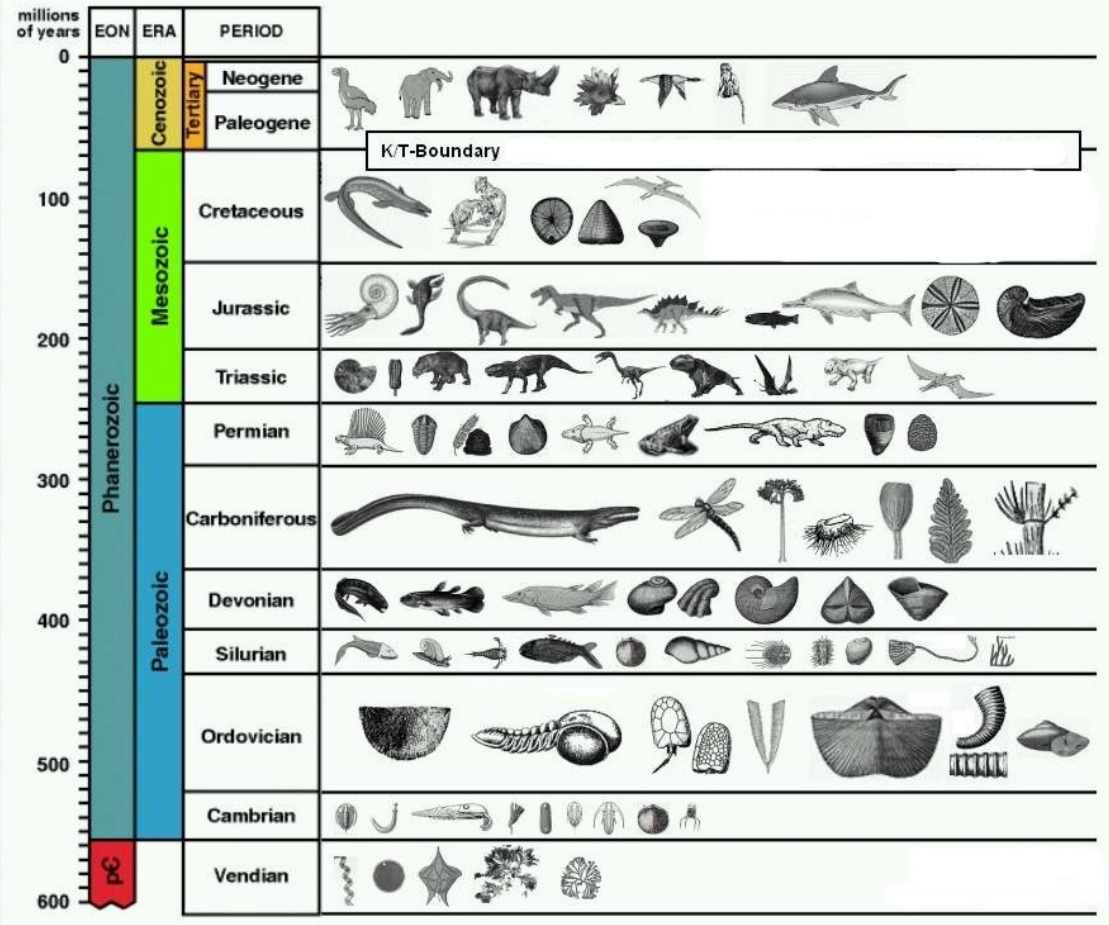
READING MUSEUM SERVICE

Hands On Learning
with Reading Museum Service

CHALK FOSSILS X4/B

The word fossil is derived from the Latin *fossilis*, which means 'dug up'. Fossils are the remains of creatures which existed long ago. Fossils range from thousands of years to many millions of years in age. The earliest fossils date from around 600 million years ago. However recent reports suggest bacteria may have existed up to 3,000 million years earlier. To put this in context, the dinosaurs became extinct just 65 million years ago. The earth itself is about 4,570 million years old. Geologists divide this vast time into various units according to events which took place in each period. The chart below gives the names of these periods, from the time of the first complex fossils through to the present. It also shows some of the living organisms (mainly animals) that lived in each period.



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Not all former life was preserved as fossils. The vast majority of living things simply vanished without trace. Fossils come in a variety of sizes, from the microscopic through to large dinosaur skeletons, and are formed in a variety of ways.

