PATHWAYS IN SCIENCE
OUR WIDE, WIDE WORLD

COMPLIMENTARY
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CRAIG AND BALDWIN

CRAIG

Pathways in Science

A new series — the first to meet the recognized need for systematic science training in all the grades of the elementary school. The six books definitely conform to the recommendations of the Thirty-First Yearbook, Part I, of the N
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planations of overgrade words. Note the stimulating illustrations. Note the Things to Think About or Things to Do.

All the books are as challenging to the child in appearance as in organization and content. Illustrated end papers and an abundance of drawings in two and three colors distinguish the first two books. Unusual features of the next four books are posed photographs and original drawings showing children in the process of scientific discovery, full-color inserts by noted artists, and animal drawings by Hugh Spenser.

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Have you ever watched the sky when day is turning to night?

PATHWAYS · IN · SCIENCE · III
A COURSE FOR ELEMENTARY SCHOOLS

Our Wide, Wide World

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Preface

Pathways in Science is designed to meet the demands of the modern tendency to introduce science as an essential part of the elementary-school curriculum by presenting a course of carefully graded problems in science for Grades I to VI. It presents a well-balanced program, which develops elementary meanings derived from the major scientific fields — astronomy, biology, chemistry, geology, and physics.

The content of this series is the result of a study of science in all grades of the elementary school, including extensive try-outs. Based originally upon the "Horace Mann Course of Study in Elementary Science"[1] and upon "Certain Techniques Used in Developing a Course of Study in Science,"[2] it has involved searching analyses of several thousand children's questions, of educated laymen's needs in science, of courses of study, and of worth-while scientific concepts.

[1] Horace Mann Course of Study in Elementary Science, Bureau of Publications, Teachers College, Columbia University, New York City, 1927.

[2] Certain Techniques Used in Developing a Course of Study in Science for the Horace Mann Elementary School, Bureau of Publications, Teachers College, Columbia University, New York City, 1927.

The volumes are organized about those principles and concepts of science which have received a high evaluation in these research studies by developing the meanings which are commonly found in the challenging problems of life. In this way the child comes to an understanding of those principles which are so essential to the interpretation of the natural phenomena of his environment. It is hoped that by the use of these books the cultural values of science will be realized more widely.

The series definitely conforms to the recommendations and the spirit of the Thirty-first Yearbook, Part I of the National Society for the Study of Education, and the requirements of recent state and city courses of study in elementary science.

Each volume of the series has been organized about a number of units. These units present a series of problems, each of which offers a real challenge to children. Sufficient information is given in the text to lead to a satisfactory solution of the problem and to an understanding of the essential meanings that are involved in the presentation.

Each unit has a page of motivating material which gives the preview to the unit and serves also to tie up unit with unit. Exercises in the form of

Things to Think About or *Things to Do* form a basis of essential activities.

The units have been so arranged that the essential meanings developed in "Our Wide, Wide World" will be utilized in later volumes of the series. Thus proper sequence is developed with an avoidance of duplication and overlapping.

A manual for the teacher accompanies "Our Wide, Wide World," giving additional information and activities. The manual will prove to be especially helpful to those teachers who are giving instruction in science for the first time. By making use of the manual, which includes a carefully prepared bibliography for teachers, it is possible for classroom teachers to secure considerable training for the teaching of elementary science while conducting the course.

Teachers should not expect the children to remember all the details given treatment in this volume. A considerable part of the information in this text is designed as context material which presents and develops an understanding of the essential meanings in terms of the child's own experiences and vocabulary. The accompanying teacher's manual lists the essential meanings and important concepts in a convenient and easily accessible way.

The vocabulary has been checked throughout by the use of the Buckingham-Dolch Word List. Whenever over-grade words are needed for the enrichment of the science vocabulary of the children, they are carefully explained in the text.

Striking features of this volume are photographs of children in the process of scientific discovery and full-color inserts by Sears Gallagher, Schuyler Mathews, Forrest Orr, and Gunmar Widforss. In this book there are also many wash drawings of plants and animals and many photographs which serve to illustrate the meaning developed in the text.

Another feature is the simple index, which permits the children to use this volume as a source book of scientific information in connection with their activities.

The authors are indebted especially to Dr. B. R. Buckingham for the encouragement and advice that he has given in this undertaking.

G. S. C.
S. E. B.

Contents

OUR WIDE, WIDE WORLD

UNIT I

The Story of the Sky

Did you ever wonder what the earth would be like without the sun?

Would the moon and the stars give us enough light to live by?

Could we possibly get along without the sun?

Tell all the things you can think of which show that we need the sun every minute of every day.

How far away is the sun?
How large is the sun?
What is the sun made of?
What are the stars?
What is the moon like?

These are questions which children have asked ever since they have asked about anything. Have you ever found out the answers to them? Grown-ups asked these questions for thousands of years before they found answers which came very near the truth.

Every day men who know a great deal about the sun and the moon and the stars are learning wonderful things in answer to these questions. Many of these things are found in "The Story of the Sky."

1. How Far Away is the Sun?

The earth is ninety-three millions of miles away from the sun. Miles, miles, miles, miles, miles, and miles are between the earth and the sun! Can you imagine how far such a great number of miles must be?

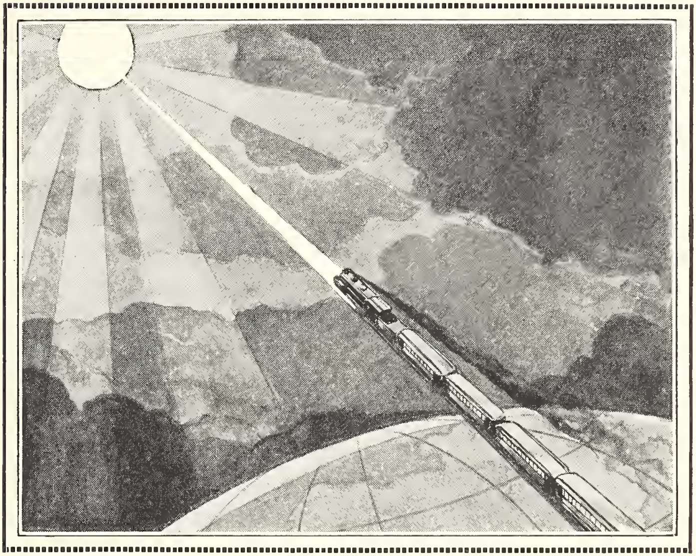
Is it farther than from your house to the North Pole? Is it farther than from your house across the ocean? Is it farther than a trip around the earth?

We can answer all these questions at once. The sun is many times farther away from us than the North Pole and the other side of the ocean and a trip around the earth put together.

Imagine flying to the sun! Tell all the reasons you can why a person could not really and truly fly to the sun.

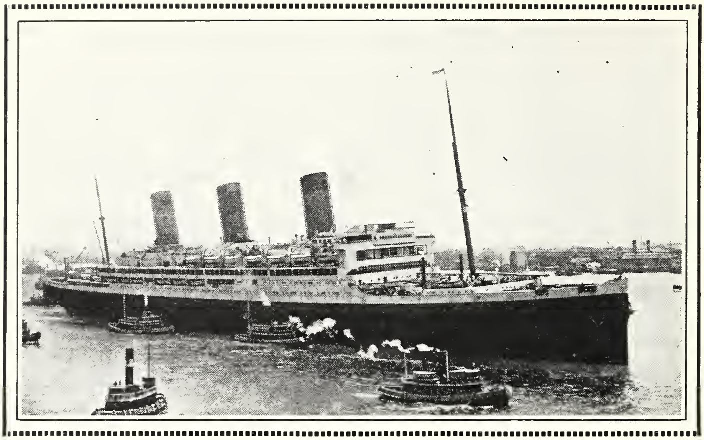
Perhaps each boy and girl said, "You can't fly to the sun because it is too far away." That is one very important reason.

Pretend that a make-believe aviator is making a trip to the sun in a make-believe airplane. Pretend that he travels at the speed at which most aviators travel on long non-stop flights.



How long do you think it would take this train to reach the sun?

He could make no stops for rest nor for gas and oil, because there would be no place for him to stop. At that racing speed it would take him eighty years to fly to the sun. Do you know anyone who is eighty years old? How does he look? How does he walk? Our make-believe aviator would be older



Do boats travel as fast as trains? How long do you think it would take this big boat to reach the sun? Read and find out

than that by the time he reached the sun. What a long, long ride!

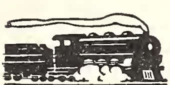
If tracks could be laid on a sunbeam, it would take our very fastest trains nearly two hundred years to reach the sun. Your grandmother's grandmother had not been born two hundred years ago.

This is one of our fastest ocean liners. If this boat could travel through space, it would take more than three hundred and fifty years for it to reach the sun.

Three hundred and fifty years ago our country belonged to the Indians. Forests covered the land. There were no cities, no railroads, not even farms.

Suppose that someone could have started to go to the sun on this boat when white men first came to America. After traveling for all those years he would still have many miles to go.

What a long, long journey! Did you think that the sun was so far away from us as that?



Things to Think About

1. Alice Smith went to visit her grandmother, who lives ninety-three miles from Alice's home. Alice was on the train nearly two hours. If she had taken a million trips to her grandmother's, she would have traveled as far as from the earth to the sun. It is a long, long way to the sun.

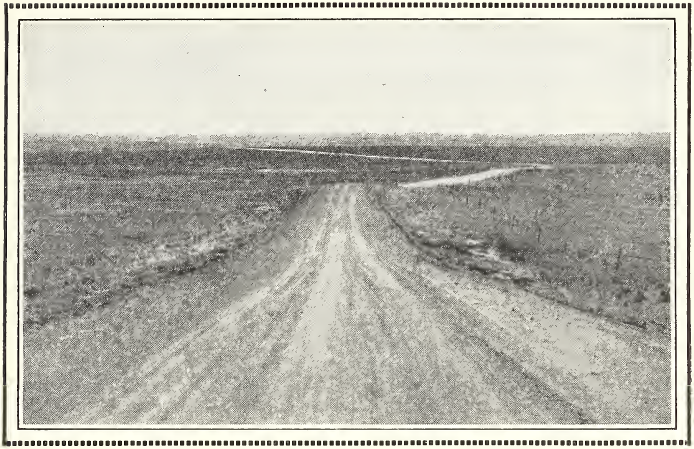
2. Marie Bracco has just come to our school from Italy. She traveled nearly four thousand miles to get to this country. It took her more than a week to get here. But just think of this! The sunbeams which come into your window have traveled more than twenty thousand times as far as Marie traveled, yet it took them less than ten minutes to get here!

2. How Large is the Sun?

How large do you think the sun is? Is it as small as it looks? Is it bigger than a house?

If you look at the sun through a dark glass, you see that it looks like a big ball of bright light. Some people say that it looks about the size of a man's head. Other people say that it seems about the size of a pumpkin. Let us find out how big it really is.

We all know that the sun looks so small because it is millions and millions



This picture shows only a tiny part of our earth.
The sun is larger than thousands of earths

of miles away. How large do you suppose the sun really is? Is it larger than your town? Do you think it is larger than our whole country?

This big bright light which we call the sun is much larger than the whole earth. It is many, many, many times larger than the earth.

The earth is a tiny ball beside the sun. If some strong giant could roll together into a huge pile thousands and thousands of earths as big as ours, he would have a pile about as large as the sun.

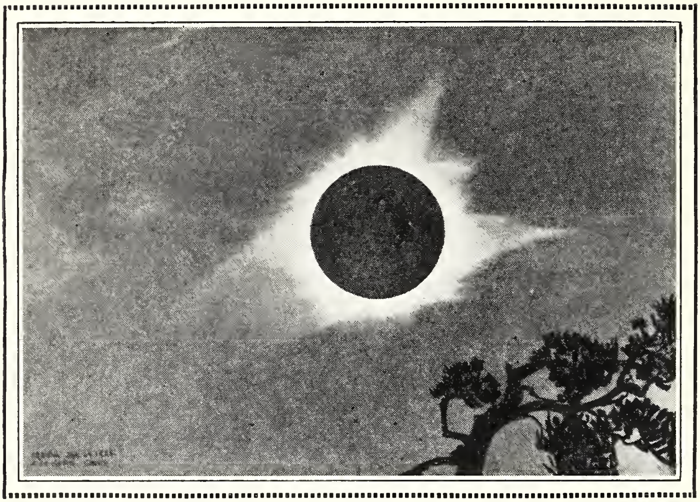
Here is another way to show how large the sun is. Let us pretend that a family of people would be able to reach the sun in an airplane. They want to see all of the outside of the sun. There is a baby in this make-believe family. They travel around and around over the sun for days and years. The tiny baby grows up to be a man. The people have seen only a small part of the sun. They travel on and on trying to see all parts of the sun. The man who was a baby when the family started is now an old man with white hair. After all these years and years and years of riding around over the sun, these people have seen less than one half of the outside of the sun.

How very, very big the sun is! No wonder it does such wonderful things! No wonder the summer sun is so hot! No wonder the sun is so bright that we must not look at it except through a very dark glass!

3. What is the Sun Made of?

The earth and the sun are very different from each other. The earth is made up of air, land, and water. There is no land on the sun. There is no water on the sun. The sun is just hot gases which have been whirling about year in and year out for millions of years.

If a make-believe aviator could fly as far as the sun, he could never know what it is like to be really close to the sun. He would have to keep hundreds of thousands of miles away from it. Great streams of hot gases hundreds



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In this picture you can see the great streams of hot gases shooting out from the sun

and thousands of miles long are shooting out from the sun all the time, like water out of a fountain. These streams are the hot gases of which the sun is made.

An airplane could not land on the sun because there would be no ground for it to land on. It would fall right through these gases when it tried to land. If the plane were anywhere near the sun, its metal body would boil as water boils on a hot stove.

When you try to understand what the sun is like, do not compare it to a huge bonfire made of thousands of bonfires as big as the world. The sun is not fire. It does not burn and blaze and smoke. A bonfire has to be supplied with wood or coal or something else which will burn. These things burn out after a while. The sun will not do this — not for millions of years, at least. The sun gives off heat and light without being fire. Men who know a great deal about the sun are not sure what does cause the sun's great heat. They see no reason why the sun should not go on shining for millions of years, just as it shines today.

Things to Think About

1. When you think how hot the sun is, are you surprised

a. that pavements dry quickly when the sun shines on them after a shower?

b. that pavements sometimes seem to burn our feet in summer?

c. that tar roads often become soft and sticky in the summer time?

d. that there are such dry places as deserts where it almost never rains?

2. Try to tell some more of these "Are you surprised" facts.

4. What are the Stars?

Do you know that our sun is not the only sun there is?

It is just one of millions of suns. These other suns are the stars which we see in the sky at night.

Stars are suns, and suns are stars.

Our sun is a star, too. Because it is

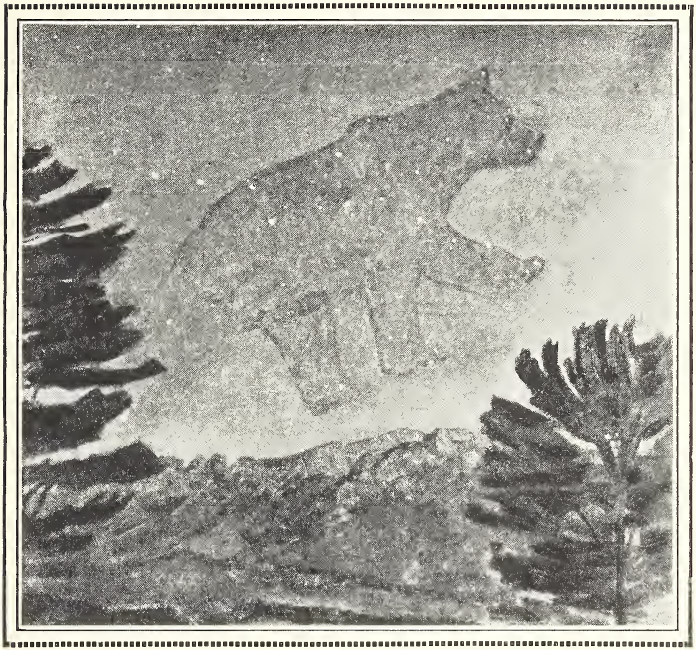
The sky full of stars is a wonderful sight

much closer to us, our sun looks bigger and brighter than any of the other stars do. When you are in your house at night, did you ever notice that your own lamps seem bigger and brighter than those in Jimmy's house across the way? They seem brighter and bigger because they are closer to you, of course.

Although these "sun-stars" look like tiny specks, many of them are much larger and brighter than our sun is. If one of the larger ones could change places with our sun, our earth would be so bright and so hot that people might not be able to live here at all.

These "sun-stars" are millions and millions of miles farther away from us than our sun is. The light which we now see from some of them began to come to us long before George Washington was born. The light from others started on its way to us before Columbus discovered America. Other stars are so far away that their light began its journey to us as early as the Bible times. We cannot imagine how many miles there are in such a long journey.

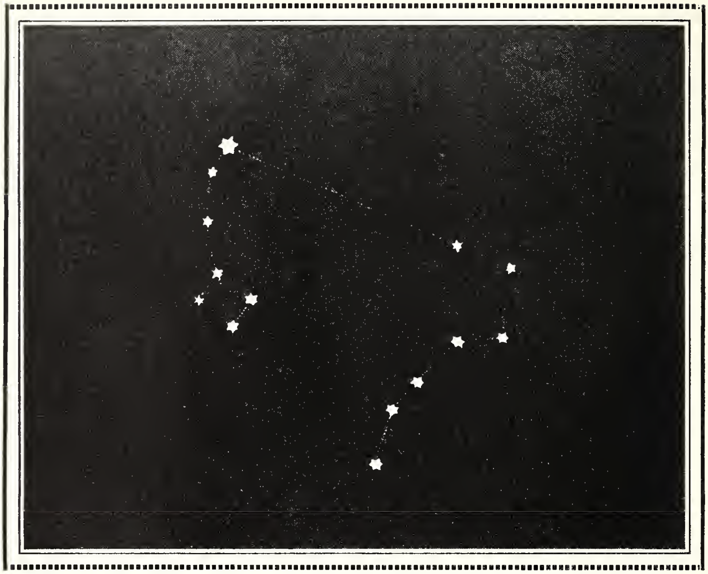
The stars are in the sky during the day just as they are at night. We do



This group of stars is called "the Big Bear."
Can you find the big dipper here too?

not see them shining in the daytime because the sun, our great star, gives us so much more light than they do. It gives us more light because it is nearer us.

At night, when our part of the earth is turned away from the sun, the light



The North Star and the dippers

of the stars can be seen through the darkness. The sun does not outshine them then. We see them shining and twinkling like thousands of diamonds.

The stars give the earth a great deal of light. For thousands of years people who traveled at night had only the light of the stars and the moon to show the way. Do you like to watch the stars?

Things to Think About

1. See if you can find the group of suns which are arranged in the shape of a big dipper. They look like the picture on page 20.

You can always find the North Star by following up the outer edge of the "dipper." It is the first star you see above the dipper. The North Star is not the biggest and brightest star in the sky, as so many people think it is. It looks smaller than many of the stars near it. Try to find it.

2. Mary and her father were looking at the stars one night. Mary said: "I like those three stars which are close together in a straight line above the top of that tree. There are two big ones and a little one. I like the little one best."

Her father said: "If you were to go away out there to get your stars, you would have two surprises. In the first place, your stars would not be close together at all. They would be millions of miles apart. Then, when you tried to find your little star, you might see that it is the largest of the three."

Do you think Mary's father was right? How should you explain these things to Mary?

5. What is the Moon Like?

The moon's light

Were you ever out of doors in the moonlight? Have you ever played tag in the moonlight? Have you ever been taken for a boat ride in the moonlight? Could you see quite plainly just where you were going and what you were doing?

The moon makes the earth much lighter than the stars do. Sometimes we say, "The moonlight is almost as light as day." Yet the moon is not a sun as the stars are. It has no light of its own, any more than the earth has. The moon receives from our sun the light it gives out. The moon's light is *reflected light.*

By reflected light we mean something like this. When you look into a mirror, you do not see your real face.

The mirror seems to throw your face back to you. What you really see is the reflection of your face.

Sometimes the light which is shining on Mary's house will make the rooms in Jimmy's house very much brighter. Jimmy's house is brighter by "reflection."

Have you ever caught some of the sun's rays in a mirror? And have you watched the bright flash of light dance around the walls and ceiling? This "light bird" is *reflected* light.

In the same way, the moon *reflects* the sun's light to the earth and makes it bright at night.

Where may you see other reflections?

Is the moon like the sun?

Although the moon and the sun both give light to the earth, they are quite different in most ways.

The sun is a huge ball of gases. The moon is not made of gases. It is hard and solid, as the earth is. It is not hot like the sun.

The moon does not make its own light as the sun does. The moon's light is reflected light. Since its light is not caused by heat, the moon could never be so hot as the sun is.

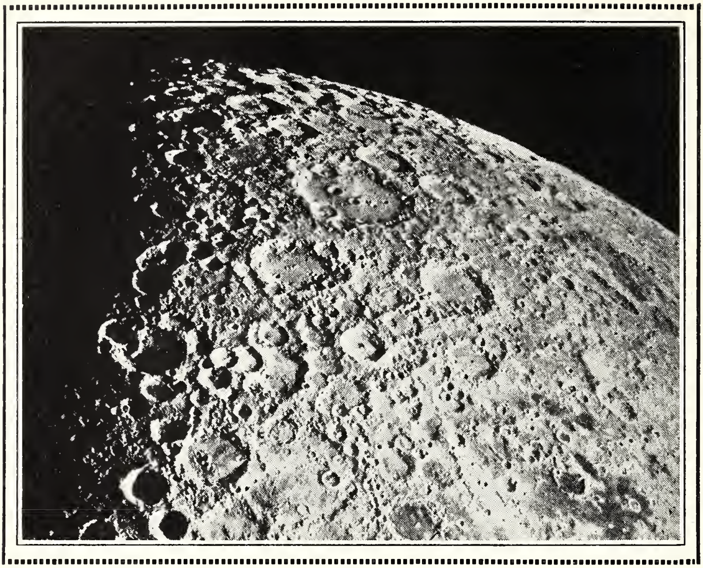
The moon is very much smaller than the sun is. The moon is much smaller than the earth is. It would take about fifty moons to make one earth. We learned on page 12 that it would take thousands and thousands of earths to make a body as large as the sun. It is hard to imagine how many moons it would take to make a body as large as the sun.

When we think of the millions of miles which lie between the sun and the earth, the distance between the moon and the earth seems very short. The moon is closer to the earth than any other body in the sky. It is the earth's nearest neighbor.

Mary's great-uncle Bob was an old sea captain. He had sailed around the world ten times. His travels had taken him as far as the distance between the moon and the earth.

Is the moon like the earth?

On clear nights it seems as though we could almost touch the moon if we were to climb to the top of some very high place. Pretend that magic or something like it could carry you to the moon. The moon looks very beautiful when it is shining away up in the sky at night, but it is not nearly so pleasant a place as the earth is. You

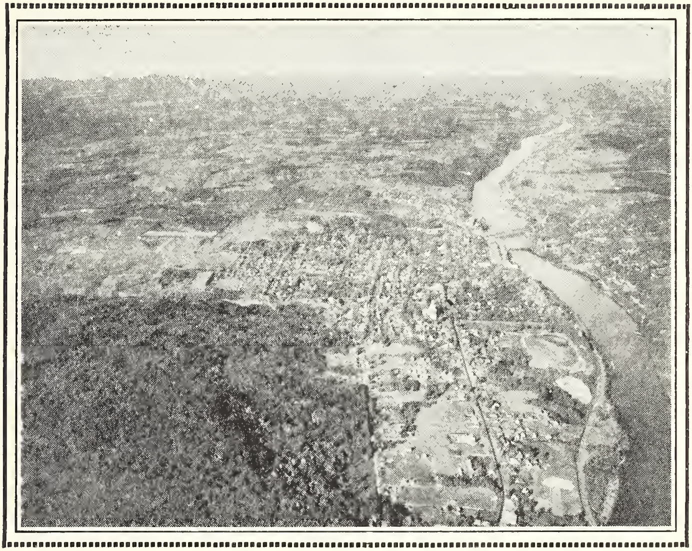


Mt. Wilson Observatory

A part of the moon as it looks through a telescope

would not have a good time at all on your make-believe visit to the moon.

