History of Life 2

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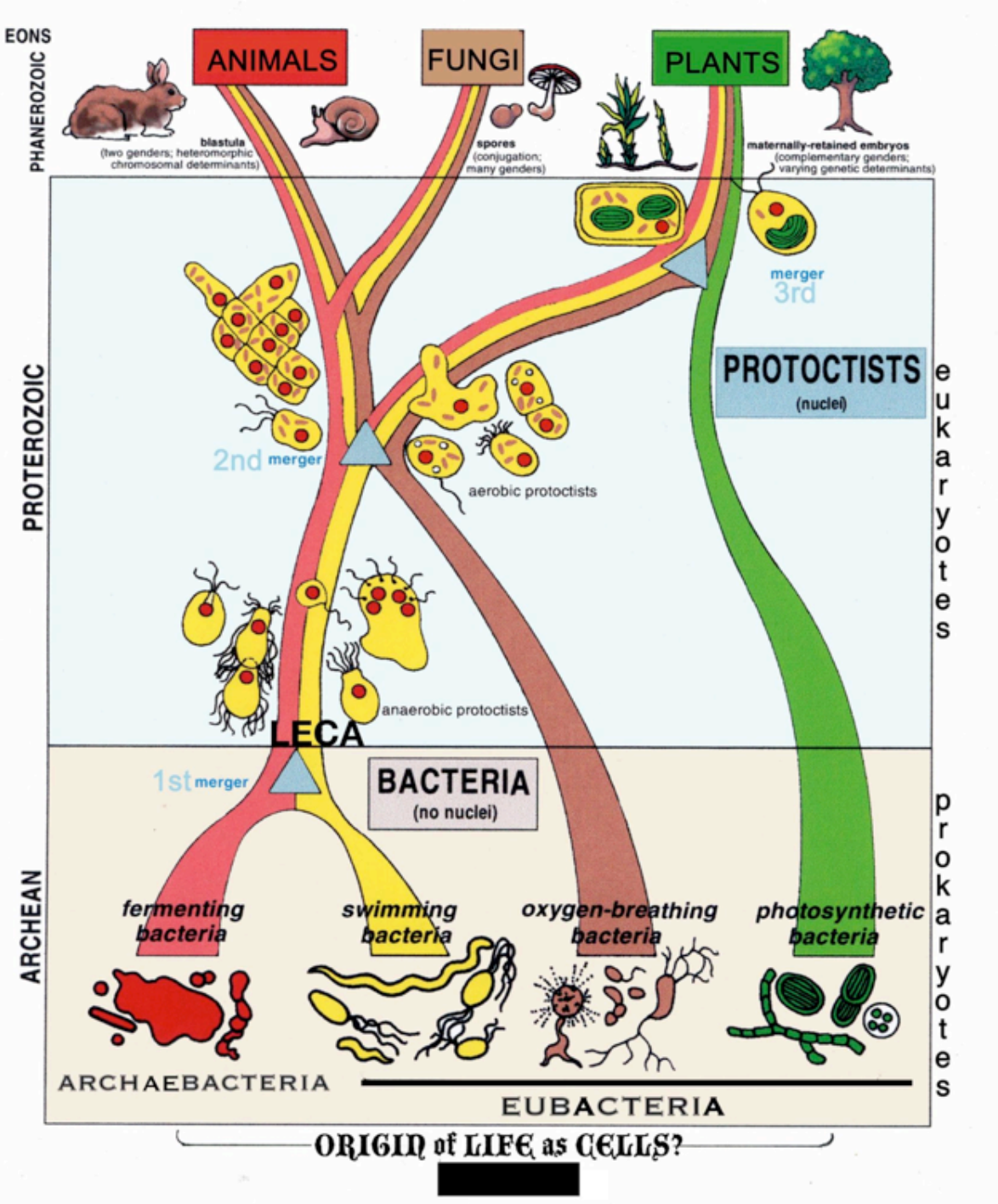
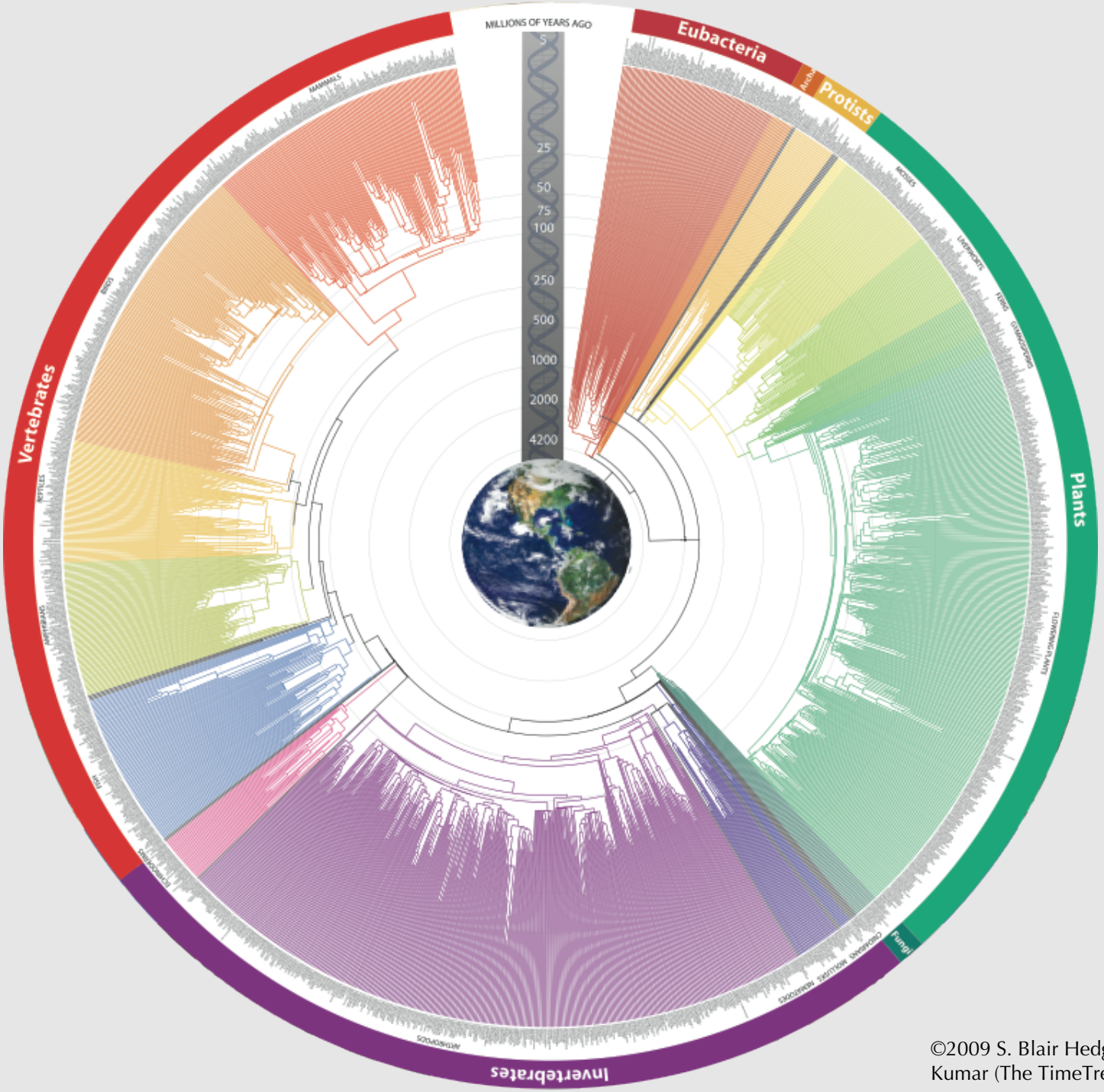
EEB464 Fall 2019

