

Andrewsarchus - A Most Mysterious Mammal

David Twamley, 3rd June 2023



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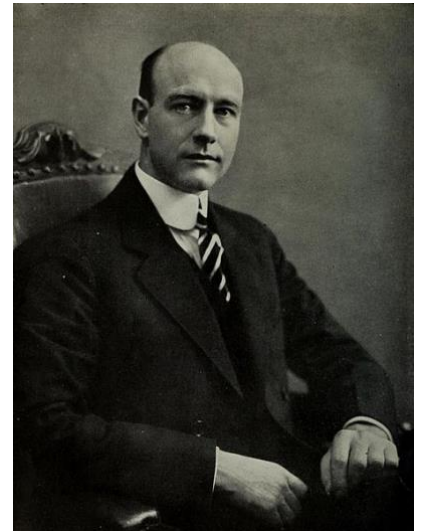
About 45 million years ago, a giant carnivore roamed the landscape of what is now central Asia, terrorizing the fauna that shared its ecosystem. After it died, its immense skull would be unearthed during a palaeontological expedition and subsequently transported to New York, after which it would be hailed as the largest mammalian carnivore ever to prowl the Earth.

Known from a single, large skull that was dug up 100 years ago, *Andrewsarchus mongoliensis* has to be one of the most enigmatic large mammals known from the prehistoric past. Just what was this beast, how did it live, and why did it become extinct?

Discovery and Taxonomy

The story of *Andrewsarchus* began in the summer of 1923, when palaeontologist Roy Chapman Andrews (1884-1960) – who would later become the director of the American Museum of Natural History (AMNH) in New York – led an expedition to the Gobi desert in search of fossils. One of his colleagues, Kan Chuen Pao, found the 83cm skull of a large carnivore in the Irдин Manha formation, part of the Erlian Basin in Inner Mongolia, dating to the Upper Eocene epoch (Wang *et al.*, 2010). The following year, the animal was given the name *Andrewsarchus mongoliensis*; the genus name meaning “Andrews’ Leader” in honour of Andrews (Osborn & Olsen, 1924; AMNH, 2013). The name was given by Henry Fairfield Osborn, then president of the AMNH and the very same man responsible for naming *Tyrannosaurus rex* nearly 20 years earlier (Osborn, 1905). The skull of *Andrewsarchus* is now on display at AMNH and remains the only known find of *A. mongoliensis* to date, although casts of the skull may also be seen at the natural history museums in London and Paris.

A second species, *A. crassum*, was named based on two premolars unearthed in the Dongjun Formation of Guangxi, China, which is around the same age as Irдин Manha (Suyin *et al.*, 1977), but the validity of this species is questionable due to the fragmentary nature of these remains (O’Leary, 1998). Another species, *Paratriisodon henanensis*, was described as an arctocyonid (a primitive group of mammals from the Palaeocene and Eocene) based on fragmentary skull and tooth remains found in the Lushi formation of Henan, China (Minchen, 1959), followed by a second species, *P. gigas*, that was named



Roy Chapman Andrews, after whom the genus *Andrewsarchus* was named.

for a molar from the same formation (Chow *et al.*, 1973). Three molars and one incisor uncovered in Irdin Manha were later referred to the latter species (Qi, 1980). Both species of *Paratriisodon* have since been synonymized with *A. mongoliensis* (O'Leary, 1998). *Andrewsarchus* has been classified in its own family Andrewsarchidae, named by Szalay and Gould (1966) and originally considered a subfamily within Mesonychidae before being elevated to family status (Zhou, 1995).

What Was *Andrewsarchus*?

