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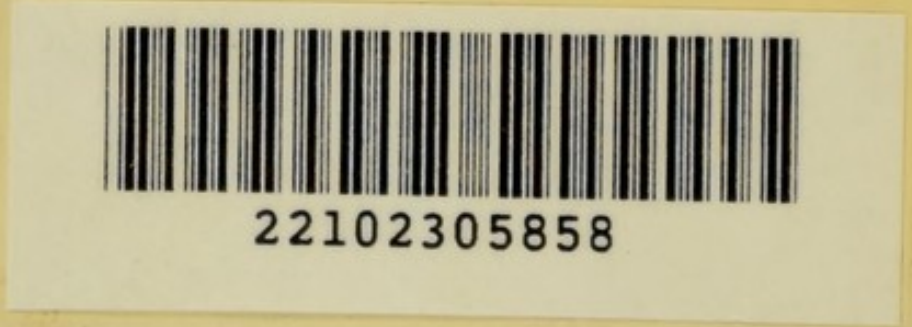
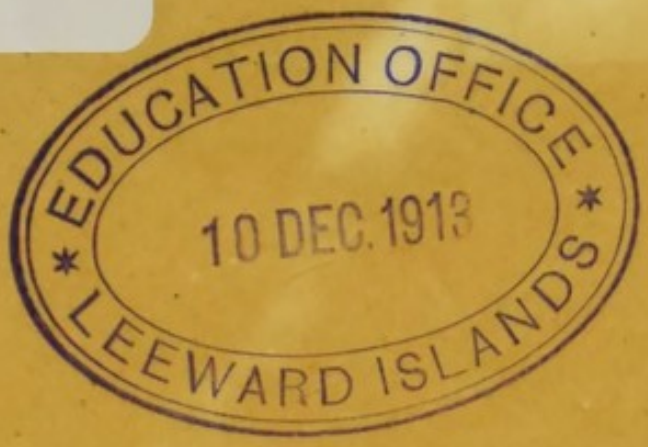
A TEXT BOOK FOR THE USE OF TEACHERS.

By A. H. KIRBY, B.A. (Cantab.).





TROPICAL HYGIENE.

A Text Book for the use of Teachers.

By

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PREFACE.

THE information contained in this book is based on the subject-matter of lectures and demonstrations given by the author, in Antigua, in 1904-8, when occupying the post of Agricultural and Science Master in that island, under the Imperial Department of Agriculture for the West Indies. The work is not intended, in any sense, to be employed as a reader. It is for the teacher, principally, to be used by him as a guide. The language in which it is written has been, nevertheless, made as simple as possible, to provide an example which may be followed in teaching.

Some of the advice and recommendations given in connection with living a healthy life will, doubtless, appear to be impracticable under present conditions. There is no reason, however, why they should not be suggested; the very fact that there is knowledge concerning them will help to bring the time when they will have become common matters in the daily life of everyone.

The aim of the book is to provide a means of teaching the principles of hygiene to the young. Those who will have a use for it are in the fortunate position of having to deal with minds that are pliable. They will, therefore, aim at preventing their pupils from being kept from progress through becoming imbued with the ideas of the present generation, which has learned as much as it can. They

will also desire to give them the knowledge that belongs to the new and future generations, for the betterment of the conditions by which they will be surrounded.

Acknowledgment is made to Mr. C. M. Martin, B.A., Inspector of Schools for the Leeward Islands, and to Dr. F. L. Norris, M.B., C.M., Chief Government Medical Officer, Antigua, for assistance in drawing up the scheme which is followed. It is also due to state that Sir Patrick Manson's "Tropical Diseases" has been used largely in compiling much of the information in the book.

TROPICAL HYGIENE.

INTRODUCTION.

1. One of the chief difficulties in teaching many subjects arises from the circumstance that the pupil is unable to appreciate the bearing that those subjects have on the conditions of his daily life. The result is that he does not approach them in the frame of mind that he bears toward ordinary questions that arise in relation to his natural surroundings, so that the teaching of them is liable to become artificial, and the teacher feels that he is not doing good work. There is no excuse for the existence of this condition in regard to a subject of such interest as Hygiene, because this touches the events of everyday life in a very intimate manner. It is one which lends itself well to the exercise of proper methods of teaching, for the teacher who approaches it in the right spirit cannot fail continually to gain new aspects of it that will endow him with an enthusiasm that he will not fall short of imparting to many of his pupils.

2. Before the treatment of the subject itself is commenced, the attention of the teacher is drawn to the circumstance that the matter in the following pages is divided into two parts. The first of these deals with it in a general, simple way, so that the

facts presented may serve as a basis for the instruction to be given in junior classes; in this part, no attempt is made to afford a description of specific diseases. The second part is intended for senior classes, alone; it should be taken up after careful revision of the first part. In cases where the subject is quite new to the older pupils, the best plan will be for the subject-matter of the two parts to be taken at one and the same time. In order to enable this to be done easily, the sub-sections are numbered throughout the book, and the connection between them is indicated by figures, in brackets, where these are required, so that cross references are made readily.

3. Where it is feasible, simple observations and experiments, to illustrate the facts that are being taught, are described. Many of these are sufficiently simple to be capable of being carried out by the pupils themselves, and insistence on the performance of them will add to the value of the subject and to the ease with which it may be taught. The teacher must not, however, be satisfied with the practical work that is detailed here; his own experience and surroundings will indicate other experiments that may well be added. He must not think, above all, that an experiment or observation is valueless because it is of a simple nature. It is its very simplicity that gives it the best educational worth, and makes it the most suitable vehicle for the transmission of the knowledge that he is desirous to impart.

4. As a preliminary to the study of Part II., it

will be the best plan, after Part I. has been revised carefully, to devote a few lessons to giving a simple description of the way in which the blood and the lymph circulate in the body and of the organs whose special duty is to deal with these, as well as of those which have to make use of the food that is taken into the system. Such work is not at present within the scope of this book, which deals with the subject of the rules of health alone, so that the presentation of such necessary facts of physiology is left to be the outcome of the teacher's own knowledge.

PART I.—THE RULES OF HEALTH.

A.—The House and its Surroundings.

5. *Keeping the house in proper repair.*—For a person to be healthy, the house in which he lives must be kept in a reasonable state of repair. If it has been neglected, so that the rain soaks in through parts of the roof or walls, or if the shutters and doors have been allowed to get into such a state that they can no longer serve as a proper protection against the weather, it is very probable that he will suffer from colds and chills. It is therefore his duty to look over his house often, in order that he may find out where repairs are needed, before the state of it becomes so bad as to cause him to have ill health. If he makes it a regular duty to examine his house in this way every week or fortnight, both in the rainy season and out of it, he will have to spend less on repairs, for he will have his attention

drawn to those parts that require to be put into good order, before they have become so damaged that a comparatively large sum of money has to be spent in order to put matters right. It is because of the neglect of such simple, regular inspection that houses are often seen in a bad state of disrepair. The occupier cannot afford to make any useful improvements, because he has allowed the property to get into such a condition that these would cost a sum of money which puts them out of his reach. If he had considered it to be part of his weekly duties to find out regularly what was wanted, he would have been able to make the alterations at small cost, just when they were required.

6. *Providing plenty of fresh air.*—Another matter that has a great deal to do with the general health of those who live in the house is the provision of plenty of fresh air, both by day and by night. Air which has once been breathed should not be breathed again, as it is poisonous, and if persons spend several hours in a room into which fresh air cannot easily come, their general health is bound to suffer. In the West Indies, as in other tropical countries, it is very unlikely that any harm will occur through this during the day, for the windows and doors are kept open in order that those in the house may not suffer from the heat. At night, however, a very different state of affairs exists. In most of the houses, especially the smaller ones, the doors and shutters are closed tightly, and those inside are breathing the same air constantly. This is why those who live under these conditions take cold easily,

suffer from chills when the wet weather comes, and are sometimes attacked by the disease known commonly as consumption. Such people are helping to kill one another while they sleep.

7. *Prevention of overcrowding.*—The evils that have just been described are generally made worse by the fact that too many people are living in the same house. It is, of course, often necessary that a large family should occupy a small house, because the head of the family cannot afford a larger one. It is a difficult matter to put this right in such countries as England and the northern part of the United States, because of the cold weather that comes during part of the year, and it is hard to prevent what is generally known as overcrowding. This difficulty does not exist, however, in the West Indies, where the air can always be let in as freely as one likes, as long as it is not allowed, while persons are ill, resting, or sleeping, to blow directly upon the body. During the night, in fine weather, there is no excuse for keeping the air out of the house and even in wet and windy weather the windows may nearly always be opened on the sheltered side of the house. All this simply points to the fact that if any special means is required for keeping the body warm, this should be done by covering it up—not by closing the shutters and doors.

8. *Keeping the house clean.*—In the same way as regularity is required in examining the house to see if repairs are required in any parts of it, there is a need for setting definite times at which it is to be

cleaned. It is too often the case that those who live in it do not think of cleaning it until its state is such that it is easy to see that a certain amount of cleaning is required. A washing and scrubbing, now and again, is not sufficient; these should be done at regular intervals. Then, again, the removal of dust is a matter of daily importance. Dust carries germs, and what is more, where it settles it makes a resting place that is suitable for the collection of the germs that are always floating about in the air. If it is remembered that many of these germs can cause diseases (32, 33, 34, 35, 36, 37, 44, 45, 48), it is easy to understand that the presence of dust makes it all the easier for the persons in the house to be attacked by those diseases. There is another point. The shaking of the floors, walls and even the roof of the house through the movements of those who are living in it, as well as through gusts of wind, will, if dust is allowed to collect, constantly cause that dust to be thrown out into the air, so that, as it settles, it will not only spread abroad those germs which it contains already, but will bring others down with it, and will give them the best chance of reaching and attacking the bodies of those who ought to regard it as one of their greatest enemies.

9. *Care of the things in the house.*—It is not only the floors and parts of the walls and of the inside of the roof of the house that act as collectors of dust. Curtains, pictures, and mats very soon become covered by it, or full of it. This is why such contents of the house should be taken out of the

house and dusted, or shaken, every day. There is another reason for this; curtains, hangings, clothes hung up against the wall, and the backs of pictures, all provide surfaces on which mosquitoes have the habit of resting. It is well known that mosquitoes carry certain diseases through biting healthy persons after having bitten those who have been attacked already by those diseases (38, 39, 40). If they are disturbed during the day, it is less likely that they will be able to stay in the house and bite those who are resting in the afternoon, or sleeping at night. Taking the curtains, etc., out every day, and shaking them, will make the numbers of them smaller, inside the house, and will lessen the chances of their causing annoyance and carrying disease. More dangerous in this connection than the curtains and other things that hang in the house are vases and other vessels which may not be given proper attention, and thus be allowed to contain water for some time. The eggs of mosquitoes are laid on the water in these, so that a fresh supply is continually produced, and the insects will always be present to carry disease (11, 38, 39, 40). Therefore vessels inside the house, containing water, should be emptied every day, in order that the chance should not be given for the eggs to be laid, and the numbers to be increased.

10. *Getting rid of rubbish and waste.*—All that has been considered, so far, has relation to matters inside the house. A person who is desirous to make his surroundings such that he may be as little liable as possible to be attacked by disease will be equally careful to make the conditions outside the house as

favourable as possible. As has been stated already, ill health will often be caused through the presence of excess of dampness; wet conditions cause the body to get into such a state that it cannot resist disease. This is one of the reasons why the house should be raised above the ground, so that moisture may not rise into the floors and walls, during wet weather, and in order that the air may be able to pass easily underneath the house. One of the most neglected parts of a property is often the ground immediately underneath the house. No trouble is taken, when it is built, to level this, so that pools of water may collect there, forming places where mosquitoes may lay their eggs; and, too often, it is a place where rubbish is thrown, in order that it may be got rid of as quickly as possible. There is, however, a more serious consideration than this, in connection with the surroundings of the house. Part of the land around it generally serves as a place where all kinds of waste things are thrown down. These often consist of the remains of food, parings of vegetables, the skins of fruit, and even (what is worse) what has passed from the body. In towns and villages, proper means for getting rid of all such things are usually provided, but even where this is not the case, there is no excuse for letting them form unpleasant heaps near the house. Where no means is provided by which they may be taken away every day, they should be buried beneath the surface of the soil, the place where they are buried being changed from time to time, in order that the patches of ground which contain them may not, themselves,

become unhealthy. The chief reason why such waste material should not be allowed to remain above the ground is that it forms places where any disease germs that may be present can remain alive, and often increase in numbers, until they get a chance of attacking human beings (42, 49). There is another reason for removing, or covering up, all the rubbish and waste that comes from the house. It forms the best places for flies to lay their eggs, so that a person who is not careful in this matter is always likely to be troubled by the number of those insects that constantly fly into the house. This is a small matter, however, compared with the danger that arises from the chance that is given for disease to be spread by the flies. They have come from the very places where disease is most likely to be, and settle on the food; so that an easy way is provided for the germs to enter the body. A person who carelessly allows the rubbish and waste, from his house and body, to remain uncovered near the place where he lives, is likely to take in disease with the very food that he eats.

11. *Keeping the land around the house dry.*— Attention has been drawn already to the necessity for taking care that no water is allowed to collect beneath the house (10). What has been said applies, in an equally important way, to the land around the house. All hollows and places where water may collect must be filled up, and, if necessary, drains must be dug in order that the rain may not form pools, but may be enabled to run away as quickly as possible. It is easy to see why this is important.

As has been stated already, mosquitoes lay their eggs on water. From the eggs "wrigglers" are hatched, and these require several days, generally about twelve, during which they must live in water, before the perfect, winged insect can be produced. If, now, care is taken to prevent pools from forming, or, if they are formed, the hollow places are filled up immediately with stones and soil, a very easy method is provided of making the numbers of these insects smaller, so that there will be much less likelihood of disease being brought by them. The necessity for keeping the land around the house clear of rubbish has been dealt with already, and it is to be remembered, in this connection, that such rubbish includes all old tins and broken bottles which are likely to be thrown out and left lying about in the yard or garden. There are certain kinds of mosquitoes, especially those that give persons filaria and yellow fever (39, 40), which like nothing better than water contained in old tins and broken bottles for the purpose of laying their eggs, so that everyone should be careful to send away, or bury, all such rubbish, in order that he may not provide an easy means for increasing the number of mosquitoes, and thus making it less likely that he and his neighbours will be attacked by disease.

12. *Keeping the land around the house clean and tidy.*—There is another circumstance that causes the number of mosquitoes in the house to be large. This is the neglect which allows "bush" to grow up around it, and which provides shelter for the mosquitoes, so that they are enabled to travel much

further than would be possible for them over bare land, or land on which ordinary crops were properly grown. It does not require much thought to make it plain that if a man cultivates his land, instead of neglecting it, he will naturally take care of it in all the ways that have just been mentioned. Such a man will be using his land for the purpose of helping him to get the things that he requires from day to day, and will, at the same time, be keeping it in such a state as to give him and his family the best chance of enjoying good health. It is too often the case, in many parts of the West Indies, that the land around the house is neglected and allowed to get into such a state as to cause misery, and even death, instead of being cultivated and made a means of producing things, such as vegetables and fruits, which a man may use himself, or sell to others, and thus provide himself with a little extra money.

13. *Proper care of small stock kept near the house.* —The plan is often followed of keeping a certain amount of small stock, such as poultry, pigs, or goats, near the house. There is no objection to this if the animals are looked after in a proper way. One of the most important things is that the animals should never, while alive, be allowed inside the house. It very often happens that fowls and other poultry are taken into the house at the end of the day. What has been said is sufficient to show that to do this is an unhealthy thing, both for the stock and for the persons who live in the house. Again, such animals, as well as human beings, require care and suitable shelter, if they are to be kept in proper

condition. It is not to be expected that everyone can afford to buy special coops and pens in which to keep them. It is, however, always possible to get pieces of board and old nails, or even parts of packing cases and boxes, from which such coops and pens may be made, with a little trouble. If the stock is worth keeping at all, it is worthy of being looked after in a proper way, and the owner should take a pride in providing suitable shelter. He will see that it is kept as far away from the house as possible, and that all waste and disused litter will be buried where it will form useful manure for the parts of his land that he is using for the purpose of growing vegetables and other useful plants. For stock to be healthy, it should never be kept on the same part of the land all the time. The pens, etc., should be moved, every few months, to another place, preferably where the land has recently grown a crop, and where no manure has been applied since this was planted.

