AMMONITES

Ammonites are a group of organisms that belongs to the Phylum **Mollusca**. Other mollusks that you might know are bivalves like clams and gastropods like snails. Ammonites are actually a part of the class of organisms called *cephalopods* which means *head-foot*. They are extremely common and are one of the best-known groups of fossils. Ammonites are **extinct**, but they are similar to the modern octopus and chambered nautilus.

Ammonite fossils look like rams' horns. The ancient Roman writer, Pliny the Elder, called these fossils "Horns of Ammon." Ammon was an Egyptian god that was often pictured with rams' horns on his head. The modern scientific name (Ammonoidea) comes from this history.

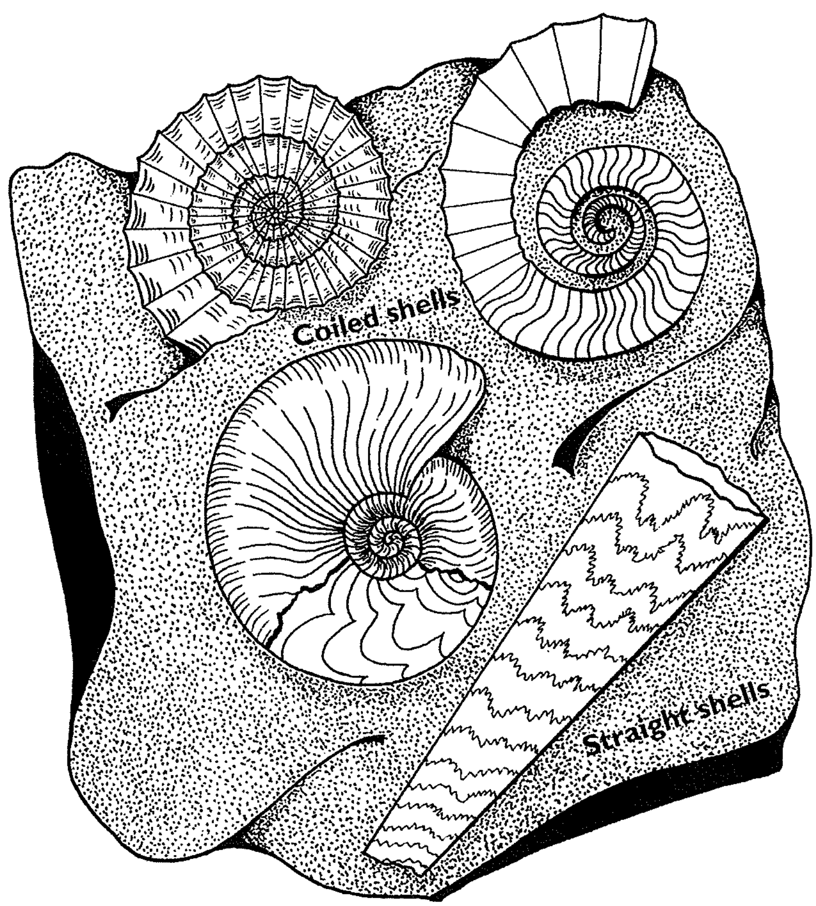
Ammonites first appear in rocks that are 400 million years old, a geologic time that geologists call the **Permian Period**. They became extinct and disappear from the fossil record in the **Cretaceous Period**, about 65 million years ago. This is the same time of the great dinosaur extinction (at the Cretaceous-Tertiary Boundary).

As an ammonite grew larger, it would create a larger shell for itself by adding a larger chamber in which it would live. The walls of these chambers are very complicated and form what are described as peaks and valleys. You can see that well in the straight ammonite pictured below.

These chambers have a very important use for ammonites. They could fill them up with ocean water. This would make them heavier and they would sink to lower portions of the ocean, perhaps to find food or perhaps to escape danger. Then, when they wanted to rise up in the ocean, they could pump out the water and become lighter to float upward.

Notice the center ammonite in the picture above. What you see is the outer shell material (with simple, wavy lines). If the outer shell is removed, you can see the peaks and valleys of the chamber walls underneath.

As you can see in this picture, ammonites could be straight, loosely curved or tightly curved.



