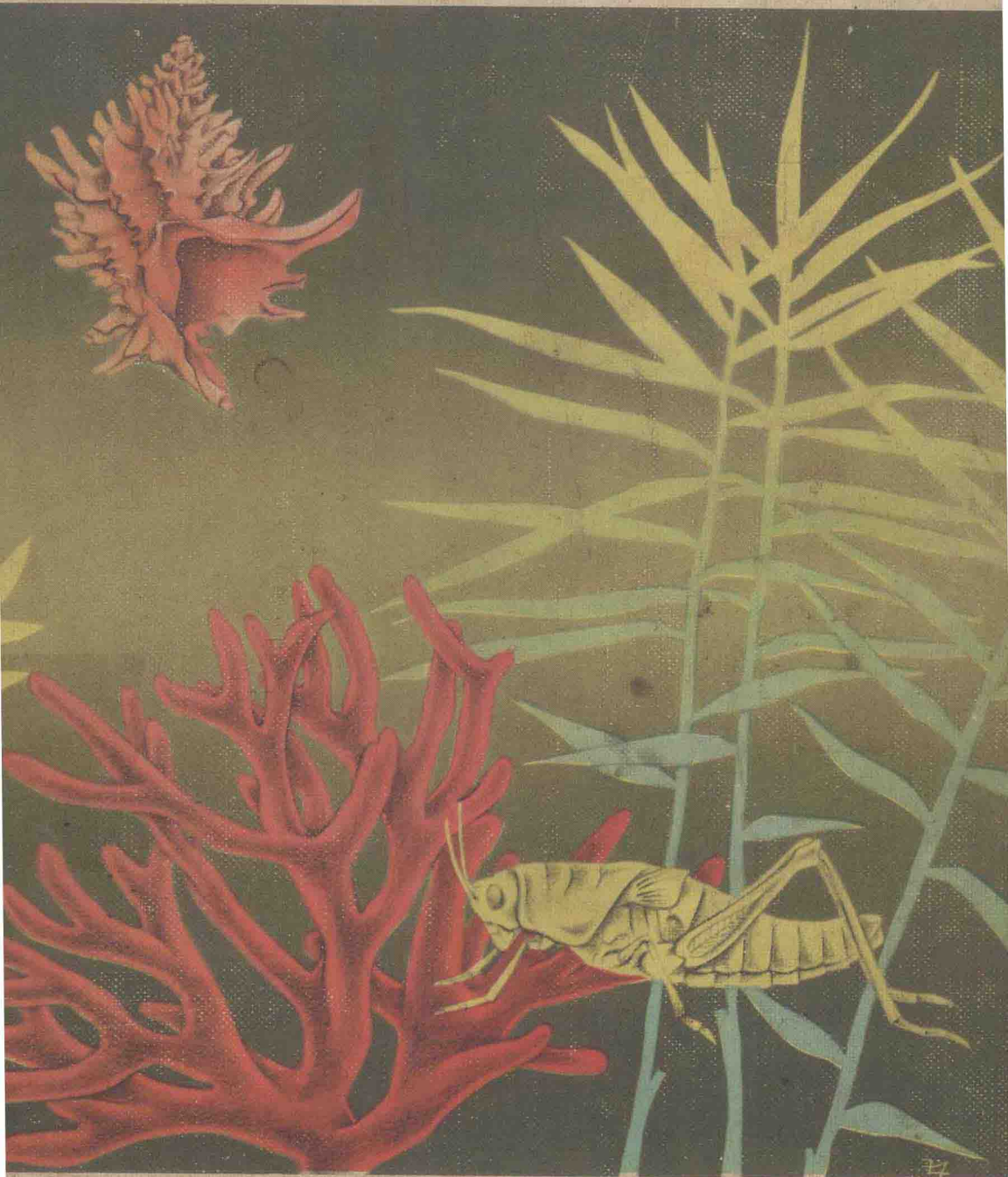
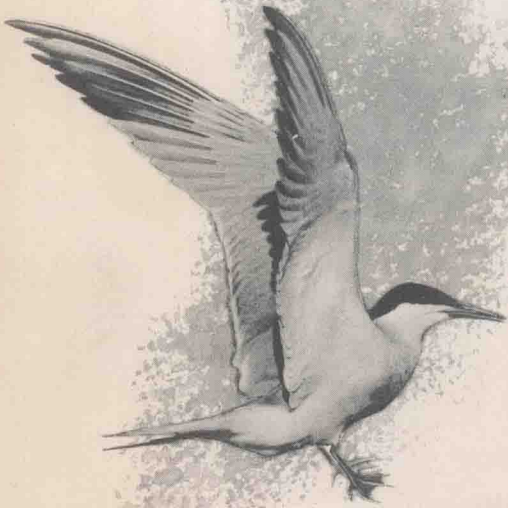


