ART TO ZOO

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MAY 1984

Fossils: Footprints Across Time

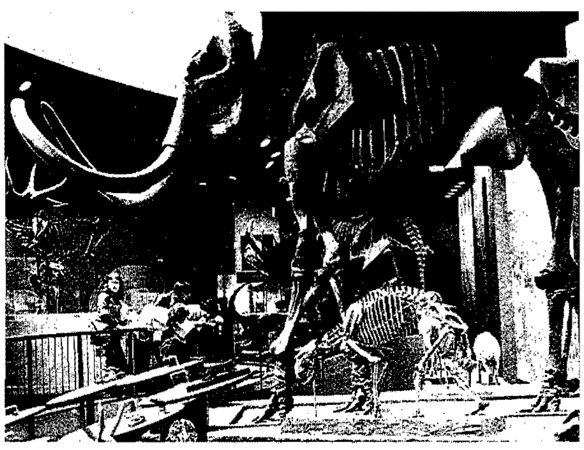
Fossilized traces of plants and animals have fascinated man throughout history. They have been the source of many superstitions: strange beliefs concerning fossils can be found in the folklore of various cultures all over the world.

The fossil shown on this page is a trilobite several hundred million years old. It and other fossils of great variety provide us with an important tangible record of the distant past. From tiny trilobite to massive frozen mammoth, fossils offer provocative evidence of some of the life forms that have inhabited the earth from almost the very beginning of geologic time. Of course even now, certain plants and animals are being preserved as fossils, and these will provide future generations with valuable information about life on earth today.

The study of fossils is fascinating to most children. If these mute examples of ancient life *could* speak, what interesting stories they might tell—and in a way, they *do* tell through the fossil record. By studying fossils your students can learn not only what the earth was like millions of years ago, but also how scientists have devised time charts to help organize this evidence of the earth's geologic history.

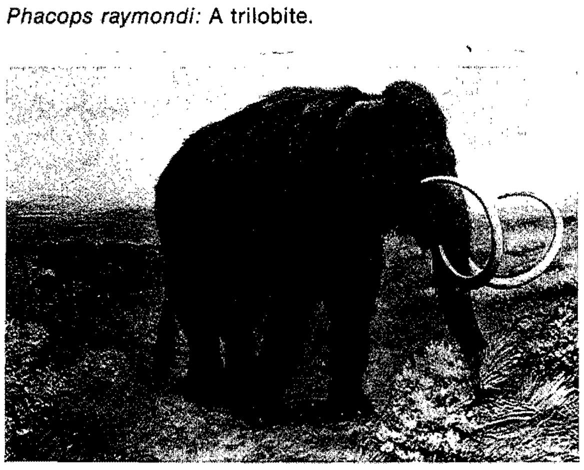
In this issue of *Art to Zoo,* we present an introductory study of fossils whereby the student learns what fossils are, considers some ways in which fossils are formed, and is given examples of uses of fossil materials in industry and everyday life. Through this study, research and writing skills will be brought into play as the children practice such fundamental skills as observing closely, making comparisons, and sequencing events.

Children examine the differences between mammoth and mastodon teeth in the Smithsonian National Museum of Natural History.



Complete reconstruction of these ancient mammals was necessary in order to put them on display in the Ice Age Hall of the National Museum of Natural History in Washington, D.C.

Phacops raymondi: A trilobite.



Reconstructing what a specimen probably looked like from bones and other evidence is part of the work of a paleontologist. Here we see an example of this work in Charles R. Knight's conception of an ancient woolly mammoth.

Reconstructrion of ancient animals from scattered fossilized bones is a painstaking job. The bones are rarely found in the shape of the animal, as evident in the photograph of the fossilized bones.

What are Fossils?

Fossils are the remains, or evidence, of any living thing from the geologic past, and as such they constitute a record of life as it has evolved throughout the long span of geologic time. Although millions of fossils are found in rocks throughout the world, these represent only a few of the numerous plants and animals that have existed since life began.

An animal or plant having hard parts, such as bone, teeth, shell, or wood, is the kind of organism usually preserved as a fossil. The organism must be buried quickly to prevent decay and then must rest undisturbed throughout the thousands of years needed for fossilization. Because of these requirements, very few plants and animals are ever preserved as fossils. Although a fossil record of all the living things that have ever existed is therefore unavailable, scientists use the fossil record they *do* have to help them reconstruct the geologic history of the earth.

The Study of Fossils

The study of fossils is called *paleontology,* and the scientists who collect and study fossils are called *paleontologists.*

The term "fossil" comes from a Latin word, *fossilis,* which means "something dug up." By definition "fossil" refers to an organism that was preserved in the earth's crust at least ten thousand years ago. (Unless, of course, it is a "living fossil"—a term that refers to present-day plants and animals that have changed very little, or not at all, when compared to their original ancestors.)

Where Are Fossils Found?

Most fossils are located in rock formed from sand, silt, mud, or other fine sediment that has gradually hardened into sedimentary rock. The ideal location for a fossil to form is beneath a quiet body of water. There the specimen can rest undisturbed as sediment quickly covers it, preventing decay.

Since igneous and metamorphic rocks are formed under conditions of heat and pressure that tend to destroy fossils, specimens are not often found in those kinds of rocks. Sedimentary rock, however, covers three-fourths of the earth's land area, which means that fossils can be found in various places all over the world.

Occasionally fossil and mummified remains are preserved by an unusual condition such as extreme cold. The Big-horned Bison and the freeze-dried leg and foot of the horse are examples of this kind of preservation: unaltered remains.