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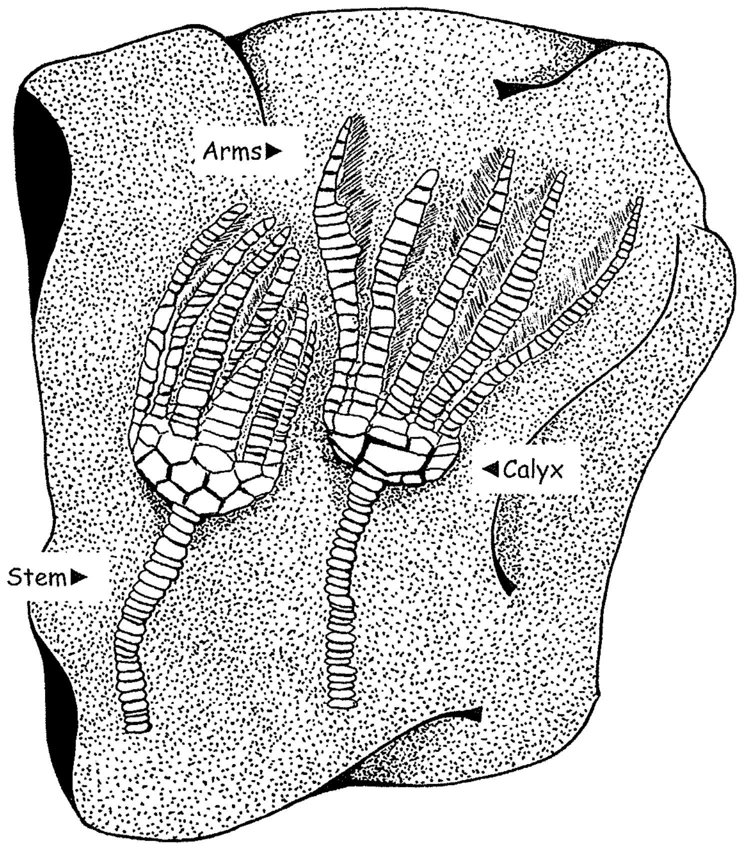
From Fossils: Traces of Ancient Life from the Sea & the Land; Darryl Powell, 2019 (www.diamonddanpublications.net)

CRINOIDS

The Phylum of *Echinoderms* includes starfish, sea urchins, sea lilies and crinoids. Echinoderms all have skeletons that are made up of small calcite plates. The plates have spines. They also have 5 "rays": scientists call this *pentagonal symmetry.* Count the number of arms on a starfish: there are, you got it, 5. It might be hard to see this in crinoids because they have more than 5 arms, but their "head" or *calyx* shows this pattern. It is sometimes easiest to see the 5 rays in the little disks of which the stalk is made, like the ones pictured here.

The name *crinoid* comes from two Greek words that mean *lily form* because crinoids look like flowers with "roots," a long "stem" and a "flower" on top. Don't be fooled, though: a crinoid is *not* a flower, it is an animal. Modern crinoids can live in shallow water, but have also been found at depths of 6,000 meters.

A fossil of a complete crinoid is a very rare discovery. Each of the small plates and disks that make up a crinoid come apart from one another when the crinoid dies. It is much more common to find bits and pieces of a crinoid. A complete fossil, similar to the one pictured below, can occur only when the crinoid is suddenly buried by a lot of mud or sediment and then dies and is preserved as a fossil.



Pictured here are the three parts of a crinoid. The bottom part is the stem. The round portion on top of the stem is called the *calyx*. Coming out of the calyx are the arms. The "hairs" that come off of the arms are called *cirri*. Cirri help move food from the ocean water down the arms and into the crinoid's mouth which is on the top of the calyx.

The earliest known crinoids come from the Ordovician Period (over 450 million years ago).

