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LIPPINCOTT'S PHYSIOLOGY



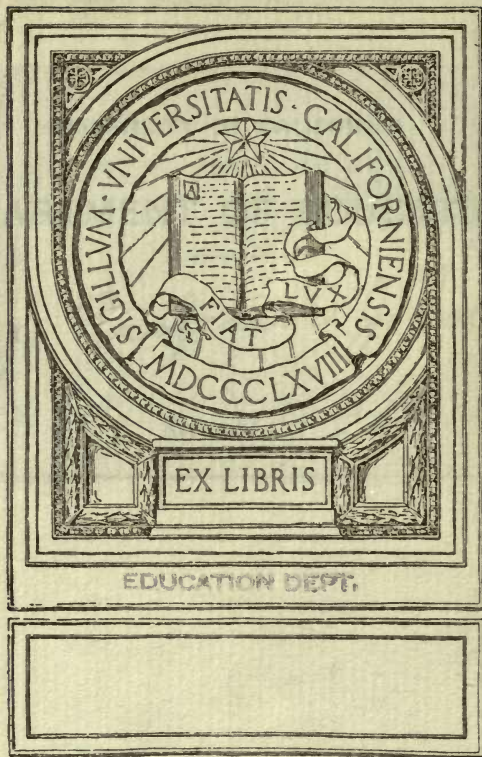
FIRST BOOK

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LIPPINCOTT'S PHYSIOLOGIES

THE FIRST BOOK
OF
ANATOMY, PHYSIOLOGY
AND
HYGIENE

OF THE HUMAN BODY

FOR PUPILS IN THE LOWER GRADES

BY

J. A. CULLER, Ph.D.

PROFESSOR OF PHYSICS IN MIAMI UNIVERSITY, OXFORD, OHIO



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PREFACE



WHAT to present and how to present it is the chief concern of the teacher of physiology in the lower grades. Without a book, the work in this subject is apt to be neglected or only fragmentary.

As soon as a pupil has learned to read fairly well, he can profitably use a primary book in physiology. Such a book should make the study of the subject interesting, definite, and systematic.

The aim of this book is to supply such a need. The language and manner of expression are such as children can understand. The simple facts only are presented, much being left unsaid, and yet definite and direct information is given as far as it goes. The ability of children to understand a subject such as this is often underestimated.

Boys and girls are always more interested when they are given something to do along with the study of the book. In several places in this book directions and suggestions are made to this end, and we suggest that the teacher add to the list as time and opportunity permit.

One aim in this book is to get the pupil to feel that he is studying about himself. If he can be made to realize, as far as a child can, how wonderfully and delicately his body is made, so that he begins to wonder and admire, then the great aim of this early study is accomplished. This counts for much more than nomenclature.

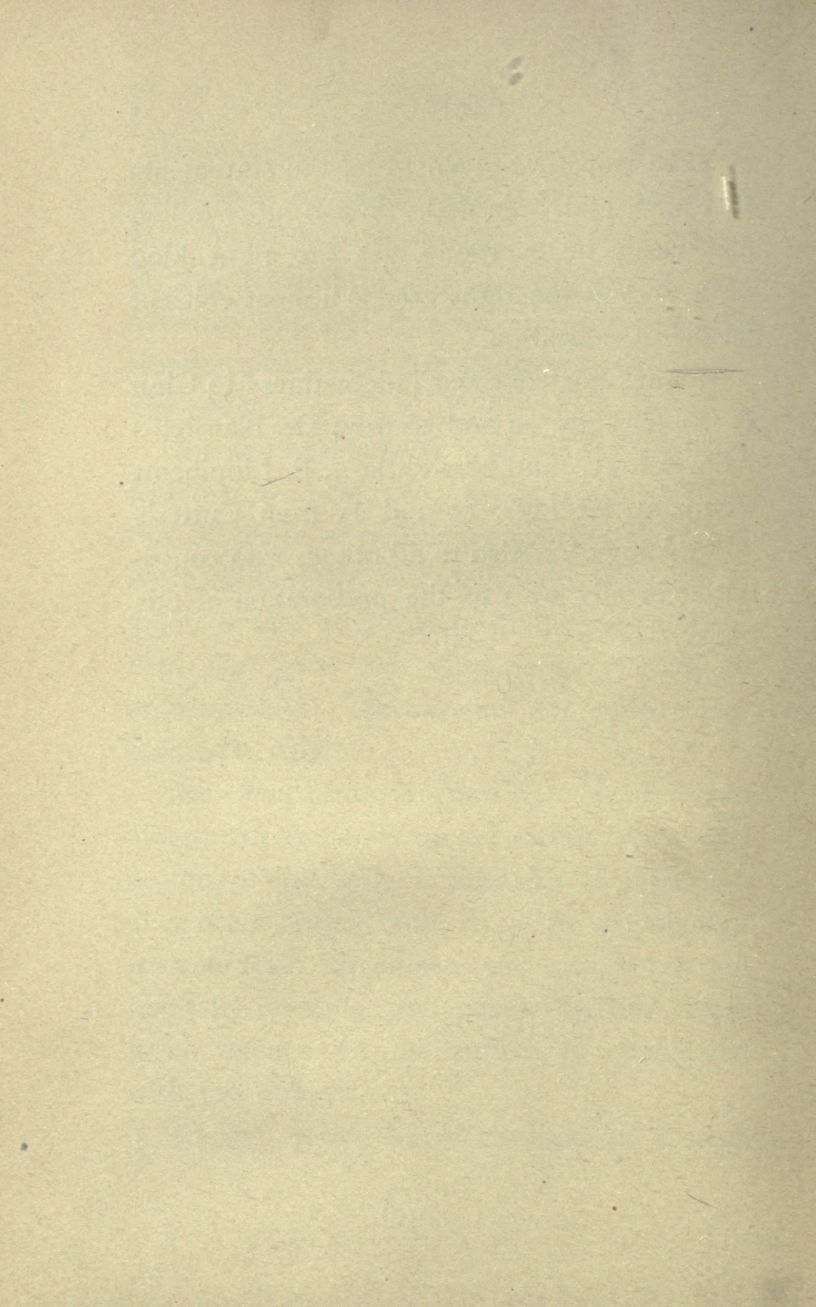
The effect of alcohol and narcotics is given along with the study of the various parts and organs of the body. The evils of intemperance are a proper study in public schools that seek to train up citizens who will be strong mentally, morally, and physically, and there is no excuse for its neglect in connection with this subject.

Several stories based on facts of history

or experience are given to fix the statements that have just preceded. While story-telling may easily be overdone, yet the right kind of a story at the right time is a most efficient means of education.

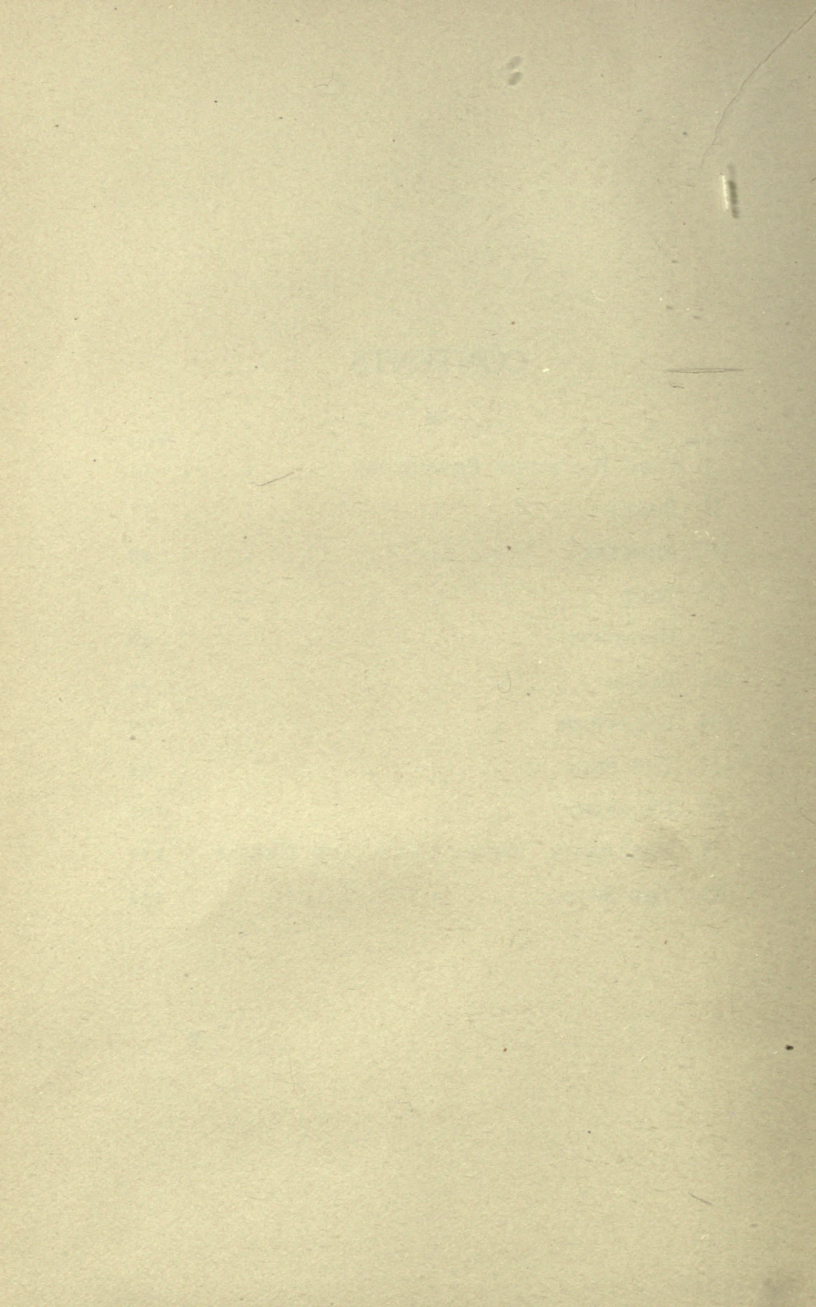
We acknowledge our indebtedness to Ginn & Co. for Figs. 24 and 30 from Dr. Blaisdell's "Physiology," and also to the J. B. Lippincott Company for Figs. 15 and 25 from Cutter's "Physiology." Also to all others who contributed in any way to the preparation of this book.

J. A. C.



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FIRST BOOK OF PHYSIOLOGY

CHAPTER I

WHY WE STUDY PHYSIOLOGY

This book should be very interesting, for it is all about ourselves.

We ought to know something about our bodies, so that we may be able to take care of them.

Every boy and girl wants to grow up strong and healthy.

There are some things that are good for us, and we ought to know what they are; then there are other things that will make us weak and sickly, and we must know how to avoid them.

Here is the picture of a young man who has always taken good care of his health.

You can see that he is strong.

He can do a great deal of work without getting very tired, and he is always in good humor and is happy.

People like to do business with him.

He is getting along better in the world than some others who had an equal chance, but did



1.—A healthy body.

not care for their health when they were younger.



2.—Two pots of flowers.

In the second picture you see two sets of plants. One of them is far ahead of the other, and yet they had an equal start. For a while

at first we could not see any difference between them.

The larger bunch grew in rich ground and had good air and sunshine.

The other one was planted in poor ground and so it could not get enough food, and it was in a place where it could not get the right amount of light.

It is no fault of these small plants that they are not as strong and large as the others, for they could not help themselves. But it is often the fault of boys and girls and men and women when they are not healthy, for either they did not know what they ought to do or else they did not do it.

Most people who are not healthy have nobody but themselves to blame.

The doctor may be able to help us when we are sick, but he cannot keep us well. We must do that ourselves.

When you know what a wonderful body you have and how nicely it works, you will surely do all you can to help it and nothing to hinder it.

There are three things that we will study in this book.

First, we will try to learn what the different parts of the body are and what they are like.

Second, what these different parts will do for us.

Third, how to care for all the parts of the body that they may do their work well.

You have all at some time taken a ride on a railroad train. You noticed that the train was pulled along by a great engine in front.

Up in the engine sat a man who was called the engineer. Now, what kind of a man do you think would make the best engineer? I think you would all say it would be the man who knew all the parts of the engine and what each part should do. But, most important of all, he should know how to manage and care for his engine so that it will pull the train swiftly and safely from town to town until it reaches the end of its journey.

These engineers go to school and study hard to learn how to manage their engines. Certainly we should be willing to learn the best way to use and care for our bodies so that they may do *their* work well.

The different parts of our bodies do different kinds of work.

No doubt you have all seen a printing-press at work. Maybe it was printing one of the papers that the boys sell on the streets. You

saw that there was a strong frame of iron to hold all the parts of the press in their proper places. One part of the machine drew in a large sheet of white paper. Another part spread the ink on the type. Then a large steel roller pressed the paper down on the metal letters. Then another part of the machine took the printed paper and folded it up ready for the boy to take under his arm and run out into the street to sell.

You noticed that there was a great number of wheels and levers and rollers.

Each one had its own work to do, and all these parts had to work together to make one complete machine called the printing-press.

If any one part failed to do its work, then the whole machine would have to stop till this part could be fixed.

In the same way our bodies are made up of many different parts, and each part has its own kind of work to do. We have a strong framework made of bone, and this holds the other parts of our bodies in their proper places.

The heart has nothing to do but make the blood go around and around through the body. The lungs only breathe in the air which we need. Our muscles move us about

from place to place. Our minds think. Our eyes can do nothing but see. Our ears can do nothing but hear.

There are a great number of parts in the human body, and when they all work together and each part does what it ought to do, then the body is in good health.

The man who owns the printing-press that we just talked about takes good care of it, so that it may last a long time. Every boy and girl should know how to take care of their bodies, so that they, too, will be strong and will last a long time.

In the next lessons we will try to learn some interesting things about this body of ours.

Questions.

1. Why can a man get along better when his health is good?
2. Tell about the two pots of plants.
3. How is physiology a useful study?
4. What three things are to be studied in this book?
5. Tell about the engineer on a railroad train. How did he learn to manage his engine?
6. Tell how a printing-press works.
7. How are our bodies like a printing-press?
8. When is the body in good health?
9. Name some things which you think are good for the health.
10. Name some things that do the body harm.

