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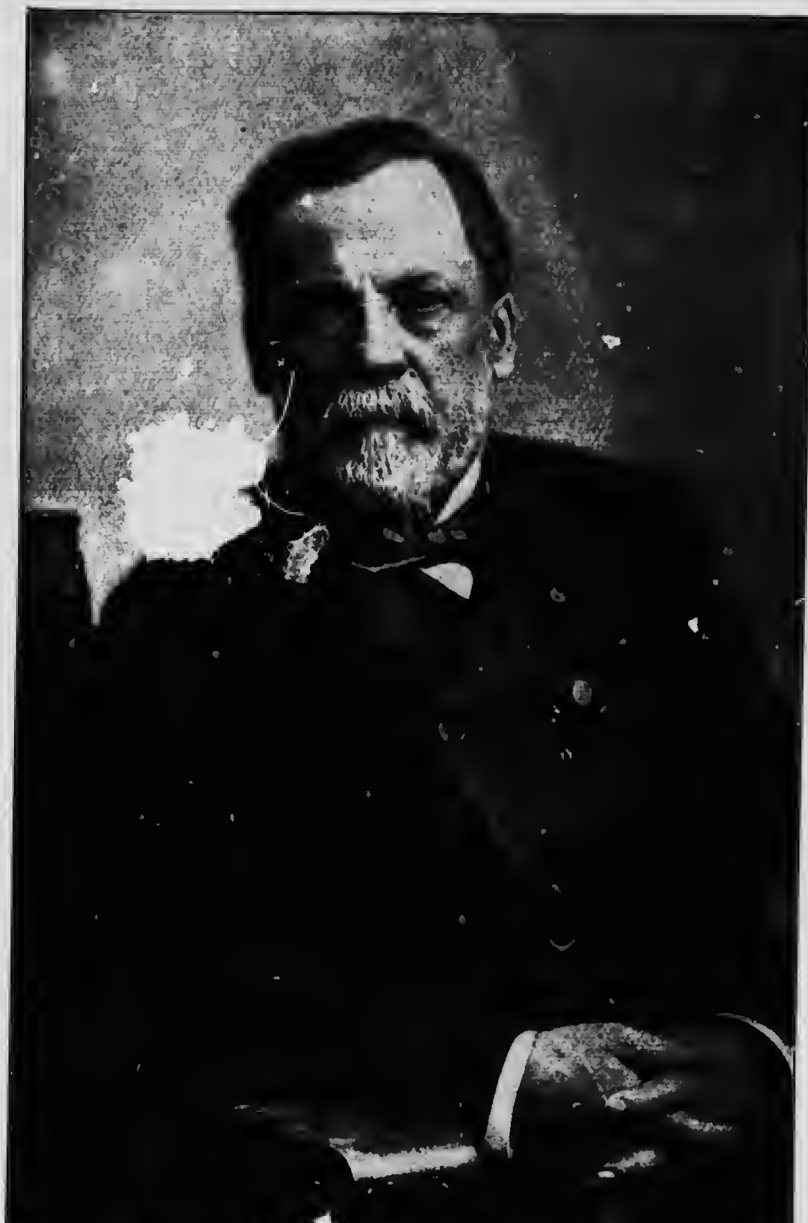

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LOUIS PASTEUR.

HYGIENE

FOR YOUNG PEOPLE

A READER FOR PUPILS IN FORM III
OF THE PUBLIC SCHOOLS

BY

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First Edition, 1909.
Reprinted 1910, 1910. 1911

PREFACE

This book is intended as a health reader for pupils of ten or eleven years of age. It is assumed that those who study it will have previously received, as provided by the school programme of study, a series of oral lessons in physiology and hygiene, somewhat similar to those indicated in the author's little book, "Introductory Physiology and Hygiene," Parts I, II and III.

The Introductory book consists of a series of lessons, most of which were taught to school children in presence of the teachers-in-training at the Kingston Model School, during the session of 1904. In it, emphasis was laid upon anatomy and physiology as the proper basis for understanding hygiene, but the instruction in hygiene was limited to sets of rules which were placed at the end of each chapter. It was expected that teachers would express these rules in simple language, write them upon the [illegible] and that pupils would learn them by heart.

After the Introductory book was published [illegible] H. Cowley, M.A., Inspector of Continuation [illegible] W. I. Chisholm, M.A., Public School Inspector, Kincardine, both pointed out that if the hygiene parts [illegible] the book were to be made at all effective, they would need to be expanded into the form of a reader. The present book is, to some extent, the result of their suggestion. Physiology still forms the foundation of the teaching, but the emphasis is here laid upon the hygiene. In short, the Introductory is a teacher's manual, this is a pupil's book.

It is almost impossible for me to make adequate acknowledgment of the help which I have received from a large number of skilled educators, and from medical gentlemen who have read either the MS. or the proofs of this book. To W. I. Chisholm, M.A.; John Dearness, M.A., Vice-principal of the London Normal School; the Rev. W. H. G. Colles, Inspector of Public Schools, Chatham; J. Russell Stuart, Esq., Instructor in Methods, Faculty of Education, Queen's University; N. W. Campbell, B.A., Public School Inspector, Durham; A. A. Jordan, Principal, Victoria School, Kingston; J. W. Plewes, Principal, Central School, Chatham; T. A. Reid, Principal, Public School, Owen Sound; J. J. Rogers, Principal, Separate School, Lindsay; A. E. Attwood, M.A., Principal, Osgoode Public School, Ottawa; and Miss Lovick, Principal of Louise School, Kingston, I am particularly indebted either for valuable criticism, or for help in reading the proofs.

J. C. Connell, M.A., M.D., Dean of the Medical Faculty, Queen's University, has read the chapters on the Eye

and the Ear; while a committee of the Ontario Dental Association has read the one on the Teeth, and supplied for it a number of valuable illustrations. Professor James Third, M.B. (Tor.), Professor Edward Ryan, B.A., M.D., and Professor W. T. Connell, M.D., M.R.C.S., (Eng.), L.R.C.P. (Lond.), all of Queen's University; E. H. Young, M.B. (Tor.), of the Staff of Rockwood Hospital, Kingston, and T. H. Middlebro, M.B. (Tor.), F.R.C.S. (Eng.), Green Sound, read the proofs and suggested improvements as the book was passing through the press.

The sources from which I have drawn material in writing this book have been very various. The standard physiologies of Howell, Ott, Schäffer, Stewart, Hall, Halliburton, and Hough & Sedgwick have been freely consulted. But on special topics I have made use of original monographs, or reports.

I am especially indebted to Sir Michael Foster's chapter on *Sunlight;* Professor C. F. Hodge's article in *The Physiological Aspects of the Liquor Problem;* Sir Victor Horsley and Dr. Sturge's *Alcohol and the Human Body;* Sedgwick's *Principles of Sanitary Science and Public Health;* J. W. Seaver's *Effects of Nicotine; Reports* of the Massachusetts' State Board of Health, 1888 to 1895; *Milk and its Relation to the Public Health;* being bulletin 41, Public Health and Marine Hospital Service, Washington, D.C., 1908; Abbott, A. C., *The Hygiene of Transmissible Disease;* and *The Life of Pasteur,* by René Vallery-Radot.

Lastly, I am indebted to Miss Margaret King, Kingston, for the drawings for nearly all the half-tone illustrations.

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HYGIENE FOR YOUNG PEOPLE

CHAPTER I.

SUNLIGHT AND PLANTS.

Come with me to a pine or tamarack plot* such as may be seen on many a Canadian farm, and let us study the effects of sunlight upon the branches of the trees.

First, walk through the clump and notice those trees on which the living branches are close to the ground, and those on which the living branches are high up on the trunk. Notice also how far apart the trees stand from each other, and whether there are many or few branches according as the trees are near together or far apart.

If you are lucky in your choice of a pinery, you will discover that when the trees are close together the only thriving branches are high up on the trunk, and that many dead ones are

* While clumps of pine or tamarack show the facts best, yet any clump of trees will do for this study.

below, all the way down. When the trees are young and far apart, the living branches are more numerous and grow out from the trunk all round. The branches extend from the top right down to the ground, and there are very few, if any, dead branches on such trees.

FIGURE 1.—Clump of old pines, lower branches gone.

Notice the branching of the trees in figure 1. The central trees are almost without living limbs, excepting near the top; whereas nearly all the trees around the outside of the plot have living branches down almost to the ground, or, at least, much lower down than in the case of the central trees. What do you suppose has made the difference in the branching?

By way of contrast, look at this other picture of a smaller clump of pines—figure 2. In this

RE 2.—Clump of young pines, branched to the ground.

group the pines are much younger and the full effect of the crowding of one tree upon the other has not yet become plain.

You see that every tree is encircled with green branches from top to bottom. There are no tall trunks such as you see in figure 1, and such as can be seen in every pine forest. Almost every branch which grew out from each stem has remained alive. Nature has done no pruning on these trees as yet.

But if you could wait for forty or fifty years and then examine this clump again, you would see that the same changes had taken place in it as in the older one. Limbs which had been crowded by trees near at hand would all be dead or dying. Trunks which had stretched upward above the others would all be green at the top, and would bear, on their lengthened sides, only the remains of former branches.

In short, the trees in figure 2 will in time come to resemble almost exactly those in figure 1.

Now look at figure 3. On each side of the gate, stand pines which are half-way in age between those in figure 1 and those in figure 2.

Here the living branches are found overarching the driveway. The dead branches are found adjoining the neighbouring trees. For some reason or other, the driveway has been the means of keeping some branches alive; while, for some equally mysterious reason, the neighbouring trees, closely crowding upon the pines, have lopped off many of their branches.

This is the way in which Mother Nature prunes the pine trees in the forest, and gives us the tall tapering trunks from which long straight beams of timber are made.

FIGURE 3.—Gate: Entrance to Grounds.

What has caused these differences in branching? Has sunshine or shade, heat or cold, rain or soil, air or food made the difference? The soil is the same under every tree in each of these clumps. The soil, therefore, cannot be the cause. Air encircles every pine and passes through amongst them. Air, therefore, cannot have lopped off most of the branches on some trees, while it has left them on others. There remains only the sunlight and shade as the cause of the difference. *And this is the cause.* When branches and leaves of evergreen trees are in the sunlight, they flourish; when they are in the shade they sicken and die.

So important is the influence of light on nearly all green plants, that the leaves are arranged on every growing stem so as to catch the greatest possible amount of light. Those that do not get a fair share sicken and die. For this reason you will find the upper leaves of the dandelion green and growing, while its under and shaded ones are brown and dying. Then, too, the dandelion by its shade kills some of the grass underneath it, and for the same reason, overarching trees kill even portions of a hedgerow.

Then again you must have noticed another way in which sunlight affects plants. Did you ever pick up a board on a grass plot in summer and find that the grass under it was almost white? In this case, there could be no doubt as to the cause of the whiteness; because the bleached spot was exactly the size and shape of the board. Moreover, when the board was removed, the grass again became green in the course of a few days or a week. If the board were allowed to remain, the grass would, in the end, die.

If you look at a leaf under a microscope you will see why its colour is green, but not all of it is green. The leaf seems to be made up of little bladders which you can see through. In the inside of each of the little bladders or sacs, are many small green balls, which in some plants move round and round in a clear liquid like water. It is these balls that give the green colour to the leaf.

Now these green balls have a most important work to do for the plant. Each one is a kind of machine for making starch and sugar, and for converting the food of the plant into the woody stuffs—the root, stem and leaf—of the plant. These balls will not form without sunlight, and this is why grass becomes pale in colour when kept from the light.

What lessons on health these plants could teach us, if we only knew enough to profit by them! Light helps us to make good blood, and good blood helps us to make healthy muscle and nerve; whereas shade and darkness will sooner or later make us pale and sickly.

QUESTIONS.

1. What difference is there in the branching of an old tree and that of a young one of the same kind? How do you account for this difference?

2. Name some plants, or shrubs, that grow best in the shade of trees. Name some that will grow only in sunshine.

3. Where have you seen plants growing that are greyish or white in colour? Do such plants grow on soil like most other plants, or do they grow on rotten wood. Do they grow in shade or in sunlight?

4. What is the cause of the green colour of the leaves of most of our trees and shrubs? What is the use of the little green balls in the inside of the little bladders or sacs which make up green leaves?

5. Why do we cover up celery in sand?

CHAPTER II.

SUNLIGHT AND ANIMALS.

Does light affect animals in the same way as it does plants? It would seem so. Even the shadow cast by an animal's own body is enough to affect the colour of its under surface. This is seen in the fact that the hair and skin on the under surface of birds, snakes, frogs, insects, fish, and many other animals, is lighter in colour than that on the sides or the back.

Does light affect human life in this way? If not, has it any effect? Look around you and see whether the faces of your friends or of strangers whom you may meet in towns and cities, are all equally ruddy or equally pale. Even a very brief look will satisfy you that they are not.

Some are ruddy, some are pale. Why the difference? Surely it must be due in part to the fact that some live much in the shade, and, like the grass under the board, have grown pale in the shade of the houses, shops, or factories in which they pass so much of the day. It would seem from all these facts that light is as necessary for the health of human beings as it is for the health of plants.

If you doubt this, consider some other facts. You find more pale people in crowded cities than in the country. People who live much in the open get their faces and hands tanned by the sun. What does tanning the skin mean? It means that the light, in striking on the skin,

FIGURE 4.—Solitary Tree, branched regularly all round, because all parts of it have been equally exposed to sunlight, shade and wind.

darkens it. As everyone knows, the skin is always paler in colour under the clothing than it is where the sun shines on it. In fact, it would seem as if the colour of the human skin varies with the strength of the sun's rays. People who live in hot climates have darker skins than th[illegible] who live farther north, where the sun's rays are not so strong.

But the tanning of the skin is only part of the effect which sunlight has on us. The light passes into the flesh, and affects the blood, and through the blood it affects every organ of the body.

Prisoners in dungeons always grow pale and weak. Of course, part of the cause of this is bad air and lack of exercise; but much of it is due to lack of light. Even if you lived in a large room and had plenty of fresh air and food, you would still grow pale and sickly if the room had not plenty of light. Just as green plants must have plenty of sunshine in order to convert their food into branches, leaves and fruit, so you also must live in the light to convert your food into red blood, ruddy cheeks, and healthy flesh.

Perhaps some of you may have read about men, women, and children who have lived for years, down in mines, and who never come out into the sunlight excepting for an occasional holiday. While a few people may live on in this way for years and may seem to be in fairly good health, yet such a mode of life is very unnatural and can only result in the growth of a weakly and short-lived race.

Some people have the notion that white cheeks in girls are more genteel than brown ones, and so girls are kept in the house much of the time or are made to wear gloves and veils when out in the sun. This is very wrong. But, of course, too much sunlight in very hot weather is not good for a person any more than too much salt or too much food.

Too much heat in summer may cause us to get heatstroke, or sunstroke as it is often called; but, apart from meeting with an accident like heatstroke in the summer, there is not much danger of sunlight doing us any harm. Heatstroke, indeed, often comes upon people who are not exposed to the sun's rays at all. Not only does moderate sunlight do us no harm; it is something which we cannot do without, because it is needed for growing the little red discs which give redness to the blood and redness to the skin and flesh.

There is one other important thing about direct sunlight which you should bear in mind.

FIGURE 5.—Sunlight kills germs. This plate had germs growing on its surface. A piece of cardboard, with the word "Sunlight" cut out of it, was then placed over the plate and the whole exposed to sunlight for half-an-hour. At the end of this time, all the germs were dead on which the sun shone.

In warm weather it kills the invisible seeds of disease which you will read about further on. As a rule, disease germs live and flourish in darkness or in shade. Knowing this, you will see how necessary it is that sunlight should, if possible, be let into every corner of our dwelling houses. The windows in cellars should be large, as well as the windows in our living rooms, and neither of them should be screened all the time so as to keep out the sunlight.

Into the living rooms and bedrooms, sunlight should be allowed to stream freely. The curtains and carpets will, of course, become faded, but that is a small matter compared with the health of a household. Heavy curtains and carpets harbour dust and disease germs, and are therefore unhealthful. Our living rooms would be decidedly better without them, and in no case should their care be made an excuse for excluding sunlight.

Not only should bedding be thoroughly aired every day but it should be exposed to direct sunshine as well. Our houses should as far as possible face the south, and the windows should be large so as to admit plenty of sunlight. It has often been noted in recent years that many more deaths from consumption occur in shady rooms in tenement houses than in sunlit ones. Houses which are shaded by trees, and rooms which get no sunlight, are the ones which we should avoid if we go to live in a city.

QUESTIONS.

1. What does tanning the skin mean?

2. The red colour of the blood is due to an immense number of little red discs which float in the liquid part of the blood. How can the number of these discs be decreased? How increased?

3. How many windows are there in your schoolroom? Ask your teacher if they are large enough to let in all the sunlight that

is necessary for health. Should the window blinds be kept down when the children are not in the school? Why not?

4. If sunlight is a good thing for children, should window panes be frosted in a school or home?

5. Why should bedding be put out in the sun every day? What is the effect of sunshine on disease germs?

CHAPTER III.

FRESH AIR.

Did you ever go into a house, a school, or a work-room, and find it stuffy? If you passed from one stuffy room to another you would, of course, not notice any difference; but if you passed from the fresh air and sunlight outside into a stuffy bedroom or school-house, you could hardly fail to notice the difference. You would soon say to yourself, "What an ill-smelling room!" And yet, stuffy rooms are exactly the rooms in which many people sleep at night and in which they work all day, because they are careless or do not know any better.

Some people have never learned that if they live in close rooms all day and sleep in stuffy bedrooms all night, they are starving their bodies.

For we may starve our bodies in other ways than by not taking enough food. Our bodies need something besides what we eat and drink. They need something which we get from the air, and which we cannot get anywhere else.

The need for this something in the air is very pressing. You can prove this yourselves by closing your mouths tightly and holding your nostrils firmly together How long can you keep from breathing? Perhaps for a minute or two. Sooner or later, however, do what you will, you are forced to breathe again. The flesh and blood cry out for that part of the air which we call oxygen.

If you went into a closet or a box, and closed it so that no air could pass into, or out of the box, you would learn, in another way, how strongly the blood and flesh crave oxygen. For a little while you would feel quite comfortable, but, as soon as the oxygen in the box became scanty through your using it up in breathing, you would begin to pant And if you did not open the box and let in some fresh air, you would soon die.

How large a room, then, should we live in, in order not to suffer from lack of air? The answer to this question will depend upon a number of things. If no fresh air could get into it, we should die in a large room just the same as if we were in a box or small closet, only we should live a much longer time. But if air is made to pass freely into and out of a room or a box, then we could live in either one until we died of hunger or thirst. What we *must* have is a constant supply of fresh air; and, if we have this, it does not matter much whether we live in a small room or a large one.

Of course, if a number of people sleep in a small room or work in a small room, you can easily see that they would use up the oxygen of the air much more quickly than if there were only a few people present. The air in such a room would need to be changed often; for, if not, the health of those in it would suffer.

At first you would notice very little change, if any. But in course of time it would be seen that overcrowding in even a large room makes the inmates pale and delicate. They would not have good rich blood, nor would they be able to digest their food properly; they would grow weak and be likely to catch some disease and die. So, overcrowding is bad for the health—overcrowding in bedrooms or overcrowding in schoolrooms or churches or factories or workshops.

There should be so much fresh air for everyone in a room that it would never be stuffy. If there are many people in a room each cannot get enough oxygen from the air, unless it is changed very often.

You will see, then, that the answer to the question, "How large a room should we live in?" depends upon two things. It depends upon how many people are in the room and upon how often the air is changed.

It may help you to understand how the air in a room may be changed, if you will perform the following experiment:

Provide two lamp chimneys and a tightly covered tin box—one that has held tea or starch will do very well. Make a hole about an inch in diameter near one end of the cover and over this hole place one of the chimneys, sealing it down with wax.

At the opposite side of the cover, punch a circle of small holes round a candle. Light the candle and bring the second chimney down over it. Fasten this chimney also to the box with wax, so that no air may pass into the box round the bottom of the chimney. Now watch what happens.

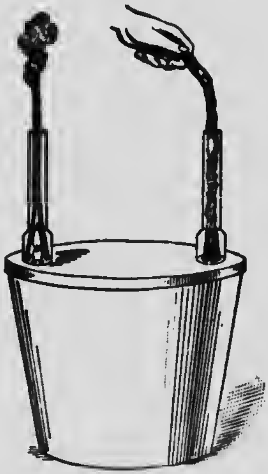


FIGURE 6.—Chimney over a burning candle on a box.

If you have arranged the apparatus properly, fresh air will pass into the box by one chimney, and foul air from the candle will go out by the other. In other words, the box will be ventilated. A piece of smoking paper over one chimney will show the direction of the air currents.

A small living room with a large family in it or a small schoolroom with many children in it, should be ventilated in somewhat the same way.

Changing the stuffy air in a room for pure air is called ventilating the room. You might suppose that it would be an easy matter to do this, but it is not.

The chief thing is to draw fresh air into our houses and get the stuffy air out. How can we do this? In warm summer weather it is easily done. We have simply to keep our windows and doors open all the time; and, if we do, there will not be much trouble about getting plenty of oxygen for the blood. But in cold weather, it is a great deal harder to regulate. While we may feel the need of fresh air, we dislike cold air, and therefore, in winter, we close up the chinks about the doors and windows in order to keep the cold air out. But even in winter, ventilation is easy, if we have plenty of fuel to burn.

And now, a word or two about breathing. It is quite true that ordinary breathing is so natural a thing that it requires no teaching and no practice. But correct breathing is another matter. Of course you know that we should always breathe through the nose. But many of you do not know why, after we have been sitting quiet for a long time, it is a good thing to take a few quick, long breaths. This rapid breathing draws more blood into the heart, and makes the heart drive the blood more quickly all over the body, especially to the brain. After boys and girls have been studying hard for, say, half-an-hour, some breathing exercises have a first-rate effect. They rest one set of muscles and bring another set into play. They freshen up the brain, brighten the mind, and make study easier. This is why your teacher every now and again stops lessons, lets in some fresh air, and spends some time in giving you breathing exercises.

QUESTIONS.

1. How can you tell that a room requires to be ventilated? What effect will stuffy air have upon people who breathe it?

2. If a room has only one window, is one opening enough to ventilate the room, or should there be at least two openings? Why?

3. How is the lamp chimney of a common coal-oil lamp ventilated? How is the same chimney ventilated, when it has a

tightly fitting cork inserted in the bottom with a candle burning on it?

4. What caused the current of air into the box through the lamp chimney?

CHAPTER IV.

VENTILATION.

The ventilation of our homes and school-houses depends chiefly upon two things, namely, upon keeping the rooms clean and upon having enough fuel.

For rooms are often musty and ill-smelling because they are not clean; and when they are not scrubbed and swept and dusted no amount of fresh air will make them smell sweet. But, if rooms are kept clean and there is plenty of fuel, there need be little trouble about ventilation.

Some of you will want to know what coal and wood have to do with the ventilation of a room. Well, they have a great deal to do with it. If you have followed me in what I have been saying, you will see that in ventilating any room in winter, the stuffy air must be let out, and the fresh air drawn in from the outside.

Often, however, this fresh air is very cold, and it must be warmed by a stove or furnace, otherwise people in the room will be very uncomfortable, and will likely catch cold and become ill. Now this warming of the fresh air costs money. It costs just the price of the wood or coal which must be burnt in order to heat the cold air and bring it up to the temperature of the living room; that is, about 67° F. as marked on your school thermometer. During cold or chilly weather ventilation costs a good deal of money; for the oftener you change the stuffy air for fresh, warmed air, the more money it costs to heat the house.

