THE INDIANA JUNIOR HISTORIAN

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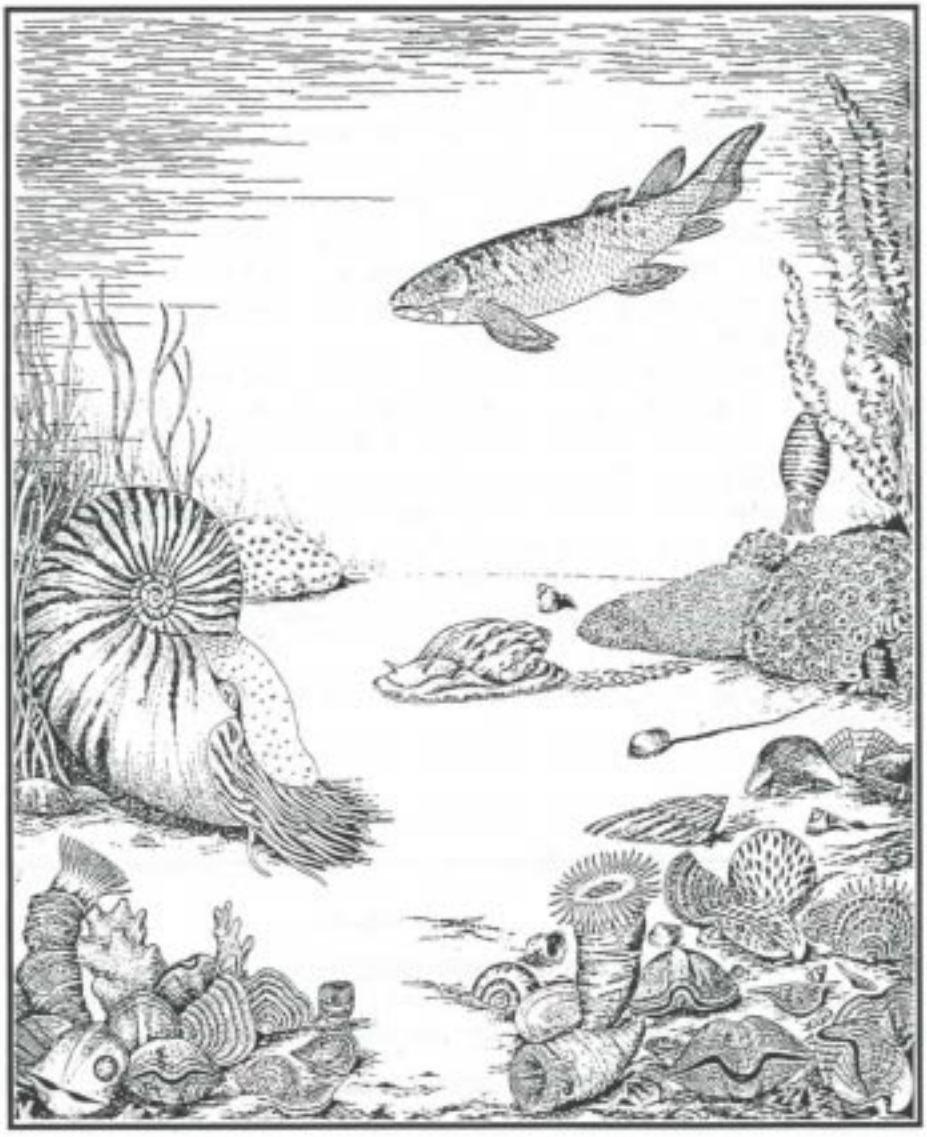
Indiana Before the Age of Dinosaurs



Plants and animals of a Late Devonian sea in what is now northern Iowa. A similar scene would have been found in Indiana in the Late Devonian period except the plants and animals would have been more crowded together. At left, items are identified as ammonoid, rugose corals, bryozoans and brachiopods; center, lungfish, stromatoporoid and snail; and right, nautiloid, colonial and rugose corals, clams and brachiopods. From: Fenton, The Fossil Book, *p. 20.*

Focus

Look around you, how would you describe the town in Indiana where you live? Is the land flat, is it hilly, are there many trees, or is the land mostly farmland? This land hasn't always looked the way it does now. The land of Indiana has undergone enormous changes that took millions and millions of years to occur.

There may be a lake or river near your town, but did you know that the land where your town and even your house stands now was once under water—not just flooded but completely under water? The land where you play baseball or volleyball was once at the bottom of an ancient sea.

Indiana used to have a sub-tropical climate, the type of climate that you might find in southern Florida today. Just imagine, there were palm trees in Indiana! The Hoosier state wasn't always warm. During the several ice ages, Indiana was covered by deep glacial ice. Only the south central portion of the state escaped the glaciers.

How could Indiana be hot and cold and wet and dry? Of course these changes didn't all happen at the same time. Over millions of years Indiana was actually wet and warm (covered by warm seas), then warm and humid (no longer under water but very swampy), and then very cold (during the ice ages when several glaciers covered most of our state).

Indiana and much of North America had been covered by warm seas, about 600 million years ago. The seas covered the land for millions of years. Then the land was gradually uplifted and the seas drained away. After millions of years had passed, the seas covered the land again, and so the cycle continued.

Not only did the seas come and go but the land actually moved, too. Scientists now believe that all of the land masses of the earth were once one large mass. Have you ever noticed how the west coast of Africa looks like it would fit right next to the east coast of South America? Scientists noticed that too. Before this one large mass divided into the continents that we know today, the land was close to the equator, making the climate of Indiana and the Midwest much warmer than we know it now. That is why the ancient seas were warm and why we had Florida-like weather all year round.

Note: Look up Pangaea in your school library for more explanation of how the continents divided.

