

ELEMENTARY SCIENCE BY GRADES



Book Four

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ELEMENTARY SCIENCE BY GRADES

EDITED BY

FRANK W. BALLOU, PH.D.

SUPERINTENDENT OF SCHOOLS, WASHINGTON, D. C.

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BOOK FOUR

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BY GRADES**

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FRANK W. BALLOU
SUPERINTENDENT OF SCHOOLS,
WASHINGTON, D. C.

BOOK I. *By* **ELLIS C. PERSING and
ELIZABETH K. PEEPLES.**
In preparation.

BOOK II. *By* **ELLIS C. PERSING and
ELIZABETH K. PEEPLES.**

BOOK III. *By* **ELLIS C. PERSING and
ELIZABETH K. PEEPLES.**

BOOK IV. *By* **ELLIS C. PERSING and
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BOOK V. *By* **ELLIS C. PERSING and
C. LOUIS THIELE.** *In
preparation.*

BOOK VI. *By* **ELLIS C. PERSING and
JOHN A. HOLLINGER.**
In preparation.

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ELEMENTARY SCIENCE BY GRADES BOOK FOUR

A NATURE STUDY AND SCIENCE READER

BY

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EDITOR'S INTRODUCTION

The Elementary Science Series has been prepared because of the very earnest belief of the authors in the importance of the subject matter to be covered, in the interests of children in nature about them, and in their ability to profit by a study of it.

Throughout the series the authors have kept in mind the psychology of the child rather than the orderly scientific arrangement of the subject matter. The vocabulary of each book has been most carefully selected from and checked against accredited lists of words of highest frequency in the spoken vocabulary of young children. Moreover, the point of view of the authors is that of explaining to children the everyday world about them and making it an object of interest and profit to them.

Simplicity has been one aim in the preparation of the readers in order that the joy of the subject and the attitudes, habits, and ideals taught by them may not be lost in a maze of mechanical difficulties.

The general aims and objectives throughout the series are those set forth in the *Fourth Yearbook* of the Department of Superintendence.¹ The subject matter of the lessons has been selected with a view of making it possible for teachers to realize those aims and objectives.

The organization of the subject matter of the series

¹ *Fourth Yearbook*, Department of Superintendence, Ch. IV, "Elementary Science and Nature Study" (Washington, National Education Association, 1926), pp. 59-112.

agrees in the main with that of the *Fourth Yearbook* course and with other leading courses of study of the country. The course can be articulated with the more formal science course in junior-high-school grades.

The national policy of conservation of our natural resources is recognized and encouraged among pupils throughout the series. The protection of trees, wild flowers, and birds is specifically taught.

Each volume of the series is organized on the basis of seasons. For example, the study of flowers is increased in the fall and spring months, and minimized in the winter season. The physical sciences are largely taught during the winter months.

Each volume contains material sufficient for a year of instruction. Each volume also carries suggestions to teachers on how to handle the activities; how to obtain materials; plans for field trips; preparation of school gardens, and other aspects of the lessons. Although each volume is a unit in itself, the series represents a unified program of instruction in elementary science and nature study. The series is built on the spiral plan and is progressive in content and style.

At the close of each chapter various suggestions and questions are offered under the heading "Things To Think About." These questions and suggestions are for the purpose of stimulating thought among the children either before or after reading the lesson.

The books are primarily designed as readers with science content for the school systems that have yet made no provision in the curriculum for instruction in elementary science and nature study. New-type tests have been included for the purpose of determining comprehension of the reading assignment.

For the schools that provide for science instruction as such even more important than the comprehension material are the suggestions contained under the title "Things To Do." Since much of the instruction covered in this series of books can be given objectively through the direct contact of children with the objects themselves, the authors of this series have indicated what may be properly done by teachers and pupils in making a study of elementary science more than a book subject. Suggestions of trips to the zoo, excursions to the country, trips to parks and woods, and observations of those activities within the home that are based on scientific principles taught in the books are the various ways suggested of making the instruction covered in this series of books more real and more vital than such instruction acquired exclusively from books.

The material in these books has been successfully tested out before publication under actual classroom conditions in both city and rural schools, both in schools that used the material primarily as readers and in schools that have permanent provision for instruction in elementary science.

FRANK W. BALLOU

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PREFACE

Elementary Science is the natural means through which a child becomes acquainted with the world about him. Without suggestion or direction some children acquire considerable knowledge of their environment; but more remain pathetically and dangerously blind and deaf to it. For the child's physical, intellectual, and spiritual good the educator should see that he is made aware of the phenomena within his observational scope, and his relations to them.

Elementary science, more than any other subject, supplies actual experience with concrete things. It is, therefore, an ideal study in elementary schools, and may be used as a basis of approach to practically every other subject. Present practice in the teaching of elementary science and nature study in the first six years has indicated the need for a graded series of readers having a science content that will conform generally in subject matter and organization to accepted requirements. It was in the hope of supplying such a need that this series, *Elementary Science by Grades*, has been prepared.

This volume of the series, *Book Four*, has been designed for use following *Book Three*. In content, it meets the generally accepted subject matter requirements except for some minor modifications that were made as the result of testing the material in the classroom. It has for its central theme the many instances of community life observable in the realm of natural science.

The vocabulary has been based upon the first, second, and third groups of Gates, "A Reading Vocabulary for the Primary Grades" and upon Thorndike's "The Teacher's Word Book."

Simplicity in subject matter and style has been an aim in the preparation of this reader in order that the joy of the subject, and the attitudes, habits, and ideals taught by it may not be lost in a maze of mechanical difficulties. The psychology of the child has been kept constantly in mind in the presentation of the subject matter.

Like other books in the series, this volume has been organized on a seasonal basis. Subject matter has been arranged throughout so it will be suitable for the season of the year in which it normally will be studied. In this book, for example, the ant, the wasps, and certain flowers are studied in the fall. The chapters dealing with astronomy and the physical sciences come during the winter months. The latter part of the book, which ordinarily will be studied in the spring, includes chapters on birds, gardening, trees, and flowers.

To test reading ability, different forms of new-type tests have been included at the end of every chapter under the heading, "Some Things To Think About." Some teachers, of course, may desire to substitute other forms or to supplement those that have been prepared. Suggested forms for activities are given under the heading, "Some Things To Do." Specific suggestions to the teacher on the teaching of each chapter are placed at the back of the book.

Acknowledgment is gratefully made to Miss Helen K. Brett, Principal of Doan School, Science Curriculum Center, Cleveland, Ohio, for reading most of the manu-

script and for helpful criticisms and suggestions; to Miss Elizabeth S. Keegan, Principal of Harvard School, Cleveland, Ohio, and Miss Margaret McCarthy, Principal of Sowinski School, Cleveland, Ohio, for trying out the materials of this book in their schools; to David W. Russell, Department of Elementary Science, Hawken School, South Euclid, Ohio, for reading parts of the manuscript; to Professor Ruth Streitz, of the University of Cincinnati; to H. M. Buckley, assistant superintendent of Schools, Cleveland, Ohio, to W. M. Gregory, Director Educational Museum, Cleveland, Ohio, and to Dr. Hanor A. Webb of George Peabody College for Teachers, Nashville, Tennessee, for reading the manuscript and helpful suggestions and criticisms; and to Mrs. Elizabeth K. Peeples, Principal in the Washington, D. C., Public School; C. L. Thiele, Assistant Director of Exact Sciences, Detroit, and Dr. John A. Hollinger, Director of Nature Study, Pittsburgh, for their helpful advice on the outline, their reading of the complete manuscript, for testing chapters of the manuscript, and for reading the proof.

E. C. P.

E. E. W.

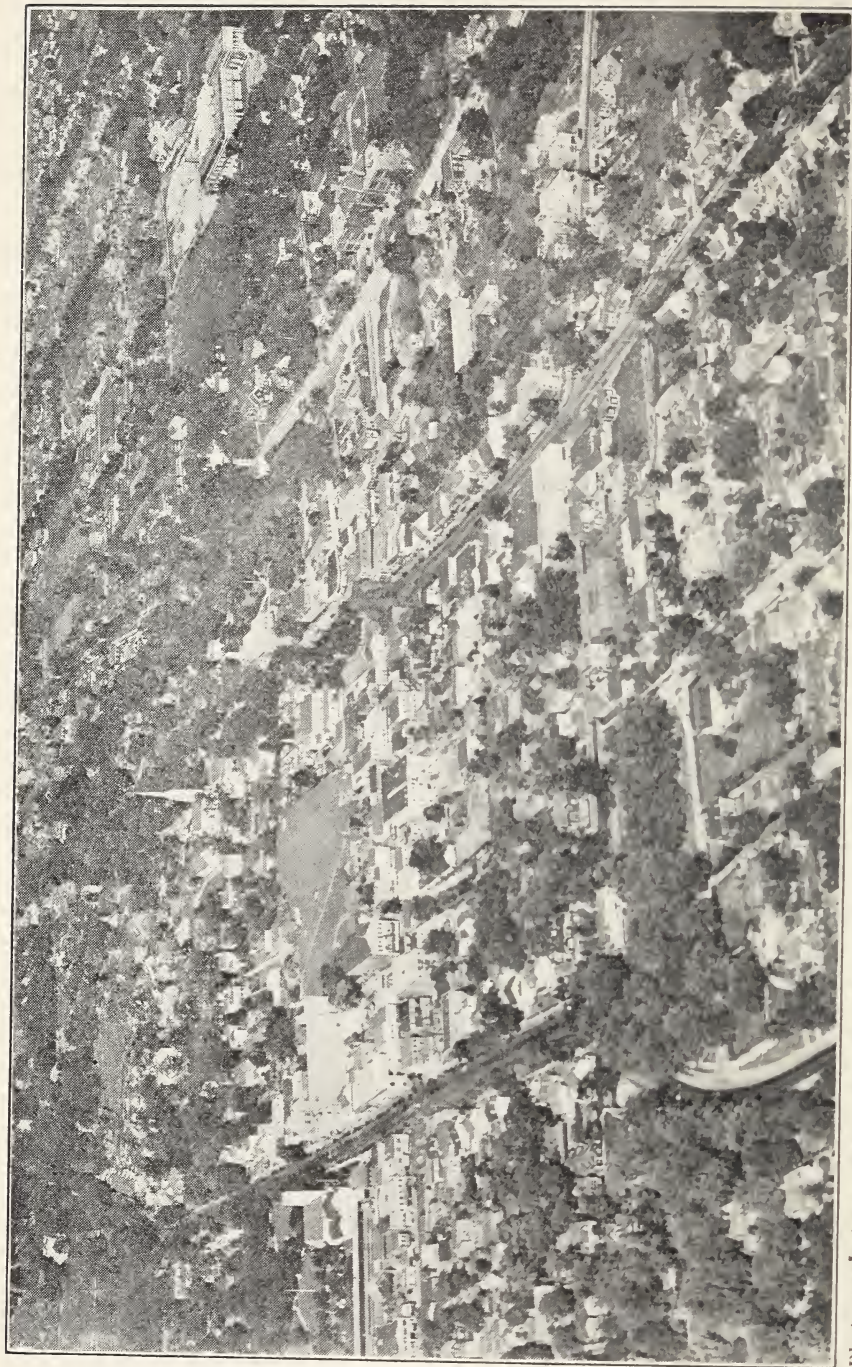
INTRODUCTION

COMMUNITY LIFE

Would you like to live alone on an island? If you were to do so, you would have to provide your own food and shelter and make your own weapons and clothing. It would be hard, even if there were fruit and vegetables and goats and cattle. Probably you would soon grow very tired of being your own grocer and butcher and carpenter and tailor. Then you would wish that there were other people on the island to help you, and you might find out that one reason why people live together is because they live more easily that way.

Do you know the story of Robinson Crusoe? You remember he lived alone with his man Friday and had to supply all his food, clothing, and shelter.

Of course you would not like to live the way Robinson Crusoe did. You are human and so



Photograph from Fairchild Aerial Surveys, Inc.

THIS IS A PICTURE OF ONE KIND OF A COMMUNITY. YOU WILL LEARN ABOUT OTHER KINDS
IN THIS BOOK.

you are happier living with people around you. It is easier to keep alive and happy when people live in groups. Other people help you, and you help them.

To-day most people live in groups of homes called villages, towns, or cities. They help each other to get food and clothing. Some people keep the markets where food is bought. Others work to make clothes for them. Many people are needed to run the trains, street cars, and busses that take them to work. Almost every person does something to help some one else live. When people live and work together, they form a community.

It is safer to live with other people than to live alone. Why? Some animals live in communities just as people do. Did you ever see animals or insects that live together, helping and protecting each other? If you have not, you may easily do so. You need not go far to find an ant hill. It is a busy little community, very much like a tiny city. Some people believe that ants manage their small city better than we manage ours. The story of the ant hill in this book will tell you how they live.

Perhaps you would like to read how one kind of insect makes a home for a large family,



Courtesy of the Connecticut Geological and Natural History Survey.

THIS PAPER NEST OF ONE KIND OF WASP IS THE HOME OF
AN INSECT COMMUNITY

or community. Find a wasp's nest. Every year these insects build a home for a very large family of wasps. Sometimes there are hundreds, or even thousands, of wasps in one nest belonging to one family or community.

Wasps very wisely make use of what they find in the world about them to build their home. They make a kind of paper from wood and, while it is still wet, like plaster, build their houses of it. When it dries, it makes a strong, safe home. The story of the "Wasp That Loves Company" in this book will tell you more about the building of this home.

Very likely you have seen a bee on some flower. Did you know what it was doing? The bee was gathering pollen and nectar. Pollen is the yellow dust on the flowers, and nectar is the flower's sweet juice. You may remember that bees cannot live without this food from plants.

In the same way, plants cannot live without bees or other insects. The plants need the insects to carry pollen. Some plants cannot grow fruits until the bees have brought them pollen. So you see that insects and animals are a help to the plants, and plants are a help to insects and animals.



Courtesy of the Brooklyn Children's Museum.

IN THE WORLD ALL ABOUT BOYS AND GIRLS WILL FIND MANY WAYS IN WHICH PLANTS AND ANIMALS HELP EACH OTHER.

Plants and animals and insects help human beings. But so do machines. Have you ever seen a windmill pumping water? When people use a windmill, the wind is helping them to do their work. The wind turns wheels, pumps water, and runs machinery that helps people.

How do you know when it is time to go to school? Do you ask your mother? It is easier and quicker to look at the clock to learn the time. Can you imagine a town or city without

clocks? No one would know when it was the right time to go to school or time to go home for dinner. The clock and the windmill are just two of the many machines that help people to live. You will learn about other machines later in this book.

In the world all around you, you will find ways in which plants and animals and people help each other. If you wish to know more about the ways in which the things about them help people to live more easily and be happier, this book will help you to find them out.

SOME THINGS TO THINK ABOUT

1. What could you use for food if you were all alone on an island?
2. What could you use to make your clothing?
3. Why would you want other people on the island?
4. What animals live in a community?
5. What do wasps use to make their homes?
6. Why do some insects live in communities?
7. What do the bees do for plants?
8. Name five machines that help us to do our work.

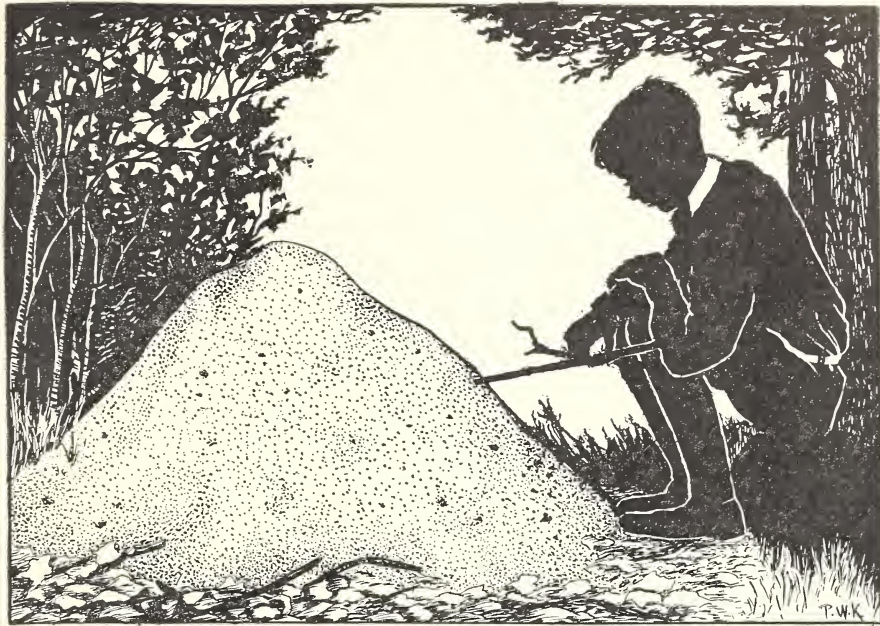
CHAPTER 1

THE ANT HILL

How many kinds of ants have you seen?
Have you ever watched ants at work carrying
 little grains of earth or bits of wood?
Have you ever seen ants hunting food in your
 mother's pantry or kitchen?

Many hundred years ago the wise old King Solomon told his lazy people to learn industry and thrift from the ants. These little insects lived more than three thousand years ago in far off Palestine, where King Solomon ruled. Today ants may be found all over the earth, except in the cold regions. If you watch them in the woods and fields and around our homes, you will learn why the wise King spoke as he did.

The largest of our ants is the black carpenter ant. It is nearly an inch long. We find these ants living in forests. They live in the trees under the bark. For their homes they make little tunnels in the wood. That is why we call them carpenter ants. The smallest of our ants



AN ANT HILL HAS MANY ROOMS AND IS THE HOME OF HUNDREDS OR THOUSANDS OF ANTS.

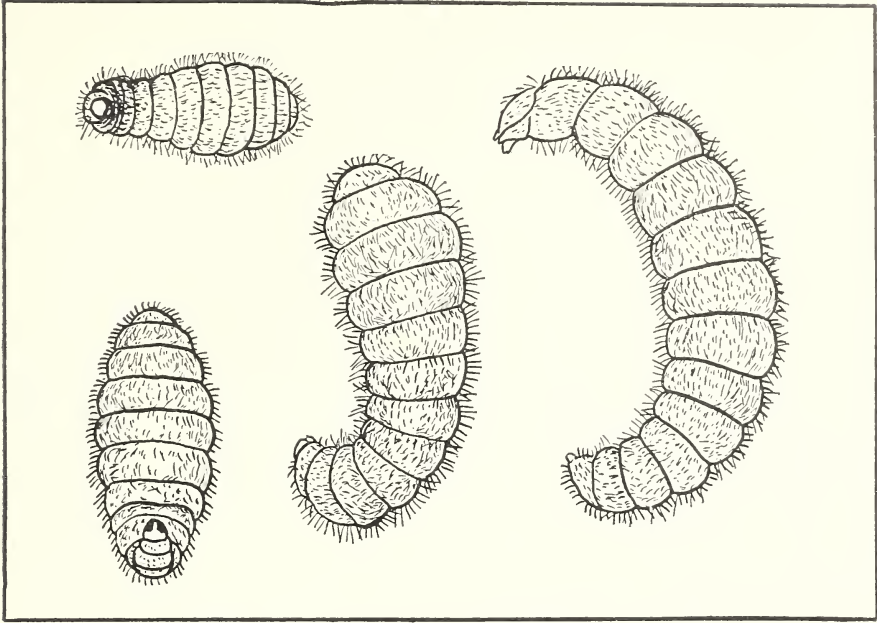
is the little red ant. It is scarcely an eighth of an inch long. These red ants live underground, near decaying wood.

Ants do not live by themselves. They live in large families, called colonies. If we were to examine an ant colony, we would find in it the mother ant, called the queen, and hundreds or thousands of her children, called workers. There are also a few male ants in the colony for a few days in the summer. One of these is the father of the colony. The males live only a few days.

Ants usually make their homes under ground. These homes contain many little rooms. All of these rooms are connected by tunnels. When the earth is dug out by the workers to make these rooms and tunnels, it is carried up to the surface of the ground and piled into a mound or hill. This is the reason the home of the ant colony is called an ant hill. The so-called white ants of Africa build hills that are taller than a tall man. Many thousands of workers live in those colonies.

Whether the colony is large or small, it usually has but one queen. She is much larger than any of her children and much less active. She may live for several years. Let us see how she spends her time.

When the queen is young, she has two pairs of wings. She needs these because she must fly away from her old home. She seeks a mate, and then she flies to a place to make her new home. After she has found a good place for her new home, or ant hill, she bites or breaks off her wings. Then she makes a few little rooms in the ground. A tunnel leads from the entrance to each one of the rooms and from one room to another. At night she closes the entrance with small pebbles or bits of earth.



OUT OF EACH EGG COMES A LARVA. THESE PICTURES, OF COURSE, ARE MUCH LARGER THAN THE LARVAS REALLY ARE.

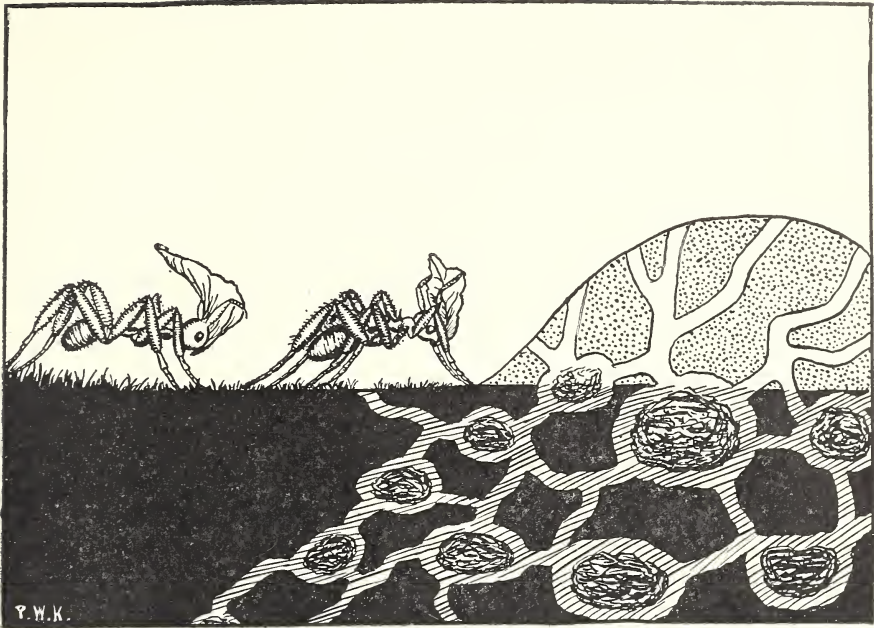
She pulls these away again in the morning. When the little rooms are ready, the queen lays a few eggs in each one. In a few days, perhaps a week, these eggs hatch. Out of each tiny egg comes a whitish larva, or grub. In the picture you can see what they look like. They do not look much like ants, do they?

The queen gathers food for these young ants and feeds them. After they have been eating and growing for a week or ten days, they stop eating. Then they change their shape and color, and remain quiet for about a week.

From each one comes a real ant. We will learn more about this wonderful change later.

These first ant children now begin to do the work of the ant hill. They do all the things that the queen has been doing except lay eggs. They build more rooms and tunnels and gather food. These busy workers also feed and care for the new larvas and the queen. She has nothing more to do but lay eggs as long as she lives. The workers carry away the eggs as they are laid and put them into the little rooms of the nursery. The nursery is a part of the ant hill that the workers have to make larger every day after the queen begins to lay eggs.

The rest of the story of the ant hill is mainly one of the life of the workers. There may be several kinds of workers in the ant hill. One kind has large jaws and is strong. They often guard the ant hill. We call them soldiers. In the homes of the leaf-cutter ants there are smaller workers that are blind. They spend all their lives in the dark food rooms, helping to produce mushroom food for the colony. Other workers, as you see in the picture, bring in bits of leaves that they have cut from plants. The little blind workers pack these bits in the dark rooms and keep them moist, so they



THIS PICTURE SHOWS LEAF-CUTTER ANTS CARRYING PIECES OF LEAVES TO THE ANT HILL.

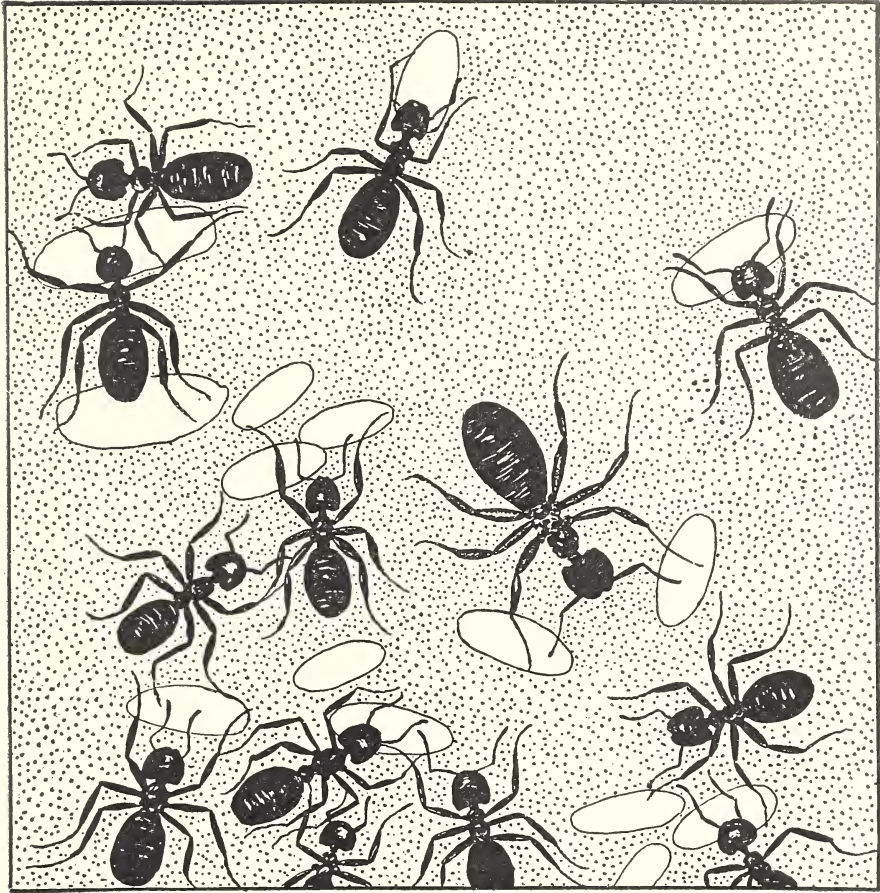
will decay. When the little pieces of leaves have decayed, the workers plant mushroom spores on them. These spores were brought by the queen from her old home so that her ant colony might have mushrooms for food. The mushrooms grow well in the dark, underground rooms, and supply the whole colony with food.

Most of the ants we see are workers of still another kind. They make new rooms and tunnels for the ant hill, feed, and care for the larvas and the queen, and keep the whole ant

hill clean. Some of them are always out looking for food in the summer. If we could see into the ant hill some day in the summer time, we would see these workers doing something else which is very interesting.

You remember that the ant larva stops eating when it is about a week old and remains quiet for several days. It grows shorter and thicker, and darker in color. The queer-looking little larva is changing to an ant. The ends of its body become alike in shape. We call this quiet stage of the ant's life the pupa stage. On the outside, the pupa seems to be quiet, but wonderful changes are going on inside of it. During the pupa days, the ant's eyes and feelers and legs and body are growing. There will be two eyes, two feelers, and six legs. If the new ant is a queen or if it is a male, there will be two pairs of wings, also.

The workers take very good care of the pupas. They carry them about in the ant hill, so that they have just the right amount of moisture and the right amount of heat. If the day is hot, the pupas are carried to cooler rooms lower down in the ant hill. If the sun comes out after a cool, cloudy morning, they are carried out in the sunshine,



WORKERS TAKE GOOD CARE OF THE PUPAS WHILE THEY ARE
CHANGING TO ANTS

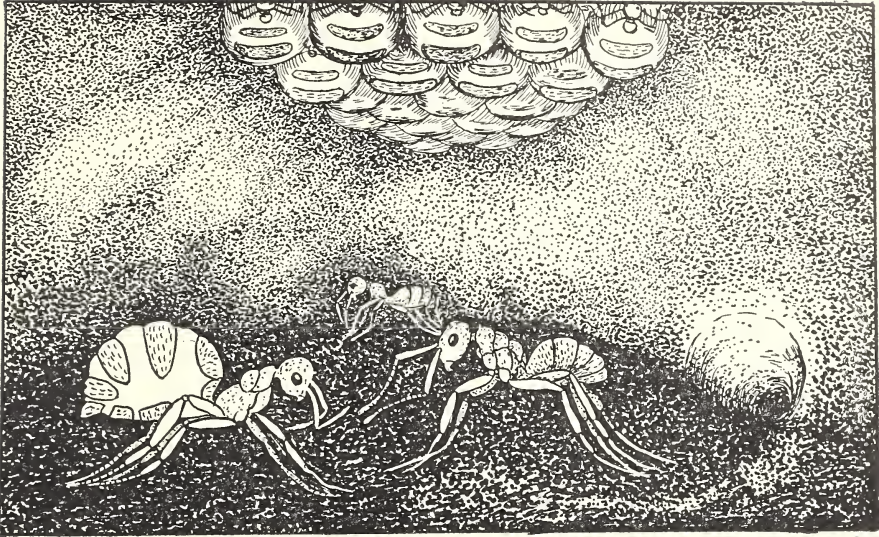
or just beneath the pavement or a flat stone that has been warmed by the sun. Whenever we see an ant hill that has been disturbed, we see the workers carrying the pupas away to some safe place. In the picture we see a number of pupas in their cases or cocoons. The two larger ones at the left are pupas of queens.

Near the top a worker is shown carrying a pupa away.

We have seen how the leaf-cutting ants raise mushrooms for food. Other kinds of ants have just as interesting ways of getting food. Most ants like sugar. They find this in sweet liquids, like the juices of fruits and the nectar of flowers. They also find it in very different places. Tiny insects, called aphids (*ā-fīds*), live on the stems of green plants and the twigs of bushes and trees. The aphids use the sap of these plants and twigs for food. In their bodies this sap is changed to a sweet liquid, called honey dew. Ants have learned that if they stroke aphids gently with their feelers, the aphids will send out little drops of this honey dew. The ants then take these drops back to the ant hill and feed them to the queen and larvas and other workers that cannot gather this food.

Some ants have learned that they can store sweet liquids in the bodies of living workers during the summer months, and thus keep this food for use during the winter. The following picture shows this strange method of storing food in workers that are called honey-pot ants.

Ants enjoy honey dew so much that they



HONEY-POT ANTS CAN STORE SWEET LIQUIDS IN THEIR BODIES. SOME OF THEM HANG FROM THE ROOF OF THE HONEY ROOM FOR MANY MONTHS AND GIVE UP THE HONEY WHEN IT IS NEEDED FOR FOOD.

take remarkably good care of the aphids. They take the aphid eggs into the ant hill and care for them over winter. When spring comes, the eggs hatch. The ants then carry the young aphids out and take them to the tender twigs of near-by bushes and trees, where they can feed. Some ants build leaf and paper coverings over the parts of the plants where the aphids are feeding. By protecting aphids in these ways, ants do a great deal of harm to fruit trees, for the aphids kill the trees when they take very much sap from the twigs. There are some blind, yellow ants that live in the soil

of cornfields. These ants place aphids on the roots of corn plants. The aphids suck the sap of the roots. This feeding often kills the corn plant.

In this chapter you have learned a few of the interesting things done by ants. Perhaps you know now why the boy shown in the first picture is watching the workers on the ant hill so closely. The next time you see ants at work, you, too, will want to learn what interesting things they are doing.

SOME THINGS TO THINK ABOUT

Can you fill in the right words to complete these sentences?

1. An ant has.....legs.
2. Ant workers have..... wings.
3. Ants live in.....
4. Ants like.....
5. Ants get honey dew from.....
6. The queen ant spends.....of her time laying eggs.

SOME THINGS TO DO

See if you can find a colony of ants near your home.

Try to see what the workers are doing at different times of the day.

Put a piece of cake near the door of the ant hill.
What happens?

Watch for winged queens and their mates flying
in clouds in summer.

CHAPTER 2

WASPS THAT LIKE COMPANY

Have you ever seen a hornet?
Do you know the yellow jacket or the brown wasp?
Have you ever examined the gray paper nest of
hornets?

Do you remember some six-legged visitors that came to see you last summer when you were on a picnic or ate your lunch out-of-doors? Perhaps one was nearly an inch long, with black and white bands around its body. Another, much smaller, may have worn yellow and black. Still another might have worn brown and black.

They did not wait to be invited, but flew in from nobody knew where, hovered a moment over the fruit or jelly, and then alighted on it and helped themselves.

Each one of these visitors has a wonderful tongue, just made to sip up sweet liquids. At the other end of its body it carries a very sharp stinger.



BROWN WASP



YELLOW JACKET



HORNET

Courtesy of the Connecticut Geological and Natural History Survey.

THESE PAPER WASPS LIVE IN COMMUNITIES.

Although all of these are wasps, we call only the brown one by that name. The one that wears black and white we call a hornet, and the yellow and black one we call a yellow jacket. Brown wasps, hornets, and yellow jackets live in colonies like the ants. For this reason we call them social wasps. They all make their homes of paper. For this reason, we call them paper wasps.

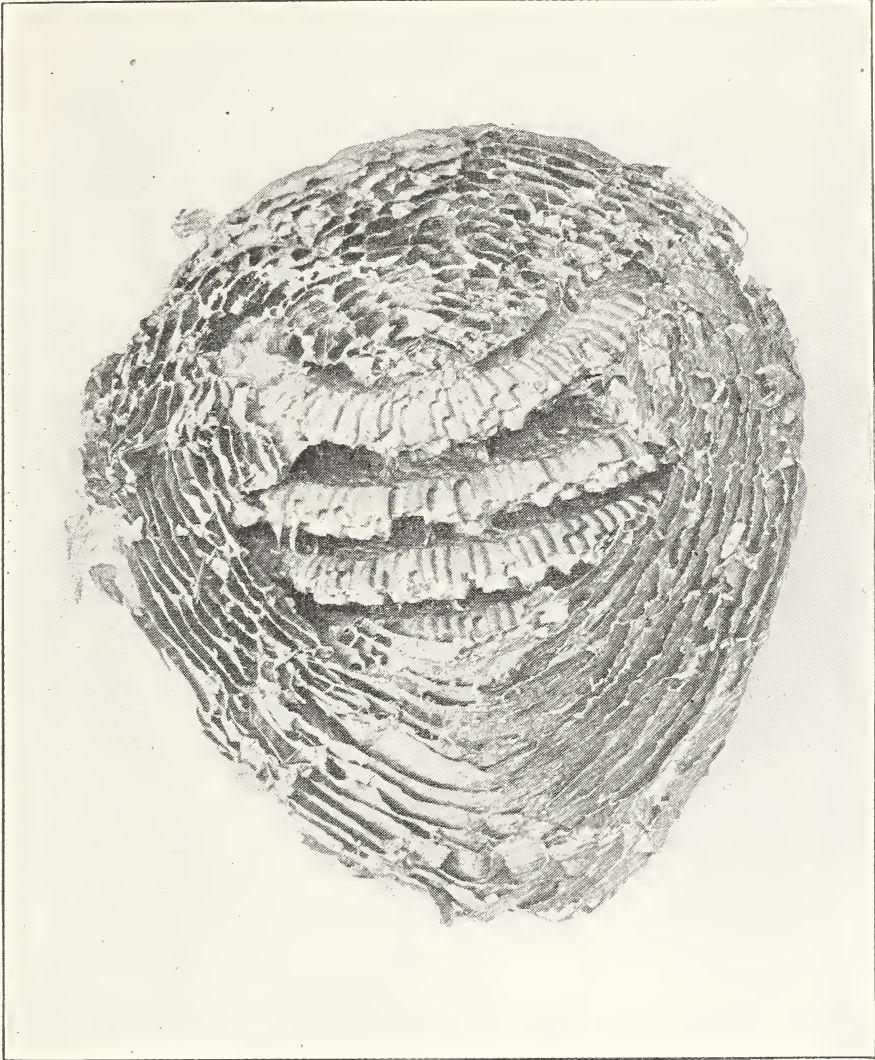
Like the ants, each wasp colony has a queen

and many workers. The queen's only duty is to lay eggs. Like the ant workers, the wasp workers make the nest, gather food, and feed the young and the queen. Unlike the ant workers, all the wasp workers have wings.

Wasp nests are very interesting, but you must be careful not to get too close to them, for the workers are always on guard and ready to use their stingers. Some of the hornet nests are no larger than your head, but a big colony of hornets will build a nest so large that you can barely reach around it with both arms. The time to study the nests is after the wasps have all left them, not during the summer months when the wasps may be at home. If you should find a nest in February or March, it would be safe to examine it.

You would find that it has the shape of a top; that it is attached at its broad end to the limb of the tree. There is no door or opening to the nest except at the pointed end, and this opening is so small that only one or two hornets can enter at the same time.

Inside the nest are a number of layers of cells, one layer above another, like the floors of an apartment house. One layer doesn't touch another below it or above it except at the mid-



Courtesy of the Connecticut Geological and Natural History Survey.

THIS IS THE WAY THE INSIDE OF A HORNETS' NEST LOOKS.
SEE THE PICTURE ON PAGE 4 ALSO.

dle of the nest where the layers are joined together for support. This leaves a space in which the hornets can walk around between the

layers to feed the young wasps in the cells. This hornet apartment house is surrounded by an outer wall, which protects it very well from the rain and wind. A large nest may have several layers of cells, and each layer, several hundred cells. Each cell is about as big as your little finger but only half as long. It is closed at the upper end and entirely open at the lower end.

When the queen hornet lays her egg in one of these cells, she must fasten it to the little ceiling of the cell, or it will fall out. She fastens it to the ceiling with a sticky substance something like glue. When the egg hatches, the larva must tie itself to the ceiling by a tiny thread that it spins, or it will fall out, too.

As it grows larger and heavier, it must spin more threads to hold itself in its little room or cell. These larvae are fed by nurses who go from cell to cell. Each little larva wrapped up in its cell puts its head out as far as it can to get the food. When it has grown to be a full-sized larva, and doesn't want to eat any more, it spins a silken floor for its little room or cell and changes to a pupa. In this form it remains quiet for several days while its wings and legs and eyes and feelers and stinger are

forming. As soon as it gets to be a real hornet, it breaks out of its pupa skin, and begins its duties as one of the workers in the large family.

The nest of all the paper wasps is made of rough gray paper. These insects make paper of wood pulp. Paper factories use this, too. The workers find dead wood and scrape off the fibers and chew them until they form a thin paste. Each worker brings a mouthful of this wood paste and spreads it in a thin layer along the edge of the cell or wall that is being made, until it is the right size. If the colony is becoming larger by the hatching of more eggs into larvas, the workers make another layer of cells and a new wall large enough to enclose the new layer. In the hornet nest, these later layers are narrower than the first, so that the nest remains shaped like a top. By the time the smallest layer is made, the hornets that grew in the first layer have all left their cells. The workers clean out these older cells, and the queen lays more eggs in them. In this way each cell in the nest may be used several times during the summer.