CHAPTER II

THE BONES

EVERY animal has some kind of a framework to hold its body in shape and to make it strong. Some have this framework on the outside and some on the inside. A crab has no bones on the inside of its body, but it is covered by a hard crust. An oyster has a strong, hard shell on the outside of its body. A turtle has a strong shell on the outside and also bones on the inside.

A man and all the larger animals have their framework on the inside.



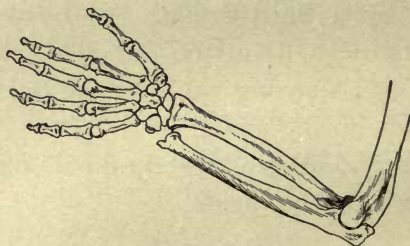
3.—The framework.

You see in the picture the framework of a monkey. The monkey is a very lively crea-

ture, and can climb a tree or jump a long way from limb to limb; but if he did not have this framework of bone he would be nearly as slow as a snail.

We have inside of our bodies a framework of bone much like that of the monkey, only our bones are larger and stronger and we stand up straight.

Let us try to find some of the bones of our body. How many bones have you in each



4.—Bones of hand and arm.

finger? How many in the fingers and thumbs of both hands? Can you feel any bones in your wrist? Try. You see in the picture that you have two bones above the wrist and these run all the way to the elbow.

Feel for them in your own arm. Count the bones of the wrist as you see them in the picture.

Feel for a bone in your arm above the elbow.

There is only one bone here, but it is a long and strong one.

Try to find your collar-bone and your shoulder-blade. You can easily find your ribs, for they are near the outside and extend from the backbone around the body to the breast-bone in front.

In the leg is the largest and strongest bone in the body. It is between the hip and the knee.



5.—The femur.

In the picture you can see how it looks. This bone needs to be strong, for it has to hold up the weight of the body, and also any other weight that a man may carry in his arms or on his shoulder.

From the knee down to the ankle there are two bones again, just as we found two in the arm lying side by side.

The bones of the ankle and foot are about like those of the wrist and hand.

Kinds of bones.

There are about two hundred different bones in the human body. Some of them are called *long* bones, and this is the kind you have in your arms and legs. Some are called *short* bones. You have these in your wrist and ankle. Others are the *flat* bones, such as are found in the skull and the shoulder-blade. The *irregular* bones form a fourth kind. These are such as the jaw-bone and backbone.

Bones are made in a great many different sizes and shapes so that they may fit in where they belong and may be most useful to us.

Joints.

You can see that it would not do to have only one long bone in the arm or leg, for then we could not bend the arm at the elbow or the leg at the knee.

You have counted and found that there are many bones in the hand, and so there can be many joints. Our hands are very useful to

us because they have so many joints and so can bend in so many different ways.

Bend your arm at the elbow. You find that you can bend the arm in and out, but you cannot bend it sideways. The elbow-joint acts much like the hinge on a door, and so it is called a *hinge-joint*. The knee is the same kind of joint.

Now swing your right arm about, using the joint at the shoulder. Feel with your other hand and see if you can tell how this joint works. Try this at home where you can take off your clothes. This is called a *ball-and-socket* joint. The same kind of joint is found in the hips. In picture 5 you can see the ball at the upper end of the bone.

Our backbones are made up of thirty-three different bones placed one on top of the other. This allows us to bend the body forward and backward or sideways.

How would you have to act if the backbone were one long, solid bone?

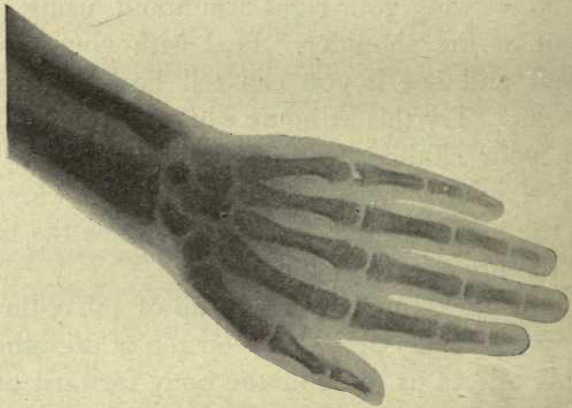
How the joints are made.

Where the bones come together at the ends they are bound by very strong bands to keep them together and in their right place. Sometimes a bone is pushed out of place by acci-

dent, and then the doctor has to be called in to set it right.

In children a very soft cushion is found between the ends of the bones at all the joints. This is called cartilage.

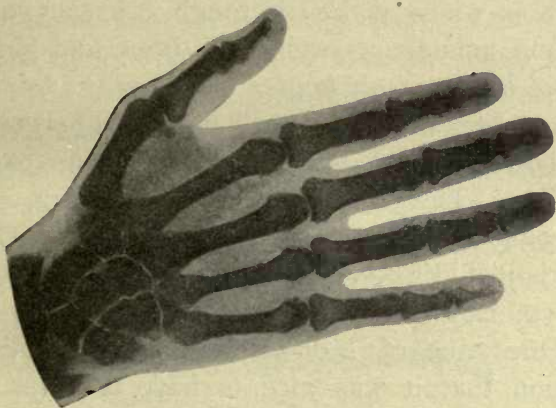
In older persons this cushion of cartilage is not nearly so thick, but the bones never come close together.



6.—Bones of a boy's hand.

This is a picture of the hand of a boy who is ten years old. You see there is a wide space between the bones in the wrist and at the joints of the fingers. These spaces are filled with soft, tough cartilage. Some of the cartilage is turning to bone, as you can tell by the thin buttons of bone which you see in each joint.

By the time the boy is about fifteen years of age these buttons will grow thicker, and will fasten themselves to the end of the bones, and then the hand will be as you see it in picture 7.



7.—Bones of a man's hand.

Between the many bones of the backbone there are soft cushions of this sort. They act like the springs under a buggy, and prevent any sudden jolting of the body and head when we walk or run or jump.

What bone is made of.

If you will try you can find a large bone out in a field or in a boneyard. Look at it closely. You will find that it is very hard and is hollow.

When it was alive it was filled with a fatty substance called marrow.

Also, get a piece of fresh bone from your butcher. Try to cut it with your knife. You find it very hard, but it has soft matter mixed with it which makes it tough. In all very young animals, as well as in boys and girls, there is more soft matter than hard. As we grow older the bones get harder and harder.

The substance that makes the bone hard is lime. The bones of small children are soft because there is not much lime in them. The ear is just like bone, but it has no lime in it, and so you can bend your ear without breaking it.

One tribe of Indians had a very foolish notion that it was nice to have the tops of their heads flat. So when their children were very young they would press a board down on the tops of their heads and tie it there till the bones of the skull would get lime into them and then they would stay flat.

You can see that you ought to be very careful how you stand and sit and dress while you are young. After a while the bones get hard and then you cannot change them. Boys and girls should stand straight and sit up straight and keep their shoulders up. It looks much better, and it is better for the health.

Something for you to do.

The next time you have chicken for dinner save the long bone of the chicken's leg and put it into a bottle. Pour in enough water to cover the bone. Then pour in about three tablespoonfuls of muriatic acid. Leave it there for one day. Now take the bone out and you will find it so soft that you can tie it into a knot.

The acid has eaten away all the lime and left all the soft part. Try it. In the picture you see the rib of a lamb that was treated that way and then tied into a knot.



8.—Bone tied in a knot.

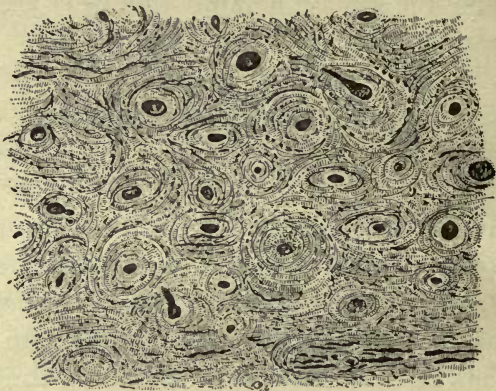
Now get a bone that has been used in making soup. Put it into the stove with the hot coals and leave it there for a few hours. Then take it out and you will find that all the soft part has been burned away and only the lime is left. Try it.

Broken bones.

The bones of grown people are hard and strong, and yet they will bend a little. In children they will bend a great deal, but are

often broken. Bones are often broken by a fall down-stairs or from a tree, or by slipping and falling on a leg or arm. When this happens a surgeon must be called in to set the bones in place again. You must then keep the broken part very quiet for three or four weeks or more until the broken ends grow together.

If you have good health and are careful the ends will grow together again, but the bone will never be quite so good as it was before.



9.—Cross-section of bone.

How bones grow.

The bone is alive just like flesh and other parts of the body. The picture shows how a thin slice of bone looks in a microscope.

The slice was cut across the bone. You see that it is full of small holes. Blood-tubes pass through these holes and carry blood to all parts of the bone. That is the way the bone gets its food.

Now you can see that the blood should have in it what the bone needs. If the bones cannot get from the blood the kind of food they need, they will not grow and make a strong framework for our bodies.

Things that harm the bones.

You have just seen that the bone is alive, and so of course it can become diseased. The doctors all tell us that tobacco has a very bad effect on the bones of a growing boy. The boy who uses tobacco will never be as large and strong as he would have been without it. His bones will not grow well because he is feeding them poison instead of pure blood. In this way many boys are stunting their growth by the use of cigarettes.

Any drink, too, that has alcohol in it is a poison to the blood. One who uses such a drink cannot be healthy.

Questions.

1. What kind of framework has a crab? An oyster? A turtle?
2. What kind of framework does a monkey have? Of what use is it?
3. What kind of framework is in the human body?
4. How many bones in the whole hand?
5. Where is the largest and strongest bone in the body? Why is it so strong?
6. How many bones in the whole body?
7. Name four kinds of bones.
8. What is the use of joints?
9. Name two kinds of joints and give an example of each kind.
10. How do the joints in the boy's hand differ from those in the hand of the man?
11. What makes bone hard?
12. Why are the bones of young children soft?
13. Have you tried to tie a bone in a knot?
14. What should be done when a bone is broken?
15. What does a cross-section of a bone look like under a microscope? What are the holes for?
16. What are some things that harm bones?
17. Could you throw a ball if there were no bones in your arm?

CHAPTER III

MUSCLES

IN the last lesson we learned that the bones are the framework of the body. They keep the body in shape. They make it strong. They protect some parts of the body from harm. They help us to make swift motions. But the bones cannot move themselves, and a man would not be of much use if he could not move about. You know that you can move your body in all sorts of ways. How do you do this? We will try to tell you in this lesson.

Now look again at the first picture in this book. You cannot see this man's bones because they are all covered up with muscles. On his arm you see a large bundle of muscles. They make his arm strong.

Let us try to find some muscles on our own bodies. Put your hands on your cheeks and close your teeth together. Bite the teeth together several times while you feel for the muscles in the cheeks. Keep on doing this till you know just about where the muscles are,

and how strong they are. The upper ends of these muscles are fastened to the skull, and the lower ends to the lower jaw-bone. When we make them shorter they pull the jaw up. In this way you can bite off your food and chew it.

There are other muscles around the mouth so that you can pull your lips back and show your teeth, or you can draw your lips to a small round hole as boys do when they whistle.

Then there is another muscle which is fastened to each corner of the mouth, and we use it when we laugh or smile.

There are a great number of muscles in the face, and we can use them just as we like. Boys and girls can make their faces look happy and cheerful, and then people will like to be with them, or they can draw the muscles so that the face will look sour and cross, and then people will want to shun them.

We must be careful about this while we are young, for when we get older our faces will stay the way we have trained them.

Now hold out the right arm. Place the left hand upon it above the elbow. Bring the right hand up towards the head, and you can feel a large muscle which gets harder and shorter. This is the one that bends the arm in at the elbow.

Put the left hand below the elbow and close the fingers of the right hand. You can easily find the muscles that do this work.

Now grasp the back of the leg below the knee and raise yourself upon your toes. You find here a large muscle which pulls hard enough on your heel to raise your whole weight. Every movement of the body is made by a muscle. If we could not use them we would be perfectly still and helpless.

What the muscles are.

Most of the meat which we eat is muscle. Beefsteak was the muscle of the ox. Lean pork was the muscle of the hog. When these animals were alive they used these muscles to move themselves about.

When you get a piece of beefsteak at the butcher shop its color is pink, and it cannot be easily pulled apart. After it is boiled till it is tender, you can divide it into threads so fine that you can hardly see them. A muscle is a bundle of such fine threads of lean meat tightly bound together.

How the muscles are fastened to the bones.

Most of the muscles are fastened at each end to a bone. When they get shorter they

pull on the bones, and in that way we make most of our movements.

Many of the muscles taper at the ends into a white cord, and this cord is fastened to the



10.—Tendons of hand.

bone. Rub the fingers over the back of the hand and you can feel the cords that pull the fingers out straight. Try it.

It would not do to have large muscles down

in the fingers or wrist, for that would make them too large and clumsy. The muscles that close and open the fingers are put on the arm below the elbow, and only these tough, slender cords run down to the fingers. In this way the hand can be very strong and yet be small.

Feel across the inner side of the wrist. These cords pull the fingers shut. You can see them in picture 10.

All such cords are called *tendons*. They are used in a number of places in the body. You can easily find the strong tendons at the elbow or back of the knee or back of the ankle above the heel.

How we make our muscles work.

The muscles cannot move themselves any more than the bones can.

How, then, can you throw a ball or run or jump? You have just learned that all the motions of the body are made by the muscles. You can sit or stand whenever you wish to do so. You can bend your arm or knee whenever your mind tells that muscle to go to work.

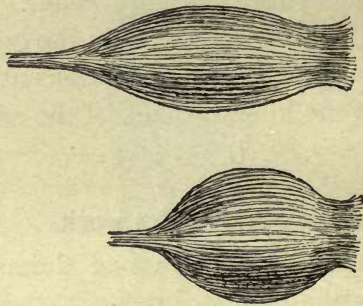
The mind must be joined to the muscle in some way.

We find that there is a cord called a nerve which runs from the brain out to the muscles.

When the mind wants a muscle to work, it sends word down along the nerve and the muscles act when they receive this order.

We will learn more about this wonderful arrangement when we get farther on in the book.

In picture 11 you see a bundle of muscle. The upper part shows how it looks when it



11.—Muscle.

is resting. When the mind orders it to go to work, it draws up till it looks like the lower part of the picture. By doing this it gets much shorter and pulls hard on anything that is fastened to the end of it.