Falls of the Ohio State Park

The Falls of the Ohio State Park is a great place to see and learn about fossils. The Falls of the Ohio area is famous to those interested in fossils and draws visitors from all over the world.

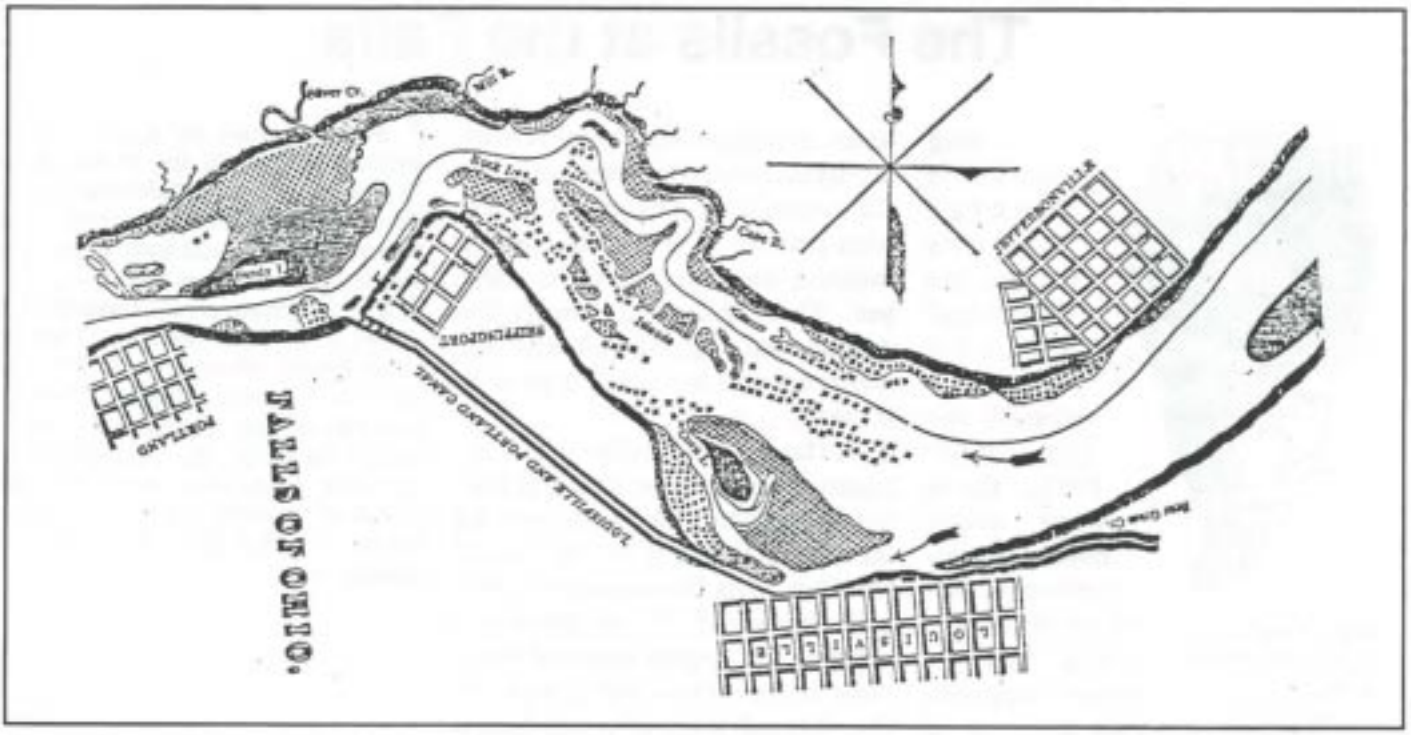
The park is open year round though the fossil beds can be seen only when the level of the Ohio River is low—usually during August, September, and October. Then, a visitor can walk on the exposed bedrock river bottom and view the fossils preserved in the limestone. Because the flow of the water is diverted to the Kentucky side of the river (by man-made structures), the bottom of the Indiana side of the river is exposed during low flow.

The interpretive center has exhibits and media presentations which explain how the fossil deposits were formed at the Falls, as well as the history of the area.

The Falls of the Ohio State Park is located in Clarksville off Exit 0 on Interstate 65 in southern Indiana. The address is P. O. Box 1327, Jeffersonville 47131-1327; telephone 812-280-9970.

Caution! A Note to Fossil Hunters

You *may not* take fossils from state or Federal property. If you look for fossils on private property, you must have the permission of the owner. Any good fossil book will give you tips on how to hunt and what you will need to take.



Map of the Falls of the Ohio from an 1847 guide for river pilots. From: Cummings, The Western Pilot 1847, *p. 53.*

The Falls of the Ohio—Where Time and History Meet

The Falls of the Ohio River, located between Jeffersonville and Clarksville, Indiana and Louisville, Kentucky, have been important in the history of Indiana and the Midwest. The falls are not the typical kind of waterfall but rather a series of rock ledges that gradually drop twenty-six feet over a distance of two and a half miles. The water in this area of the Ohio River is shallow, and as the river flows downstream (from east to west) the water swirls over the bedrock creating a series of cascading rapids.

The shallow water of the Falls provided a natural place for men and animals to cross the river. Early explorers and settlers who traveled on the Ohio River stopped at the Falls, because it was the only place along the river that required a portage[1] for boats.

Daniel Boone came to visit the Falls in 1771. George Rogers Clark brought American settlers with him to Corn Island, near the Falls, in 1778. Many of these settlers later stayed in the developing cities near the Falls, and the area early became known as a gateway to the West. The great westward expedition of Lewis and Clark began at the Falls of the Ohio in 1803.

The Falls area was a good location for many businesses since water travel came to a halt at that point, and boats had to be carried to the deeper part of the river. Men who hauled freight, or owned inns and taverns, benefitted when the water was low and boats had to stop.

