



# Adventures From the Land of Dinosaurs

## The Paleozoic Period

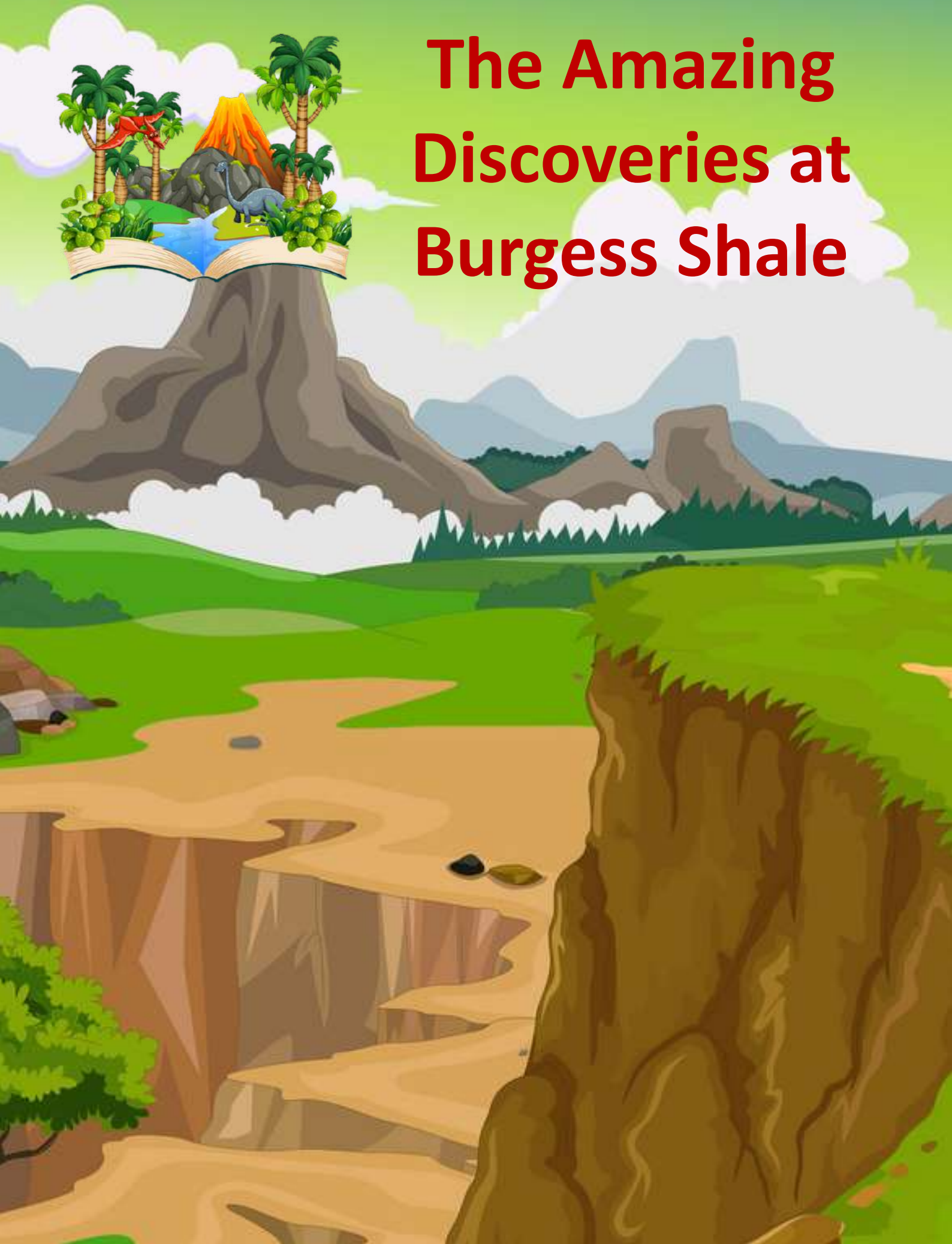




The Paleozoic period lasted from 541 to 252 million years ago. All of the major groups of animals appeared in the Cambrian, around 500 million years ago. Later we saw the arrival of king-sized trilobites, armoured fish and giant bugs. A supercontinent called Pangaea formed and stretched from pole to pole. And then, just when it was really getting going, almost all life was annihilated during the largest mass extinction in our planet's history.



