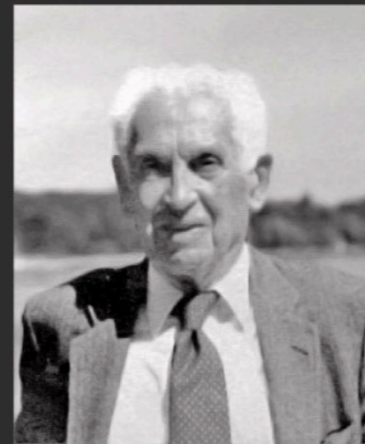


# Discontinuities in the Fossil Record

## A Problem for Neo-Darwininism



Wherever we look at the living biota ... discontinuities are overwhelmingly frequent ... The discontinuities are even more striking in the fossil record.

*Ernst Mayr*



**GÜNTER BECHLY, PhD (paleontologist):**

1999-2016 Curator for Amber and Fossil Insects at the *State Museum of Natural History* in Stuttgart

Senior Fellow with Discovery Institute's *Center for Science & Culture* in Seattle, USA

Senior Scientist at *Biologic Institute* in Redmond, USA

Chairman of the German-speaking *Center for BioComplexity & Teleology in Nature*



# Explosions of Biological Novelty

Abrupt origins are the rule in all periods of Earth History, in all geographical regions, and all groups of organisms from protists, to plants, invertebrates and vertebrate animals.

Origin of Life

Origin of Photosynthesis

Avalon Explosion (Ediacara)

Cambrian Explosion

Great Ordovician Biodiversification Event

Silurio-Devonian Terrestrial Revolution

Devonian Nekton Revolution

Odontode Explosion

Big Bang of Genus *Homo*



Carboniferous Insect Explosion

Triassic Radiations (Tetrapods, Dinos, Marine Reptiles)

Abominable Mystery (Flowering Plants)

Big Bang of Birds

Placental Mammal Explosion



ScienceDaily

Your source for the latest research news

Science News

from research organizations

Big Bang Theory Of Human Evolution?

Date: January 11, 2000

Source: University Of Michigan

Summary: Two million years ago somewhere in Africa, a small group of individuals became separated from other australopithecines. This population bottleneck led to a series of sudden, interrelated changes---in body size, brain size, skeletal proportions, and behavior---that jump-started the evolution of our species.

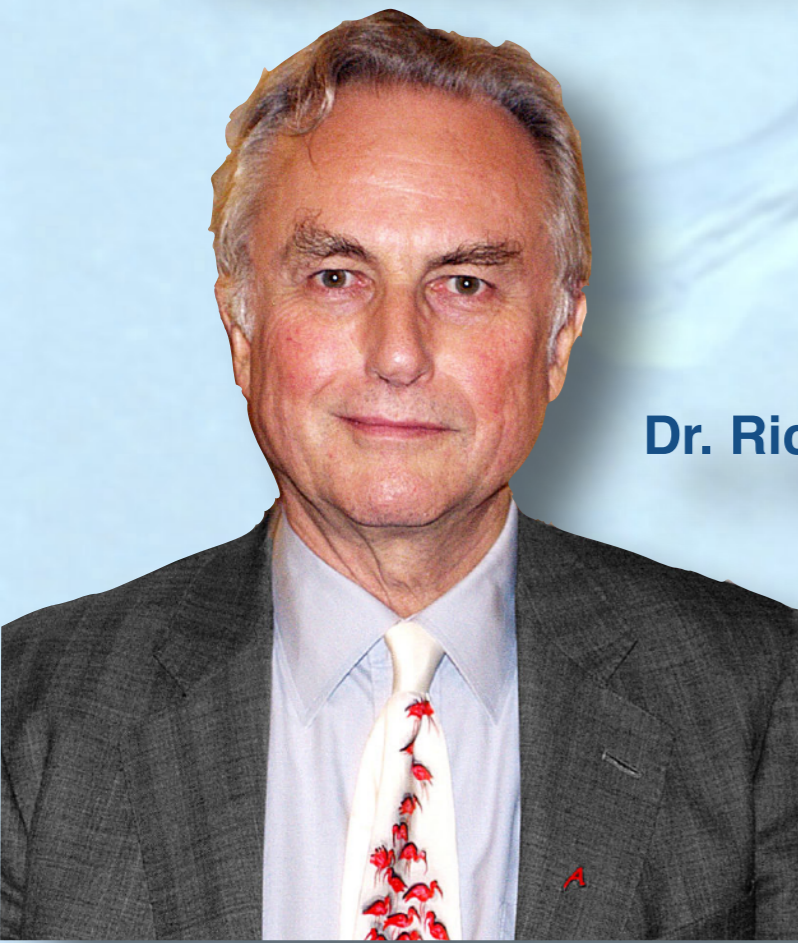




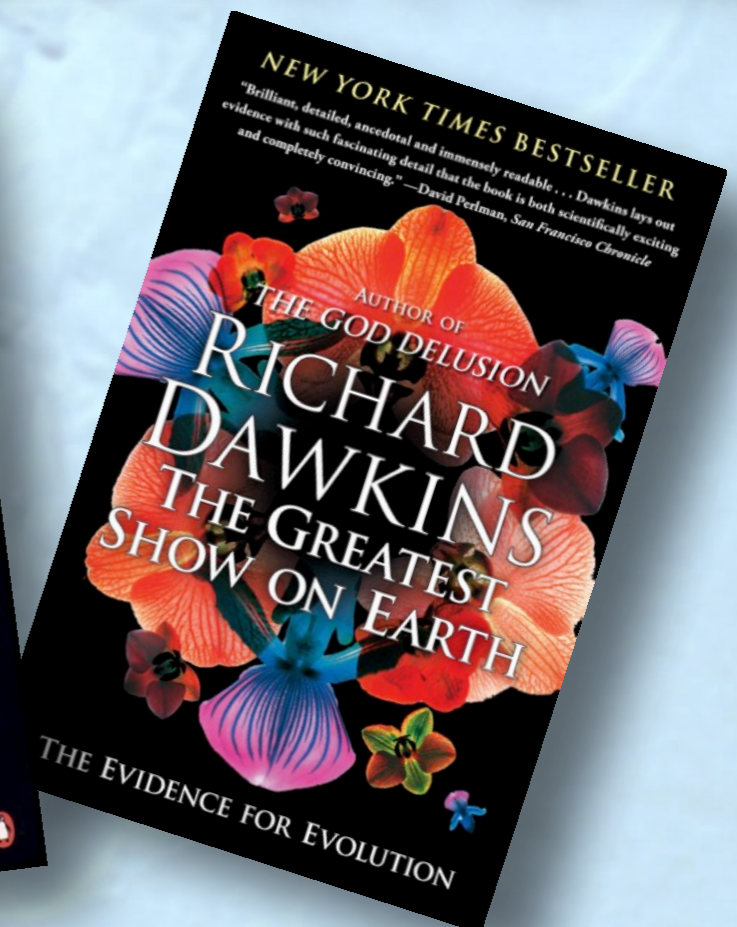
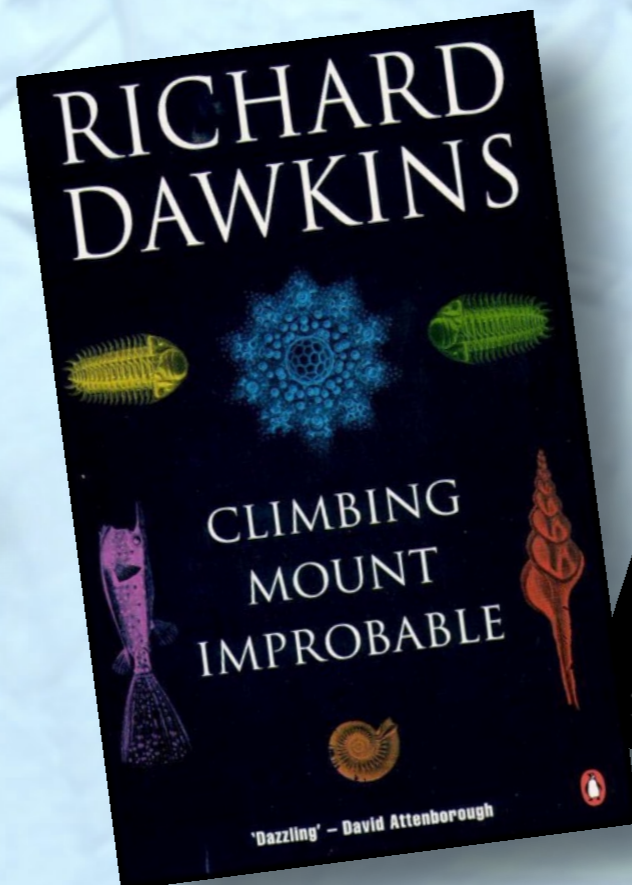
## *Natura non facit saltus*

Darwin quoted this Latin sentence six times in his *Origin of Species*. Against Huxley's advice, and with good reason!

Richard Dawkins (2009): “*Evolution not only is a gradual process as a matter of fact; it has to be gradual if it is to do any explanatory work*“



Dr. Richard Dawkins

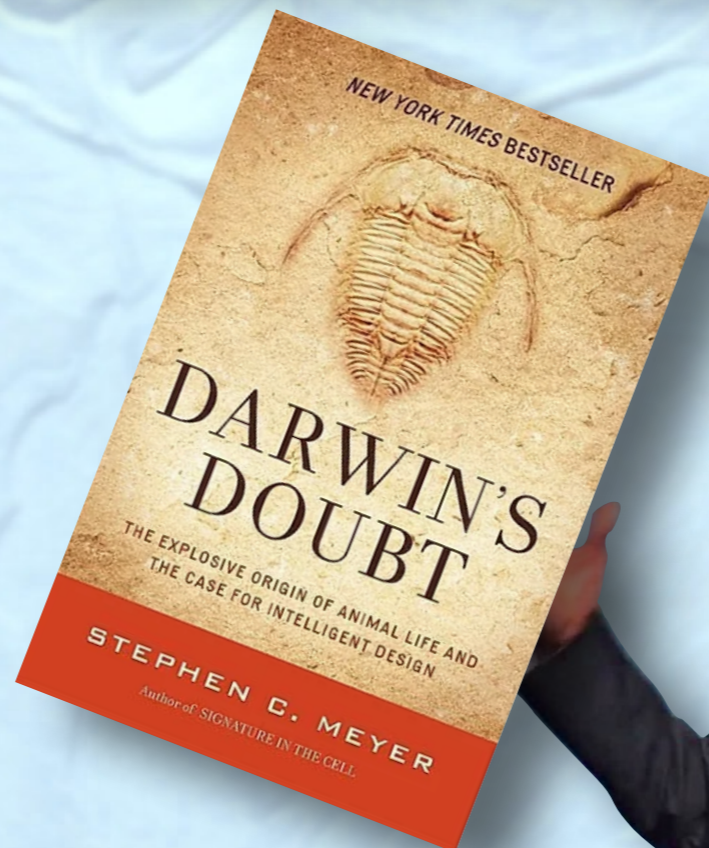




# Darwin's Doubt



**Charles Darwin (1859):** *“Geology assuredly does not reveal any such finely graduated organic chain; and this, perhaps, is the most obvious and gravest objection which can be urged against my theory. The explanation lies, as I believe, in the extreme imperfection of the geological record.”*



Dr. Stephen C. Meyer





## Darwin's Doubt Remains



The renowned Harvard paleontologist George Gaylord Simpson, who is considered as the most influential paleontologist of the 20th century and co-founder of the modern evolutionary synthesis (aka Neo-Darwinism), wrote 100 years after Darwin in 1960:

*“It is a feature of the known fossil record that most taxa appear abruptly. They are not, as a rule, led up to by a sequence of almost imperceptibly changing forerunners such as Darwin believed should be usual in evolution. ... These peculiarities of the fossil record pose one of the most important theoretical problems in the whole history of life.”*

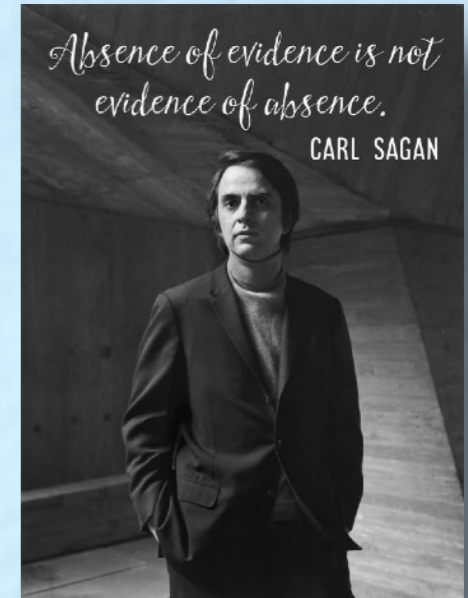


# Gaps of Evidence?

***“Gaps of evidence are gaps of evidence and not evidence of gaps” (Philip Gingerich)***

**REALLY?**

**Paul Nelson used the wonderful analogy of beach combing to show how we know whether we still lack sufficient evidence**

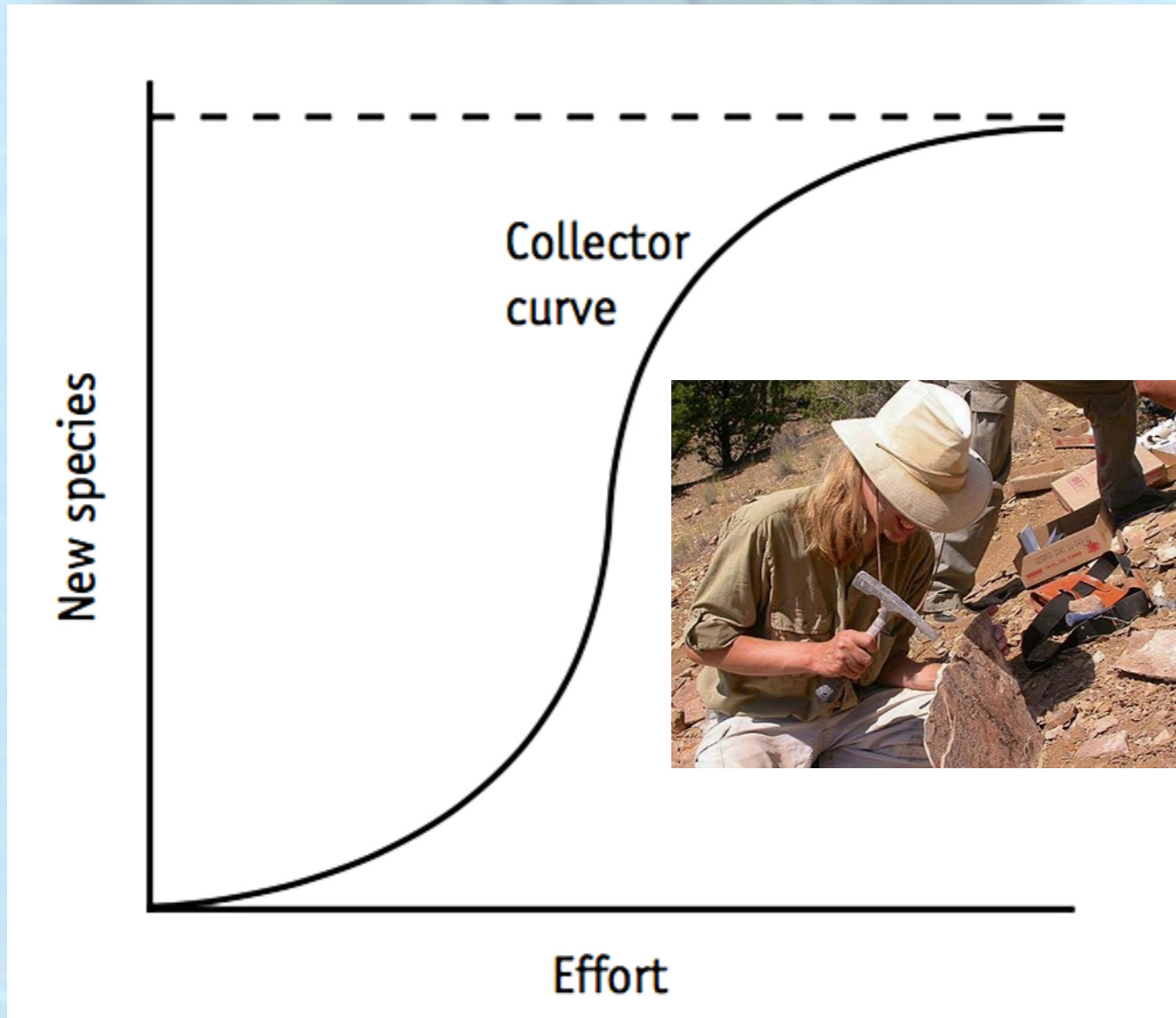


**Dr. Paul Nelson**



# Incompleteness of the Fossil Record?

Denton 1985: 80% of all modern families of land vertebrates are represented in the fossil record!



