

# The Ordovician Period

ORDOVICIAN TIMES SAW THE EXPANSION OF MARINE LIFE, UNTIL CLIMATIC CHANGES DESTROYED THE ENVIRONMENT ON WHICH SO MANY SPECIES DEPENDDED.

Throughout Ordovician times, the pace of global change quickened. During the period of just over 50 million years that the Ordovician lasted, from 495 to 443 million years ago, Siberia and Baltica moved north, the Iapetus Ocean began to close and the Rheic Ocean gradually opened to the south. The supercontinent of Gondwana continued to dominate the southern hemisphere, with North Africa at the South Pole.

Much of our knowledge of changes in the Ordovician climate and the position of continents is derived from fossils of small creatures that lived in the seas and oceans. Although primitive plants, along with a few small arthropods, began to invade the land in Ordovician times, life was still concentrated in the sea.

## MINIATURE LIFE

Fish had begun to evolve, but most marine life was still remarkably small, with few organisms growing larger than an inch or two. The most common shellfish were the superficially clam-like brachiopods, mostly about 1 inch (2 to 3 centimetres) in size. Altogether, over 12,000 fossil species of brachiopods have been recorded. They lived on the seabed or attached to other creatures, such as sea lilies. Because their shell form varied depending on local conditions, their fossils help reconstruct past environments.

## CREATING THE BLUE RIDGE

A collision between the landmasses of Avalonia and Laurentia triggered the formation of what are now the Blue Ridge Mountains of Virginia, deforming earlier sedimentary rocks.



## DOB'S LINN ROCK

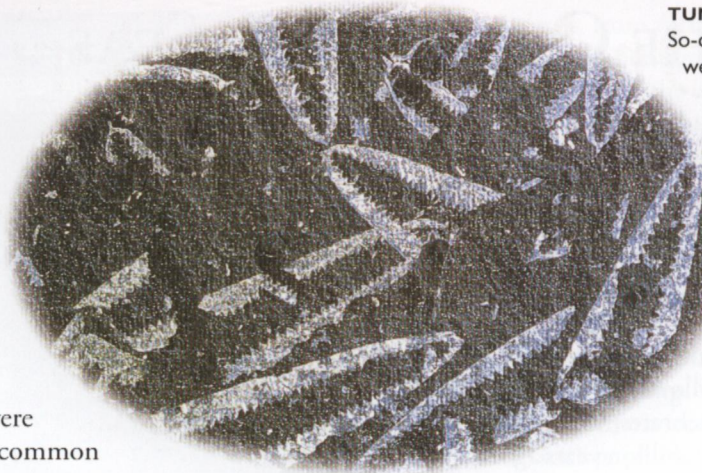
A shale rock at Dob's Linn marks the boundary between the end of Ordovician time and the start of the Silurian period. This rock, containing well-defined graptolite fossils, was discovered by schoolmaster Charles Lapworth in 1879 in the Southern Uplands of Scotland. Lapworth mapped the complicated succession of ancient marine strata and suggested the identification of a new period between the Cambrian and the Silurian. He named this new period "Ordovician" after a Romano-British hilltribe, the Ordovices.



## TRILOBITES AND GRAPTOLITES

Other fossils that help us to understand the Ordovician world include trilobites and graptolites. There were over 4,000 trilobite species, most of them less than 4 inches (10 centimetres) in length. Although trilobites spread through the seas of the world, some regions featured their own particular kinds. The global distribution of trilobite fossils has helped scientists reconstruct the positions of the Earth's crustal plates at the time.

Graptolites were strange creatures that were once even thought to be plants. These once common



## TUNING FORKS

So-called "tuning-fork" graptolites were small creatures, an inch or so (few centimetres) long, that lived in organized colonies. Each individual animal lived in one of the "cups" formed by the serrated edge of the skeleton. Tentacles used for filtering food would have projected from the skeleton. These fossils were found in Wales.

organisms floated in the seas and consisted of numerous tiny individual, yet interconnected, creatures living in a hollow tubular skeleton and filter-feeding from the plankton.

## MASS EXTINCTION

The wonderfully diverse marine life of Ordovician times – with over 600 different families of marine organisms – was not destined to last. The global climate became progressively wetter and cooler, descending into an ice age at the end of the period that drove many organisms to extinction. As ocean water was locked up in the polar icecaps, sea levels fell by as much as 1,000 feet (330 metres). The shallow seas of the continental shelves turned into dry plains, killing off many of the creatures that lived there, especially those that could not migrate from the seabed.



## GRAPTOLITE BIOZONES

The shape of graptolite skeletons changed as they rapidly evolved. These changes can be used to achieve a precise relative dating of Ordovician, Silurian and early Devonian marine strata. In 1879, a Scottish schoolmaster, Charles Lapworth, worked out the correct chronological sequence of graptolites in southern Scotland and used it to establish the correct sequence of strata. Lapworth's graptolite "biozonation" has since been used all over the world.



## HORSESHOE FOSSIL

Fossils of horseshoe crabs first appear during the Ordovician period. Like the trilobites, they were aquatic arthropods that lived on the sea bottom. Although modern-day horseshoe crabs are sometimes referred to as "living fossils" because they so closely resemble their prehistoric ancestors, none of the species living today date back to Ordovician times.