The extra expense for fuel is one reason why the houses of many poor people are so badly ventilated. They close up every chink around doors and windows, they bank the house with manure or earth, and take great pains "to keep the cold out," forgetting that they are also keeping the pure air out and the impure air in, and that this impure air is all the time becoming more and more unfit to breathe.

To make matters worse, there may be a man in the house who smokes tobacco, and so the air is poisoned still more, for tobacco smoke *is* injurious especially to young children. Add to this the further fact, that the odour of burnt food is frequently spread throughout the living room, and you can easily understand that the air in such homes is as foul and ill-smelling as it can well be. No wonder the death rate is high among people who live in such homes.

To show you how heavily disease and death press upon people who live in such ill-ventilated or very small houses, or who live crowded together in very big houses, just the same as if they were in small houses let me quote some figures from a paper by Dr. J. B. Russell, of Glasgow, Scotland, on the subject of overcrowding:

Size of House.	Number of people living in these houses.	Deaths per year.	Percentage of population.	Percentage of deaths.
One room	134,728	3,636	24.7	27.0
Two rooms	243,691	6,325	44.7	47.0
Three rooms . . .	86,956	1,747	16.0	13.0
Four rooms	32,742	581	6.1	4.3
Five rooms and up /ard	38,647	434	7.1	3.3
Public Institutions .	6,531	427	1.4	3.2
Untraced		289		2.2
Whole city population	543,295	13,439	100	100

From this table you can easily see that the death rate is very high among people who live crowded together in homes of one or two rooms. Bad air is one of the causes of this high death rate.

While overcrowding is not nearly so common in this country as in Britain, nevertheless there are many homes in America in which the ventilation is very bad. Many women among us pass much of the daytime in two rooms — the kitchen and the living room.

Now, the air in these two rooms can be made fairly healthful by careful attention to ventilation. If the living room has a fireplace with a fire burning in it, as would be the case in winter, most of the stuffy air will pass up the chimney, and fresh air will be drawn in through the chinks between the windows and window frames, and between the doors and door frames. So the inmates will be kept warm and the room will be fairly well ventilated.

How about the ventilation at night? With only one or two people sleeping in a small bedroom, even if there is a fireplace in it, the air in the room will be very stuffy before morning, and the inmates will awake feeling

FIGURE 7.—An open fireplace is a splendid means of ventilating a room.

dull and tired, and perhaps cross and with a headache. To avoid these bad effects, thoughtful people always sleep with the windows of their bedrooms open. If there are plenty of bed-clothes, open windows can do no harm and the fresh air will do us a great deal of good. We shall wake up feeling bright, fresh, and rested.

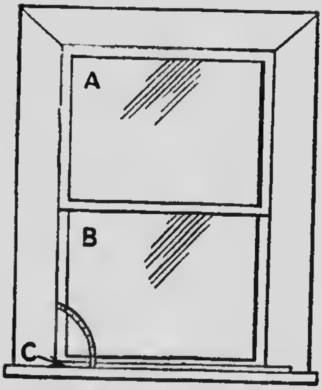
In a schoolroom, again, especially in all old school-houses, it often happens that no pains have been taken by the trustees to plan the rooms so that they can be properly ventilated. In modern school buildings, ventilating appliances are used to pump fresh air into the rooms or to suck the bad air out. But, in old fashioned buildings, other means must be used.

In all school-houses which are warmed with stoves, the window sashes should be arranged so that the upper one can be lowered from the top, and the lower one raised from the bottom. When the windows are arranged in this way, rooms can, with a little care, be fairly well ventilated. For most of the warm, stuffy air will pass out at the upper opening, and fresh air will come in at the bottom. The chief drawback to this mode of ventilation is that the pupils who sit opposite to the windows will be in a draught, and a draught is not good for anyone, especially in winter. For this reason it is better to open windows upon the sheltered side of the building, not upon the windy side.

A cold draught is air moving quickly and usually through a chink, striking on the body and cooling it. The colder the draught, the worse it is for you. If it strike your neck or uncovered head, it is likely to give you a cold, and it may perhaps make you very ill.

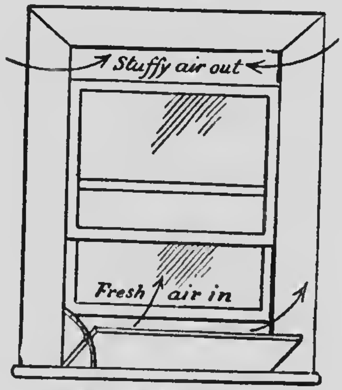
Now this draught can be largely avoided by fixing a board at the bottom of the window in a slanting direction, so that the cold air which comes in is thrown upwards into the room and over the heads of the pupils. The board should be about six inches wide, and as long as the width of the window. It should be fixed in the manner indicated in the accompanying diagram.

No. 8



Window sashes both closed.

No. 8a



The upper sash lowered; the lower sash raised.

A, Upper sash; B, Lower sash; C, Slanting board, arranged so that it can be adjusted.

The teacher should never open the windows and allow a draught to strike anyone. If the upper sash cannot be lowered, he should stop the lessons for a little, throw the door and windows wide open, and allow the children to move about in the room, so that no child will be sitting in a draught. This could not be safely done in very cold weather, for example, when your school thermometer marks 0° F. outside.

When the air has been made fresh and sweet, the doors and windows may be closed and the lessons begun again. This should be done about every half-hour. A little warm air will be lost and a little more fuel will be burnt, but the extra cost of ventilation will be repaid a hundred-fold in the better health of the pupils and the better work done by them.

QUESTIONS.

1. How is the bad air let out and fresh air let into your schoolroom during school hours?

2. When the weather is cold, open the door about an inch. Place a candle flame first at the top of the door, and then at the bottom. Can you now tell where fresh air is coming into the room and where the stuffy air is passing out?

3. How is your bedroom ventilated at night? How is the air in the living room of a small house sometimes rendered unfit for breathing?

4. How may a schoolroom or bedroom be ventilated so that no one may be sitting or lying in a draught?

CHAPTER V.

IMPURITIES IN AIR.

FIGURE 9.—Sunbeam in a cellar, showing dust particles.

Who has not watched a sunbeam lighting up the dust particles which often float in the air of a room?

Where does this dust come from? Where does it go to? Is it always in the air? You find it lying on your desks and seats any morning the caretaker has neglected to wipe it off.

What is it made of? Some of it, you tell me, comes from the streets and roads, and is, therefore, nothing more than finely powdered earth or stones. But did you ever consider whether a few of the particles might not be the seeds of tiny plants? If so, should they not grow when placed upon suitable soil?

Let us test this idea by watching some soup or broth "go bad."

"What has soup to do with pure air?" you ask. And in reply I say, "Wait and see."

First, strain the soup through perfectly clean, well boiled linen, so that you have nothing but the clear liquid. Now take two bottles or flasks, like those shown in figure 10, and pour a little of the liquid soup into each flask. One flask is open. The other is corked and has a bent glass tube running through the cork as shown in the figure.

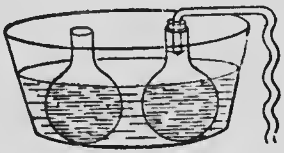


FIGURE 10.—Two flasks in a pot of boiling water.

Place both flasks or bottles in an open kettle in which cold water stands as high as the soup stands in the flasks. Put the kettle on a hot stove, and keep the water boiling in it for an hour. Of course the soup will boil also.

At the end of the hour, allow the water to cool; then remove both flasks from the kettle and leave them standing in the kitchen, or dining-room for a few days. Examine the surface of the soup each day, but do not shake the flasks. Notice whether a scum forms on the surface of the soup in both flasks about the same time. If not, on which does the scum form first—the open flask, or the corked one? Does the soup turn sour?

If you have performed this experiment carefully—and you can easily do it on a kitchen stove—you will find that the soup in the open flask has gone bad in a few days, whereas that in the corked flask has remained clear and unchanged, and in fact, is as good after a week or ten days as it was when first removed from the kettle. What has made the difference?

If you have a microscope in your school and will use it in examining the contents of the two flasks, you will find that the soup which has gone bad is teeming with thousands of tiny creatures, all moving about with a quick trembling movement. Where did they come from? You will find none of these creatures in the corked flask.

Fifty years ago the facts of which I have been speaking were just as well known as they are to-day; but at that time even the most learned men in Europe did not know how these tiny creatures got into the soup. Of course, if the experiment is not carefully performed, the soup in both flasks will go bad. Moreover, if the soup is not boiled for a long time, it is sure to go bad. This makes the matter all the harder to understand.

Among the many men who studied soups in this way, was a very celebrated Frenchman, named Louis Pasteur. His early experiments on this subject were made on a common stove. He was led to begin them by observing that beet-root sugar, in fermenting and forming alcohol, sometimes goes bad and produces sour alcohol. He had observed also that milk exposed to the air in warm weather, turns sour.

As a result of his experiments and observations on wine and milk, he came to the conclusion that the air contains the germs or seeds of tiny plants and animals, and that, whenever these fall into vegetable or meat soups, they start to grow, and they give rise to immense numbers of very small creatures.

Pasteur stood alone in this opinion. Up to about 1860, almost every scientific man in Europe believed that when animal or vegetable matter began to decay, the very act of decay gave rise to the tiny creatures which Pasteur found in soup. New life, they thought, arose out of decaying matter.

Before Pasteur could expect anyone to believe in the existence of these germs in the air, he had to prove that they could be obtained from it. He did this, in a way so simple that you can easily use the apparatus which is figured on this page, and get the same results as he did.

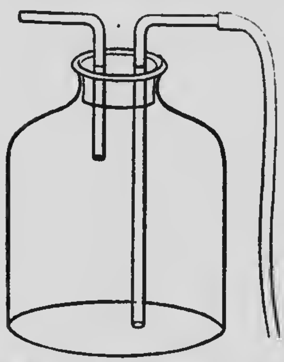


FIGURE 11.—Wide-mouthed bottle corked and with two glass tubes in the cork, one short and one long.

Take a wide-mouthed bottle which will hold, if possible, a gallon or two of water. Fit it with an air-tight cork having two holes in it. Into one of these holes fit a short glass tube, and into the other a long glass tube which will reach to the bottom of the bottle. To the outside of the latter attach a rubber tube so as to form a syphon. The outer end of the shorter tube should be tightly plugged with white cotton batting.

Fill the bottle full of water, insert the cork tightly, and start the syphon running. It is easy to do this by placing the bottle on a table, and then sucking the air out of the rubber tube with the mouth, being careful to keep the end of the rubber tube below the level of the table.

As the water runs out of the bottle, air will be drawn in through the cotton in the shorter tube, and, if you examine this cotton after you have filled the bottle a number of times with the air of a dusty room, you will see that the cotton has become slightly dark in colour. Of course in a dusty atmosphere, the cotton will darken much sooner than in a fairly pure atmosphere.

That the cotton contains germs you can easily prove, as Pasteur did, by dropping a small bit of it into boiled soup, and watching the soup go bad.

Pasteur performed experiments like these over and over again—even hundreds of times, and at length proved beyond any question that animal or vegetable soups will not go bad, if placed out of the reach of atmospheric dust. One of his flasks he kept for four years without its undergoing any change.

Having proved that the air contains the germs of animal and plant life, Pasteur's next step was to prove that these germs vary in number in different parts of the country.

In order to do this, he used a flask like the one which is shown in the figure on this page.

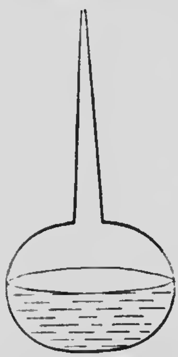


FIGURE 12.—A Pasteur's Flask sealed up with soup in it.

You see it has a long pointed neck. When testing the purity of the air he partly filled one of these flasks with soup, and then boiled it for an hour, thus driving out the air, and killing all the germs in the soup. At the end of the boiling, he melted the glass at the pointed end so as to seal up the flask perfectly and prevent all air from getting into it. Then he quickly removed the flask from the flame and allowed it to cool.

On one of his holiday trips from Paris, he carried a large number of these sealed flasks with him. The opening of these was done with great care. To avoid the little currents of air about his body, he usually lifted each flask above his head, and, with a pair of pincers, broke off the tip of the neck just below where it was sealed. As he did this, the air above his head rushed into the flask and filled it. The flask was then carefully lowered and again sealed by melting the glass.

In this way he got into his flasks a fair sample of the air of different localities with whatever dust and germs it might contain. The flasks were then set aside in a warm place, and watched to see which ones would undergo change through the growth of germs which had entered them with the air. Of the twenty-three flasks which he opened to the air on the road to his old home at Arbois, only eight went bad; whereas, when twenty similar flasks were opened in his laboratory y. .n Paris, they nearly all went bad.

On Mount Poupet, which is about 2,800 feet high, he opened twenty more flasks to the air; and of these only five went bad. Not satisfied yet, he ascended Mount Blanc and opened twenty more flasks to the mountain air. Of these only one went bad.

These experiments of Pasteur's shew us where we may expect to find the purest air. The purest air will be found on a mountain top; less pure air on a hill top, less pure air still, in a level farming district, and least of all in cities and towns.

We act upon these conclusions of Pasteur's to-day, when we wish to avail ourselves of the so-called "fresh air treatment" for the cure of certain diseases. Consumptives are often sent to woodland areas upon hills or mountains, where they pass as much of their time as possible out in the sunshine and open air. Such air is fairly free from germs and dust particles, and such air, together with good nourishing foods, mild exercise, and the oversight of a good doctor will often restore consumptive people to robust health when nothing else will.

The invisible germs of plant and animal life which Pasteur discovered in the air are often called microbes. Fortunately only a very few of them cause disease; many are harmless and some are even useful. Moreover Pasteur has taught us two things about them: first, that they are found not only in air, but on everything about us; and secondly, that boiling water will kill them.

QUESTIONS.

1. How did Pasteur prove that air in different places contains different numbers of microbes, or germs?

2. Judging from the dust and odour of your schoolroom, would you expect that there would be few, or many germs in it?

3. What can be done to lessen the number of germs on the floors and walls of your schoolroom? In the air of your schoolroom?

4. How can microbes be killed?

CHAPTER VI.

TOBACCO SMOKE IN AIR.

FIGURE 13.—A man smoking in a kitchen with his wife and children.

What other things are in air besides dust and germs?

You will tell me that there are the invisible gases of impure air as it comes from the lungs in breathing. Yes, and in our houses, especially in winter, there is the odour of food cooking on the kitchen stove. This odour is not so bad for the health, as the smoke from burning food. When, instead of being properly cooked, food is burnt on the top of a hot stove, or, in an oven, then the smoke which fills the kitchen renders the air impure and unfit for breathing.

Can you think of anything else which spoils the air in our houses, especially in the winter evenings? None of you can.

Well, I am not surprised, because we are so accustomed to this further way of spoiling the air, that we are apt to overlook it altogether. I mean, spoiling the air with tobacco smoke.

Many people do not think of tobacco smoke as a cause of the air being bad. And yet it is. They will say that dust and disease germs and the odours of decaying meat and vegetables, and sewer gas and bad drains and musty rooms and a host of other things will all spoil the air; but they will hesitate to say that tobacco smoke is as bad as some of the other things named above.

Many girls and women will say, "Why, our fathers and brothers have smoked ever since they were boys, and it does not appear to have done them much harm." This is no doubt very true. Millions of men have smoked tobacco ever since the time when Sir Walter Raleigh is said to have carried the weed over to England; but it is nevertheless true that the habit of smoking tobacco is bad for all young people. What is more to our purpose just now is that you young people should know that tobacco smoke pollutes the air and sometimes causes delicate people and very young children to become ill.

Most doctors, if their opinion were asked, would agree in saying that infants and delicate children cannot grow up into sturdy, robust boys or girls, if they have to live much in air that is poisoned with tobacco smoke.

The tobacco smoke would first enter the lungs and would then affect the blood, and through the blood it would injure the nerves and the health of the child. Some medical men doubt whether this is true; but every thoughtful and careful doctor knows that tobacco smoke in the living rooms of houses cannot but spoil the air especially in winter, when people spend much of their time indoors.

It is bad enough to breathe air that has already been once in the lungs of some other person; it is doubly bad to have to breathe it when it has been rendered still more impure with tobacco smoke.

For, just consider where the smoke comes from. It first passes from a cigar or cigarette or pipe, into the mouth of the smoker, and from the smoker's mouth it passes into the air. Now, no cleanly person should breathe this air; and no reasonable or thoughtful smoker should inflict such polluted air upon other people.

In a few years many of you young people will be the heads of houses of your own. It will make a tremendous difference to your health, comfort, and happiness whether you live in clean, well-ventilated homes, or in musty, ill-smelling ones. Now one of the first rules of health is to breathe pure fresh air. But how can you breathe pure air in your homes if the living rooms are befogged and poisoned with tobacco smoke. "Oh," you say, "we can open the windows and let out all the smoke." You may try to do so, but you cannot. Ventilation will give you fresh air, but it will not immediately remove the odour of tobacco smoke from carpets, curtains, and furniture.

The fact is that once the smoking habit has been formed, a smoker becomes a somewhat selfish man. Either he does not know that he is spoiling the air for his family, or, if he knows, he may not be unselfish enough to give up his pipe for the benefit of those whom it is his duty to care for.

In summer he can sit outside, and then his smoking will do less harm; but in winter, if he smokes in the living room, he certainly shows little regard for the well-being of his wife and children. Of course, if a man is wealthy, he can have a smoking room all to himself. If he has such a room, it should be the best ventilated one in the house, and if he is a wise parent, he will take good care not to allow any of his young children to remain in this room, while he or his guests are smoking.

Later on in our studies we shall see that there are other reasons why you lads should not learn to smoke; but just now my chief concern is that you should count tobacco smoking as one of the means of spoiling fresh air, which it undoubtedly is.

Let me now sum up very briefly the different ways in which the air of our houses, schools, shops and factories may become spoilt.

In the first place, it is spoilt when it has been breathed once; in the second place it is spoilt by dust or floating specks of matter; and lastly it is spoilt by tobacco smoke.

If you care, therefore, for your own health or for the health of others, you will avoid breathing stuffy, dusty and ill-smelling air yourself, and you will do everything in your power to guard others from breathing such air.

QUESTIONS.

1. In what different ways may pure air be made impure?

2. Why do railroad and steamboat companies provide smoking rooms for passengers?

3. Use Pasteur's apparatus (shown in Chapter V.) for smoking a cigarette. In order to do this, light the cigarette and place it in the short tube, in place of the cotton wool. Then start the water running. The smoke will now collect in the glass bottle, and if you remove the cork and place a frog in the tobacco smoke, you will soon see how it affects the animal.. Does it recover when removed from the bottle?

CHAPTER VII.

CARE OF THE HAIR.

How shall we explain the fact that changes in the colour and thickness of hair occur at such different times in different men? In one man it undergoes a rapid change in colour early in life, no matter how much care he may give it; in another man it remains thick and unchanged up to old age, even when no special care has been given to it.

The only explanation for these differences is that a man or woman inherits them from parents or near relatives. A father or mother whose hair has turned gray early in life, will often have sons or daughters or else grandsons or granddaughters whose hair will turn gray early. And the same thing is true of baldness. A young man of thirty who finds his hair falling out and knows that his father's hair also fell out at about the same age, need look no further for an explanation of his baldness. Of course, I am not now speaking of persons whose hair has fallen out as a result of disease.

These defects, however, should not discourage anyone from taking the best possible care of the hair. A great matter in caring for health is to learn all we can about the weaknesses of our bodies. For, just as we resemble our parents or grandparents in features, walk or gesture, so we may be sure that we inherit from these relatives some defects of body or mind or both, which possibly we learn about, only when we have arrived at manhood or womanhood.

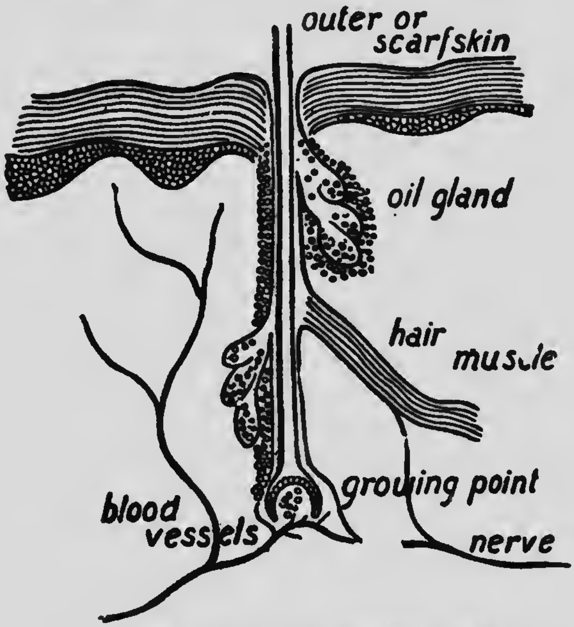


FIGURE 14.—Hair, its nerve, oil gland and blood supply.

A young man, if wise, will try to discover his inherited defects as soon as possible, and will thenceforward so order his daily life as to preserve his health and strength as long as possible. So, even if a man is descended from a gray-haired or bald-headed family, he should still take care of his hair.

In caring for the hair, three things must be kept in mind, the oil gland, the blood supply, and the nerve supply. The natural oil of the hair, which comes out from the oil gland at the side of each hair, catches some of the dust particles which are always present in air, and therefore the hair soon becomes dirty.

Hence the first rule for the care of the hair is to wash it. This should be done about once a week, with luke-warm water and castile soap. The frequency will depend upon the amount of natural oil on the hair, and upon whether one lives much in a dusty or in a pure atmosphere.

The best time for the washing is just before going to bed, so as to reduce the risk of catching cold. The hair should be thoroughly dried; if not, the drying up of the water takes heat from the head, cools it too much, and a cold is the result. For this reason, it is wise in winter after washing to sleep with a handkerchief or light towel round the head.

Another good rule is to comb and brush the hair three or four times a day. This removes from the scalp the white scales known as dandruff, and the friction reddens the skin and brings more blood to the roots of the hair.

FIGURE 15.—Brushing the Hair.

Brisk, hard rubbing with the fingers (massage) will also increase the flow of blood to the scalp.

What is the good of getting more blood to go to the hair? Just this. The great work of the blood, in every part of the body, is to carry in nourishment and to carry away dead waste. Whatever, therefore, will make the blood go more quickly to the hair must be good for the hair, because it will thus get more nourishment; the oil glands will do their work better, the nerve threads will do their work better, and the hair will be stronger and healthier, and will not turn gray so soon nor fall out so early.

FIGURE 16.—Massaging the Scalp.

Of course, combs and brushes should be kept thoroughly clean, otherwise there would be no use in washing the hair. Surely, I need not say that the combs and brushes in public washrooms should not be used. Nor should I have to add that no one should go to a barber's shop in which unclean combs, scissors, brushes, or razors are used.

I know a man who was a stranger in a city, and who wished to have his hair cut. He went into the first barber shop he came to. A short time afterwards, he was amazed to find his scalp itchy and very uncomfortable, and upon consulting a doctor, he was told that he had caught the horrible disease called barber's itch. The tiny disease germs had begun to grow about the roots of his hair. Luckily for him, however, he soon had them killed, or they would have caused the loss of much of his hair with a great deal of discomfort besides.