Not only settlers and explorers traveled to the Falls. Many scientists and naturalists came there, too. John James Audubon came in 1808 and stayed until 1809 sketching and studying the many birds in the area. Many came to see the fossil beds at the Falls.

The history of the Falls of the Ohio began long before explorers and settlers became interested in the area. It began millions and millions of years ago.

1 Portage means carrying boats overland from one body of water to another or avoiding an obstacle, like rapids.

The Fossils at the Falls

Horn coral commonly found at the Falls. From: Perry, Fossils, p. 30.

Long before George Rogers Clark, the buffalo and Native Americans crossed the Ohio at the Falls, there were other residents, according to evidence which remains. This evidence suggests that millions of animals once lived at the Falls of the Ohio. Some of these animals were Coelenterates. They were not the only animals living in the area of the Falls, but they were one of the largest groups.

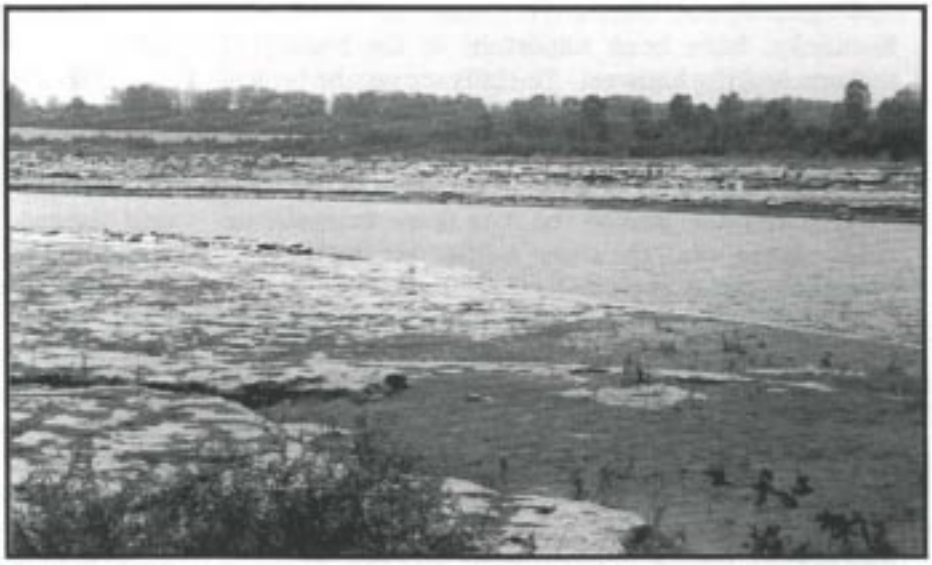
You may not have heard of the Coelenterates, but you may be familiar with some of their houses. The Coelenterates were animals without bones. They had soft sac-like bodies with a two-layered wall and a single opening surrounded by tentacles. Since they needed some type of protective covering, many of these animals had the ability to secrete a limy substance around themselves that would harden and form protection for them. This hardened protection or house is what we call **coral** today.

The Falls of the Ohio has massive coral beds exposed for visitors to see. These beds are between 325 million and 265 million years old. But how did we get coral in Indiana? You know that coral is commonly found in warm seas, like the Caribbean Sea. During the Devonian period[1] of geological history, Indiana was covered by a warm sea. Three hundred twenty-five million years ago, the climate was warm enough for coral to grow in Indiana.

There is probably coral beneath you right now, but it is buried so deep that you could never dig far enough to find it. At the Falls of the Ohio, this Devonian coral has been exposed.[2] These corals are some of the largest exposed fossil beds in the world—over 220 acres. The sheer diversity of visible fossils make the Falls of the Ohio remarkable.

[1] See the chart on page 8 for the ancient periods in the Paleozoic era. The periods from the Cambrian through the Mississippian eras represent a time when Indiana would have been under water for a portion of that period.

[2] The Devonian corals have been exposed at the Falls because of the constant flowing of the river over the coral beds and because there is less soil covering the land in the southern portion of the state. The glaciers pushed dirt and rocks over the upper two-thirds of the state. You would have to dig deep to find Devonian corals near South Bend.



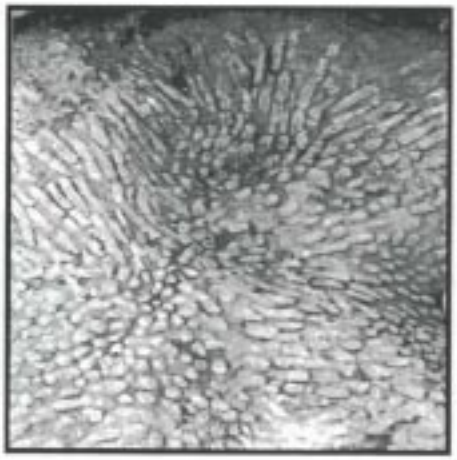
During the summer and early fall when the river is low, the fossil beds at the Ohio can be seen.

A Scientist at the Falls in 1844

Dr. Albert C. Koch was a German scientist who immigrated to the United States in 1826. Little is known about his early life here, but by 1836 he had opened a museum in St. Louis. Koch was also an avid geologist and collector of fossils. In 1844 he began a two-year collecting trip around the eastern half of the United States. He remained at the Falls of the Ohio until November 2. The following excerpts are from his daily journal, translated and edited by Ernst A. Stadler.

Louisville, Monday, the 9th of September. This morning at six o'clock I arrived here, the next goal of my journey. The first thing I did was to go to an old fossil collector whom I had known previously and who gave me advice as best he could, but to be sure I walked to New Albany, which is four English miles from Louisville, to visit Dr. Clapp, the best geologist in this region and the owner of an important collection of local fossils. . . .

