



Evolution Observed and Thought About

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Los Alamos Faith and Science Forum

Prologue: Religious Objections

- Evolution seems to say there is no God because it would show a world that develops without purpose or direction, and so many object to it.
- In support of this rejection of evolution are several salient arguments:
 - - It is not gradual but shows sudden appearance of different forms of life—
 - **Cambrian explosion**, (First complex life forms--seemed to appear all at once from no precursors)
 - Lack of **transitional forms** (showing abrupt changes rather than gradual ones)
 - The world is indeed young and so no time for evolution—
 - radioactive aging methods are wrong.
- **This talk has been constructed to consider these objections**

What probably happened!



A General Reaction

- In Matthew Arnold's Dover Beach he voices what many have felt about the effect of science on faith:
- The Sea of Faith
- Was once, too, at the full, and round the earth's shore
- Lay like the fields of a bright girdle furled.
- But now I only hear
- Its melancholy, long, withdrawing roar,
- Retreating to the breath
- Of the night-wind, down the vast edges drear
- And naked shingles of the world.

Is Evolution Really Random?

New scientific evidence seems to show that we no longer need to feel this way or object

Instead this summer's talks will attempt to show that evolution, while often random, is not always so, and that there is **considerable room for a creator's purpose.**

Introduction

A fossilized bird skeleton is shown embedded in a light-colored, textured rock matrix. The skeleton is oriented horizontally, with the head to the left and the tail to the right. The wings are spread out, showing the intricate structure of the feathers and the underlying bone structure. The tail feathers are also visible, showing a similar structure. The fossil is well-preserved, with clear details of the bones and feathers.

–Facts and Observations

–Theories

–Religious reactions

Observations

- Dating Rocks
- Fossil Evidence



Dating Rocks

- Radioactive decay—Objections
- Other methods
 - Thermo-luminescence
 - Geologic formations (Goosenecks of San Juan)
 - Magnetic Reversals
 - Light and the Cosmos

Goosenecks of the San Juan River

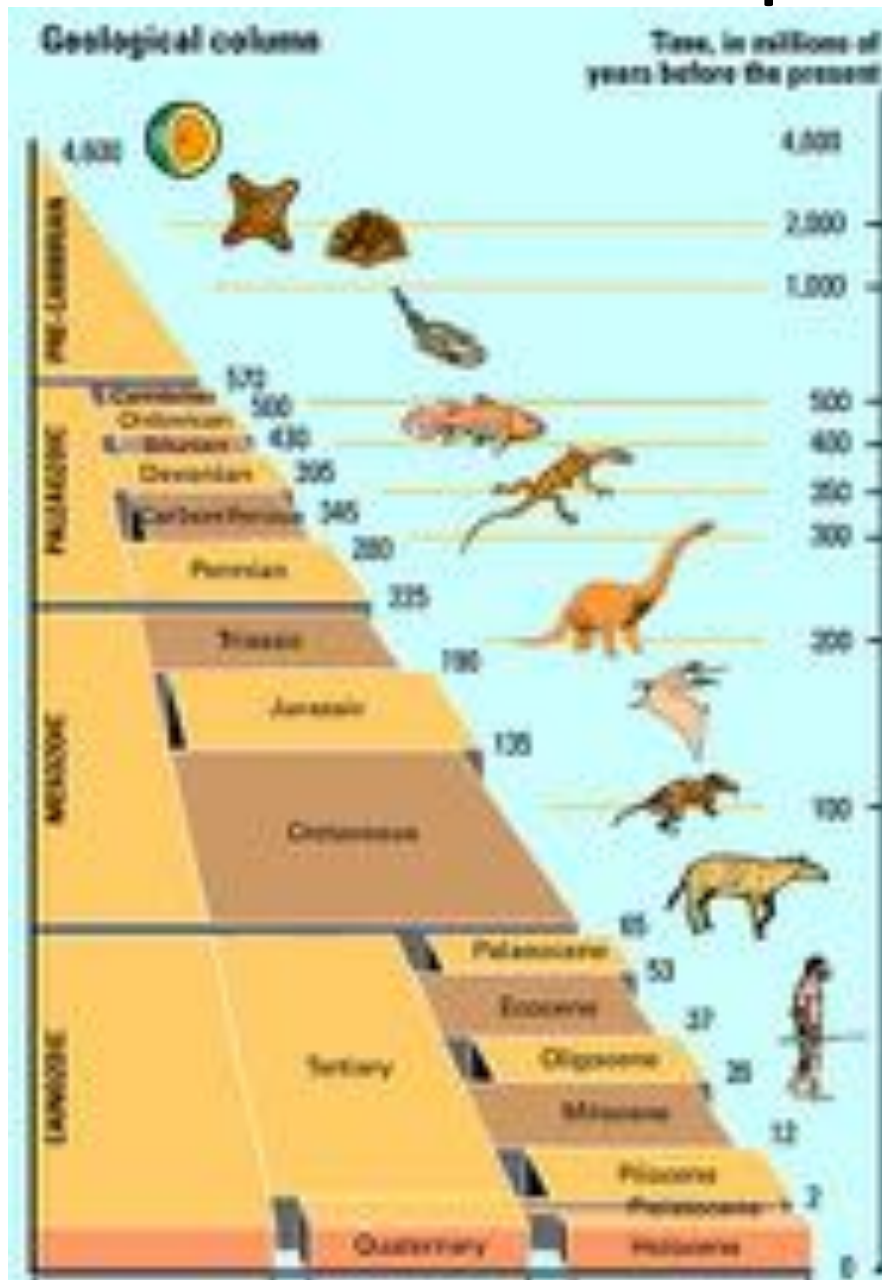


Fossil Record

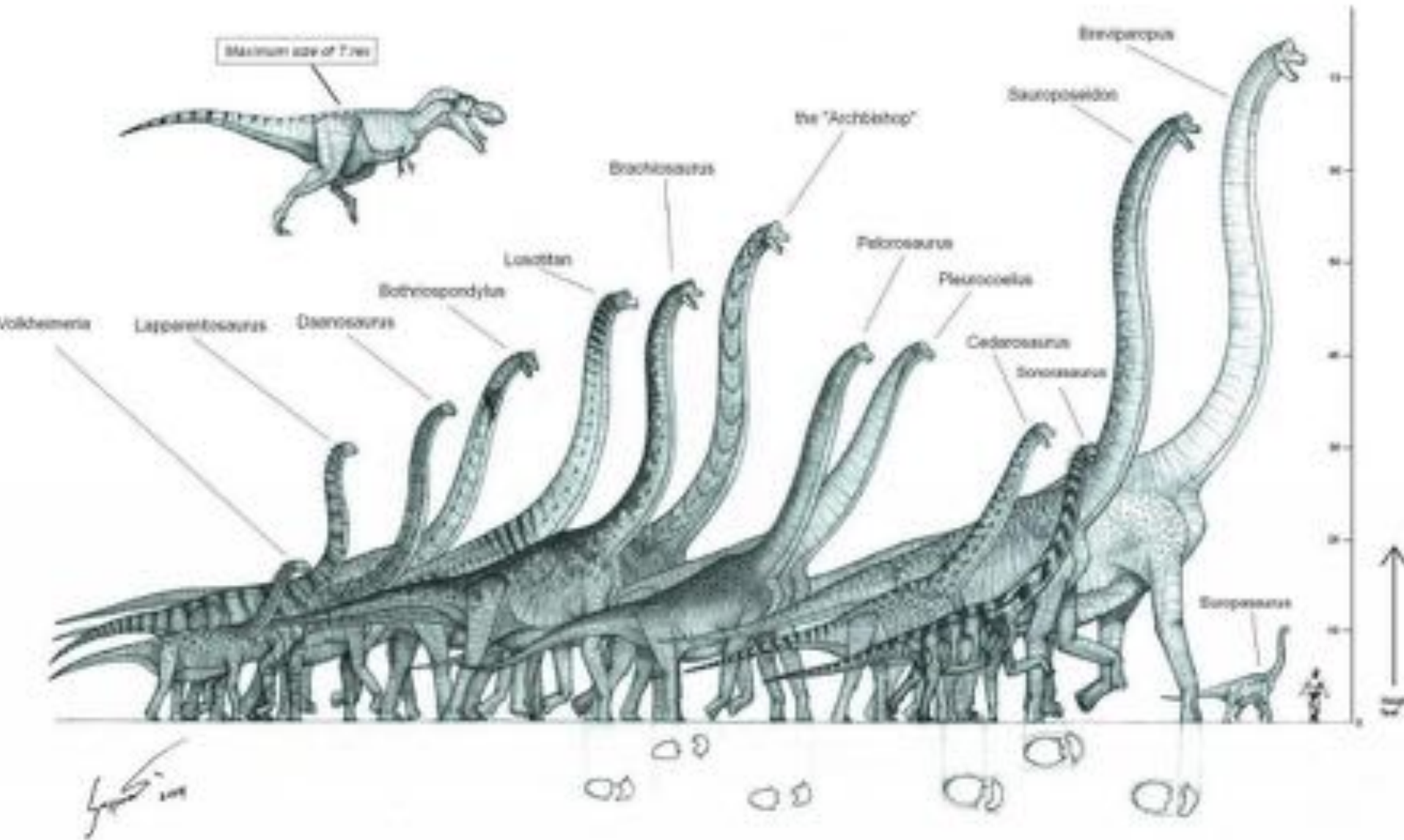


- Progression of Complexity—Objections
- Orderly progression in rock strata
 - (mammals but no rabbits with dinosaurs)
- Cambrian Explosion—Objections
- Transitional Forms—Objections