Learning outcomes

- Understand major events in metazoan life
- Be able to explain endosymbiosis
- Start to consider explanations for patterns

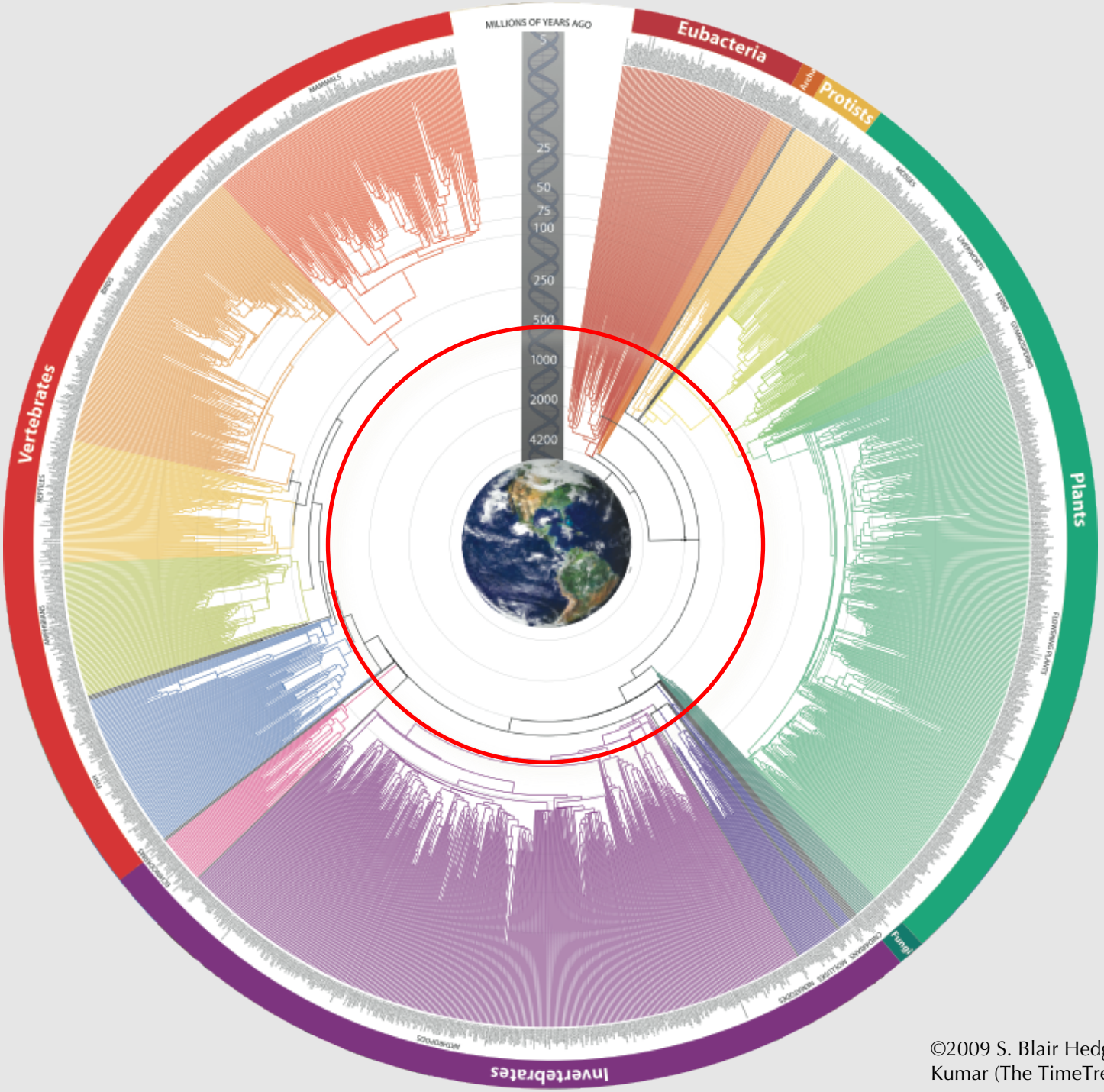




Precambrian: 4,500-550 MYA

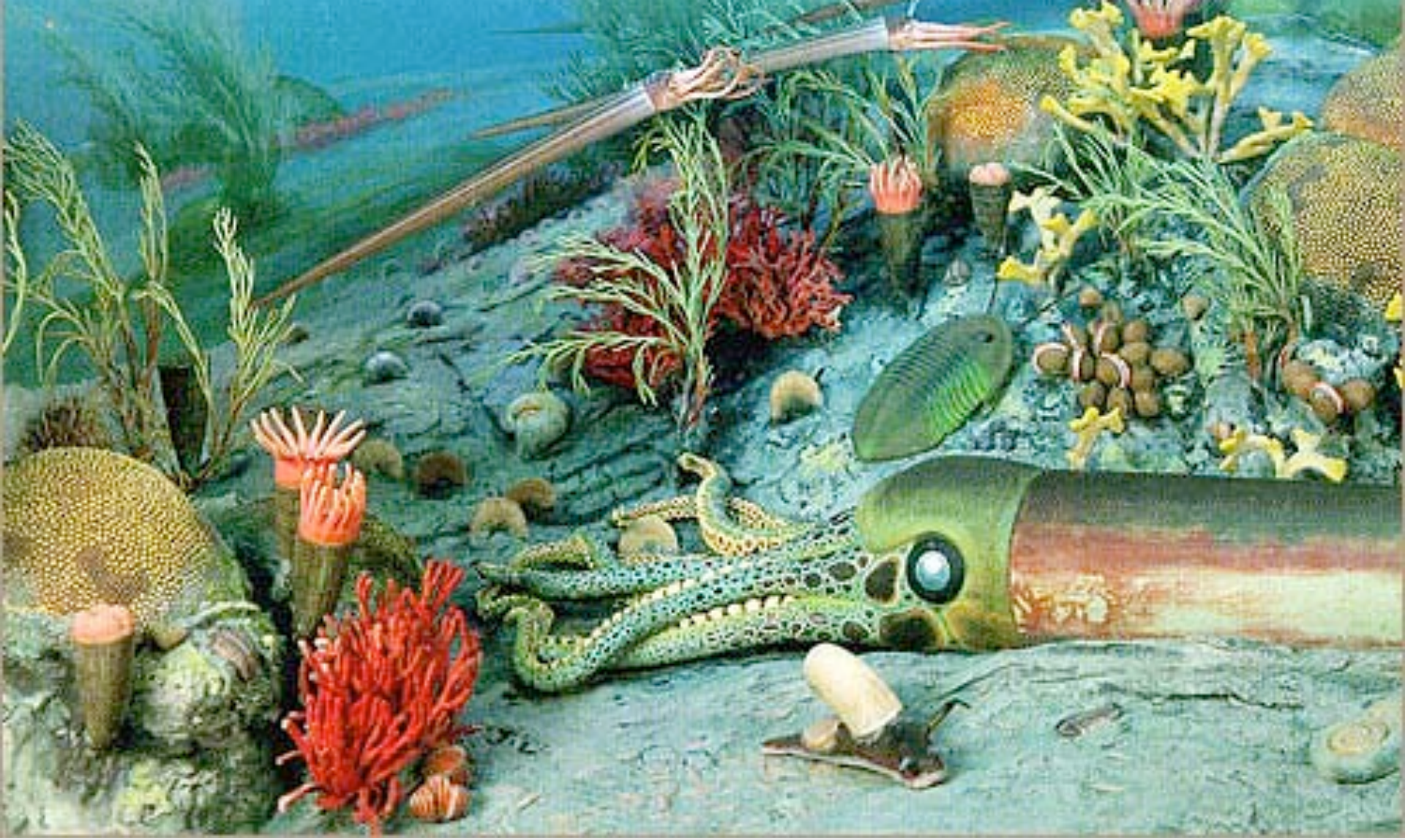
First single-celled organisms, simple plants, and invertebrate animals: algae, bacteria, jellyfish, flagellates, amoebas, worms, sponges