Tuesday, the 10th of September. My expectations concerning the local fossils I found quite satisfied, if not surpassed. The shells and corals are frequently so beautiful and perfect, as if the animals whom they once served as houses and covering still lived in them.

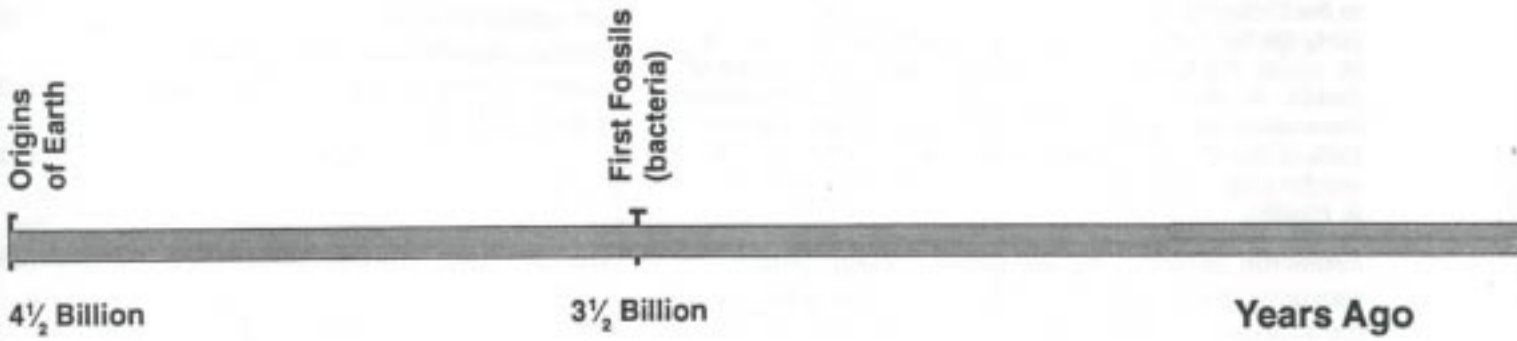


Example of fossil corals seen today at the Falls.

Jeffersonville, Wednesday, the 11th of September. Because yesterday I collected fossils which appeared in the upper stratum of the local limestone, I now went to work on a lower stratum which is considered part of a still older secondary formation and which contained almost more petrifactions than the first. Indeed, I made the observation that the whole bed of the Ohio, as far as the falls of it stretch, that is four English miles, is an almost uninterrupted coral deposit. The corals existing here are of 45 to 60* different species, and many of them are of an extraordinary size. . . . A rather special phenomenon is that many of the shells, as well as the corals, lie loose on the rocks in which they once were embedded but from which they have been apparently torn out by the water. . . . *Wednesday, the 2nd of October.* . . . Already I had found and collected more than 60 species of the rarest primeval corals and shells, of the choicest examples of which some had been first discovered by me, and now I was walking on a continuous layer of prehistoric corals of the most varied sizes, which, frequently interlaced with one another, formed curious shapes and often appeared like beautiful large flowers surrounded with garlands of leaves. One who does not have occasion to enjoy this view can best get an idea of it if he imagines the ice flowers and leaves on frozen windowpanes on a large scale and spread out over several English miles. I found a coral stem which formed a circle with a diameter of ten feet, although the branches were not over half an inch thick. Some corals run helter-skelter like tree roots; many have the form of garlands or resemble honeycombs so much that the local inhabitants took them to be petrified wax, petrified honey, or petrified wasps' nests; others, again, have great similarity to horns and are know by the name of petrified buffalo horns; still others look like the blossoms of the aster or the so-called horsetail and are often so small that one can hardly see them with the naked eye. This is, as I want to express it, a subterranean magic garden which is open only for quite a short time every four to five years at the most, as it is now for the inquiring geologist, and where there are uncovered for science many new species of the wondrous creatures which might well belong to the first works of creation, for they come from a formation which is even below the coal. . . .

**Scientists thought until recently that there might be as many as 600 different species at the Falls. Today, they believe that there are about 150 species.*