Gradual Development

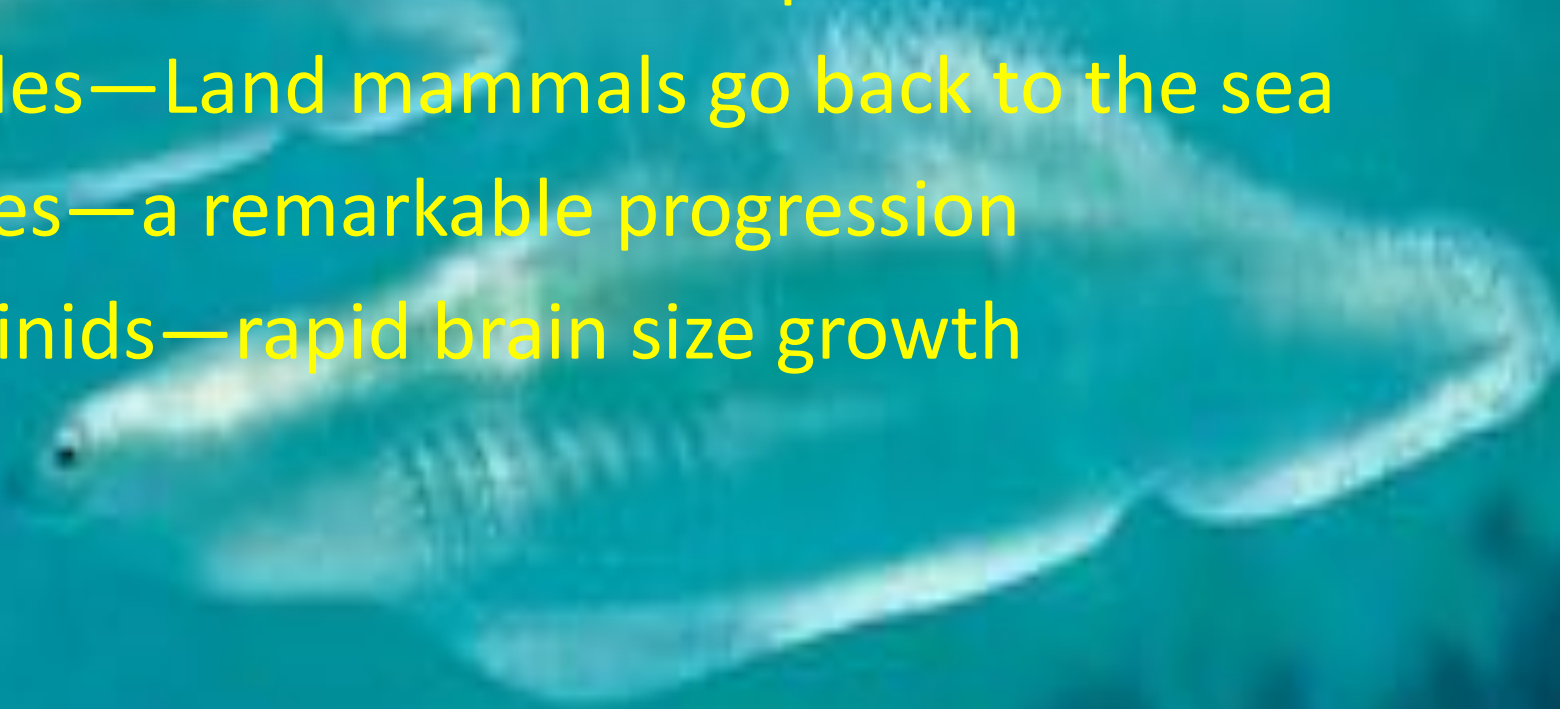


Amazing variety

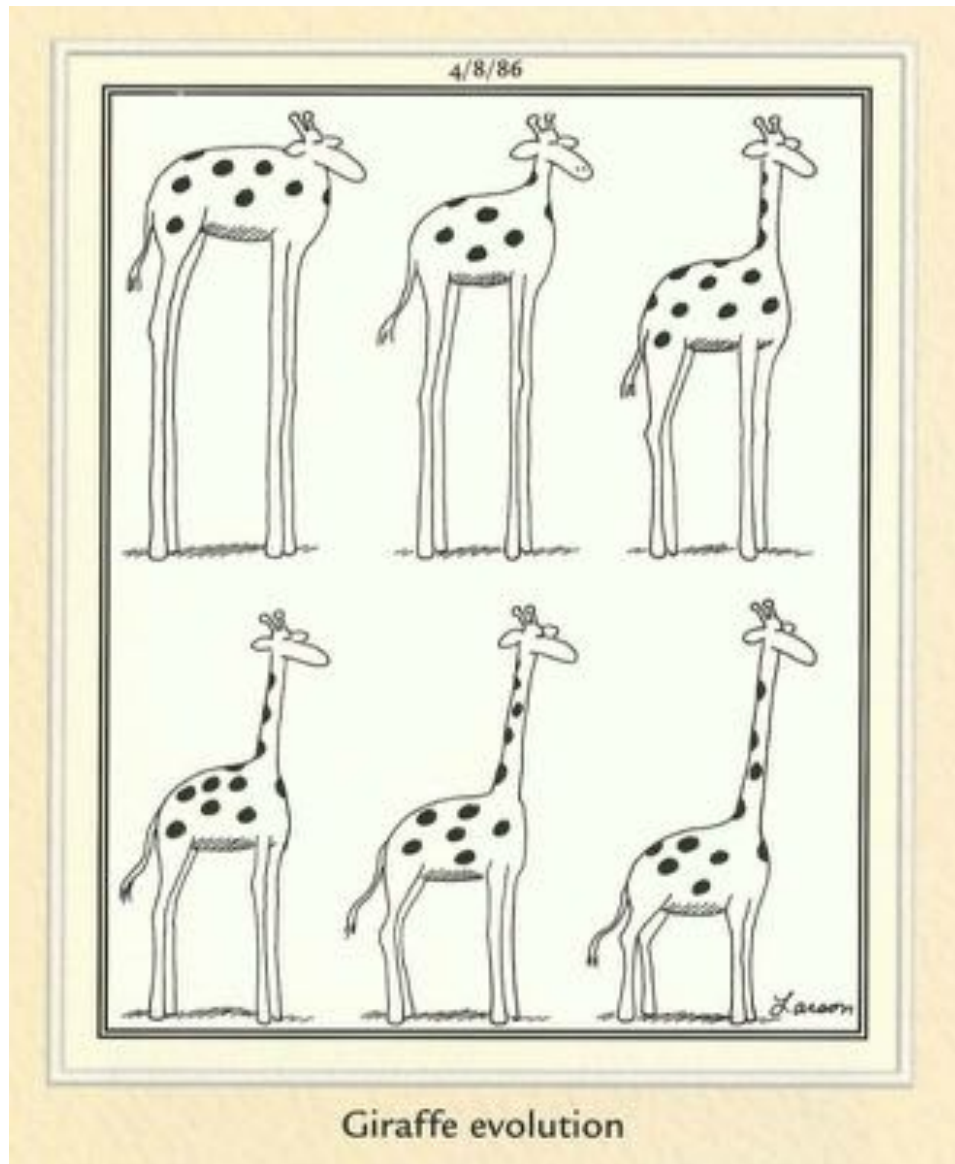


Transitional Forms

- Cambrian from Ediacaran (explosion)
- Tiktaalick—fish become amphibians
- Whales—Land mammals go back to the sea
- Horses—a remarkable progression
- Hominids—rapid brain size growth



Transitional Forms



Emergence of Complex Life

- **Timeline:**
- 850-630 Ma: Cryogenian Period: extensive world-wide glaciations
- 630-542 Ma: Ediacaran fossils
- 542.0 ± 1 Ma: Pre-Cambrian/Cambrian boundary
- ~530 Ma: the Cambrian Explosion
- 525-520 Ma (Chengjiang fauna) and 505 Ma (Burgess Shale)

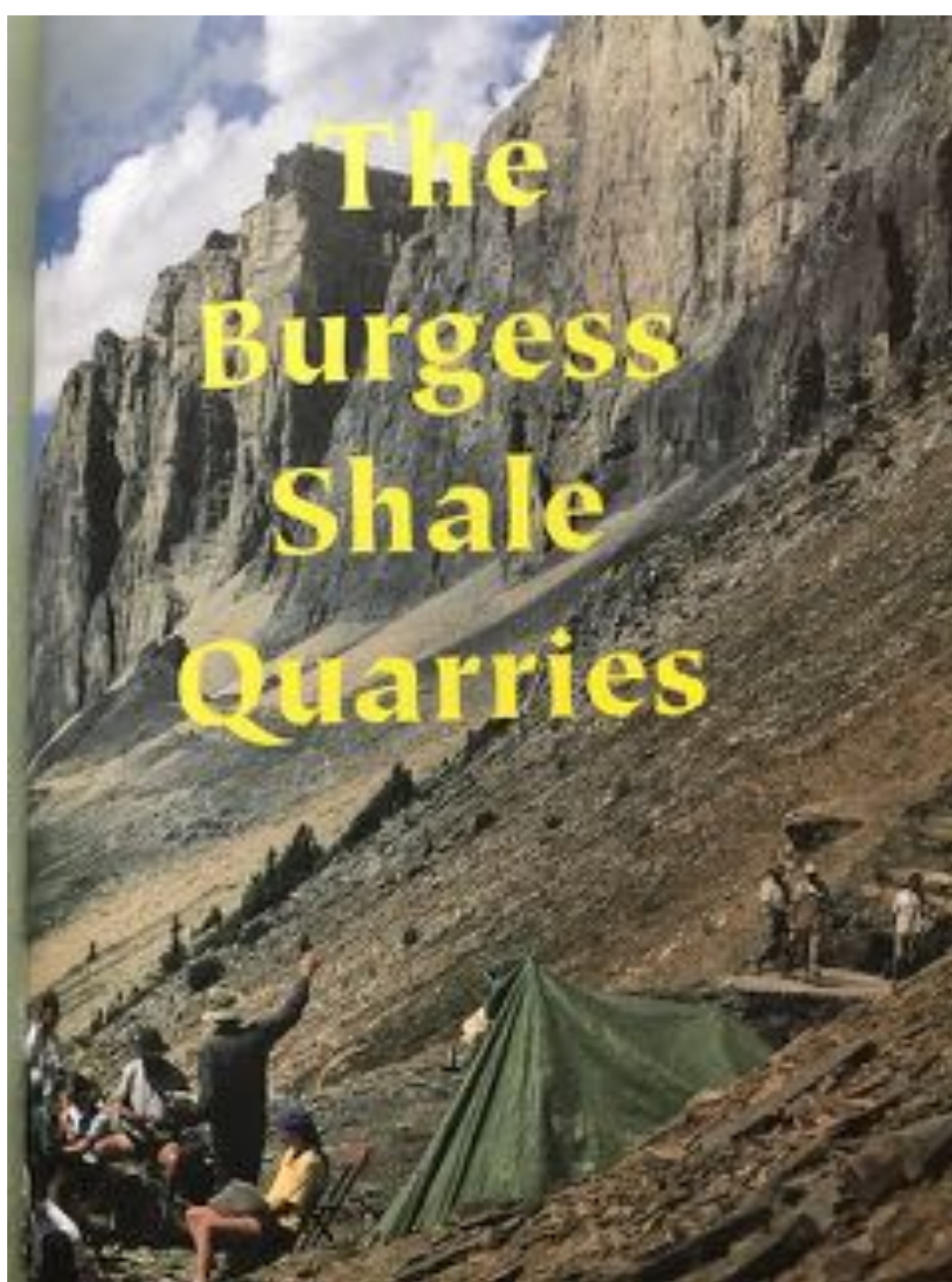
Ediacaran Life

- Late **Precambrian** fossil discoveries also now include representatives of sponges, cnidarians (the group that includes modern jellyfish, corals and anemones), mollusks and various wormlike groups. **Some of the new fossil discoveries, in fact, appear to be more primitive precursors of the later Cambrian body plans.** The discovery of such precursors shows that the Cambrian organisms did not appear from thin air.⁸ Further discoveries will no doubt reveal more clearly the relationship of Precambrian organisms with the creatures found in the Burgess Shale and Chengjiang deposits.⁹
- <https://biologos.org/common-questions/scientific-evidence/cambrian-explosion/>

Ediacaran Life Form



The Burgess Shale Quarries



Burgess Shale

- These fossil beds provide evidence of **virtually all of the 32 phyla**, plus about **20 other animal body forms** that are so different from any modern animals that **they cannot be assigned to any one of the modern phyla**. These unassignable animals include a large swimming predator called *Anomalocaris* and a soft-bodied, detritus- or algae-eating animal called *Wiwaxia*.
- <http://glencoe.mheducation.com/sites/dl/free/0003022010/18927/animalorigins.pdf>

Burgess Shale and Chengjiang Area

- Fossil formations like the Burgess Shale (and the excellent ones from China) show that **evolution cannot always be thought of as a slow progression**. The Cambrian explosion involved rapid evolutionary diversification, followed by the extinction of many unique animals. **Why was this evolution so rapid?** No one really knows. Many zoologists believe that it was because so many ecological niches were available with virtually no competition from existing species.
- *Ibid*