Is it worth while to give you girls advice about curling your hair with hot tongs? The heat kills the hair, and dead hair tends to fall out. If you must curl your hair, use soft silk rags with which to do it, but don't pull on the hair, or you will hurt the root and make the hair fall out. Sheet lead and hard paper are almost as bad as curling tongs. Pulling on the hair in combing out the tangles is another cause of hair falling out.

A word of advice to boys. Don't wear tight-fitting, hard, and heavy hats or caps. These lessen the flow of blood to the hair, with the result that the hair loses some of the nourishment it needs, and the dead waste at the root is not carried away as it ought to be. The growing point is suffocated, and, in the end, the hair dies and falls out.

Hats and caps should be light, and should have small openings in the top to admit air. A woman's head-gear is generally lighter than a man's, and, for this reason she is not so often bald as a man. Delicate people may have to wear somewhat heavy hats and caps, but healthy people should never do so.

It sometimes happens that the beauty of a face is spoilt by an extra growth of hair. Such hair can be removed by the use of a fine needle and a current of electricity. The hairs must be removed one by one. The process is a very slow one if there are many hairs to remove; but an expert surgeon will, in time, take out every extra hair.

QUESTIONS.

1. What are the advantages of keeping the hair short, especially in young children? What is the advantage of brushing the hair? Of massaging the hair?

2. What diseases of the scalp are frequently caught in school? [Insects (lice) are best killed by an application of coal-oil to the scalp. Or, a carbolic acid lotion of 1 part acid to 20 parts of warm water may be used.]

3. In trying to get rid of barber's itch, will it be necessary to change the cap which the person usually wears, or at least to change the lining? If a child with this disease should change the peg on which his cap was hung at school, or at home, what would likely be the effect upon other children using this peg?

CHAPTER VIII.

CARE OF THE SKIN AND NAILS.

You may have noticed when you have cut or broken the skin on your finger that the cut sometimes heals quickly. Sometimes though, it takes long to heal, becoming red and sore and festering. This is because some of the invisible germs in the air have got into the wound and have started to grow. In their growth, they destroy some of the tender flesh, and make the cut hot and painful. Then the doctor has to wash the wound out with great care, and cover it afterwards, and try to prevent any more growth of these invisible plants.

The doctor, in fact, does exactly the same thing as a careful gardener does when a tree gets its bark cut or broken. The gardener has learned that a tree often begins to rot when part of its bark or wood has been removed. So he covers the cut with paint. This prevents the invisible germs from alighting upon the wound and beginning to grow on the moist wood. It is now well known that decay in a tree nearly always begins where microbes start to grow.

FIGURE 17.—Lower part of the trunk of an oak tree showing a rotten part near the ground which is slowly healing. Also the stump of a limb that has been cut off and is healing.

Again, the decay of fruit is caused by the growth of invisible germs, and, therefore, when a rotten apple or orange is packed among sound ones, decay soon spreads to the sound fruit. In order to prevent the decay from spreading, some packers of apples and oranges are careful to wrap up each one in paper.

From what has been said about the skin and about trees and fruits, you learn that the first thing to be done in the case of cuts or wounds of the skin, is to see that they are washed clean with soap and well-boiled water. They should then be covered with a clean cotton or linen cloth to prevent disease germs from getting into the wound and perhaps into the blood, and thus causing blood-poisoning.

For the same reason, pimples or boils should never be pricked with a pin or opened with a common pen-knife. A needle or sharp knife-blade may be made quite safe for opening a boil or abscess, by boiling it in water for ten minutes. Or, a needle may be heated red-hot in a fire and then cooled, after which it is safe to use. In both cases the heat kills any invisible germs that may cling to the needle or knife, and that might otherwise get into the pimple or abscess and cause blood-poisoning and perhaps death.

Next to caring for cuts, bruises, or pimples on the skin, comes the very important question of how we shall treat the skin so that it shall always be able to do its work well. All I shall say about the matter now is that we must bathe the skin daily and change our underclothing at least weekly. In the next chapter, you will be told how bathing should be done.

Every child should know that the skin consists of two layers, an outer one, called the scarf-skin, which has no feeling in it, and an inner one, the true skin, which contains blood and nerves, and which hurts us very much when it is cut or deeply pricked.

When you study the nails closely, you slowly come to see that they are nothing more than thickened scarf-skin. Like the scarf-skin, the nails have no blood vessels in them and no nerves. They neither bleed nor pain us when we cut them. As they keep growing all the time and do not rub off in small flakes as the skin does, they must be cut from time to time in order to prevent them from becoming too long.

It is the true skin at the root of the nail which makes the nail grow out towards the tip all the time, just as it is the true skin underneath which gives rise to the outer or scarf-skin.

What is the use of the nails? You will tell me at once that they protect the soft flesh at the ends of the fingers and toes. So they do, and in addition, the finger-nails help in picking up or in handling very small objects.

Should the nails be cared for as the skin is or may we neglect them without any danger to ourselves or to others? The answer to this question will depend upon our calling in life. If a man is a surgeon and has to perform a surgical operation upon one of his patients, then the life of his patient may depend upon whether the doctor keeps his nails clean or not.

If disease germs from any source happen to enter the wound which the surgeon makes, then the patient may lose his life. Fortunately, all well-trained surgeons know this very well, and there are no men in the world who keep their clothing and their hands and nails so clean as careful surgeons. Nor is there any room in the world so clean as the one in a hospital in which a careful surgeon operates.

The habit of biting the nails is not merely a dirty habit, it is a dangerous one as well, because people who bite their nails run the risk of swallowing some of the many microbes that are mingled with the dirt under the nails. You must not think that many people have caught diseases from biting their nails. Excepting in the case of careless nurses, dentists, or surgeons, it is very likely true that very few diseases have been spread in this way. But, apart from any danger of this kind, it is fitting that we should keep the nails clean, because well-kept finger-nails are pleasing to look at. Dirty nails are abominable.

Nails that have been bitten off for years so that the fingers are stubby, and the flesh rolled over the tip of each nail, are even more abominable. Most of you have no doubt seen such finger-nails and have noticed that their owner is ashamed of them. Grown up people who have bitten their finger-nails for years, will often keep their ugly finger tips out of sight.

How are finger-nails to be kept clean? The only articles needed are a nail-brush, a nail-cleaner, and a file. The two latter are often combined in one piece. The brush should be

FIGURE 18.—Hand with Bitten Nails.

FIGURE 19.—Well-kept Finger Nails.

used with soap and water until the dirt becomes quite soft. It can then be removed without any trouble by means of the nail-cleaner. It is a mistake to use a pen-knife to remove dirt, unless the blade is rather dull, because a sharp blade cuts or scratches the under surface of the nail, and later on the dirt clings to these scratches, and it then becomes a difficult matter to remove it.

When the nails have grown too long, they should be cut with a pair of sharp scissors—not with a pen-knife. Their shape should be rounded like the end of the finger, not square, nor pointed. After cutting, they should be made smooth with the file.

Toe-nails should be cut straight across. This prevents them from growing into the flesh at the corners, as they do sometimes, especially if they are pressed upon by tight shoes.

QUESTIONS.

1. Explain how some cuts, or deep scratches are slow in healing. How do wounds heal on trees? Do wounds ever cause decay of the wood? How is this prevented?

2. How is blood-poisoning sometimes caused in surgical operations? Can you suggest a reason why it may be more dangerous to perform a surgical operation in a private house than in a hospital.

3. What are the uses of finger-nails? Why should they be kept clean? How should they be cut? How shaped?

CHAPTER IX.

BATHING.

You will be surprised to learn that in the days of the Roman Emperors, Rome had splendid public and private baths. In still earlier times, the Romans used to bathe in the Tiber after taking exercise; but when ample public supplies of water had been brought to the city, large public swimming baths, and at a still later date, small public and private ones, came into general use. But, as stated above, it was in the days of the Emperors that the public baths came to be structures of great splendour. "To such a pitch of luxury have we reached," says Seneca, a Roman writer, "that we are dissatisfied if we do not tread on gems in our baths."

FIGURE 20.—Three forms of scrapers used by the Romans in taking off the scarf-skin. Also a small flask of oil for anointing the skin.

The baths of many wealthy Romans were very costly structures. Swimming baths, warm baths, hot-air baths, and vapour baths were all in common use. As they had no true soaps, they used a scraper of curved metal with which to remove the scarf-skin from the body.

I mention these things in order that you may understand how high a value educated Romans placed upon cleanliness of the skin. They seem to have learned much better than we have that a person, unless very strong, cannot remain long in good health if he does not keep his skin clean.

You will understand the reason of this, when I tell you that from one to four pints of sweat come out on the skin every twenty-four hours. You must remember also that the skin is growing from beneath towards the surface all the time. Sweat is in reality a kind of poison which is gathered up from all over the body. When it dries up, it leaves behind it on the skin, salts and other matters which, along with the scarf-skin, should be removed by the daily bath. A weekly, or even a monthly bath, is all that some people ever take. But weekly baths are not enough, if we wish to keep the skin so clean that it can do its work well.

A clean body, clean clothing, a clean house, a clean yard, clean outbuildings, and a clean village or town are all forms of cleanliness without which individual health and public health are impossible.

Baths are spoken of as hot, when the water is at a temperature of about 100° F. to 108° F.; as warm, when the water is from 96° to 100°; as tepid, when the water is from 86° to 96°; as cool, when between 65° and 80°; and as cold, when from 50° to 65°.


FIGURE 21.—Bath-mitten or glove, a good substitute for a sponge.

And first, as regards cold baths: many middle-aged people say that they cannot stand the effects of a cold bath. This may be true of people who are over middle life; but it is not true of most young people. There is not one strong person in a hundred who will not be benefited by a cold bath. Where there is no bath-room in a house, the sponge bath may be used instead. All that is required for this is a basin, a rough towel and a sponge; and surely there is no house in the land so poor as not to be able to afford these articles.

The truth is that most people dislike the cold, and so do not take a cold bath. It takes a good deal of courage to walk from a warm bed and plunge into water at a temperature of 60° to 65°. But all those who are in the habit of doing this say that they get great benefit from it. It wakes up mind and body better than anything else does.

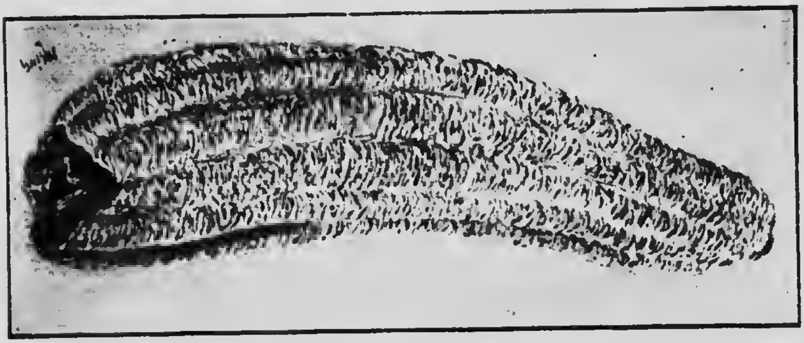


FIGURE 22.—Lufa, a first rate thing for taking off the scarf-skin while bathing.

Soap should be used in taking baths. The cold water alone gives a shock to the body that is good for it; but it is not cleansing. After covering the skin with a lather of soap, the bather should lie in the water and rub the body with a hand-towel, sponge, or lufa He should then dry himself by rubbing vigorously with a coarse towel until his body is all in a pink glow.

One should not remain in a cold bath longer than about half-a-minute. The first effect is to drive the blood away from the skin into the inward parts. After coming out of the water, the brisk rubbing helps to make the blood return to the skin again, and the bather should then feel warm, comfortable, and well.

This warm feeling, following a quick cold bath is the best test of whether a cold bath agrees with us or not. If we feel chilly, and remain so for several hours, we shall do well to use a cool bath instead, or even a tepid one. But most people can take a cold bath daily and be the better for it, if only they will take a little trouble. If cold baths are begun in the warm weather of summer and continued daily into the autumn and winter, they will agree with and benefit all but the very delicate and the aged.

But no cold bath should be taken in a cold bathroom. The room should be comfortably warm.

FIGURE 23.—A large Roman Bath. A bather in the act of entering the water.

Once a week a warm bath should be taken before going to bed. This softens the skin and removes matter which cold water will scarcely remove. Moreover, taking a warm bath at night lessens the chance of catching cold, just as washing the head at night does. In fact, the warm bath once a week and the washing of the scalp can both be done at the same time. The warm bath has a very decided effect upon the bather. For one thing it is found to be soothing, especially to nervous people, and for this reason it tends to promote sleep. It is particularly agreeable after hard bodily labour, and it quickly removes pain in the muscles or soreness of the joints.

The tepid bath is used chiefly for cleansing purposes, and, apart from this, has little or no effect upon the health. When applied to the face and hands in cold weather, tepid or warm water tends to cause chapping and roughening of the skin. For this reason, it is better in winter to wash with cold water.

The hot bath has a very marked effect upon the body, so marked indeed that it should not be taken except under the advice of a physician. It has been found to be of great benefit in treating diseases like neuralgia, rheumatism, gout, and some kinds of heart disease; but no sick person should risk taking baths at temperatures of 102° F. to 108° F., except under the advice of a physician.

To sum up; warm baths are best suited for delicate people, for young children, and for the aged; whereas cold baths are best suited for the active and strong. But regular daily bathing of some kind should be practised by everyone who wishes to take care of his health.

Before closing this chapter, it may be of interest to some of you to know that massaging the face; that is, pinching the skin and kneading the flesh will prevent the on-coming of wrinkles and will help to remove pimples and blotches. The improvement of the complexion by massage is due to the improved circulation of the blood brought about by the massage.

QUESTIONS.

1. How do we know that the Romans placed a high value on bathing? How often should we bathe? Why so often? Why should the under-clothing be kept clean as well as the skin?

2. At what temperatures are baths taken? How are baths at different temperatures described?

3. How often should a warm bath be taken by healthy people? For what purpose? Would it be wise to take a cold bath in a very cold room? Why not?

4. Describe the most convenient method of bathing, for persons who have no bath-rooms or bath-tubs.

CHAPTER X.

THE TEETH.

The part of a tooth which we can see is the *crown*, and the part that is hidden in the jaw is the *root*. Running up into the middle of a tooth from the tip of its root, is a small canal into which and out of which blood passes through small tubes. This blood nourishes the tooth and keeps it alive and well.

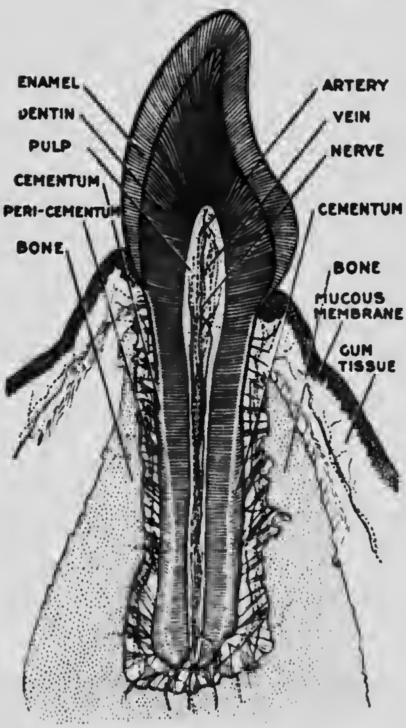


FIGURE 24.—Section of a tooth showing enamel, dentine, cement and pulp cavity.

In addition to the blood tubes, a fine nerve passes up the canal to the pulp cavity in the middle of the tooth. The nerve tells us when anything goes wrong in the inside of the tooth. If the nerve gets very much worried, we say the tooth is aching. But no healthy tooth ever aches. The ache always comes on when a cavity has formed somewhere in a tooth, and when air or small pieces of food have got into the cavity far enough to worry the nerve. If we wish, therefore, to avoid toothache, we should take great care of our teeth.

What makes a tooth decay? There are different causes, of course, but in most cases the decay starts where small particles of food stick to the teeth. If, after a meal, you look into a mirror, and examine your teeth, you will see little bits of food in white patches along the edge of the gum and between the teeth. After every meal these patches of food should be removed in part by a quill toothpick, and the rest should be brushed off.

Because, if we do not keep our teeth clean, some very, very tiny plants begin to grow on these particles of food and start the decay of the teeth. You will think it very strange that plants should grow on the teeth, but they do. If you were to take a microscope and look at some of this white stuff on the teeth, you would find some very small plants which look like little rods.

Of course, these plants are never big enough to be seen with the naked eye.

After what you have read about Pasteur's work with soup, you will not need to be told where these germs come from. They are in air and in food, and therefore soon get on the teeth. All that these microbes need in order to grow is a good moist warm soil, and this soil they find all ready at hand for them in the patches of food which cling to the teeth.

Just as the rain and heat of summer help to make the grass and flowers grow in our gardens, so the moisture and warmth of the mouth make these invisible plants grow, first on the white patches of food, and then on the teeth.

But how do they manage to make a tooth decay? It is so hard and firm, one would think that these little plants could do no harm to a strong healthy tooth.

Well, in the first stage of their growth these plants do no harm. They simply grow and increase in number in the little particles of food. Very soon this food starts to spoil, and, as the tiny plants grow on the decaying food, an acid, something like vinegar, forms on the tooth and begins to make it decay.

At first the harm done is very slight indeed; but when the food particles are not brushed off after every meal, the decay goes on from month to month, and from year to year, until at length we feel the tooth a little sore, and on getting some one to look at it, we find that there is a cavity in it.

For many a day we do not notice the decay going on. There is no nerve on the outside of a tooth; and so, when the decay begins, we do not feel any pain. It is only when the decay has reached the little space in the middle of the tooth, where the nerve lies, that we feel pain.

FIGURE 25.—Decay has just begun in one of these teeth; in the other, the decay is more advanced.

But invisible plants, by their growth, not merely decay the teeth; they cause stones which are as hard as marble to decay. If you will take the trouble to look at the very old tombstones in any old burial ground, you will see that they are quite unlike the new ones. The smooth polish that was once on them, is there no longer. The letters and dates can hardly be read. They are more or less covered with moss.

FIGURE 26.—An old Tombstone.

How have they become so changed? The answer is that their surface has been altered in part by the growth of invisible plants, and that after this has gone on for many years, another kind of plant, the mosses, begin to grow on them, and then the decay goes on faster than ever.

Stones from volcanoes have been worn down and partly turned into soil in this same way. So we need not wonder any longer as to how these invisible plants make cavities in our teeth.

Another way in which decay may begin is by seeds of berries or pieces of bone, or even the bristles of a tooth-brush, getting between the gum and the root of the tooth. When this occurs, it gives a chance to the invisible plants to start to grow in the tiny wound, and, since the root of the tooth is much softer than the crown, the decay goes on all the faster. So, you must be careful to remove all such things.

FIGURE 27.—Teeth showing proper management and care.

The teeth should be brushed up and down, never across from front to back. Always use a brush the bristles of which do not spread. Fine tooth powder should be used to polish the enamel, and some harmless mouth wash like listerine to rinse the mouth and kill disease germs. Now and again the crown of each tooth should be polished with tooth powder on a narrow chisel-like piece of wood, so as to prevent the formation of a crust, which is known as tartar.

A quill or wooden toothpick should be used in removing the tougher pieces of food which may become fixed between the teeth.

Before using a new brush for the first time soak it in water from twelve to fifteen hours. This prevents the bristles from coming out. If you find your brush too stiff, soak in warm water a few minutes before using it. Use a small brush in order that there may be room enough for it between the cheeks and the teeth.

Always brush from the gums towards the grinding surfaces of the teeth. Never brush across the teeth as this habit makes it impossible to reach the parts requiring it most, and frequently cuts deep grooves in the necks of the teeth, necessitating fillings, and causing the gums to fall away from the teeth.

The proper way to use a brush is as follows: beginning at the upper back teeth, place the bristles high up on the gums and by rotary motion carry them straight down past the ends of the teeth. In this way you have the benefit of massaging the gums, and brushing all foreign material from the surface of the teeth. Repeat with the teeth in the lower jaw, but in this case, you will of course brush from the lower gums upward.

After having brushed the teeth thoroughly in this manner, it is sometimes wise to place the brush with the bristles against the teeth; agitate slightly so that the bristles may penetrate between the teeth, and then rotate towards the grinding surface of the teeth. Continue this procedure until you have covered all the teeth, brushing downward for the uppers and upward for the lowers.

FIGURE 28.—A brush very much like the one shown in this cut should be used, because its inequalities can get between adjoining teeth. A small brush with one row of bristles in it is large enough for children up to twelve years of age.

Any difficulty experienced in using this method soon disappears with practice. The inner and grinding surfaces of the teeth should be brushed as carefully as the outer surfaces.

QUESTIONS.

1. Make a drawing of a tooth from memory and mark upon it the name of each part. What is the use of the little hole in the root?

2. What is the chief cause of the decay of teeth? On what do these tiny plants, or bacteria, grow at first? Where, afterwards?

3. How may cracks be made in the covering of a tooth? Will these cracks promote or retard the decay of teeth? Describe one way in which stones are made to decay.

4. Would it be fair to reason thus:—Decayed teeth cause poor mastication of food; poor mastication leads to ill-digestion of food; ill-digestion or indigestion causes poor blood; and poor blood leads to lack of growth and lack of strength in children?

5. What is one cause of foul breath? How can it be remedied?

CHAPTER XI.

CARE OF THE EARS.

The chief use of the outer ear is to help us to hear a little better than we could without it.

The *real* ear lies deep in the bones of the head, and is, therefore, so well covered up that it can be harmed only when people are very careless, or very ignorant. None of you young people would wish to be thought either ignorant or careless, and therefore will, no doubt, be glad to learn how to take care of the organ of hearing.

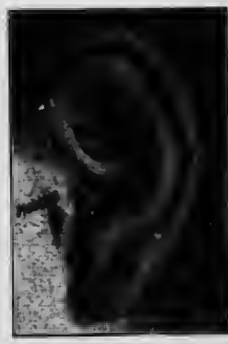


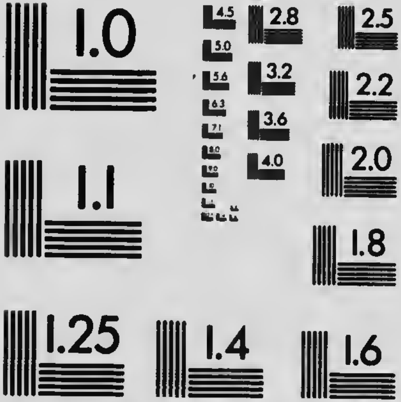
FIGURE 29.—Outer Ear, showing the meatus or opening into the ear canal.

Surely it is not necessary to tell you not to put small round objects, like beans or peas, into the outer ear.

To be sure, an accident like this sometimes happens amongst farmers. During harvest time, in handling the ripe grain, a seed of wheat, peas, etc., may get into the outer ear, and when not removed in time the warmth and moisture causes the grain to swell and start to grow. As a result, the person suffers great pain.

MICROCOPY RESOLUTION TEST CHART

(ANSI and ISO TEST CHART No. 2)



Objects like beads may be very hard to get out. Sometimes in trying to get them out, they are forced further inward and fastened so firmly in the ear canal, that they can be removed only with great difficulty. Quite often, they will fall out, if the head is bent over to one side and the outer ear pulled so as to straighten the canal.