# The Amazing Discoveries at Burgess Shale





During the construction of the Canadian Pacific Railway in 1909, Charles Walcott discovered the now famous Burgess Shale fossils. The creatures found in the Burgess Shale date back to the Cambrian, 510 – 505 million years ago. Scientists have uncovered around 150 species of animals, algae and bacteria. What's amazing is that 98% of these species were soft-bodied creatures that don't usually fossilize well. They're preserved so spectacularly because they were probably buried rapidly by an underwater mudflow.





Vauxia was a simple branching sponge that belongs to the same group as today's harvested bath sponges. And like modern sponges it lived by filtering tiny food particles from the water.

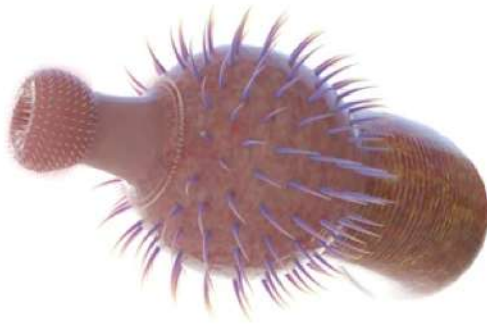
**Vauxia**





Scientists know that the worm *Ottoia* was both a predator and a scavenger. They have found one with its last meal preserved in its gut and others eating a carcass.

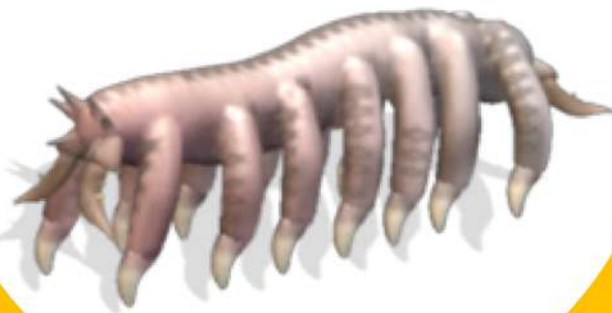
## ***Ottoia***





Asycheaia was a lobopod, which is a close relative of today's velvet worms, water bears (tardigrades), and arthropods, such as crabs. It lived alongside sponges.

## **Asycheaia**





Originally scientists thought Hallucigenia had a row of tentacles along its back and walked on spikes. But later they found that the spikes go on the back and it actually had two rows of legs.

## Hallucigenia





Many specimens of the arthropod *Marrella* have a dark stain that is high in copper – it might be blood.

## ***Marrella***





Several specimens of Waptia have been discovered with up to 24 eggs attached to the underside of their headshields. This suggests this shrimp-like arthropod cared for its young.

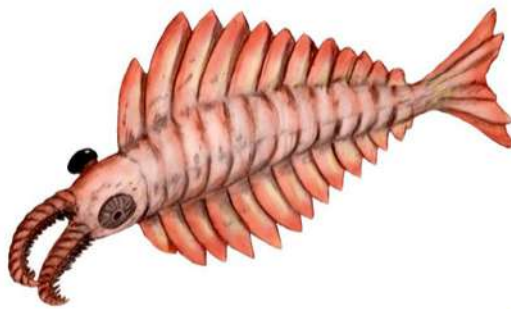
**Waptia**





Anomalocaris was the largest predator in the Cambrian.  
It used its two front appendages to catch prey and  
popped its food into a circular-shaped mouth.