We have some muscles that do their work without our thinking about them. Our hearts work all day and at night while we are asleep.

The muscles that make us breathe keep on working while we are thinking about other things. If we had to think of our heart and lungs to keep them going, we would not have time to do anything else.

How to make muscle strong and healthy.

Muscles get strong by using them. If you use your right arm more than the left one, the right arm will be stronger. When a muscle works hard more blood will flow to it, and it will keep getting larger and stronger.

It is good that boys and girls like to run and jump and play when they are out of doors. This gives them good exercise and makes them grow. Play is not the only exercise that will make children healthy. Useful work will do it just as well. Work in the garden and about the house is very good exercise. Any outdoor work that children do cheerfully is good for their health.

Boys sometimes go to the extreme, and try to do more than they are able to do. Such exercise does more harm than good. You cannot make the muscle strong by working very hard for a few days. Good exercise every day for a long time is needed. When you are very tired that means that your

muscles need rest. Good air, good food, good exercise, and the proper amount of sleep and rest will give you healthy and strong muscles.

Effect of cigarettes and tobacco on the muscles.

It is certain that cigarettes do a great deal of harm to the muscles as well as to the whole body.

A boy who has been smoking cigarettes for some time, can generally be picked out in school. He smells bad, to begin with ; but that is not the worst part of it. You can tell from the way he acts that there is something wrong with both his mind and his body.

It has been found in many schools that the boys who smoke cigarettes are a year or more behind the other boys who do not smoke.

Tobacco is a poison to the blood. When the blood is bad no part of the body can be healthy.

At first a boy gets very sick when he tries to use tobacco. All tobacco contains a deadly poison called *nicotine*. It is this poison that makes him sick. After a while he gets used to the poison and it will not make him sick, but the poison harms him just as much.

You can often tell that a boy uses tobacco by the way he works. His muscles have been poisoned by nicotine or have been starved by bad blood. After such a boy works for a little while he gets very tired. A healthy man would call him lazy, but he does get tired, because his weak, poisoned muscle does not have the power to do much work.

You have learned that the muscles are all controlled by nerves. Nicotine also poisons the brain and nerves so that they cannot send the proper order down to the muscles. Such a person gets awkward and his hand shakes. The nerves cannot bring the right kind of an order to the muscles, and the muscles do not have the strength to do their work.

Effect of alcohol on the muscles.

There are some drinks that are very bad for the muscles. They are such as beer, whiskey, wine, and hard cider.

These drinks are not good for us because they all contain alcohol. Alcohol is a poison to the body.

People used to think that alcohol made the muscles stronger. They thought they could do more work when they drank whiskey and beer. We know now that this is not true. It

has been tried many times, and it is always found that the men who drink whiskey and beer and wine will get tired and give out sooner than those who do not.

The young men who are trained for hard games, like boat-racing, foot-ball, wrestling, and the like, are not allowed to use any alcohol or tobacco. The muscle cannot be trained to work hard for a long time if it has any nicotine or alcohol in it.

Some people think they can make themselves healthy by drinking beer, because beer makes them fat. They think they are healthy when the body is fat. This is a great mistake. They get more fat, but less muscle. They get weak instead of strong. Our strength is in our muscles, and not in our fat.

You can plainly see why men and boys who drink alcohol and smoke cigarettes are not wanted in the stores, or in the shops, or on the railroads. They are not worth as much as are those with strong, healthy bodies.

The only safe way is to let tobacco and strong drink alone.

Your body is doing its best all the time to keep you in good health. You ought to help it, and not hinder it.

Questions.

1. Name four uses of bones.
2. How can the bones be made to move?
3. Find the muscle you use when you bring your hand to your mouth.
4. What is a muscle?
5. How are muscles fastened to bones?
6. What are tendons? Where can you find some of them?
7. How can the mind make the muscle work?
8. How can a muscle move a bone?
9. Name some muscles that keep working all the time.
10. What will exercise do for the muscles?
11. What are some of the bad effects of smoking cigarettes?
12. Why is a cigarette smoker not wanted in the big stores and shops?
13. What are some of the bad results of drinking alcohol?
14. What is the best drink?

CHAPTER · IV

FOOD

Appetite.

THE growing boy or girl gets hungry very often. This is the way our bodies tell us that we need more food.

If you are healthy and do not spoil your appetite, it will tell you just what you ought to eat. Sometimes it tells us to eat something sour. At other times it tells us to eat something sweet. Sometimes it will call for vegetables, and at other times for meat.

When we are sick our appetites often call for things that are not good for us. At such times we must eat only what the doctor tells us to eat.

Some boys spoil their appetites by doing things that make the body unhealthy. The boy who uses tobacco will get an appetite for it that will grow stronger and stronger. It is not safe for him then to follow his appetite in anything.

People who drink whiskey or beer or any strong drink that has alcohol in it will get a

very strong appetite for such drinks. The more they drink the stronger the appetite becomes.

After a while the appetite gets stronger than the man, and he cannot quit even when he wants to do so.

A good appetite will always want the things that are good for us.

Sometimes even young boys and girls lose their appetites. They come to the table at meal-time, but cannot find anything there that they like. This means that something is wrong. Maybe they have been eating too much candy or other things between meals. Maybe they ate too much at the last meal or have not had enough exercise.

Here is a good recipe for keeping up a healthy appetite. It was written by Alice Cary.

“ My lad, who sits at breakfast
With forehead in a frown
Because the chop is under-done
And the fritter over-brown,

“ Just leave your dainty mincing
And take, to mend your fare,
A slice of golden sunshine
And a cup of morning air.

“ And when you have eat and drunken,
If you want a little fun,
Throw by your jacket of broadcloth
And take an up-hill run.

“ And with the one and the other
You will be so strong and gay
That work will be only a pleasure
Through all the rest of the day.

“ And when it is time for supper
Your bread and milk will be
As sweet as a comb of honey.
Will you try my recipe ?”

Why we eat.

Our food does three things for us. It makes us grow. It makes us warm. It makes us strong, so that we can work.

We can say that a steam-engine eats coal. The engine will run as long as the engineer keeps up a good fire and keeps water in the boiler. When he lets the fire go down the engine will stop. Then we can say that the engine is hungry and must have some more of its kind of food before it will run again.

When you get tired and hungry, you know that you must eat again before you can do much more work. We eat for nearly the same reason the engine does, but we cannot use coal for our food.

The proper kinds of food for us.

We need five different kinds of food.

The first kind is *proteid*. We get it from such food as eggs, meat, vegetables, and milk.

The second kind is *starch*. We get it from such food as flour, rice, potatoes, and fruit.

The third kind is *fat*. We get it from such food as butter, cream, and fat meat.

The fourth kind is *water*.

The fifth kind is the *minerals*.

No one of these kinds of food would satisfy us. We must have some of each kind. Milk is nearly a perfect food, for it has all the different kinds mixed together.

Tea and coffee are not foods at all. Children will always be in better health if they drink only milk and water. They should never drink tea and coffee.

Enough of all the minerals, except one, is already in the other kinds of food. That one is salt. So we add salt to our food when we cook it or while we are eating.

Water.

A large part of the body is water.

We cannot live long without it. All of our

foods contain water, but we need to drink a great deal besides.

Water is a food because our bodies need it and cannot be healthy without it.

It is our natural drink, and when we are real thirsty nothing is so good.

It is a blessing that water is so plentiful. Some places are a desert because there is no water there, but we have great lakes and rivers of it. We can drill a hole down into the ground and are almost sure to strike a vein of good, fresh water. Sometimes it comes up itself to the top of the ground in a cool spring.

The water that comes from springs or from deep wells is nearly always good to drink. The water from a shallow well or from a river near a town or city may be very bad. A great deal of sickness and death is caused by drinking impure water. If you think the water you have to drink is not good, you should boil it before you drink it.

Never drink the water from a shallow well if you can avoid it. Here you see the top of a well which is almost sure to contain bad water. The well is walled up with loose stones and is only about fifteen feet deep. When a heavy rain falls, the water will carry

into this well any poison or filth that may be near. The well may look clean and neat on top and yet hold very bad water. Whole families often get typhoid fever or other kinds of disease by drinking from such a well.



12.—An old well.

The ice which is used in the summer-time should never be put into the drinking-water. The ice is not pure when it is taken off of water that was impure. Then, too, the ice in the water makes it too cold to drink. It is

much better to drink the water just as it comes from the hydrant or spring or deep well.

Manners at the table.

There is a right and a wrong way to act while you are at the table. It is easy to tell how boys and girls have been trained by seeing how they eat.

Everything that is done at the table should be refined and polite.

We cannot tell you here all the things you should do or should not do at the table, but here are a few rules which you must try to observe.

Be sure you never use a knife to carry the food to your mouth. You must use your fork or spoon for that purpose and must learn the right way to hold them.

Be careful not to make any noise with your mouth when you eat or drink.

Do not let your knife or fork rattle on your plate.

Do not lounge or rest your elbows upon the table.

Do not rise in your chair to reach for anything. Ask for it in a polite way.

While we eat we should be cheerful and

happy. This will not only give us a pleasant time, but our food will do us more good.

There are many rules of this kind, and you can soon learn them if you will try.

Your teacher will tell you about them, and you can notice how polite people eat.

Every one will be much better pleased with you when you eat in the right way, and you will not need to be ashamed to eat with polite people when you are older.

Questions.

1. What does the appetite tell us ?
2. How may the appetite be spoiled ?
3. Repeat Alice Cary's recipe for an appetite.
4. Why do we eat ?
5. What three things will food do for us ?
6. What kinds of food do we need ?
7. What are the best drinks ?
8. Where can pure water be found ?
9. Why do shallow wells often contain impure water ?
10. Why is it wrong to drink ice-water ?
11. Why should we be cheerful and happy at the table ?
12. Tell all you can about good and bad table manners.

CHAPTER V

DIGESTION

The teeth.

After the food is taken into the mouth it must be chewed. This is done by the teeth. You had no teeth till you were a little over a year old, and then your first set came through the gums. Then you had only ten upper teeth and ten lower ones.

When you were six or seven years old your first teeth came out and new ones came in their places. Count your teeth and see how many you have now.

These are the only teeth you will ever have, and if you take good care of them they will last a long time.

How a tooth looks on the inside.

Picture 13 shows you how a tooth looks when it is cut in two lengthwise. A tooth is alive and grows like other parts of the body. It gets its food from the blood. At the lower end of the tooth you can see how the blood-tubes enter and carry blood up through the centre.

In the picture you see that in this tooth eight lines enter in at the bottom. Six of them stand for blood-tubes and two of them for nerves. These nerves also run to all parts of this central part of the tooth. Even a very small opening in to where the nerves are will give us a severe toothache.



13.—Section of front tooth.

The outside rim at the top of the tooth is called enamel. It is the hardest substance in the whole body. When the enamel is kept clean it is a beautiful white, and needs to be very hard, for we use it to grind our food.

Care of teeth.

The teeth are not only useful for chewing our food, but we look much better when we have sound white teeth.

The girl in the picture is enjoying a hearty laugh. It does any one good to have a hearty laugh when something very amusing happens. At such times a set of sound white teeth,



14.—A girl laughing.

such as this girl has, adds very much to the personal appearance.

The best way to have good teeth is to begin to take care of them when we first get them.

Here are a few rules that you ought to follow.

Never pick your teeth with a pin or any other hard substance. Use a toothpick.

Do not bite on anything that is hard.

Do not allow any bits of food or candy to remain between the teeth.

Wash the teeth often with a tooth-brush.

Do not take any very hot or very cold liquid into the mouth. Either may crack the enamel.

Have the dentist look over your teeth once in a while to see if they are sound. A small cavity can be filled with gold and the tooth will be almost as good as new.

Saliva.

When you think of something real good to eat you say it makes your mouth water. This fluid is called saliva. While we are grinding our food between our teeth a great deal of saliva pours into the mouth. It wets the food and changes some of the bread and potatoes and other kinds of starch into sugar.

When the food has been ground up fine and mixed with the saliva the tongue pushes it into the back part of the mouth.

Swallowing.

The food is now ready to be swallowed. It enters the top of a tube called the *gullet* or *oesophagus*. The gullet is just back of the

windpipe. The muscles of this tube squeeze the food down farther and farther till it reaches the stomach. This is done every time we swallow.

If we attempt to swallow food that has not been well chewed and mixed with saliva it will stick in the gullet. The same thing will happen if we try to swallow too large a mouthful. Some animals have been choked to death in this way.

The large lump of food that is stuck in the gullet will press on the back part of the windpipe and shut off our breath.

The stomach.

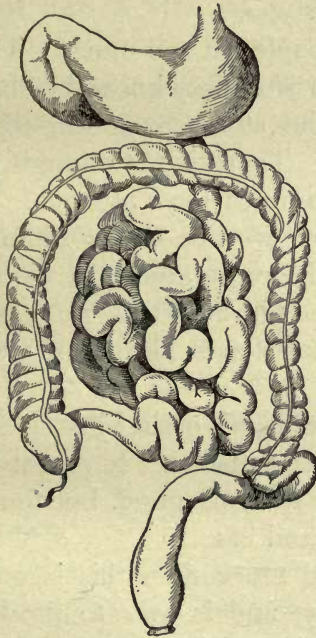
The stomach is a bag that looks very much like what you see at the top of this picture. A man's stomach will hold about three pints. The gullet pushes the food in at the top. Then the muscles of the stomach begin to roll the food about and mix it thoroughly.

At the same time the stomach pours out on the food a sour liquid called the *gastric juice*. This juice will digest nearly all of the first kind of foods that we told you about on page 43. It changes such food to a liquid form.

You can now see why the food should be cooked till it is tender and then chewed real

fine before it is swallowed. The stomach can then easily mix it with the gastric juice.

As soon as any of the food is digested and changed to a liquid it passes out at the other end of the stomach.



15.—Stomach and intestines.

After a hearty meal it will be two or three hours before the stomach is empty again. If the stomach is not healthy or the food is very hard to digest it may take four hours or more.

After the stomach has been hard at work with one meal, it should be allowed to rest for a while. It is a bad practice to eat between meals. Wait till the next regular meal, and then the stomach will be greedy to get it and digest it for you.