http://www.pbs.org/wgbh/nova/link/hist_nf.html



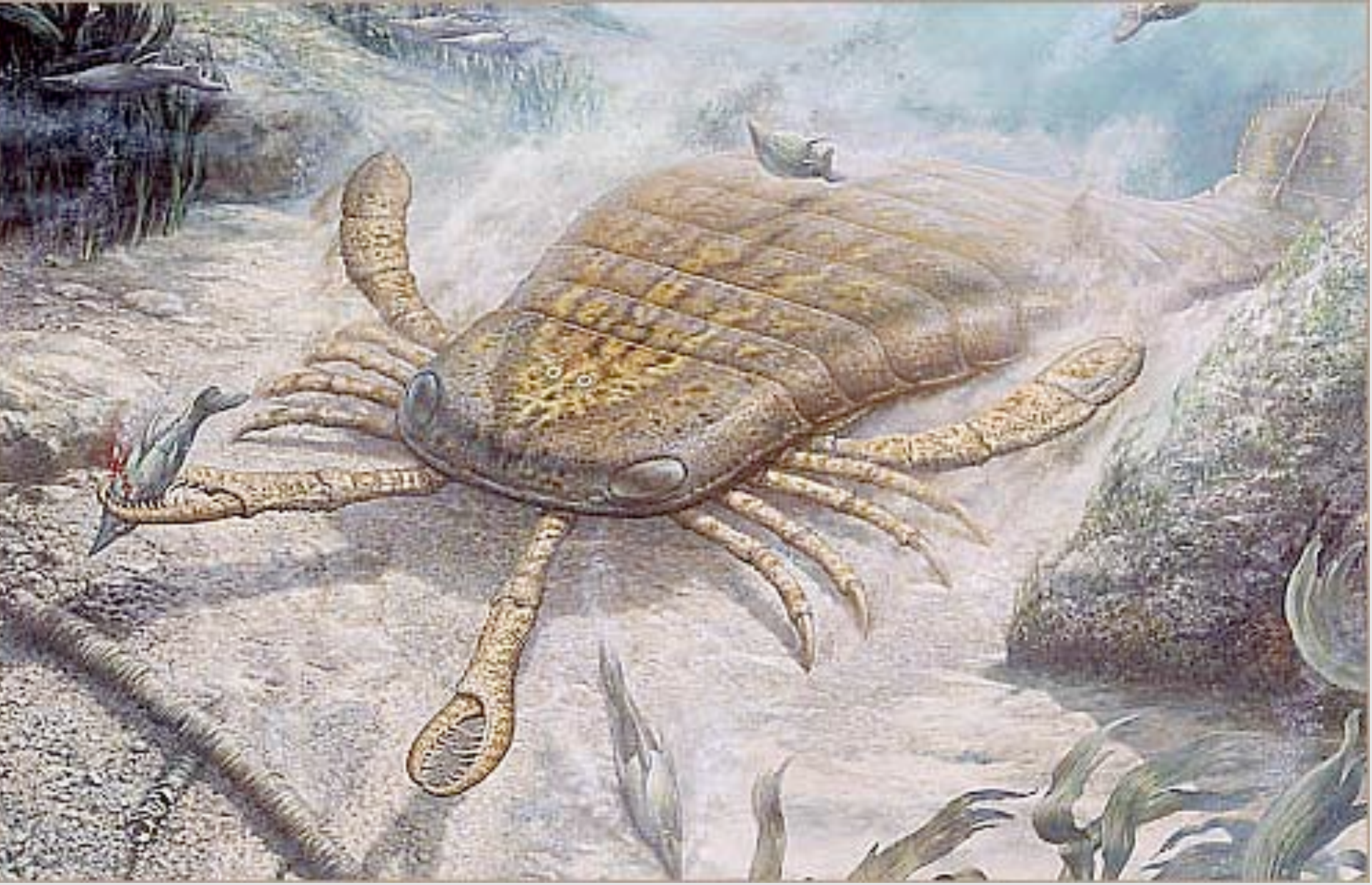
Cambrian: 550-505 mya: First trilobites, forams, brachiopods, nautiloids, clams, snails, crustaceans, crinoids, gastropods, corals, protozoans

http://www.pbs.org/wgbh/nova/link/hist_nf.html



Ordovician: 505-438 mya. First starfish, sea urchins, blastoids, eurypterids, bryozoa, scaphopods, jawless fish, echinoids