Permineralised fossils are organisms which became covered by sediment soon after death. As the organism slowly decayed, water infused with minerals passed through it, replacing the chemicals in it with rock-like minerals. Over millions of years the original organism was completely replaced by these minerals and what remains is a rock-like copy of the original. The fossil has the same shape as the original object, but is actually rock. This process results in loss of original colour. The photograph on the right shows the fossil of a huge tree that was formed by the permineralisation process.



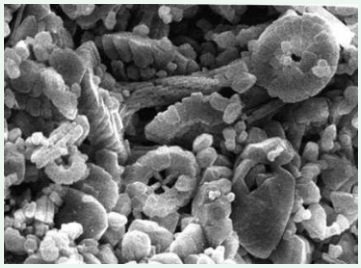


In other cases the original remains of the organism completely dissolve and all that is left is an organism-shaped hole in the rock. This kind of fossil is called a mould fossil or typolite. If this hole is later replaced by new, unrelated minerals it is called a cast fossil. In some cases replacement occurs so gradually that tiny features are preserved despite the total loss of original material. The photograph on the left shows a mould fossil of a shell.

Finally, there are trace fossils: marks in the rock which result from the activities or presence of animals and plants. Examples of these traces include footprints, burrows, root tunnels and even animal droppings (which are called coprolites) and vomit (regurgitaliths). The photograph on the right shows a fossilised dinosaur footprint.



Chalk



Chalk is relatively common in and around Reading. This chalk was formed about 100 million years ago in the Cretaceous Period. At this time there were extensive tropical seas covering the area. Countless tiny floating algae left microscopic plate-like remains (called coccoliths) behind when they died. The photograph on the right shows a highly magnified piece of chalk, revealing these tiny coccoliths.

These microscopic particles accumulated on the sea bed and formed a kind of mud. Gradually layer upon layer built up. This was then transformed into rock by geological processes. As more sediment built up on top the sludge was subjected to heat and pressure which removed the water and compacted the sediment into rock which in some places is hundreds of metres thick. The white cliffs of Dover (below) are an exposed chalk bed of this kind.

Chalk is white because the coccoliths it is made from are colourless. The same is true of many limestones, but most limestones also contain impurities such as clay which gives them a darker colour. Cretaceous chalk is free from impurities because sea levels were very high, so there was little land exposed to supply other material. Chalk which was subjected to further heat and pressure became marble.

Chert and flintstones are also common in the chalky soils around Reading. Chert and flint are made from silica. Most of this silica probably came from the sea sponges and micro-organisms such as diatoms and radiolarians that once swarmed in the sea. This silica gradually built up in the beds of chalk as they were being formed and turned hard. As it oozed into some burrows/cavities the silica sometimes enveloped the remains of marine creatures. This is why some nodules of flint, when they are broken open, reveal a fossilised creature inside.



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Ammonite



Ammonites were marine animals that ranged in size from under an inch (2cm) to about 9 feet (3m) in diameter. They were protected by a shell (usually spiral-coiled) that contained many air filled chambers. As the animal grew, new chambers were added behind the outer chamber. The animal lived only in the outermost chamber.



Despite the fact that they look like snails, ammonites did not move by crawling across the ocean floor. Air in the unused shell chambers allowed the animals to float and they moved by jet propulsion - expelling water through a funnel-like opening to propel themselves in the opposite direction. The modern nautilus (right) gives us some idea of what a living ammonite would have looked like.

Ammonites probably lived for about two years. A nautilus creates a new chamber in its shell at a rate of one every four weeks, equal to 13 each year. Using this as a guide an ammonite shell containing 26 chambers could be assumed to have housed the creature for two years. Evidence suggests that some female ammonites grew up to 400% larger than the males.

Ammonites began life as tiny planktonic creatures less than 1mm in diameter. In their infancy they would have been vulnerable to attack from other predators including fish. They quickly assumed a strong protective outer shell that would shield their soft interior from damage. However, fossilised adult ammonites have been found showing teeth marks from ichthyosaur attacks.



On the other hand, ammonites were themselves predators, feeding on most living marine creatures including molluscs, fish and even other cephalopods (octopuses, squids etc.). By analogy to modern cephalopods, their method of attack probably consisted of silently stalking their prey, then rapidly extending their tentacles to grasp the target. The photograph on the right shows a nautilus capturing a crab. Once caught the prey would be devoured by the ammonite's powerful jaws located at the base of the tentacles, between the eyes.