Cambrian Explosion



Cambrian Explosion

Opabinia



Hallucinagenia

Two Conceptions



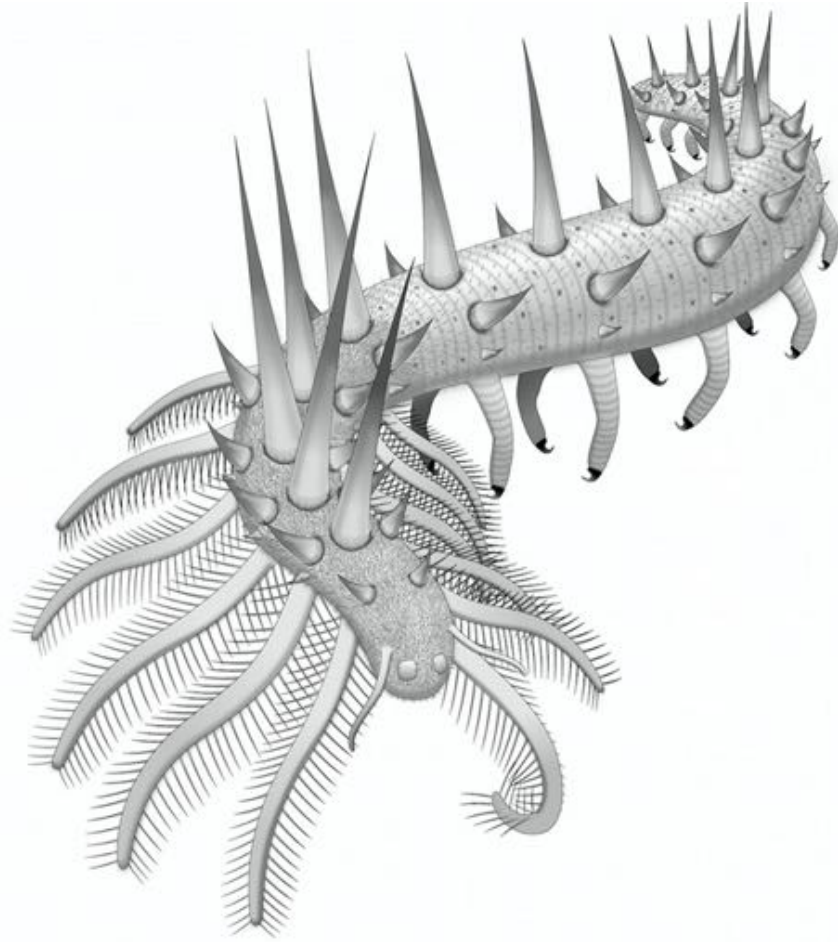




Its Fossil



Collinsium



Collinsium

Actual Fossil



Cambrian Explosion

Wiwaxia



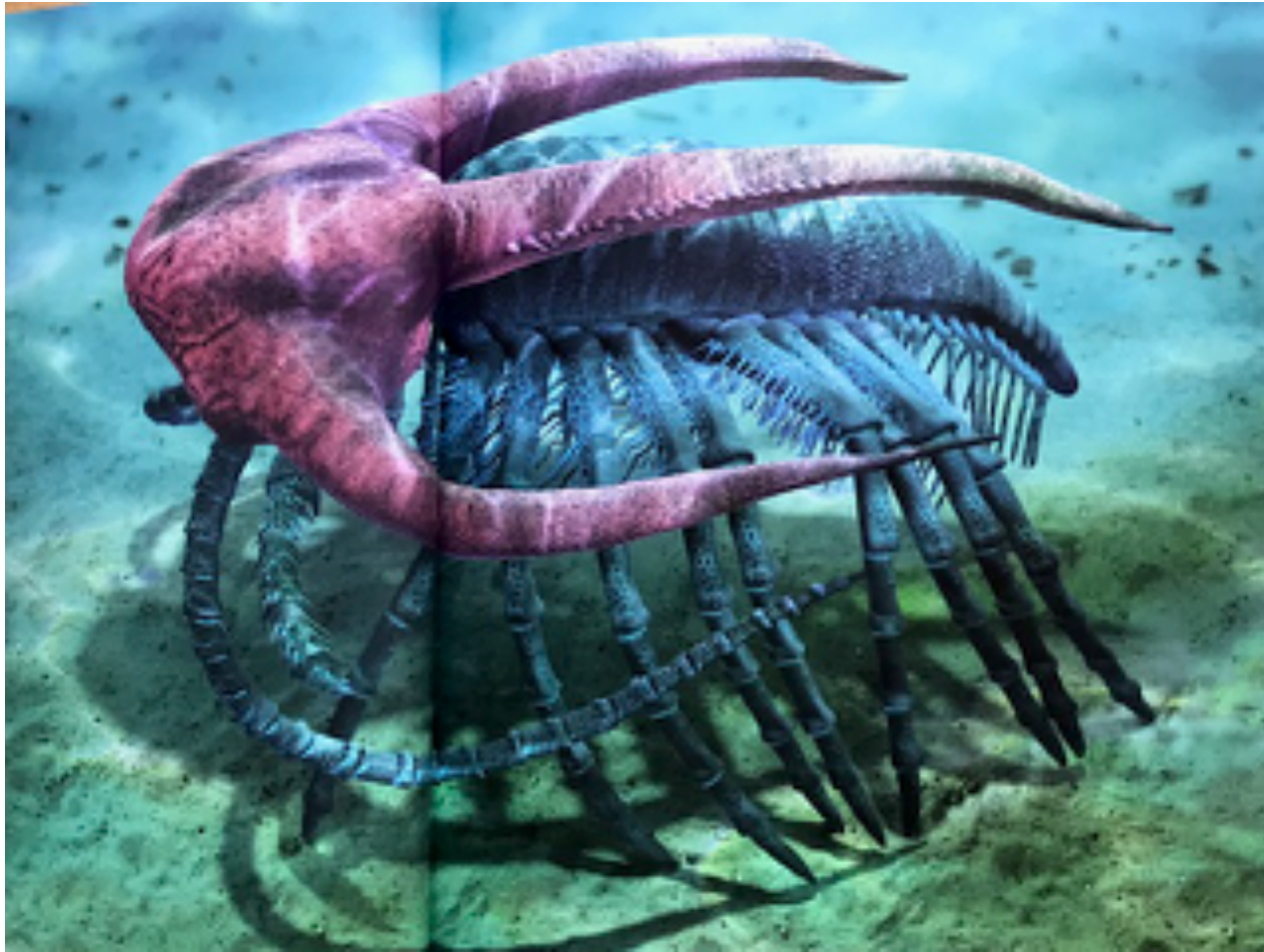
Anomalocaris (two conceptions)



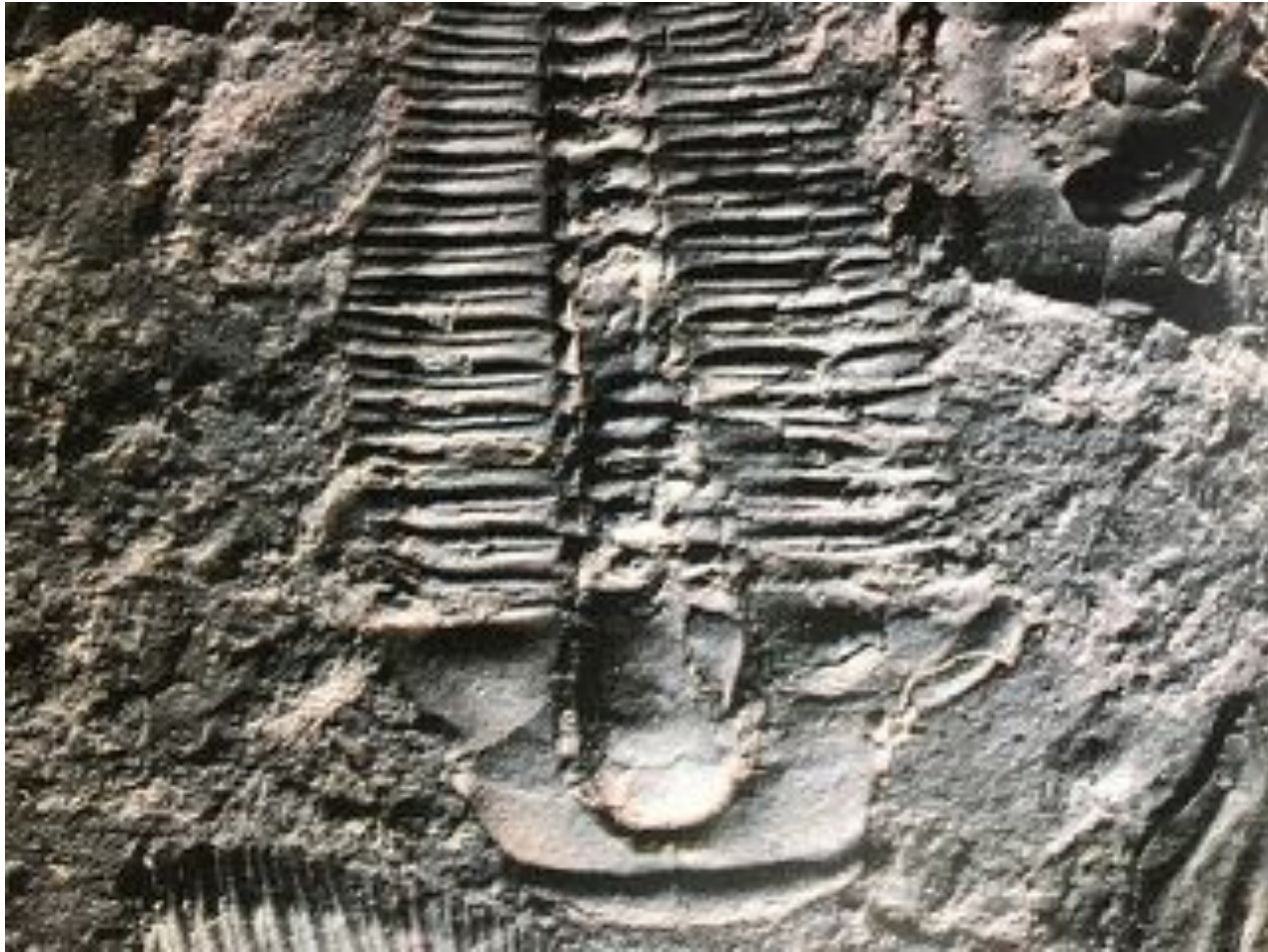
Metaspriggina Our Ancestor?



Most common fossil in Burgess Shale
~15,000!



Cambrian Trilobite



Transitional Forms

“Missing Links”

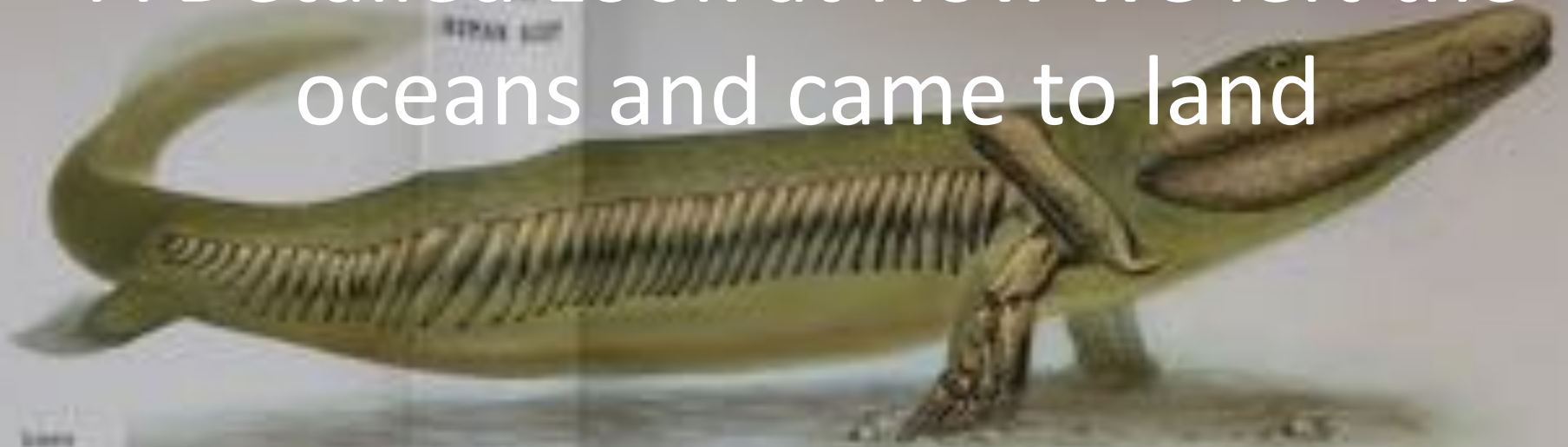
- The following is a rather detailed treatment on one example (fish to land animals)
- In addition we'll look at evolution of:
 - Horses
 - Whales
 - Humans

The Objectors' View?



Transitional Forms

A Detailed Look at How we left the oceans and came to land



NEIL SHUBIN

WITH A NEW AFTERWORD

NEIL SHUBIN

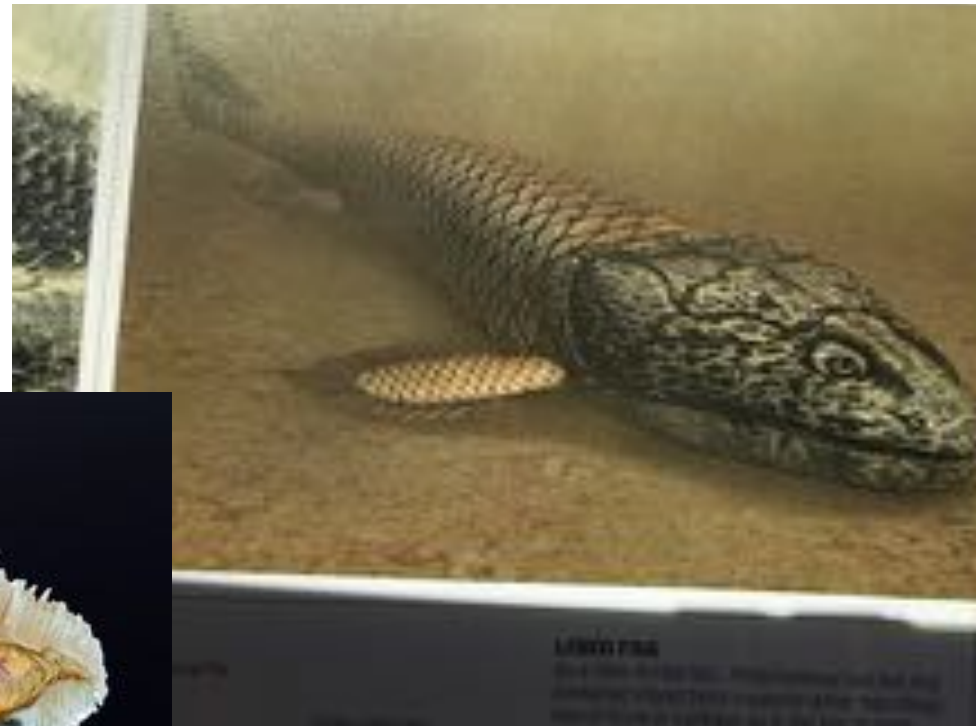


www.nortonbooks.com

Eusthenopteron's notoriety comes from the pattern of its fin [endoskeleton](#), which bears a distinct humerus, ulna, and radius (in the fore-fin) and femur, tibia, and fibula (in the pelvic fin).