http://www.pbs.org/wgbh/nova/link/hist_nf.html



Silurian: 438-408 mya First land plants, ferns, sharks, bony fish, scorpions

http://www.pbs.org/wgbh/nova/link/hist_nf.html

Richard Bizley

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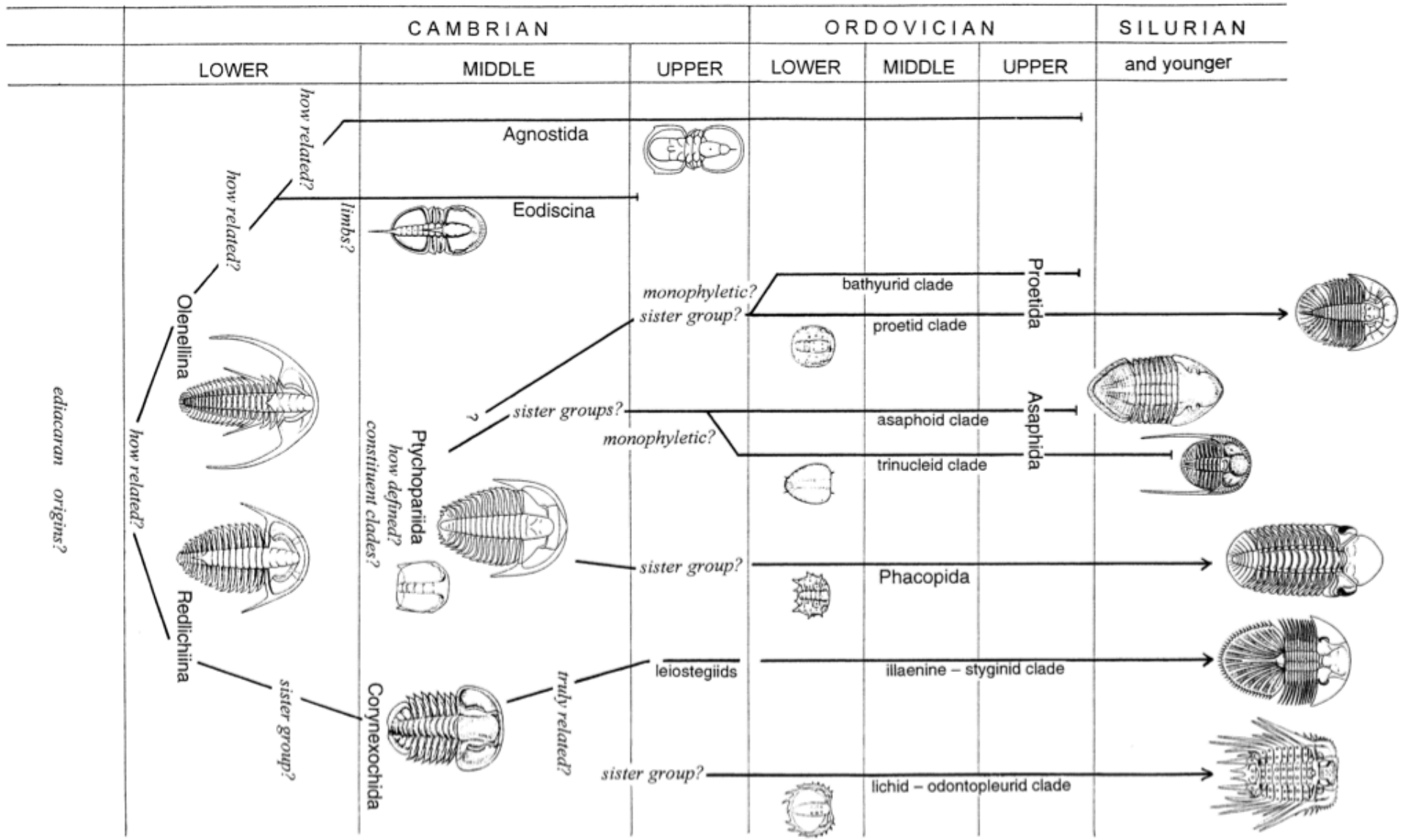
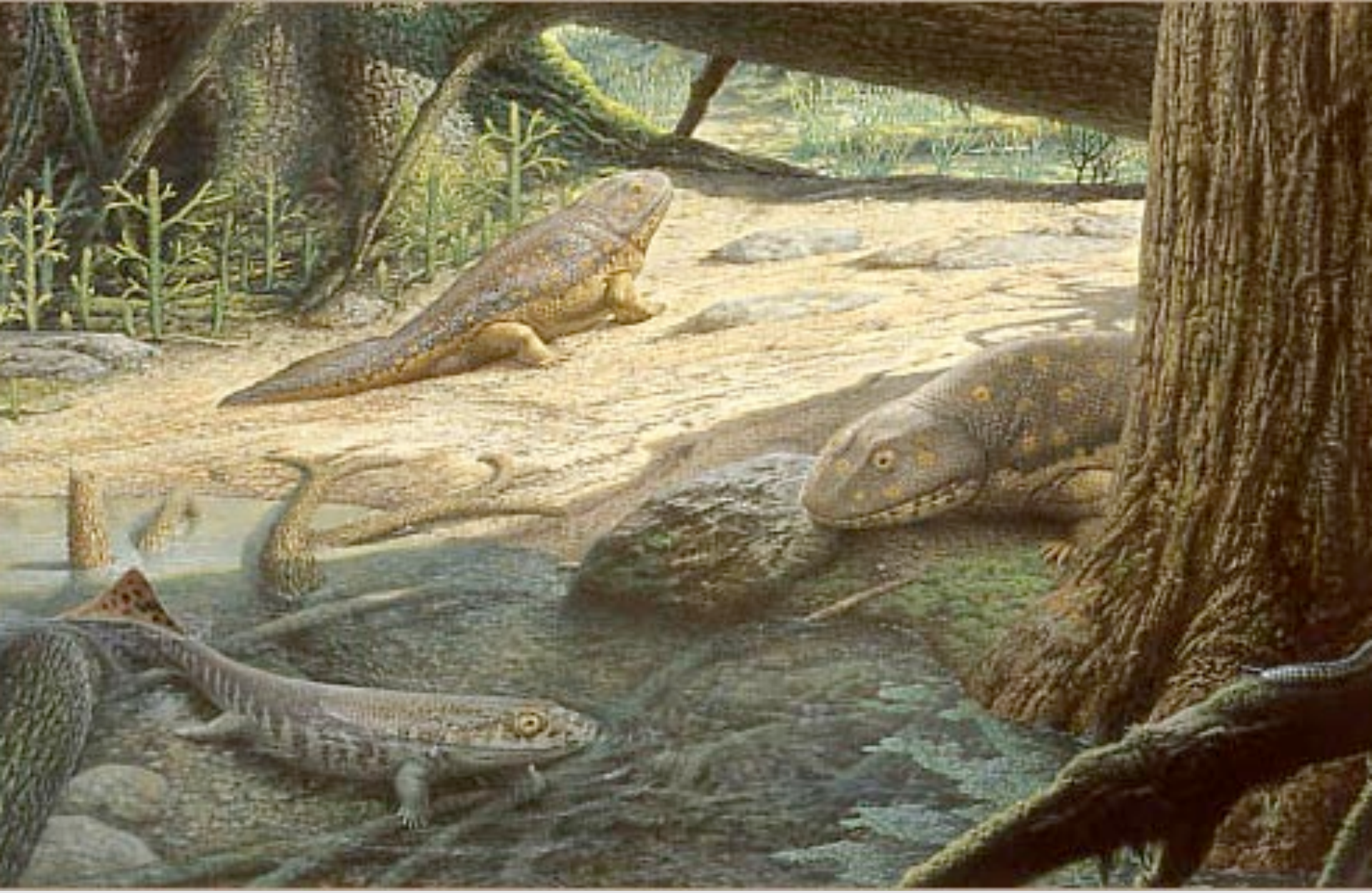


Fortey. Trilobite Systematics: The Last 75 Years. Journal of Paleontology (2001) vol. 75 (6) pp. 1141-1151



Devonian 408-360 mya: First insects, tetrapods, ammonites, placoderms

http://www.pbs.org/wgbh/nova/link/hist_nf.html

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Carboniferous: 360-286 mya: First reptiles, spiders, amphibians, conifers, synapsids