The outer part of the canal is lined with wax-glands and hairs. The latter keep out the larger dust particles, and any small insect that might try to enter the canal. Should an insect get in, it should be at once smothered with oil, or water. After it is dead, it will either fall out

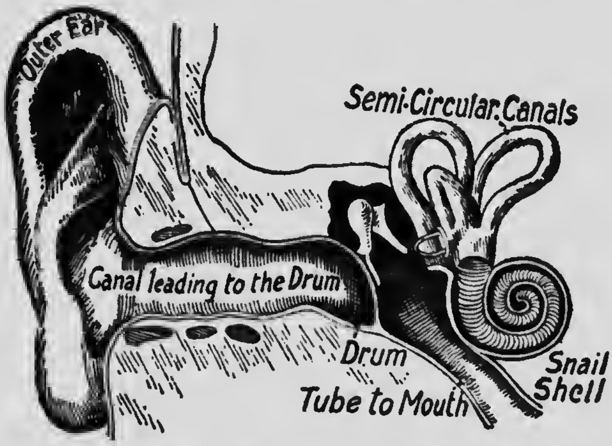


FIGURE 30.—Outer, Middle and Internal Ear. The latter consists of the semi-circular canals and snail shell. The middle ear lies between the drum and the internal ear.

on inclining the ear to one side, or it may be removed by syringing the ear with warm water.

The syringe will also remove any cakes of wax that may form in the canal. It is not necessary to drop oil into the ear to soften the wax. As a rule, ear-wax is soft and comes away of its own accord from every healthy ear. But sometimes it slowly hardens in the crooked canal, and causes slight deafness. People who work much in dusty air are subject to this kind of trouble. They often undertake to remove the wax by the aid of ear-scoops or mops, and sometimes do themselves great harm. These little instruments are very useful in the hands of a skilled physician but are dangerous when used by others.

I once knew a man who pierced his ear drum while cleaning his ear with the blunt end of a darning needle. Ever since, he has had a buzzing in his ear, something like the noise that comes from a telegraph wire when the wind is blowing hard.

The best thing to do, therefore, when dulness of hearing comes on, is to go to a good physician and be guided by his advice.

While the outer ear and the canal may cause us a little trouble and pain now and again, it is nearly always the middle ear, lying inside of the drum, which gives rise to most of our ear troubles. The middle ear is a little cavity in the head, situated about an inch above the roof of the throat, and joined to the throat by a little tube—the Eustachian tube.

A "cold in the head," which has lasted for a long time, sometimes spreads up to the middle ear, along the Eustachian tube. The redness, heat, and swelling in the throat and nose are followed by redness, heat, and swelling in the middle ear, and then we have ear-ache.

In very bad cases, the ear drum may break, and the ear-ache be followed by "running at the ear." If long continued, this is always serious, because, it spreads to other openings in the bones of the head, and then death may result. For this reason, some life insurance companies will not insure the life of any person who suffers from this kind of trouble.

Children who suffer from measles, scarlet fever, or diphtheria are always in danger of having trouble with their ears. For this reason, the doctor who attends the children is always on the lookout for ear-ache during the course of these diseases, and he places a flannel bandage round the ears to guard against inflammation of the middle ear.

How many of you young people, when you grow up, will use some of the numerous "ear-drops" which are advertised for the cure of ear-ache? Or, how many of you will allow sweet oil and laudanum, or even strong brandy, to be dropped into an aching ear? How many of you will still use the old-fashioned remedy of roasted onions as a poultice?

The hot onions are really quite safe but the other remedies are not. Heat is always soothing to a painful ear. It relieves the pain much better than the ear-drops do. Anyone may prove this for himself by simply dropping some warm water into an aching ear, and afterwards getting the sufferer to lie with the ear upon a rubber bag filled with water as hot as can be borne. This is a good remedy to use until the help of a doctor can be obtained.

In case of delicate children, or of adults who are subject to ear-ache, it is a good plan to use the old-fashioned night cap, especially if the bedroom is a cold one. Sometimes a child wakes up in the middle of the night suffering from ear-ache. This is often caused by the ear next to the pillow being unduly heated in the early part of the night. Later on, the child turns on the other side, and the over-heated ear is exposed to the cold air of the room, with the result that the ear begins to ache.

It is proper that pupils should test their sense of hearing. This can easily be done by the ticking of a watch. Each ear should be tested separately. One ear should be covered with a pad of cloth and then bandaged with a handkerchief, so as to exclude all sounds. Then the pupil should close his eyes, while a comrade holds a watch, first far away, and then gradually nearer to the ear which is being tested.

All the while the pupil should be asked whether he hears the ticking or not. In this way, the distance at which he can just hear the watch ticking can be found out and measured. The other ear should then be tested in the same way. Of course, the distance at which the ticking can be heard will depend very largely upon the kind of watch. Some tick much louder than others. The average distance for the class should be taken, and then it can be seen which pupils are dull of hearing.

Some teachers prefer to test the hearing of pupils by speaking to them in a whisper. This method has one advantage over the other. You can never be quite sure when you use a watch, unless it is a stop-watch, whether the pupil actually hears the ticking as far away as he supposes. But, you can test his hearing by asking him different questions in whispers and always whispering the questions equally loud, while you move nearer him, or farther away.

QUESTIONS.

1. What is meant by the outer ear? What is the name of the partition which closes the inner end of the canal? What part of the ear lies next to the drum but deeper in the head?

2. What objects sometimes get fastened in the canal? How is wax best removed from the ear canal? How may a pea cause more trouble in the canal than a bead of the same size?

3. Describe one cause of ear-ache. How does this trouble often begin? What are the signs of a sore throat? What is a good remedy for a bad ear-ache until the doctor comes?

4. What infectious diseases are likely to impair hearing? If a very young child becomes deaf, what language trouble may follow from the deafness?

CHAPTER XII.

THE EYES.

Have you ever noticed how hard it is to see a crayfish or a minnow in a brook when the sun is shining full on the water, or to read the names of the books in a book-case when the front of the case is covered with glass? Or, have you noticed how hard it is to see some parts of a blackboard in a schoolroom?

In all these cases, a person, if he wishes to see things clearly, must move from one place to

FIGURE 31.—Eye, showing the tear gland, and the tear duct for carrying the tears down into the nose.

another or wriggle from side to side in his seat. Of course, in some schoolrooms the blackboards are so good and so well placed that every boy and girl in the room can see clearly every word that is written upon them. This is because no part of the board is smooth and shiny, but every part of it is a dull black.

Some blackboards are all right for a while after they have had a coat of dull black paint, but after the pupils and teachers have used the board for some weeks or months it slowly becomes smooth and shiny again, so that words or drawings placed upon it cannot be seen by pupils in some parts of the room. When this happens, it is very bad for the eyes, and the blackboard should get another coat of paint so as to make it all a dull black again.

Some blackboards are made of glass, the surface being made rough by grinding; some are made of large slabs of slate; some of wooden boards, or of wall plaster that has been painted black. The great thing about any blackboard is that it must not be shiny.

Slate boards and ground-glass boards are expensive but last a very long time. Sometimes they are smooth and shiny when first put into the school, and if they are, they are bad for the eyes and should not be kept. Shiny leaves also in copy books, reading books, or note books, are bad for the eyes, and should not be used.

You should try to find out how the glass over a book-case or over a picture, shines and glistens and troubles the eyes.

Let me give you a hint how to find out. Stand before the glass of a book-case, or picture, and see whether you can notice the image of a window of the room reflected from the glass, just as you have often seen your own face reflected in a mirror. If you notice this, you have found out how a well-worn blackboard shines and glistens, and why it is hard to see the words that are written upon it. The light coming from some window in the room falls upon the blackboard, and then glances back to your eyes, so as to prevent you from seeing clearly.

In some very badly planned school-houses, the children are seated so as to face one or more

FIGURE 32.—Wrong position of a person in reading at a window.

windows. The light, therefore, falls straight upon the eyes and hurts them. It is not so bad when the windows are placed on both sides of the room, though this is bad enough; but the best source of light is from ceiling windows and from those on the left side of pupils, so that no shadow may fall upon books or papers lying on the desk.

And now I want to tell you about another thing that is bad for the eyes. It is bad to read

FIGURE 33.—Right position of a person in reading at a window.

a book with small, dim print; and it is bad for children to read even large print, if they are kept at it for too long a time. Physicians tell us that when boys and girls are kept looking at near objects, like books, slates, copy books, or sewing cards, all day in school, their eyes become tired and strained.

They should, therefore, be rested every now and again by looking at distant objects. Even a look across the room at a map or picture on the wall, for half-a-minute or so, is restful. But looking at objects within three feet of us for some length of time is tiresome to the eyes, and, if kept up daily for months or years, will strain the eyes and produce headache.

A number of years ago, a little girl in one of our public schools was troubled very much with headaches. Her father took her to the family doctor. After treating her for some time, the doctor began to suspect that the trouble lay in the child's eyes. He, therefore, advised that the child should be examined by an eye-specialist; that is, by a doctor who knows a great deal about the eyes. The specialist fitted her eyes with glasses which, in a short time, stopped the headaches altogether.

One day, a year or two afterwards, one of the lenses fell out of its frame while the child was playing. To have the glass put in again, it was taken to a local jeweller, who, not knowing much about eyeglasses, replaced the lens in its frame with the front side towards the back. Soon the headaches returned as bad as ever, and the girl had to be taken a second time to the specialist. A brief test of the glasses soon revealed the mistake of the jeweller, and on putting the glass into the frame properly, the headaches soon disappeared again.

One other thing I wish to tell you about. When boys and girls study their lessons at home they have often to do so by lamplight. And very few of them know how to do this kind of work without hurting their eyes.

FIGURE 34.—Wrong position of the lamp in reading or study.

They often sit on a chair at the side of the table and face a lamp without any shade on it. This is quite wrong. If a book is too heavy to hold in the hands, you must place it on the table, of course; but in this case you should always place a shade upon the lamp, so that the light will fall upon the page and not upon your eyes.

FIGURE 35.—Right position of the lamp in reading or study.

If the book is small and not heavy, you should turn your back to the lamp and get the light to fall straight upon the page. If you are reading in a room in daytime, you should follow the same rule: sit with your back partly turned to the window so that the light falls on the book over your shoulder.

QUESTIONS.

1. Why is it difficult to see objects under water? How is it that we cannot see clearly what is written on some blackboards? What is the chief thing in a good blackboard? Is the one in your schoolroom shiny?

2. How many windows are there in your schoolroom? How does the light fall on the desk at which you study in school? How does it fall upon the table at which you study at home? Do you use a lamp shade?

3. The type, the length of line, and the space between the lines in this book (not in these questions) are about right for your eyes. Compare them with others in books that you use and see which is more easily read.

4. In what different ways can you rest your eyes, when they are tired? How do our eyes get tired?

5. How is the eye protected from a side blow with a stick? How may an eye get injured by a toy pistol? From a firecracker? From a careless use of scissors. Or, from using a table-fork to untie the knot in a shoe-lace?

CHAPTER XIII.

THE WORK OF THE BLOOD.

You already know a great deal about your body which, as a whole, is a most wonderful machine.

It is covered with tough skin which protects the flesh, bones, nerves and muscles. In your skull you have a brain; and, running down from the brain, and protected by the backbone, you have a spinal cord somewhat of the same nature as the brain. Both brain and cord send out nerve threads to, and receive nerve threads from, every other part of the body. Within the chest lie the heart and lungs; within the abdomen are the stomach, liver, and intestines.

The heart pumps the blood up to the head, down into the hands and feet, round and round the body without ever stopping once as long as we live. While the blood is thus circling round and round through the body, it is always carrying on two great kinds of work. In the first place, it sucks the nourishment out of the food which we eat, and carries this nourishment all over the body in a most wonderful set of blood tubes. In this way, the skin, bones, nerves, muscles and flesh of all kinds are kept well nourished.

In the second place, the blood gathers up from every corner of the body the waste matter which is always being formed, and carries this waste partly to the lungs as impure air, partly to the skin as sweat, and partly to other organs, where it is got rid of. The blood is thus a most wonderful mixture of different kinds of stuff. All the good from our food goes into it; all the dead waste from the flesh goes into it; so that it is never exactly the same for any length of time.

Most of you know that the pinkish or reddish colour of the skin is due to the red blood beneath; but only some of you have noticed that the flesh is red. If you have not, just place your fingers between your eyes and a lamp flame. Or, look at the sun through your fingers. When you do this, you can see the separate bones of the fingers, and between them, the bright red flesh.

FIGURE 36.—From an X-ray photograph of the bones of hand and wrist.

The flesh is not all of the same colour. Look at the flesh between one joint of a finger and the next joint, and then say whether the flesh in this place is the same, or a different colour from that along the side of the bones where there is no joint. You see it is a brighter red between one finger and the next one, because there is more blood there.

The joints are tied together by tough stringy bands or ligaments, and these bands as well as the bones have less blood in them than the soft flesh, and are therefore not so reddish.

It is very important to know that the flesh in every part of your body is crammed full of blood, running in a net-work of fine tubes called capillaries. Some of these tubes are so small that you cannot see them, unless you look at them with a powerful magnifying glass. Other tubes are large enough to be easily seen with the naked eye, and the largest one in your body is about as wide across as your thumb.

The tubes which carry the blood from the heart to the outermost parts of the body are called arteries, while those that carry the blood back again to the heart are called veins. The capillaries convey the blood from the ends of the arteries to the beginnings of the veins.

The blood in the arteries is not the same colour as that in the veins. That in the arteries is a bright red and is known as arterial blood; while that in the veins is a dark red and is known as venous blood.

If you will look at the diagram of the circulation of the blood on the next page, it will help you to understand where the change in colour takes place. The heavy black lines denote the arteries, the dotted ones denote the veins. Notice that one change in colour is represented as taking place in the lungs, the venous blood changing to arterial blood. A second change is represented as taking place in the fine blood tubes of the flesh. Here the arterial blood changes back again to venous blood.

The cause of this change in colour is easily understood. While the blood is passing through the lungs, it gives up a poisonous gas, called carbon dioxide which it has gathered from all over the body At the same time it takes up a load of oxygen from the air sacs of the lungs. In doing this it changes from a dark red to a bright red.

As this bright red blood passes through the flesh in the fine blood tubes of which I have spoken, it changes to a dark red through losing much of its oxygen and taking up carbon dioxide. In other words, the very opposite change takes place in the flesh from that which takes place in the lungs.

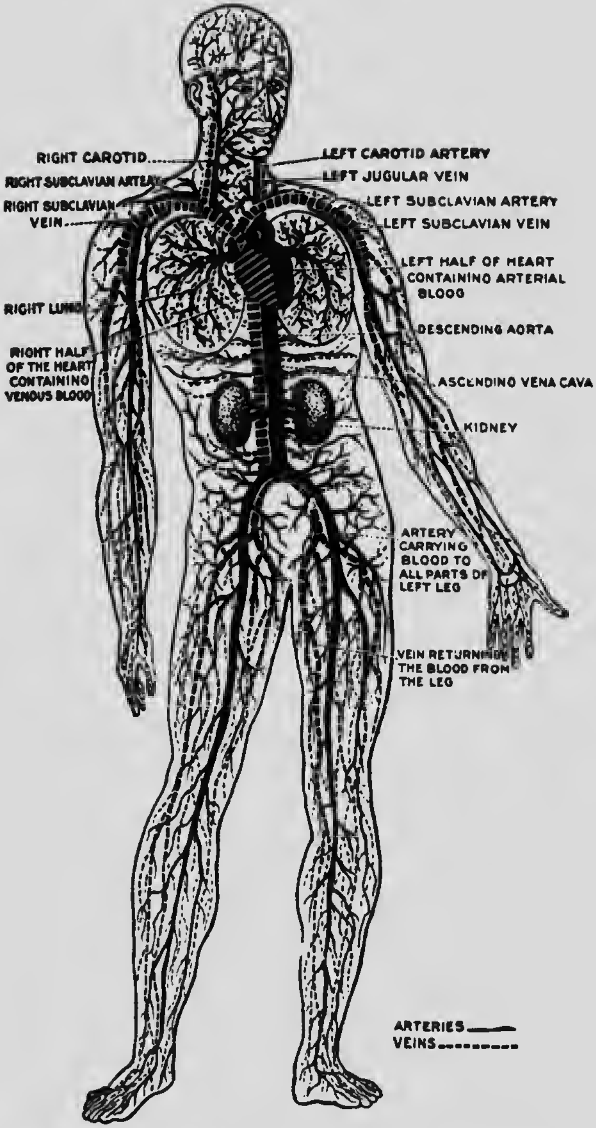


FIGURE 37.—Diagram of the Circulation of the Blood.

Of these two changes, the one that takes place in the lungs is the most important, because it is the one over which you have most control. If you have learned to breathe properly by expanding the chest, and sitting or standing up straight, then the lungs will take in plenty of air, and the blood will get all the more oxygen and be able to give it to the muscles, nerves and other organs of the body.

But, if you sit with rounded shoulders and hollow narrow chest, you will not be able to breathe properly, and you may be quite sure that, if the seeds of consumption lodge in your lungs, you will be much more likely to take this disease and perhaps die from it.

You see, therefore, that it is not enough to breathe fresh air, you must learn to breathe properly, hat is, you must expand your chest so that the fresh air may pass into every nook and corner of the lungs.

As I have just hinted, it is necessary that the blood should get rid of the waste, or poison, which it gathers up from the flesh. If the carbon dioxide which is part of this poison were not passed out of the body almost every second, by means of the lungs, we could not live for ten minutes. If more of the poison were not thrust out by means of the skin and kidneys, we could not live over two or three days.

QUESTIONS.

1. Point out the position of the heart in your body, and tell what its work is. What is the name of the tubes in which the blood is carried away from the heart? In which the blood is carried back again?

2. How do you know that flesh is reddish in colour? What gives the flesh this colour?

3. What gas does blood get from the lungs? What gas does it give off to the lungs?

4. What does blood do with other waste matter which it gathers up from the body? What organs of the body take this waste from the blood?

5. At what two parts of the body does blood change from a dark red to a bright red and *vice versa*? Why should a person be particular to breathe properly?

CHAPTER XIV.

TOBACCO AND THE BLOOD.

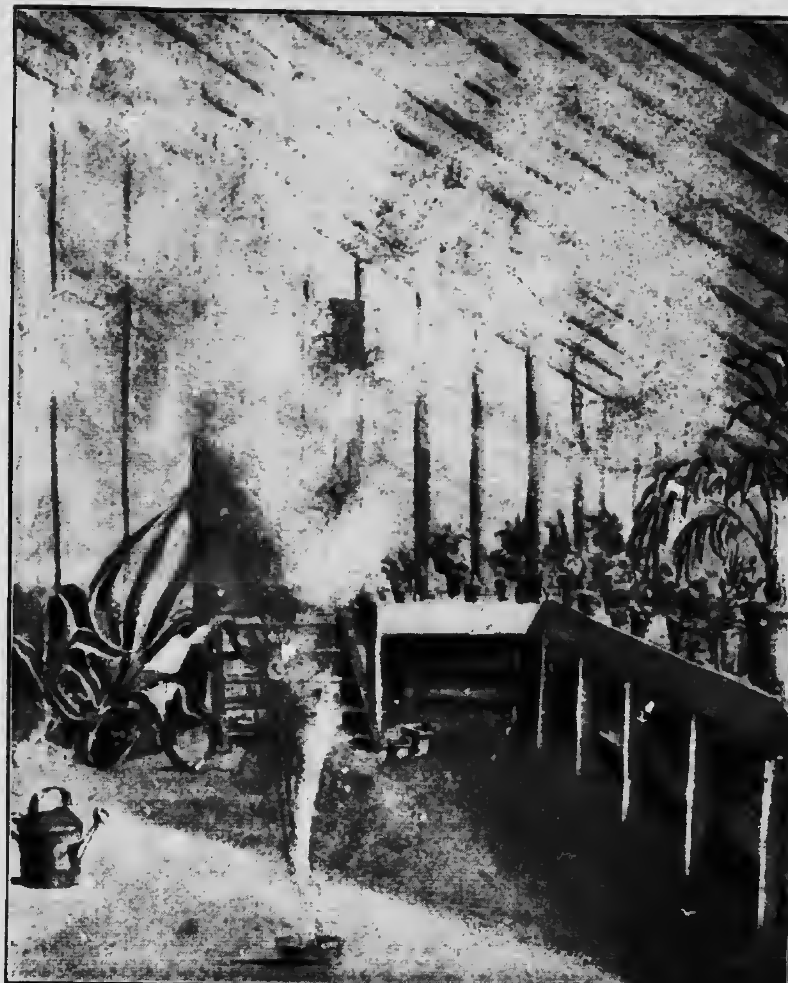


FIGURE 38.—Tobacco Smoke in a Conservatory, where it is useful in killing insects.

If you will hunt up the word *nicotine* in a good dictionary, you will find that this substance is described as an oily, colourless liquid, with a burning taste and disagreeable smell. It is very poisonous.

Haberman, a German scientist, studied the effects of this substance very carefully. He found out how much of it was in a cigar. You know that before lighting a cigar, it is usual to cut off a small piece from the end which is placed in the mouth. Such short pieces, Haberman found, contain about $3\frac{3}{5}$ per cent. of the nicotine which is in the whole cigar. (Ask your teacher to explain what per cent. means.)

Then there is the part which is smoked that is, partly turned into ashes, the smoke being drawn into the mouth. In this part, Haberman found 60 per cent. of the nicotine. More than a quarter of this amount passes through the lining of the mouth and enters the blood.

Lastly, there is the unsmoked part; that is, the part which is in the mouth, and which becomes too hot to burn up to the lips. This contains 36 per cent. of the nicotine.

You will notice that this part contains more than its due share of the poison. Why? Clearly, it is because some of the nicotine from the far end, and from the middle of the cigar, collects at the end next the mouth, as the burning goes on. It is for this reason, that careful smokers throw away—not a short part of the cigar—but often as much as half of it. In this way, they do not take so much of the nicotine into their blood, and they do not get its bitter, burning taste.

When nicotine thus enters the blood, it slows down the rate and lessens the strength of the heart beat, and when heavy smoking has been indulged in for years, it sometimes brings on a disease that is called "Tobacco heart." It also produces a disease of the throat known as "Smoker's sore throat." But, of course, many moderate smokers go through life without getting either of these diseases.

In the case of young people, the use of tobacco is believed to check the natural and healthy growth of the body. That tobacco does this is very difficult to prove, because, if a boy is undersized, no one can say whether his small size has been caused by tobacco or not. He may have been born undersized, as many a boy is, and he may remain undersized without being a smoker.

Professor Seaver collected some very interesting facts about the young men who entered Yale University between the years 1890 and 1897. For example, he found out that, on the average, those who smoked were about fifteen months older, on entering, than those who did not smoke; that they were not able to take as much air into their lungs at a breath by about five cubic inches; that they were not so tall; and that only five per cent. of them gained the highest rank in their studies.

FIGURE 39.—Both boys are of the same age. Tobacco smoking has not made the difference in their size.

In other words, the students who did not smoke were able to enter college at an earlier age; they were taller; they had a larger measurement round the chest; and more of them took higher rank in their studies than did those who smoked.

These are very striking facts. Do they not show you young people, that if you wish to have strong, healthy bodies, and clear, vigorous minds, you will avoid the use of tobacco altogether.

Thoughtful men always consider it wise to learn everything they can from others. Why should boys not do the same thing? Not merely should you learn what you can about the effects of tobacco from those who are wiser than yourselves in this country; but you should, if possible, take a wider view still, and try to find out how wise men in other countries look upon the tobacco habit.