The workers must constantly gather food to feed the larvas and the queens. When night



THE BROWN WASP'S NEST HAS ONLY ONE LAYER OF CELLS.

comes, the workers go into their well built home and rest till morning.

The brown wasps build a nest of paper, too, but it is much smaller than the hornet nest, because the colony is smaller. The hornet nest is usually built in the woods or in an orchard. The nest of the brown wasp is often built in a barn or some other building, and so it is protected, but one kind builds in a tree as shown in the picture. Each cell is closed at the top and open at the bottom like the hornet cell, but it is very much smaller.

Our smallest social or paper wasps are the

yellow jackets. Each colony builds a nest in a hollow tree or underground, and in this way the nest is well protected. The yellow jacket colony is larger than either of the others. Sometimes, there are as many as three thousand workers in it.

All social wasps like the sweet liquids found in ripe fruits. Some catch other insects and eat them. Hornets destroy many flies and mosquitoes.

There is not much danger of being stung by any of these wasps when they are away from their nest hunting for food, but, when their nests are disturbed, they are quick to sting the disturber. The hornet sting is the most painful of all. The hornet flies very fast, usually toward the face of a person, and just before she reaches her mark she turns her body so that the stinger strikes first.

The stinger is very sharp. It is very slender, and inside is a tube. Through this tube the insect pumps a tiny drop of poison after the stinger enters the skin. It is this poison that causes the pain and swelling that follows a sting.

When winter comes, the workers all die, for they have stored no food. The queen lives

through the winter, but not in the old nest. She finds shelter in some building if she can, or in a hole on the sunny side of a tree, where the winter sunshine will warm her during the day-time. When the warm spring days come again, she creeps out, gets some food, and finds a place for her new nest. Then she makes a few paper cells and lays an egg in each one. When the eggs hatch, she feeds these first larvas herself, but as soon as they get to be workers, they take care of her and the hungry larvas that are hatched later.

SOME THINGS TO THINK ABOUT

Pick out from the list of words below the correct ending for each of the statements :

queens	winter
paper	workers
yellow jackets	larvas
hornets	summer
brown wasps	black
white	yellow
brown	wasps

1. Social wasps build their nest of.....
2. Three kinds of paper wasps are.....,
and.....
3. Hornets are black and.....
4. Brown wasps are black and.....

5. Yellow jackets are black and.....
6. The largest paper wasps are.....
7. The smallest paper wasps are.....
8. The first paper makers in the world were
.....
9. We should examine wasps' nests only in the
.....
10. Among the paper wasps only the..... lay
eggs.

SOME THINGS TO DO

Set out some sweet food for wasps, and watch them gather it.

Look for their nests in the winter time.

If you find a wasps' nest in the winter, look for the little layers of paper in its wall. With a pair of scissors cut away a part of the wall so that you can see the cells beneath it.

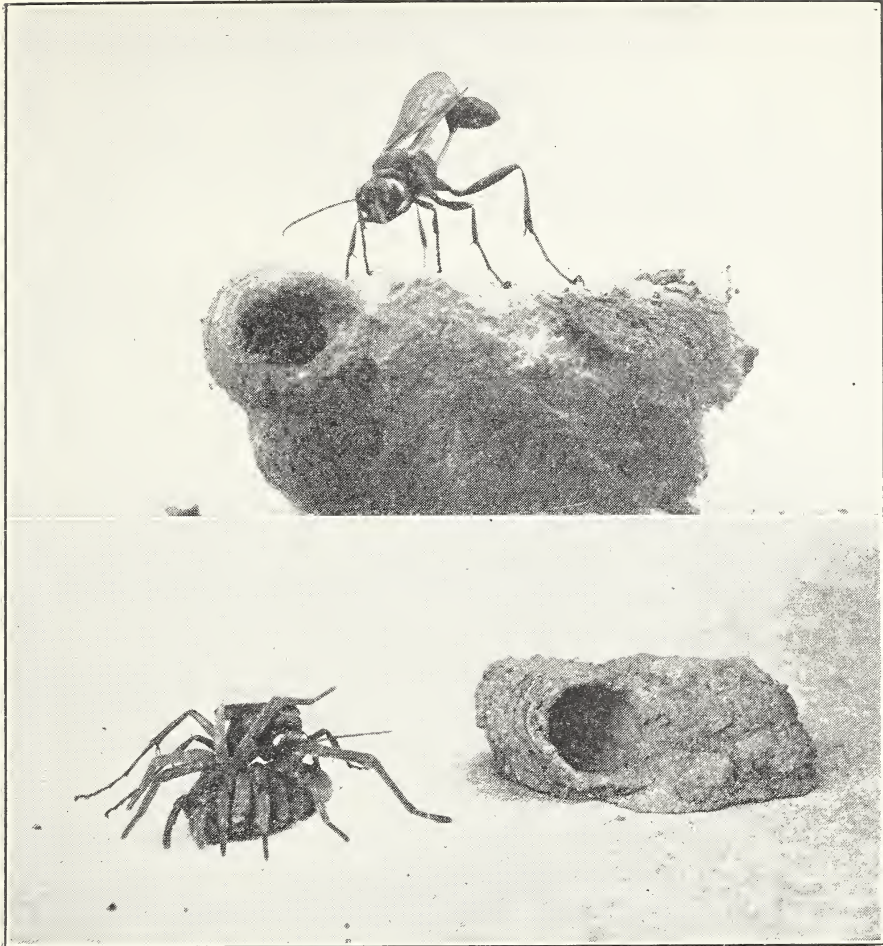
CHAPTER 3

WASPS THAT LIVE ALONE

Have you ever seen a mud dauber's nest?
Have you ever watched the potter wasp making
her little jug nest?
Have you ever seen a carpenter wasp or a digger
wasp at work?

In this chapter we are to learn some interesting things that other kinds of wasps do. These wasps like to live alone, so we call them solitary wasps. They all use mud in making their nests. For this reason, we call them mud wasps.

Among the mud, or solitary wasps, there are no queens, no workers, no colonies, no big nests. There are only male and female wasps. All of the females can lay eggs. The male, or father wasp, dies very soon after the mating flight. When a female is ready to start her nest, she makes a cell of mud and lays an egg in it. After the egg is laid she hunts among the plants near-by until she finds a caterpillar or



Photographs by Cornelia Clarke.

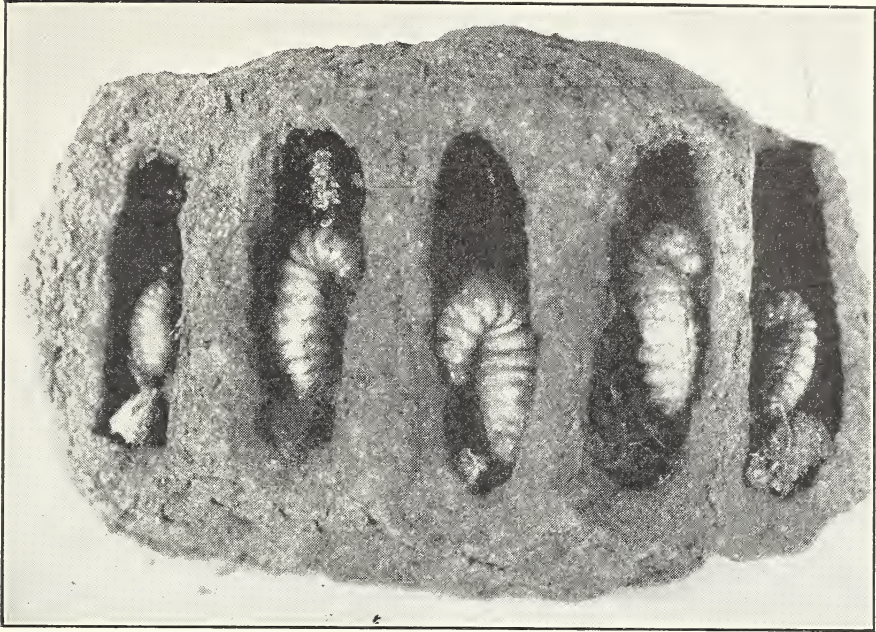
IN THE UPPER PICTURE THE MUD WASP IS SEEN GUARDING HER NEST. BELOW SHE IS DRAGGING A SPIDER TO BE PUT INTO THE NEST AS FOOD FOR A LARVA.

a spider. She stings this prey so that it will lie still, picks it up with her jaws and feet, and flies with it, or drags it, to her nest.

After putting the caterpillar or spider into her nest close to the egg, she closes the cell with

mud. In this way, she provides fresh meat for the larva that will hatch from the egg. The mother wasp then flies away, and never sees the egg again. After some days the egg hatches, and the larva finds the food its mother left for it. After living upon the spider for several days, it reaches its full size, and stops growing. It then changes to a pupa, and remains quiet for several days. After that it bites its way out of the cell as a full-grown wasp.

Some of the mud wasps make more than one cell at a place. The beautiful steel-blue insect that we call the mud dauber makes several rows of cells in its nest. In each cell she places a spider that has been stung and then seals it up. The young wasps must have meat. Mud dauber is not a good name for this wasp, though, because it is very clean and dainty. A better name for it is the mason wasp. Opposite is a picture of the mason wasp's nest. This nest is usually built in a barn or other building where it is protected from the weather. It is usually built on the side of one of the timbers or on the under side of the roof. It contains several rows of cells, built alongside of each other. In each row there may be five or six cells. In the early summer you may



Photographs by Cornelia Clarke.

THESE LARVAS ARE FEEDING ON CATERPILLARS OR SPIDERS THAT THEIR MOTHER HAS PUT IN THEIR CELLS.

see the female mason wasp stepping daintily around the edge of a little rain puddle, or along the bank of a stream where she gathers the mud to use in making her nest. By watching in what direction she flies, you can find out where she is building her nest. If you should happen to find her at work, you would hear the strange, buzzing sound she makes. Mud wasps do not sting as easily as paper wasps do, so we can watch them with less danger.



Photographs by L. W. Brownell and Cornelia Clarke.

THE JUG-SHAPED NESTS OF THE POTTER WASPS ARE FASTENED TO A TWIG. WHEN THE YOUNG WASP IS FULL-GROWN, IT BREAKS THROUGH THE MOUTH OF ITS JUG.

The most beautiful mud nest is the jug-shaped nest of the potter wasp. It is about the size of a marble. The base of the nest is attached to a twig with its short neck and mouth turned downward so that rain cannot get in. The egg is laid and the food stored before the jug is finished. The hole is left lightly covered, for the escape of the young wasp. The potter wasp is only about half an inch long, but the lines of her smooth-walled nest are often as beautiful as those of a vase made by a human

potter. As this nest is exposed to the weather, the wasp makes it as strong as she can. She mixes the mud she uses with a fluid from her mouth and adds hair that gives this cement an added support.

Carpenter wasps cut holes in wood as round as a lead pencil and three or four inches deep. Beginning at the bottom, these tunnels are then divided off into cells by mud partitions. In each cell, as it is made, food is stored, and an egg is laid. Then the cell is closed with mud.

Digger wasps make tunnels in the earth. One kind of these wasps digs a hole an inch deep. She lays her eggs in it, and places with them a caterpillar or two, then caps it over with earth. This covering is done so carefully that it is impossible to tell where the nest is. Another kind of digger wasp, after closing the nest with earth, picks up a little pebble and taps the earth with it so as to make this filling as smooth and firm as the solid earth around it.

Our largest wasp is known as the killer wasp. It is longer and heavier than any other wasp. It digs a tunnel several inches long underground, lays its eggs in this, and stores its nest



Photograph by L. W. Brownell.

A KILLER WASP DRAGS A BIG CICADA TO ITS HOLE IN THE EARTH.

with cicadas or harvest flies for its larvas to eat.

Wasps are hard workers. A digger wasp will often move earth weighing a thousand times her weight. This is as much work as a man would do if he should dig and carry away fifteen large truckloads of earth. Some wasps have been seen working all through the night. One was seen working for forty-two hours without stopping.

SOME THINGS TO THINK ABOUT

Read each of the following sentences carefully. Some of the statements are true and some are not true. On a page in your notebook put the numbers one to ten in a column. Write *True* after each true sentence number and *False* after each false one.

1. The mud dauber is a dirty and clumsy wasp.
2. Mud-wasp larvas eat dead spiders.
3. The nest of a mason wasp may contain thirty-six cells.
4. The carpenter wasp makes her home in the ground.
5. The most beautiful mud nest is that of the potter wasp.
6. The killer wasp is smaller than any other wasp.
7. Some wasps work all night.
8. Mud wasps do not live in colonies.
9. All female mud wasps lay eggs.
10. The carpenter wasp eats caterpillars.

SOME THINGS TO DO

Look for solitary wasps at work.

Try to see them making nests.

Try to see them capture and carry their prey.

Collect nests of wasps after the insects have left them.

CHAPTER 4

SEPTEMBER WILD FLOWERS

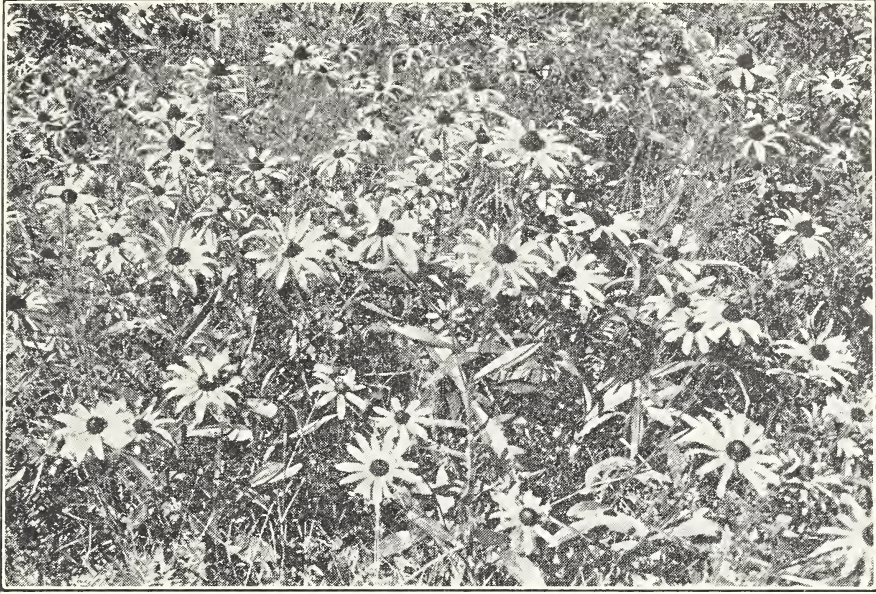
Where have you seen the Black-Eyed Susan?
Where would you look for Bouncing Bet?
Have you ever seen the spearmint?

You have already read about many wild plants that blossom in the spring and others whose flowers bloom in late summer and autumn. If you go for a walk through the fields on a bright fall day, you will see many plants with beautiful colored flowers and others with their ripened seeds.

THE BLACK-EYED SUSAN

We like the Black-Eyed Susan because it has beautiful flowers. The flowers look like yellow daisies with black eyes or centers. The eyes are not really black, but are purplish brown in color.

Black-Eyed Susans often grow in the farmer's fields. Although he likes to see the beauti-



Photograph from J. Horace McFarland Co.

THE FLOWERS LOOK LIKE YELLOW DAISIES WITH BLACK EYES.

ful flowers, he does not want the plant to grow in fields where he is raising crops. When he finds this plant among his crops, he calls it a weed. Can you tell why?

Do you think that you could tell this plant without the flowers? Perhaps you will know it by the leaves. The next time you see a Black-Eyed Susan, look at the leaves as well as the flowers.

The first home of this plant was on the western plains of the United States. For a long time it did not grow in the eastern part of our country, but finally the seeds were brought to

the eastern states in grass seed. When the farmer sowed the grass seed, he often sowed Black-Eyed Susan seeds, too. There is another way these seeds have been scattered. Sometimes farmers in other parts of the country bought hay from the western states. The plant with its seeds may have been in the hay. In this way the seeds may have been so widely scattered.

THE BOUNCING BET

When the first people from Europe came to live here, they brought the Bouncing Bet with them. They planted it in their gardens. It grew so well that it soon began to grow along the roads and in the fields. Now it grows by the roads and railroads and in our pastures. It is one of our common wild flowers.

Perhaps you have often seen this plant with its pink or white cluster of flowers. It has a strange stem, part of which grows under the ground. Such stems are called underground stems. Instead of new plants always growing from seeds they sometimes grow from this underground stem. This will help you to know why there are often many Bouncing Bet plants living together.



Photograph from J. Horace McFarland Co.

THE BOUNCING BET HAS PINK OR WHITE CLUSTERS OF FLOWERS.

In pioneer days the juice of Bouncing Bet was sometimes used for soap. When the stem and leaves were crushed in water, they made the water soapy, and fine clothes could be washed in this water. For this reason the plant was called soapwort.

Could you tell this plant without the flower? If you will look carefully at the stem with its leaves, you may be able to tell it before the blossoms have opened. The Bouncing Bet is often called a weed, too.

THE MINTS

The mint plants were used long ago and also have many uses to-day. They are often used in the kitchen in preparing our food. Perhaps you have eaten mint jelly at some time. Sometimes bits of the leaves are put in salads and other foods.

There are many kinds of mints, but we shall study just one or two of them. You may have some of them growing in your garden. Many people plant mints in their gardens so the leaves will be handy when they are cooking.

Peppermint is a plant that blooms from June to September. It grows anywhere but



Courtesy of the Wild Flower Preservation Society.

THE PEPPERMINT PLANT HAS CLUSTERS OF SMALL FLOWERS
AND A SQUARE STEM.

likes soil that has plenty of water. Often people think of it as a weed, but in some states farmers raise this plant on their farms as a regular crop. More than one thousand acres

are used to raise peppermint in our country. Most of the peppermint fields are in New York, Indiana, and Michigan.

From the peppermint plant an oil is taken. This oil is used for medicine and to flavor candy. Have you ever eaten peppermint candy? Perhaps you have eaten after-dinner mints.

The flowers of the peppermint are very small. They are purple or whitish. The peppermint has a strange stem. It is not round like most stems, but it has four corners. The square stem will help you to tell it from other plants. You can also tell it by the odor of peppermint. If you have tasted the leaves at some time, you know they have a burning taste.

Spearmint is the mint used most often in the kitchen. It is used in sauce and with iced tea. You probably have tasted spearmint gum. Spearmint is very much like peppermint.

Like the Bouncing Bet, it can be grown from seeds or from its underground stem. A small piece of underground stem will soon produce a large number of mint plants. Many people grow spearmint in corners of their gardens, where it is handy for use in the kitchen.

In the summer, look for the flowers you have studied in this lesson.

SOME THINGS TO THINK ABOUT

On one side of the page you will find questions and on the other side you will find the answers.

Write the number for each question on a piece of paper and opposite each number write the correct answer.

- | | |
|--|-------------------------------------|
| 1. How did the seeds of Black-Eyed Susan come to us? | 1. It grows where it is not wanted. |
| 2. Why is Black-Eyed Susan called a weed? | 2. For the oil. |
| 3. Why was Bouncing Bet sometimes used for soap? | 3. To flavor jelly. |
| 4. Why are some mints grown in fields? | 4. In the grass seed. |
| 5. When does the peppermint have flowers? | 5. The juice makes water soapy. |
| 6. How are mints used in the kitchen? | 6. June to September. |

SOME THINGS TO DO

Make a trip to the fields to see the Black-Eyed Susan, Bouncing Bet, and the spearmint.

Draw pictures of the leaves of each of these plants.

Put part of a Black-Eyed Susan plant with a flower between two blotters and let it dry. Then mount or paste it on a sheet of paper. Write the name *Black-Eyed Susan* on the paper so you will not forget it.

You may do the same with the peppermint and Bouncing Bet.

Labels may be cut into narrow strips and used to fasten flowers and leaves to the paper.

CHAPTER 5

TURTLES

How many kinds of turtles have you seen?

Have you ever found turtles in the fields and streams?

Have you ever seen a snapping turtle?

There are about fifty kinds of turtles living in the United States. Some of these turtles live on land, but many of them live in the water or in wet places. The box turtle is one kind that lives on land. You may have read about this strange animal and how he closes up his shell when he is frightened. The painted terrapin and the snapping turtle are two common water turtles.

You will find the painted terrapin living in the ponds and rivers of eastern North America. On a bright sunny day you may see one sunning itself on a log or rock near the water. When an enemy comes near, the terrapin slides down into the water and swims away to a place of safety.



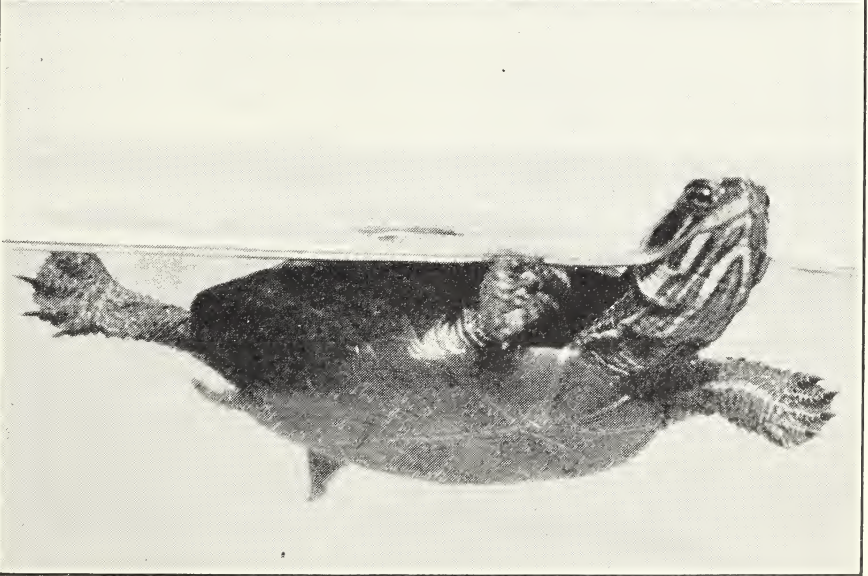
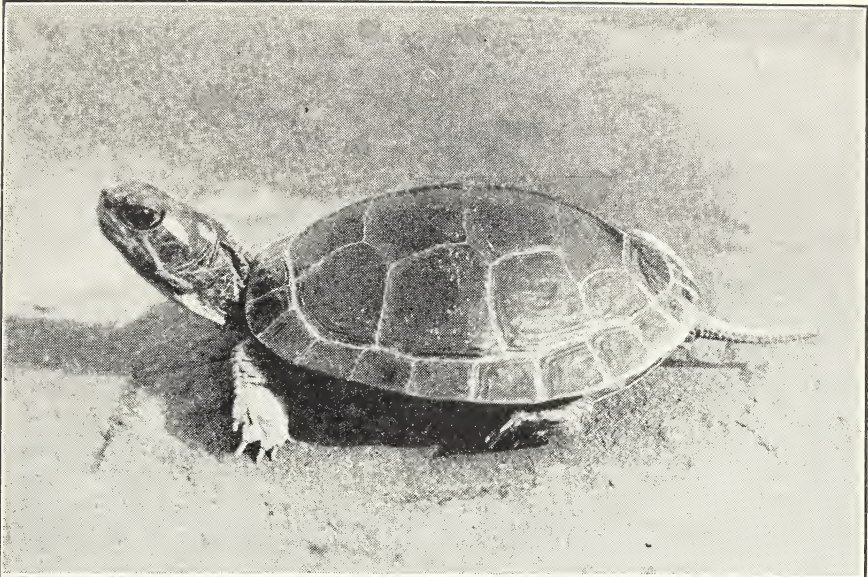
Courtesy of the American Museum of Natural History.

TURTLES LIKE TO SUN THEMSELVES ON LOGS IN THE WATER.

Like most other turtles, it has a hard shell which often grows to six or eight inches in length. What is the purpose of this hard shell?

If you frighten it you soon find out. Head, legs, and tail disappear within, and the turtle is safe from many enemies.

On the back of the terrapin you will find patches of greenish black with a border of yellow. Around the edge of the shell is a row



Photographs by L. W. Brownell.

THE PAINTED TERRAPIN MAKES A GOOD PET FOR THE AQUARIUM.

of red spots. These odd marks and colors will help you tell this kind of turtle when you see it.

The painted terrapin makes a good pet for the aquarium. There should be a rock or pile of sand in the aquarium so that the turtle can climb out of the water. It may be fed raw chopped liver, beef, or fish. Do not try to keep two painted terrapins in the same aquarium because they eat each other's legs and tails.

Boys in the country usually know the snapping turtle. If you hold a stick near its mouth, you will soon see why it is called a snapping turtle. This turtle does not make a good pet, and you should not try to play with it. With its sharp strong beak, it can give a dangerous wound.

Turtles make their homes at the bottom of muddy streams and ponds. They also like grassy places and in the summer, sometimes, are found far from the water. The turtle is clumsy on land, but it can travel fast in the water. Its flat webbed feet make natural paddles for pushing itself along when it swims.

The shell of the snapping turtle does not cover its whole body. It must have other ways of protecting itself. Can you think of any way?

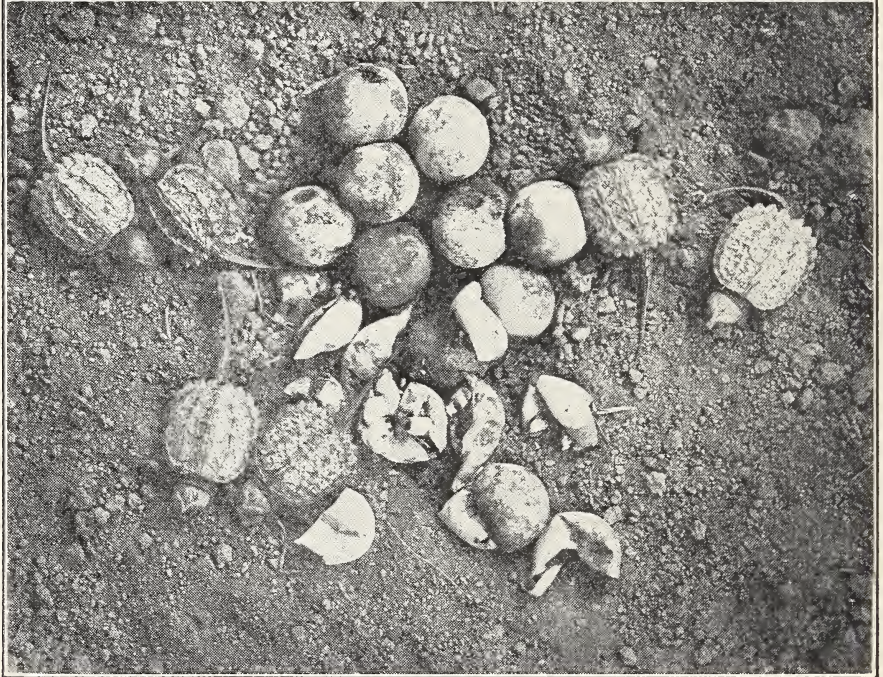
When it lies quietly on the ground, the turtle looks almost like the ground and rocks. Your eyes need to be very sharp to find it when it is not moving. As you have already learned, this turtle can bite its enemy as well as hide from him. The turtle does not have teeth, but it can bite so hard with its jaws that it can take off a man's finger. The jaws are so powerful that it can hold fast to a stick even when the stick is lifted in the air.

The turtle has a head that looks much like the head of a snake. Snakes and turtles belong to a large group of animals called reptiles.

Do you know where turtles live during the winter?

As soon as the weather is cold, the turtle seeks a winter home. It sometimes goes under a log near the stream where it lived during the summer; or the winter home may be away down deep in the mud by the stream. Many turtles find muskrat holes and live in them during the cold months. The turtle does not eat during his long rest and sleep. When animals sleep all through the winter, they are said to hibernate (hī-bēr-nāt).

Where do you suppose water turtles lay their eggs? In the water, you would naturally



Photographs from N. Y. Botanical Garden and Verne Morton.

ABOVE: THE SNAPPING TURTLE BURIES ITS EGGS. BELOW: THE EGGS HATCH AND THE YOUNG TURTLES COME OUT.

say. But on the contrary, they seek a dry place on land. Usually they find soft ground or sand near the water. They do not make a nest, but in the early summer they bury the white, leathery eggs in the ground. Here they leave them to be hatched in the warm sunshine. The snapping turtle lays about twenty-four eggs, each about the size of a walnut. Most turtles do not lay so many eggs as this.

The eggs and young turtles are in great danger of being destroyed. A skunk may find the eggs before they are hatched and eat them. A farmer may plow through the eggs and destroy them. When the young turtles hatch from the eggs, fish and other animals like to eat them. If a turtle escapes its enemies when young, it may live to be thirty or forty years old.

Have you ever eaten turtle soup? Many people like it very much. Some people like fried turtle, too. For this reason fishermen and trappers catch thousands of snapping turtles and send them to the large cities each year.

Unlike the snapping turtle, the shell of the soft-shelled turtle is soft like leather. Soft-shelled turtles live in streams and lakes and

have strong webbed feet for swimming. The neck is long and can be easily moved. There are several kinds of soft-shelled turtles in North America. They make better soup than the other turtles. Have you ever heard of eating turtle shell? When cooked, it is tender and very much liked by some people.

SOME THINGS TO THINK ABOUT

Can you fill in the right words to complete the sentences?

1. The painted terrapin has a row of..... spots around the shell.
2. The painted terrapin makes a.....pet.
3. The snapping turtle does not make a good
4. The snapping turtle likes streams with abottom.
5. Turtles belong to a group of animals called
6. There are about.....kinds of turtles in the United States.
7. The turtle's shell helps.....it.

SOME THINGS TO DO

Young water turtles make good pets. Put one in an aquarium by itself. Put a stone in the aquarium so that part of it is above the water. Then the

turtle may come out of the water to rest on this stone.

Feed the turtle. You may have to try a number of things until you find what it likes.

If you do not have an aquarium, you may use a large pan. Put sand or stones in one end. Then fill the pan with water. Of course, the turtle will not stay in such a pan. You must cover it with screen wire. You can buy this at a hardware store. Make a fence around the pan with the screen wire. Then put wire over the pan on top of the fence.

If you cannot find little turtles in the ponds near your school, you can buy them in the stores. Most stores where pets are sold keep them.

Can turtles hear? You can answer this question if you watch the turtle. What does it do if you make a noise?

Can the turtle see you? How can you find the answer to this question?

Write the names of three kinds of turtles that you know.



Photograph by Ewing Galloway.

THE CRAYFISH LIVES INLAND IN STREAMS, PONDS, AND LAKES.

CHAPTER 6

THE CRAYFISH

Where would you go to find crayfish?
How does a crayfish swim?
How do they use their big claws?

Lobsters live near the seashore; crabs live both on the seashore and inland, but the crayfish, which is their near relative, lives only inland in streams, ponds, and lakes. The crayfish is sometimes called the cousin of the lob-

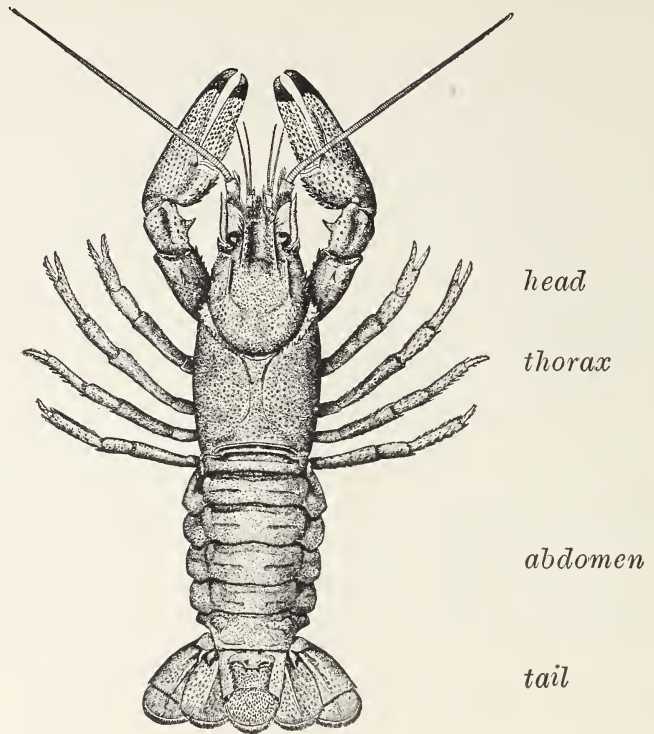
ster. The crayfish and the lobster have shells covering their heads and the greater part of their bodies. They both have large nippers or claws with which to seize food and to protect themselves from their enemies.

The crayfish makes a very entertaining pet in an aquarium. If it is given enough sand or gravel, it will dig a shelter. Watch it carry pebbles and stones in the two small nippers at the end of its second and third pair of legs. Try to catch some crayfish; you will have a very good time with them.

There are two main parts to the body of the crayfish. The first part consists of the head joined closely to the thorax (thō'rāks). The second part consists of the abdomen (ăb-dō'měn) and tail. (See the picture.)

The crayfish, unlike an insect, cannot move its head without also moving its body. The head and thorax are covered with a strong shell. Can you tell why it is unable to move its head?

The abdomen is jointed so that it can be curled up under the body. The tail is like a fan. It can be closed or spread out. It can be lifted up or curled underneath. In times of danger how do you suppose the crayfish protects its abdomen and tail?



THE CRAYFISH

On the under side of the abdomen are small organs called swimmerets. These help the crayfish to swim.

When the crayfish lays eggs, they stick to the swimmerets, and the young crayfish stick also until they can swim by themselves. It is fun to watch a mother crayfish swim with the small crayfish hanging to her.

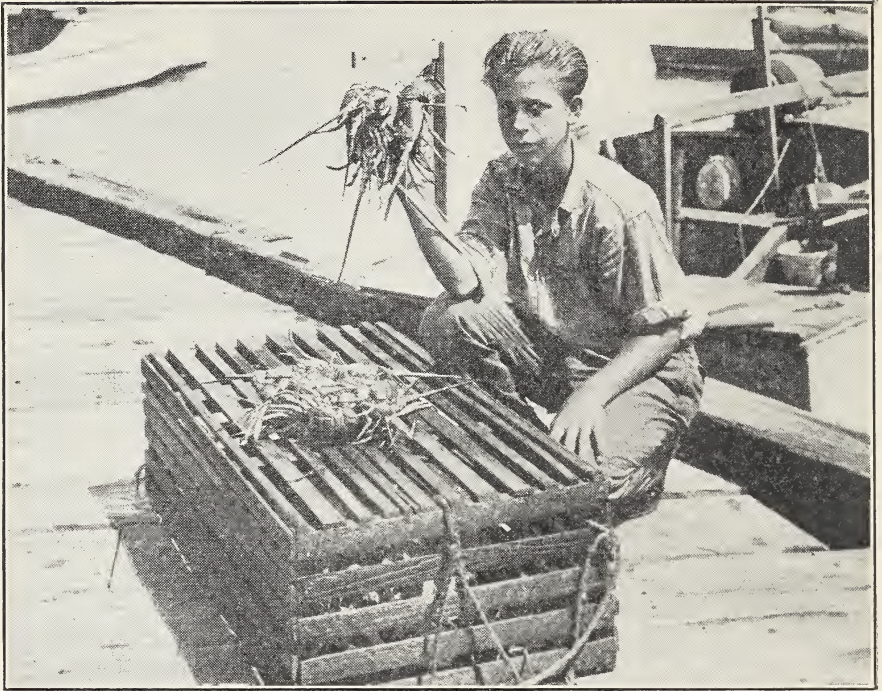
The crayfish has very interesting eyes and legs. The eyes are placed at the end of long stalks. They can move in almost every direc-

tion. Each eye is made up of hundreds of small eyes. Each small eye can see only in one direction. The world must look very strange seen through the eyes of a crayfish.

Of the crayfish's ten legs, the first pair are used as arms. They are large with huge jaw-like claws. The crayfish fights his enemies and grabs his food with these first legs. He also uses them to crush his food before he eats it. The next two pairs of legs are alike. They are slender and more delicate and are used for walking as well as for digging and carrying. These legs have small nippers at the end. When the crayfish eats, his second and third legs take the crushed food from his first legs to his mouth. The last legs are without nippers. These are the legs the crayfish depends upon for walking.

We think of the crayfish as an animal well fitted to get along in the world. It has ten legs for walking, fighting, eating, and digging, many eyes for seeing, a tail for swimming, a shell for clothing or armor, and little swimmerets for swimming and carrying its young.

The young crayfish soon outgrow their shells. When this happens, the old shell opens on the back, and the young creature pulls



Photograph by Ewing Galloway.

BOYS LIKE TO CATCH CRAYFISH.

itself out. When the crayfish does this, it is said to molt. The crayfish has to be very careful while this new shell is soft and tender. Young crayfish molt about seven times during the first year, but older ones shed their old coats only once a year. The reason the young crayfish molts so often is that it is growing rapidly, and it becomes too large for its old shell. It has to get rid of the old coat and grow a new and larger one.

Crayfish look for food at night. They eat

young insects, little fish, and other small animals. Sometimes they eat young, juicy plants.

Some crayfish live on land. They dig holes deep enough to give them water and to keep them wet. A farmer does not like to have too many crayfish in his fields. They cut the corn and cotton plants, which they use for food.

We have saved the most interesting thing about crayfish for you to learn for yourself. How does it swim? Why does it swim as it does, and what is the advantage of swimming so? Can you tell from watching it?

SOME THINGS TO THINK ABOUT

Some of these sentences are true. Some are not true. On a piece of paper write the number of each sentence. If it is true, write "Yes" beside the number; if it is false, write "No."

1. The crayfish is a good aquarium pet.
2. The crayfish is not well equipped to take care of itself.
3. The nippers are used for walking.
4. The eyes cannot be moved.
5. The eyes are on the end of stalks.
6. The crayfish cannot protect its tail and abdomen.
7. The female crayfish carries her eggs on the top of her body.

8. The young crayfish does not molt.
9. Crayfish live in ponds and streams.
10. Crayfish do not live in fields.

SOME THINGS TO DO

Make a trip to some stream to catch crayfish for your aquarium.

You may take a little net to catch the crayfish.

Put water and little stones in your aquarium before you put the crayfish in it.

Feed the crayfish little bits of beef or fish. Take out the bits which the crayfish does not eat. This will help keep the water clean.

You will have a good time watching the crayfish. You can see all the parts of its body about which you have read.



Courtesy of the U. S. Forest Service.

THE BEECH TREE HAS SMOOTH, LIGHT GRAY BARK.

