example is the widening of the vessels of the abdomen which occurs after a meal when the organs in the abdomen are all busy digesting the meal. Less blood then goes to the brain and skin. The result is that after a heavy meal we do not feel inclined to think or work much because less blood goes to the brain, and we also feel 'chilly' because less blood goes to the skin. You remember the saying, 'After dinner rest awhile'; well, now you know why. It is to allow the food to be properly digested, and not to force the blood to the brain and muscles by working them too soon after dinner.

83. Let us now consider bleeding and its dangers. Bleeding occurs when any blood-vessel is damaged so that a hole is produced in its walls. Bleeding may be of three kinds according to the vessel damaged—namely, (1) capillary bleeding, (2) arterial, and (3) venous.

(1) *Capillary Bleeding.*—When we cut or prick the finger-tip where there are no large arteries or veins, the blood comes out in drops from the capillaries. After a short time, however, Nature stops the bleeding in her

own way by causing the blood to clot in the tiny cut pipes. To treat a cut we should therefore help Nature as much as possible. The best way is to suck the wound or to hold it under a tap and let warm water run on it for a short time. This will increase the bleeding a little and get rid of any dirt or disease germs which may have got into the cut. It is also a good thing to wash the skin around the wound with soap and water and then with a weak antiseptic lotion (such as Condy's fluid or carbolic acid lotion, 1 part of the acid in 40 parts of water). A pad of clean linen or a piece of lint should be placed over the wound and tied on tightly with a bandage or piece of tape. Nature will then cause the blood to clot in the small vessels, and in a few days the wound will be healed.

(2) *Arterial Bleeding.*—When an artery is injured the blood that comes from it is bright red in colour, as it has come direct from the left side of the heart. Each beat of the heart drives the blood through the arteries, so the blood from a cut artery escapes in little spurts or jets corresponding with each beat of the heart. Unless the bleeding from an artery is stopped quickly, the person will lose a large quantity of blood, which may bring on a faint. When a person faints he usually turns very pale, because very little blood goes to his head and face; he also falls down and becomes unconscious, because too little blood goes to his brain. When the cut artery is not very big, Nature may again be able to stop the bleeding by causing the blood to clot in the vessel. Persons who have fainted on account of the amount of blood they have lost (I do not mean those who faint from the pain of the cut or the mere sight of the blood) should never be given brandy, sal-volatile, or other

stimulants. While they are faint the heart is acting less strongly, and that is another way in which Nature helps to produce clotting in the cut pipe. When a very large artery is cut the blood rushes out so quickly and with so much force that, unless the bleeding is stopped at once, the person will probably bleed to death. The best way to stop the bleeding from an artery, say, in an arm or leg, is to tie a bandage very tightly round the limb above the cut. That will press on the chief artery of the limb and prevent blood getting down it.

(3) *Venous Bleeding.*—When a vein is cut the blood comes from it, not in jets or spurts, but with a steady, even flow. The colour of the blood is dark purplish-red, and not bright red as from an artery. Tying a bandage on a limb below the cut will stop the bleeding from a vein. Bleeding from an arm or leg is also lessened by holding the limb straight up in the air until proper treatment can be used.

84. We have seen that one danger of bleeding is that a person may faint or even die from the amount of blood lost from the body. Secondly, there is always the danger that dirt or disease germs may get into the wound and poison it. If that happens, there will be pain in the cut after a few days, the parts around will become hot, tender, swollen, and painful, and an abscess containing 'matter' may form. Even from a slight cut a person may get severe blood-poisoning which in rare cases leads to death. A third danger of bleeding is one which occurs in people who constantly lose quantities of blood from any cause. Such people often become very pale, because their blood is watery and contains too little colouring matter.

85. When we take exercise we make the muscles of the body do more work. When the muscles work they want more blood, therefore during exercise the heart beats faster and stronger than when we are resting. The extra work done by the heart sends the blood round the body more quickly, and so all the organs of the body get supplied with more blood. Our breathing is also quicker during exercise. The action of the muscles of the limbs and of breathing drives the blood on in the veins, and in that way improves the circulation. If we do not take exercise but stand about much, the weight of the blood makes it collect in the veins of the legs and abdomen. This causes the veins to swell and stand out, especially in the legs, where they are known as *varicose veins*. In people who stand much, such as shop-assistants, the liquid part of the blood often soaks through the walls of the blood-vessels into the parts around, and causes swelling of the legs and ankles, especially at night. People who do not take much exercise often have a bad circulation and suffer from cold or 'dead' fingers and chilblains. We must also remember that if we press too much on any part of the body the circulation may be hindered. Such things as stays, garters, collars, and braces should be loose, so as not to press on the blood-vessels and in that way hinder the circulation of the blood.

86. We have seen that exercise gives the heart more work to do, in order to feed the muscles with extra blood. Exercise therefore throws more strain upon the heart. This greater force of the heart-beat produces a greater strain on the large arteries. When exercise is taken in proper amount, and enough food is eaten, the heart and

blood-vessels are able to stand the extra work given them to do and are even the better for it. If too violent or too much exercise be taken, however, the heart and blood-vessels may not be able to stand the strain and may then become diseased. Young men who go in too much for athletics—such as rowing, jumping, running, etc.—in this way often contract heart disease, from which they never recover. People who are not strong or who already suffer from heart or lung disease, should seldom take violent exercise but mild exercise, such as walking, tennis, croquet or other games of that kind.

87. By taking too much food at any meal we overload the stomach and make it swell out. If you look for a minute at Fig. 4 you will see that the heart and stomach are very close together. If we eat too big a meal the stomach may press the heart upwards and prevent it beating properly. That explains the pain people often get 'over the heart' after taking a big meal. They think the pain is there because they have heart disease. In most cases there is no sign of heart disease, but it is simply the pain of indigestion, due to eating too much food or eating it too quickly. Drinking too much—especially 'gassy' liquids like lemonade and soda-water—swells the stomach out with liquid and gas, which may also make it press on the heart and interfere with its action.

88. Constantly eating too much may act on the heart and blood-vessels in other ways. If we eat too much fattening food, such as bread, potatoes, sweets, and pastry, and do not take enough exercise to use it up in the muscles, we are apt to become too stout owing to fat being stored up in the body. Not only is it unpleasant and incon-

venient to be too stout, but, under those conditions, *the heart becomes fatty* and cannot keep up a good circulation of the blood. Too much beer-drinking also makes people very fat.

89. We have seen that a certain amount of nitrogenous food is necessary to repair the waste of the tissues which is constantly going on. Too much of such food is distinctly harmful, especially if we do not take much exercise. It makes the heart beat more forcibly, which leads to weakening and disease of the walls of the arteries. Later on this may lead to disease of the kidneys and sometimes to serious bleeding in the brain. Middle-aged and elderly people should therefore always eat less meat than they did when young.

90. Let us now consider the effect of smoking. Boys under twenty should never be allowed to smoke. Men over twenty often find a pipe or cigar soothing to the nerves, especially after a good dinner. Smoking in moderation probably does no harm, provided the tobacco be not too strong and cigarettes be avoided. Smoking too much—especially strong cigars and tobacco, and, above all, too many cigarettes—has a very bad effect upon the heart. It makes the heart beat too fast and irregularly, and acts in every way as a heart poison. Even quite a few cigarettes a day may have this effect upon the heart of young boys, and for this reason, I say, boys should never be allowed to smoke.

91. Then what is the effect upon the heart of taking alcoholic drink? Alcohol in small quantities is a stimulant to the heart. It makes the heart beat more quickly and with greater force. When we are in good health it is unwise thus to stimulate the heart with

alcohol, because we are then using up its reserve strength which is often necessary to help us through any severe illness we may get. Alcohol not only stimulates the heart and improves the circulation for a time, but also stimulates the brain and muscles to do more work. After a short time, however, this stimulating effect of alcohol upon the heart and circulation, muscles and brain, disappears, and is followed by the opposite effect —namely, that of depression. Then the heart, muscles, and brain work more slowly and more feebly than before. Large quantities, especially of strong alcoholic drinks, such as whisky or gin, have a distinctly poisonous effect upon the heart, and people have been known to die almost at once after drinking a large amount of whisky, particularly on an empty stomach. **Children and young people should never be given alcoholic drink when in health**, because the poisonous effects upon the young heart are very marked.

92. In disease alcohol is often of great benefit, especially in severe illness when the heart is acting feebly. Drinkers who become seriously ill with pneumonia or influenza, for example, often die from failure of the heart. Temperate people and total abstainers are much more likely to recover from such illnesses. We may sum up, therefore, and say that: (1) Healthy children should never take alcohol; (2) healthy young people do not require it, and are better without it; (3) too much alcohol is bad, not only for the heart and circulation, but for most of the organs of the body, and people who drink too much are liable to suffer from diseases of various organs; and (4) alcohol is often of great value in severe illness.

CHAPTER VI

THE LUNGS AND RESPIRATION

93. We have learnt in the chapter on the circulation of the blood that impure blood, containing much carbonic acid gas, is taken to the lungs to be purified, and that in the lungs it parts with its carbonic acid gas, and receives oxygen in exchange, by means of which the blood is made pure again. Every cell of the body requires oxygen to carry on its work properly; every cell likewise makes carbonic acid gas, which it sends into the blood. This carbonic acid gas, which makes the blood impure and dark purplish-red in colour, is removed from the blood in the lungs and finally gets out of the body in the breath. It then mixes with the air of the room, which it makes gradually more and more impure.

94. The presence of carbonic acid gas in the air we breathe out can be shown by a simple experiment. Get some lime-water from the chemist and put it into a bottle. Shake the bottle so as to mix the air and lime-water well. The lime-water remains clear. Blow into the bottle for a minute or two, then put the cork in and shake the bottle again. The lime-water will now turn milky from the presence of a fine white powder in it. This powder is chalk, or carbonate of lime, which has

been formed from the lime in the water and the carbonic acid gas in the air breathed out.

95. The air we breathe out—that is, the *expired air*—contains less oxygen and more carbonic acid gas (CO_2) than the air we breathe into the lungs or the *inspired air*. Expired air is also warmer than the inspired air, because it has been warmed up by the heat of the body. It is also moister than inspired air, as can be easily shown by breathing on a looking-glass or window, when the glass will become 'steamy' owing to the deposit of moisture on it from the breath. The changes which take place in the inspired air are brought about in the lungs and air-passages during the process called breathing or *respiration*. We have seen, however, that every cell of the body takes up oxygen and gives out carbonic acid gas.

96. The parts used in breathing are as follows: The *nose*, which leads into the back of the mouth called the *pharynx*. At the bottom of the pharynx is the voice-box or *larynx*, from which the windpipe or *trachea* is continued down the neck into the chest. In the chest the windpipe divides into two main branches (*bronchial tubes*), one for each lung. After entering the lung, the bronchial tube splits up into smaller and smaller tubes, each of which ends finally in a cluster of little air-sacs, like a bunch of grapes.

97. The *larynx* is a box made of gristle or cartilage, in which are found the two folds of tissue (*vocal cords*) by which we produce the sounds of the voice in talking and singing. The windpipe is a stiff tube with rings of gristle all along it which help to keep the tube open, otherwise we should not be able to breathe. It is lined

with a layer of moist membrane which helps to warm the expired air and to make it moist. On the surface of this moist membrane are very delicate, hair-like threads. These threads are constantly moving in one direction, towards the mouth, in a wave-like manner resembling the wave-like movements produced when wind blows over a field of tall corn. In this way any small particles of dirt or any expectoration formed in the lungs or bronchial tubes, are gradually carried towards the larynx and then got rid of by coughing.

98. The lungs, called by butchers the 'lights' because they float in water on account of the air in them, are contained in the chest, one on each side of the heart. They are covered by a smooth membrane, the *pleura*, which allows them to move easily in the chest during breathing. The lungs are soft and spongy to the touch, and usually pale pink in colour in animals. In people who live in towns all their life the lungs become dark grey on account of all the particles of dirt and soot inhaled with the air. The substance of the lung is made up of the bronchial tubes which, by frequently dividing, end finally in the little air-sacs and air-cells. These are so small that they can only be seen with a microscope. In the walls of these air-cells there is much *elastic tissue*, and very fine capillaries are also present. The walls of these capillaries and air-cells are so thin that the CO_2 of the blood can easily pass through them into the air in the air-cells. At the same time, the oxygen can pass from the air of the air-cells into the blood and so purifies it.

99. Owing to the presence of the large amount of elastic tissue like indiarubber in the lungs, these

organs are as elastic as a toy balloon. If you blow into such a balloon it fills with air and gets bigger. When you leave off blowing the balloon gets small again and the air rushes out. It is just the same with our lungs. When we take a breath we draw air into the lungs which fill out; when we stop breathing in, the blown-out lungs get smaller again like the balloon, and the air is forced out. This happens every time we breathe, which is about sixteen times a minute.

100. The act of breathing can be divided into two steps or stages: (1) Breathing-in air, which is called *inspiration;* and (2) breathing-out, which is called *expiration.* In inspiration we use certain muscles joined to the ribs, by which the chest is made bigger. If you stand in front of a looking-glass and look at your chest while taking a deep breath, you will notice that the chest expands or gets larger. The ribs are lifted up and the the breast-bone is pushed forward, so that the chest gets bigger from side to side and from front to back. At the same time the chest or thorax, becomes deeper inside by the action of the midriff or diaphragm, which becomes flatter and lower. When the chest thus gets bigger in inspiration, the lungs fill out with air so as to fill the chest. In the second stage of breathing, or *expiration,* we do not use many muscles, but the lungs simply get smaller because they are elastic and have been stretched during inspiration, just as the stretched toy-balloon gets smaller when we stop blowing air into it. We can therefore understand why tight clothes, such as tight stays and braces, are so harmful. They prevent the chest expanding properly, so that sufficient air never gets into the lungs when tight clothing is worn.

When we breathe-in deeply, and also when we breathe-out forcibly, we use many more muscles than when we breathe gently in the ordinary way.

101. We have already seen one important connection between breathing and the circulation. By breathing, impure blood containing much CO_2 is taken to the lungs where it is purified, losing its CO_2 and receiving oxygen in exchange. In addition to this, respiration improves the circulation in several ways: (1) It makes the heart beat more strongly and quickly; (2) it draws more blood into the lungs; and (3) it sucks blood into the heart from the large veins (the *venæ cavæ*) which join it. In three ways then breathing, especially deep inspiration of air, helps and improves the circulation. In order to get the full benefit of this improved circulation, however, it is necessary that the air we breathe should be pure air containing plenty of oxygen and very little carbonic acid gas. If the air we breathe is impure, then the blood taken to the lungs can never be properly purified. It will never get rid of its CO_2 and never receive a full supply of oxygen. As a result, the blood which gets back to the heart from the lungs is never good blood, and therefore the tissues of the body, never receiving good blood, cannot do their work properly.

102. After running a race or sometimes even a short distance, one pants for want of breath. That is what is meant by being 'winded.' Running causes more fuel to be burnt up in the muscles, and to burn up this fuel properly more oxygen is needed than when we are at rest. The heart beats faster so as to send more blood to the lungs to fetch the oxygen, and when this oxygen cannot be supplied quickly enough for the muscles to

use we get winded. By training we can learn to run longer and longer distances before getting winded. People suffering from lung or heart disease are often short-winded because they do not get sufficient oxygen for the needs of the body. People who have poor, pale blood also become winded on going upstairs, for example, because their blood has too little of the red colouring matter in it. We have already seen that it is the red colouring matter of the blood which carries the oxygen from the lungs all over the body.

103. You may think it unnecessary for me to write a paragraph telling you the proper way to breathe. You will say, 'Surely everyone knows how to breathe, just as he knows how to walk and stand!' but you are mistaken. Just look round about you and see how many (for I am sure there are some) people are breathing with the mouth open. All those who are doing so *are not breathing in the proper way.* We should **always breathe through the nose** and not through the mouth. In breathing quietly the mouth should always be kept closed. When we have a 'cold in the nose,' the nose is blocked by thick fluid and then we are forced to breathe with the mouth open. We should also take good deep breaths now and again, especially when we are out in the open air where the air is purer than inside houses and schools.

104. In the first place, by breathing through the nose, the air we take in becomes warmed before it reaches the windpipe and lungs. If we constantly breathe cold air through the mouth it is apt to lead to disease of the lungs and air-passages. After coming out of a warm room at night it is very important to breathe through

the nose, so that the cold night air may not strike upon the lungs. Secondly, the air in passing through the nose becomes moist as well as warmer. Air which is very dry is irritating to the throat and lungs. When a room is warmed by hot pipes, or by a gas-stove, the air in the room is apt to become very dry, which causes a tickling sensation in the throat and makes us cough. For this reason there should always be a dish with water placed near the hot pipes, or the gas-stove, so as to keep the air of the room moist. Thirdly, by breathing through the nose we can at once smell any harmful vapours, too much smoke, or 'stuffiness' in a room. We then know that the air in the room is not good to breathe and should be purified by opening the windows. Lastly, and by no means the least important, the nose acts as a filter and prevents particles of dust and germs of disease getting down into the lungs. Just think of the amount of black which comes from the nose each time you use a handkerchief on a foggy day. If you did not breathe through the nose all that black dirt would get down and irritate the lungs. As the nose in this way gathers together disease germs, we should remember to use our handkerchief often to get rid of these germs. The frequent use of the handkerchief will also free the nose of any fluid which may prevent nose-breathing, which is so necessary for good health.

105. Children should be taught when quite young to breathe through the nose. If they get used to doing so when awake they will soon learn to sleep with the mouth closed. Sleeping with the mouth open makes people snore, which is very unpleasant for anyone sharing the same room. Breathing through the mouth

at night makes the tongue very dry and causes an unpleasant taste in the mouth on getting up in the morning. This often happens when we have a 'cold in the nose.' Constantly breathing through the mouth by day leads to serious results to a child's health, both of the body and of the mind. The child with its mouth always open has a dull, heavy, and stupid look. The nose becomes compressed from side to side, and the nostrils are small. The child does not talk well, and cannot pronounce the letters *m* and *n* properly. The hearing often becomes affected. Sufficient air does not get into the lungs, and the chest becomes deformed as a result. The heart cannot work well, and the circulation of the blood is not properly carried on. The child often suffers from headache, and becomes very miserable and pale. Its brain cannot work well, and a mouth-breathing child is usually very backward at school. Lastly, through not expanding the chest fully during breathing, the lungs are never sufficiently filled with pure air, and this very often leads to that terrible disease called consumption.

106. Many children breathe through the mouth because it is easy, and because they have never been taught to breathe through the nose. Others do so because of swellings at the back of the mouth and nose. The swelling at the back of the mouth is due to *enlarged tonsils*. That at the back of the nose is known as *adenoids*. If children are taught when young always to breathe through the nose, these swellings probably never occur. If, however, these swellings have formed, the child will always breathe through its mouth with all the serious results we read about in the last paragraph. In

that case the quickest and surest remedy is to have the swellings properly removed by a surgeon. The child will then quickly breathe and hear well again, and will soon become bright like an ordinary child.

107. Children should start quite early in life to take breathing exercises. They should take several deep breaths frequently during the day, either in the open air or with the windows widely open. During school hours the teacher should let the children do this frequently. In that way they will learn the importance of breathing properly, and it will also make them fresher for their lessons by making the heart beat more strongly, by improving the circulation of the blood, and so sending pure air all over the body, especially to the brain. Various forms of gymnastics, drilling, and breathing exercises, especially in the open air, should be frequently practised. In this way the chest will become properly expanded and well formed, and the lungs made healthier and more able to resist such diseases as consumption, bronchitis, etc.

108. Every time we breathe we use up a certain amount of the oxygen in the air and give out carbonic acid gas. In that way human beings by breathing make the air of a room impure, and if the air of the room were not changed so as to get rid of the poisonous carbonic acid gas, we should die gradually from want of pure air. You have probably been told the terrible story of the 'Black Hole of Calcutta,' in which 146 people were shut up one night. Next morning only 23 of them were left alive, the rest having been slowly suffocated or poisoned, by the carbonic acid gas which was made by the breath of so many people.

109. Human beings make the air impure in another way besides breathing. Tiny, invisible particles of animal matter are thrown off by the skin into the air. This explains the 'stuffy,' unpleasant smell we notice on entering crowded rooms—such as schoolrooms, theatres, concert-halls, also railway-carriages, trams, and omnibuses. People who do not wash their bodies often enough with soap and water give off very many of these impure particles of animal matter. This shows us the importance of frequently bathing ourselves, so as to wash away these particles from the surface of the body. The air of rooms is also made impure by the burning of gas or oil in them. When gas or oil is used to light a room, oxygen is used up to produce the light and much carbonic acid gas is sent into the air. One gas-burner or oil-lamp produces more carbonic acid gas than several people breathing in a room.

110. The air of living-rooms and buildings, such as schools, should therefore be frequently changed to get rid of the carbonic acid gas and to supply more oxygen. The process of purifying the air is called *ventilation*. Houses can be thoroughly ventilated by what is known as the *natural method*. By opening the windows, preferably at both top and bottom, fresh air is able to come in from the outside. The foul air escapes partly from the opening at the top of the window, and partly up the chimney, the flue of which should always be kept open. The foul air in a room is warmer and therefore lighter than the cold, pure air which comes into the room. Being lighter it rises to the ceiling and so escapes from the opening at the top of the window. A fire in the grate helps to ventilate a room, because the smoke

passing up the chimney draws air up with it, and so fresh air must come in from outside to take the place of the air which has escaped up the chimney. **It is particularly important thoroughly to ventilate our bedrooms** in which we spend so many hours every night. We should train ourselves when quite young to **sleep with the bedroom-windows open at night.** Once we have learnt to do that we never go back again to the old custom of keeping the windows closed. We find we wake up much fresher after sleeping with open windows, and better able to work both with body and brain. If it is not found possible to have the windows open on account of the cold outside or because of draughts, then we should always remember to open the door and windows when we are out of the room. This is most important in the case of schoolrooms and bedrooms. Some housewives object to open windows, because it makes the curtains, carpets, and furniture dusty and dirty. Surely it is much more important to have in our houses plenty of fresh air, which will keep us in good health, than to keep the curtains free of dust! When the furniture is old we can buy new; but when we become ill, very often no amount of money can restore us to health. But while I would insist on the importance of free ventilation by means of open windows and fireplaces, we should never sit in a strong current of cold air or a 'draught.' If we do we are liable to catch colds and other diseases through the rapid cooling of the body. When we are sitting in a room with the windows open, we should always keep the door closed to avoid draughts. Care should also be taken that cold currents of air from under the door do not make the feet and legs cold. Flowers and plants help to make the air of a room impure at night, and

should therefore never be kept in bedrooms during the night time.