Now there is always one way in which we may learn what any great nation thinks on any great subject, and that is by reading the laws which are passed by its parliament. What then does Germany think about boys smoking? She says that no boy under sixteen years of age shall smoke, and Japan says that no young person under twenty years of age shall smoke. Ask your teacher, if you do not already know, what the laws in Canada say on this important subject.

There is no doubt that cigarette smoking lowers one's power of doing bodily labour or playing games like football, hockey, or baseball. For this reason, the captain of an athletic club will not allow any of his men who are to play the season's matches, to smoke tobacco or to drink liquors containing alcohol. If he does so, he knows very well that his team runs the risk of being beaten.

Tobacco does not injure men over twenty-five so much as it does younger people. I mean that the effect on the mind is not so marked in the one case as in the other. For one thing, tobacco cannot stunt the growth of young men at twenty-five, for they are already full grown. But, in the case of lads of fifteen or eighteen years of age, going into a business, where quickness, accuracy, steadiness, patience, and other good qualities are required, tobacco smoking, and especially cigarette smoking, is a decided drawback. Business men tell me that boys who have acquired the cigarette habit are not so reliable, nor so quick, nor so painstaking as those who do not smoke. For this reason, some employers will not engage a clerk if he is known to be a user of tobacco.

QUESTIONS.

1. What is the effect of tobacco smoking upon boys, the first time it is tried?

2. How much nicotine did Haberman find in each of the three parts of a cigar? What is the objection to smoking a cigarette or cigar up to the very end? Spanish smokers generally throw away half of each cigar. Why?

3. What is the effect of nicotine on the heart? What is "smoker's sore throat?" Can it be proved that the use of tobacco stunts the growth of boys? Why not?

4. Why are athletes forbidden to smoke? Why do some business men decline to employ boys who smoke cigarettes?

CHAPTER XV.

FOOD.

The blood sucks up all the good it can get from our food. Indeed I might almost say that the food first becomes blood, and that the blood afterwards becomes flesh.

If this be true—and there is no doubt about it—then we ought to be careful to eat nothing but good foods; because good foods, when eaten by healthy boys and girls, will make good blood, and good blood will make stout, sinewy bodies. On the other hand, poor food or ill-digested food will mean poor blood and puny, stunted bodies.

I wonder how many of you have noticed how green the grass looks on a lawn and how well the crops look on a farm when there has been plenty of rain. How many of you, during a dry season, have seen the grass turn brown very early, and the crops turn out short in the stalk, and the yield of grain scanty?

Do you suppose the difference is caused by the plants being well fed in a rainy season and poorly fed in a dry season? When rain is plentiful, the roots of plants can suck up plenty of food from the soil; when rain is scarce, they cannot do so and they are thus partly starved. The rain makes all the difference in the world.

Of course, some soils are so poor that they contain little or no food for plants; for example, soil that is composed of pure sand. No amount of rain will make grass grow upon a sandy desert. But, if the soil is good, the amount of food which a plant can get will depend upon the rain-fall. In other words, plants may be starved either because there is no food in the soil, or because there has been no rain.

When the soil is rich in food and there is plenty of moisture, then plants grow best. Illustrations of this may be seen on any farm on which there are different kinds of soil. Trees as well as grass and grain vary in growth with variations in soil and moisture.

A double row of maples planted along Park Avenue, Kingston, over fifty years ago, illustrates well how plenty of plant-food and

FIGURE 40.—Avenue of trees all planted at the same time. Winter scene.

moisture act upon the growth of trees. If you look at the picture of these, you will see that the trees about the middle of the row are taller and have bigger trunks, than those at each end of the avenue. All the trees got exactly the same amount of rain and sunshine; the soil was, at the time the trees were planted, exactly the same over the whole length of the street.

What then caused the difference in growth? Briefly, it was caused by the fact that the middle trees got most food. There was low-lying ground about the central parts of the avenue, and for many years the street scrapings were carted to this part, to bring it up to the level of the rest of the avenue. These scrapings were rich in plant food.

Moreover, there was a soakage of the rainfall from the higher areas of the park towards this low-lying part of the avenue, and the two things —the more abundant food supply and the greater moisture—combined to make middle trees grow larger than the end ones. In order, therefore, that young trees or young plants of any kind may grow into strong, healthy, big ones, they must get plenty of plant food and plenty of moisture.

In a similar way, young animals can grow into strong big ones only by being well fed. Every good farmer knows this. I once knew two men who lived on adjoining farms. The one was a good farmer, the other, a very poor one. They each had some well-bred calves. During the spring and early summer, one fed his calves on plenty of fresh milk; later on, he mixed oatmeal with their milk, and gave them all the green grass they could eat.

The other fed his calves on skimmed milk, and allowed them to run in the common pasture. Before the summer was over, anyone could see a marked difference in the two sets of calves. The better fed were longer, taller, heavier, and better-looking than the other; they took the prize at the county fair, and sold for a higher price.

And the sad thing about the whole matter was that the poor farmer did not know how there had come to be such a difference between his calves and his neighbour's. He did not see that his animals were shorter, lighter, and skinnier, just because he had ill-fed or under-fed them all summer.

And I am afraid that many fathers and mothers half-starve their children. I don't mean that any parents are so wicked as to actually refuse to give their children enough food; they simply do not know how to feed

FIGURE 41.—These children are all of the same age—well fed and growing. Why do they differ in size?

their boys and girls. A few parents may be so very poor in some of our large cities that they cannot buy enough good food for their children. But, in many cases, when children are thin and pale and too small for their age, they have become so, because the blood could not suck enough nourishment out of the poor food that was given to the children.

Because, as you already know, good blood can come only from good food, and good blood alone can make strong, sturdy bodies. Poor blood will come from poor food, and poor blood can make only poor flesh, poor muscles, poor brains, and poor everything in us.

Again, it often happens that food is good enough of its kind; but, if it is always of one kind, it may not contain enough nourishment to keep us alive. For, we must eat different kinds of food in order to have healthy blood. You know that dogs are fond of meat. But dogs have been starved to death on food that was nothing but pure fat. And human beings also would soon starve to death on a diet of pure sugar, pure starch, or pure fat.

What then is good food? In answer, it may be said that good food is a mixture of a number of different things. You will understand best what is meant if I talk to you for a little while about milk.

Milk is the food of many young animals, and it is the food which we all took when we were babes. It is sometimes the only food which people can take when they are very sick. So, pure milk must be a good food. It is, in fact, the best of all foods for young children. If we can only find out, therefore, what the different things are which are contained in milk, we shall have taken a long step towards finding out what good food is.

Then there is another good thing about milk. It is easily digested, if only it is drunk in the right way; and the right way is to sip it. Some people drink a glass or two of milk all at once. This is quite wrong; because, all our food should be mixed with saliva before being swallowed.

Saliva is the juice which comes into the mouth when we chew anything. The drier our food, the more saliva is formed. It acts upon our food in such a way as to prepare it for passing through the walls of the intestine and getting into the blood; and of course the saliva has no chance to do this, if food is swallowed as soon as it enters the mouth.

The proper way, then, to take milk is to sip it; that is, to take it in small mouthfuls and allow it to remain two or three seconds in the mouth. In this way it becomes mixed with saliva, and is, therefore, more quickly digested when it reaches the stomach.

If a person is weak and sickly, the milk ought to be warmed—not boiled—before being drunk, because warm milk digests faster than cold milk.

QUESTIONS.

1. Why do farmers look anxiously for rain in a dry season? Is the rain one of the foodstuffs of plants? What proof have you seen that well-fed trees grow bigger than poorly-fed ones?

2. What proof have you seen that well-fed an mals grow larger than poorly-fed ones? What reason is there for believing that well-fed children grow bigger and stronger than ill-fed ones?

3. What other causes besides lack of food may produce stunted children? Name three foods which if alone fed to a man would not keep him alive.

4. Why is milk called a perfect food? How should it be drunk? Why? Why should it be warmed before being given to a sick or delicate person?

CHAPTER XVI.

WHAT MILK CONTAINS.

To begin with, milk contains five different things. You all know two of these already, water and cream. And some of you who have been in a cheese factory will know of a third thing that is present in milk, namely, curd. In making cheese, there is added to warm milk a substance called rennet, which is prepared from the lining of a calf's stomach, and which turns warm milk into a soft jelly-like mass, called curds, and a liquid called whey. When a calf has sucked its mother, the milk turns into curds and whey in its stomach. The same change takes place in the stomach of a child.

But milk contains two other things besides curds, cream, and water. It contains a little sugar and a little salt. And these are the five things which all good foods should contain. They are not always called curds, cream, sugar, water, and salt. We give them other names when they are found in meat or bread or vegetables; but the important thing to know is that every article of food should contain more or less of these five things.

They are present in pure milk in just about the right amounts to make good flesh and blood in young children. But, in many other kinds of food, for example, meat, they are not present in the best proportions to make good blood. Meat contains a great deal more of the curdy matter, and, if it is very fat meat, it contains a great deal more of the creamy matter or fat and not enough of the sugar [illegible] salt; but no matter what article of food [illegible]nk of, it contains one or more of these [illegible] different things, and all of them are necessary for making good blood.

Now, in order that you may have clear ideas about milk, let me give you, as nearly as possible, the exact amounts of the five substances that are present in 100 parts of the milk from a fairly good cow:

I.	Curd..................	$3\frac{1}{2}$	parts.
II.	Cream, or butter fat....	$3\frac{3}{4}$	"
III.	Milk Sugar...........	5	"
IV.	Salts of different kinds..	$\frac{3}{4}$	"
V.	Water...............	87	"

These five things make up the food of every person. The gentleman with his many courses of food at dinner, and the beggar with his wallet of bread and cheese and his cup of water, both make their meal out of these five things.

Man, everywhere, civilized or savage, white or black, does the same. To make good blood you must eat some of these five kinds of food. You could live only a short time on fats alone, or on sugar alone. You could live for a long time on curds, salt, and water; but you would not be in very good health. You would very likely grow sick after some time and you would probably die. You must have some of each of these five kinds of food. Not too much of any one of them and not too little, but just enough of each to make the good blood which alone can give health and strength.

Now I am sure, that some of you wish to know what is the proper amount of each of these things which should be taken as food. And I must tell you that this is a very hard question to answer.

Not all of us require exactly the same amount of each. Some people require more of one thing, and some require more of another, according to the kind of work that they do, and the season of the year, or the part of the world they live in. You will be told about this when you reach a higher class in school. Meantime, the important thing for you to remember in this lesson is that, if you would grow strong, and remain strong men and women, you must eat food that contains curds, butter or fats, sugar, salt, and water, in about the following proportions:

1. Curdy matter, generally called proteids, and found in milk, eggs, lean meat, fish, also in considerable quantities in peas and beans, about 2 to 3½ oz. daily.

2. Fats, as in milk (butter), fat of meat, cod-liver oil, lard, olive oil, about 3½ oz. daily.

3. Starches, sugars, gums, jellies. Found chiefly in potatoes, cereals, beets, fruits and vegetables. The first two of these are generally called carbo-hydrates, and you need from 9 to 12 oz. daily.

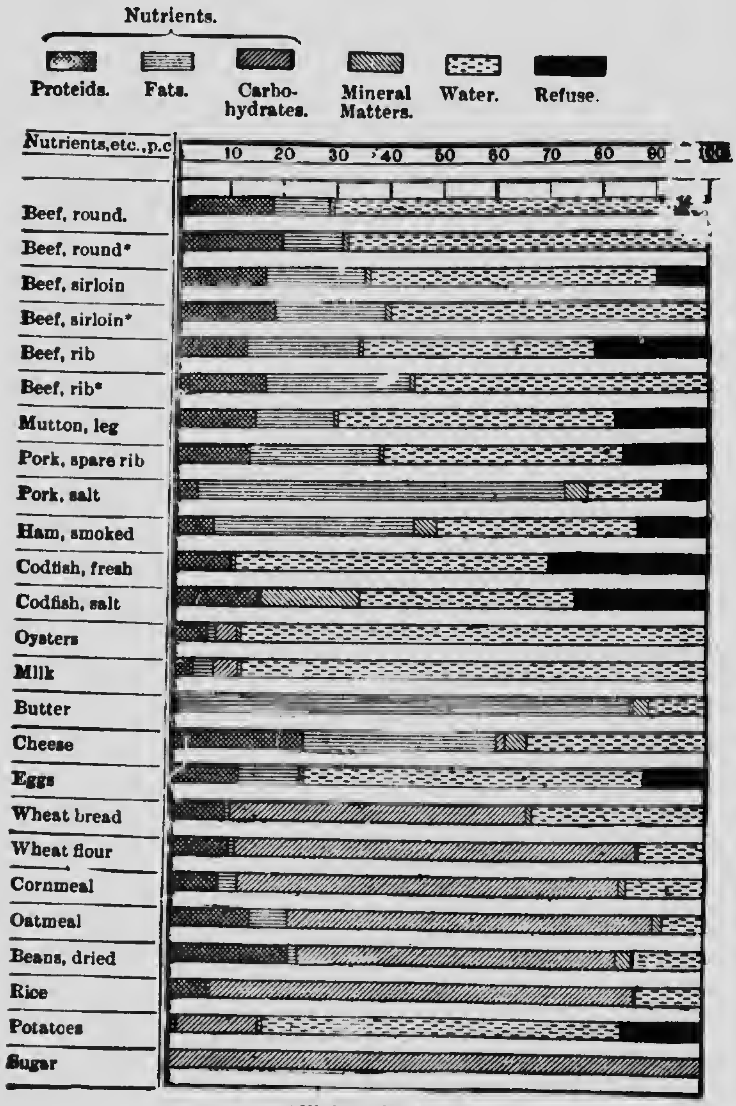
4. Salts. Found in all foods. In addition to what is in our food we take table salt; in all about 1 oz.

5. Water makes up a large part of all our foods; but in addition to what is in the food itself, we must drink water, tea, or coffee so as to take, in all, about 90 fluid ounces, or over two quarts per day.

When people are young and strong, they pay little or no special attention to the choice or to the cooking of their food; but, if they and their parents disregard all care in its selection and preparation, they are likely to pay the penalty of their carelessness or ignorance later on in life.

The following table shows the proportions of proteids, fats, carbo-hydrates, salts, and water which are present in most of our common articles of food. The pupil should compare each of them with the standard diet given above, and see what each article lacks in order to supply the proper amount of each food-stuff required by the body:

COMPOSITION OF FOOD MATERIALS—(*Atwater*).



* Without bone.

FIGURE 42.—Composition of Food Materials.

QUESTIONS.

1. Write down from memory the composition of good milk. Which of the five things present in milk will also be present in cheese?

2. How is it that the Esquimaux eat such large quantities of fat; whereas people in hot countries eat chiefly fruits and vegetables?

3. How is it that some people need to pay but little attention to the choice of their food, or to the cooking of it? Will a man who sits and writes all day require as much food as a labourer? G reason for your answer.

4. In planning a meal, how may the lack of carbo-hydrates in beefsteak be remedied? What other food should be eaten with bread and water in order to make a proper meal? Why?

CHAPTER XVII.

DIGESTION.

"Will it make any difference," you ask, "what kind of food we eat, so long as it contains the right quantities of curds, fats and starches or sugar"? Yes, it will make a great deal of difference, especially if your digestion is not good. In this case you must be doubly careful to select foods that are easily digested. The choice of food, the cooking of food, and the chewin of food are, to some extent, in your own keeping, and you can either care for your digestion, or ruin it just as you choose.

Not all foods are equally digestible. Some are hard to digest; some are easy. Some that are hard to digest when raw, are easily digested when properly cooked. Some that are easily digested when raw can be made hard to digest when badly cooked. For example, raw eggs are very digestible, even by delicate stomachs; but if fried or boiled hard, they become more difficult of digestion.

Next to selecting easily digestible foods, it is important to eat each meal slowly and to chew the food very thoroughly. The chewing of the food is in fact the only part of the act of digestion which you can fully control. Once you have swallowed your food its digestion is beyond your control.

Digestion takes place partly in the mouth, partly in the stomach, and partly in the intestines. We may, therefore, speak of mouth digestion, stomach digestion, and intestinal digestion.

It would be an easy matter to tell you about some of the changes which food undergoes in the stomach and in the intestine; but it would not be profitable to do so at this time. Even if you knew something about these changes and had a severe attack of indigestion, you could do nothing for yourself. You would have to go to a good doctor for treatment and trust to him to cure you.

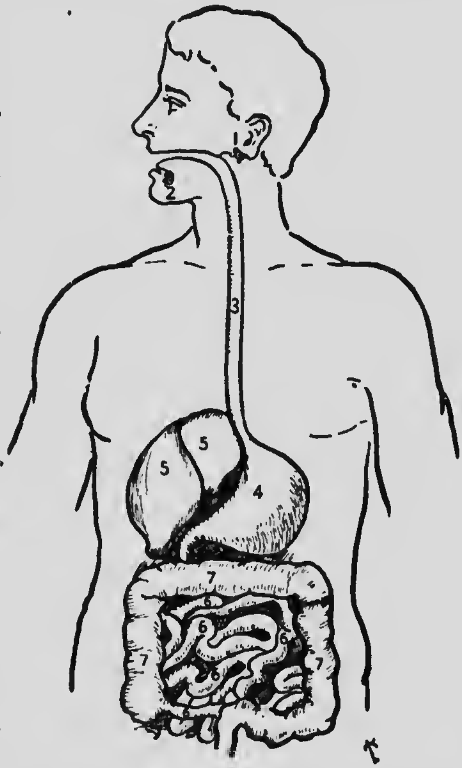


FIGURE. 43.—Diagram of the food tube, or intestine. 1 and 2, salivary glands; 3, gullet; 4, stomach; 5, 5, liver; 6, 6, the small intestine; 7, 7, 7, large intestine, or lower bowel.

But you can do a great deal to avoid stomach and intestinal indigestion, if you avoid the use of alcohol and tobacco, chew every bite of food twenty or thirty times before swallowing it, and avoid overstrain and worry. These things, at least, are within your control.

Some of you are no doubt saying to yourselves, "What you tell us may be all very true; but we have often to hurry at breakfast to get to school in time, and our fathers and brothers have to hurry to reach their work on time. How, then, can we eat breakfast slowly?"

"Then, too, at noon," you tell me, "there is the same hurry—hurry home, for the walk is long, and hurry back to work, for the noon recess is short. Our fathers, brothers and sisters, too, who are in shops or factories or in the harvest field, must hurry at noon both coming and going."

All of this, I have no doubt, is very true; but all very wrong. As I have already pointed out to you in other matters, you may commit wrongs against your stomach for months; sometimes, if you are very strong, for years; but sooner or later you will suffer for it. The hurried meal and the hurried walk to work are the sure forerunners of the pain, discomfort, and weakness which you will suffer later in life.

The right time for young people to begin to form good habits is now; and I know of nothing which will help you more to keep well than forming good regular bodily habits. There should be regular hours for eating, drinking and for the movement of the bowels.

Suppose you begin with eating. Form the habit of taking at least half-an-hour to a meal, and chewing every bite until it is almost nothing but pure liquid. This will allow the saliva to mix thoroughly with the food, and, as soon as this has been done, the process of digestion is well begun. When you swallow the food that has been thus thoroughly chewed, the changes in the food produced by the saliva still go on in the stomach for over half-an-hour.

Moreover, the thorough grinding of the food under the teeth reduces it to very small pieces, and this enables the juices of the stomach and of the intestines to digest the food more thoroughly and quickly than they could if the food had been swallowed in lumps.

Another rule that must be kept in mind is this: while chewing the food, one should not drink large quantities of water, tea, or other liquid; because doing so dilutes the saliva, and weakens its action on the food. Try to drink the liquid you need in the interval between one meal and the next.

Then, too, meals should be taken at regular intervals during the day. Breakfast at 9 or 10 o'clock, dinner at 1, and tea at 6, are not the hours of the day for meals. They should be eaten at least five or six hours apart, and there should be no eating between meals; because the stomach needs rest for the same reason that your muscles do.

At the table, while taking meals, not a word should be said about worries and anxieties; because these interfere with digestion; they should be forgotten if possible for the time being. Rather should you pass part of the time in telling good stories, or in pleasant conversation. "Laugh and grow fat" is a very old and true saying.

People who are delicate should never eat when tired. They should lie down for half-an-hour before meals. Moreover, in their case, it is a good plan to eat only a little at a time and to eat oftener than three times a day. Those who have hard bodily labour to do and those who are recovering from severe illness may, if their digestion is good, be allowed four or even five meals a day.

QUESTIONS.

1. Name some kinds of food that when badly cooked become harder than when they are raw. Name some vegetables that are softened by boiling. Should good cooking make food harder to digest, or easier?

2. Give two or three reasons, if you can, why food should be well chewed before it is swallowed. What parts of the act of digestion can we control?

3. What objection is there to eating in a hurry? How long should we spend at a meal? How long should we rest after a meal? Why?

CHAPTER XVIII.

A ROMAN WINE FARM.

Is there any food in wine or in alcohol? No doubt the juice of the grape contains some valuable foodstuffs, just as the grapes themselves do; but, after the juice has fermented by standing in the air, the juice changes very much, and comes, in reality, to contain much less nourishment than it did at first. How does this change take place?

Thanks to excavations that have been made in the neighbourhood of Pompeii and to accounts that have come down to us from Roman writers, we know pretty well how wine was made in Italy about the beginning of the Christian era.

A well-preserved Roman farmhouse about seven miles south-east from Mount Vesuvius, has recently been unearthed and you may gain a very good idea of its various parts by looking at its ground plan. The building, whi : was about 130 feet long by 82 feet wide, was overwhelmed with pumice stone and dust at the same time as the city of Pompeii, in the year 79.

As can be seen from the plan, there was only one entrance but this was large enough to

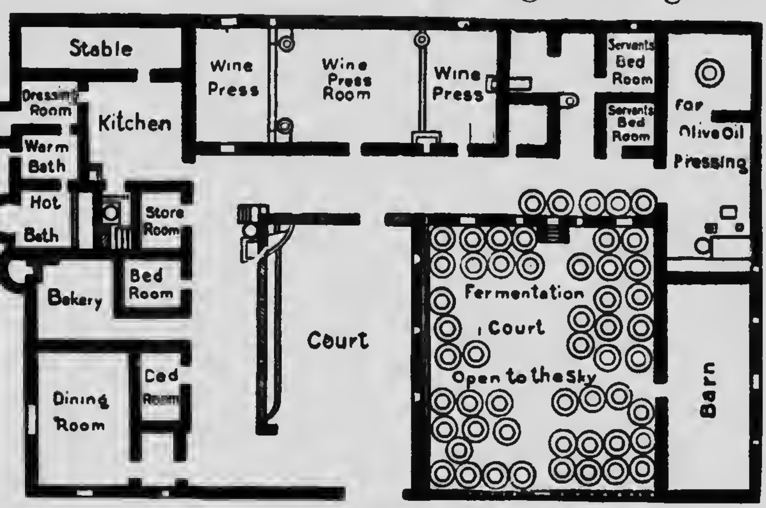


FIGURE 44.—Ground plan of a Roman farmhouse.

admit a span of horses abreast. The stable was entered through the kitchen. The court was open to the sky. So was the fermentation court, a fact which must be remembered when we consider that here fermentation of the grape juice took place

The circles in the two rooms denote the large vats or tubs in which the wine was fermented. The farm must have grown large quantities of grapes; because the vats were altogether capable of holding between 600 and 700 barrels of wine. Moreover, the owner of the farm must have been wealthy; because, lying in one of the largest vats and covered with its lid, were found several bags of jewelry, gold and silver coins, and richly embossed silver cups. The latter were evidently used in drinking the wine.