http://www.pbs.org/wgbh/nova/link/hist_nf.html

BBC Walking with Monsters

Permian 286-248 mya Heyday of synapsids

http://www.pbs.org/wgbh/nova/link/hist_nf.html

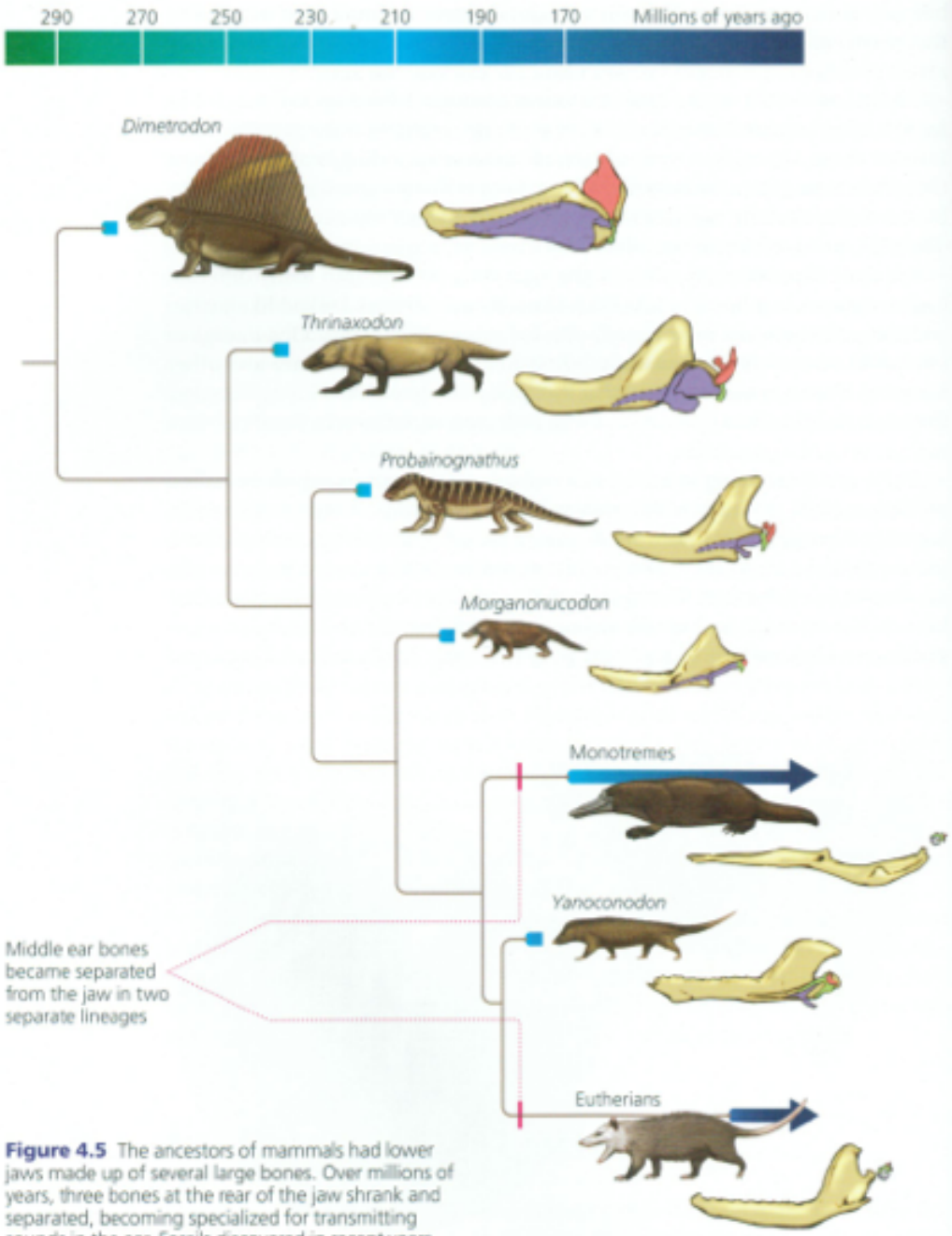
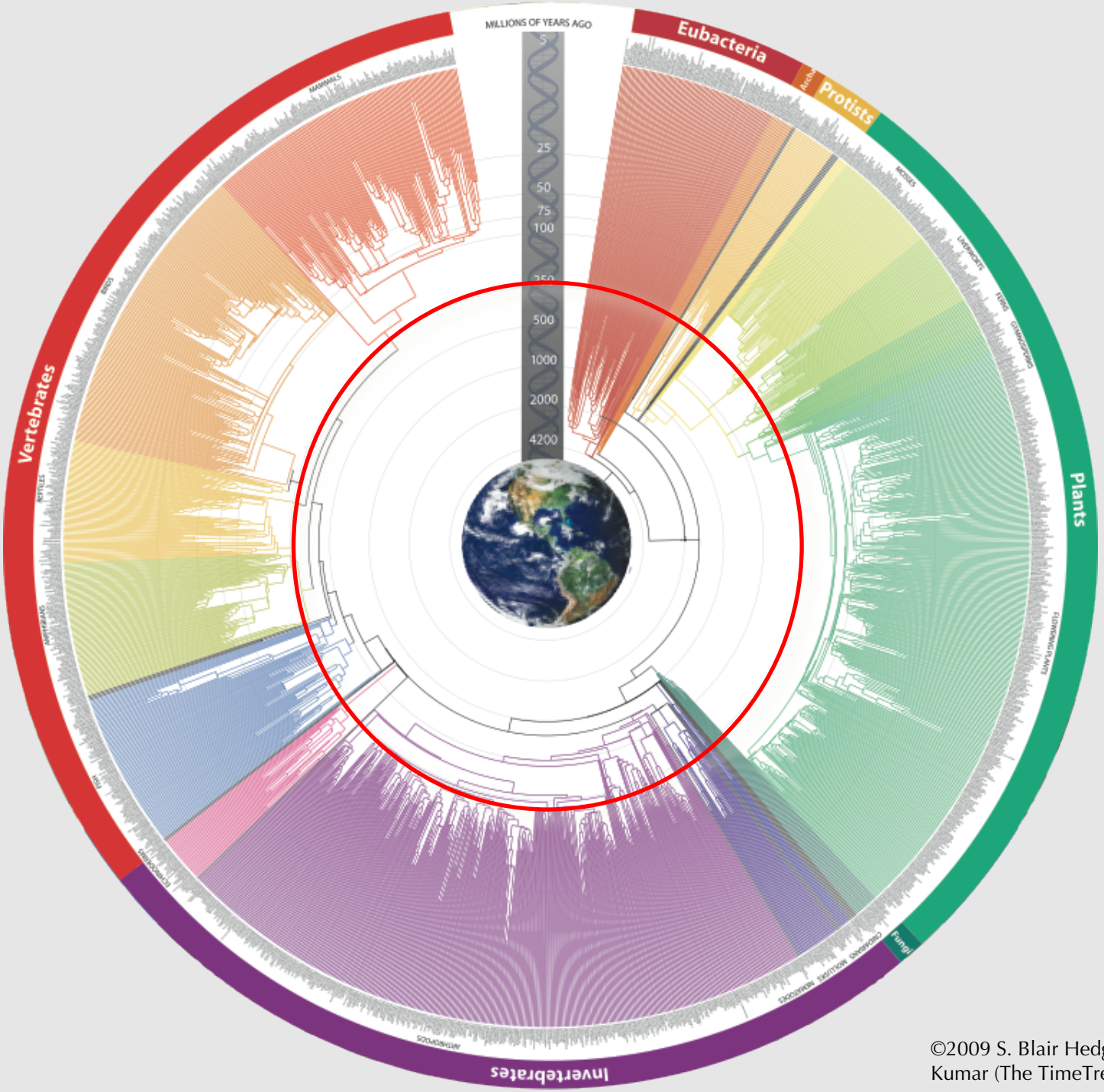


Figure 4.5 The ancestors of mammals had lower jaws made up of several large bones. Over millions of years, three bones at the rear of the jaw shrank and separated, becoming specialized for transmitting sounds in the ear. Fossils discovered in recent years have revealed that ear bones separated independently in the two main lineages of living mammals, the monotremes and the eutherians.