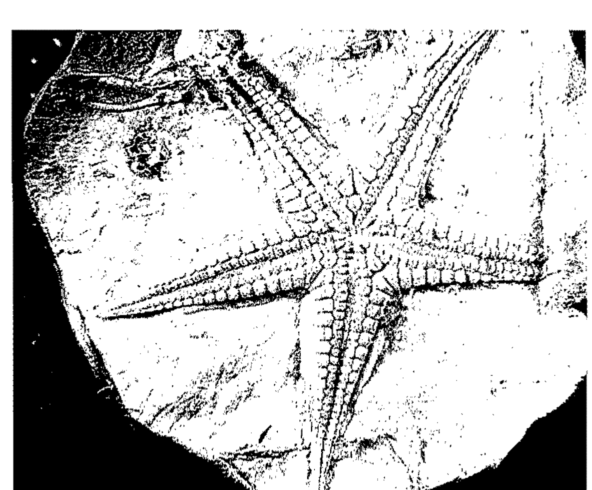
How Fossils Are Formed

There are two general types of fossil records:

1. *Unaltered Remains.* In rare situations an entire plant or animal, or some of their various parts (including the soft tissues), may be preserved intact by unusual conditions such as extreme cold, chemical action, or extreme dryness.

2. *Altered Remains.* This type includes most fossils because the great majority of plants and animals are *changed* in some way after the organism dies. These changes may take place in the following ways:

PERMINERALIZATION: This process occurs when the porous matter of bone, shell, and wood is partially infiltrated by mineral-laden water seeping into the pores of the specimen, resulting in a stony fossil that is heavier than the original specimen but otherwise usually unchanged.



A fossil starfish (fossilized by permineralization).

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continued from page 1

REPLACEMENT: When the infiltration occurs more slowly over a longer period of time, the hard parts of the original specimen can be completely dissolved and later replaced by mineral matter.

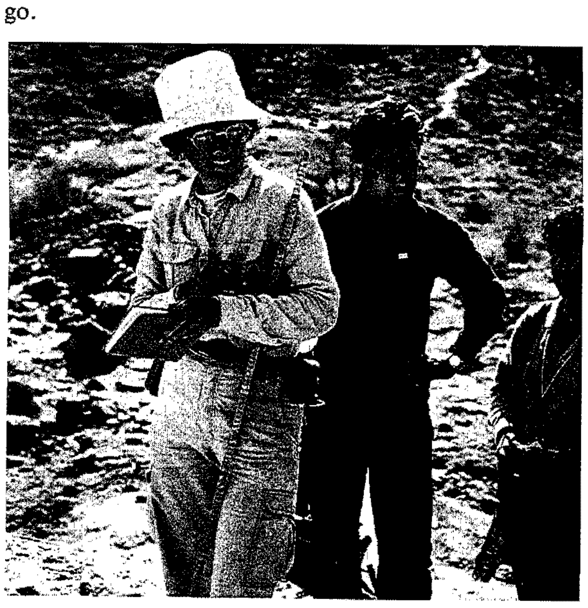
CARBONIZATION: Soft-bodied animals and leaves and stems of plants may become a fragile carbon film after volatile body chemicals escape during decomposition, leaving behind only a thin layer of carbon.

TRACKS AND TRAILS: These include traces of activities—locomotion, resting, eating, excretion, and mating—of the extinct animals. In order for these traces to be preserved, they must be covered by a fresh layer of sediment and remain covered in order to prevent destruction.

MOLDS AND CASTS: Molds and casts can occur together in nature. Molds are formed when either part or all of a plant or animal is pressed into surrounding dirt, which later hardens into rock. This imprint is called a MOLD. Sometimes dissolved minerals fill the mold and then harden, forming a replica of the original imprint-maker. Such a replica is known as a CAST.

Fossils of Man

It is not known precisely when man's ancestors first appeared on earth but scientists believe that these ancestors were here by 4.5 to 5 million years ago. After Darwin published *The Descent of Man* in 1871, interest concerning man's origin increased rapidly, but fossils of early man have been difficult to find. What is known about man's ancestry has been learned from fossils discovered during the last hundred or so years. Much remains to be known, however, and the search continues today. In 1983, discovery of a fossil primate believed to be a link to a common ancestor of man was made in Kenya by Richard Leakey and Alan Walker. Also, during this century, radiochemical techniques have become important tools for dating hominid (man-like) fossils. Genetic differences between modern higher primates have been found—based on developments in molecular biology—that suggest how far back in time the relationships between man and the other primates go.



Pictured above is Dr. Anna Kay Behrensmeyer (wearing the hat), a paleobiologist at the Smithsonian's National Museum of Natural History, along with two other scientists from China. They were part of a team of scientists from several different countries who participated in a "dig" at the Siwalik Beds of Pakistan in 1982. Dr. Behrensmeyer is standing near the spot where two heel bones of 9-million-year-old hominoids were found. (Photograph credit: Dan Chaney)

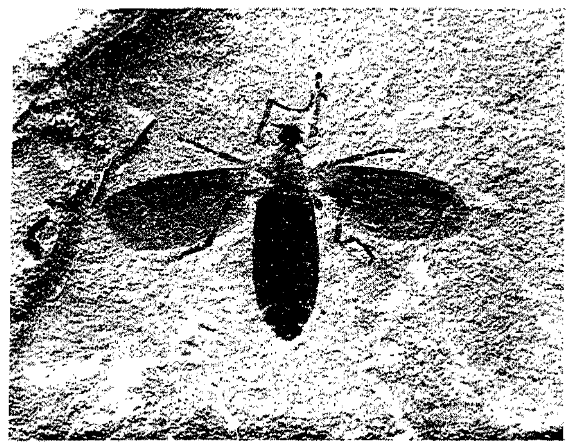
Some Things Fossils Tell Us

The study and dating of fossils provide today's geologists, archeologists, and paleontologists with invaluable information to use in reconstructing the geologic history of the earth. With this information scientists have organized geologic time into large divisions according to the events or characteristics of that interval of earth history. By doing this, they have been able to show the evolution of living things throughout geologic history, from the simplest one-celled plants and animals at the beginning to the most complex organisms alive today.