Many people eat too much. They keep on eating even after they know they have enough. They fill the stomach so full that it cannot work well. There is not enough gastric juice to digest so much food at once. This is not so bad when we are eating simple food like corn bread or potatoes or oat-meal, but it is *very* bad for us when we eat too much of the strong foods like pork and beef and eggs.

You should quit eating just as soon as you *begin* to feel satisfied. It is not the amount we eat that does us good, but the amount we can digest and use.

Any food more than this is only a burden to the body, and is *sure* to produce poisons that will make us sick.

The intestines.

When the food leaves the stomach it passes into a long tube called the intestines. In the picture 15 you see them below the stomach.

They are often called the bowels. You see there are two kinds. The small intestines are in the centre and the large ones are around them. This tube is very soft and is folded back and forth many times. If it were stretched out into a straight tube it would reach a distance of nearly twenty feet.

When the food gets into the small intestine two more juices are poured out upon it.

Bile.

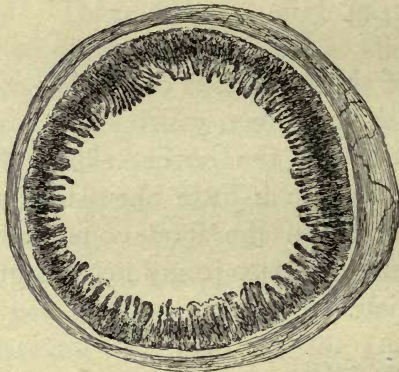
One of these juices is called *bile*. The bile is made by the liver, which is on your right side just under the lowest ribs. The liver stores the *bile* in a little bag called the *gall-bladder*. When the food comes along, this juice pours out onto it and helps a great deal in digestion.

Pancreatic juice.

The other juice is called the *pancreatic juice*. It is gathered up by the *pancreas*, which lies right below the stomach, and is not nearly so large as the liver. This juice is poured out onto the food along with the bile, and the two work together to digest the food in the intestines.

How the food gets into the blood.

The *bile* and the *pancreatic juice* digest the food that was not digested before. No food can get into the blood or do us any good until it is first changed to a liquid. The muscles of the intestines keep mixing the food with these juices till it is all in a liquid form. Then it soaks through the sides of the intestines and

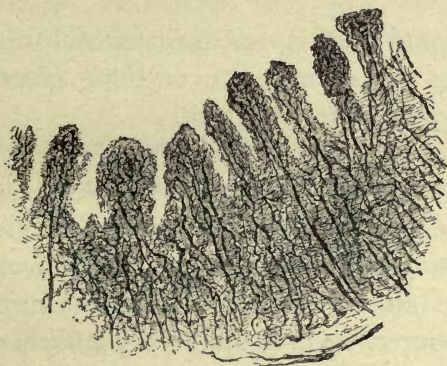


16.—Section of small intestine.

is carried away in the blood-tubes. In picture 16 you see a very thin slice across the small intestine of a cat. It is enlarged here so you can see it more plainly. Ours are made in the same way. You see the tube is not smooth on the inside, but is much like the nap on velvet. Each little tuft has blood-tubes in it,

and when the food comes along it is easily soaked up and carried away in the blood.

Picture 17 shows you how some of these same tufts look when we see them through a



17.—Villi of small intestine.

strong microscope. You can see the blood-tubes running down into each one and coming close to the food.

The work of the liver.

After the food gets out of the intestine and into the blood-tubes it is not yet ready to be sent out over the body. It is not good blood yet. Nearly all of it must now go through the liver. The liver, as we have learned, takes *bile* out of it. It also takes out other things that would poison us if they would ever

get to the heart. It changes the food, too, in some other ways.

After the liver has done its part, the liquid food is now ready to be carried up to the heart.

A good liver is our most faithful friend. If it gets out of order, everything goes wrong, and we become very sick.

Review of the work of digestion.

After you swallowed your food you did not have to give it any further attention.

The stomach took whatever you gave it, and poured upon it the sour *gastric juice* and mixed all well together. This digested part of the food and it began to flow out of the other end of the stomach into the small intestine. In three or four hours the stomach was empty.

In the intestines two more juices were poured upon the food. They are called the *bile* and the *pancreatic juice*. The *bile* is made by the liver and the *pancreatic juice* is made by the pancreas. The intestines mixed the food with these juices and digested all that was not digested in the stomach.

Now the food was all in a liquid form, and soaked through the sides of the intestine and

was carried away in blood-tubes to the liver. The liver purified it and made it into the right kind of blood for the body, and then it was sent on to the heart.

This is all wonderful, and you will learn many more interesting things about it in the larger books.

Care of stomach and intestines.

Every boy and girl wants to have a healthy stomach and intestines.

People who have stomach trouble are very miserable, and are of little use in any kind of work until they get well again. If your stomach and intestines will not do their work, it is no use for you to eat. The food cannot do you any good, for it cannot be digested and get into the blood.

The way to keep anything in good order is to take good care of it. Learn to do this while you are young, and you will be sure to have better health and will be much happier when you are older.

Here are some things that you should do and some things you should not do. Follow all of these rules, and you will never be troubled with bad digestion :

Eat only good food.

Eat food that is well cooked.

Chew the food thoroughly till it is in fine pieces.

Drink *only* milk and water.

Eat only three times a day. The stomach must have some rest.

Stop eating before the stomach is too full. Overeating is the cause of a great deal of trouble.

Eat but little candy, and have it pure.

Never drink ice-water. The water may be cool, but ice-cold water is always bad for the stomach. If you want to cool off, plunge your hands into cold water, but do not drink it.

Be cheerful and happy while you eat. Good cheer will help digestion.

Never drink anything that has alcohol in it, for alcohol spoils the gastric juice and makes the food hard to digest.

Do not drink anything while the mouth is full of food. Keep on chewing the food till the saliva has had time to wet it. Food digests better when it is well mixed with saliva.

Eat more of the simple, coarse foods and less of the strong meats. A good soup made of beef-broth and vegetables is an excellent food.

A story.

A long time ago there was a great king whose name was Nebuchadnezzar. He lived in a grand palace and had an army of servants about him to do his bidding. One day he told his chief servant to search through his kingdom for the best boys he could find and bring them to the palace.

The king told him to get only those boys who had good health and a pleasing face and who were quick to learn. The servant hunted all around and brought in a large number of the best boys.

Then the king told him to take good care of them and train them for three years. At the end of that time the king said he would call the boys before him, so that he could see how they looked and what they could do.

Now the king had told his servant to give the boys all the rich food they could eat. They could have all the meats and dainties they wanted and all the wine they could drink. Their table was to be just as rich as that of the king himself. He thought he was doing the best thing for the boys.

The most of them ate and drank what the servant gave them, and thought it was very good; but four of them did not like this rich

food, and asked the servant to let them have just simple vegetable soup, and instead of wine they asked for pure water.

Then the servant said that he had to do just as the king told him, and he feared his master would be angry unless they did just as they were ordered to do.

The four boys then asked him to try them just for ten days to see how they would get along, and not tell the king anything about it. They knew that they were right.

The servant liked these boys, and so he let them try it. When the ten days were up, they looked so healthy and were so bright that the servant let them eat this kind of food all the time.

At the end of the three years the king sent for all the boys. He looked at them closely and examined them to see what they could do. Then he picked out these four boys because they had the best health and the brightest minds, and he kept them in his palace.

They were a great help to the king, and grew up to be very famous men. We often talk and read about them even to the present day.

Questions.

1. How many teeth have you in each jaw?
2. What causes tooth-ache?
3. Why is the enamel on a tooth so hard?
4. Why should we take care of our teeth?
5. How can we care for our teeth?
6. What is saliva, and of what use is it?
7. Tell what you know about swallowing.
8. Describe the stomach.
9. What does the stomach do with the food?
10. Why is it wrong to eat too much or to eat between meals?
11. What two juices act on the food in the small intestine?
12. Tell about *bile*.
13. Tell about *pancreatic juice*.
14. Why must food be digested?
15. How does the food get into the blood?
16. Tell what you can about the work of the liver.
17. Give a short account of the whole work of digestion.
18. Give some rules for eating and drinking.
19. Tell the story of the four boys.
20. What were the names of these boys?

CHAPTER VI

THE BLOOD

THE blood goes to every part of the body. It makes its way even into the hard bone and the teeth. If you push a fine needle through the skin at any place on the body, some blood will run out. The skin looks pink and the cheeks red because the red blood is just under the skin.

There is enough blood in your body to fill a tincup six or eight times. Of course, there is more blood in a large body. A large man has about eight quarts of blood.

About one-thirteenth of the weight of the body is blood. If your weight is one hundred and thirty pounds, then your blood by itself would weigh ten pounds. Divide your weight in pounds by thirteen, and the answer will be about the number of pounds of blood you have.

The heart.

The blood is never still. It is moving around and around through the body all the

time. What makes it move? You say the heart does it, and that is correct.

In the picture you see how the heart looks. It is about as large as the fist and is made of strong muscles. The heart is double. There is the right heart and the left heart. These two are tightly fastened together. The left heart is stronger than the right one because it has harder work to do. Each half of the



18.—The heart.

heart has two tubes at the top of it. One tube carries the blood in and the other carries it out. The blood first goes into the right heart, and when it is full it squeezes upon the blood and forces it out through the other tube and sends it to the lungs.

When it comes back from the lungs it goes into the left heart, and when it is full the strong muscles on that side squeeze the blood

out through another tube and send it out on its trip through the whole body.

Care of the heart.

You all know where your heart is, but maybe you have not thought how faithful it is to you. It beats all day and all night. The only rest it ever gets is the short time between the beats. If your heart would get badly out of order or would stop for just one minute you would die.

Some people take very poor care of the heart. Boys and men often have what the doctor calls "tobacco heart." Such a heart will flutter. At times it beats very rapidly and at other times slowly.

This bad condition is often caused by smoking cigarettes or by using tobacco in any way. If the heart does not beat as it should, then the body cannot get the blood it needs. You cannot be healthy without a good heart. Your heart will do good work for you if *you* do not hinder it.

Beer is bad for the heart, for beer makes fat. The heart must be made of strong muscles. Beer changes some of the muscles of the heart to fat. This makes the heart weak, and it is not able to send out a strong current

of blood through the body. People often die because they keep on drinking beer till the heart is so fat and weak that it cannot work any longer.

The arteries.

The blood is forced out by the heart through strong tubes called *arteries*. They spread out all over the body. They divide into a great many branches, and get smaller and smaller till they are finer than a hair. When an artery is cut the blood will spurt out in a stream. If the artery is a large one, the person would soon bleed to death unless he knew what to do at once. If such an accident should ever happen to you or to one of your friends, press the cut tight together with both hands. Do not be afraid of the blood. No time must be lost.

Also, if you can have some one to help, tie a handkerchief or strong cord around the leg or arm *above* the cut. Draw the cord as tight as you can to press the artery shut, so the blood cannot get down to the cut. As soon as the doctor comes he will know what to do.

The pulse.

The arteries are put deep down under the skin, but in a few places they come very

close to the surface. At such places we can plainly feel the pressure on the blood whenever the heart beats. This pressure or throbbing in an artery is called the *pulse*.

The *pulse* can be felt most plainly at the wrist.

The girl in the picture is counting her pulse. If she does it correctly, she will know how fast her heart is beating. You try it.



19.—Counting the pulse.

Look at the second-hand of a watch and count till it goes once around. This tells you how often your heart beats in one minute.

I have just tried, and I find that my heart is beating eighty times in one minute.

How fast does yours beat ?

Now exercise for a few minutes and then count again. See how much faster the heart is beating. When we work we need more blood. The heart tries to give it to us. What a faithful old heart we have !

Capillaries.

At the ends of the arteries is a network of very fine tubes called capillaries.

The blood is now pushed on from the arteries into these small tubes. Here is where the blood feeds the body and takes away any waste matter. The capillaries are very small, short tubes ; but there are so many of them that if you push the finest needle through the skin at any place you are sure to run the needle through some of them and to let some blood out.

The blood keeps flowing on through them in a steady stream.

Veins.

The heart sent the blood out through the arteries and then through the capillaries.

Now the blood goes into another kind of tube called a *vein*. The veins carry the blood back to the heart again.

Pull up your sleeve and grasp your arm with the other hand. You see that the veins will fill up with blood. This blood was moving up the arm, but your hand stopped it. As soon as you let go it will move on back to



20.—Veins in the arm.

the heart. Many of the veins are close to the surface of the body, and you can see that it would not be right to wear any tight bands or tight clothing on any part of the body, for that would stop the flow of blood in the veins.

Red corpuscles.

The blood looks red, but it is not all red. I drew a little blood from my thumb and looked at it with a microscope.

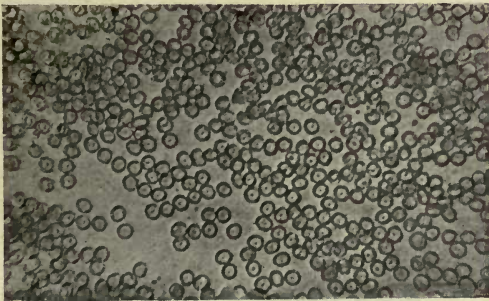
In picture 21 you can see how it looked.

The little round bodies are called *red corpuscles*.

They are the only part of the blood that is red. There are so many of them that they make all the blood look red.

The red corpuscles are so small that you cannot see them unless you look through a strong microscope. The same microscope that made the blood look like picture 21 made the finest kind of silk look like picture 22.

Old people do not have as many red corpuscles in their blood as do young people, and so they are always pale.



21.—Red blood-corpuscles.

The work of the red corpuscle is to carry oxygen from the lungs out to all parts of the body.

White corpuscles.

There are also many white corpuscles floating along in the blood with the red ones, but not nearly so many of them. They are always on the lookout for any substance that

may harm the body. They try to keep us from getting sick. If we do get sick, they do their best to make us well again. When any of the little germs of disease get into the body, they try to kill them off. If the white corpuscles are good and strong, they nearly always succeed.

When you cut your finger, a great number



22.—Fine silk.

of them will hurry to that spot and will try to heal it. The white matter that you often see in a sore is made of the white corpuscles.

They are our body's best friends, and we ought to do all we can to keep them strong and in good health. Alcohol has a very bad effect on them. They do not seem to care

whether they work or not when alcohol gets into the blood. This is one of the reasons a hard drinker will catch a disease much quicker than other persons. The nicotine of tobacco is also a poison to them.