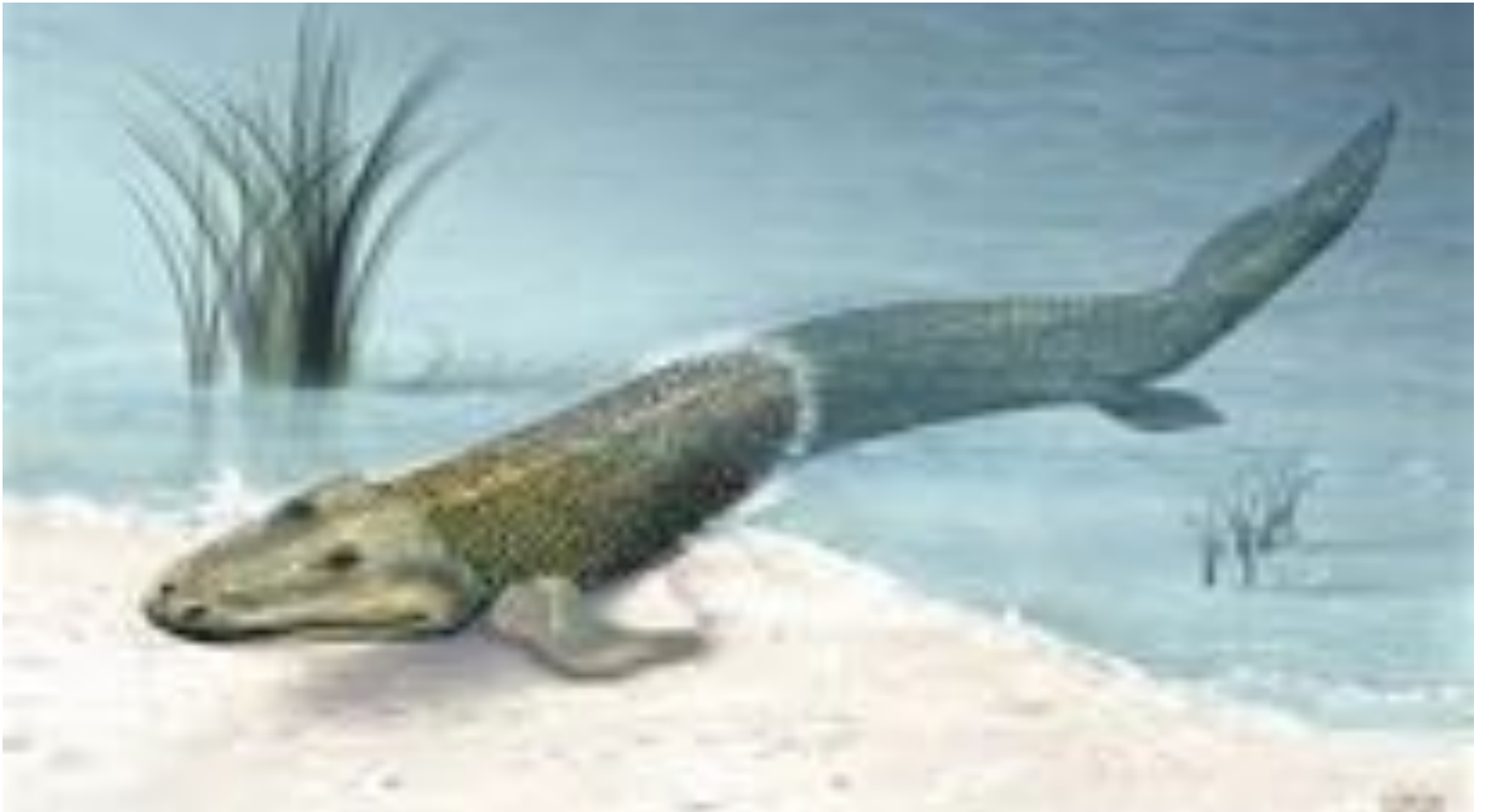
Panderichthys



Found Link



Tiktaalik



Acanthastega



Acanthostega is a famous Devonian tetrapod. It had four limbs that ended in eight fingers or toes, but it also had some primitive features, such as fin rays along both the top and bottom of its tail. *Acanthostega* had a well-developed gill skeleton, so it probably used its gills for respiration as well as having had an air bladder for breathing air. The ear was similar to that of other tetrapods and included a stapes (see p.182); in fish, the equivalent bone is involved with operating the gills.



paddlelike
limb



BEST AS PADDLES

The limbs do not look like they were capable of bearing *Acanthostega*'s weight and were probably used as paddles. *Acanthostega* was probably an ambush predator that lived in shallow rivers.

Ichthyostega

Ichthyostega

2000 mm long
1000 mm high
1000 mm wide
1000 mm deep

Ichthyostega was the first tetrapod to be named, its fossils found from tracks in the Devonian, and it lived at the same time as *Acanthostega*. *Ichthyostega* has four short limbs that have puzzled paleontologists for decades, but new research is clarifying some aspects of its anatomy. Its short limbs, for example, appear to have been adapted for hauling itself out of the water in an *Ichthyostega*.

Ichthyostega spent most of its time in water, but its vertebral column appears to have been adapted to a form of terrestrial locomotion. Its body was covered in bony scutes, which together with its stout shoulders and forelimbs, suggest that strong muscles were used to pull the animal along on land. Its posture may have been better adapted to swimming.

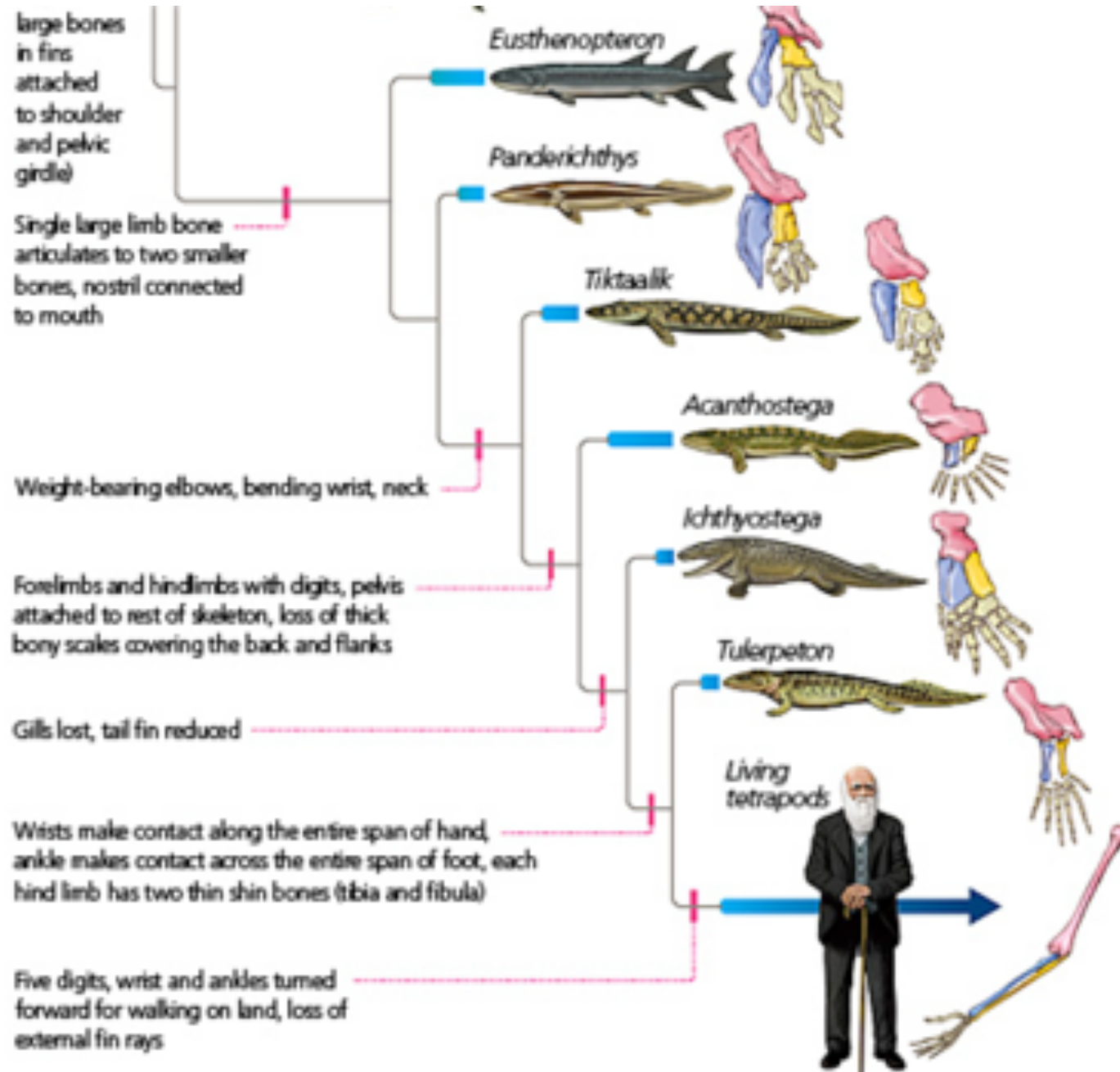
SHORT LIMBS
Ichthyostega's short limbs and one of the leading signs of its adaptation to land were its short limbs. The fact was held by that the walking style would have been the most efficient in water or land if walked, it could have walked.

Ichthyostega's large teeth point to it being a predator, but did it hunt on land, in water – or both?