CHAPTER 7

OUR FOREST TREES

How can you tell the beech tree from other trees?
What kills the chestnut trees?
Do any forest trees bear fruit? Tell about them.

THE BEECH TREE

Do you know the beech tree when you see it?
You can easily tell it by the smooth light gray
bark. Some people like to cut their names

in the bark of this tree. Perhaps you have seen letters or figures cut on one of these trees. Can you think of a good reason why it should not be done?

The very young twigs are pale green but turn light gray as they grow older. If you will look at the beech tree in winter you can see its slender twigs. It is a beautiful tree even without its leaves. Another way to tell this tree is by the shape of the leaves. They are dark green on top and light green underneath. They have small whitish veins running straight from the center rib to the small sharp teeth at the edge. In the fall the leaves turn to a pale golden yellow.

Have you ever seen flowers on the beech tree? You can find them if you watch a twig in April. The blossoms come after the leaves have started to grow. Most boys and girls know the beechnut, the fruit of the beech tree. Beechnuts grow in tiny burrs. They are a favorite food of squirrels and are often eaten by birds.

Do you know where the beech tree grows best? It grows well in the good ground of valleys, or even on higher land, if the soil is rich and deep. You probably have seen the wood of this tree but did not know it. Some-



Photographs by L. W. Brownell.

THE FLOWERS OF THE BEECH.

THE BURRS OF THE BEECH.

times it is used for school desks, for boxes, and for barrels. The handle of your chisel may be made of beech wood.

THE CHESTNUT TREE

Have you ever gone on a nutting party? In autumn, it is great fun to hunt for the brown chestnuts among the leaves under the trees. The chestnuts grow in burrs on the branches, and most people usually are so busy picking and eating them that they do not notice the beautiful tree.



Photograph by L. W. Brownell.

THE CHESTNUT GROWS IN THE PRICKLY BURRS.

The bark is dark gray in color with long flat ridges. The main trunk of the older tree is usually so large that you could not reach around it. Often there are no branches for ten or fifteen feet above the ground. When the branches of this tree do not bear burrs or blossoms, you can tell it by the leaves. The tip of the chestnut leaf is pointed, and when the sides curl up, the leaf looks like a tiny canoe. Around the edges are sharp teeth that look like those of a saw. How is the chestnut leaf different from that of the beech?

If you should go to the chestnut tree the last week in June or the first week in July, you would see long tassels hanging from the twigs. These are the blossoms from which the fruit or burrs grow. The nuts are brought into our cities in the fall of the year by thousands of bushels and sold in the stores and on the corners of the busy streets. You have perhaps bought chestnuts from a man roasting them in a small pan on the street.

Chestnut wood is light and soft. It is used for telegraph poles and fence posts. Often boards are sawed from the chestnut logs and used about the farm. In several states these trees are nearly all dead. They have been killed

by a plant disease that is called the chestnut blight.

THE HEMLOCK TREE

Have you ever had a hemlock for a Christmas tree? Several years ago some people used it for this purpose, but lately it is not used so much as some other trees. The shape and the dark green needles help to make it a beautiful tree.

Some of the leaves stay on the hemlock tree all the year. Trees that stay green through the winter are called evergreens. You remember the chestnut loses its leaves in the fall and lives through the winter with bare twigs. The beech, too, sheds its leaves during the winter. Most trees do not have leaves in winter, but a few like the hemlock keep some of their leaves all the year.

Do you know how to tell the hemlock from other evergreen trees? The leaves grow along two sides of the twig. They are sometimes called needles because of their shape. Do you think they look like the needles of the pines you have read about?

When the cones of the hemlock are first formed, they do the work of a flower although



Photograph by L. W. Brownell.

A HEMLOCK TREE IS BEAUTIFUL WITH ITS GREEN LEAVES AND BROWN CONES.

they do not look like other blossoms you know. Later they become the fruit and contain the seeds. From these seeds, new hemlock trees will grow. The small brown cones not one inch long will help you to know this tree when you see it.

Each year thousands of truckloads of hemlock bark are gathered. The bark contains a substance that is used to tan leather. The wood is soft, not very strong, and will not last a long time. Some of it is used to make paper, boxes, and crates.

SOME THINGS TO THINK ABOUT

1. This chapter tells about three forest trees. Name them.
2. This chapter describes two nut trees. Name them.
3. It tells about one evergreen tree. What is it?
4. It tells the uses of the beech wood. What are they?
5. It tells the uses of hemlock wood. What are they?

SOME THINGS TO DO

Go on a trip to see the beech, chestnut, and hemlock trees.

Gather leaves of the beech and chestnut trees. You need not pull them from the trees. In the fall you can pick them from the ground after they drop.

Gather nuts of these trees, too.

Put the leaves and the nuts of each tree on a piece of cardboard about as large as this page. They can be held in place with threads sewed through the cardboard.

Show your specimens to other pupils. Invite pupils in other rooms to see the collection you and your classmates have made.

Draw a picture to show the shape of the hemlock tree.

Try to find cones of the hemlock, then look carefully for the seeds that are hidden in it.

Try to find pieces of wood from each of these trees. Men building houses may help you.

CHAPTER 8

NEIGHBORHOOD TREES

Have you ever tasted the sap of a maple tree?
Do you know where there is an ash, a sugar maple,
or a linden tree?
How many trees do you know by name and sight?

You probably have noticed beautiful trees and how much they add to the beauty of a yard or street. In the fall of the year have you ever gathered the fallen leaves of trees in great piles and played in them?

THE ASH

In this chapter you will learn more about trees. The ash tree gives us the ash wood from which we make our baseball bats. Its wood is also used to make the handles of rakes and forks and shovels. Skis, long runners that boys and girls fasten to their feet for travel over the snow, are made of ash wood. It is used for these purposes because the little fibers



THE BLOSSOMS, LEAVES, AND FRUIT OF THE ASH.

of the wood lie straight. This makes the wood strong and hard to break.

Ash wood is very light in color, and is often used to make the tops of work tables, for it does not splinter easily.

There are several kinds of ash trees, but the white ash is the most common. It grows to a height of more than a hundred feet. Its bark is covered by low ridges that join other ridges every few inches.

The twigs of the ash, as you see in the picture, are always in pairs and opposite each

other. So are the leaves. The leaves are compound, that is, each leaf is divided into several parts, called leaflets. When the ash leaf falls from the twig, it leaves a three-cornered scar as large as your thumb nail. A maple leaf scar is not half that large. Can you see a reason why?

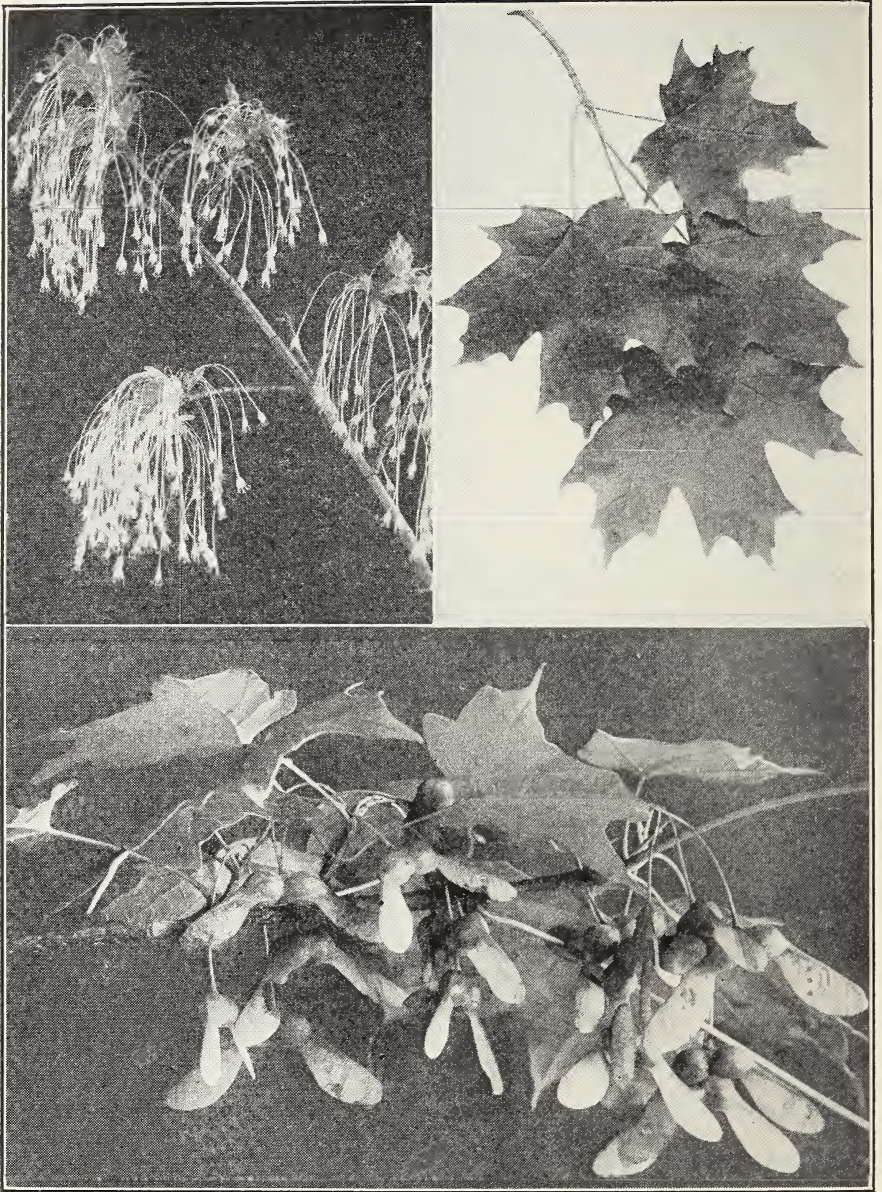
Clusters of greenish-white flowers appear on the ash in May, and in June the winged seeds are hanging, ready to be blown away by the wind.

You see the seed is placed at the bottom of the long, narrow wing, and at the lower end of the seed as it falls is a sharp point. When the seed hits the ground, this point helps to plant it.

THE SUGAR MAPLE

Perhaps you know the beautiful sugar maples in their red and gold fall colors, but can you tell them just as surely in their green summer dresses, or in winter after all their leaves are gone?

First, you must learn how all of the maple family differ from the oak family and from the other trees in the woods and parks. Their branches, twigs, and leaves always grow in



Photographs by L. W. Brownell. Courtesy of "Nature Magazine."

YOU CAN TELL THE MAPLE BY ITS FLOWERS, ITS LEAVES, AND
ITS SEEDS.

pairs and opposite each other. In this they are like the ash, but the twigs of the ash are larger than those of the maple. You should not mistake a maple for an oak or a beech or even an ash, either in summer or winter. But how can we tell the sugar maple from other maples? By the leaves in summer, and by the bark and branching habit in winter. The sugar-maple leaf has five main points, while the red has three, and the Norway seven. Besides, the Norway-maple leaf shows white sap when you pull it off the twig, but the sugar-maple leaf does not. Its sap is as clear as water. The white-maple leaf has little teeth all along its edge. The edge of the sugar-maple leaf is smooth.

In winter, a sugar-maple tree at a distance looks somewhat like a very thin whisk broom. The branches spread in a way quite different from those of other trees, as you see in the picture. The bark is made of close-fitting, strap-like plates on the surface, not shaggy and loose-fitting like that of the white maple, or with flaky ridges like that of the red maple.

You can tell the sugar maple in summer and in winter. Its flowers come in fringe-like clusters at the tips of the higher branches. They are greenish-yellow in color, and only sharp

eyes will notice them; sharp eyes that are looking early in the spring for tree flowers as well as for those blooming nearer the ground.

In a month, the seeds are fully grown, and each has a broad, green wing, on which it will soon sail away on the wind. This seed is the first of all the maple seeds to ripen. It does not sleep over winter and sprout the next spring, as the others do, but sprouts, if at all, within three weeks after it has been blown from the tree.

Boys and girls who live in the northern states and Canada could tell us interesting things about "sap-making" time, for there the sugar-maple tree is a common forest tree. Their fathers and older brothers go out in the woods very early in the spring, while the snow is still on the ground, and tap the trees by boring small holes into them. Each hole is about as large as your thumb, and about as long. A little metal tube is driven into the hole, and a bucket or pail is hung on this tube.

The sap of the sugar-maple tree has a little sugar in it, and a great deal of water. Drip, drip, drip, comes the sap into the pail. Next day the men and boys drive through the woods

with a barrel on a sled. They pour the sap from the full pails into the barrel and hang up the pails again. When they have the barrel full, they drive back to the "sugar camp," where big kettles are ready to boil the sap for hours. This long boiling takes most of the water out of the sap, and leaves a delicious, sweet syrup, which we call maple syrup. If this syrup is boiled a while longer, all of the water goes off as steam, and we have maple sugar left. Surely you know how good *that* is.

The wood of the sugar maple is very useful. It is used to make furniture and floors, and many other things. Thousands of sugar, or hard, maple trees are cut down every year, and this means fewer "sugar camps."

THE LINDEN

Butter ladles, wooden spoons, wooden toys, and many other small things are made from parts of the linden, or basswood tree. This wood is soft and easily cut.

The linden is one of our native forest trees. The European linden is planted as a shade tree in parks and lawns. How can we know a linden when we see it?



Photographs by L. W. Brownell. Courtesy of "Nature Magazine."

IT IS EASY TO KNOW THE LINDEN BY ITS LEAVES, FLOWERS,
AND FRUIT.

In summer we can tell it by its leaf, flower, and fruit. The leaf is nearly as broad as it is long, and has a short tip. There are little teeth all along its edge. The strangest thing about it is that one-half of the leaf is always larger than the other, a little broader, and comes down a little farther on the stem.

The flower, too, is interesting. A cluster of three or four little greenish-yellow starlike flowers grows on a slender stem out of the middle of a flat, leaflike wing. This wing is much lighter in color than the leaves. It forms a fine parachute for the little ball-shaped fruits when they are ripe. They use this parachute when they are blown from the tree. Only the linden has a fruit wing like this.

Honey bees like the nectar of the linden flowers. They come out after the leaves are half grown and have lots of nectar. The flowers of the ash and sugar maple bloom before their leaves appear. They do not produce nectar, so the bees do not visit them.

SOME THINGS TO THINK ABOUT

Can you answer the following questions?

1. What are some of the things made of the wood of the ash tree?
2. Why is it used for these purposes?
3. How can you tell the ash tree?
4. How are the twigs of the ash tree and the maple tree alike? How are they different?
5. How are the seeds of the ash, maple, and linden trees scattered?
6. How would you know the leaf of the Norway maple tree?
7. Why is the sugar maple called by that name?
8. What are some of the things that are made from the linden or bass wood?

SOME THINGS TO DO

Explore your school yard. See if you can find an ash tree, a sugar-maple tree, or a linden tree there.

Perhaps you pass one or more of these trees on your way to school. When you have found one, watch it week by week, in the spring, and put down the date on which you first see the flowers or leaves appear.

When the leaves of these trees are fully grown, get a perfect one of each kind and ask your teacher to show you how to make a blue print of it. That is a very good way to keep a record of the kinds of trees that you learn to know.

Then, in the fall, watch these same trees again to see color changes in the leaves, and also to see which begins to lose its leaves first.

When Arbor Day comes, your class will want to plant a tree. Which of these would you like to plant? Why?

If you gather the seeds when they are ripe, you could start your own little trees. You will enjoy taking care of the young trees. Then on some Arbor Day in the future, you can plant your largest tree out in the yard.

Visit a saw mill, a planing mill, and a furniture factory, if you can, and report to your classmates the interesting things you see there.

CHAPTER 9

MUSHROOMS

Where would you find mushrooms growing?
Where do people get mushrooms for the market?
Where have you found puffballs?

Have you ever heard of a plant without roots, without a stem, without leaves, without flowers, without fruit, and without seeds like most plants have? There is such a plant called the mushroom. Perhaps you have never thought of the mushroom as a plant. The way mushrooms live and grow is an interesting story.

You probably have seen gray, white, brown, or red mushrooms in the woods. No matter how long you look, you will never find one that is green like the leaves of other plants. They do not have the green material that gives other plants their beautiful color. If plants lack this green material they cannot make their own food. For this reason mushrooms live in strange places. They like to grow

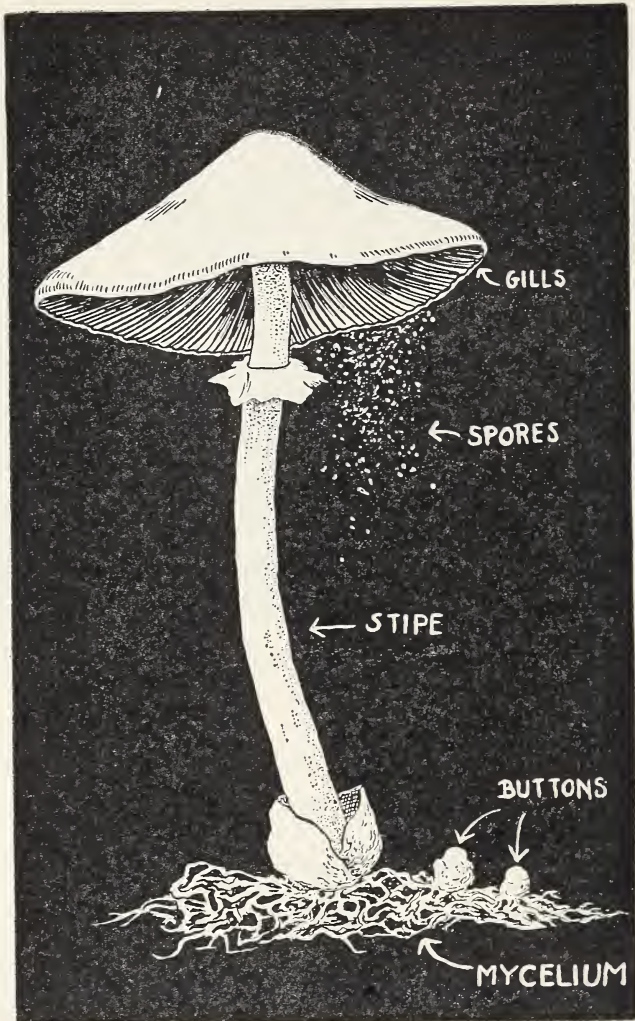


Photograph from J. Horace McFarland Co.

MUSHROOMS ARE FUNGUS PLANTS.

in rich earth and near old logs or stumps or trees where there are decaying plants for food. Mushrooms and puffballs are called fungus plants because they are not green and can not make their own food. There are hundreds of other fungi that often are found growing on living trees or other plants. Then they act like robbers because they take food that the plant has made for itself.

Instead of roots mushrooms have fine white threads that can draw out of the ground the rich food they need for life. These threads are called mycelium (mī-sē' li-ŭm). They act some-



YOU CAN LEARN THE PARTS OF THE MUSHROOM FROM THIS PICTURE.

what like roots but are not nearly so strong. Since these plants can grow in the shade they do not need stems to lift their tops to the light. Instead they have parts that grow several inches high, and are called stipes (stīps).

Some mushrooms make delicious food. Others are poisonous. It is hard to tell which ones are dangerous, and children should never eat the mushrooms they pick. Many people die each year from eating poisonous mushrooms that have been gathered by mistake.

A mushroom starts from a tiny spore. This spore sends out delicate white threads or mycelium. From these the mushrooms shoot up. When they first appear above the ground, these little shoots look like small white buttons. The buttons grow larger and larger, and the stipes grow taller until the plants become the mushrooms we know. When they grow large enough, spores are formed underneath the umbrella-shaped caps. When the caps are shaken, the spores fly out like dust. If they land on rich damp ground, new mushroom plants will grow from them the next year.

The puffball is another plant that grows like the mushroom. It does not need sunlight; it is never green, and it lives on the food green plants have made. In dead leaves and other parts of the plant is stored the food that makes the puffball grow.

The inside of a puffball, or the "meat," is the part that changes to threads and spores.



Photograph by L. W. Brownell.

PUFFBALLS LIVE ON THE FOOD GREEN PLANTS HAVE MADE.

When these are dried, they become the dust or smoke that comes out of the puffball when it is broken. Young puffballs are very good to eat.

Important things to remember about the mushroom and puffball are, first, that they are fungi; second, that the main part of each of these plants is the network of mycelium; and third, the part we eat produces the spores.

SOME THINGS TO THINK ABOUT

Pick out the correct ending for each sentence.

1. The mushroom is
 - a plant
 - a rock
 - an animal
2. Mushrooms grow
 - in the water
 - in rich earth
 - on rocks
3. Mushrooms get their food
 - from animals
 - by making it,
 - from dead green plants
4. Mushrooms have
 - a mycelium
 - leaves
 - stems
 - roots
5. New mushrooms grow
 - from seeds
 - from spores
 - from bulbs
6. Mushrooms need
 - sunlight in the fall
 - shade in the spring
 - dark places
7. Puffballs are
 - mushrooms
 - fungi
 - weeds

SOME THINGS TO DO

Find as many different kinds of mushrooms as you can.

Find as many fungi as you can.

Draw and paint pictures of the mushrooms you think the prettiest.

If you have a mushroom book in the library, try to name all of the mushrooms you have seen.

Shake some spores on a piece of paper and look at them through a microscope or reading glass.

Try to grow some mushrooms in your cellar. You can do this by shaking spores into a box of rich earth which you should keep cool and well watered.

Try to find out where mushrooms are raised for market.

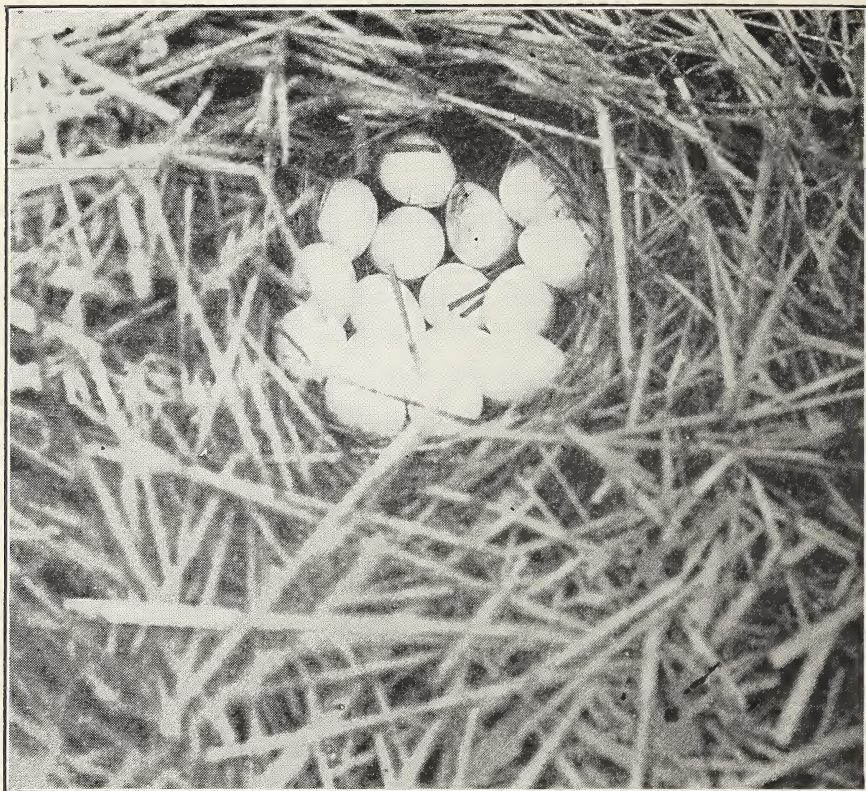
CHAPTER 10

THE BOBWHITE

“Bob White, Bob, Bob White.” Have you ever heard that call down in the meadow?
Where do bobwhites live?
What color is the bobwhite?

No bird really says “Bob White.” People have for a long time thought that the call of the quail sounded like someone saying, “Bob White, Bob White.” The call comes from the ground or a low bush or fence post, for the quail, which we often call the bobwhite, spends most of his time on the ground hunting for seeds and insects that make up his food.

In most sections of the country the bobwhite and his mate remain at home the year around. In May they build their nest of grass and leaves on the ground. Then the mother bobwhite lays ten or twelve white eggs in it. The mother and father birds sit on the eggs, taking turns, for two weeks. Then the little quail chicks break out of their shells.



Courtesy of "Nature Magazine."

IN THE NEST ON THE GROUND, THE MOTHER BOBWHITE LAYS
TEN OR TWELVE WHITE EGGS.

When the young robins break out of their egg shells, there isn't a feather on them, but the little bobwhites are all covered with brownish-gray feathers. Each one is ready to scurry under a brown leaf right away if their parents whisper that there is danger around.

Young robins do not even have their eyes open when first hatched and are so weak that they cannot hold up their heads. But young



Courtesy of U. S. Biological Survey.

THE MOTHER BOBWHITE IS SITTING ON ANOTHER NESTFUL OF EGGS.

quails are wide awake from the first. They are not only able to run, but also are able to get their own food the first day they are out of the shell.

By the first week of June, the female bobwhite is sitting on another nestful of eggs. The farmer watches for her as he drives the mower around the hayfield, for he does not want to hurt her. Everybody likes the bobwhite family. By the middle of July the last brood of the season is able to take care of itself. One



Photograph by L. W. Brownell.

BOBWHITES ARE HARD TO SEE BECAUSE THEIR COLORS ARE LIKE THE BROWN LEAVES AND TREES.

pair of bobwhites has brought thirty or forty little ones into the world, but all of them will not live to see the next year. Red squirrels, weasels, and other animals catch them in the night. Hawks catch them while they are feeding in the daytime. They have brown and gray colors and look much like the leaves and weeds among which they live. Their enemies must have very sharp eyes to see them.

Hunters like to shoot quail in the fall when they are nice and fat. But not all the hunters

can shoot well enough to hit them, for quail can fly very fast.

Farmers are very glad to have the quail family in the fields. They are almost always eating insects and weed seeds. They destroy thousands of potato beetles and other pests that would eat the farmers' crops. For this reason laws have been made to keep people from killing quail during most of the year, but foxes, hawks, red squirrels, and weasels do not know the laws of men.

SOME THINGS TO THINK ABOUT

Can you fill in the right words that will complete these sentences?

1. Bobwhites or quails eat.....and.....
2. They do not fly.....when winter comes.
3. They live in our.....
4. Farmers like to have quails on the farm because they.....
5. Many young quails are killed by....and....
6. Quails build their nests of.....and.....

SOME THINGS TO DO

Boys and girls who live in the city should go to the museums and see bobwhites mounted in the cases. You can tell the male by his white collar.

The female is brown all over. Perhaps you can see them alive in a large bird cage at the zoo.

Boys and girls who live in the country should try to find where the quail live in the fall, so that when the snow comes they can put grain out where the quail can get it, because the snow and sleet cover up the weed-seed food supply.

CHAPTER 11

OUR WINTER BIRDS

Have you a winter feeding table in your yard for the birds?

Among your guests, do you see the tree sparrow, the junco, the cardinal, or the goldfinch?

Which of these stay all year in your neighborhood? Which do you see only in winter?

When birds like the robins and flickers, which spend the summer in the northern states, fly south, there are some birds that come from Canada to spend the winter months with us. Among these are the tree sparrow and the junco, or snowbird.

The tree sparrows spend their summers in Canada. Away north, near Hudson Bay and in Labrador they make their nests and rear their young. The nest is usually made on the ground. When winter begins in this northern home, the tree sparrow flies away southward, and spends the cold months in the northern states.



THE TREE SPARROW HAS A DARK SPOT IN THE MIDDLE OF ITS GRAY BREAST AND ITS TAIL IS FORKED.

You can tell the tree sparrow by looking at his head, his breast, and the end of his tail. The top of his head is brown; he wears a dark spot in the middle of his gray breast and his tail is forked.

The tree sparrows build no nests when here with us and seek their shelter in an evergreen bough, a hollow tree, or even a snow drift. Thus you can see they need your thoughtfulness and care in providing food and shelter for them. Later you will learn something about feeding boxes.

Another visitor is the junco, a grayish-blue fellow with white feathers along the sides of his tail. You see the white feathers plainly when he flies. These outer tail feathers have been named "call colors" for when the birds fly at night these colors keep them from being separated. The junco's bill is pinkish-yellow and his head is black. He comes to a feeding board along with the English sparrows early in the morning but he is smaller than they are and has a much more musical note. His note sounds like a happy and contented "true-true-true." He is also quicker in his movements than the English sparrow.

While some juncos or snowbirds remain



Courtesy of the National Association of Audubon Societies.

THE JUNCO IS GRAYISH-BLUE IN COLOR AND HAS WHITE FEATHERS
ALONG THE SIDES OF HIS TAIL.

north all winter, some others go as far south as our southern gulf states.

At the feeding table you may see two beautiful birds that spend the winter and summer

with us. They are the cardinal and the goldfinch. The cardinal does not live in some of the northern states but the boys and girls who live there and in Canada know his cousin, the beautiful evening grosbeak.

The cardinal or red bird has the finest coat of any of our winter or summer birds. In winter he is not quite so brilliant a red. He has grayish tips on his feathers which are a protection to him. How?

Even if you have not seen him in all of his living beauty, you have seen his pictures in colors and know how pretty he looks. In his scarlet coat and crest with his black face and throat and his yellow bill, he is handsome.

Perhaps you may see him feeding on the snow, or flying in front of a clump of evergreens on a sunny morning in winter. If you are successful, you will not forget the sight.

The female cardinal is not so brightly colored as her mate. She wears a coat of dull pink with some gray and green mixed with it. These colors make it harder for her enemies to see her when she is on her nest.

The cardinals in the spring usually build

their nests of twigs, rootlets, and bits of grass in a tangle of wild grapevine or an undergrowth on the edge of a woods.

The cardinal's song is rich and clear. He watches from the top of a tall tree while you search for him through the woods. Then as you start away, sorry that you have not found him, he whistles a loud "What cheer, What cheer, de - ar, de - ar, he - ar, he - re, he - re," from his tree-top perch.

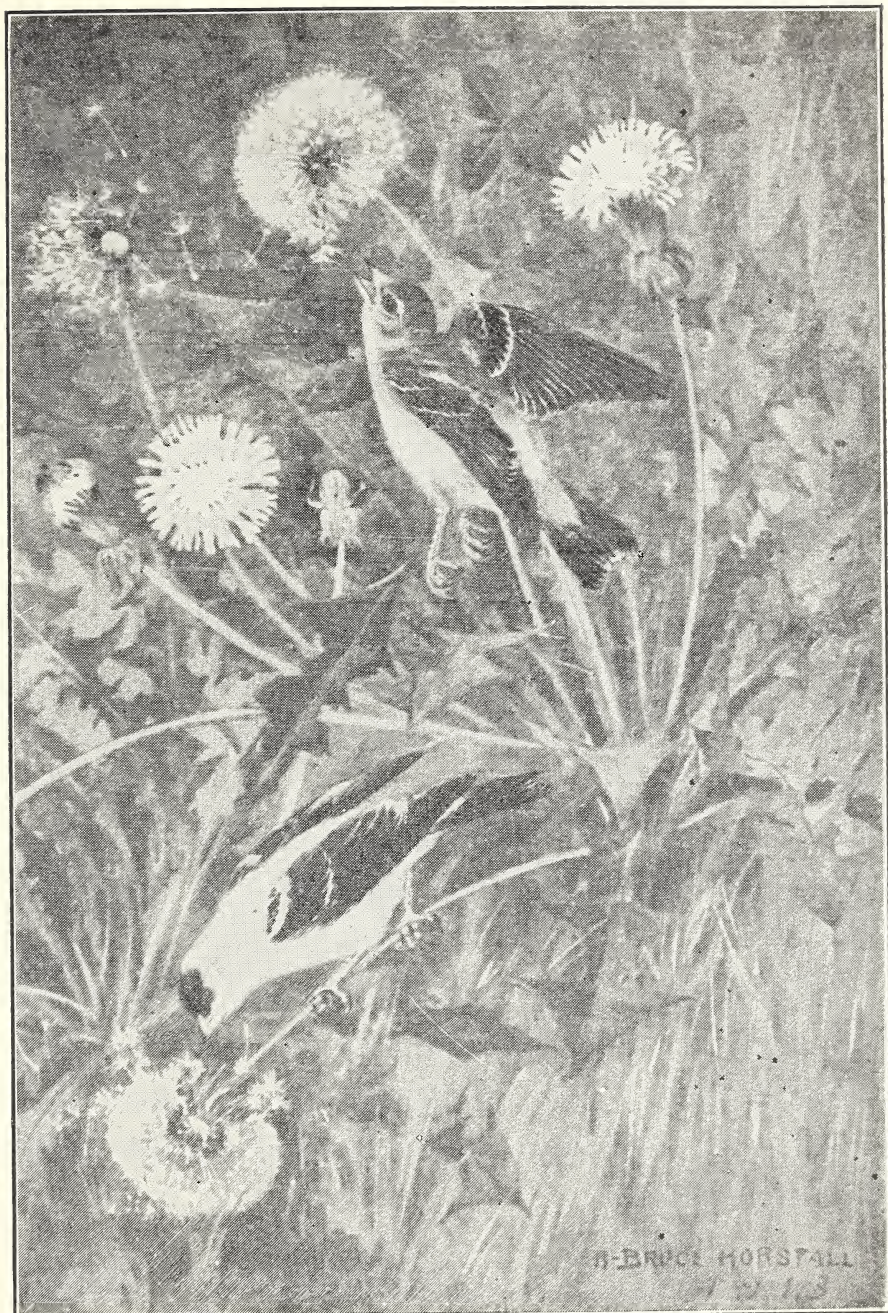
This is his summer call, in the winter you only hear a "chip, chip" note.

All through the year the cardinals eat seeds and berries. When the little cardinals are hatched in May, they, however, are fed on insects.

One of the cheeriest little fellows that you may ever see around the feeding table is the goldfinch.

Yet if he can find sunflowers with plenty of seeds in the garden he will not visit your feeding table.

Can you think of a way to attract the goldfinch? You will know him the minute you see him by his golden yellow coat, his black and white wings and his black cap pulled down over his eyes. His mate and the baby gold-



Courtesy of the National Association of Audubon Societies.

THE GOLDFINCH HAS A YELLOW COAT AND BLACK AND WHITE WINGS.

finches wear olive-green coats instead of yellow ones.

You must not miss the flight and song of the goldfinch. His flight is not straight as a grackle's or robin's but is made of dips and rises. As he flies, his song sounds like "per-chic-oree." He has a beautiful perch song, too,



in the summer. This song is very beautiful and has been compared to a canary's song and for that reason the bird has been called the wild canary.

Since they are very fond of the seeds of the thistle plant, they have been called "thistle-birds."

Birds repay us for our care and protection for they eat the insects and the eggs of the insects that would destroy our gardens and trees. You will learn more about the work they do for us later.

SOME THINGS TO THINK ABOUT

You will find in these columns the word or words needed to complete the statements below.

cardinal	wild canary
junco or snowbird	song sparrow
goldfinch	robin
north wind	flicker
tree sparrow	thistle bird
	cats

1. Two birds that come from Canada to spend the winter are the.....and the.....

2. A dark colored bird with white side tail feathers is the.....

3. Two birds that stay all year are the.....and the.....

4. "What cheer" sounds like the note of the.....

5. "Per chickoree" sounds like the flight song of the.....

6. The goldfinch is also called the.....and.....

7. The winter feeding table must be protected from.....

SOME THINGS TO DO

Remember it is hard to have both birds and cats. Cats are true to their natural instincts when they try to catch birds.

If there are no cats around, you can brush the snow away from a place in the yard and put the food there on the ground for the birds.

If there are cats in the neighborhood, put your feeding board on top of a post. Arrange the board so it will be hard for cats to reach. Or hang a feeding box on a wire out of the cat's reach.

Put out your food in the winter evenings and watch for your visitors early next morning. They usually get around before you are downstairs. You will have to get up when it is just getting light. When they understand you have food for them, they will come back through the day.

Be sure to put out a dish of water, too. Birds must drink often, even in winter. If the day is very cold, the ice may have to be broken for them to get water.

Fasten a bit of suet, an ear of corn, and a piece of apple to your feeding board. Then watch to see which birds come to eat.

CHAPTER 12

THE BEAVER

Have you ever seen an animal that cuts down trees?

Have you ever seen a beaver dam?

What do you know about a beaver?

When you are out for a hike and near a stream, keep your eyes open for the signs of a beaver dam or the animal itself.

Near a broad shallow place in the stream you may find some fresh chips on the ground beside the stump of a small aspen tree. The stump will look queer to you for there will be no ax marks on it, but there will be teeth marks.

Who do you suppose used his teeth to cut down this tree? A fat dumpy little fellow who has a remarkable tail. It is about a foot long, broad, flat, hairless, and wrinkled. The beaver uses it as an oar in swimming and to warn other beavers of danger. This he does by slapping the water very hard with it. A loud noise that can be heard a long distance is the result. The hind feet of the beaver are webbed. Why?



Flashlight photograph by George Shiras 3rd.

THE BEAVER USUALLY WORKS AT NIGHT.

The beaver has teeth suited for gnawing and grinding and also very strong jaw muscles. It weighs from twenty to forty pounds.

The beaver's ears and eyes are small but very keen. It has a short strong neck. The front feet are used for digging and the hind feet are like a duck's and used for swimming. The fur is very fine and a glossy brown in color.

Beavers build houses for themselves along the banks of streams or lakes, and live in these all winter. Near the house they build a dam



*From a drawing by Louis Agassiz Fuyertes.
Courtesy of the American Museum of Natural History.*

MUD IS PILED ON THE POLES OF THE BEAVER HOUSE TO MAKE IT TIGHT.

across the stream so as to make the water deeper. The purpose of this dam is to keep the water at such a height that it will cover the doors of their home and keep such enemies as the fox from capturing them.

In building the dam the beaver first cuts down young trees and floats them to the middle of the stream and then they are forced to the bottom and held there by mud and stones



Flashlight photograph by George Shiras 3rd.

THIS BEAVER IS BUSY MENDING THE DAM WITH STONES AND MUD.

that the beavers pile upon the trees. The beaver and his friends generally work at night laying large sticks across the trees and filling the spaces with mud until they have a dam which is thirty or more feet wide and several feet high. In the cold weather, even with ice on the pond, they can bring up these pieces of wood and use their bark for food. After they have eaten the bark off, they use the sticks to make the dam stronger. If they are not able to build a dam they build a house above ground often

three or four feet high. This is made from a pile of poles and the spaces filled with well packed mud. Above the water the family has a home well lined with grass and having two doors, both beneath the water.

The beaver is a careful workman. Every fall it repairs its house by adding new sticks and more mud. Then when the cold weather comes and the mud is frozen it has a warm house.

Beavers are very fond of the bark of trees, such as the aspen, birch, elm, and willow.