111. By keeping our blinds up and windows open we also allow as much *sunlight* as possible to enter our houses. Sunlight not only makes our homes look bright and cheerful, but also cheers and gladdens our heart and makes *us* bright and cheerful. Sunshine also has the power of killing disease germs and for that reason we should admit as much as possible into our rooms.

112. When many people are in one room and there is little or no means of ventilation, some of the people may even die from the effects of the foul air, as we saw was the case in the 'Black Hole of Calcutta.' Usually the air we breathe, even in a crowded, badly-ventilated schoolroom, is not so bad as to cause anybody's death, but still it does produce serious results. Children who live in houses in which the windows are never opened and who therefore constantly breathe impure air, are often small, pale, and sickly-looking, and wanting in strength of body and mind. Often in the early years of a child's life the seeds of disease are sown in this way, from which it will suffer ever after. People who do not allow plenty of fresh air to enter their houses never have good, healthy blood in their bodies. Their organs do not work well and the brain especially becomes dull. Such people, too, are more liable to all sorts of diseases of the lungs and throat, such as consumption, bronchitis, and many others.

113. Savages in Africa and other parts of the world who practically live out in the open air, are always healthy and strong, and never suffer from these lung

diseases as civilized people do. Those of you who have been fortunate enough to spend a holiday at the seaside or at a farmhouse, know how different and how much healthier and fresher you feel after being there for a few days. It is because you are out for many hours in the day breathing the good and pure air of the sea or country. Babies and young children should be taken out for several hours every day. Even in winter this will do them good, provided they are warmly clothed.

114. If human beings are not supplied with oxygen they very quickly die from *suffocation*. When we hear of people dying through a fire in a house, such people are usually not burnt to death but are suffocated by the smoke, and very soon become insensible and fall down. In the same way people who are drowned or strangled very soon become insensible from want of pure air. Even when they seem to be dead we can sometimes revive them by making them breathe artificially for some time. Many mothers take their babies into bed with them to sleep. As a result of this, hundreds of poor little infants die every year from suffocation. The child gets right under the blankets, or rolls over on its face, or is smothered by the mother's body, in each case dying from want of air. Babies should always be put to sleep in a cot, but well covered with warm blankets to keep their little bodies warm. If parents cannot afford to buy a cot, a drawer placed on two chairs or a clothes-basket will do almost as well.

115. During muscular exercise we breathe more quickly, so that the lungs receive more pure air as well as more blood. The lungs also expand better during exercise, which leads to an increase in the size of the chest as well

as to a healthy shape. Those who take plenty of exercise rarely are 'flat-chested,' and are more likely to escape lung diseases, the most deadly of which is consumption.

116. In various parts of this chapter I have told you how to take care of the lungs. Here I shall just put together the most important things to remember: (1) Always breathe through the nose. (2) Take deep breaths several times during the day, especially when out in the open air. (3) Always freely ventilate your rooms and houses, especially the bedroom in which you spend so many hours every night. (4) Take plenty of outdoor exercise, by which the lungs become nourished with more blood and with pure air, and so are better able to resist diseases. (5) Avoid sitting in draughts, getting wet, and sudden cooling of the body, as by going out of a very warm room into the cold night air. In that way we catch 'colds,' bronchitis, inflammation of the lungs, and other serious diseases. We should be particularly careful not to neglect an ordinary 'cold.' Very often after a cold we get a cough lasting for a week or two, due to some irritation in the lungs and windpipe. If this cough continues for a month or longer, it may mean that serious trouble is coming on, such as the beginning of consumption or bronchitis. It is advisable in such a case to get a doctor to 'sound' the lungs and chest. Very often a change of air will set things right again. (6) People who are 'weak-chested' or who suffer from cough should avoid going out in a fog or when a keen north or east wind is blowing. (7) Reading aloud, speaking, and singing are good exercises for the lungs as they teach us to inspire deeply. It is important for children to assume a good attitude when reading and writing. The

body should be upright, the head erect and the eyes not less than 10 inches from the book or paper. In this way the chest can expand properly and the lungs become well filled with air. (8) Lastly, we should avoid breathing air which is impure or contains any irritating fumes or gases. Thus people who live in houses in which the drains are bad often breathe foul air. This may make them pale and sickly, and more likely to get diseases, such as diphtheria and blood-poisoning.

117. When people have weak lungs or a sore throat, smoking is very bad for the lungs and windpipe, because it irritates those organs and leads to a cough. Smoking is also harmful if the voice is hoarse from too much speaking or from catarrh of the voice-organ. Smoking many cigarettes and inhaling the smoke is particularly injurious. The lungs then instead of getting pure air, have the irritating smoke brought to them which may lead to bronchitis and lung disease.

CHAPTER VII

THE MOUTH AND TEETH

118. The mouth is to the digestive organs what the entrance-hall is to a house. If a dirty or objectionable person comes into the hall we turn him out; if he is clean and respectable we allow him to come into a room. In the same way, if bad or nasty food is taken into the mouth, it is not allowed to pass down into the stomach but is rejected or cast out again. On the other hand, if the food be nice it is allowed to remain. A visitor, before he goes from the hall into a room, prepares himself by taking off his hat and coat, and leaves them outside with his umbrella. Likewise food, before it is passed down into the stomach, is prepared in the mouth by being chewed and mixed with the saliva.

119. The roof of the mouth or *palate* is hard and bony in front, soft and fleshy at the back. From the middle of the soft palate there hangs down the fleshy *uvula*. On each side of the soft palate at the back of the mouth are the *tonsils*. In the floor of the mouth is the tongue. At the sides of the mouth are the fleshy cheeks, and in front the lips. In the substance of the cheeks and under the lower jaw and tongue are the bodies known as the *salivary glands* which make the *saliva* or spittle. The shape of the mouth is due to the two *jaw-bones* (upper

and lower), and to the *palate-bone* which forms the roof. The teeth are firmly fixed in the two jaw-bones, and are partly covered by the gums. The cheeks, lips, and floor of the mouth are composed of muscle or fleshy substance mixed with fat. The muscles help to move the lower jaw in chewing the food and in talking. The muscles of the lips are called the muscles of 'expression,' because it is by their action that we get the expression of the face in smiling, laughing, and crying. The whole of the inside of the mouth is lined with a smooth, moist membrane, which covers the cheeks, gums, palate, tongue, and lips. In the mouth the food is (1) tasted by the tongue, and perhaps rejected if it be very nasty; (2) chewed and broken up into a fine pulp by means of the teeth; (3) wetted by being mixed with the saliva, which comes into the mouth from the salivary glands.

120. The soft palate is used in swallowing to shut off the back of the mouth from the back of the nose. The hard or bony palate is used in talking. Sometimes people are born with a hole in the palate, which prevents them talking properly unless an operation be performed to close this hole. The tonsils act as *filters*, and prevent too many disease germs getting into the lungs and stomach. Often in children the tonsils are enlarged and lead to thickness of speech. When this is the case children are more likely to suffer from sore throat, so that very big tonsils should always be removed by operation. Children with large tonsils often have swellings at the back of the nose (*adenoids*), which lead to mouth-breathing and its terrible results we spoke about in the last chapter.

121. The tongue is a fleshy organ joined to the back

of the mouth. It can be very freely moved in all directions. It is composed almost entirely of flesh or muscle, and is covered by a moist membrane. The surface of the tongue is smooth underneath but rough on top, especially near the back. This roughness is due to the presence of a number of small raised points all over the top of the tongue. It is by means of these raised points that we taste things. Those at the back of the tongue are largest of all, and it is there that we taste things best. In health the tongue is red and moist, and the roughness of the surface can just be felt and seen. In disease the tongue may become coated with a white 'fur,' or it may be large, smooth, and pale red, or small and dark red. A furred tongue means that the stomach and digestive organs are out of order and not working properly. Usually an aperient medicine or pill quickly makes the tongue clean and healthy-looking. The tongue is used (1) for tasting food; (2) for moving the food about while being chewed; (3) for swallowing; and (4) in speaking. Only those things which dissolve in water, such as sugar, can be tasted. Substances like sand or chalk, which do not dissolve in water, cannot give rise to a sensation of taste, but only of touch. We cannot taste sand. We can only feel by the touch that it is in the mouth. The tongue can taste only sweet, sour, bitter or salt things. The 'flavour' of food is not tasted by the tongue, but really smelt by the back of the nose. That explains why we are unable to taste our food when we have a cold in the nose and cannot smell. It is really because the nose is blocked and the smell of the food, therefore, cannot get to it. The same thing happens when the nose is pinched, so that by closing the nostrils nasty medicine can be swallowed without being

tasted. The tongue should be protected from constant irritation, as this may lead to serious disease, such as cancer. Too many condiments and highly-seasoned foods should be avoided. Too much smoking, especially clay pipes, may irritate the tongue, and sometimes causes cancer of the tongue or lip. A roughness on the inside of a tooth may do the same thing if allowed to rub against the tongue for a long time. We should have the tooth filed by a dentist, so that its surface becomes smooth again.

122. The *saliva* or spittle is a thin, watery fluid which is made by organs called the *salivary glands*. There are three salivary glands on each side of the mouth: (1) a large one just below and in front of the ear; (2) a smaller one under the lower jaw; and (3) a small one under the tongue. The saliva from these glands flows into the mouth through small tubes. In the saliva is a substance called a *ferment*, which can digest cooked starch. Food—such as meat, potatoes, etc.—is of no use to the body until it has been *digested*—that is to say, changed into a soluble form in which it can pass into the blood. The starch in the food is thus partly digested by the action of the saliva and changed into sugar. By 'cooked' starch is meant starch which has been heated during the manufacture or preparation of the food. The starch in bread and boiled potatoes is cooked and can be acted on by the saliva, while the starch in an uncooked chestnut is 'raw,' so that the saliva has no action upon it. Raw chestnuts are, therefore, indigestible unless well chewed and slowly eaten. The saliva of infants during the first seven or eight months of life (before any teeth are cut) does not contain this

starch-digesting ferment. We should therefore never give babies nursery biscuits or any food which contains starch, until they are at least seven or eight months old.

123. The following are the uses of the saliva: (1) The saliva is mixed with the food during the process of chewing. In that way the food is moistened so that it can be made into a round mass ready to be swallowed. (2) Saliva changes cooked starch into sugar and so helps in the digestion of starchy food. (3) It keeps the mouth moist, without which we should be unable to eat or talk. The manufacture of the saliva and its flow into the mouth are controlled by the brain and nervous system. When we are nervous or afraid the supply of saliva stops, and the mouth becomes dry and parched, so that we cannot eat or talk. The Chinese are said to use this as a means of detecting a guilty person. The suspected person is placed with a number of others, and each one is given some rice to eat. The guilty one is so nervous and frightened that his saliva does not flow, and the rice sticks in his mouth and throat so that he cannot swallow it. In that way the culprit is discovered. This story is interesting, but, I should think, is not strictly true. On the other hand, the smell, the sight, or even the thought of nice savoury food, makes the 'mouth water,' causing an abundant flow of saliva. Sour things also make the saliva flow freely. Sucking a piece of lemon is a much better and pleasanter way of quenching the thirst than drinking a lot of water or beer. Mountain climbers know this and always carry lemons with them to quench the thirst.

124. If the saliva is wasted the mouth will be constantly dry, with the result that speaking and the chew-

ing of food cannot be properly carried on. The salivary glands will also have too much work to do in continually making up for the saliva which is wasted. Some smokers spit a great deal when smoking and in that way waste large quantities of saliva every day. When smokers do this it shows that so much smoking is not good for them. They should therefore smoke less, and if they still spit they ought to smoke very little or not at all. Chewing tobacco is an objectionable habit which is not so common as it used to be. It should be avoided because it wastes much saliva and also discolours the teeth.

125. Spitting is a very dirty as well as a very dangerous habit. You need not be told how filthy and rude it is to spit about rooms, streets, trains, trams, and omnibuses. One sometimes sees people outside omnibuses spit into the road right on to people passing in the streets. Then, if it is at all windy, the passengers sitting just behind on the top of the omnibus may get some of the particles of saliva in their faces. This, of course, is disgusting but also very dangerous. All kinds of germs are present in the mouths of people, and diseases such as diphtheria, influenza, inflammation of the lungs, and consumption may be spread in this way through people spitting. The waste of saliva by spitting is not the same as the getting rid of phlegm in certain diseases of the lungs and bronchial tubes.

126. Consumption of the lungs is a very terrible disease, killing thousands of people every year in England alone. It is due to a small microbe which gets into the lungs and gradually destroys them. During the illness patients bring up from the lungs a

great deal of phlegm which contains millions of the microbes. If this phlegm is expectorated everywhere, these microbes get into the air and food, and so are inhaled or swallowed by other people, giving them consumption. Consumptive people should therefore never expectorate about rooms, streets, or public conveyances; nor should they swallow the expectoration, because in that way they may cause disease of their own stomach and intestines. They should use small pieces of rag, which can be burnt at once, or should carry about with them small pocket spittoons to use when required. These can be disinfected easily with carbolic acid and so the germs are killed. Kissing on the mouth is another dangerous custom, because it may be the means of spreading diseases such as consumption, diphtheria, measles, scarlet fever, influenza, inflammation of the lungs and others. Consumptive persons should never kiss other people nor be kissed on the mouth.

127. Let us now learn a little about the teeth. A new-born baby has no teeth showing in its mouth. Even at birth the teeth are already formed, but they are deep down in the substance of the jaw-bones. During life we have two sets of natural teeth. Babies begin cutting the first set, called the *milk-teeth*, at about six months. By the end of the second year the cutting of the first set of teeth is usually completed. Rickety babies are late in cutting the teeth. Often they do not begin to do so until they are a year old, and may not have them all until three years of age. Children begin to get their second set, or *permanent teeth*, at six or seven years of age. The first permanent tooth to be cut is the 'six-year-old' molar, which comes through at

the back of the jaw before any of the temporary teeth are lost. The milk-teeth then gradually come out and their place is taken by the permanent teeth. The permanent teeth are all cut by the age of twelve or thirteen, except the *wisdom teeth*. These are right at the back of each jaw and do not appear until about twenty-one years of age. The permanent teeth should last us through life.

128. The teeth may be divided into three groups, according to their shape and use: (1) Incisors or front teeth; (2) canine or dog teeth; and (3) molars or back teeth.

(1) *Incisors.*—The four middle teeth in each jaw are the biting or nibbling teeth. They are chisel-shaped, and are used mainly for biting off food, such as a biscuit or crust of bread.

(2) *Canines.*—The pointed teeth, one on each side of the four central biting teeth, are called the *eye* or *dog* teeth. These are used for tearing food such as meat.

(3) *Molars.*—Next to the dog-teeth are the flat-topped teeth called the *grinders* or *molars*. Two of these are smaller than the others and are called the *bicuspids*. The molars are used to grind the food into a soft, pulpy mass. In the first set of teeth there are four incisors, two canines and four molars in each jaw, making twenty in the mouth altogether. In the permanent set there are four incisors, two canines and ten molars in each jaw, making thirty-two teeth in all.

129. The part of the tooth seen in the mouth is called the *crown*. Each tooth has also a *root* or *fang*—the molars have two or three such roots—which is firmly fixed in a hole in the jaw-bone. The outside of a tooth

is composed of a very hard, white substance like ivory, called the *enamel*. Inside the enamel is the *dentine*, which is like bone. Inside each tooth is a space going right to the bottom of the root, in which are the blood-vessels and nerves of the tooth. When the enamel and dentine of a tooth are damaged, as in decay, the nerves of the tooth become inflamed and very painful. That is the cause of toothache.

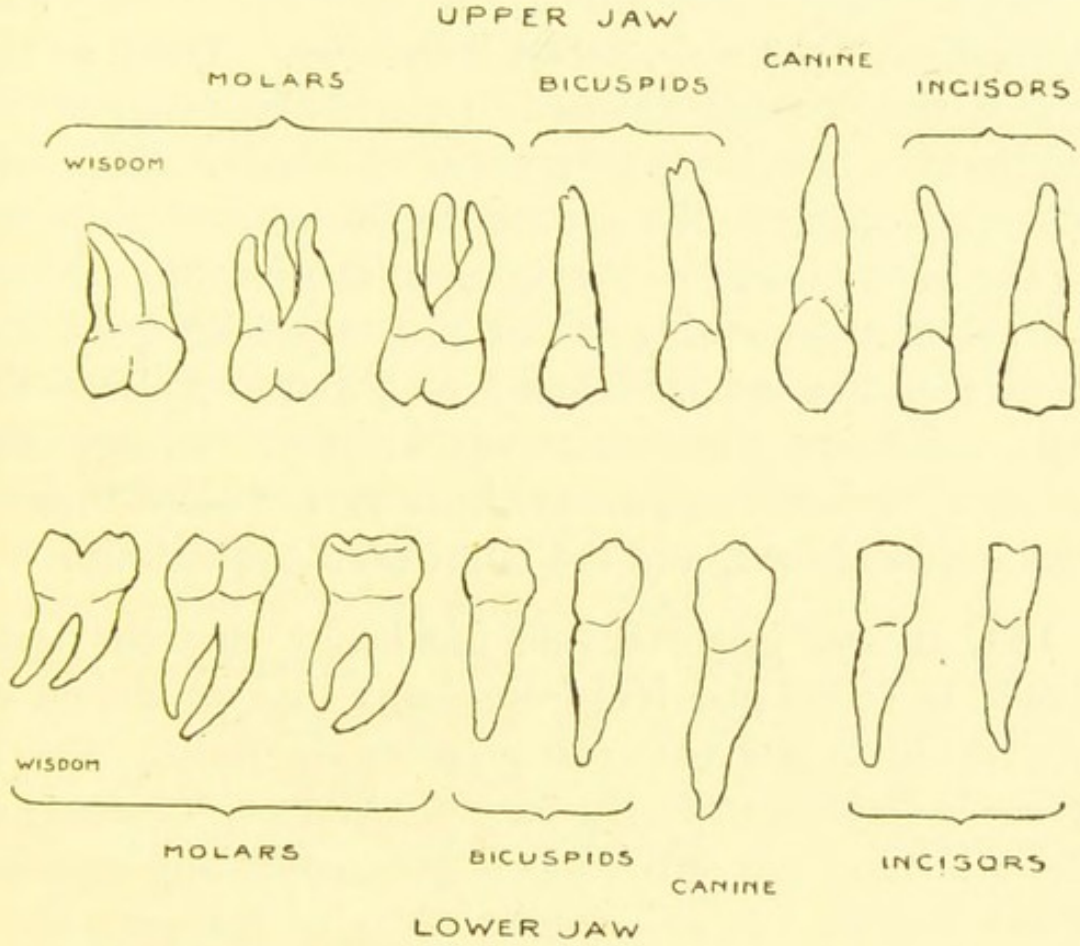

FIG. 9.—DIAGRAM OF THE PERMANENT TEETH.
(Modified from Paul's 'Domestic Economy.')

130. The teeth are used in chewing food which they tear and grind up into a soft pulp. Unless the food is thoroughly chewed it cannot be properly acted upon and digested by the stomach and intestines. A piece of meat or cheese, or a hard-boiled egg, will take very

much longer to digest if 'bolted' or swallowed whole than if thoroughly chewed in the mouth. Children therefore should never be allowed to eat quickly by 'bolting' the food. Once a child gets into this bad habit it will be very difficult to correct later on in life. The harder or tougher the food the longer it should be chewed before it is swallowed. A piece of meat, for example, should be chewed about thirty or forty times. If insufficiently chewed, food may give rise to pain and discomfort after meals, called *indigestion*. Then, as the food is not properly digested, it cannot be taken up by the blood to nourish the tissues of the body. This may lead to stunting of the growth in the case of children. In the case of adults it may even shorten life. Moreover, thorough chewing of the food, especially hard and tough food like crusts of bread or biscuits, polishes the teeth and keeps them sound and healthy. Savages and animals, such as dogs, always have perfect teeth because they eat hard food, and the latter even gnaw bones.

131. It is so important for our health that the teeth should be sound and free from decay that we should do everything in our power to preserve the teeth. This is specially important in the case of children, for decay of the milk-teeth not only leads to indigestion and stunting of the growth, but also causes decay of the permanent teeth. Unfortunately, at the present day many people do not realise the importance of having their teeth properly looked after. A short time ago some dentists examined over 10,000 school children and found only 1,500 of them with sound teeth! Children should be taken to the dentist when quite young, so that they may become accustomed to the dentist and not fear him. You should always go to a *qualified dentist*.

132. A tooth is decayed when the enamel becomes imperfect and has a hole in it. This hole gets gradually larger, decay eats away the enamel and dentine, and finally the crown of the tooth is destroyed and breaks off or the tooth has to be pulled out. In some people the teeth decay very easily, either because they are weak and sickly, or sometimes because it is 'in the family.' Usually, however, it is due to want of proper attention to the cleanliness of the mouth and teeth. After every meal little particles of food lodge around and between the teeth. These particles of food, especially sugar and starchy food, such as bread, become acted upon by germs or microbes which are present in the mouth. By the action of these germs, bread and sugar are changed into sour or acid substances. These acid substances dissolve the mineral matter out of the teeth leaving the animal matter. Other germs then attack and destroy the animal matter and so decay is produced. Once decay has started in a tooth it gradually spreads if not attended to by the dentist, until at last the nerve of the tooth is reached. Then, when food is eaten, particles of it get into the hole and set up inflammation, which leads to toothache. The pain of toothache is very severe, giving rise to sleepless nights and terrible pain all day, so that in a very short time the child suffering from toothache becomes quite ill. The child, knowing that eating on that side of the mouth increases the pain, will eat only on the other side. Particles of food will then collect on the bad side and never be removed by chewing. This may lead to decay of the other teeth near the first bad one. Having only one side of the mouth to eat with, the child will probably not chew its food well and so gets indigestion, and the food is not

properly absorbed by the blood. From the inflamed tooth 'matter' may constantly ooze in small quantities and give rise to a very foul breath. The 'matter' mixes with the food and saliva in chewing and is swallowed. This may lead to very serious diseases of the blood and other parts of the body. Lastly, the matter in the tooth may spread and cause an abscess of the jaw-bone, giving rise to a 'swollen face,' and this abscess may burst through the skin and discharge matter for years.