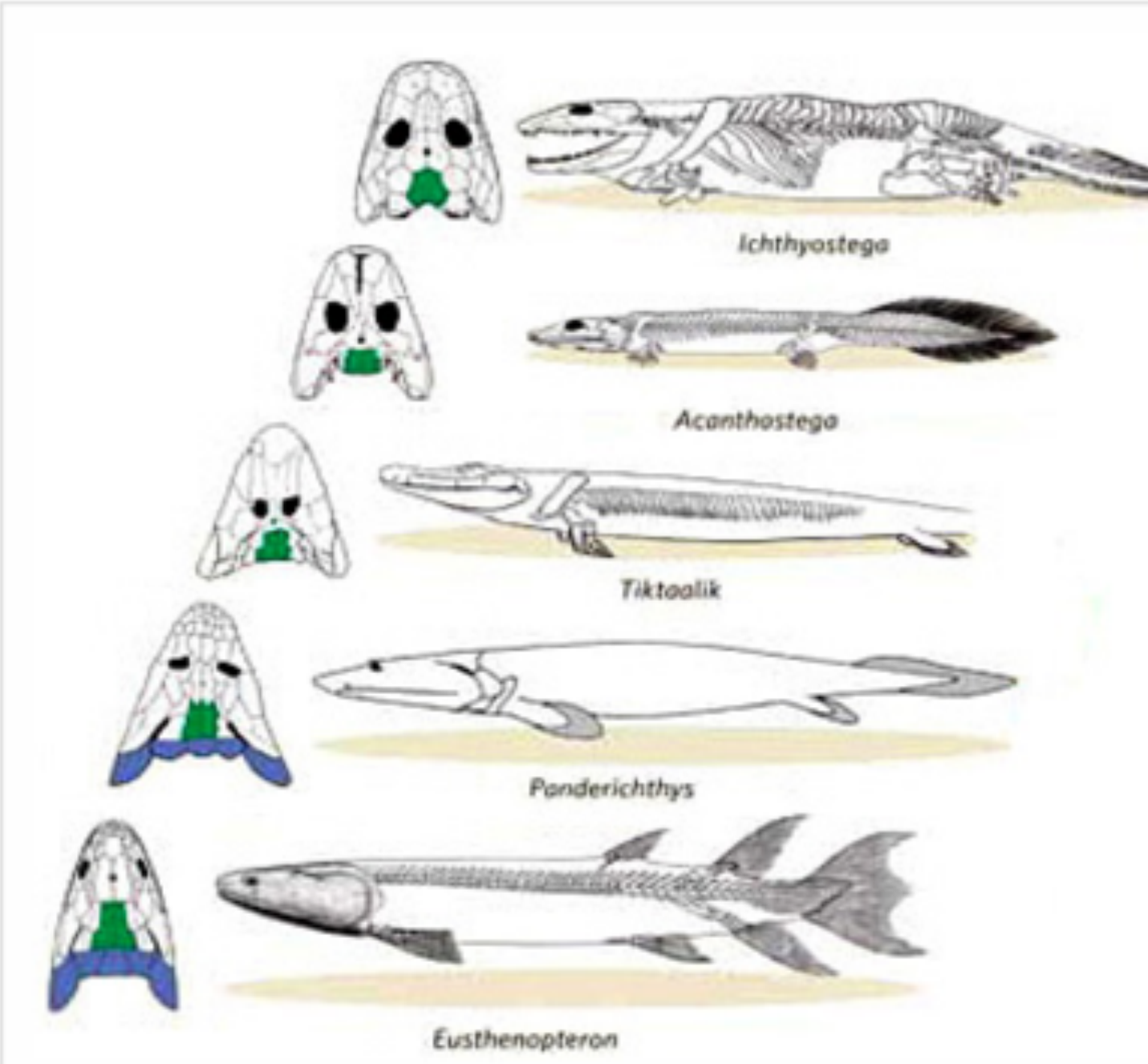


Short limb

Short limb

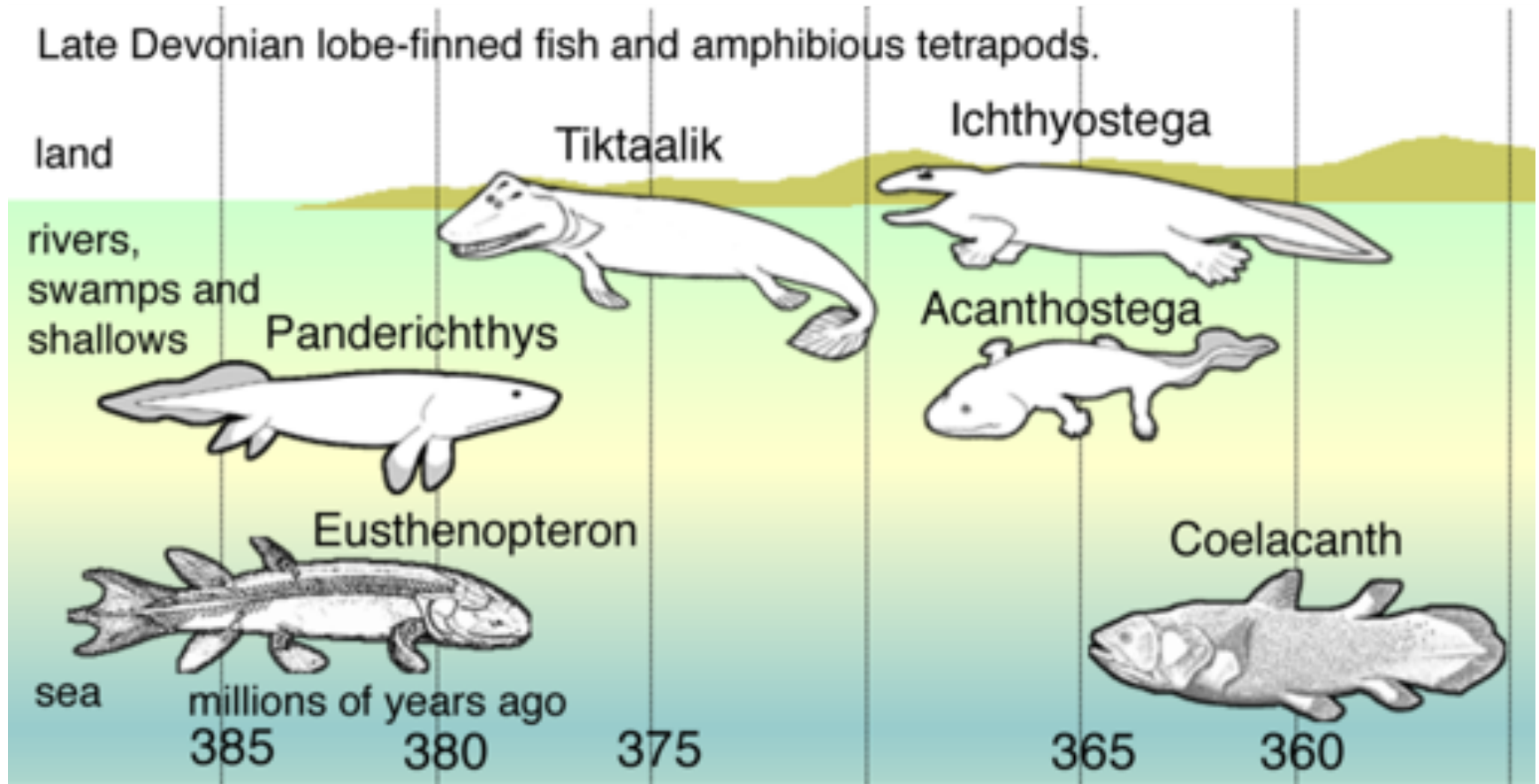


We can even track individual traits, like skull bones and limb structure.

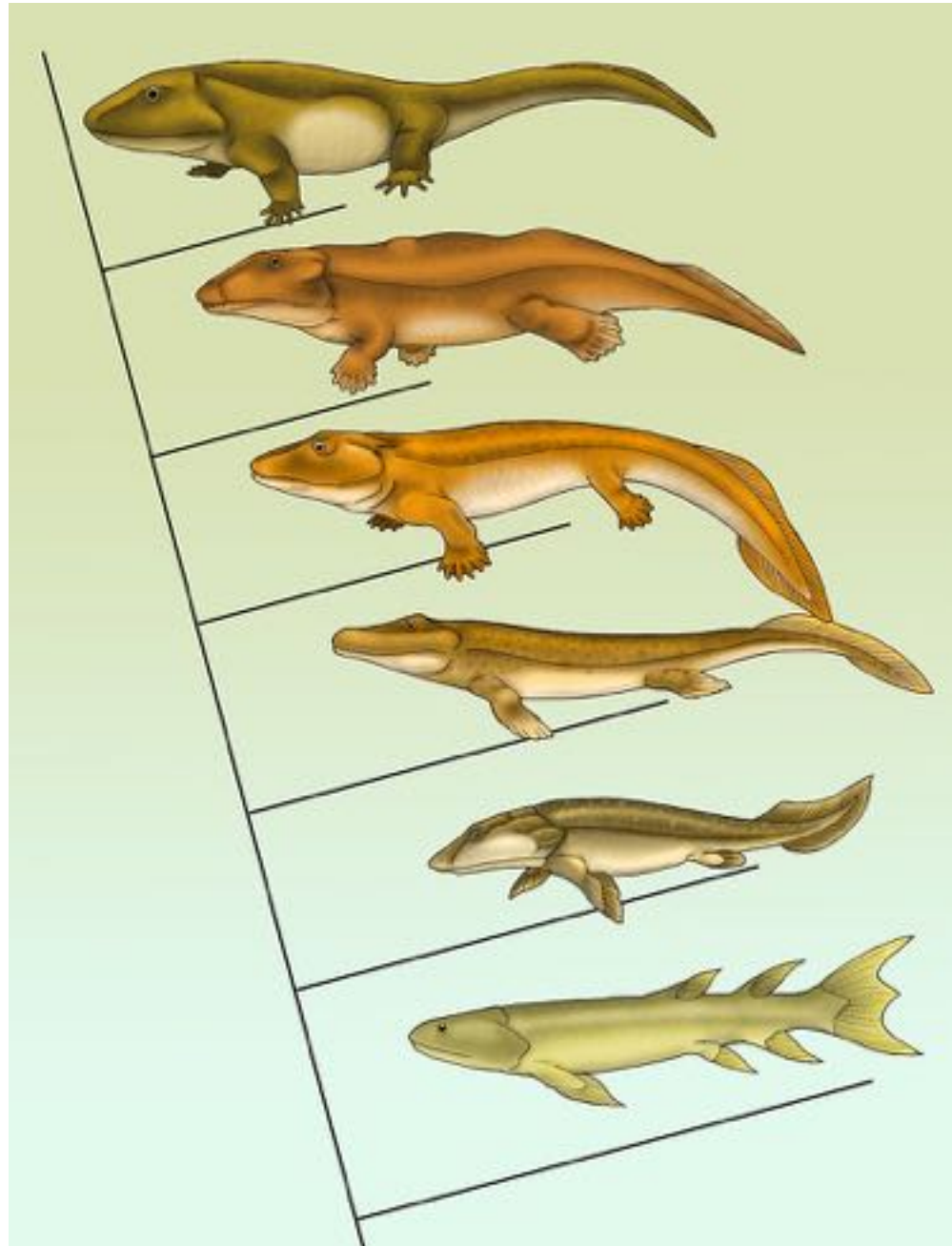


Summary

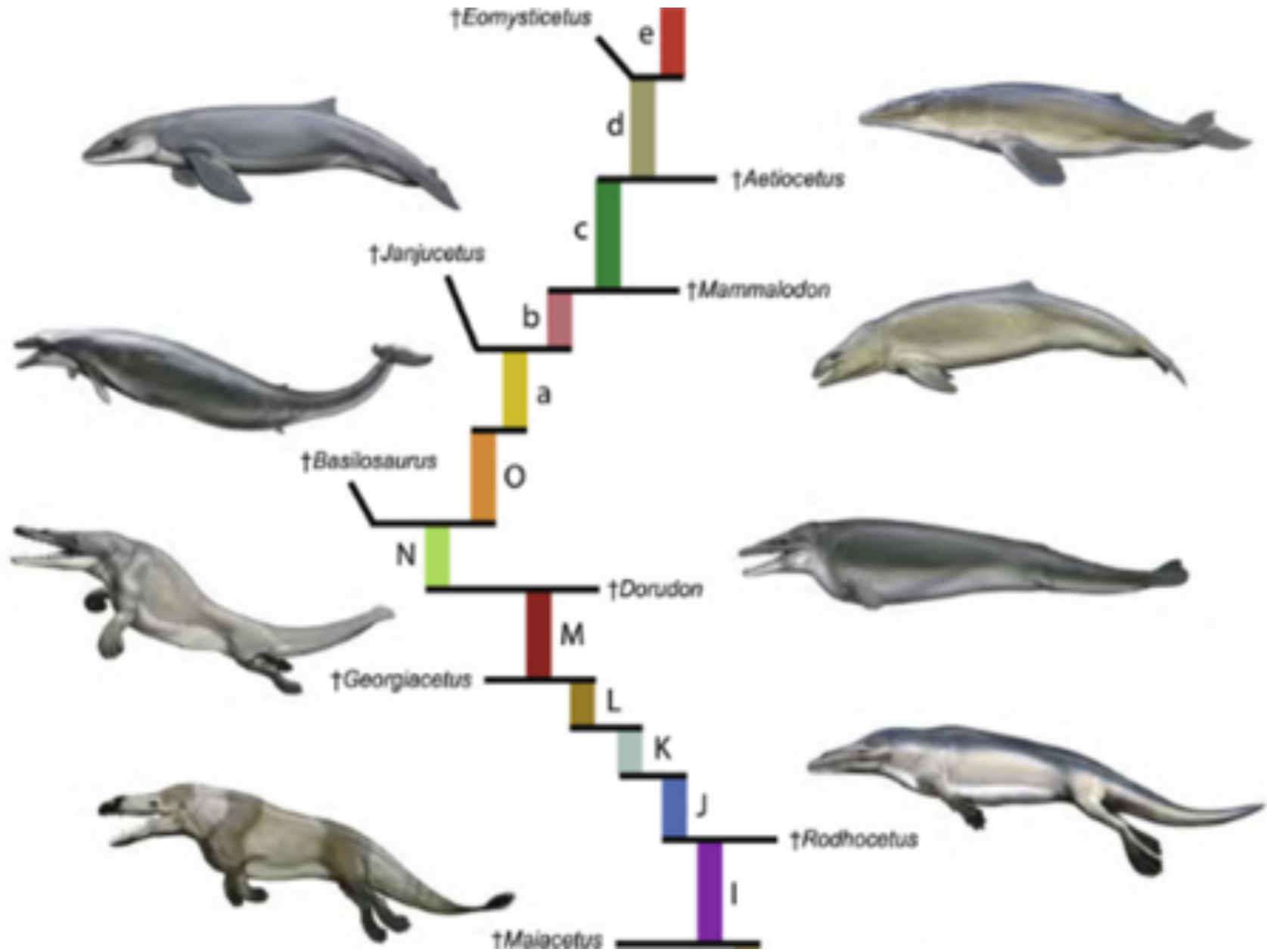
We do indeed see transitions




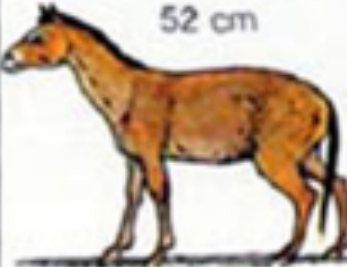
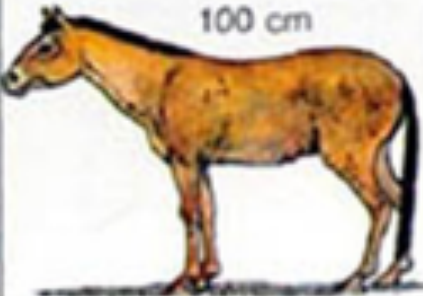
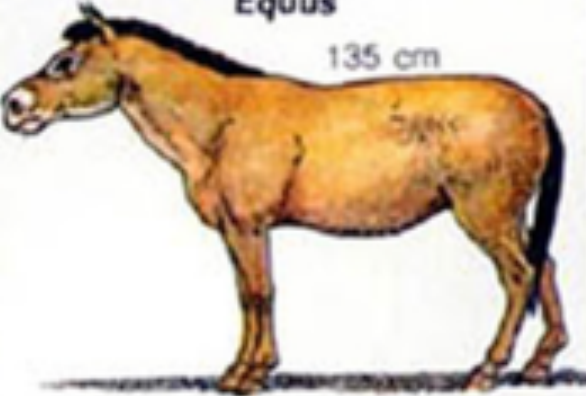




Can you name these?