Zimmer 2010. *The Tangled Bank* p. 70



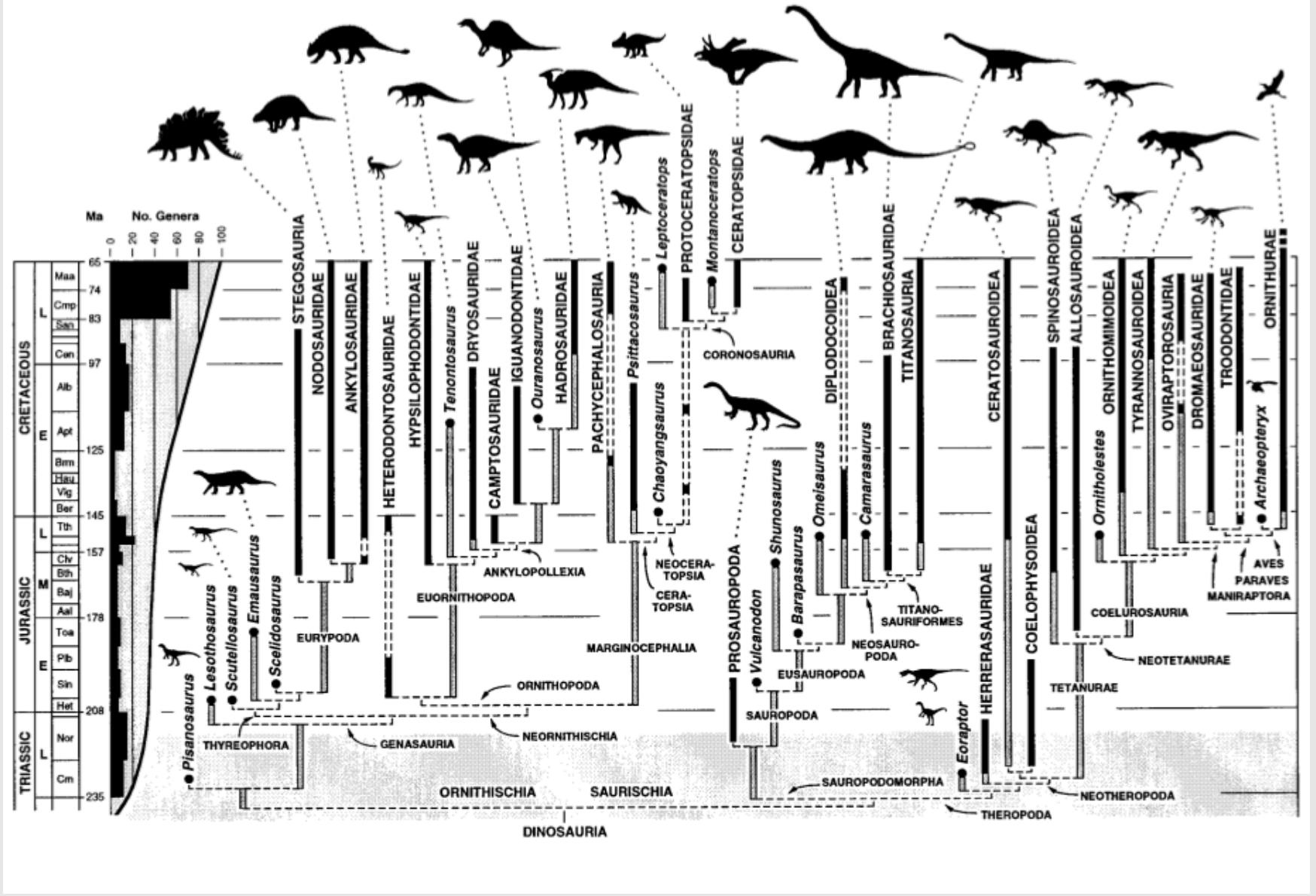
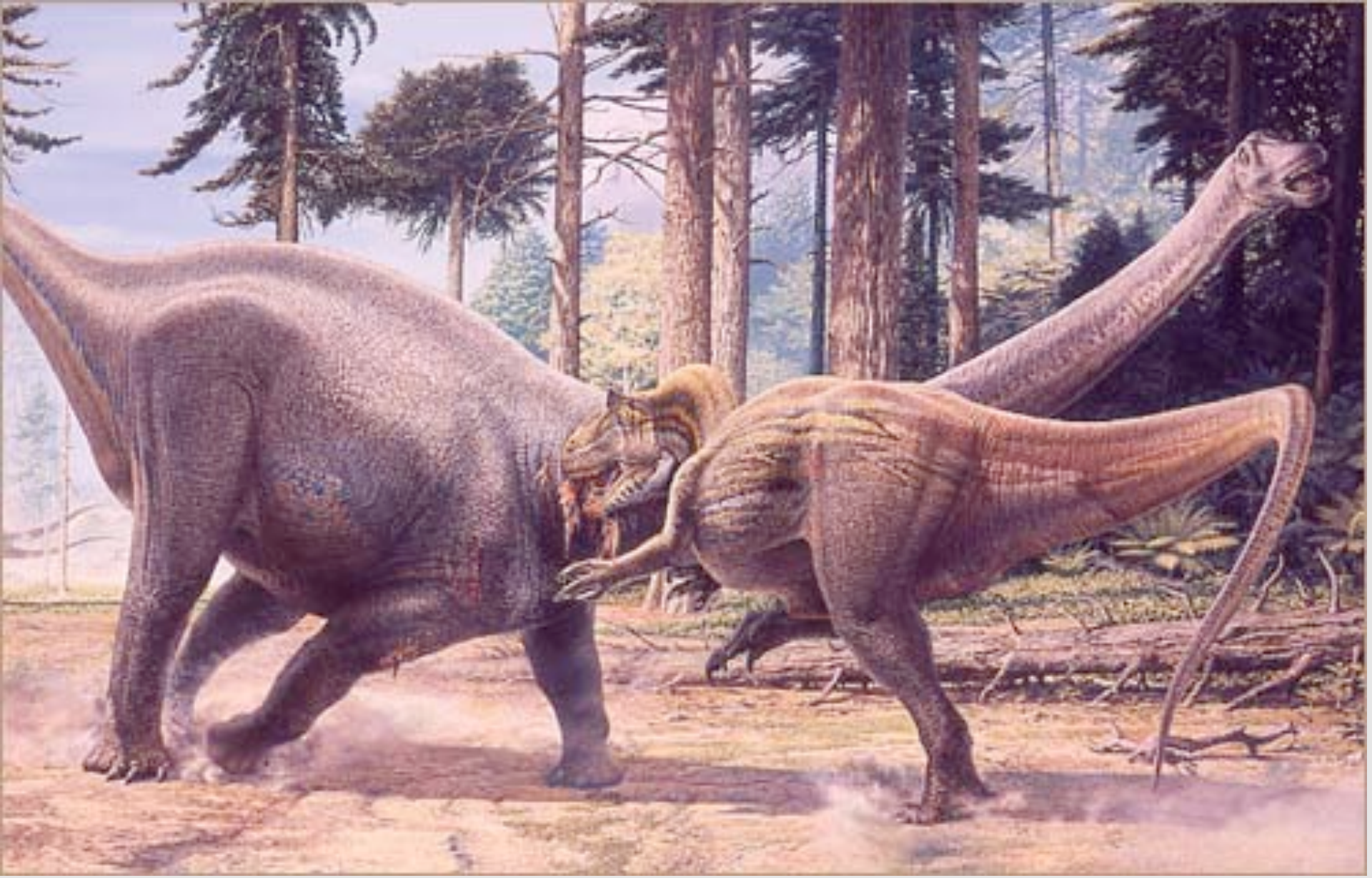


Fig. 1. Temporally calibrated phylogeny of Dinosauria, showing known temporal durations (solid bars), missing ranges (shaded bars), and ranges extended by fragmentary or undescribed specimens (dashed bars). At left is tabulated the number of recorded nonavian dinosaurian genera per stage and an estimated curve of generic diversity, taking in to account available outcrop area (*87*). Basal or primitive taxa, in general, appear earlier in time than more derived members of a clade. Long missing ranges result from preservational bias against small body size (less than 2 m), which truncates the early record of many clades, and from intervals for which there is little corresponding exposed terrestrial rock (such as the Middle Jurassic). The shaded zone (bottom) indicates the initial stage of the dinosaurian radiation before their dominance of land faunas in taxonomic diversity and abundance.