14. *Collection and storage of water.*—In many parts of the West Indies, arrangements have been made for a good water supply, even in the more distant districts in the country. The water from this should always be used, in preference to any other that may be obtainable, although it may be necessary to carry it some distance. Water from ponds should never be drunk or allowed to be brought inside the house, even if the greatest care is taken to prepare it for use (39, 42, 43, 44, 45, 49), for there is always the chance that it may be drunk by a thirsty person before there has been time

to boil it (23). Notwithstanding the great amount of care that has been taken to provide a supply of pure water, in pipes, wherever any considerable number of persons live, there are still places where rain-water has to be collected and stored for a time. Where such storage is necessary, an effort should be made to provide stone, brick, cement, or iron receptacles for the purpose; water should never be stored in wooden tubs or buckets. Another important matter is that as much care must be taken to prevent such water from helping to produce mosquitoes, as is necessary in connection with the water that may collect accidentally beneath and around the house (9, 11). All tanks, butts, etc., should be covered with wire gauze, except where the water enters them. If the water is being collected from the roof, the gauze should be made to come close up to the delivery pipe, or, better, it should run into a wire strainer let into the covering of the tank, and care should be taken always to remove leaves and dirt which are washed from the roof into the strainer. If the water is poured into the tank or butt, a proper cover for the opening left for this should be provided, and care should be taken that this is always replaced after the receptacle is filled. Water should never be dipped out of butts, tanks, or cisterns; they should be always provided with a tap or plug, placed three or four inches above the bottom, by which it may be drawn; the tap is the better arrangement, as less water is wasted by the employment of this than if a plug is used. The drawing of the water from near the bottom of the vessel in which it is stored

is useful in another way. For many reasons it may not be found possible to use wire gauze for covering it; in such cases, a teaspoonful of kerosene should be poured on the surface of the water, once a week; this will be quite as useful as the gauze, in keeping out mosquitoes, and it will not make any difference to the water; for what is required will always be drawn from near the bottom. More will be said, later, in connection with storing and using water (23, 38, 39, 40, 42, 43, 44, 45, 49).

B.—Food and Water.

15. *Kinds of food.*—If notice is taken of the food that is eaten every day, it will be seen plainly that it is made up largely of three kinds of things; these are the part containing sugar and starch, the part which is mainly made up of fat, and the part that is not of the nature of sugar or starch, or fat, but which the food must contain in order that it may be of use to the body. For instance, the sugar-cane, molasses, syrup and many fruits contain a great deal of sugar; bread, the yam, eddoes, sweet potatoes and Irish potatoes are made up largely of starch; pork, butter, milk and many soups contain a large amount of fat; while lean meat, fish, the white of eggs, peas and beans, and cheese are made up, to a much greater extent, of the kind of food that is neither sweet, starchy or fatty. None of the things that are eaten consists entirely of any one of these, for they are all required by the body, in order that it may continue to live and thrive. This shows that all these kinds of food have their uses in helping the

body to live, grow and work. The foods, however, which contain chiefly sugar or starch, and those which are mainly made up of fat have a very different use from those which do not contain much of either of these things, and the best understanding of the difference between the last kind of foods and the others can be obtained by considering for what purposes they are required by the body.

16. *Need for the different kinds of food.*— One of the facts that are most easily noticed, about the body, is that it is warmer than the things around it. In order to give it this warmth, something that it takes in must be used up, just in the same way as, if a fire has to be kept burning, plenty of fuel must be given to it. It is easy to see that the things which a person eats are the means by which his body is made able to be always warm. The kinds of food that have this special duty are the sugars and starches, and the fats. In being used up, inside the body, they give out heat. They have another use as well, for they help to keep in the heat that has been made already, by covering the body with a certain amount of fat. This is why starch, sugars and fats are often spoken of as fattening foods. Such kinds of food, however, cannot be sufficient for the needs of the body. When it is young it must grow, and whether it is young or old, something must always be given to it, to make up for the waste that is caused through its continuing to live and do the work that is required of it. In other words, the body is always growing. What part of the food is it that is used up for the purpose of

making the body grow? It is the third kind of food that has been spoken about already—the kind which does not consist of starch, sugar, or fat, but the kind which is found chiefly in lean meat, fish, the white of eggs, peas and beans, and cheese. In persons who are young and still growing, this kind of food adds to their bodies and makes them bigger, and makes up as well for the waste that goes on in them; in older persons, it has the latter use, alone, because they are no longer growing, but still have to do work, so that their bodies would waste away if something was not given to them which can make up for this waste. It will be convenient to call this last kind of food growth-making. Thus all these kinds of food may be put together as follows:—

Heat-giving	Sugars and starches.
	Fats.
Growth-making	The kind of food in:
	Lean meat.
	Fish.
	White of eggs.
	Peas and beans.
	Cheese.

17. *Water and other substances in food.*—It must not be forgotten that most foods are made up largely of water; in fact, many of the foods that are eaten consist of water to such an extent that one-half, or even more than three-quarters, is made up of it. Thus a pound of meat, without bone, contains about three-quarters of a pound of water. There is another thing that must be remembered about foods as well. Most of them contain a certain

amount of salt, as well as bone-making substances, and all these are required if the food is to be of use to the body. So that the daily food must be made up of the following kinds of food:—Heat-giving, growth-making, bone-making, salt, and a certain amount of water. These five kinds are absolutely necessary, in the daily food, if the body is to live, grow, and be able to work.

18. *Meals, and the proper times for them.*—Even if the proper kinds of food are eaten, they will not be of the best use to the body unless they are eaten at the right time. It is too often the case, in the West Indies, that persons commence the day with little more than a drink of sugar and water, and that they have little or nothing until the time comes for them to go to bed, when they eat a heavy meal and go to sleep almost immediately afterwards. It is plain, from what has just been said, that this way of feeding is quite wrong. The body is doing its hardest work during the day, and not at night, so that it requires most of its food at that time, and not when it is supposed to be resting. Therefore the food that is provided for meals during the day should be divided into three parts; the first and second parts, to be eaten before going to work and at "breakfast," being the largest, the rest being left to eat about two hours before going to bed. Eating a lot of food just before sleeping at night causes unhealthiness, and often leads to the kinds of fits that are known in some parts of the West Indies as "speechless." All this shows that three meals are required during the day, the two

chief ones before going to work and toward midday, and a third, light one, an hour or two before going to bed.

19. *Proper food for adults.*—This consideration of the right times for food to be taken leads to the subject of the kinds of food that are best to be eaten, both by those who are grown up and by children. The chief mistake that is made by those in the West Indies who have to do hard work with their hands is that the food which they eat does not contain sufficient of the growth-making kind; not that this is required, in their case, for the purpose of making the body grow bigger, but, as has been learnt already, for making up for the waste that goes on in it. This is often because these persons cannot afford to buy much of those foods which contain these kinds, for they generally cost much more than the foods which contain chiefly sugars, starches and fats. Peas and beans, however, and even fish, in some of the islands near the coast, are comparatively cheap, and these will quite fulfil the purpose of giving the body those kinds of food that are required for making up for the waste that goes on every day, especially through working. A man does not require much land for the purpose of growing enough beans for the use of his own family, and even a certain amount that he could sell to others, and if everyone made up his mind always to grow a certain amount of these, they would soon become cheap enough for everybody to be provided with as much of them as they could want. Everyone, therefore, should make a point of including a certain

quantity of these in his daily food, and in that of his family. The large meals, made up chiefly of starch and fat, that are so often taken, are required because these have so little of the growth-making kind of food in them that a great amount has to be eaten before the body can get enough of this kind of food for its needs. The greater use of fish, and peas and beans will lead to the eating of smaller and more useful meals, and the better appearance and health of the body.

20. *Proper food for the young.*—The feeding of infants and children is of so much importance, because, if they are given the proper kinds of food, they will grow up and become strong and healthy men and women, who, if they happen to fall sick, will be able to get better much more quickly than if they had been fed on foods consisting chiefly of sugar, or starch and fat. The greatest mistake is generally made in the feeding of infants. In some parts of the world, they are given the mother's milk for much too long a time, so that not only the infant suffers, but the mother as well. This is not usually the case, however, in the West Indies; here the tendency is to begin to give an infant such starchy foods as "fungee" (or "cookoo"), bananas and messes made with rice, yams, or sweet potatoes, long before it is able to digest such things properly. It is for this reason that so many infants die, and that even those who live are unhealthy and grow up with unshapely bodies. It is to be remembered that infants are not ready for such foods until they are at least six months old. The proper thing to do is to

give them the mother's milk until they are about seven months old, and at the beginning of the eighth month to let them eat a certain amount of the starchy foods just spoken of, well mixed with milk. It is quite wrong to think that a young child can live on the things that are regularly eaten by those who are old enough to choose what they will eat, and it must never be thought, because a young child is quiet and ready to sleep after such food, that this is in any sense a fitting diet for it. The greatest care is thus required in seeing that the helpless infant gets the right foods, but whatever may be the amount of this care, the good that has arisen from it will be undone unless the child, when he or she becomes older, is not taught what foods should be eaten, and is not enabled, as well, to get enough of the proper kinds. The growing child who is old enough to go to school is certainly in want of the starchy, sugary and fatty kinds of food, but it is especially important that he should have plenty of the growth-making foods as well, for the want of the body for this kind at this age is particularly great, for two reasons: the body is always adding to its size—is growing, in fact; and the waste that goes on, owing to the quick changes that are taking place in it, continually requires something to make up for it. This is why the food of growing children should always include a fair amount of lean meat, fish, eggs, or peas and beans.

21. *The preparation of food.*—Most of the foods that are taken need to be cooked before they are eaten. It has been learnt already that food must

be chosen carefully, whether it is for those who are young and still growing, or for those who are older. In the case of foods that require preparation, all this care is wasted unless they are cooked properly. The first thing to understand is that they must be cooked sufficiently; they must not be simply "warmed up," and then eaten in a hurry. Foods prepared in this way are made harder for the body to use, that is, they are more indigestible than if they had not been cooked at all. Besides this, certain kinds of meat, however carefully they may have been chosen, are likely to contain small, living animals which can cause serious disease. It must be remembered that ordinary cooking is done in two ways: in the first, the food is made hot as quickly as possible, kept at the greatest heat for a few minutes, and then the cooking is done at a lower degree of heat; in the second, the heat is gradually raised and then kept at the highest degree for some time. The first kind of cooking is used for meat that is being boiled or roasted; the meat to be boiled is put into water that is already boiling, and that to be roasted is put on the fire when this is at its hottest; they are kept at this degree of heat for about ten minutes, and then the cooking is finished with the water gently simmering, or the meat slowly roasting, as the case may be. This is done because the great heat, at first, forms a harder layer, or skin, on the outside of the meat, which prevents the good juices in it from going out into the water in which it is boiled, or into the gravy which comes from it. The second kind of cooking is used in making soups or nourishing broths

for sick persons, or for boiling starchy foods, such as corn or rice. The meat or rice or corn should be put into cold water, which is slowly warmed until it boils, and then the boiling is kept up for some time. In the case of the meat for making soup or broth, it is evident that the part that the person is going to eat is the liquid that is made from the meat, and not the meat itself; the slow cooking will therefore get all the good food out of the meat, and what is left behind will be useless for food. It is for a different reason that the starchy foods, such as corn and rice, need to be put into cold water, which is gradually made hotter and then allowed to boil for some time. These are made up of a very large number of small grains, which must be made to swell and burst before the boiling water can cook them properly, and bring them to such a condition that they can be used easily as food by the body. All this shows, firstly, that food must be cooked so that the part that is eaten may hold in it as much as possible of the things that are useful to the body, and, secondly, that certain kinds of food must be cooked slowly at first, so that they may be brought into such a state that the body may use them most easily.

22. *Cleanliness in preparing food.*—The consideration of one of the most important things that are connected with the preparation of food has been left to the last. This is cleanliness. First of all, various foods, such as most fruits, lettuce and other vegetables that are eaten without being cooked, should be washed, preferably in water that has been

boiled, before they are eaten. As will be seen later (32, 33, 42, 43, 44, 45, 49), the small, living beings which cause many diseases are nearly always to be found in dust and dirt, and if they are given a chance to enter the body, they will cause ill-health, and even death. Secondly, all dishes, plates, cups and basins in which such food is kept, or from which it is eaten, must be washed carefully, and never used unless they have just been made quite clean. Thirdly, this cleanliness is especially required in regard to milk. It is best to boil milk in a clean vessel, and then to let it cool in that vessel, while it is kept covered with a clean piece of muslin or linen. Lastly, even with cooked food, the plates and dishes from which it is eaten, and the knives, forks and spoons which are used for eating it, should have been washed in hot, clean water, and the hands should be made quite clean, with soap and water, before every meal (42, 43, 44, 49).

23. *Obtaining water fit for drinking.*—Nearly all foods consist largely of water, as has been noticed already (17). This water which they contain is not, however, sufficient for the needs of the body, for if a person eats food alone, without drinking, he soon becomes thirsty, and when this is the case, the best drink that he can take is clean, pure water. There is one thing, in connection with water, that makes it most important to be most careful as to where it comes from, and as to how it is stored, before it is drunk. This is the fact that most of the water which is used in this way has fallen, as

rain, on to the ground and has soaked into the earth, so that it is very likely to have taken up small, living beings from the dust and dirt, which will cause disease if they are allowed to get into the body. The same thing is likely to happen, as has been learnt, if it is stored in vessels that are dirty or not properly protected, so that dust may not be able to get into them (14). All that has just been said shows plainly that, unless the water is known to be quite good, and has been kept in vessels that have been cleaned carefully, something must be done to it which will take out or kill, and so make harmless, the small, living beings in it that will cause those who drink it to suffer from ill-health. For this purpose, some persons use filters. In these the water has to pass through a substance which contains a large number of very small holes, which are so small, in fact, that the living beings in it cannot get through as well, and so are left behind. For ordinary use, these filters are out of the question. They cost a great deal of money, and even when they are used, it cannot be quite certain that the water which comes from them is clean and safe to drink. Besides this, the part of them that filters the water has to be wiped and carefully boiled in water nearly every day, or it will only make the water contain more of the beings that cause disease, instead of ridding it of them. It is necessary, therefore, that there should be found a simpler, cheaper and safer means of making pure the daily supply of drinking water. This is provided by boiling the water in clean vessels and allowing it to cool, in a place where there is no

wind and dust, while covered with a piece of linen or muslin. Some persons will not boil their drinking water in this way, even when they know it to be impure, because it tastes "flat," and is not as refreshing to drink as ordinary water. It is easy, however, to get rid of this taste. This is done by shaking the water up in a large, clean bottle, or by pouring it from a height, backwards and forwards, from one clean vessel to another. Boiled water tastes "flat" because there is no air in it, and shaking it up, or pouring it to and fro several times, gives it back the air, and makes it as refreshing as it was before it was boiled.

C.—Clothing.

24. *Proper kinds of clothing.*—Much has been said about the place in which the body is to live, and the kinds of things that must be taken so that it may be nourished in the best way, and without danger of becoming diseased. There is, however, another important matter that needs careful and continuous attention. This is clothing. The purposes of clothing are to give a decent covering to the body, and to prevent it from being wetted or cooled suddenly in the air so that it becomes chilled. In the West Indies, there is no need to wear a number of garments; there should only be that amount of clothing worn which will fulfil the purposes that have just been mentioned. The most important thing is that the garment next to the skin should be soft and somewhat thicker than the others; it should be made of flannel, or some similar material, which

will easily keep in the heat of the body and take in the perspiration without becoming wet quickly itself. Cotton garments are not the best for this purpose, because, after a person has been working hard, or walking for some time, they easily become wet, and when the person sits down to rest, the heat of the body is used to dry the garment, so that he soon becomes chilled, and will probably suffer from a severe cold in consequence. It is especially important that young children should wear a well-fitting flannel under-garment next the skin, as at their age they are very likely to take cold. Older persons usually have to work, so that their outer clothing should be as simple as possible, made of strong stuff, and such as will not get in their way when working or walking. Much money is often spent on buying special clothes to wear on Sundays. so that little is left over for the purpose of getting good, useful working clothes, and the disused Sunday clothes have to be worn until they are only fit to be thrown away, during week days, even though they are quite unfitted for the purpose. If notice is taken of the best among those persons who could well afford to buy gay clothing, if they wished to do so, it will be seen that what they wear on Sundays is very little different from what they put on during the week. This is not because they waste money on buying fine clothes for use every day, but because they are not so ignorant as to spend it on garments with which to "show off" before their neighbours once a week, or on holidays. It should be easy to see that it is much better for men and women to spend

money on clothing which will make them healthy, comfortable, and fit to do good work every day, than on that which they buy for the neighbours to look at, and which only makes more sensible persons laugh at them (32, 46).