Also, through study and examination of fossils, scientists gather information that helps to explain early environmental conditions, such as changes in climate and land and water patterns, that may have been factors in causing the extinction of particular plants and animals.

Certain fossils are also important economically. New uses of the fossilized remains of ancient plants and animals are constantly being discovered. Many everyday items, such as household cleaning products, paints, shellacs, shoe polish, plastics, plant foods and insecticides, cosmetics, and certain foods and drugs, are a few examples of products made using some of these fossilized materials.

Additionally, the "fossil fuels," coal and petroleum, are important as energy sources. Petroleum in particular is a prime energy source, and as such is both economically and politically significant worldwide.



Carbon film of a bee.

Tracks of the dinosaur *Iguanodon*.

Geologic Time and Dating Methods

The accurate placement of fossils and geologic events is as significant geologically as the placement of people and historic events is historically. To achieve this placement, scientists work with the concepts of *relative* and *absolute* time.

RELATIVE TIME refers to the placement of organisms and events in an orderly chronological series. This information is organized into what is referred to as the Geologic Time Chart. The geologic chart is read from bottom to top, with the earliest time unit at the bottom of the chart and the most recent one at the top.

In general, the important things for your students to know about relative time are stated briefly as follows:

The history of the earth is separated into four large divisions called *eras*.

The earliest era is referred to as "Precambrian." and represents about 4 billion of the 4.6 billion years of estimated age of the earth. During the Precambrian, the simplest forms of plants and animals evolved; however, few fossils have been discovered from that era.

The second era is called the Paleozoic, or "ancient life," era. During this time, multicelled plants and animals evolved in the seas and spread to the land. Among the plants on land were horsetails, mosses, ancient conifers, and the ferns. The animals in the sea included trilobites (like the one pictured on the first page). brachiopods, snails, crabs, and starfish. On land, vertebrates were first represented by amphibians and later by reptiles. This era lasted about 350 million years.

The Mesozoic, or "middle life," era, the third division of geologic history, is referred to as the Age of Reptiles. In this era, seed-bearing plants were in evidence and the first flowering plants appeared. Dinosaurs flourished and then became extinct at the era's very end. The Mesozoic lasted about 165 million years.

The fourth, or Cenozoic era, of "recent life," is also known as the Age of Mammals. It began about 65 million years ago and is the era in which we are living today. During this time mammals spread and diversified, hardwood trees and grasses were in evidence, and perhaps only 4 or 5 million years ago hominids appeared.

Eras are divided further into periods, epochs, and ages. (Refer your students to geologic time charts in reference and guide books for more detailed information concerning the divisions of geologic time.)

Someone has compared geologic time to our calendar year and noted that when viewed in that proportion, the entire existence of man on earth would fill less than the last half-hour of the last day of December and that the *written history* of man would be represented by just a little more than the last minute of the year! (*The Geologic Time Line activity to help children grasp the vastness of geologic time is described on page 4 of this issue of* ART TO ZOO.)

The concept of ABSOLUTE TIME involves the dating of materials to determine the measurement of time in actual years since a fossil or a rock was first formed. New techniques, using radiochemical dating methods, enable scientists more accurately to establish dates and times. (The bibliography in this issue of *Art to Zoo* includes sources where information may be obtained about some of these techniques.)

Developing a Teaching Approach

Once you have become familiar with the background information about fossils as presented in this issue of *Art to Zoo,* you will be ready to plan a teaching approach in line with your curriculum objectives. Although the study of fossils outlined here is clearly science-oriented, you will find activities that apply to art, creative writing, and "career awareness" too.

The objectives for the following lesson are to enable the student to:

- learn what fossils are and where they may be found.
- explain how some fossils are formed.
- cite examples of some uses of fossil materials in industry and everyday life.

Lesson: Fossils—Our Link with the Past

NOTE TO TEACHERS: For use in this lesson, you will need to have on hand unlabeled fossil specimens and unlabeled photos and drawings of fossils. For help in obtaining these materials, contact your school science coordinator or curriculum specialist; an area college, university, or natural history museum; and local "fossil enthusiasts" who might be willing to share or lend some of their fossil specimens. Then at the *appropriate time* in the lesson ask your students to bring in any fossils they themselves may already have.

1. First show your students an unlabeled photo or drawing of a trilobite and ask them to examine it closely. Do not tell them what it is. [Teacher's Note: Use an opaque projector to reproduce the photo on *page 1* if needed.

Then have several of the youngsters describe what they see. Encourage the children to use their imaginations and try to guess what the "creature" in this photo is. Ask: Do you think this is a photo of something alive? Why do you think so? Is it plant or animal? What makes you think so? If the students are uncertain, ask: Does it have a head? eyes? mouth? After getting the students involved in speculation about what the "creature" is, ask them where they think it came from. Give them time to share their ideas.

Now have each student write an essay describing what the fossil looks like and what he or she imagines its origins to be. Could it, for example, be a creature from another planet . . . or one from the future, caught in a time warp? or possibly some form of life from our distant past?

Once the children's essays have been completed and read aloud to the class, they may be displayed on a bulletin board around the picture that inspired them.

2. Now tell the students that the "creature" in the photograph is a "time traveler" of sorts—that it is a photo of a fossil that lived several hundred million years ago. Ask the children if they have ever found a fossil. If so, ask them to bring any fossils they already have to school, and use these, along with your additional unlabeled fossil materials, to set up an "interest center" around the bulletin board display. To encourage *discovery* of what fossils are and some ways in which plants and animals become fossils, have the students work in teams to find out about the materials in the interest center. Assign each team several of the photos, drawings, or fossil specimens and ask the children to use reference and guidebooks, such as those listed in the bibliography at the end of this article, to research the materials. For each fossil assigned, have the children find the *common name* as well as information as to how the fossil was probably formed.