Was There a Dinosau

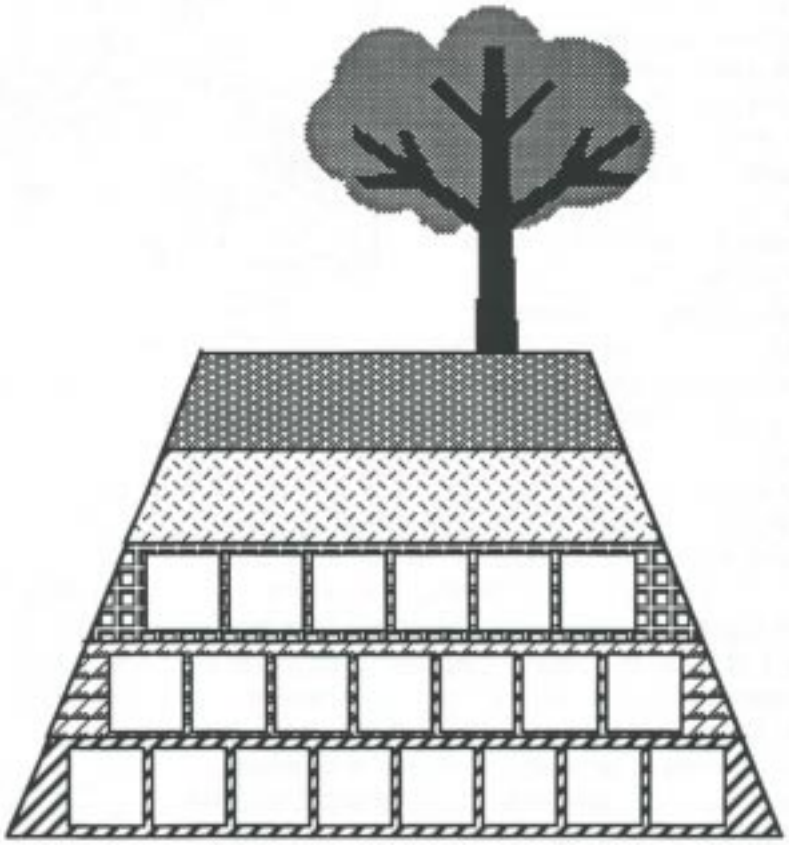


Maybe! But scientists don't really know if dinosaurs lived in Indiana. Evidence of dinosaurs has been found in the Western and Northeastern United States and Canada. Their bones have been discovered in Mesozoic rocks (formed 60 to 120 million years ago). No dinosaur bones or Mesozoic rocks have ever been found in Indiana. Why? Because forces within the earth caused Indiana and surrounding states to be uplifted, exposing layers of Mesozoic rocks that might have contained dinosaur bones. After millions of years these rocks and bones would have eroded away leaving no clues about Indiana dinosaurs. They might have lived here but we don't know for sure. What do you think? Was there a dinosaur in your backyard?

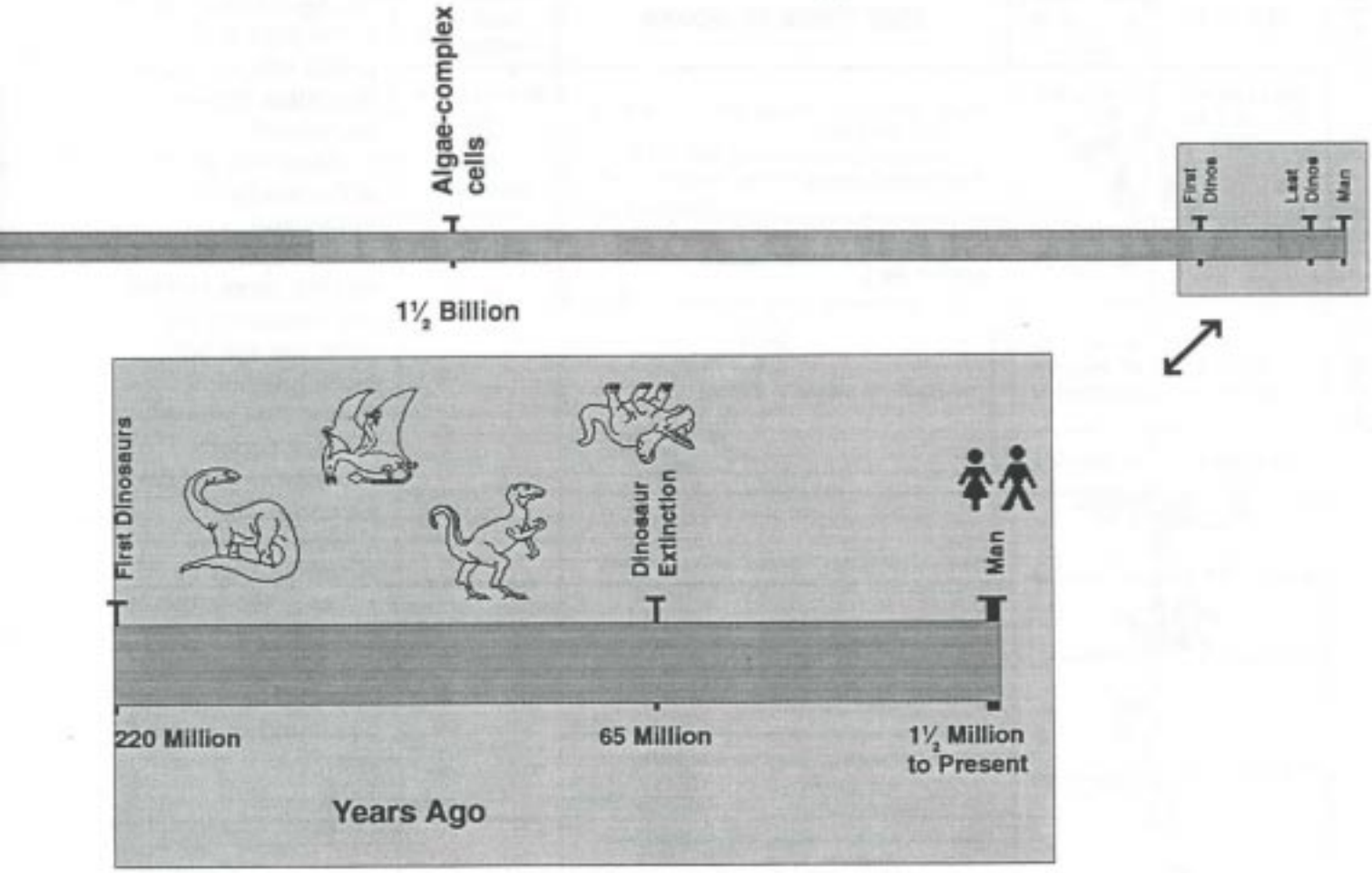
From: The Prehistoric Indiana Gallery, Indiana State Museum.

Words in Stone

Match the rock layers with the clues at the bottom of the next page and find the missing letters.



ur in Your Backyard?



From: The Fossil Factory, *pp.* 22-23.

Clues for Words in Stone

- The last letter is S but the 3rd and 4th letters are the same as the last.
- O comes before the 1st S.
- I comes after the 2nd S.
- F is at the opposite end from the last S.
- L is next to the last S.

- The 1st letter is the 3rd letter of the alphabet.
- The 4th letter is the 1st letter of the alphabet.
- O is to the right of the letter in the 1st clue.
- S is the last letter.

- R is the 4th letter from the end and the 3rd letter from the beginning.
- L comes immediately before S.