There is no air on the moon, and there is no water. You would find no wells, rivers, lakes, or oceans. The moon is as dry as a desert. Where there is no water you would not expect to find grass, trees, flowers, or



This is how a part of the earth looks from an airplane high up in the air. Does it look like the picture of the moon? How is it different?

animals. Nothing grows on the moon. It is bare and ugly.

You would have to walk over sharp, uneven rock. You would have to climb over steep, high mountains. You could look down into the tops of some of the mountains. You could see miles down inside them. Such a hole in the top of a mountain is called a crater. The moon has many craters. People on the earth have taken pictures of these mountains. When you see the moon through a telescope or a field glass, it looks like these pictures.

If you could look into the sky at night during your imaginary visit to the moon, you might see a big bright light which would look very much like another moon. Instead of another moon, however, it would be our earth giving reflected light to the real moon.

But it would not be safe to stand quietly and watch the sky at night during this visit. The weather on the moon would be most unpleasant. The night side of the moon is so cold that you would freeze, no matter what you might take along to keep you warm.

In painting this picture the artist imagined he was standing on the moon and looking at the earth

The day part of the moon is so hot that most of your body would boil away if you were there. Even a make-believe person could find no place to stay on the moon.

You see, the moon is both hotter and colder than the earth is. The chief reason why the moon is both hotter and colder than the earth is because a day on the moon is as long as fourteen days on the earth. A night on the moon is just as long. The moon becomes painfully hot during this long day. It becomes painfully cold during the long, long night.

Try to pretend that you could live comfortably on the moon. During one of your moon days your friends at home would be having fourteen earth days. They would go to school ten days. They would go to Sunday School twice. They would have two Saturdays for play. At the end of seven earth days, you would be having noon on the moon.

Could you wait so long as that for your lunch? At the end of the next seven days, night would come to the moon. You would not make a fuss about going to bed at the end of a moon day, would you? You would get a long, long rest, though, for the night would be just as long as the day.

The part of the moon which is turned toward the sun for fourteen earth days has a chance to become much hotter than the part of the earth which is turned toward the sun for only one day. The part of the moon which is turned away from the sun for fourteen earth nights has a chance to become much colder than the part of the earth which is turned away from the sun for only one night.

Things to Think About

1. Although the moon makes the earth much brighter than the light of all the stars put together, yet the moon is no bigger than a speck compared with one of the stars. Can you believe that? Let us figure it out. Are the stars suns? Are many of them much larger than our sun?

2. Copy the following sentences on a piece of paper and see if you can finish each of them correctly. Then you can see why moonlight is so much brighter than starlight.

a. The stars look small because they are ----- ----- -----.

b. The stars give us little light because they are ----- ----- -----.

c. The moon gives more light because it is so ----- ----- -----.

Things to Do

Make fifty-one balls of snow or clay or sand. Save one for a moon ball. Squeeze all the rest of the balls together for an earth ball. Your moon ball looks very small beside your earth ball, doesn't it?

B. WHAT THE SUN GIVES US

Can you answer these questions?

1. Which do we need most in the cold winter time

our stoves and furnaces *or* the sun

Why?

2. Where do plants get their food to make them grow?

Why are healthy people able to work hard and play hard?

3. Why do we not see

trees with black leaves | black grass
gray flowers | gray people

1. Light and Warmth come from the Sun

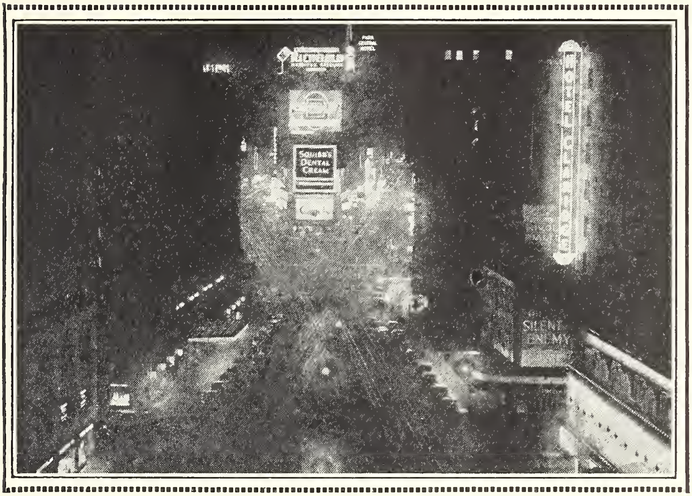
Can you name some other ways of lighting and heating which are just as good as the sun's lighting and heating?

Of course we have very strong electric lights to see by at night. Some

A city street in the daytime

streets in our cities are almost as light at night as they are in the daytime. But only a few streets of a city are as light as day, however. Cities haven't enough money to keep all their streets so light as that.

Electric lamps give our homes enough light at night for us to work or play as much as we wish. But the lamps in your home keep only your



A city street at night

house light. They do not make it possible for a person in Jimmy's house across the way to see, to read, or to play.

Among the strongest lights in the world are the signal lights which show aviators where the landing fields are. Yet aviators often get away from their course because they cannot see these signal lights through the fog.

No lights are so strong as the sun's light. The sun lights up all of our out-of-doors, even when clouds come between the earth and the sun. The sun lights up one half of the earth all the time.

Furnaces and stoves keep our houses almost as warm in winter as they are in summer. But none of these can take the place of the sun.

Furnaces and stoves have not heat enough to warm the whole out-of-doors. We do not keep our windows wide open on cold days, because an open window can soon take away almost all the warmth that the furnace or stove has given to the rooms. There is quite a difference between a stove or furnace, which heats a house, and the sun, which is always warming a half of the whole earth.

Plants, animals, and people must have light and heat from the sun in order to live on the earth

This is a land of snow houses and fur clothes

There is no place on the earth where the sun's rays do not shine at some time during the year. Even the coldest parts of the earth are warmed by the sun's rays. You have heard about the cold lands where the Eskimos live. You remember that the Eskimos wear clothes made of fur. The Eskimos live in the lands near the North Pole. The earth's coldest lands are around the North Pole and the South Pole. Snow and ice stay there all the year through. Yet the sun gives even those freezing places a great deal of heat.

For three months out of every year the sun shines there day and night. It pours and pours heat into the ice and snow. Why do they not melt away so that the land can become a warm, comfortable place? This is why.

For three long winter months the sun does not shine there at all. During this time these places do not have the warmth of the sun's rays. All is darkness and cold. Snowflakes fall and cold winds blow most of the time.

During the long winter months so much snow falls that three months of sunlight are not enough time in which to melt it all. The air cannot become very warm because the melting ice and snow use up so much of the heat which the sun gives the earth during the summer months.

Those three months of darkness cause the lands near the North and South Poles to be freezing cold all the year round. These places would be too cold for anyone to live in at all if the sun did not shine there as it does during the light months of the year.

Suppose there could be one place on the earth which the sun's rays never would reach. All the furnaces, stoves, radiators, and electric heaters in the world would not be hot enough to warm a building in such a spot.

On the other hand, there are parts of the earth where the sun shines hot and burning every day, winter and summer. During the day, in some of these places, a person would not be much hotter if

This is a land of sunshine and little clothing

he were seated close to a blazing fire. It is so hot that most people cannot move about in the noon sunlight without becoming very ill. At night, however, these places are usually quite comfortably cool.

So you see the sun is the greatest heater as well as the greatest lighter that the earth has. What should we do without the sun's heat and light?

2. The Sun gives us Color

On rainy days people say, "What a dull, gray day!" When clouds cover the sun, the whole world seems dull and gray. The sky is gray. The water in the rivers and lakes looks brown and muddy. The grass is a dark, dull green. Even the flowers seem pale and faded.

As the sun shines out more brightly the colors become more gay. Red oak leaves, goldenrod, vegetables in the market, gardens, orange and green taxis — all sing their colors to the sunny world. The world is full of color, because the sunlight is full of color.

The sunlight has many colors in it. These colors can be separated from one another. Often we can see the red, orange, yellow, green, blue, and violet, each by itself, in the sunlight.

After a shower you can often see
the lovely colors of the rainbow

Finding colors in sunlight

Drops of water separate colors of sunlight. They make a rainbow. After a shower we often see a rainbow shining across the sky.

When grass is being watered in the summer time, a little rainbow sometimes can be seen in the spray. We often see a little rainbow in a glass of water where the top of the water touches the glass. Have you found other rainbows? Where were they?

The colors of the sunshine can be separated by means of a glass prism. When you look through a prism, everything you see has a border of color around it. People, houses, trees, chairs, tables, all look beautiful when you see them through a prism, for they are edged with stripes of red, orange, yellow, green, blue, and violet.

Hang a prism in the window. When the sun shines through it, red, orange, yellow, green, blue, and violet dance on the wall. In these colors we can make ourselves see flower gardens, bright-colored birds, gay silks — everything in the world whose color we love. All their colors are shown in the color which the prism throws on the wall.

Many other objects act as prisms. The edge of the driver's mirror on an automobile causes rainbow colors to be formed. A glass bowl sometimes has rainbows in it. These objects act like prisms and divide the sunlight into separate colors. What other objects have you seen which act like prisms?

What color really is

Mary has a pretty bright-blue dress. What makes her dress look blue? Is it the dye? Why are not all dyes blue? This is why.

Color comes from the light of the sun. When you look at one color, you see only a part of the sun's color. Although the sun gives all its colors to Mary's dress, the dye in the material gives back only one. It holds all the rest of the colors. Mary's blue dress holds the red, orange, yellow, green, and violet and gives back to us only blue. Therefore we say, "Mary's dress is blue."

Alice's red dress keeps the orange, yellow, green, blue, and violet and gives back the red of the sun's rays. So we say, "Alice's dress is red."

Grass looks green to us because the green in the sunshine is reflected back to us by the grass. A bluebell looks blue to us because the flower's petals keep all the colors but blue. They throw the blue back to us.

Why does a buttercup look yellow? Why does an orange look orange? Why does a violet look violet?

When all colors are put together they form white. Bill's white blouse looks white to us because it throws back almost all of the sun's colors. It holds very little color in itself.

Fresh snow is the purest white we can find. On sunny days we want to shut our eyes or cover our faces when we look at the snow. People sometimes become blind from having to look a long time at wide fields of snow. The snow is throwing back to us all the sun's colors together. It is hard for our eyes to look at all of this at once.

Quite a different thing is true of black. Black is no color. Objects which are black give back none of the color which they receive from the sun's rays. A black coat and a black hat look black to us because they hold all of the sun's colors. No color is given back to us.

When we look around in the dark night, we see no colors at all. Everything looks black or gray. The green leaves on the trees are black. The walls are gray. Mary's blue dress looks black. Alice's red dress looks black. Everything is black or gray because the sunlight, with its colors, is gone.

Something to Do

1. Pretend that you are in a beautiful garden at night when the moon and stars are shining. These flowers are growing in the garden:

Pansies	Daisies
White roses	White peonies
Red roses	Golden glow
Lemon lilies	

2. Pretend that you are going to gather a bouquet. Which of these flowers could you see to pick most easily? Why?

3. Draw a picture of your house. Color it as it would look through a prism.

4. Make a picture of your street or yard, (1) as it looks in the daytime, (2) as it looks at night.

3. The Sun gives us Food

1. The sun helps to give us food.

2. It helps plants and animals to grow.

Look back at the picture on page 37. Can you see where the picture tells these two things to you?

Let us see if we can prove that the sun does these two things for us.

Here is a good breakfast for boys and girls:

Orange juice	Buttered toast
Cereal	Milk
Soft-boiled egg	

The sun helped to give Mary this good breakfast

Can you tell how the sun can give this good breakfast to you?

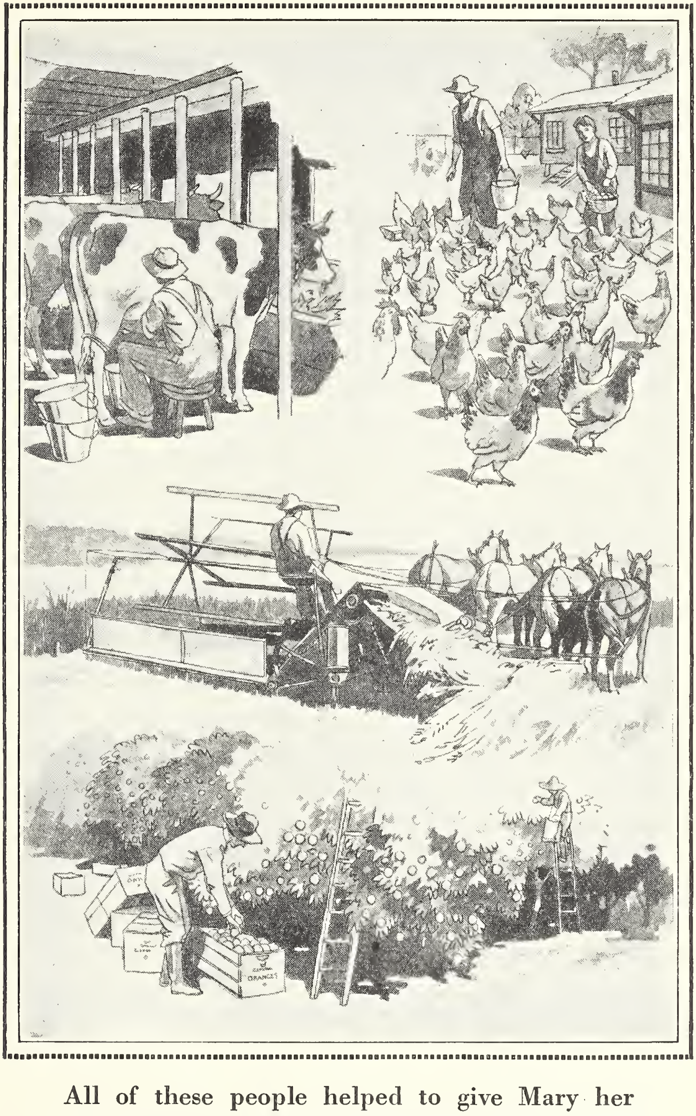
How the sun gives us food

Of course we all know that before the storekeeper or the milkman had anything to do with this breakfast, farmers, near and far, had been getting it ready. One farmer had fed and milked the cows. Another had cared for the hens which laid the eggs. Still another farmer had raised the wheat which made the flour for the bread. A farmer in California or Florida had watched over the trees on which the oranges grew.

Now, what does the sun have to do with any of this?

The cows were able to give good rich milk because they ate plenty of grass and grain. The hens were able to lay fine eggs because they ate corn and bran and grass. The grass and grain needed sunlight to make them grow. The sun made the orange trees grow. You would have had no breakfast to eat if there had been no sun. The sun really did give you your breakfast, did it not?

The cows and hens had food from the plants to make them grow. All



All of these people helped to give Mary her breakfast. Can you see that the sun helped, too?

animals get their food from plants in one way or another. If they themselves do not eat plant food, they eat other animals which do eat plant food. The sun makes the plant food grow. Whether our food is animal food or plant food, the sun is needed to make it, just the same.

Where do plants get their food?

Can you think of anything which does not need food to make it grow?

Plants are like everything else. They need to have food to make them grow. But where do they get their food? The farmer gives grain and hay to his cows or turns them out to pasture where they can nibble grass all day. He feeds his hens bran and grain or turns them loose to pick up grass, seeds, leaves, or insects. All animals have food ready-made for them. But who brings food to plants?

They are given water sometimes. But plants as well as animals need more than water to make them grow. People do not feed plants as they do animals. A plant cannot travel around and find food for itself as a cat hunts for mice or birds.

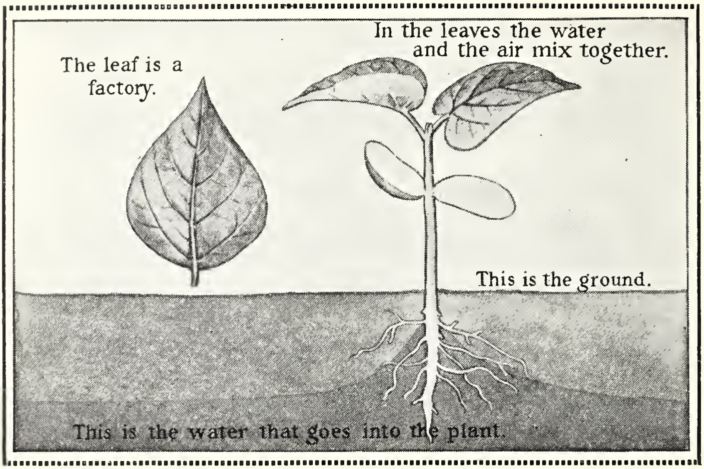
Three guesses where plants do get their food.

1. From the ground? *Partly right.*
2. From the water? *Partly right.*
3. Plants make their own food! *Exactly right.*

Every plant is its own factory

Only plants have to make their own food. Every other living thing has food ready-made for it.

Of course many things are done to get food ready for us to eat. But suppose a person should be asked to *make*



With the help of the sun, plants make their own food

some potatoes for dinner. How could a potato be made? What should you put together to make a potato? Of course no person could *make* a potato. It is not hard to grow potatoes, but no one has ever really *made* one.

A plant's food cannot be found already made. The plant must make its own food in its own food factory.

The plant gets some of the materials for its food from the soil, that is, from the ground in which it grows. These are water, iron, and a few other materials.

You could never guess where the rest of the material for plant food is kept. It is kept in the air!

The roots of the plant take up the water, which holds the iron and other materials. This water goes through the stem to the leaves. In the leaves the water meets the air, and the water and a part of the air are joined together. The strength, or energy, of the sun is the power which makes the air and the water join together.

This is the way the plant's food factory works. It sounds very simple, but only plants have ever been able to make food in this way.

The sun gives the plants energy (that is, strength or power) to grow and to make other plants like themselves. This

These are the plants
the sun made

These are the boys
who ate the plants
the sun made

These are the plants
the sun made

This is the cow
which ate the plants
the sun made

These are the children
who drank the milk
that came from the cow
which ate the plants
the sun made

"The House that Jack Built"

energy does not stop with the plant. It goes on and on into everything which eats the plant.

The energy which the sun puts into plants is rather like "The House that Jack Built."

The energy of all people comes from the sun. The energy which mother needs to take care of her home and children comes from the sun. The energy which father needs in order to work every day for his family comes from the sun. The energy of all people comes from the sun through the food they eat.

Things to Do

1. Here is another verse for the "House that Jack Built" story of food:

Here is the grass
  the sun made.

Here are the hens
    that ate the grass
    the sun made.

Here are the children
    who ate the eggs
    laid by the hens
    that ate the grass
    the sun made.

2. See if you can make up other verses for this story. Draw pictures of your story.

3. Can you draw a picture of a plant, showing how water is drawn from the ground to the leaves of the plant? Show that the water and a part of the air are joined together in the leaves. Do not forget that the leaf machine does this with the help of the sun.

4. Here is a way to prove that the plants need the power of sunlight to make their food:

Take two plants which are as near alike as possible. Keep one plant in a sunny spot. Keep the other in a dark place. Give each plant the same care. Water each one every day. At the end of three weeks stand your plants side by side. It will be easy to tell which plant was kept in the dark.

UNIT II

Plants and Animals of Long Ago

Perhaps you think that the greatest changes which have taken place on the earth are changes which people have made.

People build towns and cities. They cut down forests. They build dams so that there will be water where there was no water before.

These are great changes indeed. But the greatest changes are those which the old earth itself has made.

Some of our hot, dry deserts were once cool and shady forests. Many rivers are flowing today where there were once wide plains covered with grass. Some of our meadows and pastures were once at the bottom of rivers or lakes. Some of our rich wheat farms were once covered with a sheet of ice over a thousand feet thick. Cold places, where many of the Eskimos now live, were once warm enough for ferns to grow as tall as trees. Many places where mountains now reach up into the sky were once low and flat like a floor.

Such changes take place very slowly. During any one of them hundreds and thousands of years passed by.

Such changes are taking place in the earth right now. They take place so slowly that many people do not know they are happening at all. Most of us should not know about them if wise men did not tell us.

1. The Young Earth

"What was the earth like in the beginning?"

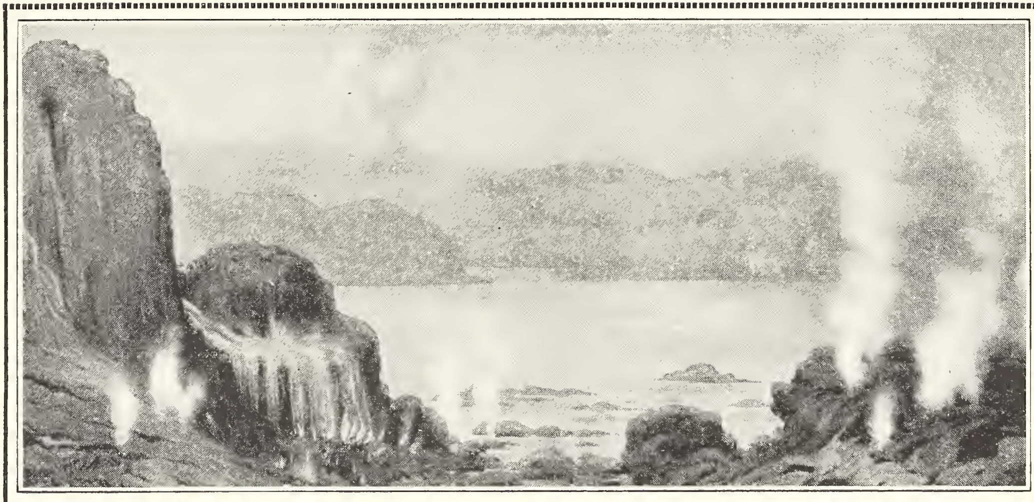
So many children ask this question that this book is going to help you to understand something about it right away.

In its very, very beginning, the earth was a part of the sun. This is how it became separated from the sun. A huge band of hot gas was pulled off the sun. This hot gas whirled and whirled about in space. It stayed away from the sun. It did not fall back into the sun. As it whirled, it cooled. As it cooled, it formed into a number of great, solid balls. One of these great, solid balls became what we now call the earth.

When it first became a hard, solid ball, the earth was not at all the way it is now. For millions of years it was a lonely place indeed. No people lived here then. There were no animals. There were no trees or grass or plants of any kind. The earth was a bare, rocky place. Nothing covered its bareness. There were no rivers or lakes or oceans. Not even a blanket of soil was spread over the young earth. For millions of years the earth was bare rock. There was no water on it. There was no air around it.

Plants could not grow without air, water (or moisture), and soil, so, of course, there were no plants. Animals could not live without the plants for food, so, of course, there were no animals.

Millions of years were needed for the air and water to form. Millions of other years were needed for soil to collect on the outside of the earth. Millions and



After millions of years air and water formed on the young earth

This picture was taken through a microscope. The tiny plants are like those which first grew on the earth

millions more years went by before trees, grass, lakes, and rivers had covered the earth and made it beautiful. After this time many animals roamed through the land.

The first plants were the tiniest kinds of plants. The first animals were the tiniest kinds of animals. Some plants and animals as small as these are living on the earth today. They are so small that they cannot be seen unless a lot of them are growing together. Many of them cannot be seen at all without a strong microscope.

More millions of years passed by after the days of these tiniest plants and animals. By this time, most of the kinds of plants and animals were much larger. You could easily tell which were plants and which were animals. There were many different kinds of plants and animals. They were living far and wide over the earth. Finally, some of them became giant plants and giant animals.

2. The Coal Age

About three hundred millions of years ago, there was a time when great numbers of giant plants grew on the earth. In those days the earth held great forests of beautiful dark-green ferns. They grew in all parts of the earth. They grew as far north as the places where the Eskimos live now. The earth was warm all over, then.

The world was beautiful, but very strange. It seemed to be all one color — green. No bright-colored flowers blossomed in the forests. No butterflies flashed their colored wings through the grasses. No bright-colored birds flew busily about building their nests or sang their songs at evening. No animals walked about. Except for a few insects, everything was very still in the great fern forests.

Slowly these giant plants died. Today we have no ferns so large as these old, giant ferns. They fell down into the

© Field Museum of Natural History

These giant ferns lived millions of years ago. Plants like these are not living today soft, swampy earth and were slowly covered over by the mud and water.