After the students have completed their research, have them label their specimens and report their findings to the class. The students' reports need not be too technical but should include, for example, that their fossil was:

an impression left by a leaf or an insect

or

a thin carbon film of an organism's remains

or

a footprint or some other trace of an organism's activity

or

a shell made heavier during fossilization by minerals partially filling its pores

or

petrified wood which is really not wood but a completely changed specimen

or

a photo of a woolly mammoth fossilized because of freezing

or

a drawing of the skeletal remains of a prehistoric animal that was trapped in a sticky tar pit

or

an insect preserved in ancient sap that has hardened and changed to amber.

3. Now discuss with your students what fossils are, the conditions necessary for fossils to form, and where fossils are usually found. Then make a chart on the chalkboard of the two general types of fossil records, unaltered remains and altered remains, as explained earlier in this article.
Here is how to start such a chart:

Types of Fossil Records
Unaltered Remains *Altered Remains*

Ask the students to group their photos, drawings, and fossil specimens into the two above categories as you list them on the chalkboard. Help the students to see that fossils can be organized into the above categories, depending on whether the fossils are relatively unchanged (unaltered remains) or have been changed to varying degrees and in various ways (altered remains). When the chart has been completed, ask the students into which category most of their fossils fit. (There should be many more fossils in "altered remains.") Now ask the students to think about the fossils they have listed under *altered* remains and about some of the ways in which these fossils were formed. Then discuss how each of the fossils on the list could have been formed. If examples of the fossilization processes and fossil forms outlined in the background information of this issue are not represented on the list, ask the students to use the guidebooks again to find the additional examples.

4. Now ask the students how we know what the earth was like millions and millions of years ago. After discussing the importance of fossils as evidence about the past, provide each student with an incomplete geologic chart (included in the PULL-OUT PAGE of this issue). Have them work with a partner and use reference materials and guidebooks to complete the geologic time chart. Ask them to show:

- How long each era lasted in millions of years
- Some of the forms of life that evolved in each era (either by listing or sketching).

5. Next, divide the class into four committees. Assign each committee one of the eras to research, and ask the children to create a mural showing life as it evolved during that particular era. When the time charts and murals have been completed,

6. have the students use the information they have gained by asking each of the committees to plan and present a report about the era assigned to them. Then have the committees display their murals in order, showing geologic time from the earliest era to the present. Next, discuss the completed mural by asking the following questions: What are some of the things fossils show us about the life forms shown on the mural as you look from earliest time to the present? In which era do you see the simplest life forms? The most complicated? Explain to the children that early forms of life slowly changed from one-celled to multi-celled, to complex living things.

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"Hallucigenia" Contest

An exhibit featuring fossils of some of the strangest looking animals that ever lived recently opened in the Smithsonian's National Museum of Natural History. Included in this exhibit are a diorama (pictured here) as well as fossils representing some of the 140 species of soft-bodied animals and plants discovered accidently in the fall of 1909 by Charles Doolittle Walcott, fourth Secretary of the Smithsonian Institution. Mr. Walcott was on a fossil-hunting trip near Burgess Pass high in the Rocky Mountains of western Canada when he found the specimens.

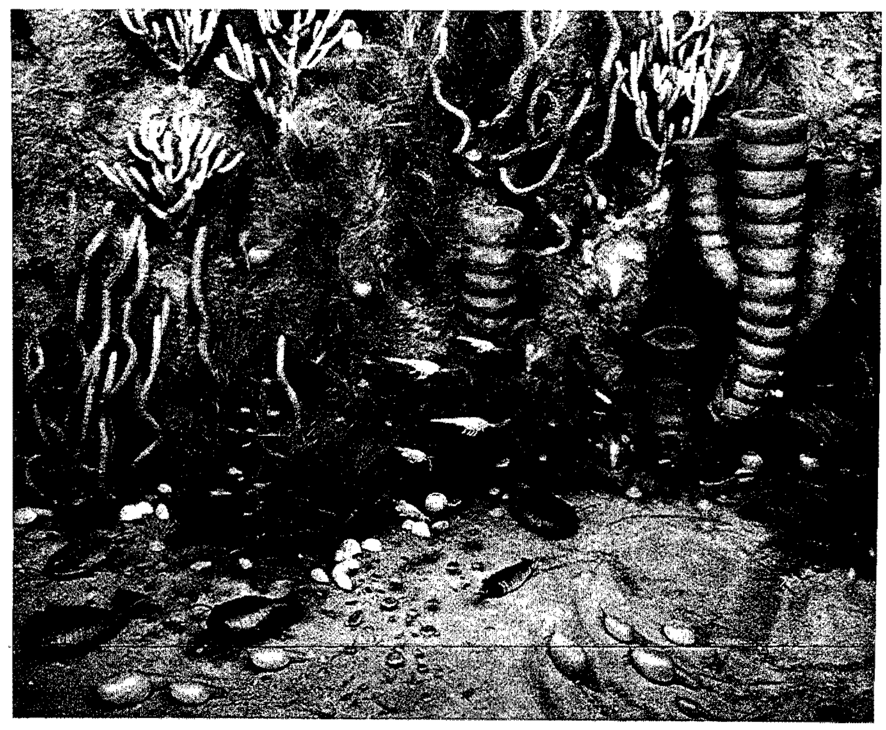
The discovery of the "Burgess Shale" fossils was of great interest to scientists because the exquisitely preserved specimens are all either partly or entirely soft-bodied. As we have seen, preservation of soft-bodied animals and plants is extremely rare in the geologic record. It occurred in this instance because the creatures were covered suddenly by an underwater mud slide—and this protected them from scavengers and decay.