Transitional Forms

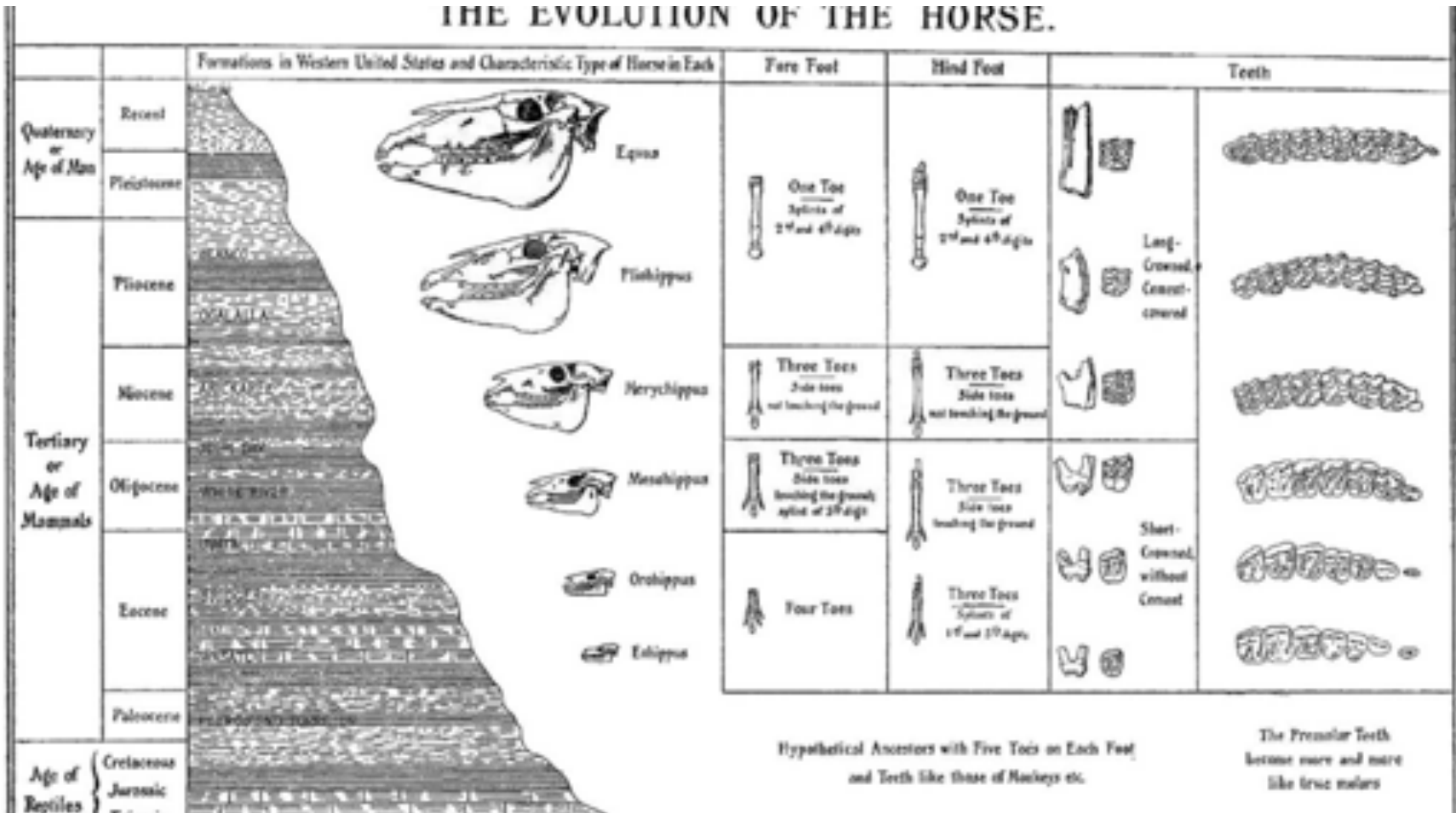


Transitional Forms

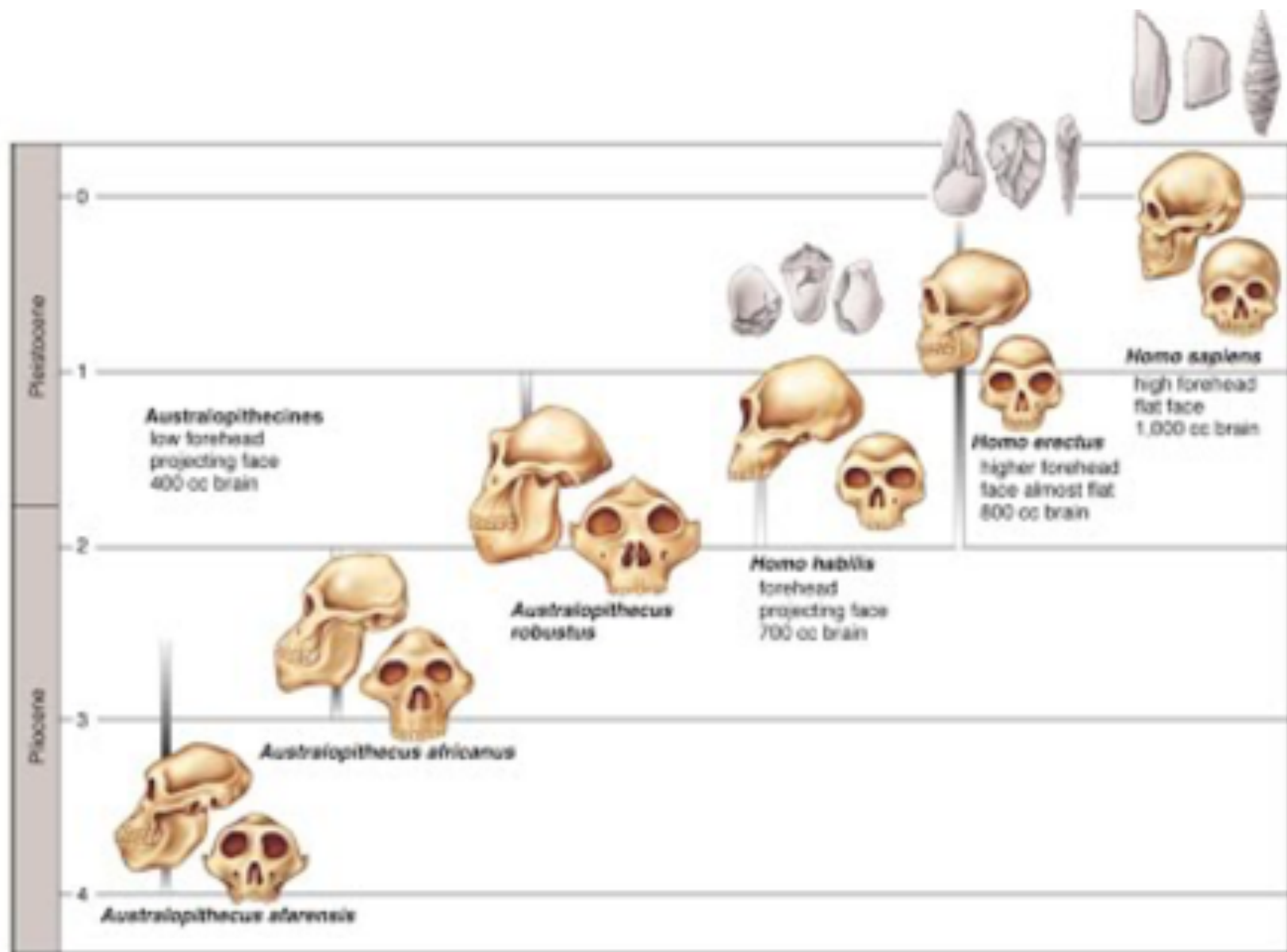
50 million years ago	35 million years ago	26 million years ago	3 million years ago
<p><i>Eohippus</i></p> <p>38 cm</p> 	<p><i>Mesohippus</i></p> <p>52 cm</p> 	<p><i>Merychippus</i></p> <p>100 cm</p> 	<p><i>Equus</i></p> <p>135 cm</p> 
 <p>Forefoot</p> <p>Skull</p>	 <p>Forefoot</p> <p>Skull</p>	 <p>Forefoot</p> <p>Skull</p>	 <p>Forefoot</p> <p>Skull</p>

Transitional Forms

THE EVOLUTION OF THE HORSE.

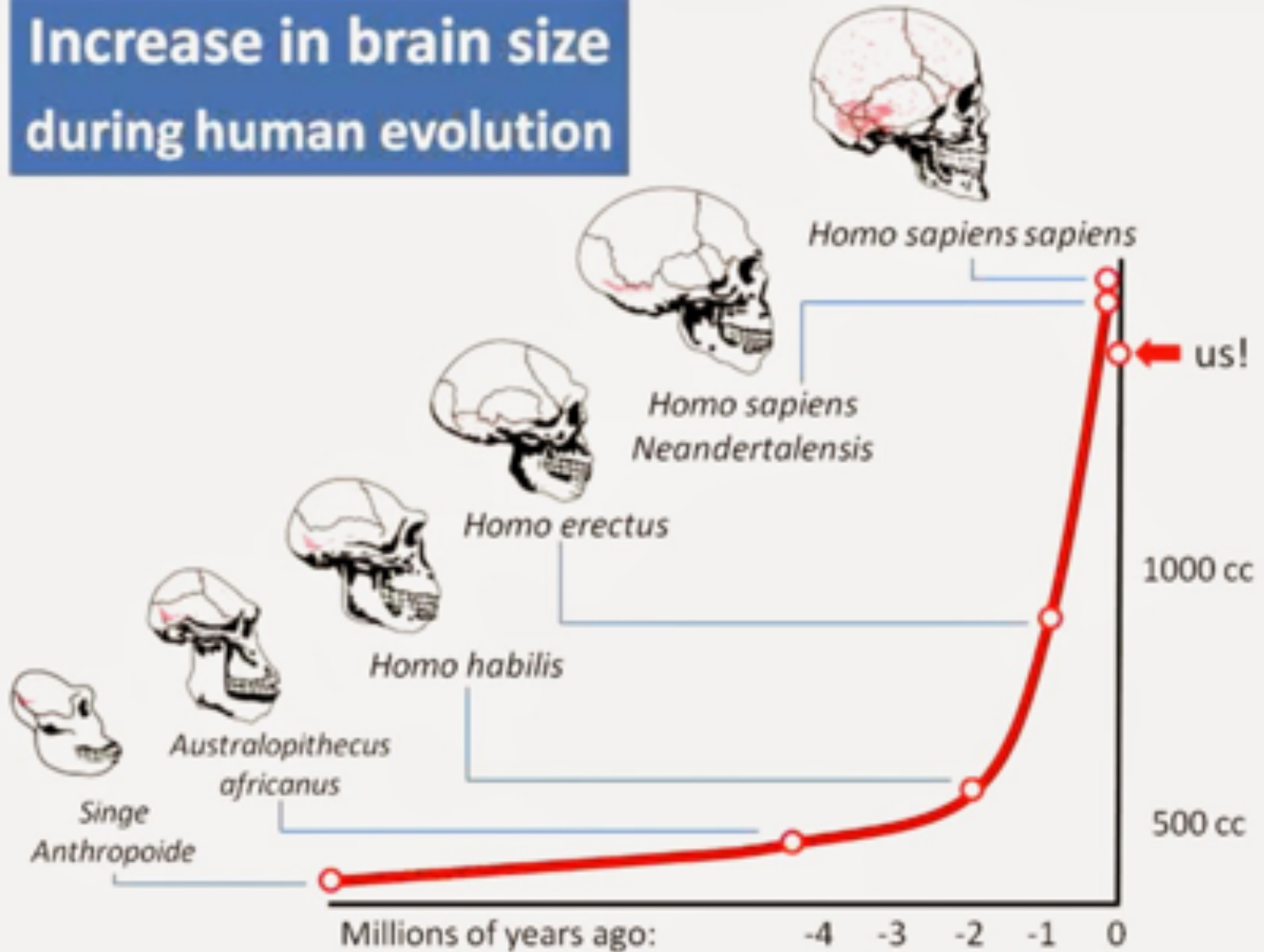


Millions of Years Ago (MYA)