For millions of years these great ferns lay in the earth. More soil formed on top of them and packed them down, harder and harder. Very slowly they turned into what we now call coal. The time of the great fern forests is called the "Coal Age."

Things to Do

Take several pieces of coal. Study them closely in a good light. See if you can find places which look like leaves or other parts of plants which grew long ago.

3. The Age of Reptiles

After the Coal Age came a time which is called the "Age of Reptiles." The word *reptile* means "to crawl." Many kinds of reptiles are living on the earth today. Snakes, turtles, alligators, and lizards are reptiles.

Reptiles are slow-moving, cold-blooded animals. They have neither feathers nor fur. They are covered with a tough skin or shell.

Do you know what is meant by a "cold-blooded animal"? Dogs and cats and many other animals are warm-blooded. That means that their bodies are usually warmer than the rooms or the out-of-door places where they are found. The bodies of cold-blooded animals are about as cold or warm as the water or air that they are living in. Fishes are cold-blooded animals. Did you ever catch a fish? Do you remember how cold it felt?

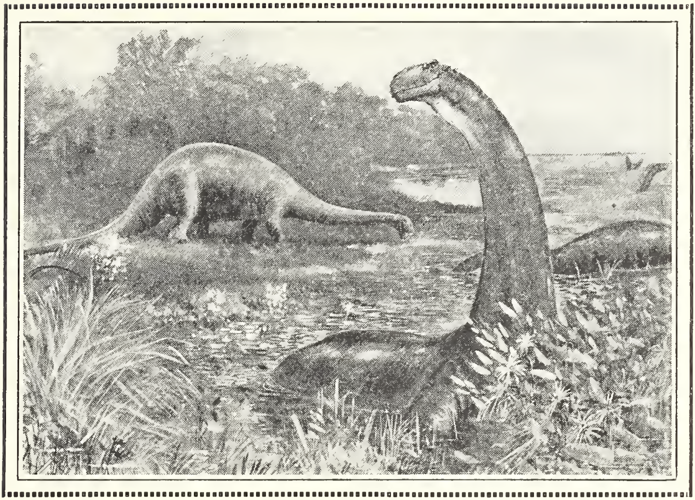
The Age of Reptiles was over one hundred millions of years ago. There were other animals living in many parts of the earth at that time, but the reptiles were the greatest and the strongest.

The reptiles of those days were not the snakes, turtles, and lizards of our days. Strange creatures called dinosaurs crawled over the earth at that time.

There were several kinds of dinosaurs. Some were bigger than elephants. Some were as tiny as robins.

Some of the largest dinosaurs had a huge backbone which ended in a long thick tail. The Thundering Reptile was one of these.

They are called "Thundering Reptiles" because anything so heavy would probably shake the ground if it walked about on land. Many of them weighed over forty tons. That is more than five hundred men would weigh.



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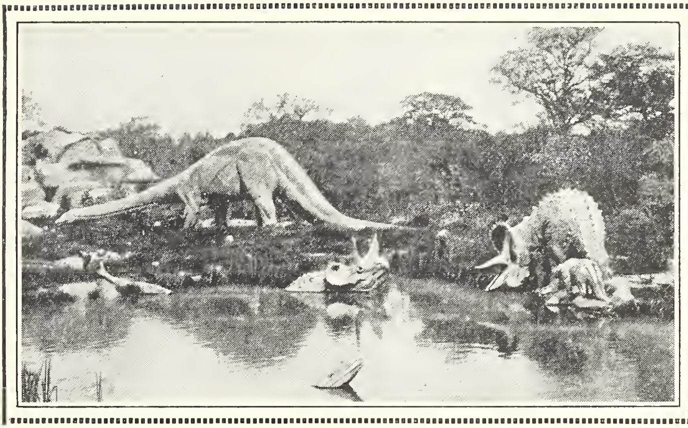
Here are some Thundering Reptiles

The Thundering Reptiles lived in swamps. Their food grew near the water's edge. They spent much of their time in the water. Did you ever notice how light your body feels when you walk about in water that comes above your waist? The Thundering Reptiles half walked and half floated about in the water. They were too heavy to walk about comfortably on land.

The legs of the Thundering Reptiles were much larger than those of the elephants in the zoo. Their necks were much longer than those of the giraffes in the zoo. Their long legs and their long necks helped them to reach the trees, vines, and tall grasses which grew around the water. Their necks were very thick as well as very long. Their heads were tiny. Their brains weighed only a pound or so. Their teeth were wide and flat.

They did not kill the other animals, because they did not need their meat for food. They were too slow and too lazy to do much fighting even if they needed to. They were likely to be killed by the other dinosaurs because they were unable to fight.

The Three-Horned Face was another kind of dinosaur. It had a fierce and



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Many of the plant-eating dinosaurs liked the plants which grew near the waterways

ugly appearance. It had a thick, short neck like an elephant's. Around its neck was a bony collar which stood out like a fancy ruffle. It had three horns. On its head were two long horns. A shorter horn was on its nose. Its mouth ended in a short, sharp beak like that of a huge bird. Of course you do not have to be told why this kind of dinosaur is called the "Three-Horned Face."

Its head looks as if it were well made for attacking, killing, and eating other animals. The bony collar could have protected the neck from the teeth and claws of enemies. The collar's most important use, however, was to balance the great heavy horns which grew on the front of the animal's head.

Possibly the Three-Horned Face could fight if it needed to, but it did not kill other animals for food. It ate grasses, leaves, and other plants instead. The strong, pointed beak at the end of the jaw was a great help in breaking off stiff, hard grasses, or the woody twigs of low bushes. The back teeth were well made for chewing the hard food. Something very strange happened to its back teeth. As soon as the teeth were worn down by hard chewing, they were pushed out of the way by new teeth

The Tyrant Reptile and the Three-Horned Face

which took their place. The Three-Horned Face had any number of new sets of teeth during a lifetime.

Another family of the dinosaurs had huge tails and stood on two legs only. Their front legs were very small, with sharp, eagle-like claws by which they grasped their food. Their heads were large. They had long, thick, sharp teeth.

They ate other animals. Sometimes they ate animals which had been dead a long time. The name for these is the "Leaping Reptile." Another dinosaur which looked much like the Leaping Reptile is called the "Tyrant Reptile." He was larger than most of the others. He had terrible claws, jaws, and teeth.

There were many other kinds of dinosaurs, but there is not enough room to tell about all of them. You have been reading about the ones which children like best when they go to a museum to visit the dinosaurs.

Skeletons of most of these strange creatures have been placed in museums. When you look at them, you feel like the little girl who said, "That animal is so funny looking, it seems as if it couldn't be an animal."

If you should travel all over the world, you wouldn't find one of these creatures alive today. No man has seen a live one. The time when dinosaurs nibbled the trees and grasses or walked about in the swamp lands looking for tender water plants was ages and ages before the earliest people were living.

Things to Do

1. Make a Thundering Reptile out of clay.

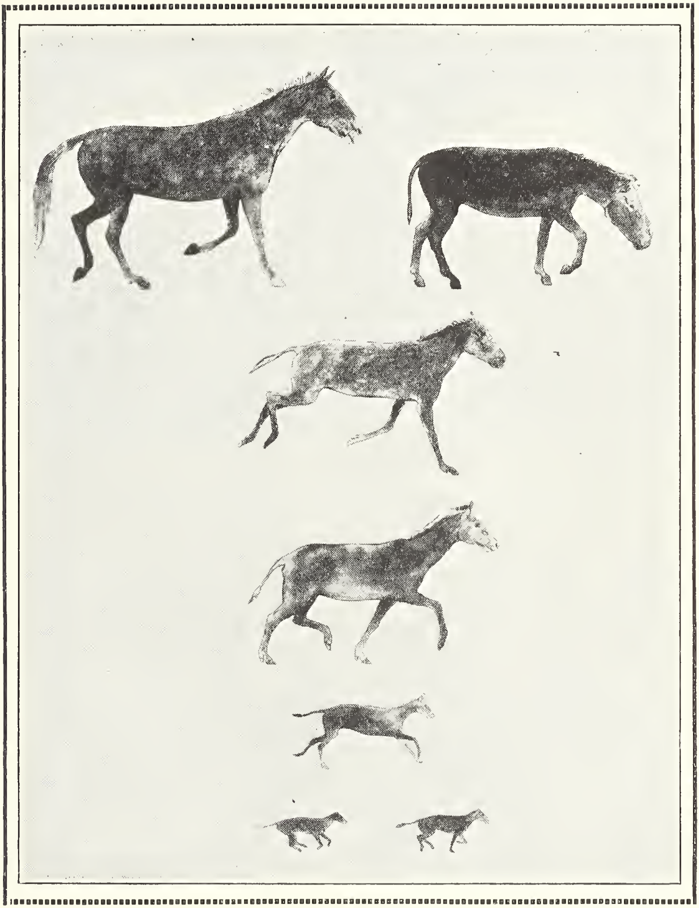
2. Make a Three-Horned Face out of clay.

3. Draw a picture of a fight between a Tyrant Reptile and a Three-Horned Face. You might make other kinds of dinosaurs watching the fight. Do not forget to put trees in your picture. Many of the trees of that time looked somewhat like our palm trees. Near the water grew a giant weed which was very much like the weed we now call "horsetail." You can find it in swamps and meadows and near railroad tracks.

4. The Age of Mammals

For many more years the reptiles ruled the earth. During this time animals of a different kind began to live on the earth. These animals were not reptiles. They did not crawl. They walked or ran. They did not lay eggs as the dinosaurs did. They were warm-blooded animals. These animals are called "mammals." Cows, horses, sheep, cats, pigs, giraffes, elephants, skunks, bears, and many other such animals are some of the mammals of today. In this next age we hear about the first animals of this sort. This age is called the "Age of Mammals."

Among these early mammals were the grandfathers of many kinds of mammals which we find on earth today. At first they were very small.



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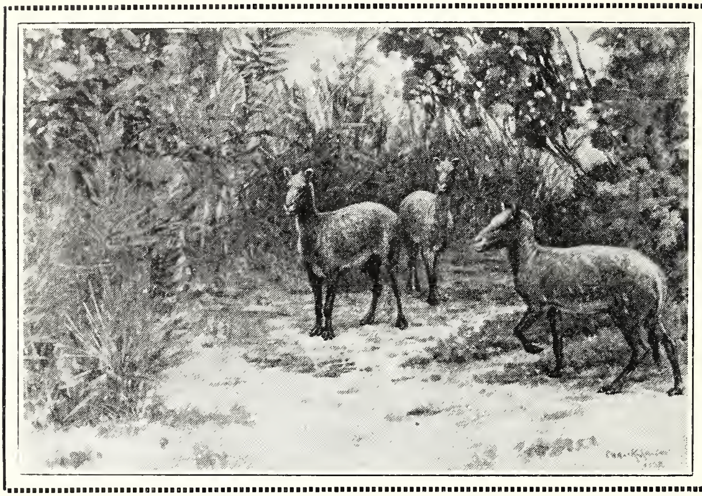
The horse was once a little animal less than one foot high



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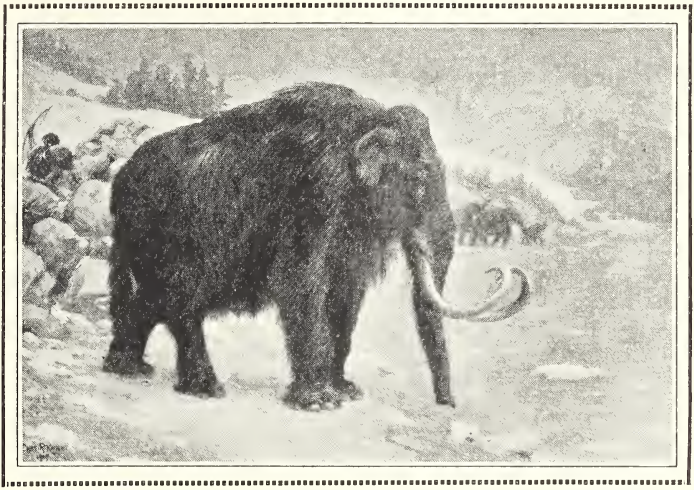
Early mammals. The four-toed horse

Imagine horses eleven inches high, camels the size of cats, and elephants no larger than sheep! If the giant dinosaurs had been out of the way the world of that time would have seemed like a big toy shop.

These new animals did not stay small, however. As the ages went by they became larger and larger. The horses went through very interesting



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The elephant's grandfather. He is called a mammoth

changes. At one time they had four toes. Later they had only three. Their feet were not hard hoofs as they are now. After many more ages the horse and camel grandfathers became as large as they are at present.

The elephant grandfathers went through very great changes. These mammals, once no larger than sheep, became huge creatures called "mammoths." The mammoths were as large as the elephants of today. They were covered with long, shaggy hair. Their tusks were over fifteen feet long, and often weighed as much as one hundred and seventy pounds. The mammoths lived in Russia and in nearly all parts of North America. They were strong creatures and were able to live through storms and freezing weather.

Elephants of today are quite different from the old mammoths. They are not found in cold places like those in which the mammoths used to roam. They are found only in the warm forests of India and Africa.

None of the mammoths are alive today. If you want to see a mammoth, you will have to go to a museum. People of today have never seen live mammoths. The mammoths in the

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People who lived at the same time that the mammoths did, drew this picture on the wall of their cave

museums have been dead for thousands and thousands of years.

It is true that no people of any time have ever seen living dinosaurs. But many people were living in the world when the mammoths were alive. These early people feared the mammoths. They hunted them, and often killed them. They held great feasts with the mammoth's flesh for food. They made weapons of its bones and tusks.

We know that people were living on the earth during the time of the mammoths, because men have found pictures of mammoths drawn on the walls of caves. The people who drew the pictures made their homes in the caves. They must have seen live mammoths, or they could not have drawn these pictures.

People are mammals. You are a mammal, and so are all your friends. People were the last kind of mammal to begin life on the earth.

5. What are Extinct Animals?

Some children who went to a museum to see the dinosaurs and early mammals asked two very important questions. The first question was, "When is an animal extinct?"

The second question was, "How do

we know that these things about these old animals are true?"

Should you like to know the answers to these questions, too?

The children asked the first question because a man at the museum had said, "Long before the mammals became such great creatures, the dinosaurs were extinct."

The children asked, "When are animals extinct?"

This is what the man told them:

When we say an animal or a plant is extinct, we mean that that kind of animal or plant cannot be found living anywhere on the earth today. If your dog should die, we should not say that dogs are extinct, because many more dogs would be left in the world. We can be sure that there will be plenty of dogs for ages to come. However, if something should happen so that all the dogs in the world should die, then we should say that dogs were extinct.

No dinosaurs are living anywhere in the world today. Dinosaurs are extinct. Elephants are living in the world today. But no elephants of the kind which are called mammoths are living in the world today. The kind of elephant which was called a mammoth has become extinct.

Because certain kinds of plants and animals are large and strong, do not think that they will never become extinct. The tree-like ferns of the Coal Age, the huge dinosaurs, the great mammoths, all had their turn at being the most important things on earth, yet none of them are here now. They are all extinct. The mammoths were the youngest of these old giants. They disappeared thousands of years ago.

Things to Think About

1. Did you ever hear of any other animal which is extinct? Reindeer and buffalo have been in danger of becoming extinct. However, people have made laws to protect them until now large numbers of them are roaming through their home pastures.

2. Did you ever hear anyone say that some animal is in danger of becoming extinct? Should you know, now, what the person meant?

6. How do we Know that these Things are True?

For many years people have been finding records of plants and animals of long ago. Do you know what a "record" is? This will help you to understand.

When your report cards are given to you at school, you are getting a *record* of the kind of work you have been doing in school. If your grade keeps a weather chart, you are keeping a *record* of the kinds of weather which have been taking place around your school. When a person keeps a diary, he is keeping a *record* of the things he has been doing and seeing.

The records of the early plants and animals were not made in the way in which records are made today. These early records are not found in paper books or on large cards. They are shown to us in rocks or in piles of hard clay. Some of these records have been found on top of the ground. Others have been found underneath the ground.

Long, long ago someone discovered the bones of some huge animals. These bones were partly under the ground and partly on top of it. People wondered what sort of creatures these must have been. It was finally decided that

A record of early animals. At one time these were the bones of a great dinosaur

these must be the bones of giants. So people made strange tales about the giants who had once lived on the earth. Some people said prayers to the bones.

But after a while they had to stop believing these stories. These bones were found to be the bones of giant animals, and not the bones of giant men. The stories were not all spoiled, however. One can imagine quite exciting stories about the great animals. But of course we can really believe only what the men who know about these things are able to find out from the bones and the rocks and the clay. Men who know about such things are called scientists.

As the years went by, scientists began to look for other records of animals which had lived and died long before people lived in that part of the country. They found strange footprints in rocks. These marks were not like the marks made by the feet of any animals living at that time. As the men studied the rock, they found that it was very old.

"The footprints must be older than the rock," they said. "Footprints can be made only in soft material. Old animals have left their footprints in mud which afterwards hardened into rock.

These animals must have lived here ages ago." They agreed that at one time strange animals which are now extinct had lived in that part of the country.

Another record of these old great-great-grandfather animals was made in much the same way, but it tells us more about the animal. An impression of the animal's whole body was found in the rocks. Do you know what an impression is?

If you live in a snowy part of the country, you may have made "snow angels." You lie down against a snow bank. Pressing your body hard into the snow, you move your arms up and down on the snow. When you stand up you see the shape of yourself in the snow. The place where you moved your arms up and down looks like wings. A sand

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Another record of early animals. This is an impression of a dinosaur called "The Duckbill"

"angel" can be made in the same way. This "angel" in the snow or sand is an impression.

Ages ago when the animals lay down and died, the impression, or shape, of their whole body was left in the mud. This mud hardened into rock. The impression, or shape, of the animal's body was left in the rock. It looked the way it did when it was first made in the mud. These impressions are very valuable now. They tell us many things we want to know about what the world was like before man was here.

One of these records alone would not tell us very much about the plants and animals of long ago. But several records together tell us many true stories which are as interesting as the stories which are told about the animals of today.

7. What are Fossils?

All these records of old animals and plants are called fossils. The footprints in the stone are fossils. The impressions of the animal's body in the stone are fossils. The bones and skeletons are fossils.

The fossil which most of us know best and which is most useful to everybody right now is coal. Coal, you remember, is what is left of the old giant ferns which grew here before the animals lived. When the ferns died, they dropped down to the earth. They were covered by more ferns and trees. They were pressed down into the earth and became a part of it. They took with them the energy by which the sun had made them grow. Think of the energy that coal gives back to us now! It makes heat for our houses. It runs steam engines. In all sorts of ways it gives out the energy which the sun put into it so long, long ago.

8. What causes Animals to become Extinct?

Many children ask this question after they have seen fossils in a museum or after they have read about plants or animals of long ago.

"Why are there no dinosaurs or mammoths now?" "What caused them to become extinct?" These are questions which the men at the museums are asked over and over again.

Have you wondered about this, too? Have you asked about it at home? Have you tried to find the answer from pictures or from books? There are many answers to this question.

Probably no one thing caused any kind of animal to become extinct. Scientists believe that some of these things may have happened:

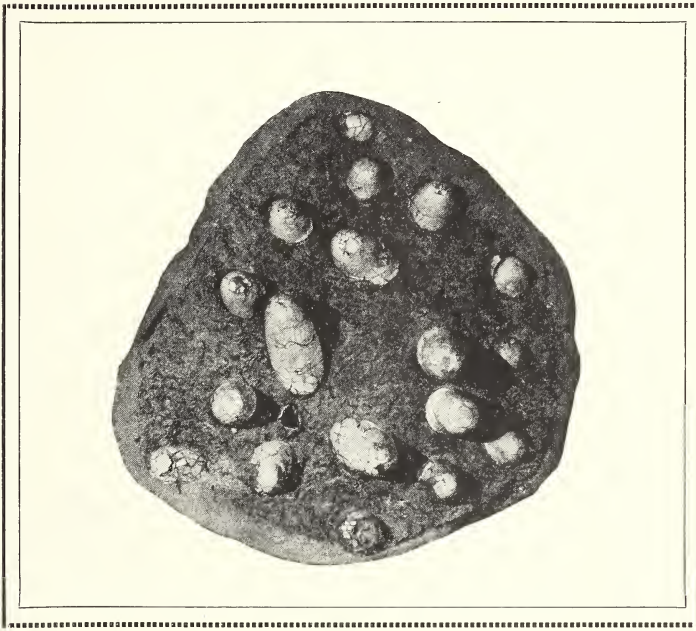
1. Perhaps the animals used to feed in swamps which dried up. Since their food dried up and they could not get the right kind of food, they all died.

2. Perhaps the animals had been living in a warm country which slowly grew colder. The plants which grew there while the country was warm could not live there when it was cold. When the plants died, many animals had nothing to eat, so they starved.

3. Perhaps water came over the land where there had been no water before. This would drown the animals.

4. Perhaps snow fell so hard and so long that the animals were buried in the snow. This ended the lives of many of the mammoths.

5. Perhaps there was enough food for only one kind of animal, so the smartest kind of animal took the food.



©A. M. N. H.

A dinosaur's nest. These eggs are millions of years old

Perhaps these smarter animals killed many of the rest in fights for food.

6. Possibly many of the mammals ate the dinosaur eggs. If no baby dinosaurs were hatched, there would be no dinosaurs of that kind to take the place of the old ones when they

died. That kind of dinosaur would then become extinct.

The fossils do not exactly tell us these things, but they make us think that such changes could have taken place. Of course these changes were made very slowly. Probably thousands of years went by while they were happening.

Things to Think About

You can see that the earth is very, very old. You can see why we say that it is millions of years old. A million years is a long, long time. It is too long for anyone really to understand, but we might try a little.

Think how long a few weeks seem when you are waiting for Christmas to come. Think how long the year is between one Christmas and the next. When you have a birthday, does your last birthday seem long, long ago? It is only one year.

Listen to the clock while it ticks for a whole minute. If it ticked once every second, it ticked sixty times while you were waiting. Did the minute seem a long, long time while the seconds were ticking themselves away? Do you know how long it takes a clock to tick one million seconds? It takes nearly two weeks. Can you imagine nearly two whole weeks of seconds? Wouldn't the time seem long if you were watching the clock every second of that time? Now suppose that each second were one year long. What a long, long time one million years would be!

The earth is many millions of years old. How very old the earth is! How much older is the big, old sun!

UNIT III

Animals of Today

Do you suppose that lions, tigers, giraffes, woodchucks, snakes, cows, sheep, cats, bees, fish, birds, and the rest of the different kinds of present-day animals will always be living here on the earth? Is it possible for any of them to become extinct?

It is not always so easy as it seems for animals to stay alive. The next stories tell you about the dangers which animals meet in their everyday lives. They also tell you how animals are protected against these dangers.

A. WHAT HAPPENS TO ANIMALS WHEN THE SEASONS CHANGE?

Do you know what is meant by the change of seasons? Spring, summer, fall, and winter are the four seasons of the year in most places. When winter turns to spring we say that the season changes. When summer turns to fall we say that the season changes. There is a great difference between winter and summer.

People have learned how to prepare for the winter season of the year, in which living is so much harder than it is in summer. The animals cannot care for themselves as people can, and many of them lose their lives when the cold season of the year comes round.

1. Dangers of Cold Winter

Many times the animals have to fight against deep snows and strong, sharp winds. Sometimes the snow is so deep that the animals cannot climb out of the drifts. Sometimes they become so tired that they cannot get to the places where they live.

Huge snowbanks often block the way

© Charles Belden

These sheep have been caught in a heavy snowfall. Do you think they are quite safe from the storm?

and keep animals from leaving their homes to hunt for food. If animals are "snowed in" too long, they starve.

Food is scarce in winter. Most of the animals which die in winter do not freeze. They die because they do not have enough to eat. Perhaps you can name some of the foods which animals have in summer but which they do not have in winter.

Animal enemies are keen and fierce in winter. Most animals grow very hungry in winter, because food is scarce. An animal will fight much more fiercely when it is starving than when it has plenty to eat.

2. How Animals are Protected against Winter

There are many ways by which the animals can find food and safety in winter.

A number of things are left for them to eat. Brightly colored berries, seeds, unpicked fruits, mosses, buds, nuts, tender roots and branches, insects in the bark of trees, smaller animals, and the food which people provide, keep many animals from starving in winter.

