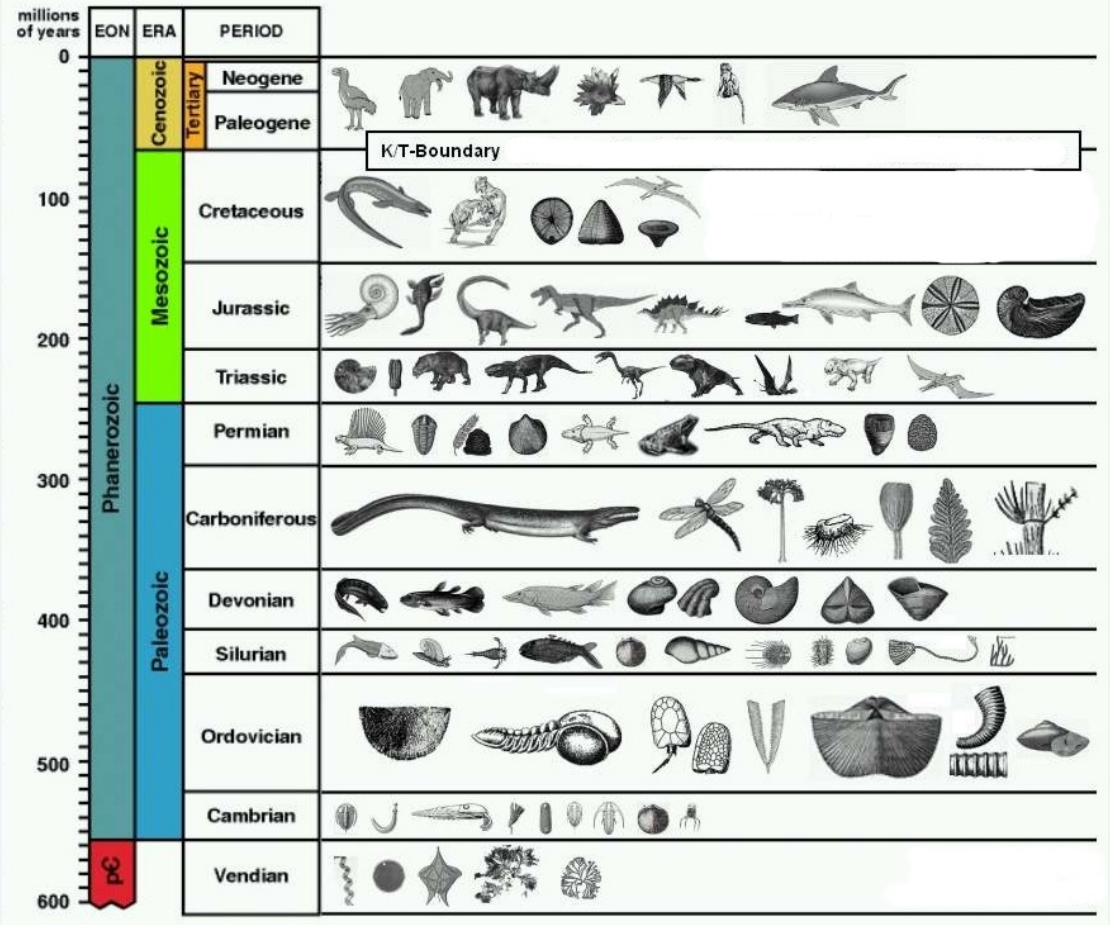
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COAL FOSSILS X6/A

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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COAL FOSSILS X6/A

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. They 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.

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COAL FOSSILS X6/A

Coal

The fossils in this box are the remains of plants from about 310 million years ago. The period between about 360 and 300 million years ago is called the Carboniferous Period. This is in turn divided into two parts called the lower (earliest) and upper (later) Carboniferous. In Britain the rocks of the lower Carboniferous Period were laid down under the sea, while those of the upper period were made on dry land. The fossils in this box are from the upper Carboniferous Period.

Much of the coal that is found beneath the landscape of Britain was created in the upper Carboniferous Period. At this time Britain and much of northern Europe was hot and was covered by a rainforest which looked similar to that found in Brazil today. When trees die in a stagnant peat swamp environment low oxygen levels prevent their complete decay by bacteria. If these masses of undecayed trees are later buried under sediments (mud and sand swept over them by a river or the sea) then coal will form. In the majority of cases the boundary between coal and the surrounding rock is abrupt, suggesting that the sudden onset of sea and river environments quickly destroys the peat swamp and begins the process of coal formation.

Fossils of the plants that contributed to this process can be found within the coal and sometimes in the shale and sandstone sediments that overlie it. Beds of coal are usually quite thin. The weight of the sediment has caused the peat to become considerably compressed. Current estimates are that the coal seams found in Britain represent only a sixth of their original thickness when they were peat. A few examples of the many species that existed at that time are included in this box.