Continued on next page.

Much of an ammonite's life was spent in shallow waters. The evidence to support this includes their diet, which could be found in the greatest volumes in the warm shallows. It is also unlikely that their shells could withstand the high pressures present in deep water (over 100 metres). Another theory based around their assumed social behaviour suggests that their shells were decorated by an array of patterns, indicating that colour/good light played a large part in their lives.

Ammonites first appeared in the late Silurian to early Devonian Periods (about 400 million years ago) and were abundant in the seas for 300 million years. At several points in this long history they faced major extinction events, with often only a few species surviving. Each time, however, this handful would diversify into a multitude of forms. Ammonite fossils became less abundant during the latter part of the Mesozoic Era (from 251 to 65 million years ago), with none surviving into the Cenozoic Era.

Flint with Impression of Sponge



Sponges are one of the most primitive multicellular animals, lacking internal organs, nervous tissue, a circulatory system, or a gut for digesting food. To obtain food, the sponges filter the water around them as it passes through tiny pores located on their outer walls. To support and protect their soft bodies, sponges produce skeletons of calcium carbonate, silica, or a soft organic material called spongin.



Sponges date back to a period known as the Neoproterozoic Era, which began 1,000 million years ago, well before the explosion of life forms in the Cambrian Period. It is not known how old this example is or where it originates from. The fossil record of sponges is not abundant, although a famous locality for them is the Cretaceous Faringdon Sponge Gravels in Faringdon, Berkshire (now Oxfordshire). A photograph of a fossil sponge (*Raphidonema farringdonense*) from this locality can be seen on the left.

At first sight this specimen looks like nothing more than a fragment of a flint nodule. Such flints are common in the chalk-rich soils around Reading. However, when these nodules are split open, they are sometimes found to have a cavity in the centre in which there are the fossilised remains creatures or traces of their presence. This is the case here. Nothing remains of the original sponge but the pock-marked inner surface of the nodule indicates that it once probably held more extensive sponge remains.

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Sea Urchins



Living sea urchins (left) are covered with spines, but these usually decay quickly after death leaving a shell, which is also called the test. Fossilised sea urchin tests are relatively common. The earliest sea urchins are found in the Ordovician Period.

A sea urchin has no visible eyes, legs or means of propulsion, but it can move freely over surfaces by means of its adhesive tube feet, working in conjunction with its spines. The mouth is found on the lower surface. The mouth is a complicated arrangement of muscles and teeth called 'Aristotle's lantern' which allows the urchin to bite, chew, grasp and grind. A photograph of a sea urchin broken open to expose Aristotle's lantern can be seen on the right. Sea urchins eat plant and animal matter, including sea weed, decaying matter, algae, dead fish, sponges, mussels, and barnacles. The mouth is connected by a gut to the anus on the upper surface. Sea urchins do not have a brain.



The smallest and most well preserved of these examples (marked number 2) belongs to the Micraster genus (group) of sea urchins. The Micraster genus is found in the Cretaceous Period. This group evolved rapidly and is used as a zone (or index) fossil - that is, particular species help geologists to date the rocks in which they are found. The name micraster is derived from two Greek words - micro, meaning small, and aster, meaning star. A star shaped pattern can be clearly seen on this example.





Specimen number 3 is an example of *Sternotaxis planus*. Specimen number 4 is an example of *Echinocorys scutata*. Both of these species are believed to have burrowed into the mud on the sea floor and to have eaten the tiny creatures they found there.



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Pectinidae Fossil



This flint pebble shows the impression of a pecten shell. These molluscs lived on the sea floor, filtering algae and tiny animals from sea water. They would open their shells to filter and close up when threatened. Pectens were not attached to surfaces and may have swum around.



Scallops, which are widely eaten today, belong to the Pectinidae group. A scallop can swim by rapidly opening and closing its shell, making a whistling noise as it does so. The Great Scallop (*Pecten maximus*) can reach a width of 15cm. A photograph of one swimming can be seen on the left.

Inoceramus Fossil



The Inoceramus genus had a worldwide distribution between the Jurassic and the Cretaceous Periods. They probably lived in much the same way as Pectinidae. Most species have prominent growth lines appearing as raised semicircles concentric to the growing edge of the shell. Palaeontologists suggest that the giant size of some species was an adaptation for life in the murky bottom waters, with a correspondingly large gill area that would have allowed the animal to cope with oxygen-deficient waters.