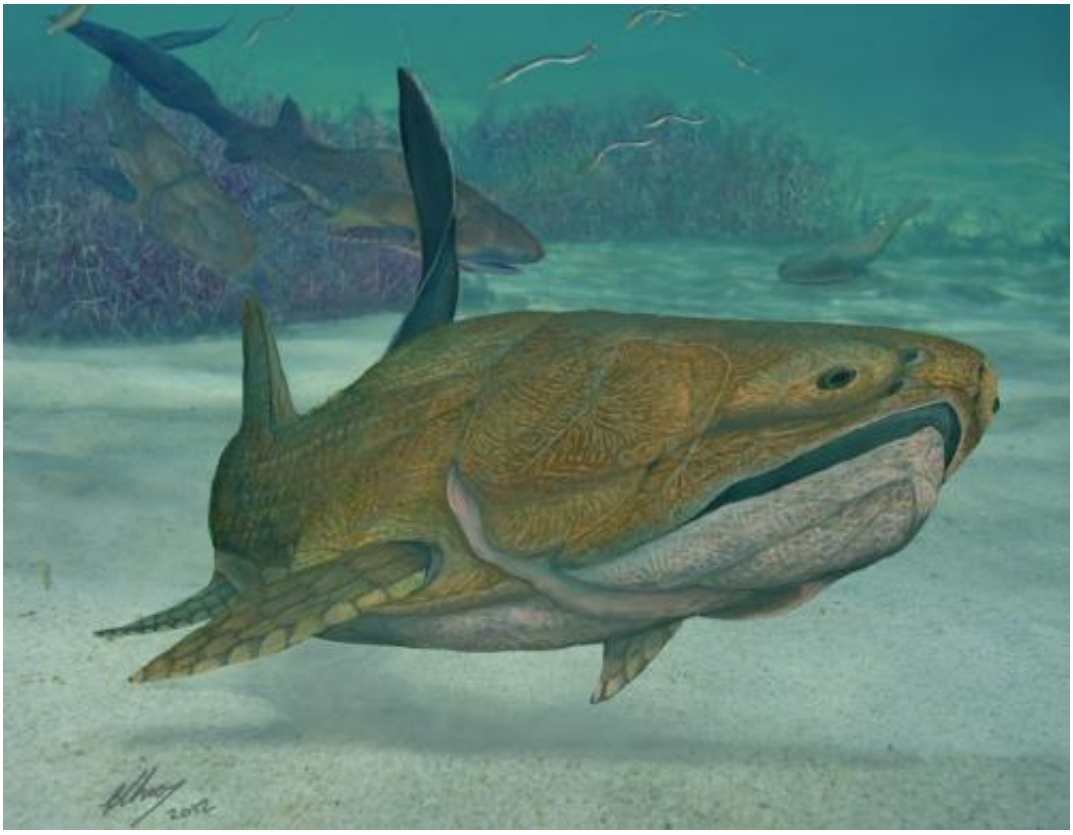
# Extraordinary 'missing link' fossil fish found in China

September 26 2013, by John Long



Finding Entelognathus is a revelation comparable to the discovery of Archaeopteryx. Credit: Brian Choo

A spectacular new "missing link" fossil has been unearthed in China. The 419 million year old armoured fish, called Entelognathus, meaning "complete jaw" solves an age-old debate in science. For palaeontologists

this fish is as big as finding the Higgs-Boson particle because of its immense significance to our understanding of early vertebrate evolution.

This is arguably one of the most exciting fossil discoveries in the past century since Archaeopteryx, the first fossil to bridge the gap between dinosaurs and birds.

Lead author on the study, Zhu Min of the Institute of Vertebrate Palaeontology and Palaeoanthropology in Beijing, said when I spoke to him:

Wow, it is beyond our wildest expectation if we stick to the available phylogenetic scenario. But the fossils provide evidence to force us to have a reconsideration on the hypothesis.

So what is this hypothesis he refers to? For decades there has been heated debate among scientists as to which early back-boned fishes were ancestral to modern fishes. Living jawed fishes fall into two major groups: sharks, rays and chimaerids (chondrichthyans) and true bony fishes (osteichthyans).

This new discovery shows beyond doubt that an extinct group called "placoderms" were actually the ones that gave rise to all modern fishes.

Despite dominating the seas, lake and rivers of the world for more than 70 million years, almost no-one today would know the difference between a placoderm and a pachyderm. Yet placoderms were truly pivotal to our distant deep evolution.

They were innovators – the first creatures to evolve jaws, teeth and paired hind limbs (pelvic fins). They were the first to have three semicircular canals in the ear for improved balance.