How did these weird animals live—move—breathe? What were their food sources? Were they scavengers or did they prey on each other? These are a few of the questions that scientists are trying to answer about the Burgess Shale fossils.

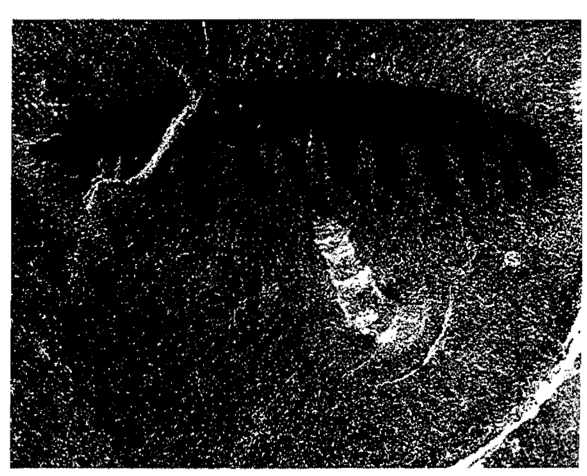
A photograph of one of the Burgess Shale specimens *(Aysheaia pedunculata)* is shown here. Next to it is an artist's conception of what *Aysheaia* probably looked like. Using an opaque projector, ask your students to examine both the photograph and the drawing. Now have them take a look at the photograph of the stilt-legged and seven-tentacled *Hallucigenia sparsa* and speculate together about what the living creature might really have looked like. For example, do you think the animal had a head—and if so, where was the head attached to the rest of the body? It's also possible that what we see here is just a fragment of a larger animal. What could this larger creature have looked like?

You might even want to stage a class contest, with the winner being the student who most plausibly drew and described the *Hallucigenia*.

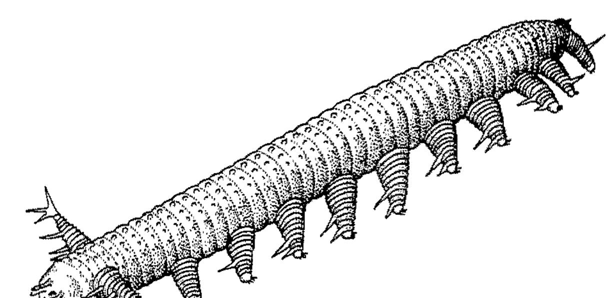
Printed here is an artist's line drawing of *Hallucigenia sparsa*. This could be used—after the students have completed the contest—to show how Smithsonian scientists have interpreted the fossil.



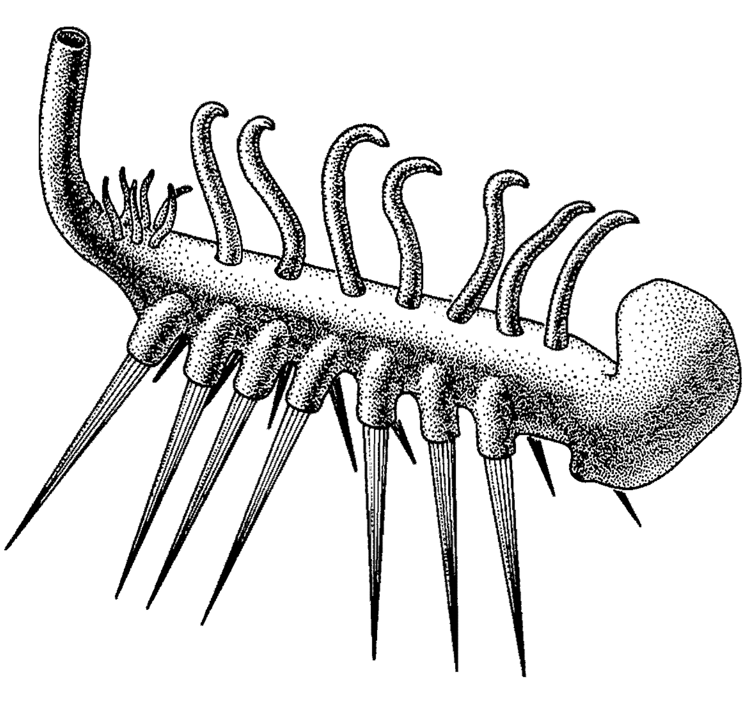
The Burgess Shale, a diorama recreating the ancient habitat of the plants and animals found in the Burgess Shale of British Columbia, is on permanent display at the National Museum of Natural History in Washington, D.C. (Photograph credit: Chip Clark)



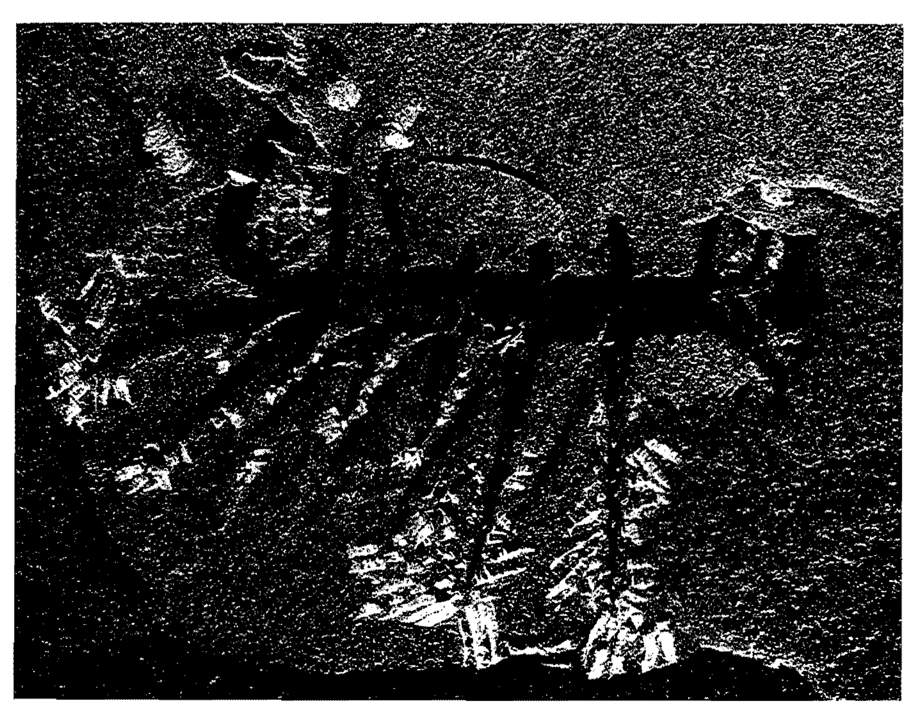
Aysheaia pedunculata, a Burgess Shale invertebrate with a pudgy body and stubby legs. *Aysheaia* was a sea-floor dweller suspected of having characteristics common to both worms and arthropods.