From these sources we learn that the ripe grapes were first placed upon an elevated platform. Over the grapes were placed boards, and the juice was pressed out by a heavy beam brought down upon them from above. The platform was a sloping one, so that the juice could be conveyed away through tubes or troughs to vats in the corridor, but chiefly to those in the fermentation court.

Freshly pressed juice is sweet; that is, it contains sugar, but it does not contain any alcohol, or spirits of wine. It is, therefore, not intoxicating, and is usually spoken of as the unfermented juice of the grape.

But this juice, on standing exposed to air, soon undergoes a marvellous change. In the course of days or weeks, large bubbles form on its surface, its colour changes, it loses its sweet taste, and it is found to contain alcohol. In addition, vinegar often forms in it, and then, of course, the wine tastes sour.

Whence has the alcohol come, and whence the vinegar?

If you will read over again the chapter on Pasteur's experiments with air, you may make a pretty close guess as to what takes place. Germs of different kinds fall into the juice from the air and start to grow. In the very act of growing, they set up changes in the sugar which is present in all grape juice. One of these changes is seen in the bubbles of gas, and other changes are seen in the formation of alcohol and of vinegar.

While the ancient Hebrews, Greeks and Romans all knew of the change of grape juice into wine, they were quite ignorant of the cause of the change. In fact, it was not until between 1856 and 1860 that fermentation, as it is called, began to be understood. Pasteur proved that it was due to the growth of a very tiny plant, the yeast plant, the germs of which are often present in the air and on the fruit itself. Not merely so, but he found that when the wine turns sour, the souring is due to another tiny plant, the vinegar plant, which grows in the fermenting juice along with the yeast plant.

In fermentation, the yeast plant turns the sugar into alcohol and into the gas which is contained in the bubbles. The more sugar there is in the juice, the more alcohol can be made from it up to a certain limit; and the less sugar, the less alcohol. The same is true of the sugars which ferment and form ale and cider.

Even in very early times, a further change was made in the fermented juice. After the fermentation had ceased, the alcohol was separated from the rest of the juice. This was done by means of a still. The fermented juice from grapes, apples, corn, or barley is placed in the

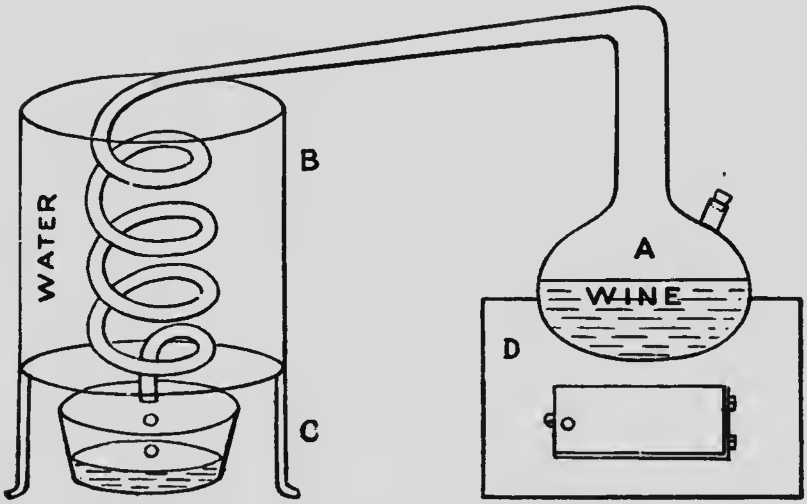


FIGURE 45.—Distilling Apparatus.

part A, and heated over a fire in D; the alcohol comes away from it in the form of a fine mist or vapour, and, in the coil B, which is surrounded with water to cool the vapour, it is turned into a liquid and drops out into a vessel C.

This alcohol is very strong, that is, it contains much less water than the alcohol that is in wine.

Liquors made in this way are called distilled liquors and include rum, brandy, gin, and whiskey. I suppose that this separation was first made by those who were fond of strong alcohol and were not satisfied with the smaller quantity that is present in wines. At any rate, it is a well-known fact that people usually acquire the alcohol habit by first drinking the weaker fermented liquors, like ale or wine; but in the end they drink the strongest distilled liquors they can get

There are from five to ten parts of alcohol in every hundred parts of fermented cider.

In beer, there are from four to six in every hundred.

In wines, the quantity of alcohol varies from eight or ten up to seventeen parts per hundred.

Whiskey, rum, brandy, and gin contain from thirty to fifty parts of alcohol in every one hundred of the liquor, and consequently produce intoxication much more quickly than does beer or wine.

QUESTIONS.

1. Draw from memory the ground plan of a Roman farmhouse. Isaiah speaks of "treading the wine press." What is referred to? Can you quote a text of Scripture that condemns the drinking of wine?

2. What changes take place in the fermentation of grape juice? What is the cause of these changes? Will similar changes take place in juice that is squeezed out of apples?

3. What further change takes place in fermented grape juice, when it is heated in a "still"? What names are given to different

liquors formed in this way? How do these liquors differ from fermented ones?

4. How is vinegar formed from wine? Ales and wines sometimes become musty, and so disagreeable that they cannot be used. May these changes be caused by other germs getting into the liquid from the air, and producing further changes than are produced by the yeast plant and vinegar plant?

CHAPTER XIX.

NARCOTICS.

Tea, coffee, and cocoa are all drunk, chiefly because they make people feel better by causing the machinery of the body to work faster. For this reason, they are spoken of as stimulants. Alcohol also seems to be a stimulant when taken in small quantities; but in reality it is not. It is more like a poison, and the sleep of the drunken man is almost exactly like the sleep caused by a narcotic poison.

A narcotic poisor is a substance which puts a person into a deep sleep. Alcohol, ether, chloroform, opium, and to a less degree, tobacco, all belong to this class. Used in small quantities, they seem to excite the nerves and stir up the machinery of the body like tea and coffee.

When, however, they are taken in larger quantities, they dull the nerves and finally put a man into a deep sleep like that of the drunkard.

It is not always easy to tell whether a man is in a drunken sleep or in a sleep caused by opium. A few years ago, a divinity student in one of our American colleges was found about 10 o'clock at night lying on the street. The policeman who found him could not awaken him and therefore had him driven to the police station. The doctor who was called looked carelessly at the sleeping man and said "Drunk; he'll be all right in the morning."

The policeman, however, could find no smell of alcohol from his breath, and telephoned for another doctor. This one made a more careful examination, and said he thought the sleep was due to opium. In the morning, friends of the student discovered his whereabouts, and a third and still more careful medical examination, shewed that the man had been stricken down with a fit of apoplexy.

You see, then, that sleep may be caused in different ways. The sleep produced by ether, chloroform, opium, and strong alcohol are all very much alike. In fact, before the days of ether or chloroform, rude surgeons, called bone-setters, used to give a man enough alcohol to throw him into the deep sleep of drunkenness. When in this deep sleep, a broken bone was set or some other operation was carried out on the man.

This, then, is one great difference between alcohol on the one hand and tea or coffee on the other. The latter, if drunk very strong and in large quantity, is very disagreeable. It will make us sick, but it will not throw us into a deep sleep. No doubt you yourselves know some people who take more tea or coffee than is good for them. When they do, they become nervous, their hands tremble, they do not sleep, and they suffer from indigestion ; but, as a rule, few people injure themselves by drinking too much tea or coffee. In the case of alcohol, it is quite different. The drunkard's nerves break down, his hands tremble, he gets indigestion, and does not sleep well, unless under the influence of the alcohol.

A second marked difference between tea and alcohol is that the thirst for the latter becomes stronger and stronger, until at last, it is quite beyond control. It is strong alcohol only that the drunkard wishes, and a small quantity does not satisfy him. If he has the money to pay for it, he does not cease drinking until he is dead drunk. He will sacrifice his wife, children, home, honour, and friends in order to get money to satisfy this craving.

This is true of other narcotics also. The longer they are used, the stronger becomes the craving for them. This is particularly true of opium. Those who become slaves to the opium habit are known as opium fiends, and in this case, just as in the case of drunkards, home, honour, friends are all sacrificed to enable them to indulge a debasing and deadly habit.

QUESTIONS.

1. What are narcotic drugs? Mention the names of some. How can you sometimes distinguish between the sleep of the drunkard and the sleep caused by opium?

2. What drug was formerly used to produce insensibility to pain, before chloroform or ether was discovered?

3. Point out two or three differences between the effects of tea and coffee and those of alcohol. What disease is sometimes caused by drinking much strong tea or coffee?

CHAPTER XX.

HOW FOOD SPOILS.

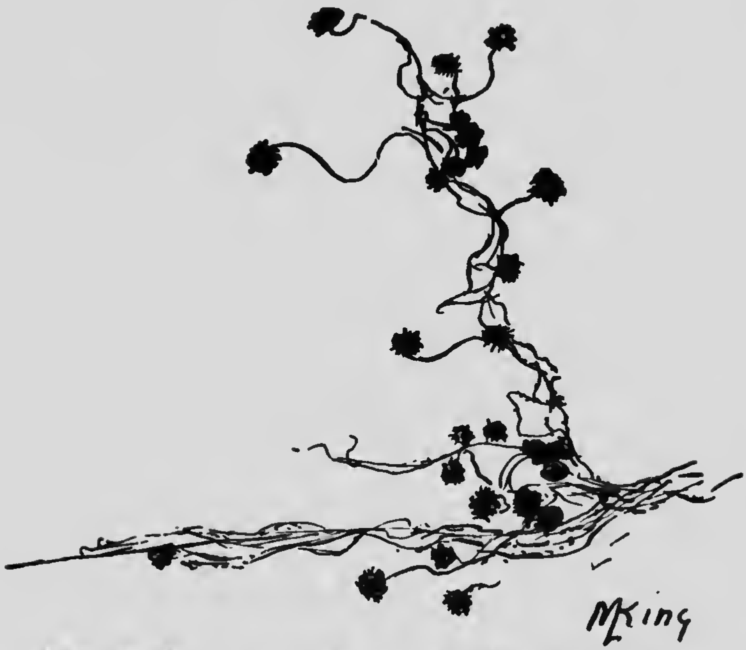


FIGURE 46.—Mould from cheese, much magnified. The little round knobs contain the tiny seeds, or germs, of the plant. These are carried about in the air and when they fall upon bread, cheese, or other suitable soil start to grow.

A few years ago, two women were overheard talking about canning tomatoes.

One of them told the other how she had peeled the tomatoes very carefully, and then boiled them for about half-an-hour. After they had cooled, she poured them into well-washed glass jars, put on the lids, and screwed them down tight. The jars were then carried to the cellar and stored for winter use.

But to her surprise they nearly all went bad. After trying to can them in this way for three years and finding that only a few of them remained good, she gave up trying. In looking into the jars which had gone bad, she found that there was always a whitish scum on the top. They smelt musty also when opened, and they often tasted quite sour. Sometimes also a jar would burst, spilling its contents all over the floor. What was the matter?

The other woman said she had been canning tomatoes and different kinds of fruits for many years, and rarely did any of her jars go bad. She had been careful to wash the fruits and tomatoes so as to remove any dust that might be clinging to them. She had then boiled them for about half-an-hour, and at the end of that time had at once poured them into jars which had themselves been boiled in water for half-an-hour. The covers and rubber rings had also been thoroughly cleansed with soap and hot water. In fact, she had taken great pains to have everything exceedingly clean, and in handling the hot jars and covers she had to use towels so as to prevent her hands from being burnt. Why did her jars remain good?

To answer this question, you must remember what you have read about Pasteur's experiments with soup.

You remember that when he boiled the soup well and took care that no air should get into it, the soup remained good for four years. But, whenever he allowed the air to enter his flasks—no matter how well he had boiled the soup,—it went bad. The germs from the air, falling upon the soup, started to grow and spoiled it.

Now, perhaps, you can tell me what mistakes were made by the first woman in trying to can her tomatoes. Ah! I see you have all discovered where she went wrong. She was not clean enough in her operations, and she should have bottled her fruit when it was boiling hot.

Either the tomatoes were not boiled long enough to kill all the microbes which were sticking to them; or the jars, covers, and rubber rings were not cleaned well enough; or else she delayed so long in canning, after taking the kettle from the stove, that fresh germs fell from the air into the vegetables.

You may be perfectly certain of one thing, her tomatoes went bad because some living germs were enclosed in every jar.

They know these facts very well in factories in which lobsters, salmon, and different kinds of fruits, vegetables, and soups are canned. In these places, however, the canning is more easily done than in our kitchens. Because, after the meats or vegetables have been put into the tins and the covers put on, a small hole is left in one end of the can, and then the cans are all well boiled, usually in steam.

The boiling not merely cooks what is in the tin but kills all microbes that may be either inside or outside of the tin. Then the moment it is withdrawn from the steam, the small opening in the end is covered with solder. The contents are then as safe as were those in Pasteur's sealed flasks.

From all this you will see that microbes spoil our food whenever they get a chance. They settle upon milk and turn it sour, and upon raw meat and make it decay. They attack ripe fruit and cause it to rot, and get into butter and make it rancid.

Our only remedy against them is to kill them and to keep our food perfectly clean. They grow quickly in warm weather and in warm places, but grow slowly, or not at all, in cold places. In summer we should place our milk, meats, and fruits in a perfectly clean ice-box. In winter, there is no trouble in keeping our foods from spoiling, because they can be kept very cool or even frozen. Frozen microbes which lie on frozen food are dormant and cause no decay, but they resume their activity as soon as they become warm.

QUESTIONS.

1. Pasteur proved that microbes were likely to be in the air of all ordinary dwellings. Will they be upon our hands and our clothing also?

2. Name five different things, any one of which might give, in the process of canning, microbes to the canned vegetables or fruits.

3. Write out such clear directions for canning fruits or vegetables, that if the directions are followed, no germs are likely to get into the cans or jars.

CHAPTER XXI.

SLEEPING.

Before giving you some simple rules which you should observe about sleeping, I should like to remind you of what has already been said about the ventilation of your bedroom. It would be better for us all if we had no such rooms in our houses as bedrooms.

"How could we do without bedrooms?" you ask. Very easily. Consumptives who take the open air treatment for this disease manage to get along very well without bedrooms. Not only do they get along without bedrooms, but many of them recover their health, partly because they give up sleeping in bedrooms. And surely, if sleeping in the open air helps to cure consumption, it ought to be good for people who are not ill with any disease.

Here is a picture of a large house in which there are some eighteen bedrooms. It would perhaps be more correct to say that there are eighteen dressing rooms; because, the bedrooms are all on verandahs. The dressing and undressing is done in a small inner room, no larger than the stateroom on a small steamer.

The beds remain on the verandah all summer, in fact each bedroom is a part of the verandah

FIGURE 47.—Large, many-windowed house. Verandah bedrooms.

curtained off. The beds themselves can be withdrawn from the verandah to the dressing-room through a French window; that is, one which opens like a door down to the level of the floor.

In winter the bed is kept in the dressing-room all day. At bed-time, after the person undresses, the bed with its occupant is rolled out from the dressing-room on to the verandah. It remains there all night in the very coldest weather, and in the morning it is rolled back again into the dressing-room. The occupant then gets up and dresses in a warm room.

Hudson Bay trappers often journey for hundreds of miles in winter, and sleep soundly out in the snow, wrapped up in their warm fur robes.

We do not need to sleep in the snow, but there are many reasons why we should sleep on verandahs. It insures that we shall breathe pure air, if the atmosphere in the locality is pure. This will help to make us sleep soundly, and we shall wake up in the morning feeling rested, and fit for our work during the day.

The verandahs in this house are partitioned off, so that each person has a share of the verandah to himself. But in some houses that are used for the treatment of consumptives, there are only two divisions to the verandah, one for female, and one for male patients. Or, there may be separate verandahs at opposite ends of the house.

If you sleep on a verandah in winter, not only should you have plenty of bed-clothing on the bed, but you should wear a cap so that you may not catch a cold in the head.

Do you notice anything striking about the windows in this house? You say they are large, and that there are many of them. What will be the advantage of so many windows? You say they will let in sunshine as well as fresh air, and you are quite right.

All our houses should be well-lighted, well-ventilated, and have verandah bedrooms, but I am afraid such houses will not come into general use until people have learned to obey the laws of health much better than they do at present.

How long should we sleep? That will depend upon a number of things—upon one's age, upon one's health and strength, upon one's habits, and upon the amount and kind of work which one has to do each day.

In the case of children, those of four or five years of age should sleep about fourteen hours; those of six or seven, about thirteen hours; those of eight or nine, about twelve hours; those of ten and eleven, about eleven hours; while those of twelve and thirteen, should sleep about ten and a half hours.

Most healthy adults need at least eight hours sleep; but feeble people, delicate people and people who have been ill for a long time, require much more than eight hours sleep.

Then again, bedrooms should not be kept warm in winter. If, however, your bedroom has a stove or heat coils in it, you should place the bed so that the head may be as far as possible from the heat. In this way the sleeper's feet will be warm and his head cool.

It is a good rule never to go to bed with cold feet. If you do, you will not be able to go to sleep until the feet become warm, unless you are very tired.

FIGURE 48.—Boy in bed. Correct position in which to sleep.

Then as to the bed itself, there should, if possible, be a separate one for each person.

For one reason, people sleep better singly. In a single bed you can curl up comfortably. In any bed in which two persons sleep, especially, if it is a narrow one, you must usually lie straight, and, as a rule, you do not sleep so well in the straight position as in the curved. Besides, if your bed-fellow happens to be restless, tossing and turning from side to side, you cannot sleep well.

The mattress should be smooth, moderately hard, well-aired daily, and well-sunned at least once a week. The pillow should be just high enough to keep the head level when a person is lying on his side. In this position the heart has no extra work to do, and therefore gets rested. A high pillow is objectionable, because the higher the pillow, the harder the heart has to work in order to pump the blood to the head.

Bed-clothes should be warm but not too heavy. Sometimes children are restless and kick off the bed-clothes. This is usually because they are not well or because they are too warm. When thus uncovered, they may catch cold. To avoid this, it is a good plan to make them wear pyjamas in place of the old-fashioned night-gown.

Avoid if possible sleeping on the back. Try to form the habit of sleeping on one side; the right, is the better. Have regular hours for going to bed and for rising. In fact, you cannot begin too soon to live a regular life in all things. By this I mean that you should make out a kind of time-table for each day and follow it as closely as your school time-table is followed by the teacher.

QUESTIONS.

1. How many windows are there in your bedroom? If only one does it allow sufficient sunshine and fresh air to enter? Do you place the bed-clothes at the open windows to get the air during some part of the day? What will be one of the effects of sunning them?

2. Where should the bed be placed so that you may not lie in a draught? If the door is kept shut, do you arrange two openings in the windows, one through which the stuffy air may pass out, and one through which the fresh air may come in?

3. Has your house a verandah on which you can sleep, at least during the summer? Would a tent, with the flaps raised from the ground, be as good a place in which to get fresh air as a verandah?

4. How many hours should children sleep? How many should adults sleep? Explain how single beds are better than double ones? How high should a pillow be?

CHAPTER XXII.

EXERCISE.

Can you recall to mind the changes that took place in the beat of your heart and in your breathing, as you ran that quarter mile race a short time ago? You remember your heart began to beat fast and you could feel it pounding away in your breast so heavily that you thought it might break. Your breathing, too, became quicker and quicker, until toward the end of your race you were gasping for breath. And when you had reached the end, you were only too glad to lie down and rest.

But while you did not often engage in a quarter mile race, you were always ready for a game of hare and hounds and would sometimes in autumn join in a cross-country run of a mile for the pure love of exercise. You came back feeling a little tired, of course, but feeling also that you were the better of your run and the excitement of getting back without being caught.

What further effects had the long run upon you besides quickening the heart beat and the breathing? You say that you became very warm and that the perspiration was pouring down your hot, flushed face. You were very thirsty, also, and you drank two or three glasses of water before your thirst was quenched.

Later on, after you had bathed and rested a little, you felt hungry and ate a very hearty meal. You had been in school all morning and afternoon and felt that some fresh air and the excitement of being chased, were just what you needed. And you were quite right.

Sitting in school all day had tired you very much. You did not know that the blood in your muscles and in the inside of your body was running very slowly. It was stagnating, I might say. You were not suffering any pain, but you were feeling uneasy and fidgety and had an intense longing to get out into the fresh air and sunshine.

And you girls were just as fidgety as the boys. You did not care to take a cross-country run, but you did want to get outside, just as much as the boys; and you had visions of a brisk walk home or of a game of tennis or, a romp with the collie dog, who knew how to play tag almost as well as you did.

What effect do you suppose this exercise—whether in sports, in games, or in work—for some of you have your share of household work to do—had upon your health? Did the quickened heart-beat and respiration, or the hot and ruddy face, covered with perspiration, do you good or harm? Let us try to find out, but, first, you must know that the blood usually moves along the larger arteries at the rate of about ten inches per second.

Now the quicker heart-beat would produce one very important effect. It would send the blood round and round through your body, just so much faster than it would if you were sitting still or lying down.

The heart is just a pump. If you wish to bring water very fast from a well, you work the handle of the pump very fast and you get a larger stream of water. And in the same way, the faster the heart beats, the more quickly the blood is pumped all over the body. Will this be good or bad for you? Let us see.

You remember the two kinds of work which the blood is doing all the time. It sucks nourishment from the food and carries this nourishment to the muscles, and to the nerves, and every part of the body. You remember also that the blood gathers up the dead waste from every nook and corner, and carries it to the skin, lungs, kidneys, and bowels where it is thrust out of the body.

This being the great work of the blood, it is easily seen that the oftener the blood circles round and round, the more likely the body is to be well-nourished by the food, and the more likely the waste is to be all gathered up and passed out of the body.

The blood is like a staff of servants in a big house. The faster the servants work and the more thoroughly they do their work, the better and cleaner the house is kept. So, the more rapidly the heart beats and the quicker the breathing, the faster the blood goes and the better for you; that is, supposing you have healthy hearts and healthy lungs, which all of you young people should have.

Then again, when you get hot from taking much exercise of any kind, the nerves make the blood leave your innermost parts, so that more of it goes to the skin all over the body. This is why your face grows red. And then the blood in the skin stirs up the sweat glands and makes them produce more sweat. Thus, still more of the dead waste of the body is carried out through the skin, in addition to the extra amount that is passing from the lungs.

So you see that exercise is a good thing. It strengthens the heart, and it strengthens the muscles of breathing and all other muscles that come into play in the exercise. It quickens the blood flow, and by so doing, it carries more nourishment into, and dead waste out of, every nook and corner of the body.

If the exercise be not too violent, it can do you no harm, and as I have tried to show you, it does much good. But sometimes young men hurt themselves by overstraining their muscles and nerves. This they do not do in taking their regular exercise. They do it in taking part in athletic contests, in which they wish to come out the victors at all costs.

And sometimes the contests are so keen that young men suffer from their effects for the rest of their lives. They get disease of the heart or blood vessels or other parts of the body, and are never so strong again. All this is, of course, very wrong. Contests in rowing, hockey, football, running, lifting weights, and such like, are all very well when kept within proper bounds; but, like many other good things, they may become a source of great injury.