133. You see what very bad results may follow upon decayed teeth. I am now going to tell you how to take care of the teeth so as to prevent decay as much as possible, and I urge and impress upon you the importance of following these rules closely. **The teeth should be properly cleaned after each meal, but especially at night before going to bed.** It is during the night that most mischief is done to the teeth. At night the mouth is not used, so that the food particles remain there and become changed into acid which destroys the enamel. The teeth may be brushed in the morning after getting up, but it is much more important to do so after breakfast and, if possible, after each meal. A baby's mouth should be wiped out after each meal with a piece of clean linen placed over the nurse's finger, moistened with water or a mixture of glycerine and borax. As soon as the child can understand, it must be taught to use a tooth-brush. For cleaning the teeth use a hard brush—but not too hard—or it may injure the gums. Soak the brush in luke-warm or cold water, rub it on a piece of curd soap or other good soap and then use. Some people prefer a powder to soap.

Finely-powdered precipitated chalk may be used, or failing this a little common salt. In brushing the teeth the brush may be used from before back, but should especially be moved up and down so as to get into the spaces between the teeth. The tops of the teeth should also be brushed, likewise the surfaces on the inside next the tongue. After brushing the teeth, it is a good plan to use a disinfecting mouth-wash to rinse away any particles of food remaining, and also to get rid of as many germs as possible. A weak solution of permanganate of potash (Condy's fluid) or other antiseptic, such as boracic acid lotion, may be used as a mouth-wash. It is quite as important to clean the teeth properly after meals, and especially at night, as it is to wash every morning after getting up. Large particles of food which lodge between the teeth after eating should be removed by the use of a tooth-pick after each meal. A quill tooth-pick is the best to use. Metal tooth-picks are too hard and may injure the enamel. Wooden tooth-picks are dangerous as they may cause splinters to get into the gums. Sometimes the teeth are too close together to get a tooth-pick between them. In that case a piece of thread or waxed 'floss' silk held by the two ends may be forced between the teeth, and by pulling it to and fro we get rid of food particles. By biting hard food we also help to preserve the teeth, because it clears away particles of food from them and polishes the enamel. It is a good plan to give a child a crust or hard biscuit occasionally so as to give its teeth plenty of work to do.

134. I am afraid that the very mention of the dentist will frighten you and make you think of his 'forceps'

which he uses to pull out teeth. I can assure you that the dentist is one of our best friends and that we do not go and see him often enough. Now, one of the commonest causes of decay is overcrowding of the teeth in the mouth. People often have too many teeth for the size of their jaws. The teeth then overlap and are so close together that the tooth-pick cannot be made to pass between them. If children have not been taken regularly to see the dentist when quite small, they should certainly visit him when they are about seven or eight years of age, when the permanent teeth are being cut. The dentist can then regulate the teeth so that there may not be too many in the mouth and also that they shall not be too close together. Children and adults should visit the dentist regularly three or four times every year. In that way early decay of the teeth will be detected if present. The dentist can then 'stop' the tooth and the decay will not spread. The milk-teeth of a child require special care and attention, as regards both cleaning and stopping, if decay be present. People often neglect going to a dentist even when they know their teeth are decayed. They wait till it is too late, and then have to lose the decayed teeth. Remember that very often a dentist can stop a tooth which looks hopelessly decayed, and that a stopped natural tooth is better than an artificial one.

135. If, in spite of all precautions, teeth are lost through decay, it is very important to have them replaced by artificial teeth. When there are gaps in the mouth between the teeth, food cannot be properly chewed and indigestion results. This is particularly the case with the back teeth or molars which grind the

food into pulp. Artificial teeth require attention and care as well as the natural teeth. After a meal the natural teeth should be brushed, and the artificial teeth should be taken out and brushed so as to get rid of particles of food. Artificial teeth should always be removed at night, brushed, and kept in a glass of weak mouth-wash or Condy's fluid. It is dangerous to go to sleep with artificial teeth in the mouth for they may become loose and be swallowed.

136. We must remember that our teeth are formed very early in life. It is therefore important that infants should be well fed from birth, in order that the sets of teeth may be good. Mother's milk or good cow's milk is the best food for infants. When infants are fed on skimmed milk, or on patent foods with very little milk in them, they are liable to have bad teeth as well as soft and unhealthy bones. It is commonly thought that sugar is bad for the teeth. We have seen that sugar is a food which becomes changed into acid in the mouth, and so may lead to decay of the teeth. If the teeth are well cleaned after meals and at night, the danger of decay from taking sugar will not be great. Of course, if a child eats too many sweets, that will take away its appetite for food and spoil its digestion. This may lead to an unhealthy condition of the body and possibly to decay of the teeth. Mothers are warned against the use of 'teething-powders,' which are so often given to babies to soothe them when cutting the teeth. These powders are dangerous because they often contain strong medicines such as opium, and sometimes they contain 'quicksilver' which itself is very bad for the teeth.

137. The constant drinking of acid drinks like lemon-

juice or lime-juice may do harm to the teeth by dissolving some of the mineral matter out of the enamel. The drinking of very cold or iced water or other liquids, or the eating of too many ices, is very bad for the teeth ; it causes the enamel to become damaged and so prepares the way for decay. Europeans who live in very hot countries, such as India, drink a great deal of iced water or lemon-squash. As a result their teeth decay very readily.

CHAPTER VIII

THE DIGESTIVE ORGANS

138. It is well known that if people go for any length of time without food, even though they do no work, they die of starvation. If they do work and get no food, then they die more quickly. It is therefore obvious that food is required to keep us alive. Food nourishes and feeds the tissues of the body, and repairs the waste which is constantly going on in the body during life. We have seen that the blood, by its circulation through all parts of the body, carries the necessary nourishment to the tissues and organs. But a slice of bread or a piece of meat put into the blood will not nourish the body, because the tissues cannot make use of it in that form. The bread, the meat, and almost everything we eat must be changed into a form in which it can be taken up by the blood. The process by which food is changed so that it can be absorbed by the blood is known as *digestion*.

139. The following are the stages of the process of digestion: Food is taken into the mouth, where it is *chewed* or *masticated* by the teeth, helped by the saliva and tongue. It is then *swallowed* and so passes down the gullet to the stomach. Here it remains for three or four hours and undergoes certain changes. The altered

food then leaves the stomach and enters the small intestine. The upper part of the small intestine is joined by the pipes coming from the liver and sweet-bread. When food is being digested, the liver and sweet-bread send fluids through these pipes into the intestine. These fluids help to digest and further to change the food, so that it can be taken up or absorbed by the blood-vessels. As the digested food travels along the small intestine, most of it that is of use to the tissues of the body is absorbed by the blood-vessels of the intestine. What is unabsorbed by the small intestine passes on into the large intestine and is there absorbed, especially the water. What remains becomes gradually solid and finally passes out of the body from the end of the intestines.

140. You see that food during its digestion and passage through the body travels along a tube or canal which is straight in some parts, curved and coiled in others. This tube, from the mouth to the end of the large intestine, is called the digestive tract or the *alimentary canal*. The digested food which is absorbed by the blood-vessels of the intestines, is carried by the blood to the liver where it is further acted upon. It is then carried to the right side of the heart by the great vein—the inferior vena cava (see Fig. 8, on the circulation). From there it goes to the lungs to be purified by receiving a supply of oxygen, and is taken back to the left side of the heart. This *pure blood, rich in digested food*, is then carried all round the body to supply the various organs—such as the brain, muscles, etc.—with the nourishment they require to do their work satisfactorily.

141. In order that you may understand the digestion of foods, you should know something about their composition. All kinds of food must contain two or more of the *five* necessary ingredients. These necessary ingredients are known as the essential constituents of

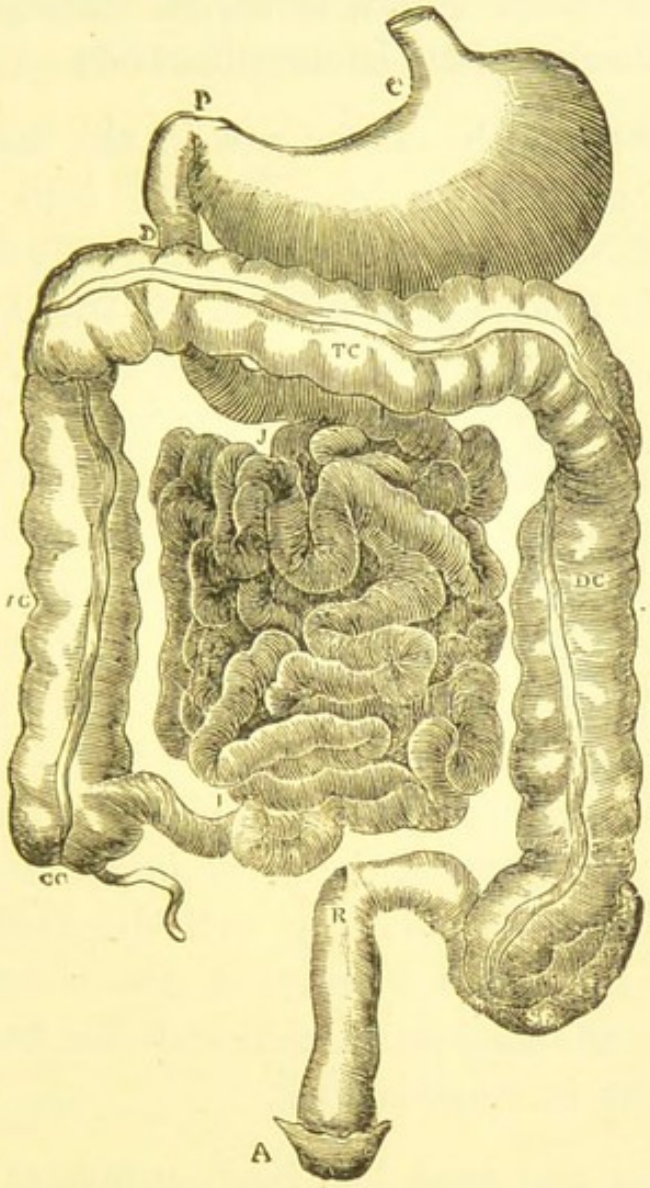

FIG. 10.—STOMACH AND INTESTINES REMOVED FROM THE ABDOMEN
C, P, Stomach; D, J, I, small intestine; CC to A, large intestine.

food. They are: (1) Nitrogen-containing food, called *proteids;* (2) *fat* and oils; (3) sugars and starch, or *carbohydrate* food; (4) *mineral salts;* and (5) *water.* Most articles of diet—such as meat, milk, bread, cheese,

etc.—contain all these five necessary constituents but in different proportions. A certain amount of them is required every day in order to keep the body in good condition. We require also (6) a plentiful supply of *oxygen* which is received through the lungs. Oxygen is as much a food as bread, meat, or water, for if it be withheld from us we die from suffocation.

142. In the mouth—as we saw in the last chapter—the food is ground up by the teeth into a pulp and thoroughly mixed with the saliva. Already in the mouth the process of digestion is started, for the cooked starch (as in bread, potatoes, etc.) is partly digested and changed into sugar. Thorough mastication of the food is very important for this, and also for the following reasons: A solid lump of food—such as a piece of meat—takes very much longer to digest in the stomach than if first ground into a pulp by the teeth. By not masticating the food properly, then, we give the stomach much harder work to do; we may make the work so hard for the stomach that it cannot do it, and so bring upon ourselves all the pain and inconvenience of *indigestion*. Besides, the food, through not being well digested, cannot be absorbed by the blood to nourish the tissues. In that way much of the food is wasted, and the body gets thin and unhealthy in consequence.

143. When the food has been sufficiently chewed it is swallowed. In swallowing, the pulpy mass of food is pushed by the tongue to the back of the mouth and is grasped by the muscles of the pharynx or back of the throat. By the action of these muscles the food is forced down the gullet into the stomach. The gullet is a long, fleshy tube running from the throat through the chest

into the abdomen, where it opens into the stomach. During swallowing food is prevented from passing up the back of the nose by the raising of the soft palate. If the soft palate is paralysed, as sometimes happens in disease, then liquids may be forced back through the nose during swallowing. Food is prevented from passing down into the voice-box and windpipe by means of a

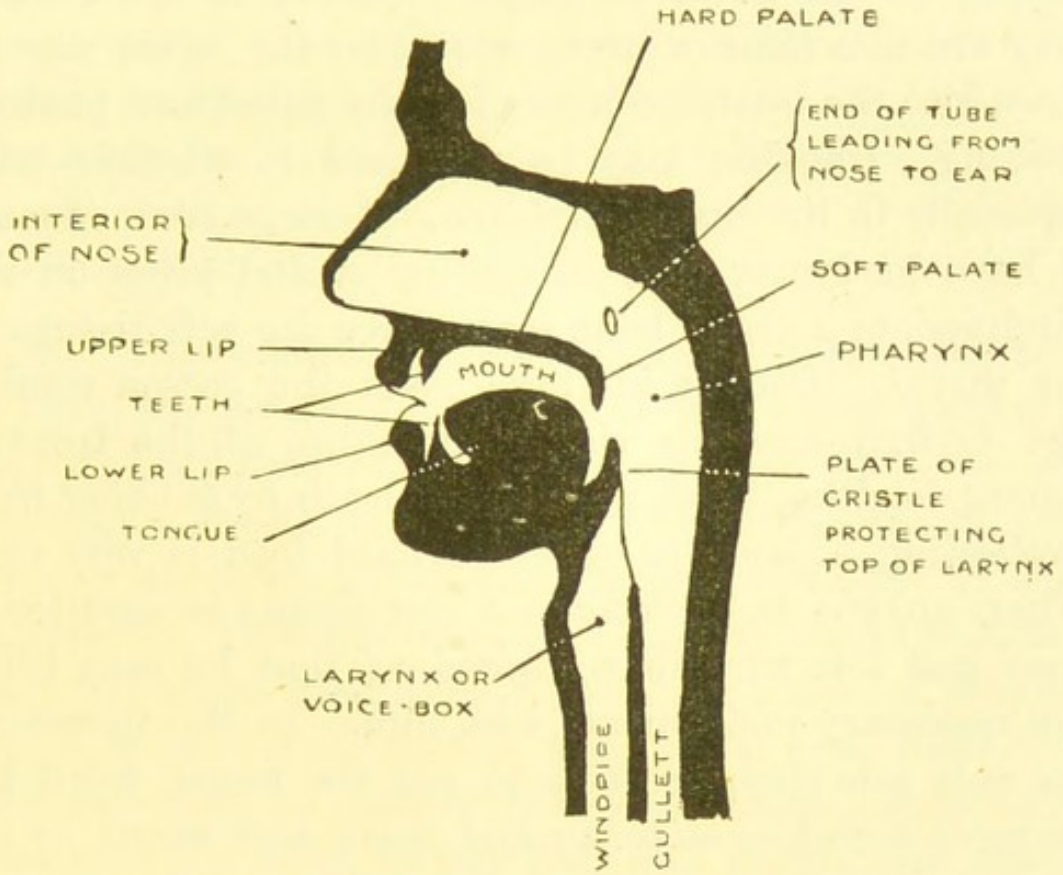

FIG. 11.—SECTION OF PART OF HEAD AND NECK, SHOWING THE CAVITIES OF THE NOSE, MOUTH, AND PHARYNX; ALSO THE WINDPIPE, LARYNX, AND GULLET.

small plate of gristle, which stands as a kind of sentinel or guard at the entrance to the larynx, which it closes during swallowing.

144. During the act of swallowing we stop breathing for an instant. A fit of laughing or a sudden surprise when swallowing may make the food 'go the wrong way'

—down into the voice-box instead of the gullet. Usually this at once causes violent coughing by which the food is expelled from the air-passage. Sometimes in disease and also when people are drunk, if food gets into the windpipe it is not expelled by coughing but is allowed to remain there blocking the air-passage. That is called *choking* and quickly causes death from suffocation. People should never be given anything to drink when they are in a faint or unconscious, for the liquid may go down into the windpipe instead of the gullet and produce choking. Choking may be produced in another way, especially in the case of children. A large bone or mass of hard food may stick in the gullet and press on the windpipe, or a sharp bone may pierce the soft tissues of the throat. Usually in these cases the person vomits, and in that way gets rid of the cause of the trouble. Among healthy, sober individuals death by choking from swallowing a bone or mass of hard food is very rare. When anyone is choking, a doctor should be sent for at once and told why he is wanted, so that he may bring the necessary instruments with him. In the meantime the only safe thing to do is to put the finger down the person's throat so as to try and make him vomit, in the hope that the bone or other obstruction may be removed in that way.

145. The stomach is a large, hollow, pear-shaped bag into which the food is received during a meal. The action of the stomach on the food is like that of a churn in which butter is made from cream by being constantly shaken. The stomach wall is composed of a thick layer of fleshy tissue, by the action of which the food is constantly tossed about so that it may be

thoroughly mixed with the digestive juice. This fleshy layer is covered with a thick membrane, which contains numerous glands for the manufacture of the digestive fluid of the stomach. This fluid contains a little free *acid** and two ferments called *pepsin* and *rennin*. The acid and pepsin help to digest the nitrogen-containing foods or proteids and change them into a simpler and soluble form, in which they can be absorbed by the blood-vessels. Rennin acts on milk and makes it clot, forming 'curds and whey.' Human milk forms a fine, soft clot in the stomach, while cow's milk gives rise to a firm, hard clot. For this reason human milk is better for babies than cow's milk.

146. If the stomach forms too much or too little acid or too little pepsin, the food does not digest properly, and various forms of *indigestion* result. When we eat very many sweets or much pastry a great deal of acid forms in the stomach, giving rise to '*heartburn*' or *acid indigestion*. This has nothing whatever to do with the heart but arises from the stomach. Often a lot of sour wind is belched up from the stomach in such cases. A little carbonate of soda swallowed in some water will counteract the effect of the acid and relieve the heart-burn.

147. By constantly receiving too much liquid the stomach becomes blown out, so that in time its fleshy wall gets weakened. This also gives rise to a form of indigestion, because the stomach wall is no longer able to toss the food about properly so that it gets thoroughly mixed with the digestive juice. Indigestion also results from insufficient mastication of the food in the mouth

* The acid is hydrochloric acid.

and from overloading the stomach with too much food and drink, especially alcohol. Nature often cures an attack of indigestion produced in this way by emptying the stomach at once and so getting rid of the indigestible meal. The abdominal and stomach muscles contract violently and produce *vomiting*, by which the food is all got rid of through the mouth.

People who drink too much alcoholic liquor often suffer from constant or *chronic indigestion*, and not only lose their appetite for food, but also frequently vomit after a meal. Babies very easily vomit, so that they should always be kept quiet after being fed, and should not be tossed up in the air or shaken about on one's knee.

148. The stomach will stand a good deal of rough treatment, but only up to a certain limit. If this limit be passed, the stomach will either strike work altogether and reject the food by vomiting, or will do its work only partially and so give rise to indigestion and other troubles.

(1) **We should never overload the stomach** with food or drink. This may lead to 'spasm' of the stomach, 'wind round the heart,' or even vomiting, by which the whole meal is rejected and wasted. If we constantly eat too much at a meal, the stomach will become blown out and its fleshy wall weakened, so that chronic indigestion may result. We should, therefore, eat small meals fairly often, at intervals of, say, three to four hours. The heaviest meal of the day—namely, dinner—is best taken in the evening when the day's work is done; we can then rest afterwards, and so allow the meal to digest thoroughly. If meals are taken more frequently, or we get into the bad habit of eating sweets and cakes or of drinking between meals, the digestion of the previous meal will be hindered, and indigestion will follow.

(2) **Food which takes a long time to be digested** in the stomach, such as smoked meat and cured fish, **should not be taken in too great amount.** People with weak digestions should avoid such foods altogether, whilst those with healthy digestions should masticate these foods well so that the digestive juices can act upon them thoroughly. It is wise to train children to take all kinds of food, otherwise the digestive power for the particular kind of food avoided in childhood may become deficient from want of use. This is particularly true of fatty food, a good supply of which seems to be specially useful in protecting the body against the germs of consumption. Young children should take plenty of fatty foods, such as cream, butter or margarine, and bacon fat.

(3) **The food we take should be about as hot as the body itself.** Cold food does not arouse the stomach to action so much as hot food. Very cold liquids may hinder or even stop digestion for a time, and are also liable to cause cold or catarrh of the stomach. For this reason it is unwise to eat ices after a good dinner. A hot meal is better digested than a cold one, because it excites the formation of more digestive juice and greater movements of the stomach. Very hot foods may damage the stomach just as much as very cold. A glass of hot water, however, will often relieve the pain of indigestion. Iced drinks and ices are bad to take when we are hot and thirsty. A cool and slightly sour drink, such as lime-juice or lemon-water, relieves thirst much more effectively. A cup of hot, fresh tea, by inducing perspiration and increasing the flow of saliva, relieves thirst very well. Condiments such as vinegar, mustard, pepper, etc., improve the appetite and help to digest food

better. In small quantities they are very useful with our meals, but excess should be avoided, as this acts injuriously upon the tongue, stomach, liver, and kidneys.