Our winter animals are often great thieves. The farmer has to guard his grain, his chickens, his vegetables, and his seeds from the animals, whose hunger makes them very bold.

The question of food in winter is partly settled by the fact that there are fewer animals to eat it. Many birds fly to the south, where there is plenty of food. Frogs and turtles spend the winter in holes in the mud. Snakes and toads also crawl under the ground for the cold months. Woodchucks sleep all winter in their tunnels under the ground. Chipmunks, skunks, and bears have long winter naps in their snug shelters. Muskrats and beavers stay in houses which they have built in the water.

The colors of most animals in winter protect them from their enemies. A

The rabbit's coat changes color to be like the colors of spring, summer, autumn, and winter

white or gray animal cannot be seen very plainly against the snow or against the gray earth and trees. He cannot be caught by an enemy so easily as he could be if he wore the brighter colors which animals wear in summer.

A squirrel's coat changes from brown to gray in winter. So does a rabbit's. Some rabbits become nearly white. A weasel's coat changes from reddish brown with a stripe along the back to pure white with just a black tip to the tail. Even his name changes. In winter he is often called an ermine.

The juncos have white breasts, with smooth dark-gray wings and heads. Their white and black and gray colors look like shadows on the snow. Chickadees wear suits of gray and black. Even the English sparrow's feathers change from brown to gray in winter.

Do you know of any other animal whose color is very well suited to the white-and-gray winter world?

During this time cats, dogs, horses, sheep, owls, sparrows, and all the animals that have to live where it is cold have an extra coat of fur or feathers. In the fall an animal loses much of the coat he has worn all summer. We say that he is molting. The new coat of fur or feathers is much warmer than the summer one was. In the spring the animal loses much of his winter coat. A brighter-colored, thinner coat takes its place.

Most animals have some kind of shelter into which they can escape from severe weather. Birds and other small animals find safety among the thick branches of the evergreen trees. Rabbits crawl under low bushes, into holes

This picture shows the winter shelters of some birds and other animals in the ground, or into hollows at the roots of trees. Squirrels find shelter in all sorts of places. They build themselves nests in the branches of trees. They camp in old holes of woodpeckers, and even in people's attics. Porcupines stay in hollow trees, in small caves, or in holes in the ground.

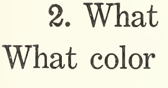
You see, the animals are very well taken care of in winter, after all. We must remember, too, that winter does not last forever. Spring always follows. Before winter's small food supply is all gone, spring arrives with dainty food of all kinds. Before the sharp winds and deep snows have killed all the animals, the mild air and warm rains of spring have taken the place of those chilly dangers.

Things to Think About

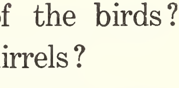
1. Can you tell about other places where animals find shelter in winter? What about dogs, cats, rats, mice, horses, cows, or sheep?

2. In winter, deer and other wild animals often come very close to places where people are living. You can feed them. In summer, they are very wild. You can hardly find them in the woods. Can you tell why this is so?

3. In the winter the life of people, like that of animals, is different from their life in summer. Tell some of the things you do in winter which you do not do in summer. Do you wear different clothing? Do you eat different food?



Things to Do



1. Take a winter walk in the fields or parks.

2. What colors were the coats of the birds? What color were the coats of the squirrels?

3. See if you can meet any other animal whose coat shows very plainly that it is his winter coat.

B. HUNGER AMONG THE ANIMALS

Have you any kind of pet which you care for yourself?

What do you have to do to take care of your pet properly?

What happens if you forget to feed your pet?

Does he have more than one way of showing that he is hungry?

What do you think is the most important duty you have in the care of your pet?

1. Hungry Times

The cold, hungry days of winter finally pass away. Spring seems ready to make life easy for the animals.

Grass grows all about in spring. Plants of all kinds are sprouting out of the ground. Tender leaves and branches are growing on the trees and bushes. Insects and worms are hatching. Hundreds of moles and other small creatures

Pets need to be carefully
sheltered, fed, and watered

are being born. But a great many animals die in the mild spring and summer weather, in spite of the fact that the out of doors has this great supply of good things to eat.

The number of animals which need to eat this food is larger in the spring and summer than it is in the winter. Birds come back from the south. In-

The spring pantry must be full
of food for all kinds of animals

sects hatch from their eggs and begin to eat plants. Skunks, bears, woodchucks, chipmunks, frogs, toads, snakes, and turtles have been asleep most of the winter. When they awaken in the spring they are as hungry as hungry can be, because they have not eaten for such a long time. Many young animals are born in the spring. All these animals try to get their share of spring's supply of food.

Is there always food enough for all the birds and mammals and reptiles? Many things can happen to keep spring's food supply from lasting all summer.

Many insects hatch only in the spring. When the great spring supply of a certain kind of insect is gone, the animals which eat them have to look for other kinds of food.

The same thing happens to animals

© A. M. N. H.

These birds must live near the water. Their food is here. What do you think they eat?

who have been depending upon young animals for food. Most animals do not have birthdays just any time of the year as people do. They usually are born in the spring. Late in the summer, when few young animals are being born, this kind of food is hard to find.

In summer, lack of water seems to

be the chief reason why animals go hungry or starve to death. Spring rains are often followed by long dry spells. Many animals live on tender green plants. These plants often dry up. Sometimes they become so brown and hard that the animals are not able to eat them. When the plant food dries up, the animal food becomes hard to find.

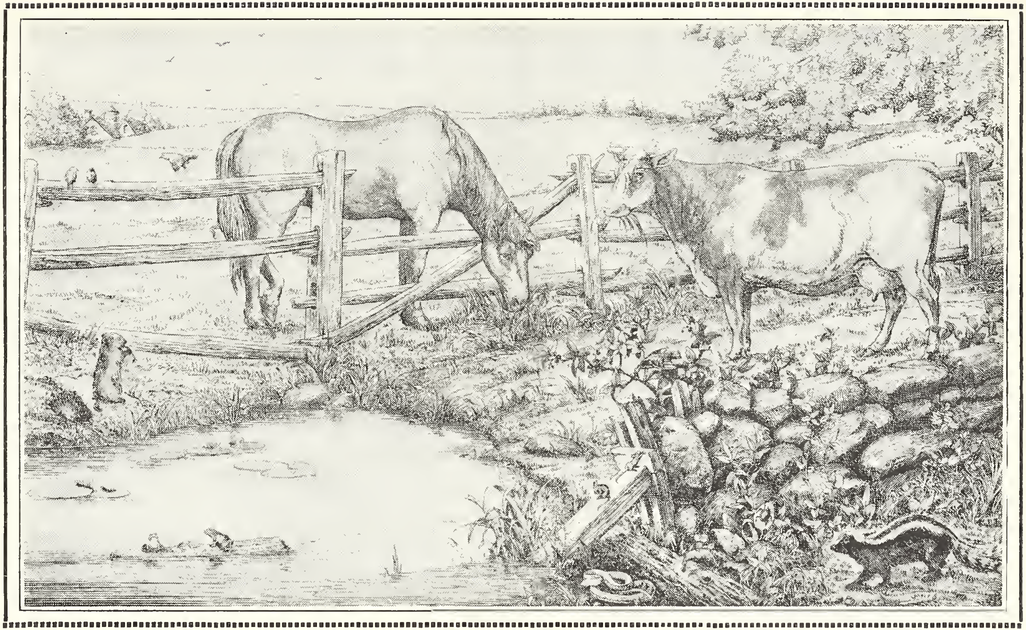
When little or no rain falls, the drinking water dries up. This causes very great trouble, for the animals can go without food longer than they can go without water.

2. How are Animals Protected against Hunger?

Although animals are often in danger of starving, they are protected from it in many ways.

Here is one of the ways in which nature makes the food supply go round to a great many animals. Many different kinds of animals live in the same place. Since different kinds of animals eat different kinds of food, there will probably be enough food for all.

Think of some pasture or field where there is a little brook. Cows, horses, or sheep feed on the grass there. Perhaps some woodchucks have their holes in the ground. Many kinds of insects live in the grass. Skunks come there at night to catch the beetles. Near a stone wall you may find some garter snakes or milk snakes. Underneath the ground, meadow mice nibble at the grass roots. Some of the birds eat insects. Some eat berries and larger fruits. Some live on seeds. You can catch minnows in the streams. Frogs



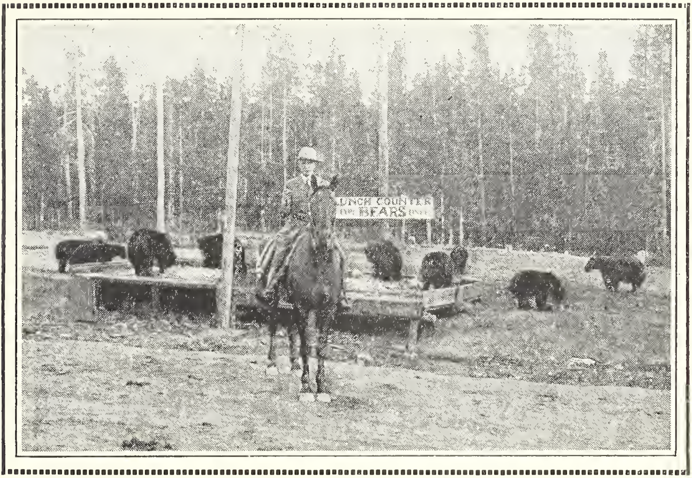
Many different kinds of animals live in the fields. How many can you find in this picture?

live in the low, swampy places made by the brook. Perhaps you can name many more animals which might be found there.

Many kinds of animals can find food in so small a place because they like many different kinds of food. If all the animals were cows, the grass would soon be all gone. If all the animals were skunks, the beetles would all be eaten in no time. But since the many different kinds of animals need many different kinds of food, there is enough food for all.

Here are some of the ways in which people are helping to keep animals from starving:

Many states own great forests which are called "animal preserves." No one is allowed to harm the animals in these places. Food is placed where animals



© J. E. Haynes

A feeding station for bears in Yellowstone National Park

can get at it easily. These food supplies are called "feeding stations." Men are paid to keep these feeding stations supplied with food.

Children who live in the city know how carefully the birds and squirrels and other animals are cared for in the city parks. The city pays people to scatter food for them several times a week. Visitors to the parks bring bread crumbs, grain, or nuts to coax the little creatures to come near them.

In the city streets, pigeons and sparrows fly in and out among trucks, wagons, and street cars to pick up crumbs and grain. Have you ever watched a crowd of birds helping a horse to eat his lunch? When he spills the oats out of his feed bag, a dozen little bills are ready to snap up what falls.

Do you know any other ways by which people help to feed wild animals?

Things to Think About

1. Here are some of the dangers which come to the food supply of people:

Cold winter weather	Storms and floods
Dry summer weather	Harmful insects (pests)
Too much rain	

2. How do people manage to have enough food, in spite of these dangers to their food supply?

Things to Do

1. What animals can you help to keep from starving during the winter? What animals can you help to keep from starving during the summer?

2. What food shall you give them?

3. What plan have you for giving this food to them?

C. ANIMAL ENEMIES

Have you ever watched a cat being chased by one of his enemies? How does he protect himself? From what animals does a cat try to keep away?

What animals try to keep out of reach of a cat? Do they escape from him? How do they make their escape?

Many animals try hard to escape being eaten, but they work just as hard to catch other animals for food for themselves. Can you tell about any animals which do this?

Can you name an animal which has no enemies?

Do you think it would be a good thing if none of the animals in the world had enemies? Why not?

1. Which Animals are Enemies?

All animals have enemies. Usually their enemies are animals which want them for food.

It is not always true that an animal is smaller than its enemy. In many cases the smaller animals, such as insects, make life very unhappy for the larger ones.

Did you ever stop to think which are the large animals and which are the small ones? It is hard to decide, isn't it? Most animals are larger than some and smaller than others.

We need not be surprised, then, to find out about "food chains." "Food chain" is a queer name for the way some animals get their food. Here is a food chain:

In a certain pine wood little insects called aphids, or plant lice, suck the juices from the trees. Spiders eat the aphids. The spiders are the food for small birds, such as tits and warblers. They, in turn, are caught and eaten by the hawks. We call this a "food chain" because it is a whole chain of animals which are looking for food.

Here is another food chain. See if you can tell which are the large and which are the small animals. Minnows are eaten by codfish, codfish are eaten by seals, seals are eaten by sea leopards, and killer whales use the sea leopards for food.

Killer whales *eat* *sea leopards* *eat* *seals* *eat* *cod* *eat* *minnows*

Here is another chain of enemies: Insects and worms are eaten by birds. Red squirrels sometimes kill the birds and eat their eggs. Cats destroy the squirrels. Dogs are enemies of the cats.

The very small animals are not often in danger from the very large ones. A large animal like the lion would not bother to feed on mice. It would take too much of his time to catch and eat enough mice to satisfy his hunger. A lion would rather kill a large animal, like a zebra, for food. Usually animals have enemies somewhere near their own size. The cougar, or mountain lion, chooses a deer, a young calf, or a colt for food. He is not satisfied with the rabbits and squirrels. They are killed by his smaller cousins, the wildcats or the bobcats.

Many creatures are devoured before they have a chance to grow up. Great numbers of caterpillars do not become butterflies at all, because hungry birds think they make a good supper. The eggs of fish and toads are such dainty food for the other water creatures that thousands of them never hatch into little fish or tadpoles at all.

Although people are great friends to animals, they are also great enemies. Hunters, trappers, and fishermen have done more toward destroying many kinds of animals than all their other enemies put together.

People have been enemies to some helpful animals without knowing that they were helpful. Skunks, some kinds of hawks, crows, and owls have been treated very badly. They were known to eat chickens, ducks, geese, eggs, seeds, young plants, and other things which man wants to keep. These are their bad habits. For a long time people knew more about their bad habits than they did about their good ones. They did not know how many mice, beetles, and other harmful creatures these animals used for food. Now that people have learned that these animals do more good than harm, they will protect them instead of destroying them.

Of course no one person has done all these things which are harmful to animals. Probably nobody ever made more than one of these mistakes. Many, many people have never done any of these harmful things and have done a great deal to keep other people from doing so.

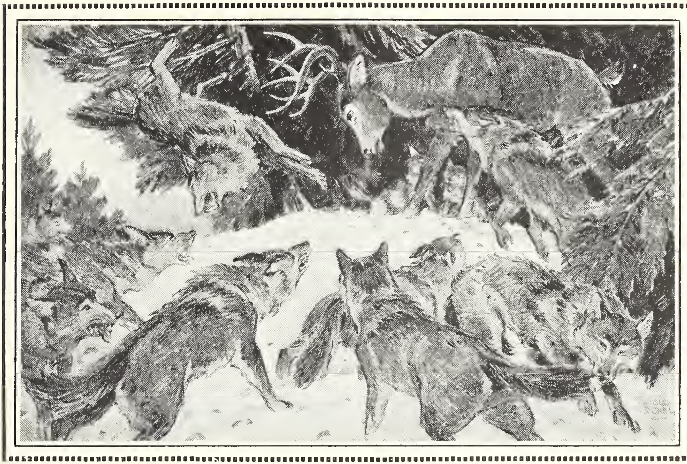
2. How Animals catch Other Animals

Each kind of animal has his own way of catching the animal he wants for food. Some of them win their battles by their size. That is true of a dog who wants a rabbit or a chicken for dinner.

Other animals are cunning. They catch their food by watchfulness. Did you ever see a cat watch and wait a long time for a mouse or a bird? He creeps close and closer without a bit of sound, until, with a noiseless jump, he holds his dinner fast in his claws.

Tigers, wildcats, and cougars get their food in this way.

A number of animals are so strong and so quick that they are not afraid to catch animals much larger than they are. A lion can kill a giraffe which is more than twice his size. He springs heavily upon the neck of the giraffe. He hangs on so tightly that the giraffe cannot shake him off. The long, slim neck and the small head of the giraffe have no chance against the lion's thick neck and huge head with its great jaws and cruel teeth. A giraffe's hoofs are little help against the ugly claws of the lion. Sometimes he can get into a position where he can kick with his hard hoofs. But usually the large, gentle giraffe has to give up in the fight against the fierce strength of the lion. The best way he can escape being



Wolves hunt in packs

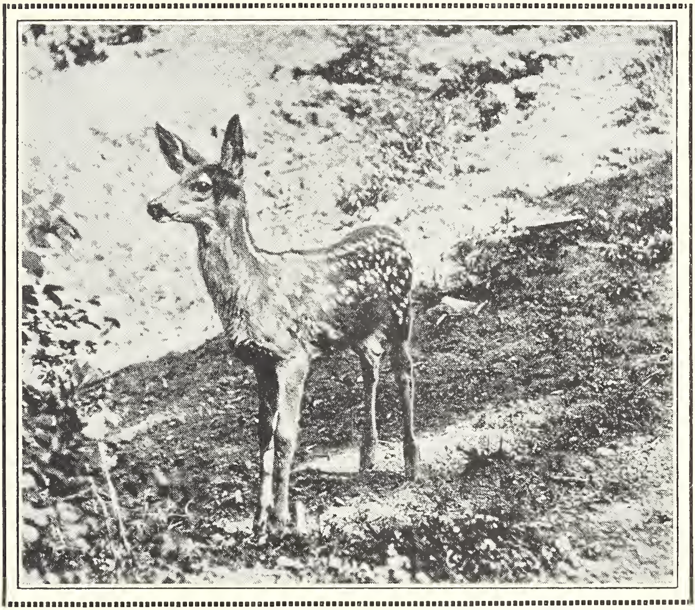
killed is by seeing the lion first, and then running away on his long, strong legs.

Some animals join themselves in packs to hunt. By working together wolves kill deer and cattle, which are much larger than they are. They have killed so many cattle and sheep on the cattle ranches that the United States government has had to help the owners to protect their animals. It is said that coyotes treat their enemy, the dog, in a very clever way. When a coyote comes close enough to a ranch for the dog to chase him away, he leads the dog out to a place where there are several other coyotes. They all fall on the dog, giving him a great scare. This is probably true, for dogs who know coyotes will never chase them any great distance from home.

3. How Animals are Protected against their Enemies

Nature protects every animal from its enemies in one way or another.

A great number of animals have colors like the places in which they live. Woodchucks are the color of dry grasses. Common toads look like lumps of earth. Tree frogs become the color of the place where they are sitting.



U. S. Forest Service

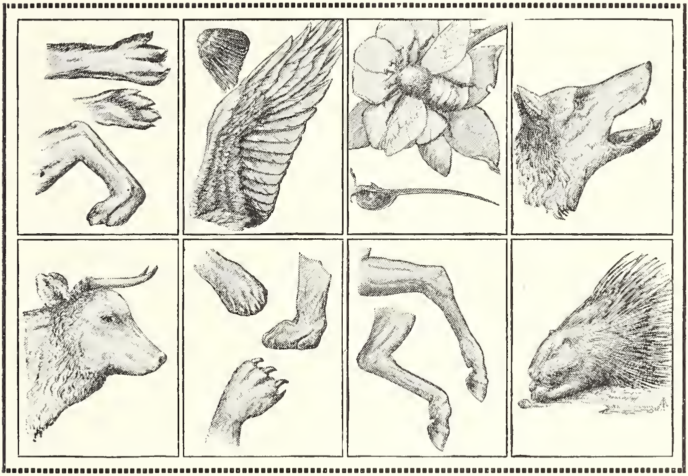
A young deer's coat is spotted to look like sun shining through the leaves

Winter birds are gray and white like the snow with its shadows. Fawns, or baby deer, have spots which look like the ground where the sun is shining through the leaves. One might pass more than one baby deer and not see him.

W. L. Underwood

The toad is safe because the dog remembers how bitter the last toad tasted

Some animals are not eaten by enemies because they have an unpleasant taste. Toads have a bitter liquid in the warts of their skin. When a dog or other animal bites him, this liquid flows out, and the toad is dropped right away. A dog seldom tries a second time to eat a toad.



Some ways by which animals protect themselves. Can you name the animals which use these for protection?

Many animals protect themselves by running away from danger. Chipmunks quickly scamper out of sight. Rabbits dodge and hop rapidly away. Birds fly. Giraffes and deer can run on and on for miles without getting tired.

Moles and earthworms keep out of danger's way by spending their lives underneath the ground.

Other animals meet their enemies by fighting back. Bees sting. Wolves bite. Lions claw. Cows use their horns. Horses kick and bite. Skunks throw out a liquid which has a very bad smell.

Porcupines are protected by sharp, needle-like quills which grow with the rest of their hair.

Owls and bats work at night when they cannot be seen easily.

Frogs, toads, and fish lay so many eggs that, although thousands of their eggs are eaten, toads, fish, and frogs will probably always be with us. Mice and rats, too, are bound to live on because they have such large families and because they will eat almost any kind of food.

Things to Do

1. All animals have some way by which they can protect themselves against their enemies.

Can you name other animals that are protected in these ways which the book tells about?

2. Can you make out of clay an animal hunting another animal? If he is creeping up to surprise an animal, how must his body be shaped? If he is a real fighter, what kind of jaws and teeth must he have? What sort of shoulders?

3. Perhaps you would like to make a picture of some animals escaping from their enemies. If an animal is running away, what sort of legs would he have? If he is dodging, will his hind legs or his front legs be the stronger?

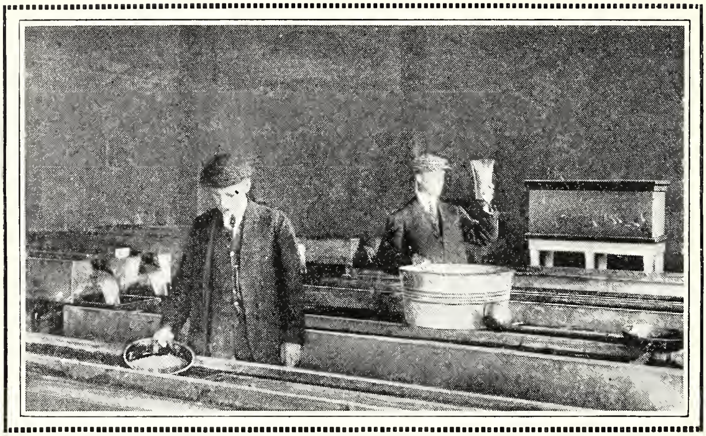
4. What are People doing to Protect the Animals?

When people finally found out that their pleasures and some kinds of work were taking the lives of a great number of useful animals, they began to feel worried and very much ashamed. They knew that a lot of insects and mice would spoil the trees and crops. If there were no enemies of insects and mice, there would be many more of them than there are now. People found that they must save the lives of the birds and other animals that like insects and mice for food. Now they are trying in every possible way to save the useful animals.

In city parks and country woods people have made bird sanctuaries, places where no one may harm the birds. In these sanctuaries everything possible is done to make life easy for the birds that come there. In the city parks bird houses, bird baths, and bird feeding stations are set up. In the country woods there are feeding stations and watering places.

Jack, Helen, and their friends visit the bird sanctuary

Fish hatcheries have been built in different parts of the country. In these hatcheries thousands of fish eggs are carefully watched and guarded until they are hatched. When the young fish are large enough they can be sent to the streams and lakes to take the place of the fish which have been caught by



In a fish hatchery. The men are measuring trout eggs and putting them in hatching trays

the fishermen. We say that the streams and lakes have been restocked with fish.

People have been able to help the animals a great deal by means of laws. The government has made laws which forbid people to shoot the useful animals except during a certain part of the year. The hunting season for most animals is in the fall, when the young animals are old enough to care for themselves. A hunter is allowed to kill only a certain number of each kind of animal. Most kinds of fish can be caught only at certain times of the year, also.

Things to Think About

Do you believe this?

1. If all the children, grandchildren, and so on of one pair of rabbits were allowed to live for five years, the rabbit family would be as large as this:

1,200,000,000 rabbits.

A human family of father and mother and the number of children that would usually be born in five years would be as small as this:

5 people.

2. If all the children, grandchildren, great-grandchildren, and so on of one pair of robins were allowed to live for fourteen years, they could eat up all the insects, shrubs, and grass that are in Central Park in New York City. Even then some of them would be hungry.

3. If all the birds in the world should die, by the end of six years people would not be able to live on the earth. Can you tell why they could not?

