Nature and Science Reader Book 6

The Work of Scientists

Edith Patch & Harrison E. Howe

This edition published 2025
by Living Book Press

ISBN: 978-1-76153-909-1 (hardcover)
978-1-76153-897-1 (softcover)

First published in 1933.

This edition is based on the 1933 printing by The MacMillan Company.

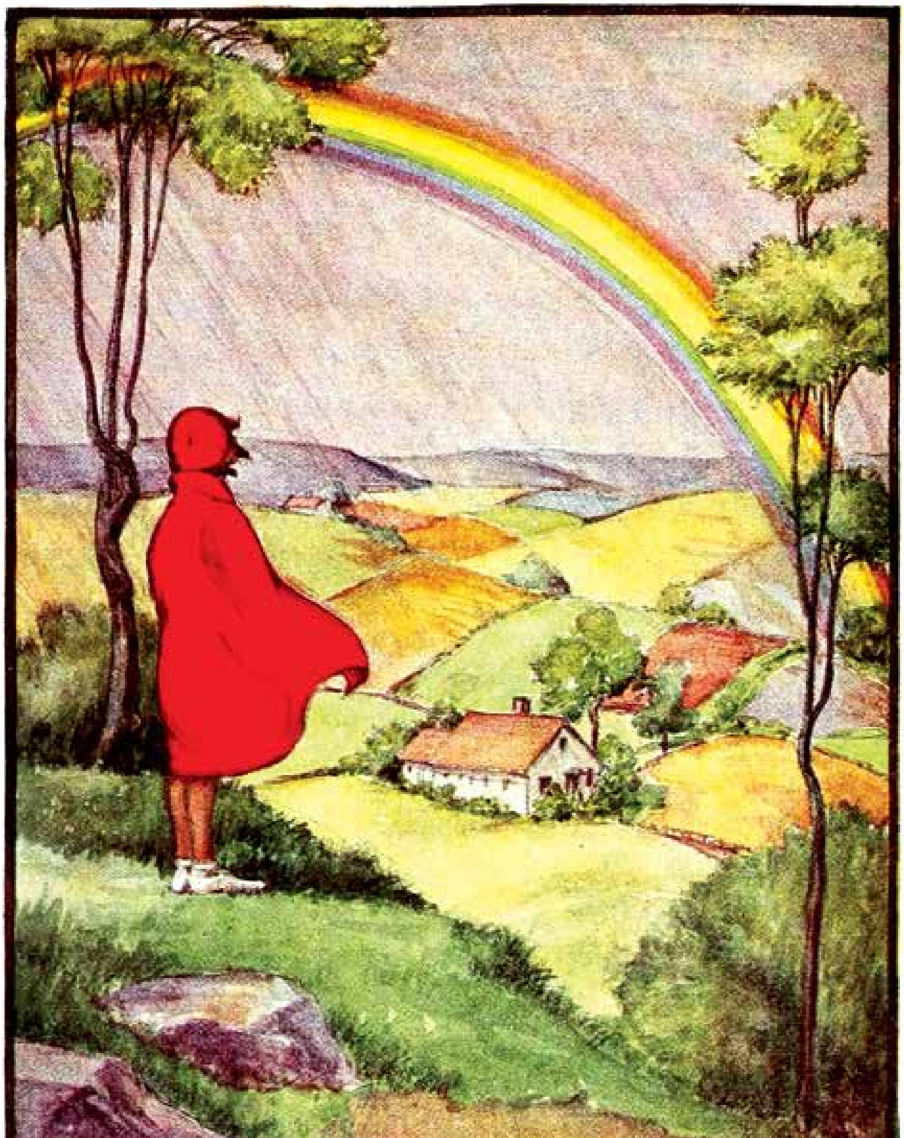
NATIONAL LIBRARY OF AUSTRALIA
A catalogue record for this book is available from the National Library of Australia

The Work of Scientists

by

Edith Patch & Harrison Howe

LIVING BOOK PRESS



A rainbow may be termed the spectrum of sunlight (see page 157).

Contents

FOREWORD TO BOYS AND GIRLS

The names of about 22,000 men and women occur in a recent edition of a book called *American Men of Science*. If you wish to learn what these scientists do, you can read accounts of their work.