Aysheaia pedunculata. (Line drawing: Lawrence Isham)



Hallucigenia sparsa. (Line drawing: Lawrence Isham)



Hallucigenia sparsa, a strange-looking Burgess Shale specimen that moved about by means of seven pairs of sharply pointed spines. *Hallucigenia* was a scavenger and may have gathered food by using the seven tentacles found on the upper surface of the animal's body. (Photograph credit: Chip Clark)

Geologic Time Line Activity

This is an activity to help the children understand the immensity of geologic time and man's relationship to it. Set up a simulation using a ball of twine to represent all known geologic time since the Earth was formed, with man's existence being represented by the last one-half inch of the time line. You will need to tie enough twine together to equal approximately 240 yards.

The time line is based on the idea of one calendar year's representing all geologic time, and in this representation, man's existence is shown by only one half-hour. Using this idea, one day would equal 48 half-hours. If this figure is multiplied by 365 days in the year, then one gets a figure of 17,520 half-hours in a year which could be related to a time line using 17,520 half-inches to represent 4.6 billion years of geologic time. By changing the half-hours to half-inches and then to yards, we arrive at approximately 240 yards, which is about two and a half football fields, goal line to goal line.

You could divide the 240-yard time line into the four eras by tying a brightly colored ribbon on the twine at the end of each era. The *approximate* figures on the chart below should help you set up the time line. Use a white ribbon tied on the last half-inch of the twine to represent man's existence. (One half-inch equals very approximately 250,000 years.)

Have the children walk through the simulation activity. To help emphasize the length of the different eras, a child could be stationed at the end of each era and asked to hold the ribbon.

Since this activity requires a lot of space, it would be best to do it in an out-of-doors setting. However, where outdoor space is limited, it could be done in a gym, a hallway, or a cafeteria. You could probably adapt this activity in other ways to fit the needs of your particular situation.

Era	Precambrian	Paleozoic	Mesozoic	Cenozoic	
Approximate time represented	4 + billion years	0.345 billion years	0.160 billion years	0.065 billion years	4.57 billion years
Yards on time line	210 yards	18 yards	9 yards	3 yards	240 yards

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Films

This Land, a Shell Oil film. (41 minutes, 16mm, color.) Excellent to use in conjunction with a geology/fossil study. For general audiences.
Fossils: Exploring the Past, an Encyclopedia Britannica film. (16 minutes, 16mm, color.) Highlights the activities of paleontologists, and the processes of fossil preservation. For general audiences.

continued from page 2

7. *Now, using the background* information included in this issue of *Art to Zoo,* discuss the concepts concerning the earth's geologic history which you feel are appropriate for the level of your students. Reinforce the concept that scientists have been able to learn what the earth was like millions of years ago by putting together many facts, and that much of this information was obtained through a study of fossils.

8. *Finally, let your students experience* "first-hand" some ways in which fossils are formed: make fossil models as a class activity. (See the Pull-Out Page for complete directions for making four different models.)

And as a culmination to their study of fossils, you might give your students a chance to internalize what they have learned in one of the following ways:

- By writing an essay explaining how fossils are "our link with the distant past."
- By organizing a fossil exhibit using the materials from the "interest center," the geologic time charts, the "eras" mural, and the fossil models they made in class. Invite other classes to visit the exhibit.
- By taking on the role of a particular fossil and telling:

  What kind of plant or animal it is . . .

  The era in which the organism lived and a description of other life forms in existence then . . .

  How the organism became a fossil.

Orientation Program for Young Visitors

A fascinating world of people and objects, history and activity awaits your students at the Smithsonian Institution. The Smithsonian Visitor Information Center is pleased to announce a new *Orientation Program for Young Visitors,* designed especially for students ages 10–15. The program is a 20-minute slide talk which introduces the collections in the Smithsonian's three largest museums: the National Museum of American History, the National Museum of Natural History, and the National Air and Space Museum. Students will also discover some of the highlights of the National Zoo, the Arts and Industries Building, and the Smithsonian's art museums. Whatever the interests, from airplanes to zebras, each student will find something to spark the imagination.

To schedule, call the Visitor Information and Associates' Reception Center at 202-357-2700.

Video Cassette Available from the Office of Elementary and Secondary Education

A 50-minute video cassette of the Smithsonian Institution's seminar on the "Impact That Computers May Have on Human Learning" is available to teachers for viewing free of charge. (Return postage is required.) To obtain the cassette simply send your request to:

Computers and Human Learning
OESE, Arts and Industries Building 1163
Smithsonian Institution
Washington, D.C. 20560

Suggested Activity: A Fossil-Finding Field Trip

If your school is near a known fossil site you may want to give your students the chance to look for fossils in a natural setting.