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COAL FOSSILS X6/A

Sigillaria Species

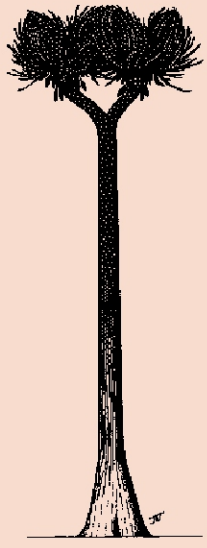


Although the environment that produced the fossils in this box looked similar to that of Brazil today, the kind of plants that flourished then were, in fact, very different from those found in a modern rainforest.

Tree-sized plants dominated, but these were largely plants called club-mosses - extremely fast-growing plants adapted to growing in low nutrient, waterlogged soils. It has been estimated that their 1-2m wide stems could grow upwards at several metres per year, to a height of 40 metres. They were not seed plants as are most large plants growing today; they reproduced by means of spores. Unlike true trees their trunk contained relatively small amounts of wood. Instead, much of the trunk consisted of soft tissue called periderm, which enabled the plants to grow quicker than woody trees. They grew into mature plants, reproduced, and then died. Most modern-day trees, in contrast, reproduce for many years after reaching maturity. For this reason, many palaeontologists call these extinct plants giant herbs rather than trees.

Other plants also grew in the forests, but mainly in the less waterlogged areas, such as on the raised banks of rivers that threaded their way through the swamps. There were tree ferns, looking very similar to those tree ferns growing today in places like New Zealand. There were also some seed plants belonging to a number of now extinct groups such as the cordaites (distant relatives of today's conifers) and the seed-ferns (distant relatives of the modern cycads).

This is a trunk section of a plant in the *Sigillaria* genus. *Sigillaria* were spore-bearing, tree-like plants which flourished in the early Carboniferous Period. They had leaves and roots very similar to their contemporaneous cousin *Lepidodendron*, but differed in that they exhibited much rarer branching and their tall, columnar trunk lacked the scale-pattern of *Lepidodendron*, instead exhibiting straight, fluted furrows along the trunk midsection. Occassionally the trunks were smooth.



Right: A plant of the Sigillaria genus.

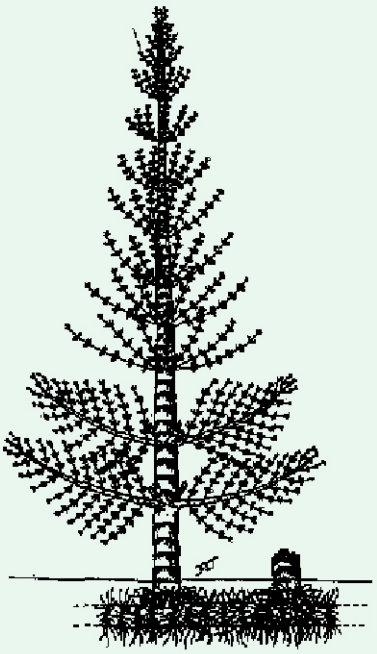
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COAL FOSSILS X6/A

Calamites Fossil



Calamites is the name of a group of extinct tree-like horsetails to which the modern horsetails (below) are closely related. Prehistoric calamites were capable of achieving heights of around 30 feet (9m), but modern horsetails vary between 2 and 24 inches (5-61cm). The stems of modern horsetails are hollow or contain numerous elongated air-filled sacs. Calamites were similar in that their trunks and stems were hollow, like wooden tubes.



The trunks of calamites had a distinctive segmented, bamboo-like appearance and vertical ribbing. Calamites reproduced by means of spores, but they also possessed rhizomes (creeping rootstalks) which allowed the production of clones of one tree. This is the only group of trees of their period known to have a clonal habit. This type of reproduction would have allowed them to spread quickly into new territory, as well as helping to anchor them firmly in the unstable ground along rivers and in newly deposited delta sediments.



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COAL FOSSILS X6/A

Seed Fern Fossils

The four samples in this box represent two different carboniferous seed fern genera (singular: genus). A genus is a group of related species.

Two Alethopteris Specimens



Alethopteris is a genus of 'seed fern'. This name is misleading since, despite appearances, seed ferns were not ferns at all, but instead were true seed plants. Ferns reproduce by means of spores, rather than seeds, which are located on the lower surface of their leaves. Seeds contain nutrients which give a seedling a secure start in life. Seed ferns were the first plants to develop this method of reproduction. They varied in size from small plants to trees. Typically, *Alethopteris* plants had tongue-shaped leaves with a sunken mid-vein. Seed ferns are now extinct. They were severely reduced in their diversity at the end of the Permian Period, and finally became extinct at the end of the Cretaceous.

Two Neuropteris Specimens





Neuropteris was a genus of fossil seed ferns characterised by leaflets that were usually blunt-tipped and attached to the base at a single point (as opposed to the entire leaflet). Specimen number 4 belongs to the *Neuropteris sheltoni* species.