(4) **Exercise promotes appetite** by using much food as fuel during the contraction of the muscles. The fuel used up must be replaced by other food, the craving for which gives rise to the feeling of hunger. Exercise also aids digestion by improving the circulation of the blood through the stomach, intestines, and liver. We must remember, however, that exercise causes fatigue of the digestive organs as well as of the muscles; it is therefore unwise to eat a hearty meal immediately after violent exercise. We should rest for half an hour or more before giving the stomach a big meal to digest. After meals, too, we should 'rest awhile,' because the digestive organs then require much blood to carry on their work. We should not draw the blood away from the digestive organs by making the brain or the muscles work hard immediately after a meal.

(5) Most men enjoy a pipe or a cigar after dinner because it is soothing. The practice is a sound one, because they sit still while smoking and indulge in light, pleasant conversation, which rests the body and brain, and so aids digestion. Too much smoking, and especially smoking immediately before meals, is harmful and to be avoided, because it takes away the appetite or craving for food.

(6) Alcoholic liquor in the form of beer, wine, or spirits and water, taken in small quantity with a meal, does no harm. One cannot maintain, however, that it is necessary for healthy adults. As the taste for alcohol grows on people it should be taken in strict moderation,

only once, or at most twice, a day with food. **Drinking alcoholic liquor between meals, drinking neat or undiluted spirits, and constantly taking alcoholic drink at all hours of the day, are most dangerous.** Too much alcohol has a very serious effect upon the appetite and upon the state of the stomach. The stomach wall becomes diseased, so that the food is badly digested and vomiting often produced. Lastly, **alcohol should on no account be given to children in health.**

149. After a meal has been in the stomach for three or four hours it is reduced by digestion to a fluid about as thick as pea-soup. It then leaves the stomach and enters the small intestine, where it becomes mixed with the liver juice, called *bile*, and the sweetbread juice. These juices, together with that made by the wall of the small intestine, complete the process of digestion. The bile helps the sweetbread juice to digest fatty food. The sweetbread juice also completes the digestion of starch which was started in the mouth by the saliva, and the digestion of nitrogenous or proteid food which was begun in the stomach. The intestinal juice changes sugar into a soluble form, so that it can be absorbed by the blood-vessels.

150. The *liver* is a dark brown, solid organ composed of a very large number of cells. It has a rich supply of blood, so that every cell of the liver has a small blood-vessel touching it. The liver manufactures the bile which is stored in the gall-bladder and sent into the intestines after each meal to aid digestion. All the blood coming from the stomach and intestines with digested food passes through the liver, where it is further acted upon

before the blood reaches the heart. If we do not take sufficient exercise, the liver becomes sluggish and does not send enough bile into the intestine. This leads to headache, sallow colour of the skin, and other unpleasant consequences. In those who take too much alcohol the liver becomes diseased, which often causes death. The *sweetbread* is a gland resembling the salivary glands. The sweetbread juice is the most powerful of all the digestive juices, and digests raw and cooked starch, fats, and nitrogenous or proteid foods. The sweetbread has a pipe or duct, through which its juice passes into the intestine.

151. The *small intestine* has a fleshy or muscular layer in its wall, and is lined inside with a membrane containing the intestinal glands. This membrane is provided with numerous folds and small projections like the finger of a glove. In this way the area of the surface of the inner wall of the intestine is enormously increased. The chief function of the small intestine is to *absorb the digested food*, and the area of the intestinal surface is increased by these folds and projections so that the food may be absorbed the more readily. Along the whole of the small intestine are found very many tiny blood-vessels with thin walls, called capillaries. Food by being digested is made soluble, so that it can pass easily through the inner wall of the intestine into these thin-walled capillaries. That is known as the 'absorption' of food, and closely resembles the process of respiration in the lungs, by which oxygen from the air passes through the capillary walls into the blood.

152. The *large intestine* is like the small intestine in structure, but is wider and has no folds of membrane or

projections on its inner surface. Most of the digestible portion of the food is absorbed by the time it reaches the large intestine. It is the duty of the large intestine to absorb what is left unabsorbed by the small intestine, especially the *water*. The digested food when it passes from the small to the large intestine is like a thick fluid. By the gradual absorption of the water in the large intestine its contents become more solid, and finally only waste matter is left which is passed out of the body. If, owing to the presence of bad or indigestible food or to an unhealthy condition of the bowel, the contents of the intestine are passed from the body too frequently, say, more than twice in one day, the water does not get time to be absorbed. Under those conditions very soft or liquid matter passes from the body—a condition called *diarrhœa*. The opposite condition, when the bowels act less often than once every day, and the matter passed becomes very solid and hard from absorption of too much water, is called costiveness or *constipation*.

153. By far the most common cause of all bowel trouble, and also of many other slight ailments—such as headache, feeling of tiredness, giddiness, &c.—is habitual costiveness or *chronic constipation*. The following points should be remembered in this connection:

(1) The bowels should act at least once every day. Eating plenty of fruit, vegetables, and salad helps to produce regularity of the action of the bowels. A glass of cold water taken on getting up in the morning will often have the desired effect. Of course, exercise is very necessary to keep the bowels regular. A bad habit developed in childhood may remain all through life. Children should therefore be taught and encouraged to

relieve the bowels regularly, at the same time every day, either on getting up in the morning, or after breakfast, or just before going to bed. In this way the bowel will get into the good habit of wanting to be relieved regularly every day. When the desire for relief comes, it should be responded to at once, otherwise the opportunity of the day may be lost. I am laying so much stress on the avoidance of habitual constipation because it is the cause of a very large amount of human misery and suffering.

(2) Cold is also a cause of intestinal trouble by producing 'catarrh of the intestine.' Diarrhœa is usually the result. In the summer-time, when we are apt to discard much of our clothing and bed-covers at night, particular care should be taken that the abdomen is protected from chill. For this reason we always put a 'binder' round a baby's abdomen, and people who live in hot climates wear a 'cholera-belt' round the abdomen to guard against chills. Children should always be warmly dressed about the thighs and abdomen.

(3) Food which is particularly indigestible may irritate the intestine and produce diarrhœa. Certain things—such as unripe or overripe and rotten fruit, stale and partially decomposed fish and meat—all give rise to catarrh of the intestine and very severe diarrhœa, which may be fatal. In hot weather, owing to the rapid growth of microbes in food, fish, meat, and milk are likely to go bad quickly, and often give rise to outbreaks of diarrhœa. Many babies fed on cow's milk die from diarrhœa in July and August every year. This may be prevented, to a great extent, by boiling all milk, which kills the microbes and renders them harmless.

CHAPTER IX

*FOOD AND HINTS ON EATING**

154. We take food for four reasons: (1) to promote the healthy growth of the body during the growing age; (2) to feed the tissues, especially the brain and muscles, with fuel, so that they may carry on their work properly; (3) to maintain the bodily heat; and (4) to repair the waste of the tissues. At all times, whether we are at work or at rest, and even during sleep, the tissues of the body are being used up. Every beat of the heart, every breath we draw, means a certain amount of wear and tear of tissue. Food is required to make good this constant wear and tear.

155. The amount of food required varies under different conditions.

(1) Children require more food in proportion than adults, because they have not only to repair the waste of tissue, but to provide nourishment for the growing bones, muscles, and other organs. Children also need more fatty food than adults, as they lose more heat in proportion from the surface of their bodies. In old age we all need less food and should therefore eat less. Women require rather less food than men.

* For much of the information in this chapter I am indebted to Dr. Hutchison's book on 'Food and the Principles of Dietetics' (Edward Arnold).

(2) When working hard with the muscles more food is required than when we are at rest. For brain work we need good healthy blood containing a sufficient quantity of food nourishment. There is no special brain food, as is so often stated. Too much food is not good for brain work, as it makes the brain dull and sluggish. Too little food is also bad for the brain. A healthy, well-fed body is absolutely necessary for the proper working of a healthy, active brain.

(3) We usually require and eat less food in summer and in hot countries than in winter and in colder climates. In winter we eat more food, especially fat, which is the best heat producer.

156. As we have already seen, an occasional overloading of the stomach may cause 'acute indigestion' with pain in the region of the stomach and heart. It may set up irritation of the stomach and intestines and lead to vomiting and diarrhœa. Habitual over-eating may lead to weakening of the stomach wall, resulting in indigestion, to obesity (stoutness), to disease of the kidneys, heart, and blood-vessels, and possibly also to gout and rheumatism.

157. It is astonishing how long we can live without food, if we can get water to drink. But under such conditions it is not possible to do much physical or brain work, or to keep up the bodily heat without artificial warmth. If people constantly get insufficient food they become pale and flabby. Digestion is bad, and the body is less able to resist disease, especially consumption and other infectious diseases. The mental power is also diminished, and there is a feeling of depression and discomfort.

158. As we saw in the last chapter, all our foods contain some or all of the five necessary ingredients or essential constituents. These are: (1) nitrogenous or proteid food; (2) fats and oily food; (3) carbohydrate food; (4) mineral salts; and (5) water. In addition to these five necessary constituents which we eat and drink, there is a sixth—namely, oxygen—which is necessary for all the tissues of the body, and which we take in through the lungs in breathing.

(1) *Proteids* all contain nitrogen and are therefore called *nitrogenous* foods. They form new tissue, especially the bones, blood, and muscles of growing children, and repair the waste of tissue in children and adults. Nitrogenous foods are absolutely necessary for the maintenance of health and strength. They may be derived from animal or vegetable sources. Animal proteids occur in greatest amount in meat, fish, and cheese; vegetable proteids in peas, beans, and bread. Animal proteid is easier to digest than vegetable proteid.

(2) *Fatty* and *oily foods* are the best heat producers, and so help to maintain the bodily warmth. Fats occur in largest amount in butter, cream, margarine, dripping, and oils. Cream is the dearest, while margarine and dripping are the cheapest, of the fatty foods. We have seen that children require much fatty food, and they should be encouraged to take plenty of it. Fat not only helps to keep the body warm, but also helps to build up the tissues, especially the brain and nerves and the marrow of the bones, which contain much fat.

(3) *Carbohydrates.*—The carbohydrate foods include sugar and starch. They are the fuel or work-producing foods. A baby during the first year of its life does not

do much work, and therefore requires less carbohydrate food in proportion than an adult. We must remember, too, that a baby under six or seven months cannot digest starch at all. If an adult takes too much carbohydrate food—such as sugar, potatoes, or pastry—he may become excessively stout, owing to the storing up of fat in the body. Sugar is a valuable food when we are doing hard work. Mountain climbers often take it in the form of chocolate because of its sustaining power. It is a good food for children in the form of jam, treacle, honey, and chocolates, but, of course, cannot take the place of fat entirely.

(4) *Mineral salts* are necessary for the formation of healthy bones, blood, teeth, and other tissues. The most important salts required are common salt (sodium chloride), and the phosphates of lime and potassium. We have already seen that growing children require phosphate of lime to form sound bones and teeth, and phosphate of potash to produce healthy muscles and blood. Common salt is usually added to food—such as meat, fish, and eggs—when eaten. The other salts are present in foods, such as meat, milk, bread, vegetables, and fruits. By taking plenty of such foods, therefore, we get a sufficient supply of these salts for the needs of the body.

(5) *Water.*—Nearly three-fourths of the whole weight of the body is water, and an adult loses about six pounds of water each day in the urine, sweat, and the expired air. These two facts show the great necessity for water. By drinking only water, and taking no other food, people can live very much longer than if given plenty of food but no water to drink. Milk, which is the natural food for babies, is nearly nine-tenths water, showing that

water is an important food for a baby. Mothers do not think that babies cry sometimes because they are thirsty. A drink of pure, cold water will relieve a baby's thirst better than milk. Water also helps a baby's stomach and bowels to digest and absorb the food. Great care should be taken that all drinking water is quite pure. The ordinary domestic filters are worse than useless, for they may increase the number of germs in the water. If it is not certain that the drinking water is quite pure, it should be boiled before it is drunk. Cisterns in which water is stored should have tightly-fitting covers, and be cleaned out at least once every year.

159. The five necessary constituents, proteids, fats, carbohydrates, salts, and water are present in most articles of diet, but in different proportions. Thus meat and fish, cheese and eggs contain much proteid and fat, but practically no carbohydrate. Peas, beans, and bread contain much carbohydrate and proteid, but very little fat. Butter, margarine, and dripping consist almost entirely of fat. Now the body requires a certain definite proportion of these food elements, and we therefore combine foods so as to get the right proportions. Thus bread, which is poor in fat, is usually eaten with butter or margarine; meat, which is poor in carbohydrate, is usually served with potatoes, which contain much carbohydrate, or it may be stewed with potatoes, turnips, carrots, and onions, which forms a cheap and wholesome dish.

160. Milk is the only thing which can be regarded as a complete food. It contains proteids, fat (cream), carbohydrate (milk-sugar), salts, and water, in the proper proportions for a growing baby. Milk is there-

fore a perfect food for infants, but it is not so for healthy adults, because it contains too little sugar and too much water for their requirements. In diseases such as fevers, milk is a very valuable article of diet. People should therefore learn to take milk during childhood so as to get to like it, in case they may have to live on it when ill later on in life. 'Soda-water' added to milk makes it more digestible, so that persons who cannot take pure milk can often take milk and soda.

161. Proteids and fats are dear foods, carbohydrates the cheapest. Vegetable foods are much cheaper than animal foods in most countries. To poor people with large families the cost of food is an important consideration. They want to get the most valuable foods for the least money. The cheapest sources of proteid or nitrogenous foods are '*skim* milk, cheese, some forms of fish (herring and salt fish), the cheaper cuts of meat, and, if the digestion be good, the pulses (peas, beans, etc.).'—Hutchison. Bread and sugar are amongst the cheapest sources of carbohydrates, whilst the cheapest fats are margarine and dripping. Margarine is a wholesome and nutritious food, and far preferable to the cheap, inferior classes of butter. The nutritive value of a food is not always as great as might appear from its composition. The proteid or carbohydrate in it may be in a form which is not readily digested and absorbed. In such cases, part of it will be wasted and pass through the alimentary canal unabsorbed and unused by the tissues of the body.

162. Man is the only animal that cooks its food before eating it. Savages in some parts of the world, however, still retain their animal instincts and eat raw

meat. Civilized people cook meat, fish, and most other foods, thereby making them more appetising. I cannot here go into the methods and details of cooking, but shall merely tell you what cooking does to food. (1) Cooking makes food more palatable and tasty by adding various flavours to it according to the method used in its preparation. (2) It enables food to be kept longer than when raw. (3) It makes food more wholesome by destroying disease germs and worms which may happen to be in it. (4) It makes vegetable foods more digestible, because cooked starch is easier to digest than raw starch in food. (5) We have already seen that warm food is easier to digest than cold, because it increases the 'churning' action of the stomach and also makes it pour out more digestive fluid.

163. The more digestible a food is, the more quickly does it leave the stomach after a meal. Warm fluids are very rapidly digested. We therefore usually start dinner with a little warm soup which is quickly absorbed, and excites the stomach to make much digestive juice. Of solid foods, the softer and finer kinds are more digestible than the harder and coarser. Thus fish is more easily digested than meat, sole and whiting being the most digestible of all fish. Sweetbread and white meat, such as chicken, are more digestible than red meat or dark poultry, such as geese. Fine bread is more easily digested than coarse, and mashed potatoes than boiled or baked. Amongst the most easily digested foods are beef-tea and meat juices, milk, raw and soft eggs (boiled or poached), oysters, white fish, bread and biscuits, sweetbread, chicken, and

pigeon. These are good foods for invalids and people with weak digestions. Next come mutton, beef, veal, beef-steak, rice, cabbage, etc. The foods most difficult to digest — and therefore suitable only for healthy persons with good digestions—are smoked beef and tongue, smoked and salt fish, roast goose, nuts, pease and lentil porridge. Mushrooms, crabs, and lobsters are also rather indigestible foods. Cheese, especially the softer kinds, such as Gorgonzola, Stilton, cream, etc., is somewhat indigestible, and does not agree with people whose digestion is weak. By thorough mastication, however, cheese, as well as other so-called indigestible foods, can be digested by most people.

164. Of every seven children born one dies before the end of a year, or, in other words, out of every 1,000 children born in this country over 140 die before they are one year old. This enormous and cruel sacrifice of babies can be prevented to a large extent. It is due to want of care on the part of mothers, but more especially to the ignorance of mothers concerning the feeding of infants. It is most important both to mother and baby that she should nurse her child until it is nine or ten months old. If the mother has not enough milk to satisfy the baby, she should still nurse it, but give the baby some feeds of modified cow's milk in addition. If the mother cannot nurse her baby at all, then the child should be fed on good cow's milk. This is not exactly the same as mother's milk and should be modified before giving it to the baby. In the first place, the milk should be got from a reliable dairy so that it may be as pure as possible. But to make sure that there are no living disease germs in the milk, it should always be

boiled before use. In this way the germs of consumption, typhoid fever, diphtheria, scarlet fever, and diarrhœa, which sometimes occur in milk as sold in shops, will be destroyed and rendered harmless. To keep milk sweet it should be kept in a clean jug or can and covered with a piece of fine muslin to keep out flies and dust. Then the milk should be diluted by adding pure water, barley-water, or lime-water to it. It is best to add one part of lime-water* to two parts of milk. Cow's milk forms a harder and less digestible clot in the baby's stomach than mother's milk. The lime-water makes the clot looser and more digestible. To make the mixture more like mother's milk, some 'milk-sugar' or fine white castor sugar and cream should be added to it. The heat of the mixture when given to the baby should be about the same as that of the hand. Sometimes this modification of cow's milk may not agree with the baby, causing it to pass unhealthy 'curdy' motions. In such cases special modifications of milk must be tried. When a baby is constantly fed on boiled cow's milk, it is advisable to give it a little orange or grape juice once or twice a week so as to keep its blood in a healthy condition. Remember also that babies sometimes cry because they are thirsty, and that a drink of cold water relieves the thirst better than milk. The old-fashioned bottle with long rubber tube should never be used. The best is a boat-shaped bottle with the teat attached directly to one end of the bottle. Two such bottles should be used, so that one may be soaking in water while the other is used to feed the baby. Immediately after use the bottle should be washed out with hot water, the teat should be turned

* Lime-water is very cheap and can be bought from any chemist.

inside out and washed, and bottle and teat allowed to soak in a basin with water.

165. The younger the baby the less it requires at each meal. Up to three months it should have 2 to 4 ounces; from three to six months, 4 to 6 ounces; and from six to nine months, 6 to 7 ounces. Whether breast-fed or bottle-fed, a baby should always get its meals regularly. If fed too often or 'whenever it cries,' it will suffer from indigestion, pain in the stomach, and diarrhœa. Up to three months a baby should be fed every two hours through the day and twice in the night. From three months it should be fed every two and a half hours till five months old, and every three hours till nine months, and once only during the night. If an infant or child is fed on too little proteid, mineral, or fatty food, it will become pale, flabby, and rickety. Its blood will be pale, its muscles soft and unhealthy, its bones will be rickety and bend easily, and its teeth will not be strong and sound. On the other hand, if the child is given too much proteid or fatty food, it will suffer from irritation of the stomach and bowels, with pain, vomiting, and diarrhœa. A child fed on too much sugar or starch often looks plump and fat, but is really flabby and rickety. It may also suffer from griping pains in the belly and diarrhœa.

166. Condensed milk should never be used when good fresh milk can be obtained; it is not only less suitable for infants, but more expensive than fresh milk. Condensed milk labelled 'Skimmed,' 'Separated,' or 'Machine-skimmed' milk should NEVER be used for babies, because it has been robbed of all the cream, which is absolutely necessary for infants. The ordinary con-

densed (sweetened) milk is not good, because it has too much sugar and too little fat. The only kind of condensed milk which may be used for babies is *unsweetened condensed whole milk*, which, when mixed with two parts of water, is like cow's milk. Patent foods should not take the place of milk, but may be added to the cow's milk in feeding babies. Only those foods—such as Allenbury's and Mellin's—in which the starch is all changed into sugar beforehand, should be given to babies under six or seven months. Most 'infant foods' contain starch which is useless and even harmful to infants before they have cut any teeth. All these patent foods are expensive.

167. The feeding of older children requires almost as much care as the feeding of infants. Mothers sometimes feed children a year old upon beef-steak, fried fish, potatoes, pickles and, indeed, anything and everything which they themselves eat. That, of course, is absolutely wrong and very bad for young children. Babies should be weaned when about ten to twelve months old. They should continue to get several feeds of milk during the day, so that a child of eighteen months or two years should still be taking 1½ or 2 pints of milk. From the time of weaning, starchy food—such as rice, potato and oat-flour, semolina, Robb's biscuits, rusk, or bread-crust, —may be added to the milk. In addition to this, a child one year old may be given the yolk of an egg beaten up in milk and sweetened with white sugar. A little later the diet may be made more solid by giving thin bread-and-butter or a biscuit with the milk, mashed potato or bread-crust soaked in gravy, and bread soaked in bacon-fat. When about eighteen months old, some pounded or

finely-minced underdone roast mutton or beef should be given once a day, for dinner.

168. After two years, children may eat anything that is wholesome and easily digested. Oat and wheat meal porridge, rusks or bread, with butter, dripping, or margarine, eggs and bacon, for breakfast; fish, chicken, underdone roast meat, with potatoes or other vegetables —such as cauliflower, cabbage, and spinach—and milk or suet pudding, for dinner. Jam, treacle, honey, and chocolate supply the necessary sugar, whilst fruits and vegetables provide some of the mineral salts necessary. Honey and fruit (raw and stewed) are particularly useful, as they are slightly aperient and promote a regular action of the bowels. Besides milk, or occasionally cocoa made with a lot of milk, a child should be given only pure water to drink. **Tea and coffee are harmful for young children, and alcohol in any form is poisonous for them when in health.**

169. Let us here set down some general rules for the feeding of children. Children should have their meals at regular intervals and at stated times. They should not be allowed to eat sweets and cakes between meals, because these spoil the appetite and the digestion. Children ought to breakfast at half-past seven or eight o'clock. At eleven they should have a cup of milk and a rusk or biscuit; dinner at one or half-past, and supper at half-past five. Younger children may have a cup of milk during the night. Crusts and hard biscuits are good for children, as they help to keep the teeth in sound condition. Babies and young children should never be given a dummy teat to suck. It is bad for the mouth and jaws, and also produces a lot of wind in the stomach.

