FOSSIL COLLECTING IN PENNSYLVANIA

by

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INTRODUCTION

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The Pennsylvania Geological Survey frequently receives requests for information on where to collect fossils in the Commonwealth. This book is intended to supply such information; thus the major portion of the book is devoted to a geographic and geologic description of fossil localities, including lists of the fossils to be found at each locality.

Although knowing the location of fossil-collecting sites is important, there is more to fossils than just collecting them. The study of fossils (paleontology) is the lifetime work of many scientists. Their work has given answers to some of the basic questions of the evolution of life and the world we live in. To have a comprehensive understanding of what fossils signify gives the collector a greater appreciation of the hobby in which he is engaged. To enhance this appreciation, the first portion of the book is devoted to the significance and uses of fossils as well as the description of the major groups of fossils that one may encounter when engaged in fossil collecting in Pennsylvania. For those interested in further information on paleontology, references are listed near the end of the book.

WHAT IS A FOSSIL?

Fossils occur in many forms. The footprint or burrow of an animal preserved in rock is a fossil; a clam shell preserved in rock is a fossil; the imprint of a leaf in a rock is a fossil. A fossil is any naturally formed record of animal or plant life found in rocks that gives an idea of the appearance of the original organism.

Imagine for a moment a common dweller of today’s oceans—the clam. A clam is composed of two shells (called valves) surrounding a fleshy body which contains muscles that open and close the shells. If we examine the various processes that may affect this clam after it dies, we will learn the many ways in which the clam can be preserved as a fossil.
Some examples of fossils.

When the clam dies, the fleshy parts quickly decay and disappear and the shells are left to be washed about on the sea bottom or shore. Because the muscles that held them together are gone, the shells frequently separate. The shells may be destroyed by currents on the sea bottom, or they may be buried beneath sediments, which continually accumulate on the sea floor. Burial by sediments is the first step in fossilization.

The sediment surrounding the shell may become compacted and turn into hard rock, and the shell may be preserved with no further changes. But many shells are dissolved by the water in the compacted sediment, leaving a space that becomes a mold, which preserves all the details of the shell surface. If other material later fills this space and hardens, the hardened material becomes a cast. Both casts and molds are fossils because, although nothing of the original shell is left, we can see what the shell looked like. Since the outside and inside of a shell generally are different, we call molds and casts internal (inside) and external (outside), depending on which part of the shell they represent. Molds are common as fossils, but casts are relatively rare.
If the clam shell escapes being dissolved, it may be affected by other processes as the rock around it hardens. One of these processes is replacement. When examined microscopically, most rocks formed from sediments are found to contain many very small pores and spaces. The pores and spaces may be interconnected and may contain water carrying dissolved minerals. Under certain conditions, minerals carried by this water will be substituted for the material of the shell, which is commonly the mineral calcite, so that the shell is gradually replaced by minerals such as quartz or pyrite.

Some animals, such as insects, possess no hard parts (skeleton or shell); their body covering consists of an organic compound called chitin, a material similar to our fingernails. These animals, when buried, are preserved under only the most exceptional circumstances whereby the chitin, through a process called distillation, is reduced to a thin carbon film as the sediment is compacted. This film may preserve many of the very fine features of these animals.

Plants are usually found as two types of fossils. One is the imprint of leaves, ferns, and seeds that have been carbonized by the distillation process discussed above. Limbs, roots, and trunks of trees are many times preserved as casts and molds; rarely, large portions are preserved through replacement of plant tissue and filling of tissue pore spaces by silica and other minerals. This is also called petrifaction. The trees found in the Painted Desert and Petrified Forest of the American West are examples of this process.

The track made by the dinosaur as it stopped by a stream to drink and the trail of the crab skittering along the seashore, when preserved in rock, are also fossils because they give us an idea of what the feet of the animal looked like. The burrows and feeding traces of animals are also fossils; tracks, trails, burrows, and traces are referred to as "trace fossils."

Preservation by burial in sediment is one of the most important processes in the formation of a fossil. Many organisms do not die in places where sediment is being deposited and thus have no opportunity for fossilization. The possession of hard parts is also very important in the formation of a fossil. Animals and plants live today for which there are no known fossil ancestors. These unknown ancestors lacked hard parts, died where no sediments were being deposited, or were not preserved due to a combination of these two factors. Trace fossils may be the only record we have of many of the animals that did not possess hard parts.