- There is an N in the 5th position and the 8th position.
- A is next to the last N.
- E is the 3rd letter to the left of the 1st N.
- The letter before E is the same letter before E in the alphabet.
- O is to the immediate left of the 1st N.
- V is between E and O.
- I is to the immediate right of the 1st N.

Geologic Time Scale and Indiana Rock Chart

ERAS	PERIODS	APPROXIMATE LENGTH IN YEARS	ROCK TYPES IN INDIANA	PRINCIPAL MINERAL PRODUCTS
CENOZOIC	QUATERNARY (PLEISTOCENE EPOCH) 	1 MILLION	*Glacial drift: till, gravel, sand, silt (including loess), clay, marl, and peat (Till and gravel contain boulders of many kinds of sedimentary, igneous, and metamorphic rocks)* Thickness 0 - 500 ft.	*Sand and gravel, Clay, Marl, Peat, Ground water*
CENOZOIC	TERTIARY	60 MILLION	*Cherty gravels, Sand and clay* } *Scattered deposits* 0 - 80 ft.	*Glass sand*
MESOZOIC	CRETACEOUS, JURASSIC, TRIASSIC	70 MILLION, 35 MILLION, 30 MILLION	No deposits in Indiana 	
PALEOZOIC	PERMIAN	25 MILLION		
PALEOZOIC	PENNSYLVANIAN 	20 MILLION	*Shale (including carbonaceous shale), mudstone, sandstone, coal, clay, limestone, and conglomerate* 1,500 ft.	*Coal, Ceramic clay, shale, Oil and gas, Crushed stone, Building sandstone, Refractory gravel*
PALEOZOIC	MISSISSIPPIAN 	20 MILLION	Upper Part: *alternating beds of shale, sandstone, and limestone* 500 ft. Middle Part: *limestone, dolomite; beds of chert and gypsum* 300 ft. Lower Part: *shale, mudstone, sandstone; and some limestone* 600 ft.	*Oil and gas, Building limestone, Crushed stone, Gypsum, Ceramic shale*
PALEOZOIC	DEVONIAN 	60 MILLION	Upper Part: *carbonaceous shale* 100 ft. Lower Part: *limestone, dolomite; a few sandstone beds* 40 - 80 ft.	*Oil and gas, Crushed stone*
PALEOZOIC	SILURIAN 	40 MILLION	*Dolomite, limestone, chert, siltstone, and shale* 100 - 300 ft.	*Crushed stone*
PALEOZOIC	ORDOVICIAN  	70 MILLION	*Shale, limestone, and dolomite* 700 ft. *Limestone, dolomite, and sandstone*	*Crushed stone, Oil and gas*
PALEOZOIC	CAMBRIAN	80 MILLION	*Sandstone and dolomite*	
PRECAMBRIAN ERAS		3 BILLION	*Granite, marble, gneiss, and other igneous and metamorphic rock types*	

Not exposed at the surface in Indiana

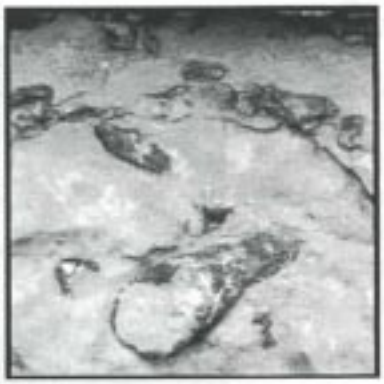
- Which era is called the Age of Dinosaurs?
- During which period will you find the oldest exposed limestone?
- When was the time of the woolly mammoths and mastadons? Can you tell, from looking at the chart, what other natural occurrence happened during this period?
- What periods combine to form the Paleozoic Era?
- How long was the Mesozoic Era?
- Using the length in years column, can you place these eras or periods on the time line found on pages 6 and 7?

From: Indiana Geological Survey, Circular 5, *p. 13.*

Tales Told By the Dead*

If you like solving mysteries and you know how to put clues together, then you will like studying fossils. A fossil is evidence that something lived long ago, at least 10,000 years ago. It can be a piece of shell, or bone, or a footprint, or an impression of a leaf. There are billions of fossils all over the world, and you don't have to be a paleontologist (someone who studies ancient life) to find them. Indiana has some wonderful fossils.

Most living things will not turn into fossils when they die, however. They will decay or dry up and blow away, leaving no trace. The majority of fossils that we find today were once sea creatures that were buried quickly when they died and had hard parts like shell or bone that did not decay. When the sea animal died, its body settled into the mud and sand on the bottom of the sea, and the soft parts of the body decayed. Over thousands of years, more layers of sand and mud built up, pressing down on the remains of the sea creature, and turning the mud into stone.



A cast of a horn coral at the Falls.

The actual shell or bone could be trapped in the stone or, more likely, an impression or mold was formed. For instance, if you press a shell into modeling clay and then lift the shell out, you have a mold of that shell. The ancient shell or bone may dissolve away after millions of years but a mold of that object remains in the stone.

When a mold is filled with minerals carried by water seeping into the rock, a cast is formed. Imagine that our modeling clay mold is filled with plaster of Paris. Once you remove the clay mold, you have a cast of that mold showing the same details of the shell. Molds and casts show only the external details of the organism. None of the internal parts are preserved.

Remember that a fossil is evidence that something lived at least 10,000 years ago. That evidence could be in the form of a footprint or burrows and not be part of the actual organism. These are called trace fossils.

You can even find fossils while you are walking around your town. Many of the buildings in your town will be made of limestone—the very stone that the Indiana fossils are buried in. You must look very carefully at the limestone because these fossils will be very small, but they are there. Happy hunting!