# LIFE IN THE ORDOVICIAN SEAS

**T**HE ORDOVICIAN PERIOD MARKED A TURNING point in the evolution of marine life. Many organisms were increasing in size, strength and speed of movement. Jawless organisms called conodonts, which are extinct today but were common in the Ordovician seas, were particularly significant as they were closely related to the first vertebrates. The appearance of the first fish-like jawless vertebrates was followed by the evolution of the first shark-like vertebrates, which had jaws and teeth, more than 450 million years ago. During this period, there is also evidence that animals began to move onto land.

## CONODONT MYSTERY

Two questions puzzled paleontologists for a long time – what were the conodonts and who were their closest relatives? Until the 1990s, these were difficult questions to answer, since the only fossil remains of the animals were tiny tooth-like structures found in rocks from late Cambrian to late Triassic times (520 to 210 million years ago). No one knew what kind of creature these teeth belonged to until the first conodont with preserved soft tissue was found in Carboniferous rocks in Scotland, and then later in South Africa. These finds have shown that the teeth were indeed a feeding apparatus, positioned below a pair of



well-developed eyes. The presence of a nerve cord, a notochord (a flexible rod) and muscle blocks, all located in its back, shows that these animals were actively swimming chordates, closely related to the backboned vertebrates. They also have vertebrate features such as a head and paired eyes moved by muscles. Consequently, some experts argue that conodonts are more advanced chordates than the Cambrian vertebrate ancestor *Pikaia*, and may be closely related to the fish-like jawless vertebrates.

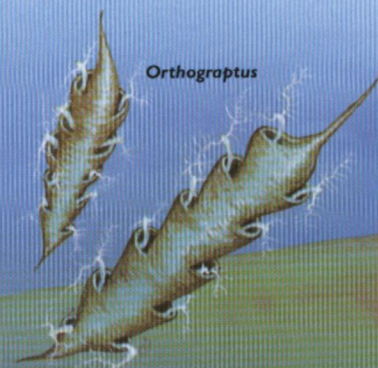
## TINY TEETH

These comb-like strands are the tiny fossilized feeding apparatus, 1 inch (2-3 centimetres) long, from the mouth of a large Ordovician conodont. Conodonts are thought to be related to the chordates, including the true backboned creatures, the vertebrates.



## ORDOVICIAN SEAWORLD

The upper waters of the oceans teemed with planktonic life, including the extinct graptolites (*Orthograptus*). On the seabed, there were abundant shellfish such as brachiopods (*Strophomena*), rugose corals and moss animals (*Strictoporella*). Trilobites (*Triarthrus*) and snails (*Cyclonema*) searched around the seabed for food. More mobile swimming filter-feeders were the first jawless and toothless fish-like vertebrates (*Sacabambaspis*), while the toothed but jawless conodonts (*Promissum*) were active predators, along with the tentacled cephalopods (*Endoceras*) and nautiloids.



*Sacabambaspis*



*Strictoporella*

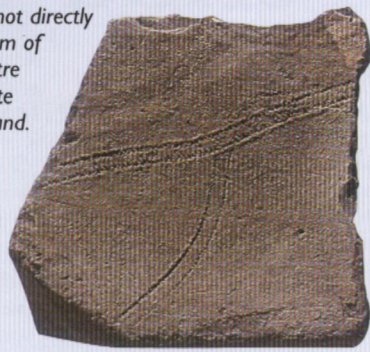


*Triarthrus*

Coral

## SETTING FOOT ON LAND

Animals gained a foothold on land at this time, not directly from the sea, but through the "backdoor" medium of freshwater. Sets of parallel trackways, a centimetre wide, have been found in 450-million-year-old late Ordovician freshwater deposits in northern England. They were probably made by a millipede-like arthropod, an animal with a segmented body, numerous jointed legs and an exoskeleton. No body fossils have yet been found for this creature. Arthropods were ideally suited to make the transition from the supportive environment of water to dry land, with its desiccating air and primitive vegetation.



and *Arandaspis*, from Australia. They are younger, but still Ordovician in age. Their wide geographical separation reinforces the view that their ancestry lies much further back than previously thought, possibly in Cambrian times.

The fossil remains indicate that Ordovician agnathans were very different to the few jawless vertebrates that survive today – the lampreys and hagfish. Typically, they had heads and bodies that were covered with tough leathery plates made of bone-like material. Only the scaly tail had flexibility for swimming. Without jaws and teeth, they must have fed on food that was small and numerous, such as planktonic microorganisms.

## ORDOVICIAN JAWLESS VERTEBRATES

Fossils of the very early fish-like jawless vertebrates (agnathans) are rare at first in Ordovician strata but become more common in rocks from the succeeding Silurian and Devonian periods. There is no question, however, that agnathans did exist in Ordovician times.

In 1892, American paleontologist Charles Walcott, famous as the discoverer of the Burgess Shale (see page 64), found a fragmentary agnathan in the Harding Sandstone, Colorado. These strata are over 450 million years old. The same rocks have produced other remarkable vertebrate remains, including the scales of jawed shark-like gnathostomes. The oldest complete agnathan fossils are *Sacabambaspis*, from Bolivia,

## BRACHIOPODS

The most common and successful Ordovician shellfish were the brachiopods. Most brachiopods, like these orthids, were permanently anchored to the seabed or to other shells by a short fleshy stalk called a pedicle, though some lay freely on the seafloor sediment. They lived by drawing seawater through their open shells and filtering out microscopic particles of food. Although they resemble clams (bivalve molluscs), they are not related to them.