25. *Wearing clean clothes.*—Clothing should always be clean. This forms another reason why money should not be wasted on fine clothing, for unless a person has one or two changes of clothing, he cannot wait for the clothes that he wears every day to be washed properly when they have become dirty. It must be remembered that the perspiration contains poisonous things that are being turned out of the body because, if they remained inside it, they would do it harm; therefore it is necessary that the clothes that take in the perspiration, with those poisonous things, should be kept clean, and therefore as free from them as possible. It is especially important that the clothing worn by sick persons should be always clean; they will thus be likely to get well sooner than if they are neglected and allowed to become uncomfortable. In the case of any person suffering from any disease, such as yaws, consumption, measles, or small-pox, which he may easily give to others who live or come near him, the clothing should be disinfected, or better burnt; it should never be handled to any extent, or worn by others, for it forms an easy way of carrying the disease to them, from the person who had it first. To return to those who are well, the person who is careful to wear clean clothes always will have the best chance of enjoying good health, and will be much

more respected by everybody else, than if he is careless and content to keep on wearing them after they have become dirty (33, 41).

26. *Need to change the clothes often.*—All this shows that clothes should be changed often, especially for the purpose of being washed. This is not all, however. After work has been done, or when a person has walked some distance, even if the clothes are not dirty, they should be changed for clean, dry clothing, and hung up to dry in the air. They will then be comfortable and pleasant to wear when they are dry. It should be a rule, that is always followed, to change the clothing at the end of the day's work; this will make the body feel much more comfortable, and far less likely to take colds and chills, than if a person sits about in his wet clothes, which still contain the poisonous perspiration, and which take heat from his body, thus chilling him, during the time that they are drying on him. It is of the greatest importance, in connection with this, that clothing should be changed immediately after it has been wetted by rain; the person who has been caught in a storm should not wait a moment, after reaching shelter where he can change his clothes, before doing so, and wiping the body quite dry with a towel. If he has become wet through, it is no use for him to take shelter where he cannot do this; it is much better for him to walk on, even if the storm continues, until he reaches his home, and then to dry himself thoroughly and put on clean clothes, as has just been stated (46).

D.—Personal Habits.

27. *Cleanliness of the body, especially of the hands and feet.*—All that has been said about the necessity of having clean clothing, for use always, will be wasted, unless it is well understood that the body must be kept clean, before everything. There is no excuse, at the present day, for anybody not to know this, for all are taught the necessity for the frequent, careful washing of the body, especially of the hands and feet. Some will not listen to what is told them, because they think that it will be too much trouble to wash themselves regularly. They have not tried it; so that they do not know that the custom of doing this easily becomes a habit, with the result that they soon do it without feeling "bothered" by it. Neither do they know of the comfort that comes from it; for if they had allowed themselves to get used to that comfort, they would never so much as think of letting their bodies remain dirty. In connection with this form of cleanliness, there are special reasons why the hands and feet should be washed frequently. One reason is that they are the most likely to get dirty quickly, for the hands are always handling things, and are, therefore, continually getting more or less soiled; the feet, too, quickly get dirty, whether boots are worn or not. Again, the hands are used for eating part of the food, such as bread, and the dirt on them is very likely to contain some of the small, living beings that cause disease, and even the eggs of certain worms which will hatch out others like them,

in the body—worms that live in the body and do it a great deal of harm (42, 49). It is, therefore, easily seen that the hands should be washed often, especially before every meal; that they should always be washed before eating is particularly important. The hands of young children, too, should be kept constantly clean, as far as this is possible, for such children generally keep on putting their hands in their mouths, and as they are fond of playing with dirt, they are very likely, indeed, to get the small, living things that cause disease, and the eggs of worms, into their bodies, if proper attention is not given to this matter of cleanliness. In regard to the feet, there is particular cause for keeping them clean when boots are not being worn. As has just been learned, dirt is very likely to contain the eggs of worms; this is especially the case with dirt that gets on to the feet from roads, and the soil from gardens and fields where cane and other crops are grown. Certain of these eggs can produce worms that can pass from the dirt on the feet and legs into the body, where they can do a great deal of harm; they are the same as those which come from the eggs which dirty persons eat with their food, and can do as much harm in exactly the same way (49).

28. *The avoidance of spitting.*—Another habit which is just as bad, in its way, as allowing the body to be dirty, is that of spitting. Some persons who ought to know better than to do so constantly spit, wherever they happen to be. They do this on the road, in the fields, and even in vehicles in which they are riding, and the houses where they live.

This is bound to make others feel very disgusted and uncomfortable; such misbehaviour is only the more annoying because it is only very rarely that people who are in good health need to spit. It is another matter in the case of those who are suffering from bad colds, with a cough, or from a disease which is commonly known as consumption. Such persons find it necessary to get rid of the phlegm which comes from the windpipe, but these, equally with those who are healthy, must not carelessly do so, wherever they happen to be at the time. More than this, it is especially important that they should be very careful in this matter. The spittle contains just those small, living beings that are giving them the disease, and which will make others ill in the same way through being blown by the wind into their mouths when what the sick person has spat out has dried up, as it is bound to do, sooner or later. Such sick persons should always use a piece of clean rag, which should, preferably, be burnt, when it has become soiled, or at least be put into a strong mixture of carbolic acid and water, and then washed and dried in the sun. If a person who suffers in this way has to stay in the house a great deal, especially if he or she is bound to lie in bed most of the time, a vessel containing a mixture of the same things (carbolic acid and water) must be provided, and they must be careful always to use it, so that they may be prevented from giving their relations and friends the disease that they are suffering from themselves (32, 37).

29. *How to hold the body, when walking, sitting*

or lying down.—It has been learnt already that, if a person is to be healthy, he must have plenty of fresh air to breathe (6). This, however, will not do him as much good as it ought, if he does not use his lungs thoroughly and well, so that the air goes easily into them at every breath, and his chest is well filled with it. Whatever he may be doing, he should always carry his body so that the shoulders are not allowed to fall forward, and so that air can pass without difficulty into the chest. There need be no stiffness or difficulty when this is being done, once the person has accustomed himself to doing it. In saying all this, there is no intention to cause him to keep his body in an ugly, very upright position, and this is especially important in the case of young children. The thing to be aimed at is always to walk, sit, or lie down so that it will be easy to take deep breaths all the time. When children are writing, they are most likely to put the body into such a position that they cannot breathe properly. Care should therefore be taken to make them keep what they are writing upon as much in front of them as possible, and they should not be allowed to lean the head to one side, or to have their eyes nearer than ten inches from their work. In this way, both their lungs and their eyes will be prevented from being injured in a way which may cause them to be weak all their lives; care in these matters would cause the number of narrow-chested, short-sighted children, that are seen every day, to become much smaller. On the other hand, young children should never be made to sit in very upright, constrained positions.

The proper thing is to correct any tendency to walk or sit in a slovenly manner, and not to keep them sitting, without a chance of running about in the fresh air (or at least standing up and being made to breathe deeply for a minute or two) for more than half-an-hour at a time. Older children may be controlled more firmly; though there will not be much need for this to be done, if proper care has been taken to make them sit and walk properly when they were younger. A very useful thing is to teach them to take several deep breaths as soon as they get up in the morning. In either case, once the lungs have been used to getting the proper quantity of air, the body will always be carried and rested in such a way as to give them this quantity, in a properly natural and unconscious manner.

30. *Attention to the necessities of nature.*—Most of the kinds of attention to the body that have been dealt with are such that a person could go on living for some time without troubling himself much about them; that is if he did not care about his state of health, or if he had no respect for himself, and did not care about that of others. There are, however, certain wants of the body of which notice must be taken; everyone is made conscious of these from time to time. These are connected with the means of getting rid of the waste that, as has been learnt, must pass from the body as long as it continues to live. In connection with these, everybody should thoroughly understand that, whenever his feelings tell him that there is a need for getting rid of this waste, he should pay attention to the necessity as

soon as possible. What is more, he should get into the habit of seeing to these things regularly, or he will injure himself in such a way as to make his life miserable and to cause his health to suffer seriously. There is another very important matter in relation to this that is constantly neglected to a very unbecoming degree, in the West Indies, as well as in some other parts of the world. Places are provided where these necessities of the body may be attended to decently, but it is far too often the case that these are not used, on many occasions; the person who feels the necessity does not take advantage of the means that are provided for him, in his need, with the result that his carelessness and ignorance combine to disgust those who have more respect for themselves, and make it very likely that he will be the means of causing others to have serious, and sometimes fatal, diseases. It is the smallest thing to be expected of a human being: that he will have sufficient knowledge, and a good enough opinion of himself, to prevent him from behaving in a way that can only be excused in the lower animals.

31. *What temperance means, and why it is necessary.*—A last, but most important, matter to be considered at this stage is that of temperance. Temperance means moderation in all things. It means not allowing the body or mind to have or to do more than is best for them. As has been learnt, the body must eat and drink foods and liquids in order that it may be kept alive. There is a danger, however, that, in taking those things, a person may get to think too much of the pleasant feelings that

they give him. When he does this, he causes his body to suffer harm, and, what is worse, he allows his taste for the food and drink to become master of his mind, so that he no longer takes as much of them as is necessary to him, but allows them to get the better of him, and so takes much more than he needs. Such a person is to be pitied, for he is no longer able to rule himself. It is easy to see that the right course is for everyone to rule himself, and not to be ruled by the things that happen to be near him. This is not only the case with eating and drinking. It is equally important in regard to thinking, and, what is too often forgotten, speaking. It is an excellent rule for a person to stop eating or drinking anything, whatever it may be, as soon as he feels that he is doing so just because it happens to taste nice, and never to say anything just because what he is going to say will surprise or annoy some of those who are listening. "Think before you speak" is very good advice; it is equally necessary to "think before you eat," or drink, or indeed do anything at all. If every person was always careful about all these things, he would save himself, and others, a great deal of misery. Too much of anything is bad, and true temperance does not consist in denying oneself the things and actions of which one may partake, but in never allowing the liking for those things to cause one to enjoy more of them than is good for oneself or for others. It is of little use for a person to try to make his business prosper in the way that he wants, or to try to rule others, if he cannot rule himself.

Suggestions for Observations and Experiments.

(*a*) *The necessity for fresh air.*—It has been made plain that everyone should always breathe fresh air, in order that the body may be kept healthy and strong (6, 7). If a person breathes impure air, especially in a room where the air is shut out, and where there are several persons all continually breathing the same air, the general health is bound to suffer, and it may be that this may take place to such an extent as to cause that person to be attacked by serious disease (32).

A simple experiment may be performed, as follows, for the purpose of showing that the air is changed very considerably when it is breathed. Take a wide-mouthed glass jar and put it under water, in a basin, with the mouth uppermost, so that all the air escapes, and the water runs in. Make a loop at the bottom of a piece of wire, and fix a very short piece of candle into it, so that when the wire is held hanging down, the candle stands upright in the loop, at the bottom of it. Perform the first part of the experiment by lighting the candle and lowering it into a jar which is exactly similar to the one which is standing in the water. The candle continues to burn. Now, raise the jar that is in the water, keeping the rim below the surface, until the greater part of it is out of the water. Using a straw, or a piece of indiarubber or glass tubing, blow air up under this jar, until all the water is driven out. Place the palm of the hand tightly over the rim of

the jar, still keeping it under the water, and then lift it out and put it right side up on the table, with the palm still tightly pressed over the mouth of it. Light the piece of candle, and quickly removing the hand from the mouth of the jar, lower it steadily by means of the wire into the jar. It goes out immediately, showing that the air in the jar, which has been breathed, is so different from ordinary air that the candle can no longer burn in it.

It may be shown that breathing the air, and burning a candle in it, cause it to be changed in much the same way, by means of the following experiment. In order to perform this, it is necessary to have some lime-water at hand. A good way to make lime-water is to get some rain water and to put about a teaspoonful of ordinary lime into it, and then, keeping it in a stoppered bottle, to shake up the mixture from time to time for a couple of days. After this, the lime is allowed to settle, and the clear liquid above, which is lime-water, is poured off carefully; this may be kept, for future use, in a bottle having a well-fitting cork. For the purpose of experiment, two or three teaspoonfuls of the lime-water are poured into a wide-mouthed glass vessel of the kind used for the last one; one of the palms is then pressed tightly over the mouth of the jar, and the lime-water is shaken up in it. It will be seen that the liquid remains quite clear. The jar, still containing the lime-water, is then put back on the table, and a lighted piece of candle is lowered into it, in the way that has been described, until it is just above the lime-water. After the candle has

been allowed to burn in this position for a short time, it is drawn out, and the lime-water is shaken up in the jar, as before. It now becomes milky, showing that the burning candle has made some important difference to the air in which it has been burning.

The second part of the experiment consists in filling the jar full of water, turning it upside-down, with the rim just below the surface, and then filling it with air from the body in the way that has been explained. Afterwards, it is turned so that the mouth is upwards, and kept closed by the hand, just as before. The hand is removed, two or three teaspoonfuls of lime-water are poured into the jar, and the liquid is shaken up in the same way as this was done after the candle had been burning above it. The lime-water turns milky again, showing that breathing the air has much the same effect upon it as is produced when things burn in it.

The two matters of explanation that are required in connection with this experiment are, firstly, that a kind of burning takes place inside the body, in order that it may be kept alive and warm (14), and that, secondly, this burning is very similar to the ordinary kinds of burning, such as that of a candle, in that it causes a substance to be produced, in the air, that turns lime-water milky. The point of importance, in relation to health, is that air containing this substance in any quantity is harmful to those who breathe it, so that where many people are crowded together, in rooms, fresh air should be allowed to come in freely, to be breathed instead of that which has already been made impure.

(*b*) *Dust in rooms.*—Leave a sheet of paper, or a plate or saucer, in a corner of the room for a day or two. At the end of the time, it will be found to be covered with dust. Explain that this dust most generally contains a large number of germs, many of which are capable of causing diseases (8).

(*c*) *Need for regular dusting.*—If possible, keep one of the rooms in the school empty, and do not allow it to be dusted for a day or two. Compare the state of this room with one that has been used and dusted regularly. Show that constant attention is required in order to prevent dust, and the germs in it, from collecting on the things inside the house (8).

(*d*) *Collectors of dust.*—Show the pupils that pictures, and wall diagrams and maps, collect dust behind them, unless they are regularly taken down and dusted. Explain that, in decorating the interior of the house, it is best to use pictures that are hung from the wall, and which can therefore be taken down easily and wiped free from dust (8).

(*e*) *Hiding places for mosquitoes.*—Tell pupils to search behind curtains and clothes hanging against the wall for mosquitoes, especially during the day. They will be almost sure to find the insects in such places. Explain that most kinds of mosquitoes rest in this way during the day, and come out to bite at night. This is why curtains and hangings of every kind should be used in the house as little as possible, and why, when they are necessary, they (as well as clothes) should be taken down frequently and shaken and brushed, preferably outside the house (9).

(*f*) *Mosquitoes and water.*—Put a small basin of water in a dark, shaded corner of one of the rooms in the school, choosing if possible a place where you have seen mosquitoes resting during the day. It is most probable that, after a day or two, wrigglers will be seen in the water. Show these to the class, and put a few grains of rice in the water, so as to supply food to the wrigglers. Pour off most of the water every other day, and carefully put a fresh supply in the place of that which has been poured away. On about the eighth or ninth day, put a large glass tumbler, or a bell jar, or other suitable glass vessel with a wide mouth, upside-down over the water containing the wrigglers. At about this time, it will be seen that several of the wrigglers have altered their shape, and that they move in a very different way from that which has been observed hitherto. They now have distinctly large heads, with a small "tail." What is more striking, however, is that they no longer move about freely and energetically in the water. Instead of this, they remain just under the surface of the water, with two ear-like organs at the uppermost part of what appears to be the head. This is the pupa, or resting stage, of the mosquito, and the ear-like appendages are breathing organs. (Compare what is said later about the way in which the insect in its first stage—the larva—breathes.) It is at this period that the perfect, or flying, insect is formed. Make the pupils watch the pupae that have been now obtained, from time to time. During the next two or three days, they will see that perfect mosquitoes are flying about

over the water, while there will be empty skins in the place of what were once the pupae. If they happen to make observations at the right time, they will see the perfectly formed insect ridding itself of its pupal case, on the top of the water; it rests there for a time, until its wings dry, and then it is able to fly.

These observations show that where uncovered water is left so that mosquitoes can get to it, wrigglers are very likely to be found in it, sooner or later. They go further to demonstrate that these wrigglers go through another stage—the pupal stage, as it is called—which only lasts a day or two, and at the end of which perfect mosquitoes are produced. This all shows that water should never be left exposed, where there are mosquitoes, either inside or outside of the house. More definite observations are described below, which show plainly the way in which mosquitoes are produced continually where water is allowed to stand for any time, or where there are sheltered pools or slowly moving streams. It is important that the connection between the conclusions to be drawn from such observations, and the rules to be followed in order to remain healthy, should be plainly shown (9, 11, 38, 39, 40).