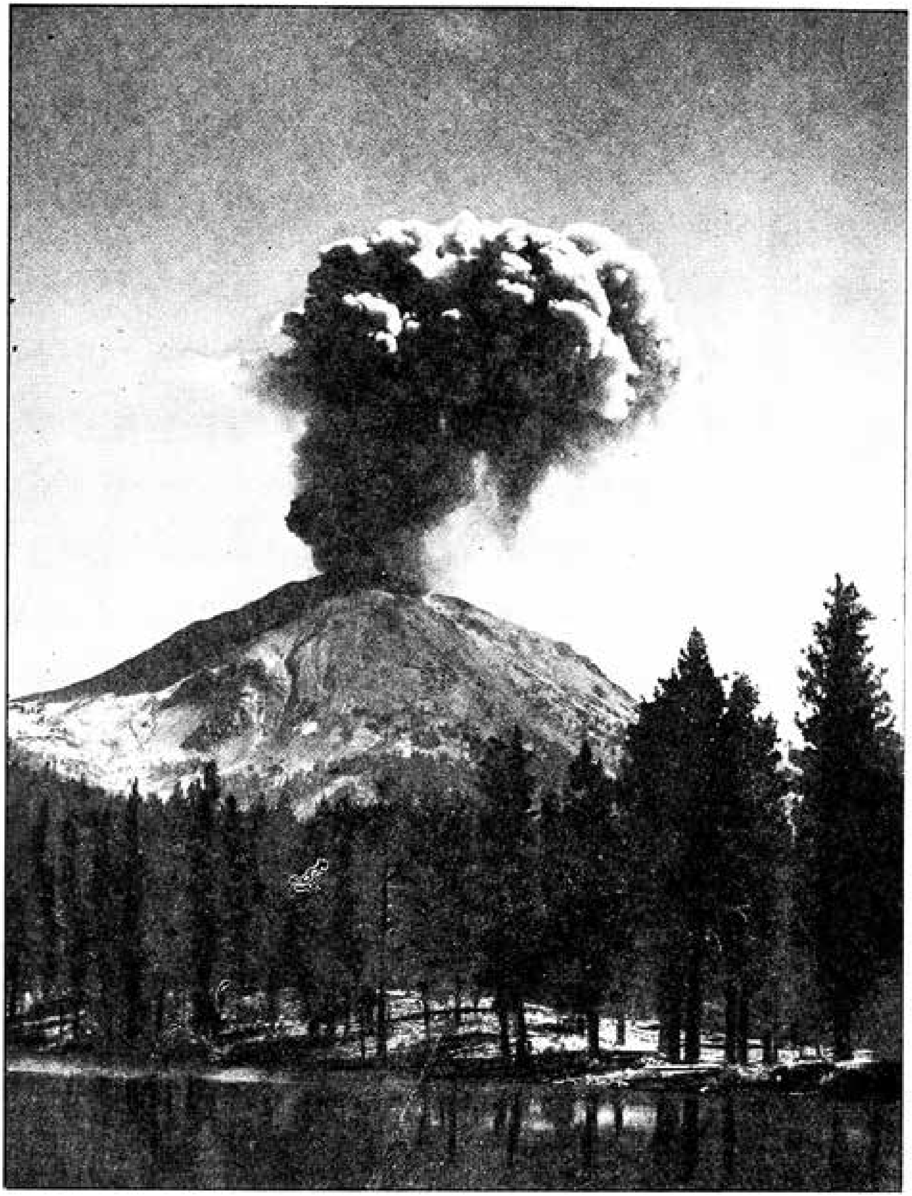
This reader tells you about some of the subjects scientists study and about some of the facts they have learned. That is why we have called this sixth book in the series *The Work of Scientists*.

It is likely that some of you will decide to be scientists when it is time for you to choose what you will do in the world. It may be that your own names will appear in some future edition of *American Men of Science*.

EDITH M. PATCH
HARRISON E. HOWE

UNIT ONE

EARTH SCIENCES and ASTRONOMY



Courtesy Chester Mullen

Mt. Lassen, California volcano, in eruption
The earth's crust does not always remain quiet.

AN OUTING WITH A GEOLOGIST

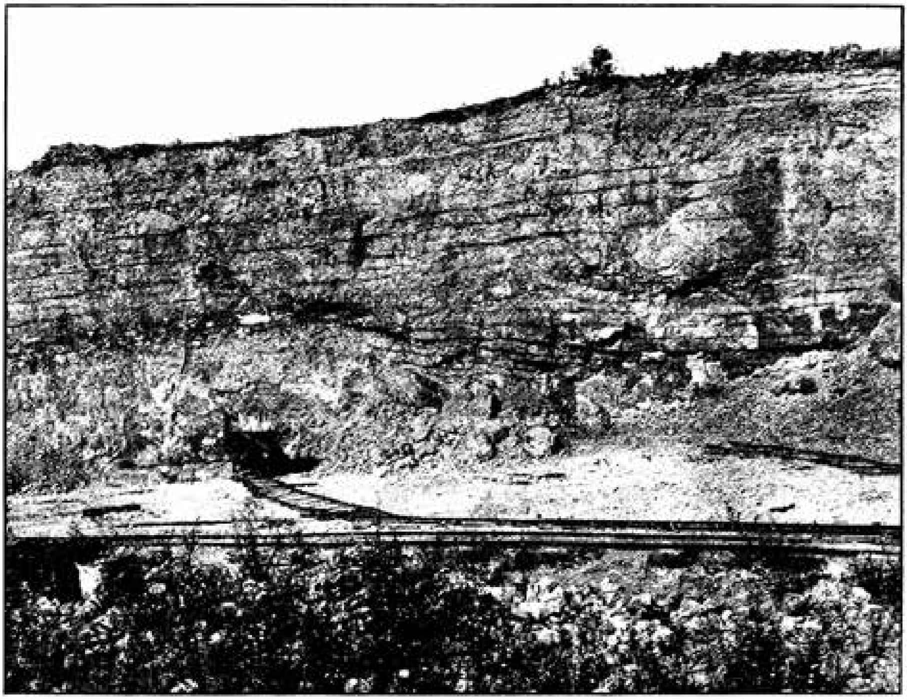
Today we must put on old suits, thick stockings, and old, rough shoes. Anything else will be ruined, for we are going to clamber about over the rocks of a stone quarry and dig fossils from its hard limestone.

As our guide for the trip, we shall have a *geologist* — a man who studies rocks and the things in them, as well as the uses to which they may be put. He comes early, bringing several sharp-pointed hammers, which he calls prospector's picks, and half a dozen chisels. He reminds us to bring some bags and old newspapers, besides our notebooks and pencils.

The quarry lies near the edge of the city. Years ago it was worked for building stone. As we ride to it in a bus, we see several houses whose walls are made of its dark gray limestone. This quarry now lies neglected and quiet, though other quarries in the neighborhood are being used to produce crushed stone for concrete pavements.

After we get off the bus, our geologist guide leads the way to the floor of the quarry. There we stand on the surface of a bed, or layer, of limestone, from which the layers above have been removed. Yet we can tell what they were like, for the edges from which they were broken show plainly in the walls of the quarry. Some of them are thick, and others are thin. Near the top, they stop at an almost level line, above which is a layer of gravel and soil.

Some of us wish to know how it came to be there, but our guide tells us that we shall find out best by beginning at the bottom.