redrawn after Benton (2009)

**nature**  
International journal of science

Absolute measures of the completeness of the fossil record

Mike Foote & J. John Sepkoski Jr *Nature* 398, 415–417 (1999)

## Absolute measures of the completeness of the fossil record

Mike Foote & J. John Sepkoski Jr

Department of the Geophysical Sciences, University of Chicago, 5734 South Ellis Avenue, Chicago, Illinois 60637, USA

Measuring the completeness of the fossil record is essential to understanding evolution over long timescales, particularly when comparing evolutionary patterns among biological groups with different preservational properties. Completeness measures have been presented for various groups based on gaps in the stratigraphic ranges of fossil taxa<sup>1,2</sup> and on hypothetical lineages implied by estimated evolutionary trees<sup>3–5</sup>. Here we present and compare quantitative, widely applicable absolute measures of completeness at two taxonomic levels for a broader sample of higher taxa of marine animals than has previously been available. We provide an estimate of the probability of genus preservation per stratigraphic interval<sup>6,7</sup>, and determine the proportion of living families with some fossil record<sup>8–10</sup>. The two completeness measures use very different data and calculations. The probability of genus preservation depends almost entirely on the Palaeozoic and Mesozoic records, whereas the proportion of living families with a fossil record is influenced largely by Cenozoic data. These measurements are nonetheless highly correlated, with outliers quite explicable, and we find that completeness is rather high for many animal groups.





# Why Millions of Years is still Abrupt

The average longevity of an animal species is only about ...:

- 5-10 my for marine invertebrates
- 3-10 my for insects
- 2,3-4,3 for mammals

Thus, a window of time of 5 million years is equivalent to a succession of just 1-2 species with only minor change!



Dakota Formation

Carmel Formation

Temple Cap Formation

Navajo Sandstone

Keyenta Formation

Moenave Formation

Chinle Formation

Moenkopi Formation

Kaibab Formation





# Late Heavy Bombardment

4.1-3.8 bya (maximum at 3.9 bya)

## LETTER

doi:10.1038/nature13539

### Widespread mixing and burial of Earth's Hadean crust by asteroid impacts

S. Marchi<sup>1</sup>, W. F. Bottke<sup>1</sup>, L. T. Elkins-Tanton<sup>2†</sup>, M. Bierhaus<sup>3</sup>, K. Wuennemann<sup>3</sup>, A. Morbidelli<sup>4</sup> & D. A. Kring<sup>5</sup>

*“Existing oceans would have repeatedly boiled away into steam atmospheres as a result of large collisions as late as about 4 billion years ago.”*  
(Marchi et al., 2014, Nature)





# The Origin of Life

**3.8 bya (4.1 bya is highly controversial)**


**3.77 bya: Filamentous microfossils of bacteria from the Nuvvuagittuq Greenstone Belt in Quebec**

**Right after the Late Heavy Bombardment**



**nature**  
International journal of science

**Evidence for early life in Earth's oldest hydrothermal vent precipitates**

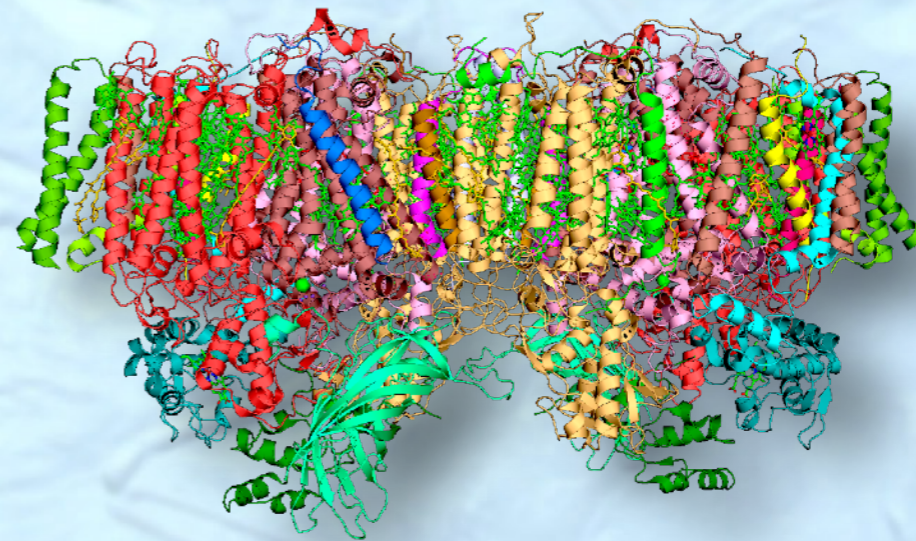
Matthew S. Dodd, Dominic Papineau , Tor Grenne, John F. Slack, Martin Rittner, Franco Pirajno, Jonathan O'Neil & Crispin T. S. Little

*Nature* **543**, 60–64 (02 March 2017)



# Origin of Photosynthesis

3.8 bya



**New Scientist**  
Volume 217, Issue 2905, 23 February 2013, Pages 9

This Week  
**Photosynthesis began on Earth 3.8 billion years ago**  
Jeff Hecht

Earth and Planetary Science Letters 363 (2013) 192–203

Contents lists available at SciVerse ScienceDirect

**Earth and Planetary Science Letters**  
journal homepage: www.elsevier.com/locate/epsl

Biological Fe oxidation controlled deposition of banded iron formation in the ca. 3770 Ma Isua Supracrustal Belt (West Greenland)  
Andrew D. Czaja<sup>a,b,\*</sup>, Clark M. Johnson<sup>a,b</sup>, Brian L. Beard<sup>a,b</sup>, Eric E. Roden<sup>a,b</sup>, Weiqiang Li<sup>a,b</sup>, Stephen Moorbath<sup>c</sup>

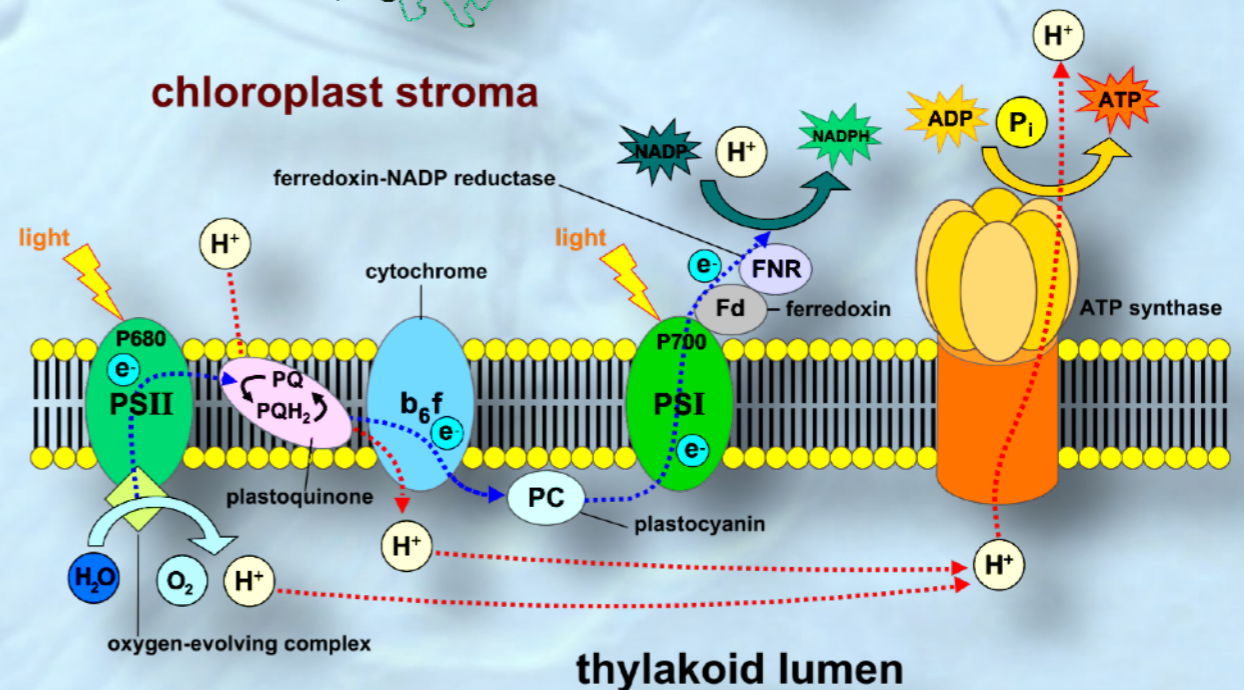
**nature** International weekly journal of science

NATURE | LETTER

**Rapid emergence of life shown by discovery of 3,700-million-year-old microbial structures**

Allen P. Nutman, Vickie C. Bennett, Clark R. L. Friend, Martin J. Van Kranendonk & Allan R. Chivas

Nature 537, 535–538 (22 September 2016) | doi:10.1038/nature19355





# Avalon Explosion

575-565 mya

A strange world of microbial mats with enigmatic sessile organisms (“Garden of Ediacara”): glide symmetry, fractal growth, quilted structure, no visible inner organs

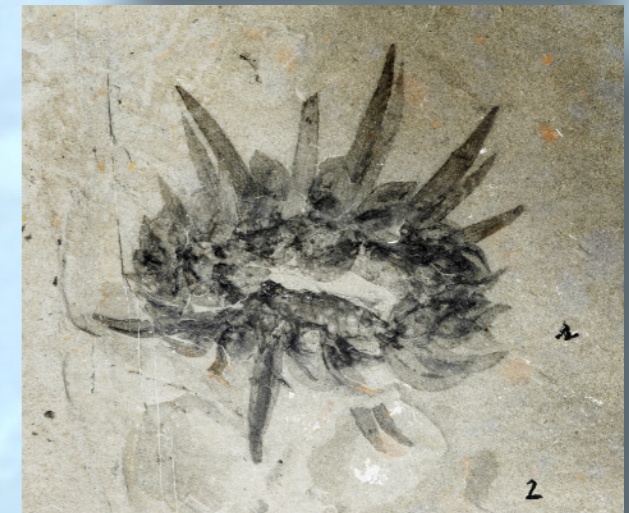
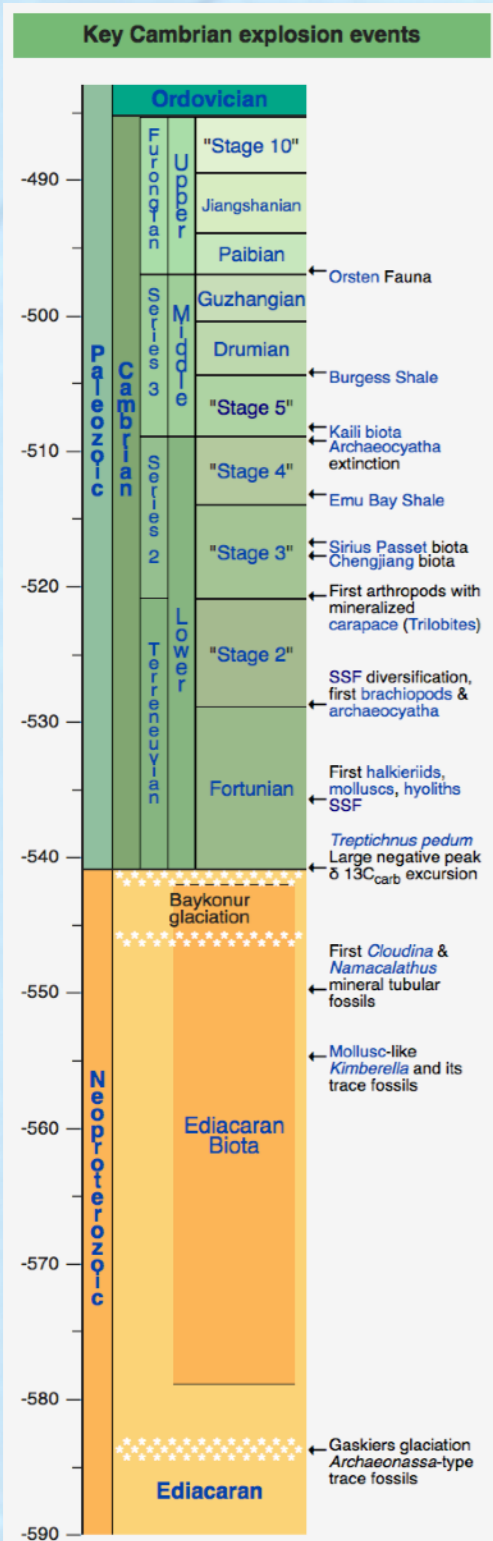




# Cambrian Explosion

537-508 mya

20 of 33 known metazoan animal phyla





# Cambrian Explosion

537-508 mya

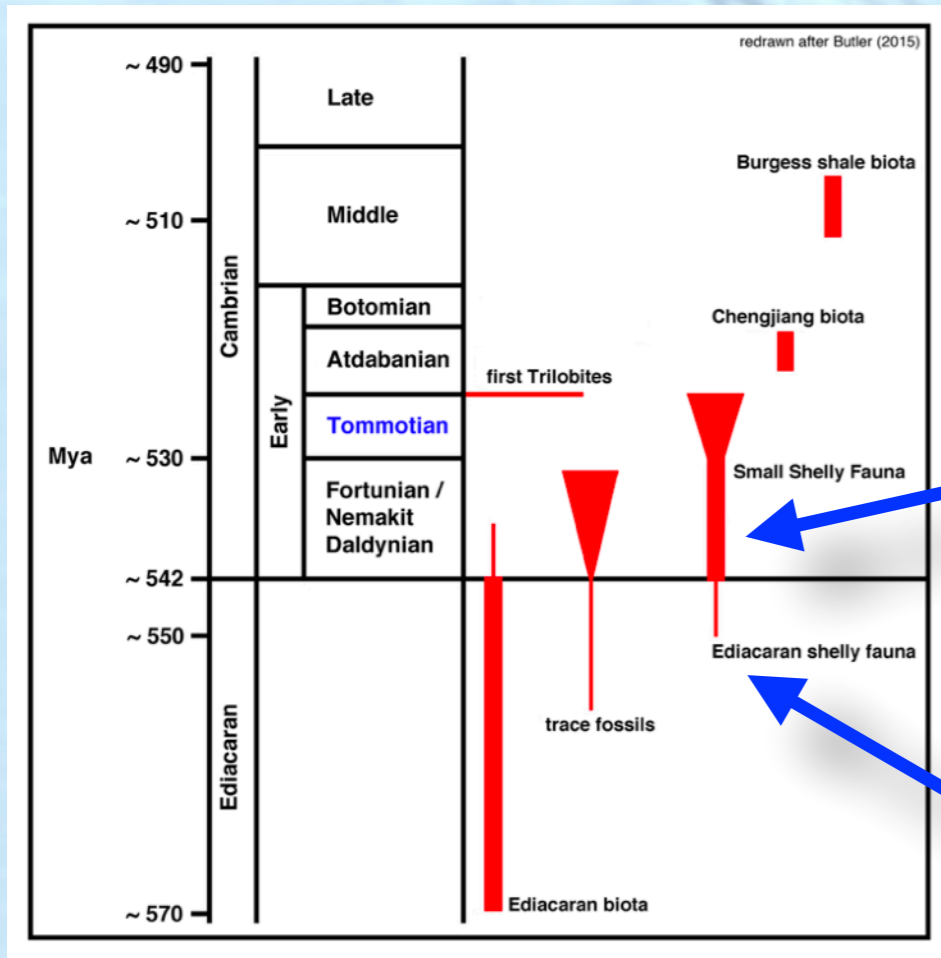
Recent demise of the artifact hypothesis by the discovery of Burgess-shale like deposits from the Ediacaran of Mongolia (2016) and China (2011): only algae!



