

New insights into the survival techniques of a prehistoric beast

August 10 2017, by Julien Benoit



Two male Moschops are fighting using their ornamented head as a weapon.
Credit: by Alex Bernardini, SimplexPaleo

Imagine a rhinoceros-like beast with a sprawling, lizard-like gait and you will picture quite a good portrait of what [Moschops](#) looked like. They are certainly among the most fascinating monsters of the South African prehistoric bestiary.

The Moschops fossil we examined belongs to an animal family called [Dinocephalia](#). The name translates as "terrible head" or more accurately "terribly large head", a name that's richly deserved. They lived in the Middle Permian – around 260-270 million years ago. Their fossils have been found mostly in South Africa and in Russia.

The South African Karoo around Beaufort West is literally stuffed with large remains of dinocephalians' fossils. Some of them are the remnants of thickened cranial skulls, others pebbles of bones eroded by torrential rains. Before becoming fossils, these bones were part of the impressively thick and horned skull of these massive creatures.

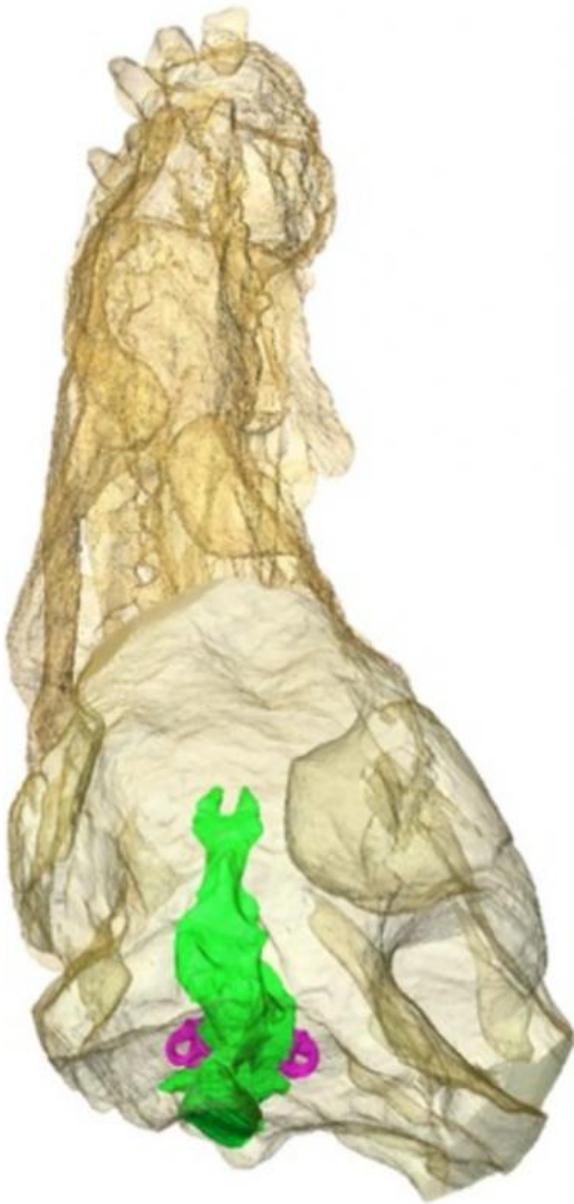
The Moschops fossil we examined was discovered in South Africa in 1911. It would have been safe to assume that nothing new and groundbreaking could be discovered about a fossil found more than a century ago. But that's not true. The recent development of [CT and Synchrotron scanning](#) has opened an entire new way of studying fossils, particularly what used to be "soft tissue", like their brain. The new techniques allowed us to discover previously overlooked features which have simply been out of reach, invisible from the outside.

Our [new study](#) of a complete skull of Moschops has revealed that this thickened and dense braincase was housing a remarkably small and overprotected brain.

A very small brain

With a body weight reaching up to one or two tons and a brain the size of a [chicken egg](#), Moschops's brain was probably one of the smallest among its contemporaneous species. However, small brain size is not an issue when you are the largest animal of your time. Unlike mammals and humans, the ability of the Moschops to survive and reproduce was not a matter of how smart it was, but how strong it was, particularly when it

came to fierce head-to-head combat.



Moschops



Mammal

The skull of Moschops and that of a mammal (platypus) with the same proportions to emphasize the difference in brain size.

Their anatomy shows that male Moschops were ramming into each other like giant, overweight goats using their skulls as a weapon.

The very fact that Moschops was practising headbutting testifies to a certain level of social organisation, which is often associated with hierarchical ranking in modern species. So, despite its small brain, the Moschops wasn't stupid.