170. Let me next give some general hints on eating and drinking for adults. In different chapters of this book I have told you the effects of under-feeding and of over-eating on the various organs. Here I shall merely give a few general hints on eating and drinking. Three meals a day suffice for most people—breakfast at eight or half-past eight, lunch or dinner at one or half-past one, and dinner or supper at seven. During the afternoon a cup of tea, with some bread-and-butter or a biscuit, is indulged in by most people, and is quite allowable as well as refreshing. It is not good to start work in the morning, especially hard work such as labourers do, on an empty stomach. A light meal, such as bread-and-butter and a cup of tea, should be taken before commencing work, if it is too early for the regular breakfast. No heavy meal should be taken after eight o'clock in the evening, but people with small appetites may take a glass of milk before going to bed. Eating and drinking between meals should always be avoided, especially the drinking of beer or spirits, which is so often done. The food we eat should be good, plain and wholesome, well cooked and not too highly flavoured. Meat once a day is enough for most people, but it may be taken twice during the day if very hard manual labour is being done. It is unwise to eat a heavy meat lunch in the middle of the day if one has to do office work or to study in the afternoon. One usually wants to sleep after a meat lunch. A little beer or wine with dinner probably does no harm to most people, but it should be taken very sparingly, if at all, in case the vice of drinking too much should be developed. Healthy individuals should take plenty of fruit, salad, and green vegetables, and in that way may often avoid the necessity of taking

aperient medicines. Pure cold water is a good healthy drink. Tea, coffee, and cocoa are the usual beverages in this country; but cocoa, especially when made with milk, is a food as well as a beverage. Tea is the national beverage, and, *when properly made*, does no harm unless taken to excess. The evil effects ascribed to tea result mainly from the drinking of 'stewed tea,' which causes indigestion. The water used for making tea should not be too 'hard.'* Before putting the tea in the pot, the teapot should be heated by steaming or pouring a little boiling water into it, and then pouring it away again. The amount of tea used is, 'a teaspoonful for each person and one for the pot.' *As soon as the water boils* it should be poured on the tea and allowed to stand for *four or five minutes, not longer*. If the tea is allowed to 'stew' on the hob, or even under a cosy, it will become bitter and not good to drink. The best plan is to use two teapots, and when the tea has infused for four or five minutes, to pour it off the leaves into the second teapot, which should also be previously heated.

171. There are certain foods which should be eaten with caution, and others which should be avoided altogether.

(1) All tainted food—such as stale meat and fish, over-ripe and rotten fruit—should be avoided. These sometimes produce very severe sickness and diarrhœa, which in some cases prove fatal.

(2) Certain shell-fish are indigestible and produce nettle-rash in some people. These are crabs and

* A 'hard' water is one containing a good deal of lime salts. You can easily tell when water is hard because it will not form a nice lather with soap.

lobsters, mussels, whelks, scallops, etc. Sometimes they contain irritant poisons, which may give rise to serious and even fatal illness. Oysters, mussels, cockles, etc., if grown in foul water, may contain the germs of typhoid fever, and should therefore never be bought from stalls in the streets, but from reliable shops.

(3) Mushrooms are indigestible and may cause pain in the stomach. Many kinds of mushroom are very poisonous, so the safe ones have to be carefully selected.

(4) Raw ham and raw sausages, such as the Germans are so fond of eating, should be avoided, as they introduce tapeworms and other animal parasites into the body.

(5) Veal, ham and pork pies, hams, and sausages sometimes give rise to poisoning, so also do tinned foods. If a tin containing tinned food is bulging or swollen out, it means that the food inside is decomposing and bad, and should not be eaten.

(6) Cress and watercress occasionally give rise to disease, probably because they are often rinsed in foul water containing the germs of disease, or are grown on infected soil.

(7) Ice cream as sold in the streets is very dangerous. It often contains millions of microbes, and children should be strictly cautioned against eating ices from barrows.

172. Although *patent medicines* cannot be regarded as foods, it will be advisable to give you here a few words of warning about using them. Many of the advertisements one reads in the newspapers puffing up patent medicines and pills, stating that they have cured people who have been ill for years and who have been 'given up' by

doctors and hospitals, are absolutely false and not to be believed. Some of them lay claim to cure every ailment and illness from which human beings can suffer—which is absolute nonsense. A few of these medicines and pills no doubt sometimes do good to people, because they contain aperient drugs which relieve constipation, and we have seen that constipation is a very common cause of many minor complaints. But these medicines are expensive; you can buy from the chemist as many pills for a few pence as you can of these patent medicines for a couple of shillings. The fact that the proprietors of patent medicines spend hundreds or thousands of pounds a year on advertising shows what enormous profits they make by the sale of these articles to the public. Lastly, some of them, such as babies' teething powders and others, contain powerful and poisonous drugs which should never be taken except when ordered by a doctor.

CHAPTER X

THE BRAIN, SPINAL CORD, AND NERVES

173. A TREE or a plant lives, grows, and dies just as an animal does. But a tree or plant cannot move from place to place, nor can it see, hear, feel, taste or smell as animals can. The reason is that plants and trees do not possess muscles, brains, or nerves which enable animals to do these things. Of course animals themselves differ very much in this respect. The simplest and lowest forms of animal life, such as a jelly-fish, are not much above the trees and plants in their power of movement and of experiencing sensations. As we go up the scale of the animal kingdom so the muscles become more definite, and the brain and nervous system become gradually more and more complicated. At last we come to man, the most perfect and complete of the animals, in whom the nervous system is a beautiful and complicated network of fibres or threads, presided over by the most wonderful of all the organs of the body—namely, the brain. Man is much above the lower animals because he can speak and think, reason and judge. For this reason the human brain is much more complicated in appearance and structure than the brain of the lower animals.

174. The *nervous system* consists of (1) the *brain*, (2) the *spinal cord*, and (3) the *nerves*. All the nerves in

the body are connected with either the brain or the spinal cord. It is the brain which controls all our actions and movements, and in the brain all the sensations of seeing, hearing, feeling, tasting and smelling are centred. The nervous system may be compared to a system of telegraph offices and wires. There is the chief or head office in the 'general post-office,' there are smaller or local offices distributed over the town in the 'district post-offices,' and there are the telegraph wires connecting these smaller offices with one another and with the head office, and running all over the country. In the same way, in the body we have the chief or head offices in the brain, smaller or local offices in the spinal cord, and the nerves connecting these offices with one another and running from them to all parts of the body. Just as telegraph wires may convey messages to the different offices, and from these offices to all parts of the country, so the nerves may carry messages to the offices in the brain and spinal cord, or from them to all parts of the body.

175. The nerves are of two kinds—(1) *sensory*, and (2) *motor*. The sensory nerves carry the sensations of touch, pain, heat and cold, sight and hearing, taste and smell, to the spinal cord and brain. They run from all the sense organs, from the muscles and joints, and from all parts of the skin to the spinal cord and brain. The motor nerves run from the brain and spinal cord to all the muscles of the body. They carry messages from the brain to the muscles, which lead to muscular contraction and movement. Nerves consist of a number of delicate fibres or threads, which start from a nerve cell and end as fine branching filaments.

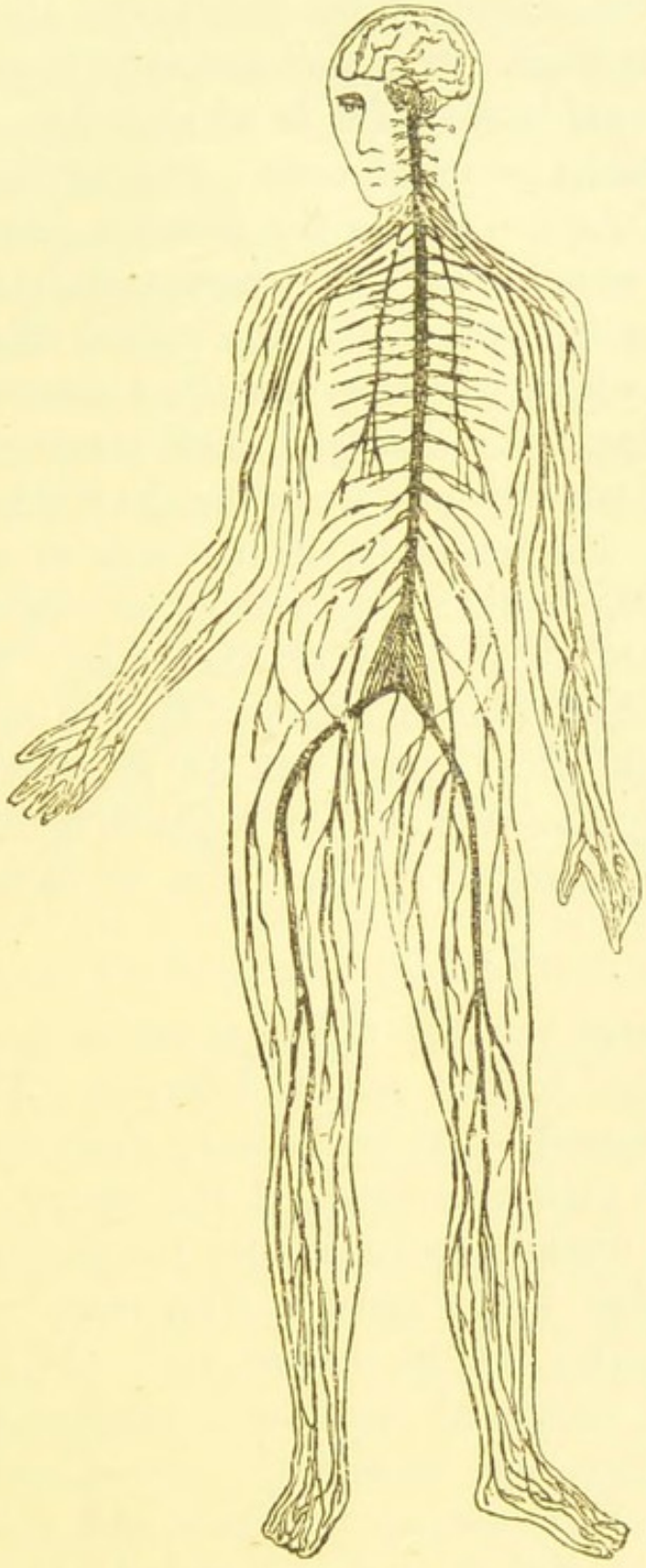

FIG. 12.—DIAGRAM OF THE GENERAL DISTRIBUTION OF THE NERVES IN MAN.

176. The *spinal cord* is the long cord of nervous matter which extends from the brain almost to the bottom of the back. It is well protected from injury by the bony tunnel in the spine in which it lies. It consists of nerve fibres and nerve cells. The nerve fibres run into the brain above and to the muscles, joints, internal organs and skin below. The nerve cells are arranged in groups, which constitute the 'local offices' of the spinal cord, where messages may be received from, and sent to, all parts of the body. Such messages are often received and sent without troubling the 'head offices' in the brain. For example, if the sole of the foot be tickled, the leg is drawn up without any message from, or interference on the part of, the brain. The pulling up of the leg is 'involuntary'—that is to say, it is done without our 'willing' to do it. Such a movement, taking place without any message being sent from the brain ordering it to be done, is called a *reflex action*.

177. A large number of *spinal nerves* are connected with the spinal cord at regular intervals. These spinal nerves are mixed—that is to say, they contain both sensory and motor nerves. If the spinal nerves are damaged or diseased, we may lose the power of feeling and of moving the muscles. The same results may follow an injury to the spinal cord. It is therefore particularly important to guard against injuries or accidents which may damage the spinal cord. A child should never be beaten on the back, and should always be carefully carried so that it may not fall. An injury of this kind received during childhood may lead to life-long lameness or paralysis.

178. The *brain* is the most important and complicated part of the nervous system. It consists really of three parts: (*a*) the *great brain;* (*b*) the *little brain;* and (*c*) the *spinal bulb*. In the brain are many groups of nerve cells, constituting the 'chief' or head offices, which are joined to one another and to the 'local' offices in the spinal cord by many nerve fibres. The surface of the human brain is very complicated, being thrown into a number of folds or *convolutions*. Owing to the great importance of the brain it is well protected from injury by the hard bony skull.

179. The great brain has many important uses. (1) It is the source of all conscious movements and actions, and in it the different movements concerned in walking, writing, talking, swimming, etc., are *coordinated*—that is to say, properly adjusted or arranged; (2) it is the seat of consciousness; (3) it is the seat of the mind or intellect; and (4) in it are centred the special sensations, such as seeing, hearing, smelling and tasting.

180. These functions of the brain must be considered more in detail on account of their importance. (1) All voluntary acts—that is, acts that are 'willed'—have their origin in the brain. Each half of the brain controls the movements of the opposite side of the body, the reason being that the nerve fibres in passing down from the brain cross over to the other side of the spinal cord. As soon as a baby is born it has the power of movement; it can suck, cry, and throw its arms and legs about. Such movements of the arms and legs, however, are jerky and irregular. As the child grows its brain develops the power of adjusting or coordinating the muscular movements. A child learning to walk or write

has considerable difficulty in getting its legs or its arms to carry out the necessary movements in an orderly manner. At the same time it has to think about each separate movement before it is carried out. In other words, each step in the process of walking, swimming, etc., is a *voluntary* act, or 'willed.' Later on, as the child becomes proficient, it no longer has to think about each separate movement that it makes in walking, swimming, etc. When that stage is reached, such actions are called *automatic* actions.

(2) The brain is the seat of consciousness, for if the brain be violently disturbed or shaken, the person becomes insensible and consciousness is lost. A blow or fall on the head, by causing violent shaking or concussion of the brain, the inhalation of chloroform or of much CO_2 may all lead to loss of consciousness. In deep sleep we are quite unconscious, but in ordinary sleep we often dream, which shows that we are not entirely unconscious. During sleep less blood goes to the brain, and fainting is also caused by a want of blood in the brain.

(3) The brain is the seat of the mind or intellect. From the time of birth, the intellect or conscious life grows by means of the messages or sensations which are constantly being sent into the brain from the eye, ear, and other sense organs. With the storing-up in the brain of a gradually increasing stock of sensations and ideas, the memory and the intellect grow. The power of speech, which the lower animals do not possess, also helps the growth of the mind or intellect. Later on, as education proceeds, we become able to control our actions, to reason and judge which are the highest and most complex functions of the brain.

181. A child usually acts impulsively, without stopping to think why it does so or what will be the result of doing so. Thus a child, playing with its toys or doing its lessons, on hearing a band passing, will wish to throw down its toys or books, and run into the street to see the performers. By education the brain should be so trained that the child may learn to control itself and to inhibit or subdue these impulsive acts. The extent to which people can restrain impulsive acts and have cultivated the power of thoughtful and deliberate action, shows how much their self-control has been developed. It is sad to think of the number of weak-minded people in the world, with little power of self-control, who can be easily swayed in any direction, often, unfortunately, for evil rather than for good. A little persuasion by a stronger-minded, unscrupulous person will often induce the weak-willed individual to do things which he knows are wrong, and for which he will be sorry afterwards. He has, however, so little power of self-control that he does what he is told, although he knows full well that it is wrong or harmful. The emotions, such as pleasure and anger, also have their seat in the brain. A person who has learnt to control his actions and emotions will never raise his voice or lose his temper when angry or vexed.

182. It is perhaps in connection with eating and drinking that persons show most markedly the want of self-control. Even strong-willed people sometimes cannot resist the temptation to partake of a dish of which they are very fond, but which they know will not agree with them and will cause them pain or suffering. How often do people go out to a dinner-party and eat all kinds of

indigestible food and drink several kinds of wine, knowing quite well that they will suffer for it the next day! One of the effects of drinking much alcohol is to weaken the power of self-control, so that the unfortunate person goes on drinking more and more spirits, wine, or beer as it is offered to him, until at last he loses almost all control over his mind and body and staggers home drunk.

183. The *little brain* helps the great brain to control the movements of the muscles, and especially helps in adjusting the muscles which enable us to balance ourselves. When this part of the brain is diseased the person becomes giddy and is unable to walk straight, owing to the loss of control over the muscles of the body and limbs. The *spinal bulb* controls and regulates the actions of important internal organs, such as the beat of the heart, the expansion of the lungs in respiration, the movements of the stomach and intestines, the manufacture of the saliva and other digestive juices, and the act of swallowing. All these functions are controlled by the spinal bulb, and do not enter into our consciousness —they are therefore called *reflex* acts. When the spinal bulb is damaged or diseased death rapidly follows, owing to stoppage of the respiration and of the heart beat. Twelve pairs of nerves—the *cranial* or *brain nerves*—are attached to the brain. Some of them, such as the nerves of smell, sight, hearing, and taste are sensory nerves, and carry messages from their particular sense organ—nose, eye, etc.—to the brain. The others are motor nerves, and take messages to the muscles of the face, tongue, heart, etc., which lead to the contractions of those muscles.

184. The various parts of the nervous system are

closely dependent on one another. If, for example, the sensory nerves of a finger are damaged, messages cannot pass from that finger to the brain, and therefore there will be 'no feeling' in the finger. This might also happen if the spinal cord were damaged. Or, thirdly, the sensory nerves and spinal cord might be quite healthy and yet sensation lost in the finger, owing to damage in the brain, where the fibres from the finger end. So that damage to any one link in the chain may lead to partial or total loss of sensation or of the power of movement. When we are well, all the actions and functions of the body are performed so smoothly that we are unconscious of the fact that we have nerves at all. In health we feel no pain anywhere, the heart, lungs, stomach, and other internal organs perform their daily work so quietly and regularly that we are scarcely aware of their existence. When we are ill, however, then there may be pain in the chest, abdomen, legs, head, or any part of the body. This is always due to painful sensations which are sent from the diseased or unhealthy organ along the sensory nerves to the brain. A healthy person is not easily startled or frightened, but when run down from overwork, worry, fright or other cause, the brain and nervous system become more excitable. The nerves are then in a 'jumpy' condition, and we are easily startled and frightened—a condition known as nervousness.

185. All the bodily organs require rest from their labours, and the brain is no exception to the rule. Some organs, such as the heart and lungs, are apparently acting continuously throughout life. Really they act and rest alternately for a short time. After each beat

the heart rests an instant, and after each inspiration the lungs practically rest during expiration. Other organs, such as the salivary glands and intestines, act for one or more hours several times a day after meals, and rest in the intervals. The brain is active when we are awake, and has one prolonged period of rest while we sleep. Sleep is just as necessary for us as food. If we were not allowed to sleep we should die or go mad. During sleep the whole body rests more or less. The breathing is slow and quiet, the heart beats more slowly and feebly, the muscles are at rest, and the brain is practically not acting, so that consciousness is lost for the time being.

186. Of course the brain is not equally fresh and active at all times of the day. It is freshest and most energetic in the morning after the long rest of the night. During the day it gradually becomes fatigued, especially when doing work which requires constant attention. Close attention to mental work is very wearying, and soon leads to fatigue of the brain. Working too long at one subject does the same thing, therefore, when we have much brain work to do, it is a relief to change the subject, say, from languages or history to mathematics or science. After sitting still studying for some time, it is wise to get up and take a few minutes exercise, preferably in the open air. This will send a fresh supply of pure blood to the brain, and enable it to work with fresh vigour. When the brain gets fatigued from prolonged study or overwork, a complete rest and change of scene are very valuable. A few weeks' holiday at the seaside or in the country is a great relief to an overworked and tired brain.

187. Babies and infants sleep the greater part of the day and night. Older children, say from three till nine years of age, should sleep from fourteen to twelve hours a day. From that time the hours of sleep should gradually be diminished until about twenty years of age and upwards, when seven to eight hours suffice. Some people can do with as little as five or six hours sleep, but that is exceptional. During summer we require rather less sleep than in the winter. In summer we should go to bed early and get up early. By rising early we can get several hours work done before the heat of the day, and can then rest while it is very hot. It is very important to make young, growing children go to bed early, so that they may get the requisite amount of sleep to allow the body and brain to rest. Parents should remember that young children require more sleep than their seniors, and they should therefore not allow the little ones to wait for their older brothers and sisters to go to bed. A child that does not get enough sleep will become weak and pale, listless and dull at lessons, and will not grow in body and mind as much as a healthy child should.

188. In order to keep the brain healthy and sound (1) it should at all times be carefully protected from injury. (2) It should not be overworked, but should have sufficient rest every night during sleep. (3) Constant worry is very bad for the brain, and is very often the cause of mental breakdown. Do not worry needlessly, and remember that by worrying we do no good, but rather harm, to ourselves and our affairs, because when we worry we are not able to work well with the brain. (4) Avoid much alcohol, and (5) too much smoking.

Smoking in excess leads to an unusually excitable condition of the brain and nervous system, which is called 'nervousness.' It also damages the nerves of the heart and prevents that organ working properly. These ill effects on the nerves are particularly marked in boys, who should, therefore, never be allowed to smoke.

189. A liberal allowance of plain, wholesome food, plenty of fresh air, exercise, and recreation are essential for the healthy working of the brain. Those who are unfortunately unable to get sufficient to eat, suffer from want of vitality in body and brain, become depressed and irritable, and unable to do much brain work. 'A hungry man is an angry man.' Children especially require sufficient and proper food if their schooling is to be of any value to them. Over-eating and breathing impure air cause the brain to become sluggish and less able to work properly. Outdoor exercise—such as gardening, or recreation in the open air—is needful for those who lead sedentary lives and study much.