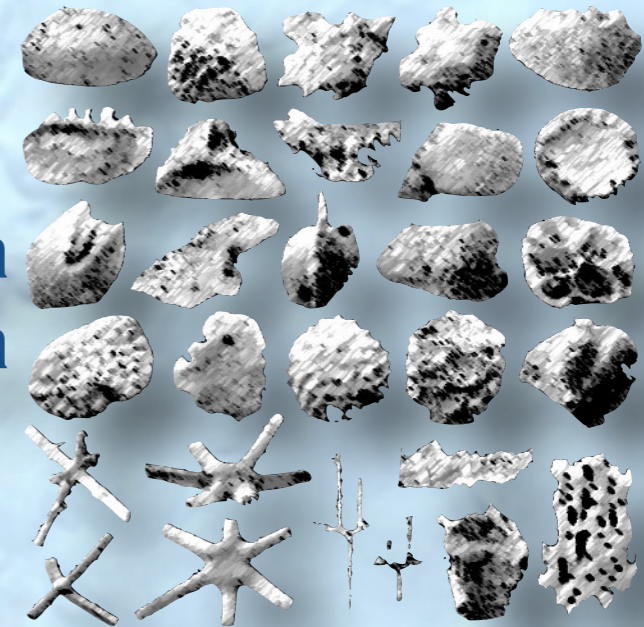


# Cambrian Explosion

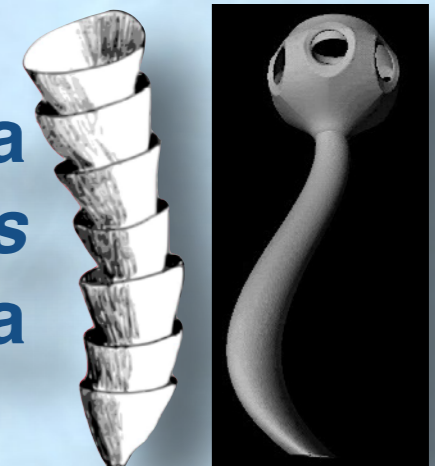
537-508 mya



**Small-Shelly-Fauna (SSF) 537-517 mya**



**Ediacaran-Shelly-Fauna  
*Cloudina* and *Namacalathus*  
549-538 mya**

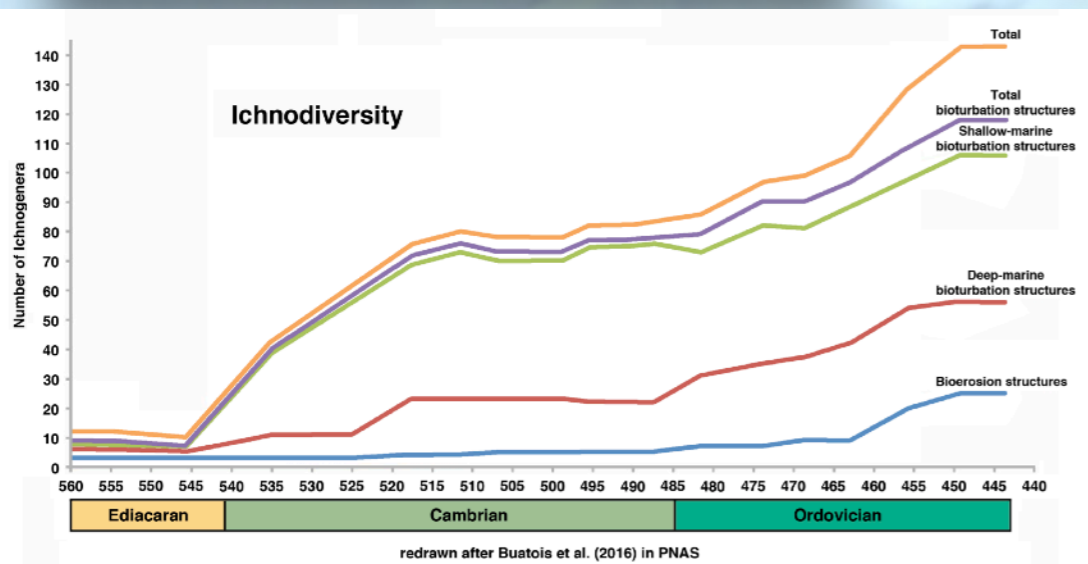
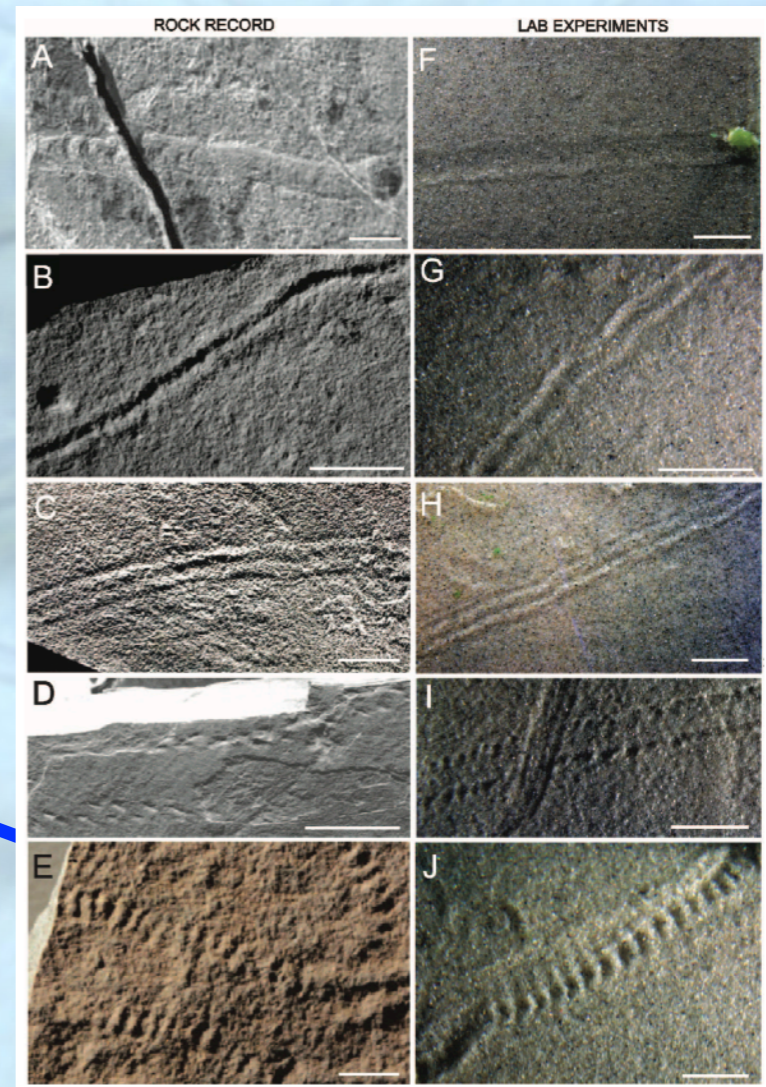
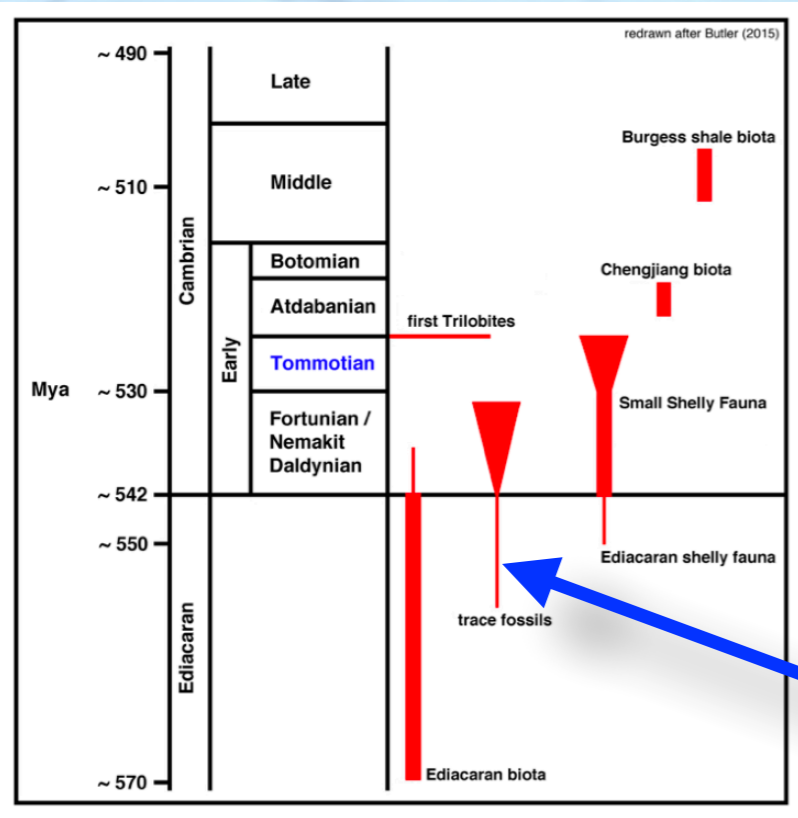




# Cambrian Explosion

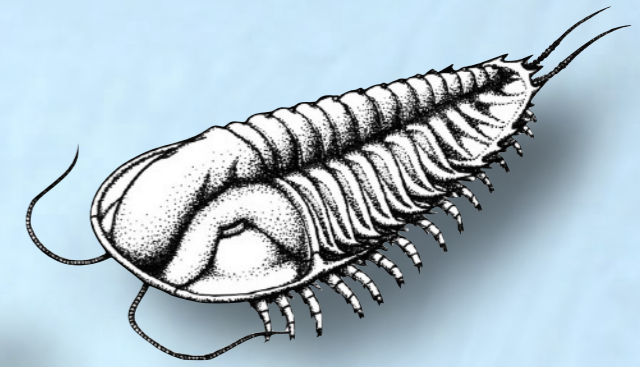
537-508 mya

Ediacaran “trace fossils” replicated by shaking up microbial mats in lab experiments (Mariotti et al., 2016)





# Cambrian Explosion



## 537-508 mya

Mail Online

Science & Tech

● PERSPECTIVE

## Early fossil record of Euarthropoda and the Cambrian Explosion

Allison C. Daley<sup>a,b,c,1</sup>, Jonathan B. Antcliffe<sup>a,b,c</sup>, Harriet B. Drage<sup>a,b,c</sup>, and Stephen Pates<sup>a,b</sup>

Edited by Neil H. Shubin, University of Chicago, Chicago, IL, and approved April 6, 2018 (received for review December 20, 2017)

Euarthropoda is one of the best-preserved fossil animal groups and has been the most diverse animal phylum for over 500 million years. Fossil Konservat-Lagerstätten, such as Burgess Shale-type deposits (BSTs), show the evolution of the euarthropod stem lineage during the Cambrian from 518 million years ago (Ma). The stem lineage includes nonbiomineralized groups, such as Radiodonta (e.g., *Anomalocaris*) that provide insight into the step-by-step construction of euarthropod morphology, including the exoskeleton, biramous limbs, segmentation, and cephalic structures. Trilobites are crown group euarthropods that appear in the fossil record at 521 Ma, before the stem lineage fossils, implying a ghost lineage that needs to be constrained. These constraints come from the trace fossil record, which show the first evidence for total group Euarthropoda (e.g., *Cruziana*, *Rusophycus*) at around 537 Ma. A deep Precambrian root to the euarthropod evolutionary lineage is disproven by a comparison of Ediacaran and Cambrian lagerstätten. BSTs from the latest Ediacaran Period (e.g., Miaohu biota, 550 Ma) are abundantly fossiliferous with algae but completely lack animals, which are also missing from other Ediacaran windows, such as phosphate deposits (e.g., Doushantuo, 560 Ma). This constrains the appearance of the euarthropod stem lineage to no older than 550 Ma. While each of the major types of fossil evidence (BSTs, trace fossils, and biomineralized preservation) have their limitations and are incomplete in different ways, when taken together they allow a coherent picture to emerge of the origin and subsequent radiation of total group Euarthropoda during the Cambrian.

paleontology | Paleozoic | evolution | Arthropoda | Cambrian explosion

**The emergence of life on Earth was much slower than previously thought: The 'Cambrian Explosion' that ultimately led to the arrival of humans actually took 40 MILLION years**

- The 'Cambrian explosion' is the most significant event in Earth's history
- It allowed for the rise of complex animal groups like the euarthropods
- New research shows the explosion occurred slowly across 40 million years
- The timing changes how we view and interpret the emergence of euarthropods

By HARRY PETTIT FOR MAILONLINE

PUBLISHED: 20:00 BST, 21 May 2018 | UPDATED: 20:00 BST, 21 May 2018

stem arthropods 518 mya  
crown arthropods 521 mya  
trilobitoid traces 537 mya  
no animals 550 mya



# Cambrian Explosion

537-508 mya

***“We now know that the sudden appearance of fossils in the Cambrian ... is real and not an artefact of an imperfect fossil record”***