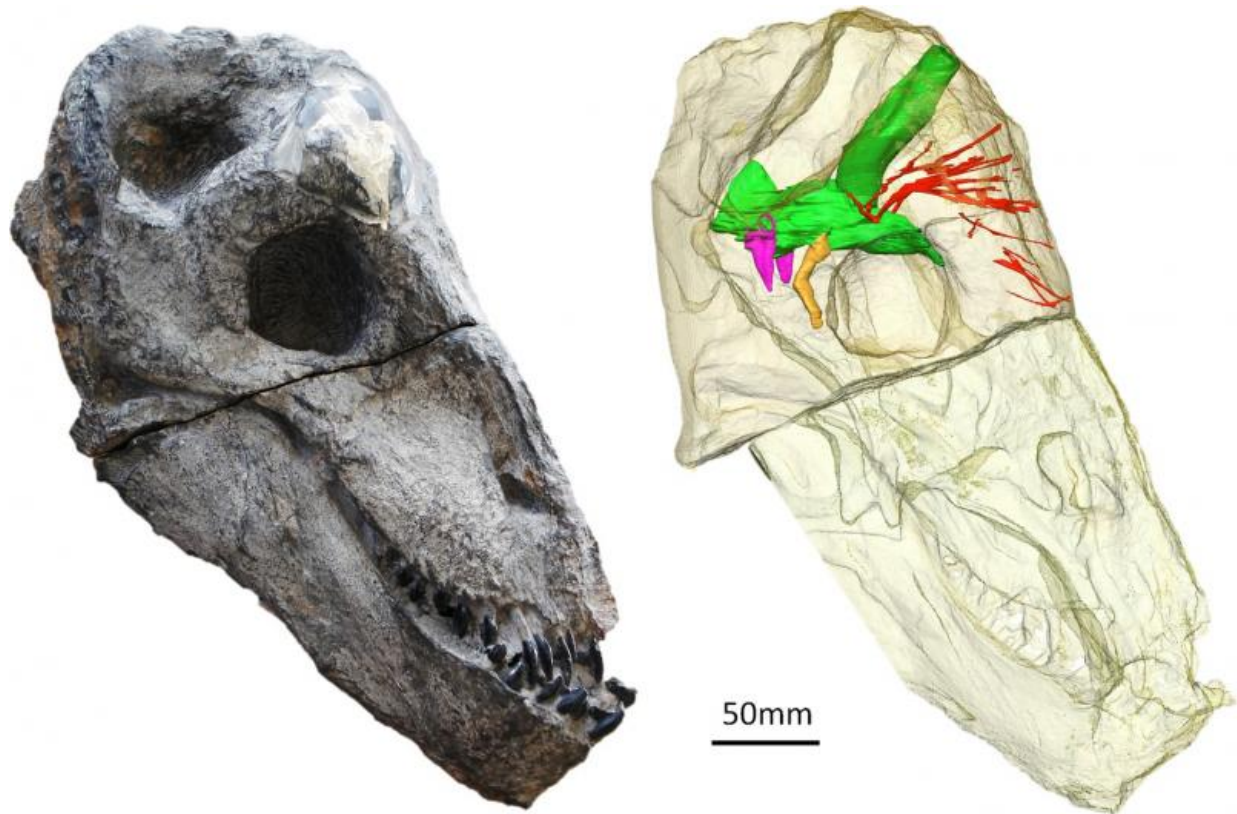
Every single behaviour is controlled by the brain, which is a delicate, yet critical soft tissue organ. Incredibly violent behaviour would thus put the brain and nerves into great danger of being injured.

[Our discovery](#) shows how, generations after generations, only the animals with the best protected nervous system survived by developing a natural helmet, enabling the dinocephalians to dominate over terrestrial ecosystems for about 10 millions of years as the largest herbivores and the top predators of the middle Permian.

Moschops's natural head shield

[We discovered](#) that the whole central nervous system was mostly surrounded by an armour of bones, including the brain itself, the inner ear and the nerve responsible for the sensitivity of the face.

This natural helmet could reach up to 15 centimetres of massive bone, the equivalent of a tank armour. Our hypothesis is that the helmet was protecting the [brain](#) and sense organs against the brutal shocks of direct head-to-head combat between males to find mates and to defend territory.



The brain of Moschops inside the transparent skull and in its inferred natural position.

Moschops is not the only animal to display such an immense thickening of the cranial roof. The [pachycephalosaurid dinosaurs](#) (which means "thick-headed lizard") are also famous for being powerful head butting fighters. This behaviour often led to [bad bone injuries still visible on fossils today](#).

In support of the "helmet hypothesis", we also found that the position of the inner ear inside the braincase of Moschops indicates that the head wasn't held horizontally as in most animals, but nearly vertically. This places the shielded skull and horns forward, an ideal posture for head butting fights.

A century long conundrum

Synchrotron radiation X-ray imaging uses a nearly kilometre long particle accelerator to see through matter – just like a medical scanner [but bigger and way more powerful](#).

Using these new techniques on the Moschops fossils were able to shed new light on the biology of these emblematic creatures. The techniques have already been used to unravel ancient envenoming capabilities and the origin of hair and whiskers in the remote ancestry of mammals.

There is no doubt that the near future will hold its promises of great breakthrough about long gone prehistoric monsters and our distant ancestors.

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