One of the most interesting studies a paleontologist undertakes is the reconstruction of an animal or plant from the fragmentary fossils found. In many cases this is a very difficult procedure because the various parts of an individual animal or plant may have been widely scattered after death, and the skin, muscles, and other soft parts are missing. It is often
A reconstruction of a Devonian sea bottom.

a. "Glass" sponge
b. Coral
c. Brachiopod
d. Pelecypod
e. Cephalopod
f. Trilobite
g. Crinoid
h. Starfish (stelleroid)
i. Armored fish (placoderm)
necessary to refer to living animals and plants to decide how to reconstruct a fossil. Many fossils have been found that cannot yet be totally reconstructed because they have no living relatives to which they can be compared. After reconstruction of a number of different fossils from the same age and environment, scientists often attempt to place them together as they once must have lived. An example of this is the sketch of the Devonian sea bottom shown on page 4.

It is important to remember in collecting fossils that what you collect is usually only a fragment or impression of the original animal or plant, lacking its soft parts and frequently lacking many of its hard parts. It is also important to remember that the fossil organism that you discover is only one of perhaps millions of similar individuals that may have lived.

**OF WHAT USE ARE FOSSILS?**

Why study fossils? Are they more than just curiosities to collect and place in a display cabinet? The answer is, as you might guess, yes. Fossils are the record of life on the earth through billions of years since the first bacteria lived and the first algae began to form layered mats still recognizable in very ancient rocks. As such they offer clues not only to the history of the development of life, but also to the character of past climates on the earth and to changes that have occurred on the earth’s surface and in its seas. Because fossils yield information about the environment in which they lived, they also tell us something about the history of the rock in which they are found. Knowledge of the rock history has practical use in the search for mineral resources such as oil and gas, coal, and limestone.

The oldest known rocks of sedimentary origin contain only very primitive fossil animals, such as algae. As younger and younger rocks are examined, we find that the fossils they contain have gradually changed and become progressively more like present-day living organisms. Detailed study of the fossils shows that certain older groups gradually changed (evolved) into younger groups. These changes support the theory of evolution, a theory with which scientists are much concerned.

The differences between fossils contained in younger rocks and those contained in older rocks provide a basis for dating and identifying rocks of similar age in widely different areas. For example, if a paleontologist finds rocks in North America and South America that contain the same fossils, he can generally say that they were formed at the same time and thus are of the same age.

A paleontologist working for an oil company does the same thing with fossils, but this paleontologist may use only very small fossils called microfossils. The paleontologist may work with rocks that occur only in
Pennsylvania. If the company has fossils from an oil-producing well drilled near Pittsburgh and drills another well in Clearfield County, the fossils may be used to indicate to the driller when the drill is approaching rocks of the same age as those in the Pittsburgh well. This may help in determining how deep one has to drill before intersecting the oil-bearing rocks.

How do fossils help us to unravel the history of the earth? The paleontologist has been able to determine the conditions under which most fossils lived by studying modern life. Corals, for example, today live in the oceans. When a coral is found in a rock, it follows that the rock material must have been deposited on a sea bottom. By collecting a large number of fossils from all rocks of a given age over a large area, those areas occupied by land and sea of that former time can be outlined. For example, the area of land and sea existing in Pennsylvania 380 million years ago has been worked out in this way and is shown below.

![Diagram of land and sea areas in Pennsylvania during part of Devonian time.](image)

Plant fossils, like animal fossils, also tell their own story. Trees grow on the land surface. Certain assemblages of plants and trees are characteristic of swamps rather than dry land. The coals of Pennsylvania are composed of trees and plants from such assemblages, indicating that during the periods of coal formation extensive swamps existed in Pennsylvania (see page 46).

Fossils may also be used to determine past climates on the earth. Corals, for example, are thought to have lived only in warm waters, as they
do today. Corals found in rocks in Alaska indicate that the area of Alaska was at one time an area of warm seas.

Fossils may also be used to identify and date the rocks in which they are found. These fossils are known as index fossils. An index fossil generally has a distinctive and easily recognizable shape, occurs commonly over a large area, and is restricted to a short period of geologic time. The best index fossils are from animals that were swimmers or floaters, so that they were distributed widely in the seas and oceans. Some of the best index fossils are graptolites and certain types of cephalopods.