(*g*) *The life-history of the mosquito.*—The ideas gained during the last set of observations may be made more definite by means of the following experiment, the purpose of which is to work out thoroughly the life-history of the mosquito. Obtain a shallow plate or saucer, half fill it with water, and place a few grains of rice in it. Put a wide-mouthed glass vessel, such as a large tumbler, up-

side-down over a piece of cardboard having a hole about three-eighths of an inch in diameter punctured through the middle of it; the vessel must be clean and dry. Provide yourself with a small phial, made of clear glass and about two inches long. (A small, wide test tube is best for the purpose, where this is available.) The phial is used for catching mosquitoes, in the following way. Take it to a place where you know that the insects are in the habit of resting, such as where clothes are hanging, the back of a door, or a part of the wall in a dark corner of a room; bring the phial *slowly* over one of the mosquitoes until it covers it—not quickly or jerkily, or the insect will be alarmed and will fly away before it can be covered; as soon as the mosquito flies toward the bottom of the phial, which it does invariably, remove it quickly, and cover the mouth with the thumb. Now move the tumbler, standing on the cardboard, to the edge of the table, until the hole in the cardboard comes as far as about an inch beyond the edge. Bring the phial up underneath the cardboard, and when it gets close to it, remove the thumb quickly, and press the mouth of the phial close against the part of the cardboard that has the hole in it. Keeping the phial close up against the cardboard, hold it in the fist, so as to make it dark inside; the mosquito will fly up toward the light, and, in so doing, will pass through the tube in the cardboard into the tumbler. Slide the tumbler and the cardboard back on to the table. Repeat this process until you have caught about ten mosquitoes. The best results will be obtained

eventually if a special attempt is made to catch mosquitoes that have had a feed of blood; these may sometimes be found easily inside a net, in the early morning. Such mosquitoes are the most likely to lay eggs.

When a sufficient number of the insects has been caught, bring the tumbler containing them, with the cardboard still underneath it, over the plate or saucer containing the water and rice. Remove the cardboard gently, and lower the tumbler steadily until it stands with its mouth in the water. There must be no quick or jerky movements, either in catching the mosquitoes or moving them in the tumbler, or they will be disturbed and will escape. Put the plate and tumbler in a dark part of the room, where the insects are least likely to be disturbed.

It will most likely be seen, after a time, that one or more of the mosquitoes is standing on the water and laying eggs on it. Even if this is not observed, it is probable that the eggs will be seen on the surface of the water, either placed close together to form a raft, or singly. The small, brown mosquito that bites at night lays them in the shape of a raft (39), while the one which is barred with white marks lays them separately (40).

In the case of the rafts of eggs, it will be observed, generally on the day after they have been laid, that the raft breaks up, and now very small wrigglers are visible in the water. The eggs that are laid separately (by the mosquito barred with white) usually take three or four days before wrigglers are hatched by them; it is noticeable, too, that these eggs

sink to the bottom before they are hatched. [It may be explained, when the study of Part II. is taken up, that this is the reason why this mosquito (the yellow fever mosquito—40) travels on board ship more easily, and for longer distances, than the other kinds; for while the eggs of these last are washed to the bottom of the water when this is disturbed, and are therefore killed, it does not matter if this happens to those of the yellow fever mosquito, for it is natural for them to sink before they are hatched.]

The wrigglers should be watched carefully. In order that this may be done most readily, a few of them should be taken out and put into a clear glass vessel full of water. For this purpose, they may be removed by means of a spoon. Another, neater, method is to take a glass tube, and with a finger firmly pressed over the top of it, gently to put the open end over one of the wrigglers, then to remove the finger at the other end, and quickly to replace it. The water rushes into the tube, carrying the wriggler with it, so that when the open end of the tube is put into the water in the second vessel, and the finger at the upper end is removed, the wriggler escapes into the water and can be observed easily.

If, now, the wrigglers are watched, they will be seen to move actively about in the water by bending the lower, more tapering, part of the body backwards and forwards. Every now and again, they will be observed to make a quick journey to the top of the water, through the surface of which they evidently push one side of the tail end. They do

this for the purpose of getting fresh air. Like all animals, they must have air. They are not able, however, to use the air that is dissolved in the water, as fish do; they can only live by breathing air from time to time. This is an interesting matter, the importance of which will be seen later.

As has been stated, the wrigglers (or mosquito larvæ, as they are often called) change after, roughly speaking, twelve days, so that they now have a much larger head, and the tail part is reduced in size; while at this stage (the pupa) it does not swim about actively, but remains with the breathing organs (situated at the top of the head) nearest the surface of the water, only lazily swimming downwards when it is disturbed, and allowing itself to float to the surface again. There is a notable difference, in this respect, between the wriggler (larva) of the mosquito and the pupa. The wriggler moves about actively, and has to make a definite effort in order to reach the surface of the water, where it breathes; the pupa floats easily just under the surface, and only moves from it on being disturbed, when it does not sink easily, like the wriggler, but has to struggle downwards.

It is now time to return to the consideration of the wrigglers that are left in the water under the tumbler. As was explained in (*e*) this water should be carefully changed every other day. This is done most easily by pouring most of it away, carefully, so that none of the wrigglers are washed away in it, and adding fresh water to that which is left. The tumbler may be removed from over the water,

until pupæ begin to be formed. When these appear, it should be replaced, care being taken that all the larvæ and pupæ are enclosed within its mouth. The observations made in (*e*) will indicate what must be expected to happen to the pupæ, and special efforts should be made for the purpose of letting all the pupils see the perfect insect in the act of escaping from the pupal skin. It need hardly be pointed out that the best plan is to destroy all such insects, after observations have been made on them, as there is no need to do anything toward increasing the numbers of these pests.

The practical employment of the knowledge gained from these observations is of the greatest importance, and more will be said in this connection later. The active co-operation of the pupils, in the experiments, should be sought, and to this end they must be encouraged to bring mosquito wrigglers, as well as live specimens of the perfect insect, to the school. They should also perform the experiments that have been detailed, themselves, both in school and at home; experiments made by pupils in their own homes will help much to increase the general interest in these matters.

(*h*) *Mosquitoes in pools, ponds and streams.*— Where it is possible to do so, visits should be made, by both teacher and pupils, to pools and ponds or streams near the school, for the purpose of discovering if any of these are breeding places for mosquitoes. This is done by trying to find the wrigglers in the water in such places. Care is required in doing this, for the wrigglers are often not easily

seen. The best places for making the observations are close to the edge of the pool, pond or stream, especially in the most shaded and protected parts. All that is required for the work is a fairly large enamelled iron cup, which is white inside, and a few wide-mouthed bottles or tins for holding the wrigglers when they are caught. A good plan is first to push the cup, while disturbing the water as little as possible, beneath the water, close to the edge, and then to hold it steadily, upright, with the rim a few inches below the surface. Any wrigglers that happen to pass through the water above the cup will then be seen easily, because they will be shown up against the whiteness of the inside of the vessel. When it has been ascertained that there are wrigglers in the water, some of them should be caught, for the purpose of further observation and experiment. To catch them easily requires a certain amount of care and practice. The best way to do this is to put the cup on its side, with the lower part of the rim an inch or two below the water, and then, with a skimming action, to bring it quickly toward the water's edge. When it reaches this it is quickly turned upright and brought up out of the water. If it is desired to keep the wrigglers, as much as possible of the water is decanted away, and the remainder is poured carefully into one of the bottles or tins brought for the purpose.

In places where several ponds or pools are found to contain mosquito larvæ, the surroundings of each should be examined. It will be found, most generally, that those which are the most likely to harbour

wrigglers are the smaller ones, which are protected by bush or trees, or by buildings, from the wind. This is a very important matter, for it shows how easily, especially during wet weather, the existence of small pools may be forgotten or ignored, while they are providing places for the production of mosquitoes in large numbers (11, 39, 40).

The experiment described above (*e*) in which mosquitoes were found to lay eggs in water kept in a sheltered part of the room, may now be used to illustrate a point of practical importance. This is the matter that deals with the danger of leaving broken bottles, disused tins, and other rubbish to lie about in the yard, near the house (11, 39, 40), or to permit vessels inside it to hold water for some time, without being emptied (9, 39, 40). It may be possible, even, to find such breeding places in actual use by mosquitoes, though this should not be the case.

(*k*) *How mosquito larvæ obtain air.*—It has been explained already that the larvæ and pupæ of mosquitoes must breathe the outside air, in order to live (*f*); they cannot, like fish, make use of the air that is dissolved in the water in which they are found. A simple experiment will show the difference. Some water is boiled, and allowed to cool in two wide-mouthed bottles, each of which is closed by a cork or stopper. On putting some small fish, such as "millions," into one of the bottles, and some mosquito larvæ into the other, it is seen that the fish soon die, while the larvæ continue to live. The way in which the latter continually visit the surface

of the water, and obtain air through a breathing organ in the tail, has been described already (*f*). It remains to state that practical use can be made of this circumstance in the life-history of the mosquito, when measures are being taken to reduce its numbers.

(*l*) *How the larvæ are killed by kerosene.*—Take two wide-mouthed glass vessels or beakers, and pour water into them until they are about three-quarters full. Carefully decant as much of the water as possible from a vessel containing wrigglers, and pour some of these gently into the wide-mouthed vessels. Put two or three drops of kerosene into one of the latter; it will be seen that the oil spreads all over the surface of the water, and forms a film. Watch the wrigglers in the two vessels. They will soon begin to swim to the top of the water, for the purpose of getting air. Where there is no kerosene, they are able to do this quite easily. A different state of affairs will be seen to exist, however, in the vessel containing the water that has been treated with oil. Here, the wrigglers are seen to swim continually from one part of the surface to another, and actually to make attempts to thrust the breathing organ through the surface. They are unable to do so, however, for the film of oil cannot be pierced by them, and they are thus prevented from getting air. In a short time they die, partly through being suffocated and partly because some of the oil enters the breathing tube, and poisons them. In the meantime, those in the untreated water are still living and moving about actively.

The practical importance of the things that are

taught by this experiment is derived from the fact that, where water exists which cannot be drained or poured away, the use of kerosene provides a cheap and effective means of preventing mosquitoes from being produced in such water. It must be remembered, however, that this use must be continuous, for the kerosene is gradually lost as vapour in the air. This is why butts or tanks containing water which is not protected by wire gauze should be treated with a teaspoonful of kerosene every week; while large pools of water will require a proportionately greater amount of the oil.

(*m*) *Enemies of mosquito larvæ.*—The larvæ of mosquitoes have several enemies which live in the water inhabited by them. These attack and eat them, especially if their food supply is small. The largest amount of attention has been directed to these enemies of the wrigglers through the existence, in Barbados, of a small fish, called "millions," which feeds on them if they happen to be present in the water (38). This fish feeds most generally at or near the surface of the water, and, in this way, it helps in another way to reduce the number of mosquitoes, for when the insects come to lay their eggs they are disturbed by it, and are consequently prevented from doing this.

The Barbados "millions" has been sent to several of the West Indian islands (as well as to other parts of the world), for the purpose of stocking streams and ponds with them, and thus keeping down mosquitoes. Where they are obtainable, a few of the fish should be caught and put into a glass vessel

containing water in which there are some mosquito larvæ. If the fish are living in a barrel or small tank, a good way to catch them is to spread a cloth well beneath the water, and then, after a few seconds, quickly to gather the corners of the cloth together and to draw it up out of the water. When obtaining them from streams or ponds, it is best to catch them with a wire strainer, or by means of a piece of mosquito netting, made into the shape of a bag, on a loop of cane or wire. In any case, when they are introduced into the water containing the larvæ, the fish will be seen to dart actively after their prey, even the smallest of them following them up in the quickest manner imaginable. The wrigglers are usually caught by the tail, and some of the fish may be seen moving slowly about, each carrying a half swallowed larva in its mouth. This experiment is most instructive, in regard to the feeding habits of the millions, and cannot fail, where the observations are carried out properly, to leave no doubt in the mind as to the effectiveness of this fish in reducing the number of mosquitoes.

It must not be forgotten that many kinds of mosquito-eating fish exist in different parts of the world. They are not always effective in keeping the water in which they live clear of wrigglers, chiefly because they are provided with an abundance of other kinds of food. The principal reason why millions are so useful in this respect appears to be that they increase in numbers so quickly as to make it likely that anything that they can possibly eat will be destroyed by them, so that, where they are present,

mosquito larvæ stand a poor chance of surviving. More than this, it is very unlikely that they will ever be produced in water that is inhabited by this fish, as has been explained already, owing to its way of feeding near the surface, and thus disturbing the insect when it is laying its eggs.

(*n*) *The different kinds of mosquitoes.*—Many different kinds of mosquitoes exist, and it requires special knowledge and care in order to be able to tell one kind from the other. It is easy, however, to distinguish between the mosquitoes that carry serious diseases, that are taken from one person to another by this insect. The study of Part II. will show that these diseases are three in number, namely, Malaria, Filaria and Yellow Fever (38, 39, 40). The mosquito that carries the first disease is different from those that carry the others, both when in the larval stage and when it becomes the perfect insect. The latter is black in colour, but its chief point of difference from the other two is that it stands with its head downwards, when resting; this is why it is often said to "stand on its head." The wriggler of this kind of mosquito is easily distinguished, too, because when it is breathing at the surface of the water in which it lives, it places its body all along, just under the surface, while the others hang at an angle, with the head downwards. As regards the filarial and the yellow fever mosquito, the insects, when they have arrived at the stage in which they are able to fly, are different in that the former is brown in colour, while the latter is greyish black, with white lines on its body and legs. Another

point of difference is that the filaria-carrying mosquito only "bites" at night, while the yellow-fever mosquito does that both by day and by night.

Instructions have been given already as to the best means for catching mosquitoes. Pupils should be encouraged to obtain specimens of all three kinds, where these are obtainable, and to learn to tell one kind from the others. In the case of the two last-mentioned mosquitoes, it is quite an easy matter for the teacher to collect several of each kind, in two different vessels, and, using the information that has been given in (*f*), to demonstrate the ways in which the eggs are laid and the difference that exists in regard to what happens to the eggs, as well as in relation to the time that they take to hatch. The procedure is to catch several insects of the two kinds, preferably those that have had a feed of blood, and having placed the different kinds in two separate glass vessels, to note that the eggs of the small, brown mosquito are laid in the form of a raft, while those of the one which is striped with white are deposited singly on the top of the water. Finally, a watch is kept for the first appearance of wrigglers when, as has been explained, these will appear, in the first case, in about a day; while three or four days will pass before they are seen in the water over which the white-striped (yellow-fever) mosquitoes were placed. The experiment may well be extended by feeding the larvæ, as was shown in (*f*), until the perfect insects are produced; it will then be seen that each kind of mosquito lays eggs which produce its own kind, and no other. Draw attention to the

practical importance of this fact, which consists in the circumstance that the different kinds of mosquitoes are entirely distinct from one another, so that there can be no doubt as to the kind of harm that is done by each, or as to the methods that have to be used for getting rid of them.

(*o*) *The use of nets and wire gauze against mosquitoes.*—The use of nets and wire gauze, in this connection, is to prevent mosquitoes from getting into places where they may do harm. Where these insects are common, the windows and doors of houses and other buildings are often covered with wire gauze, especially on the windward side, for the purpose of preventing them from getting into the rooms and biting the persons who live or work in them. The use of wire gauze in this way is not as common as it might be, for the gauze is expensive, and nets are far more usually employed against the insects. It is not only in houses and buildings, however, that the mosquito is harmful. It has been learned that it lays its eggs on the surface of water, and the very fact that water is required for the wrigglers from the eggs to live in makes it an important matter that care should be taken to prevent it from being able to get to water for the purpose of laying eggs. This is why all places where water is stored should be covered with wire gauze (14).

It is a simple matter to show that nets and wire gauze, of the proper kind, are useful in keeping mosquitoes out of the places that are protected by them. The simplest plan will be to make the trials, first, with the material from which the nets are made.

For the purpose, a small cage having the two largest sides made of mosquito netting may be used. To make this, a box made of thin wood, about four inches square and an inch and a half from the bottom to the lid is useful; the exact size is not important, for as long as it is not too large, it will be quite serviceable for the purpose. The cage is made by taking off the lid, carefully knocking off the bottom of the box, and tacking pieces of the netting on to the two open sides of the wooden frame that has been thus obtained. A useful method of fixing the netting to the frame is to draw its edges into position, and then to tack narrow pieces of tape, or of cotton material, along the edges of the wood, so that no open places may be left by which the mosquitoes may escape. If a box of the kind is not obtainable, four pieces of thin wood can be easily tacked together to form a square or oblong frame, to which the netting is secured by tacks, on the open sides. In either case, the next thing to do is to bore a hole, about half an inch wide, in the middle of one of the pieces of wood forming the narrow sides of the cage. An easy way to do this is to take a piece of iron that is not larger than the hole required, and to heat it red hot and press it against the wood, doing this until it has passed through it and made a hole of the size that is wanted. To use the cage, several mosquitoes are caught in the way described, and introduced one after the other into the cage by putting the phial or tube with its open end on the side of the cage where the hole is and sliding it along, over this, when if the phial or tube is made dark by cover-

ing it with the fingers, the insects will fly through the hole into the cage. A convenient way of closing the hole is by means of a piece of cotton wool. After a few of the insects have been introduced into the cage in this way, the number of them is carefully noted, and it is placed on one side for observations to be made from time to time. It will be seen that the mosquitoes crawl about, over the surface of the netting, but that they cannot pass through it, and are forced to remain in the cage, where they die after a time. This is sufficient to show that, where mosquito netting is properly used, a perfect protection against the insects is afforded.