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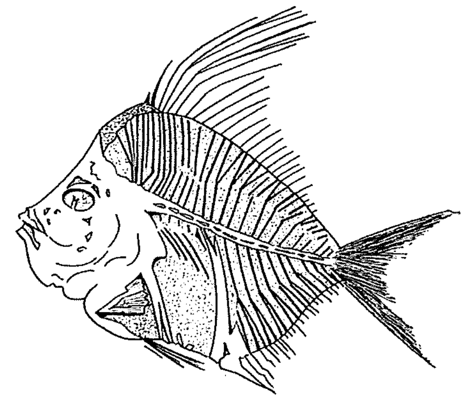
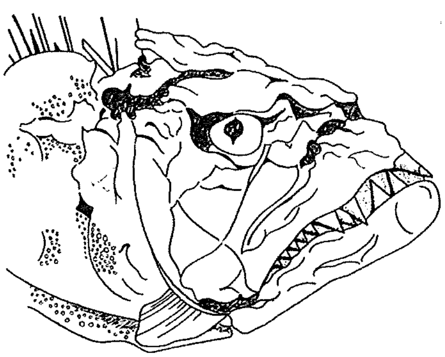
FISH



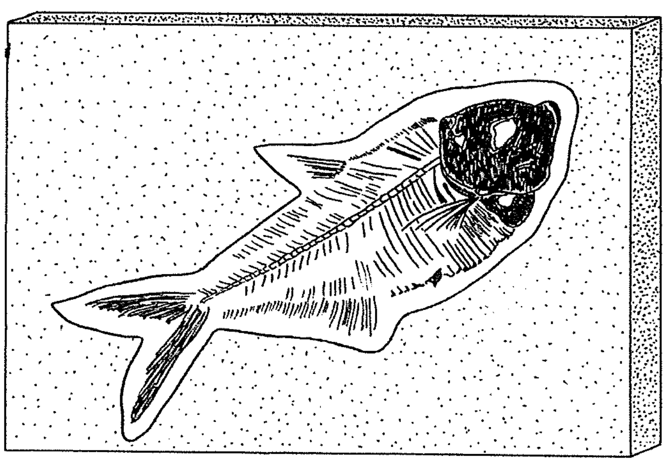
The evolution of fish begins over 500 million years ago in the Cambrian Period. **Jawless fish** first appear in the fossil record in the Cambrian Period (approximately 510 million years ago). This was also the Period in which *vertebrate* animals appear. This includes the fish and a group called *chordates*. **Armor-plated fish** occurred in the Ordovician Period which was 438 to 505 million years ago. By the time of the Silurian Period (408 to 438 million years ago) fish with lobed fins and movable jaws appeared. Rocks of the Devonian Period (360 to 408 million years ago) contain many different kinds of fish, so many that Geologists refer to the Devonian as ***The Age of the Fishes***. The first bony fish occur in the Devonian Period, approximately 375 million years ago.



Fish continue to be plentiful through geologic time. By the Triassic Period (208 to 245 million years ago) bony fish known as *teleosts* are the dominant variety of fish in the world's oceans. During this Period, fish-like predator reptiles lived in the oceans as well. They had paddle-like limbs that allowed them to swim well.

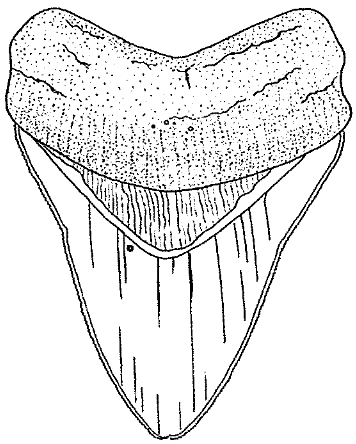
By the time of the Jurassic Period (144 to 208 million years ago), which is best known as *The Age of the Dinosaurs*, bony fishes were very common. The fish that are called *Modern Fishes* are first found in rocks of the Cretaceous Period (65 to 144 million years ago). These fossil fish are very much like fish that we know today.

It is interesting that even though there were two major extinctions during the geologic history of fishes, as a group they survived and became very plentiful.



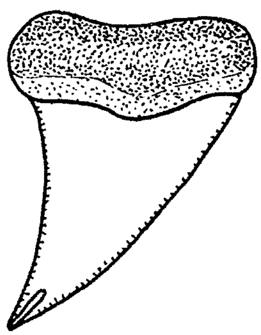
Below is a picture of a bony fish skeleton from the fine-grained limestone of the Green River Formation of Southwest Wyoming. They are from the *Eocene Epoch* which was 56 to 34 million years ago. The Green River Formation is famous for the number and variety of fish and other species that were preserved in the very fine lime mud. Other life preserved in the Green River Formation includes birds, turtles, snakes, leaves and many different varieties of fish.