A man who drinks whiskey and smokes cigarettes is more likely to get sick than a man who does not use them, and then it takes a longer time for him to get well.

The liquid part of blood.

The corpuscles are carried along in a liquid. The liquid is composed of water and the liquid foods. You learned a little while ago that the meat and potatoes and other foods were changed into a liquid when they were digested in the stomach and intestines. Now we find this food in the blood, and the heart keeps pushing it out through the arteries to the capillaries. In that way every part of the body gets the food it needs.

Blood-clot.

As long as the blood is moving about in the body it is a very thin liquid, but it will soon form into a clot when it is taken out of the body. When you cut your finger or any part of the body the cut will soon fill up with

a thick clot of blood. If it is not a very bad cut, the clot will soon stop the bleeding. It is good for us that this is so, for a very little cut might bleed us to death if it did not have a way of stopping itself. When a large artery is cut the clot cannot stop the blood, and we have to hold the blood in till a doctor comes and ties the end of the artery.

Questions.

1. How much blood is in your body?
2. Describe the heart.
3. What causes tobacco heart?
4. What effect does beer have on the heart?
5. Describe the arteries.
6. What can you do when an artery is cut?
7. How many times does your pulse beat in one minute?
8. Tell about the capillaries.
9. What is the use of the veins?
10. What makes the blood red?
11. What work do the red corpuscles have to do?
12. Of what use are the white corpuscles?
13. What is the liquid part of the blood?
14. What is the use of a blood-clot?

CHAPTER VII

BREATHING

Why we breathe.

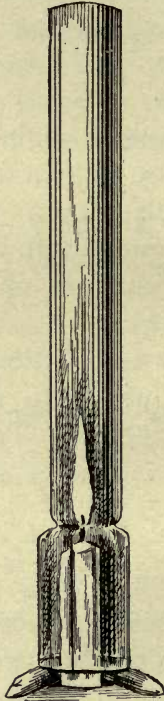
THE food of a steam-engine is coal, but the coal alone will not make a fire. There must be a strong draft of air. When we have good coal and a good draft, then we can have a good fire and can get up steam, and the engine will do work.

A man's body is a little like the engine. Food alone will not keep us alive, but we must breathe in the air. Then the food and the air together will make us warm and enable us to work.

Something for you to do.

Place a lamp-chimney over a lighted candle. Let the chimney rest on two pencils, as you see in picture 23. The candle-flame will be even brighter than before. A little smoke will show that the air is rushing in at the bottom of the chimney. Now take the pencils away and let the chimney sit down on the box or paper. The flame will soon die out

because it cannot get fresh air. This shows you that the candle alone cannot burn. It takes *the two together to make a fire*. The



23.—Candle-flame.

part of the air that the flame wants is *oxygen*. Everything that is alive, even the trees and the grass, must have oxygen that they may live.

The reason we breathe, then, is that we may get oxygen to combine with our food. This is what keeps us alive and makes us able to think and work.

The nostrils.

Air should be breathed in through the nose and not through the mouth. The nostrils warm the air before it gets to the lungs, and also strain out the dust and the dirt. Even when you run or work hard you should breathe through the nose. Before going to sleep be careful to have your mouth closed, and lie in such a way that the mouth will not drop open during the night.

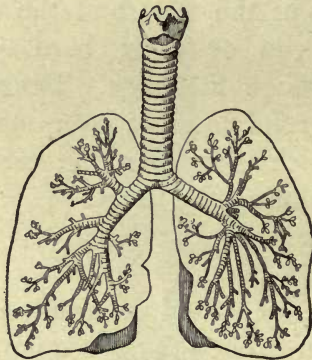
The windpipe.

A large tube called the windpipe conducts the air down to the lungs. Grasp your throat with your fingers and you can feel that this pipe is made of rings. You can also see them in picture 24. They are not hard bone, but are so stiff that the windpipe stands open all the time. On the top of the windpipe is a lid that can open and shut. When we breathe it is open; but when we swallow food the lid closes down, and the food passes over it and down another tube called the gullet.

When we are not careful, some food gets under the lid and into the windpipe, and we have to cough hard to get it out.

The lungs.

Each of us has a pair of lungs. If you could look into your chest, you would see your lungs and heart about as they are placed in picture 25.

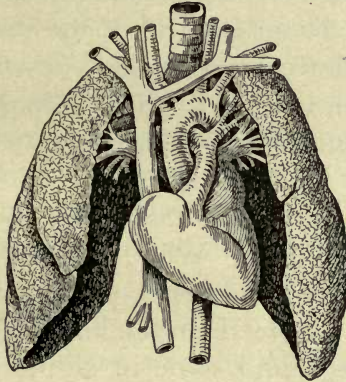


24.—Air-tubes.

The lungs are not firm like the muscle in your arm, but are soft and spongy. When you fill your lungs with air, they swell up and get much larger.

Look again at picture 24, and you see that the windpipe divides at its lower end into two branches. One branch goes to each lung. Then these divide again and again until the

tubes are as fine as a hair and reach every part of the lung. At the end of each one of the fine air-tubes is a thin little air-sac. When you take a deep breath, it is like blowing up a million little balloons all at once.



25.—The lungs.

Just outside the little air-sacs are fine tubes that carry blood. We will now try to learn what all this is for.

What the lungs do.

Awhile ago we learned that when the blood went out through the body, it gave up its food, and the red corpuscles gave up their oxygen. The blood then came back through the veins. Much of the waste matter that the body did not want any more came back with it. The

corpuscles are not red any more, for they have lost their oxygen and are now purple in color. Such blood is impure. It would not do for the heart to send this kind of blood out again. It must be made pure.

The right heart first sends it into the lungs. There the blood gets rid of the waste matter in it, and the corpuscles load up with oxygen and turn bright red. Now it comes back to the heart, and the left heart takes it and sends it out over the body again.

Do not think that this happens to all the blood at one time. While some of the blood is in the heart and lungs, the rest of it is out on its trip. Some is in the head, some in the arms or legs, and some in all other parts of the body. After awhile this blood, too, will come back to the heart and lungs.

So it keeps going around and around. It takes about twenty seconds for a drop of blood to make a trip from the left heart back to the left heart again.

How the lungs purify the blood.

The air which we breathe out is impure. It was changed in the lungs.

You just learned that each air-sac in the lungs is surrounded by tiny tubes full of blood.

When you take a breath, the oxygen of the air will go right through the sides of the air-sac and get to the red corpuscles of the blood. The gas that makes the blood impure is called *carbon dioxide*. This gas, along with some other waste, comes from the blood over into the air-sac and then we breathe it out.

Then we take another fresh breath, and the same thing happens again. We will have to keep on doing this as long as we live. Breathing is one of the most important things we have to do ; and we will now tell you something about pure air and how to breathe.

Cigarette smoke.

Any boy can now see why the smoke of the cigarette does so much harm.

The cigarette smoker does not only draw the smoke into his mouth and blow it out again. That would be bad enough, but he inhales it. He takes it down into all the little air-sacs, where it gets real close to the blood. The lungs are trying to make the blood pure, but they cannot do so unless we give them pure air. Cigarette smoke contains a deadly poison called *nicotine*. This poison goes from the air-sacs into the blood, and so is carried out into the whole body.

Is it any wonder that cigarette smoke so quickly ruins the health of the body and of the mind?

Pure air.

The air in the country is nearly always pure. That is the reason you should play out in the park or take a romp in the open fields or work in the garden. Exercise will do you no good unless you can get good air at the same time.

In the crowded city the air often gets very bad, even in streets. The worst air is often found in the rooms where we live and where we sleep. We cannot always tell that the air is bad by the way it smells. The little germs of disease are so small that we cannot see them, and yet if they get into the blood they can make us very sick. They like to live in damp, dark rooms, but the sunlight will kill them. Every room should often be aired out, and the sunlight should be allowed to pour right into the room for a part of the day.

Sick people get along much better when they can lie in a room where the air is dry and there is plenty of sunlight.

We cannot help breathing some of these little germs into our lungs every day; but if our lungs are good and sound, we will breathe

them right out again, and they can do us no harm.

How the breath makes air impure.

The air may be very pure when we take it into the lungs, but it is not pure when it comes out. We take some of the oxygen out of the air every time we fill the lungs, and in its place we breathe out bad air. When you stay long in a small room that is closed up tight you get sleepy and do not feel well. This is because the air is getting bad and you are breathing some of the old breath over again. If you let in fresh air, you will soon get wide awake again and will be as lively as ever.

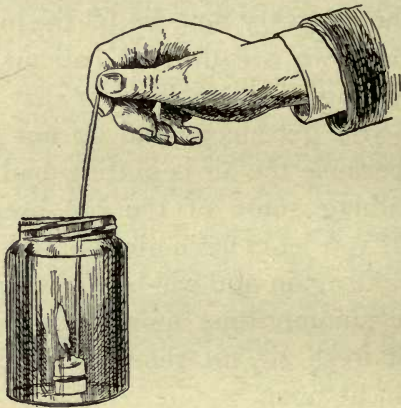
In the summer-time most people can have plenty of fresh air, for then the windows and doors can be open.

In winter the coal-stove or grate will take out a great deal of bad air; but if there are many people in the room, the window should be let down just a little at the top so fresh air can be coming in all the time.

Something for you to do.

Take a short piece of a candle and fasten it to a wire, as you see in the picture. Light the candle and let it down into the fruit-jar.

It still burns brightly. Now lift the candle out. Put your mouth close down onto the mouth of the jar and breathe out slowly a long breath from your lungs. Let the candle down into the jar again and it will burn very dimly or go clear out. Try it.



26.—Breath and candle flame.

The candle needs oxygen just as we do. When the air will not keep a candle burning very brightly, it is certainly not fit for us to breathe. If we keep on breathing bad air our life will grow dim or will go out just like that candle light.

If a mouse be put into a jar of that impure air he will jump about for a short time and

then fall over on his side. He is not dead, but has only fainted. If you shake him out onto the table where he can get fresh air he will soon revive and run off. If he is left in the jar very long, he will die because he cannot get oxygen.

Good air while we sleep.

We should be very careful to have good air in the bedroom, because we go on breathing all night. Before you go to sleep, be sure there is some way for fresh air to get into the room. Open a window a little from the top, no matter how cold it is on the outside. Some people sleep in summer-time on the top of their houses, so they can be sure to have plenty of fresh air. They have the bed inside a cage that is covered only with a thin net to keep out the mosquitoes and other insects. Some sleep in tents out in the yard, and it always gives them better health. This shows how important it is for all of us to breathe only good air.

Because some boys and girls are afraid in the dark, they cover themselves up, face and all, under the blankets. Then they have to breathe the bad air from their lungs over and over again. This is a very bad thing to do.

Some children have become very sickly and have suffered from bad diseases because they slept in this way.

If you will think of how the candle acted in bad air, you will not go to sleep again with your head under the covers.

How often we should breathe.

I have just counted and found myself taking fifteen breaths in a minute. Then I stood up and took some rapid exercise and then counted again, and found I was breathing thirty times in a minute. You try it.

When we do hard work of any kind the blood must go around faster. The heart beats faster, and so we must breathe faster to make the blood pure.

When boys run a long race they breathe very rapidly. Some cannot run very far till they are out of breath. If they would practise running every day, and would learn to take in deep breath only through the nostrils, they would not get short of breath for a long time.

It is found that a cigarette smoker soon gets out of breath. His lungs will not hold as much air as they should. The tobacco has spoiled a part of the air-sacs, hence the

rest of them have to be filled oftener to get the right amount of oxygen to the blood.

When young men are trained for athletic games, like foot-ball, wrestling, running, and boxing, they are not allowed to use any tobacco or drink any beer or whiskey. They tire out and lose their breath much sooner when they smoke or drink, and are almost sure to lose the game.

Men who drink alcohol sometimes get so short of breath that they cannot lie down. They have to sit up all the time for fear they may smother to death.

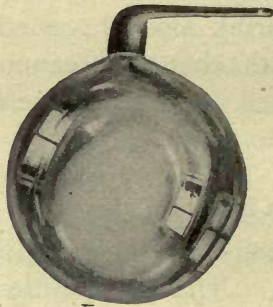
Taking a deep breath.

A man's lungs will hold about 330 cubic inches of air. That is a little more than one and one-half gallons. When he fills his lungs full he can then breathe out 230 cubic inches of air, which is almost exactly one gallon. Some air always remains in the lungs. Blowing soap-bubbles is a good practice in breathing. If you can blow a bubble five or six inches across, with one breath, you are doing very well. It is good for the health to take fresh air deep down into the lungs every once in a while.

We should learn to sit and walk with the

chest forward and the shoulders back. This gives the lungs room, and then it is easy to fill them with air.

Some girls have a very bad fashion of fastening the dress very tight about the waist. This cramps the lungs. Such a girl cannot take a full breath. She tries to make up for it by breathing faster, but she will



27.—A soap-bubble.

be sure to have poor blood and poor health. The lungs must get enough air so that each red corpuscle can get its load of oxygen, and also the poison in the bad blood must get out into the air. This can never be done well when the lungs are squeezed out of shape.

It is very good for any one to go to an open window or out onto the porch and take five or six deep breaths every day, winter and

summer. Fill the lungs full and hold it there for a while. Then breathe out and fill them again.

If you will practise this and make sure that you always get plenty of good air to the lungs, it is quite likely you will never catch a cold.

How the body is kept warm.

When coal is burning in a stove, you know that, if it can get a good draft of air, it will make the stove very hot. If you want the coal to quit burning, you close the damper so the air cannot get in.

The oxygen of the air which you breathe is carried by the red corpuscles out even to the tips of the fingers and toes. When it unites with the food, it makes heat just as it did with the coal in the stove. There is no blaze of fire in the body like the one in the stove, but the food is slowly burned, and that keeps our bodies warm.

Just warm enough.

Our bodies must not get too warm nor too cold. Look at the thermometer in your house or school-room. It ought to show a temperature of 70 degrees. Your body on the inside

is 28 degrees warmer than that. That would make your temperature 98 degrees.

It will be almost exactly 98 as long as you are not sick. If you get a fever, your temperature may go up to 103 or 104 degrees. Then the doctor says you are very sick.

No part of our body can do its best work unless its temperature is 98 degrees or very close to it.