QUESTIONS.

1. What change takes place in the heart-beat and in breathing when you run fast, or take any violent exercise? When you sit quietly, as in school, what change takes place in heart-beat and breathing? What effect will the quietness have upon the flow of blood through the body? What further effect will this have upon the nourishment of the body and the removal of waste?

2. What organs, or parts of the body, pass out the waste from the blood? Where does the blood get this waste? What proof have you seen, during exercise, that more waste is removed from the body than during rest, or sleep?

3. What danger is there in overstrain during athletic contests? What games or sports have you seen at which there has been overstrain? What bad result might come to a boy from lifting a weight that was too heavy for his strength?

CHAPTER XXIII.

AN INFECTIOUS DISEASE.

Louis Pasteur's name will always be remembered in connection with diseases like cholera and consumption, which spread from person to person.

His study of germs in air helped him immensely in a task which he undertook later in life and which was in reality nothing less than the discovery of how disease is spread from one animal to another.

A disease of the silkworm, called pébrine, was ruining the silk growers in France. It had spread all over Europe, and thence to China. In 1864 Japan was the only country it had not reached.

At the earnest request of the French Government, Pasteur undertook to study the disease, and started in June, 1865, for the south of France where the disease was worst. At this time he had never even seen a silkworm. On arriving there, he was greatly grieved to see the want and suffering which had befallen the peasants, as a result of the wholesale destruction of the silkworms.

Whence came the disease? No one knew. But one of the signs was that the animal became covered with little brown or black spots. The nursery owners spoke of it as a plague or cholera.

You probably all know that the silkworm is not a worm at all. It is an insect, and like some insects which you are familiar with, it passes through four different stages during its lifetime. First, there is the egg stage. From the egg, there hatches out a grub or caterpillar, which is its second stage. The caterpillar eats the leaves of the mulberry, casts off its skin several times, and then passes into the third stage, known as the chrysalis. This is the stage in which the animal lies dormant, being rolled up in a covering of silk, called the cocoon. After remaining quiet in the cocoon for some time, it works its way out and enters upon its fourth stage,—that of the moth. As soon as it has laid its eggs, the moth dies, and the eggs in the following spring hatch out into a new batch of grubs or caterpillars.

We do not grow the Chinese silkmoths in this country, as the French do in France; but many of you must have seen the large American silkmoth. The grub stage, the cocoon, the pupa, taken from the inside of a cocoon, and the male moth are all shown in the accompanying figures.

FIGURE 49.—Grub of American Silkworm Moth, often found upon our oak trees.

FIGURE 50.—Cocoon of the American silkworm.

If you have not seen the big green grub of the American silkmoth, you must surely have seen the grub of the potato beetle. These eat the leaves of the potato, just as silkworms eat the leaves of the mulberry. Some of you also must have noticed the grub of the codling moth, as it was eating its way into an apple; and some of you have seen the

FIGURE 51.—Pupa from inside of the cocoon of the American silkworm.

grubs on currant bushes. All these insects go through much the same stages as the silkworm.

FIGURE 52.—Male Moth of American Silkworm.

By hundreds of experiments, which cost him an immense amount of very hard work, Pasteur discovered that the disease was caused by very tiny microbes which grew chiefly in the bodies of the silkworm and formed the brown spots. He found these microbes in the eggs, in the worms, in the pupa, and in the parent moths. Sometimes he could find them in one stage only. This puzzled him very much, but he worked on.

After a careful examination of hundreds of the animals with his microscope, Pasteur observed that the intestines of the diseased animals were all crammed full of microbes, and of course the waste from their bodies was also. If any of this waste passed from the leaves into the intestine of a healthy worm, as might happen in feeding, then this worm also at once took the disease. Not only did its intestine become diseased, but its whole body.

Another way in which the disease was spread was by one silkworm scratching another with its sharp pointed claws. If a healthy worm, in crawling over mulberry leaves, happened to touch the waste from the body of a diseased worm and then afterwards scratched a healthy worm, this worm caught the disease. The microbes entered the body of the healthy worm through the wound or scratch, and set up the disease.

Still another way in which the disease was spread was by the wind. When the waste from the body, or, when the dead bodies of diseased worms had dried up and formed dust, the disease germs in this dust did not die. On the contrary, they were often whirled away in the wind and settled down on the leaves of the mulberry. This dust when eaten with the leaves, soon gave the disease to healthy worms. And so the trouble had spread until, in one province alone in France, the silkworm industry had fallen off in value to the extent of $1,500,000 per annum.

Microbes which live upon animals, as these microbes did upon the silkworm, are often spoken of as parasites.

QUESTIONS.

1. How did Pasteur's studies of germs in the air help him in his study of the silkworm disease?

2. What marks on the silkworms showed that they were suffering from the disease? In what stages of the animal's life did the disease show itself?

3. In what three different ways did the disease spread? What was the cause of the disease?

4. Where were the microbes most numerous in the bodies of the silkworms?

CHAPTER XXIV.

MICROBES AND DISEASE.

Having discovered the cause of the silkworm disease and how it was spread, Pasteur's next care was to find a remedy. This proved a simple matter compared with his previous labours. In order to stay the progress of the disease, he saw clearly that there must be no disease germs in the moths which laid the eggs.

But how was he to find out if there were? Pasteur depended upon his microscope. At the moment when the moths leave their cocoons and mate, the silk growers were directed to separate them. They were to place each female on a little square of linen. On this, it would lay its eggs. The moth was then to be pinned up on one corner of this piece of linen. When it had died and dried up, the dead body was to be reduced to powder with a little water, and then some of this paste was to be examined under a microscope. If the least trace of disease germs was found, the piece of linen together with the eggs was to be burnt.

Those peasants who were unable to use a microscope were told to preserve a good many of the moths in alcohol after the females had laid their eggs. The Government undertook to have skilled men examine these dead moths afterwards and tell the peasants whether the eggs which had been laid were likely to be healthy or not.

Pasteur's plan worked perfectly, and he was overjoyed at the prospect of being able to save the silk industry of his country. But, perhaps, his crowning joy in all this work was that it opened up the prospect of being able to stop similar diseases among other animals, and especially among human beings.

After his work on the silkworm was finished, he proved that a number of diseases from which human beings suffer are caused by parasitic plants, or bacteria, getting into the intestine with the food or passing into the body with the air, or perhaps, through a cut or scratch. In short, he discovered that some diseases spread among human beings in much the same way as pébrine did among silkworms.

If you will review what you have been told about the spread of the silkworm disease, you will see that it took place in one or more of three ways, namely, (1) by the germs getting into food, or (2) by their being carried in the air, or (3) by their getting into the body through scratches or wounds.

Now these are almost precisely the three ways in which disease germs enter the human body.

Again, if you consider the way in which Pasteur advised the silk growers to fight the disease, you will see that his plan was to separate the healthy from the unhealthy. And this is precisely one of the ways in which to-day we seek to stop the spread of communicable diseases, like scarlet-fever, diphtheria, and small-pox. We *isolate* the sick ones, that is we keep them separate from healthy people.

FIGURE 53.—The germs of Consumption are the very fine curved dark lines on the grey ground.

And now you will probably wish to know the names of some of these diseases. I shall, therefore, make a list of a few of the most common ones :—

Typhoid fever.	Pneumonia.
Consumption.	Influenza.
Diphtheria.	Cholera.

And very probably the following, though it cannot be said that in every case, the special bacterium of each disease has been separated and recognized;

Common cold (Catarrh).	Measles.
Chicken-pox.	Mumps.
Dysentery.	Whooping Cough.

Scarlet-fever and Small-pox are caused, not by parasitic plants, but by equally small parasitic animals getting into the body.

Bacteria grow with enormous rapidity. Many of these plants are so tiny that about 20,000 of them can be laid side by side within the length of an inch. When supplied with plenty of food, one of these tiny plants may increase to 15,000,000 in a day.

Do not imagine, as some people do, that the bacteria which cause disease fly or crawl about on everything. They do nothing of the kind. They usually spread by one diseased animal, or human being giving the plants, or germs, to another.

In the very act of growing in the body, these bacteria produce a poison which causes pain, fever, head-ache, loss of appetite and loss of flesh. Each disease is caused by a different microbe. Some microbes are present in the air; some, in water, milk, food; while some lie on the earth's surface, especially where there is filth.

QUESTIONS.

1. Unhealthy moths produced unhealthy eggs and unhealthy young. Do you think this law might be true for other animals also?

2. How did Pasteur separate healthy moths from diseased ones? Name one or two diseases, in which part of the treatment is to shut people up in a room by themselves, or in a hospital with others who are suffering from the same disease.

3. Name as many diseases as you can which are caused by microbes? How are these diseases spread?

4. If you are suffering from a common cold, what would you do to prevent it from spreading to other members of the family? What does "catching a cold" mean?

CHAPTER XXV.

CONSUMPTION.

As consumption causes more deaths than any other disease in America, it will be well for you young people to study this disease and try to understand how it spreads from one member of a family to another.

While a continued cough, along with paleness and loss of weight, are often signs of the disease, it does not follow that these are always the signs of it. The only certain sign is the germs in the sputum; that is, in the stuff which is coughed up from the lungs. These may be found by any well qualified physician.

And now let me give you an illustration of how this fell disease has often spread from person to person in a large family.

Over forty years ago there lived in Renfrew County, a farmer who had a family of eight healthy children. The mother was a large and very strong woman. The father was somewhat undersized, but, nevertheless, a man of fair average health.

But a time came when he caught a severe cold; in fact, he seemed to suffer from a number of colds. Scarcely had he got well from one, when he caught another. He coughed a great deal and spat upon the floor, without ever once thinking that there was any harm in doing so. Then he slowly grew pale and weak, and as he was unable to work his farm, his wife insisted upon his seeing a doctor.

The doctor gave him medicine for months, but it seemed to do him no good. He grew worse and worse, and, in the course of a year or two, he died.

At the time of the farmer's death, his eldest son was about 25 years of age. Strange to say, at least it seemed very strange in those days, this son caught cold in much the same way as his father did, and before three years had gone by, he too had coughed his life out.

FIGURE 54.—House in which seven persons died of consumption in two years. It had become thoroughly infested with the germs of the disease. The two surviving members of the family moved into a new house, shown in the next illustration, where they have lived for the past seventeen years.

And in the course of a number of years, every child but one in that large family sickened and died in almost exactly the same way. The mother nursed every one of them. Her love and care was unceasing, but it was all of no avail against this terrible disease.

A similar story could be told of thousands and thousands of homes not merely in Canada, but all over America and Europe; and a similar story will be repeated and repeated in the future until you young people preach and practice proper methods of stopping the spread of this disease.

Forty years ago the common opinion about the disease was that it was passed on from parent to child. It was believed that, if one parent died of consumption, one or more of the children were likely to inherit the disease.

FIGURE 55.—House without the Germs of Consumption.

We do not believe this nowadays. We know that a child may inherit delicate lungs or a delicate heart or delicate nerves from a parent; but we do not believe that any child ever inherits consumption.

How consumption spreads from one member of a family to another is now easily understood. The disease is caused by a plant so small that it can be seen only with a very powerful magnifying glass. The plant is usually found in the lungs, but, as a matter of fact, it may start to grow in any other part of the body except the teeth.

In its growth in the lungs, it slowly kills small portions of these organs. These are coughed up daily for months and months, until at last there is not enough of the lungs left to keep the sufferer alive. When those who have consumption are not careful to destroy the sputum with its thousands of tiny plants but deposit it on the floor where it dries up, the dried sputum may be the means of spreading the germs of the disease all over the house.

For you can easily see that the dried sputum will be walked upon and broken into dust. When the floor is swept, this dust, crammed full of the tiny plants which cause the disease, is scattered through the air, gets upon the food, and is breathed by every member of the family. No wonder, then, that once consumption enters a house, it often carries off more than one member of the family.

But consumption spreads in other ways than from sputum. One who has the disease may give it to another by contact, as in kissing. A consumptive mother may in this way give it to a child. Then, too, the germs may be passed from one person to another through using the same drinking cups, forks, spoons, and towels, especially if these articles are not carefully washed. Moisture from the breath in coughing or even speaking, may convey the germs to others.

There is still some dispute as to the part which meat plays in carrying the germs of consumption. We know that cows suffer from a form of consumption which is much like that which afflicts human beings; and we know that milk from tuberculous cows will give consumption to human beings; but whether the meat from such cattle will give the disease to human beings is still open to doubt.

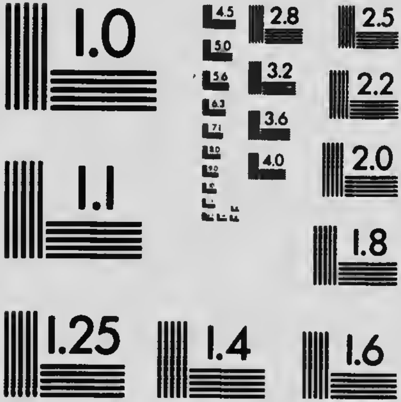
No careful person, however, will use either of these kinds of food if they are known to come from a diseased animal.

The question is sometimes asked:—"Can a consumptive patient remain at home without giving the disease to others"? The answer is "Yes, if proper care is taken."

If the sick one is very cleanly in every way; if he washes his hands and mouth often; if he always coughs into a handkerchief; if he always

MICROCOPY RESOLUTION TEST CHART

(ANSI and ISO TEST CHART No. 2)



deposits his sputum in a paper handkerchief or paper spittoon, so that it can be afterwards burned; if the remnants of his food are destroyed; if the clothing, table linen, dishes, bed linen, and towels are all carefully disinfected by chemicals or in boiling water; then a consumptive person may live for months with others in the same house without great danger of giving them the disease.

FIGURE 56.—A small cheap wooden house, in which a consumptive may live near his own home.

If there is any person in the world who should learn the laws of health, it is one who is in the early stages of consumption. Because, the only hope of curing this disease is in obeying these laws. Medicines alone will not effect a cure. But sunshine, fresh cool air—night and day—much rest, and plenty of easily digested food will, if the disease has not gone too far, cure it in the course of a few months or years.

But do not imagine that a consumptive person can carry on such treatment all by himself. The fact is that in the case of diseases like consumption, which last a long time, the best results can be secured only when the treatment is carried on under the eyes of a skilful physician.

QUESTIONS.

1. Do children inherit consumption from parents? If not, explain how parents may give consumption to children.

2. How do the germs of consumption cause the disease? What should be done with the sputum of consumptives?

3. Specify the different ways in which this disease may be spread. Explain what precautions should be taken in order that a consumptive person may not give the disease to others in the same house.

4. What are some of the signs of this disease in the lungs? What is the only certain sign? How may the disease be cured?

5. What other parts of the body may consumption attack besides the lungs? Turn up in your dictionary the meaning of "King's evil," and of "scrofula."

FIGURE 57.—Three Members of a Temperance Society. From a painting by J. F. Herring.

CHAPTER XXVI.

ALCOHOL AND ANIMALS.

How have doctors found out the proper doses in which to give medicines to men, women, or children?

In the case of medicines that are not poisonous, there would not be much difficulty; because, more or less could be given without much danger of doing any great harm. But, in the case of poisons, like strychnine and arsenic, which are often given as medicines, you must sometimes have wondered how the proper dose had been determined.

How the proper dose was discovered will probably never be known. In the case of new medicines, however (and new ones are being discovered almost every year), how are the safe doses known? In a very simple way. The medicines are first given to animals like guinea pigs, rabbits, dogs. If they die from large doses, then smaller doses are tried. In this way the right dose is soon discovered, and the precise effect which the medicine produces is also noted.

FIGURE 57.—Three Members of a Temperance Society. From a painting by J. F. Herring.

From the effects which medicines produce upon animals, doctors know pretty well what the effects will be upon human beings. This was the way in which Dr. Hodge, of Clark University, Worcester, Mass., sought to find out the effects of alcohol. For many, many years, there had been bitter disputes between temperance workers and moderate drinkers as to whether alcohol injures or does not injure, every human being who drinks it. So Dr. Hodge was asked to study the question.

In May, 1905, he took two puppies, three months old, and began mixing alcohol with their food. These two he named Tipsy and Bum. Two other puppies of the same age were kept in a kennel alongside of the first two, but these got no alcohol with their food. These two he named Topsy and Nig.

During the first six months, the four dogs were weighed once a week; but Dr. Hodge was unable to say that there was any stunting of growth or any increase of fat in the two dogs to which the alcohol was given. But he did notice two or three other effects that were very striking and very important.

For example, he noticed the very thing that some doctors have pointed out in the case of those who regularly drink alcohol; namely this, that drinkers are more liable to catch certain diseases and suffer more from them than abstainers do. When these dogs were two years old, a disease broke out among the dogs in Worcester, and these four took it. But, strange to say, Tipsy and Bum, or shall we say the two drinkers, took the disease much more severely than Topsy and Nig did. The alcoholic dogs nearly died; whereas the other two were scarcely sick at all.

But Tipsy and Bum taught us another lesson. A little instrument, called a pedometer, was tied to the collar of each of the four dogs, for the purpose of finding out how far they walked or ran about each day. You have probably heard that men sometimes carry such instruments in their pockets for the purpose of knowing how many miles they have walked in playing golf or in hunting deer.

Now, Dr. Hodge found out in this way that Tipsy and Bum were not nearly so fond of running about as the two abstainers. In fact, they were always lazy. For every 100 yards that Nig went, Bum went only 71 yards; and for every 100 yards that Topsy went, Tipsy went only 57.

Nor were the two alcoholic dogs able to keep up the running as long as the two others. The four were trained to run after a ball and bring it back to Dr. Hodge, whenever he threw it a hundred feet across the college gymnasium. This test lasted for fifty minutes each day, for fourteen days. Nig and Topsy brought back 922 balls out of 1,400, whereas, Bum and Tipsy brought back only 478 balls.

In short, these two dogs behaved in exactly the same way as drinkers do who work in mines, factories, or mills. Employers tell us that drinkers lose much more time than non-drinkers do, and that they cannot work so hard, nor so long.

Lastly, Bum's improvement in general health and in activity, after he became a teetotaler, turned out to be as marked as in the case of a reformed drunkard. But, it was over a year before this change came about. At the end of this time, his strength and endurance were almost, but not quite equal, to that of Nig's.

So far as could be seen, there was no decrease in the intelligence of the alcoholic dogs. One difference, however, they did show. They were much more timid in the presence of strangers than Topsy and Nig. These would run to meet strangers, jumping about and barking with apparent pleasure; whereas, Tipsy and Bum would slink away in fear. [illegible]tles and bells made them howl, but the[illegible]ls merely made Nig and Topsy prick up th[illegible] ears in curiosity.

QUESTIONS.

1. How is the dose, and the effect of a new medicine discovered? What animals are used for these purposes?

2. For what purpose did Dr. Hodge use Topsy and Nig? Did alcohol stunt the growth of Tipsy and Bum? How do we know?

3. In what three respects did the two alcoholic dogs differ from Topsy and Nig at the end of six months? How was their activity and staying powers tested? What is a pedometer?

4. How did alcohol affect the intelligence, and the courage of the dogs? What improvement took place in Bum after the giving of alcohol was stopped?

CHAPTER XXVII.

THE ALCOHOL HABIT.

Why do people "take to drink"?

It is not because they like alcohol when they first taste it. On the contrary, ales, brandies and whiskies are very disagreeable to most young people. It is only after repeated trials that they learn to like them. If young people, therefore, were guided by the sense of taste, they would never grow fond of alcohol.

Why then do they drink it at all? Usually, for different reasons. Some, because it is fashionable with their companions; some, because they like the excitement which the alcohol causes; some, because they feel dull or fatigued; and some, in order to drown care and worry. The drunkard, of course, drinks because of the intolerable thirst which he has acquired for it and which he cannot resist.

If you will think the matter over carefully, you will see that the liquor habit is acquired just like any other habit. It must have a beginning. It is not full-formed at first, any more than the habit of industry or the habit of idleness or the habit of smoking tobacco. It must be learned.

Every thoughtful person, I suppose, when he makes up his mind that he will acquire some habits and shun others, does so after giving the matter careful consideration. Let me ask you to do the same thing before u allow yourself to drift into the drinking habit

I have great faith in reasoning things out with young people, because I believe that, if I can get them to look at both sides of a question, they will generally choose the right.

Of course, I know that there are a considerable number of silly people who will take their own way, no matter what reasons you give them for acting otherwise. Unfortunately, these people have been born lacking in right reason, just as others have been born lacking strong hearts or sound lungs.

But I hope that there are none such among you young people. You, I am sure, wish to be masters of yourselves. You do not wish to become the slave of any bad habit, and therefore, I appeal to you to consider carefully the evils of the liquor habit before you take one drop of beer, wine, whiskey, brandy, or other intoxicating liquors.

If you were to ask me to tell you of the benefits to be derived from the liquor habit, I could not do so, for I do not know of any. Alcohol is a drug, like ether and chloroform, and like these drugs it can put to sleep those who drink it. It is not a food; nor is it, in the proper sense of the word, a stimulant, like tea or coffee.

As a drug, it is proper that it should be taken only when ordered by a physician. But remember, the opinion of physicians as to the use of alcohol in curing disease has undergone a tremendous change in the last forty years, especially in England. Nothing brings out this fact more clearly than a glance at the bills for milk and alcohol in seven of the large hospitals in London, for the years from 1862 to 1902.

Just compare these two items in the diagram given on next page, and see how the use of alcohol has fallen off, and the use of milk has increased. These figures tell us as plainly as can be, that medical men are losing faith in the use of alcohol for the cure of disease, and are coming to trust more and more to good milk.

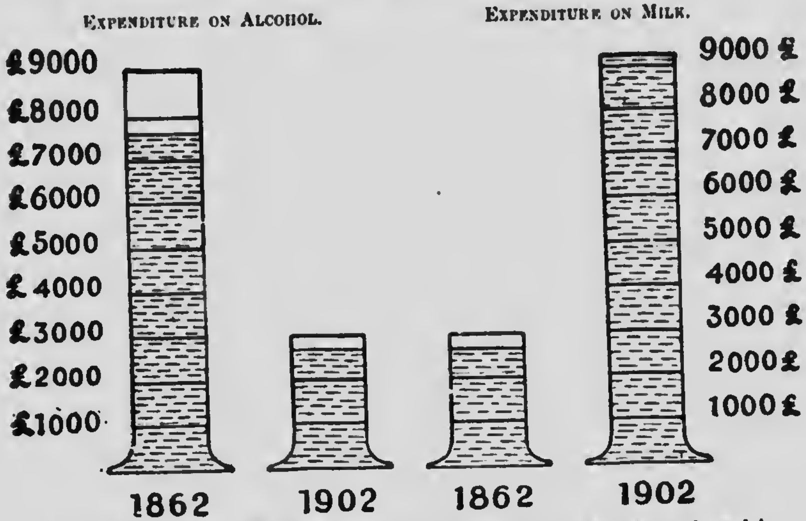


FIGURE 58.—Diagram showing the relative cost of milk and alcohol used in seven large London Hospitals from 1862 to 1902.

Remember, too, that during the last forty years the number of patients treated in these hospitals has largely increased, and you will understand that the amount of alcohol given to each patient now is much less than it was forty years ago.

What then are the objections to the use of alcohol even in small quantities? They are numerous, but I can in this chapter mention only a few. There is, above all, the danger of acquiring the habit. Taking a little is usually followed by taking a little more.