## **Anomalocaris**





Opabinia was a bizarre arthropod with five stalked eyes and a long “nozzle” that ended in claws. It used this to catch prey.

## Opabinia





Possibly a very early ancestor of vertebrates (animals with a backbone), Pikaia was an eel-like animal with no eyes. It used small feelers to find food in the mud.

## **Pikaia**





Wiwaxia was a slug-like animal covered in leaf-shaped scales and spines. Sometimes their armour shows signs of damage, indicating they may have been attacked by a predator.

**Wiwaxia**





Echmatocrinus is thought to be an early echinoderm, belonging to the group that includes starfish and urchins. It attached itself to the seafloor and used its arms to transport food to its mouth.

## **Echmatocrinus**







# The King of the Trilobites





Dr David Rudkin was on the hunt. The year was 1998 and the palaeontologist (that's someone who studies fossils) was visiting a site known for fossils from the Ordovician – roughly 445 million years ago. He was looking for tracks left by trilobites, marine arthropods that were common back then. Large trilobite fossils had been found before in the area, but they were rare. David knew he had a better chance of finding their tracks, which were often bigger.





David was scrambling around rock ledges during low tide along the Hudson Bay coast in Manitoba, Canada. After stopping to take a closer look at something, he noticed he was literally stepping on the exposed portion of a fossil. He immediately realized he had found something special.





Removing the specimen was difficult. David and his team were in a race against the ocean. They only had about an hour and a half before the tide came in and submerged the fossil.

They were not prepared for a large excavation either, but they managed to get the specimen out ... in a few pieces. After some work, the trilobite was found to be almost complete, only missing a little part of its tail. The team were stunned by how big it was. It was gigantic – about the size of a pillow.





The team called the king of the trilobites *Isotelus rex*. It was the largest trilobite ever found. But who knows how many other giant trilobite fossils are hiding beneath the tides, waiting to be discovered ...

*Isotelus rex* was seven times larger than an average trilobite.





# Secrets of the Fossils





Most of the time palaeontologists handle fossils with extreme delicacy. Other times, cutting or drilling into fossils can tell us a lot more about them. But the fossils from a site in Herefordshire in the United Kingdom have to be totally destroyed to see how amazing they are. The Herefordshire fossils are preserved in breath-taking details in 3D. however, it took over 150 years for scientists to figure that out, because the fossils are hidden inside hard, rocky structures called concretions.





To see the amazing fossils, the concretions are first split open in the lab. Around half of them will contain a fossil. Then the concretions are trimmed with a rock saw and mounted on a special slide. Specimens are ground down to less than the thickness of a human hair before photographed. This process is repeated hundreds of times until the entire specimen has been sliced up and uploaded onto a computer. At this point the original specimen had turned to dust, but a digital fossil is reconstructed by combining the sections together using computers.

Concretion





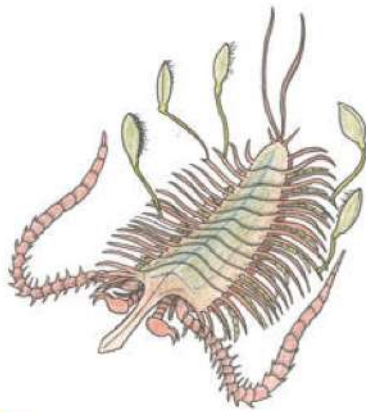
From these virtual fossils, palaeontologists have discovered over 30 species, including sponges, worm, and molluscs. About 430 million years ago, these critters were living in a shallow subtropical sea that was south of the equator. They probably spent their time in deep, dark water roughly 100-200 m (330 – 660 ft) down. Out of 3670 specimens, over a quarter of them are arthropods, related to modern animals like crabs and spiders.





One arthropod, called Aquilonifer, used a long thread to carry its babies.