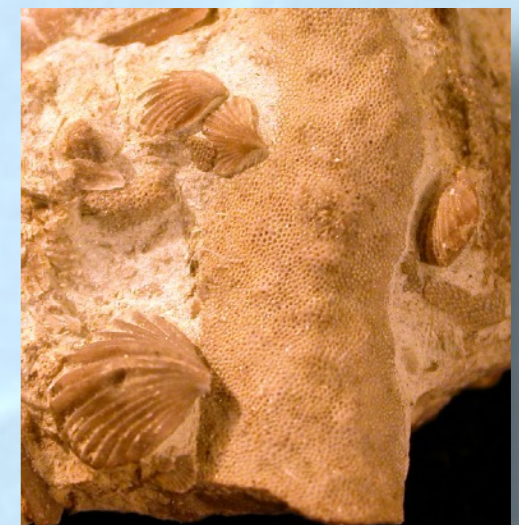
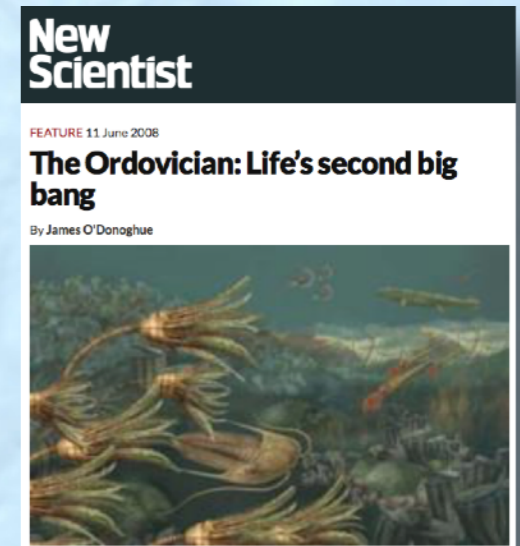
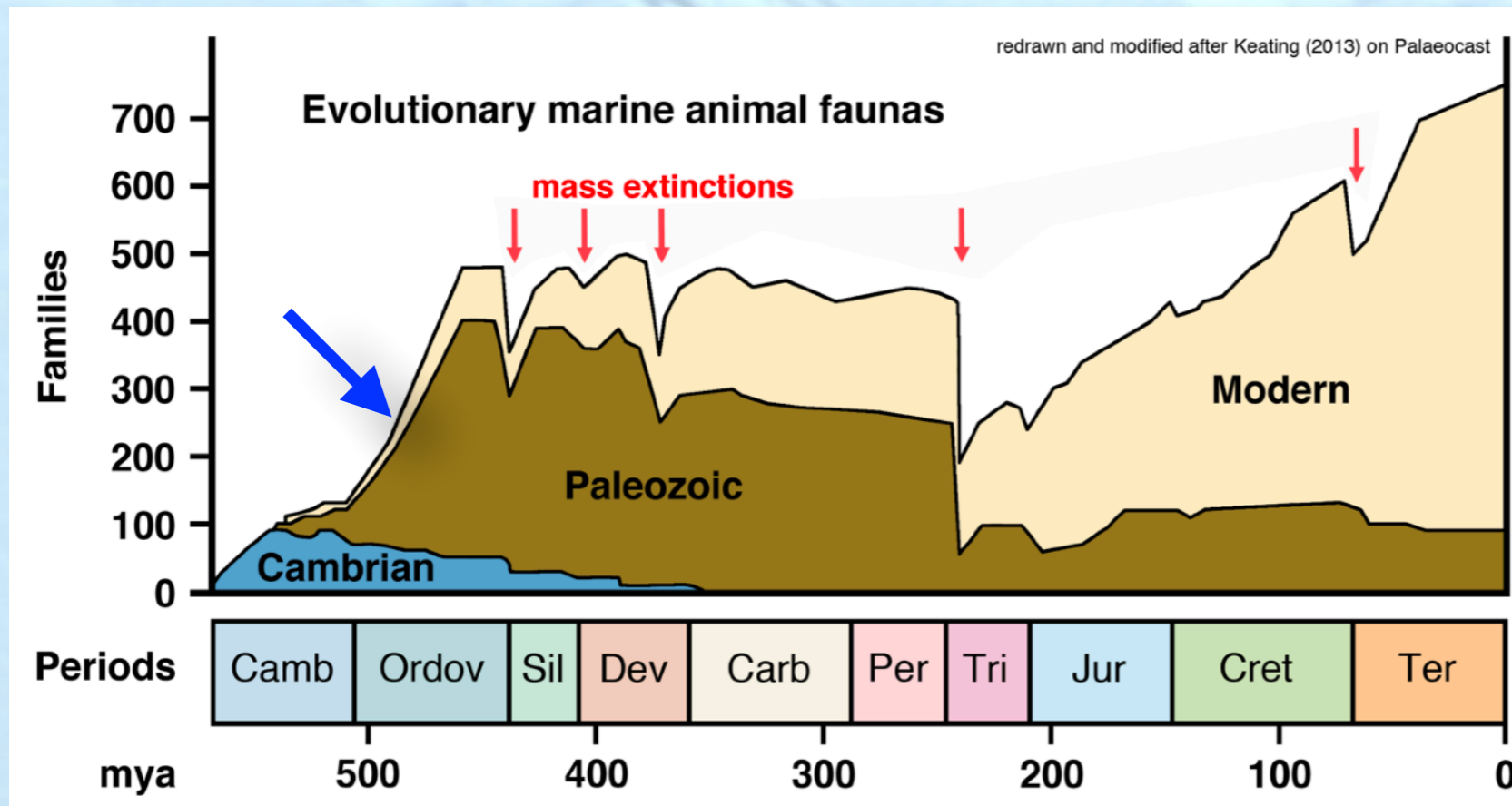
**(Derek Briggs 2015: The Cambrian explosion. *Current Biology* 25/10, 864–868)**





# Great Ordovician Biodiversification Event

485-460 mya (maximum at 470 mya)

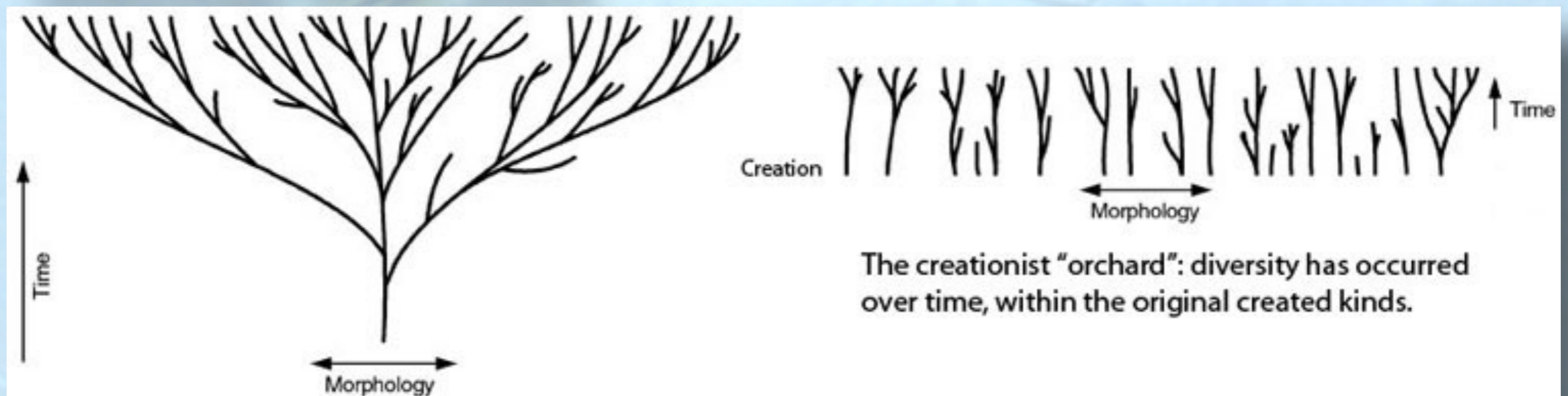




## *Top-Down* instead of *Bottom-Up*

The Neo-Darwinian theory of evolution predicts a *bottom-up* pattern of appearance of biological disparity: first species differences, then genus differences, then family / order / class differences, and at the end phylum level differences.

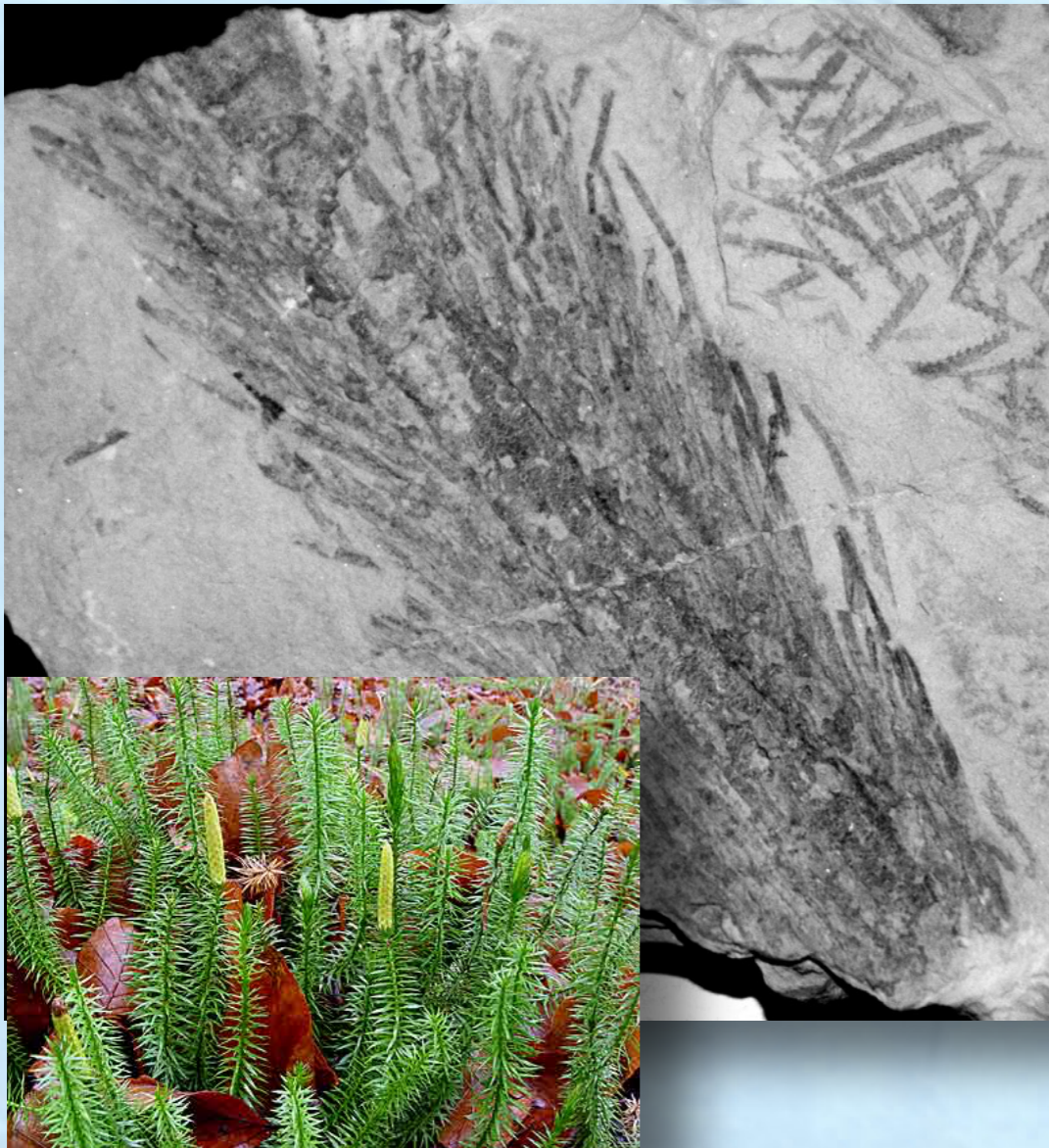
The fossil record shows the opposite: a *top-down* pattern, with phylum differences appearing out of nowhere in the Cambrian Explosion, only later diversified on the family level in the Ordovician GOBE event.





# Silurio-Devonian Terrestrial Revolution

ca. 427-393 mya



One of the two oldest known vascular land plants, *Baragwanathia* from the Late Silurian, already belongs to the modern group of club mosses.

Bateman et al. (1998) concluded that “*the Siluro-Devonian primary radiation of land biotas is the terrestrial equivalent of the much-debated Cambrian "explosion" of marine faunas*”

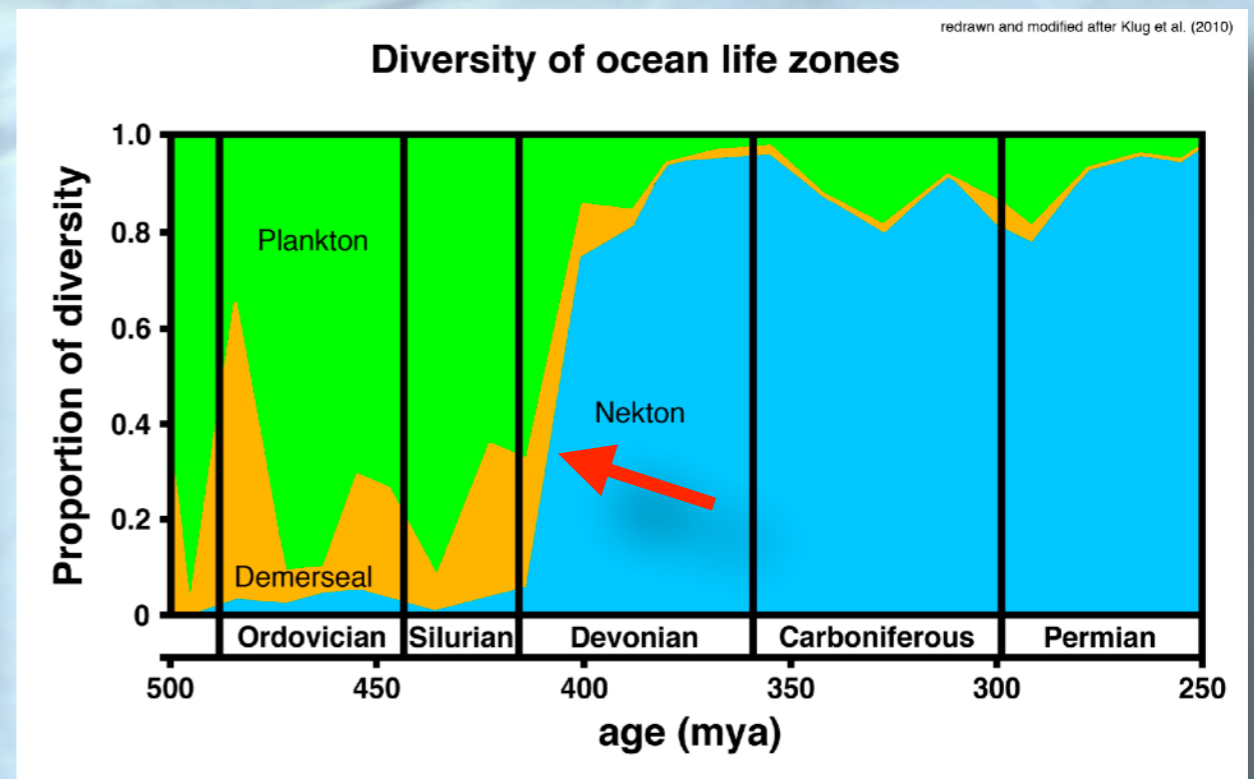


# Devonian Nekton Revolution

ca. 410-400 mya



Devonian radiation of marine nektonic animals (active swimmers like jawed fish and ammonoids) and synchronous decrease in planktonic and demersal taxa (Klug et al. 2010).





# Odontode Explosion

ca. 425-415 mya

Evolution of teeth in jawed fish with earliest Chondrichthyes, Sarcopterygii, and Actinopterygii all suddenly appearing within 10 million years of the Late Silurian to Early Devonian.