In winter-time we wear heavy clothes to keep the heat in our bodies from getting away, and we live in warm rooms for the same reason.

Another good way to keep warm is by exercise. When we make our muscles work, the food is burned up faster, and that makes us warmer. Good exercise in the cool fresh air is a much better way to get warm than to sit all day by a warm stove.

We can nearly always manage to keep our bodies from getting too cold, but there is often danger that they may get too hot. The body has a very nice way of keeping itself from getting too warm, and we will study that next.

How sweat cools us.

When the body gets too warm, the sweat begins to pour out all over the surface of the

skin. As soon as the sweat gets to the air, it begins to dry up, and that takes heat from the body. This is a way nature has to keep us from getting too hot.

Put a drop of gasoline on the back of your hand, and it will feel very cool because it dries up so quickly.



28.—A water-jug.

Dip one of your hands into warm water, and then hold both hands up where the wind is blowing. The wet hand will feel much cooler than the dry one, even if the water is very warm.

In some warm countries they make their water-jugs out of clay that is much like our flower-pots. The water will soak through the

sides of the jug and keep it wet on the outside. Then they hang the jug up where the wind is blowing, and after a while the water is nice and cool. Sweat cools our bodies in just the same way.

The picture shows you a water-jug of this kind. This one was used by a boy in Cuba.

Will alcohol warm the body.

Some men think that if they take a drink of whiskey or beer on a cold day it will keep them warm.

It has been found out that this is a mistaken notion. Alcohol will soon make the body colder. When a man drinks whiskey, a great deal of the warm blood will come to the surface of the body just under the skin. The heat can then easily get away. He will lose more heat than the alcohol can give him. Then, too, his food will not burn as well as it did before. The alcohol smothers out his fire. A man who uses strong drinks will freeze to death sooner than those who do not.

The very best way to keep warm is to eat a hearty meal, take full breaths of fresh air, and keep the blood in rapid motion by exercise.

A story.

One very cold day six men started out on a long trip. They had food enough with them to last for three days. After they had travelled for two days it grew bitter cold, and they lost their way. Soon it began to get dark. They could make no fire, for they could find no wood to burn. They thought they would all surely freeze to death before morning. Their leader told them all to eat heartily of the food they had with them, for he knew that was the only way they had to keep warm.

Then they ran about and took all sorts of exercise to get warm, but they were not able to do this all night.

So they spread a blanket on the ground, and all lay down very close together and covered themselves as best they could. Just before this three of the men took a large drink of strong whiskey. They thought it would help to keep them warm. The other three believed they could get along better without it. They were all so tired that they went to sleep. The next day they were found there, but the three men who drank the whiskey were frozen to death. The other three had suffered very much with the cold,

but not even their little toes were frozen. Their food and breath kept making heat all night and kept them from freezing.

Questions.

1. What two things make fire burn ?
2. Tell about the experiments with the candle and lamp-chimney. Have you tried it ?
3. Why should we breathe through the nose ?
4. Describe the windpipe.
5. Tell about the air-tubes and air-sacs in the lungs.
6. Why is the blood sent through the lungs ?
7. How is the blood purified in the lungs ?
8. Why is cigarette smoke so harmful ?
9. Tell all you can about pure and impure air.
10. What makes the air in a room impure ?
11. Show the effects of breath on a candle flame.
12. How can we have fresh air while we sleep ?
13. How often do you breathe ?
14. How much air will the lungs hold ?
15. What keeps the body warm ? How warm should it be ?
16. How do clothes keep us warm ?
17. How does sweat cool the body ?
18. Tell the story of the six men.

CHAPTER VIII

THE SKIN

What the skin is.

THE skin is a thin covering stretched all over the outside of the body. There are two layers of skin. The outside one is called the scarf-skin, and right under it is a second layer called the true skin. The scarf-skin is thin, but it may grow quite thick. A man who works every day with a shovel or pick will have a hard, thick scarf-skin on the palms of his hands. Corns on the feet are caused in the same way by the rubbing of the shoes. You see how the body tries to protect itself by making the skin hard and tough wherever it is needed. A little cut or scratch in the skin will soon show us how useful the skin is as a protection to the tender parts under it.

This outside skin is a great deal like the outside bark of a tree. The bark may be called the skin of the tree. In the centre of the tree is the hard wood. Around it is a tender bark, which is a little like our true skin. Outside of all is the rough bark, which

is like our scarf-skin. You can cut away the bark without hurting the tree if you do not cut too deep.

Nails.

The scarf-skin is not the same all over the body. On the tops of the fingers and toes it changes to a harder substance, called finger-nails and toe-nails. The nails keep growing out all the time, and we have to pare them off. They need care, and should be cleaned every day. Some boys and girls have a bad habit of biting their finger-nails, so they always look rough and ragged. Such a hand never looks well.

Hair.

On the head is a heavy growth of hair. This also is a part of the scarf-skin. The hair is alive but it cannot feel, and so it does not hurt to cut it. In picture 30 you can see the root of a hair. It is deep down in the skin. A tiny blood-tube runs into the bottom of each hair and brings it its food. On each side of it you see a little sac, which holds a kind of oil. This is poured onto the hair and keeps it soft and glossy.

Care of the hair.

A fine head of hair makes one look a great deal better. It also protects the head and keeps one from catching cold easily. We must take proper care of the hair if we want it to be in good condition. The scalp and hair will get dirty, and must be washed once in a while, but not too often. It is not good to wet the hair every time you wash your face, for that will make it lose its gloss and become brittle. Comb the hair dry, and every few days brush the scalp briskly with a hair-brush. It does no good to put oil on the hair. If the scalp is healthy, it will give the hair all the oil that it needs.

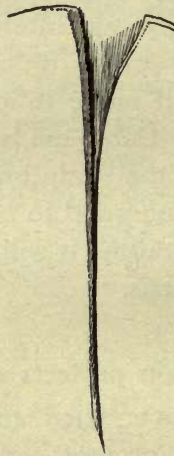
How the scarf-skin protects us.

If you have ever tried to pick a splinter from your hand or foot, you know that the skin is very tough.

The butcher always saves the skin of a calf or ox because it can be used in making boots and shoes. It is hard to get through the skin to the tender parts under it. The little germs of disease would like to get in where the blood and tender flesh are, but the skin acts like the walls of a castle and keeps

these enemies out. You can even take poison into your hand, and it cannot easily get to the blood unless the skin is cut or scratched.

It hurts when you are stung by a bee, because he makes sure to put his poison



29.—A bee-sting.

under the scarf-skin. You can see in this picture a bee-sting as it looks under a microscope. The point is finer than the sharpest needle, so that he may be sure to push it through the tough skin when he stings us.

The color of the skin.

Between the scarf-skin and the true skin are little grains of coloring matter.

These are the cause of the difference in the color of the skin of different people.

The grains are very numerous and black in the Negro. In some people they are yellow. In white people they are of a light color, but when the sun shines upon the skin, they get darker, and then we say the skin is tanned. In many people these grains are collected in spots, and when the sun makes these spots darker, we call them freckles.

A few people have no coloring matter in the skin at all. This is unfortunate. They look very pale; and even their eyes and hair are not colored as they are in other people. Such persons are called *Albinos*.

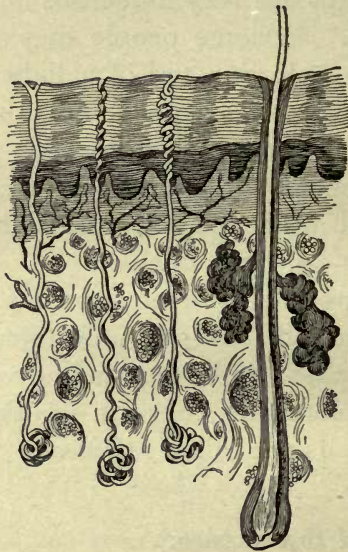
A study of the picture.

The picture 30 shows you about how the skin would appear if you could look down into it and see everything very much enlarged.

At the top is the layer of *scarf-skin*, which is also called the *epidermis*. Below it is the thicker layer called the *true skin*.

At the top of the true skin you see ridges and points. These are called papillæ. These are the ends of the nerves of feeling.

Running down through both layers of the skin are tubes, which you can see are coiled



30.—The skin.

up at the lower ends. These are the sweat-tubes. The picture also shows one hair and its oil sacs. These sacs are called *sebaceous glands*. The fat in the skin makes it smooth and plump.

Nerves of feeling.

The nerves of feeling are just below the scarf-skin all over the body. When the least thing touches the body, these nerves report it to the mind. If it were not for this, we might often be severely hurt without knowing it.

These nerves of feeling are very numerous on the ends of the fingers, but there are only a few on our backs. Can you tell why this is so?

Sweat-pores.

The surface of the skin is full of little openings called pores. They are the ends of the sweat-tubes. There are a great number of them. Nearly 20,000 of them are on the palm of the hand alone.

The sweat-tubes bring water and waste matter from the blood out through the pores. When the pores are stopped up in any way, the poison and water cannot get out. If all or most of your pores are stopped, you will get very sick.

Bathing.

You can now see plainly why we ought to keep the body clean. There are several good reasons for bathing. The sweat often pours

out on the skin, where it gets mixed with dust and dirt that dries and closes the pores.

The skin is also kept oily so it will not break or crack. This oil also gathers dirt.

Then the scarf-skin is growing out all the time, and its loose scales need to be rubbed off. Bathing keeps the pores of the skin open so the sweat-tubes can do their work. At least once every week the body should be washed all over. In summer we need a bath oftener than in winter.

If you have a bath-tub in your home, so much the better ; but you can keep the skin clean without it.

A large basin of soft water, a sponge or wash-rag, some good mild soap, and one or two large towels, are all that is needed for a good bath. After bathing you must be sure to rub with the towels until the skin is pink and *real dry*.

If you will be careful about the rubbing, there will be little danger of catching a cold after a bath.

Clean clothing.

The clothing next to the skin will soon get dirty. Even when it looks white, it may hold a great deal of waste matter that has come

out of the pores of the skin. Such clothing must be often washed, not only for the sake of our own health, but to make ourselves agreeable to other people.

When you go to bed, all the clothes you wore in the daytime should be taken off, and only a night-dress should be worn while you sleep.

A good bath, a clean night-dress, and clean bedclothes will help you to sleep soundly.

How to have a clear skin.

People who have good health always have a nice clear skin. The best way to have a good complexion is to take good care of the health of the whole body. When we eat too much or do not eat the kind of food that is good for us, the skin will often get coarse and will break out in pimples.

Simple, coarse food will make the best complexion. You remember the story of the four boys who would not eat the king's meat, but wanted only their simple kind of food. When they came before the king, he said they were fair to look upon.

If the skin is not healthy, it will do no good to put any kind of wash or powder upon it.

Nothing but good health will make a good complexion.

Effect of alcohol on the skin.

The true skin is full of fine blood-tubes. Alcohol makes these tubes larger, and then too much blood is found in the skin. After a while, if a man keeps on drinking, these tubes will stay larger all the time. This makes the face red. You can tell an old drinker by the appearance of his nose. It is swollen and very red. His eyes are blood-shot for the same reason.

The man who drinks whiskey or beer or any strong drink soon gets so he does not care about his health. He allows his skin to get very dirty, and then it will not do its share of throwing off the waste and poisons of the body. Alcohol puts so much poison into the body that even a healthy person could not get rid of it all.

When the body is not in good health, it is much easier to catch any disease that comes along. The drunkard is the first to catch diseases and is much more apt to die when he gets them. He is not strong enough to fight them off. This is the reason a doctor does

not have much hope for a drinker when he gets real sick.

The surgeon does not like to cut through the skin and operate on an old drinker because he knows his patient is apt to die in the operation, and if he does live, it will take a long time for the cut to heal.

Effect of tobacco on the skin.

The evil effects of tobacco can be seen in the skin as well as in the rest of the body. When a man takes a strong poison like nicotine, every part of his body must suffer. It does most harm to boys under twenty-one years of age.

The skin tries to throw off the tobacco poison, but it has enough to do without that. When you give it too much extra work it can do nothing well.

When a tobacco user comes out of the bath you can often smell the tobacco in the water.

The skin of a boy who smokes cigarettes becomes sallow and has an unhealthy look. This cannot be cured by bathing and rubbing the skin. The only way is to let tobacco alone, and then the body will cure itself.

Questions.

1. Tell about the two layers of skin.
2. Tell all you can about the nails.
3. Describe a hair.
4. How can the hair be cared for?
5. Why is the scarf-skin made so tough?
6. What gives the skin its color?
7. Tell about the parts you can see in picture 30.
8. What is the use of the nerves of feeling in the skin?
9. What is the use of the sweat-pores?
10. Why should we bathe?
11. What is the best way to have a good complexion?
12. What bad effects does alcohol have on the skin?
13. What bad effects does tobacco have on the skin?

CHAPTER IX

EXCRETION

How the body gets rid of poisons and waste.

THIS is a short chapter, but a very important one. Our good health and our very life depend on how well we can get rid of poisons and waste. Poisons are often taken into the body with the food and drink. Poisons are made inside of the body itself, and there is always a great deal of waste matter that must be thrown out.

The most of this kind of work is done by the lungs, the liver, the skin, the kidneys, and the intestines.

The lungs.

We have learned that the air that comes from the lungs is impure because it is loaded with a waste called *carbon* dioxide. It got this from the blood in the lungs. Besides this a great deal of water comes out with the breath. The carbon dioxide is a gas, and so we cannot see it, but you can show that it is there by

trying the experiment we told you about on page 76 of this book.

You can easily find the water in your breath by breathing against a cold window-pane. The water will collect on the glass. On a cold day you say you can see your breath. This is only water taken from the blood, and when it strikes the cold air it forms into very small drops like fog.

The breath works for us both when it goes in and when it comes out. When it goes in it carries oxygen to the blood and when it comes out it brings waste and poisons from the blood.

The liver.

The liver is a very important part of the body. We told you something about it on pages 55 and 57. Read that again.

If your liver would cease to work for only a short time you would get sick and die.

It gathers up many poisonous substances from the liquid food and the blood. It takes out the bile and turns it to good use in digestion. A healthy liver will always do its work well if we do not give it too much to do.