4. What is your answer *now* to the question "Would it be a good thing if none of the animals in the world had enemies?"

5. Since so many millions of animals are born every year, why is it not right for a fisherman or a hunter to say, "I can take as many as I want, for there are plenty more"?

6. Why is it not right for boys or girls to take birds' nests out of trees before the baby birds can fly, to shoot robins and useful birds, or to capture chipmunks, squirrels, and other small animals which are easy to find?

UNIT IV

How Animals care for their Children

What are some of the things your mother did for you when you were a baby?

If you had been able to take care of yourself as well as you can now, would your mother have done so many things for you when you were a baby?

If your mother had had a thousand children, or even a hundred, do you think she would have given you as much loving care as she did?

Do your parents still take care of you in many ways? Do you suppose they will ever stop doing so?

1. Animal Families

There are all kinds of families in the animal kingdom. There are large families and small families.

There are families in which the young babies are carefully cared for by the parents. There are families of babies who would not know their parents if they should see them.

There are families in which both the father and the mother care for the young animals. In some families, only the mother cares for the young animals. These babies never see their father at all. In other families, only the father cares for the babies. These babies never see their mother at all.

Some animals are cared for by their parents for a long time. Others are just started in life and then are left to care

This baby must be cared for
by his parents for a long time

for themselves. All kinds of families are needed to make up a world.

2. Animal Babies who never see their Parents

Can you blame a mother who has over a thousand children if she does not stay near them to feed them and to keep them out of danger? She could not do so if she tried. They travel around so fast that no parents in the world could keep watch over them all even if they wished to do so. The children who belong to such large families do not need their parents' care. They are perfectly able to take care of themselves as soon as they are born.

Codfish

The codfish have families of this sort. The mother cod lays over six million eggs. Each egg floats around by itself on the top of the water. How could any mother keep watch over a family like this? Of course a great many of these eggs and a great many of the young fish are eaten by the bigger fish. But this is a good thing. If all the eggs hatched and became grown-up fish, the sea would be so filled with codfish that there would not be enough room for other kinds of fish.

Grasshoppers

Grasshoppers never see their children. The mother grasshopper takes good care of her eggs, however. Early in the fall she digs a hole in the ground and places there a number of cases of eggs. Each of these egg cases holds from twenty-five to one hundred and twenty-five eggs. When cold weather comes most of the grown-up grasshoppers die. The eggs stay carefully packed away in the ground all winter. During the next spring the eggs are hatched. The young grasshoppers come out of the ground to feed on the blades of grass. They look like grown-up grasshoppers except that at first they have very large heads and no wings.

The mason wasp and its nest

Some animals that never see their babies do help them a little. They take good care that the babies have plenty of food to eat when they hatch.

The mason wasp

The mason wasp builds a mud nest on the stem of a plant. When the little jug-shaped nest is finished she fills it with the bodies of spiders which she has caught for food. She lays an egg in the little pile of spiders and plasters a neat mud door over the top. She keeps on working until she has made several of these nests. The little wasps which

A caterpillar which will be food for young flies. The white spots are the eggs of the fly

hatch from the eggs have a fine supply of food that lasts until they are big enough to leave their little mud homes.

Flies

Certain kinds of flies lay their eggs on the bodies of caterpillars. These eggs look like tiny rolls of cotton. When the young flies hatch, they feed upon the body of the caterpillar. Some flies lay too many eggs. The little flies eat the caterpillar all up before they are half grown. From that time on they have no more food, so they all die. But the mothers who lay only a few eggs on each caterpillar give their children a good chance to live and grow.

The monarch butterfly

The beautiful monarch butterfly supplies good food for her large family of ugly little caterpillars. She lays her eggs on young, tender milkweed plants. When the eggs hatch, the young caterpillars feed upon the milkweed plant until they are full grown. Then they fasten themselves to the undersides of the leaves, where they build their cocoons. These cocoons are a lovely green, and they look as though they were held together with golden nails. In a few days they have become beautiful red-brown butterflies like their mother.

Cowbirds

Mother cowbirds do not take care of their babies themselves. They leave

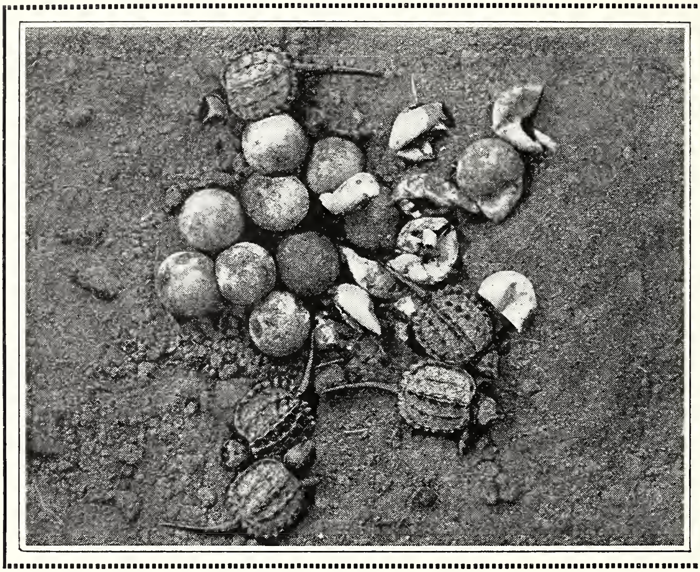
The mother warbler is feeding the big baby cowbird along with her own little babies

them to be cared for by other mothers. This strong brown bird does not bother to build a nest of her own. She lays her eggs in the nests of other birds who are smaller than she is. She often chooses a warbler's nest. The mother warbler hatches the big baby cowbird along with her own little babies.

Sometimes the baby cowbird is hatched first. The mother has to leave her own eggs to feed the cowbird, and the little warblers are not hatched at all. If all the baby birds come out of the eggs at the same time, the cowbird is so much stronger that it gets most of the food. The baby warblers are often pushed out of the nest by the unwelcome visitor. The poor mother warbler is usually worn out by caring for this greedy bird, who is soon larger than she is.

People dislike the cowbird almost as much as the other birds do. It does eat harmful insects, but it also takes the lives of many helpful birds. The good which it does is spoiled by the harm it does.

All the care that some animals need to give their babies is to lay the eggs in a place where they are sure to hatch.



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Snapping turtles hatching without their mother

Turtles

Snapping turtles belong to this group of mothers that do not worry. In the spring the snapping turtle leaves the water to find a damp spot on the bank for her eggs. She scoops out a hole in the soft earth and crawls into it. She wiggles about until she is covered with the loose dirt. Only her head sticks out.

Then she lays about two dozen eggs. When she crawls out of the hole she moves very carefully so that the earth can fall back on the eggs and cover them.

In a few weeks the little snapping turtles hatch out of the eggs and climb out of the hole. They look very much like their parents. They find their way to the water. Even though they are baby turtles, they eat the same kinds of food and live about as the larger turtles do.

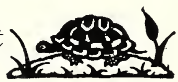
Most turtles are born in very much the same way.

Alligators

The mother alligator makes a very queer nest for her eggs. She piles together a big heap of dry leaves, twigs, and fine earth. She crawls into the ground under this pile and lays about thirty or forty eggs. Then her duties as a mother are over. Off she goes to do the things that alligators like to do.

The hot sun and the moist ground cause the sticks and leaves to decay. The place becomes very warm while this is happening. After many weeks the alligator's eggs are hatched. The baby alligators creep out of their shells and out of the ground. They too find the water right away. After they have moved into their new home they live about as the big alligators do.

Things to Think About



1. Baby snakes very often do not see their mothers. They can take care of themselves without much danger.

2. Salmon and frogs do not care for their babies. What other animals do you know about that do not need their mother's care?

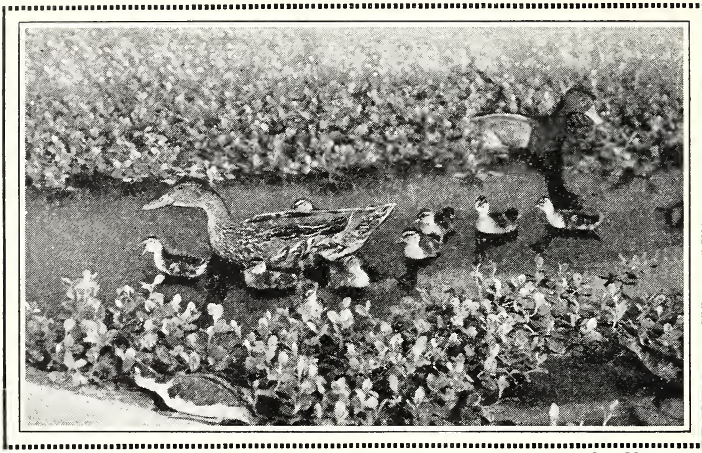
3. Animal Babies which receive a Little Care from their Parents

Some baby animals are so strong as soon as they are born that they need their mother's care for only a very short time.

Jack rabbits

The home of jack rabbits is an open nest under bushes or weeds. The mother jack rabbit tramples down the grass to make a soft place. She lines it with loose fur from her body.

That is about all the care the young jack rabbits need. They are covered with fur when they are born. Their eyes are open. They can run about. They stay with their mother as long as they need her milk for food. As soon as they can eat other food, young jack rabbits leave the nest and take care of themselves.



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Mother mallard duck taking her babies for a swim. The young ducks will soon be able to take care of themselves

Mallard ducks

Mallard ducks are the best known of all the wild ducks. In the nest the mother duck places a thick, soft lining of down from her own breast. She lays about fifteen eggs. The ducklings which hatch from these eggs are wide-awake little balls of down. They scratch around for food soon after they are born. They do not stay in their soft.

downy nest very long. In a short time they can get along without their mother's care. They soon travel away by themselves to find new feeding places.

Chickens, turkeys, goslings, and tame ducklings all have the same kind of free-and-easy life when they are small.

Things to Think About

1. Young geese do not need their mother's care very long. They can find food and protect themselves when they are quite young.

2. Baby partridges are very strong and active. What other animals can you name which need their mother's care for only a short time?

4. Animals which give their Babies a Great Deal of Care

Many of the mammals have small families of babies that need a great deal of care. Since the family is quite

This baby elephant is learning about water holes. One of the grown-ups has just given him a shower bath. What else might he need to find out about water holes?

small, the mother is able to give them the care which such helpless babies need.

Elephants

The mother elephant has only one baby at a time. Once in a while there are elephant twins, just as there are boy or girl twins.

An elephant baby has very good care. The mother tramples down the grasses to make a soft cradle for her two-hundred-pound baby. He cannot walk around on his wobbly legs right away as a calf or a colt does. He is several days old before he can move about very much.

When he is old enough the baby elephant trots along through the forest close to his mother. At first he feeds on his mother's milk, and then he eats leaves and grasses, but he never has any meat. Usually several mother elephants with their babies travel together. They are called a herd of elephants. In a herd there may be babies, mothers, grandmothers, and great-grandmothers all traveling together. The young elephants stay under their mothers' bodies and away from the edge of the herd.

During her lifetime a mother elephant has several babies. She gives the same good care to each one.

Whales

Some of the whales are said to be the largest animals which have ever lived upon the earth. There are whales that weigh nearly as much as two thousand men. Many small towns do not have so many men as that.

These big whale mothers have big whale babies. Whale babies are about fourteen feet long. Measure fourteen feet in your schoolroom to see how long a baby whale may be.

For many weeks this giant baby cannot care for itself nearly so well as a baby jack rabbit can. It feeds on its mother's milk for many more weeks than the jack rabbit does. For many

Little bears must stay close to their
mother when she is looking for food

weeks the mother watches and cares for her baby, and then she teaches it how to care for itself.

Bears

The mother bear is another large mammal that has few children in her family. She usually has two babies at a time. Unlike the children of the elephant and the whale, the bear babies are very small when they are born. They are only eight or nine inches long. Measure on your ruler to see how small that baby is. They are very helpless. They have no hair on their bodies. More than a month passes before their eyes are open and they are able to follow their mother about.

The mother bear stays in a cave all winter. She has to eat enough food in the summer to last her all winter and to feed her babies when they are born in January or February. What a good thing it is that they are so small! A hungry family steps out of the cave when spring arrives. But spring brings much food which bears like to eat, so they soon grow to be big children who are full of life.

Some animal mothers have quite large families of babies which cannot take care of themselves at first. Their eyes are closed. They have no covering on their bodies. However, they grow fast enough to care for themselves in a short time.

Red squirrels

The homes of the red squirrels are usually in hollow trees. The father and mother squirrel make the nest cozy and warm with dry grass and leaves In May or June four, five, or six baby squirrels are born. There is only one family a year.

The baby squirrels are not at all pretty. Their eyes are closed, they have no fur, and their heads are very large. As they grow older their eyes open, their bodies become covered with red-brown fur, and their heads no longer look too large for their bodies. They are much prettier then.

The red squirrel is a careful mother. The young squirrels seldom leave their nursery until they are almost full grown.

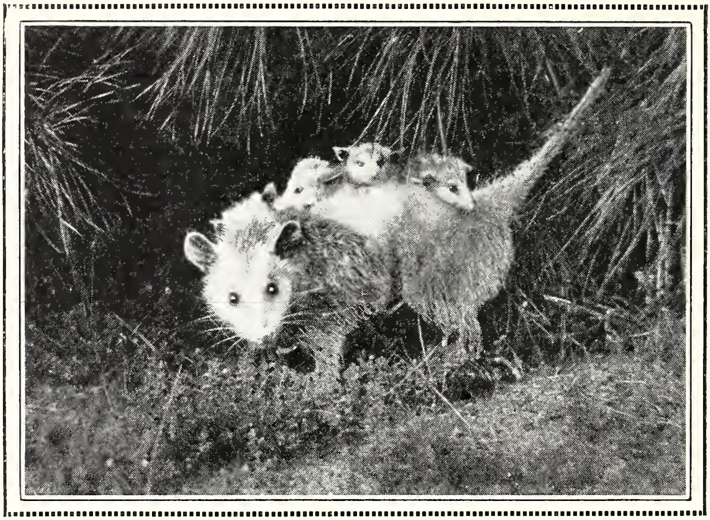
Orioles

Oriole parents make a beautiful nest of grasses, bits of string, and hair. The father gathers the material, which the mother weaves into a long pocket or bag. This hangs from the twigs on the very end of a high branch. The nest is wider at the bottom than it is at the top. The weight of the birds pulls the nest shut at the top. The whole family is safe from almost any enemy when they are in this pretty shelter.

The mother bird sits on the eggs

What does this picture tell you about the good care which baby orioles receive from their parents?

while the father guards the nest. Soon from four to six blind, naked little orioles are crying for food. The father works very hard indeed to bring enough worms and bugs to feed his large family, who are called the "cry-babies" of the bird world. Even when their eyes are open and they are covered with coats of feathers, the father keeps on bringing them food. They are cared for until they are able to fly.



A family of opossums. Read to find out how very busy an opossum mother is

When some animal babies are born they are so small and helpless that they are carried about in a pocket in the underpart of the mother's body.

Opossum

The opossum is about the size of a large cat. The opossum babies are about one-half inch long. Look on your ruler to see how very small these babies are. The mother takes them up with her lips and places them in her pocket.

In three or four weeks the babies are the size of house mice. But they do not leave their mother's pocket until they are two months old.

The mother makes a home in a hollow tree or in grasses near a swamp. This nest shelters the mother and her babies until the young are able to care for themselves. The mother has two or three families a year to take care of. There are from five to fourteen babies in each family. When the babies of the first family are about the size of house rats, the babies of the second family are placed in the nursery pocket.

The first family have to feed on something besides their mother's milk now, so they all go out in search of insects, grain, fruit, or vegetables. You might wonder how the mother carries so many children around with her. While the second family is being carried about in her pocket the first family rides on the mother's back. When she bends her tail over her back the little ones wrap their tails around it. They also stay on by clinging to her fur.

Is not the opossum a busy mother?

Kangaroos

You may have seen pictures of kangaroos in your picture books. Do you remember the bright-eyed baby looking out of its mother's pocket? This baby is carried in the nursery pocket for several months.

Other animals carry their babies about when they are young and cannot help themselves.

This baby needs a great deal of care

Cats

Have you ever seen a mother cat move her kittens when she wants them in another place? How does she carry them? Why does she move them? Can she leave them by themselves when she goes to search for food?

Monkeys

Many monkey mothers carry their babies in their arms very much as human mothers do. They do not dare to put them down and leave them. The young monkeys might get into many of the troubles that human babies would get into if they were left by themselves. Tell what you think might happen to the monkey's baby if it were left alone.

Things to Think About

What other animal mothers do you know about which give their babies care for a long, long time?

5. Families cared for by Both Father and Mother

The work of caring for the babies usually rests with the mother. Many times, however, the father and mother work together in caring for their young.

We have read how both parents of the oriole and of the red squirrel work together. The father goldfinch feeds the mother while she is sitting on her eggs. Among the grosbeaks and the wrens the father works as hard as the mother does in caring for the young birds.

Among some kinds of birds the father works so hard to bring food to the mother and the babies that he is tired out by the time the little birds can fly. His body becomes thin, and his feathers look dull and ragged. But the mother and the babies are fat and well because he has taken such good care of them.

The scarlet tanager

Scarlet tanagers are beautiful birds. The father has a bright-red coat. He wears this coat as long as the baby birds are in the nest. When he is flying about looking for food, his bright color is often seen by an enemy who would like to eat the baby birds. Instead of flying toward the nest, the father tanager flies away from it. The enemy follows him until it gets tired. In this way the bright colors of the father bird protect the baby birds.

When the whole family is flying about together looking for food, it is not safe for the father bird to wear such bright colors. Enemies could be drawn toward the baby birds instead of away from them.

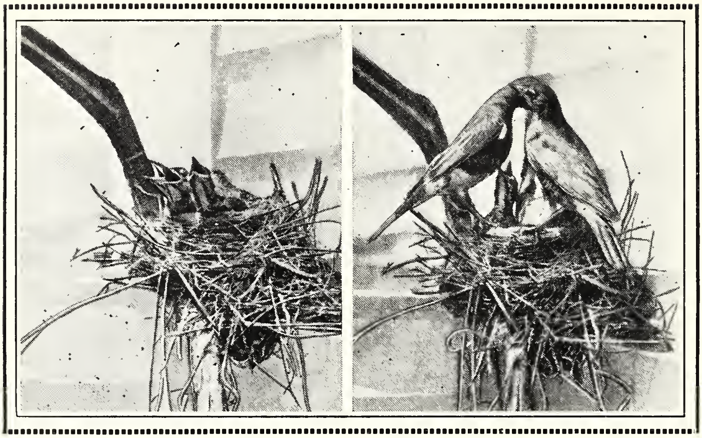
A very great change takes place in the color of the father bird at this time. The bright-colored feathers drop out of his coat and dull-brown feathers take their place. The father, the mother, and the baby birds are all about the same color during this time. All the birds are protected by their color as well as by the father's strength.

Pigeons

Among the pigeons both the father bird and the mother bird sit on the eggs. The father stays on them in the daytime while the mother sits on them at night.

Both parents feed their babies. In the throat of the parent bird is a kind of pocket called a crop. In this crop there is a thick white liquid called pigeon's milk. The babies feed on this for four or five days. The parent bird holds the baby bird's beak in his mouth and pumps this pigeon milk into it.

After four or five days this milk disappears. Then the young pigeons eat grain which has been softened in the crop of the parent bird. Many other baby birds eat food that has been partly digested by the parent bird and then coughed up.



W. L. Underwood

A family of robins. Both parents are needed to care for these hungry babies. Many insects and worms are needed to quiet their calls for food

Robins

Have you ever watched a pair of robins build their nest and raise their babies? Here is a picture of a family of robins. Do you think their nest is very neat? What do you think they used to make their nest? Who do you think takes care of the babies? Do you think it is very easy to keep these hungry babies fed?

Things to Think About

1. Both father and mother lion are needed to care for their babies in the proper way.

2. Baby wolves receive the care of both parents, too. Do you know of other animal families where this is true? You will have to be careful about this answer. In many cases only the mother takes care of the babies, you know.

6. Families cared for by the Father Alone

There are a few families in the animal world where only the father takes care of the young.

The stickleback

The stickleback is a small fish found in streams and oceans in many parts of the world. In the spring the father's body takes on bright colors so that he looks like a small rainbow. He is called

© William Thompson

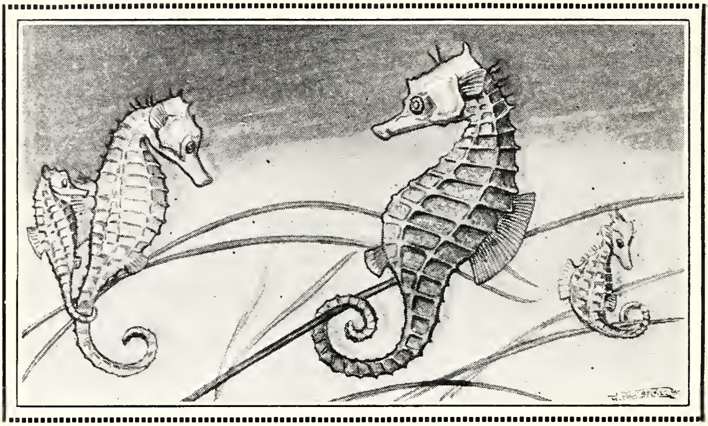
A fish which builds a nest. The father stickleback takes good care of the young

a stickleback because sharp points like thorns stick out of his back. Because of these thorns, any fish which tries to catch a stickleback is very sorry afterwards.

The father stickleback makes a nest for the eggs. He pulls together bits of stems, leaves, roots, or seaweed. With a sticky liquid from his body, he fastens them together into a tiny nest shaped like a barrel. This strange nest has a front door and a back door, with a room in the middle for eggs.

When the nest is ready he invites a mother fish to lay her eggs inside. She swims through the front door, lays her eggs in the little room, and then leaves the nest by swimming out of the back door. The father stickleback invites many more mother fish to lay their eggs in the nest he has made. After each mother has left her eggs, the father pours over them a liquid from his body. If he did not do this the eggs could not hatch.

When the nest is full of eggs, the father stickleback keeps watch at the door, protecting the eggs from all enemies. The mother sticklebacks would come back to eat the eggs if the father



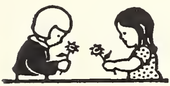
A sea horse

did not keep them away. Although he is a tiny fish he is a great fighter. Because of this care, most of the eggs are allowed to hatch.

Even when the eggs have hatched, this father's duty is not yet over. He seems to spend his day trying to keep the young fish near the nest. As soon as he drives them all into one door, they swim out of the other. Even though they will not stay in the nest as their father seems to want them to do, it is likely that they are saved from a great deal of harm by staying so near it.

The sea horse

The sea horse also is a careful father. He carries the eggs in his breast pocket until they are ready to hatch.



Things to Think About

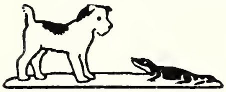
1. All animal parents give their babies as much care as they need to have. Some animals are able to take care of themselves as soon as they are born. The parents of these animals do not need to give them much attention. Most animals leave their parents as soon as they are able to find food for themselves.

2. Babies such as you were when you were little (that is, human babies) need the most careful attention of all babies in the world, because they are unable to help themselves for the greatest length of time.

3. Human parents care for their children for years and years. They get food for their children,

they give them a home, and they see that the children have plenty of good, comfortable clothing until they are really grown up.

4. They send their children to school. Many parents send their grown-up children away to college, where they study about the work they want to do during their grown-up lives.



Things to Do

One day Herbert made a chart of animals. He divided his large piece of paper into four parts. The top of his chart looked something like this:

MAMMALS	REPTILES	FISH	BIRDS

In the space under Mammals he pasted pictures of several mammals. He wrote the names of these mammals — pig, dog, rabbit, and so on. Then he wrote several interesting facts about mammals. Here they are:

1. Mammals are warm-blooded animals.
2. They have lungs to breathe with.
3. Their bodies usually are covered with hair.

4. The mothers feed their babies milk from their own milk glands.

In the space under Reptiles he pasted pictures of a turtle, a snake, an alligator, and a dinosaur. This is what he wrote about reptiles:

1. Reptiles are cold-blooded animals.
2. Some have legs, and some have not. They all crawl.

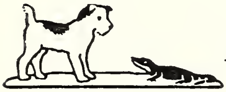
The next space told about fish. There were pictures of a salmon, a flounder, and a few other fish. Herbert wrote these facts about fish:

1. They have bones.
2. Their bodies are covered with scales.
3. They have cold blood.
4. They do not have lungs. They breathe through their gills.