Similar tests with wire gauze have to be conducted under different conditions. This material is usually employed for protection against mosquitoes that may fly in from the open-air outside. The matter of importance, under such circumstances, is that, as has been actually observed where the meshes are not sufficiently small, some of the insects that are crawling about on the gauze may be actually blown through it. This makes it necessary to carry out the trials under circumstances which will imitate, as far as possible, the conditions under which wire gauze is used for the special purpose. To do this, cages similar to that which has just been described are made, except that in this case the gauze, instead of netting, is tacked on to the open sides, and is arranged so that short pieces of it, on each side, are pressed over the wooden frame, in order that there may be no places left where the insects may escape by crawling under the edges of the gauze.

A few mosquitoes are placed in the cage, in the way that has just been explained; and it is fixed upright, on one of the window sills in the room where the observations are to be made. One of the best ways to do this, where there are window sashes, is to put the cage on the sill, with one of its wire sides toward the outside, and to pull the sash down on to the top of it, so that it is firmly held in place. The reason for placing the cage in such a position is that it may be arranged in such a way as to let the air blow through it, and thus to give the best chance for the mosquitoes to be assisted in escaping from it by being carried through the meshes while they are crawling about on the wire. With gauze of the proper kind, none will escape, and the experiment will plainly show how useful this is, in preventing the insects from getting into places that are required to be protected from them.

(*p*) *The chief food bodies.*—Among the foods of human beings, milk is one of the most important, chiefly because it is the proper food for the young. It is evident that, if it is capable of being used alone, as a food, it must contain all the food bodies that are required for the nutrition of the human system. It will be interesting to see how it can be shown that milk contains these food bodies, and while this is being done, useful examples showing the nature of these bodies will be afforded, for the purposes of demonstration (15, 16, 17).

It will be well to recall the fact that the necessary food-bodies are: heat-givers, growth-makers, bone-making substances, and water (15, 16). Attention

should be drawn to the special uses of these kinds, and to the way in which they occur in ordinary foods. It is a matter of difficulty to show, in a simple way, the exact forms in which these exist in such foods, because, of course, they are all mixed together in the various proportions belonging to each food, so that it is usually impossible to separate them from one another in such a way as to show the definite nature of each. What has been done, so far, is to take examples of representative foods, each of which consists mainly of one of the different kinds. In this way, the heat-making foods have been shown to be chiefly those containing large amounts of starch or sugar, or both, or of fats; while such foods as lean meat, fish, the white of eggs, peas and beans, and cheese, have been stated to contain mainly the growth-making food bodies, which are required by the young in order that they may grow and repair the waste that is going on in the body, and by those who are older, for the latter purpose, alone.

The teacher may commence the demonstrations that are necessary in connection with this part of the subject, by bringing before the class as many of the different foods as may be shown conveniently, and making the pupils familiar with the different kinds of food-bodies that they chiefly contain. Sugars, starches and fats will be brought together to form examples of foods containing chiefly food-bodies that are heat-giving, while those that are mentioned in the last part of the foregoing paragraph will serve to demonstrate the foods that contain bodies

that are required for giving material for growth, and for repairing waste. In doing this, a good opportunity will be afforded for showing why it is necessary for the diet to consist of different foods. This is not only because the body would soon get tired of one food alone, but because any one of them is not capable of providing all the food-bodies in the right proportions. The reason is thus given for eating bread and vegetables with lean meat, and soups and broths. The insufficiency of heat-giving food-bodies in the latter is made up by those that are present in the former, and the lack of growth-makers in the bread and vegetables is provided for in the latter. Fish, the white of eggs, peas and beans, and cheese will also be mentioned as growth-makers, with which it is necessary to eat bread or vegetables, in order that a properly mixed food may be obtained.

As has been indicated, milk contains all the food-bodies that are necessary, in fairly reasonable proportions. Another interesting matter is that milk may be used for demonstrating the presence and kinds of these different food-bodies, in a fairly simple way. The manner in which this is done is described in the following paragraph.

The appearance and ordinary characteristics of milk are sufficient to show that it contains water. An additional demonstration of this fact may be obtained by boiling it, when some of the water forms steam, and comes away from it as such. To show the presence of the principal food-bodies in milk, the following experiment may be performed. Some

fresh milk is allowed to stand. Cream rises to the top, whence it may be removed by skimming. As is well known, this is used for making one of the chief fatty foods, namely, butter. Thus by allowing milk to stand, it has been shown that it contains a large proportion of heat-giving food—fat. It may be demonstrated that it contains a small amount of another heat-giving food by tasting it; milk has a slightly sweet taste, showing the presence of sugar in it. To proceed with the experiment, the milk from which the cream has been skimmed is taken, and some lime-juice is squeezed, or poured, into it, and it is shaken up. A thickened, curdy part immediately separates from it. It is this part (curds) that is used for making cheese, which, as has been learned, is composed largely of the growth-making kinds of food-bodies. Finally, some of the milk is taken and is heated thoroughly for some time, in an old spoon, over a flame. A small amount of ash-like dust is left. This consists chiefly of the bone-making part of the milk. The useful circumstance in connection with this experiment is that an ordinary, common food—milk—has been shown to contain all the kinds of things that are required for keeping the body alive, namely, water, heat-giving substances, growth-making substances and bone-making substances; and while the experiment has been performed, an opportunity has been afforded of showing the nature of all these different bodies that are required for enabling human beings, and other animals, to grow and thrive.

(*q*) *Filtering water.*—To show what happens to

ordinary water when it is filtered, the following simple experiment may be performed. A circular piece of unused blotting paper is cut from a large sheet of it by putting a saucer upside-down on it, and running a sharp knife round the rim, with sufficient pressure to cut through the paper. This is then folded with one half doubled over on the other, and folded again in the same way, so that a piece having the shape of a quarter of a circle is obtained. A clean metal or glass funnel is taken, and the blotting paper, opened out so as to become funnel-shaped itself, with one of the folds on one side, and three on the other, is pushed point-downwards into the funnel; the funnel is then put into the neck of a bottle, or flask. Finally, some muddy water is poured into the funnel, care being taken that it does not come above the top of the blotting paper, when it will be seen that the water that passes through into the bottle or flask is quite clear, while the mud is left on the blotting paper.

Blotting paper is full of small holes; this is why it sucks up liquids, such as ink, when it comes into contact with them. In the experiment, it has acted as a filter; that is to say it has kept back the larger particles that were in the water, because these could not pass through the small holes in it. Ordinary water, however, is likely to contain particles, as well as germs, that are so small that they can pass easily through the holes in blotting paper. This is why, if these have to be removed from the water by filtering, special substances have to be used in the filter (23).

Where a Berkefeld filter can be obtained, the inner, porous cylinder of this should be shown to the pupils just after it has been cleaned, and when it has been in use for a day. The deposit of fine mud that is seen in the latter case has been separated from the water, which has passed from the outside to the inside of the cylinder, and has been purified, on its way. The fine mud contains germs that were in the water, and some of these may be of the kinds that produce disease. Where it has been possible to show such a filter, it will be easy to explain the necessity for cleaning, and boiling in water, the porous cylinder, at least every other day. If this is not done, it is quite likely that the germs will actually "grow through" the cylinder, and appear in the filtered water. The growing through is enabled to take place because the germs that are left on the dirty cylinder naturally increase in numbers, so that they will be produced gradually further and further inside the stuff of which the cylinder is made, until they pass through it. The practical importance of this fact is that it shows that if such a filter is not cleaned constantly and carefully, it will serve as a means of increasing the numbers of germs in the water, instead of removing them.

(*r*) *Proper kinds of clothing*.—Sprinkle water lightly on a piece of cotton material, or linen, and on a piece of woollen material, or cloth, or flannel. The cotton, or linen, becomes quite wet, and cold and clammy to the touch; while the material containing wool takes in (absorbs) the water, and still feels warm, when touched. This simple observa-

tion goes far toward showing why it is best for woollen garments, or garments made of material which contains a fair proportion of wool, to be worn next to the skin, especially where it is likely that a good deal of perspiration comes from the body (24).

It has to be considered that the perspiration is given off by the body, in the state of vapour, as well as in the liquid condition. Even when a person "feels cool," his body is giving off perspiration; he does not notice this, however, because it is in the condition of vapour. The observations that have just been described may be completed by showing that woollen garments are best for wearing next the skin, even under conditions in which little liquid perspiration leaves the body. There is needed, for this purpose, a shallow vessel, in which water is boiled. Strips of cotton or linen, and of woollen material, are hung in the steam from the vessel, for a few minutes; then the vessel is removed. After a short time, it is found, as before, that the cotton or linen is quite cold and damp; while the material containing wool has absorbed the steam, and can be found, by wrapping it round the hand, to still "hold the heat."

PART II.—COMMON DISEASES, THEIR CAUSES AND PREVENTION.

A.—Diseases Transmitted in the House, more Especially.

In considering diseases, the first thing to be understood is that there are few of these that a person can have already, as soon as he or she is born. Nearly all diseases are carried, or transmitted, to those who are healthy, from those who happen to be suffering from them. As will be seen, some diseases have to travel in a very roundabout way before they can get from one person to another, but this makes no difference to the general principle that if a person is attacked by disease, the cause of it has been allowed, by carelessness, ignorance or misfortune, to travel to him from some other person who has already suffered, or is suffering from that disease. It is the certainty of the truth of this principle that makes it much easier, now that it is recognized, for a person to keep himself healthy, than it has ever been in the past. No one believes, nowadays, that sickness arises in the form of 'visitations,' or 'plagues,' for the existence of which there is no ordinary explanation. For the greater part, the cause of disease is known, and it is known, too, how diseases can be prevented from spreading from one person to another. This should be evident from what has been studied already in Part I. Therefore, certain

rules for avoiding disease have been drawn up, with the certainty that those who follow them will, under ordinary conditions, remain healthy. More than this, for special diseases, laws have been made by which those in authority can punish such as do not follow the rules in relation to those diseases. For those who are not ignorant, wickedly careless, or stubborn, these laws are not needed, for all sensible people will recognize the necessity for living in such a way as to give them the least chance of getting diseases, and, what is even more important, of passing them on to others. It is repeated, then, because it is very necessary to understand, that diseases do not come without reason, but are carried, in various ways, from one person to another. A proper knowledge of this will help greatly in learning what is necessary to be known concerning the diseases that are about to be described.

32. *Consumption.*—One of the diseases that are carried most easily from one person to another is consumption. This most usually attacks the lungs, and it is easy to tell when a person is suffering from it. The commencement may be an ordinary cold, from which there is a partial recovery, the person attacked being left with a cough which becomes increasingly distressing, and for which there appears to be no cure. Later, the body gradually gets thinner and thinner, and the phlegm that is brought up after coughing is found to contain blood. The wasting continues, even though the appetite may be good, or possibly better than usual, until the sick person dies, sometimes in a surprisingly

short time after the disease first showed itself. The cause of the disease is a very small germ, or bacillus, which gets into the lungs and causes changes to take place in them, so that they gradually become less able to take in the air that is so necessary to the body, and less capable of making use of the small amount of air that gets into them. It should be mentioned, by the way, that these germs may not only attack the lungs, but other parts of the body as well, though the former case is by far the more common. To return to this, it is evident that whatever comes from the lungs must contain a very great number of these germs, each of which is capable of giving a healthy person the disease. This explains why it is very important that a person should be always careful when and where he spits, and that he should never allow himself to get into the disgusting habit of constantly spitting wherever he happens to be (28). The fact is much more easily understood in regard to persons who are evidently suffering from the disease, for what they spit out (sputum) carelessly will dry up in a short time and the germs in it will be blown up into the air, and some of them very probably taken into the lungs of a healthy person when he breathes; thus he will be given a good chance of getting the disease. What is even more important is that any person may have the germs in his lungs for some little time before he appears to be ill and the disease shows itself; he may, in fact, only seem to have a slight cold. None the less is he able to give others the disease, especially if he is careless in the matter of spitting.

The other important point in preventing the transmission of this disease is that the person who has it should be kept away (isolated), as much as possible, from those who are healthy. It is not meant by this that he should be shunned by all those who knew him (or her) before he became sick, but that his relatives and acquaintances should not come into close contact with him. He should sleep by himself, and should never be allowed to have much to do with children, as the latter are especially liable to get the disease from others. The handkerchiefs used by him should be carefully disinfected (28) before being washed, or, better, he should use, instead of these, clean pieces of linen rag, which should be burnt after he has done with them. Though what is being said here has, all along, little or nothing to do with the curing of diseases, but rather with their prevention, it is not out of place to say that the person who has consumption already will be given the best chance of getting better if he always has plenty of fresh air, especially at night. In addition, his body should be kept warm, by means of proper clothing; he should be given plenty of good food, and should be treated in a kind and considerate way by others, so that his mind may not be allowed to dwell too much on the fact that he is suffering from a dangerous disease. All this will help him to recover, and to become capable, once more, of mixing freely with those around him, and of doing useful work.

The points to be remembered, in connection with consumption, are, then:—

(1) Always to live in plenty of fresh air.

(2) To take care not to allow the body to become chilled.

(3) To be careful not to come into close contact with consumptive persons.

(4) To acquire good and decent habits in regard to spitting, and, by example and by teaching what one has learnt, to make others careful and decent in the same way, as well.

(5) To get advice from the doctor, whenever any member of the family has a bad cold and cough.

33. *Yaws.*—A person who has become attacked by this disgusting disease is very likely to suffer at first from fever and uncomfortable feelings about the body, which cause restlessness, together with pains that are of the kind generally understood as "rheumatic." Later, the skin becomes dry and scaly in patches, where the yaws themselves will appear later. When they begin to develop, the yaws form swellings covered by a yellow matter; these swellings may vary greatly in size. As the yaw gets older, it usually becomes covered with a dry crust, of a dark colour. It generally takes about two weeks for this to form, and, during this time, a good deal of itching is felt near the parts attacked. After some weeks, the crust falls away, leaving the skin looking fairly healthy, or, instead of this, small ulcerated sores may be left. These are the main points in connection with the development of the disease, but it usually exhibits differences in appearance on different parts of the body; there is no need to describe these, as they are sufficiently well recognized where the disease is at all

common. At present, it is not known, with certainty, what germ is the cause of the disease, but, what is more important, it has been made certain that the only way in which persons can get it is by coming into contact with those who have it already, by wearing their clothes, by bathing in water that has been used by them, or even by living in houses where those having the disease have dwelt. All this may be expressed shortly by saying that the disease is contagious. A person cannot be born with it, neither can it enter his body except through broken parts of the skin, such as scratches, sores, or wounds. It is those who are dirty in their habits that are most likely to suffer from the disease, especially if they do not keep any sore places on the body carefully dressed, with something that will kill germs, and covered up. They will also be more likely to be attacked by it if they bathe or wash themselves in ponds or other collections of water that are commonly used by others, or if they live in dirty houses, or are not particular in regard to keeping themselves and their children away from persons who are careless and dirty in their habits.

All this shows that the chief means of preventing the attacks and spread of this disease is cleanliness. What cleanliness means has been explained (8, 10, 12, 13, 22, 23, 25, 26, 27, 28, 30), and it must be well understood that it also means keeping away from those who have the disease already, as well as those who are so ignorant that they do not keep themselves clean. It is not out of place to say, here, that anyone who happens to get the disease,

through carelessness, or accident, should be shown to the doctor, at once, and whatever advice he gives must be carefully followed, and the remedies that he supplies must be used exactly in the way that he suggests. This is especially important, in one way, because the ointment that will be used, on the doctor's orders, prevents the sores from drying up and shedding the germs in them into the air, and thus giving the disease to others. The very best thing is for those who have the disease to be kept away from such as are healthy. In order to make this easier, yaws hospitals are provided in some colonies, and persons badly afflicted with the disease should be sent to them, without delay. This is the best and fairest course for them, for in the hospital they will be given proper attention and the best chance of recovering, and once more taking their place among those who are healthy.

The means for the prevention of yaws may be put together shortly, as follows:—

(1) Cleanliness in regard to the person and the house.