BIOLOGY



Kroeber Wolff Weaver

Biology

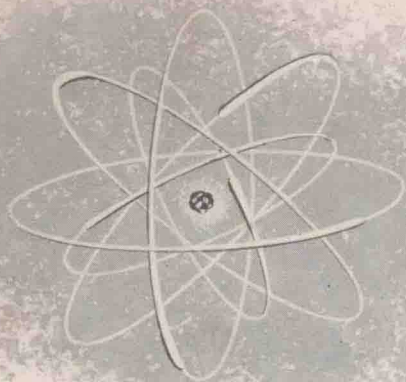


ELSBETH KROEBER

WALTER H. WOLFF

RICHARD L. WEAVER

D. C. HEATH AND COMPANY BOSTON



Preface

WE ARE CONVINCED that the study of biology is an exciting adventure for boys and girls. All young people are interested primarily in themselves and in everything related to themselves. They want to know how their bodies work, how bacteria and infectious diseases affect them. They are interested in their behavior and how they change as they mature. They want, of course, to understand reproduction and how characters are, and are not, passed on from parent to child. All this constitutes a large part of the book.

But young people with imagination and a spirit of adventure want, too, to go farther afield. They wish to become acquainted with the world around them, the great outdoors, the vast number of interesting living things. They are interested, also, in the world in its beginnings, how the earth changed in past ages, and what lies ahead. In two hundred years from now will people live as they live now? Will there be food enough to go around in another hundred years? Will we still be dependent upon green plants as we are now? Even in urban schools it is easy to arouse the pupils' interest in questions such as these. But to appreciate the role that plants and animals play they must learn these subjects at first hand. They must get out-of-doors.

To help the teacher stimulate an interest in outdoor biology, field trips have been described. These are grouped into one section at the front of the book for ready reference. If pupils can be made to feel the need for studying some biology out-of-doors, they will be better prepared for the last unit, Conservation. So that pupils may be ready in interest and understanding

for this important topic, it is placed at the end of the book; but references to ecology and conservation are made again and again in the earlier units. No pupil should be permitted to complete his biology course without help in developing an interest in conservation and an appreciation of its importance.

In the experience of many teachers the objective of developing scientific attitudes and habits is best achieved if the subject is not didactically presented and belabored. The text and exercises, therefore, have been carefully written to incorporate consistently the scientific attitude of mind and scientific methods of arriving at conclusions. There is no chapter on scientific attitudes and scientific methods.

Great care has been taken, also, to achieve simplicity of expression. Difficult nonscience words have been excluded; only the essential technical terms have been included and these have been listed at the end of the chapter to help the pupil master them. The glossary at the end of the book is designed to assist the student further. Much thought and labor has also been expended to avoid abrupt transitions from idea to idea. The treatment of content carries the student forward gradually from each sentence and idea to the next.

Because illustrations are almost if not just as important as words in developing ideas and teaching facts, they have been made an integral part of the text. Nearly all illustrations are referred to, and their legends often ask pertinent questions. Many of the illustrations may be used as a basis for questions and exercises.

End-of-chapter materials were designed to be of maximum help to both

the teacher and pupil. Here are: (1) a series of questions which will indicate to the pupil whether or not he has achieved an understanding of the subject, not merely the memorization of the words of the book; (2) a minimal list of technical terms essential for discussion of the topic and further reading; (3) a small number of exercises or experiments which can be easily carried out by all pupils (The *Teacher's Manual* includes further suggestions for exercises for those teachers who have the time and necessary equipment for further experimentation); and (4) a short bibliography. Aside from an occasional reference work only books and articles of proved interest to the pupil have been included.

An appendix, consisting of details of a number of type forms, will be useful to pupils who are preparing for college entrance examinations. Others, also, will find this section useful.