**FINDING FOSSILS**

Although fossil-bearing (fossiliferous) rocks are present in many areas of Pennsylvania, fossils are not always easy to collect. They are found only in sedimentary rocks, such as limestone, shale, and sandstone, and then only in a small portion of these types of rocks. If you are a beginning fossil collector, you are advised to visit localities described in this book in order to become acquainted with the types of rock that contain fossils and to find out what fossils look like.

In this book fossil localities are described for 52 of Pennsylvania’s 67 counties. A map of Pennsylvania showing the location of each of the sites is on page 50. A detailed location map also accompanies each site description. Pennsylvania highway maps and topographic maps may further aid the collector in finding the localities described.

In addition to a description of the fossil sites, we include a list of the generic names of fossils we have found at each site, the type of rock and its geologic age, and other information that may be of interest to the collector. We expect that careful searching at any locality will uncover additional genera of fossils not given in the lists.

For the ambitious collector, the 1980 edition of the *Geologic Map of Pennsylvania* (Map 1 of the Pennsylvania Geological Survey) will be of great aid. This map shows the many rock formations throughout the state. If a sedimentary rock formation is found to contain fossils at one place, it is likely to contain fossils elsewhere. After learning which rock units contain fossils, refer to this geologic map to find other areas underlain by the same rock units. You may then explore these areas for additional localities.

**COURTESY IN COLLECTING**

Overuse of a site by students and exploitation of a site for commercial purposes have resulted in the closing to the public of two famous localities, as well as several less famous sites, in the past two decades. Please
do not do anything that will cause property owners to remove localities described herein from future collecting.

Remember that in almost all cases the site at which you are collecting is on private property. If possible, obtain permission from the owner before you collect. Even roadside exposures within the highway “right-of-way” are private property. If someone questions your presence at a roadside exposure, explain your activity and request permission to continue collecting. Do not destroy fences or other private property and do not leave litter. Other people may want to visit this site, and careless or heedless actions on your part may destroy this opportunity for them.

COLLECTING AND PREPARING FOSSILS

The collector should take to the fossil locality a hammer, scrap paper, and a collecting bag. A hand lens is useful where the fossils are small.

A chisel-edge hammer, such as that used by bricklayers, is most convenient for both breaking rock from the outcrop and for splitting the sample along natural layers. The rock at some localities is weathered so that it is fragile and easily broken, whereas at other localities it may be unweathered and very difficult to break.

Specimens collected in the field should be wrapped in layers of paper to preserve them; it is then most convenient to place them in a collecting bag. It is important that specimens be labeled with the locality and any other pertinent information when they are collected. Labeling at collection time will allow the specimens to be properly identified at a later date. A sample of the label used by the Pennsylvania Geological Survey is shown on the following page.

After the fossils have been collected, it is often necessary to clean them by removing any dirt and rock layers that hide part of the specimen. It is advisable to wash the nonfragile specimens with water and a soft brush and then to work on the rock with various chipping and scraping tools, ranging in size from cold chisels to fine needles, depending on the size and fragility of the fossil. Old dental probes, if you can obtain them, may be sharpened easily into needle and chisel points and make very useful tools in cleaning fossils. Fragile specimens may be protected with a coating of clear plastic spray or clear nail polish.

After individual fossils have been cleaned and prepared, identification labels should be made out for each specimen, giving the locality, the fossil’s name, and the name of the collector.

One of the best virtues of a fossil collector is patience. Many of the very best specimens that have been collected come from sitting in one spot at a fossiliferous outcrop and patiently examining each piece of rock for fossils.
IDENTIFYING AND CLASSIFYING FOSSILS

A fossil-collecting expedition is complete only when the fossils found have been given their proper names. All fossil plants and animals can be classified into progressively more limited categories until a generic and a specific name (genus and species) is applied. The first step, a simple one in most cases, is to decide if the fossil is an animal or plant (Kingdom Animalia or Kingdom Plantae). Then the fossil is placed in its proper phylum (plural: phyla) and class. Classes are subdivided into families and families into orders; these are mainly of interest to scientists and are not discussed here. The section of this book entitled "Characteristics of the Major Fossil Groups" (page 14) contains descriptions of the various phyla and classes and will help you classify your specimen in the proper category.