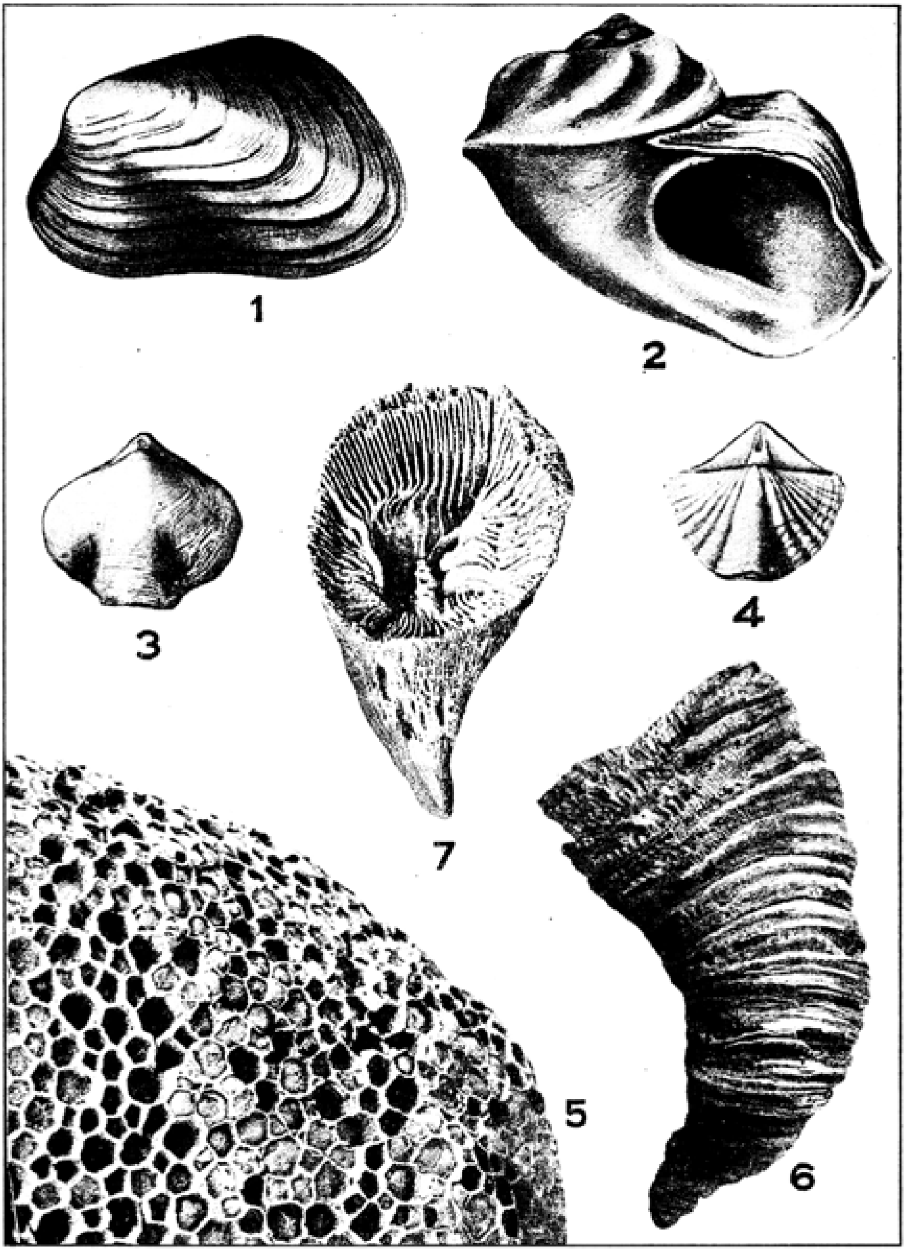
Courtesy Carroll Lane Fenton

AN ABANDONED LIMESTONE QUARRY

FOSSILS

By this time several of us have picked up fossils, which lie here and there on the surface of the rocks. Some of them look like petrified horns, that is, horns that have turned to stone. Others suggest honeycombs of limestone. A few plainly are the shells of snails and clams or other mollusks, while some are what we call lamp shells.

We see a great many more fossils lying in the solid stone, so our guide hands us the hammers and chisels. He shows us how to cut the specimens out without breaking them — how to chisel and pound most effectively. He takes our fossils as we find them and lays them in rows on a large, flat stone. Laughing, he calls

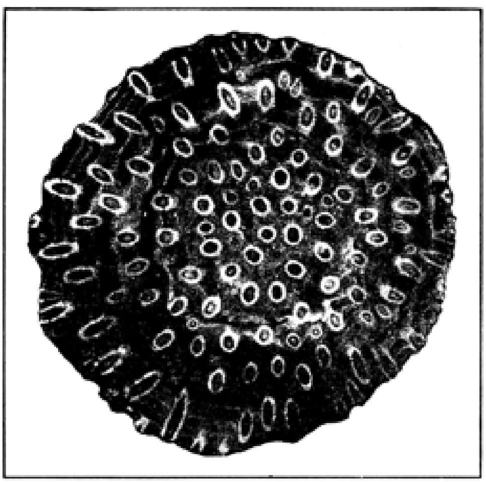


Courtesy Carroll Lane Fenton

FOSSILS FOUND IN LIMESTONE
1, CLAM; 2, SNAIL; 3 AND 4, LAMP SHELLS; 5, HONEYCOMB CORAL;
6 AND 7, HORN CORALS

Courtesy Carroll Lane Fenton

A SHARP-POINTED HAMMER, CALLED A PROSPECTOR'S PICK, AND TWO CHISELS FOR TAKING OUT FOSSILS



Courtesy Carroll Lane Fenton

POLISHED SECTION OF CORAL COLONY FOUND IN A BRICK-CLAY PIT

it his demonstration table and asks us to gather for a little lecture.

First, he picks up some of the snails and clams, holding them where we can all see them. He reminds us that, although some snails live on land, these shells are like those of snails that dwell only in water. Clams, too, are water dwellers.

But what of our "horns"

and "petrified honey-combs"? Taking one of the "horns," the geologist hits it a blow with his hammer. An end breaks off; so he chooses another "horn" and splits it lengthwise. We see that it is filled with ridges and cross partitions, like those in the broken pieces of coral which a friend sent us last winter from the coast of Florida. The geologist assure us that our horn fossils are really corals, and that the object that looks like honeycomb is also coral.