A few words are pertinent concerning the *Teacher's Manual* and the introductory section of the text titled "Biologists Study Living Things." The *Teacher's*

Manual includes in some detail our aims in teaching biology and the methods of presentation which have been found useful by us in our many years of biology teaching. We wish, therefore, to recommend this to the teacher's attention and to say no more on these subjects here. We wish, however, to recommend for pupils' use the introductory section of the text. In it are useful hints to the student on how to study biology and how to study from a text. It is hoped that students will read those pages, especially at the beginning of the course, and at other times as need for such help is felt.

We wish to thank the many users who sent in helpful criticisms of the predecessor of BIOLOGY. These suggestions were all taken into account in preparing the manuscript for this text. We particularly want to thank Mr. Rex Conyers, University City High School, University City, Missouri; Miss Katherine Hertzka, Atlanta Public Schools, Atlanta, Georgia; Mrs. Charlotte O. Wolff and Mrs. Richard L. Weaver.

ELSBETH KROEBER

WALTER H. WOLFF

RICHARD L. WEAVER

The Authors

ELSBETH KROEBER was formerly First Assistant in Biological Science and Administrative Assistant at Midwood High School, Brooklyn, New York. She has also been Chairman of the Department of Biology at James Madison High School, Brooklyn, New York.

WALTER H. WOLFF is Principal of the William Cullen Bryant High School, Queens, New York. Among his former positions are the following: Instructor, School of Education, The City College of the City of New York, and Chairman of the Department of Biology and General Science, DeWitt Clinton High School, Bronx, New York.

RICHARD L. WEAVER is Associate Professor of Conservation, Conservation Department, School of Natural Resources, and Associate Professor of Conservation Education, School of Education, University of Michigan, Ann Arbor, Michigan.

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Contents

Introduction:	Biologists study living things	1
	Field trips	10
<i>Unit One</i>	<i>How living things are alike</i>	28
CHAPTER 1	What cells are	30
CHAPTER 2	What cells do	40
CHAPTER 3	Tissues and organs	49
<i>Unit Two</i>	<i>The many kinds of plants and animals</i>	56
CHAPTER 4	A third of a million kinds of plants	58
CHAPTER 5	A million kinds of animals	80
CHAPTER 6	Classifying plants and animals	127
<i>Unit Three</i>	<i>Plants the world's food makers</i>	138
CHAPTER 7	Leaves	140
CHAPTER 8	Roots and stems	151
<i>Unit Four</i>	<i>How our bodies work</i>	168
CHAPTER 9	The foods we eat	170
CHAPTER 10	Digestion and absorption	190
CHAPTER 11	Blood and circulation	205
CHAPTER 12	Lungs and breathing	225
CHAPTER 13	Excretion	235
CHAPTER 14	Ductless glands	242
<i>Unit Five</i>	<i>Why we behave as we do</i>	254
CHAPTER 15	The simplest kinds of behavior	256
CHAPTER 16	Our nervous system	270
CHAPTER 17	Changes in behavior	279
CHAPTER 18	Growing up	290

<i>Unit Six</i>	<i>Bacteria and health</i>	298
CHAPTER 19	Bacteria and disease	300
CHAPTER 20	Body defenses against disease	310
CHAPTER 21	Some recent discoveries	324
CHAPTER 22	Stopping the spread of disease	331
CHAPTER 23	Building health	346
<i>Unit Seven</i>	<i>Reproduction</i>	360
CHAPTER 24	Reproduction in some simple organisms	362
CHAPTER 25	Plant reproduction	370
CHAPTER 26	Animal reproduction	386
<i>Unit Eight</i>	<i>Heredity and environment</i>	402
CHAPTER 27	Why offspring resemble their parents	404
CHAPTER 28	Why offspring differ from their parents	411
CHAPTER 29	How characters are changed	422
CHAPTER 30	Improving plants and animals	434
CHAPTER 31	Human heredity	447
<i>Unit Nine</i>	<i>The history of living things</i>	458
CHAPTER 32	Fossils and their history	460
CHAPTER 33	From simple organisms to complex	471
CHAPTER 34	Theories to explain change	488
CHAPTER 35	History of man	495
<i>Unit Ten</i>	<i>Conservation</i>	506
CHAPTER 36	Materials used and re-used by living things	508
CHAPTER 37	The tangled web of life	515
CHAPTER 38	A bountiful future	528
<i>Appendix</i>	The structure of some animals other than man	556
<i>Glossary</i>		569
<i>Index</i>		589

Biologists Study Living Things

What is biology? You have been studying biology for many years. You probably never knew it, but you have been studying biology ever since you were a baby — ever since you were able to use your eyes and your ears and your other sense organs and were able to use your mind. All your life you have lived with yourself, with other people, and with other living things. You already know a lot about living things. And that's *biology* — the study of all living things. The dictionary calls it "the science that deals with living things."