(2) Attention to the matter of dressing wounds and sores, and of keeping them clean.

(3) Keeping away from persons who have the disease already, and especially from fresh-water bathing places that are used by many persons.

(4) Care in keeping the parts where the yaws appear, on persons suffering from the disease, covered with the ointment that the doctor has advised.

(5) Sending those who have the disease already

to hospitals, where they will have the best chance of being cured themselves, and the least opportunity of giving it to others.

34. *Measles.*—This disease, like consumption, is met with to a greater extent in temperate climates than in the tropics. It is, nevertheless, very likely to break out very suddenly, and, especially where it has not shown itself before, to any extent, it may cause several deaths. Such a sudden breaking out is called an epidemic. Children most usually suffer from the disease; in fact it is regarded particularly as a complaint of early childhood. As has been said, it appears suddenly, so that the important things to consider are what should be done with those who are suffering from it, and how those who are still healthy should behave, in order that it may not be spread. To put it shortly, the only preventive measure is isolation. The meaning of this has been indicated already, when consumption and yaws were receiving attention. It means keeping the sick away from the healthy, so that these may not be infected. This can be done most easily by putting the person who is suffering from the disease in a room, in the house or a hospital, which only the doctor and those who are nursing the patient are allowed to enter. In a hospital, where the rooms, or wards as they are called, are large, isolation is made easier because all those having the disease can be put into one of them. The other important precaution is that the clothes and bedding used by the sick person should be disinfected and washed, as soon as they are required no longer. It is not necessary to say much

about this disease, because it is not always present to a large extent in the same place, like most of the more common diseases. It comes and goes quite suddenly, and the important thing is to find out when it has come. This will always be done quickly where care is taken to get the doctor's advice whenever children are taken ill, especially if they are seen to have a rash, with fever. After this has been done, it will be very certain that few others will get the disease, provided that all the doctor's orders, about those who are healthy, as well as in connection with those who have been attacked by it, are promptly and carefully obeyed.

35. *Small-pox.*—It has just been pointed out that some diseases are not present constantly, but that they break out suddenly, without warning, and then die out after a time, which may be very much shortened if they are discovered early enough, and if those who live in the district where they have appeared follow the instructions that are given to them. Measles, it was learnt, is one of these. Small-pox is exactly similar in this respect; but it is more likely to spread among older persons, and will not be confined chiefly to children. The information that has been given about measles applies with equal force to small-pox, but there is another thing to be considered, in relation to the latter disease, which is of such great importance that everyone should arrive at a proper understanding concerning it. This is vaccination. It is well known that vaccination is practised for the purpose of preventing persons from being attacked by small-pox. This is

not absolutely effective in all cases, but it always serves as a safeguard, to some degree; for those who have been vaccinated, though there is a possibility that they will be attacked by the disease, suffer from it, when this is the case, much less than those who have not been treated in this way. The manner in which vaccination forms a complete or partial protection from small-pox is easily explained, in a broad way, as follows. Whenever harmful germs get into the body, they produce poisons (toxins) which are responsible for most of the damage that is done. The body, on the other hand, when the germs have entered it, has the power of producing substances (antitoxins) which can make the toxins harmless. In an ordinary, healthy body, these antitoxins are not present; it is only when the disease germs enter it that they are found. If, now, a means can be found of causing the body to produce the antitoxins, in a harmless way, it will have an advantage in being already prepared to resist the disease when it gains an entrance. As is well known, the substance that is used for vaccination (vaccine lymph) is obtained from calves; the calves that are used for the purpose are suffering from a mild form of small-pox, called cow-pox. Vaccination consists, therefore, in infecting the blood with a mild form of small-pox, in order that the body may produce the antitoxins that it will need if it happens to be attacked by the true small-pox. It will then be able to resist the disease from the very beginning, and will either show no symptoms of the attack, or these will only be comparatively mild. The prin-

ciple of vaccination has now been extended to the treatment of other diseases, for instance, diphtheria, which is a very dangerous disease in colder climates, the throat being the part that is most seriously affected. The important things to be remembered are that all children should be vaccinated, when only a few weeks old, and that it is best that they should be vaccinated again, when about fourteen years of age. There is the additional circumstance that, when the disease happens to visit a certain district, all the grown-up persons in that district should, properly speaking, be vaccinated again.

It is convenient, here, to say something about the way in which infants, as well as adults, should be looked after, when they have been vaccinated. Care should be taken, by using proper clothing and by avoiding exposure, that they do not get a cold or a chill, as they are likely to suffer to a slight extent from fever. The sore places, where the vaccination has been done, should not be wiped or touched in any way, but should remain covered by the cotton lint that has been put on, until this is removed or renewed by the doctor, or when he orders this to be done. It may be necessary, in the case of young children, to put a pad, or a thick bandage, over the sore part, to prevent them from scratching it.

The danger of small-pox, in a place where people are dirty and careless, or so ignorant that they do not care about any of the things that have just been learned, is not only that some of them may die from it, but that those who take the disease will get ugly marks on their faces, or even be left blind by it, and

will very probably be weak, and suffer from ill health, all their lives, afterwards. It is therefore necessary that everybody should do all that is in his power, in the ways explained already, to give the disease the least chance of spreading and becoming dangerous.

It is thus seen that the precautions to prevent small-pox from being introduced into a district, or from spreading there, are as follows:—

(1) Vaccination of all young children, and of others who have not been vaccinated before, at least.

(2) To report all suspicious cases of illness, as quickly as possible.

(3) To keep those having the disease, or suspected of having it, away from the healthy. (Isolation.)

(4) The disinfection, or, if necessary, the destruction, of all clothes and bedding used by those suffering from the disease.

36. *Chicken-pox.*—What has been said about the prevention of small-pox (and measles) applies to the disease known commonly as chicken-pox, except that, unlike small-pox, there is no vaccination required in connection with this. As is well known, it is most likely to attack children, and although it does not often cause death, it is very important to do everything to prevent its spread, because it may cause children who have suffered from it to become weak, and so prevent them from growing into strong men and women. Little need be said as to the ways of keeping it from spreading, if what has been learned

about measles and small-pox is thoroughly well remembered. It is easy to find out when children are suffering from it, and there should be no difficulty in keeping the sick ones away from those who are healthy, as well as in taking care that all clothes and bedding are disinfected and carefully washed before being used again.

37. *Whooping cough.*—This is a very distressing complaint, that appears suddenly, like measles, small-pox and chicken-pox. It usually attacks children when they are only a few years old, and is very likely to spread quickly among them and to cause several of them to die. This tendency to spread is helped, in most cases, by neglecting children when they are first attacked by it, and allowing them to run about with healthy children. Enough has been said to show that, when whooping cough appears in a district, as soon as ever a child is seen to be suffering from a cold or cough, it should be kept by itself (isolated), and that the advice of the doctor should be sought immediately. In addition, such a child should be made to behave itself decently in the matter of spitting, and should be provided with a vessel containing a disinfecting substance, mixed with water, into which it may get rid of the phlegm that comes from the throat and breathing tubes during the fits of coughing (28, 32). It must be remembered that although whooping cough, like other diseases, such as measles and small-pox, may not often end in death, it is nevertheless important that everything should be done to prevent children from getting it. The reason has been given

already: it is because all children should always be kept as healthy as possible, in order to give them the best chance of growing up strong and healthy, and thus of resisting any disease by which they are likely to be attacked when they are older.

38. *Malaria.*—This is probably the most important disease in the tropics, for it is always present in nearly all hot countries, and has caused, in the past, a great amount of suffering and death. Fortunately, the knowledge concerning it has increased to such an extent, in recent years, that there is need no longer for any fear about living in most tropical countries, provided that care is taken by everyone to do what he is told, in order to prevent himself and his neighbours from getting it. The study of the prevention of malaria falls naturally into three parts: (1) the constitution and uses of the blood; (2) the life-history of the very small animals (parasites) that cause the disease; (3) the life-history of the mosquitoes which carry it. These will be taken in order.

The blood consists of a liquid which contains an extremely large number of more or less solid bodies, each of which is very small, so that the chief kinds among them are called corpuscles. Of these corpuscles, the principal kinds that are of interest, in the present connection, are the red and the colourless corpuscles. The former contain a red colouring matter, and it is these that give the blood its well-known appearance. It will have been learned already, in relation to plants and animals, that the air contains a gas called oxygen, which is necessary

to all kinds of life. It is now that a step further in this knowledge can be taken, so that it may be known how the body makes use of the oxygen that is taken into the lungs. There is no difficulty in seeing that, unless this oxygen is given a means of getting to every part of the body, it cannot be used by those parts. How is it, then, that it is taken to the places where it is needed, in order that the whole of the body may be properly supplied with it? The answer to this question is that it is carried by the red corpuscles in the blood; these themselves take away some of the waste substances that are made when the oxygen is used, so that they may return to the lungs and get rid of the waste, and while doing this, take in more oxygen, which they carry into the body once again. The red corpuscles are extremely small, flat, round bodies which cannot move by themselves, but which are carried along in the blood, as it flows through the arteries and veins. Enough has been said to show how important it is that there should be no interference with their work, and that nothing should happen to make the numbers of them smaller.

The other kind of corpuscle which must be considered—the colourless corpuscles—is equally important, but in a different way. These are more evidently alive; they have no definite shape, but continually change their form, being extremely small, jelly-like bodies which are not merely carried along by the blood, like the red corpuscles. They are able, on the contrary, to move through the blood by themselves, somewhat, but not exactly, in the same way as a jelly fish travels through sea water. As in

the case of the red corpuscles, the question has to be answered as to what special work these do, in connection with keeping the body alive. In answer to this, it may be stated definitely that their particular duty is to help it to fight against disease. It has been explained already that many kinds of disease are caused by germs, or by very small animals, that get into the blood. There must, therefore, be some means in the healthy body of getting rid of these if they happen, in any way, to pass into it. This means is provided by the colourless corpuscles. As has been said, they are evidently alive, and able to move by themselves. They are therefore capable of attacking, and actually feeding upon, any harmful living beings that happen to get into the blood. This they do continually, as long as a person is healthy, but they are less able to perform their work properly if he happens to be ill, or suffering from a cold or a chill. This is why those who are weakly, or who have been exposed to the rain or cold winds, are most likely to suffer from blood poisoning, after cuts or bites, or from fever. All this shows the importance that these two kinds of very small bodies in the blood possess: the red corpuscles in feeding the body with oxygen, and the colourless corpuscles in helping it to get rid of disease.

The next thing to be considered is the story of the life of the very small animal that causes persons to suffer from malaria. This can only live, as far as is known, in the blood of man and in the mosquito; in fact, it cannot complete the story of its life unless it can pass from the mosquito to man, and

from man to the mosquito. This is the circumstance that makes certain kinds of mosquitoes so important in relation to malaria. In order to get a starting-place for describing this life-cycle, as it is very well called, it will be convenient to begin with the stage at which the parasite is set free in the blood. When this stage is reached, the large numbers that are usually present attack the red corpuscles and feed on them, so that each parasite gradually grows larger, while the amount of substance in each corpuscle attacked naturally gets less. This feeding on the corpuscles continues until the parasite in each of them reaches a stage at which it is large enough to divide up into several smaller bodies, called spores. These are seen, under the microscope, as clusters made up usually of eight to sixteen of the spores, contained in the pale remains of what was at first a red corpuscle. In other cases, where there has been a severe attack of malaria for one or two weeks, the remains of the affected corpuscles are seen to contain the parasite in the form of one, or sometimes two, crescent-shaped bodies; these are also a form of spore. The important thing to remember is, however, that whichever form the spores may take, the final result is that the corpuscles containing them are broken up, and they escape into the blood. It is easy to see, now, why persons with malaria are likely to become very weak and bloodless, as it is called. Their red corpuscles in the blood are being destroyed in large numbers, so that the body is no longer fed properly by it, and there is the additional bad effect of the poison (toxin) that is produced by

the parasites. It is during the time that the parasites are attacking, and feeding inside, the red corpuscles that the person in whose blood they are has a high temperature, or as it is often put, suffers from fever; it is at the stage when the corpuscles are being broken up that he has fits of shivering, or ague. The length of time taken for the temperature to rise and for the shivering fit to come on depends, therefore, on the time that it takes for the parasites to attack, and break up, the corpuscles. This, again, depends on the particular kind of the parasite which is causing the disease, for there is more than one variety. This is why, sometimes, the attack comes on every day (quotidian ague); at others, every other day (tertian ague), and at others still, every third day (quartan ague). The time at which the fever begins to go down (when the temperature starts to fall), just before the patient commences to suffer from ague, is the stage at which quinine should be given, for it is then that the spores are about to leave the remains of the corpuscles and be set free in the blood, where many of them will be killed by the quinine.

In the ordinary course, the spores that are set free from the corpuscles undergo changes that are unimportant in dealing with the subject in the present simple way. The important matter to consider is what things may happen to them when they reach this stage. It may be said, broadly, that the possible happenings are six: (1) they may attack other corpuscles; (2) they may be attacked by the colourless corpuscles, and thus be destroyed; (3) they may

travel to the inner parts of the body, where they change their form and rest for a time; (4) it is probable that some are unable to attack new red corpuscles, so that they die, and cause no more trouble; (5) if the sick person is taking quinine, as has been seen, many of them will be killed by it; (6) they may be taken in by mosquitoes which happen to bite the sick person. These changes may be dealt with, in order, as follows.

In the first case, when other red corpuscles are attacked, the result is simply to cause another onset of the fever, and, as has been seen, the time at which the onsets take place will depend on how long it takes the parasites to destroy the red corpuscles. This is the reason why, in malaria, the fever always comes on at regular intervals. In the second case, those parasites which are attacked and fed upon by the colourless corpuscles will, of course, not be able to help in giving another attack of the fever, and if the body is healthy enough, the parasites will be destroyed by the colourless corpuscles at such a rate that it will be able to "throw off" the fever. Where, as in the third case, the parasites go to rest in the inner parts of the body, this may cause it to happen that the attacks of the fever may cease, until the body is made weaker by a chill, exposure, or by its being affected by another disease. This is one reason why those who have had malaria should take great care of themselves, and why, even if they do so, they are likely to suffer from it, for a time, when they go to live in a colder climate. There is no certainty about the fourth case, in which newly

formed spores may possibly die through not being able to attack fresh red corpuscles; it is probable that such weak spores will be accounted for by the white corpuscles, in any case. The fifth instance, where they are killed by quinine, has been considered already. The importance of this is very great, and serves to show why quinine is so highly thought of in the treatment of malaria, and why it is generally necessary for those who suffer from the disease to take it, preferably under the doctor's orders. The sixth and last instance, in which a person with malaria is "bitten" by mosquitoes, which thus take in blood containing the parasite, is so important that it must be considered specially.

The mosquito does not actually bite human beings. What it really does is to pierce the skin by means of some of its mouth parts, and then to suck the blood. This habit of the mosquito forms a means by which the malarial parasite gets into its body. It is now that the parasite reaches its complete stage, and this stage can only be attained inside the mosquito. As this is the complete stage of the parasite, it is the last one, and as a result of it, swellings (cysts) are formed on the inside of the stomach of the mosquito. New parasites, spindle-shaped at this stage, are produced in these swellings, and finally (usually in about a week) they burst, setting the parasites free in the body of the mosquito. In this way, the latter get into the blood of the insect, and are carried to the mouth parts. There are situated, in the mouth parts of the insect, glands which give a liquid, much as saliva is formed in the human mouth, which serves

the purpose of keeping the blood liquid while it is being sucked from the person that the mosquito is "biting." It is because some of this liquid gets into the blood when the bite is given that irritation and itching are felt near the parts pierced by the mosquito; this, however, has nothing to do with the giving of malaria, or any other disease. The important fact is that, when a mosquito, which has already bitten a person with malaria, bites another, after the time required for the parasite to develop (nearly a fortnight), the very best chance will be given for the latter to be carried to the blood of the healthy person, there to begin the life-history that has been described already; this is the only way, as far as is known, in which a healthy person can be attacked by malaria.

Now, that it has been shown definitely that the only way in which malaria can be passed on from one person to another is by means of the mosquito, it is easy to understand why the life-history of this insect, which forms the third part of the present discussion, has become of such great importance in the study of the disease. It has been explained already (9, 11) that the eggs of most mosquitoes are laid on the surface of water, and it will be well understood, by now, how the different stages of the insect are developed from these, until it becomes perfectly formed, and reaches the state in which it is usually known as a mosquito. This is the stage at which it is dangerous, in that certain kinds are capable, when they reach it, of carrying malaria and other diseases from sick persons to those who are healthy. The

practical application of this knowledge is that everything should be done to prevent mosquitoes that are already living from biting healthy human beings, and to take such measures as will reduce, as far as possible, the number of these pests.