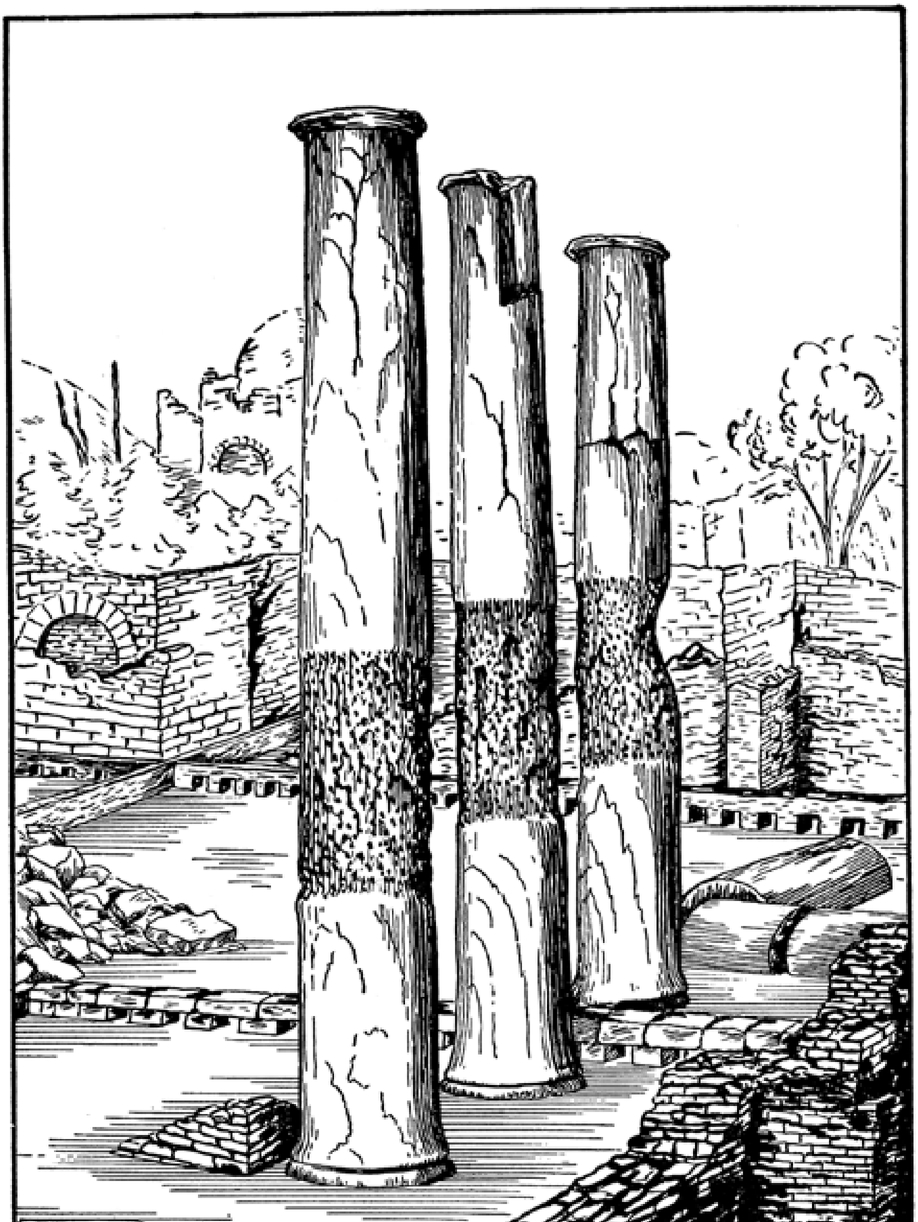
These corals and mollusks must have lived here when the rocks were soft enough to cover the creatures when they died. No coral could have drifted into the mud from any great distance without being broken — and of course it could not get in after the mud had hardened. We have been pounding at an ancient coral reef, whose once living animals have been transformed into stone.

LAND MAY RISE AND SINK

But just a minute. Corals live in the sea and in the sea only. So the waters above the reef must have been salty — and the very surface on which we are sitting must have been the bottom of the sea! This is a real discovery, for the nearest seashore is now hundreds of miles away. But our guide tells us that it has not always been there. Land often has risen above salt water.

Land has sunk beneath salt water, too. Indeed, it is sinking in many places today. Hudson Bay is a sea lying on what really should be a part of North America. Puget Sound, Chesapeake Bay, and the inlets of Maine are one-time valleys filled by arms of the ocean.

In Pozzuoli, Italy, there is a ruin of a Roman temple whose floor lies beneath the Mediterranean Sea, though it must have been built on land. High up on the columns of the temple are holes made by boring marine clams. Plainly, the land on which



TEMPLE OF JUPITER SERAPIS, IN POZZUOLI, ITALY the temple was built once sank several feet beneath the water, from which it is now slowly rising. The land is not so steady as it seems.