Sereno. The evolution of dinosaurs. Science (1999) vol. 284 (5423) pp. 2137-47

Triassic 248-213 mya First turtles, cycads, lizards, dinosaurs, mammals

http://www.pbs.org/wgbh/nova/link/hist_nf.html

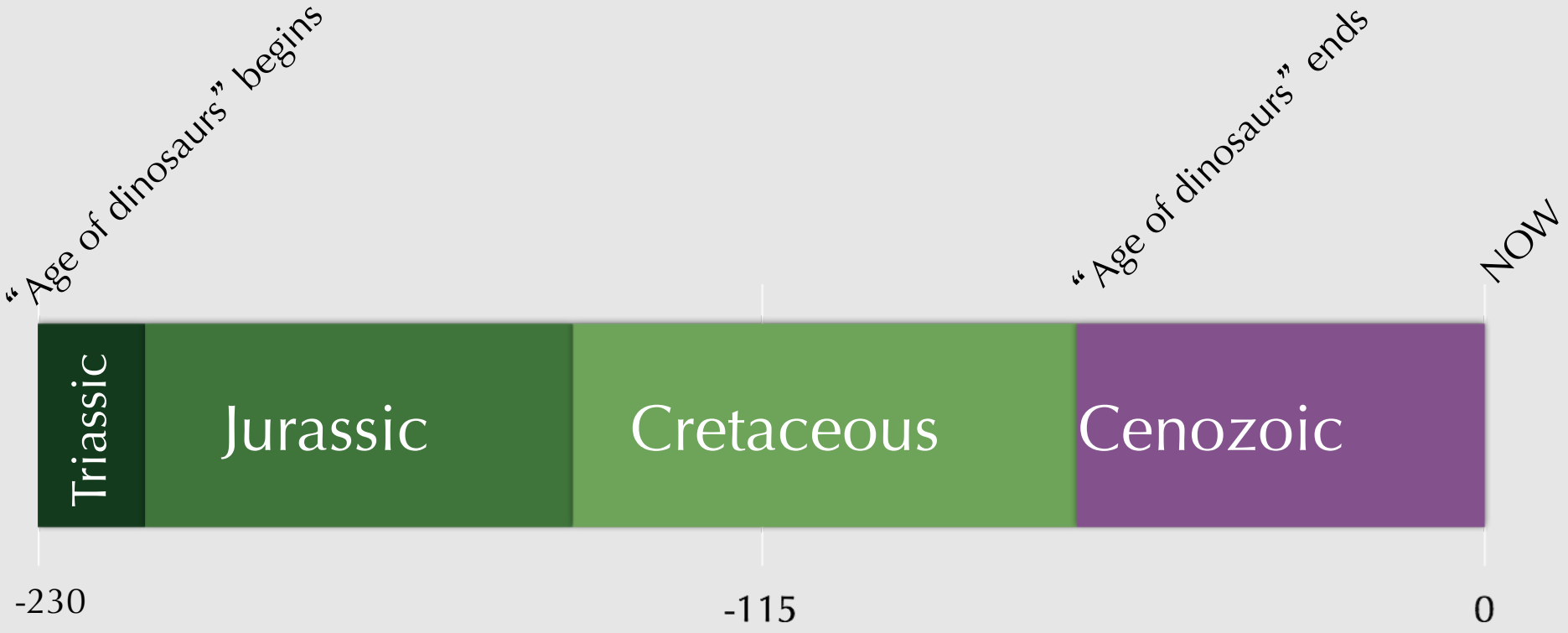


Jurassic 213-145 mya First squids, frogs, birds, salamanders

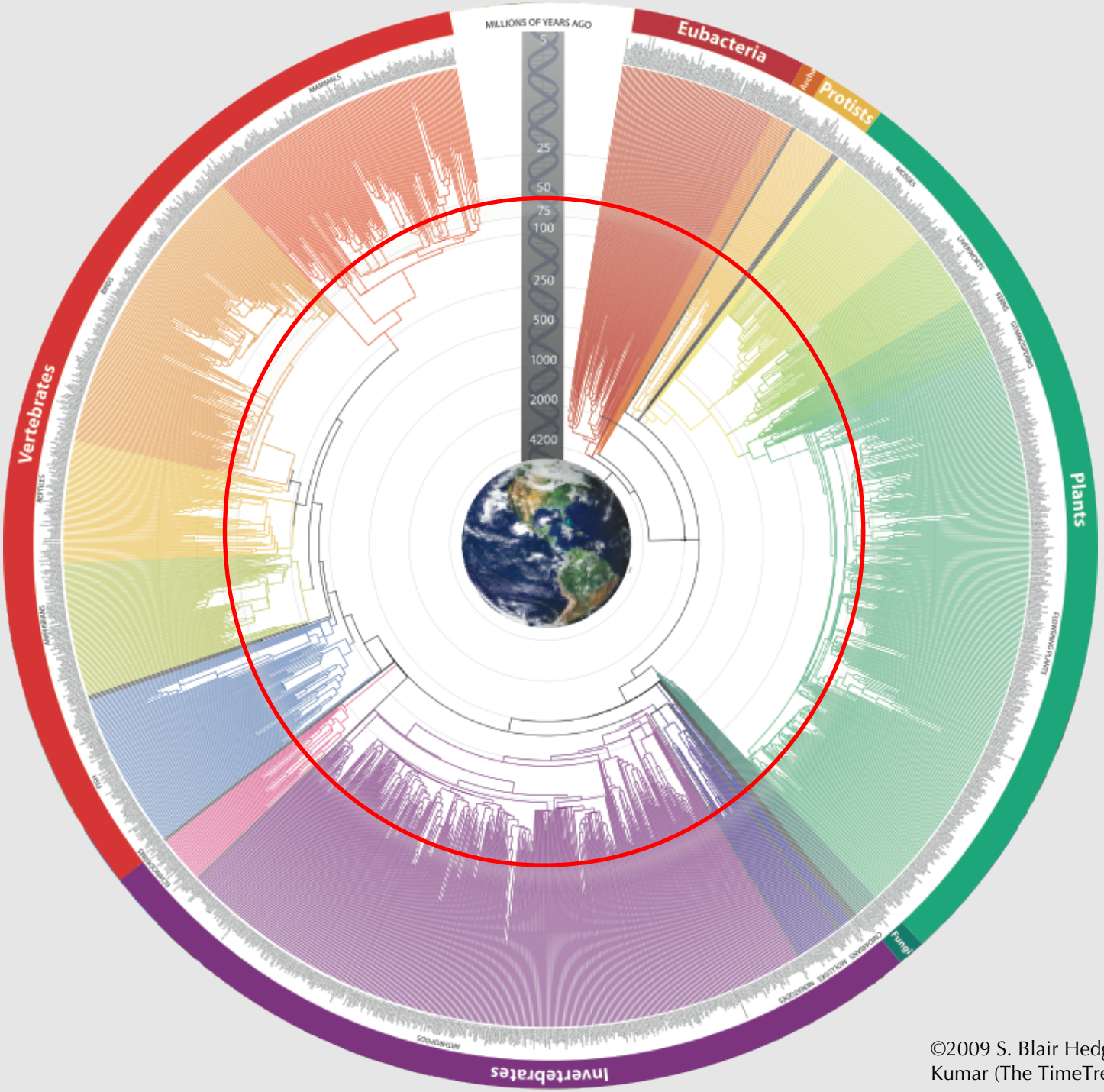
http://www.pbs.org/wgbh/nova/link/hist_nf.html

Cretaceous 145-65 mya First flowering plants (?), snakes, modern fish, rise and fall of toothed birds, heyday of dinosaurs

http://www.pbs.org/wgbh/nova/link/hist_nf.html


“Age of dinosaurs” begins
“Age of dinosaurs” ends
NOW
Triassic
Jurassic
Cretaceous
Cenozoic
-230
-115
0