An important circumstance in the life of the mosquitoes that carry malaria is that they only bite at night. This is why it is so strongly advised that all persons who are able to do so should always sleep under a mosquito net, which should be kept well repaired. This should be let down some time before the sun sets, and well tucked in; if this is not done till later, some of the mosquitoes are sure to be flying about, and there is a great chance that several of them will be imprisoned within the net, and its use rendered of no avail. Where mosquitoes abound, it is especially necessary that those persons living in the house who are known to be suffering from malaria should sleep under nets, for they will thus be given the least chance of handing on the disease to mosquitoes, and in this way causing it to be spread. The most effective way to escape the mosquito is, however, to live away from the streams and wet land, which are naturally inhabited by it (10, 11). Care should be taken, in any case, to avoid the company of those who have the disease, especially in the evening, when the insects are biting. In this matter, it is particularly important that children who are living in unhealthy, wet places should be kept away from the house. Such children are in the greatest degree liable to help in spreading the disease, for although they appear to be healthy,

their blood is full of the parasites; and their apparent health is only due to the fact that they have been able to survive because their bodies have attained a peculiar condition which allows the malarial parasites to live in them without producing any of the ordinary symptoms of the disease. It is an interesting circumstance that these children generally get rid of it when they are about fourteen years of age, but they are less able to make a good recovery from other kinds of sickness than if they had never had malaria. Finally, if it is necessary that a person should live in a malarious district for any time, quinine should be taken regularly, in amounts recommended by the doctor, and this is especially important if any of the symptoms of the disease begin to show themselves.

In the foregoing paragraph, the personal precautions that are best to be taken, for avoiding the disease, have been indicated. It is evident, however, from what has been learned about the part that the mosquito plays in carrying the disease, as well as from the knowledge that has been gained concerning its life-history, that the best results, for all those living in a given district, will be gained if everyone does what he can to prevent the mosquito from being able to exist there, and to destroy those that may come into it. The study of the stages through which the mosquito passes before it reaches that of the perfect insect, with the power to fly, will have caused it to be evident that if it is made difficult or impossible for the eggs to be laid on the surface of water, where the wrigglers can be hatched from

them, or if precautions are taken to kill any of the wrigglers that may have been produced, a simple means is provided for reducing the numbers of the insect to such an extent as to make the chances that the disease will be carried from one person to another as small as possible. Past considerations (10, 11, 14) have shown that this result may be brought about by draining and cultivating the land, and by covering the surface of water which must remain with kerosene, or by protecting it from mosquitoes by means of properly arranged screens of wire gauze. In regard to the employment of kerosene, it must be remembered that this is useful in two ways: it kills any wrigglers that may be in the water already, by suffocating and poisoning them when they come to the surface to breathe, and it also kills the mosquito when it tries to lay eggs on the surface of the water. Good results have been obtained, where there are large pools, or quantities of slowly running water, which cannot be dealt with in the ways mentioned, by putting small fish, such as the Barbados "millions" into them; these eat the wrigglers that are in the water, and disturb the mosquito while it is attempting to lay eggs on the top of it.

A review of these methods of preventing malaria will lead to the following summary of them. The first five means are matters of personal care against getting and spreading the disease; the rest have relation to the destruction of the mosquito, so that there may be no way in which it may be carried from the sick to the healthy.

(1) The use of nets, particularly for the malarious.

(2) To live in places where the land is dry and the disease is not common.

(3) To keep away from malarious persons and unhealthy districts, especially at night.

(4) The prevent strange children who are likely to have malaria from being about the house for any length of time.

(5) To take quinine regularly, under advice, when it is necessary to stay where many people are suffering from malaria.

(6) To drain and cultivate the land around the house (11, 12).

(7) To screen all water that must be allowed to collect, or to pour kerosene on it regularly (14).

(8) To introduce small, surface-feeding fish into ponds which cannot be drained or filled up, and into the streams.

39. *Filaria.*—This disease, which is called more correctly filariasis, is also known as the Rose, and, in aggravated cases, gives rise to the condition that is usually called elephantiasis. It is like malaria in that it is carried by mosquitoes, though the cause of it and the way in which it affects human beings are quite different from the similar circumstances of that disease. It is unlike malaria on account of the fact, especially, that the parasite which causes it does not cause direct harm to the blood, but affects that part of the body known as the lymphatic system in such a way as to bring about changes of a serious nature, and often to shorten the life of the person attacked. It will be convenient to study the prevention of the disease much in the same way as that of malaria has

been considered, and the subject will again fall naturally into three parts: (1) the uses of the lymph and the lymphatic system in the body; (2) the life-history of the parasites that cause the disease; (3) the relation between the life-history of the mosquitoes that carry the disease and that of these parasites. The best plan will be to take these in order.

It has been learned already that the blood is the liquid that visits every part of the body, and carries the food that is required in order that those parts may not waste away, but remain alive and useful. The fact was pointed out that one of the things necessary to the body that are carried in the blood is oxygen, and that this is done by means of the red corpuscles. This is not all, however. It is easy to see that if the bodies of those who are young are to increase in size, or grow, and if the waste in these, as well as in the bodies of those who are older, has to be repaired, food must be carried to those parts where it is required, and there must be some means whereby it is given up by the blood when it reaches them. How is this food given up to those parts? The answer is that part of the blood is forced through the walls of the vessels which carry it. This part is called lymph; it is an almost colourless liquid and may often be seen where the skin has been rubbed off so as to cause a slight amount of bleeding; after the blood, this liquid appears, and then dries up and a scab is formed. What has just been said is intended to give some idea of the appearance of the lymph; the important thing to remember is that it is always being forced out of the blood vessels, so that the

parts of the body through which they run may have the necessary food brought to them. It is a fact that more of this lymph is forced out of the blood vessels than is needed by the parts near them; there must therefore be some means by which the lymph that is not required may be carried away. This means is provided by what is called the lymphatic system. The lymphatic system consists of thin-walled tubes, running through the limbs and trunk, and leading at last to one main tube (the thoracic duct), which opens into one of the chief veins of the body, near the left shoulder. At certain places, such as the armpits and the neck, these tubes become wider and form glands; it is these glands that become swollen and painful in certain diseases, and in blood poisoning. What has just been said will make it plain that lymph that travels along these tubes will eventually reach the main tube (the thoracic duct) and will be poured back into the blood, from which it came originally. This is, then, the use of the lymphatic system: to return to the blood the lymph that is not wanted.

The second matter to receive attention is the parasite that causes filaria. Blood taken two or three hours after sunset from a person who has the disease will often show the presence, under the microscope, of a large number of small worms, each of which is about one seventy-fifth of an inch long; it is not likely, however, as will be explained later, that these will be easily found in the blood of a person in which the disease has reached the stage of elephantiasis. These very small worms are each covered by a loose

sheath or coat, inside of which they can be seen to move backwards and forwards, while they wriggle about actively. It is not these that do the damage, however. They are merely a young stage of the parasite. The interesting fact is that they cannot grow any larger unless they are removed from the blood, and this has to be done, as far as is known, by a mosquito. The past considerations of the habits of mosquitoes will make it easy to understand that the chances of removal in this way are very great; and as was the case in malaria, the study of what happens to the worms at this stage will help to make plain the way in which this disease is spread. When the worms pass into the stomach of the mosquito, they are of course contained in the blood on which it has fed. They move about in this blood, which gradually thickens, because it has been removed from the veins. This movement is continued until the worms are able to get out of the sheath which covers them, for this is held more or less firmly by the thickened blood, while they are struggling in it, and is eventually left behind. At this stage, the worms are able to do more than wriggle; they move along until they come to the part of the mosquito that is situated immediately behind the head (the chest or thorax). Here, they find their way into the muscles, where they remain for sixteen to twenty days, during which time they increase in size to about one-sixteenth of an inch, while other changes, such as the formation of a mouth, take place. At the end of this period, they pass to the head of the mosquito and wait near its mouth until

it bites a person, when they pass into his blood. It is an interesting fact, in connection with this, that the worms will not leave the mosquito unless it is making a meal of blood; trials in which the insects were fed on bananas showed that the worms in their mouth parts continued to remain there. Under the proper conditions, then, the worms reach the blood once more; thence they travel to the lymphatic system, which has just been described. In the lymphatic system, they grow greatly in size, becoming three or four inches in length. Eggs are laid at this stage, and these hatch, giving rise to the very small worms that were considered at the beginning of this account of the life-history; so that what has been said forms a complete story of the existence of the parasite.

This story only requires to be finished by a consideration of the way in which the filarial worm does harm to the body and causes the disease for which it is responsible. It must be remembered, firstly, that as far as is known, the harm is caused only by the fully grown forms in the lymphatic system; the minute worms in the blood, which can only grow up if they pass into the mosquito, have not been proved to do any damage. The fully grown worms, on the other hand, cause fever (what is known as fever and ague, in Barbados), and their presence interferes with the flow of the lymph, so that the parts near them swell and become inflamed. It is the circumstance that this lymph may be kept back in the tissues, instead of flowing into the blood, that causes them, sometimes, to become permanently changed

and much swollen; this is the condition known as elephantiasis. The stopping up of the lymphatics, in this case, may be so complete as to prevent the newly hatched worms from being carried through them to the blood. The explanation is thus provided, of the fact mentioned above, that these are by no means to be found always in the blood of a person suffering from elephantiasis.

The account of the life-history of the filarial worm would not be complete without the mention of the fact of its being possible for it to reach man from the mosquito by other means than the circumstance of a bite from the latter. It is thought that the worms may escape from a mosquito when it is laying eggs, or when it dies, so that there is a chance of their being contained in drinking water. There is the certainty, at any rate, that they can live in water, and this gives another reason for the exercise of care in filtering or boiling water that is intended for drinking purposes (23).

In the first part of the book, as well as in what was said in connection with malaria, sufficient attention was given to the life-history of the mosquito, which forms the third matter for discussion, to make it unnecessary to deal with this in detail. The chief circumstance of importance is that the worms are carried by a small, brown mosquito, which only bites at night, and rests during the day in dark, sheltered places, such as those behind doors, curtains or clothes, or in cupboards. A fact of great interest has been mentioned already, namely, that the small

worms, which must enter a mosquito in order that they may complete their life, are only found in the blood, near the skin, at night—at the very time when the mosquito is biting, so that they seem to come into the outer blood for the very purpose of being taken into the mosquito. As this insect is of the kind that lays its eggs chiefly in small pools, water barrels, cisterns and indeed in anything that is able to hold water for a time, the need of special care in storing water, and in keeping the land around the house dry and clear of rubbish, is again indicated unmistakably.

The facts that have been given above show that the precautions for prevention of the disease are, to a great extent, the same as those for malaria, as both are spread by means of the mosquito; though more care, even, is required in the case of filaria, as the mosquito which carries it is particularly fond of laying its eggs in pools, tanks, barrels and any rubbish around the house, such as tins and broken bottles that have been thrown out of doors. The methods for prevention may, therefore, be put together as follows:—

(1) That everyone should sleep under a net, where it is possible to do so. This is especially important in the case of those who are suffering from filaria, for they are the very ones who give the disease to the mosquito, which carries it to others.

(2) That the land around the house should be kept drained and tidy, and should be cultivated if possible.

(3) That water which has to be kept should be screened or treated regularly with kerosene.

40. *Yellow Fever.*—This is a disease that is rare in the British West Indies. It has not been known in several of the islands for many years, and the chances of its visiting most of them are small, especially now that so much is known about the disease and the way in which it is carried. There is the circumstance, besides this, that wherever it may break out, the prompt measures taken by the authorities are sure to be effective in preventing its spread to any great extent. It is best, however, that all should learn as much as they can about it, in order that they may know what to do to prevent themselves from getting it, if it happens to come into the district in which they live. This knowledge is even more important, from another point of view, for the persons who possess it will be able to use it for the purpose of helping those who are trying to keep the disease from spreading, by doing what they are told, in a sensible way, and by making others understand that it is necessary to do this, as well.

It is almost certain that yellow fever, like malaria and filaria, is caused by a parasite that lives in the body, and as is the case in the first-mentioned disease, brings about changes in the blood that cause serious illness. In yellow fever, this illness usually lasts for a much shorter time than malaria, but it is much more likely to end in death. The important thing to remember is that, like the diseases just mentioned, yellow fever is carried from the sick to the healthy by a mosquito. This mosquito is easily

recognized, as it flies about and bites during the day, as well as at night, and it is plainly striped with white on the body and legs; it is therefore sometimes known as the "Scots Greys" or the "Tiger" mosquito. It is like the small brown mosquito that carries filaria, in that it prefers to lay its eggs in the water in barrels and tanks, or in tins and broken bottles that have been thrown away, or in pools. This makes plain another reason, in addition to those that have been given, for not allowing water to stand for any time in barrels or tanks, unless they are properly screened with wire or treated with kerosene, as well as for keeping the land around the house clean and tidy, and preferably cultivating it.

The connection of the mosquito with the disease will make it easy to understand that, where this is given the smallest opportunity of laying its eggs, and thus producing other mosquitoes like it, there will be the least chance for the disease to spread, even if it happens to break out. Further, it has been explained already that the outbreaks of yellow fever usually take place suddenly, and that if the disease is recognized quickly enough, and if the instructions of those who have to give advice about it are followed promptly and carefully, it cannot remain long in a place where it has appeared. There is thus no difficulty in seeing that, where the disease is unfortunately present, it is the duty of those living there to report all suspicious cases of sickness or fever as soon as they can, in order to make the chances as small as possible for the persons attacked to afford a means of giving it to others.

In considering, then, the means for the prevention of yellow fever, these are, for the greater part, very similar to those in connection with malaria and filaria. They are expressed as follows:—

(1) Care in preventing mosquitoes from laying their eggs on water that is being stored.

(2) Keeping the land around the house tidy and free from standing pools of water.

Where the disease has already broken out:

(3) Keeping away from those places where persons are known to be suffering from it, especially at night.

(4) The use of nets, when sleeping, particularly by those who are showing any signs of sickness.

(5) Promptly reporting any cases of suspicious sickness or fever.

(6) Doing everything to help those who are trying to prevent yellow fever from spreading.

41. *External Parasites.*—These are the annoying, small animals, generally insects, that may be found on the skin, or in the hair, of human beings, and which feed there for a shorter or longer time. Although they are placed here in the section entitled "Diseases Transmitted in the House, more Especially," it must be understood that they cannot be described as diseases, in the true sense of the word. (This is why the heading of this sub-section has been placed in brackets.) One kind of harm that these animals do is to cause irritation, and this may take place to such a degree, especially in the case of sick persons and young children, that they lose a great deal of the strength that they have got, and the

chances of their thriving properly are reduced. This, however, is not the chief danger that may arise from them. The irritation that is caused by their bites often makes the person bitten rub those parts to such an extent that sores are formed, which may take some time to heal, or may even, if they are dirty, cause blood poisoning and lockjaw. The bites of mosquitoes may sometimes have this effect; it must be carefully distinguished, however, from the power of those insects to carry actual disease, such as malaria, filaria, and yellow fever. The chief among the other external parasites that may cause irritation, sores and even blood poisoning through their bites are fleas, jiggers (or chigoes), lice, bugs and ticks. What is most important, in connection with these animals is that their presence, to any degree, is a proof of lack of care and cleanliness, either in regard to the body or the house. Where the body is looked after properly, with respect to its cleanliness and that of the clothes which cover it, and where reasonable attention is given to keeping the house clean and tidy, there will be little chance of any serious discomfort or ill-health from the presence of these pests. Where they are found, there must be at the same time dirt and carelessness, and if they ever appear it is a hint to the householder that the state of the house, or of those that live in it, is unsatisfactory.

A fact of great importance, in connection with such external parasites, is that some of them are known to carry disease, much in the same manner as this is done by mosquitoes, and time may show

that all of them are dangerous in this way. Fleas, for instance, spread the much dreaded disease known as plague, which attacks rats and human beings; when the rats die, the fleas leave them, and may reach human beings, to whom they will probably carry the plague. This disease, fortunately, does not usually exist in the West Indies, but it may be brought from other places where it is commoner, with the result that an outbreak is caused which is likely to be particularly severe in overcrowded and insanitary districts. When it visits a place, one of the chief signs of its existence is the finding of large numbers of dead rats; this circumstance, in fact, is an almost infallible warning, to those who live in the district, that plague is present; special means should therefore be taken, under such conditions, to effect the greatest care in regard to the cleanliness of the house and of the body, and all places where the disease has appeared should be avoided, as far as possible. When an outbreak occurs, it is usually the case that those whose duty it is to look after the health of the people in the district (the sanitary authorities) will immediately set to work in order to do what they can to prevent the disease from spreading. They should, therefore, be helped in every way that is possible, especially in the matters of reporting persons who become sick suddenly; of removing and destroying (generally by fire) all rubbish and waste; and of killing the rats, which are helping, in the way described above, to spread the disease. Plague is the only disease, in the West Indies, that is known with certainty to be carried

by any of the parasites mentioned. It is of interest to state that a fever known as Tick Fever or Relapsing Fever, which occurs in many parts of the world, is carried by the body louse, the bed bug and ticks, and that there exists a disease in the United States, called spotted fever, which is thought to be carried by the last-mentioned parasites.