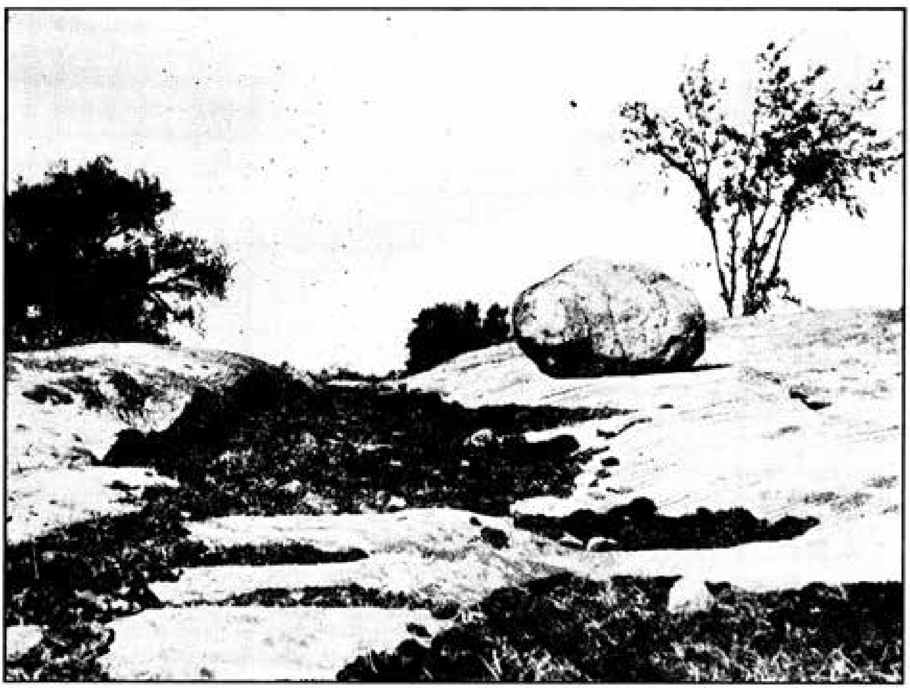
SOME CHANGES IN THE EARTH'S SURFACE

Of course, when great continental areas sank, they went down very, very slowly. As the waters advanced, marine life followed: seaweeds, corals, snails, starfish, and other forms. Rivers flowing into the sea brought silt (mud), which settled to the bottom and buried the creatures lying upon it.

As the mud turned to stone, the shells, bones, and coral masses became fossils. When, centuries later, the earth's surface shifted again, the layers of stone in some places rose above the ocean. In time, land was slowly formed between them and the water,

Broken shells of sea animals called trilobites, lying on a slab of limestone so that they were at last located far from shore. We have dug fossils today from their stony graves in just such layers of stone.

On land, of course, the rain, wind, and frost destroy rocks instead of making them. Yet there are many places where rocks have been made. In lakes and river valleys, beds of sandstone have formed, containing the bones of fish and impressions of leaves. Animals coming down to drink have sunk in quicksands in such numbers that their petrified skeletons now form thick bone beds. In other places, animals failing to find shelter from sands blown by the wind in such storms as sometimes rage over deserts have been buried on dry land. Finally, huge glaciers, much larger than those of Greenland or Antarctica today, crept down from the north. They broke and ground off rock as they came, bringing it mixed with their ice in the form of boulders, gravel, and sand.



Glacial boulder and patches of drift, lying upon ice-worn limestone

When this glacial ice melted, the material in it was left on the surface to become soil throughout the northeastern part of our country.

It is this glacial deposit (really rock that has been broken and ground to bits) which lies at the very top of the quarry wall, on the flat surface over which the glacier once moved. Our guide reminds us that the ledge on which we are sitting is much older than either the glacial drift or the sandstones containing leaves and fish bones. He also offers to show us how a geologist reads the earth's history. We take out our notebooks and pencils and begin working.

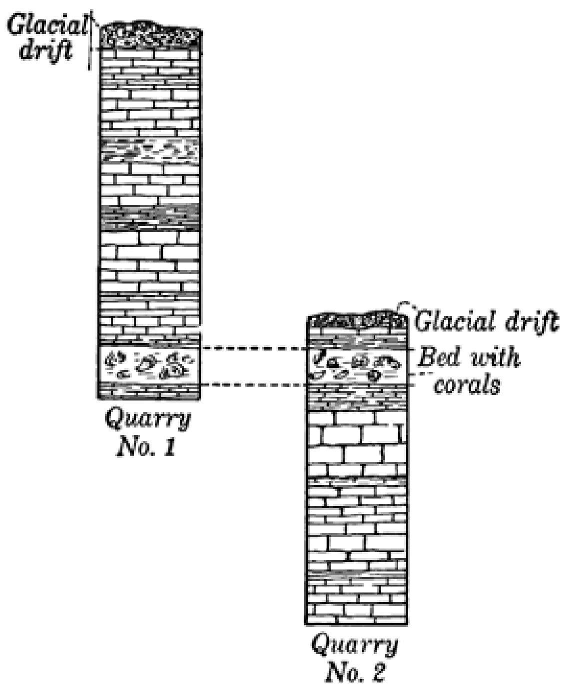
LAYERS OF ROCK

We look at the rock containing the fossils we first found, measure its thickness, and briefly describe it. We do this with the bed next higher up, and the next, and then the next, until we have climbed to the top of the quarry. We make a sketch somewhat like that of Quarry No. 1, on page 12. We find that we have a *geologic section* of the whole series of beds. It is arranged from bottom to top, like the rocks themselves, and it tells all we need to know about them. Each time we stop, we collect a few fossils, labeling them to match the descriptions in our notebooks. If we wish to do so, we may thus study the fossils in every bed we "section."

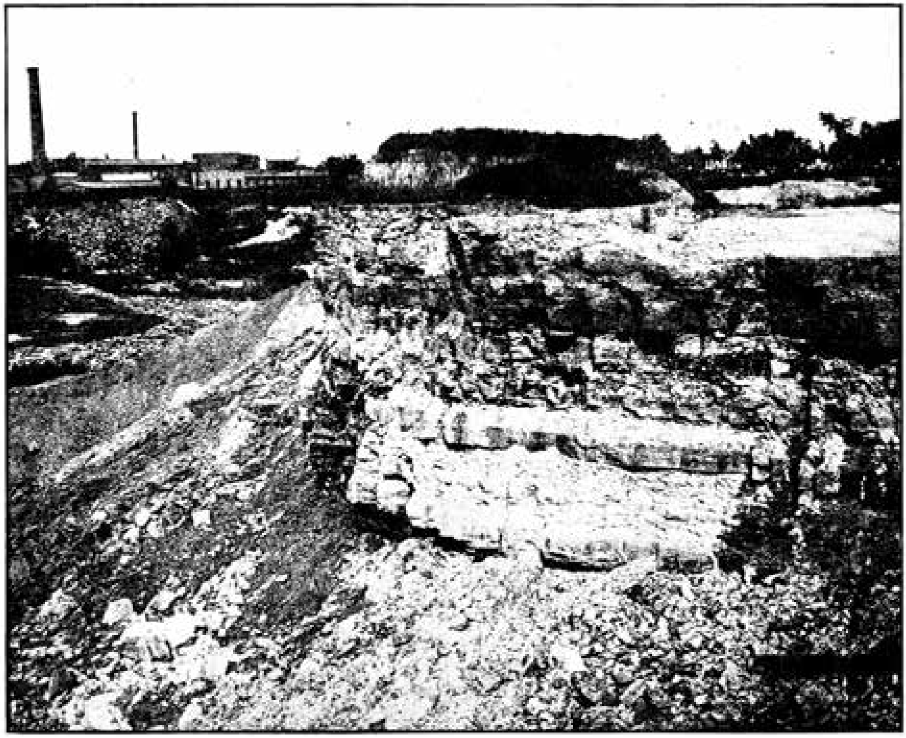
Now our guide asks us to follow him to another quarry a mile away. We gather our possessions and start out, taking care to leave none of the hammers and chisels.