Hominin Brain Size

Increase in brain size during human evolution



Theories of Evolution

- Darwin's view of gradual melding
- Lamarckianism
- Gregor Mendel's discrete heredity
- Discovery of genes and alleles
- Neo-Darwinism Synthesis

Glens's summary ven diagram

Religious Reactions

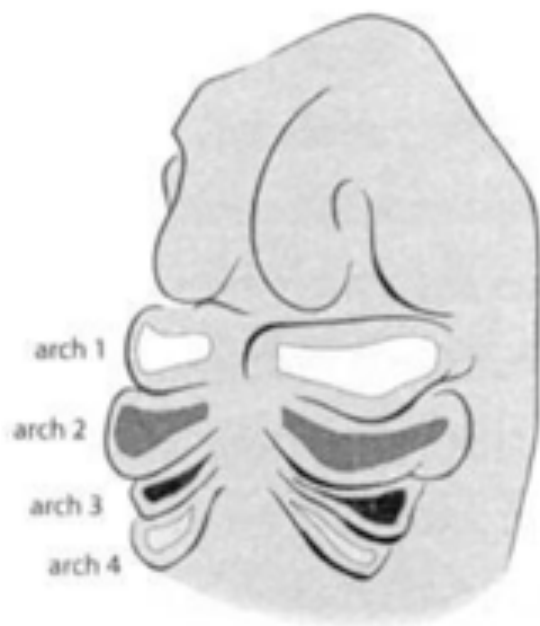
- 19th Century
 - General acceptance even from faith based scientists
- 20th Century
 - General acceptance of random rather than directed
- Current—
 - Bio Logos “Does the Cambrian Explosion pose a challenge to evolution?”

The end

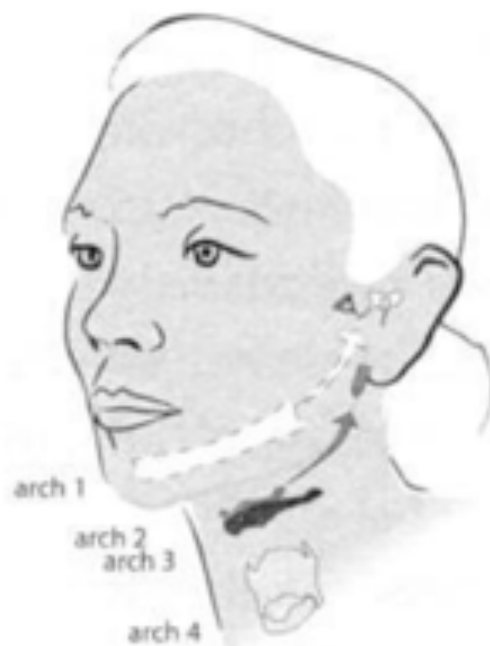
References

- *Prehistoric Life*, Dorling Kindersley, ISBN 978-0-7566-9910-9
- “*Your Inner Fish*” Neil Shubin
- “*Finding Darwin’s God*”, Kenneth Miller
- *New Cambrian fossils -Marble Canyon of Burgess Shales*
<https://www.livescience.com/43270-new-burgess-shale-fossils-canada.html>

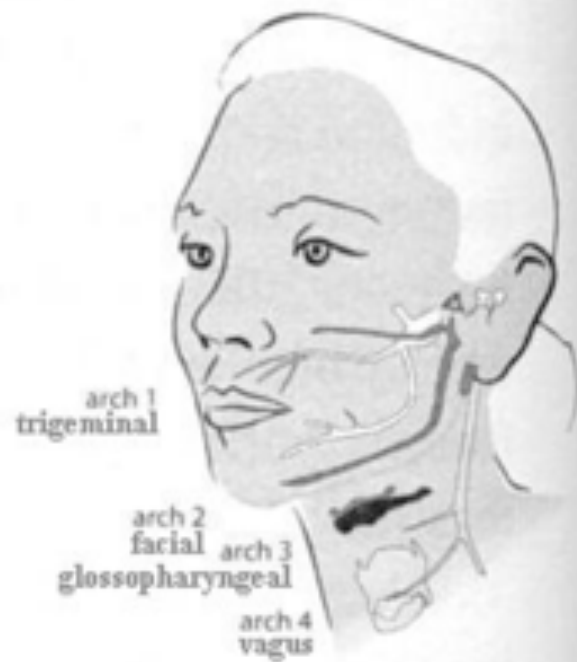
developing fetus



bones and cartilage in adult



nerves in adult



The Three Brains



NEW BRAIN

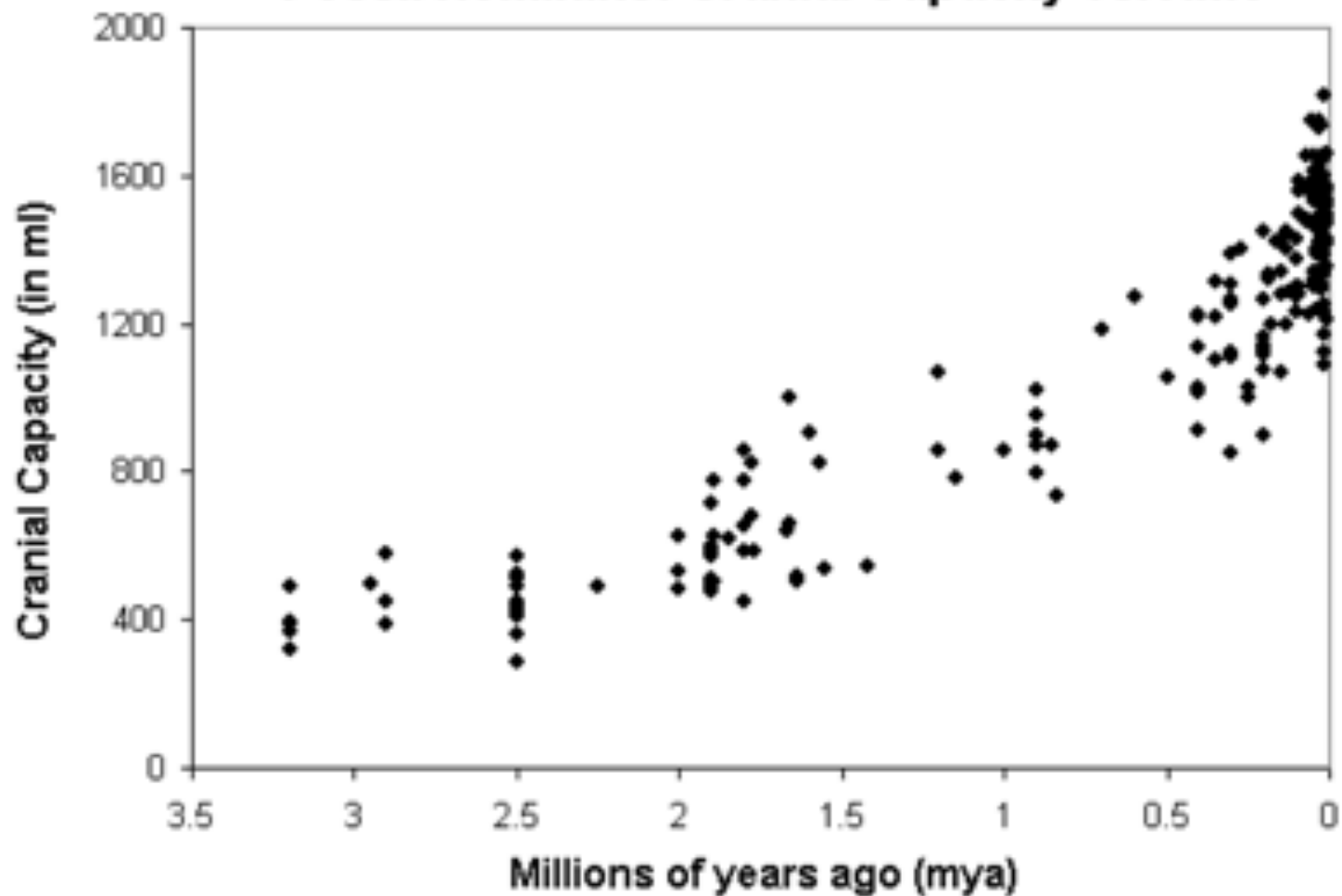
MIDDLE BRAIN

REPTILIAN BRAIN

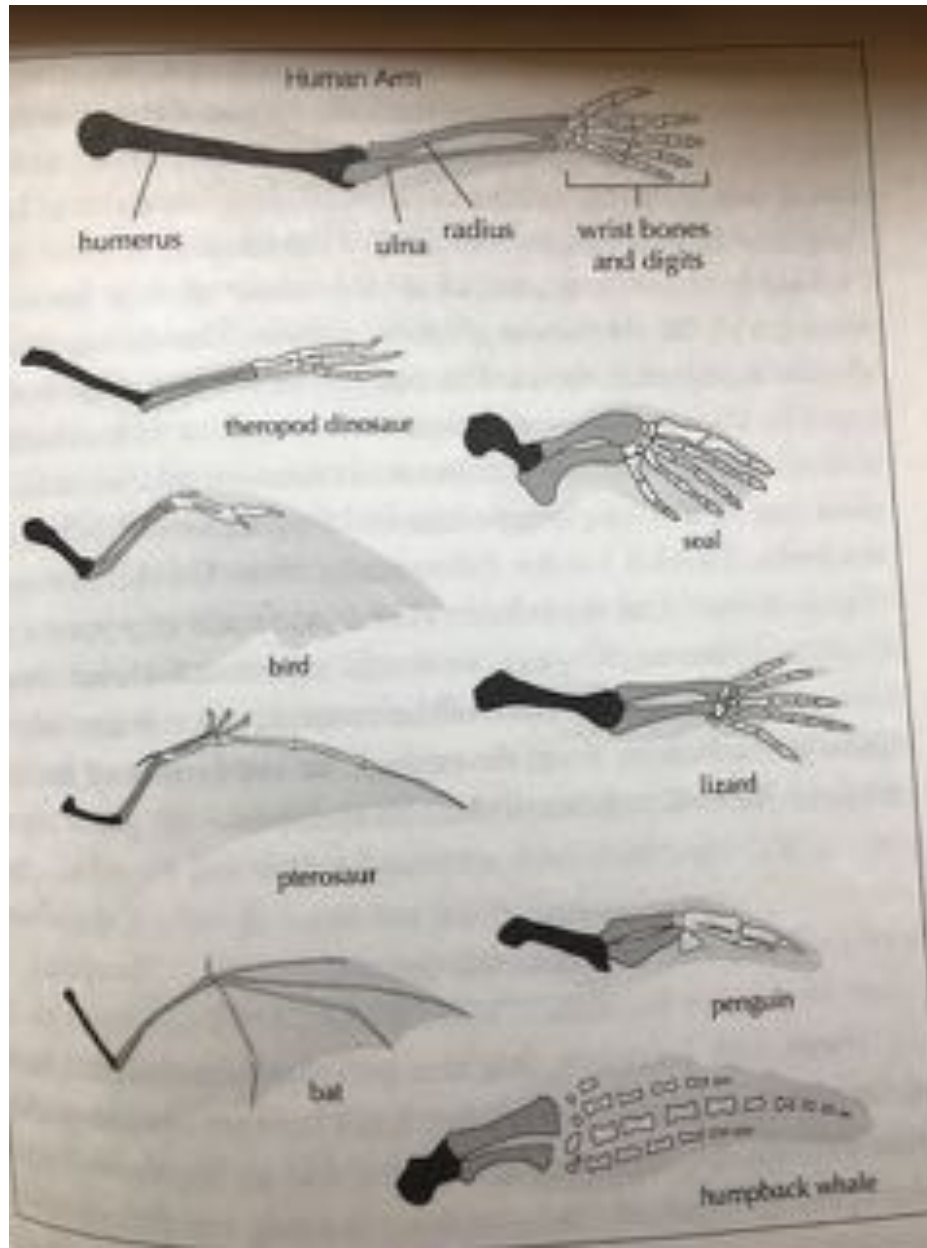
Evolution of History in Us

- Gills (Inner Ear and Facial Nerves)
- Brain (three basic parts superposed)