**Ideas that Push the Boundaries**  
[Explore this journal >](#)

Prospects & Overviews

**The odontode explosion: The origin of tooth-like structures in vertebrates**

Gareth J. Fraser , Robert Cerny, Vladimir Soukup, Marianne Bronner-Fraser, J. Todd Strelman 

First published: 17 August 2010 [Full publication history](#)

DOI: 10.1002/bies.200900151 [View/save citation](#)

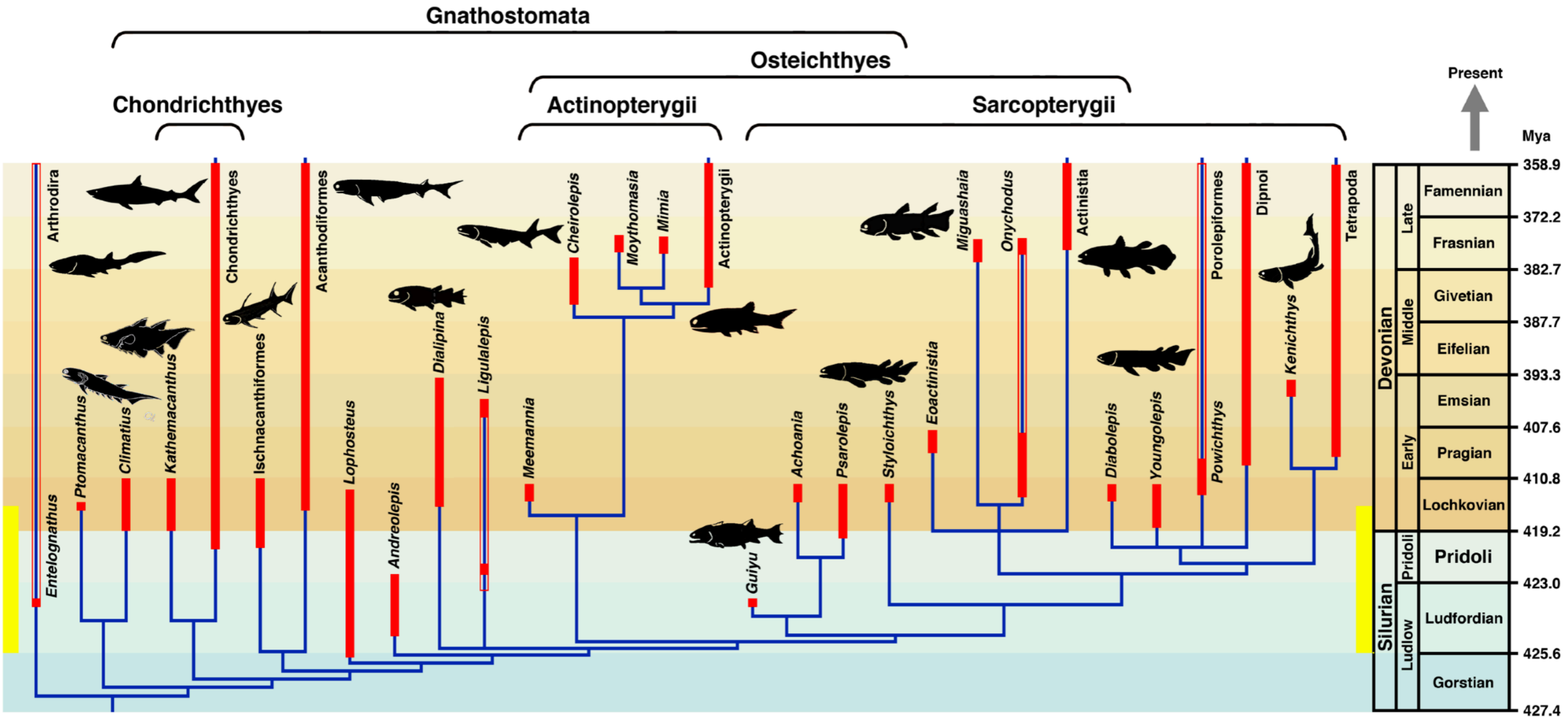


View issue TOC  
Volume 32, Issue 9  
September 2010  
Pages 808-817



# Odontode Explosion

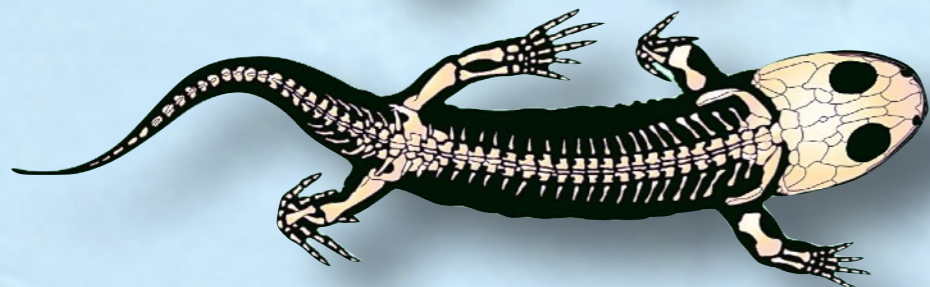
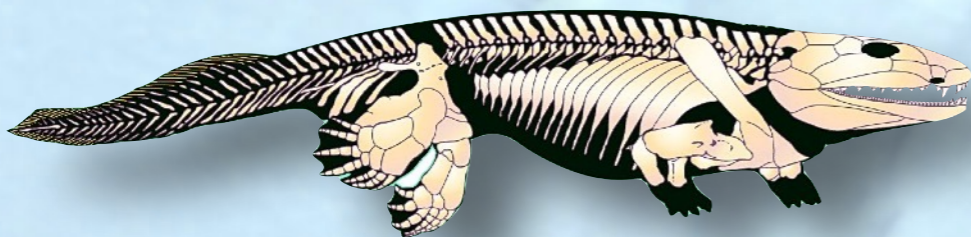
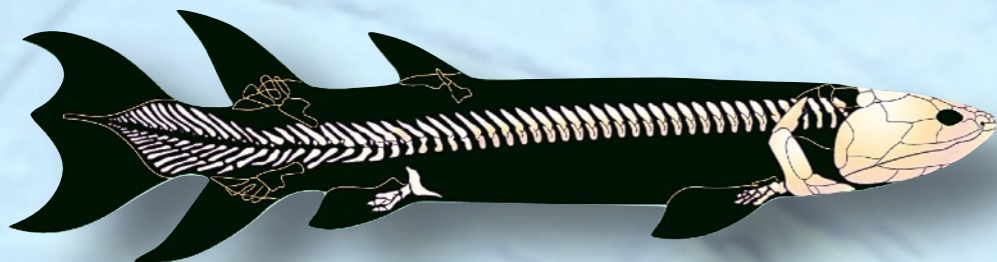
ca. 425-415 mya



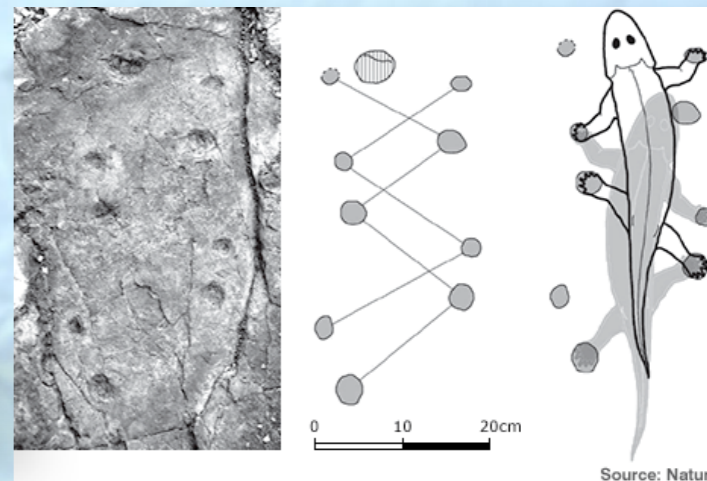


# Devonian Terrestrial Revolution

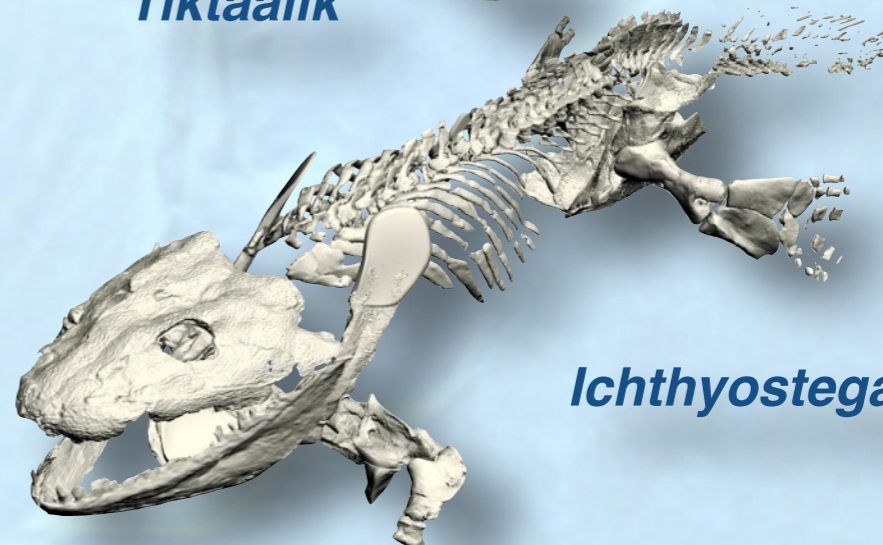
395 mya



Zachelmie  
tracks



*Tiktaalik*

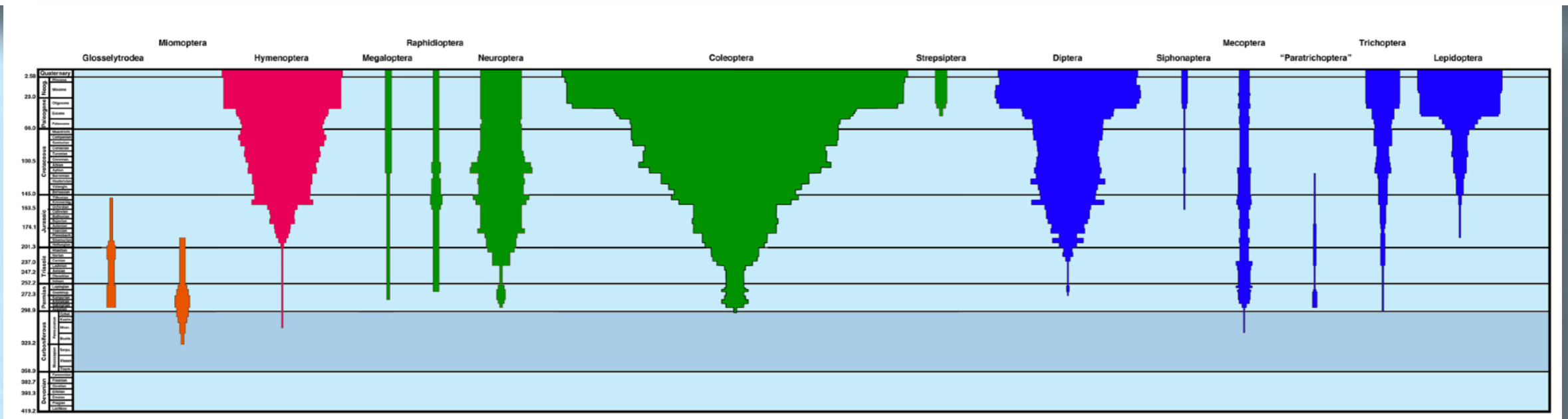
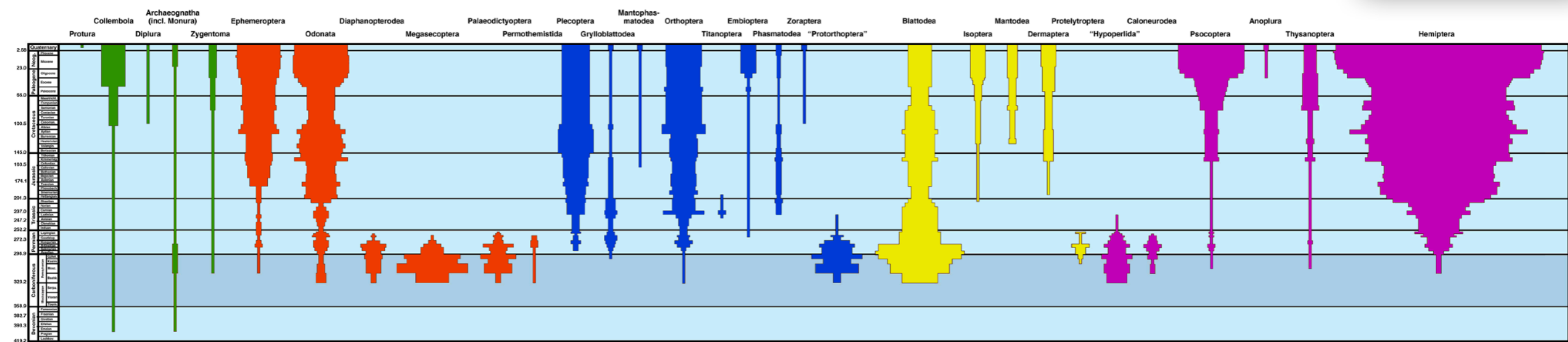


*Ichthyostega*



# Carboniferous Insect Explosion

325-314/307 mya





# Carboniferous Insect Explosion

325-314/307 mya



- **Palaeodictyoptera:** *Delitzschala* (Germany, 323-318 mya)
- **Mayflies:** *Triplosoba* (France, 303-299 mya)
- **Dragonflies:** *Eugeropteron* etc. (Argentina, 325-324 mya)
- **Stoneflies:** *Golou* (China, 318-314 mya)
- **Roaches:** *Kemperala* (Germany, 318 mya) and *Qilianiblatta* (China, 318-314 mya)
- **Orthopterans:** Archaeorthoptera (Czech Rep., 324 mya)
- **Thrips:** *Westphalothripides* (France, 314-307 mya)
- **Plant lice:** *Westphalopsocus* (France, 314-307 mya)
- **Bugs:** *Protoprosbole* (316 mya) and *Aviorrhyncha* (France, 314-307 mya)
- **Holometabolan larvae:** *Metabolarva* (Germany, 314-307 or 306 mya) and *Srokalarva* (USA, 311-307 mya)
- **Wasps:** *Avioxyela* (France, 314-307 mya)
- **Beetles:** *Stephanastus* (France, 303-299 mya)
- **Scorpionflies:** *Westphalomerope* (France, 318-314 mya)

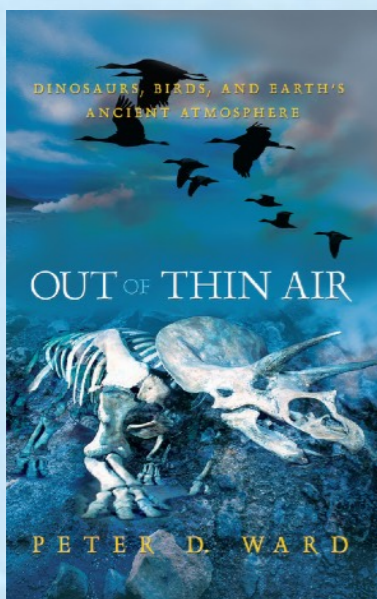


# Triassic Explosions

after End-Permian mass extinction 252 mya

(also Triassic Metazoan Radiation or Post-Permian Radiation)

No new phyla and classes, but many new families and orders of marine invertebrates (bivalves, ceratites), insects (Diptera, Coleoptera), marine reptiles, and terrestrial tetrapods.