We come to a quarry which looks much like the first one, except that it is bigger and somewhat deeper. But as soon as we begin to collect fossils, we find a difference. In the first quarry, the coral bed lay at the bottom, while here it lies a few inches beneath the soil. We wonder if this layer may be another bed, but both the rocks and fossils are of the very same kinds. Again our guide helps us to make a section, and once more we sit down to talk.

Some of us have been wondering how the ages of rocks can be determined—how to tell which rock layer is old and which is young, and how all of them are arranged in orderly series. It may seem almost like lucky guesswork to tell all this, but the geologist insists that it is only common sense. To prove it, he asks us to look at the geologic sections for the quarries we have seen this morning.



We do so, but the two sections are still a puzzle until someone solves it and shows how simple it really is. These layers of rock lie one above another, like bricks in a wall or boards in a lumber pile. The first one put down must lie at the bottom; the last layer of all lies at the top. But since the coral bed is the same in both quarries, the other layers of rocks cannot be the same. So we merely put our first section above the second, letting the coral beds overlap or match. Now we have our complete section. The position of the glacial drift does not count. It was not laid down until after the long, long ages when the limestones had



BEDS, OR STRATA, OF CLAY IN A BRICKYARD

been lifted up and the layers above the coral bed in the second quarry had worn down.

It is really easy to do this. Yet the geologist tells us that men did not find out how to unite the sections of two quarries until about 1800. It was then that an English surveyor named William Smith proved that bedded rocks form orderly series, each formation with its special types of fossils. We have repeated his discovery today.

THE WORK OF THE GEOLOGISTS

But why should people match series of strata (layers)? Why make sections of quarries, hills, and mountains? What difference does it make whether rocks lie level or slantwise?

While we rest after luncheon, the geologist answers some of

IRON MINE NEAR LAKE SUPERIOR
IRON ORE IS ONE KIND OF ROCK.

our questions. He reminds us that, when we decided to visit the quarry, we asked him to come as our guide. Why? Because he, a geologist, had done these very things about which we were asking. By doing them, he had learned to understand the rocks. He had learned how to write the earth's history. He had learned how to tell which rocks and fossils are oldest. He had learned how the different layers were formed and what had happened to them afterward.

The geologist studies rocks in order to learn the earth's history. But he does a great deal more than that. Many of the things we use are made from minerals found in rocks, or even from the rocks themselves. Limestone is used in the manufacture of cement. Both bricks and many dishes come from clay. Oil and gas lie in the pores of sandstone — if the sandstone is bent at the proper angle. Coal is a black rock that burns.

All these things the geologist studies, and by his knowledge, he helps us to find them. In the old days, if a man wished to find coal, iron, or gold, he bought a pack mule and set forth to hunt for it, without much idea of what he might find. He now hires a geologist, who studies maps and books to find the likely places and then leads the way to those that seem best. Or, if published facts are lacking for that part of the country, he uses what knowledge he has. Soon he picks out a region where the desired substance *may* be found and then tries to find it. He may fail, of course, but his chances are much better than those of the old-time prospector, who had to rely on his own experience, hard work, and luck.

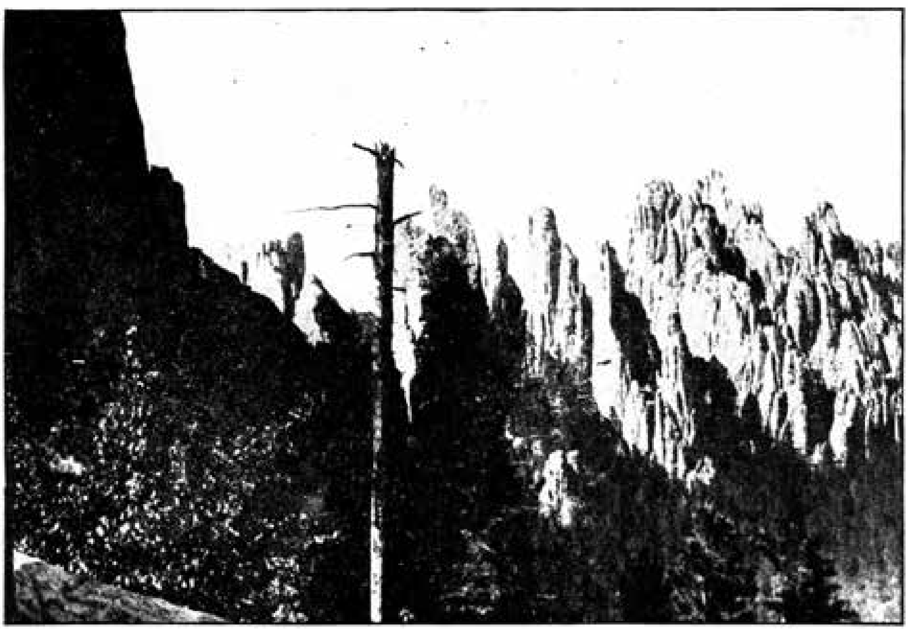
There is not really any mystery about the geologist's method. He merely hunts for the kinds and ages of rock which can — and should — contain the desired substance. If there are fossils, he uses them as guides. If fossils are lacking, minerals may serve the purpose. And by his knowledge of how the rocks lie, he may picture what lies far below the surface. If he fails to find what is wanted, he is able to keep his employer from wasting money in useless digging or drilling.