**This is the title of the first chapter of a very informative book entitled* The Fossil Book.

Making Casts and Molds

You can make your own plaster casts and molds. This way you can preserve the impression of a seashell, or a coin, or even a footprint.

You will need

- modeling clay
- plaster of Paris
- water (for mixing the plaster)
- a spoon
- shampoo or cooking oil
- an old plastic bucket
- a knife
- scissors
- cardboard
- tape

1. Shape a hunk of modeling clay into a round, thick pancake. Make a deep impression into the clay with an object.
2. With the scissors, cut a strip of cardboard about two inches wide and long enough to go all the way around the edge of the clay. Wrap the cardboard around the clay and tape it tightly in place.
3. Mix a small portion of the plaster of Paris in the plastic container (follow the directions on the package). Work quickly; it dries fast.
4. Spoon the plaster over the impression until it is about an inch thick. Let the plaster harden for about three hours. Then gently untape the cardboard and peel off the clay. Set the plaster aside and let it get even harder overnight. You now have a plaster cast of the impression.
5. Tape the cardboard around the cast so it fits snugly.
6. Brush the surface of the cast with a thin layer of shampoo or cooking oil. Make sure you don't miss any spots or your plaster pieces will stick together.
7. Mix a fresh batch of plaster and cover the cast up to the top of the cardboard. Let the plaster harden for a day, then tear away the cardboard and separate the two plaster layers. Let the plaster harden for another couple of days, and then rinse it off.

You now have a plaster mold and a plaster cast of the original object. They should make a perfect fit.

From: The Fossil Factory, *p. 13.*

Why Are Fossils Important?

Fossils give us clues to the past. They tell us about the geography and ecology of our world millions of years ago. Fossils show how life has changed over time. They help to prove that areas of the earth were once connected. Fossils from a certain time period clearly mark rock layers (strata) and can be matched with rock layers in other locations. These are index fossils, and their occurrence in rocks located miles apart proves these rocks were formed at the same time. This can be important in mapping rock formations and in locating valuable mineral deposits.

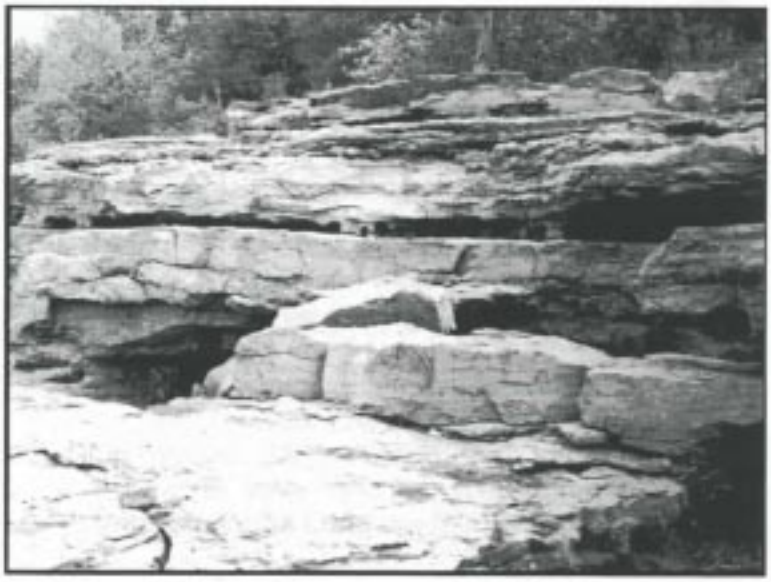
Fossils reveal the surroundings of ancient organisms. They show whether the land was under water, dry, or swampy. Fossils may record the climatic conditions in which the organisms lived. The corals found in the Midwest show that warm, shallow seas covered the area. Plant fossils show that the climates of Antarctica and Greenland were once much warmer than they are now.

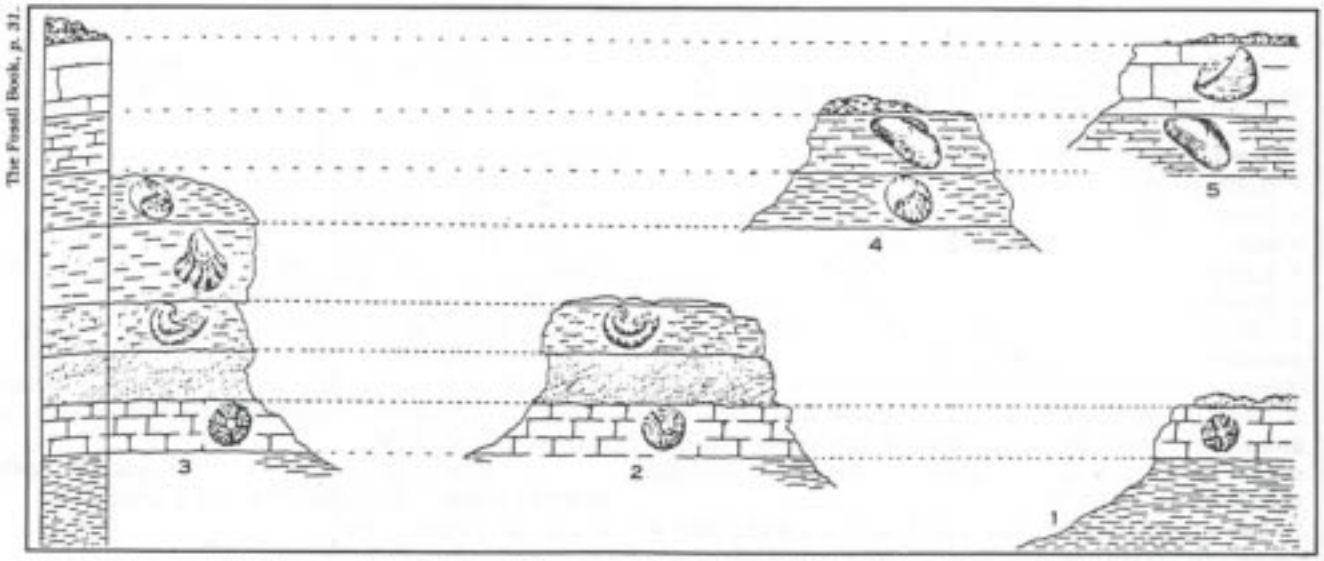
Fossils provide natural resources valued at billions of dollars. Nearly all of our fuels are fossil fuels. Coal and oil are formed from the remains of ancient plants and animals. Fossil limestones make excellent building stone. Micro-fossils are used as filters, fillers, in polishes, and for many other purposes. Some phosphate beds are associated with large deposits of fossil bones. Amber and jet are fossils used as jewelry.