Mother beavers take good care of their babies. They feed them with milk. When the young beavers are about four weeks old, their mothers teach them to swim and to dive. When they are a little older, they are taught how to take care of their beautiful fur. Soon they learn to use their large, strong front teeth to bite the bark from tree branches which their parents have cut for food. When they are a year old, they are able to cut down trees themselves, just as their parents do.

SOME THINGS TO THINK ABOUT

Some of these sentences are true. Some are not true. On a piece of paper write the number of each

sentence. If it is true, write "Yes" beside the number, if it is false, write "No."

1. Beavers cut down trees so they can eat the bark.

2. Beavers like the bark of the aspen tree the best.

3. Bare sticks are used in making the dam and house.

4. Beavers cut down trees with their tails.

5. Beavers were trapped for their fur coats.

6. The hind feet of the beaver are useless for swimming.

7. The beaver uses its tail for steering and sculling and signaling.

SOME THINGS TO DO

If you live in the city, find living beavers in your zoo, or see mounted ones in your museum.

Be sure to notice their big front teeth, and their useful tails.

On the map of your state, find streams or towns named for the beaver.



Photograph by L. W. Brownell.

A MUSKRAT LOOKS SOMETHING LIKE A BEAVER EXCEPT THAT IT IS SMALLER.

CHAPTER 13

THE MUSKRAT

Have you ever seen a live muskrat?

Have you ever seen their runways leading from the stream to the cornfield?

Have you seen their dome-shaped houses on low, flat land?

There are more muskrats in North America than any other kind of fur-bearing animal. They live in almost every pond and stream. Although they have been trapped for their fur

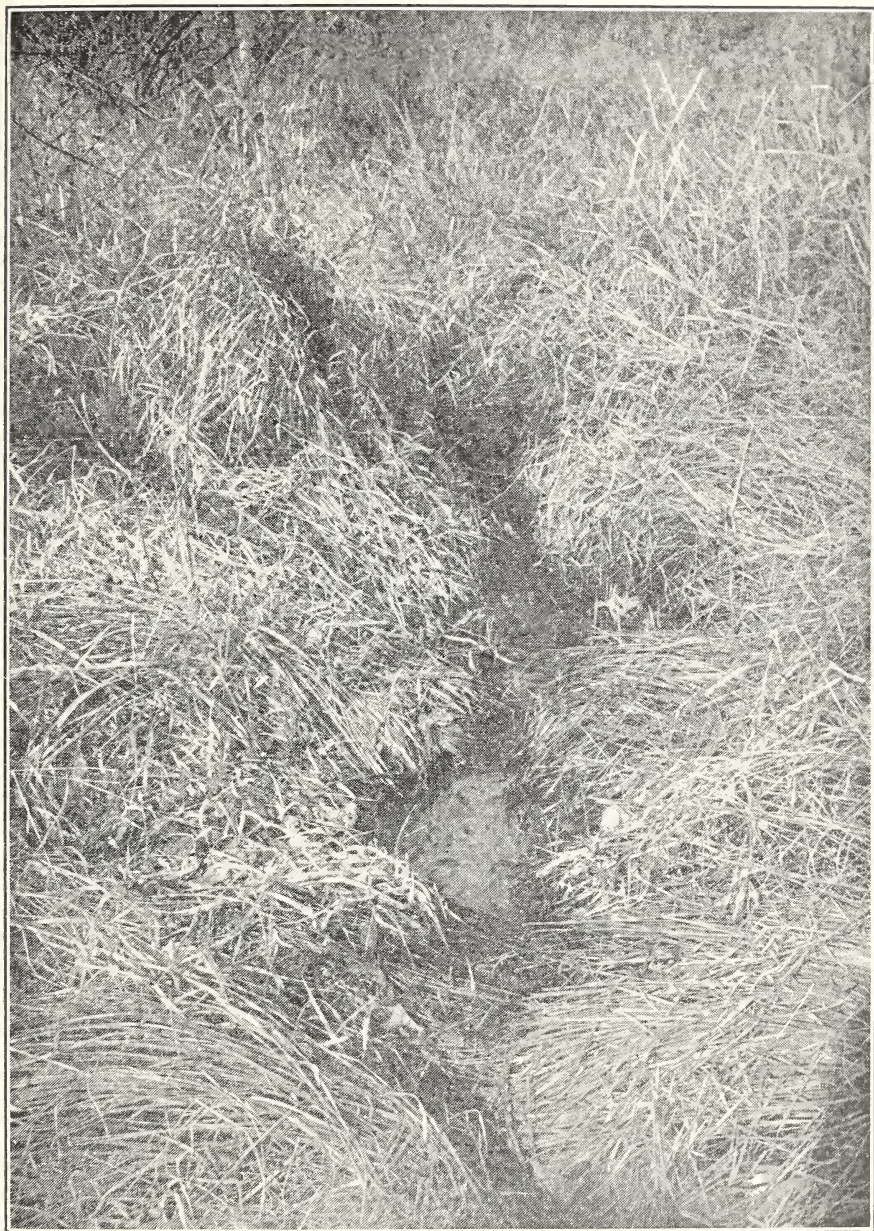
for many, many years, they can still be found in many states in great numbers.

In some ways the muskrats are like their cousins, the beavers. The entrance to the muskrat house is always under water, but the front door is not so large as that of the beaver houses, for muskrats do not take sticks of wood into their houses. From the front door a hallway leads up into a dry house, which may be several feet from the water.

Muskrats do not eat bark, or cut down trees, or build dams. They like corn and turnips and almost any other crop the farmer raises. They also catch and eat insects and other small animals. Farmers know the little paths they make that lead from the stream or pond up the bank to the field or garden.

Farmers also know that the muskrats will gather and store away some of the harvest for food during the winter. Then when spring comes again and the farmer sows his seed, these animals help themselves to some of that, too. When the young plants begin to grow, they eat the tender leaves. All summer long the muskrats find plenty of food. If there are no crops near-by, they live on wild plants.

The outer fur of the muskrat, like that of



Photograph by L. W. Brownell.

THIS IS A MUSKRAT PATH DOWN TO THE WATER.

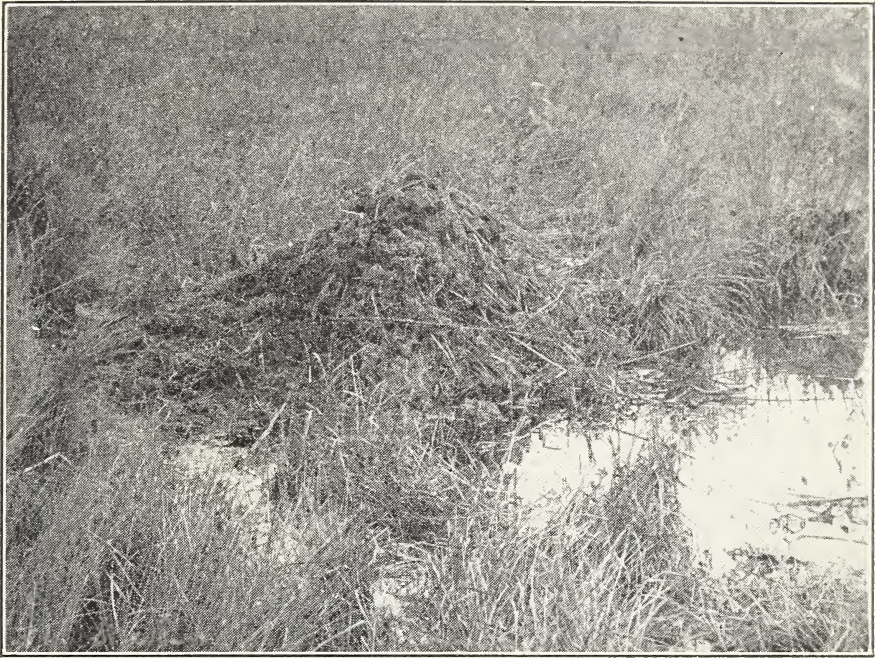
the beaver, is glossy brown, with a layer of lighter brown fur beneath it. It is much thicker and finer in the winter months than in summer. Many of these animals are caught each year by placing traps in their paths.

The muskrat's head, body, and feet are like those of the beaver except that they are not half so large. His tail is very different from the beaver's tail. It is flat, but very narrow, and it cannot be used for sculling, or as a rudder, or to slap the water for a danger signal.

The muskrat has very fine front teeth. All the gnawers have them—the beaver, the squirrel, the rabbit, the rat, the mouse, and many others. These teeth get sharper the more they are used. The front of each tooth is covered with a very hard material called enamel. There is no enamel over the back of the tooth. So the front edge of the tooth is the last to wear away, and thus keeps sharp.

There may be several doors to a muskrat's house, but all must be entered under water. For a short time, there may be more than one family living in a house, but the visitors soon move to a home of their own.

One family may have as many as thirty young in a summer. The young are born blind,



Photograph by L. W. Brownell.

ALL OF THE DOORS TO THE MUSKRAT HOUSE ARE UNDER WATER.

just as kittens are. At first, they have no hair on them. But their mother keeps them warm and feeds them milk, so they grow very fast.

No matter where you live, it is likely that muskrats live within a few miles of your home. When you are near a stream or pond in the country in the summer or autumn, be sure you look for a small, dark object moving along just at the surface of the water. The muskrat swims with his nose barely out of water. Swimming this way he thinks there is no danger. Like the beaver, he is more likely to move

about at night. When he knows that he has been seen, he quickly dives and swims away under the water.

SOME THINGS TO THINK ABOUT

Can you fill in the right words to complete these sentences?

1. Muskrats belong to the same great animal family as the.....

2. Muskrats have.....fur. It is.....in winter than in summer.

3. Farmers do not like the muskrats because they eat.....and.....

4. Muskrat houses are built on the stream bank so that they must be entered.....

5. Our most abundant fur-bearing animal is the

6. Some reasons why muskrats are so abundant:

1.

2.

3.

SOME THINGS TO DO

Look for the paths of the muskrat leading up the bank from the water of any stream or pond. Watch for swimming muskrats.

At your zoo, try to see the beaver and the musk-

rat, and see in how many ways they are alike, and how they are different in appearance.

Obtain a piece of muskrat fur and compare it with a piece of beaver fur.

CHAPTER 14

THE BEAR

Have you ever seen an animal that sleeps all winter?

Have you watched a bear walk?

Do you know what bears like to eat?

Do you know where bears live in winter?

Do you know that little bears are born in February in a den under the ground? They live there until April when their mother brings them from their winter home out into the fresh green woods.

In this country we have two kinds of bears, the gray or grizzly bear and the black bear. The grizzlies are larger and are found only in our western mountains. Black bears that are sometimes "cinnamon" brown or even yellowish are found in our forest regions, east and west, and in the canebrake country of the south.

Long ago, bears were hunted not only for their skins, but for their flesh as well, it being



Photograph by H. Armstrong Roberts.

A FULL-GROWN BEAR IS A HEAVY ANIMAL, BUT IT CAN CLIMB
WELL.

used for food. The skins were made into rugs and overcoats.

Bears have many interesting ways of doing things. For instance, when they walk they put the entire foot on the ground. Other animals walk on their toes. Bears often walk on their hind feet, holding the forepaws out before them like hands. They will attack an enemy in this position, striking powerful blows or using the strong forelegs in a crushing "hug."

A full-grown bear is a heavy animal, but he is very quick in his actions. He can run very fast, climb a tree, and can even catch fish with his paw.

Bears eat many kinds of plants. They also like insects of all kinds, including stinging wasps and bees. The favorite food of the bear is the honey that bees store. Bears also eat such animals as field mice, chipmunks, woodchucks, gophers, and even beavers. If they live near settlements, they soon learn the way to the farmer's potato field and the pig pen. Bears have never been known to kill any of our larger animals to use as food, and no bear, not even the grizzly, has been known to eat human flesh.

The beaver and muskrat store up food for

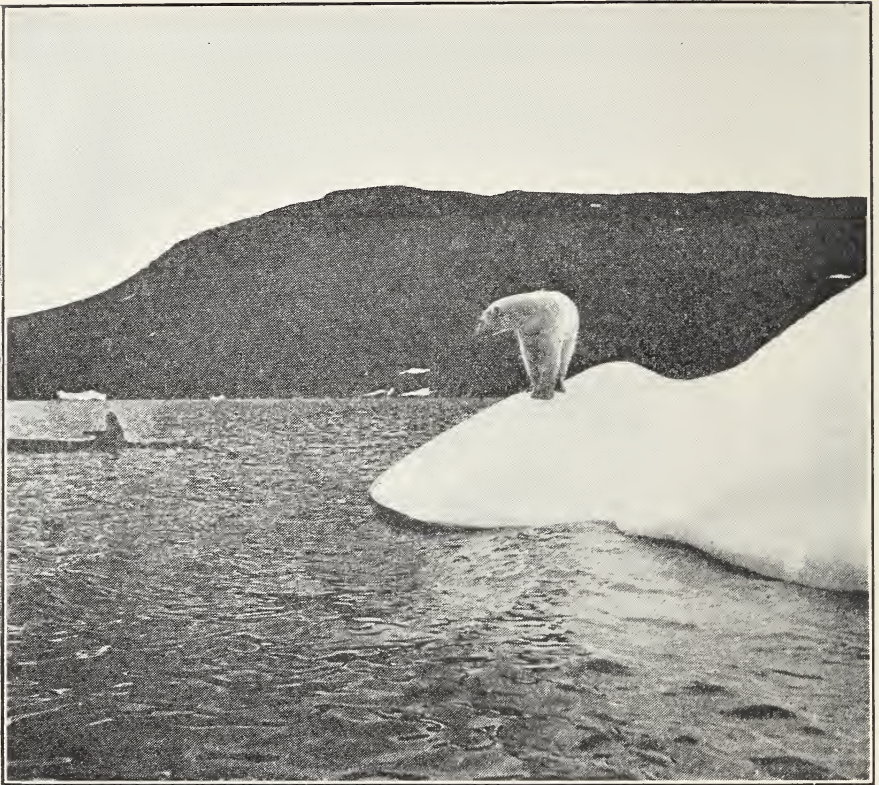


Courtesy of U. S. Biological Survey.

A BEAR IS QUITE FAT WHEN IT IS READY FOR ITS LONG WINTER SLEEP. THIS IS A PICTURE OF A GRIZZLY.

winter, but the bear does not. He is quite fat when ready for his long sleep. He searches about and finds a dry cave among the rocks on a mountain side, or a snug little pocket under the fallen trees in the forest. He goes in, closes the entrance with stones or brush, curls up, and goes to sleep. We say he hibernates. His heavy fur coat keeps him warm all winter. The mother bear finds a cave or den for herself, too.

The cubs are born in the den during the



Courtesy of Donald B. Macmillan.

THE WHITE COAT OF THE POLAR BEAR MAKES HIM HARD TO SEE
WHEN HE IS ON THE ICE.

winter. At first they are tiny and helpless. The mother bear is a very good mother. She keeps them warm, and gives them milk. By the time spring comes, and the mother bear is ready to leave the den, the cubs can walk along after her. They must obey their mother when she tells them, in her way, not to go too close to danger. If they disobey her, she boxes their ears.

Black and cinnamon bears are often captured while they are cubs and trained to do many interesting tricks. Some of them learn to sit on chairs, dance, turn somersaults, and climb trees or poles at the command of their keepers.

The polar bear, that beautiful big white animal who lives in the far north, doesn't hibernate as his southern relatives do. His white coat not only keeps him warm, but makes him hard to see on the ice, where he watches for fish or seal.

SOME THINGS TO THINK ABOUT

Can you answer these questions?

1. What two kinds of bears live in this country?
2. What do bears eat?
3. Do bears walk like other animals? Why?
4. Can bears be tamed and taught to do tricks?
5. Where do bears spend the winter?
6. Why is the polar bear white?
7. Do you know what young bears are called?

How are they fed when they are little?

SOME THINGS TO DO

When you visit the bears at your zoo see how the polar bear differs from the grizzly and black bear in size and shape and habits.

Enos Mills has written a most interesting book entitled *The Grizzly*. Get this book at a library and read it. When you have finished, see if you agree that the grizzly is our most interesting wild animal.

CHAPTER 15

SNOW AND ICE

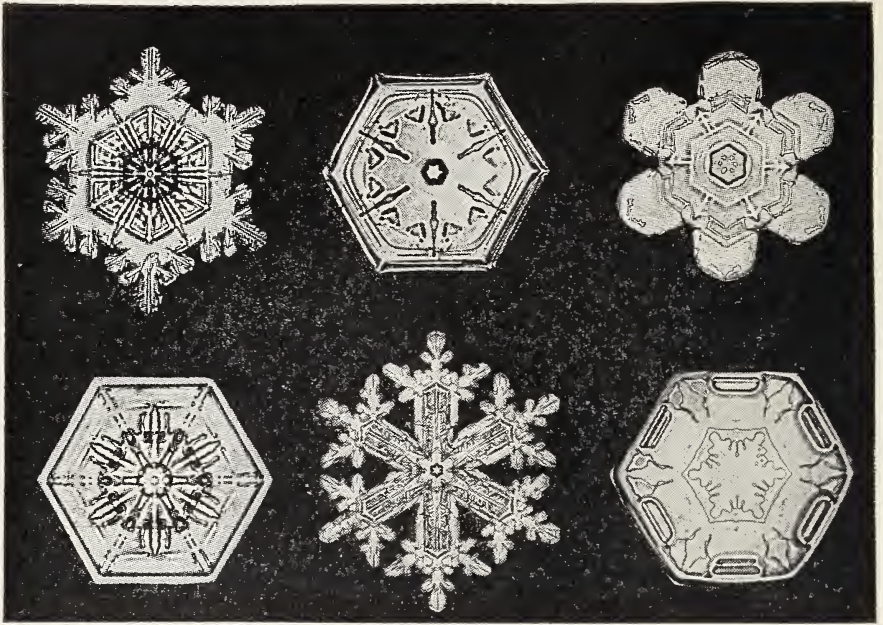
Do you like to see the snow come flying through the air?

Have you ever made paths through the snow?

Have you watched men harvesting ice?

Do you know that snow, hail, sleet, ice, fog, and clouds are all made of water? They do not look alike, but they are made of the same thing. Clouds are just masses of fog moving slowly through the air with the wind pushing them. If this mass of fog is chilled by cooler air, the little mist drops are brought closer and closer together until they touch, and form larger drops of water. If these larger drops are too heavy to float in the air, they have to fall. Then we call them raindrops.

If those tiny mist drops are chilled so suddenly that they haven't time to come together, they are changed to snow crystals. If you live where there is snow in winter you have seen beautiful snow crystals falling on your coat sleeves, when the day is very cold.



Photographs by W. A. Bentley.

THESE PICTURES OF SNOW CRYSTALS ARE ENLARGED MANY TIMES.
EACH SNOWFLAKE IS MADE UP OF MANY SNOW CRYSTALS.

When many snow crystals stick together, they form a snowflake. Sometimes snowflakes are very large. They are made up of many hundreds of snow crystals.

When the mist forms raindrops and these freeze, they fall as little grains of ice, called sleet. When large raindrops freeze as they fall, we call them hail. Sometimes the water in the air changes to crystals of ice instead of drops of water. We call these ice crystals, frost. These have a great variety of beautiful shapes. So frost, hail, sleet, snow, and ice are nothing



Courtesy of the Canadian National Railways.

BOYS AND GIRLS LIKE TO PLAY IN THE SNOW.

but frozen water. In the colder parts of the country all of these are to be seen in winter except hail. Strangely enough, this falls only in the summer time. Hail forms when rain-drops fall through freezing cold layers of air.

Boys and girls like snow best of all, because they like to play in it, and on it, and with it. Snowballs and snow men and snowshoeing and coasting and skiing are all such fun.

Snow is very useful to plant and animal life. All over the northern countries snow in winter covers the earth like a soft blanket. It



Photograph by H. Armstrong Roberts.

SKATING IS GOOD EXERCISE AND IT IS A FINE SPORT.

keeps the cold winds away from the young wheat crop, and from other plants and animals that live under it. Even larger plants, like the

trees, grow better if the snow protects their roots during the winter months. Then when spring comes, the melting snow gives the earth a new supply of water. All growing things welcome this, and life begins anew.

Boys and girls get a lot of fun on the ice, too. If you know how to steer a sled, coasting is fun, but if you know how to skate, that is still more fun. Every boy and girl living where ice in winter forms on lakes and ponds should learn how to skate. Skating is good exercise, and gives a great deal of pleasure. When you get used to your skates, you will learn fancy skating. When you can do figure eights and figure threes and serpentines on either edge of your skates, you will think that there is no finer sport than skating.

Ice is very useful in warm weather to make foods cold, and to cool liquids that we drink, such as water, milk, and fruit juices. Much of the ice we use is manufactured, but many tons of it are still taken in winter from our northern lakes and streams. This ice is stored in ice houses. These are built close to the bank of the pond or lake. When the ice is about eight inches thick, it is cut into cakes about three feet long and two feet wide. These are cut with

large hand saws, or by an ice knife drawn by a horse. The cakes are floated to the ice house and carried into it by horse or a tractor. The floor and walls of the ice house are lined with sawdust, and a ceiling of this material is often used. The sawdust is used to help keep the warm air from melting the ice.

As we watch the men cutting the cakes of ice and floating them along the lanes of water leading to the ice house, we see that about one inch of the cake is out of water. About seven inches of it are under water. Since ice is made of water, you may well wonder why it floats on water. Most things get smaller as they get colder, but when water changes to ice it expands a little. This means that it occupies a little more space than it did before. For this reason, a block of ice is just a little lighter than a block of water of the same size. So, being lighter, it must float. This is the reason why ice forms at the top of a pond or stream, giving us skating and ice boating.

When we think of floating ice, we think of icebergs. Icebergs come from glaciers. Glaciers are great masses of ice that move slowly down narrow mountain valleys. In some countries, these glaciers melt and flow to the sea as rivers,



Courtesy of the Canadian National Railways.

SOMETIMES ICE IS CUT INTO BLOCKS BY HAND WITH SAWS AND
SOMETIMES BY A MACHINE. THESE ARE STORED UNTIL
NEEDED.

but in Greenland, for example, they reach the sea before they melt. If the sea were still, they would move out into it a long way, but the tides and waves break off the end of the glacier before it gets very far from land. We call this broken piece an iceberg. It floats for weeks and months before it melts.

Only about one-eighth of an iceberg is above water. If an iceberg rises one hundred feet in the air, we know that a mass of ice about seven hundred feet thick is under water. The captains of ocean steamships must be careful not to let their ships get near icebergs because they cannot see this great mass of ice below the water. Several years ago the steamship *Titanic* struck the hidden part of an iceberg at night. The ship sank, and most of the passengers and crew lost their lives. Now we send ships to the North Atlantic ocean to watch for icebergs and warn ships of their danger.

Glaciers once covered our northern states. When they melted, they left sand banks and gravel banks and rounded boulders here and there over the land. These rounded boulders were in the bottom of the glacier as it slid along over the earth. When they were pushed against softer rocks below them, they scratched

and cut away the surfaces of these rocks. When they were pushed against rocks harder than they were, the harder rocks scratched and cut away the surfaces of the boulders. Boys and girls who live in that part of the country once covered by glaciers can find many such rounded stones, and can see these scratches on many of them. Sand and gravel are made up of the small particles of stone that were thus ground from these boulders and rocks, as the glaciers slid along.

SOME THINGS TO THINK ABOUT

Can you fill in the words which complete these sentences correctly?

1. Mist is made of tiny drops of.....
2. Rain is made of larger drops of.....
3. Hail is frozen.....
4. Snow flakes are made of many.....
5. Snow crystals are very.....
6. Boys and girls like snow because.....
7. Plants and animals like snow because.....

SOME THINGS TO DO

If you live where it snows in winter, catch some snow crystals on your coat sleeve on some cold, still day and study them with a magnifying glass.

Get some pictures of snow crystals and post them in your schoolroom.

Drop a piece of ice carefully into a glass half full of water. What proportion of the ice extends out of the water? Most of it, or not? If you use a small cube of ice and a ruler, you may be able to learn how much of it is out of water, and how much is under water.

Can you find a pebble or boulder that was scratched by a glacier?

CHAPTER 16

THE MILKY WAY

Can you find Cassiopeia's Chair and Orion?
Have you ever seen the Milky Way?
Have you ever seen a large telescope?

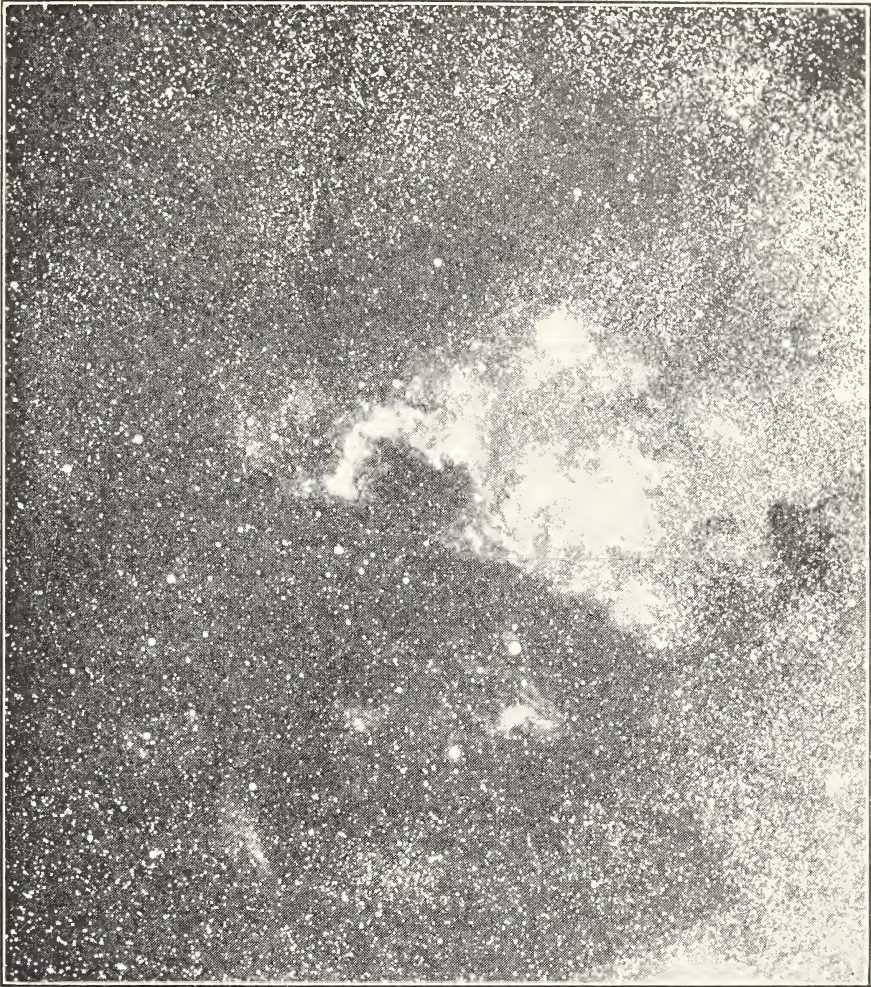
Do you look at the sky at night? If so, you have probably seen some groups of stars that you already know. You remember reading about Cassiopeia's Chair and know where to look for it. Perhaps on a clear night you will see a band of light stretching through it. This band of light is a part of the beautiful Milky Way.

The Milky Way gets its name from the fact that it looks like a stream of bluish watery milk spilled across the sky. It also looks like a fine white mist, or like a smoky, trailing cloud. One can see part of the Milky Way on almost any clear night. It stretches in a band from one side of the sky to the other. At the horizon, the place where the earth and sky seem to meet, the earth hides the Milky Way



THE MILKY WAY STRETCHES ACROSS THE SKY AND LOOKS LIKE A LONG SMOKY CLOUD.

from our sight. If we could see all of it, we would find that it makes a complete circle in the heavens around the earth. Sometimes the Milky Way, like the stars, seems to have changed its position in the sky. This is because



Courtesy of the Yerkes Observatory.

ASTRONOMERS HAVE FOUND THAT MILLIONS OF LITTLE STARS
MAKE UP THE MILKY WAY.

the earth is moving. We merely see it from a different position.

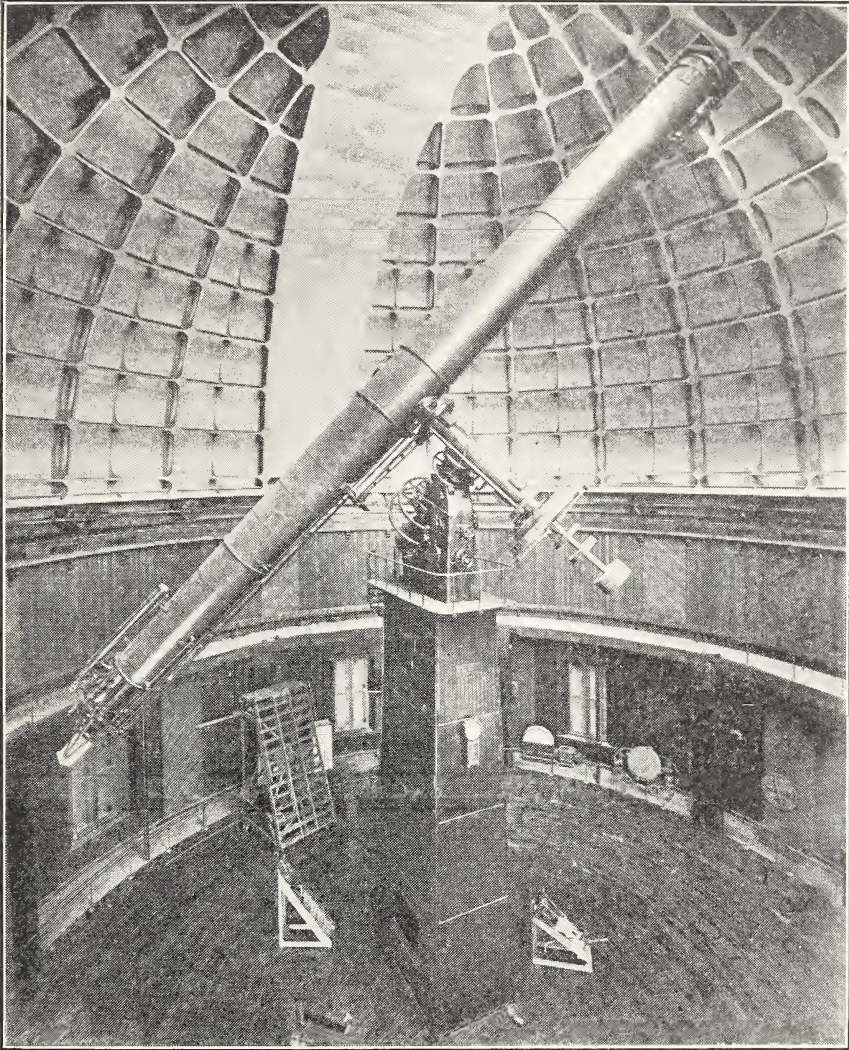
In the summer you may see the Milky Way stretching across the sky from north to south-east. In early winter, however, this beautiful

band of light passes from east to west, a little to the north. In early spring the Milky Way is not so bright as you find it in the summer. Have you ever seen it in spring?

Astronomers look at the stars with large glasses called telescopes. When they look at the Milky Way through the telescope, they find that it is the light of millions and trillions of stars too far away to be seen with the naked eye.

Telescopes were invented about 400 years ago. Before this, through long centuries, people had only their eyes to tell them about the stars. They could not find out what the Milky Way really was, but they enjoyed telling stories about it. The American Indian said that it was a cloud of dust made by a horse and a buffalo racing across the sky. Other Indians said that the bright stars in the Milky Way were campfires built by people who had died and had gone up into the sky. They believed that the bright path in the sky was the Happy Hunting Ground, or the place called Heaven. Do you know any other stories about it?

The Japanese have some very pretty stories about the stars and about the Milky Way. These stories say that the Milky Way is a



Courtesy of Lick Observatory.

GREAT TELESCOPES LIKE THIS MAKE IT POSSIBLE FOR US TO
LEARN A GREAT DEAL ABOUT THE HEAVENS.

bridge drawn between two lovers who have died and gone to different stars and that the bridge is used to cross the distance between them.

A Chinese story says that the Milky Way is a river in the sky with silver fish in it. It says that when we cannot see the Milky Way it is because the fish are afraid of the new moon which looks like a fishhook, so when there is a new moon, the little fish hide.

The astronomer with a telescope enjoys these stories, but he does not believe them. He knows that the Milky Way is the light of distant stars. He can see the stars through his telescope. If you look through a large telescope, you, too, can see these stars.

SOME THINGS TO THINK ABOUT

1. This chapter tells where to find the Milky Way. Where is it?
2. It tells about the telescope. How does it help us see the Milky Way?
3. It tells about the stars in the Milky Way. How many can be seen?
4. Long ago people made up stories about the Milky Way. What stories do the Indians have?
5. The Japanese tell a story, too. What is it?

SOME THINGS TO DO

Look for the Milky Way on a clear night. Look for it in the winter. Tell where you see it.

Look again for it in summer. Tell where you see it.

If you have an opera glass at home, use it some night to look at the Milky Way.

You may use a field or bird glass, too.

CHAPTER 17

HOW TO TELL DIRECTION

How can you tell the north when the sun is setting?

How can you tell the north without the sun?

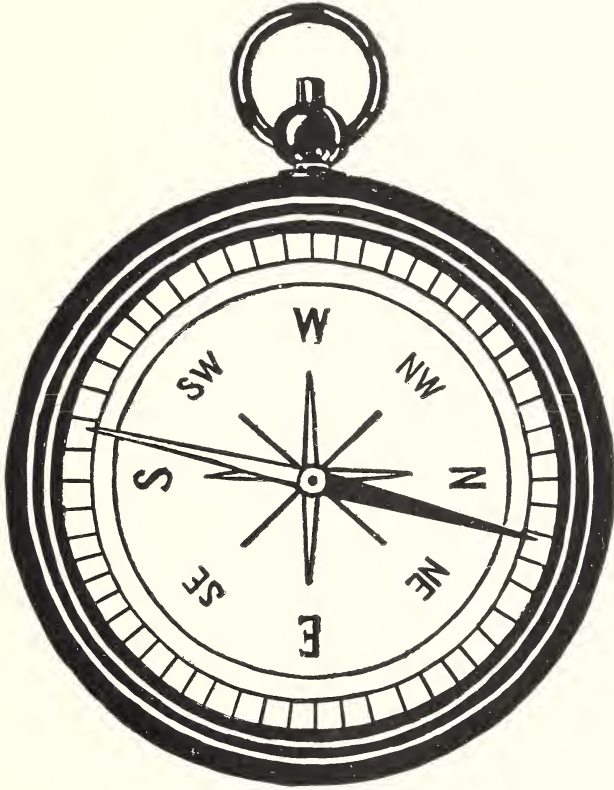
What is a compass?

When you are in the woods and can see the sun, it is easy to find the north. But the sun does not shine every day, and you should know how to find the north without its help.

On the bark of some trees you will find large green spots. These pieces of bark are green because very tiny plants are growing on them. These tiny plants grow better on the north side of the trees than on any other side. This is one way in which you are able to tell which direction is north. Sometimes other plants called mosses also grow on the north side of trees.

Another way of telling north is by stones. Often tiny plants grow on the north sides of large stones. If you will look for the green

color on the old bark of trees and the green patch on stones, you will know which way is north.



THE COMPASS NEEDLE ALWAYS POINTS TOWARD THE NORTH AND SOUTH.

Still another way of telling direction is with the compass. In the picture you can see a compass. It is called a magnetic compass because its needle is a little magnet. You remember reading about the bar and horseshoe magnets.

About eight hundred years ago, European

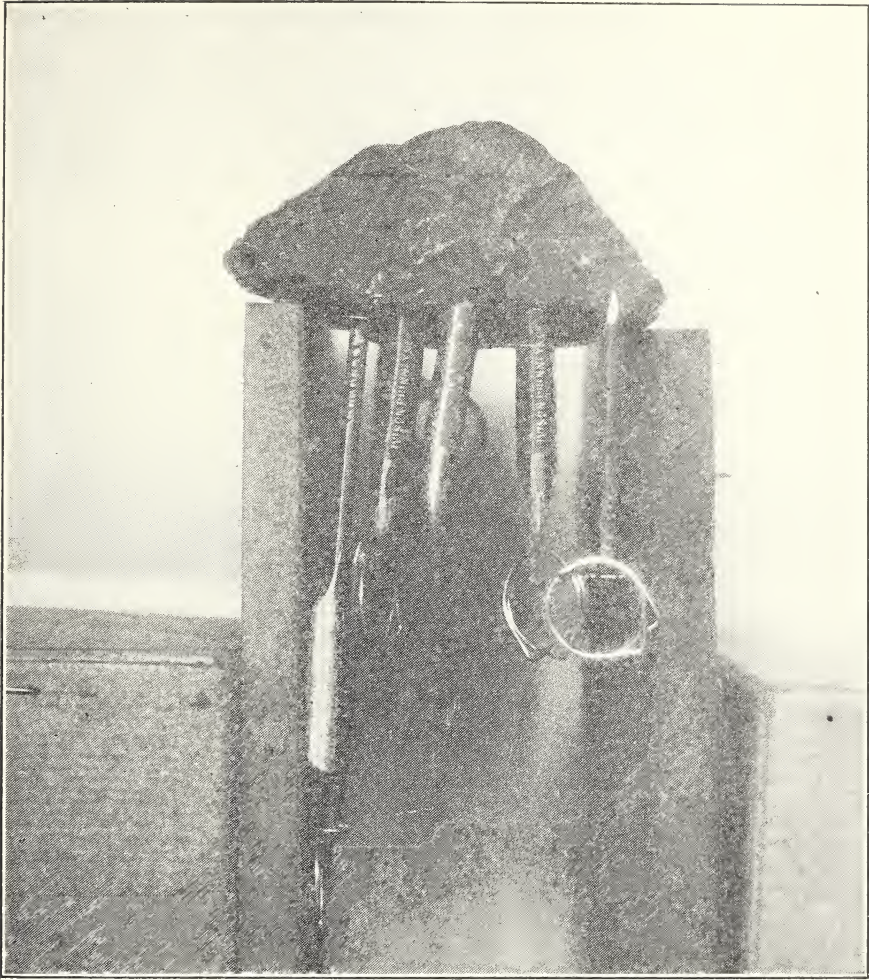
sailors learned from the Chinese the use of the compass. Until then, journeying at sea had been rather uncertain wandering with only the sun and stars by which to tell direction. On cloudy nights or in a storm the sailors were forced to guess their way.

What a great discovery the compass was! With the little needle pointing always toward the north and south, men could sail without seeing the stars. They could tell their direction even on a dark night.

How is it that the compass needle does this? Do you remember what you learned about the bar and the horseshoe magnets? These are pieces of iron that pull certain things to them. Since the needle of the compass is a tiny magnet, let us learn a little more about magnets.