SHARK TEETH



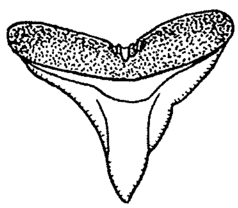
Sharks are often referred to as "Living Fossils" because they have not changed very much throughout the history of the Earth. Scientists are starting to think this is not really accurate. However, it is true that sharks have been swimming the world's oceans for millions of years.

Shark skeletons are made of a material called *cartilage*. Cartilage is stiff, but it is not hard like bone. When an animal dies, its cartilage starts to rot and fall apart. Because of this, fossilized shark skeletons are not found (except for a few very, very rare shark fossil discoveries). What are found, and in great numbers, are fossilized shark teeth. Until about 150 years ago, before shark teeth were properly identified, people thought they were preserved *Bird's Tongues*!



Fossilized shark parts, like scales and teeth, first appear in the fossil record about 400 million years ago in the Late Silurian and Early Devonian Periods. Teeth, scales and other parts of ancient sharks are found throughout the rock record. Paleontologists report that there is still a lot to learn about the relationships between the different shark species that have been discovered.

Pictured here are the fossilized teeth from three different sharks. The top picture is from the Carcharodon Megalodon; the middle is from the Mako shark; the bottom is from the Dusky shark.



The giant fossilized shark teeth from the Megalodon are up to 6 inches long and have been discovered all over the world. Paleontologists believe the Megalodon was the largest shark that ever swam the oceans. Based on the size of the teeth, it is estimated that this fish-eating monster of the sea was up to 50 feet long and weighed as much as 20 tons! The modern Great White Shark is a descendent of the Megalodon. Megalodon appears to have become extinct around 12,000 years ago.

Modern sharks have rows of razor sharp teeth in their mouths. Over time, the front row of teeth will fall out and the next row will move forward to the front - like it is on a conveyer belt. This may explain why there are so many fossilized shark teeth in the rock record. First, they are the only real hard part of a shark. Second, the shark continued to create new rows of teeth throughout its lifetime. Once again, we study the modern animal to better understand the ancient one! This is what paleontologists do.

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TRILOBITES

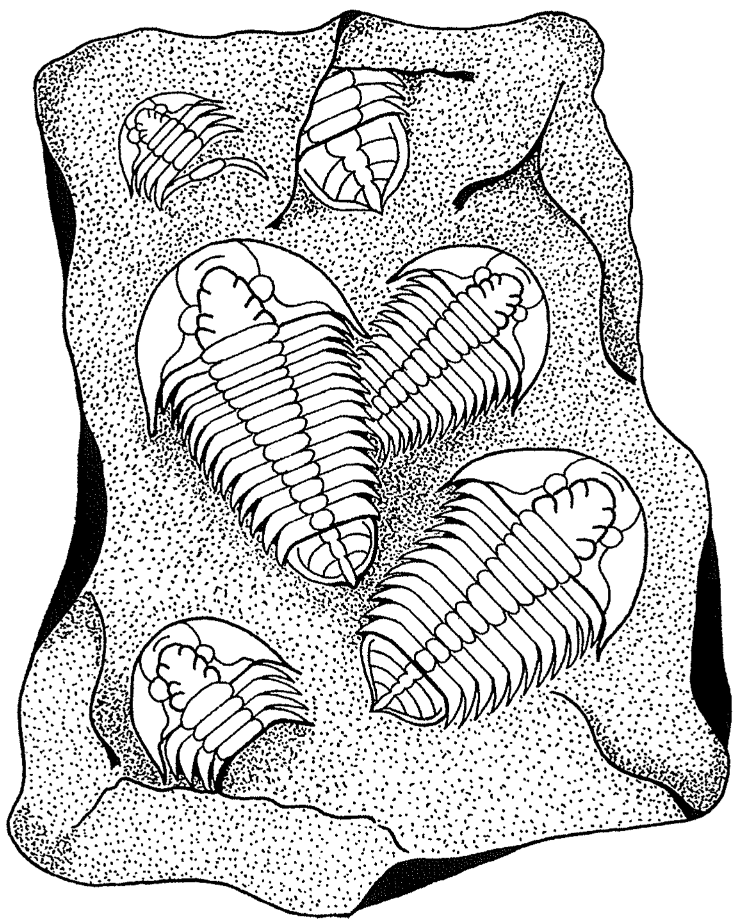
One of the best known - and most popular - of the marine fossils are the trilobites. They belong to the Phylum known as the **arthropods**. Arthropods have a hard, outer skeleton (which biologists call an *exoskeleton*) and jointed legs. Examples of modern arthropods include crustaceans like lobster, crabs, shrimp and crayfish and all flying and crawling insects. "Arthropod" is from the Greek language and literally means "**jointed foot.**" Trilobites belong to this family of organisms.