In planning such a field trip, check first with your local library, natural history museum, college or university, spelunker groups, or geological society for more information about the fossil localities near you. Factors to consider in planning a successful trip include: student safety, site conservation, and accessibility of a site where fossils are likely to be found.

Obtain permission from the property owner of the fossil locality well in advance of your trip and find out if there are areas at the site that should be off limits to the students, either owing to safety hazards, or for conservation purposes. Also, make sure that adequate assistance and supervision is available to ensure a safe and productive trip for every student.

NOTE: Photographs not otherwise credited are from the collections of the Smithsonian Institution.

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Editor: Bobbi Bedford
Regular Contributors:
THE ANACOSTIA NEIGHBORHOOD MUSEUM
THE CHESAPEAKE BAY CENTER FOR ENVIRONMENTAL STUDIES
THE COOPER-HEWITT MUSEUM OF DECORATIVE ARTS AND DESIGN
THE HIRSHHORN MUSEUM AND SCULPTURE GARDEN
THE MUSEUM OF AFRICAN ART
THHE NATIONAL AIR AND SPACE MUSEUM
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THE NATIONAL MUSEUM OF AMERICAN HISTORY
THE NATIONAL MUSEUM OF NATURAL HISTORY
THE NATIONAL PORTRAIT GALLERY
THE NATIONAL ZOOLOGICAL PARK
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Associate Editor: Ruth W. Spiegel

Art to Zoo brings news from the Smithsonian Institution to teachers of grades three through eight. The purpose is to help you use museums, parks, libraries, zoos, and many other resources within your community to open up learning opportunities for your students.

Our reason for producing a publication dedicated to *promoting the use of community resources among students and teachers nationally* stems from a fundamental belief, shared by all of us here at the Smithsonian, in the power of objects. Working as we do with a vast collection of national treasures that literally contains the spectrum from "art" to "zoo," we believe that objects (be they works of art, natural history specimens, historical artifacts, or live animals) have a tremendous power to educate. We maintain that it is equally important for students to learn to use objects as research tools as it is for them to learn to use words and numbers—and you can find objects close at hand, by drawing on the resources of your own community.

Our idea, then, in producing *Art to Zoo* is to share with you—and you with us—methods of working with students and objects that Smithsonian education staff members have found successful.

We are especially grateful to Raymond Rye, Museum Specialist, Department of Paleobiology, National Museum of Natural History, for his advice and assistance in preparation of this issue of *Art to Zoo.* Additional assistance was provided by:

Dan Chaney, Museum Specialist, Department of Paleobiology, National Museum of Natural History;

Fred Collier, Collections Manager, Department of Paleobiology, National Museum of Natural History;

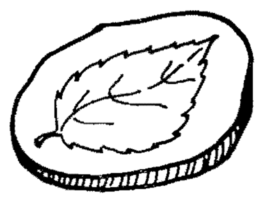
Joan Madden, Chief, Office of Education, National Museum of Natural History; and

Donald Ortner, Curator, Department of Anthropology, National Museum of Natural History.

Making Models That Look Like Fossils

We have learned that real fossils may take thousands or even millions of years to form, but anyone can make a "model" of a fossil in just a few minutes. Using quick-setting materials, you can imitate some of the processes of fossilization that took many, many years and possibly even thousands of tons of pressure to occur in nature.

For example, to create a fossil-like leaf *imprint,* just follow these directions:



First, soften some modeling clay by kneading it with both hands. Then smooth the clay into a small pancake-like shape. Press a leaf firmly into the clay and then remove the leaf carefully. The clay can be hardened by baking in a kiln or an oven at a low temperature. When it has cooled, you will have a fossil-like leaf imprint.

Now . . . are you ready to make some more models? Just follow these directions for making both a mold and a cast of a clamshell.

► BUT CAUTION! PLEASE READ THIS FIRST.

Choose an uncluttered flat place to work (like a table or the floor), and cover the area with newspaper. You will be using plaster of paris to make some fossil models. Plaster of paris is a chalky powder that when mixed with water forms a quick-setting material. Throw all unused plaster away with the newspaper as you clean up. *Do not* pour plaster into the sink as it could cause the drain to clog.

Directions for Making a Fossil-like Mold

Mix about one-half cup of plaster of paris with enough water to make a thick yet workable paste.

Pour this mixture into a small cardboard container such as a milk or juice carton. Fill the container about half full.

Gently wipe off any loose material from a clamshell. Then spread a *thin* layer of vaseline on the outside surface of the shell and press this side into the plaster to make an impression of the shell. Allow the plaster enough time to harden completely.

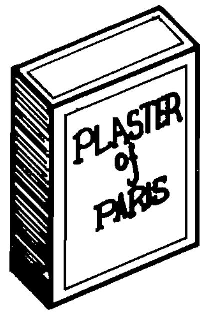
Next, spread a *thin* layer of vaseline over the inside of the clamshell and also over the entire exposed surface of the now-dried plaster block.

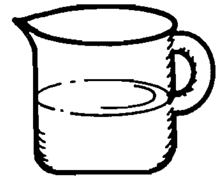
Again mix about one-half cup plaster of paris with water to make a thick yet workable paste.

Pour this mixture into the cardboard container completely covering the shell. (In addition to covering the shell, this layer of plaster should be between one and two inches thick.)

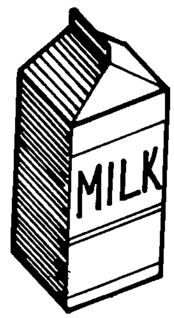
Allow this layer of plaster to harden completely.

Now tear the cardboard carton away from the block of plaster. Then pull the two layers of plaster apart. (The layers should separate easily.) Remove the shell. And there you have it . . . a mold of the clamshell!





(Use Only Top or Bottom of Shell.)



To Make a Fossil-like Cast

Spread a layer of vaseline over the half of the clamshell mold with the cavity. Fill the cavity with plaster of paris mixed as directed before.