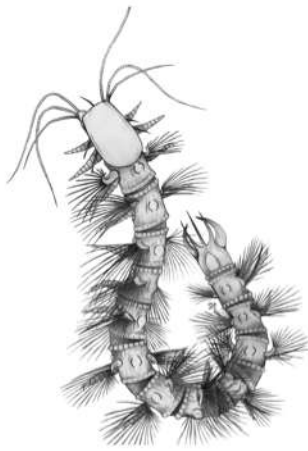
## **Aquilonifer**





Another, named Enalikter, didn't have eyes and had two pairs of spikes at the end of its tail.

## **Enalikter**



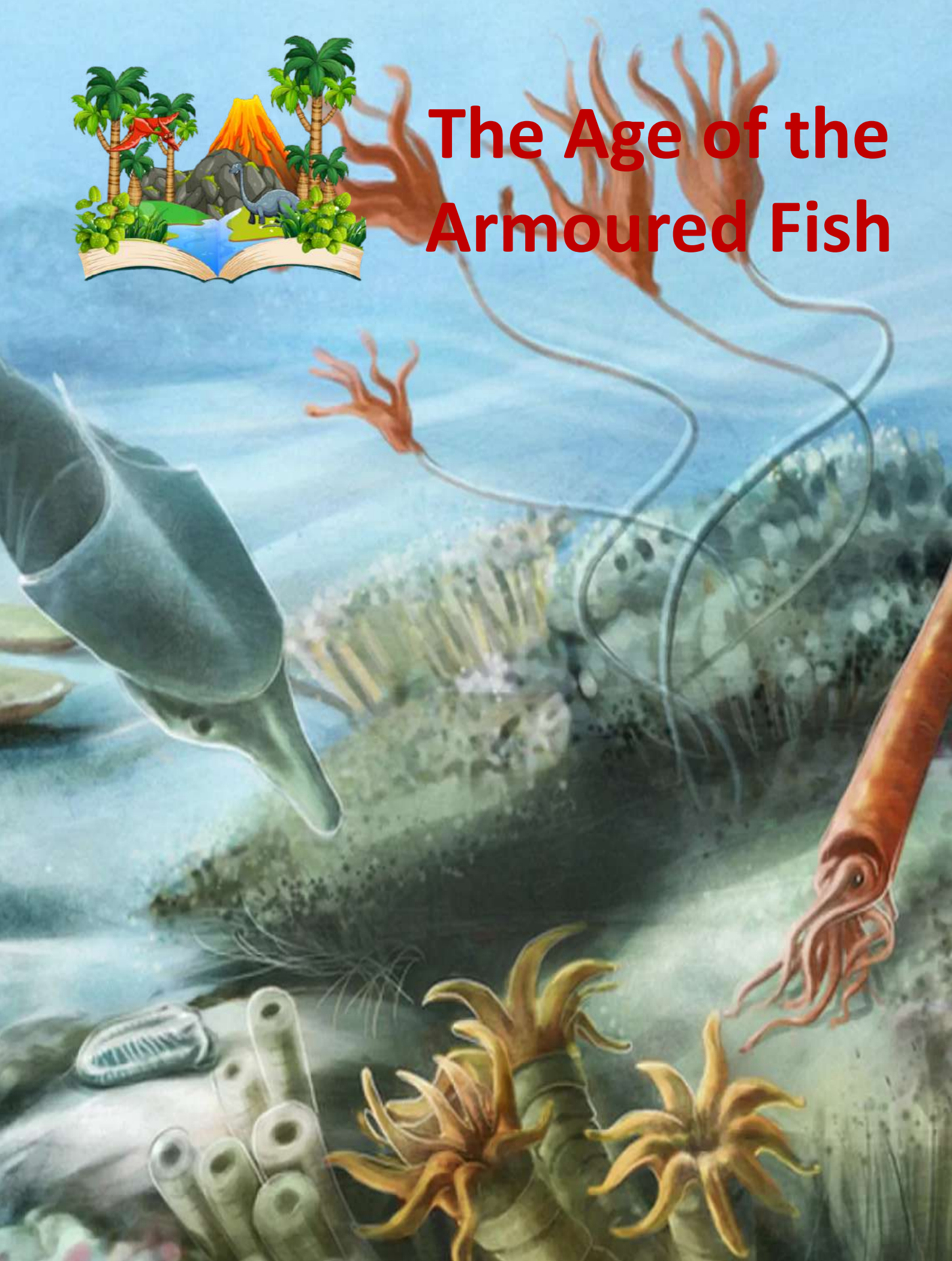
At some point volcanic ash buried the animals in mud on the seafloor. Hard concretions formed and topped the fossils from being squished, preserving them perfectly for us to study in the future.