Although you already know something about yourself and perhaps some other living things, you will be astonished to discover how many exciting

things in biology you had never heard of before or had never guessed would be possible. Exciting discoveries are being made all the time. Perhaps the most interesting of these will be the discoveries that are about you yourself and other human beings — discoveries about our diseases, how the parts of our bodies work, how children get to be like and different from their parents, and so on.

As you read, you will discover that biology covers an enormous field. And you will see opening up to you one occupation after another and one interesting hobby after another. There are so many interesting hobbies and jobs connected with biology that we could not

Some biologists care for animals in zoos. This girl is feeding a reindeer, Orlando





This New York City biology student is doing an experiment in his study of plant diseases.
Wide World

name them all in these pages. Whether you enjoy being out-of-doors or in a laboratory; whether you enjoy working with people, with experimental animals, with plants, or mostly with chemicals; whether you enjoy settling down or exploring the ends of the earth; whether you are interested in looking into the past or looking into the future, there are jobs or hobbies for students of biology.

Science. Since biology is a science, you ought to know what a science is. The dictionary tells you "a science is a large body of knowledge based on facts

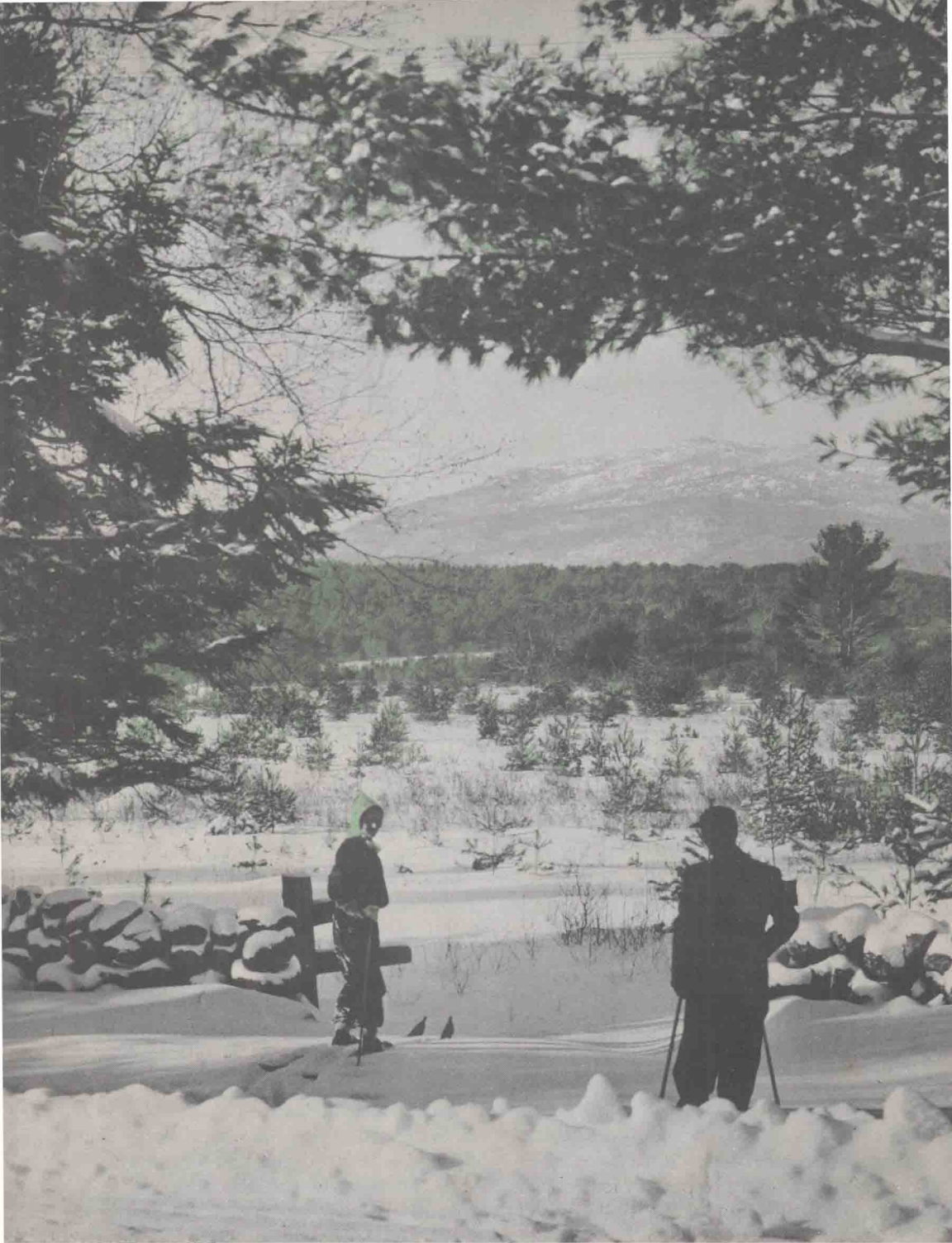
or truths known by actual experience or observation." Notice that the knowledge is based not on guesses or suppositions, but on facts. The knowledge is gained by systematic study through the use of scientific methods. And it is important to know that there are many scientific methods. What a biologist does depends on what he or she is trying to find out. Sometimes this means just going out to look and listen, as when a biologist is learning about animals and plants out-of-doors, or when he hammers rocks, or studies how chickens act in a farmyard. Close observation is necessary to the biologist and to every other kind of scientist.