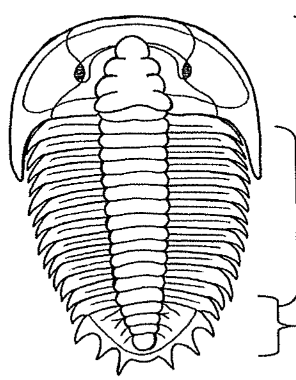
The first arthropods that appear in the rock record are trilobites. They are first found in rocks of lower Cambrian age (over 500 million years old!). Though other arthropods survived to the present day, trilobites became extinct at the end of the Permian Period, about 250 million years ago.

The name *trilobite* literally means *three lobes.* Look at the individual trilobite below. Paleontologists identify three parts of the trilobite. One lobe is the head, which is also called the *cephalon.* The second lobe is the body or the *thorax.* The third lobe is the tail or the *pygidium.*

There are approximately 17,000 known trilobite species (that is, different "kinds" of trilobites).

When a trilobite needed to protect itself from predators, it would roll up in a ball, like an armadillo does today.





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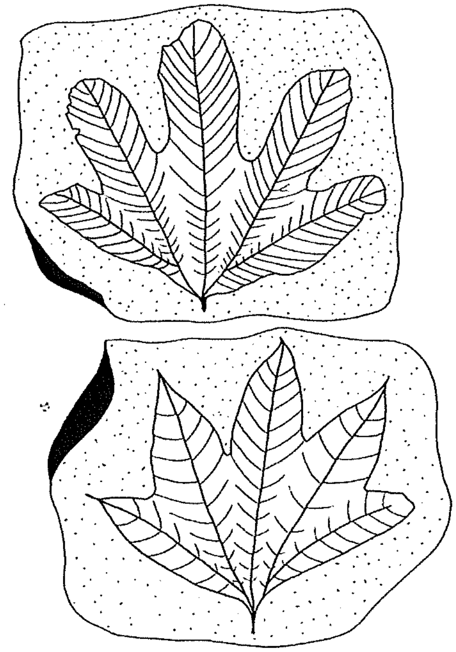
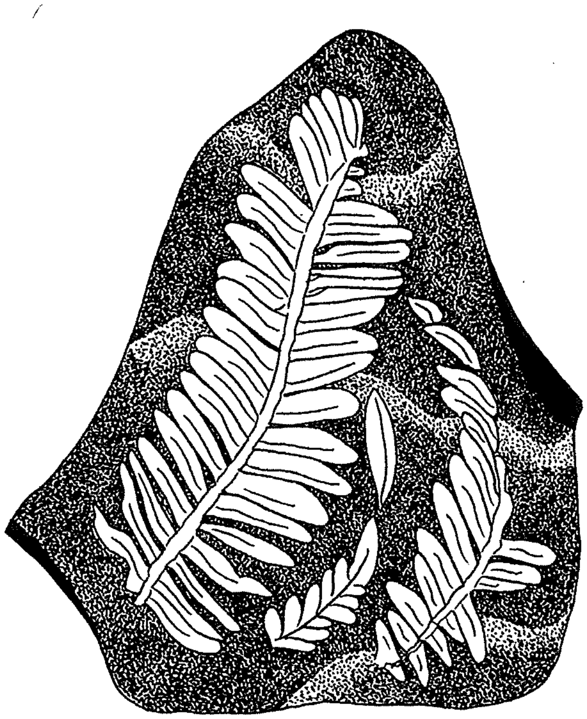
FERNS & PLANTS



Fossilized shells and bones are common because hard parts fossilize more easily. Soft parts, like the skin of a dinosaur or plants and leaves, almost always begin to rot right after the organism dies. Coal and oil are the rotted and preserved remains of ancient plants. It takes a very, very special situation that can trap a plant or leaf in a way that natural processes can preserve the shape and the parts or structures of the leaf. Therefore, plant fossils are rarer than bone and shell fossils.