# The Age of the Armoured Fish



The Devonian (419-359 million years ago) is known as the Age of Fishes. Many fish groups appeared for the first time, including sharks and the ancestors of salmon. Two other groups – the Ostracoderms and Placoderms – developed bony plating around their heads, bodies and fins. The oceans were battleground, and this armour was needed for protection.





Dunkleosteus is thought to be the first “super predator”.  
It had one of the most powerful bites ever.

## **Dunkleosteus**



## Placoderms

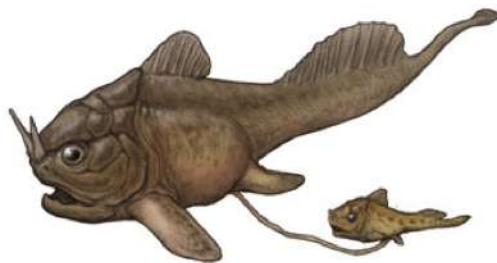
These armoured fish had jaws and lived in both freshwater and ocean environments. While most were active predators, some ate small plants called algae or fed on tiny creatures called plankton, in a similar way to modern basking sharks. Fossils from this group have been found on every continent.





**Materpiscis** gave birth to live young.

## **Materpiscis**



Entelognathus is the oldest known fish with a modern jaw.  
It was discovered in China and is 419 million years old.

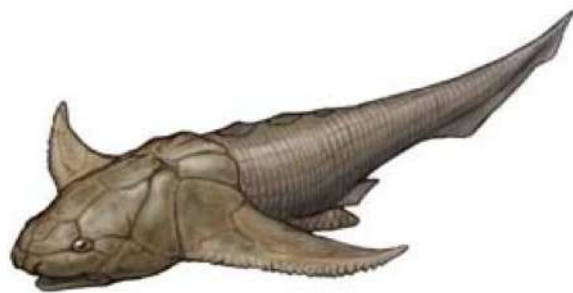
## Entelognathus





Lunaspis was found in 400-million-year-old rocks in Germany, China and Australia.

## **Lunaspis**



Brindabellaspis was an odd fish with a platypus-like snout.