Nearly three thousand years ago a Greek found a strange piece of rock in the country of Magnesia. This rock, which was really a kind of iron ore, would pull bits of iron to it. It was first called a lodestone, and later a magnet, from the name of the country where it was found. This was a natural magnet. Later people found out how to make a magnet by rubbing a piece of iron with a lodestone.

The ends of a magnet are called the poles.

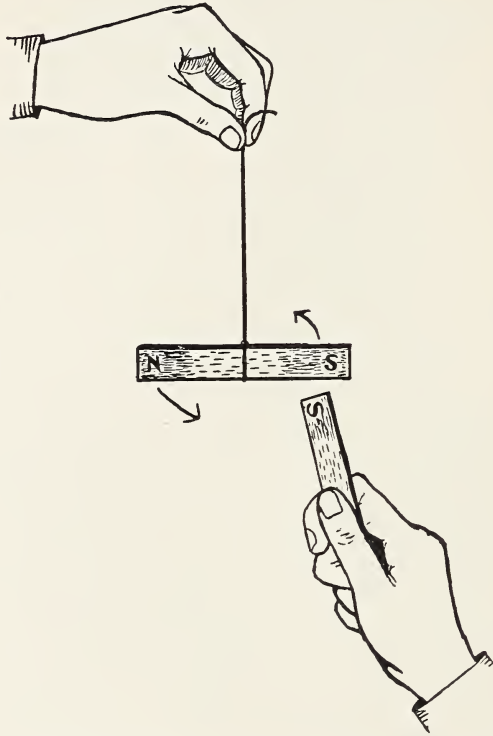


Photograph by Brown Brothers.

BITS OF STEEL AND IRON ARE PULLED TO A LODESTONE.

If a bar magnet is brought near to a pile of tacks, many will stick to the ends and but very few or none to the middle. So we see that it is the ends or poles that attract other pieces of iron.

Now, if a bar magnet is allowed to hang and swing freely, it always takes a north and south position unless there is another magnet near it to pull it in some other direction. This is be-



THE S POLE OF ONE MAGNET MOVES AWAY FROM THE S POLE OF THE OTHER.

cause the earth itself is a magnet. Being a magnet, it has two poles. Let us see what effect one magnet has on another.

Hold one bar magnet with a string as shown in the picture. Now, bring the S pole of another magnet near the S pole of the magnet

on the string. What happens? The S end of the magnet on the string will move away. If you follow it, it will continue to move. It can even be made to swing around in a circle.

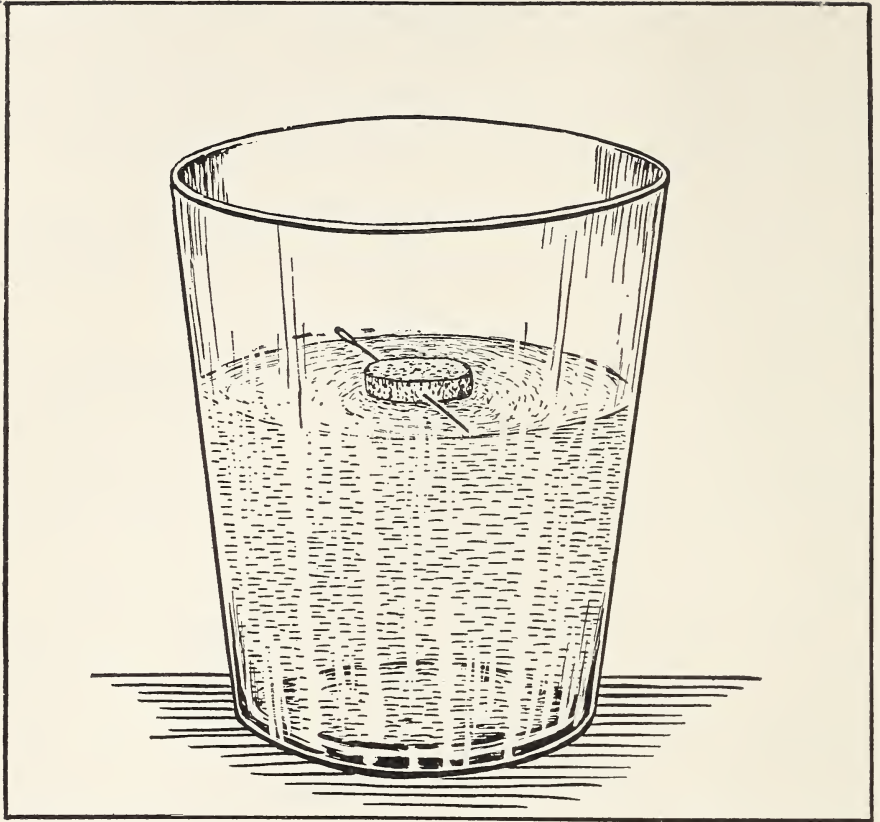
However, if you hold the N pole on one magnet near the S pole on the other, they will be pulled together.

Now, since both the earth and the needle of the compass are magnets, it is easy to see what happens. In just the same way the N attracting pole of the earth pulls one end of the compass needle and pushes the other end away.

It is easy to make a little compass if you have a small magnet. Rub a needle with the magnet from the point down toward the eye about ten or fifteen times, being careful not to rub it in the opposite direction. Test it by holding near some tiny bits of iron. If it has been magnetized, it will pick them up or be drawn toward them.

Push the needle through a cork and let it float on the water in a drinking glass. Does it point north and south? If so, it is drawn by the pull of the magnetic poles of the earth.

The first picture in this chapter is a magnetic compass such as you can buy at a store. It is a small magnet balanced on a fine point so that



YOU CAN MAKE A COMPASS LIKE THIS YOURSELF.

it can swing round and round. Under the magnet is a card on which letters stand for the various directions. Look carefully at the card and tell for what these letters stand. These directions are called the points of the compass. A new kind of compass has been invented to be used on steel ships. This is called a gyro-compass.

SOME THINGS TO THINK ABOUT

Pick out the correct ending for each sentence.

1. Before sailors learned to use the compass they told the direction by

- the stars and sun
- the clouds
- the tides

2. A bar magnet has

- one pole
- three poles
- two poles

3. The needle in the compass is

- made of gold
- made of iron
- made of glass

4. Lodestone is a piece of rock that

- pushes iron away
- draws iron to it
- has no effect on iron

5. The earth is like

- a horseshoe magnet
- a bar magnet
- no magnet

6. You can make a magnet by

- heating the needle
- painting the needle
- rubbing a needle with a magnet

SOME THINGS TO DO

Boxing the compass means naming the points of the compass. Can you do it?

Make a compass like the one you have read about, using a needle and a cork. Does it work?

You may know some surveyor who will show you the compass and tell you how he uses it.

CHAPTER 18

THE STORY OF TELLING TIME

Without a watch or a clock, how could you tell whether it was morning or afternoon?

Have you ever seen an hourglass or egg timer?

Do you know how to make a sundial?

Imagine a world without a watch or a clock. How hard it would be for us to live in that world! We could never plan to meet our friends or to do things at any certain time, for we should not know when the time came. In that case we would surely try to find some way to measure the passing of time. Can you think of any plan?

For ages men lived with no way at all of telling time. The rising and setting of the sun made their day. Probably the first attempt to divide the day into parts was by means of a shadow.

If you will notice the shadow that is cast by a tree or a stick in the sunshine, you will find that as the sun rises in the sky during the

morning hours, the shadow grows shorter and shorter until the sun is highest in the sky. In the afternoon, the sun gradually becomes lower and as it does the shadow lengthens again.

It was easy to divide the day into two parts by noticing just when the shadows were short-



Courtesy of Todhunter, Inc.

THIS IS ONE KIND OF A SUNDIAL.

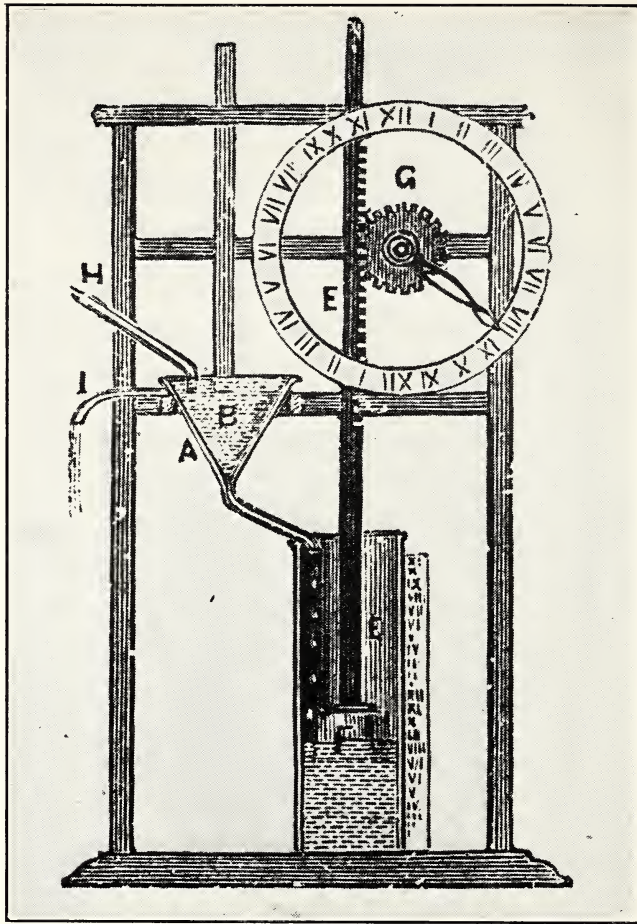
est. From this, the sundial, or shadow clock, developed. A half circle of stones around a pole formed one of the earliest sundials. As the shadow moved from one stone to another, it marked the passing of a part of the day. Of course, in some seasons the days were longer than in others. What difference, if any, do you think that would make in telling the time?

Later, a half of a hollow ball with a small bead in the center of the ball was set hollow side up. When the sun shone on the bead, the shadow fell on the inside of the ball, which was divided into twelve parts. At night and on days when the sun did not shine, there was no way to tell the passing of time. The sundial was used until about one hundred years ago. To-day you will often see sundials in parks and gardens as a part of the decoration.

The Egyptians had water clocks. The simplest of these was a jar with a small hole in the bottom from which the water dripped. Sometimes it dripped into another jar with a float. As the float rose, it moved a hand that pointed to the time.

Sometimes a copper bowl with a hole in the bottom was placed in the water of a pool or a dish. Slowly the water came into the bowl and filled it. A guard emptied it, struck it with a gong for the hour, and set it back into the water again.

During the time of Alfred the Great in England candles were used to tell the time. The ones used were twelve inches long with a notch at every inch. They burned from notch to notch in twenty minutes. How long could a



Photograph by Brown Brothers.

AS THE FLOAT OF THIS EGYPTIAN WATER CLOCK ROSE, IT MOVED
A HAND THAT POINTED TO THE TIME.

candle last? The candle might be called a fire-clock, since fire is used to mark the passing of time.

Have you ever seen an hourglass? It is really two glasses with a tiny passage between them. Very fine sand runs slowly from one



Photograph by Brown Brothers.

IT TAKES AN HOUR FOR THE SAND TO RUN FROM ONE PART OF THIS GLASS TO THE OTHER.

to the other. In an hour all the sand will pass through the opening. The glass is then turned over, and the sand starts back again.

The hourglass was used in churches so that the preacher could see how long he had talked.

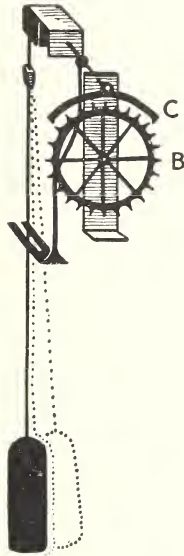
Half-hour glasses were also made. Both hour- and half-hour glasses were used on the ships of the British navy until about a hundred years ago. Sometimes a small three-minute sand glass is used nowadays to tell time for boiling eggs.

The modern clock is run either by a weight or by a spring. A Grandfather clock is run by a weight. This weight is pulled up usually by winding on a wheel the string that holds it. Then as this weight slowly goes down, it turns the wheels of the clock. The problem is to allow the weight to move at exactly the right rate so that the hands of the clock will show us the correct time. Several ways of controlling the movement of the weight have been tried but the pendulum was found to be the best.

In 1582, Galileo, an Italian scientist, about whom you will learn more later, discovered how the pendulum worked by watching a swinging lamp in a church tower at Pisa.

You can discover for yourself the same things that he discovered by making a simple pendulum. A pocketknife tied to a string about three feet long will do. Swing the knife a short distance and count the number of times it swings in a minute. Now swing it a longer

distance and again count the number of times it swings in a minute. Use instead of the knife some other object twice as heavy. Does the rate per minute remain the same? Shorten the string, and see what happens to the rate.



THE HANDS OF SOME CLOCKS ARE CONTROLLED BY THE SWINGING PENDULUM.

If it were not for the part C, the weight or spring of the clock would spin the hands quickly, and the clock would not keep time. Can you see how the pendulum A moves the part C so that the wheel B is released just one cog at a time?

You have no doubt discovered that the time of the swing is not changed by changing the width of the swing nor the weight of the object. However, it is changed when you change the length of the string.

The picture will help you understand how

the pendulum allows the clock weight to drop a little at a time. Now you can see why, if the pendulum is shortened, the clock gains time; if it is lengthened, the clock loses time.

Many clocks nowadays have springs instead of weights. A spring can be made to turn the wheels of a clock just as it turns the wheels of your toys. The pendulum controls the unwinding of the spring just as it did the dropping of the weight.

A clock with a pendulum will not keep time while you carry it about. Why not? Therefore, in watches and in many clocks, the balance wheel has replaced the pendulum. The movement of the balance wheel back and forth is controlled by a tiny hairspring which coils and uncoils. The hairspring can be tightened to make the watch run faster and loosened to make it run more slowly.

In some large buildings, perhaps in your school, the clocks are run by electricity.

How different our modern clocks are from the old sundials, water clocks, candles, and hourglasses. Think how much we depend upon knowing the exact time, and how very accurate the machinery of even the simplest watch or clock must be.

SOME THINGS TO THINK ABOUT

Find the right word for each blank.

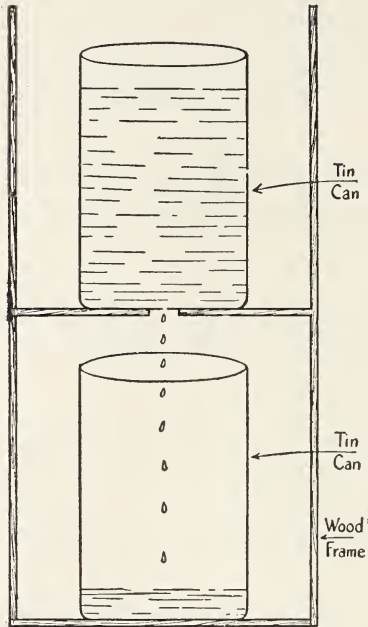
1. Sundials are often used to-day for.....
2. When the sun is.....in the sky the shadow of a stick is shortest.
3. The sundial was used until about.....years ago.
4. The sundial would not tell time at.....
5. Both kinds of water clocks made use of..... to mark the hours.
6. Hour glasses have.....inside of the glass.
7. The pendulum is used to keep clocks from going too.....or too.....
8. In a small clock or watch the.....takes the place of the pendulum.
9. By tying a string to your knife you can make a simple.....
10. You cannot carry a clock with a.....around and keep it going as you do your watch.

SOME THINGS TO DO

Make a simple shadow clock.

Make a simple water clock. Find four pieces of board from a store box and make a frame as in the picture. Then find two tin cans. Punch a hole in the bottom of one can and put the other can above it as shown in the picture. Now put water in the upper can and see how long it takes for it to drip into the can below. Do not make the hole too large

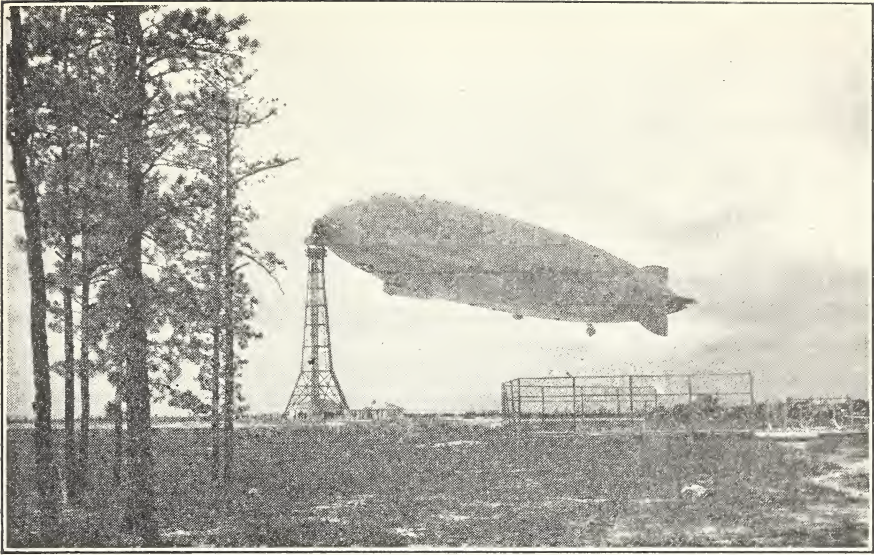
at first. You can make it large enough so that the water will go through in fifteen or thirty minutes. When the can above is empty, you may pour the water from the lower can back into the upper one again.



A SIMPLE WATER CLOCK.

Find pictures in magazines of the sundial and the hourglass.

The egg timer is one kind of hourglass and may be obtained at a hardware store.



Courtesy of the U. S. Navy Department.

THE LOS ANGELES IS MOORED TO ITS MAST.

CHAPTER 19

AIRSHIPS AND BALLOONS

What is a dirigible balloon?

What keeps the airship up in the air?

What is inside the balloons?

How would you like to go on a trip in a large dirigible or airship? You may have seen or read about one of our large dirigibles. The *Los Angeles* is one of them. About three hundred men are needed to take this giant dirigible from the hangar. The hangar is a large building where airships are kept. The airship is taken from the hangar and fastened to the

mooring-mast. When all is ready it is unfastened from the mooring-mast and starts on the trip.

Wouldn't you like to know something about the story of the dirigible? Long ago experiments were made with balloons. You remember that hot air, being lighter than cold air, always rises. At first people made a fire under the large bag of the balloon in order to fill it with hot air. When it was filled, they let it go. The air in the balloon was lighter than the air around, so it rose from the ground. Some of these balloons went up a half mile, and were carried almost five miles by the wind before they came down.

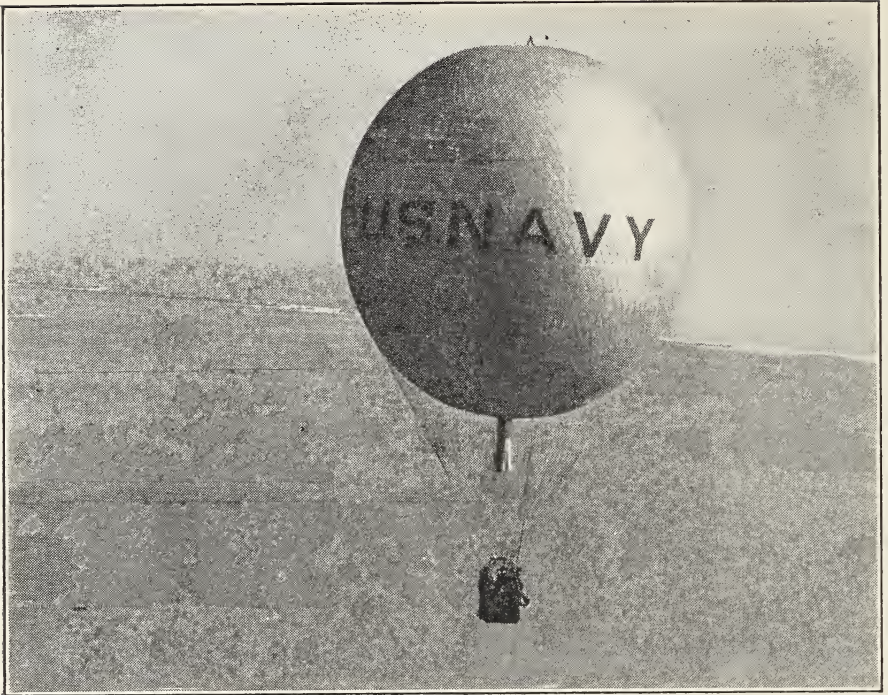
Before people went up in balloons, they wanted to see if they would carry passengers safely. They sent a sheep, a duck, and a rooster up in a balloon. The balloon rose 1,500 feet, and came down in a forest two miles away. These animals were the first passengers ever to go up in a balloon. The first men went up about two months later in a hot-air balloon. They rode in a basket which was tied to the big bag. They took a little furnace with them in order to keep the air hot in the balloon.

A few months later two men went up in a balloon which was filled with hydrogen. This is a gas very much lighter than air, but dangerous to use for it explodes and burns. The balloon rose quickly and carried the men for several miles. When they wished to come down, the men opened a valve which let out some of the hydrogen, and the balloon came down and landed safely.

Men have gone up in these ball-like balloons to study the upper air. But they find it hard to breathe if they go very high. Do you know why? There is less air pressing on them the higher they go, and of course there is less air to breathe.

After a while instruments for finding the temperature and the pressure of the air were put in a small balloon which was then sent up. These balloons were made so that they would burst when they went very high. When the balloons did burst, the instruments fell to the earth and the temperature and pressure of the air at the time of bursting could be seen. One of these balloons went up about twenty-three miles before it burst.

During the World War kite balloons were used to watch the enemy. Men hid in the basket



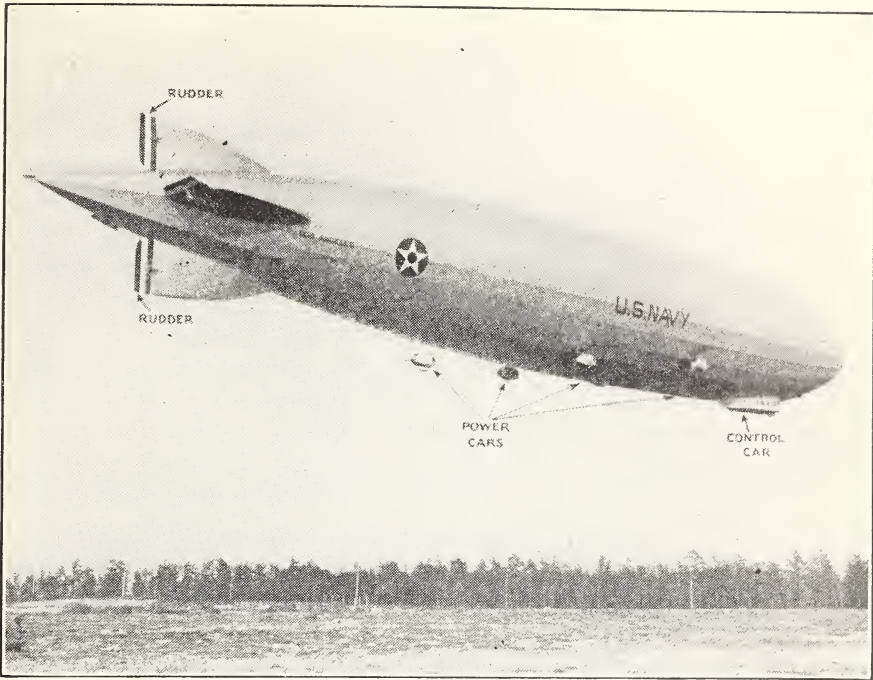
Courtesy of the U. S. Navy Department.

BALLOONS CAN TRAVEL ONLY IN THE DIRECTION IN WHICH THE WIND IS GOING.

of the balloon, while it was held to the earth by a long rope.

Early balloons could not be steered. They could only travel in the same direction as the wind was going. For this reason, they were not useful for carrying passengers from one place to another. The balloons needed something that would enable men to steer them.

A gasoline engine like the one that makes automobiles go was placed in a balloon. The



Photograph from Wide World.

IN THE PICTURE YOU CAN SEE THE CARS THAT CARRY THE ENGINES, THE RUDDER, AND CAR FOR PASSENGERS FROM WHICH THE AIRSHIP ALSO IS CONTROLLED.

shape of the balloon was changed to that shown in the picture. This balloon is called a dirigible, which means that it can be steered. The gasoline engine turns a propeller which pulls the balloon through the air. At the end of the balloon are the rudders, used to steer it. You can see the shape of the rudder in the picture. Can you tell how they work?

The dirigible is cigar-shaped. Can you tell why? The frame must be built of light,

strong metals. It is then covered with fine cloth. The inside of the ship is often divided into as many as twenty rooms for the gas bags and it often has many motors. For safety, the gas is put into a number of bags instead of one large one. Then if one should burst, the others will help keep the dirigible up. The larger the dirigible, the more it can lift, if it is filled with a light gas.

The car for passengers is larger than a sleeping car on a train. It has five roomy compartments with windows and upholstered seats which can be made into beds, just as on a sleeping car. Regular meals are served on the *Los Angeles*, which was built to carry passengers. This is the airship which made the first trip from Germany across the Atlantic to the United States without making a stop. It traveled a distance of 5,060 miles in 81 hours. How many miles an hour is this?

In 1923 the United States Navy launched the *Shenandoah*, built to carry guns and men for fighting. It was filled with helium, a gas next to hydrogen in lightness and much safer since it will not burn nor explode. The *Shenandoah* traveled across the United States to the Pacific Ocean and back again, but it was

later wrecked in a storm as it was flying over Ohio.

The *Graf Zeppelin*, a dirigible larger than either the *Los Angeles* or the *Shenandoah*, in 1929 flew from Lakehurst, New Jersey, completely around the world in twenty-one days. The airship went across the Atlantic to Germany, then over Europe and Siberia to Japan. From there the *Graf* flew across the Pacific to Los Angeles and back to New Jersey. It carried passengers, mail, and freight.

People who go up in airships usually carry parachutes with them. Parachutes are like umbrellas except that they are larger and stronger. Hold an open umbrella in the air as high as you can reach, then pull on it quickly. You will find that it does not come down easily.

A parachute being much larger than an umbrella will help hold a person up in the air. He will fall, of course, but he will not fall so fast or hit the ground so hard.

Usually there is a parachute for every person who rides in an airship.

SOME THINGS TO THINK ABOUT

Can you answer these questions:

1. What difference is there between the dirigible and the balloon used long ago. In what way are they alike?
2. What difference is there between air and hydrogen?
3. What difference is there between a parachute and an umbrella? In what way are they alike?
4. With what gas are dirigibles now filled?
5. What difference is there between the speed of a train and a dirigible balloon?

SOME THINGS TO DO

Find pictures of balloons and airships in magazines.

Make an airship somewhat like the *Los Angeles* out of paper.

CHAPTER 20

WATER WHEELS

Why is it so much easier to swim with the current than against it?

Have you ever seen an old mill by a stream of water?

Do you know why there are large power houses at Niagara Falls?

At Niagara Falls the crashing of the water as it plunges down more than one hundred sixty feet and strikes the river below makes a noise like thunder. It can be heard for many miles. Spray is dashed high in the air. Can you imagine how much force or power this water has?

Niagara is the greatest waterfall in this country. Its name means "thundering water." Its power is so great that it is used to make the electricity that lights the streets and houses and drives the street cars of many cities. It has been said that if all the power of Niagara were used, it would do as much work in eight hours as a hundred million men.

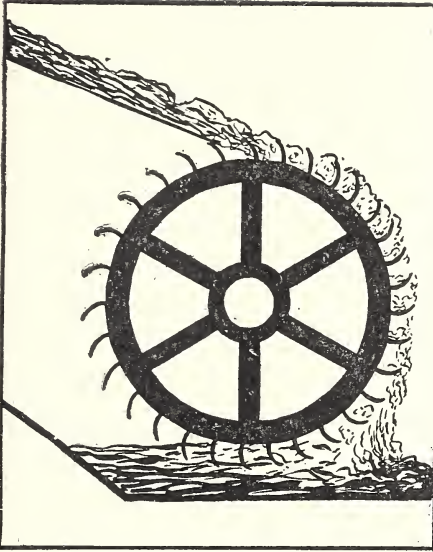


Photograph by H. Armstrong Roberts.

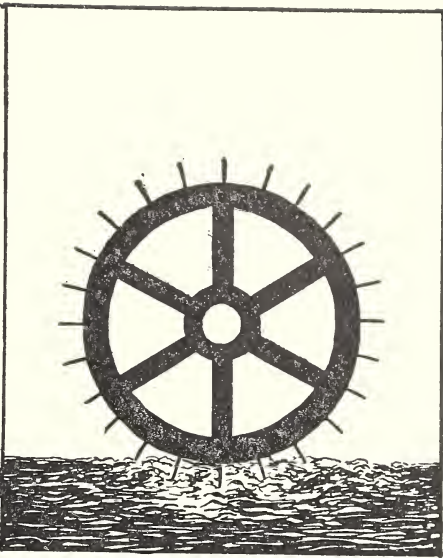
YOU MAY STILL SEE SOME OF THE OLD MILLS RUN BY THE WATER IN THE STREAMS.

There are many waterfalls scattered through the country and there is power, too, in every running stream. When you wade in a brook or a river, you can feel the push of the flowing water.

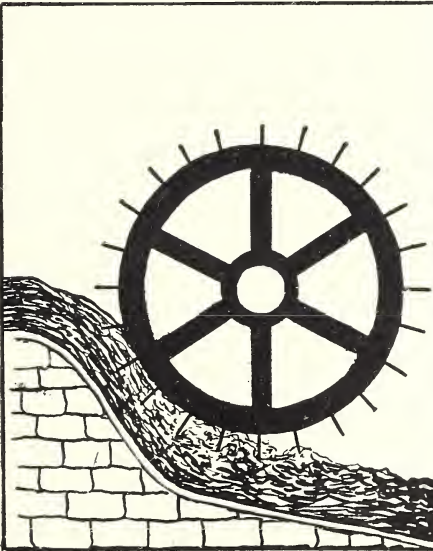
Long ago men learned to make the power of running water work for them. They made simple water wheels. They attached them to mill wheels to grind their grain. In those days the farmers came from miles around, bringing



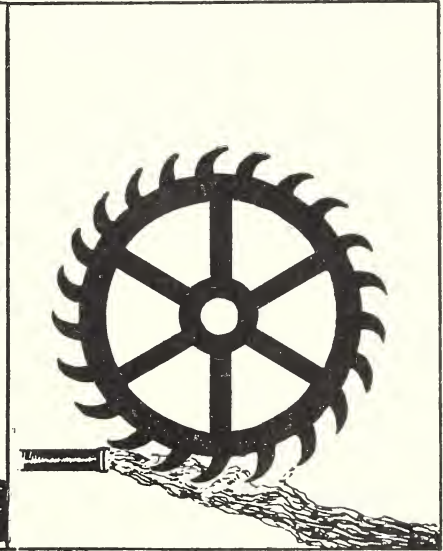
OVERSHOT WHEEL



UNDERSHOT WHEEL



BREAST WHEEL



PELTON WHEEL

THIS SHOWS HOW FOUR DIFFERENT KINDS OF WATER WHEELS ARE RUN.

their corn and wheat to be ground into meal and flour. Sometimes sawmills, too, were run by the water wheel, and logs were brought to be sawed into boards. As you travel in the country to-day you may still see some of the old mills which were once run by the flowing water in the streams.

These early water wheels were not all alike. Look carefully at the pictures. There is the overshot wheel which has buckets on its rim into which the water falls from a trough above. Both the weight and the push of the water help to turn this wheel. As it turns, the buckets underneath are emptied and come up to be filled again.

The undershot wheel has paddles around the rim. It was set into the stream and the water turned it by pushing the paddles underneath.

The breast wheel has paddles also, but the water strikes it higher up, as you would guess from the name. In this way, the weight of the water helps to turn it.

These wheels were fastened by belts to other machines. Sometimes the shaft or rod which ran through the center of the water wheel had other machinery attached to it. In one way or another, the water wheel had to be fastened to

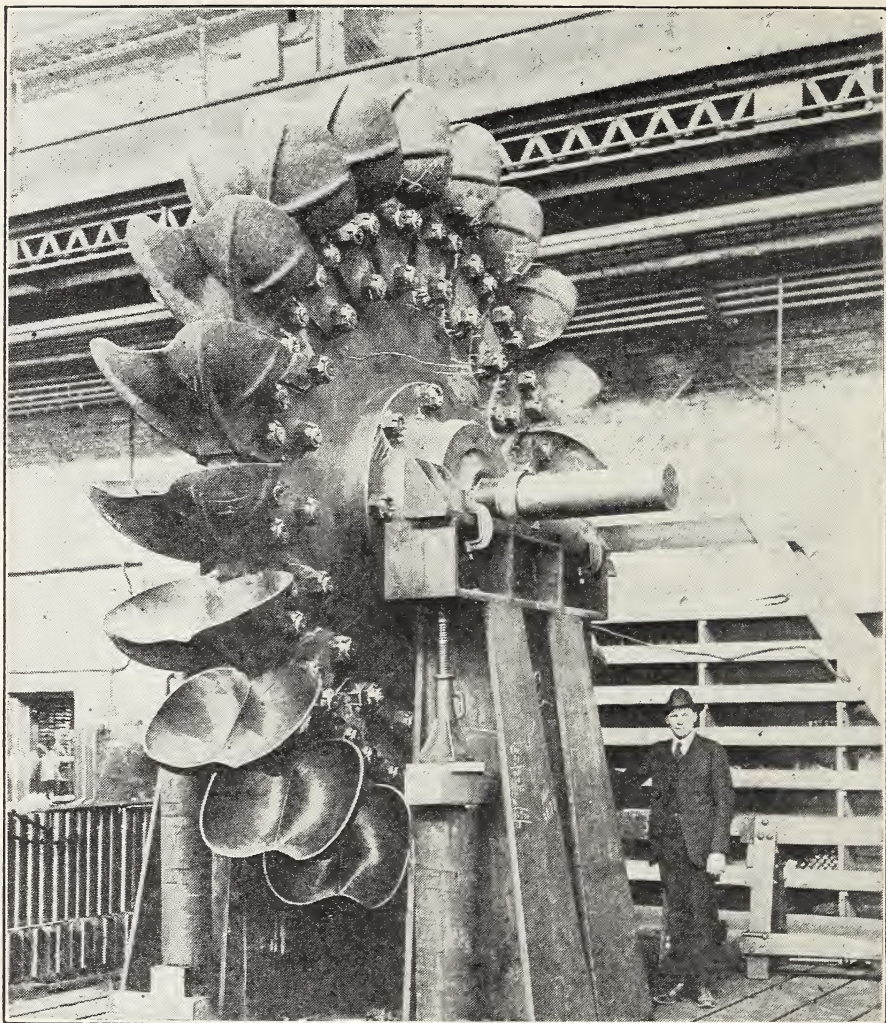
machinery in order to do any work. Perhaps you have seen such machinery.

Sometimes the stream moved swiftly enough to turn the undershot wheel. Sometimes the overshot or breast wheel was built at natural waterfalls. More often, however, a dam had to be built. From the dam to the mill, the water came rushing down in a deep narrow ditch called the mill race, or if the wheel was overshot, it poured through a wooden or metal trough into the buckets at the top of the wheel.

The old mills in country places are not used very much to-day. Their wooden water wheels are likely to be covered with moss. Now either Pelton wheels or turbines are used.

The Pelton wheel, named for the man who invented it, is often a huge iron wheel which looks very little like the old wooden water wheel. Look at the picture of the Pelton wheel. It is about three times as tall as the man standing beside it.

The Pelton wheel is widely used in the western mountains. Water is brought down in pipes from high up in the hills, and is directed through a nozzle against the buckets or cups on the rim of the wheel. The water has great force. How it roars as it dashes against the

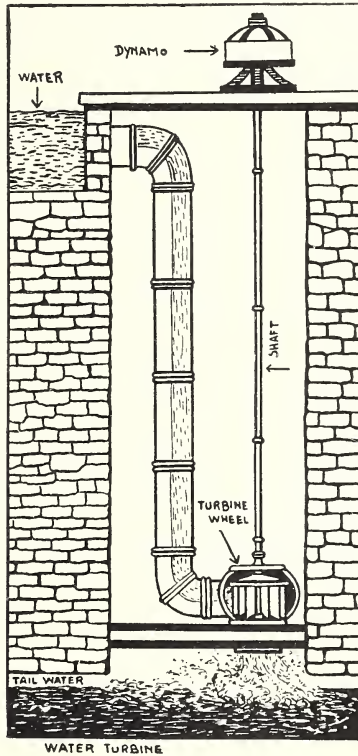


THE PELTON IS A MODERN TYPE OF WATER WHEEL.

great buckets! It turns not only the great heavy wheel but all the machinery fastened to it.

The turbine has curved blades or vanes. It is often placed on its side at the bottom of a deep

pit. About a mile above Niagara Falls, there is a canal which carries off the water that is to be used for water power. Great pipes carry it down into a pit which is 136 feet deep. At the



THE FORCE OF THE FALLING WATER MAKES THE TURBINE WHEEL SPIN.

bottom of the pit are huge turbines, some of them 8 or more feet in diameter.

The pipes that bring the water down are enlarged to make a casing for the turbine. The water is directed against the vanes of the

wheels. As the great wheels turn, they turn great dynamos to which they are fastened at the top of the pit and make electricity for all the people of the near-by cities. You will read more about electricity later. After the water has done its work, it runs out of the pit through a tunnel and back into the river below the falls.

SOME THINGS TO THINK ABOUT

Can you fill in the right word to complete these sentences?

1.is the greatest waterfall in this country.

2. The.....water wheel was run by water flowing under the wheel.

3. The.....water wheel was run by water falling on it.

4. The.....wheel is named for the man who invented it.

5. The water wheels used at Niagara Falls today are called.....

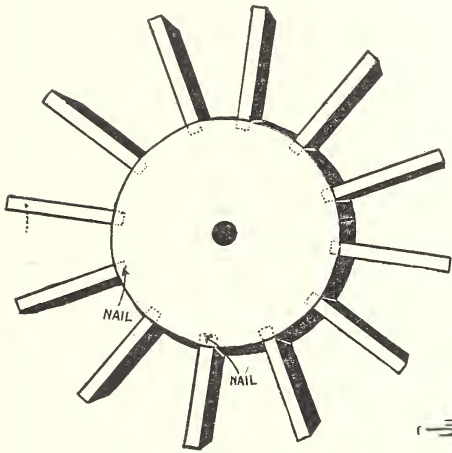
6. The mill race ran from the dam to the.....