Significantly they were also the first vertebrates to develop copulatory behaviour for mating. We must thank the placoderms for inventing the satisfying way we humans procreate.

The innovative placoderm. Credit: Tim Evanson/Wikimedia Commons

Enter Entelognathus, an exquisite fossil known from perfect 3-D preserved fossil remains found in Yunnan, China. The results of their study have just been published in the journal *Nature*.

Entelognathus is special in showing an almost perfect intermediate condition between ancient placoderms and modern bony fishes. At around 50cm long it had bony plates enclosing the head and front of its

body, exactly like a placoderm.

But its lower jaw is composed of a complex set of bones, unlike other placoderms whose jaw was made of a single bone.

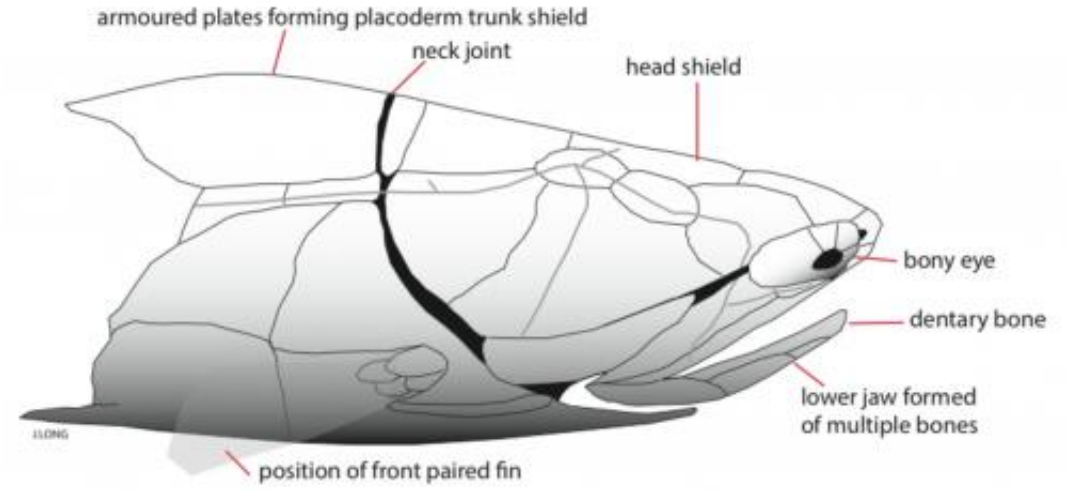
This pattern of bones in Entelognathus precisely matches those in the lower jaw of early fossil bony fish (osteichthyans). Entelognathus also possessed special bones underneath its lower jaws called gulars, which are today only found in bony fishes.

This fish shows the first appearance of the dentary bone which is found in all bony fishes, amphibians, reptiles and mammals. It is the very same bone in our lower jaw.

The new discovery from China gives us powerful new insights about the building of the human body plan, which began seriously with these ancient fossil fishes.

An Australian coauthor on the paper, Brian Choo, has been working with Zhu in China for the past four years. He told me it's "a specimen that rips up the textbooks and says to you, 'Look pal, this is how it really happened'."

The term "missing link" is in reality a bit of a misnomer. The term was first used to show how prehistoric human fossils like Peking man (Homo erectus) were good intermediate forms between apes and humans.




The head of Entelognathus. Credit: John Long

These days new discoveries in palaeontology have filled in most of the missing gaps between major animal groups. For example, we have perfect intermediate fossil forms that bridge the gap between between fishes and amphibians (such as Gogonasus), between reptiles and mammals (such as Cynognathus) and between dinosaurs and birds (such as Archaeopteryx).

In reality evolutionary theory predicts that any fossils filling in new data on an evolutionary lineage is just a new hypothesis about its sequence of character evolution. It doesn't really imply any direct ancestry between any living or fossil species.

For me the really exciting thing about Entelognathus is that even in the 21st century palaeontologists are still making really big discoveries that fill in major missing gaps in our knowledge about the evolution of the modern fauna.

All fossils touted as "missing links" are contentious to some, those

minority groups within society who for some or other reason do not believe in evolution. For these people news of Entelognathus will be challenging, but most will simply ignore it as it doesn't abide with their world view.

Yet all of these disbelievers still rely on evolution in their daily lives, as new vaccines and antibiotics or new crops bred to withstand environmental extremes to feed us, are all advances in science underpinned by evolutionary principals.

So believe it or not, evolution is helping everyone one of us on the planet, every day to live better lives. Thanks Entelognathus, you're a real hero.

**More information:** phys.org/news/2013-09-fish-fos … ds-jaw-dropping.html

*This story is published courtesy of* The Conversation *(under Creative Commons-Attribution/No derivatives).*

Source: The Conversation