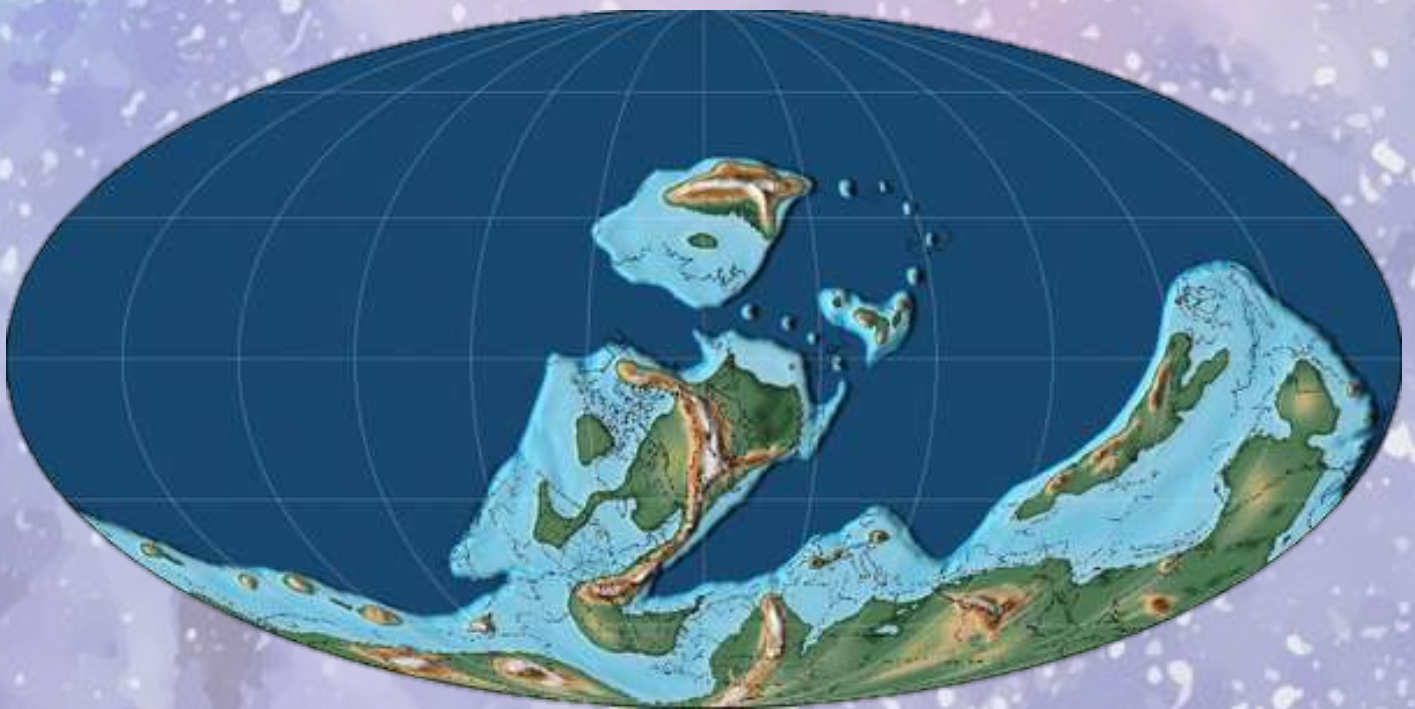
## Brindabellaspis





## Devonian Map

At the start of the Devonian, plants had finally moved onto land. They were leafless and small, growing only 6 cm (2 in) tall, forests containing trees that could grow as high as 30 m (100 ft). armoured fish dominated in the water – until they went extinct due to climate change and competition from other animals.





Hemicyclaspis had sensory pores on its shovel-shaped headshield. These may have helped it navigate in murky water.

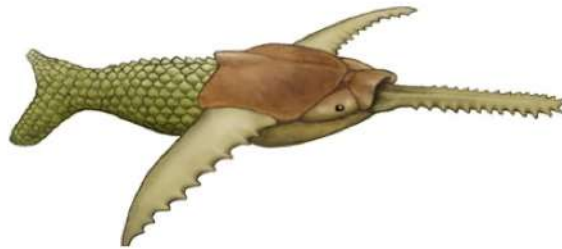
## **Hemicyclaspis**





The mouth of Doryaspis was located near its eyes, just above the dart-like plate sticking out from its head.

## **Doryaspis**



Boreaspis may have used its long snout to stir up mud to find food. It lived in lagoons.

## **Boreaspis**





Lungmenshanaspis had a large hole in its head, which helped it to smell and breathe.

## **Lungmen- shanaspis**



## Ostracoderms

This group of armoured fish were jawless, meaning they couldn't chew. Without jaws they probably swam through the water with their mouths open, feeding on algae or small animals near the bottom. They were mostly small fish – the largest was only 60cm (24 in) long.







THINK

DIGITAL ACADEMY