Fossil Hominins: Cranial Capacity vs. Time



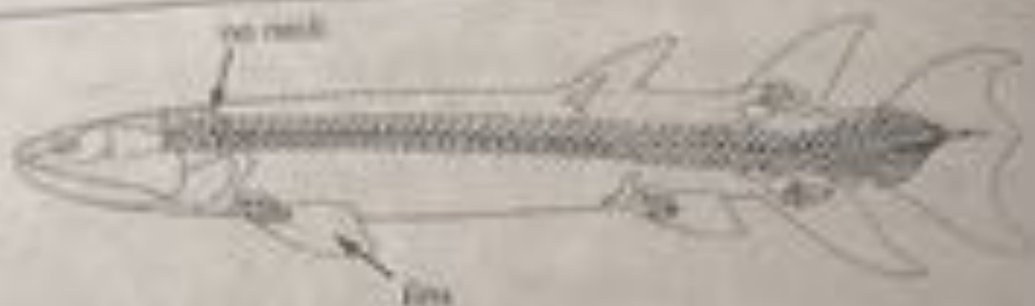
Transitional Forms



FISH



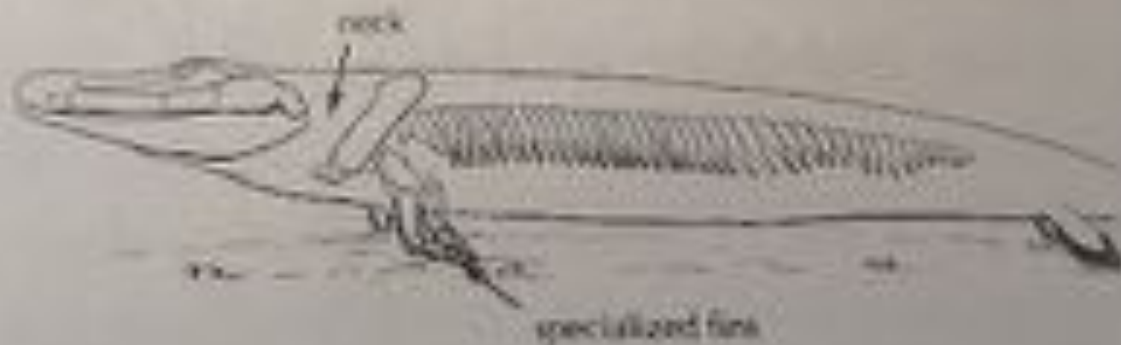
round head
eyes on side



NEW FOSSIL



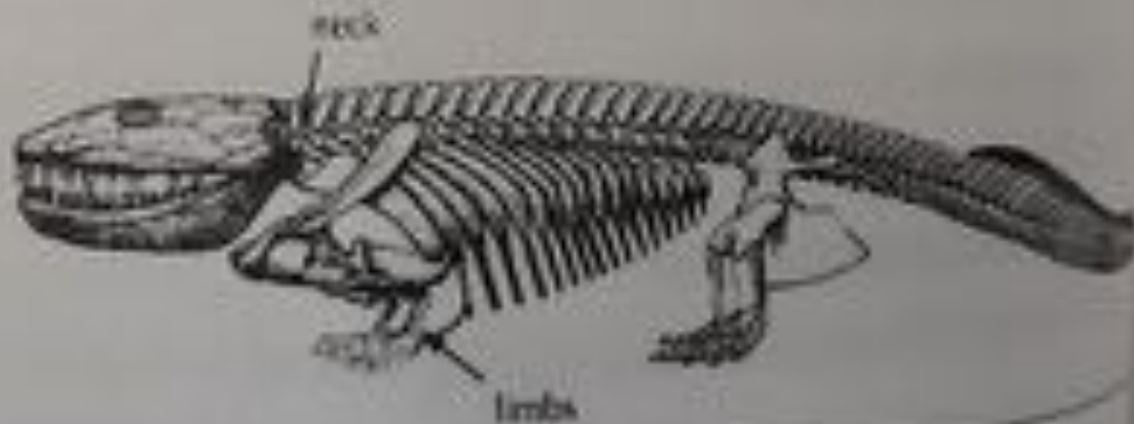
flat head
eyes on top



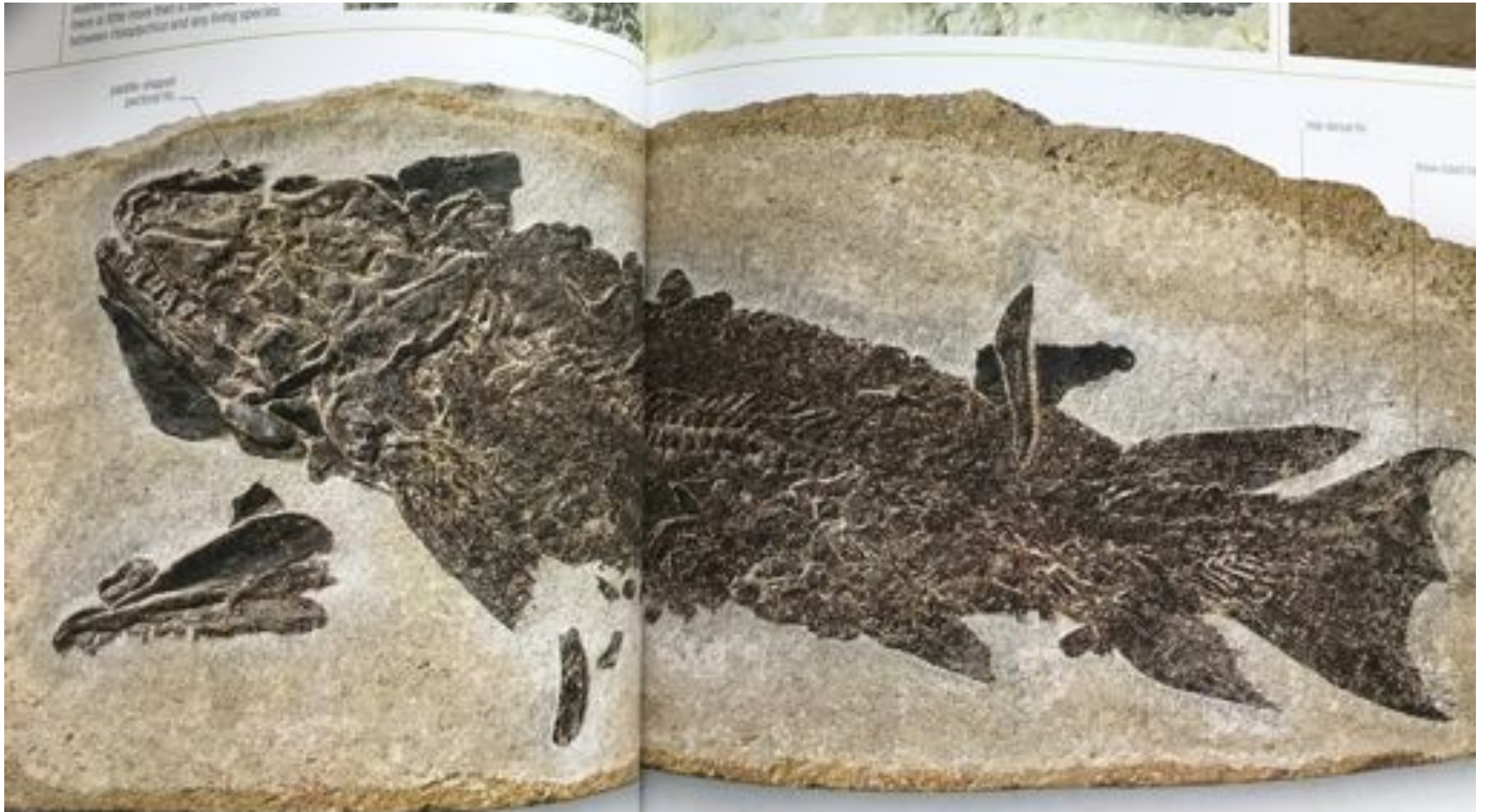
TETRAPOD



flat head
eyes on top



Tristichopterus



Tiktaalik

GROUP Sarcopterygians

DATE Late Devonian

SIZE 1.1–1.3 m (3.6–4.3 ft)

LOCATION Canada

In many respects, Tiktaalik is a fish that shows even more tetrapod-like features than *Panderichthys* (see p.137). For example, *Panderichthys* has a series of bones that joins the skull to the shoulder girdle. There is also a series of bones that covers the gill region. These bones

are absent in tetrapods, and most of them have since also been found in Tiktaalik—at least, they have never been found. And many of the tetrapod features that Tiktaalik does share with *Panderichthys* appear to be at a more advanced stage in the transition to land vertebrates. For example, it has an even longer snout and shorter rear portion of the skull than *Panderichthys* and a wider round notch (the spiracular notch) at the back of the skull.

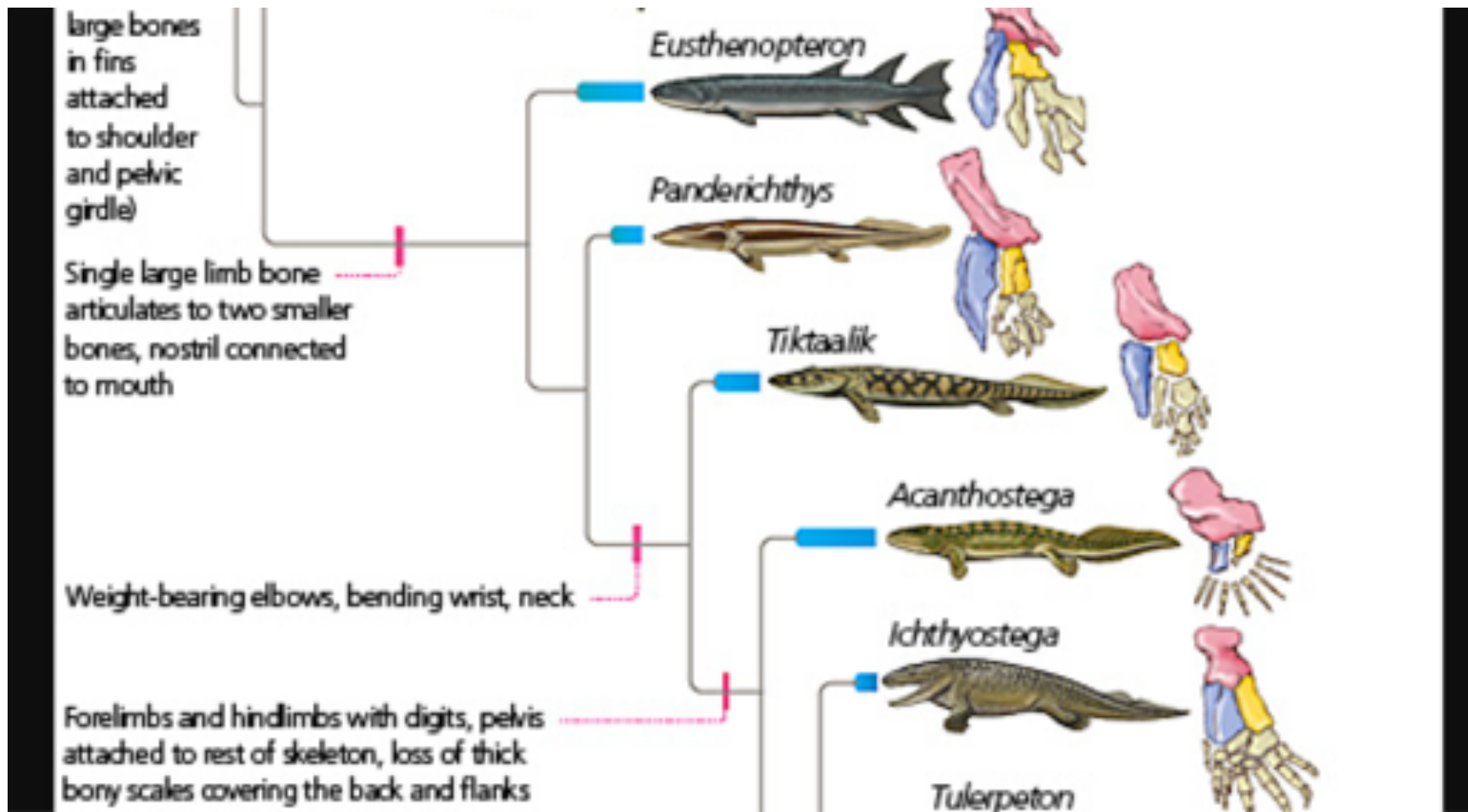


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Transitional Limbs



Halkieria



metasprrigina



Very Early Fish Sacabambaspis



- The *Larus Gulls* of the Northern Hemisphere: Notice the darkening of the feathers in a clockwise direction starting at the bottom. Gull species near each other can interbreed, except between the Herring Gull and the Lesser Black-Backed Gull that diverged from each other long the longest ago. This inability to breed tells the story of how the species likely spread overtime around the world and met back up, now no longer able to interbreed.

