

Transcript - Fossil

- **The oddest couple in the fossil record**

In 1975, a paleontologist discovered the fossilized cast of what was once an animal burrow, in the KwaZulu-Natal province of South Africa.

Back in the early Triassic Period, 250 million years ago, that hole in the ground had become filled with soft sediment that eventually hardened and preserved everything inside.

And in that burrow, researchers discovered the nearly complete remains of a small animal called *Thrinaxodon*, one of the early mammal relatives known as cynodonts.

But it wasn't alone in there.

Almost 40 years later, researchers took the cast from South Africa to France where it underwent a high resolution scan, revealing another occupant in the burrow.

And it wasn't another *Thrinaxodon*.

It wasn't even a member of the same species.

Thrinaxodon's roommate was actually an amphibian called *Broomistega*.

And that makes this burrow cast an incredible fossil, because it contains not just the animal that probably made it, but also some unlikely company -- a very rare animal that might've been among *Thrinaxodon*'s prey.

So, this burrow cast preserves a snapshot in time - one that's given paleontologists a wealth of information about animal behavior and interactions in the deep past.

But how did this odd couple end up together?

And what killed and preserved them this way for a quarter of a billion years?

Well, it looks like their luck ran out, when a behavior that usually would've helped them survive just didn't work.

To figure out how *Thrinaxodon* and *Broomistega* became entombed together, scientists looked at the burrow itself, along with their fossilized bones.

They concluded that the likely cause of death was a flash flood that carried fast-moving water and sediment into the burrow, encasing the animals.

This would explain the distinct layers of sediment found in the burrow, as well as the fact that the skeletons of both animals were almost complete and fully articulated.

Thrinaxodon was found lying on the floor of the burrow, with *Broomistega* alongside and slightly on top of it, probably from being moved by the flood waters.

But what were these two animals doing in the same burrow to begin with?

Thrinaxodon was a carnivorous proto-mammal and *Broomistega* was an early amphibian relative - not exactly a common pair.

First off, we know that *Broomistega* is not the burrow creator, because it didn't have strong forelimbs for digging.

And you might remember from our episode on synapsids that *Thrinaxodon* was a burrower.

So the burrow probably belonged to *Thrinaxodon*, and *Broomistega* was just a visitor.

From there, the researchers considered five possible scenarios that might've brought these two together - and they were able to use the bones of both creatures to figure out which one was most likely.

The first scenario was that this was all just some kind of coincidence.

Like, say, *Broomistega* was randomly washed into the *Thrinaxodon* burrow, by a flood or heavy rains.

But the burrow entrance probably would've been just big enough for *Broomistega* to fit through head first, seeing how it's similar in size to *Thrinaxodon*.

So it's unlikely that it could've just washed in.

Okay, so what if *Broomistega* was dinner for *Thrinaxodon*?

Thrinaxodon did eat meat, and, well, *Broomistega* is made of meat.

And the researchers had noticed that *Broomistega* had two small holes above its left eye, which looked like bite marks.

But when they compared the distance between those holes with the distances between the upper and lower canines in *Thrinaxodon*, they didn't match.

Also, *Broomistega*'s skeleton was pretty complete, and it didn't have any other tooth marks on it.

So it doesn't seem like *Thrinaxodon* was actively snacking on that *Broomistega*.

Ok then, maybe *Thrinaxodon* was just stashing it in the burrow to eat later?

Well, this probably wasn't the case either.

Some modern animals do stash away some of their prey to eat later, but this behavior is pretty rare, especially in hot environments like where *Thrinaxodon* lived, where food decays quickly.

That rules out three of the five scenarios that were proposed.

And if this seems like a lot of possibilities to consider, well, that's part of the scientific process!

So, the fourth scenario asked, what if *Thrinaxodon* was already dead when *Broomistega* wandered in?

You can't exactly object to an intruder in your burrow if you're dead.

This scenario was also rejected based on the position of *Thrinaxodon*'s skeleton.

Its spine was curved against the wall of the burrow, which suggested that its body was still pliable at the time, not stiff like it would be if it had died and then became rigid, in that process known as rigor mortis.

Instead, the flow of sediment and water were able to mold *Thrinaxodon*'s body to match the curve of the wall.

So it either died during the flood or just before it.

OK, so!

The final scenario is that maybe *Thrinaxodon* wasn't dead, but instead was just... sleeping. I know this sounds like some kind of euphemism, but this is what researchers think is the best explanation, based on the skeleton itself and on what's known about the environment that these animals lived in.

First of all, the position of *Thrinaxodon*'s forelimbs, to the side of its skull, looks like a natural resting position.

And the Early Triassic climate of southern Africa was dry and warm, and in these conditions today, there are many animals that do what's called estivation.

This is similar to hibernation, except it's done in hot, dry conditions, not cold ones.

Animals enter a deep sleep, or torpor, to slow down their metabolism and reduce their activity during hot periods in order to survive.

And it's likely that *Thrinaxodon* would have done this, too.

Several burrows have been discovered from the Karoo region of South Africa with *Thrinaxodons* found curled up inside, suggesting that they were preserved while asleep.

So, with *Thrinaxodon* in a deep sleep, *Broomistega* must've crawled into the burrow on its own.

Living amphibians, especially juveniles, which this *Broomistega* was, are known to retreat into the burrows of other animals for protection.

And this amphibian would've needed a quiet place to hide out.

Because, it looks like it was having a tough time.

The scans revealed several partially healed broken ribs, suggesting that it was likely crushed just a few weeks before it died.

Although this wasn't a lethal injury, it was probably really painful for *Broomistega* to move and breathe.

So, based on all of the evidence we've managed to find from this remarkably preserved fossil pair, we can finally play back their final moments:

It was a super hot day in the Early Triassic, and *Thrinaxodon* was sleeping deeply in a cool underground burrow.

Its heart beat slowly and its forelimbs were sprawled out on either side of its head.

It was in a deep enough sleep that it didn't notice an intruder entering the burrow.

Broomistega was struggling to breathe and to move.

It had been injured a few weeks ago, but it slowly made its way across the dry landscape, looking for somewhere cool and recover - a safe haven from predators.

Finally, it spotted a burrow and crawled in.

There was already something inside, but it didn't move, so the young amphibian lay down to rest.

Both of these creatures should've been safe in the burrow, but it was actually a death trap.

Suddenly, muddy water came rushing in, pushing their resting bodies against the wall of the burrow, and killing them.

The sediment covered their bodies, and over time they became fossilized, only to be found together, 250 million years later.

And this fossil burrow tells us something about South Africa's Karoo ecosystem and how species interacted, even in the distant past.

Different species sheltering together, especially in spaces that are as confined as a den or burrow, is pretty rare, even in living animals.

So this discovery is unique, because it allowed researchers to investigate the interaction between, and the behaviors of, two very different animals, one an early relative of mammals and the other a possible forerunner of modern amphibians.

Thrinaxodon's burrowing skills are likely what allowed it and other early mammal relatives to survive the End-Permian Extinction, with many mammals still burrowing today.

And this amazing find also shows the potential ancient roots of a behavior still seen in living amphibians - the habit of retreating to burrows in tough times.

Both of these behaviors - ones that their relatives still do today - were probably important for the survival of these species.

This odd couple of the Early Triassic is a snapshot in time, preserving a moment between two completely different species just trying to survive another day in our planet's history.