SOME THINGS TO DO

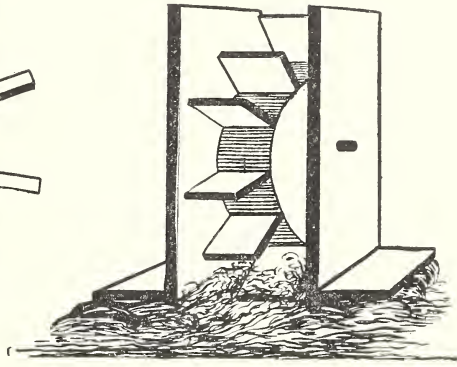
Make a simple kind of undershot water wheel. If you have some tools in your room at school or at home it will not be hard to do. Saw a wheel

about four inches across out of a board with a coping saw. Bore a hole in the middle of the wheel. Then put a round piece of wood about six inches long in the hole. This is the shaft for your water wheel. Push the wheel on so it is in the middle of the shaft.

Around the edge of the wheel make twelve saw cuts like those shown in the picture. Cut twelve



THE WHEEL.



THE WHEEL COMPLETED.

pieces of thin board about two inches long and two inches wide. You can get the thin boards from old boxes which you may get at a store. Fit the pieces of board into the saw cuts. One nail put in as shown in the picture will hold the paddles in place.

Next make a little box without ends in it so the water can run through it. Make the sides about eight inches high. Near the top of the box bore a hole in each side for the shaft of the water wheel. Now take the shaft out of the wheel and put the

wheel into the box. Then put the shaft through the side of the box, the water wheel, and the other side of the box. Put a little automobile grease on the shaft where it goes through the box. Now you are ready to try your water wheel in some stream, in the park, or the country.

CHAPTER 21

WINDMILLS

Why do we see windmills in the country and not in the city?

How does the wind turn the mill?

In what country are there large numbers of windmills?

The wind, as well as the water, has been made use of by man to help him do his work. You have probably seen a windmill. You have no doubt played with a pinwheel. Did you ever think that the wind turns the pinwheel in much the same way that it turns the windmill?

Long ago men learned to use the power of the wind. The first windmills had four large canvas sails attached to a shaft or rod. Sometimes each of these sails was thirty feet long. Can you picture them flapping in the wind?

If you have ever tried to hold an umbrella or a large sheet of paper against the wind, you know how much force it has. Perhaps you have been on the water in a sailboat. If you



Photograph by Ewing Galloway.

THE WIND TURNS THE VANES OF THESE OLD DUTCH WINDMILLS WHICH STILL GRIND GRAIN.

have, you know how the wind pushes against the sail and moves the boat through the water.

In just the same way the wind pushed against the sails of the old windmills, moving them along and turning the shaft to which they were attached. This shaft, of course, just like the shaft of the water wheel, could be made to turn any wheel attached to it.

Holland is sometimes called the "land of



NEW STEEL WINDMILLS HAVE MANY USES, BUT THE MOST IMPORTANT IS TO PUMP WATER.

windmills.” The old-fashioned kind with the great canvas sails is still in use there. They dot the country, and day after day, they pump the water from the low, wet land into the canals. If it were not for the pumps and the canals, Holland would be covered with water, for much of the land is below the level of the sea.

The windmills in use in this country look very different from these old mills with their great sails. The wind wheel is made of wooden or steel slats. The one in the picture has eighteen of these slats. Having so many of

them, they do not have to be so large as the old canvas sails. The entire wheel is usually only about eight or ten feet across. Sometimes a wheel is not more than six feet across, but there are others, used for pumping from very deep wells, that are twenty feet across.

If you will look closely at the picture, you will see the main shaft in the middle of the wheel. The slats are attached to it, so that it must turn when they do. You will also see an iron frame around the wheel near the edge. This frame holds the slats in position so that the wind strikes them on the slant. The sails of the old mills had to be turned by hand when the wind changed. Now, there is a rudder or vane that keeps the wheel turned to the wind. This is a great help, for you can imagine how hard it would be to turn the great wheel by hand.

The mills of Holland are built near to the ground. Usually, the sail which is down just misses touching the earth. In this country, the wind wheel is placed on the top of a tower, higher than the near-by trees and buildings. This allows it to get the full sweep of the wind.

On many farms the windmill is used to pump water. In the picture you can see how

the shaft of the wind wheel moves the pump rod up and down. It is a great help to the farmer to harness the wind in this way to do his pumping for him, as you would soon understand, if you were to pump some water by hand from a deep well. It is very hard to move the pump handle up and down, and on a large farm much water is needed.

In dry countries where there is not enough rainfall the crops must be watered or irrigated. The windmill is sometimes used to pump water for irrigation. On some farms it also runs machinery to grind feed or to saw wood.

There was a time when people thought that the windmill might be made to run a generator to make electricity just as a water turbine does. But the wind often blew too hard, sometimes not hard enough, and sometimes not at all. The windmill usually is used for work which can be done while the wind blows. It is most useful for pumping water, for this, after being pumped, can be kept in a tank and used when needed.

SOME THINGS TO THINK ABOUT

1. This chapter tells of three kinds of windmills. What are they?

2. It tells how windmills are used in Holland. How are they used?

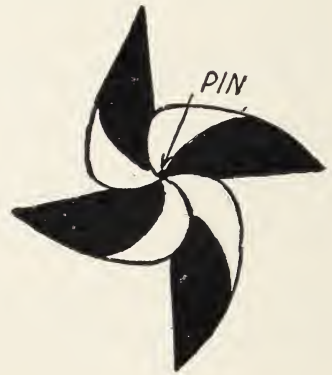
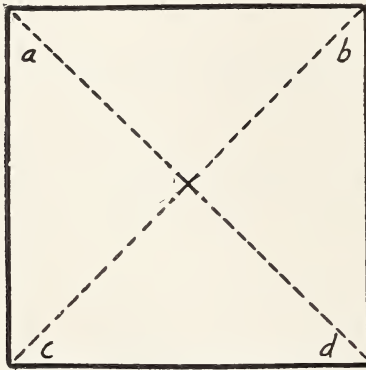
3. It tells about the improvements made in windmills. What are they?

4. It tells the use of windmills in our country. What is it?

5. This chapter tells how the wind makes the windmill work. How does it work?

SOME THINGS TO DO

Make a pinwheel. Cut a piece of strong paper three inches long and three inches wide. Draw lines as shown in the picture. Cut with the scissors



on the lines, but stop before you get to the center. Fold each corner over to the center and put a pin through all the corners and the center. Then put the pin into the end of a stick and your pinwheel is made. The stick will be the handle for your pinwheel. Hold the pinwheel to the wind and turn it in different directions. Which way does it run best?

CHAPTER 22

KITES

What kind of kite do you like best?

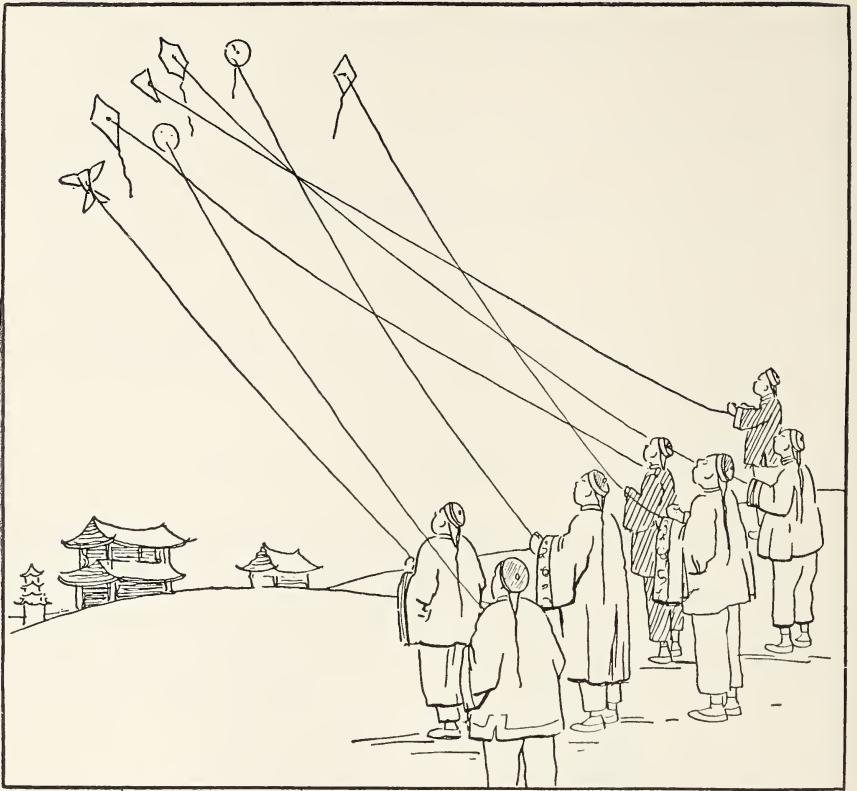
What makes a kite fly?

What is a box kite?

A kite, a string, and a boy, or a girl, is that all it takes to fly a kite? No, indeed. There is one thing more—the wind! That is why boys build kites in the winter. They are getting ready for the windy days of spring.

Did you ever feel a kite tug and pull in your hand, as if it wanted to carry you with it, as it soars higher and higher? Sometimes you run with your kite in your hand. Then the kite will seem to fly even if there is very little wind.

Does your town have a kite tournament in the spring? Some towns and cities do. Many of the children are busy building kites for weeks, large ones and small ones and pretty ones and funny ones, because usually there are prizes given for the best kite of each kind. Sometimes the prize is for the heaviest



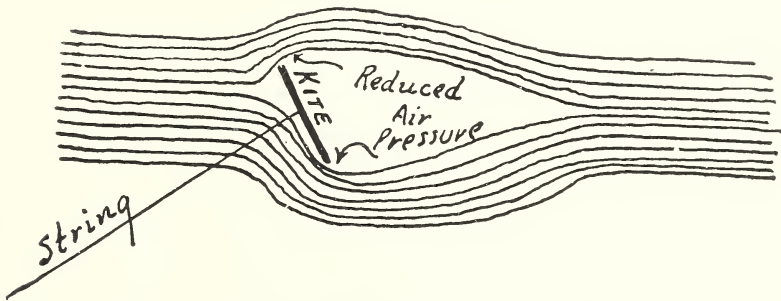
THE CHINESE HAVE FLOWN KITES FOR HUNDREDS OF YEARS.

kite. Sometimes it is for the most beautiful one, or for the one that stays in the air the longest. But no kite that will not fly can take a prize!

In this country only children fly kites, but in China kites are playthings for men and women, too. Perhaps the kite was invented by a Chinaman, for kites have been used by the Chinese for hundreds of years. They make beautiful kites in China, and strange ones, too.

On a kite-flying day there you will see dragons in the air, great dragon-kites. Some of the Chinese kites look like flowers, others like insects or birds. On a holiday whole villages will have kites in the wind; the air will be full of them.

Did you ever wonder why a kite, which is heavier than the air, will fly? If you know why



WHEN YOU PULL ON THE STRING, THE WIND BLOWS AGAINST THE UNDER SIDE OF THE KITE AND HELPS TO LIFT IT IN THE AIR.

kites fly it will be easy for you to understand how airplanes stay up in the air and fly. When you pull on the kite string with the front edge of the kite raised, the wind blows against the under side of the kite and helps to lift it. The kite will not go up unless you pull on the string, so the string really helps to lift it, too. The kite will not fly well, of course, unless it is a windy day. When the air is still, you may make the kite rise by running along with the

kite string. But as soon as you stop the kite will fall to the ground.

Kites were used as toys and playthings for many, many years before men discovered that by using a kite they could learn about the air far above the earth. Then they put thermometers and other recording instruments on kites and sent them up. In that way they learned how cold it was, and how fast the wind was blowing high above the earth.

Perhaps you remember about the use which Benjamin Franklin made of a kite. One day he wanted to find out if electricity and lightning were the same. He made a kite with a wooden frame and covered it with silk. Then he fastened a small wire to the kite. On the kite-string at the lower end he put a piece of silk ribbon and tied a key to the string. When a thunderstorm came, he put up his kite and held it by the silk ribbon. After a while he held his finger to the key and saw a spark. He had used the kite to bring electricity from the sky.

Some kites have been used by the army for signals. They have been used to lift flags or lanterns. Other kites have been used in which there was a camera which took pictures. Mar-



Photograph by H. Armstrong Roberts.

A BOX KITE NEEDS A STRONG WIND TO FLY WELL.

coni, the inventor of wireless, used a kite as an aërial in experiments. He used it to help him hear a message from across the Atlantic ocean.

Kites are used in so many different ways that you probably know of other uses.

Do you make your own kites or do you buy them from the store? If you will follow the directions which are given at the end of this chapter, you can make your own kites and have a good time doing it. A tailless kite, like the one in the picture, is a good kind of kite to make first because it will fly in less wind than other kites. It is a good lifting kite, and that is important. You can use it to send up flags.

Another good lifting kite is a box kite, but it needs a strong wind. A large box kite will lift a man. Sometimes the weather bureau uses box kites to learn about the weather. Do you know how?

Perhaps you would like to make some funny kites, with pictures of animals or faces pasted on them to make them more interesting. An easy way to make these kites is to use colored paper. Cover the sticks with red paper, then cut a face with eyes, mouth, and teeth of white paper and paste it over the red paper. Or you might cut out pictures of fishes or birds and paste them on your kite.

There are "stunts" that you can do with kites, too. One of them is flying kites tandem.

Put one kite up about a hundred feet or more, then put up another kite about 50 feet and tie the kite-string to the string of the first kite. Then let out more string and fasten another kite to the string of the first one. You will find that the two or three kites will have a much greater pull than just one kite.

Another thing that is fun is to put a paper pinwheel of colored paper on the kite string. Put the kite string through the center of the wheel and watch it go up the string. See if a flat piece of paper will go up the string.

You may not only have great fun with your kites, but you will learn many interesting things about flying, and every boy and girl is interested in flying nowadays.

SOME THINGS TO THINK ABOUT

On one side of the paper you will find the beginnings of sentences and on the other side you will find the ends of sentences.

Write the number for the beginning of each sentence on a piece of paper and opposite the number write the correct ending.

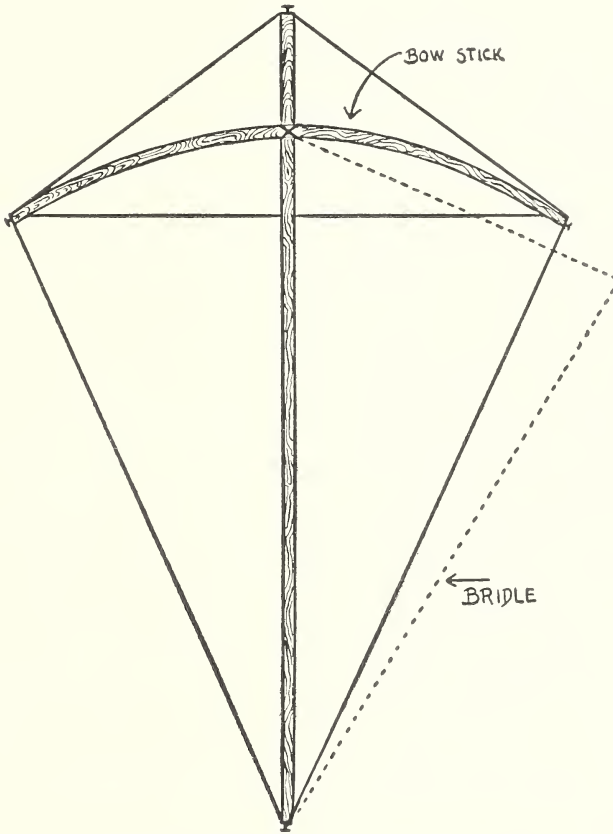
- | | |
|---------------------------|---------------------|
| 1. Kites | 1. for toys. |
| 2. Kites may have
been | 2. for experiments. |

- | | |
|--------------------|---|
| 3. The kite string | 3. used for signals. |
| 4. The wind blows | 4. fly with very little wind. |
| 5. Kites are | 5. to learn about the air far above the earth. |
| 6. Tailless kites | 6. against the lower side of the kite and helps to lift it. |
| 7. Kites are used | 7. helps to lift the kite. |
| | 8. are favorite toys. |
| | 9. invented by a Chinaman. |

SOME THINGS TO DO

Make a tailless kite. Find two thin sticks of wood about forty inches long and about as thin as regular cigar-box wood. Cross the sticks about eight inches from the ends of them. Put a little nail through the two sticks to fasten them together firmly. Then tie the sticks with strong string as shown in the picture. Put a little nail in the end of each stick. Lay the sticks flat on a table and bend one stick so that its center is about five inches above the table. Fasten a strong string across from one end of the bow stick to the other end. Then fasten a string to each nail in the end of each stick. You may now cover your kite with tissue paper or newspaper, fastening the edges to the string.

Make the bridle of string as shown in the picture. Fasten a string to the wood, where the sticks cross, and to the end of the stick. The string



HOW TO MAKE A TAILLESS KITE.

should be long enough to reach to the side of the kite as shown in the picture. Tie the flying string to the bridle and you are ready to try your kite.

After you have made this kind of kite and flown it you will be eager to try other kinds.

CHAPTER 23

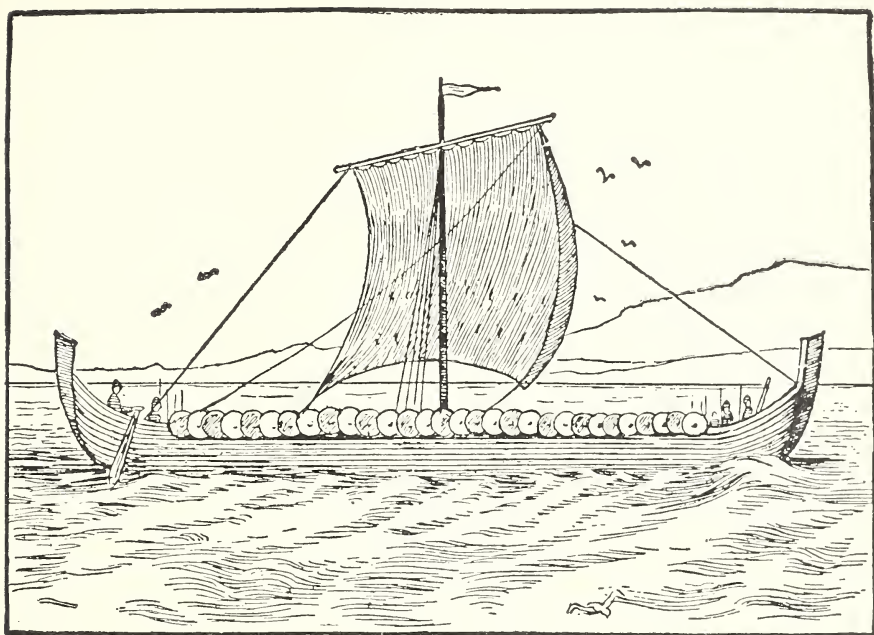
SAILBOATS

How is a sailboat guided?
Can you sail without wind?
Have you ever seen a yacht?

Do you know the story of "Old Ironsides?" It was our most famous square-rigged ship. It had many sails and was able to go very fast.

The sailboats of long ago were very different from our sailboats of to-day. The very early boat used by the Egyptians was small and had one mast with a square sail. The Viking ship was small and had a sail, but also had oars pulled by men to send it through the water on calm days. It was with such a boat that the Norsemen crossed the Atlantic Ocean. Their boats were very small, and only brave men would start to cross the ocean in them.

At a later time, sailboats were built with three masts and high sides. These ships had a deck and cabin. Spain built the swiftest of these ships. Columbus used a Spanish ship



THE NORSEMEN CROSSED THE ATLANTIC IN A LITTLE VIKING SHIP LIKE THIS.

with three masts for his trip across the Atlantic Ocean. Even these ships were not large. Of the three ships Columbus had, the *Santa Maria* was the largest, but the steamships that cross the Atlantic Ocean to-day are more than 300 times as large as it was. Soon after Columbus made his voyage the French built a ship with four masts.

The Spanish galleon was another kind of ship with sails. The sides were built high and with heavy material. You may have seen a model of the galleon in a store. Some people

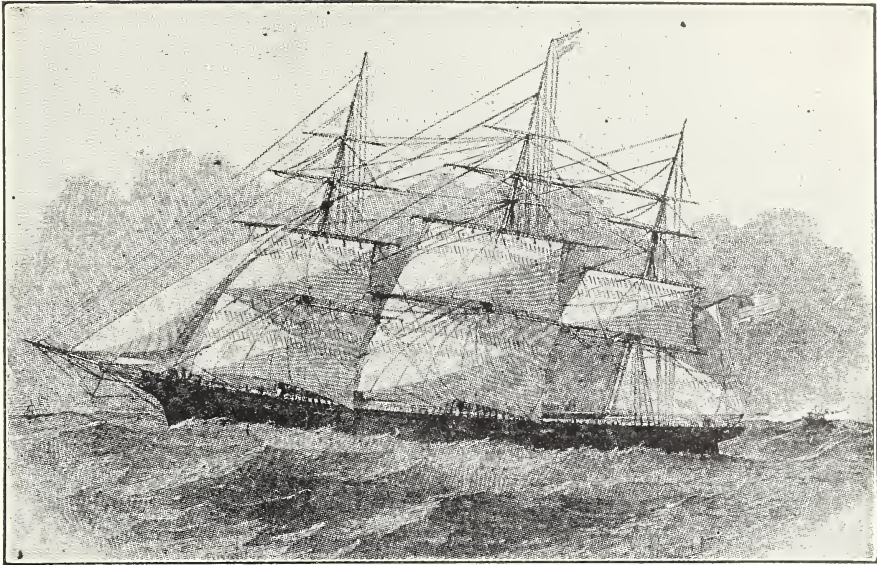
buy them as decorations for the home. It is fun to make models of this kind of sailing ship.

The frigates were built a little later. You may have seen pictures of the frigate in the motion picture show. They were not only built



MANY PIRATE SHIPS HAD CARVED FIGURES ON THE PROW AND MANY GUNS.

in England but here in America as well. These sailing ships could cross the Atlantic Ocean in about 25 or 30 days. It was during this time that the people began to use the wheel to steer ships. The wheel was fastened to ropes coming from the rudder. When the wheel was turned to the right, the rudder moved one way. When it was turned to the left, it moved the other



THE "SOVEREIGN OF THE SEAS" WAS ONE OF THE FINEST OF THE CLIPPER SHIPS.

way. Each time the rudder is moved the course of the ship is changed. Before the wheel was used a lever or handle was fastened to the rudder. This lever was called a tiller. It is still used on small sailboats and iceboats.

You may have seen pictures of pirate ships in the motion picture show. Did they look like any of these ships you have read about? Many of the pirate ships had carved figures on the prow and guns.

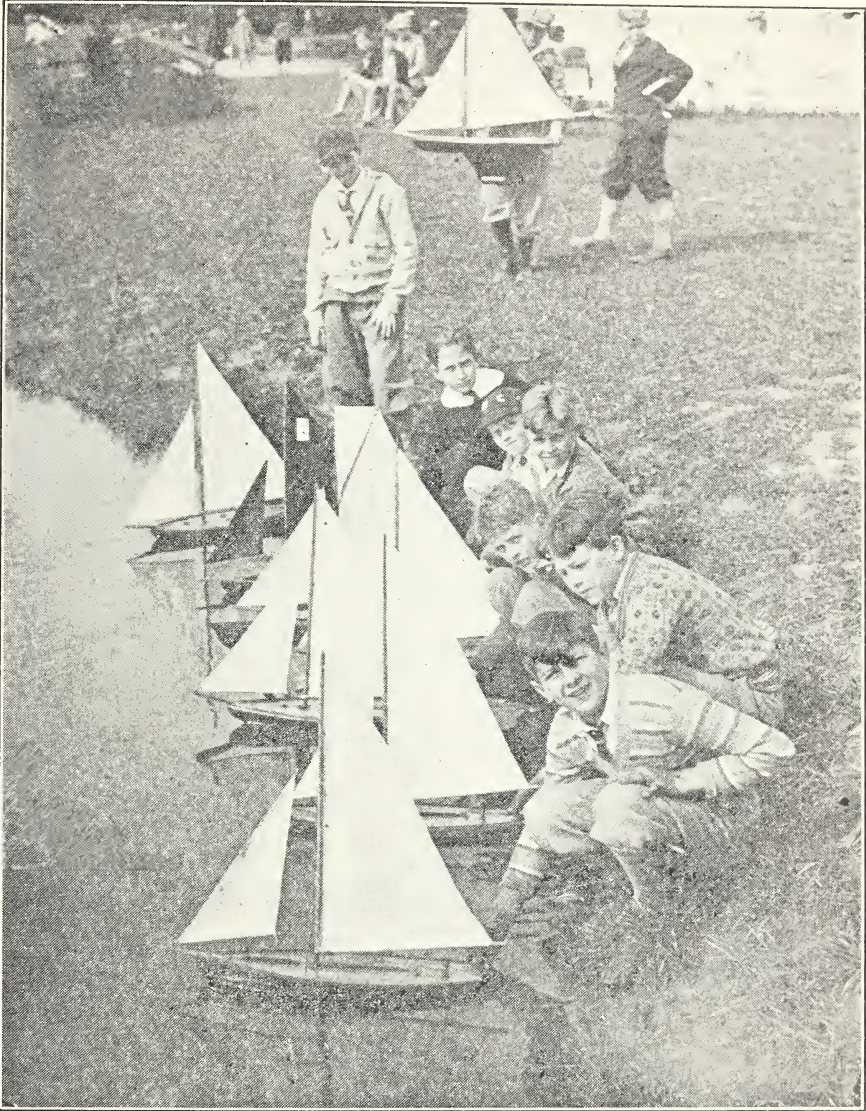
What an adventure it would have been about seventy-five years ago to take a trip on one of the clipper ships! They were the fastest sail-

ing ships that had been built up to that time. The *Sovereign of the Seas* was one of the finest of these beautiful ships. This ship has a record of 437 miles for her best day's run on a trip from New York to San Francisco. This is the world's record for any sailing ship on any sea. The clipper ship, *The Flying Cloud*, made 433½ miles in one day. The clipper ships were built in New England.

The period of the beautiful clipper ship was a short one. The ships that took the place of these sailing ships were made of iron and were driven by steam engines instead of by wind and sail. Robert Fulson built the first successful steam-driven boat. John Fitch ran a steamboat from Burlington to Trenton on the Delaware in 1788 and a few years later Robert Fulton ran a steamboat on the Hudson river.

In this country we still have many sailing ships but they sail only along the coast or on the lakes. They have two, three, or four masts and are called schooners. Schooners to-day are used mainly in the lumber and fishing industries.

The yacht is a sailboat that is used for pleasure. People use it for racing and for short trips. Yacht races are very interesting. Have



Courtesy of the Montclair Public Schools.

BOYS AND GIRLS CAN MAKE THEIR OWN MODELS OF SHIPS.

you read about the two yachts, the *Shamrock* and the *Reliance*?

What an adventure it would be to put sails

on a rowboat and go sailing on the river! This would not be a fancy yacht, but one could have a good time with it.

Men used the sail to make their ships go with the wind for a long time. Then they learned how to make the ship go against the wind. It may seem very strange that ships can be made to sail against the wind. This was a discovery of very great importance. When the great Spanish Armada went out to conquer England, it could only move with the wind. But the English ships could sail into the wind. This gave them such an advantage that the Armada was defeated. Thus the importance of this new kind of ship in battle was clearly shown.

SOME THINGS TO THINK ABOUT

Can you fill in the words to complete the sentences correctly?

1. The early Egyptian sailboats had.....mast.
2. Columbus used a Spanish ship with.....masts.
3. The steamships of to-day are more than.....times as large as the ship in which Columbus sailed.
4. The *Sovereign of the Seas* was the.....sailboat.

5. It sailed.....miles in one day.
6.is a sailboat used for pleasure.
7.have taken the place of the sailboat.

SOME THINGS TO DO

Draw pictures of some of the sailboats you have read about in this chapter.

Make a model of the sailboat you like best.

Visit the stores or a museum to see the models of the ships. This will help in making your model. You may not be able to make a ship just like the models but do the best you can. Read carefully the descriptions and look at the pictures in this reader before you begin. You will find other books in the library that will help you to make your model.

CHAPTER 24

BIRD BATHS AND FEEDING BOXES

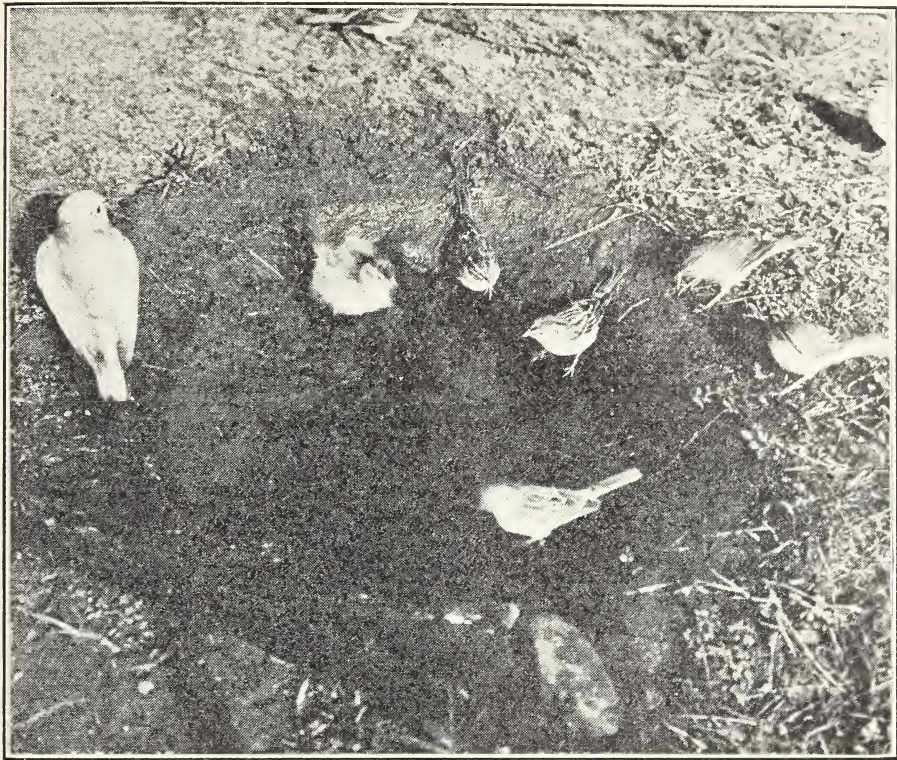
What birds have you seen since we were reading about our winter birds?

Have you a bird bath in your yard? Do the birds use it in winter?

Should feeding tables for birds be put on the north or the south side of the house?

Birds like to take baths, even in winter. Let's watch those English sparrows splashing away there at the fountain. See how they duck and splash, throwing the water in all directions. Here is a newcomer. Let's see what he does. How fine he looks in his gray-brown suit with its light wing bars, and its black bib.

He is standing on the edge of the basin, chirping away, but he hasn't got his toes wet yet. He hops into the water, where it is about half an inch deep, and out he hops again. More chirping and dancing about. There, he goes in again, this time in water an inch deep. But out he comes again. He seems to need more cour-



Courtesy of "Nature Magazine."

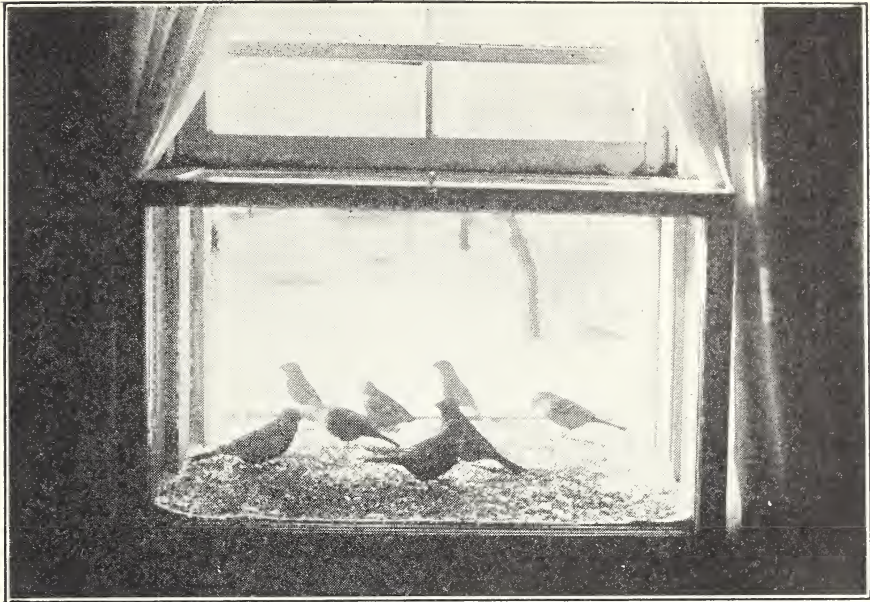
BIRDS LIKE TO TAKE BATHS, EVEN IN WINTER.

age. After a little waiting, he goes in again, at the same place. This time he stays. Just watch him splash. First, he strikes his bill into the water from side to side; then he raises his feathers all over his body, and with his wings throws water over his back. Now he is wet all over, and seems to be glad of it. Have you ever felt that way when you were in swimming? Now he is splashing away with the best of them.

A minute or two of this fun, and out he flies to a near-by bush. There he sits for a moment and starts to slick himself up, but he sees the others still having a good time in the water, so he flies back and joins them again for another good splash. A minute later he returns to his perch, and starts to dress or preen his wet feathers again. After five minutes of this, he seems to be sure that every feather is straight and in its right place. In this rapid work with bill and foot, he hasn't made a single awkward movement. Away he flies to another part of the park.

Your bird bath should be on the south side of the house, for that is the sunny side. You can use any shallow, wide vessel, but metal pans will soon rust unless they are painted thoroughly inside and out. A shallow enamel vessel would last well. Larger bird baths are made of cement. They should never be more than three inches deep, and shallower toward the edges.

Only for safety from cats, the bird bath should be at least four feet above the ground. After a bath, birds fly to near-by perches to preen their feathers. If the bath is placed near a sunny window sill, the birds will go there to

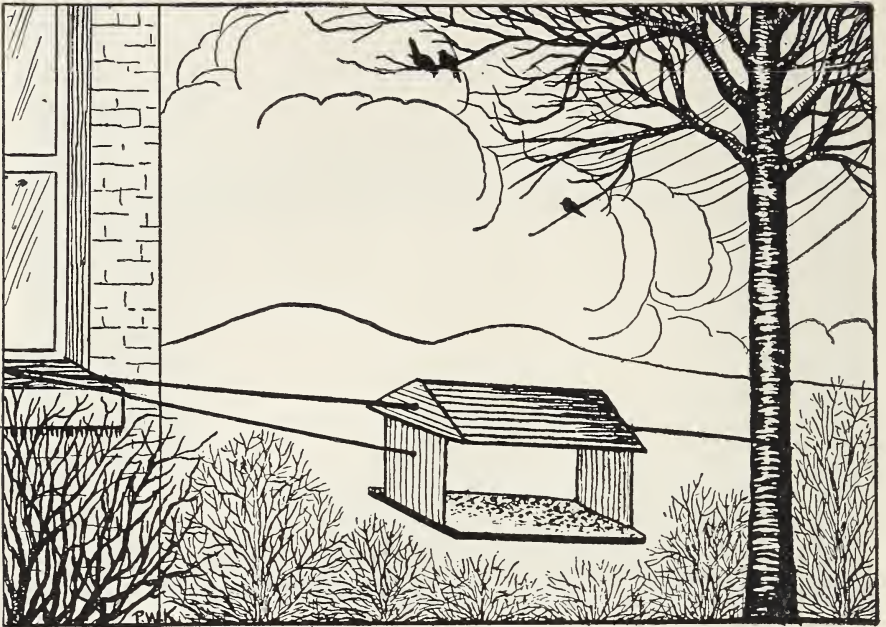


Courtesy of "Nature Magazine."

A WINDOW FEEDING BOX ATTRACTS MANY BIRDS.

dress their feathers, and you will have a very good chance to see them at a distance of only a few inches. Sitting quietly just inside the window, with the shade down so as to hide your face, you can see the bird's colors and its movements very well. You can also hear many of its notes that you have never heard before.

We have another chance to see birds when they come to our feeding boxes and tables, although we cannot get so close to them. These feeding boxes and tables should be put up early in the winter. When snow and sleet cover the weeds, seeds, and berries, the birds have a



THIS KIND OF FEEDING BOX CAN BE FASTENED TO A TREE.

hard time finding food. As we have already learned, the feeding box or table must be put out of the way of cats. The feeding box, open on one side only, gives better protection to the birds than the feeding table, but you cannot see your guests so well when they visit it. Half the fun of feeding the birds is to see them. A feeding table that has a wide roof to keep the snow off is very good. The roof should be high enough for you to see under it.

This feeding box can be fastened to a tree or to the house near a window where you can easily reach it to place food. In the picture you

see one hung on a cord that is cat proof.

Be sure to put water out for the birds each day. In very cold weather this will freeze quickly and should be renewed.

Some birds are very fond of suet and others like fresh fruit and vegetables. To prevent these things from being carried off by the birds, they should be put into little baskets made of wire.

SOME THINGS TO THINK ABOUT

Can you fill in the words which complete these sentences correctly?

1. Birds like to take baths, even in.....
2. A bird bath should not be more than..... inches deep, and should be.....toward the edges.
3. Bird baths should be put near a.....win-
dow.
4. Feeding boxes and tables attract birds in
.....
5. Be sure to put.....out for the birds every day.
6. Some birds are very fond of.....and others like fresh.....and.....

SOME THINGS TO DO

Through the summer and autumn gather ripe grass seed and weed seed. Spread these out to dry

in the sun on a big newspaper for several hours, and then store them in a dry place. These seeds will add to your bill of fare for the birds in winter.

Put up a bird bath and a feeding table in your yard.

Keep a record of the birds that visit it.

CHAPTER 25

THE BIRDS' RETURN

What is the first spring month?

What signs of spring do you hear in the air?

What signs of spring do you see in the ground?

The first warm days that come after the snow and ice of winter disappear make several things happen. Down by the spring in the woods the swamp cabbages poke their curled green leaves through the black mud. Even before they appear, the red spotted flower caps have pushed their way up.

In the bushes by the roadside the song sparrow has found his song again. Overhead, the white-maple trees are putting out their little yellow tufts of bloom. Hanging over the side of the old stone wall you can see those strings of yellow gold, the star-like flowers of the yellow jasmine.

With these signs of early spring comes a new note from the top of the tall white-pine tree: "Chisel dee, chisel dee." That is a restless

fellow up there, and if we watch a moment he may fly out. There he goes; he is black all over and is nearly a foot long. His tail is as long as his body and is V-shaped at the end. We can see it as he flies away from us. We call him the boat-tailed grackle, or just blackbird when we want to give him a short name.