The final refinement of the identification is to determine the genus (plural: genera) and species of the fossil specimen you have found. All individual specimens of the same species may not look exactly alike, but they will have many features in common. This you can see by observing individuals of the species to which you belong (Homo sapiens). You can best identify the genus of the fossils you collect by comparing them with pictures of fossils. The sketches at the back of this book illustrate most of the fossils you are likely to encounter at the localities described in the book.

Fossils on these plates are generally not shown at their actual size because of space limitations. The amount of reduction or enlargement is
shown under each fossil sketch. The figure “x0.8” means that the picture is eight-tenths the size of the actual specimen. Keep in mind, however, that all specimens of the same genus will not be the same size, just as all Homo sapiens are not the same size. Illustrations of fossils not shown on these plates may be found in one or more of the books listed in the “Addi-
tional Reading” section near the end of this book. Two of the most useful references are *Index Fossils of North America*, by Shimer and Shrock, and the *Treatise on Invertebrate Paleontology*, published by the Geolog-
cal Society of America and the University of Kansas.

The examples below show how three different organisms are classified into various categories. The names may seem strange because they are based upon Latin and Greek words, but this has been done so that the names may be used and pronounced all over the world in an internation-
al system (code) of zoological nomenclature.

<table>
<thead>
<tr>
<th>Category</th>
<th>Example 1</th>
<th>Example 2</th>
<th>Example 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kingdom</td>
<td>Plantae</td>
<td>Animalia</td>
<td>Animalia</td>
</tr>
<tr>
<td>Phylum</td>
<td>Tracheophyta</td>
<td>Brachiopoda</td>
<td>Chordata</td>
</tr>
<tr>
<td>Class</td>
<td>Gymnospermae</td>
<td>Articulata</td>
<td>Mammalia</td>
</tr>
<tr>
<td>Genus</td>
<td>Pinus</td>
<td>Atrypa</td>
<td>Homo sapiens</td>
</tr>
<tr>
<td>Species</td>
<td><em>strobos</em></td>
<td><em>reticularis</em></td>
<td></td>
</tr>
<tr>
<td>Individual</td>
<td>White pine tree</td>
<td>Sea shell</td>
<td>Man</td>
</tr>
</tbody>
</table>

It is common practice to simplify frequently used names by dropping or changing endings. For example, members of the phylum Brachiopoda are called brachiopods; members of the class Mammalia are called mam-
mals. The generic and specific names are not used informally and are al-
ways written as you see them above, following rules of the International Code.

**GEOLOGIC TIME**

The earth has been in existence for over 4,000 million years. To be able to talk about portions of this vast amount of time, scientists have sepa-
rated it into divisions (called eons, eras, and periods), which are charac-
terized by certain kinds of fossils. In fact, fossils were one of the original means by which the boundaries between these various time divisions were established. The accepted time divisions are shown on the geologic time scale on the following page. The first column shows the times at which the various periods started, in millions of years before the present. The second column indicates some of the characteristic animals and plants that lived in these periods of the earth's history. The third column shows the many types of rocks formed in Pennsylvania during certain periods of time. If you examine the time scale, you will see that during most of the Jurassic and Cretaceous Periods no sediments were deposit-
Geologic time scale.
ed in Pennsylvania. We thus assume that Pennsylvania was mainly a land region during these periods. Therefore we have no fossil record of life during these periods in Pennsylvania. The fourth and fifth columns list the period, era, and eon names that we use for the various divisions of time. As you can see, it is much easier to say that you found a Devonian age fossil than to say that you found a fossil between 365 and 405 million years old. The period names will be used a great deal in later portions of this book.

The geologic time scale is the standard to which scientists refer in dating the various portions of the earth's history. Using this standard, paleontologists can study what occurred all over the world at any one time. The periods and eras represent, in general, times during which major geologic events took place, such as the formation of a range of mountains or the deposition of a certain suite of rocks. Many long and detailed books have been written on the subject of geologic time and the many geologic events that have taken place since the earth began. For those interested in this fascinating subject, references are given in the section on "Additional Reading."