The fourth space held pictures of a robin, a bluebird, a duck, and several other birds. This is what Herbert wrote about birds:

1. Their bones are very light.
2. Their bodies are covered with feathers.
3. They have two legs and usually two wings.
4. They lay eggs.

Should you like to make a chart like this? What else could you tell about each of these different kinds of animals? What could you tell about the way in which they take care of their children?



An Animal Game

It is fun to play this game. Choose an animal, but do not tell the name of it. Tell all you can about this animal. Tell how it looks, where it gets its food, where it makes its home, and so on. See if the rest of the children can tell you whether it is a mammal, a reptile, a fish, or a bird. Then tell the name of the animal if the children have not already guessed its name.

UNIT V
The Story of Plants

Do you Know?

Do you know that some kinds of plants live to be only one year old? They never grow any older.

Do you know that some plants are the oldest living things?

Do you know why plants do not grow in the winter time?

Do you know why plants have seeds?

Do you know that seeds can travel for miles and miles?

Do you know the three things which plants need to make them grow?

1. How Long do Plants Live?

After school begins in September, the cool autumn days soon come along. During these days the out of doors changes as though an unkind fairy were waving her wand over it. The leaves fall from the trees. The grass and weeds grow brown and dry in the fields. Most of the flowers are gone from the gardens, and the bushes look brown and bare.

Children often ask: "Where have the flowers gone?" "Are the trees dead?" "Why does the grass stay brown and dry?"

Can you answer these questions?

Here is the answer to these questions. Some of the plants really and truly die when winter comes. They will never grow again. Other plants look as

Out of doors in the fall

if they were dead in winter, but they really are not dead at all. They are resting through the winter months. When the winter is over, they will grow to look just as they did the summer before.

These two kinds of plants have names. They are called "annuals" and "perennials." The plants which really and truly die at the beginning of winter

These flowers usually are annuals. They live only one year are called annuals because they have lived only one year. Plants which live on and on, year after year, are called perennials.

Things to Think About

Shall we call the plants by these names, too? Can you remember to call a one-year plant an annual? Can you remember to say "perennial" when you are speaking of a plant which lives many years?

2. About Annuals

Here are the pictures of some flowers which usually are annuals.

Here are the names of some other flowers which are annuals.

petunia
bachelor's-button
zinnia

Can you name some other flowers which are annuals? If you have these flowers in your garden, you must plant their seeds every year. They will not live on through the winter.

Here are the names of some vegetables which are annuals:

peas	lettuce
beans	radishes
cabbage	tomatoes

If you raise these vegetables in your garden, you must plant their seeds every year. Can you name other vegetables which are annuals?

The story of Helen's sweet peas

Helen had a garden of sweet peas. Many different things happened to the growing plants. Helen's mother said it made her think of Helen herself growing up.

Early in April, Helen planted her seeds. She made a ditch about two inches deep and placed the seeds in the ditch far enough apart so that they could grow without crowding.

About three weeks later tiny green sprouts poked their heads above the ground. For a while Helen and her father were very busy protecting the baby plants from the insects and birds that wanted to eat them.

When the plants were about six inches high, Helen's father said, "Your plants must have something to climb on." Helen and her father drove stakes into the ground and fastened strings from the stakes to a sort of fence which had been built over the long row of sweet peas. Curly green threads (called tendrils) help the sweet peas to climb. These were already growing on the plants. They soon fastened themselves around the strings, and the plants began to climb up and up.

The lifetime of Helen's sweet peas. Here are the baby plants, the grown-up plants, and the plants in their old age

In the latter part of June, Helen began to watch the buds which were growing here and there on her plants. On the Fourth of July, Helen picked a small bouquet of flowers — pink, blue, and white. She gave her first bouquet to her mother.

Helen's grandfather said to her, "The more you pick your blossoms, the more blossoms you will have to pick."

Helen thought this was very queer, but she picked her flowers very carefully every other day. Each time she picked them she had more to pick — just as her grandfather had said.

By the first of August the vines had climbed higher than Helen's head. Someone else had to pick the blossoms which grew at the top. Helen said to her mother: "The sweet peas have lived only part of a year. But they have grown to be taller than I have grown in the eight years of my whole life."

Her mother answered: "You must remember that their life is much shorter than yours. In a month or so your sweet peas will be in their old age."

The sweet peas took a great deal of Helen's time and attention. Sometimes the weather was very dry. During this time Helen gave her flowers big drinks of water from her watering can. Sometimes the weather was very stormy. Once the rain came down so hard that the vines were pulled and broken. After the storm Helen and her father spent a long time getting the vines fastened back so that they could grow nicely again.

In the autumn the blossoms were not so fine as they had been in the summer. Little seed pods were forming here and there. Finally Helen said: "I think I shall not try so hard to keep the blossoms picked. I shall leave some on the vines, so that I can have seeds for next summer's garden."

By the time the frosts came the sweet-pea vines looked dry, brown, and old. They had lived their life. They had sprouted from the seed, blossomed, and formed seeds of their own all in one year. But Helen could always have sweet peas in her garden, because they left seeds which would grow into new plants the next year.

Can you tell why Helen's mother said to her, "Your sweet-pea vines make me think of you growing up"?

Things to Do

1. Plant some peas or beans in a dish of sawdust. Keep them in a warm light place. Keep the sawdust damp.

Look at your seeds every day.

Does anything happen the first day?

2. On the fourth day take one seed out of the sawdust. How does it look? Can you see a leaf? Can you see a root?

3. On the sixth day take another seed out of the sawdust. Can you see a leaf now? Can you see a root?

4. When you see a real leaf and a real root, you had better put your plants in soil. They need more food than the seeds can give them.

5. Keep a record of your plants. Write down the date when they were planted in sawdust. Write down the date when you planted them in soil. Write down the date when your plants blossomed.

6. Tell how long your plants lived. Tell what you needed to do to keep your plants healthy and growing.

3. About Perennials

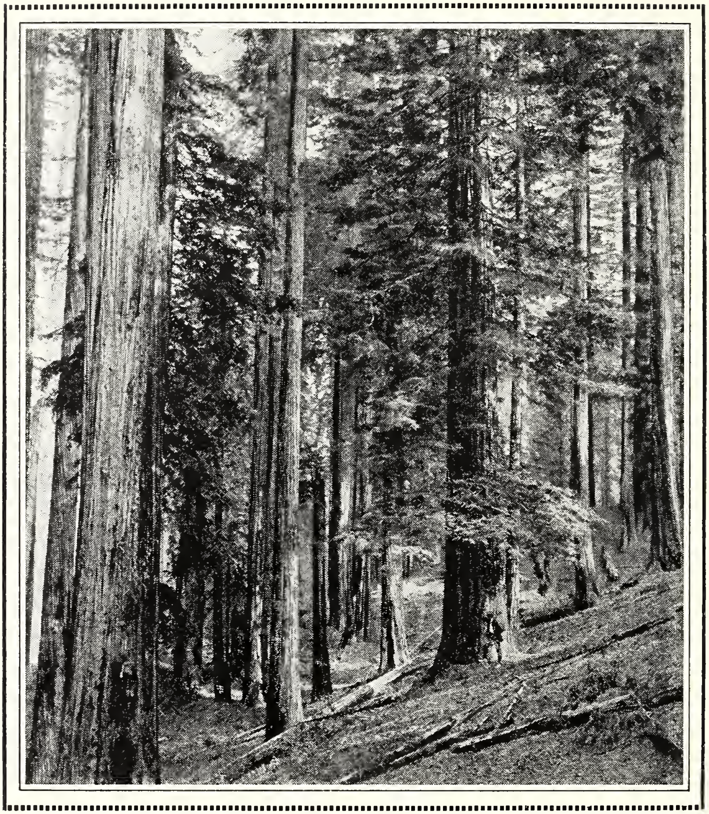
Perennials are very much like annuals, except that they do not die when autumn comes. They keep right on living, year after year, as people do. Some perennials live only a few years. Others live much longer than people have been known to live.

A large elm tree grew in front of Alice's house.

"That tree is very old," said her father. "When my grandfather was a boy he climbed up in it to see the first steam train go through this part of the country. It is over a hundred years old."

"Will it be standing when I am grown up?" asked Alice.

"Probably," replied her father. "We shall take good care of it."



U. S. Forest Service

Some of the trees which grow in these forests are the oldest things living on the earth

In California some trees are growing which are over four thousand years old. As long ago as Bible times those very trees waved their branches in the sunlight and gave nesting places to birds. They are the oldest living things.

All trees are perennials. How many kinds of trees can you name? Every tree you can name is a perennial.

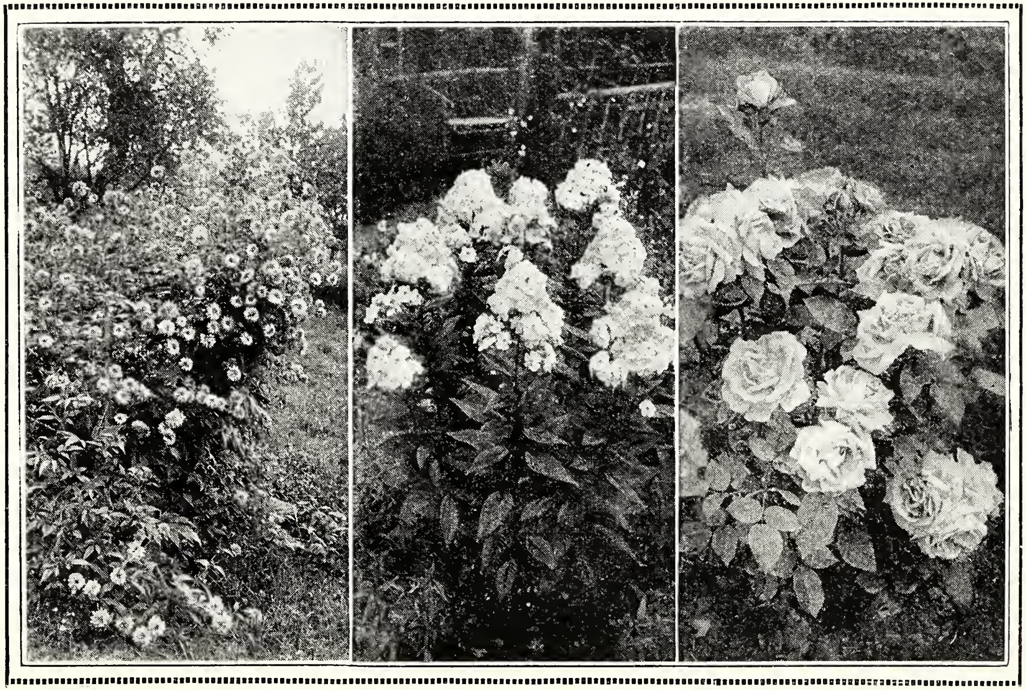
On the next page are pictures of some flowers which are perennials.

Do you know these flowers when you see them in a garden?

Here are the names of some other perennials:

dandelion	buttercup	peony

Can you name some other flowers which are perennials? Unless the frost kills them, perennials will come up every year without being planted. Very few vegetables are perennials. Asparagus is one. Many kinds of weeds and many of the wild flowers are perennials.

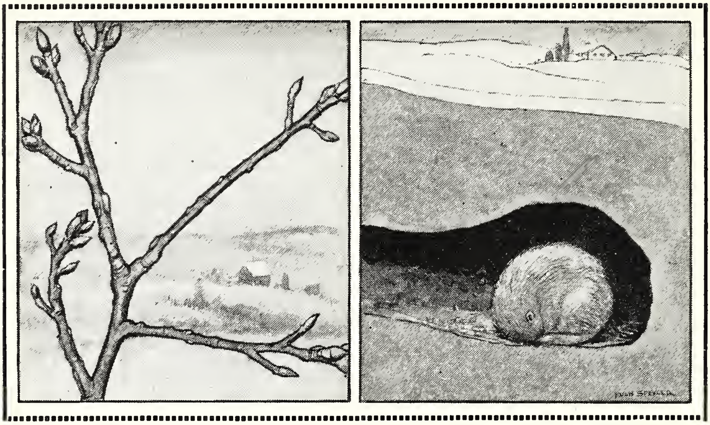


Golden glow, phlox, roses. These are perennials

Perennials in winter

Geraniums, begonias, and coleuses are plants which people have in their houses in winter. These are perennials. They will live on from year to year if they are not killed by the frost. That is one reason why people bring such plants into the house for the winter. Sometimes plants are left in a warm place in the cellar for the winter. They do not grow in the cellar, but they are safe from the cold frost, which might injure their roots if they were in the ground all winter.

Most perennials are not injured by the frost in the ground. Many of them look as though they were dead in winter, although the frost has not killed them. A woodchuck looks that way, too, when he sleeps all winter. He is not dead, however. He is only sleeping. His heart beats very slowly, and you can hardly



Both woodchuck and tree are resting during the winter

see him breathe. But he is not dead. A few warm spring days will make him as full of life as ever.

We might say that perennials sleep through the winter, too. Most of them lose their leaves. They do not grow. They look dead. But, like the woodchuck, they are only resting during the cold winter months. The warm spring days will change their looks very greatly. They will soon look green and alive again.

When the woodchuck goes to sleep in the fall, he is very fat. This fat keeps him alive all winter. It is his food. The perennials have food stored away, too. A plant may store food in its roots or in its stem or in its buds.

Things to Think About

1. Do you think there are more perennials or more annuals in the world? Why do you think so?

2. If you had a garden should you plant more annuals or perennials in it? Why?

4. Plants do not grow during Winter's Cold

Did you ever stop to think how funny it would be if children stopped growing in the winter time and could grow only in the warm days of spring and summer? Can you tell why you grow as fast in winter as you do in summer?

Plants do not grow as people do. The trees, the grass, the wild flowers, and all the plants which spend the year out of doors can grow only during the warm parts of the year.

Most perennials can live during cold winter weather, but they cannot grow during that time. In one way plants are like the animals. In winter they are in greater danger from starving to death than they are from freezing to death. This is why:

We know that the food of green plants is made by the plants themselves. We know that water is drawn up out of the ground through the roots of the plant and is made into food in the leaves. In winter the water in the ground usually becomes solid ice. Now, roots cannot soak up a piece of solid ice. When no water or moisture can be soaked up through the roots to flow through the stems and branches to the leaves, the plant can make no food for itself.

One of two things may happen when this cold time comes. Some plants die, leaving seeds to make new plants of the same kind for the next year. These are the annuals. Other plants live on the food which has been stored away in one of their parts. These are the perennials.

Things to Do

Early in the spring when the buds are all tight shut, bring some branches inside and put them in a vase of water. If you keep them in a warm place in the sunshine, the buds will open. You will like to watch the tiny wrinkled things unfold.

The buds on the branches outside must wait until the weather is warm. The warmth of spring acts like the warmth of the room. It seems to waken the plants from their winter rest, as it wakens some of the animals from their winter rest.

5. About Seeds

How wonderful a seed is!

Did you ever see lettuce seeds? They are little black things about the size of the point of your pencil. Just one of these tiny specks will grow into a big head of lettuce. One head of lettuce will make a salad big enough for a whole family of hungry people!

Helen's sweet-pea garden was a rainbow of blossoms. She picked them every other day. She took bunches of them to her grandmother. She gave bouquets of them to her friends. She took baskets of them to the hospital. Her mother always had a big bouquet of sweet peas on the table.

These hundreds of lovely blossoms came from just a pocketful of seeds!

A great oak tree grew on the lawn

beside Helen's house. It was so tall that its branches reached much higher than the roof. Its shadow was so big that Helen's family and the neighbors could gather in its shade on summer afternoons. Its trunk was so big that Helen and Alice could hardly touch each other's hands when they tried to stretch their arms around the tree.

The girls used to play with the acorns which fell off the tree. Sometimes they pretended that the acorns were thimbles or dolls' teacups.

When Helen's grandfather told her that this big tree was once a little acorn no bigger than her thimble, she said: "It does not seem possible, does it? The seed is so small, and the tree is so big!"

She tried to imagine putting the great tree back again into a package no bigger than a thimble. That was too hard even to imagine, because the tree had grown so much from the time it was a little seed.

6. Why Plants have Seeds

A plant has seeds so that there will be more plants like it the next year.

We read on page 189 that an annual dies at the end of the summer. The sweet peas, nasturtiums, marigolds, lettuce, radishes, and the rest will die when autumn comes. But even though they all die, there will be plenty of these kinds of plants in the world the next summer.

Before an annual dies it makes seeds which will make the same kind of plant grow another year. It will not be the same plant, remember. The seed will grow into a new plant with new roots, new stems, and new branches all its own.

A bean grows into a bean vine.
It cannot grow into anything else

Perennials, too, have seeds. Although perennials keep on growing year after year, they need seeds just the same. Seeds are not needed to keep the same plant growing year after year. They are needed to make new plants of the same kind. The earth needs new perennials as well as new annuals every year. Can you tell why?

One thing is very sure to happen to growing seeds. The plant which grows from a bean will be a bean vine. If you plant lettuce seeds, you will have lettuce plants. Radish seeds become radish plants.

We can be sure that the new plant will be much like the mother plant, because one of the parts of the seed is the beginning plant. It is there in the seed before it leaves the mother plant.

7. Where to look for Seeds

When Helen was learning how to care for her sweet peas, her grandfather said: "Be sure to keep the blossoms picked, so that the seed pods will not form. When the seed pods do form, the flowers will not be so fine."

Where would Helen look for seeds that were beginning to grow?

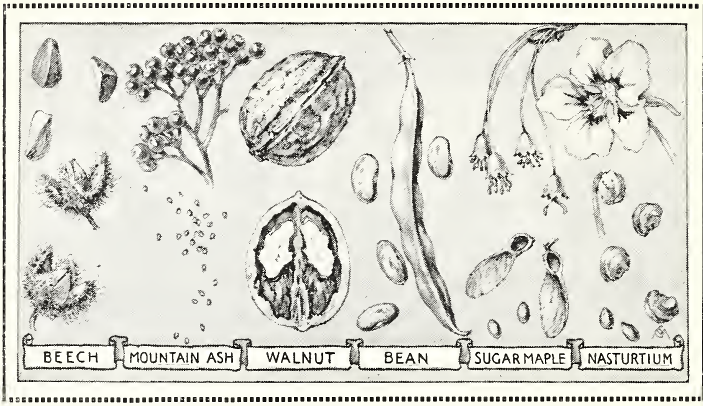
Where should you expect the seeds of other plants to begin to grow?

The seeds of a plant are always formed in the flower. When the flower fades, we say that the plant is "going to seed."

This is true of all seeds. The seeds of little radishes, big pumpkins, little pansies, or big watermelons, all have their beginning in the flower of the plant. When the flower fades, we begin to see the seed part of the plant.

The seeds of some plants are covered by just a pod. In this case it is easy to see where the seeds are. Sweet peas, green peas, string beans, lima beans, and other plants hold their seeds in pods.

Other plants hide their seeds away. Sometimes we have to look deep into juicy fruit in order to find a plant's seeds. Apples, pears, peaches, plums,



Seeds are covered by all sorts of coats

tomatoes, and watermelons have their seeds protected in this way. Did you know that the hard "pit" of a plum or peach is its seed?

Some seeds have such a hard covering that you have to use a hammer or a nutcracker to open them. These are the nuts. Walnuts, butternuts, pecans, and many other nuts have these hard coverings. In spite of this hardness, these seeds are able to split their coverings and grow into little plants. Many of these little plants grow into trees which have more nuts like the one from which the little plant grew.

Other seeds are covered by only a thin skin. You can find the seeds very easily. Wheat, rice, oats, rye, and many other grains have seeds with this sort of covering. The seeds are the most important part of the grain plant. People raise the grain because they want the seeds for food.

All trees have blossoms and seeds. We all know apple blossoms, cherry blossoms, and plum blossoms. Did you ever see the blossoms of the maple and the oak? They are harder to find because they are green like the leaves. Most of our large forest trees have blossoms.

Do you know the pretty winged seeds of the maple tree? Acorns are the seeds of the oak tree. The seeds of the mountain ash are found in the orange berries which grow in great bright clusters among the green leaves. Hundreds of little three-sided beechnuts are the seeds of the beech tree. All trees have seeds.

Things to Think About

1. What plants can you name which are raised just for their beautiful flowers?

2. What seeds, besides those which the book mentions, are guarded by juicy fruit?

3. Cut an apple or a pear in half, across — not up and down. See how beautifully the seeds are arranged in a little flower shape.

4. What other seeds can you name which are guarded by a hard shell?

5. Can you name other seeds which are used for food?

8. How Seeds are Scattered

If all the hundreds of acorns on an oak tree should drop straight down to the ground under the tree and plant themselves there, imagine what would happen! Would there be light enough under the mother tree for all these young trees to grow to their full size? Would there be room enough in the soil for their roots? Would all of them be able to make food from the soil where they were growing? What do you think might happen to the parent tree?

Suppose the thousands of seeds of a dandelion plant should fall straight to the ground under the plant instead of being carried anywhere and everywhere by their fluffy white sails! Would there be as many dandelions as there are in the world if that were the case?

In order that plants may have enough light and food and space in which to grow, their seeds must be scattered far and wide. There is not enough food in any one spot for a family of animals. Animals can move about from place to place to find food, but plants cannot move themselves from the place where they start to grow. Since there would not be enough food for the plant and all its seeds to grow in one spot, the seeds must move on to another place.

Seeds are carried to their growing places in many ways. Some of them are carried miles and miles away from the mother plant.

Dandelion and milkweed seeds are fastened to silken fluff which helps them to float away with the wind. The seeds of the maple have two wings and

Some of these seeds sail to their planting grounds. Can you tell which seeds these are? Others are carried about by people or animals. Can you tell which seeds travel in this way?

look like butterflies. They go sailing and whirling through the air far away from the mother tree. The ash has only one wing for its seed, but it sails quite as far as the maple seed.

People scatter seeds in many ways. The farmer, the vegetable gardener, the lady who takes care of a flower garden, all plant seeds with great care. Many times boys and girls carry seeds about without knowing it. Did you

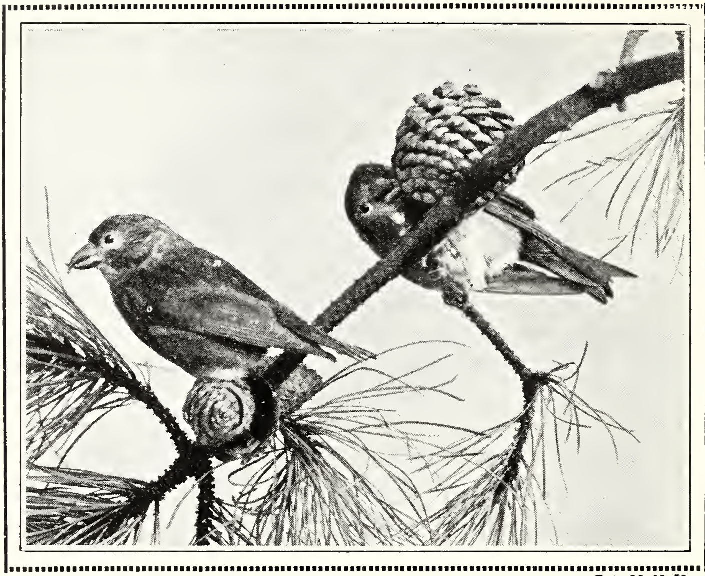
What seeds are these children planting? Do you think they know that they are scattering seeds?

ever find seeds on your clothing when you were walking through weeds? Burdocks and sticktights have little claws, or hooks, which help them to take long rides on people's clothing and on the fur of animals. People who go nutting in the woods often drop some nuts on the way home. Many times these nuts sink into the ground and plant themselves. As you walk along a weedy path, you knock the seeds off the plants, scatter them, and plant them without thinking about it at all.

A squirrel buries a nut in the ground for his winter store. He may forget about it, or he may not need it for food. Since it is never dug up and eaten, it is quite likely to sprout and grow into a tree.