If we eat too much, or eat food that is not good for us, we may give the liver more work than it is able to do. Then some bad blood

gets past it and we get sick. When a man drinks alcohol he always overloads his liver. Alcohol is a poison, and the liver tries to keep it out of the blood. While it is doing this, it cannot do its other work in the right way.

Alcohol also spoils the digestion of the food, and that throws more work onto the liver. An old drinker's liver gets weaker and smaller, and so you can see that alcohol gives the liver more to do and then makes it weaker so that it cannot do it.

The kidneys.

There are two kidneys in the human body, one on each side of the backbone at the small of the back. Each kidney has the shape of a bean, and is about four inches long, two and one-half inches broad, and one inch thick.

Their work is to take water and several kinds of poisons and minerals out of the blood. When they do not work right, we soon know that something is going wrong with us.

The water washes away the poisons that the kidneys gather up. We should drink plenty of water. The skin and lungs are throwing off water all the time, and the kidneys take out about three pints every day, and the body needs a great deal all the time.

It will do no harm to drink good water even when you are not thirsty. If you get too much the kidneys and skin will soon take it away, and it will carry poisons and waste out with it.

A man can live a long time without other foods, but he would hardly get through a single day without water.

We have already told you about the work done by the skin and the intestines, and so we end this chapter here.

Questions.

1. How do poisons get into the body?
2. How are the wastes and poisons taken out of the body?
3. Tell what the lungs do.
4. Tell what the liver does.
5. Describe the kidneys.
6. What work is done by the kidneys?
7. Why should we drink plenty of good water?
8. What two things does breathing do for us?

CHAPTER X

THE BRAIN, SPINAL CORD, AND NERVES

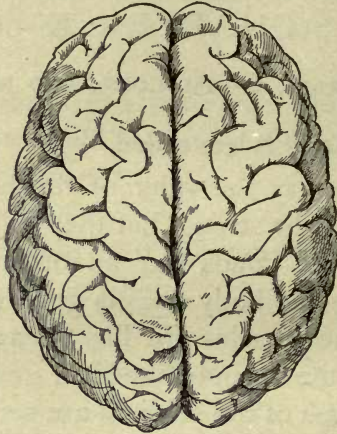
How the body is governed.

THE brain is the ruler of the body. The muscles may be strong, but they will not move till the brain sends out an order to them. Everything the body does is governed by the brain. The muscles are like an army of soldiers, and the brain is like their general. All the messages of the soldiers are sent in to the general, and then his orders are sent out to the soldiers. If the army is well trained, it will do only what it is ordered to do, and will not move until it gets orders from the general. In the same way, if our muscles are well trained, they will carry out the orders of the brain.

What the brain is.

The brain is made of a soft, delicate substance. It is very easily harmed, and so it is enclosed in a hard, bony case called the skull. The brain weighs about three pounds. It is gray on the outside and white on the inside.

If you could see the top of your brain, it would look like what you see in picture 31.



31.—The brain.

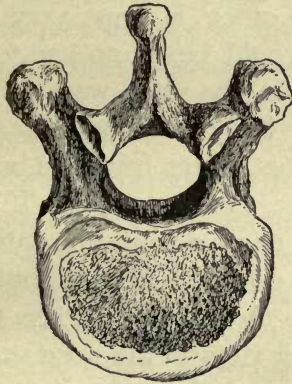
It is not smooth on the surface, but lies in folds or ridges.

The spinal cord.

The spinal cord of a man is about eighteen inches long and about as thick as the little finger. At its upper end it is connected with the brain and runs down through the backbone.

You have learned that the backbone is made up of a number of bones placed one on top of the other. Each one has a hole through

it, as you can see in picture 32. Altogether these holes make a long tube and in it the spinal cord is placed. This makes a strong covering for it. It is very tender, like the brain, and so it can be easily hurt.



32.—A vertebra.

You can easily see how the spinal cord is placed inside the bones if you will examine the neck of a chicken. The next time you have chicken for dinner pull apart the bones of the neck and you will find the spinal cord inside.

Nerves.

The nerves are fine white threads that run out from the brain and spinal cord to every part of the body. The brain could not send

an order to the hand or foot unless it had a nerve to send the message on.

There are many telephones in a town, and a wire runs from each one to a central telephone office. Messages are going back and forth over some of the wires all the time, so that the central office is kept very busy. Your telephone would be of no use to you without the wires. In the same way the brain cannot control the body without the nerves. One pair of nerves comes from the brain out to the eye and we use it to see. If these nerves were cut in two we would be entirely blind, no matter how good the eyes might be. Another pair goes to the ear and we use them to hear. Another pair runs to the nose and still another to the mouth, and we use them to smell and taste.

A great number of nerves run from the brain down through the backbone. These are tied up into a bundle which we have called the spinal cord.

At a number of places along the backbone we find holes in the sides of the bones. Nerves branch off from the spinal cord and come out through these holes to all parts of the body.

A large nerve is only a bundle of a great many smaller ones. It is like one of the large

cables which you see on the telephone poles near the central office. Two or three hundred wires are often put inside a lead tube and each wire covered so it cannot touch the others. A large nerve is made up a great deal like that. It keeps branching off and getting smaller and smaller till it is so fine you cannot see it without a strong microscope.

What the brain does.

The brain, the spinal cord, and the nerves are together called a nervous system. We have just learned something about what the parts of this system are and where they are. Let us now try to find out what they do.

The brain is the most important part of our bodies. We use the brain when we think. If the brain is good and healthy, we can get good lessons and can think well. We use the brain to work out examples in arithmetic or to prepare lessons in geography and language and spelling. When a boy or girl does not have good lessons, we think that he either does not have a good brain or he is not making good use of it.

We make our brains stronger by using them. The more we think the better we *can* think. One thing you learned about the mus-

cles was that they would grow strong by use. It is the same with the brain. A lazy boy will never have a strong body or brain because he will not use them.

What the nerves do.

There are two kinds of nerves. One kind carries messages *to* the brain and the other carries messages *from* the brain out to the body. Ends of nerves are found under the skin all over the surface of the body. Whenever the skin is touched even by a feather, a report is sent in at once to the brain. In this way the mind is warned at once of any danger that might come to the body. If it were not for these nerves, you could put your hand into the fire or cut off a finger and it would not hurt. I fear we would not take very good care of our bodies if it did not pain when we are scratched or cut or bruised or burned. These nerves have other uses too, but we will tell you about that in the next chapter.

The other nerves are used to carry messages from the brain out to the muscles. When I want to move my big toe, the brain sends an order all the way down to a muscle there and the toe is moved. We cannot feel anything going along the nerve, but we know

that if this nerve were cut in two we could not make the toe move, no matter how hard the mind would try.

What the spinal cord does.

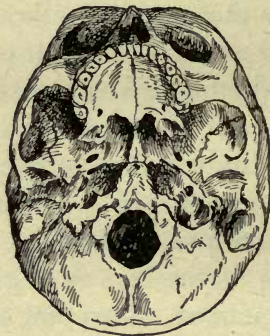
The spinal cord carries messages back and forth between the body and the brain ; but it does more than that. It often takes part of the work of the brain upon itself and sends out orders to the muscles without telling the brain anything about it. If you put your hand on a hot stove, the nerves send in a message to the spinal cord, and right away an order is sent back to the muscles of the arm to pull the hand away. When you make up your mind to take a walk, the brain sends an order to the muscles of the legs to begin work ; but after you are started, the spinal cord will look after the walking, and the mind can be free to think of other things.

The upper part of the spinal cord is thicker than the rest of it. This thick part is just inside the skull. In picture 33 you can see the hole where the spinal cord enters the base of the skull. This part of the cord is very important. It looks after our breathing and the beating of our hearts. We may stop breathing for a little while, but it will soon start

again in spite of all we can do. The mind cannot stop the heart at any time.

If any serious accident should happen to this part of the spinal cord death would follow at once, for the heart and lungs would stop their work.

You see that the whole spinal cord is very useful to us. It watches over our bodies all



33.—A skull.

day and night. It is always on guard to keep us from getting hurt. It leaves the mind free to study and think. No wonder it is so well protected inside a strong, bony tube.

Sleep.

All healthy boys and girls are all the time doing something. Their minds are at work

all day and their bodies are active in work or play. The brain and the whole body must have rest or they will soon break down. We cannot get complete rest while we are awake. When we are in sound sleep the brain is not doing anything, and the body is doing only enough to keep us alive till we get awake again. The heart beats slower and we do not breathe so often when we are asleep.

You must have plenty of sleep during the night or you will not be able to do good work the next day. You cannot even play well unless you have had a good sleep. Most people need about eight hours of sleep every night. Children should sleep nine or ten hours out of every twenty-four.

Night is the proper time for sleep. Babes and young children need to sleep some in daytime, but the boys and girls who read this book should get enough of good sound sleep in the night so that they can be *wide awake* all day. A sleepy boy is not of much account in school or in any other place.

Habit.

Most things are hard to do the first time we try. After we have done them several times they become much easier, and by and by the

way we do things and the way we act become fixed habits. You can now tie your shoe-strings without thinking about it, but it was a task for you at first. It has become a habit. The way a man ties his necktie is a habit with him, and it is hard for him to tie it in any other way.

You can get into a habit of always being neat and clean ; of having good lessons every day ; of always being pleasant and polite ; of always being on time. There are many habits of this kind that every boy and girl should try to form. If you will try them till they become easy then they will be a habit with you, and you would rather follow them than do any other way.

It is easy to get into bad habits, and then it will be hard to get away from them. A boy can get into a bad habit of smoking cigarettes, and then he gets an appetite for it. Then the two together are stronger than the boy, and he will not quit even when he knows his bad habit is killing him.

Men and boys get into the habit of going "down town" in the evenings. Every evening they are almost sure to go again. They get into a bad habit of drinking, and keep on going from bad to worse.

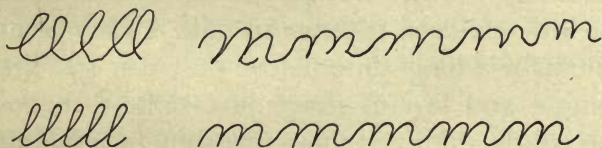
Every boy and girl should try to have many habits, but they should all be good ones.

It is easy to fall into bad habits, but very hard to get out of them.

Skill.

We all want to have strong muscles, but we want them to be well trained, too.

When the muscle will do just what the mind wants done, it is a trained muscle. Boys and girls should try hard every day to train their muscles to do things well. If you do not train them they will always be awkward. You



34.—Before and after long practice.

want to be a good writer. Then you must practise every day to get the muscles of your arm and fingers trained. The last page in your copybook should be much better than the first one. If it is not, then you are not getting any good out of your practice in writing. Try again, and think all the time that you are trying to get your muscle to obey

the mind. It will be sure to do so if you will try your best every day.

The writing in this upper line was done by a little girl several years ago. You can see it was hard for her to make the pen go right. She went right on doing her best, and to-day she can write like that in the second line.

It is the same way with drawing. You know what a poor picture you made when you first tried to draw. You can do much better now, and if you keep on trying, your mind and hand will work nicely together.

You must also train the muscles of the mouth if you want to speak well. It is hard for little children to learn to talk. They have to try for a long time before they can get the tongue and lips to move just right to make the words. Maybe there are some words you do not say very well yet. Some boys and girls mumble their words so that you can hardly tell what they are trying to say. They are not trying, and they will never do any better till they do try.

A story.

More than two thousand years ago there lived in the city of Athens a boy whose name was Demosthenes. He was not as bright as

some of the other boys. He had to study very hard when he wanted to learn anything. He could not speak his words plainly and he stammered. He was awkward in his motions, and people laughed at him.

One day, after he had grown older, he went to hear a famous speaker in Athens. There he saw what wonderful power there was in a great speech by a great orator.

He thought if he could only speak like that how much good he could do and what a great man he would be. So he made up his mind that he would be a great speaker. He went to work with all his might, and one day he got up before a large audience to make his first speech. He did not speak well, and the people laughed at him and hissed him.

Many young men would have given up and not tried any more. Demosthenes only said that he would try all the harder, and now he went to work in dead earnest to make his muscles obey his mind in just the way he wished.

Part of the time he stood before a mirror while he practised speaking. There he could see for himself how he looked. If he did not stand in the right manner or if he moved his hands or arms in an awkward way, he could see it in the mirror and would correct it.

He had a bad habit of holding one shoulder higher than the other. To correct this, he would stand with this shoulder just under the point of a sharp sword while he was speaking.



35.—Demosthenes.

Sometimes he would shut himself up for several weeks in a cave, and there he would practise speaking.

At another time he would go down to the seashore and fill his mouth with pebbles and then speak. If he could learn to talk well with pebbles in his mouth, then surely he could do much better when he took them out.

The above picture shows him at this practice.

At last Demosthenes became the most famous speaker in the world.

Boys and girls who are willing to go through the long practice that is needed to get the body to obey the mind may also be famous in one way or another.

Effect of alcohol on the brain and nerves.

You must use your brain when you think. You can do good thinking only when your brain is in good working order. You have learned that a muscle must have food that it may do work. It is the same way with the brain. Every time the heart beats, a part of the blood is sent to the head to feed the brain. Press the ends of your fingers against either side of your neck and you can feel the pulse of the blood as it goes up through a large artery to the head. This blood must be good and pure, and there must be plenty of it. Unless this is so, we cannot do good thinking. Anything that will poison the blood or weaken it will have a bad effect on the brain.

When alcohol gets into the blood some of it is carried at once to the head. The brain is excited by it, and for a while seems to be brighter than ever. Very soon the poison of the alcohol is sure to have its bad effect. The

brain gets stupid and will not work again till the body sends it good blood.

The alcohol has also been spoiling the work of the stomach and lungs and liver and kidneys so they cannot make good blood. In this way, too, the brain is both starved and poisoned.

A man may seem to get over the bad effects of a few drinks of alcohol, but he is getting weaker in body and mind all the time. If he keeps on drinking, it will soon be plain that he cannot think about anything as well as he did before.

Alcohol makes the nerves lose their power over the muscles. The hand trembles and loses its skill. Such a person cannot write as well as he did before. He cannot even raise a glass of water to his mouth without showing how weak and unsteady he is. Alcohol has made him awkward and clumsy. He is not wanted any more to do fine work in the shops and offices, and so his wages go down. People do not trust him, and he cannot get a good position.