190. The effects of alcohol on the nervous system are so serious, and of such very great importance to the well-being of the whole nation, that I propose going into them at some length. You have probably heard of those terrible cases, though I hope you have never experienced such a thing yourself, where a father has come home on Saturday night after having spent a quarter or half his week's wages on drink. The beer or spirits he has been drinking all the afternoon and evening has made him drunk, so that by the time he reaches home he is quarrelsome and no longer master of his actions. He quarrels with his wife, finds fault with her and with everything, and very often ends by striking her and

possibly also the children. It is sad to think of all the misery which is thus brought into many a home by this vice of drunkenness, especially when, as is so often the case, the man is a good husband and father in his sober moments. Just think, too, of the waste of money which could so usefully be spent in getting good food for Sunday's dinner, and for better dinners on the other days of the week. Also of the better clothes and boots the money could buy for the children, and the fires it could pay for in the cold winter days.

191. Or take even the worse case of a woman who drinks too much. Instead of looking after her home, her children, and her husband's comforts, she spends most of her time, and a good deal of her husband's money, drinking in a public-house. Very often the little children are left at home to look after themselves, sometimes remaining all day without any food. The poor little children left alone all day must do something to pass the time. They play with whatever they can lay their hands on, and very often this is a box of matches. They have seen their parents strike these matches on the box, so they do the same, and the next minute the child's clothes are alight, and the poor child is a mass of flames. Other mothers, for fear of their little children getting hurt in this way, have even been known to take them to the public-house with them, and very often let the children drink of the beer or gin or whatever it is they themselves are drinking. That is a terrible thing to do, for alcohol is poison to the body of a young child, and, at the same time, it teaches the child the bad habit of drinking, so that when it grows up it will be probably as fond of it as its mother was.

192. Now, let us see what is the result of too much beer and spirit drinking. Well, many things may happen. The man or woman may become a confirmed drunkard, so that he or she is never sober, and therefore unable to look after his or her business or home. Such people end their days in prison or the workhouse, or get ill and die in hospital. Or they may get some disease of the brain, or the liver, or nerves, or stomach, or, indeed, of almost any organ in the body, and, after months of suffering, die from the effects of the alcohol. Or it may be especially the brain and the mind which are destroyed by drink, so that the person has to be shut up in a lunatic asylum. Just think of it! nearly a quarter of all the people in the lunatic asylums in the country are there because they have drunk too much alcohol! In most cases it is their own fault, and if they had been wise enough and strong-minded enough to keep away from drink, they would now be strong and healthy citizens going about doing their ordinary work instead of being shut up for the rest of their days in asylums. Then think of all the crime that is traceable to drink! Ill-treating wives and children, robberies, even murders, are in many cases due to drink, and if only people would keep away from alcohol, half our prisons, as well as half our lunatic asylums, would be empty.

193. Now, this very dreadful state of things—poverty, sickness, and crime—can be changed and improved in one way, and that is by avoiding too much drink. I would almost say by avoiding alcoholic drink altogether, because the taste for it grows, and by commencing with a little, which is harmless, a man or woman may soon get to take too much, which is harmful in the ways we

have seen above. For growing children and young people it is like poison; while for grown-up people a little may be harmless, but there is always the danger that they will get to like it, and so in time take too much of it.

CHAPTER XI

THE SENSE ORGANS

The Eye.

194. In principle the eye is like a photographic camera. The chief parts of a camera are (1) the lens, (2) the dark chamber, (3) the sensitive plate or film at the back, and (4) the diaphragm or 'stop,' which is placed in front of the lens. When an object is photographed, it is placed in front of the camera, and the rays of light from it pass through the lens. The lens 'focuses,' or brings to a point, the rays of light coming from the different parts of the object photographed. A picture of the object is thus formed on the sensitive plate at the back of the camera. The 'stop' regulates the amount of light passing through the lens, and helps to produce a clearer picture of the object photographed. Similarly, in the eye rays of light pass through the lens which focuses them on the sensitive screen at the back of the eye called the *retina*. A clear picture of the object looked at is thus formed on the retina. This picture or 'image' formed on the retina causes a message to be sent to the brain, where it gives rise to a sensation of vision.

195. The eyelids and eyelashes protect the front of the eyeball from too much light and from dust particles.

The eyelids are constantly blinking so as to keep the surface of the eyes moist and free from dust. The eyelashes also warn us of the approach of insects, etc. The eyeball is well protected all round by the bony wall of the orbit (see Fig. 1, p. 9). The front of the eyeball is transparent so as to allow the rays of light to pass into the eye. The rest of the eyeball is tough and opaque; a little of this part is seen in front as the

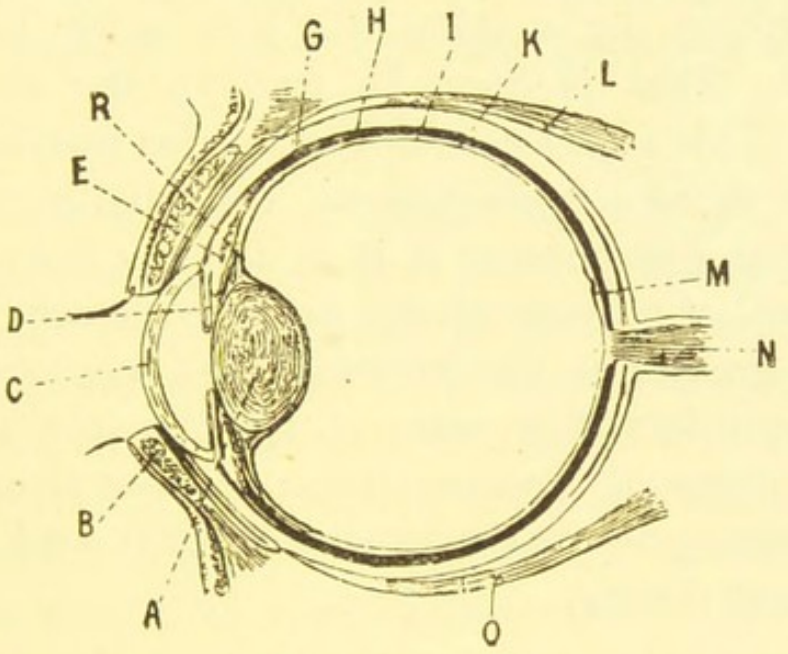

FIG. 13.—SECTION OF THE EYEBALL.

A, Lens; B, eyelid; C, cornea, the transparent part of the eyeball; D, iris or 'stop'; the space between the upper and lower parts of the iris is the pupil; G, the sclerotic coat, seen at the side of the cornea as the 'white of the eye'; K, M, the retina; L, O, muscles of the eyeball; N, optic nerve.

'white of the eye.' The colour of the eyes—blue, brown, etc.—is due to a coloured curtain or screen, in the middle of which is a round hole called the *pupil*. Just behind the pupil is the clear, glassy lens, and at the back of the eyeball is the sensitive layer, called the retina, enclosed in the globe of the eye, which is a dark chamber like the body of a camera. The retina is really a layer of nerve substance produced by the thinning out of the optic

nerve, or nerve of sight, which comes from the brain. The eyeball can be moved in all directions by means of six small muscles which are attached to it.

196. The *lens* is like a magnifying-glass, and helps to form on the retina a clear picture of objects looked at. In a healthy eye, a distant object gives a clear picture on the retina without any muscular effort. A near object, however, would not give a sharp image on the retina, except by making the lens more bulged or 'convex.' That is done by working the small lens muscle. This adjustment of the lens for looking at near objects is called *accommodation*. The smaller the object looked at and the nearer it is to the eye, the greater is the amount of accommodation necessary to see it clearly, and the greater is the muscular and nervous strain. After about forty-five years of age, the eye gradually loses its power of accommodation for near vision. It is then necessary to wear spectacles for near work, such as reading and sewing.

197. Many more children wear spectacles nowadays than formerly. This is partly due to the fact that more trouble is taken at the present day to examine the eyes of children properly, and so more cases of slight defect are discovered. Another reason is that young children are allowed to do too much fine eye-work—such as sewing and reading—and in that way may do serious damage to the eyes. Sight is defective when the eyeball is too short or too long or not quite round in front.

(1) *Long-sightedness.*—This is due to the eyeball being shorter than usual. Many children are a little long-sighted, which, if they use the eyes too much, leads to irritability of the eye, with redness of the eyeball and

eyelids, and very frequently also to headaches and neuralgia in the head. As a rule, the use of convex spectacles, especially for near work, relieves the troublesome symptoms.

(2) *Short-sightedness.* This is due to the eyeball being longer than usual. A short-sighted person, when reading or sewing, brings the book or work quite close to the eyes, and cannot see it distinctly at the proper distance (10 or 12 inches) from the eyes. Short-sighted people require concave glasses, especially for seeing things at a distance.

198. **Before getting spectacles always have the eyes examined by a doctor,** who will order the glasses necessary. You should never go to a spectacle-maker to have the eyes examined. The eye is a very delicate organ and should therefore be treated with great care. When anything is the matter with it a doctor should be consulted; if glasses are required he will order them, and they should be made by the optician or spectacle-maker from the doctor's prescription only.

199. When the two eyes do not look in exactly the same direction, the person is said to squint. Squinting is produced by the weakness of one of the small muscles of the eyeball, and in children is often caused by doing too much near work. Squinting can be remedied by the use of special glasses. People who are colour-blind cannot tell the difference between certain colours. Most colour-blind persons cannot tell red from green, but usually say they are shades of the same colour. It is fortunate that colour-blindness is rare, for it is a defect of the eye which cannot be remedied.

200. Let us now set down a few rules for the care of the eyes. (1) The eyes should be carefully protected from injury at all times. Sometimes even a slight injury to the eye may lead to partial, or even total, loss of sight in that eye. Here let me warn you against the dangerous habit of carrying a stick or umbrella under the arm with the point upwards. Sometimes people's eyes are injured in that way.

(2) When anything gets into the eye, the eye should not be rubbed to and fro, but gently rubbed two or three times towards the nose and then the 'nose blown' hard. If this does not succeed, the upper lid may be pulled down over the lower lid once or twice. If the particle of dust still be there, get someone to turn up the upper lid, and then carefully wipe away the offending particle with the corner of a soft handkerchief or a soft camel-hair brush moistened with water.

(3) Weak, underfed children and adults, especially when they live in dark, badly-ventilated and unhygienic rooms, often suffer from catarrh of the eyes, with redness and inflammation of the eyelids. If not properly attended to this may lead to loss of the eyelashes, much thickening of the lids and constant 'watering of the eyes'; or sometimes an ulcer may form on the eyeball and cause partial or total loss of sight. People suffering from sore eyes require plenty of good food and fresh air; also tonics, such as cod-liver oil. The eyes should be well bathed several times a day with warm boracic acid lotion, and at night a little vaseline or boracic acid ointment should be put inside the lower lid so as to prevent the eyelids sticking together in the morning. If this simple treatment does not do much good in a few days a doctor should be consulted. This condition of

the eyes is often 'catching,' therefore anyone suffering from sore eyes should have a towel to himself, otherwise the disease may spread to others. When the eyes are washed or bathed with a lotion, a clean piece of linen rag or lint should be used each time and burnt after use. The same piece of linen or lint should never be used twice over.

(4) The eyes of young children require special care. (*a*) Young children should not be allowed to do fine work, such as sewing, reading, or writing with a pen or pencil. (*b*) They should not hold any work or book nearer to the eyes than 10 inches. Any symptoms pointing to defective sight, such as redness of the eyes or headache after reading a short time, holding the work very near the eyes, etc., should be attended to by having the child's eyes examined by a doctor.

(5) Reading, sewing, or other fine eye-work should never be done in a dim light. Books we read should be printed in large type.

(6) The walls of rooms in which we sit much should be light in colour, and preferably of a green or yellow shade, which is more restful for the eyes than red.

The Ear.

201. The organ of hearing, the ear, consists of three parts: (1) the outer ear, (2) the middle ear, and (3) the internal ear.

(1) The *outer ear* includes (*a*) the *lobe* of the ear at the side of the head, which is usually known as 'the ear,' and (*b*) the canal leading down from the lobe into the head. This canal is about an inch long and is closed at its end by the *ear-drum*. At the entrance to this

canal are some fine hairs which prevent insects getting into the ear. In the wall of the canal are small glands which constantly make the wax of the ear. The wax helps to prevent insects getting right down the outer ear to the drum.

(2) The *middle ear*, and (3) the *internal ear*, are deeply embedded in one of the skull-bones and are therefore well protected. The middle ear contains three very small bones, which convey the vibrations of sound from the ear-drum to the internal ear. The internal ear is very complicated in structure and contains the ends of the nerve of hearing, by which the sensations of sound are carried to the brain. There is a narrow tube running from the middle ear to the back of the nose. The place where this tube opens into the back of the nose is seen in Fig. 11, p. 91. Every time we swallow, this tube opens and allows air to enter the middle ear, otherwise we cannot hear properly. When we have a 'cold in the nose' this tube becomes blocked, which leads to temporary deafness, because air cannot get into the middle ear. Growths at the back of the nose (adenoids) often cause deafness by blocking the end of this tube and so preventing the passage of air through it to the ear.

202. The ear is a very delicate structure and should be carefully treated. (1) It is very dangerous to strike anyone on the ear, because permanent deafness may be thus produced. (2) Sometimes in measles, scarlet fever, and ulceration of the throat, inflammation spreads from the throat along the tube to the middle ear. This may lead to the formation of matter, which bursts through the ear-drum and discharges into the outer

ear—often called a 'running from the ear.' This is a dangerous condition and should always be carefully attended to by syringing out gently with warm boracic acid lotion. If not properly seen to, the 'matter' may eat its way into the bones of the skull leading to permanent deafness, or may even spread to the brain and cause death. (3) *Wax* in the ear should be carefully removed from time to time with an ear scoop or other blunt instrument. If it be allowed to accumulate, it dries and hardens on the drum and so gives rise to deafness. In removing dried wax from the ear, pins and other sharp-pointed instruments should never be used, otherwise the drum may be pierced and deafness perhaps follow. To soften the wax, a little warm oil may be dropped into the ear, which should then be gently syringed out with warm water or boracic acid lotion. (4) Sometimes children force buttons, peas, etc., into the outer ear. These must always be extracted with caution. In the case of a pea in the ear, it is not wise to syringe, because the warm liquid causes the pea to swell and to become more firmly fixed.

The Nose.

203. We have already seen that the nose is important in breathing, as it warms the inspired air and also filters off germs and dust particles, and so prevents them getting into the lungs. It is the lower part of the cavity of the nose which is thus used in breathing. The upper part of the cavity is used in smelling. We have also learnt that we taste with the tongue, and that the flavour of food is chiefly detected by the sense of smell. Therefore, when we have a cold in the head and are unable to smell, we cannot taste our food.

The Skin.

204. Through the skin we get sensations of touch and of heat and cold. We can feel much better with the finger tips and the tip of the tongue than we can with any other part of the body. We can tell the heat of water better with the point of the elbow than with the hand. Pain is usually associated with the skin sensations, but very strong stimulation of any sense organ—for example, a dazzling light or the roar of a cannon—may produce painful sensations.

205. All the senses can be trained by education. For example, blind persons can be taught to read by feeling raised letters. Sailors, by constantly looking out for ships at sea, train their sense of sight so well that they are able to see things at a greater distance than landsmen. The skilled ear of a musician can name any note we may strike on the piano. It is one of the main aims of education to teach people to use the senses properly so that they may become more skilled. It should be noted, however, that 'it is not the *sense organs* that become educated, but the power of the brain to perceive and discriminate' (L. Hill).

CHAPTER XII

THE SKIN

206. The skin is the natural covering of the body. It has several important functions: (1) it keeps the muscles and other organs in position and protects them from injury; (2) it helps to regulate the loss of heat from the body by means of the perspiration; (3) it helps to purify the blood; and (4) it contains the organs of feeling which give rise to the sensations of touch, pain, heat, and cold.

207. Before considering these functions more in detail, let us briefly inquire into the structure of the skin. It consists of two thicknesses or layers: (1) the outer layer, called the *epidermis* or 'scarf-skin,' and (2) the deeper layer, called the *dermis* or true skin. The outer layer or epidermis is insensitive to touch and pain. When much thickened it forms corns and warts, and when the skin is 'raised into a blister' it is because watery fluid gathers between the two layers of the skin. The skin over a blister may be snipped with a pair of scissors without causing any pain, thus showing that the epidermis is quite insensitive. The epidermis is pierced by a great number of small holes or pores, through which the sweat oozes out. It is calculated

that there are more than two million pores distributed over the surface of the body. If the skin be not kept clean by frequent washing, the pores will become blocked with dirt, and the sweat will be unable to pass through them. The epidermis also contains the tubes of the oil-glands of the skin and the little pits in which the hairs lie. The dermis, or true skin, is the sensitive layer of the skin. It contains many nerves and blood-vessels, so that a prick or cut in the 'true' skin is (1) painful, because the nerves are damaged or irritated, and (2) bleeds, because the minute capillaries are damaged. In the dermis are the small glands which manufacture the sweat and the oil of the skin, and also the lowest part of the hair follicles or pits. In some parts of the body the sweat glands are very numerous, as on the forehead and in the armpits; in other parts the oil glands are more numerous, as on the back of the neck and shoulders and at the sides of the lower part of the nose. When the skin is not kept perfectly clean dirt accumulates in the openings of these oil glands, producing the familiar unsightly 'black-heads.' Below the skin is a layer of fatty tissue all over the body. This gives 'roundness to the form' of the limbs and body, and also helps to prevent the loss of too much heat from the body.

208. We are now in a position to understand better the functions of the skin. (1) By forming a covering to the whole body the skin naturally protects the part beneath. The fatty layer beneath the skin forms a soft cushion or pad, which acts as a kind of buffer when the body is struck or pressed upon. (2) A very important function of the skin is the regulation of the bodily heat by means of the perspiration or sweat. When we are

cold the blood-vessels of the skin become smaller, and less sweat is made by the sweat glands. When we are heated, as after exercise, the blood-vessels of the skin get larger, the sweat glands are very active, and help to cool the body by pouring out much sweat. Alcoholic drink also causes the blood-vessels of the skin to increase in size, and so leads to great loss of heat from the surface

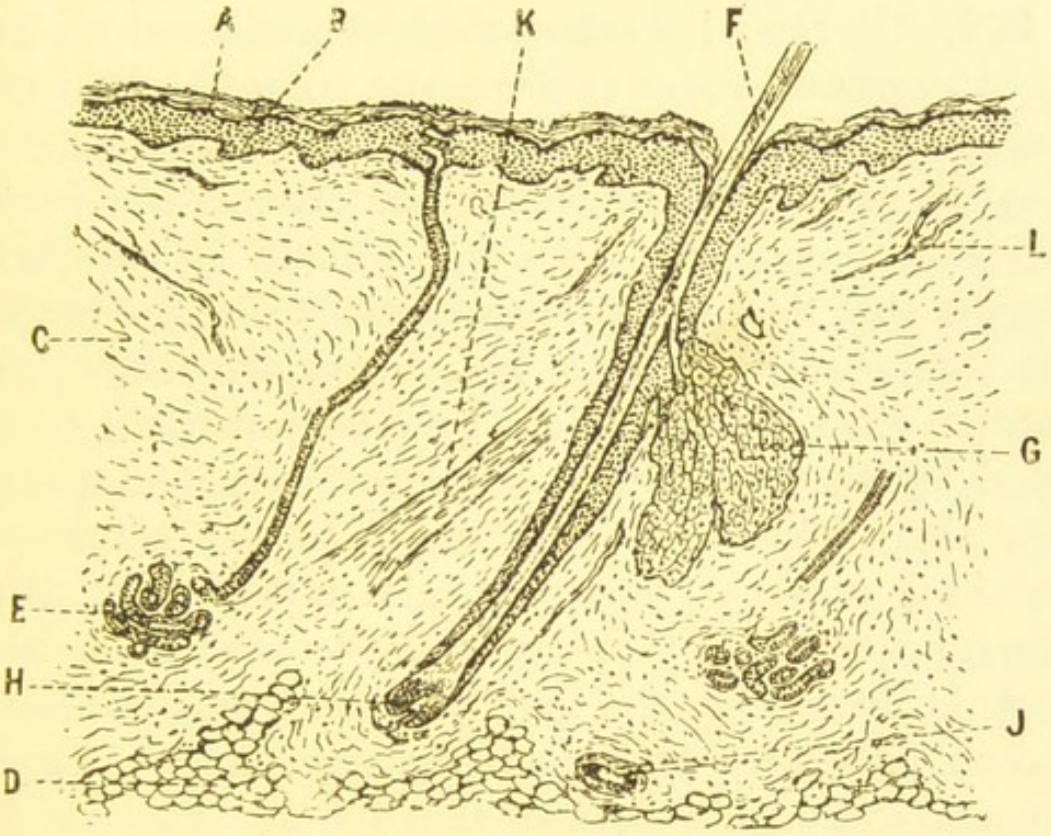

FIG. 14.—SECTION OF SKIN AS SEEN UNDER THE MICROSCOPE.

A, Horny layer; B, soft-growing layer of the epidermis; C, dermis; D, fat; E, sweat gland; F, hair; G, oil gland of hair; H, bulb of hair-root; K, muscle of hair; J, L, blood-vessels.

of the body. It is, therefore, most unwise to take alcohol before going out into the cold night air, with the idea of 'keeping out the cold.' (3) The skin helps to purify the blood by removing small quantities of CO_2, salts, and urea from it, and getting rid of them in the sweat. (4) The skin contains the organs of feeling in which the sensations of touch, pain, heat, and cold are produced.

These sensations are carried to the brain by the sensory nerves. If the sense organs in the skin or the sensory nerves are damaged or diseased, the power of feeling will be lost. When large areas of skin are damaged, as by a burn or scald, a 'scar' is produced in which no sense organs are found. A scar is therefore insensitive to touch, pain, heat, and cold.

209. The most important waste materials which have to be regularly removed from the body are CO_2, urea, and certain salts. If these are not constantly got rid of they accumulate in the blood and tissues, and lead to serious consequences. We have learnt in an earlier chapter that the CO_2 is removed mainly by the lungs in the expired air. A little also leaves the body in the sweat. Most of the urea and salts are removed from the blood by the kidneys and leave the body in the urine. The skin helps both the lungs and the kidneys by removing some CO_2, urea, and salts in the sweat. If the skin is unable to act properly for any length of time, more work is thrown on the kidneys, which may ultimately become diseased. This shows the importance of keeping the skin thoroughly clean so that the sweat glands may act properly, and avoid giving the kidneys more work than they are intended to do.