Peter Ward (2006: 160): *“Thus, the diversity of Triassic animal plans is analogous to the diversity of marine body plans that resulted from the Cambrian Explosion. It also occurred for nearly the same reasons and, as will be shown, **was as important for animal life on land as the Cambrian Explosion was for marine animal life.**”*



# Triassic Tetrapod Radiation

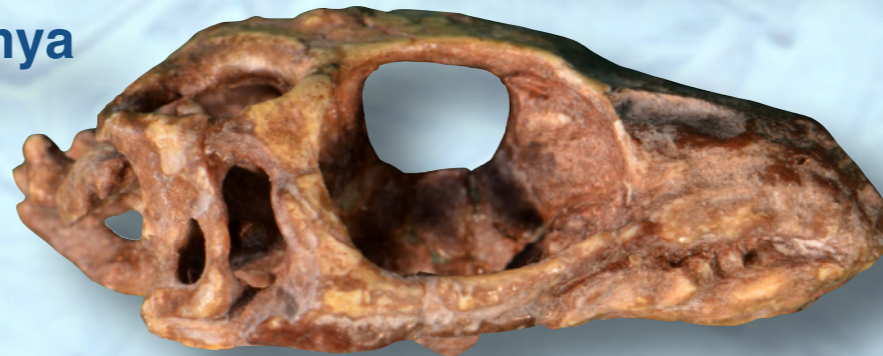
251-240 mya



Dinosauria: *Nyasasaurus*, 245-240 mya



Mammaliaformes: *Haramiyida*, 247-245 mya



Lepidosauromorpha:  
*Paliguana*, 251 mya



Testudines: *Pappochelis*, 240 mya

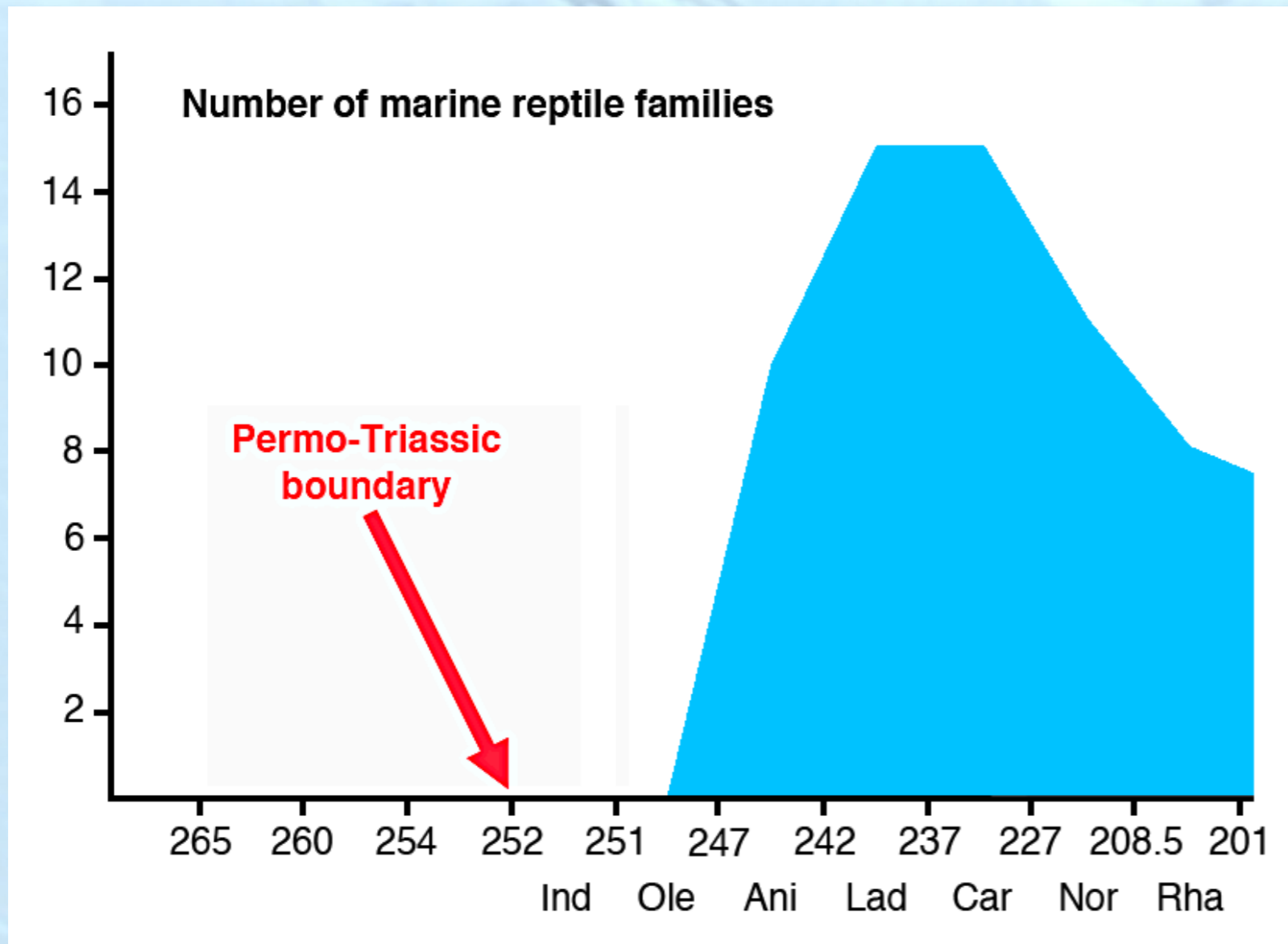


Crurotarsi: *Ctenosauriscus*, 247 mya



# Early Triassic Marine Reptile Radiation

248-240 mya



Number of marine reptile families jumps from zero to 15 within a few million years

*Aptodontatus unicus*





# Early Triassic Marine Reptile Radiation

248-240 mya



placodontians



pachypleurosaurids



ichthyosaurs

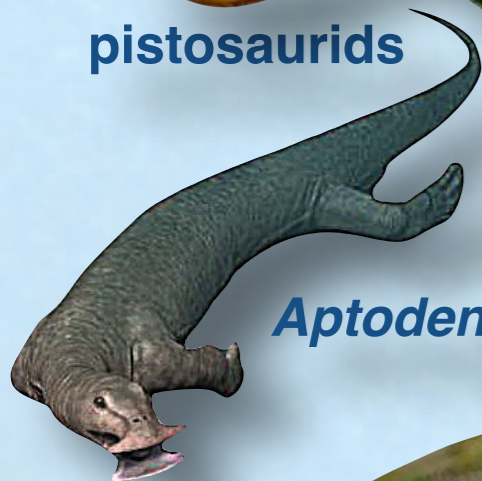


pistosaurids

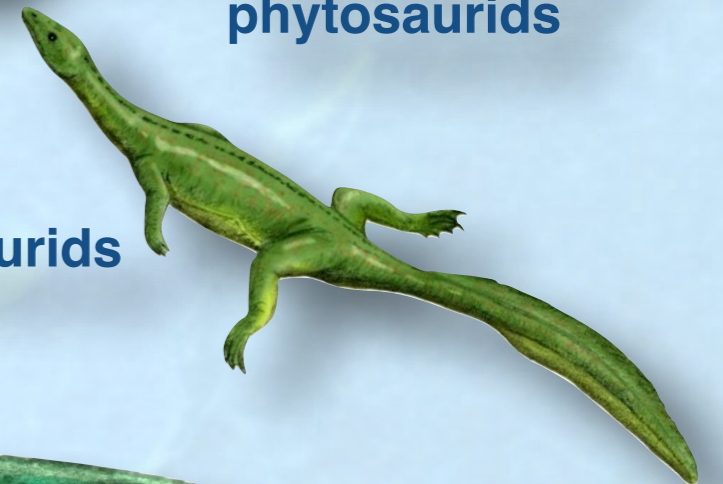


thalattosaurids

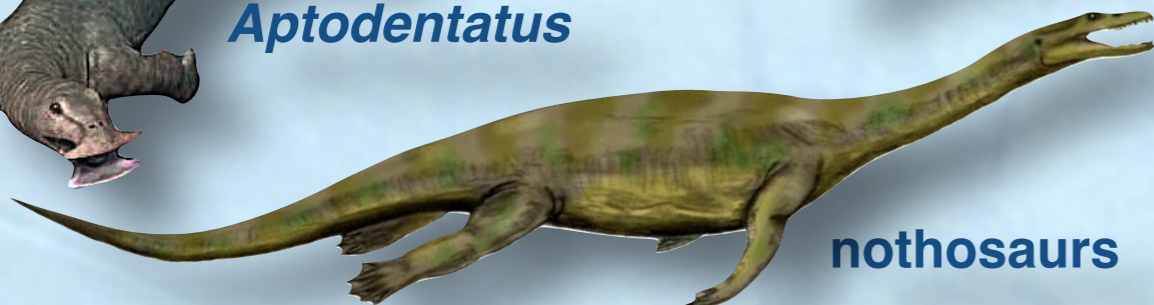
mystriosuchine  
phytosaurids



*Aptodontatus*



tanystropheids



nothosaurs



# Mid Triassic Gliding Reptile Radiation

230-228 mya



*Sharovipteryx*



*Pterosauria: Preondactylus*



*Icarosaurus*

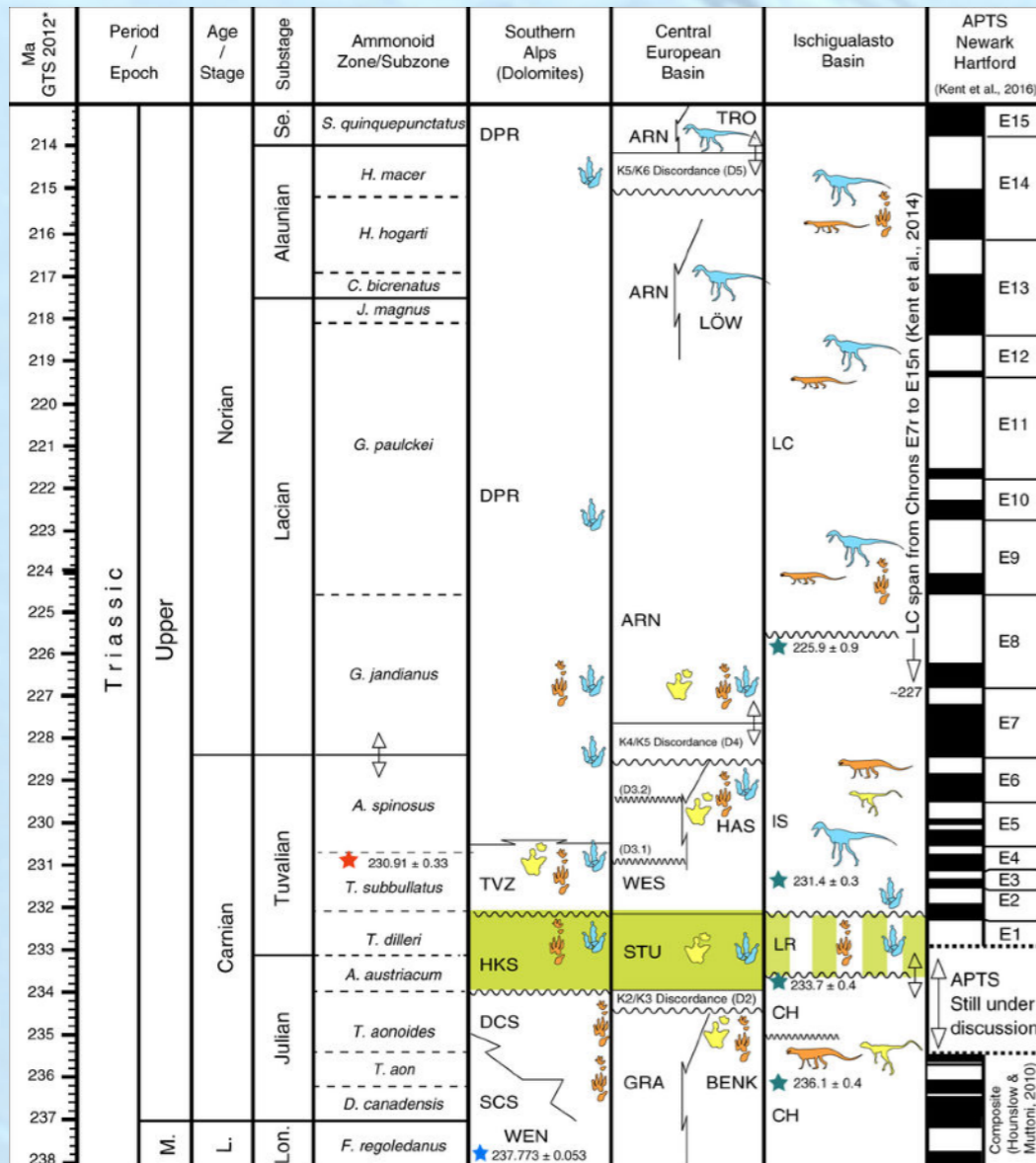


*Longisquama*



# Upper Triassic Dinosaur Explosion

234-232 mya (Carnian Pluvial Episode / CPE)



It was an “explosive increase in dinosaurian abundance” and “it’s amazing how clear cut the change from ‘no dinosaurs’ to ‘all dinosaurs’ was”.

nature COMMUNICATIONS

ARTICLE

DOI: 10.1038/s41467-018-03996-1 OPEN

Dinosaur diversification linked with the Carnian Pluvial Episode

Massimo Bernardi<sup>1,2</sup>, Piero Gianolla<sup>3</sup>, Fabio Massimo Petti<sup>1,4</sup>, Paolo Mietto<sup>5</sup> & Michael J. Benton<sup>1,2</sup>

NATURE COMMUNICATIONS | (2018)9:1499 | DOI: 10.1038/s41467-018-03996-1 | www.nature.com/naturecommunications