These ancient relics from the past affect our lives every day!

From: A Golden Guide: Fossils. *pp. 20-21.*

Layering of the bedrock at the Falls of the Ohio State Park.





Fossils from certain time periods mark rock layers and can be matched with rock layers in other locations.

An Apple for Everyone

• Audubon Society Staff and Thompson, Ida. *The Audubon Society Field Guide to North American Fossils.* New York: Alfred A. Knopf. 1982.

• Baird, Clay. *A Journey To The Falls.* Louisville: Prairie Lithographing Corp. 1976.

A brief overview of the history beginning with prehistoric times.

• Eldredge, Niles, and Gregory Douglas. *The Fossil Factory.* Reading, MA: Addison-Wesley Publishing Company, Inc. 1989.

Wonderful book designed for children and teachers, highly recommended.

• Fenton, Carroll Lane. *Tales Told By Fossils.* New York: Doubleday & Co. 1966.

Good basic information for the student interested in fossils.

• Fenton, Carroll Lane and Mildred Adams Fenton, *et al. The Fossil Book: A Record of Prehistoric Life.* New York: Doubleday. Revised 1989.

Classic book with 1500 illustrations in this revised edition.

• Koch, Albert C. *Journey Through a Part of the United States of North America in the Years 1844 to 1846.* Carbondale: Southern Illinois University Press. 1972.

Provides a daily account of Koch's travel in America.

• Perry, T.G. *Fossils: Prehistoric Animals in Hoosier Rocks.* Bloomington, IN: Indiana Department of Conservation, Geological Survey, Circular No. 7, December 1959.

Excellent source for the serious student.

• Powell, Richard L. *Geology of the Falls of the Ohio River.* Bloomington, IN: Department of Natural Resources, Geological Circular 10.

Designed for readers with knowledge of geology.

• Rhoades, Frank H.T., Herbert S. Zim, and Paul R. Shaffer, *A Golden Guide: Fossils.* New York: Golden Press. 1962.

This is an old standby for children. Newer scientific findings are not included in this volume.

• Stidworthy, John. *More Science Projects: Fossils.* New York: Marshall Cavendish. 1989.

This book offers fossil facts and projects for students.

• Taylor, Paul D. *Eyewitness Books: Fossils.* New York: Alfred A. Knopf. 1990.

This is a very interesting book, a good way to interest students in the study of fossils.

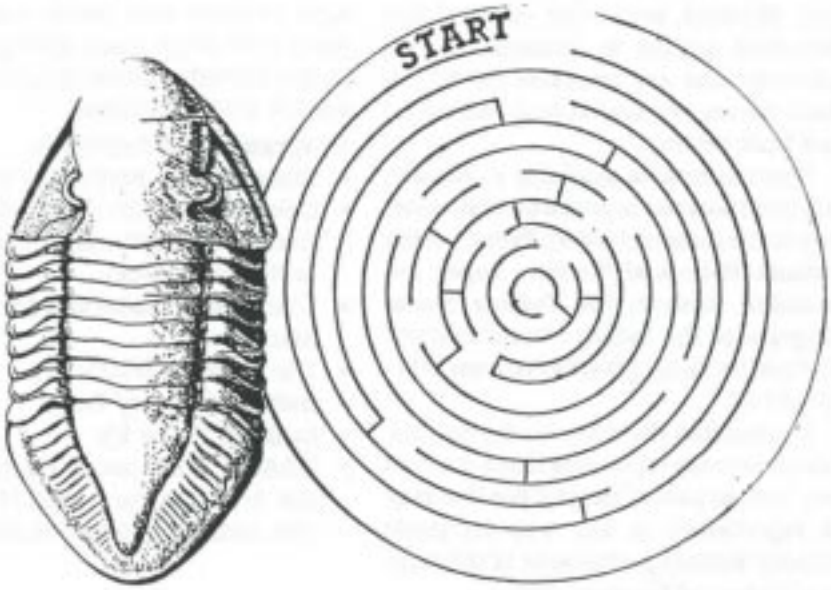
Other Resources

• The Falls of the Ohio State Park; see page 2.

Special Thanks

• Ronald Richards, Curator of Paleobiology and Chief Curator of Natural History, Indiana State Museum, for his assistance in the preparation of this issue.

Help the Paleontologist Find the Fossil!



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The image above is the elevation drawing for the Indiana State Library and Historical Building by Pierre & Wright, architects. Indiana Division, Indiana State Library.

The Indiana Historian fulfills the mission of the Indiana Historical Bureau by providing resources and models for the study of local history to encourage Indiana's citizens of all ages to become engaged with the history of their communities and the state of Indiana.

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Mission Statement

The Indiana Historical Bureau provides programs and opportunities for Indiana's citizens of all ages to learn and teach about the history of their state and its place in the broader communities of the nation and the world.

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- Books on Indiana, midwestern, and local history
- Classroom materials for Indiana history
- *The Indiana Historian*
- Indiana History Day
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