Many seeds are scattered from evergreen cones by the crossbills and other birds which like them for food. As they pick the seeds from the cones, many seeds are dropped to the ground. Other birds which like the bright bittersweet and mountain-ash berries let the seeds drop to the ground as they eat the fruit. Many seeds plant themselves and grow after they have passed through the bodies of birds.

When the blossoms of the tumbleweed and the Queen Anne's lace fade, they



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Do you know that birds help seeds to travel?

become brown and dry. They curl up into a sort of ball which stays on the plant until the stalks are old and break easily. The wind finally breaks off these tops. Off they go, tumbling and rolling over the fields. Sometimes they roll around over the tops of snowbanks. When the snow melts, the seeds sink

Some of these seeds pop out of their pods. Some of them float on the water. Read to find out which seeds travel by air and which seeds travel by water

into the ground. The seeds are often planted miles away from the place where the plant grew.

Other plants shoot their seeds far and wide. The witch-hazel pods split themselves open with a loud pop, sending the seeds far away as if they were shot from a popgun. The pods of the jewelweed split and curl up like little worms. This throws the seeds far, far away from the plant.

Water ash, alder, and many other kinds of plants grow on the banks of streams and lakes. They drop their seeds into the water. Some of them float in the water like little boats. Others look more like the water spiders which crawl or swim over the top of the water.

Things to Do

The children in Miss Smith's room gave a seed show or exhibit. All through the autumn they had brought different kinds of seeds to school. The children found that their seeds traveled in many different ways. They also found that many different kinds of seeds traveled in the same way.

The children invited Miss Gordon's grade to see their exhibit. Each child who brought seeds had told as much as he could about his seeds. He told the name of the seed, where it was found, how it traveled, and any other interesting thing he knew about the seed or the plant.

Miss Gordon's group said that they had learned a lot from the exhibit. But Miss Smith's children believed that they had learned more.

Things to Think About

1. Hundreds and thousands of the seeds which travel about never find any place to grow. Many of the seeds which do get themselves planted do not grow. Is this a good thing or is it a bad thing?

2. Look on page 141 to see what would happen if all of certain kinds of animals were allowed to grow up.

3. If all the seeds of all the plants should live to become full grown, the world would soon be so full of plants that there would be no room for people or houses or stores or anything but plants. After a while there would be no room for the plants themselves. They would not be able to get enough light. They could not make enough food. What a world it would be if all the seeds of all the plants should live to become full grown!

UNIT VI

The Earth we Live on

Here is a Question Box

Do you know how very small our big earth is?

Do you know how very big our small earth is?

Do you know why we do not have daylight all the time?

Do you know why the earth never stops moving?

Do you know that everything in the world is either a solid or a liquid or a gas?

1. How Very Big our Earth Is!

In the daytime, when you play out of doors, the earth seems large. It seems to have no end. In cities the parks, the streets, and the buildings seem to be all there is to the world. In the country the hills, the woods, the fields, and the farms seem to reach everywhere. But great places like these seem like tiny specks when you think of the rest of the earth.

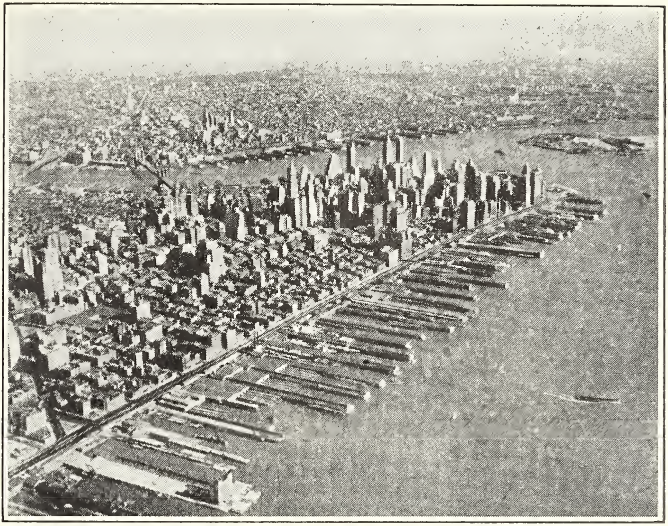
Did you ever try to find your town on a globe or on a map of the world? If your town is too small to have its name on a world map, find a large city which is somewhere near your home. Just a dot is used to show this big place!

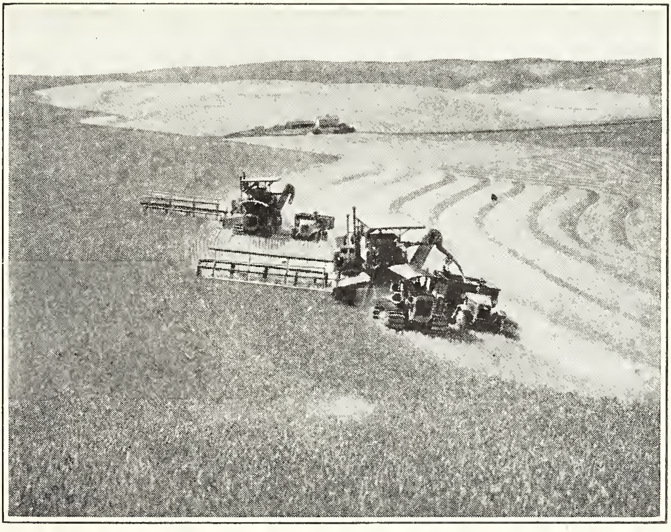
On the globe find the longest journey you have ever taken. Cut a strip of paper as long as your journey measures on the globe. Now cut a strip of paper long enough to reach all the way around the globe. Place your "journey" strip of paper beside the "round the globe" strip of paper. How do they look together?

Cut a piece of paper the size which the United States has on the world map. The United States is a very large country. Fast trains take four days and four nights to cross it. Lay your piece of paper over other places on the world map. How many, many pieces of paper of this size you would need if you were trying to have enough to cover the whole world map!

A fast boat takes at least four days and four nights to cross the Atlantic Ocean. This is one of the smaller oceans.

Our earth is a very, very large place. Don't you think so?





These great places really are very small places

2. How Very Small our Earth Is!

Wonderful thoughts can come to you when you look up at the dark sky full of bright, twinkling stars.

Do you know the poem which says,

> At evening when I go to bed
> I see the stars shine overhead;
> They are the little daisies white
> That dot the meadows of the night.

Although these shining specks look no larger than daisies, hundreds of them are suns which are much larger than our sun.

Suppose that there could be a huge giant who could travel around through the sky. Suppose that he could ride from one sun to another as easily as we can ride from city to city.

Suppose that this giant should say to himself: "I should like to find that wonderful place called the earth. So far as I know, it is the only place where people live."

Then he would ride around for millions of years, looking above and below the suns, around and about the suns, to find this place called "earth." If it were possible for such a giant to travel in this way, he might pass the earth a dozen times without seeing it at all.

Our earth is so much smaller than the stars that it would be as hard for such a giant to find it as it would be for you to find a needle in a haystack.

Things to Think About

Which of these thoughts do you think is more nearly true?

Our earth is very small

or

Stars are so large and so far apart that our earth seems very small beside them.

3. Why we do not have Daylight All the Time

What a queer world this would be if daytime should last all through the year! Do you think that you could live in a world which never had any night?

Do you ever wonder what causes day to follow night, and night to follow day, as it always does all through the years?

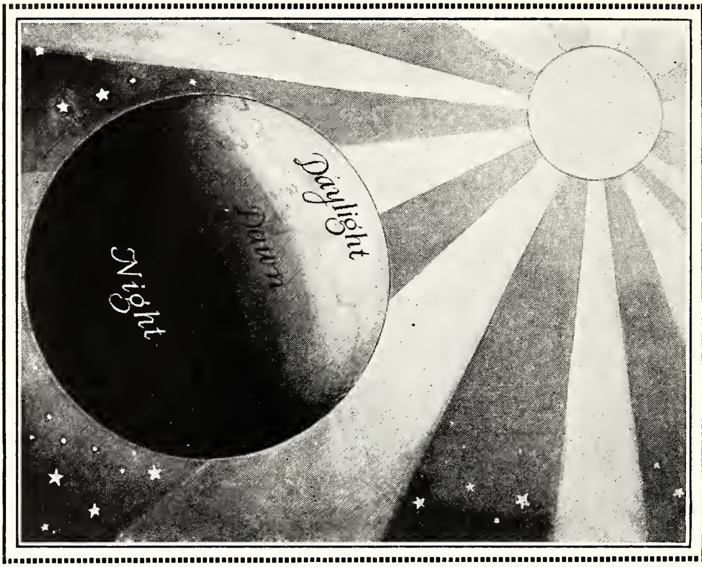
The earth is always moving. It never stands still. The earth never stops moving, because it cannot stop. There is nothing to stop it. It is always spinning round and round somewhat like a top.

Although the earth moves fast, it takes a long time to turn itself all the way around. While the earth is turning itself around once, many things are happening to us. We go to bed once and we get up once. We eat breakfast, dinner, and supper. We go to school, and we come home from school. It takes the earth twenty-four hours to spin all the way around. We call twenty-four hours a day, but it is really a day and a night.

Play that you are the earth. Turn yourself around and around. Pretend that your face is a person who is riding around on the earth every day.

Perhaps you can stand where a bright light shines on your face. Pretend that this bright light is the sun. Now try the same trick again. As you spin around, the light does not shine on your face all the time, does it? Which way must you be turned to have the light shining on your face?

The same thing happens to the earth. The sun shines on only a part of the earth at one time. As the earth turns



As the earth turns around, night becomes day and day becomes night

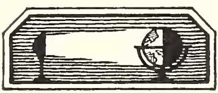
its great self around, only half of it is brightened by the sun.

The part of the earth which is turned toward the sun is light. It is having day. Animals are looking for food. Plants are growing. Children are playing or going to school. Grown-ups are working.

Mills and factories are running with

a busy hum. Automobiles carry people about. House-building and road-building fill the day with noise. The world seems to be busy and very much alive.

The part of the earth which is turned away from the sun is dark. It is having night. Many flowers have closed their petals. A few animals are hunting for food. Trains are running, boats are traveling, night watchmen and policemen are on guard, but most people are asleep in their beds. Night is a time of rest for most of the world.



Things to Do

Stand your schoolroom globe where a bright light can shine on the place where you live. Turn the globe around very slowly.

Can you see how the earth turns you away from the sun so that night comes to you?

Can you see how the earth turns you toward the sun so that day comes back to you?

Things to Think About

1. We could not live on an earth which always had daytime any more than we could live on an earth which always had night. The daytime earth would become so hot and dry that neither people nor animals nor plants could stay alive. A night earth would become so cold that nothing could stay alive.

2. Night is needed to cool the earth after the heat of day. Day is needed to warm the earth after the coolness of the night.

3. Tell some other reasons why we must have night in order to live.

4. Tell some other reasons why we must have day in order to live.

UNIT VII

Waters of the Earth

A Water Record

Everybody knows that people could not get along in this world without water. It is fun to see how very important water is in the lives of people. Did you ever keep a water record? At the top of your paper write "When did I use water yesterday?" Then make a list of all the different ways in which you had anything to do with water during that day. Have your record begin with getting up in the morning. Have it close with going to bed at night.

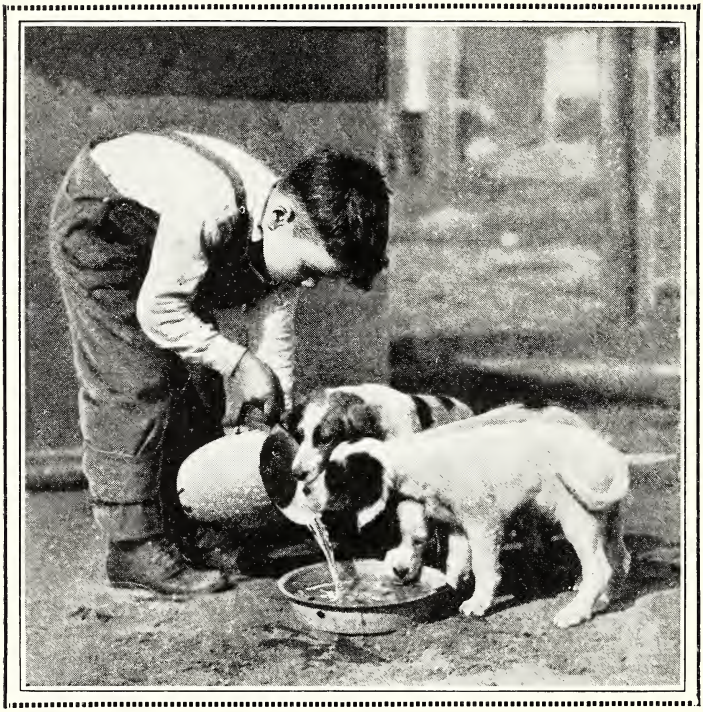
Try to remember how many times you washed your hands or took a drink. Put down the times other people used water in doing things for you, such as washing your clothes, and so on. If you played in water, put that down too. You will have a long list in a very short time. Read your list to the rest of the class. You will see that there are several things that everyone does with water. Check the things which most of the other children did, too. What are they? Could your day have been very well spent without plenty of water?

1. Animals must have Water

You have told many of the ways in which people need water. What are some of the ways in which animals need water?

Of course we all know how necessary it is for animals to have water to drink. Did you ever forget to leave water for your cat or your dog or your bird? Do you remember how sorry you felt to see the animal so uncomfortable? You will always remember, too, how eagerly your pet drank the water which you finally gave him and which he needed so badly. Animals are like people and plants. They must have water to drink.

Most animals like to get their bodies into water. They seem to enjoy it as much as you enjoy having a bath. Watch the sparrows in the street when



Bob does not forget that animals need plenty of water

they find a puddle of water on a hot summer's day! What a splashing a canary makes when he takes his bath in his little tub! And dogs! How they love to go in the water! Some animals make their homes in the water or at the water's edge. Beavers, muskrats, and otters do this. The water is their "safety zone." Can you tell what that means?

Many animals need to stay in moist places so that their skin will not become too dry. Snakes, toads, frogs, and turtles are usually found in shady places where there is a little moisture. Toads often crawl into the ground to find a moist kind of comfort. On summer days, out in the pastures, cows and horses stand in the water for hours. They are peacefully enjoying the coolness which the water provides. Cattle on the ranches used to die of thirst when the summer was very dry.

2. We must drink Water

The inside of our bodies needs to be kept clean as well as the outside. The water we drink takes care of the inside

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Read to find out why these animals need to stay in such a damp place

of our bodies as truly as the water in which we wash cleans the outside. Many impure things enter our bodies. Other things become impure after they go into our bodies. A good drink of water four times a day is one of the best ways by which we can get these impurities out of the way.

Water helps to make our blood. The greater part of our blood is water, in which many things are carried. One very important thing which is carried by the blood is food. The blood carries the food we eat to all the different parts of our bodies.

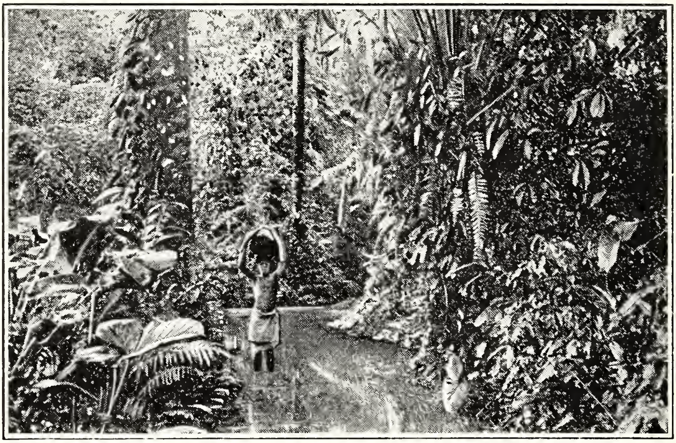
3. What would Plants do without Water?

What happens to your plants when you do not water them?

What has to be done to a garden during dry weather?

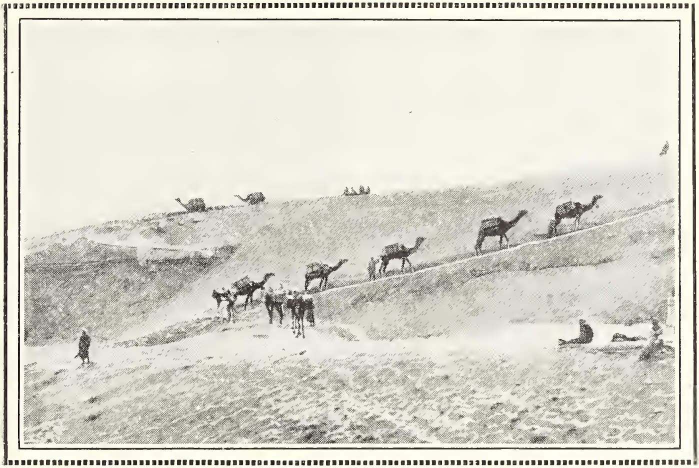
What happens to the farmer's crops when there is little rain during the summer?

Plants must have water. Sunlight, air, and good soil are not enough to make plants grow. Plants also need water in order to grow.



Read to find out why these trees
and vines grow so close together

In some countries there is so much heat and so much rain that forests grow very thick and fast. A person who wants to go through one of these forests has to cut a path, because the vines and trees grow so close together. If someone tries to follow the path a few days later, he can hardly find it. The plants have grown so fast that they have filled the path.



Read to find out why trees and other plants do not grow in this sandy place

Some other countries have a great deal of heat, but few plants grow there. The reason is that these places have almost no rain. These places are called "deserts." Most plants cannot grow on deserts because the ground is so dry. A few plants can grow there in spite of the dryness. Cactus plants can live there. They do not live without water, however. On the outside of the plant is

These ditches have brought water for many miles to a country where there is little rain. The water will help the crops to grow

a thick, tough covering that has many thorns. Water is stored up for a long time inside the plant. Sometimes travelers on the desert cut open certain kinds of cactus plants and drink the water which is inside.

Some of the best soil in the world is found in the desert lands of our own country. The only reason plants do not grow there is because there is no water for them. In some dry places people have been able to bring water from the mountain streams. This water is carried across the land through miles and miles of ditches. By bringing water to the desert, people have made great gardens.

If you should go to parts of California, you would see miles and miles of orange trees, lemon trees, walnut trees, fig trees, peach trees — all kinds of fruit trees. Before people were able to send the water from the mountains, however, this land was a bare, dusty desert. Everything was there to make plants grow, except water. But the trees could not grow without water. As soon as water could be brought there, California was able to have the greatest fruit farms in the world.

Things to Do

1. Do you know what it means to invent things? It means to find a new way for making things, all by yourself.

2. Make a plan by which water can flow from mountain streams to land far away which is too dry for crops to grow.

3. If there is a sand table in your schoolroom, try your invention there. Make the mountains in one end of the table and your desert at the other. How can you get water from your mountains to your desert? How can you show that your mountains have plenty of water? How can you show that your desert has too little water?

4. If you have no sand table, try your plan out of doors.

5. If you cannot work out this plan out of doors, draw a picture of your invention.

4. Dissolving Things in Water

Here is an old story about a donkey whose master often gave him loads that were heavy to carry. One day the donkey was carrying a heavy load of salt. He had to cross a stream of water. The poor donkey's feet slipped on the stones, and he fell down into the water. When he stood on his feet again and lifted his load out of the water, he went on with his journey. To his great surprise his load was much lighter than it had been before he fell into the water.

The next day the donkey was carrying a load of sponges for his master. When he came to the stream, he remembered what had happened to his load the day before. He walked to the middle of the stream and sat down in the water. When he stood up, he thought that his load would be lighter, just as it had been the other time. Imagine how disappointed he must have been when he found that his load was much heavier than it was before!

Alice says, "All these things will dissolve in water." Is she right?

Can you tell why the donkey's load was lighter when the water was mixed with his salt?

Can you tell why it was heavier when the water soaked into his sponges?

We say that water *dissolves* some things. This means that the salt mixed with the water when the donkey's load slipped into the water. When we dissolve salt or sugar in water, the salt or sugar mixes with the water. We cannot see the salt when it is dissolved or mixed with the water. Put a stone and a lump of salt into a glass of water. Stir them with a spoon. What happens to the lump of salt? What happens to the stone?

When you make lemonade, what happens to the sugar? Sometimes you have to stir the sugar for a while because it settles at the bottom.

When we put a spoonful of sugar into hot tea, the sugar dissolves more quickly than it does in ice-cold lemonade. A hot liquid dissolves things more quickly than a cold liquid does.

Salt dissolves very easily. But sometimes we find that some of it has dropped to the bottom of the glass.

This happens because we have put more salt into the water than the water can really hold.

Can you think of other things which can be dissolved in water?

On page 243 the book says that our blood carries food to different parts of our bodies. Do you know how food can be carried about by our blood? The food which we eat becomes dissolved in the blood. Do you suppose any boy or girl as old as you ever thinks that spinach is carried to the bones in the little green pieces into which it has been chewed before it is swallowed? Do you think any child imagines that meat and potato are carried to the muscles in small brown and white pieces? How thick our blood would be if this were so!

Food is dissolved in our blood very

much as sugar and salt are dissolved in water. The blood which is carrying food to your bones and muscles is as clear and red as the blood you see when you cut your finger.

Things to Do

1. Put some red ink or other coloring into a glass of water. Put a white flower in the glass of water. After a day or so the flower will turn pink or red. This shows you that water does go up through the stem of a plant into the flowers and leaves.

2. Write a story about a child who decided to go through life without ever touching a drop of water. This child would get into a lot of trouble, wouldn't he? Some very funny things might happen to him, too. Don't you think you can make up a very interesting story about this child?

UNIT VIII

The Air Around Us

What do you think air is?

Could you live without air? Why not?

Think of all the uses we have for air. Write them down on a piece of paper to keep until you have finished reading "The Air Around Us."

See how many of these uses are in the story.

See if the book gives any uses for air which were not on your list.

After you have read the story, answer the first question again. Is your answer the same as it was at first?

1. What is Air?

At the corner of the street stood a new house. No people had moved into it yet. No furniture had been placed inside.

One day Bill said to Bob, "When I passed by that new house on the corner today, every room was filled to the ceiling with something."

"What was it filled with?" asked Bob. "When I came past I didn't see anything at all."

"Neither did I," said Bill. "But it was full just the same."

"Full of what?" Bob asked.

"Full of air," said Bill.

"Air isn't anything, so there," cried Bob. "Air doesn't fill up a room in a house or anything else!"

"Yes, it does. I can show you," said Bill.

Do you think Bill played a good joke on Bob? *or*

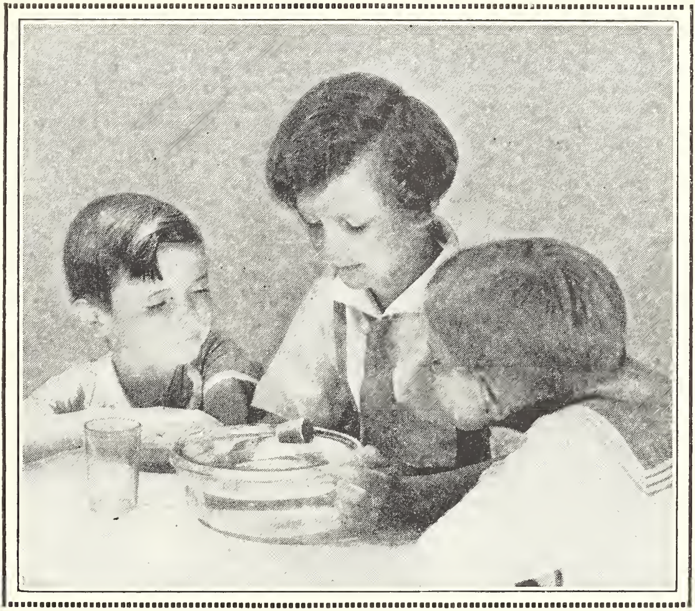
Do you think that Bob was right? Should you say, as he did, "Air is nothing?"

Does air take up room?

Here is a good thing to try. When you have tried it, you will know whether Bob was right or whether Bill really had played a good joke on him. Bill had tried to do this just before he tried to play his joke on Bob.

Fill a pan full of water. Float a cork on the water. Take a drinking glass. See that it is empty. Turn it upside down. Then push it down quickly into the water over the cork and hold it there.