Of course, such work demands men who have been specially trained. No one geologist can know all about rocks, minerals, fossils, and oil "pools," any more than one naturalist can know all about plants, birds, insects, and stock breeding. Each man has his specialty. When his work takes him beyond his own knowledge, he calls on other specialists for help.

Thus you will find some geologists who scour the plains of the South and West in search of oil. They know that where strata lie in domes, each layer like a huge upturned saucer, deposits of oil are likely to be found. So they search the surface, examine drillings, and study tiny fossils by means of microscopes, all in order to find the sticky black fluid which may be refined to provide gasoline, paraffin, and dozens of other products.

The geologist who seeks minerals works differently. He must know ores whenever he sees them and must learn how they lie far beneath the surface. Fossils will not often help him, for most of the rocks with which he deals are cooled lavas or else strata so changed that no fossils remain. Some of the lavas flowed from volcanoes. Others cooled before they reached the surface, yet formed huge mountains as they were pushed outward. It is the geologist's job to find out what form the lavas have taken, what minerals are in them, and how those minerals may best be mined.

Such men, of course, examine rock sections and crystals with the same care that our guide gives to fossils, for, after all, rocks are only huge masses of minerals, more or less mixed together, and it is not always easy to tell what their value may be by looking at the surface. You know zinc as a light gray metal, which you often see as a coating on the pipes of furnaces. But one ore of zinc is dark red, like garnet, while another is a dull, rusty brown. Silver may be pure and so may copper; but as a mineral in ores, the former is likely to be black and the latter green.

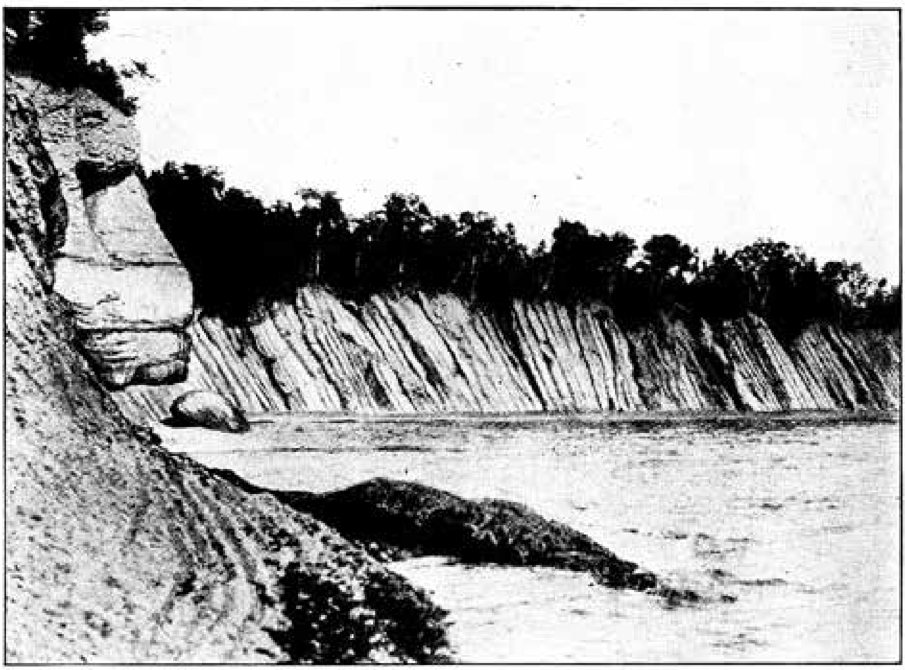


Pinnacles of granite in the Black Hills, once molten rock, or lava

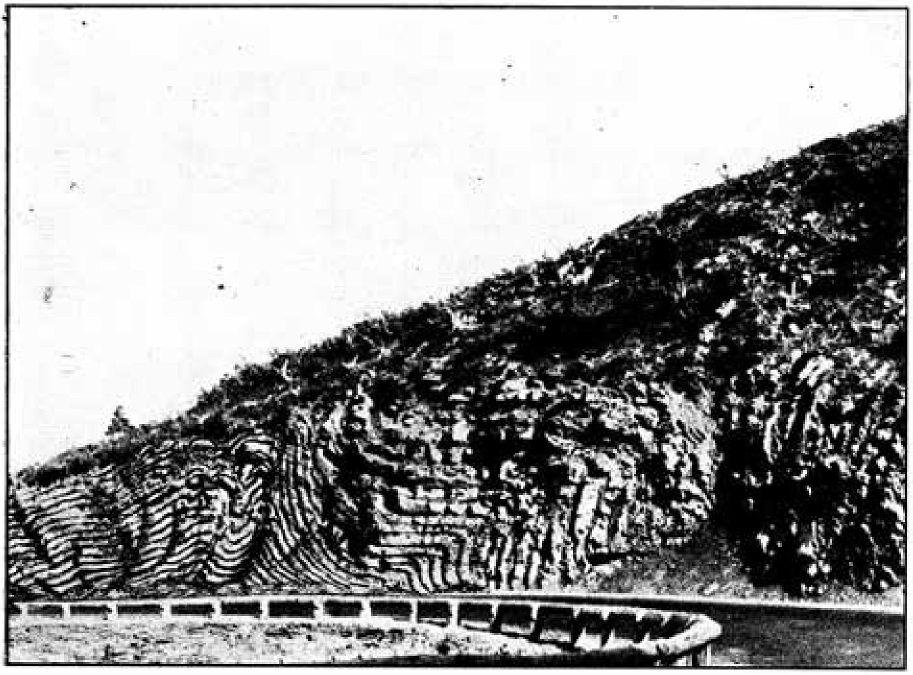
Unless the geologist can recognize these substances and many others, he cannot tell workmen where to find them.