He has flown down to the garden over there where a man is plowing. Let's try to get a closer view of him. There he is with his head just above the furrow. You see he is walking like a chicken. He doesn't run like a robin or hop like a sparrow. He is looking for fat grubs or larvas, and he seems to know that these can be found best where the gardener's plow has turned the soil. Now we are near enough to see him well. Look at the beautiful colors on his neck in the sunlight, and the white ring around his eye.

He and his mate will soon be building their nest in the top of the old white-pine tree where they will live till Jack Frost comes again. During the summer months many a bug and beetle and grasshopper and a few cherries and some young corn will go to feed the growing family of the grackles.

We are always glad to hear the early spring



THIS GRACKLE IS FEEDING ITS YOUNG.

“chisel dees” of the grackle, and to see its strong, straight flight across the March sky. When they gather in enormous flocks in the autumn ready for their flight south they make a great racket each evening before they go to sleep.

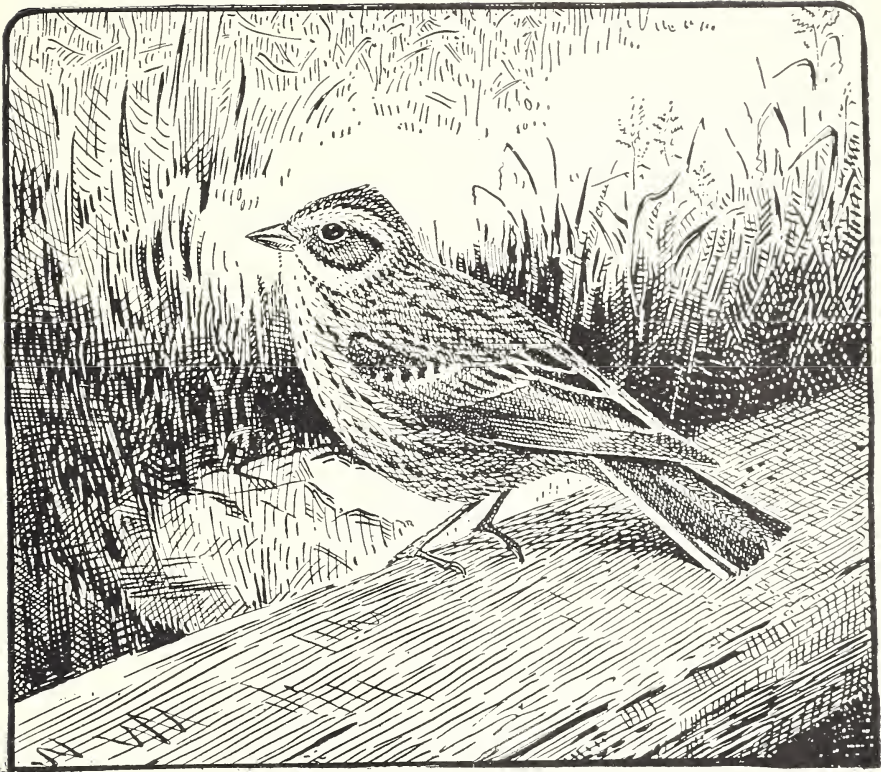
While the grackles are calling from the old pine top, we hear another note from the meadow. This one is sharp and clear. You can hear it a long way. It sounds like “Chee er, Chee er.” This is the spring greeting from the

meadowlark. He sings as he walks in the brown grass. His back and sides are brown, but his breast is yellow, and he wears a black bib. Let's get close enough to see him, if we can. Oh, there he flies. He saw us first. See the rapid wing-beats and the white feathers along the sides of his tail as he flies quickly to the ground.

He and his mate will build a nest in a clump of grass soon, and when the five speckled eggs hatch, many a cricket and grasshopper will be caught to feed the hungry little ones.

The meadowlarks stay later in the autumn than the grackles. Sometimes they stay all winter.

After the grackles and meadowlarks are started on their housekeeping, a new song comes from the lowlands just as the day is closing. The little singer stands on a fence post or the top of a bush, and, with his bill held high, he gives us his twilight or vesper song. He belongs to the sparrow family, and because he sings at vesper time he is called the vesper sparrow. Starting with a trill, his song breaks into a series of "seep, seep, seer, seer, seep, seers." As we come closer to him, he flies to another bush, and shows us his white tail



Courtesy of the U. S. Biological Survey.

THE LITTLE VESPER SPARROW IS ANOTHER OF THE BIRDS THAT RETURN TO US IN THE SPRING.

feathers, just as did the junco and meadow-lark.

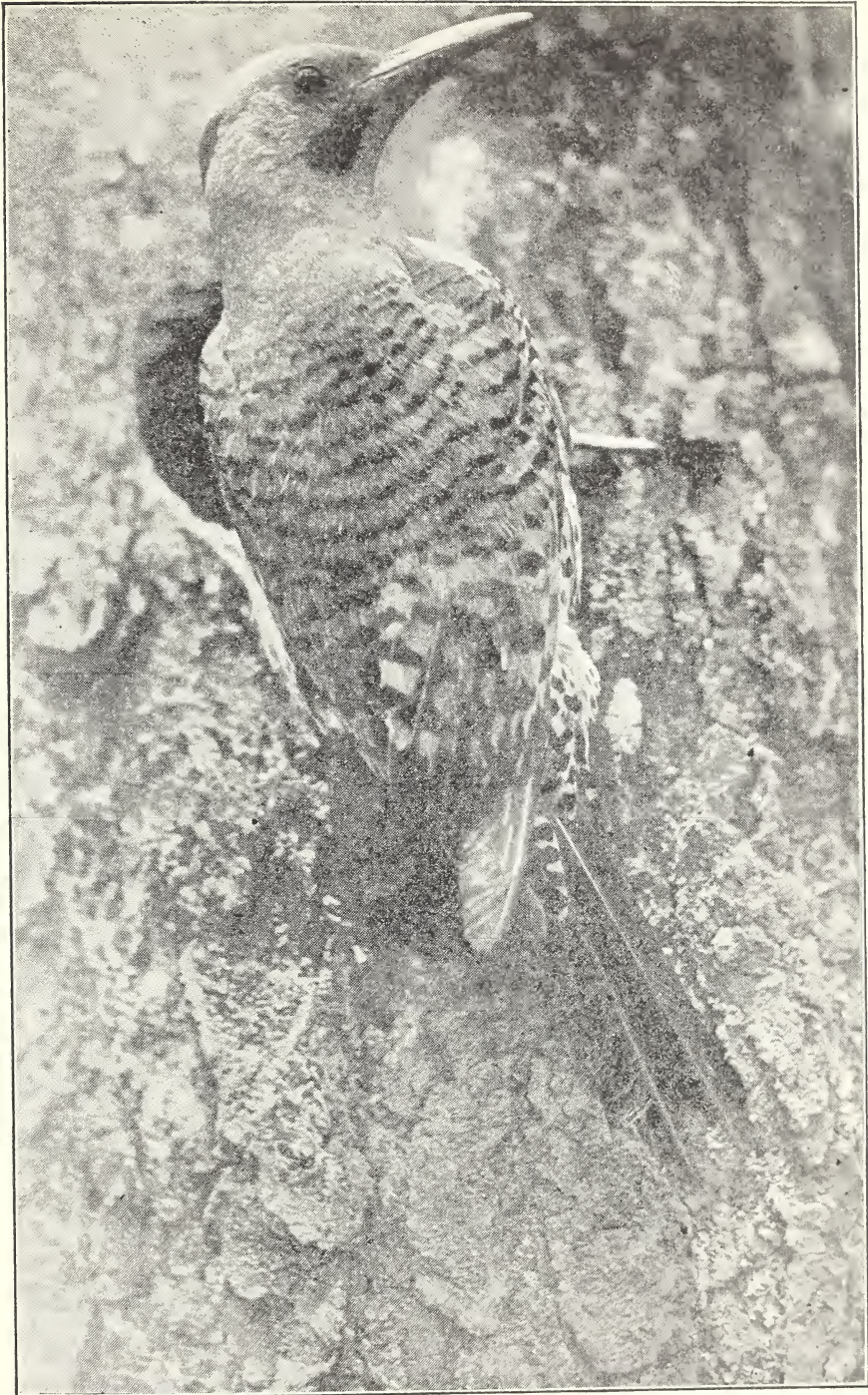
One of the interesting sights in the early spring woods is a flock of flickers, busily searching for ants and other insects under the brown leaves. If it were not for their movements we could hardly see them, for they are brown like the leaves. When they see us coming, they fly away from us, keeping close to the

ground. As each one spreads his wings in flight, he uncovers the big white spot in the middle of his back. It looks as if a number of rabbits were running away from us, showing their "cotton tails." In a few days the flickers begin to choose their mates. Here and there throughout the bare woods we can hear their queer love song—"Wick up, wick up, wick up."

Here is a young fellow looking very fine and handsome. He wears a new brown suit and a crimson cap on the back of his head. His fawn waistcoat is decorated with jet black dots and a jet black crescent across his breast. The under side of each wing and tail feather is golden yellow, and his bill shines ebony black in the sunlight.

After showing off all these fine colors to his mate, while they sit lengthwise on a high limb, he flies to a near-by tree, and hammers its trunk with his strong bill. Then he seems to listen for an answer from some other flicker away off in the woods, and says "Skew" and hammers again.

Soon the flickers choose a dead limb or tree trunk for their nest, and dig a hole as large as your fist in it with their bills. Six or seven eggs



Photograph by L. W. Brownell.

A HOLE IN A DEAD LIMB OR TREE TRUNK IS THE HOME OF THE
FLICKER.

are then laid on the sawdust nest, and after two weeks these begin to hatch.

The flicker's flight is like that of the goldfinch. He flies in dips and rises. So do all the other woodpeckers. The flicker is one of the largest of that family, and the downy woodpecker is the smallest. You may have seen the downy woodpecker at your feeding table, for he stays all year.

A month after the flickers appear we see another woodpecker in the woods. He is smaller than the flicker and larger than the downy woodpecker. He is much brighter in color than either. He has a crimson head, a blue and white body, and blue and white wings. He doesn't say "Wick up," nor "Skew," but he says "Skurl, Skurl." He arrives just about the time cherries are turning red, and he likes red cherries.

He makes a hole in a dead tree as the flickers and other woodpeckers do and makes his nest inside. This is the red-headed woodpecker. His mate lays six white eggs and after they hatch, the mother and father woodpecker kill so many insects to feed their babies that they more than pay for the cherries they ate earlier.

SOME THINGS TO THINK ABOUT

Some of the following sentences are true and some are not true. On a page in your notebook, put the numbers one to ten in a column. Write *True* after each true sentence number and *False* after each false one.

1. We look for the grackles early in the spring.
2. Grackles often build their nests in tall pine trees.
4. The bird that sings "chee er, chee er" is the grackle.
4. The vesper sparrow sings in the morning.
5. Three members of the woodpecker family are the downy, flicker, and red-headed.
6. The red-headed woodpecker stays with us all year.
7. The downy shows a white spot in his back when he flies.
8. The red-headed woodpecker likes cherries but he and his mate feed their young on insects.
9. The grackle and the flicker fly south when spring comes.

SOME THINGS TO DO

Try to see whether woodpeckers perch like other birds.

Name the birds told about in this chapter, and see if you can imitate the song of each.

Watch for each one in the spring. Try to see its colors and its flight.

Watch the flicker and see if you can tell why it is called the "yellow hammer."

Keep a record of the dates on which you first see each of these birds in the spring.

CHAPTER 26

GROWING PLANTS FOR OUR GARDEN

Have you ever had a garden of your own?

What flowers are you going to plant in your garden?

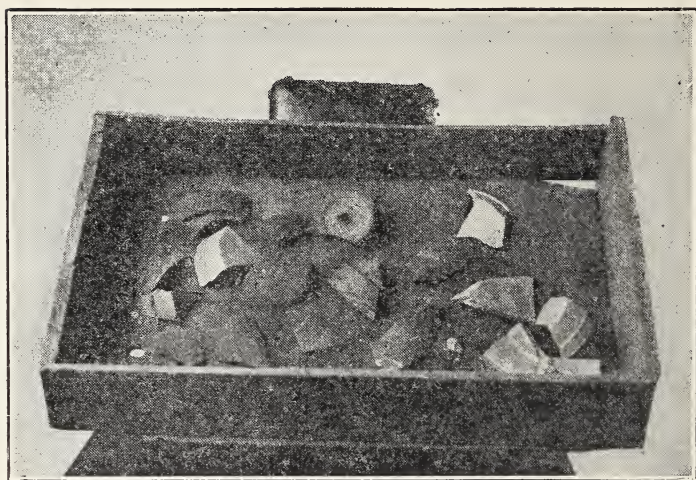
What vegetables are you going to plant?

You have already read about the care of a small garden. This year have a larger garden of your own.

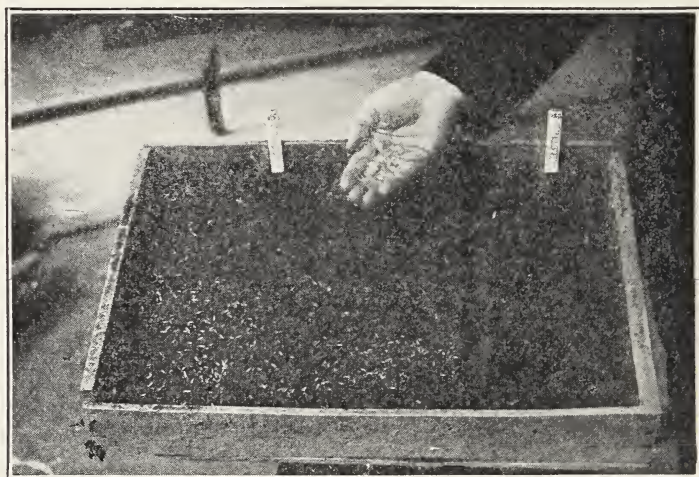
The first thing to do is to plan it. There are many flowers and vegetables that you could plant. But it is better to choose a few flowers and a few vegetables and divide your garden into two sections.

In one section plant flowers such as the nasturtiums, zinnias, and cosmos. In the other section plant vegetables such as radishes, lettuce and tomatoes.

A garden could be planted around Easter time. Jack Frost is still around then, however, and he might nip the little plants just as they were starting so it is safer and wiser to start a garden in the house.



CRACKED FLOWER POTS SHOULD BE PUT IN THE BOTTOM OF THE BOX SO IT WILL DRAIN WELL.

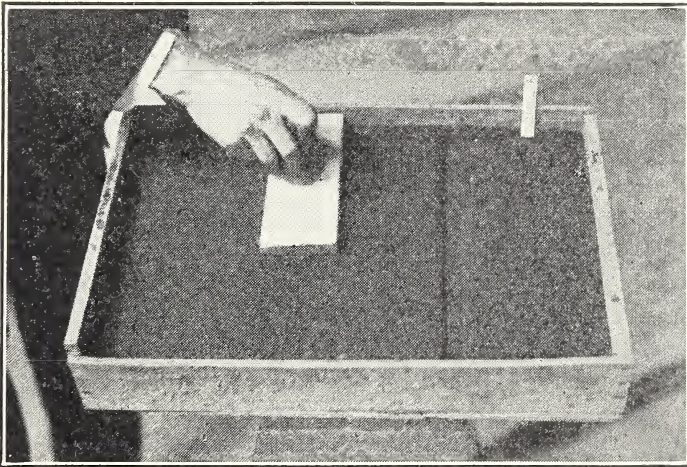


AFTER THE SEEDS ARE PLANTED, PUT LABELS SO YOU WILL KNOW THE SEEDLINGS WHEN THEY COME UP.

Shallow boxes filled with earth make fine schoolroom gardens. Boys and girls often volunteer to bring the things that are needed—empty boxes, rich earth from the woods, a



SHAKE SOME FINE EARTH OVER THE SEEDS WITH A SIFTER.



PRESS THE EARTH FIRMLY AND WATER THE BOX. THEN WATCH FOR THE SEEDLINGS.

small watering pot, some wooden plant labels, and a few pennies for the seeds.

After the boxes are filled with earth, little furrows are made about two inches apart. Then

the seeds are dropped in the furrows one at a time, about an inch apart. The nasturtium seeds are large so they are dropped in the furrow about two inches apart, and covered more deeply than the others. Small seeds need only about a quarter of an inch of earth over them, but nasturtium seeds should be covered a half-inch deep.

After the seeds are planted and the earth pressed down, the box gardens should have a little shower of water from the watering pot. Then they should be set away in a closet or dark place for a day or two.

Very soon signs of life will be seen along the furrows. Little seed leaves will appear and children who have not forgotten to label each furrow when they finished planting will now be glad.

It is great fun to watch the seedlings grow. Some grow faster than others. Some are much smaller than others. Some have round leaves and some have thin, slender leaves.

As soon as the seed leaves appear, the box gardens are put on the window sill in the light. Twice a day they should be watered but just a little sprinkle from the watering pot.

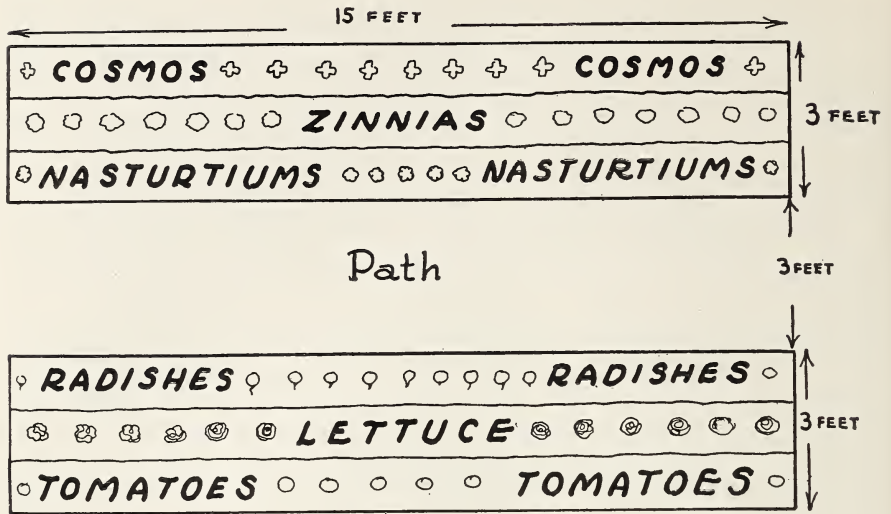
The little seed leaves have been doing all the

work of feeding the plant. After a week the real leaves, the kind the plant will have all summer, appear. The little plants will soon be ready to live in the big garden out-of-doors.

In another week you can safely transplant the flowers and vegetables; that is, put them in the summer garden. There is no danger from Jack Frost. He has gone for the season. The outdoor garden should be cleared of all trash. The soil should be turned over so that the fresh air can mix with the grains of sand, for plants, like human beings, need fresh air. Then it should be made smooth with a rake and hoe.

When the garden is all ready for the little plants you should be careful how you arrange them. You know sunlight is needed for plant growth so the shortest plants should be set nearest the path. Where should the tallest plants be set? Why? To keep the rows straight a good gardener uses a string drawn from one end of the garden to the other. Each end of the string is fastened to a little stake. These stakes are moved when each row is planted or transplanted.

The cosmos is planted on the last row because that will grow taller than anything else



PLAN FOR A VEGETABLE AND FLOWER GARDEN.

in the garden, the zinnias are next planted in the flower section and then the nasturtiums. You may plant as many different kinds of vegetables and flowers as you choose, but be careful of the arrangement.

In the vegetable section the tomatoes should be planted on the last row as they grow very tall. In what rows are you going to plant your radishes and lettuce?

You must think also about the amount of space each plant will take up. Tomatoes, for example, will take up a great deal of room later on, so should be planted rather far apart, from one to two feet depending upon the kind. The radishes and lettuce should be planted about



A GOOD GARDEN SHOULD BE WEEDED OFTEN.

two inches apart, the cosmos and zinnias about six inches apart, and the nasturtiums a little farther.

You have already learned how to plant a tree and in transplanting the plants from your window garden to the outdoor garden you should handle them in the same way.

After your garden is planned and planted, then comes the care of it.

On hot dry days the garden should be watered with a watering can. The can may have to be filled a good many times for all the plants to get a good drink. The soil needs to be hoed

and raked frequently so that the weeds cannot grow among the flowers and vegetables.

The stems of the tomato plants may not be strong enough to support the plants when fully grown. Stakes should be put in the ground beside them when you see they are beginning to bend over, unable to hold themselves in an upright position. The plants are tied to these stakes with pieces of twine and then they cannot fall over. To make the plants tall and full instead of thin and spreading the side branches should be pinched off as they start to grow.

When school begins again in September, if you have done your work well, you will be able to show your schoolmates beautiful flowers and fine ripe tomatoes. How proud you will then be of your garden!

SOME THINGS TO THINK ABOUT

Can you fill in the word or words to complete these sentences correctly?

1. It is interesting to watch your own.....
grow.
2. Three favorite flowers for the garden are
.....,and.....
3. Three vegetables often planted are.....,
.....and.....

4. Seeds may be started indoors in.....
5. In order not to forget the kind of seed planted in a row, the row should be.....
6. When planning our garden, we should be sure to have the.....plants nearest the path.
7. Plants grow best when the soil of the garden is kept.....

SOME THINGS TO DO

Plan a garden for the out-of-doors.

Start some box gardens indoors.

When warm weather comes set your plants out
in the big garden.

CHAPTER 27

SHEEP

Did you ever see sheep feeding in a pasture?
Where are the largest flocks of sheep found?
Why is woolen clothing the warmest?

The hair in your woolen sweater was first worn by sheep. The sheep's hair is cut off its body and spun into yarn. That yarn may be knit into sweaters or woven into cloth.

Many years ago when the sheep were wild animals and roamed about the mountains their wool became thick to protect them from the cold, and now we wear it to protect us from the cold.

A strand of wool has little scales on it. These scales are so very small that you cannot see them with your eyes. They give the wool the crinkly appearance. But when this wool is spun into yarn, the little scales on one hair catch and tangle with those of the others and make the yarn strong and warm.

Some sheep fur is used for lining coats and



Photograph by Charles J. Belden.

THE MOTHER SHEEP AND A LAMB.

some lambs have such beautiful curly hair that it is used for the outside of the coat where it shows.

When the sheep were wild animals, they gathered together for protection and had watchers to warn them of danger. As soon as the signal came, they made their escape following a leader over rocks and ledges.

If you watch a flock of sheep, you can see them follow their leader.

The teeth of the sheep are arranged so that

they can cut off small grass at the roots. They are able to find plenty of food in a place where cattle would starve to death.

In the picture you see the mother sheep, called the ewe, and the young sheep, called the lamb. The father sheep, the ram, is strong and brave and uses his big horns to defend his flock against their enemies.

Our largest flocks of sheep are to be found in the western mountain states. They often have to go up over the sides of mountains to find grass to eat. These paths are very steep and dangerous, but the sheep is a very sure-footed animal. Its feet have strong sharp hoofs. Each hoof is divided into two parts and these can be moved slightly, somewhat like our fingers, though they cannot be bent. These little hoofs help the sheep very much in keeping its foothold on stony, sloping ground. Do you now know why it is called sure-footed?

The wool forms for the sheep a loose coat and allows air to get in between the skin and the coat. This air is warmed by the sheep's body and in cold weather the coat of wool keeps the colder air from getting in, and in hot weather it keeps the warmer air out. By holding this layer of air close to the sheep's body and pre-



Photograph by Charles J. Belden.

YOUNG LAMBS ARE VERY GENTLE AND PLAYFUL ANIMALS.

venting either colder or warmer air from getting in, wool makes a fine coat for the sheep in both cold and warm weather. How does it make a warm coat for a boy or girl?

There have been many interesting stories



Photograph by Charles J. Belden.

IN THE SPRING OF THE YEAR THE THICK WOOL OF THE SHEEP
IS CUT OFF BY SHEARERS.

about shepherds keeping watch over their flocks and protecting them from wild animals. Do you know of any such story?

In the spring of the year before the sheep lose their heavy coats, they are taken to a

stream and their wool is scrubbed well. The men who are to cut the wool use a pair of large queer-looking scissors called shears. The men are called shearers, and they can cut the coat so it comes off in one big piece called the fleece.

The sheep is then set free to grow another heavy wool coat. All the wool is packed in large sacks and shipped to the spinning mill.

After the wool is spun into yarn, it is often given some color, perhaps blue or pink or yellow or red or black. This is done by soaking it in some coloring liquid called a dye. The white wool takes these colors quickly.

Besides providing us with wool the sheep also provides us with food and a soft leather. You have eaten lamb chops and mutton stew. In some countries the milk of the ewe is used instead of cow's milk. It is said to be very good as baby's food.

SOME THINGS TO THINK ABOUT

Can you answer these questions?

1. Why are sheep very useful to us?
2. What are some of the things we make from wool?
3. What do we mean by the fleece?

4. At what time of the year do men shear sheep? Why then?

5. What name is given to the mother sheep? To the young sheep?

6. What is done with the sheep just before shearing time?

SOME THINGS TO DO

Learn to tell the difference between woolen cloth and cotton cloth.

Put on a woolen bathing suit when you go swimming, then put on a cotton one. Which do you like better? Why?

Watch sheep and lambs when you see them in the country. How do they eat?

Make a list of things you have that are made of wool.

CHAPTER 28

PLANTING A TREE

What tree blooms early in the spring?
Have you ever helped transplant a tree?
What is an enemy of trees?

Let's choose a nice tree to plant in the school yard. A tree is a living thing, and although it seems so quiet to us, it is very busy growing and making food. After we have chosen one, we must not transplant it while it is growing.

In transplanting a tree be careful not to injure its roots when you take it from its old home to its new one. You know the roots are very important in its growth. Day and night, even when you are asleep, you keep on growing, and so do the trees, but trees do not grow during the winter. You grow all through the winter, while the trees are resting. They stop growing about the time Jack Frost comes back in the autumn, and do not begin again until he leaves in the spring. We must transplant our little tree while it is resting. October and April are the best months for transplanting.



Courtesy of the Canadian Forest Service.

SO THAT THERE MAY BE PLENTY OF TREES TO TAKE THE PLACE OF THOSE WE CUT DOWN, THESE MEN ARE PLANTING LONG ROWS OF YOUNG EVERGREENS. WHEN THEY GROW LARGER, THE TREES WILL BE TRANSPLANTED AGAIN.

Now how shall we get the new home ready? Tree roots go out this way and that through the soil. Their tiny rootlets wrap around the soil grains, for there they find both moisture and food. When we take the little tree up, we must not shake the soil away from these little roots if we can avoid it. We must dig the new home big enough to take in all these rootlets without crowding them.

Each year many new rootlets grow into the soil. They, too, need rich earth for their share of food and moisture. After we have dug a hole big enough for the roots of our tree, we should



Courtesy of the U. S. Forest Service.

YOUNG TREES NEED TO BE WELL CARED FOR UNTIL THEY BECOME
FIRMLY ROOTED.

make it a little deeper and wider, and put some very rich soil into it. Old barnyard manure is excellent for this. Then some fine soil over this makes a good floor for our little tree. While some one holds it upright, others throw in the soil over and around the roots. When the hole is nearly filled, the soil should be pressed down firmly so that the little rootlets can find the soil grains close to them. The last thing we can do for them is to give them a good drink of

water. After "tamping" the soil around the little tree, we should pour a bucketful of water slowly over the new soil. Then we should use the rest of the soil to make the hole level with the ground.

If the weather is warm and dry, we shall give the little tree a good drink of water each day for the first week.

What kind of a tree will you choose to transplant? Will it be a Norway maple, or a sycamore, or a pin oak? All of these do well in the city. Perhaps your school is in the country. A sugar maple would do well there. It is a beautiful tree in early autumn, when the leaves are all red and gold.

Remember that trees are living things. Breaking branches, and cutting initials in the bark of trees are things that do not help trees grow.

Scout axes should always be in the hands of boys who love trees, and who would never strike a tree just to cut something. Remember this when you get to be a scout.

Also remember that fire is the very worst enemy of trees in the forest.

Boys and girls like camping, and nothing is finer for them. But the first lesson in camping

is to learn how to control your fire and to be sure that it is out before you leave it unguarded.

SOME THINGS TO THINK ABOUT

Can you fill in the words which complete these sentences correctly?

1. Little trees should not be transplanted while they are.....

2. A tree's roots get.....and.....from the soil.

3. When we transplant a tree we should not shake the.....from the roots.

4. A....., a.....and.....grow well in the city.

5. A beautiful..... would be a fine tree to plant in the country.

6.is the worst enemy of trees in the forest.

SOME THINGS TO DO

Tell why Arbor Day comes in April and October.

Transplant a tree following the directions given here.

When you go camping, be sure your fire is out before you leave it.

CHAPTER 29

FRUIT TREES

Do you like to go into the orchard when the trees are all in bloom?

Do you like to gather apples and peaches and cherries when they are ripe?

Have you ever eaten green apples? Were they good for you?

Birds and bees and boys and girls love the fruit trees. Long before the apple blossoms come, the bluebirds return from the south and fly to the orchards. They hunt holes in the old apple and pear trees where they can make their nests.

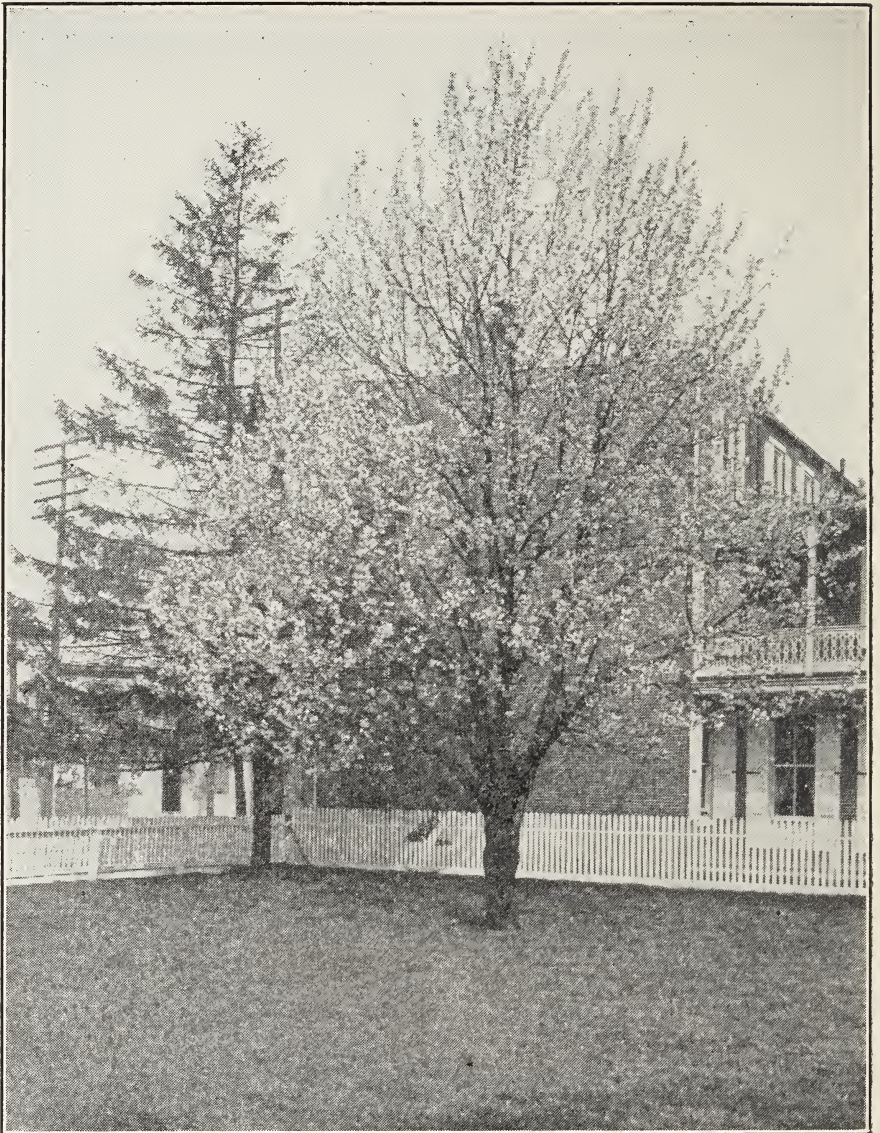
A little later the robins and the wrens and the orioles and the turtledoves find homes in the orchard trees. Downy woodpeckers and screech owls are often housekeeping there.

Then, when the trees are in bloom, from the opening of the first buds of the earliest plum tree to the last of the late apples, the honey bees are very, very busy. Every flower of the



Courtesy of U. S. Department of Agriculture and Frank M. Chapman.

THE BEE HELPS THE BLOSSOMS ON THESE FRUIT TREES TURN INTO FRUIT. AT THE TOP IS A PLUM TREE AND BELOW IS AN APPLE TREE.

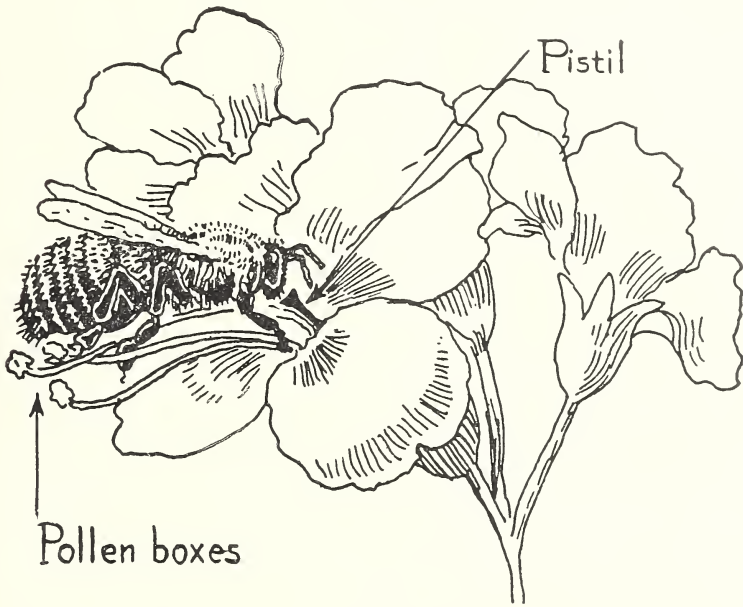


Photograph from J. Horace McFarland Co.

THIS IS A PICTURE OF A PEAR TREE IN FULL BLOSSOM.

plum trees, the cherry trees, the peach trees, the quince trees, and the apple trees holds a tiny load of nectar for the bees. The bees make

honey from the nectar. As a bee creeps into a flower for it, her hairy body brushes against the little pollen boxes, and some of this magic dust sticks to it. When she goes to the next flower for nectar, some of this pollen dust gets



POLLEN FROM THE HAIRY BODY OF THE BEE IS RUBBED OFF ON THE PISTIL OF A BLOSSOM.

rubbed off on the end of the pistil of that flower.

This is shown in the picture.

Soon her little nectar sac is full and she is ready to fly back home to the hive. Before she goes, she combs the rest of the pollen from her hairy sides and back, rolls it up and packs it

away in little baskets she carries on her third legs. When she gets home, other bees help her unload her wares and store them away in cells. Later they will be used to feed the queen and the young bees.

Then she returns to the orchard and gathers another load. She repeats these trips all day and every fair day until the last of the nectar and pollen has been harvested.

Now let us see what happens to those little grains of pollen that the bee carried to the pistil.

They find a sweet liquid there. In this liquid each grain quickly swells. It breaks its coat, and grows downward inside the pistil. At the bottom of the pistil the pollen finds a little room in which there is a tiny seed-to-be, or ovule. Material from the pollen tube enters this little ovule, and at once the ovule begins to grow into a seed. As soon as the seed begins to grow, the new little fruit begins to grow, too, the little cherry or apple or peach or plum.

We are very glad the bees like to work in the orchard, for if they didn't we should not have so many fine fruits. It is true that bees give us a great deal of honey and beeswax each year, but these things are of far less value than



BEEs HELPED TO CAUSE THESE APPLES TO GROW. CAN YOU TELL HOW?

the fruit that they cause to grow by carrying pollen.

Orchards in bloom are very beautiful. The valleys of California with their great orchards of citrous fruits, oranges, lemons, grapefruit,

almonds, apricots, peaches and prunes, are known all over the world for their beauty. The great peach and apple orchards of the eastern states and the citrous orchards of Florida bring every year many visitors to admire them.

A boy who lives in a city likes to visit his cousins in the country whenever he can. If he goes in early summer, he helps pick cherries. Do you suppose all the cherries the boys pick get to the house in the pail? Cherries cannot be stored as fresh fruit, but must be eaten or cooked or dried. They make very good pies and jam. Later in the summer the boys gather plums and early apples. Then toward the end of the summer, they gather peaches and late apples.

Of our eastern fruits, only apples and the Florida citrous fruits can be stored without being cooked or dried. We find many kinds of dried fruits in central California where in the summer the air is very dry.

Ripe fruits are very good for us all to eat. They help us keep well. Many fruits can be prepared for food in other forms, such as apple butter, apple sauce, apple pie, apple jelly, and apple dumplings.

Be sure you eat fruit in some form every day.

SOME THINGS TO THINK ABOUT

Can you answer the following questions?

1. What is the first fruit tree in bloom in the spring? What color are its flowers?
2. What fruit trees are usually the last to bloom?
3. Do you have peach trees in your neighborhood? What color are their flowers?
4. What are some of the citrous fruits? Where do they grow?
5. Why do bees fly to fruit blooms? Is their work there of any value to us?
6. What does pollen look like?
7. What does the pollen grain do when it gets on the top of the pistil?
8. What fruits can we store without cooking them?
9. What fruits must be cooked or dried in order to preserve them?

SOME THINGS TO DO

Visit the market and see how many kinds of fruits you can find that grow on trees.

Can you find more of these in summer than in winter?

Visit the orchards in the country in winter and in summer and see if you know all of the different kinds of fruit trees.

CHAPTER 30

SPRING WILD FLOWERS

What flowers do we find in the woods when the plum trees are in bloom?
What flowers do we find along the streets then?
Which ones do we find growing in dooryards?

In the woods the bloodroots, hepaticas, red maples, and arbutus all begin to bloom before the fruit trees. Sometimes they have all come and gone by that time. Along the streets the white maples and white poplars have bloomed. In the yards and parks the snowdrops, crocuses, and yellow jasmynes have come and gone.

When the fruit trees are blooming, look in the woods for the purple, yellow, and white violets; the long fuzzy string flowers of the oak; and the white mass of blooming dogwood.

Along the streets look for the catkins of the Carolina poplar or the cottonwood, the greenish-yellow flowers of the Norway and sugar maples.



Photograph from J. Horace McFarland Co.

EARLY IN THE SPRING APPEAR THE WHITE STARLIKE FLOWERS
OF THE BLOODROOT.

In yards and parks look for the colored and white tulips, the colored and white hyacinths and the yellow forsythia. And don't forget to admire the beautiful magnolia trees in full bloom.

All of these, like the early fruit trees, bloom before their leaves are fully grown.