When the brain becomes very weak or unhealthy, it will think very strange things and will imagine many things that do not exist. Such a person is called insane, and has to be

locked up to keep him from harming other people. Alcohol makes many men insane.

The children of drunkards are often weak and diseased. It is no fault of the children, but they have to suffer for the alcohol which their father drank.

Not many boys who now read this book ever drank any whiskey or beer or wine, but we want you to know how much evil it is doing to many older people. Now is the best time for you to begin to be an able and healthy man. Our bodies are not of much use to us without a good brain, spinal cord, and nerves, and we know that alcohol has the worst kind of an effect upon the whole nervous system.

Effect of cigarettes on the brain and nerves.

Many boys who would not think of drinking whiskey are doing their brains and nerves great harm by smoking cigarettes. We have shown you how tobacco will poison the blood. It is this kind of blood, then, that must feed the brain. A cigarette smoker cannot sleep well at night. When he gets up in the morning he does not feel fresh and strong. He comes to school sleepy. He cannot make his brain work, for it is poisoned and weak. Of course, he cannot keep up in his school-work.

A story.

In one of the schools of a Western town was a bright boy eleven years of age. He had started to school when he was six, and was promoted every time with high grades. His teachers all praised him for his good deportment and good lessons. The boys and girls all liked him because he was smart and was good at running, jumping, and playing ball. He was now about half-way through the fifth grade when something began to go wrong. Neither the teachers nor the scholars could guess what the matter was. The boy began to be careless about himself. He would go about with his hat pulled down over his eyes and would not look square at you when you would speak to him. His clothes and shoes were not brushed, and he walked in a slouchy manner.

In the school-room he did not give attention, but spent much of his time looking about or just staring without looking at anything. At other times he would start some mischief that would annoy the other scholars, and when the teacher would try to correct him he would only grunt out some impolite reply and then sulk in his seat.

What in the world had gone wrong !

The boy would try sometimes to master himself. He would try to force himself to study and act as he used to do, but he could not keep it up.

After this had gone on for several weeks, he stayed one evening after school of his own accord. When all the children had gone, he came up to the teacher and said that he wanted to tell her something. He told her that he once smoked a few cigarettes just to see what it was like, and after he had learned, he wanted to smoke them all the time. He said he could see that if he did not stop, they would ruin him, and he wanted to quit.

His teacher always liked to do anything for the good of her scholars, and she was very glad when the boy came right out and told her all about it. He promised that he would come to her every day for one month and tell her that he had not used tobacco in any way.

He was a manly little fellow and kept his word. He now thinks that this changed his whole life. If he had gone on with cigarettes, it is almost certain that he would soon have quit school, and would have gone with bad company and become a drunkard at last.

This all happened a number of years ago. The boy passed on through every grade in

school and then graduated from college. He is now a useful and successful man, but he never forgets that evening in school when he had the courage to quit smoking cigarettes.

Questions.

1. Describe the brain.
2. Tell about the spinal cord.
3. What is the use of nerves?
4. How are nerves like telephone wires?
5. What does the brain do? How can it be made strong?
6. What are the two kinds of nerves and what does each do?
7. What does the spinal cord do?
8. Why do we need sleep? How much sleep should we have?
9. Tell all you can about habit.
10. How can you learn to write and draw and speak well?
11. Tell the story of Demosthenes.
12. How does alcohol harm the brain and nerves?
13. How does tobacco harm the brain and nerves?
14. Tell the story of the boy who smoked cigarettes.

CHAPTER XI

THE SENSES.

WE have five senses. They are seeing, hearing, feeling, tasting, and smelling.

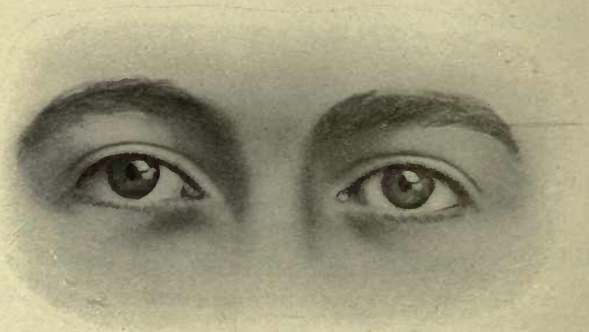
The mind uses these senses to find out about things it wants to know. If you would lose all your senses, you could not tell whether you were alive or not. When I hand you something and ask you to tell me all you can find out about it, you *look* at it, then maybe you tap it and *listen* to the sound, then you *feel* it or *taste* and *smell* it. This is all we can do with the senses, but all that we know was first learned in this way.

The eyes.

The eye is the shape of a ball. It is set in a bony socket on a bed of fat. It is covered with a tough coat called the white of the eye. In front it is as clear as glass, so the light can get in. A little farther back is a curtain, which in some people is black and in others blue or gray.

In the centre of the curtain is a round hole,

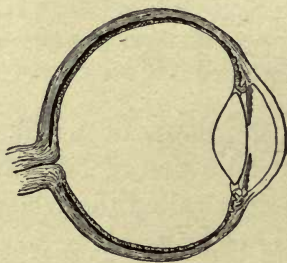
that gets large when the light is dim and small when the light is bright. Look into a mirror



36.—The eyes.

and see how the curtain works when you suddenly make the light bright and then dim.

The light goes through this hole and then



37.—Section of eye.

on through a lens that you can see in picture 37. This lens acts just like the glass in

your microscope and makes a picture on the back part of the eye. The nerve then carries it to the brain, and in that way we see.

How we move the eyes.

Muscles are fastened to the eyeball on the top and bottom and at the sides. When they pull, they roll the eye up or down or sideways. This is a great help to us when we want to look around. You can see the whole side of a room without moving your head.

How the eye is protected.

The eyes are very delicate and can be easily harmed. Curtains called eyelids are made to close over the front of the eye, and we wink whenever there is danger of dust or dirt getting into the eye.

The eyebrows also protect the eyes by keeping sweat from running down into them.

Just above the eyes are little sacs that gather from the blood a liquid called tears. A little of this liquid keeps running out over the eyes all the time to keep them moist and wash away any specks of dust. At the inner corner of the eye is a small tube that carries the tears into the nose. When you laugh real

hard or cry, the tears come so fast that the tube cannot carry them off, and they run over on the cheeks.

Care of the eyes.

Most people say they would not give up their eyes for the world, and yet they use them so badly that we would think they did not care for them.

You should never look at the sun or any bright light. Do not try to read out in the bright sunlight. When you use a light that is too strong, the sight will get dim.

It is just as bad to read when the light is too weak. Do not try to read in the dusk of the evening or in the dark corner of a room or by any weak, flickering light.

Do not sit facing the light when you read, but let it fall down over your shoulders upon the book.

Do not read while you are lying down. People have made themselves blind by reading in this way.

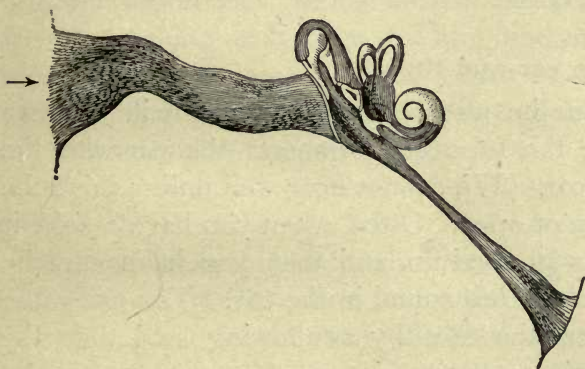
Alcohol and tobacco have a very bad effect on the eyes. Alcohol affects the nerve, so it cannot carry a true picture back to the brain, and it weakens the other delicate parts of the eye. Cigarettes have had such a bad effect on the

eyes of boys that the doctor told them he could not keep them from going blind unless they would quit smoking.

If you have good eyes and take care of them, they will be good for nearly all your lifetime.

The ear.

We would lose a great deal in this world if we had no eyes, but it would be about as bad



38.—The ear.

if we had our eyes, but had no ears. If you had to give up your eyes or your ears, which would you let go? Think carefully before you answer.

The part of the ear outside the head catches sound and sends it into the ear. People who

cannot hear very well put their hands back of the ears to catch more sound.

The rest of the ear is just the size and shape that you see in picture 38. One of these is on each side of the head in the bone of the skull.

Waves of sound come in where you see the arrow in the picture. These waves shake the ends of the nerves at the other end of the ear, and the nerves then carry the sound back to the brain.

The ear and throat.

In the picture, on the right of it, you can see the tube that connects the ear with the throat. We cannot hear well unless this tube is kept open. Often, when you have a cold, it gets stopped up, and then you have earache or a roaring sound in the ear. You can often open the tube by swallowing, and then the roaring stops.

Care of the ears.

The ear tries to protect itself, but often we have to help it. The tube that leads into the ear is lined with hairs and wax. These keep out insects and dirt. Sometimes, though, a bee or bug will creep away into the ear and

cause a great deal of pain and fright ; but the doctor can soon pull it out.

The ear should not be filled tight with cotton. If any cotton is used, it should be very loose and only at the entrance of the ear.

Very loud sounds injure the ear and often make people deaf. When you are expecting a very loud sound, it is a good plan to hold the mouth wide open or close the mouth and put your fingers in your ears.

It is wrong to pick the ear with an ear-spoon or with anything else, or to put any kind of a liquid into it unless it is the order of the doctor. The ear, like the eye, is too valuable and delicate to be tampered with.

Feeling.

We can learn a great deal about things by the sense of touch. You will find it an interesting game if you will blindfold one of your playmates and then put different things into his hands and see if he can tell what they are. He can tell that it is an egg, or a stone, or a pencil, or a marble, and do it all by feeling. Once in a while he will make a bad mistake, and that is where the fun comes in.

Blind children learn to read with the fingers. On the pages of their books the letters are

raised, and by running their fingers over them they can tell what the words are. One girl, whose name is Helen Kellar, can neither see nor hear, and yet she can tell what you are saying by holding her fingers on your lips while you are talking.

Taste and smell.

The nerves of taste are in the tongue, and the nerves of smell are in the nose.

These two senses do not tell us so much as any one of the other three, but they are very useful.

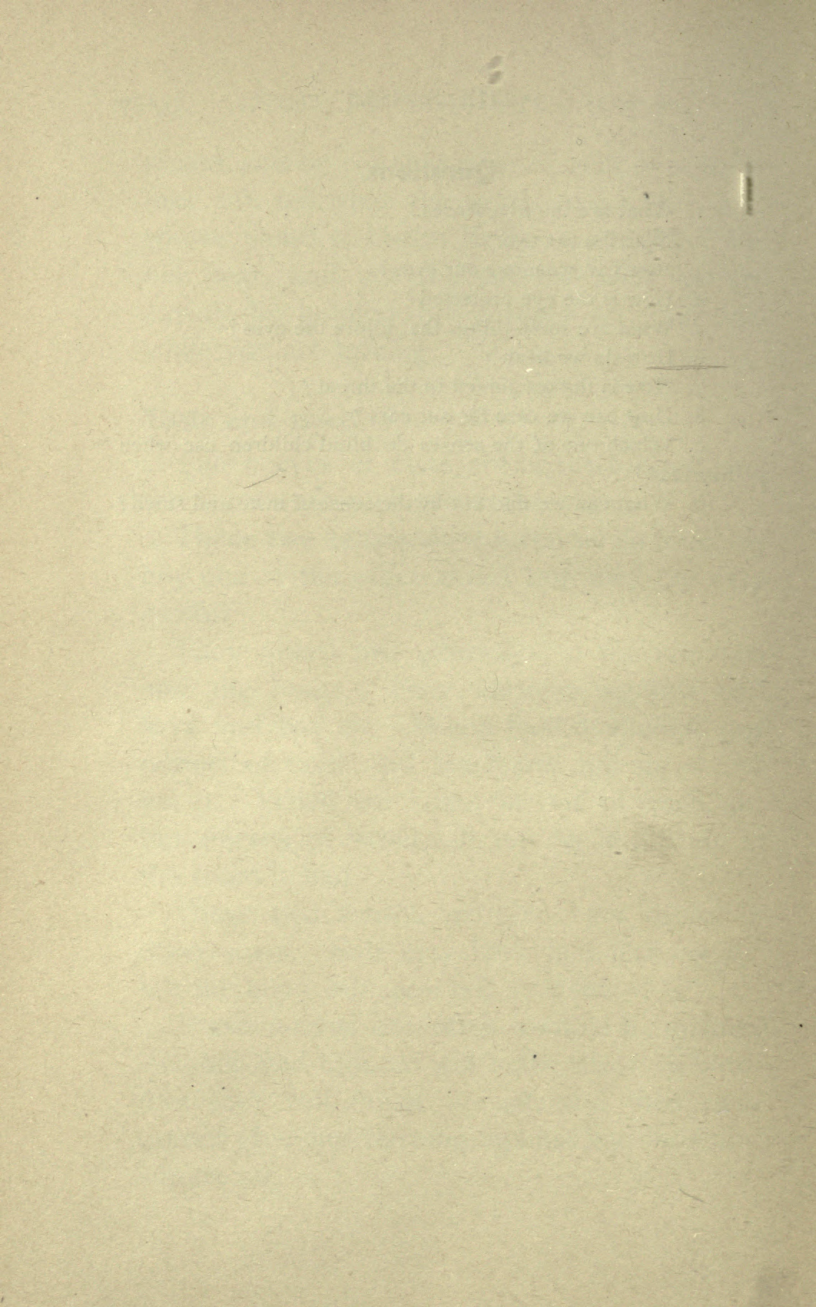
They guard the gateways to the stomach and the lungs. They warn us against bad food and bad air. When food is spoiled, our nerves of taste and smell will tell us not to eat it. When we come in out of fresh air, our nerves of smell will tell us if the air in the room is bad.

These two senses are also very useful in other ways. Salt may look just like sugar, but the taste will soon tell us which it is.

These nerves are often spoiled by misuse. Alcohol and tobacco will make them so blunt that they will be of no use, and then they cannot give any warning against bad food and impure air.

Questions.

1. What are the five senses ?
2. Describe the eye.
3. How can we move our eyes ?
4. How is the eye protected ?
5. What are some things that injure the eyes ?
6. How do we hear ?
7. How is the ear joined to the throat ?
8. How can we care for our ears ?
9. Which one of the senses do blind children use when they read ?
10. What can we find out by the sense of taste and smell ?



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