210. It will now be very clear why it is so important for the health and well-being of the body to keep the skin thoroughly clean. Not only does strict cleanliness enable the skin to do its work properly, but by frequent bathing and washing with soap many diseases may be avoided. Microbes or disease germs exist everywhere, and they thrive particularly well on dirt. Dirty people are therefore more liable to boils and abscesses of the

skin—which are due to microbes—as well as to ringworm, itch, and similar conditions. The whole body, and particularly those parts which perspire freely—namely, the armpits, groins, and feet—should be washed with soap and water every day. This may be done by taking a tepid bath every morning, or by washing the body with hot water and soap and then taking a cold bath. Those who have accustomed themselves to a cold bath find it very invigorating. After a cold bath, the body should be well rubbed with a rough towel so as to produce redness of the skin and a feeling of warmth. People who are blue and cold after cold baths should not take them, as they evidently cannot stand them. Sea-bathing is a particularly healthy and refreshing form of cold bath, especially for those who can swim. A hot bath is best after violent exercise, because it cleanses the skin well after the excessive perspiration, and also takes the feeling of fatigue out of the muscles and limbs. An occasional Turkish bath, in which the body is heated up considerably, is very beneficial. It cleanses the pores and oil glands of the skin more thoroughly than an ordinary bath, and gives tone and a feeling of freshness to the whole body. A hot bath or a Turkish bath is good for colds and slight rheumatic pains in the joints. The patient should go to bed immediately after the hot bath, and put plenty of blankets on the bed so that he may perspire freely. A bath should never be taken less than two hours after a meal. A 'cold' bath varies in temperature according to the season of the year. In winter it may be even at the freezing-point of water (32° F.), but only strong, healthy people can stand the bath so cold as that. Those who are not robust should never take a cold bath below 50°, so that in winter some

hot water should be added to the cold bath. A 'warm' or 'tepid' bath is one at about the body temperature, namely, 98° to 100° F. A 'hot' bath may be taken at a temperature of 105° to 108° F. If a thermometer be not handy, the temperature of a hot bath can be roughly guessed by dipping the elbow into the water. It should be just hot enough for the elbow to bear without causing pain. When preparing a hot bath for children, one should always put the cold water into the bath first, and then add the boiling or hot water to it. Occasionally a child falls into the bath while the nurse or mother turns her back, and if the boiling water be put in the bath first, the child may fall in and be scalded to death while the cold water is being fetched. The soap used to wash the skin should be pure and not irritating to the skin. Many cheap scented soaps are very bad in this respect. Some soaps, such as 'mottled' soap, contain much alkali and are harmful to the skin.

211. The hands are often used at meals to convey bread to the mouth, and any dirt or microbes on the hands may get into the body with the food in that way. The hands should therefore be washed before each meal, so that they may be freed from dirt and microbes as much as possible. Living as we do in dusty, smoky cities, a morning bath or wash is not sufficient to keep us clean the whole day. In order to keep the face and hands clean, it is necessary to wash them several times a day. It is particularly important for painters and plumbers to wash the hands very thoroughly before taking food, otherwise the lead which they use in their work may be carried from their hands into the system, and lead to slow poisoning. Lastly, we have already

seen how very important it is to keep the mouth and teeth scrupulously clean by frequent use of the tooth-brush and soap and a mouth-wash. Cleanliness of the hair and nails will be alluded to later on.

212. A baby's skin is very tender and sensitive, and therefore requires particular care. A baby should be washed all over twice a day. In the evening just before being put to bed, a warm bath should be given and the best curd soap used. The skin should be rubbed dry with a soft towel, special care being taken to dry the skin well in the folds of the groin. The water in the morning bath should be tepid at first, but gradually colder water should be used, so that the baby may become accustomed to a cold bath when quite young. In this way it will be hardened to changes of temperature, and be less liable to colds and bronchitis or other chest diseases.

213. The skin is constantly pouring out sweat and oily matter, which are absorbed by the underclothes and give them their unpleasant odour when soiled. This is particularly the case with socks and stockings. At night the underclothes should be 'aired' by being spread out over the backs of chairs or the bedstead rail. Underclothing should be changed at least once a week, and in the summer, when we perspire more freely, they should be changed twice. The feet perspire very much as a rule, and, as they are covered with boots or shoes, are not freely ventilated. A little dusting powder, composed of equal parts of powdered starch, oxide of zinc and boracic acid, put into the socks every morning will prevent excessive perspiration and the unpleasant smell resulting from it. Socks should be changed at least twice a week

and in some cases more often; and occasionally it is advisable to change them every day.

214. The home should at all times be kept clean and tidy. By frequently dusting and washing, accumulations of dirt and dust are avoided, and in this way there will be less chance of infectious diseases arising in the house. Plenty of fresh air and sunlight, as we have seen, are valuable means of maintaining good health, both bodily and mental. Bedrooms should be kept particularly sweet and clean, and it is advisable to cover the floor with oilcloth rather than with a carpet, as carpets collect dust and dirt, and are less easily kept clean than oilcloth. Special attention should be paid to the cleanliness and proper ventilation of lavatories, and to the disposal of refuse and waste food. These are liable to give rise to bad smells, especially in summer-time, and so may lead to disease. All utensils in which food is placed, and the cupboards in which they are kept, should be perfectly clean and protected from flies and other insects, which may carry disease germs on their bodies and legs.

215. Man is a warm-blooded animal. It matters not whether he lives in the tropics or in the arctic regions, whether it be very hot or very cold around him, the hotness or temperature of his blood remains practically the same when he is well. In that respect he is unlike the frog, which is a cold-blooded animal and becomes heated or cooled according to the temperature of its surroundings. In health the average temperature of the human body, as tested by putting a thermometer or 'hotness measurer' under the tongue, is 98·4° F. If in disease the temperature rises or falls much, we die. Heat is being constantly made by the muscles and

internal organs, and is distributed all over the body by the circulating blood. By the skin, urine and expired air heat is being continually lost from the body. The brain regulates the production and loss of heat, and keeps the temperature of the body constant in health. Loss of heat from the surface of the body or skin takes place in two ways: (1) by the perspiration, and (2) by the body parting directly with some of its heat to surrounding objects which are colder than itself. The loss by perspiration is controlled by the nervous system; the direct loss from the body can be diminished by putting on suitable clothes and by warming our houses and rooms.

216. We have seen that the skin contains an enormous number of sweat glands. These are continually making the sweat which oozes slowly from the pores on to the surface of the body. The perspiration slowly formed in this way disappears into the air as vapour, or 'evaporates' as fast as it is formed. This is known as the 'invisible' or 'insensible' perspiration, because we are not conscious of it at all. In hot weather, and after exercise, the perspiration is made much more quickly and is poured out of the glands faster than it can evaporate. It then collects in beads or drops on the forehead and other parts of the body, and may also saturate our clothes. That is the 'sensible' or 'visible' perspiration. The formation of much sweat helps to cool the body and to prevent it getting overheated in very hot weather. In summer the skin acts freely, and we perspire a great deal; in winter we perspire less, and more water is removed from the blood by the kidneys and passed out as urine.

217. In order that the skin may act properly it must be kept thoroughly clean and free from dirt, otherwise the pores will be blocked and the perspiration unable to escape. People who perspire easily and freely are less liable to suffer from 'sunstroke' or 'heat-stroke,' because the body loses much heat by perspiring and is less likely to become dangerously overheated. It is often thought that excessive perspiration is a sign of weakness. That is by no means the case, and, indeed, in very hot climates, it is better for one's health and general condition if one perspires much. When perspiring freely one should not sit in a draught, because the body may become unduly cooled, and a chill, cold or even inflammation of the lungs may result. It is best to remove the clothes which are wet with perspiration, and to take a warm bath, or, if that is not possible, to rub the skin dry with a rough towel. It is dangerous to drink iced or cold drinks when we are very hot.

218. We wear clothing for protection against heat and cold, wet and injury; also for the sake of decency and for adornment. Clothes protect us from the heat of the sun's rays. Light clothes attract and absorb less heat than dark clothes, therefore in summer it is customary to wear white or light dresses and grey suits. Black and dark clothes absorb much heat and therefore make one feel very hot when worn in the summer. We also wear clothes to protect us from cold and to keep our bodies warm. Between our skin and underclothes there is a layer of air which is warmed by the body. Air is a bad conductor of heat, and it is really this layer of warm air which helps to keep us warm. Loose clothes are therefore warmer, as well as more comfortable, than

tight clothes. Two thin, loose undergarments are warmer than one very thick, tight one, because there is more air entangled by the two loose garments.

219. Wool is the best material to use for underclothing for various reasons : (1) Wool is a bad conductor of heat and so feels warmer to the body. (2) Wool is more open in texture than cotton or linen, and so allows more air to be entangled between the skin and underclothing. Woollen clothes, therefore, not only *feel* warmer but *are* warmer than cotton or linen. (3) Wool absorbs the perspiration better than cotton, and does not feel wet or cold, as cotton underclothes do, after sweating. Woollen underwear therefore guards against a chill after excessive perspiration. When very hot from cycling, rowing, tennis, etc., a 'sweater'—that is, a knitted wool jersey—is an excellent thing to put on to guard against a chill and to absorb the perspiration.

220. Flannel is a good, warm material for the underclothes of children. It is also frequently used for children's night-dresses. As it is somewhat expensive, those who cannot afford flannel use a material called flannelette. This is a very dangerous material for children's night-dresses, for it is very inflammable. Once it catches alight it burns very quickly, and soon the poor child is in flames. In such cases the child usually rushes out of the room for help, and the air or wind makes the material blaze all the more. The proper thing to do is to seize the burning garment bravely in the two hands, and to roll it up, if possible, into a ball. If the clothing is already burning freely, the child should be completely wrapped in a blanket or rug, by which the flames may be stifled. Every year many children die

a frightful death by burning from this cause alone. Such accidents can be prevented by the use of a good fireguard, and by buying *non-inflammable* flannelette instead of the ordinary, dangerous kind. It is not more expensive than the ordinary flannelette.

221. It is very unwise for women to wear long, trailing skirts, particularly in the streets. Long skirts gather up dust, mud, and filth from the roads, which are taken home and brushed out in the house. Short skirts are much cleaner and more hygienic, as well as more comfortable to walk in, than long skirts.

222. Ordinary clothes afford very little protection against the wet. To keep out water, special material, such as mackintosh, is necessary. Wet clothes do us no harm while we are walking and moving about, but it is very dangerous to sit still for any time with wet clothes on or with wet feet. In this way colds and rheumatism are often caught. Wet clothes should always be taken off at once, if possible, and the body rubbed thoroughly dry.

223. We have already seen that the clothing should never be worn so tight as to interfere with the proper working of any part of the body. Tight stays and bands round the waist cause deformity of the chest, prevent proper breathing and action of the heart, and also interfere with the circulation and the digestive organs. When taking exercise and doing gymnastics, it is particularly important to have all the clothing loose, so as to allow free play to the muscles and bones of the limbs and trunk. Tight boots prevent good circulation in the feet and so cause chilblains. By pressing unduly

on the feet, tight boots also cause deformity of the feet and toes, corns, bunions and ingrowing toe-nails. Sandals are the healthiest things for children to wear. Tight garters, sleeves, wrist, and collar bands and gloves—all prevent a good circulation of the blood—and may cause coldness of the limbs, chilblains, swollen veins and congestion of the skin. Tight hard hats, especially as worn by men, often cause headache and discomfort by interfering with the circulation in the scalp. Possibly, too, this leads to early baldness in men. We should probably be healthier if we went about without hats altogether.

224. A healthy, well-kept skin is smooth and clear and of a good colour. Want of cleanliness leads to a number of disorders due to germs—such as boils, pimples, and abscesses. Ringworm, the itch, sores on the head, and other unpleasant skin diseases are often produced by insufficient washing of the body and underclothes. Several of the *infectious* diseases — such as measles, German measles, scarlet fever, small-pox, etc.—produce skin rashes by which these diseases can be recognised. By paying particular attention to the cleanliness of the body, the clothes, and the home, and by keeping away from houses in which any of these diseases is known to be present and from persons living in such houses, the risk of catching an infectious disease is greatly lessened. Measles, whooping-cough and scarlet fever are serious diseases when they attack very young children. We should therefore do all we can to protect young children from them. When one child in a family is ill with measles or scarlet fever, the mother very often allows the other children to be in the same room with the little patient. The idea is that all children must catch the

disease at some time or another, and therefore the sooner it is over the better. That idea is quite wrong for two reasons: (1) All children do not necessarily get measles, scarlet fever and whooping-cough; and (2) it is much less serious for an older child to get such a disease than for a young child to do so. Young children should therefore be carefully protected from these diseases, and it is possible that they may escape them altogether. A child suffering from any of these illnesses should be kept in a room apart from the other children, and if thorough isolation is not possible, the child is best sent to a fever hospital. **Children should not be allowed to go to school from a house in which any infectious disease is present** until the patient is quite better or has been removed to a hospital **and the house has been thoroughly disinfected.** It is very wrong of parents to send their children to school when there is an infectious disease in the house, for in that way the disease may be spread throughout the school.

225. In the case of small-pox we have a very valuable and safe method of prevention in *vaccination*. Every baby ought to be vaccinated before it is six months old, and it will then be well protected from small-pox for several years. In addition every child should be *re-vaccinated* during its school age when eight or ten years old. The chances of getting small-pox are extremely small when people are re-vaccinated.

The Nails.

226. The nails protect the ends of the fingers and toes from injury. They are really a modification of the upper layer of the skin (epidermis), from which they grow.

Like the epidermis the nails are insensitive and can be cut without pain. Dirt containing numerous germs is apt to lodge under the nails, and so may get into our food. The habit of biting the nails is therefore dangerous, because in that way very many microbes may be swallowed. The nails should be kept clean and neat by scrubbing with a nail-brush and soap, and then scraping with a penknife or nail-cleaner. They should always be neatly cut and trimmed, and the skin pushed back at the root of the nails so that it may not grow over them. In cutting the nails care should be taken to cut them properly at the sides to prevent them growing into the flesh. This is specially important in the case of the toe-nails, which often grow into the flesh owing to the pressure of tight boots. Particular care should be taken to keep the toe-nails clean and short, because dirt very quickly accumulates on the toes, owing to the great amount of perspiration which is formed by the skin of the feet. The feet should be washed every day, otherwise they may smell very offensive.

The Hair.

227. Like the nails the hairs are formed from the superficial layer of the skin. They are set in small pits or depressions in the skin and stand out beyond the surface for a greater or less distance (see Fig. 14, p. 143). The roots of the hairs in the skin are kept constantly moist by little oil glands which lie close to them. The hair grows throughout life, but as we get older it becomes thinner and grey in colour. In order to preserve the hair it should be kept clean, and, above all, should be *well* brushed twice a day. Hard brushing frees the hair

from dust and dirt to some extent, and also keeps it in good condition by increasing the flow of blood to the roots.

228. Dust and dirt collect in the hair even more than they do on the skin. The hair also becomes greasy, owing to the fatty matter which is constantly poured out upon the roots by the oil glands. If this fatty material is allowed to accumulate, it decomposes and makes the hair smell very unpleasant. Sometimes loathsome insects may get into the hair and give rise to a sore head from constant scratching and tearing of the skin. By careful attention to cleanliness these troubles may be avoided. In the first place, the hair of children, girls as well as boys, should be kept short, for short hair can be kept clean much more easily than long hair. When girls reach the age of fifteen or sixteen years, the hair may be allowed to grow long. Girls who wear the hair long should certainly have it plaited back in school, so as to prevent, as much as possible, the risk of catching insects from other children. Secondly, the hair should be well brushed at least once, and preferably twice, every day. Artificial grease should not be used on the head, unless the scalp is very dry and scurfy. Combs and brushes, which become greasy and soiled from constant use, should be washed every fortnight with soap and water to which a little washing soda has been added, then thoroughly rinsed in clean water and allowed to dry.

229. Thirdly, children's heads should be *washed at least once a week* with soap and water and then rinsed in two or three changes of fresh water. When thoroughly dried with a rough towel, the hair should be carefully combed with a fine-toothed comb, so that any stray

insects, which may have got into the hair and not been removed by washing, may be found and got rid of. Long hair is difficult to dry, and on that account girls and women wash the head less often than they should, for it is long and heavy hair which collects most dust and dirt, and is most in need of frequent washing. Nobody should go longer than a fortnight, at the very most, without washing the head. After washing and rubbing with a towel, long hair should not be plaited or tied back, but spread out so that it may dry as quickly as possible. If the hair is very heavy and difficult to wash properly, it is wise to have it shampooed by a hairdresser every fortnight. Fourthly, the hair should never be crimped or screwed up in curl-papers or dyed. The hair is only weakened by these artificial devices, and the result is not pretty, for after all the natural appearance of the hair is the best.

230. Lastly, the greatest care should be taken to keep the hair free from insects and the germs of ringworm. Even perfectly clean children run the risk of catching insects from other children in school. If, on combing the hair with a fine comb, insects are found, the scalp should be sponged with some carbolic acid lotion (1 part of the acid dissolved in 20 parts of water), care being taken that none of the lotion trickles down the forehead into the eyes. It must also be remembered that this lotion is poisonous, and should be kept out of the reach of children. When these insects are present in the head, their eggs, or 'nits,' as they are called, are found in large numbers tightly stuck on to the hairs so that they are not easily removed. In such cases it is best to cut the hair short. If, through scratching, the child has

already made the head bleeding and sore so that scabs have formed, the hair should be cut very short, the scabs soaked off with warm oil, and then some 'white precipitate' ointment put on the places from which the scabs were removed. The child should be prevented from scratching its head, otherwise the blood and poisonous matter will lodge under the nails, and be spread to other parts of the head and possibly the face.

231. *Ringworm* is a disease due to germs, which may affect the head or the body. It is very difficult to treat when on the head, because the disease spreads by means of the cap from one part of the head to another. It may last for a year or more unless thoroughly treated. The head should be shaved, and a piece of thin paper sewn into the cap and changed every day, so that the disease may not be spread by means of the cap. The actual treatment should be left to the doctor. A child with ringworm should not be allowed to hang his cap up on the pegs, either in school or at home, because in that way the disease may be spread to others.

CONCLUSION

In these pages I have endeavoured to tell you, as simply as possible, something about the structure and working of that wonderful machine, the human body. I have also given you the most important rules to be followed if you would live healthy and happy lives. It has taken many pages to tell the story, but the 'Laws of Health' can be summed up in a very few lines:

1. Lead a regular life; eat and drink, work and sleep, take exercise and recreation at the proper times.

2. Dress in a sensible and healthy fashion.

3. Keep your bodies, clothing and homes thoroughly clean.

4. Ventilate your houses well, and live out in the open air as much as possible.

5. Let your food be plain, nourishing and wholesome, but do not take too much of it.

6. Avoid too much smoking and taking alcohol to excess; and

7. Do not worry overmuch, especially about trifles.

Regulate your lives according to these rules, and, by your example, others may be induced to do the same.

SUMMARIES

CHAPTER I.: INTRODUCTORY—PAGE 1

THE human body is like a steam-engine. Both consist of many parts and joints requiring attention and care. Both require fuel and air.

The fuel produces heat in each case, which is changed into work.

The human body differs from an engine (1) in being much more delicate and complicated; (2) it is made of many kinds of material or tissues; (3) it grows from infancy through childhood to manhood; (4) an engine requires only fuel (coal); the human body requires not only fuel but also a special kind of food containing nitrogen to make up for the waste of the tissues; (5) a human being not only works but thinks and reasons.

SIGNS OF PERFECT HEALTH.

1. No pains or aches anywhere.
2. No sickness or other unusual sensations or feelings.
3. A well-formed, healthy-looking body.
4. Appetite good and all functions properly carried out.
5. Feeling well and active and clear-headed.
6. Sleeping well.

How to Keep Healthy.

1. Live regularly; eat, work, play, exercise and sleep, all at the proper times.

2. Eat good plain food. Avoid too much meat, tea, and alcohol.

3. Breathe pure air as much and as often as you can. Ventilate your rooms well.

4. Dress properly; avoid chills and getting wet.

5. Keep your body and house clean. Avoid injuries to any part of the body.

6. Avoid excesses of all kinds, especially too much eating and drinking, and too much smoking.

CHAPTER II.—Page 7.

1. The body is *supported* by the bones of the skeleton.

2. The skull *protects* the brain. The chest-bones and the hip-bones *protect* the heart, lungs, stomach and other internal organs of the body.

3. The bones also serve for the *attachment of muscles*.

Long bones are hollow in the middle and consist of a hard, dense substance. At the ends they are spongy inside with a thin shell of hard bone outside.

Short, flat bones are spongy inside with a thin, hard shell.

Bone consists of one-third animal matter and two-thirds mineral matter.

Children require much proteid and mineral food, as well as fat, to produce healthy, strong bones. The bones of children who do not get proper food become soft or rickety and bend easily.

Milk is the best food for babies till they are a year old.

The bones should always be carefully looked after, lest they may bend, break, or become dislocated.

Children should stand and sit in correct postures so as to avoid curvature of the spine and other deformities.

Tight stays, tight boots, and garters are bad things to wear.

The ends of bones are covered with gristle and are joined together by ligaments. The bones and ligaments form the joints. Joints should be protected from injury, cold, and wet. If the bones of a joint become separated, *dislocation* is said to take place.

CHAPTER III.—Page 21.

Muscle is the fleshy part of the body.

The muscles are attached to the bones by leaders or tendons.

Muscles contract or shorten under the influence of the will.

When muscles contract they draw the bones together, and so produce movement at the joints.

When muscles contract they use up food as fuel and produce heat and force.

In standing we do not use much muscular effort.

In sitting and standing a correct posture should always be maintained, so as to avoid curvature of the spine and other deformities.

In walking and running we use our leg muscles chiefly.

In swimming nearly all the muscles of the body are used.