Among the earliest of our spring flowers comes the bloodroot. After the first warm days

of spring its white flower pushes its way up through the brown leaf-carpet of the wooded hillsides. When the petals spread open the ground appears dotted with hundreds of star-like flowers. Each flower is made up of a circle of white petals and is more than an inch in diameter. It stands on the top of its stem about six inches above its one deeply cut leaf. This leaf is as large as your outspread hand. Instead of five fingers it has one broad one in the middle and a narrower one on each side. .

If any part of the flower, stem, leaf, or root of this plant is broken a reddish sap appears. The root has so much of this red sap that we call the plant the bloodroot. The white petals of the bloodroot soon fall and are blown away by the wind.

Soon after they are gone we have another starlike flower in the woods. But this flower has only three parts. The rays or petals may be white or purple. These are held in a green cup which also has three parts to it. Just below the flower and its cup are three green leaves. The name of this plant is trillium. The word means three. Do you know why this flower was given this name? There are white, painted, and purple trilliums.



Courtesy of the U. S. Department of Agriculture.

ANOTHER PRETTY WILD FLOWER THAT COMES IN SPRING IS THE
TRILLIUM.

The purple trillium has a very bad odor that attracts insects, and they carry the pollen from flower to flower.

After the flower of the trillium falls, its seed pod grows rapidly. When this pod is fully grown, it is scarlet in color. It is very clearly seen in the woods just above the three large green leaves.

Over in the meadow another flower is beginning to bloom as the trillium flower dies. This meadow flower is brilliant yellow in color. It grows about as high as your knee. It is shaped



Photograph by L. W. Brownell.

ALL BOYS AND GIRLS KNOW THE YELLOW BUTTERCUP.

like a little bowl or cup. Since it is just the color of good butter, the flower is called the buttercup.

The buttercup's five petals are so smooth they are shiny. In the cup are a lot of little pollen boxes, and at the base of each petal the honey bees find a tiny pot of nectar. The bees gather both nectar and pollen and store them.

The leaf of the buttercup is cut into many fingerlike parts.

When the buttercups are in bloom the grass in the meadow is thick and dark green. Their

yellow flowers stand out clearly against this dark background.

Bloodroots, trilliums, and buttercups fade quickly after they are picked. They are so much prettier and last so much longer if we leave them in the woods and meadows where they grow, that it is wiser not to pick them and let the country have its springtime beauty.

SOME THINGS TO THINK ABOUT

Some of the statements are true and some are not true. On a page in your notebook put the numbers one to ten in a column. Write *True* after each true sentence number and *False* after each false one.

1. Early wild flowers in the woods are blood roots and hepaticas.

2. The earliest flowers along the streets are white maples and white poplars.

3. The earliest flowers in the yards and parks are snow drops and crocuses.

4. A flower that has all its parts in threes is the bloodroot.

5. A flower with red sap is the trillium.

6. The buttercup has shiny yellow petals.

7. If we love the spring flowers and want others to enjoy them, we should not pick them.

SOME THINGS TO DO

Keep a record of the blooming time of some spring flowers.

Watch five kinds of trees and see when each kind blooms.

If you find some beautiful wild flowers leave them to ripen their seed, and let others enjoy their beauty, too.

CHAPTER 31

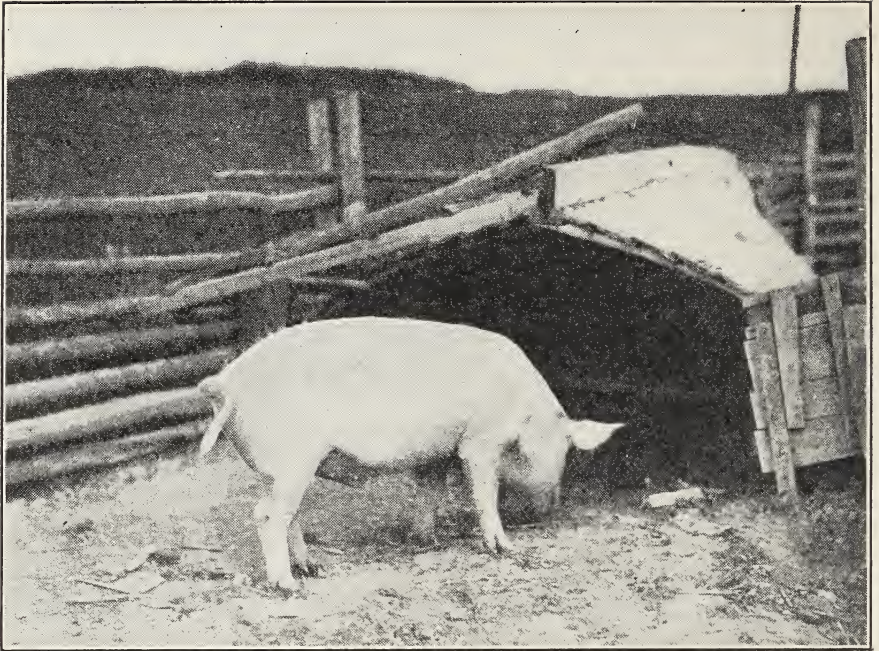
THE PIG

Have you ever had a pig for a pet?
Have you ever seen a family of pigs?
Have you ever lifted a little pig, holding it by its
sides?

A visit to a farm is as interesting to children who live in the city as a visit to a zoo. There they find various kinds of farm animals living comfortably at home. One of these contented animals on the farm is the pig. So long as the pig can find plenty of food to eat and a place to lie down to sleep, it is happy.

Like other animals, the pig uses its voice to express its feelings. When it is hungry, it squeals. When it is comfortable, it grunts contentedly.

We have already learned that the farmer raises sheep for wool and meat and a soft leather that may be made from the sheep's skin. The farmer raises pigs mainly for their meat, though a good leather is often made



Courtesy of the Canadian National Railways.

PIGS USE THEIR STRONG SNOOTS TO "ROOT."

from a pig's skin. Footballs are made from pig skins. But pigs do not have wool. Instead, their bodies are covered with hair. The hair is stiff and coarse and straight. The hairs of a pig are called "bristles." These bristles protected the animals when they were wild and traveled through thorny thickets.

A pig is not much larger than a sheep, but its appetite is much greater and therefore it gets much heavier. A sheep's legs are slender, but a pig's legs must be thick and strong to support it. A pig eats a great deal of food in



J. C. Allen, from Ewing Galloway, N. Y.

LITTLE PIGS MAKE GOOD PETS.

a day and many kinds. This is very fortunate for the farmer wants his pigs to grow as fast as possible and get as fat as possible.

Pigs like corn best of all. But they will also eat any kinds of fruit or vegetables they can find, or that may be fed to them.

Pigs find food under the ground, where no other farm animals ever look for it. They use their strong muscular noses or snouts to turn over the sod or soil. Here they find the roots of plants and small animals that they enjoy. When pigs are hunting for food this way, people say they are "rooting."

The mother pig is called the sow. Her young are born early in the spring, and there may be as many as ten pigs in the family.

A little pig makes a fine pet. His little nose and toes are usually pink. His tail is always curled unless he is sick. He is very lively and, if you try to pick him up by holding his sides, he kicks very fast with all his legs at once. You can feel his muscles sliding over his little ribs. He may be black with white spots here and there over his body, or he may be white or yellow all over, or he may be dark red.

People often think of the pig as a dirty animal, but this is not true. The pig is really

very neat and keeps his bed clean even in dirty surroundings. He does like to roll in soft mud. But he takes his bath that way. He is thinly covered with bristles and, having no long tail as the horse or cow, flies and other insects can easily attack him. He bathes in the mud to free his body from these insects.

The pig's ability to take on fat is a preparation for the cold, long winter. Man, however, fattens him for the market, and there we can buy pork chops, ham, bacon, sausage, and lard. This meat and fat all comes from pigs.

SOME THINGS TO THINK ABOUT

Can you fill in the word or words that correctly complete these sentences?

1. Pigs like to all the time they are awake.
2. When pigs are very hungry they
3. A pig's skin makes good
4. When pigs are contented they
5. makes a pig fat quickly.
6. Pigs for food under the ground.
7. Pigs give us,,, and
8. A happy pig's tail is always

SOME THINGS TO DO

Visit a farm to see the pigs.

See if any of them are rooting.

Find a mother pig with little ones on the farm.

Visit your market. See if you can find any meats that came from pigs.

Find out what uses your mother makes of lard.

CHAPTER 32

USES OF WOOD INDOORS AND OUT

How many trees can you name by looking at the leaves?

How many kinds of wood do you know?

What kind of wood do you like to cut with your knife?

You have learned about some of the trees so that you know them when you see them. You know their leaves, their flowers, and their fruits. But do you know the wood of the beautiful oak tree when you see it? Many of these woods are very pretty and as interesting as the trees themselves.

A long time ago people began to use wood to make furniture and much wood is still used for that purpose. Reed and iron are also being used in furniture making. Most furniture is made of wood because wood is plentiful, is easy to work, and it takes a beautiful polish or finish. You may have made or bought some furniture for a little toy house. What was it made of?



Courtesy of the Canadian Department of Immigration and Colonization.

LARGE TREES ARE CUT DOWN TO SUPPLY LUMBER FOR BUILDING HOUSES OR MAKING FURNITURE.

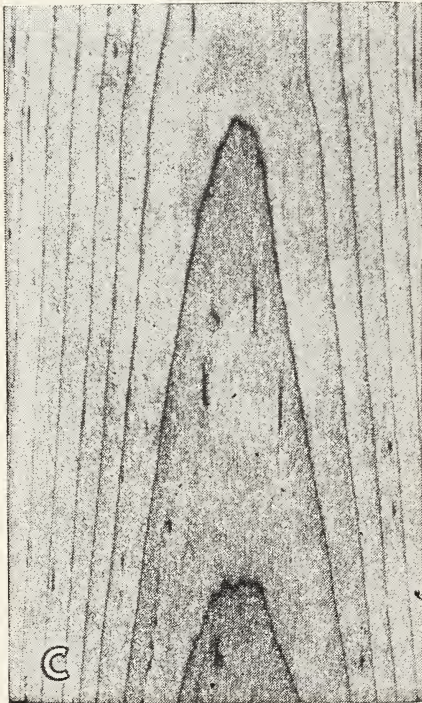
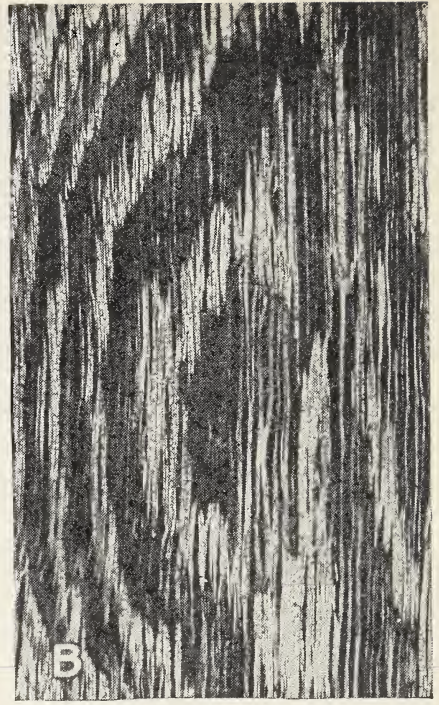
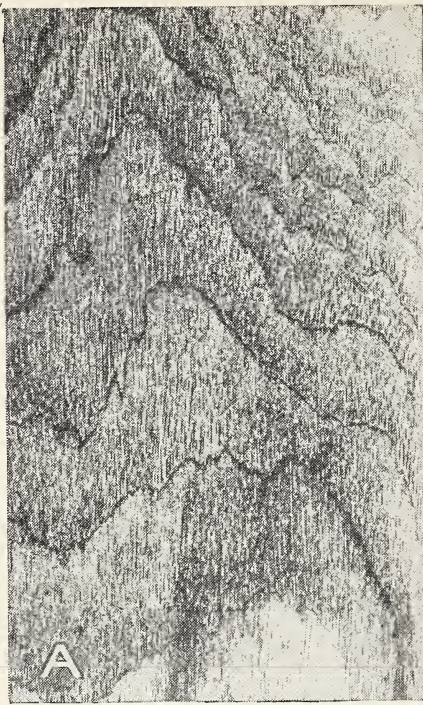
Some furniture made of iron is used in the home and at school. Your desk in school may have iron sides but you would not like to write

on an iron desk nor sit on an iron seat. The top and seat of the desk are made of wood. The iron seat would seem much colder than a seat made of wood. This is because iron would carry the heat away from your body so rapidly that you would feel cold. Iron is said to be a good conductor of heat. Wood is not such a good conductor of heat so it is better for furniture than iron.

In your home it will not be hard to see the uses of wood about you. The window frames, the floor, the tables, the chairs, and many of your toys are made of it. Many people like a certain kind of wood for furniture because it has a beautiful grain and takes a nice finish. The walnut tree from which we get our walnuts is beautiful wood for making furniture.

Birch or gum wood may be finished so that it looks like walnut. When furniture is painted, you cannot see the grain of the wood. Then of course it does not make so much difference about the kind of wood used.

The frame, the outside, the roof, the floors, and the trimming of most houses are of wood. Even the brick houses have floors, window frames, and the trimmings made of wood. Houses built largely or wholly of wood are not



Courtesy of U. S. Forest Products Laboratories.

YOU CAN TELL WOODS BY THE GRAIN.

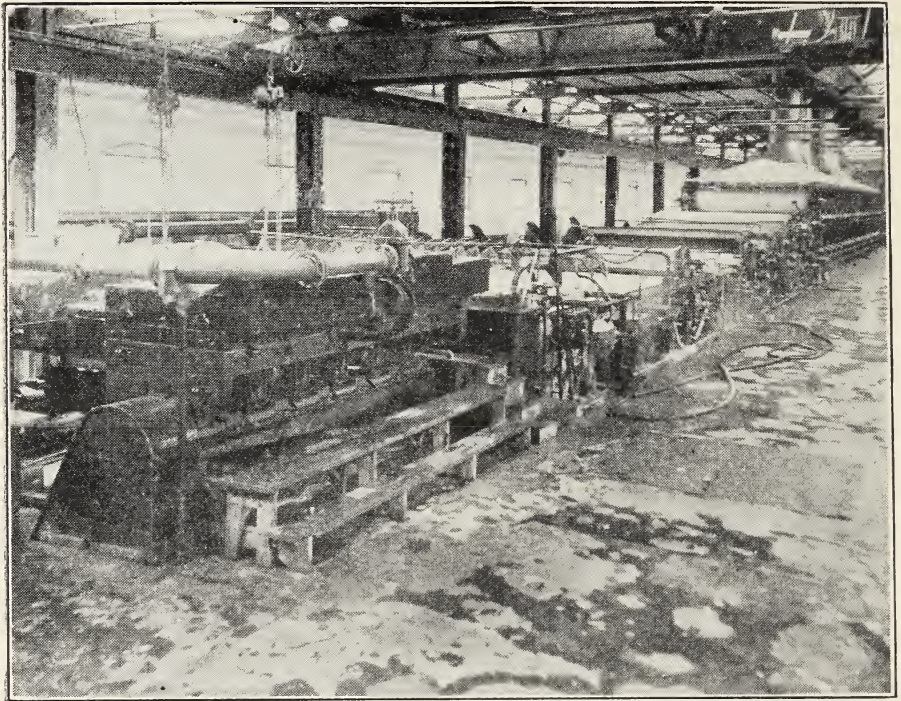
A. Black Walnut. B. White Oak. C. Red Maple. D. Beech.

fireproof. The large buildings in our cities must be built of materials that are strong and will not burn. Steel and concrete are such materials. For that reason these materials are taking the place of wood in large buildings.

Each year thousands of trees are used for railroad ties. The long steel rails that carry the express trains are fastened to these wooden ties. The telegraph wires along the tracks are usually held up by wooden poles and in some cities many wooden poles are still used to hold the wires and lights.

On the farm, it has many uses. The buildings, the fence posts, and many of the machines about the farm have parts made of wood. The handles of many of the tools, such as the axe, the hoe, the fork, and the shovel are made of very strong wood. There are wooden boxes for berries and apples and wooden baskets for peaches. Of course iron is used for the machines and tools about the farm more than ever before. But it would be hard for the farmer to get along without wood, as you can easily see.

The farmer is not the only person making use of wooden boxes. If you watch a large truck in the city with its load for the grocery



Courtesy of S. D. Warren Co.

AFTER THE WOOD IS GROUND INTO PULP, IT IS CHANGED BY THIS MACHINE INTO PAPER.

store you may see how much of our food comes in the boxes made of wood. Many thousands of trees are used each year for just such boxes. A few years ago these boxes were burned as trash but now many of them are sold to be used again for packing or for kindling wood.

The paper in this reader is made of pulp which was made from wood. All our magazines and newspapers are printed on such paper. A

great number of spruce and poplar trees are used each year to make paper. The trees are cut in pieces about three feet long. Then these pieces are put through machines which cut them into little chips. The chips are made soft and mixed with water and ground up. This material is called pulp. The pulp is run out in very thin layers over large rollers where it dries and makes the sheet of paper.

If you were in the mining region, you would see large trucks hauling long poles to the mines. Here they are cut into shorter pieces and used to hold up the rocks in the mines, so the miner can take out the coal. For this use thousands of trees are cut each year.

Before people learned to use coal, only wood was used in stoves and fireplaces to heat our houses. It is still being used to-day, where wood is plentiful. The early settlers in this country not only used it for fuel but they had to cut down the trees and burn them so there would be ground to grow their crops. We are learning to save our wood by using less of it for fuel.

If trees were always cut down and no others were planted, what would happen?

People nowadays are trying to save the trees

and plant others to take the place of those that must be cut.

SOME THINGS TO THINK ABOUT

Put the right word in each sentence. Use words from this list.

steel	farmer	paper
homes	handle	wood
trees	boxes	walnut
	pencils	

1.is still used to make furniture.
2.wood is used to make much of our fine furniture to-day.
3.and concrete are used to make fire-proof buildings.
4. Many of our.....are built of wood.
5. Thousands of.....are used for railroad ties each year.
6. The.....uses small trees to make fence posts.
7. The.....of such tools as the axe, hoe, and fork are made of wood.
8.for berries and apples are made of wood.
9. The.....in this book was made of wood.
10. Red cedar is used to make.....

SOME THINGS TO DO

Make a list of things in your room that are made of wood.

Count the number of houses on your street. How many of them are made of wood?

When you travel on the railroad train, try to see what parts of the car are made of wood. You must look carefully because it is hard to tell some of the iron from wood when it is finished.

Find out how many parts of your automobile are made of wood?

Make a list of your toys which are made of wood. Feel and tap the surfaces.

Make a collection of different kinds of wood. Carpenters will be glad to help you.

CHAPTER 33

OUTDOOR GOOD MANNERS

Have you ever built a fire in the woods?

Can you name some rules for campers?

What happens if people do not know the rules of the camp and the trail?

In the world about us there are both things that are alive and things that are without life. You have read how the beautiful green plants and interesting animals make this world a pleasant place. Boys and girls would not want to be without their toys that help them to have a good time. Men would not want to be without water wheels and windmills which help them to do their work. How hard it would be to go back to the method of telling time with the water clock or the sundial! All of these things help to make it easier for us to live together in a city or a community.

When boys and girls break their toys, they may buy new ones at a store. Men may buy new watches when they break theirs, but it is very



Photograph by Dietrich Lange.

BOYS OR GIRLS WHO BUILD A FIRE IN THE WOODS SHOULD BE CAREFUL TO PUT IT OUT.

different with animals and plants. It is true that new ones will grow. But it may take a hundred years for oak trees to grow as large as those which are destroyed by a forest fire in a few minutes. So it is very important that we know how to play among the plants and animals, and not destroy those that are our friends.

Many people go in their automobiles on long or short trips during the summer. On some of the trips they take roads that lead through the

forests. Often they camp or just build a little fire to cook a meal. If they are not careful to put it out this fire may get into the dry leaves in the woods. Soon a forest fire is raging that will destroy many thousands of trees.

Each state has its own laws about fires. Many states do not allow people to build fires without a permit. Persons building fires without permits are arrested. What is the law in your state about building fires ?

Forest fires not only destroy the trees but they kill the plants which grow on the ground under the trees. The seeds are burned, also. So it may be several years before you will see more than the black parts of the burned trees.

Forest fires are sometimes started by a burning cigar or cigarette, thrown away carelessly. If the cigar falls in the road, it burns out, but if it falls in dry leaves or grass, it may start a fire.

It is not only the people from the city who start fires that destroy the beauty of woods. The farmer sometimes burns brush. If he burns it too near the woods, or does not watch it carefully, the fire may get started among the dry leaves. This carelessness may not only



Courtesy of the U. S. Forest Service.

FOREST FIRES OFTEN DESTROY THOUSANDS OF TREES THAT HAVE
TAKEN MANY YEARS TO GROW.

cause the fire to destroy his woods, but it may destroy the trees of many other farmers.

Many people show good manners in the home, but they do not have outdoor manners. They do not know what to do when they are in the woods on a picnic or a hike. They must learn to think of others when they are in camp or on the trail.

It is a rule of the trail that you must not destroy or take more than you need. This is a



Courtesy of the U. S. Forest Service.

TELL TWO RULES FOR OUTDOOR GOOD MANNERS THAT THIS
PICTURE SUGGESTS.

good rule anywhere. If you camp near a farm, you should not steal the farmer's apples or other property. He may sell you some or even give them to you, but it is not good manners to take them without an invitation.

When some people go to a picnic, they forget that other people may wish to use the same place later for a good time. They leave the place with waste paper and bits of food lying about on the ground. It may have been a beautiful place until these people came. Things such as paper, egg shells, and orange peelings,

that cannot be used, should be burned. Another way to get rid of all waste materials is to bury them. Sometimes it may be easier to take them back to the city for the garbage collector.

If you are on a spring trip or hike in the fields or woods, think of the people who will come to this place after you. Do not break branches from the flowering dogwood to take back to the city for you will have destroyed what has taken years to grow. Then, too, the dogwood blossoms soon wilt and have to be thrown away. One should enjoy the beautiful places near the city and allow others to enjoy them, also.

When you find a patch of wild flowers, do not pick every flower, if you pick them at all. The flowers of the trillium and the bloodroot should not be picked at all, but buttercups may be picked if they are plentiful. Do you remember what flowers you read about in the other Elementary Science Readers? Which of these flowers may be picked? Do not pull up the plant by the roots when you pick flowers. Take the flower, if you must, but give the plant a chance to grow.

SOME THINGS TO THINK ABOUT

1. This chapter tells three ways forest fires are caused. What are they?
2. It tells how science helps us to live together in a community. How does it?
3. It gives several rules to observe on the trail. What are they?
4. It tells you how to act when you go to the woods. How should you act?
5. It tells you several things to do when you find wild flowers. What are they?

SOME THINGS TO DO

Form a science club in your room in school. It will help you to learn the rules of the trail and the camp.

Plan for a trip to practice your outdoor good manners.

Make a list of wild flowers which you know should not be picked.

Make a list of wild flowers which may be gathered.

SUGGESTIONS TO TEACHERS

GENERAL

1. The theme of this book is community life of the world in which we live. It should be presented in such a way as to inspire interest in and observation of other instances of the way forms of life aid and contribute to the welfare of each other.

2. First-hand observation of each subject in its natural surroundings, and preliminary discussion based more or less upon the introductory questions of each chapter, are essential to securing the best values from the reading of this book.

3. No teacher need hesitate to take her class outdoors for study because of limitations of her own knowledge. Begin very simply, with only the most familiar objects, and a very limited number of them. The subjects of the various chapters in the book are such things as may be found by anyone within a short distance of almost any school.

4. The following correlations are suggested, in so far as they fit the ability of the group, and are appropriate to the subject—oral and written expression, drawing, painting, paper-cutting and toy-making, songs, stories, poems, dramatization, games, scrapbooks, and collections.

CHAPTER 1

Ant eggs are too small to be seen easily, and larvae need special food, but the children can bring the pupas and workers

from an ant hill and keep them in a glass box which is easily made. There they can watch the pupas hatch, and watch the workers.

The box is made of two panes of glass separated by a strip of bath toweling half an inch wide. It can be held together by rubber bands. Sugar solution on a bit of cotton, and another bit of cotton soaked in water should be placed in the box as it is being assembled. These supplies will be all that the ants will require for some weeks.

If ordinary glass is used, the box should be shielded in daylight. If the upper pane is made of yellow or orange glass, no shield is necessary.

No one has studied ants more carefully perhaps than W. M. Wheeler of Harvard University. Two books that he has written will be of interest: *Ants*, published by the Columbia University Press, and *Social Life Among the Insects*, published by Harcourt, Brace & Co.

CHAPTER 2

Brown wasps are often to be seen warming themselves in the sun on window sills in the late autumn, and early spring days. At such times if it is not touched the living insect can be examined with little danger.

Hornet and wasp nests can be brought into the schoolroom with safety after freezing weather.

CHAPTER 3

Few animals show such interesting instinctive behavior as our solitary wasps. G. W. and E. C. Peckham in their work, *Wasps, Social and Solitary*, published by Houghton, Mifflin Company, tell an interesting story. The observations of J. H. Fabre and many others are briefly and well summarized by Kinsey on pages 476-488 in his *Introduction to Biology*, published by the J. B. Lippincott Company.

Solitary wasps are at work all about us during the summer but seldom during the school term. Nests of the mason and potter wasps can be brought into the schoolroom in winter and will be studied with interest by the children.

CHAPTER 4

Black-eyed Susan, Bouncing Bet, and mints should be found out of doors and studied. Their plants should also be studied indoors. Have the children bring in other weeds for study.

If possible the class should go to a vacant lot to study weeds. Count the number of different kinds on one lot.

CHAPTER 5

Even in a large city boys and girls will be able to bring in specimens of turtles for study. If the species discussed in this reader are not available make use of the species available in your section of the country.

Prepare an aquarium for a water turtle such as the painted terrapin.

Obtain turtles at a supply house or a pet store and prepare an aquarium.

Arrange for the care of the turtles as pets. Individuals or committees may be made responsible for the care of the pets for a week or longer if necessary.

In a large city, take a trip to the zoo to see the turtles.

Send to the United States Department of Agriculture for a copy of Bulletin No. 889, entitled "Fresh Water Turtles: A Source of Meat Supply."

CHAPTER 6

Crayfish can be found in ponds and streams nearly everywhere. A trip to hunt crayfish is the best preparation for this lesson. If it is impossible for the whole class to go on the trip, ask the children to bring in crayfish for observation. Place them in an aquarium and allow the children to care for them. Other trips should be taken following the reading.

CHAPTER 7

The trees mentioned in this chapter should be studied in the park or woods. Look for the fruit and leaves of these trees. Encourage the children to make collections of leaves and fruits of these and other forest trees.

Obtain specimens of wood from the lumber companies. Children will be interested in helping collect specimens of wood for the school museum.

CHAPTER 8

These trees have such characteristic bark, leaves, and twigs, as well as flowers and fruits that children can quickly learn to distinguish them. The branching habits of the three are also quite distinct, one from another, so that they are easily recognized even at a distance in winter.

One of the best ways to help children learn trees in summer is to show them how to make blue prints of their leaves. The grade of paper used in drafting rooms will do for this. It should be cut into pieces about 6 by 9 inches, in subdued or artificial light. After laying the paper upon a book or piece of stiff cardboard a fresh leaf is laid upon its sensitized surface and a piece of clear glass, large enough to cover the leaf, is then laid on it. Holding all firmly together, the exposure is made in bright sunlight for a few seconds, the glass held uppermost. The paper is then rinsed in water in subdued light, and allowed to dry. In this way a permanent record is made of the size, shape and margin of the leaf.

CHAPTER 9

Mushrooms should be studied in the field whenever this is possible. Often they may be found on vacant lots in the city or in your own yard.

For study in the classroom, mushrooms may be bought at the grocery store. Do not trouble children with the detailed structure as it is necessary to tell the life story only.

CHAPTER 10

Bobwhites are easily tamed by feeding and as they come often to feed they can be studied easily.

Have the children notice their wings, their protective coloring, and their "call" notes.

They can be found in most zoological gardens where they can be seen by the children.

While study of the living bird is much to be preferred, mounted specimens of quails are to be seen in practically every collection of birds.

The habits of the quail, as a year-round living bird, should be emphasized, for example, scratching for its food, building its nest on the ground amidst many dangers, very rapid flight as a means of safety, and its protective colors.

CHAPTER 11

A visit to a protected spot in the woods or park on a sunny day in winter is pretty sure to yield a good sight of the junco and cardinal. Tree sparrows and goldfinches are far less regularly to be found in their winter homes.

A feeding table on a south window sill at school will attract some of these birds along with others of the neighborhood.

The goldfinch is identified more easily by its flight song than by its winter plumage which is very different from its summer dress. In winter it is olive green and white.

CHAPTER 12

Beavers are now protected by law in almost all parts of the country. As a result, they are becoming much more numerous in our forest regions, and they are to be seen in most of our zoological gardens.

Norman McClintock of Pittsburgh has taken moving pictures of beavers at work and at play in their native haunts.

This renewed interest in the beaver has resulted in an abundance of illustrations of it in color in all literature devoted to Nature Study. Beaver chips and sticks will form interesting additions to the school museum.

CHAPTER 13

Children who live in the country will probably know where to find muskrat houses and paths. In the city, the museums and zoo can be depended upon for materials to answer the questions raised in this chapter.

The children will be interested in thinking of the reasons

why muskrats are still so abundant even within a few miles of large cities. The reasons are stated in the text—many young, abundant food, and protected homes.

CHAPTER 14

Let the children tell all the bear stories they know. Read Riley's story of Alex and the bear to the children, not for information, but as an example of child interest.

Enos Mills' account of bear life, entitled *The Grizzly*, and published by Houghton Mifflin Company is full of interesting information.

Seeing bears in cramped quarters in a zoo is a poor substitute for the mental pictures that are suggested to the children by such a book as *The Grizzly* or by explorers' accounts of the life of the polar bear in the far north.

Yet zoo specimens and even museum specimens should be studied by the children.

CHAPTER 15

The Bentley photographs of snow crystals, dew, frost, etc. are the finest to be had. They are reproduced in many books and magazines.

The pupils can buy these beautiful photographs of snow crystals from W. A. Bentley of Jericho, Vermont, for six cents each.

The children will enjoy making an exhibit of their own photographs of winter sports in which they were taking part.

It is interesting to demonstrate the floating of ice in a tumbler of water, in order to show what a large portion of the ice is under water. A small cube of ice can be fairly accurately measured, floated and the part out of water measured.

Pictures of glaciers and icebergs interest the children. Scratched pebbles and boulders found in the glacial drift of the northern states will be interesting objects upon which to base the story of the Great Ice Sheet in America.

Near-by sand and gravel banks familiar to the children are other interesting reminders left by the Ice Age.

CHAPTER 16

Children should look for the Milky Way on a clear night. Where a star party is practical the teacher may meet a group of children near the school, to study the stars. Permits should be obtained from the parents for this meeting. Parents and older brothers and sisters are often able to point out familiar star groups such as the Dippers and Cassiopeia's Chair.

CHAPTER 17

It is important that you have a magnet, a compass, and the other materials for the experiments. These materials are not expensive and may be obtained from the supply houses. The *Set of Supplies and Equipment for Elementary Science, Grades I to VI*, by Ellis C. Persing, contains these materials with directions for their use, and may be obtained from the W. M. Welch Manufacturing Company, Chicago, Ill.

CHAPTER 18

Several pieces of the materials such as the water clock and sundial may be made for this lesson.

The egg timer is one kind of hour glass and may be obtained at the hardware store or 5 and 10 cent store.

The materials for this lesson are contained in the Set supplied by the W. M. Welch Manufacturing Company.

CHAPTER 19

Toy balloons filled with hydrogen may be obtained at an amusement park and used for comparison with a toy balloon filled with air. The difference in lifting power may be tested by fastening small cards of the same weight to the string of each balloon. Your experiment will show that the balloon filled with air does not rise unless the air in it is hot. The balloon filled with hydrogen will lift several cards.

See suggestions for Chapter 18 for list of Supplies and Equipment.

CHAPTER 20

Pupils like to play with water wheels. If demonstration water wheels are available show the pupils the overshot and undershot types. Encourage the pupils to make one type of water wheel; the one suggested in SOME THINGS TO DO, or one of their own design.

See Chapter 17 for list of Supplies and Equipment.

CHAPTER 21

Individual pupils can make a windmill if a few tools are available in your school. Or you may have the class make one as a class project. You will find such books as *Home-Made Toys for Boys and Girls* by Hall (Lothrop, Lee & Shepard Co.) and *Our Physical World* (Longmans, Green Co.) by Downing helpful.

Weather vanes may also be made in this connection. The books already referred to will give you suggestions. Allow children to make and submit their own designs. If the designs are such that pupils can make them, allow them to be made.

CHAPTER 22

Even though kites may be purchased at a small cost children are much interested in making them. After the kites are made you may be able to arrange for a kite tournament.

One of the boys may be willing to fly his kite as an introduction to this lesson. After you have read the chapter you may want him to fly it again as an experiment to answer some of your questions about kites.

CHAPTER 23

It is impossible to give all the details for making a model of any of these sailboats. But such books as *Ship Model Making* by McCann and others will give the information necessary. The models made by pupils in the fourth grade need not be so finished as those made by adults, but the pupils will certainly learn much about sailboats by making them.

If you have a museum in your city take the class to see the different types of old sailboats.

CHAPTER 24

By experimenting with modeling clay children can get the proper shape for a bird bath.

This can then be made in cement on a larger scale, and put on a support of some kind in the school yard.

Fourth-grade children have not done much shop work, but are quite able to make a simple feeding table or feeding box for the birds.

They will be interested in keeping these supplied with food and water during the winter. Use a system of rotation of responsibility.

CHAPTER 25

The birds described in this chapter are fairly common and large enough to be seen easily. Leaving out of account the vesper sparrow, their colors, song, and manner of flight are conspicuous, and characteristic, and can readily be learned by the children.

They are all abundant in the country, and city children are sure to see and hear two or more of the larger ones on any trip to a large park or open country.

Imitation of the notes indicated is only suggestive. These birds may say something else to another listener, but it is wise to encourage children to learn birds by their song and manner of flight as well as by their colors, for we are often unable to see their colors.

Excellent illustrative material is at hand, through *Bird Lore*, the Audubon Society charts, etc. Far better than any of these, however, is the mental picture the child gets on seeing and hearing the bird in its natural home surroundings performing its normal activities.

Such results are abundantly worth the effort of taking children to the country, or of helping children in the country to see the birds around them.

CHAPTER 26

There is little that needs to be added to this chapter in the way of suggestion. Seed catalogs of dependable houses can

be relied upon for necessary information regarding planting and obtaining seeds.

Garden plans, even though crudely drawn, stimulate interest of children in this work.

Seed from plants raised by one class can be kept over till the next year.

This is an interesting and instructive project for those who give as well as for those who receive.

CHAPTER 27

Children in many parts of the country have the opportunity of seeing both washing and shearing each year, though such opportunities are becoming rarer, as we get away from primitive methods of husbandry. The sheep holds such a large place in the story of the human race that we should give the children a chance to see these things done, when possible, and help them to get acquainted with this valuable animal.

Children can easily distinguish woolen and cotton cloth, by simple methods, such as touch, absorption of water, odor and appearance of a burning thread, etc.

The children will be interested in seeing several common kinds of woolen cloth, such as mohair, cashmere, serge, flannel, etc.

Child rhymes and stories contain many references to sheep and wool.

CHAPTER 28

In the city the children will be glad to plant seeds and raise tree seedlings in boxes in the schoolroom. These can be taken home and planted if there is no opportunity to plant them later in the school yard. In the country the children will enjoy finding the best little tree in the woods or along the roadside and after getting permission of the owner, transplanting it in the school yard, and putting a guard around it. Careful record of time of budding, flowering, increase in height and girth, and fall of leaves should be kept by the children.

Note that the season's actual growth is completed within about thirty days after the buds open.

Fourteen Points for Tree-Planters¹

1. A piece of burlap or canvas should be spread over the grass, so that the dirt from the holes may be thrown upon it.

2. Holes must be made large enough for the roots to spread out naturally without cramping. (See also No. 6.)

3. Dig holes larger in circumference at the bottom than at the top to prevent water from lying about the roots.

4. Good fertile topsoil must be used about the roots. If the tree is to be planted in impoverished ground, good soil should be provided for it.

5. Plant the tree the same depth it stood at the nursery (easily determined by the dirt ring on the trunk). This is very important.

6. Lay the roots out naturally and cut off all the broken or bruised parts. (See also No. 2.)

7. Press the earth down firmly, embedding every particle of roots and working it in under the crown.

8. With small trees the dirt will settle firmly if the plant is moved gently up and down as the hole is filled. With large trees use tamping stick.

9. Pour in water to the top of the hole after filling it three-quarters full with earth. When this is settled, complete the filling-in process, leaving the topsoil loose.

10. Trim the broken or bruised branches, and also the small branches and limbs back to next largest stem.

11. It is often best not to trim the leader or central stem, as a forked tree may result. Hardwood trees, like the oak and beech especially, should not have their central leader trimmed.

12. Large trees or trees in exposed places should usually be staked. To prevent chafing, protect the tree with old hose or with burlap and sticks where wire is attached.

13. After planting, it is better to leave a cultivated area about the tree than to sod close to it. This cultivated area should be from three to five feet in diameter.

14. Fertilizer, as manure or compost, may be used either in the bottom of the hole or as a mulch, or both. Be careful not to allow manure to come in direct contact with the roots.

¹From *Nature Magazine*, April, 1927. Reprinted by permission.

CHAPTER 29

Let the children tell their experiences gathering fruit.

Let them discuss (*a*) the wisdom of breaking branches of fruit trees to get flowers or fruits, (*b*) the question of planting fruit trees at home, at school, and along the highways.

CHAPTER 30

Children quickly respond to the plea for preservation of wild flowers when it is presented to them reasonably. Such a campaign need not preclude their learning to know the flowers, however. If it is impossible to take them to the woods and fields, certain flowers may be gathered and displayed with labels in the schoolroom.

CHAPTER 31

If possible, take the children to a farm to see the pigs.

If this cannot be done, have boys or girls who have seen them there, tell all they can about them.

Take the children to a meat market. Let them see all the pork products there.

A pet pig will be of great interest at school, if some child can bring one for a day.

CHAPTER 32

From a near-by lumber company you may be able to obtain pieces of different kinds of wood about five by three inches. Label these for your school museum.

Such an exhibit of woods will help the children learn to identify the common woods used in furniture and about the home.

CHAPTER 33

Organize a science club if you have not already done so.

Plan to take the class on a trip to the woods to practice their good manners out-of-doors. An afternoon spent in the woods for a picnic will be enjoyed by children.

Help the children to make their lists of wild flowers which should not be picked.

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