As the presence in numbers of such of these parasites as are found in the house is due to a dirty way of living and to carelessness, it is easy to see that the best measure to take against them is cleanliness. Almost anyone may, however, accidentally pick up a jigger; this is why it is best not to go barefooted, especially on dusty floors in houses, stables or bathing sheds. This insect generally buries itself in the feet, where it becomes full of eggs and swells, sometimes causing a great deal of pain. When this is the case, it should be removed carefully, with a needle that has been made clean by passing it through a flame; someone can generally be found who can do this easily and neatly. The important thing is that the insect must be taken out without being burst open; if it is burst, the eggs escape and there is a chance that its numbers will be increased in this way. There is also a likelihood that the bed bugs, as well as jiggers, may be introduced into the house by accident. These usually live in crevices in the wood of walls and bedsteads, and come out to bite at night. Whenever jiggers are found, the floors should be carefully cleaned and sprinkled with carbolic acid; for bed bugs, the best plan is to rub kerosene into the wood of the walls

and bedsteads, with a soft rag, being careful to see that the kerosene gets into the cracks and crevices.

B.—Diseases Transmitted by Food and Water.

42. *Worms.*—Many kinds of worms are known, which live in the digestive organs where they do damage to a greater or less extent by sucking the blood, or by causing changes and irritation of the inner coats of the intestines. They are most generally found in children, and the symptoms that they produce are well known. These often consist in restlessness, irritableness and bad temper, convulsions in young children, and even bloodlessness (anæmia). Their importance arises from the fact that they may interfere with the proper growth of children, and make them weak and unable to resist disease; while those who are older may be affected to such an extent as to prevent them from being able to do the full amount of work that is expected from them, and to make them feel incapable of taking a proper interest in life. It is easy to see, therefore, why the study of the way in which these parasites live is so important, and how necessary it is that everything that is possible should be known about the ways in which they are capable of entering the human body.

It is the most general case, with regard to these worms, that large numbers of eggs are produced in the bodies of those who have been already attacked by them, and that these pass out of the body and

get into food or water, which, when it is eaten or drunk, carries them into the bodies of others. There is also the chance, as will be explained more fully, later, that persons who are not careful to wash their hands before eating will take them in with their food during meals. The likelihood of their being taken into the body is even greater in the case of young children who are not properly looked after and are allowed to play in the dirt and dust; children are continually putting their fingers into their mouths, and this is probably the reason why they are more generally found to be suffering from worms than is the case with older persons (27).

The important point to remember, however, is that the worms, or their eggs, are particularly likely to get into food and water. This forms one of the many reasons why there should be the greatest care in the preparation and keeping of food, and in regard to boiling or filtering water, unless it is perfectly certain that this comes from a source where there is no chance of its having come into contact with any dirt, soil or filth (21, 22, 23). One very necessary precaution is that all food and water that is being kept should be covered, preferably by being put into a wire safe or by means of pieces of muslin over the openings of the vessels which contain them. The reason for doing this is, more particularly, to keep flies from them. Flies, as is well known, lay their eggs in filth, so that the young flies that hatch out from them may possibly carry the eggs of worms, as well as the germs of serious diseases (10, 43, 44, 45); besides this, the grown flies are usually

found in the neighbourhood of filth, from which they are extremely likely to fly and alight on food, unless this is properly covered. All this makes it evident that the rules to be followed, in order that the least opportunity for the eggs of worms to enter the body may be given, are as follows:—

(1) To wash the hands carefully before eating (27, 49).

(2) To see that all cups, glasses, dishes and plates from which water is drunk, or food is eaten, are carefully cleaned, not long before each meal (22, 43, 44, 49).

(3) To keep food and water in vessels that have been well washed, immediately before these are put into them (22).

(4) To boil or filter all drinking water that comes from streams near cultivated ground, from ponds or from wells (23).

(5) To keep covered, so that flies cannot get to it, all food and water that is put aside for a time (22, 23).

43. *Dysentery.*—There will now be considered three true diseases that are transmitted by food and water. These are dysentery, typhoid fever and cholera; they will be dealt with in the order in which they have just been mentioned. It is probable that dysentery is not a disease by itself, but that it includes several diseases, all of which produce certain distressing symptoms that are generally well known. These symptoms include serious trouble with the digestive organs, including diarrhœa, with pain and more or less fever. The disease is serious,

in that it may quickly cause death, or even in those who appear to have recovered from it, the digestive organs may have been brought into such a condition that they are always weak, so that the person who has suffered from it is never in the best of health. The important things to remember, in connection with this disease, are that everyone should live in such a way that he will be given the least chance of being attacked by it, and that, if any of the symptoms appear, he should promptly seek advice from the doctor, in order to get rid of it as soon as possible. The chief things that cause the disease are impure water, bad food, intemperance, and carelessness in regard to keeping the body warm and free from chills, so that all that has been said in regard to these things is of special importance in regard to dysentery (22, 23, 24, 26, 31).

44. *Typhoid fever.*—This, like dysentery, is a disease of the digestive organs; but it is different in that its cause is definite and that it usually breaks out suddenly where a large number of persons are living together, and then disappears. What has been said about the causes of dysentery apply equally to typhoid fever.

45. *Cholera.*—As is the case with typhoid fever, cholera appears suddenly, especially where a large number of persons are travelling together, or in places in which many persons are crowded and where the conditions are dirty and unhealthy. Cholera is similar to dysentery and typhoid fever in that those who are attacked by it suffer from diarrhœa and severe pains, the digestive organs

being completely upset. It is fairly certain that cholera is caused by a definite germ that finds its way into the digestive organs with water that has been rendered impure by coming into contact with what has already passed from those who are suffering from the disease. The matter of importance is that the means to prevent the spread of all these diseases—dysentery, typhoid fever and cholera—are all very similar, and depend upon the exercise of continual care in regard to personal habits, drinking pure water, and eating well-chosen and carefully prepared food. These means for prevention may be put together, in a list, as follows:—

(1) Care to drink water that is known to have come from a pure source, or that has been carefully boiled and kept covered (23).

(2) To eat properly cooked food, and to see that the plates and dishes used have been carefully washed not long before they are wanted (21, 22).

(3) To keep the body, especially the hands, clean (27).

(4) To be careful that the body does not become chilled or exposed in any way (7, 24, 26).

(5) To lead a temperate life, especially in the matters of eating and drinking (31).

(6) To see that the waste from the body is got rid of in such a way as to prevent it from making impure the water that may be drunk by anyone (10, 30, 42, 49).

(7) To prevent any kind of waste or filth from collecting near the house and attracting flies (10, 12, 13, 30).

C.—Diseases Brought on by Wet Clothing.

46. These diseases, which are common throughout the world, most usually show themselves as rheumatism, with which is connected heart disease, and as diseases of the kidneys. They do not require any special description here; it is sufficient to point out that the best chance of avoiding them is to prevent the body from becoming chilled, especially through wearing clothes that have become wetted in the rain, or by perspiration. What has been said about the necessity for frequent changes of clothing, especially when it is wet (25, 26) will make it sufficiently evident that anyone who, through laziness or ignorance, does not take care to change his clothes immediately after a wetting, or after great exertion, is very likely to suffer from rheumatism or to be attacked by diseases that may affect seriously several of his internal organs. In any case, the matter of importance is that carelessness of this kind makes the body far less able to resist disease than if proper care of it was being taken, so that a reasonable amount of care to prevent chills from being caused by the wearing of damp clothing will be repaid by the enjoyment of a better state of health and the possession of the power by the body to ward off disease. Proper respect for the body from day to day makes it able to survive, in a healthy condition, from year to year.

D.—Diseases Caused by Careless Personal Habits.

47. *Ringworm and Itch (Scabies).*—These are diseases that are by no means confined to the tropics; they exist wherever there is carelessness in the matter of personal cleanliness, and anyone may be attacked by them, however clean he may be in his ordinary habits, if he is not always most particular to avoid the company of those who are dirty, and especially to take care never to touch towels, water for washing, or even razors and hair-brushes that have been used by such persons. Both complaints attack the skin, ringworm being chiefly found on the scalp, and itch affecting the face, mainly. The most objectionable things in the case of both of them are that they are very difficult to get rid of, and that the person who is suffering from them experiences great discomfort and is very likely to be a means of handing them on to others. Little more need be said about them than that the existence of such diseases teaches especially the necessity for continued and scrupulous care in regard to personal habits, and the avoidance of all those who have not sufficient self-respect to keep their bodies clean and wholesome (25, 26, 27).

48. *Lockjaw.*—This is often known as Tetanus. It is an extremely fatal disease that causes violent contractions of the muscles of the body, especially of those connected with the jaws, so that the victim of it cannot use these, either in speaking or eating.

The circumstance of the greatest importance, in connection with it, is that it is caused by a germ that can only enter the body through openings in the skin, such as are caused by scratches or wounds. It is a matter of interest that this germ seems to exist most frequently in certain areas of soil, so that persons living in those areas are most likely to be attacked by the disease. What has to be remembered most particularly, however, is that the germ has to get into scratches and wounds, before it can produce the disease of which it is the cause. This makes it evident that all such wounds should be kept as clean as possible, from the first. It is best, when the body or limbs have been injured, especially by rusty nails or through accidents when work is being done in the field or the factory, to let the bleeding continue for a time, and then to wash the wounds with clean water, preferably that which has been boiled recently; afterwards they should be bound up with clean linen. A good plan is for everyone to have a few pieces of such linen by him, for use when accidents happen. It is best prepared by cutting it into strips, which are put into a tin closed by a well-fitting lid. This tin is then placed in the oven, or on a fairly hot iron plate, over a coal pot, care being taken that the heat is not so great as to cause the tin to open at the joints, or the linen to burn. Finally, the tin is put away, without being opened, in a place where it will not be disturbed until it is required, and where everyone will know where to find it, immediately that it is wanted. Lockjaw is especially likely to attack young children,

so that there should be special care to cleanse any wounds that these may suffer, and to bandage them cleanly in the way that has just been described.

49. *Ankylostomiasis, Coolie Itch, Ground Itch, or Hookworm.*—Among the diseases that are chiefly due to carelessness is regard to personal habits, this has been left for consideration until now, because it is one of the most important diseases in the West Indies, as well as in many other parts of the world. It is important on account of the great number of persons that it attacks; not because it is, of itself, fatal in a high degree. The fact is that it weakens those who are victims of it to such an extent as to interfere seriously with their power to live happily, to work and to resist disease. It is, moreover, often found in children, and prevents them from becoming strong men and women. Altogether, the extent to which it exists, in some places, is capable of so weakening the persons who live there that much of their poverty arises from the fact that, owing to the general ill-health, the labour provided by them is worth very little.

The disease is caused by more than one kind of worm, which lives in the upper part of the intestines. Here, the worms fix themselves firmly to the inner wall of the bowel, and suck the blood continually. At the same time, eggs are produced, which pass out of the body with the waste from it.

This statement of the cause of the disease leads to the consideration of the life-history of the worm which produces it. This is one-third to two-fifths of an inch long, and is provided with strong mouth

parts for the purpose of fixing itself securely to the intestine and sucking the blood. The worms produce a very large number of eggs, which pass out of the body with the waste from it. From these, there hatch out similar worms, which feed on the contents of the soil and filth in which they find themselves, but which can only grow to a certain stage. When they reach this stage, they remain, slowly moving about, until they have an opportunity of entering the human body, either in dirty water which is drunk, or by getting in through the skin of the hands or feet, when these are kept constantly in contact with mud, or are allowed to remain dirty. In either case, they find their way to the upper part of the intestine, where they grow to their full size and produce eggs; these, under the proper conditions, as described above, give rise to fresh worms, which enter the bodies of other persons and again do damage and produce their kind.

The next thing to consider is the way in which these internal parasites do harm to the body. Their chief effect is to cause, in the long run, a great loss of blood, because they are always feeding on this. It is probable that they possess another means of doing harm to the body: that is by producing a poison (toxin) that passes into the blood and causes ill-health; though this is not certain. The matter of importance is that if persons who are not properly fed, or are suffering from diseases, are attacked by these worms, their power of living and doing a proper amount of work is made much less than if

they were healthy or well fed. This makes it evident that everyone should live in a cleanly way, which will lessen the chances of the worms entering the body, and that the greatest care should be taken to prevent children from putting dirt, or their dirty hands, into their mouths. The prevention of the disease, in fact, is entirely a matter of the possession of cleanly habits, both in regard to the body (25, 26, 27, 30), and to eating and drinking (22, 23, 27), and the means for this prevention may be summed up as follows:—

(1) To be careful that all drinking water is got from a pure source, or if such water cannot be obtained, that it is properly prepared for use (23).

(2) Always to use dishes and plates that have been washed carefully not long before they are required (22).

(3) To wash the hands carefully before eating (27).

(4) Always to get rid of the waste of the body in proper places that are provided for the purpose (30).

(5) To keep the hands and feet clean at all times, and especially to keep the feet out of mud and dirt as much as possible (27).

This completes the consideration of the rules of health, and of the chief diseases that attack mankind more especially in the tropics. It should be evident, by now, that the avoidance of these diseases

depends mainly on personal cleanliness and the possession of careful, regular habits. No one is too young to be taught, and to try to acquire, these habits; so that those who are still at school should be always trying to take more and more care of their bodies, and to make their manner of living decent and orderly. They will thus grow up in such a way that it will be no effort to them to follow the rules of health, and the example which they give to others by so doing will be of the greatest use in spreading a knowledge of those rules. It must be remembered, finally, that the greater the number of persons in a country who live in a proper manner, the less is the likelihood that any one of them will be attacked by disease. At the same time, the happiness and usefulness of those that live there are increased; so that the person who lives a cleanly and orderly life not only protects himself from illness, but helps to make those who live near him healthier and happier.

APPENDIX.

The following is the scheme according to which the foregoing matter has been compiled. It should serve to form a syllabus of the course, as well as an index to the book. The numbers and letters in brackets refer to sub-sections.

PART I.—THE RULES OF HEALTH.

A. The House and its Surroundings.

Keeping the house in proper repair (5).
Providing plenty of fresh air (6).
Prevention of overcrowding (7).
Keeping the house clean (8).
Care of the things in the house (9).
Getting rid of rubbish and waste (10).
Keeping the land around the house dry (11).
Keeping the land around the house clean and tidy (12).
Proper care of small stock kept near the house (13).
Collection and storage of water (14).

B. Food and Water.

Kinds of food (15).
Need for the different kinds of food (16).
Water and other substances in food (17).
Meals and the proper time for them (18).
Proper food for adults (19).
Proper food for the young (20).
The preparation of food (21).
Cleanliness in preparing food (22).
Obtaining water fit for drinking (23).

C. Clothing.

Proper kinds of clothing (24).
Wearing clean clothes (25).
Need to change the clothes often (26).

D. Personal Habits.

Cleanliness of the body, especially of the hands and feet (27).
The avoidance of spitting (28).
How to hold the body, when walking, sitting, or lying down (29).
Attention to the necessities of nature (30).
What temperance means, and why it is necessary (31).

Suggestions for Observations and Experiments.

The necessity for fresh air (a).
Dust in rooms (b).
Need for regular dusting (c).
Collectors of dust (d)
Hiding places for mosquitoes (e).
Mosquitoes and water (f).
The life-history of the mosquito (g).
Mosquitoes in pools, ponds and streams (h).
How mosquito larvæ obtain air (k).
How the larvæ are killed by kerosene (l).
Enemies of mosquito larvæ (m).
The different kinds of mosquitoes (n).
The use of nets and wire gauze against mosquitoes (o).
The chief food bodies (p).
Filtering water (q).
Proper kinds of clothing (r).

PART II.—COMMON DISEASES, THEIR CAUSE AND PREVENTION.

A. Diseases Transmitted in the House, more Especially.

Consumption (32).
Yaws (33).

Measles (34).
Small-pox (35).
Chicken-pox (36).
Whooping cough (37).
Malaria (38).
Filaria (39).
Yellow fever (40).
External parasites (41).

B. Diseases Transmitted by Food and Water.

Worms (42).
Dysentery (43).
Typhoid fever (44).
Cholera (45).

C. Diseases brought on by Wet Clothing (46).

D. Diseases Caused by Careless Personal Habits.

Ringworm and Itch (Scabies, 47).
Lockjaw (48).
Ankylostomiasis, Collie Itch, Ground Itch, or Hookworm (49).


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