Healthy muscle contains little fat and feels firm.

Unhealthy muscle feels soft and flabby and contains much fat.

To keep the muscles in a healthy condition we require (1) a sufficient supply of food (flesh-forming, carbonaceous, and mineral); (2) a moderate amount of exercise; (3) not to overtax the small muscles, such as those of the hands and eyes.

Exercise keeps the muscles and the body generally in good condition, and promotes the growth of the body.

Exercise should be taken as much as possible in the open air and in loosely fitting clothes.

Too much or too violent exercise may cause damage to muscles, bones, joints, the heart, or blood-vessels.

Want of exercise leads to an unhealthy condition and wasting of muscle, and may also cause excessive stoutness and want of tone in the body and brain.

CHAPTER IV.—Page 31.

1. The *head* contains the brain, the eyes, the ears, the nose, and the mouth.

2. In the *mouth* are the tongue and the teeth.

3. The *trunk* or body proper is divided into two large compartments by the midriff or diaphragm.

4. In the upper compartment or *chest* are the lungs, the heart, and the large blood-vessels.

5. The *windpipe* runs from the throat to the lungs, and the *gullet* from the mouth to the stomach.

6. The lower compartment of the trunk or the *abdomen* contains the stomach and bowels, the sweetbread and the liver, which are all used in digestion of food.

7. It also contains the *spleen* or *milt*, the *kidneys*, and the *bladder*.

8. In various parts of the body, such as the neck, armpits, etc., are small *glands* which filter off the microbes of disease and prevent them getting into the blood.

CHAPTER V.—Page 37.

The blood flows to every part of the body in a system of pipes called blood-vessels.

It carries to the tissues the oxygen and food nourishment they require, and brings away the waste materials (CO_2 and urea).

The blood consists of cells or corpuscles floating in a clear fluid.

The blood liquid carries food nourishment and also the waste substances (CO_2 and urea). The colouring matter of the red cells carries oxygen to the tissues.

In the body the blood is always liquid, but clots soon after it escapes from the body.

Clotting is Nature's way of stopping bleeding from cuts and wounds.

Good blood contains much oxygen and food nourishment, and very little CO_2 and urea. It is bright red in colour.

Bad blood contains much CO_2 and urea, and very little oxygen and food nourishment. It is dark purple in colour.

Bad blood is being constantly made good by passing through the lungs and kidneys.

Bad blood causes headache, dulness of the brain, pallor of the skin, and liability to serious diseases, such as consumption.

To keep the blood in a good condition we must:

1. Eat sufficient good food, especially flesh-forming food.

2. Breathe as much pure air as possible.

3. Take much exercise, especially in the open air.

The Circulation.—The heart is a pump which drives the blood round the body. The left ventricle sends pure blood to all parts of the body, except the lungs. The blood comes back impure to the right auricle, having lost much oxygen and gained CO_2 in its passage round the body. It also receives a fresh suppy of food nourishment from the digestive organs. The right ventricle then pumps this impure blood through the lungs, where it is purified and again returned to the left side of the heart. With every beat of the heart this double circulation through lungs and body goes on.

The arteries carry pure red blood from the heart to all the tissues; the veins carry impure dark blood back from the tissues to the heart.

The flow of blood in the veins is aided by muscular movements and by breathing; hence the importance of deep breathing and of exercise in aiding the circulation.

The action of the heart and the regulation of the supply of blood to different parts of the body according to their requirements are under the control of the brain.

Bleeding may be (1) capillary, (2) arterial, or (3) venous.

Bleeding, except from a large artery or vein, is rarely fatal, but is stopped naturally by the clotting of the blood.

Pressure applied to the wound will usually stop bleeding.

Bleeding may lead to (1) fainting, (2) poisoning of the wound and an abscess, or (3) anæmia, from constant loss of blood.

Moderate exercise improves the circulation and action

of the heart. Too much exercise is bad for the heart and blood-vessels, and may lead to heart disease.

Over-eating may embarrass the heart by causing the stomach to swell out and press upon the heart. Too much sugary or starchy food may lead to 'fatty' heart.

Alcohol, except in small doses, is bad for the heart and blood-vessels and, if taken at all, should be taken very sparingly. *Alcohol should never be given to children.*

Smoking in excess often has a serious effect upon the heart. Boys under twenty should never smoke.

CHAPTER VI.—Page 56.

The cells and tissues of the body are constantly taking up oxygen and giving out CO_2. The CO_2 passes into the blood in the small capillaries and makes the blood impure.

During respiration, the impure blood in the lungs gives up its CO_2 and receives oxygen in exchange, and so the blood is purified by respiration or breathing.

The CO_2 removed from the blood by the lungs escapes into the air of the room, and makes it gradually more and more impure.

Expired air contains less oxygen, but more CO_2, moisture, and warmth than inspired air.

The parts used in breathing are: the nose, pharynx, windpipe, bronchial tubes, lungs, and chest.

We breathe in two stages: (1) inspiration; (2) expiration.

Inspiration is a muscular action, by which the chest is made bigger and the lungs expand. Expiration is not a muscular act, but chiefly a passive or elastic recoil of the chest and lungs.

Tight clothes round the chest prevent the proper

expansion of the chest and lungs, and should therefore never be worn.

Deep breathing helps and improves the circulation of the blood. Breathing much pure air is the best way to keep the organs healthy and vigorous.

We should always breathe through the nose. By so doing the inspired air is made warm and moist and so less liable to irritate or to 'strike cold upon' the lungs and windpipe. By means of the nose, too, we can detect bad smells and stuffiness in rooms, and lastly, the nose filters off dust particles and so prevents these getting into the lungs.

Constant mouth-breathing in children leads to serious results to bodily and mental health. It is often due to growths at the back of the throat or nose, which should be removed by a surgeon.

It is important to teach children to breathe properly by giving them frequent breathing exercises. By breathing fresh air freely and deeply, the lungs expand well and are less likely to become diseased. The brain, too, acts better, and children learn more readily.

Ventilation.—The air of inhabited rooms is constantly being made impure by the CO_2 exhaled. By ventilation the air is frequently changed and so made pure.

To get good ventilation there must be an 'inlet' for pure air, and an 'outlet' for the impure air.

It is important to ventilate bedrooms and schools thoroughly, because we spend so many hours in them every day.

Fresh air and sunlight are two powerful agents in preventing disease; therefore allow as much of them as possible to enter your dwellings.

Constantly breathing impure air leads to stunted

growth, pale and sickly condition of the body, and feebleness of mind. It may also lead to consumption and other serious diseases.

Babies and young children should be out in the open air as much as possible even in winter time. In that way they will become hardened, and less liable to bronchitis, colds, and other chest troubles.

When we can get no air to breathe we die from suffocation.

Children are often suffocated by being taken into bed with their mothers.

A child should always be put to sleep in a cot or basket and never in its mother's bed.

The lungs will be kept healthy and strong by (1) always breathing through the nose; (2) always breathing pure air and taking deep breaths; (3) avoiding draughts and getting wet; (4) avoiding impure or irritating fumes, especially too much smoking.

CHAPTER VII.—Page 71.

The mouth is formed by the two jaw-bones, the cheeks, and lips.

It contains the tongue, teeth and gums, tonsils and uvula, and the palate.

The salivary glands are in the substance of the cheeks and under the lower jaw and tongue. They make the saliva which gets into the mouth through small pipes or ducts.

The tongue is composed almost entirely of flesh. Its upper surface is rough, and in health is moist and reddish in colour. The appearance of the tongue enables

a doctor to tell whether a person is in good health or not, because it often becomes 'furred' in disease.

The tongue is used (1) for tasting food, (2) for moving the food about whilst it is being chewed, (3) for swallowing, and (4) in speaking.

The tongue should be protected from all sources of irritation.

The tonsils are at the back of the mouth, and filter disease germs out of the food. When enlarged, they lead to thickness of speech and sore throat, and should be removed by a surgeon.

The soft palate is used in swallowing, and prevents liquids coming back through the nose.

The saliva keeps the mouth moist, so that we can eat and talk. It also mixes with the food in chewing, and helps to digest cooked starch in food. Infants under seven or eight months should never be given starchy food, because they cannot digest it.

The saliva should not be wasted by spitting. Too much smoking and the chewing of tobacco often lead to wasting of saliva in this way.

It is a filthy and dangerous habit to spit on the floor of rooms, trains, or other public places and conveyances.

Consumptive persons have to expectorate much phlegm owing to their illness. *They should never spit in the streets or on the floor* because, in that way, the disease may be conveyed to other people. They should spit into pieces of rag which can be burnt, or into spittoons which should be disinfected.

Kissing on the mouth is a dangerous habit which may spread various diseases.

The teeth are used in masticating food. If food is not

properly masticated it cannot be digested, and this leads to indigestion and other serious results.

We have two sets of natural teeth during life: twenty milk teeth and thirty-two permanent teeth.

There are four incisors, two canines, and ten molars in each jaw.

Each tooth has a crown and one or more roots or fangs. It consists of enamel, dentine, and pulp, the latter containing the nerves and blood-vessels of the tooth.

If the teeth are not carefully attended to they decay.

Decay leads to toothache, indigestion, bad odour of the breath, abscesses in the mouth, and swollen glands in the neck.

Care of the Teeth.

1. Brushing after each meal, and especially at night, to get rid of all food particles.

2. The use of a quill toothpick or piece of thread or silk after each meal, to remove food from between the teeth.

3. Eating crusts and other hard food.

4. Frequent visits to the dentist, so that early decay may be detected and remedied. Children should visit the dentist when quite young, and everyone should see the dentist three or four times a year.

Artificial teeth should be got when any natural teeth are lost.

Children should be fed on good milk and sound, wholesome food, so that their teeth may be good.

Teething powders should never be given to children.

Sour and very cold drinks are bad for the teeth and may lead to decay.

CHAPTER VIII.—Page 87.

By digestion, food is changed into a form in which it can be absorbed by the blood for the use of the tissues.

The first and most important step in digestion is the thorough mastication or chewing of food in the mouth.

During digestion, the food passes along the alimentary canal, (1) the mouth, (2) the food-pipe or gullet, (3) the stomach, (4) the small intestine, and (5) the large intestine.

In the mouth, food is tasted, chewed, and mixed with the saliva by which the cooked starch is partly digested and changed into sugar.

After being well chewed the food is swallowed, passing down the gullet into the stomach.

Food remains in the stomach usually from two to four hours. All this time it is being tossed about as in a churn and mixed with the stomach juice.

In the stomach, fleshy food is digested and milk is clotted.

Fluids, such as clear soup, tea, etc., are absorbed by the blood-vessels of the stomach.

After leaving the stomach, food enters the small intestine. Here it mixes with the liver and sweetbread juices, by which the food is completely digested.

Most of the digested food is absorbed by the blood-vessels of the small intestine and taken through the liver to the heart. From there it is sent to the lungs to be purified, and then it circulates all over the body, supplying the organs and tissues with nourishment.

Water is chiefly absorbed by the large intestine, and the indigestible part of the food is finally expelled from the body.

Choking is produced by food going the 'wrong way,' or by a lump of hard food sticking in the gullet. Drinking or talking whilst eating may make the food go down the wrong way.

Indigestion is produced by insufficient mastication of food and constant over-eating and drinking, especially alcohol.

To keep the stomach in good condition we should (1) chew our food well; (2) eat slowly, regularly, and moderately; (3) avoid indigestible food, very hot and very cold liquids and excess of condiments; (4) not take violent exercise immediately before or after meals; (5) not smoke too much; (6) avoid much alcohol.

Alcohol must never be taken between meals.

Diarrhœa is produced by cold or catarrh of the bowel, and by eating bad or indigestible food.

The bowels, therefore, should be protected from chills; and all kinds of unwholesome food should be avoided.

The bowels should be made to act every day regularly.

Young children should be taught to get into the habit of going to the closet every day. A bad habit formed in childhood may last throughout life. Chronic constipation is very difficult to cure, and is the cause of much misery and suffering.

CHAPTER IX.—Page 101.

Food is necessary (1) to promote the healthy growth of the body, (2) to supply the tissues with the necessary fuel, (3) to keep up the heat of the body, and (4) to make good the wear and tear of the tissues.

Children require more food in proportion than adults, and particularly fatty food. Women require rather less

food than men. In old age we all require less food. Extra food is required when doing hard physical work. To do good brain work, a sufficiency of good, wholesome food is required. Both over-eating and under-feeding are bad for the brain. In hot weather we require rather less food than in cold.

Over-eating may lead to indigestion and to disorders of various organs of the body.

Under-feeding lowers the condition of the body and mind, and renders the body more liable to consumption and other infectious diseases.

The five necessary ingredients of food are (1) nitrogenous or proteid, (2) fatty, (3) carbohydrate, (4) mineral salts, and (5) water.

1. Proteids are the building material of the body, and are found in meat, fish, peas, beans, cheese, and bread most abundantly.

2. Fats are the best heat-producers, and occur in butter, cream, oils, etc.

3. Carbohydrates are the fuel or work-producing foods, and consist of starches and sugars.

4. Mineral salts help to make good bones, teeth, blood, muscles, and most tissues. They are present in meat, fish, fruits, vegetables, etc.

5. Water is a valuable and necessary food. Care should be taken that all the water we drink is quite pure, or it should be boiled.

Man requires a mixed diet, and therefore combines the various foods in different proportions suited to his requirements.

Milk is a complete food for infants, but not for healthy adults. In sickness it is a valuable article of diet, for adults as well as for children.

Cooking (1) makes food more palatable, (2) makes it keep longer, (3) destroys disease germs, and (4) makes vegetable food more digestible.

Certain foods (soups, milk, soft eggs, fish, etc.) are easily digested; others (smoked meat, cured fish, shell-fish, cheese, etc.) are indigestible.

The Feeding of Infants.

1. If babies are not properly fed they become ill and die. An infant requires only milk till it is nine or ten months old. Mother's milk is best; failing that, good cow's milk, boiled to destroy disease germs, with some added lime-water, sugar, and cream, usually answers well.

2. A baby under six or seven months cannot digest starchy food.

3. A boat-shaped bottle should be used, and not one with a long rubber tube. All bottles, teats, milk-jugs, etc., should be perfectly clean.

4. A baby should be fed regularly, not whenever it cries.

5. Condensed milks should never be used when good fresh milk can be obtained.

6. 'Skimmed' or 'separated' milk should never be given to babies.

7. A baby that does not get sufficient and proper food will be pale and rickety, and will never grow into a strong, healthy man or woman.

Growing children require plenty of good, plain, wholesome food, such as milk, eggs, fish, underdone meat, and oatmeal porridge; also sugar, fruit, and vegetables.

Grown-up people require three meals a day; meat once a day is sufficient, unless we are doing hard, physical work.

The best beverages are water, milk, cocoa, tea (properly made, and not allowed to stand on the leaves), and coffee.

Alcoholic drinks between meals are very harmful, and should never be indulged in.

All tainted food (stale meat and fish, rotten fruit), raw ham and raw sausages, and cheap ice-creams are dangerous, and should be avoided.

Other foods—such as shellfish, mushrooms, tinned food, meat-pies, and watercress—may be harmful at times, and should be eaten with caution, if at all.

Never take 'patent' medicines; they are dear at any price, and may do a great deal of harm.

CHAPTER X.—Page 117.

The nervous system consists of (1) the brain, (2) the spinal cord, and (3) the nerves.

Nerves are sensory or motor, and are supplied to all parts of the body.

The sensory nerves carry messages from all parts to the spinal cord and brain.

The motor nerves carry messages from the brain and spinal cord to the muscles.

The spinal cord is the centre for simple 'reflex' movements.

The brain consists of (*a*) the great brain, (*b*) the little brain, and (*c*) the spinal bulb.

(*a*) The great brain is the seat of the mind or intellect, of consciousness, and of voluntary movements or actions. The special sensations (seeing, hearing, etc.) are centred in the great brain.

By education, the brain is trained to control our thoughts and actions.

(*b*) The little brain controls the muscles of the body and limbs, and so enables us to balance ourselves.

(*c*) The spinal bulb regulates and controls the actions of the internal organs, such as the heart and circulation, respiration, and the digestive functions.

The nervous system is very delicate and complicated in structure, and must be carefully protected from injuries, such as blows and falls on the head or back.

Brain work is very fatiguing; change of occupation or of scenery relieves fatigue of the brain.

Everybody requires sleep just as much as food. During sleep the brain rests, and consciousness is lost for the time being.

Young children require much more sleep than adults.

For adults seven to eight hours sleep are sufficient.

For the healthy working of the brain we should avoid injuries to it, overwork, worry, too much alcohol, and too much smoking. An active brain requires plenty of good, wholesome food, recreation and exercise in the fresh air, and regular periods of rest and sleep.

Taking too much alcohol may lead to disease of the brain and nerves, and of almost any organ in the body.

Alcohol drinking is also the cause of much lunacy and crime.

The vice of drinking leads to untold poverty, misery, and suffering. Drinking by parents affects their children, and leads to stunting of the growth and weakness of mind.

Avoid much alcohol; you, your children, and the nation at large will be the better for it.

CHAPTER XI.—Page 132.

The *eye* is like a photographic camera.

The most important parts of the eye are (1) the eyelids and eyelashes, (2) the pupil, (3) the lens, (4) the retina, and (5) the optic nerve.

The eyelids and eyelashes protect the front of the eyeball.

Rays of light pass through the pupil, and are focussed by the lens on to the retina.

The picture of objects formed on the retina sends a message along the optic nerve to the brain, where it gives rise to a sensation of sight.

The eye has to be adjusted or 'accommodated' to see near objects distinctly.

The chief defects of vision are long-sight and short-sight. It is necessary to wear glasses when either of these defects exists.

Spectacles should never be worn except when ordered by a doctor. They should be made according to his prescription.

Doing too much reading and sewing when young is a very common cause of defective sight in children.

The eyes should always be protected from injury. Never rub the eyes hard when anything blows into them. Sore eyes and sore lids should be carefully attended to. Remember that these are often infectious, and may be carried, by means of towel, etc., from one person to another.

Books and sewing should be held about 10 inches from the eyes.

Never try to read or work in a dim light.

The *ear* consists of (1) the outer ear, (2) the middle ear, and (3) the internal ear.

The ear-drum shuts off the outer ear from the middle ear.

The middle and internal ears are contained in one of the bones of the skull.

The middle ear communicates with the nose by means of a tube.

When this tube is blocked, as by a cold in the head or growths at the back of the nose, we become deaf until the cold is better or the growths are removed.

After measles, scarlet fever, and other infectious diseases, there is often a discharge from the ear. This is serious, as it may lead to deafness, and even cause death.

Wax should be carefully removed from the ear from time to time.

The upper part of the nose is used in smelling; the lower part in breathing.

We taste with the tongue, but the flavour of food is detected mainly by the smell.

Through the skin we get sensations of touch, heat, and cold.

Pain may arise through over-stimulation of any sense organ.

By training, all senses can be made more acute.

CHAPTER XII.—Page 141.

The *skin* (1) protects the muscles and internal organs of the body, (2) makes the perspiration which regulates the loss of heat from the body, (3) helps to purify the blood, and (4) contains the organs of feeling.

The skin consists of (1) an outer, insensitive, bloodless layer—the epidermis; and (2) a deeper, sensitive layer—the dermis—containing nerves and blood-vessels. It contains many sweat and oil glands and the hair follicles. The surface of the skin contains very many pores, which are the openings of the sweat pipes.

The skin helps the lungs by getting rid of CO_2 and water, and the kidneys by getting rid of urea, salts, and water in the sweat.

To enable the skin to act properly, the body must be kept thoroughly clean by frequent baths and washing with soap and water.

A cold bath every morning is very refreshing and invigorating, and diminishes liability to colds and other disorders.

A hot or a Turkish bath is good for colds and rheumatic pains in the joints, as well as for cleansing the body.

We should wash our hands before every meal.

The soap used for washing the skin should be good and pure.

Babies should be washed and carefully dried twice every day. Children should be accustomed to cold water when quite young.

Underclothing, especially socks and stockings, should be frequently changed and washed. Outer garments should often be brushed, so that they may look neat and tidy.

Keep your homes, and everything connected with them, neat and free from bad odours. Let plenty of fresh air and sunlight come in through the windows.

Man's temperature in health is practically constant in very hot or very cold weather. The brain regulates the temperature of the body.

Loss of heat occurs from the skin (1) by the perspiration, and (2) by direct loss to the objects around us.

When we are wet with perspiration we should avoid a draught, remove the damp or wet underclothes, and take a warm bath or dry the skin with a rough towel.

Direct loss of heat from the surface of the body is controlled by wearing more or less clothing.

Loose and thin garments are better and more comfortable than tight and heavy ones.

Wool is the best material for underclothes, because it is warmer, and absorbs the perspiration better than cotton.

Flannel is good for underclothing, but flannelette is a dangerous material for children's garments because it is so inflammable.

A burning garment should be seized in the hands, or, if it is blazing freely, the child should be wrapped in a rug or blanket.

Wet clothes should be changed as soon as possible, else colds, rheumatism, or other serious illness may result.

Tight clothes of all kinds should be avoided.

Want of cleanliness leads to boils, abscesses, ringworm, and other skin disorders caused by germs.

Many of the infectious diseases bring out rashes on the skin.

Children suffering from an infectious disease should be isolated and kept away from the healthy children.

Before any of the children in the house go back to school the house should be disinfected.

All babies should be vaccinated before they are six months old.

Children should be re-vaccinated when about eight or

ten years old. If this were always done, the terrible disease small-pox would be entirely stamped out.

The *nails* should always be kept clean and neat. When trimming the toe-nails, care must be taken that they are properly cut at the sides to prevent them growing into the flesh.

The *hair*, like the nails, grows from the superficial layer of the skin.

Hair collects dust and dirt, and becomes greasy from the natural fatty matter about the roots of the hair. It must, therefore, be well brushed every day, and should be washed every week.

It is better for school children to wear the hair short; in that way the risk of getting troublesome insects in the head will be diminished.

The hair should never be crimped, curled, or dyed, because it is weakened thereby.

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