In the next place, look at some of its effects upon the body. In the mouth it blunts the sense of taste. In the stomach it delays the digestion of the food. After long usage it shrinks the stomach and hardens the liver, and weakens the heart, and widens the blood vessels of the skin, as anyone can see for himself in the flushed face of a drinker.

But, by all odds, its worst effects fall upon the brain and nervous system, and, when these suffer, every other part of the body suffers. As you know, the brain is the chief seat of the mind, and whatever affects the brain must affect the mind.

Some people think that a small quantity of alcohol makes their brain work better; that there is a better flow of ideas and greater vigour of thought. But such is not the case. The mental excitement is due to the action of alcohol upon the arteries which supply blood to the brain. These arteries grow larger in diameter after a dose of alcohol and thus allow more blood to go to the brain. The face and neck also, grow red after strong liquor has been drunk, thus proving that more blood goes to these parts of the body.

The extra supply of blood which is thus allowed to reach the brain causes the mental excitement and produces the warm glow which is felt all over the body after taking a strong dose.

But this very excitement, this rush of ideas, is deceiving. It is, in reality, due to loss of control over the mind and usually it does not last over fifteen minutes. "What happens then?" you ask. You can answer this for yourselves. If you have ever watched a man pass under the influence of the drug, you must have noticed that his brain loses its power of working right, and his mind gradually becomes unable to think. For this reason, he is more liable to make mistakes; he can neither see nor hear properly; and if he is in charge of a train of cars or a steamboat, he is much more likely to allow an accident to happen.

Many railroad, manufacturing, and steamboat companies have learned these things to their cost and now decline to employ men who drink.

For example, here is part of an order of the Canadian Pacific Railway Company, to its employees :—

"The use of intoxicants by employees is prohibited. Their habitual use or the unnecessary frequenting of places where they are sold, while not on duty, is sufficient cause for dismissal."

You can see then how foolish it is to allow yourself to use what will certainly be an injury to you in every way. The manly lad is not the one who is persuaded to drink with men, but the one who *knows* better and has the good sense and the courage to say No, when he is urged to drink.

QUESTIONS.

1. What reasons are often given for taking alcohol? What is the only safe rule to follow in regard to its use? How is the alcohol habit acquired?

2. What are the effects of alcohol on different parts of the body? On the brain and nervous system?

3. What proof is there that alcohol sends more blood to the skin? What effect on the mind follows at first from more blood going to the brain? What further effects soon follow these again?

4. How do some railroad and steamboat companies treat drunken employees? Why should they treat their men thus?

CHAPTER XXVIII.

CLOTHING.

The desire to have stylish clothing is so strong in young people that most of you are blind to certain defects in it which often do very great harm. I shall, however, point out one defect which, in my opinion, is most serious, and which injures the health of many young people: I mean that clothing is often too tight.

In all my life I never yet met a person who said that his clothing was too tight. Men never admit that they wear hats, collars or vests which are too tight. They do admit that at times they have been coaxed to buy footwear that was a little too tight for comfort, but the pains which they had to suffer kept them from making that mistake very often.

But, as regards the head, neck and waist, most men and women will claim that they have suffered no pain when wearing hats, collars, and waist gear, and that, therefore, this kind of clothing was certainly doing them no harm, and could not be too tight. They are quite ready to assert that they have seen people who seemed to be wearing very tight clothes, but they themselves never did.

Perhaps, in a matter of dispute like this, one way to see the effect of tight clothing, that is, of pressure upon human beings, is to see how pressure acts upon trees. But you will say that trees are not human beings. No, they are not; but if we see pressure acting upon young growing plants, and changing their shape, perhaps it may help us to understand how pressure slowly but surely acts upon young people, and, without their knowing it, alters the outer shape of the body which we can see, and alters also the shape of organs inside the body which we cannot see.

It is not necessary for you to think of tight clothing as causing pain. As a general rule it causes no pain. The pressure is so slight, and so gradual, and lasts so long—often for months and years,—that young people are not aware of its effects. It is the slow steady pressure that does the harm. If it were painful, it would soon be noticed, and the tight waists or boots would soon be laid aside. The effects are all the more serious, because they are not generally painful, and so the wearer is not aware of the harm that is being done to his body.

Now let us study the effect of pressure upon trees. Select one or two in a field or a clump upon an exposed hillside. First walk round the clump, and notice the branches. If the trees are growing somewhat in the open, so as to catch the wind, you will see that the branches are nearly all leaning in one direction. The uppermost part of the trunks also are leaning over in the same direction.

Long, long ago, the Indians had noticed this strange fact about tall trees, and used it as a means of making their way in a straight course through the forest. The trees in any city park, or farm orchard, show the same bending to one side.

How has it come about that the branches and trunk are inclined to one side? The diagram given below will enable you to understand this. It shows the number of days during which the wind blew from the eight points of the compass for four weeks in July, 1907.

A somewhat similar record is found to be true for June, August and September, for most places in Ontario. This being the case, it is easy to understand how nearly all our trees lean over towards the north-east. The steady pressure of the wind is from the south-west for about half the time, during the summer months. The branches and stems being young, soft, and growing during these months, are easily made to lean over to one side by the pressure of the wind.

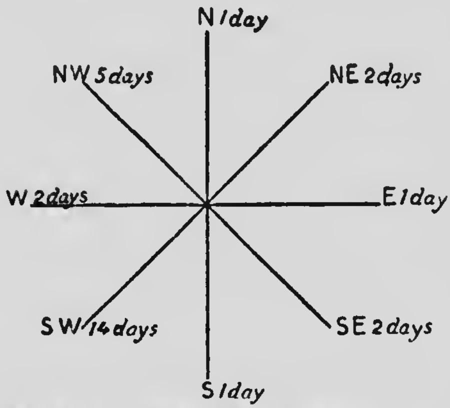


FIGURE 59.—Diagram to show the direction in which the wind blew during July, 1907.

Coming back now to the subject of tight clothing, you will easily see that just as wind presses upon young, soft, growing trees, and alters their shape, so tight clothing, whether vests, belts, or waist-bands, will press upon the lower parts of the chest and alter its shape. The size of the chest is lessened, and the lungs and heart are kept from doing their work properly. The lungs cannot take in as much air as the body needs, and as a result they become more likely to grow the seeds of consumption. The heart has not enough room for its beating, and when a person with tight chest-covering runs or works hard, he soon loses his breath.

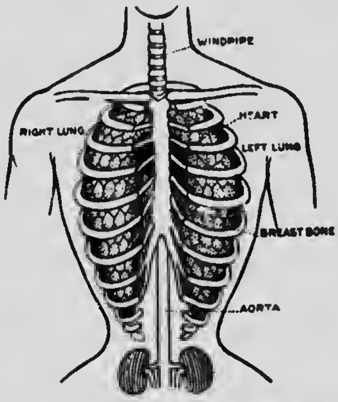


FIGURE 60.—Bones of the chest squeezed and altered in shape by tight clothing. Lungs much compressed.

But these are not the only bad effects of tight clothing round the waist. Tight vests, belts, or bands press upon the stomach and bowels and slow down the blood flow. Excepting in very strong people, this leads to indigestion, to weakness of muscle, poor health, and sometimes to horrible disease inside the body.

The harm done by tight chest or waist garments is not so much in the change in the position of the ribs, as it is to the vital organs which lie inside of the chest and abdomen. Often these become so badly diseased from tight clothing as to cause life-long suffering.

If you would like to understand how the lungs are hampered by tight clothing, just look at the following tables. The first column denotes the volume of air which these men and women passed out of their lungs, after taking a long breath, — the clothing being worn in the usual way. The second column is a similar record; but, in this case, the clothing was loosened so as to allow the chest to expand as freely as possible.

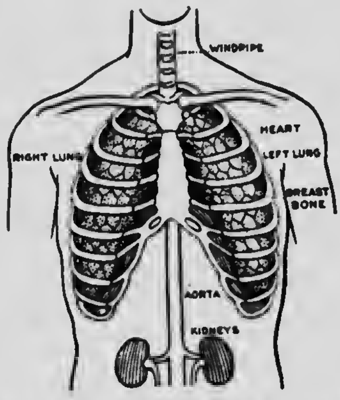


FIGURE 61.—Bones of the chest. Natural shape. Lungs large and healthy.

	Cubic inches.	Cubic inches, clothing loosened.		Cubic inches.	Cubic inches, clothing loosened.
Mr. A.......	218	220	Miss A......	170	190
" B.......	220	225	" B......	110	135
" C........	220	230	" C.......	100	150
" D........	220	225	" D......	138	143
" E........	225	235	" E......	185	193
" F (a foot-baller who wore loose clothing)...	278	280			

You see they were able to take in from 2 cubic inches to 50 cubic inches more air with loose clothing, than when it was worn in the usual way; and yet not one man or woman among them would admit that his or her clothing was too tight.

Quite apart from the poor circulation, consider what a loss of oxygen the blood must sustain every day in the case of boys and girls, and men and women who wear tight clothing. The loss of oxygen is, of course, not so great as these records seem to show, because, the breathing was forced. But, all the same, tight clothing must interfere with regular breathing, and in the end health and strength will suffer. This is particularly true in the case of growing children.

QUESTIONS.

1. From what direction does the wind blow most frequently in Ontario, during the Summer? What effect has such prevailing wind upon young trees?

2. How do we know that tight clothing alters the shape of some parts of the body? How do tight shoes affect the shape of the feet?

3. What effect has tight clothing upon the shape of the chest? Upon the waist? How will it affect the circulation of the blood above, and below the waist? If the blood cannot circulate freely through the stomach and intestines, how will the nutrition of the body be affected?

CHAPTER XXIX.

CLEANLINESS AND PURE WATER.

Knowing that infectious diseases are spread by means of germs, growing either on the body or in the body, it will be at once clear to you that you should follow certain rules, if you wish to stop the spread of these diseases.

Briefly, you should seek to control disease germs by cleanliness of person and clothing, by cleanliness of food, milk and water, by cleanliness of houses and furniture, and of everything you touch or handle.

Day schools, sunday schools, churches, street cars, railway cars, crowded places of every kind, are nests from which infectious diseases are widely spread.

He would be a bold man indeed, who would venture to tell you young people how your homes should be kept clean. No one, however, will object if I call attention to your schoolroom, for the purpose of helping you to decide whether it is as clean as it should be.

Your schoolroom is, of course, swept every evening and dusted every morning. As to scrubbing,—that is done in a very few schools once a week, in a few more schools once a month, and in the vast majority only once in a long time.

Are our schools, then, clean enough to keep down the disease germs which are always found in dust? The trustees have to pay for the cleaning, and no doubt think your school is clean. But you young people, who spend six hours a day in it, have as much interest in knowing that it is clean, as any board of trustees can have.

The school regulations require the trustees to have the floors washed quarterly, and advise that the washing be done monthly. Is this often enough?

In order to get some standard of cleanliness, let me ask how often a kitchen, or dining-room, is cleaned in a clean home, and then consider whether a schoolroom should not be kept equally clean. It seems to me that a school should be kept cleaner, because there are many more children in it than in a kitchen, and they bring in much more dust and dirt.

How often is a kitchen swept, dusted and washed? In many homes the sweeping and dusting are done once a day, and the washing once, twice, or even three times a week. If this is necessary in keeping a kitchen clean, surely our schoolrooms should be swept and dusted once a day, and washed three or four times a week. Some of you may object that this is a pretty high standard of cleanliness; but surely no standard can be too high, when we wish to control the spread of disease, and bring up healthy children.

But you will tell me that some school-houses are much harder to keep clean than others. That is quite true. Old school-houses in which the floors are full of gaping cracks—uneven, rough and generally made of pine boards—it is almost impossible to keep such floors clean. The dust of many feet has filled the cracks full, and the broom in sweeping, raises this dust again and again into the air.

FIGURE 62.—Floor full of cracks.

One step, therefore, towards getting clean schools is to have good floors, walls and ceilings. As recommended in the school regulations, floors should be made of hardwood boards, so closely laid together that, if possible, they will not harbour one particle of dust. Such floors are easily kept clean with a brush-broom. Moreover, they are easily washed. But, in dirty old schools—some of them almost as dirty as ordinary stables—one consumptive child may give the disease to half-a-dozen.

FIGURE 63.—Brush-broom.

The germs of consumption are sown oftener in childhood than in middle life. Children are more liable to take infectious diseases than adults are; and, as they cannot care for themselves, parents and trustees should see to it that school-houses are kept very much more cleanly than they are at present.

Cleanliness of person, homes, cellars, drains, outbuildings and yards, is important; but the question of pure water is much more important.

Only through plague and much sickness have we slowly learned that there is danger in drinking filthy water. The filthy water may come from a well, river or lake; it may be living water or stagnant; it may fall from the clouds or rise from the bowels of the earth; but, in all such cases the water is dangerous to drink, if it has become in any way polluted by filth.

Let me illustrate this by telling you the story of an outbreak of cholera that took place in 1854, in St. James' Parish, Westminster, London. Seven hundred people died of the disease, and many others left the city in terror of their lives. The disease was worst around what was known as the Broad Street well. From this a large number of families drew their daily water supply. At that time London had no water system such as it has now. Wells were the only source of supply.

Within the area supplied by the Broad Street well, there were two places in which there was little or no cholera. One of these was a brewery employing 70 men, among whom there was no sickness; the other was an almshouse with 535 inmates, among whom there were five deaths from the disease.

Dr. John Snow and the Rev. H. Whitehead noted these two exceptions, and noted also that both these places had wells of their own and that the inmates rarely, if ever, took water from the Broad Street well. Later on these gentlemen discovered that the Broad Street well had become polluted by soakage from a privy vault. A short time before the outbreak this vault had received the discharges from a man who was known to have had cholera. The well had thus become the means of spreading the disease among those who had drunk the water.

Ever since 1854, the distrust in wells as a source of pure water has grown so much, that people in cities and towns have given up using wells altogether, and have laid miles and miles of iron piping under ground so as to bring in water from places where it is not likely to be polluted by filth.

Even in remote country places people are growing more and more careful about their well water. And well they may. Because, in many rural districts in Canada and in the United States, there are outbreaks of typhoid fever every autumn.

This usually means that the germs of this fever have passed into wells with the surface water, either by leaking in at the top, or by soaking through polluted soil. Soakage through the soil, however, so as to pollute wells is not common, because in the very act of soaking through the soil, the water is purified. The disease germs in the filth are generally caught in the soil and never reach the well.

But soil does not always keep back disease germs in surface water. This is well illustrated in an outbreak of typhoid fever that took place in July, 1888, at the Kinsley Iron Works, Canton, Mass. No fewer than fifty men fell ill with the disease.

Some twenty of them were what are known as walking cases, that is, they were sick at their stomach, had headache, pain in the back, diarrhoea and slight fever but were able to walk about. These all got well after about a week's illness.

About ten or eleven others were more seriously ill. These were in bed with a high fever. The other symptoms were all more severe, but even these recovered in about two weeks.

All the rest of the cases were those of well-marked typhoid fever, lasting from four to six weeks. One man died.

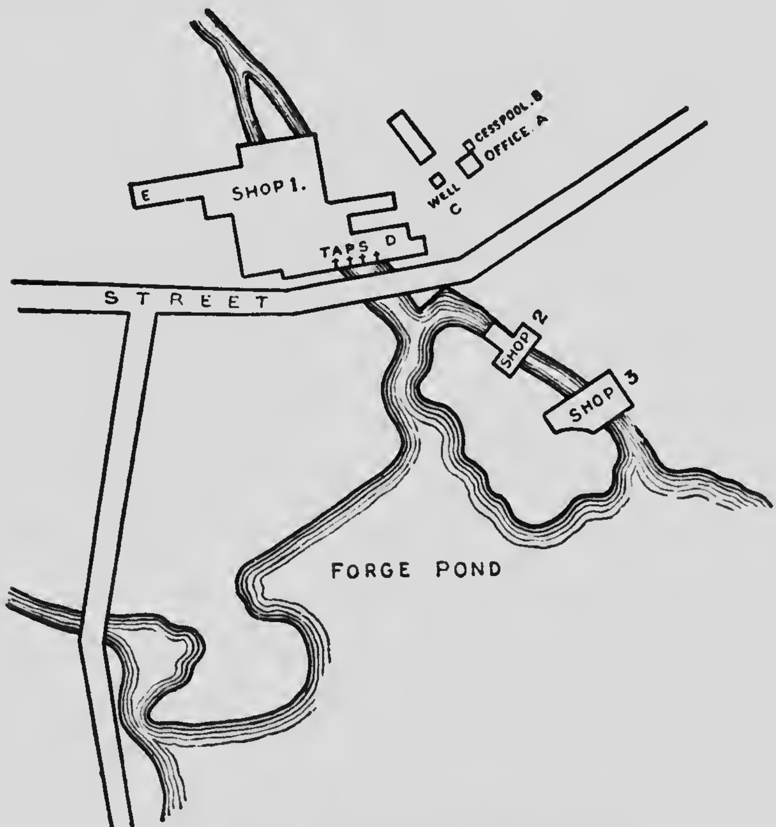


Figure 64.—Plan of the Kinsley Shops and Grounds.

The men who were taken ill were nearly all employed in the shop marked No. 1 on the plan. Of these employed in shops Nos. 2 and 3, only one man grew ill. None of the wives or children of these men took the disease, and therefore the doctor believed that the cause of the fever must have been located somewhere in the workshops.

The chief source of the drinking water used by the men was a well close to the main shop and marked C on the plan. Now and again water from taps marked D, and from the spring marked E, were used.

The facts all pointed to the source of the typhoid fever being in the well C. Note the position of this well, of the office A, and of the cess-pool B, in relation to each other. In order to help you to understand the relation of these three places, look at the accompanying drawing.

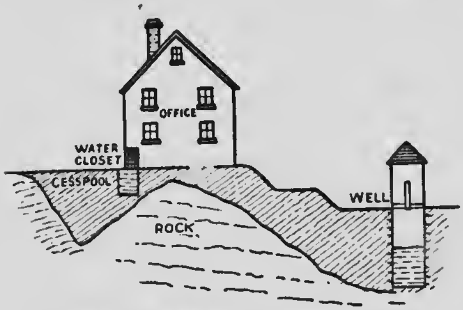


FIGURE 65.—Relation of the Kinsley Office to the well.

While the cess-pool of the privy closet is distant from the well 54 feet, yet you will notice that the former is at a higher level than the well.

The cess-pool is also separated from it by a ledge of rock which would seem to prevent any soakage from the one to the other. But, on making the proper tests it was found that the water in the cess-pool did soak through cracks in the rock, thence through the soil, and finally into the well. Were there any of the germs of typhoid in this water?

In order to answer this question, we must if possible learn something of the history of the cess-pool.

Let us remember that typhoid germs can come only from typhoid germs. The water in any well may be very bad and therefore unfit to drink, but it will not cause typhoid unless the germs of the disease are present in the filthy water.

From the Kinsley well, no fever could arise unless the typhoid germs had been present in the cess-pool, and had afterwards passed through the cracks of the rock and into the well.

It turned out on inquiry that one of the persons employed in the office had had an attack of typhoid fever the previous autumn. He was at the office and felt ill for several days, and finally called in a doctor. His case turned out to be a genuine one of typhoid fever and lasted about six weeks.

Here then was the cause of the typhoid outbreak among the men. The germs had lived over the winter; had been carried by the water from the cess-pool to the well, and, getting into the stomachs of the men in their drinking water, gave them the disease.

This is no solitary case. Thousands of wells all over America become polluted with filth containing typhoid germs during the early autumn months. People who drink water from such wells are soon ill with typhoid.

Sometimes the germs are communicated to milk from the drops of water which remain in a milk-can, after it has been washed with water from a polluted well. The germs grow very rapidly in the milk, and when people drink such milk they often take the disease.

Typhoid fever is much more prevalent in country districts than in towns or cities.

QUESTIONS.

1. Is your school-yard, outbuildings and schoolroom clean? How may ordinary sweeping help to spread disease? How should dusting be done?

2. What is meant by filthy water? In what different ways may typhoid germs get into wells? The sewage of one town is often passed into a river. How may this affect the inhabitants of another town situated lower down the stream?

3. How would you explain the fact that visitors at summer resorts sometimes return to their city homes ill with typhoid fever?

CHAPTER XXX.

PURE MILK.

Milk can be a perfect food, only when it is fresh and clean. When infected with disease germs it may become a very dangerous food. Of course, those of you who have lived on farms know a great deal about cows, about the stables in which they are kept during cold weather, about pails and milk cans and milk-houses. Most of you know a good deal about wells and pastures. But it often happens that just because you have seen a thing day after day for years, you think you know all about it, when in reality you have much to learn, and I am quite sure there are a good many things about milk that you young people do not know.

Let me test your knowledge. How many of you can tell why milk turns sour, sometimes in a few hours, in summer? Why does sour milk become half-solid, or jelly-like? What gives milk the animal taste which it often has in winter? What causes milk to have a musty smell, even when it is not sour? How can it be kept from souring? How is it that Farmer Jones' wife makes better butter than Farmer Brown's? Is it because her cows are better, or because they are better fed, or are kept in cleaner stables? And there are many other questions which I might ask you, and which I am sure you could not answer.

Some people tell us that thunder turns milk sour. But this cannot be true, because, if thunder turns milk sour in July, thunder ought to turn it sour at other times in the year. Thunder often occurs early in the spring, or late in the autumn, but it never turns milk sour in these seasons. Then, again, milk turns sour when there has been no thunder at all. Heat may be the cause, you say. This is much nearer the truth, but heat is not the cause. Heat helps on the souring, but the souring itself is caused by something in the milk. You are no doubt astonished at this. What can possibly be in the milk? You have yourself often seen the milk-pails well washed with soap and water, rinsed afterwards with boiling hot water, and then with cold. You tell me that nothing could have entered the milk from the milk-pail.

But what about the cows themselves, and the barnyard, and the stable? Have you ever seen barnyards covered with filth and mud a foot deep? Have you noticed the ceilings of the cow stables hanging with cobwebs, dust and chaff?

FIGURE 66.—Pure milk cannot be had from such a filthy stable and yard.

Did you ever see filth on the sides, flanks, or tail of the cow, especially during the winter months? Did she whisk her tail about, when she was being milked, and switch some dirt into the pail?

Moreover, did you notice whether the milker's clothes were perfectly clean or not?

Recall to mind what you have learned about dirt and bacteria, and you will soon realize that if any dirt enters the milk from any source—from the milker's hands or clothes, from the milk-pail or the stable, from the cow's udder or teats, then this dirt, containing as it does many kinds of bacteria, will sow bacteria in the milk. These bacteria in warm weather grow rapidly and soon turn the milk sour, and sour milk is bad for everyone who drinks it. It is especially bad for babies, and causes illness and death among thousands of them every July and August.

Milk is a splendid soil in which to grow bacteria. The warmer the weather the faster they grow, and the more quickly the milk turns sour. In mid-winter it sours very slowly. If it freezes, it will not sour at all, because, the bacteria do not grow in the cold.

From what has just been said, it follows that, if we desire to keep milk sweet, we must do two things: we must keep it free from dirt of every kind, and we must keep it cool.

QUESTIONS.

1. What is the cause of the souring of milk? Why is milk sometimes musty, and sometimes slimy or ropy?

2. How would you explain the fact that one farmer makes good butter while another makes bad butter?

3. Explain how bacteria may get into milk. Write out clear directions for obtaining pure milk, supposing that the cows are well fed and healthy.

4. What effect has sour milk on babies in summer weather? How can this be avoided?