Allow the plaster to harden completely before removing it from the mold. And . . . you have now made a *cast* of the shell!

(In nature a cast is formed when minerals or some other natural substance fill a mold.)

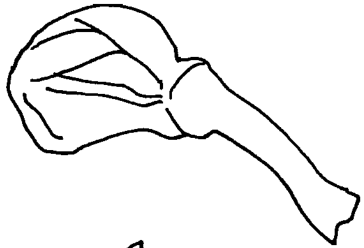
Making a Model of an Amber-like Fossil

You can also make a model of an amber-like fossil by using a small, *dead* insect, waxed paper, and either clear fingernail polish or clear glue. This model may take a few days to complete, so be patient!

Using a sheet of waxed paper as a base, place the dead insect on top of a few drops of nail polish or glue. Let the glue or polish harden, trapping the animal. Continue to add glue or polish, a few drops at a time, until the insect is completely surrounded. Be sure to allow the polish to dry and harden between layers.

When you have finished you will have a fossil-like model which shows the way insects, other animals, and some plants, were trapped in ancient tree sap. Over centuries and centuries, the sap hardened to amber.

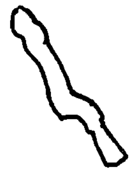
Be a Paleontologist . . .
Find the Missing Bones!



It's not an easy job to put together an entire skeleton from a pile of bones. Scientists rarely find all the bones of one animal in the same place. Very often bones from several animals of the same kind are used to reconstruct one skeleton. Sometimes artificial bones are added to replace bones that are missing.

The skeleton below is that of *Smilodon,* a saber-toothed cat. The sabertooth is the second most common animal found at the Rancho La Brea tarpits in California.

The sabertooth is missing some bones. Finish putting him together by either



- Drawing a line from each bone to where it belongs on the skeleton

or

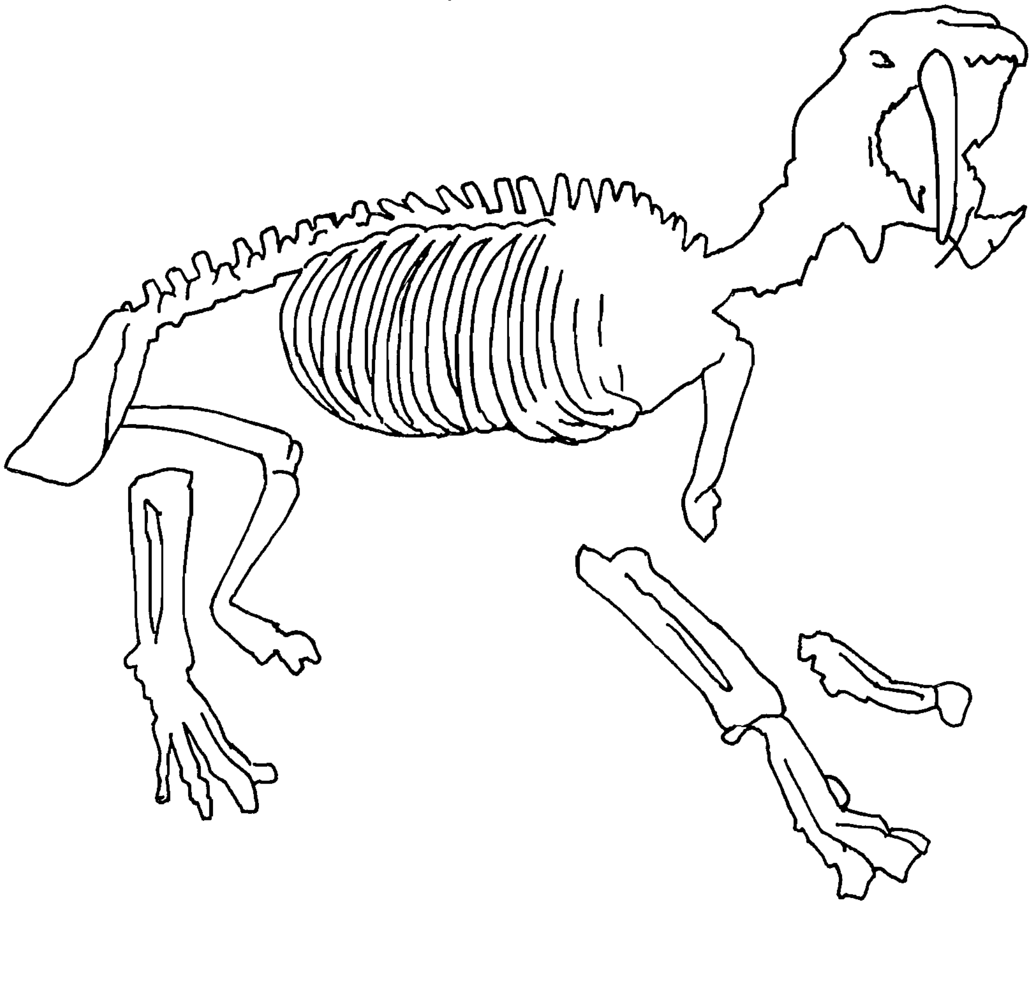
- Cutting out the bones and pasting them where they belong

or

- Sketching in the missing bones to complete the skeleton.

NOTE: USING A METRIC RULER TO MEASURE THE BONES HELPS TO SHOW WHERE THEY GO.

Now . . . it might also be interesting to read and find out more about the sabertooth and other fierce predators found in the La Brea tarpits.



Geologic Time Chart

NOTE: Use reference books to find the information to be filled in.

Era	How Long the Era Lasted (in millions of years)	Sketch or List of Some of the Life Forms Found in Each Era
Cenozoic		
Mesozoic		
Paleozoic		
Precambrian		