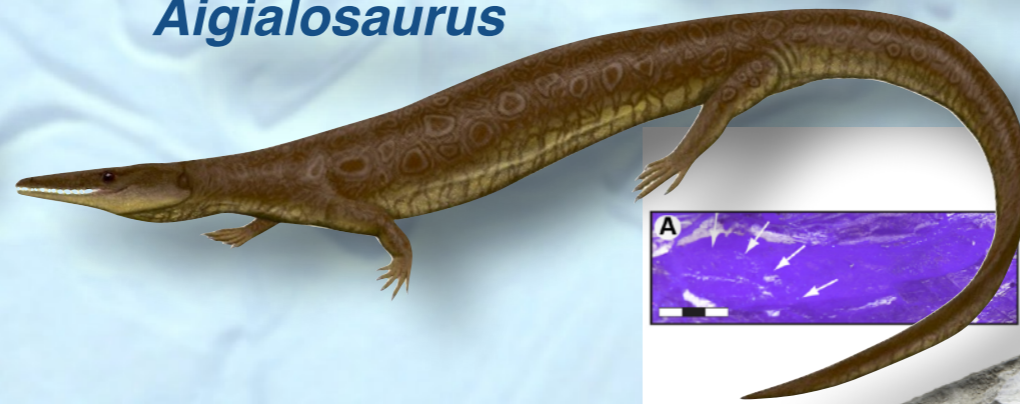
# Upper Cretaceous Mosasaur Radiation

89-66 mya

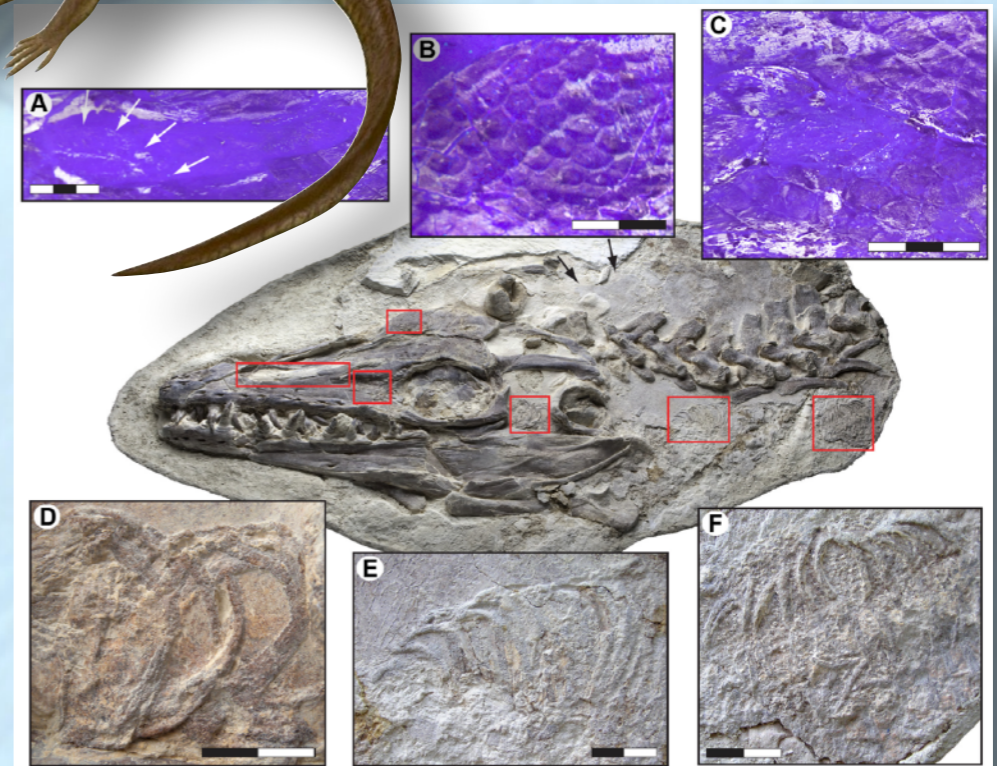
42 genera, 1-17 m, parallel instead of split bronchi (like whales, unlike monitors)



*Tylosaurus*



*Aigialosaurus*





# Origin of Flowering Plants

130-115 mya (crown group)



water lily, Crato Fm. 115 mya

Darwin's "abominable mystery": „*The seemingly sudden appearance of so many angiosperm species in the Upper Chalk conflicted strongly with his gradualist perspective on evolutionary change.*“ (Friedman 2009)

“*Then, about 125 million years ago, angiosperms and their **flowers sprang forth during the Cretaceous period, as fully formed as Aphrodite.***“ (Oskin 2015)



# Butterfly Radiation



55-25 mya

The different families of butterflies (Papilionoidea s.str. and other “macrolepidopterans”) appear abruptly without fossil transition in the Eocene / Oligocene of North America and Europe.

*Prodryas persephone*, Nymphalidae  
Eocene, Florissant, 34 mya



*Protocoeliades kristenseni*, HesperIIDae  
Eocene, Moler, 55 mya





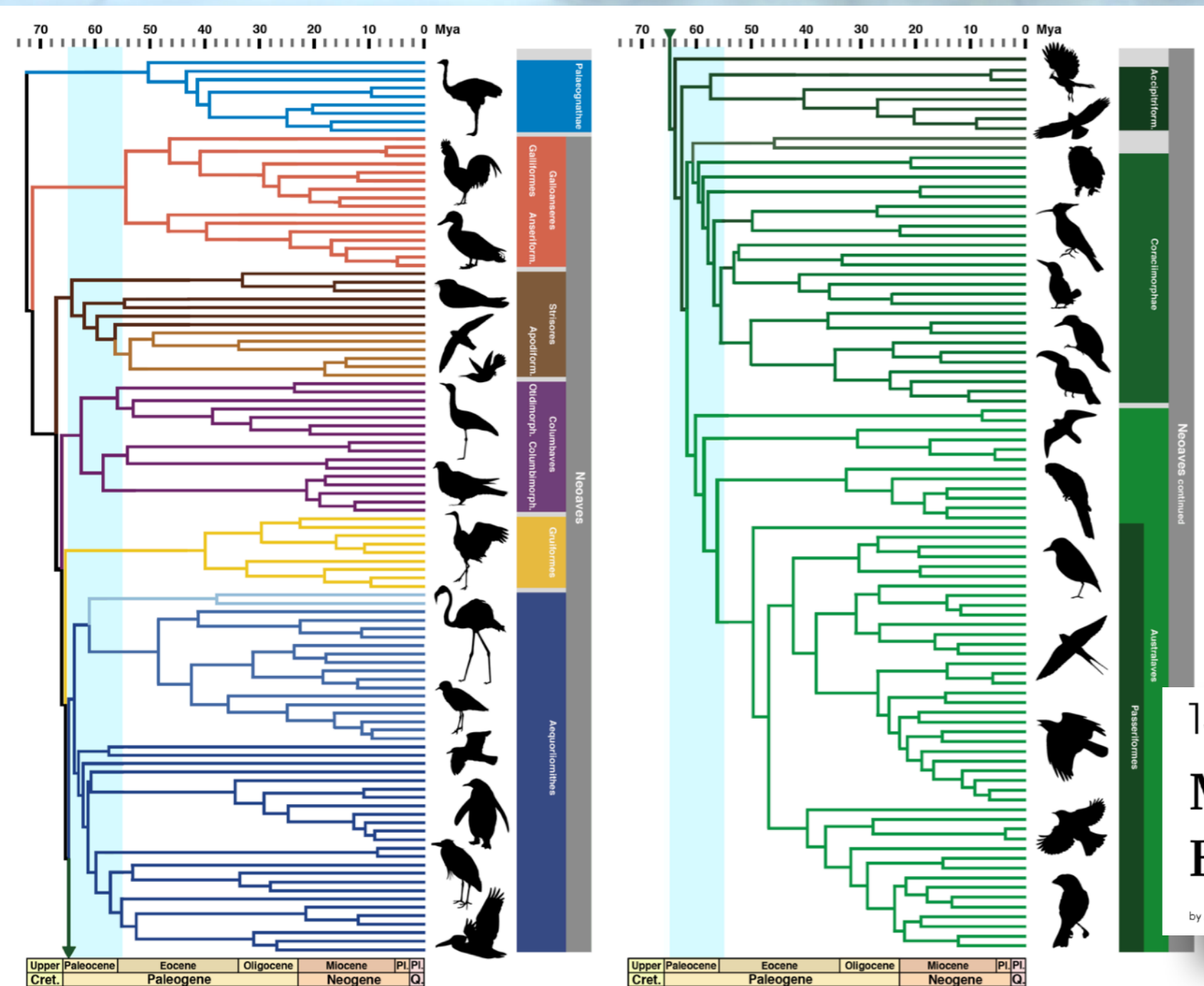
# Rapid Radiation of Modern Birds

After K-Pg-Impact: 65-55 mya



Penguin *Waimanu*  
61.6 mya, New Zealand

The phylogenomic analysis of Prum et al. (2015) showed that only 4 modern lineages originated before the K-Pg-impact



150 YEARS AMERICAN MUSEUM OF NATURAL HISTORY

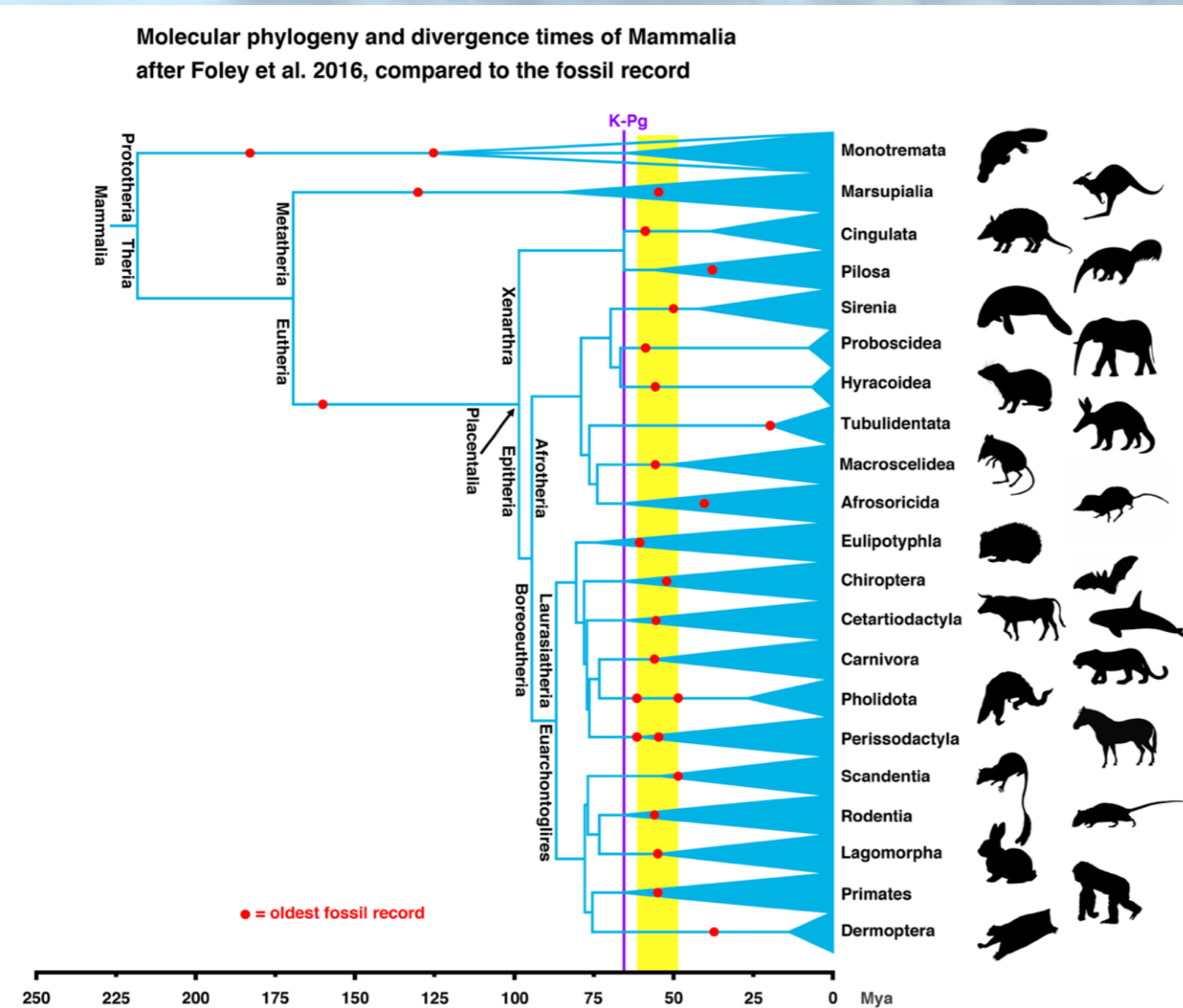
Mapping the “Big Bang” of Bird Evolution

by AMNH on Dec 11, 2014 3:20 pm

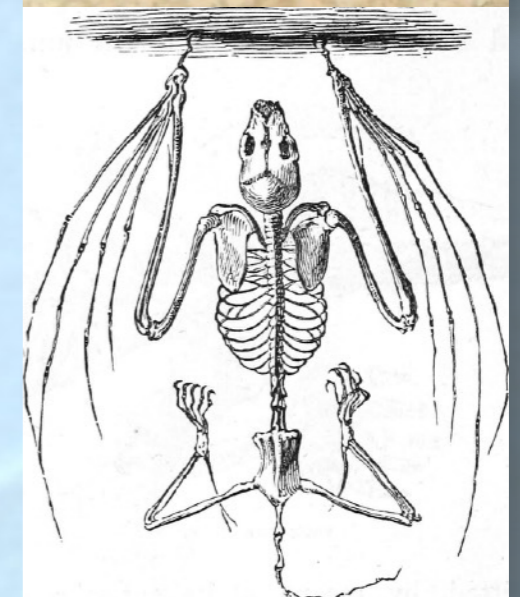


# Rapid Radiation of Placental Mammals

after K-Pg-Impact: 62-49 mya (crown group)



oldest bat  
52.5 mya



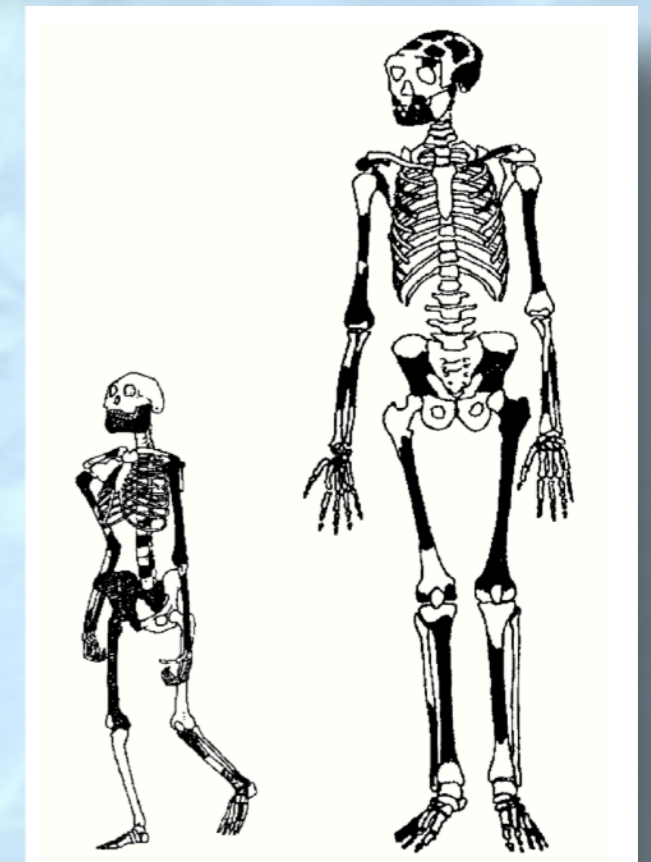


# Big Bang of the Genus *Homo*

about 2 mya

***“In sum, the earliest Homo remains differ significantly from australopithecines in both size and anatomical details. Insofar as we can tell, the changes were sudden and not gradual.”*** (Hawks et al. 2000)

***“New study suggests big bang theory of human evolution.”*** (Swanbrow 2000)



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#### Big Bang Theory Of Human Evolution?