This biologist works in a trailside museum. She takes care of some of the animals, conducts field trips, and answers questions that come by mail. *Trailside Museum, Chicago*

Sometimes the scientist plans and carries out an experiment and makes observations under special conditions which he has set up. He plans the experiment in order to answer a definite question which he wants to have answered. He calls this a *problem*. Very often before beginning an experiment the scientist makes a careful guess as to the answer. The guess is called a *hypothesis*. The experiment is planned to test this hypothesis. Sometimes several hypotheses are made. Often many experiments must be performed. It is only by using controls that the experimenter can be sure the results he gets will be correct. You will learn about

using controls in experiments as you study this book. Perhaps you already know something about the use of controls. Of course, the biologist is not finished when he records observations on his controlled experiments. He must draw conclusions from these observations. For that reason, careful and clear thinking is as much a part of any scientist's work as observing or experimenting. Sometimes the conclusions show that the guess or hypothesis was wrong. The biologist must face this honestly and start over again with a new hypothesis. He may have to do this many times before he meets with success in solving the problem.



Even when the ground is covered with snow there is much of interest out-of-doors. These skiers in New England may see deer and rabbits, such birds as grouse, pheasant, chickadees, and nuthatches, and of course, the shrubs and trees. *Eames Studio*



Off the Maine coast ornithologists study the nesting places of the double-crested cormorant.
Allan Cruickshank

As you study this book, you will learn more and more about the ways in which biologists learn about living things, how they are formed, how they live, what keeps them alive, how they may become sick, what makes them die, how they reproduce, where they came from, and how we may use other living things for our benefit. All the carefully worked out methods of discovering such facts are the scientific methods of biologists.

How you can be a biologist. You, too, can experiment; you can perform controlled experiments, observe closely, and draw your own conclusions. Perhaps

your school has a laboratory. Or some of you may have your own small laboratory at home.

Before you can do much experimenting there are some things you must learn from books. We can help you learn about biology from this book by giving you some hints. This book is divided into ten large topics or Units. Be sure you know the title of the unit before you begin it; and know the chapter title before you start reading it. If you do this, you will have some idea of what you are about to study. No one would start off in a car without knowing where he wants to go. And it's just the same in reading. You must know where you



This South Carolina class, interested in conservation, has gone out-of-doors. They are examining farm land ruined by erosion. Soil Conservation Service

are trying to get when you start reading some unit or some new chapter in your biology book. The titles are like road markers pointing the way. Don't overlook them if you want to be a good biologist.

To make things still easier for you the chapter is broken up into short sections with a few words in boldface type at the beginning of each section. After reading these words in boldface carefully, think over their meaning and ask yourself what you already know about that subject. If you know something about the subject to begin with, as you study the section, the new ideas and facts can be fitted in with what you already know; in this way the reading will be more interesting and you will remember better what you read.