In most cases, **pieces and parts** of plants are found in the fossil record, like a leaf, a stick, a piece of a tree trunk, or a branch of a fern. It would be wonderful to find an entire ancient tree, with its bark and all its branches and its leaves still attached to those branches. Such a fossil, however, has never been discovered.



So, paleontologists study the parts that they do find. In order to understand fossilized plants (and any fossil of any kind) we must **compare** them to modern leaves and plants. This gives paleontologists some ideas about the ancient plants, such as the environment in which they lived, how big they grew, what the function of the fossilized parts could have been, and so on.

This fern (left) was fossilized by a process called *carbonization*. After the fern was buried, it was squeezed by layers of decaying plants, mud, and other sediments. Over time, the plant rotted away, but the carbon in the leaves was left behind. This carbon is seen as a fossil, showing the shape and arrangement of the leaves.

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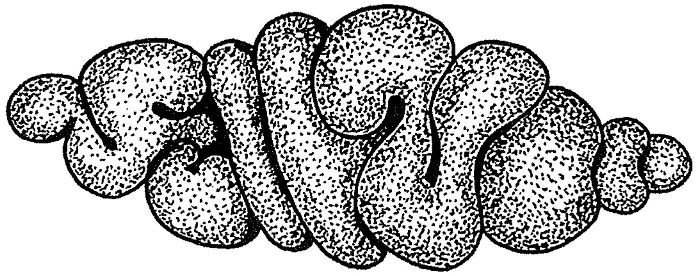
COPROLITES

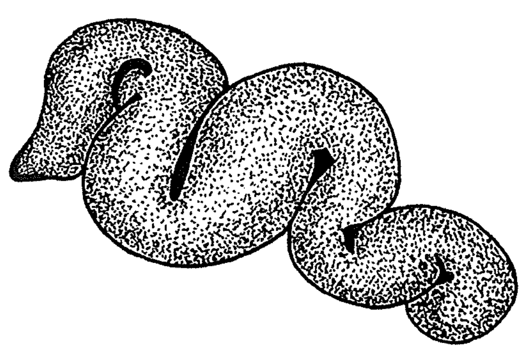


Look at these two pictures of a certain kind of trace fossil. What do they look like? If you think they look like something your dog would leave in the backyard, you are very right. They are pictures of fossilized dinosaur dung. Surprisingly, there is a lot of fossilized dinosaur droppings in the rock record!

These trace fossils are known by paleontologists as *coprolites*. The name comes from two Greek words, *kopros* which means *dung* and *lithos* which means *stone*. They were first studied, described and accurately identified by the English geologist, William Buckland. Before his study of these fascinating fossils, they were wrongly identified as *fossil fir cones*.

You might be surprised to learn that coprolites turn out to be very important fossils. Paleontologists have discovered that when the dung was fossilized, much of what was trapped in it was also fossilized! Paleontologists discovered that if they carefully slice a coprolite into very thin slices and look at it under a microscope, they can see bits and pieces of the food that they dinosaur ate. This helps them know if the dinosaur was a *herbivore* (meaning that it ate plants) or a *carnivore* (meaning that it ate animals). Then, when they know *what* a dinosaur ate, they can better understand how it gathered its food. Did it eat plants that grew in ponds or leaves from branches on high trees? Did it eat slow animals that couldn't run away or did it have to chase down its prey?

This sounds easy, but don't be fooled. By the time a dinosaur chewed and digested its food, the leftover pieces that were fossilized in the coprolite are not easy to identify. Paleontologists have to work with very small, broken, half-digested pieces. As you can imagine, studying coprolites can create many more questions than it answers. But the more they are studied, the more we will know.



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