Date: January 11, 2000

Source: University Of Michigan

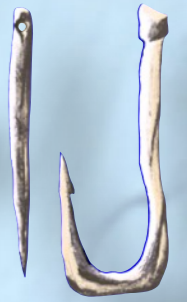
Summary: Two million years ago somewhere in Africa, a small group of individuals became separated from other australopithecines. This population bottleneck led to a series of sudden, interrelated changes---in body size, brain size, skeletal proportions, and behavior---that jump-started the evolution of our species.





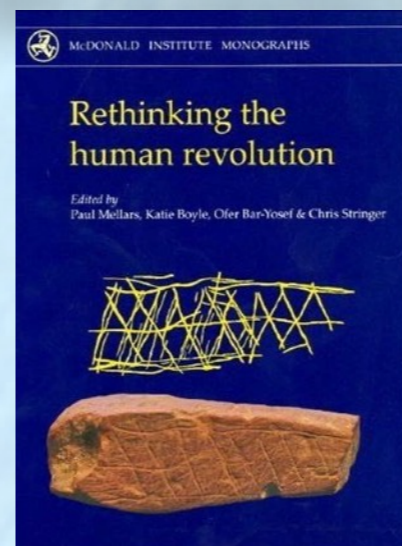


# Upper Paleolithic Human Revolution



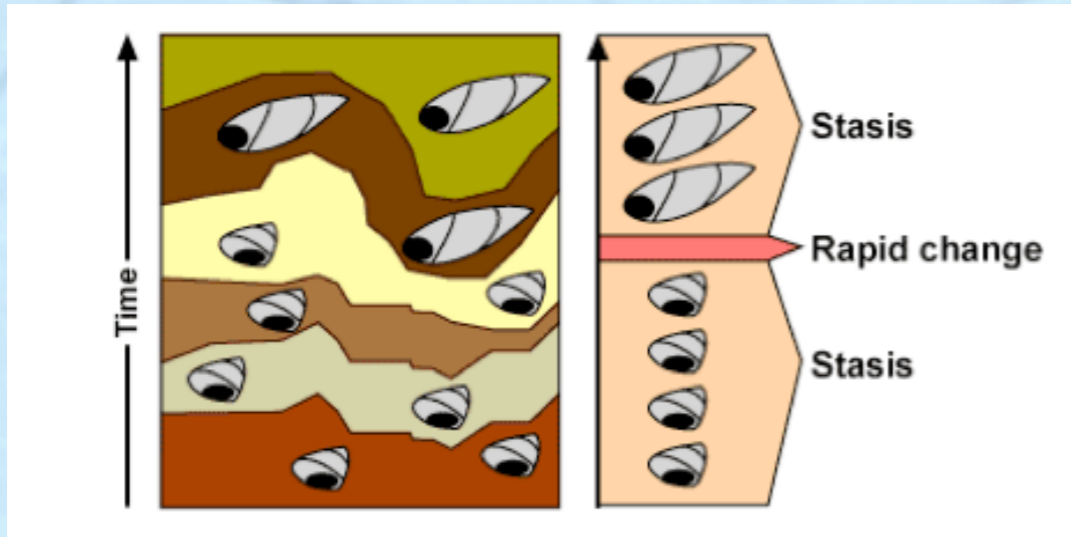
65,000-35,000 years ago

Richard Klein (2000, 2002): *“Recent interpretations of the African Middle Stone Age record are not conclusive; **the original ,human revolution‘ theory remains correct.** Middle Stone Age humans evolving in Africa may appear anatomically modern, but did not become cognitively modern until the Later Stone Age/Upper Palaeolithic. Symbolic culture emerged some 50,000 years ago, caused by a genetic mutation that re-wired the brain.”*





# No Fossils of Gradual Species Transitions



**Example: Foraminiferans**  
*Globorotalia plesiotumida* — *G. tumida*

## Evidence for abrupt speciation in a classic case of gradual evolution

Pincelli M. Hull<sup>1</sup> and Richard D. Norris

Scripps Institution of Oceanography, University of California at San Diego, La Jolla, CA 92093

Edited by Michal Kucera, University of Tübingen, Germany, and accepted by the Editorial Board October 7, 2009 (received for review March 23, 2009)

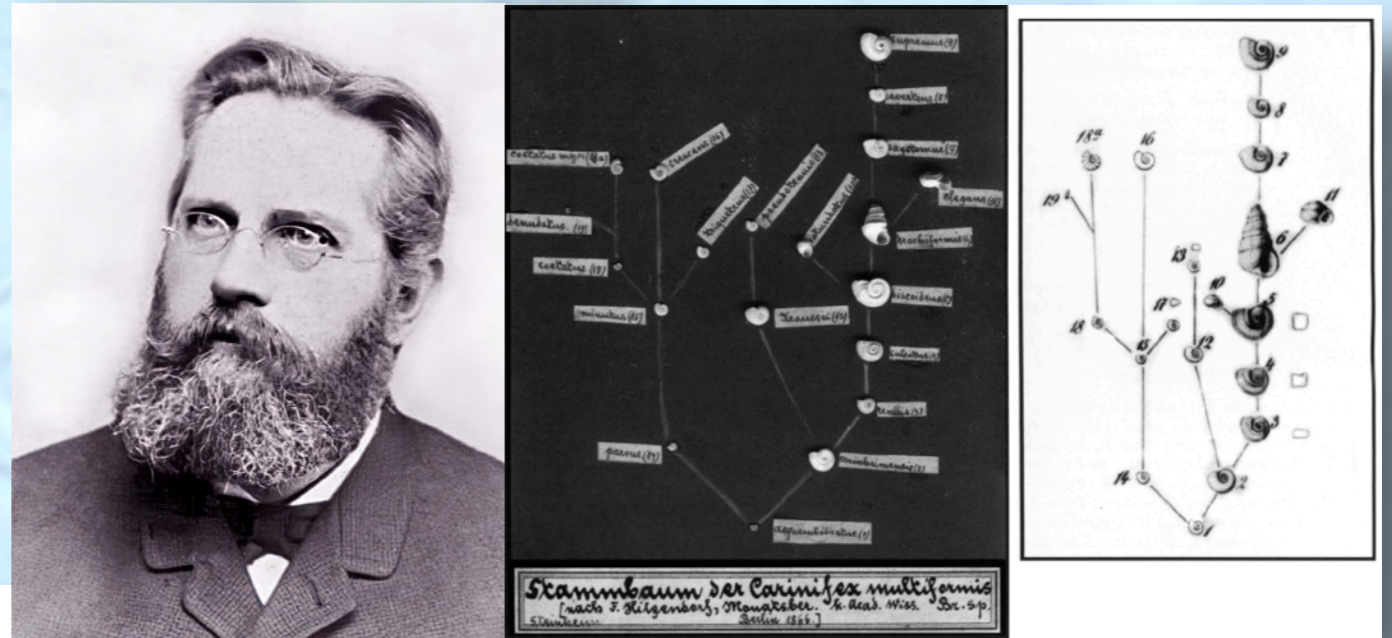


# No Fossils of Gradual Species Transitions

Example: Miocene Steinheim basin freshwater snails *Gyraulus*



Franz Hilgendorf (1866)



## Ecology and Evolution

Open Access

### Ecophenotypic plasticity leads to extraordinary gastropod shells found on the "Roof of the World"

Catharina Clewing<sup>1</sup>, Frank Riedel<sup>2,3</sup>, Thomas Wilke<sup>1</sup> & Christian Albrecht<sup>1</sup>

<sup>1</sup>Department of Animal Ecology and Systematics, Justus Liebig University Giessen, Giessen, Germany

<sup>2</sup>Palaeontology, Institute of Geological Sciences, Freie Universität Berlin, Berlin, Germany

<sup>3</sup>Key Laboratory of Plateau Lake Ecology and Global Change, College of Tourism and Geography, Yunnan Normal University, Yunnan, China



# No Fossils of Gradual Species Transitions

3rd Example: *Australopithecus anamensis* - *A. afarensis* (Lucy)  
“one of the strongest cases for anagenesis in the fossil record”

## A 3.8-million-year-old hominin cranium from Woranso-Mille, Ethiopia

Yohannes Haile-Selassie<sup>1,5\*</sup>, Stephanie M. Melillo<sup>2,5\*</sup>, Antonino Vazzana<sup>3</sup>, Stefano Benazzi<sup>3</sup> & Timothy M. Ryan<sup>4</sup>

The cranial morphology of the earliest known hominins in the genus *Australopithecus* remains unclear. The oldest species in this genus (*Australopithecus anamensis*, specimens of which have been dated to 4.2–3.9 million years ago) is known primarily from jaws and teeth, whereas younger species (dated to 3.5–2.0 million years ago) are typically represented by multiple skulls. Here we describe a nearly complete hominin cranium from Woranso-Mille (Ethiopia) that we date to 3.8 million years ago. We assign this cranium to *A. anamensis* on the basis of the taxonomically and phylogenetically informative morphology of the canine, maxilla and temporal bone. This specimen thus provides the first glimpse of the entire craniofacial morphology of the earliest known members of the genus *Australopithecus*. We further demonstrate that *A. anamensis* and *Australopithecus afarensis* differ more than previously recognized and that these two species overlapped for at least 100,000 years—contradicting the widely accepted hypothesis of anagenesis.

published in NATURE 2019





# No Fossils of Gradual Species Transitions

Hunt (2010) re-evaluated the fossil evidence for species level transformations in the light of 150 years of paleontological research since Darwin:

***“The meandering and fluctuating trajectories captured in the fossil record are not inconsistent with the centrality of natural selection as an evolutionary mechanism, but they probably would not have been predicted without the benefit of an empirical fossil record”***

VOL. 176, SUPPLEMENT THE AMERICAN NATURALIST DECEMBER 2010

## Evolution in Fossil Lineages: Paleontology and *The Origin of Species*

Gene Hunt\*

Department of Paleobiology, National Museum of Natural History, Smithsonian Institution, Washington, DC 20013

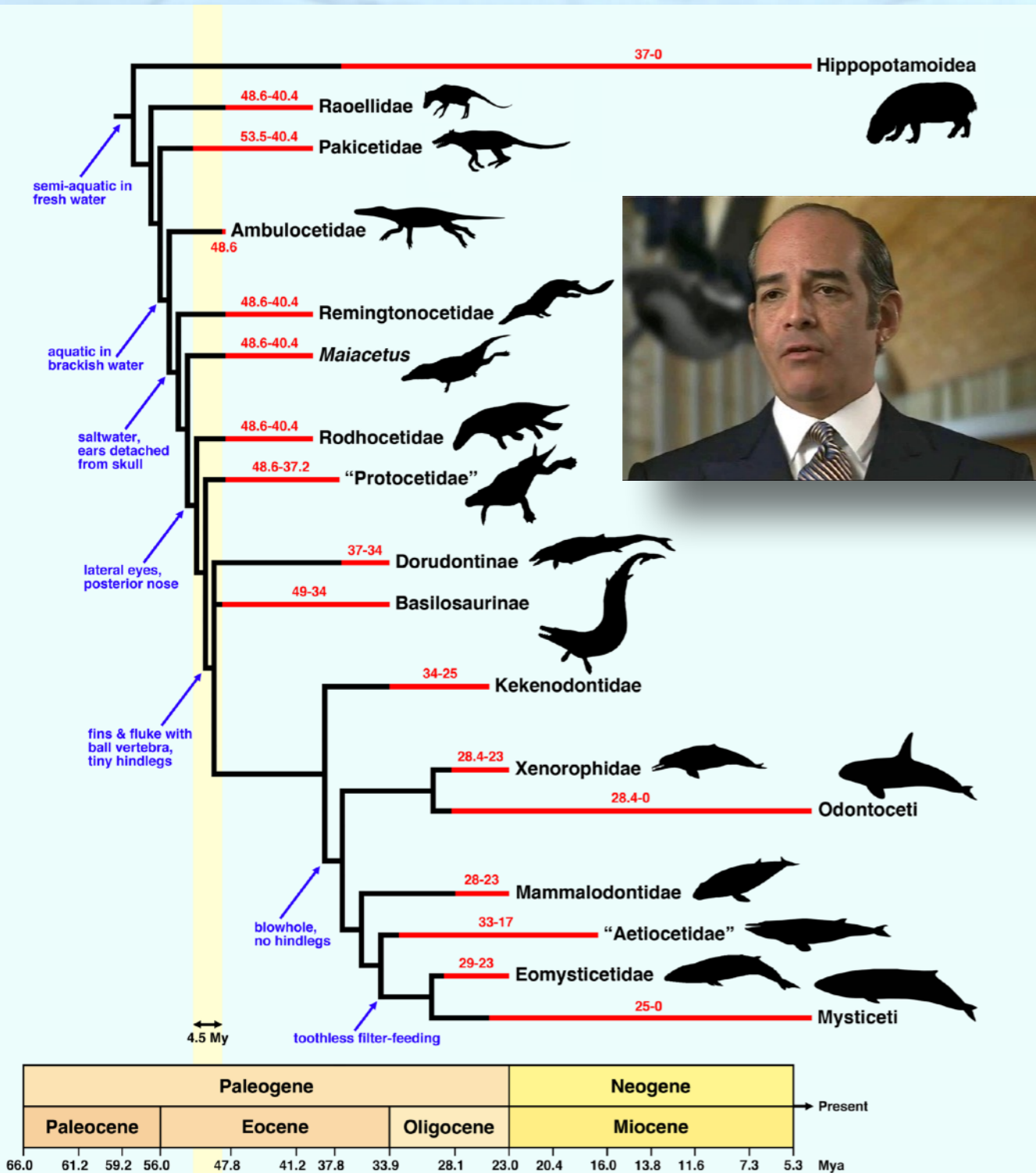




# The Waiting Time Problem

The fossil record and population genetics combined do refute the mathematical feasibility of the Neo-Darwinian mechanism.

Geological available windows of time are much too short to accommodate the required genetic changes to arise and spread in the ancestral populations.



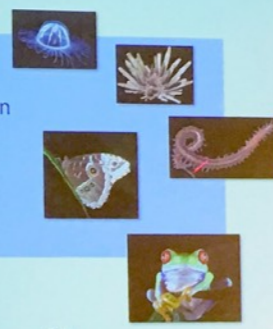


# Mainstream Evolutionists Admit the Problem

Renowned evolutionary biologist Prof. Gerd Müller at his keynote talk to the conference “*New Trends in Evolutionary Biology*” at the Royal Society in London in November 2016.

THE ROYAL SOCIETY

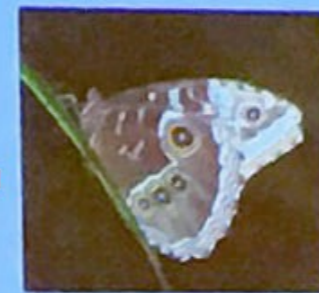


- explanatory deficits of the MS theory
- phenotypic complexity
  - biases in the generation of variation
  - phenotypic novelty
  - non-gradual forms of transition
  - non-genetic factors of change
- 



## explanatory deficits of the MS theory

- phenotypic complexity ←
- biases in the generation of variation
- phenotypic novelty ←
- non-gradual forms of transition ←
- non-genetic factors of change





# Inference to the Best Explanation

**The core predictions of Neo-Darwinism, such as gradualism, are contradicted by the empirical evidence.**

**The cumulative conflicting evidence from molecular biology, genetics, population genetics, and the fossil record can no longer be explained away as anomalies or as artifacts (e.g., of undersampling of an incomplete fossil record).**

**The total evidence is better explained with pulses of infusion of information from outside of the system (top-down) than with a purely mechanistic stepwise bottom-up process.**





# Questions & Answers