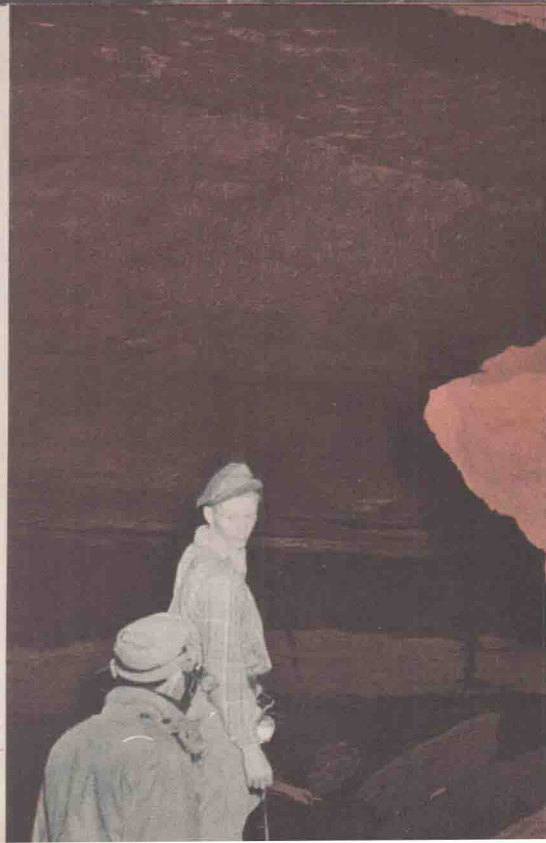
A good way to read a text. It is a good plan to read a whole section through to the end quickly to get a general idea of what it is about. But you must not stop with that one quick reading. A very few people, after a great deal of practice, learn to take in everything from one quick reading of a textbook; most of us cannot do it. After your quick reading of a section, go back to the beginning and read each sentence carefully so that you can understand and remember it. If you don't understand a sentence, read it again; often a second reading will make the sentence clear. But if it is still not clear or if any question arises in your mind, make a note of this and ask to have it explained in class. Of course, if there is a word you do not understand, look it up or ask someone or be sure to ask about it in class the next day. This kind of study is slow, but it certainly pays in the end. *Never pass over anything that you do not understand without making every possible effort to have it explained.*



These outdoor biologists went wading at night to find a spring peeper — only one inch long, but what a voice! *Frank Gehr*

The living things of caves are of special interest to many biologists. *National Speleological Society*

BIOLOGISTS STUDY LIVING THINGS





The beaver trapped by this biologist will be taken to another stream where a beaver dam will be useful. *Three Lions*

Often a close look at the pictures will help you understand what you read; but only if you read the statements and questions under the picture. This is just as important as reading the text itself.

Of course, you can never understand what you are reading in biology, unless you learn to speak the language of the biologist. That means that you must know the meanings of certain biological words. The important words are printed in boldface type. They are listed at the end of the chapter to help you. If a biological term has been used before and you have forgotten its meaning, look it up in the glossary (not the index) at the end of the book.

Now if you are studying the book carefully, your mind will be active. You will be thinking about the subject as you read. Many questions and problems will arise in your mind. This may not happen with every section but it will happen with some. The more you are thinking, the more questions will arise. Be sure to jot down your questions and bring them to class. This will lead to interesting class discussions.

Learning in other ways. Biology is different from most other subjects you

study in school. Besides learning from books, seeing moving pictures, listening to recordings, and having class discussions you learn in other ways. As you know, you find out some things for yourself by experiment. And you find out much for yourself through observations out-of-doors. Get out-of-doors and observe. This is one very important way of studying biology. Become acquainted with plants and animals. Find out where they live, how they live, and how they live together and depend on one another. If it is not possible for you to go as a class from school, go out with friends. You will want to take many field trips this year: to the woods, to the fields, to a pond or marsh, to the seashore if you live near the coast, to the desert if you can. If you live in a large city, you will be surprised how much biology you can learn in a city park or even in a city lot. This book suggests a number of field trips. You will want to take more on your own. And the better acquainted you are with the out-of-doors the more you will enjoy your trips. You may even see things that have never been seen or described before. Exploring is fun. Pack up what you need for your trip and get started. You will find suggestions for your first trip on page 10.