As *Andrewsarchus* is currently known only from one skull, as well as a few possible fragmentary remains, we know little about its overall appearance, though its true affinities with other mammals may help us build up a picture of how it might have looked when alive. After its discovery, it was suggested to be a member of the entelodontidae – a group of omnivorous hoofed mammals once thought to be closely related to pigs – due to similarities in the cranium and facial proportions (Osborn & Olsen, 1924). In fact, Szalay and Gould (1966) noted that *Andrewsarchus*'s dentition is so similar to that of entelodonts that it would have been classified as one had its premolars been found in isolation. The creature was later grouped with the mesonychia, a group of hoofed carnivores that were once thought to have been the ancestors of whales, due to having unusually triangular-shaped teeth like those of the earliest whales (Clemens, 2002). Based on comparisons with *Mesonyx* (the type genus of the group), *Andrewsarchus* was estimated to have had a body length of 12 feet (3.82 metres) with a height of 6 feet (1.89m), and was considered the largest carnivorous mammal ever to walk the earth (Osborn & Olsen, 1924). Szalay and Gould (1966) considered this estimate unjustified, and since *Andrewsarchus* had features similar to those of the entelodonts, they suggested using the proportions of entelodonts to give a more accurate estimate. Today, there is some debate among experts as to whether it was indeed the largest terrestrial carnivorous mammal, or whether that title goes to large bears such as *Arctodus* (Pepper, 2015).

While *Andrewsarchus* has for years been treated as a member of the mesonychia, later analysis of its skull morphology suggests that it was in fact an artiodactyl (even-toed ungulate), and part of a clade called the cetancodontamorph, which includes cetaceans (the group of marine mammals that includes whales, dolphins and porpoises), hippopotamuses, and entelodonts (O'Leary & Gatesy, 2008; Spaulding *et al.*, 2009). So while it is now known that *Andrewsarchus* was not a mesonychid, and that mesonychids were not the ancestors of whales, it turns out that *Andrewsarchus* itself was indeed a close relative of whales, as well as the entelodonts (AMNH, 2013). This has also led later reconstructions of *Andrewsarchus* to depict it as being more like a large pig in appearance than a dog-like creature (see illustrations below).



Compare these two illustrations. The picture at left depicts *Andrewsarchus* as a mesonychian, while the picture at right was drawn after the animal was reclassified as a cetancodontamorph. Both images © Dmitry Bogdanov

Andrewsarchus is just one of *many* fossil vertebrate species known only from partial remains, though in some cases, more remains of such an animal may come to light and provide a more complete picture of what that

animal would have looked like. A good example of this can be seen with the theropod dinosaur *Deinocheirus*, which was for nearly five decades known only from a pair of forearms discovered in Mongolia in 1965, until the discovery of a more complete skeleton, including a large, duck-billed skull and tall neural spines (Lee *et al.*, 2014). It's possible that one day, more remains of *Andrewsarchus* will also surface and provide us with a better understanding of how this animal looked in life.

How Did It Live?

Andrewsarchus lived in central Asia during the middle Eocene (47.8-38 million years ago). At around this time, the earth was still very humid and dominated by temperate and subtropical forests, while grasslands were still rather scarce (Rafferty, 2013). Asia and Europe were separated by sea and the ancient continent Balkanatolia (CNRS, 2022), and India was in the process of colliding with Asia to form the Himalayas (Ding *et al.*, 2016). The ancestors of modern artiodactyls (including whales), perissodactyls (odd-toed ungulates), elephants and bats made their first appearance, along with the majority of modern bird orders (Rafferty, 2013). *Andrewsarchus* shared its land with a variety of other mammals, including the mesonychia *Harpagolestes*, the creodont (extinct group of predatory mammals) *Sarkastodon*, the dinoceratan (large, rhino-like ungulate) *Gobiatherium*, and a number of early primates, rodents and perissodactyls (Wang *et al.*, 2010).