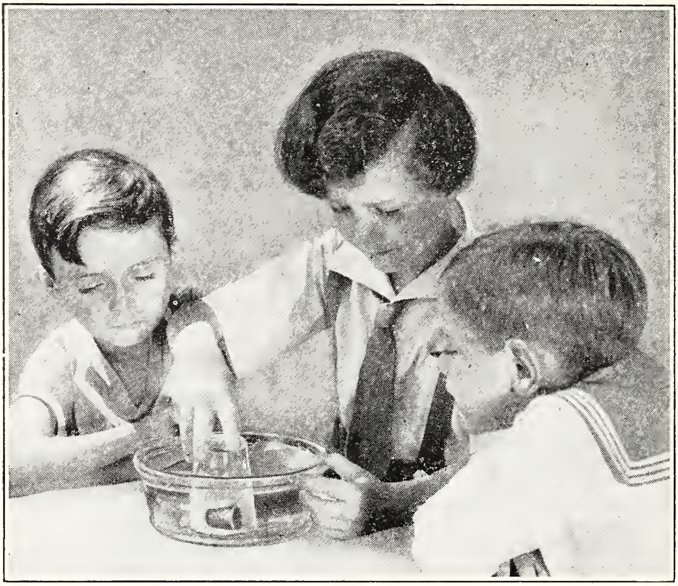
See where your cork is! It is no longer bobbing about on the water near the top of the pan. It is still on the



Do you believe that Bill can make this cork go to the bottom of the bowl without touching it?

water, but it is close to the bottom of the pan. The water outside the glass is higher than the water inside it.

Now take the glass out of the pan. See where the cork is now. It is floating on the water near the top of the pan just as it was before.



The glass was empty. Read to find out what pushed the cork to the bottom of the bowl

Try the same thing again. Does the cork go to the bottom of the pan each time you push the glass down over it? And does it bob back again whenever you take the glass away?

As you press the glass down over the cork, something seems to be pushing the water out of the way. It is air. Air was in the glass before you put the glass into the water. There was not enough room in the glass for both the air and the water. The air pushed the water out from under the glass.

Now what do you think about Bill's joke on Bob? Air takes up room in a glass. Would it take up room in a house?

Probably everyone will say that Bill knew what he was talking about. Air is not "just nothing." Air takes up room. We can feel air. We can hear air. Most important of all, we can breathe air.

We can feel air

We can feel the warm air that is around a hot stove or radiator. We can feel the freezing cold air when it bites our noses and fingers on a winter's day.

You know that you can feel air
when you walk in a hard wind

Wave your hands back and forth through the air. Can you feel something which you could not feel when your hands were still?

Wave a fan back and forth. Everyone who is near you feels the air very plainly now.

Paper, feathers, and all very light things move about when you wave a fan. A toy boat will ride all over a pan of water when the fan makes a wind to blow it about. The fan moves the air, and the moving air pushes the boat along. The moving air makes papers, feathers, and other light things move about.

You surely can feel air when it moves so fast that your hat blows off. Wind and moving air are the same thing. Sometimes the wind blows so hard that you can scarcely walk against it. You know that you can feel air when you try to walk against such a hard wind.

We can hear air

We can hear air moving about when we hear the wind blow. We can hear the wind rustle through the trees. We can hear it whistle down the chimney and through the cracks around a door. Sometimes a strong wind blows down trees and fences. This air sounds as if it were in a great rage as it rushes past.

Sometimes it roars about, high over our heads. Then it seems as if it were trying to find out how much noise it could make.

We must breathe air

Try to get along for a little while without breathing. You can hold your breath for a short time. Then you must breathe in spite of yourself.

Sometimes a baby holds his breath when he is crying. Everyone is a little frightened when he does this, and we do everything we can to make him start breathing again.

When you play tag, you have a goal to touch now and then in order to catch your breath. Hard running makes your body use up air faster than you can take it into your body. You need to stop running once in a while to take in a few extra breaths of fresh air.

When you play tag you need to stop running once in a while in order to catch your breath

An interesting thing about air is the fact that we must breathe it. We cannot get air into our bodies by drinking it as we do water. We cannot take air into our bodies through our skin as a blotter soaks up ink. We have to take air into our bodies by breathing it through our noses or mouths.

Here is another interesting fact about air. It is the only thing that we can breathe. We cannot breathe water. We cannot breathe the dry land. Some water is in the air. Some dust from the dry land gets into the air. We breathe both of these when we breathe the air which holds them. But we could not breathe them unless they were in the air.

People are not the only animals which must have air to breathe. All birds, reptiles, beasts, and fish must have air or they cannot live. Some animals need less air than others do. Fish breathe the air which is in the water. Snakes and turtles find enough air in the ground when they crawl into it for the winter. But all animals must have some air to breathe. They cannot breathe the water or the dry land any more than people can.

Plants must have air

Plants must have air in order to grow. They could not make food with-

Will this plant grow if it gets no air?

out air. The water, or moisture, that is in the ground goes up through their roots and stems to their leaves. When it comes in touch with the air, it is used in making food.

If you want to prove that plants cannot get along without air, try this plan:

Keep a glass jar over a plant for a

week or two. Have the top of the glass jar smaller than the top of the plant jar, so that there is a little path of earth between the two. This little path makes it possible for you to water the plant without taking the glass jar away. Water your plant every day. Do everything you should do to keep your plant healthy. Keep it in the sun. Do not raise the jar at all. No air must reach the plant.

What happens to your plant? Do the leaves droop? Does the whole plant look sick? What does the plant need to make it healthy once more?

2. Fire must have Air in order to Burn

Some girls and boys were having a picnic. They had planned to build a fire and cook their lunch. While the boys were fetching water from the creek, Mary and Alice cut some shavings and put some sticks over them in a pile. They lighted the shavings with a match. The fire burned for a few minutes and then went out.

Mary said: "What is the matter with this fire? It won't burn. Our matches are almost gone, and I am afraid we can't have a fire at all."

Bill said: "You didn't build it right. You just dropped the sticks down any old way. You ought to lay them down carefully, one across the other, so that the air can go up between the sticks."

Bob said: "A better way is to stand them up on end with the tops touching like an Indian wigwam. The air can go through more easily."

Bill said, "Let's each build a fire and see which burns better."

Whose fire will be ready first?

Each boy built his fire his own way. They lighted their fires at the same time. One fire burned as well as the other, because each fire had plenty of air.

Mary kept working at her fire. She finally found a place where the shavings would burn a little. She watched that place and fanned it gently with a big leaf. By and by she had a fire, too.

Bill looked at the three fires. "Now we have plenty of fires," he said. "Let's cook our lunch."

"We shouldn't have had any fire yet," said Mary, "if Bill had not known that air makes a fire burn."

"That's true, all right," said Bob. "And we must remember this, too. When we get through with these fires, we must put them out carefully. If we should go away and leave them, a little breeze could make them burn up the whole woods."

When they had finished eating, Mary said, "I shall put out my fire with this water." She picked up the pail of water in which they had washed their potatoes. She carefully poured the water all over her fire. Nothing was left burning.

Bill said: "Now Mary has used up all the water! What do you think of that, Bob? You and I must take a walk to the creek to get more water for our fires."

"I won't," said Bob. "I'm going to put sand and dirt on mine."

He scooped up big handfuls of dirt and scattered it all over his fire. At last it was out, too. The dirt kept the air away from his fire.

When the girls had washed the potatoes, they had spilled a great deal of water over the leaves on which the pail was standing. Bill said, "I shall put these wet leaves over my fire." The wet leaves kept out the air as well as the sand or the water did. This fire, too, was carefully put out. Not a spark was left.

These children left a clean, safe picnic ground for the next people who wished to eat there.

Things to Think About

1. Of course a child with good sense would not "play with fire." Why isn't it a safe thing to do?

2. Why should you always do your very best during a fire drill at school?

3. If your own house should ever catch on fire, here are some things which you could do to help:

a. Shut the door of the room that is burning.

b. Go to the telephone at once and say, "I want to report a fire." Then tell the name of your street and the number of your house.

4. Why should you shut the door of the room where the fire is?

3. There is Water in the Air

Have you ever known water to disappear from places where people have left it? It has a way of leaving without being touched by anyone.

Put a dish of water on the radiator. If you have no radiator, put it on a window sill in the sun or on the back of the kitchen stove. In a day or two the water will be all gone. If the air in the room is very dry, the water will disappear more quickly. Perhaps you can see a little ring around the dish where the water was at first. Where did the water go? It didn't leak through the bottom of the dish, or it would have left a puddle.

Why do you need to keep putting more water into your goldfish bowl? A little girl once said, "The fish drink it." Was she right? Could there be less water in the bowl when the fish, water and all, are still in the bowl?

We have to watch things that are boiling on the stove to see that they do not "boil dry." Where does the water go when the vegetables boil dry?

If you leave the cover off the paste

Where has the water gone?

jar, how does the paste look the next day? What makes it look that way?

Where *does* the water go when it disappears so strangely? Have you been able to answer the question any of the five times it has been asked? Do you think the water turns into nothing at all? Do you suppose we could get any of it back if we should try?

The water which disappeared from all these places went out into the air. We cannot see it, but we know that it is there. We know that the air is holding it. We say that the water "evaporates." It has become a part of the air. Water from rivers, lakes, and oceans evaporates. Water evaporates from wet clothes on a line when we hang them up to dry. Can you tell about other places where water evaporates? What are they?

How we know that water goes into the air

If you have a pitcher of ice water in a warm room, little drops of water form on the outside of the pitcher. These little drops have not soaked through the sides of the pitcher, because the pitcher does not leak. They come from the air. The moisture which is in the warm air turns into drops of water when it touches the ice-cold pitcher.

For the same reason little drops come on the windows of an automobile on a cold day when people are riding with the windows closed.

On wash day, or when vegetables are boiling on the stove, the windows become covered with water. The water which boiled away is turned back into water when it touches the cold window.

When you take a hot bath, the mirror in the bathroom often is covered with little drops. The hot water evaporates into the air, but when it touches the cool glass it turns back into little drops of water again.

It is a good thing for us that moisture does come back from the air. If the air did not give back its moisture, we should have no rain to water the garden. We should have no dew on the flowers. We should have no snow or frost. The air must give back the moisture which it has taken from the earth. Water evaporates from rivers and oceans very fast. Without rain and snow to fill them up again, they would soon be as dry as dust. Without rain and snow, dew and frost, the whole earth would soon be as dry as dust.

Things to Do

Plants take up some of the water which you put on them. It goes up into their stems and leaves. Then they throw off a lot of this moisture into the air. If you put a glass jar over a plant and leave it there for a little while, drops of water form on the inside of the jar. If you think the moisture came from the damp earth in the jar, try this. Put some fresh leaves into a bottle. Cork the bottle. By and by little drops form on the inside of the bottle. The leaves throw off moisture into the air which is in the bottle. The moisture which is in the air turns into little drops when it touches the cool glass of the bottle. This moisture must come from the leaves, for how else could it get inside the bottle?

4. Air is a Great "Pusher"

Air pushes on everything. It pushes on the top, bottom, and sides of everything in the world. It pushes on the inside and on the outside.

Did you ever wonder why a big plate-glass window does not fall in and break? It is because the air is pressing as hard on one side as it is on the other. If all the air could be taken out of the room, the air out of doors would push the window in as easily as you please. The wind would not need to be blowing to make such a thing happen. Air

Bob wonders what makes the milk go up into the straw. Can you tell him exactly why this happens?

presses very hard on all sides of windows and of everything else in the world.

When a fence is blown over by a hard wind, it is because the air is pressing harder on one side of the fence than it is on the other side.

Do you know why you are able to drink milk through a straw? When the straw is standing by itself in the glass, the milk does not come up to the top of the straw. The air pushes as hard against the milk in the straw as it does against the rest of the milk in the glass. When you put the straw into your mouth to drink, you pull the air out of the straw. Now the air no longer presses against the milk in the straw. But air is pressing against the rest of the milk in the glass. The air pushes this milk up through the straw into your mouth. When you take the straw out of your mouth, the milk is no higher in the straw than it is in the rest of the glass. The air has come back into the straw, and it pushes the milk down even with the rest of the milk in the glass.

Some children in school were taking care of their goldfish. They noticed some large pieces of dirt floating around near the bottom of the bowl.

"How can we take these pieces of dirt out of the bowl?" they asked. "They slip right through our fingers when we try to take them out."

Their teacher took a long glass tube about one-half inch across. She put the tube over one of the pieces of dirt. The water rushed up into the tube. The pieces of dirt rushed up into the tube with the water. Before she took the tube out of the water, Miss Smith closed it tight by putting her finger over the top end. When the tube was lifted out of the bowl, the water with the piece of dirt stayed in the tube. Miss Smith held it over the floor, but not a drop of water ran out of the tube.

"Oh, Miss Smith can do magic!" the children said.

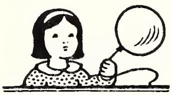
"No," said Miss Smith, "that is not magic. That is air pressure."

Water is in this tube. What will happen if Mary takes her finger away from the top end?

Then she held the tube of water over a pail and took her finger away from the top. The water ran out of the tube.

"Now you can take out the rest of the specks by yourselves," she said.

Can you explain what Miss Smith meant when she said: "No, it is not magic. It is air pressure"?



Things to Think About

1. What makes the air go out of a balloon when you unfasten the opening?

2. What makes the air go out of an automobile tire when it gets a hole in it?

3. What makes a paper bag burst with a bang when you blow it up and then hit it with your hand?

4. Remember, air presses on the inside of things as well as on the outside.

UNIT IX

Magnets and what they Do

Did you ever play with a magnet? What could you make the magnet do?

Where have you seen magnets? What could they do?

Did you ever see a magnetic compass? Who was using it? For what was it being used?

If you have never seen a magnet, you will be interested in this story. You will find out that magnets do very queer things.

If you have played with magnets, you will be interested in this story, too. You will find out how other people have used them.

1. The Work of Magnets

Some children in school had a new toy. It was a horseshoe magnet, painted red except for the ends, which were steel color. The children could make the magnet do a great many interesting things.

A little iron bar went with the horseshoe magnet. The children would move this little bar very slowly toward the magnet until it was quite near the ends of the magnet. Then, with a jump, the little bar would fasten itself to the ends of the magnet and hang there. It took a real pull to get the bar away from the magnet.

Someone put the horseshoe into a box of tacks. When it was taken out of the box, a whole cluster of tacks hung to it.

After that the children tried to get

the magnet to lift all kinds of things. It would lift needles, tacks, long wire nails, a fishhook, a small key, a small steel spring, and pen points. It would not lift paper, rubber bands, wood shavings, or cloth.

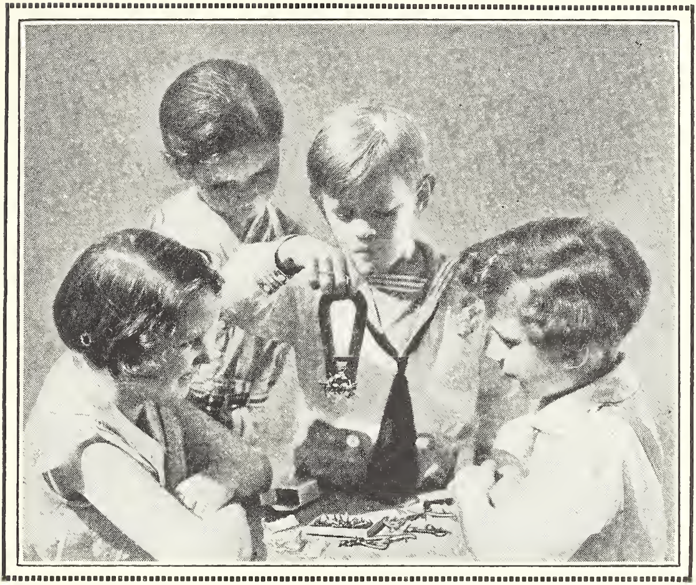
"It ought to lift the paper and rubber bands because they are lighter than the nails and tacks," said Alice.

"It ought to, but it doesn't," said Fred. "It just lifts things that are made of metal."

"It won't lift my gold ring," said Mary.

"It won't lift these pins," said Bob. "These pins and Mary's ring are both metal."

"See here. The pen points are made of steel, and so are the needles and the tacks. The magnet lifts them. The things which it does not lift are made of



Finding out what a magnet will lift

brass, gold, and other metals. It must lift iron and steel but not many other metals," said Bill.

"If we want to see our magnet lift things, let us give it iron and steel things to lift," said Mary.

The children tried all the iron and steel things they could find. If they were small enough the magnet would lift them all. Sometimes the children would mix together in a pile six or seven needles and six or seven brass pins. The magnet would come out of the pile loaded with needles. The brass pins would stay just as they were on the table. Things which were not made of steel or iron never could get a ride on the horseshoe magnet.

One day Alice was wondering how she could make the magnet do something which none of the other children had seen. As she stood thinking, she rubbed a needle along the ends of the magnet over and over again, and always in the same direction. When she put the needle down, it touched another needle which was lying on the table. Mary said, "May I take your needle, Alice?"

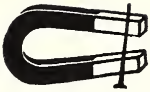
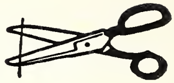
When Alice picked it up, the other

needle came, too. "Oh, look!" she said. "The needle is a magnet."

The girls found another needle. The magnetized needle would lift this too. They tried to pick up other steel things with the needle, but most of them were too heavy for the tiny magnet to lift. It would carry any needle smaller than itself, though.

Alice said: "I found a new thing to do without knowing it. I gave myself two magnets where I had only one before."

Then the children tried to make other magnets from the horseshoe, but the little magnet was not strong enough to make these new magnets. When a big magnet was brought into school, however, the children magnetized a hammer, the points of some scissors, and a lot of other needles.

 *Things to Think About* 

1. One day Fred tipped over the box of tacks. What would be the quickest, easiest, and cleanest way for him to pick them up and put them back into the box?

2. Bill's grandmother said: "When I drop my needle, I have such a hard time to find it again! I do not like to lose a needle. Someone may be hurt very badly by a needle which is lying about."

Bill magnetized the points of his grandmother's scissors. "This will help you to find your needle," he said.

Can you tell how it would help?

3. Can you think of other ways by which magnets could help people to pick up things quickly and easily?

2. The Magnetic Compass

Another thing which gave the children a great deal of fun was a magnetic compass. This was a little round, flat brass box whose top was like the glass on a clockface. Swinging from a peg in the bottom of the box was a thin piece of steel which looked a little like the hands of a clock when it is six o'clock. One hand was gray; the other hand was dark blue. These hands always pointed in opposite directions.

The compass would do a very strange thing. No matter how a person twisted the compass about, the blue hand would always point to the blackboard in the front of the room, and the gray hand would point to the back of the room. The children carried it all over the room, but the same thing always happened. When they went out to play at recess time, the blue hand pointed to the north end of the playground, and the gray hand pointed to the south end. They walked all around with it, and the same thing always happened. The blue hand would twist around until it was pointing north, no matter which way the children went.

"It always points north out here. Is it pointing in the same direction when we are inside?" someone asked. The teacher said that the blackboard was on the north side of the room.

"It always points to the blackboard in the schoolroom. Then the blue hand always points the same way. It always points north," the children said.

"The earth's Magnetic North Pole causes the needle to point north all the time," their teacher said. "It draws the compass needle toward itself."

The children learned that compasses are used in many ways. Men who steer the ships out on the wide sea cannot find their way by means of houses, hills, or towns, or by signposts as the people do who travel in automobiles on land. They have to use a compass to tell them the way.

If a person is taking a long walk through a forest, he can tell which way he is going by watching the needle of his compass. If he wants to go north, he must follow the blue hand. If he wants to go south, he must follow the gray hand. If he wants to go east, he must travel to the right of the way the blue hand points. If he wants to go west, he must go to the left of the way the blue hand points.

The children tried this themselves. They had great fun walking east, west, north, or south by looking only at the compass in their hands. They also played hide and seek with the compass. One child would hide. "Dorothy is east of you," the children would say to the

The compass tells Jack where to find Dorothy

person who was "It." This child would walk slowly east, looking only at the compass in his hand. He would use no other way to find the person who was hiding. As soon as he saw her they would both race back to goal.

One day a strange thing happened to the compass. Bill said: "I'm Daniel Boone going through the woods. Let's see. I want to go west, so I shall walk to the left of the way the blue needle points."

As Bill held the compass in his hand, he could hardly believe his eyes. The blue hand was not pointing to the blackboard at all. It was pointing directly at Bill himself!

"How does this happen, I wonder," he said.

Bob took the compass out of Bill's hand. The blue hand still pointed at Bill. Fred was standing on the other side of Bill. When he took the compass, the blue hand turned around till it pointed at Bill again.

"You must be the Magnetic North Pole," said Bob. "It always points at you."

Just then Bill reached into his pocket for his handkerchief. When he pulled it out, something else came with it and fell onto the floor in front of Bob. The needle then pointed to the blackboard. The thing that fell was the horseshoe magnet. When Bill picked it up, the needle pointed at him again.

"I thought I was through being pointed at," he said, as he laid the magnet on the table. Just as he said this, the compass pointed to the table. "That thing is surely acting funny," the boys all cried.

"It's that magnet, I believe," said Fred. "The blue needle points wherever the magnet is." He took the magnet from the table, and the blue hand of the compass pointed at him. "This magnet must draw the compass needle the way the Magnetic North Pole does."

"Yes," said Bill; "although the magnet can't be so strong as the Magnetic Pole is, it is much nearer to the compass.

Alice finds out what a magnet will do to the needle of a compass

At that moment it pulls more on the compass than the Magnetic Pole does."

When the boys took the magnet away from the compass, the blue hand pointed north to the blackboard just as it always had done before.

"Well," said Bill, "I guess if Daniel

Boone depended upon a compass to get him through the woods, he didn't carry a magnet along in his pocket. He never would have got through if he had."

Things to Do

1. Try to find a story which tells how the compass helped Columbus to find his way across the ocean to America.

2. Try to find out how the compass is used by people today. Ask your father or your mother. Ask someone who has traveled on a long journey.

3. Try to think how a compass might be of use to you some day.

Index

What this Index Is

If you want to find the page where a unit in this book begins, you turn to the Contents, at the front of the book.

But sometimes what you want to find is not where a unit begins, but where some plant or animal or other thing is talked about. One way, of course, would be to look at each page until you found what you wanted. But this takes too long. A better way is to turn to the Index, which begins on page 303. It tells you on what page you will find *rabbit* or *robin* or the other things you are interested in.

Perhaps you are interested in the strange animals called the dinosaurs. You first read about them on page 70. Then you want to know at once if your book tells you more about them. So you turn to the Index and find that pages 83, 86, and 97 also tell about the dinosaurs.

This Index, then, will help you to find quickly and put together all that your book tells about anything in which you are interested.

The Index will save time if you use it in the right way. Almost every book that you will study in later years will have an index. If you learn now to let this Index help you, you will know how to use the indexes in other books.

How to Use this Index

The words in the Index are given in the order of the letters of the alphabet. If you are looking for *dinosaur* you will know that you will not find it near the end of the list, for *d* is the fourth letter of the alphabet. You will know that *robin* will be somewhere near the end of the list, for *r* is the eighteenth letter of the alphabet.

Suppose that you wish to read about a robin. Find the letter *R* in the Index, then look through the words under *R* until you come to the word *robin.* Remember that the word *robin* would be farther along in the list than the word *rabbit.* This is because the letter *o* is farther along in the alphabet than the letter *a* is.

Beside the word *robin* you will see the number 176. This is the number of the page which tells about robins.

After some words in the Index you will see two or more numbers. This means that you will find something about the subject on more than one page of your book. After *reptile* you will find 68 and 183. This means that reptiles are talked about on each of these pages.

Some of the lines in the Index read like this:

Scarlet tanager, 173

Others read like this:

Plants, 50, 65, 187, 266;
food of, 204

That is, the scarlet tanager is talked about only on page 173 of your book, but plants are talked about on five different pages. One of these five pages tells about the *food of plants*. Because the food of plants is specially important, the words *food of* are added.

Think carefully just what word you want to look up. Only the most important words are given in the Index. Perhaps you want to find out how long ago dinosaurs lived, or perhaps you want to find out how we learned about the dinosaurs. The word to look for in each case is *Dinosaur*.

The Index

A