The geologist's work would have been easier if the earth's crust had stayed quiet or moved smoothly. But that, of course, could not happen. While some lands sank beneath the sea, others rose as hills or mountains. Strata were bent, tipped, and broken. Lava poured forth where they broke. In such places of crumpling and mountain building, the map of rocks looks like a crazy quilt, with pieces of all sizes, shapes, and colors.

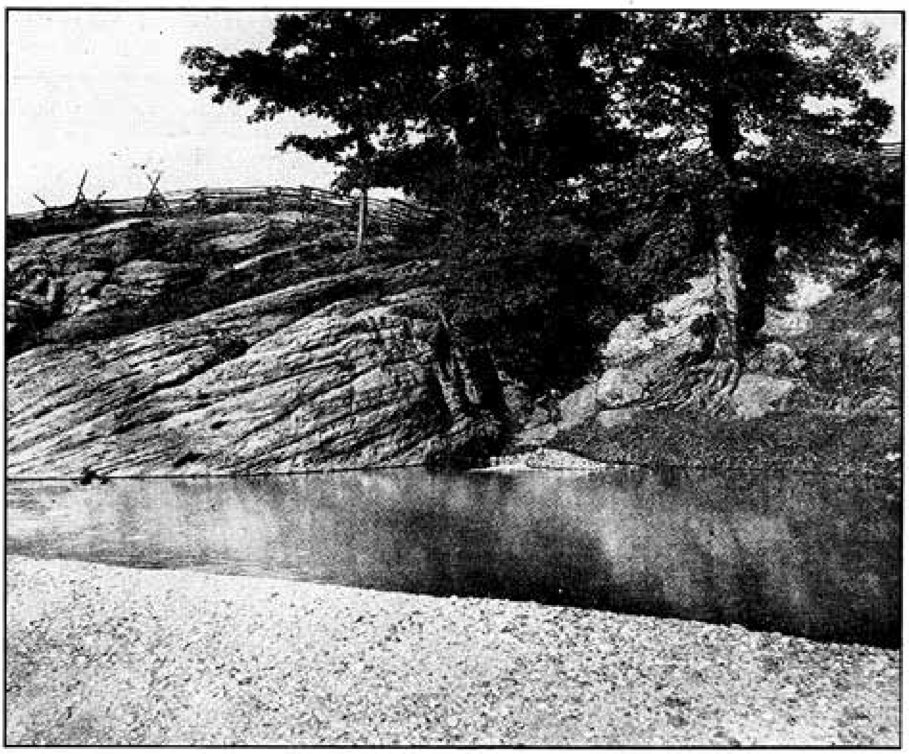
Such jumbles add to the puzzles the geologist must read. But the forces that produced the jumbles made many of the things for which he hunts. Limestone, folded into mountains, became marble. Shale, also folded, is now slate. Advancing seas laid down sands from which men make bottles, mirrors, and windows. Lavas brought gold and silver and nickel. It was



These bedded rocks were turned on edge, making mountains that have since worn away.



Rocks like these were broken and crumpled
when the Rocky Mountains were built.



These layers of glass sand were dropped
by the waves of an advancing sea.

Fossil fern leaves in shale, once mud that covered a coal seam

the tilting of strata that made the domes which are sought for oil pools. These and other movements of the earth's crust have helped men more than they have hindered.

Our guide asks us to name some of the things made from substances taken from the earth. We mention engines, automobiles, bridges — built out of iron mined near Lake Superior. The gold of our watches came from a mine, perhaps in South Dakota, Ontario, or Alaska. We have seen concrete roads and limestone houses, and we know that bricks are baked clay. The "lead" in our pencils is graphite, a form of the mineral carbon.

The money in our pockets is silver, nickel, and copper. A train whizzes by, burning a rock called coal, and the geologist remarks that many things are made from coal. He says that our clothes probably are colored by dyes from coal tar, and that much ice cream has mineral flavors.

But why continue the subject further? Everything we use comes either from the earth or from plants or animals that live upon it, getting their food from the air, soil, or waters upon the earth. The geologist tells us how these animals and plants come to live where they are and what their ancestors were millions of years ago. He also tells us where to get substances we need today for factories, machines, buildings, or even some of the things we eat and wear.

The next time someone asks us, "What good is a rock?" what kind of answer shall we give him?

ACTIVITIES

While you have been reading this chapter about geology, you may have remembered chapters in other of the *Nature and Science Readers* that have touched upon this subject. You may find it interesting to reread these earlier chapters. Pages 214 to 237 in *Surprises*[1] tell about chalk, clay, slate, coal, coral, limestone, and marble. The chapter "Hunting for Boulders" in *Through Four Seasons*[2] tells about glacial deposits. Read the chapter "The Mason's Work" in *Science at Home*. Pages 122 to 125 in the same book tell about coal, coke, gas, and fuel oil.

On page 9 of this book, there is a picture of broken shells of ancient *sea* animals called trilobites. These were three-lobed creatures. (*Tri*, as you may know, means three.) Can you tell from this picture why trilobite is a good name for them? If not, try to find a drawing of a trilobite in some encyclopedia or large dictionary.

If you were a geologist, which of the following subjects would you especially like to study?

a. Ores containing valuable minerals

b. Glacial deposits

c. Oil wells

1 References to other books will be made from time to time. On page 344 you will find a list of the books that are mentioned. On that page, the names of the authors are given, as well as the names of the publishers. You may find these books in school libraries or public libraries.

2 Also available from Living Book Press.

d. Fossils

Write a page or more telling the reasons for your choice. You may use "I'd Study - If I Were a Geologist" for a title, unless you think of a title you like better.

Read the chapter "The Old Boulder" in *Holiday Hill*[3].

3 See page 344 for book list.