We know that *Andrewsarchus* fed on meat as it had particularly large, sharp canine teeth, but most of its teeth are not particularly specialized. As the original skull was found in what was once a coastal habitat, the animal has been depicted hunting along beaches (as can be seen in its appearance on *Walking with Beasts*, but we'll get to that later). In this habitat, it would have used its canines to dig for shellfish while also feeding on turtles and washed up carcasses (Pepper, 2015). Szalay and Gould (1966) have argued that it may have been an omnivore, an idea supported by its close affinities with the entelodonts (Spaulding *et al.*, 2009). An omnivorous lifestyle might explain how *Andrewsarchus* was able to survive in its ecosystem, as the largest land carnivores alive today are bears, which are omnivores that (in most species) feed mainly on plants while supplementing their diet with animal prey (Stapleton, 2022).

Having a large skull meant that *Andrewsarchus* likely needed strong neck muscles to support its massive head. Although no such remains have been found, it may have possessed large neural spines above its shoulders like those of the entelodonts, meaning that it would have had powerfully-built forelimbs as well as a small hump resulting from the amount of muscle in this area (Pepper, 2015). While its broad cheek bones may suggest a powerful bite force (Pepper, 2015), its jaws were surprisingly rather weak, as indicated by the low sagittal crest, a narrow rostrum that appears "pinched-in" halfway along its length, orbits that are situated low on the sides of the skull, small occipital region, and small pre- and post-glenoid structures on the zygomatic arch (Naish, 2009). This further supports the idea of *Andrewsarchus* being both an omnivore and a beach comber, and also suggests that it relied mainly on carrion, as well as shellfish, as a source of protein.

Andrewsarchus became famous thanks to its inclusion in the second episode of the BBC TV series *Walking with Beasts* (2001), which marked the first depiction of it in a documentary. In the episode, which is set 36 million years ago in both Egypt and Pakistan, the animal is first seen passing a herd of *Embolotherium* (a type of brontothere, a large, rhino-like perissodactyl), and later appears attacking a turtle returning to the sea after laying its eggs (this is where the narrator, Kenneth Branagh, introduces the animal by name). Later, two *Andrewsarchus* are shown fighting over a stillborn *Embolotherium* calf, before being chased away by the mother (James and Paterson, 2001). Perhaps unsurprisingly, there are a number of inaccuracies associated with the show's portrayal of the animal. It



Andrewsarchus as it appears in *Walking with Beasts*. © BBC

was clearly produced at a time when *Andrewsarchus* was believed to be a mesonychia, and it was likely to have already gone extinct by the time the episode takes place, as it dates to the middle, rather than late,

Eocene, making it unlikely that it crossed paths with *Embolotherium*. It is also shown living in Pakistan, rather than Mongolia where the skull was found, though the narrator explains that the increased drought has forced it to forage outside of its usual habitat. Its inclusion may be down to the fact that it was considered at the time to be the largest of the mesonychids, which were then considered to be the ancestors of whales (the episode mainly focussed on the ancient whale *Basilosaurus*).

Why Did It Become Extinct?

As with any long-extinct animal, the reasons for the extinction of *Andrewsarchus* are not well-understood. Climate change is considered a major contributing factor to the genus's extinction, as the rising Himalaya mountains resulted in much of the Asian continent becoming drier as forests transitioned to open plains, resulting in a different assortment of prey animals than what *Andrewsarchus* was used to. Entelodonts also became more widespread (though they were generally small compared to their descendants from the Miocene), while creodonts such as *Hyaenodon* began to fill the niches of apex predator (Pepper, 2015). As a result of these environmental changes and the presence of competing species, *Andrewsarchus* found itself unable to adapt to a changing world and was wiped off the face of the earth forever. But the 83cm skull of a meat-eating giant would eventually wind up in the hands of the American Museum of Natural History, and become one of the most well-known mammals from the Eocene epoch.

Andrewsarchus may be fairly well-known thanks to its appearance in countless books as well as *Walking with Beasts*, but because so few remains of this creature have been found, we still know very little about both its appearance and lifestyle. But who knows? Maybe someday, more fossils of *Andrewsarchus* could hopefully give us a deeper insight into how this extraordinary animal looked and lived.

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Videos

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