BBC Walking with Beasts



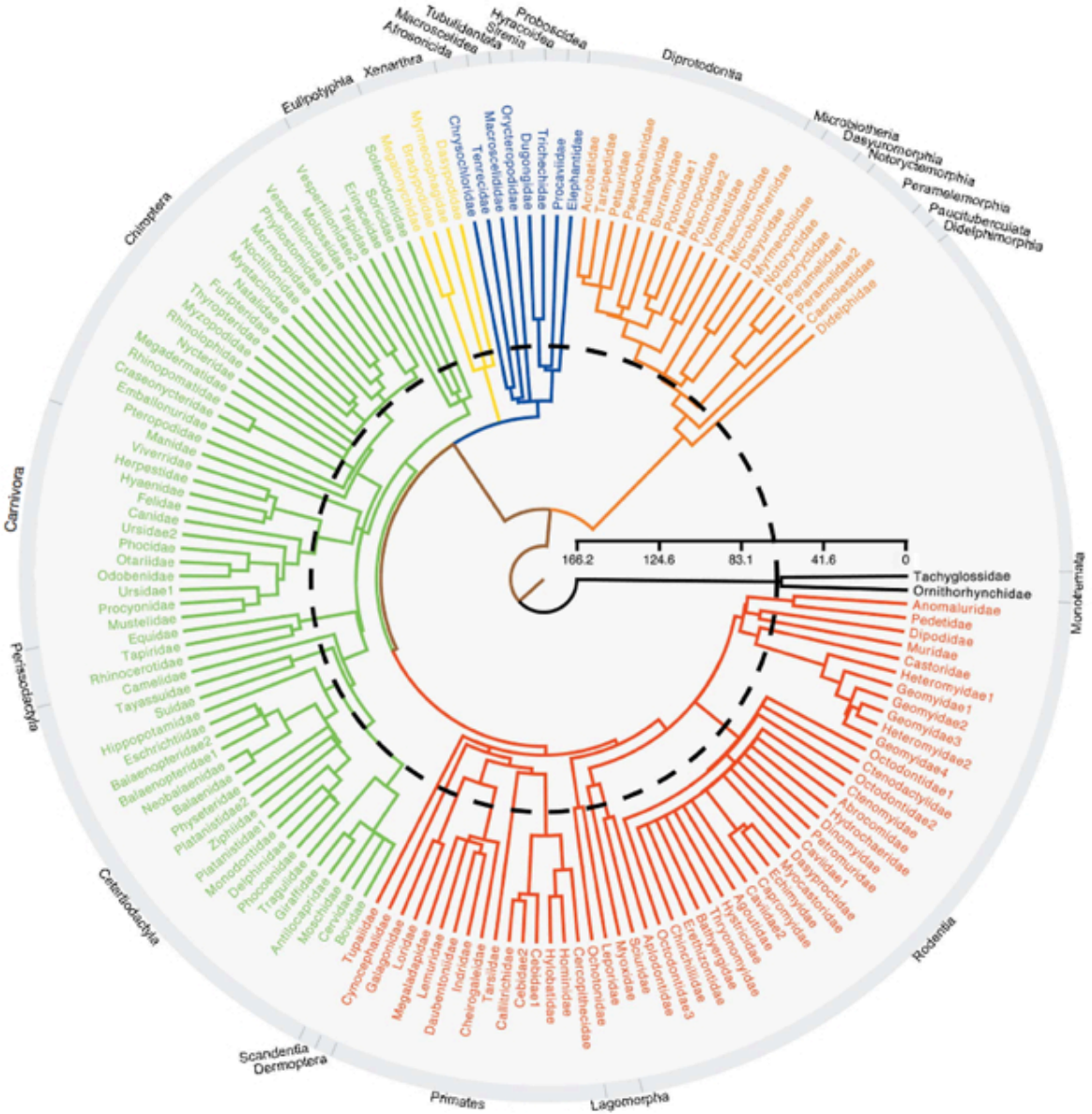


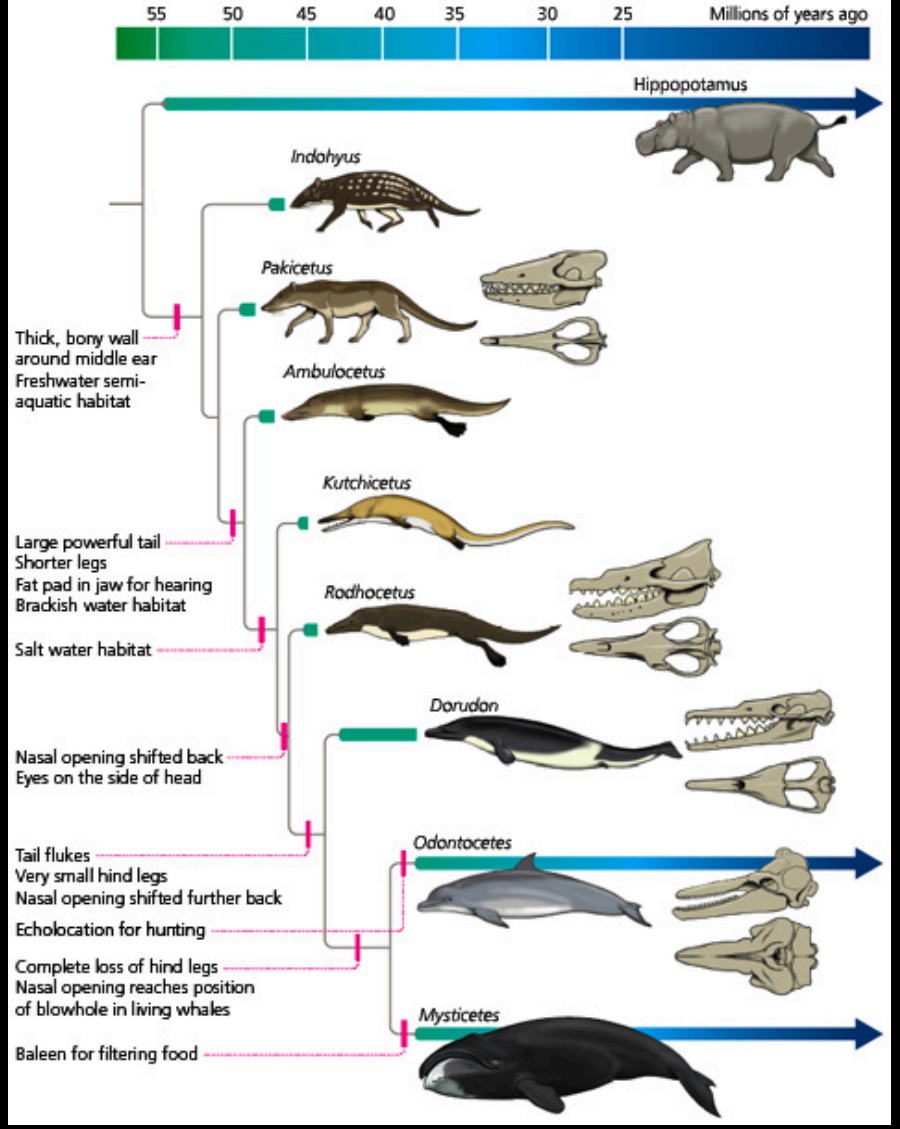
Figure 1 | Partial representation of the mammalian supertree showing the relationships among the families (following ref. 23). All orders are labelled and major lineages are coloured as follows: black, Monotremata; orange, Marsupialia; blue, Afrotheria; yellow, Xenarthra; green, Laurasiatheria; and red, Euarchontoglires. Families that were reconstructed as non-monophyletic are represented multiple times and numbered accordingly. Branch lengths are proportional to time, with the K/T boundary indicated by a black, dashed circle. The scale indicates Myr. The base tree was drawn using FigTree v1.0 (http://evolve.zoo.ox.ac.uk/software.html?id=figtree).

Bininda-Emonds et al. The delayed rise of present-day mammals. Nature (2007) vol. 446 (7135) pp. 507-512

In the early Paleocene, dense forests extended to higher latitudes. This scene is from the Early Paleocene of Wyoming. The vegetation included sequoia trees, with a dense undergrowth of shrubs such as tea and laurel, with the addition of ferns and horsetails. On the ground is Chriacus, a racoon-like omnivore. Facing Chriacus on the tree is Ptilodus, a surviving member of the multituberculates, primitive mammals often termed the "rodents of the Mesozoic. " Higher up in the tree is Peradectes (the name means "persisting biter"), an early opossum-like marsupial. Marsupials became extinct in North America by the Oligocene, and did not reappear until true opossums invaded from South America in the Pleistocene.Image and caption both from The Book of Life: An Illustrated History of the Evolution of Life on Earth

Paleocene 65-55.5 mya: Diversification of mammals

http://www.pbs.org/wgbh/nova/link/hist_nf.html

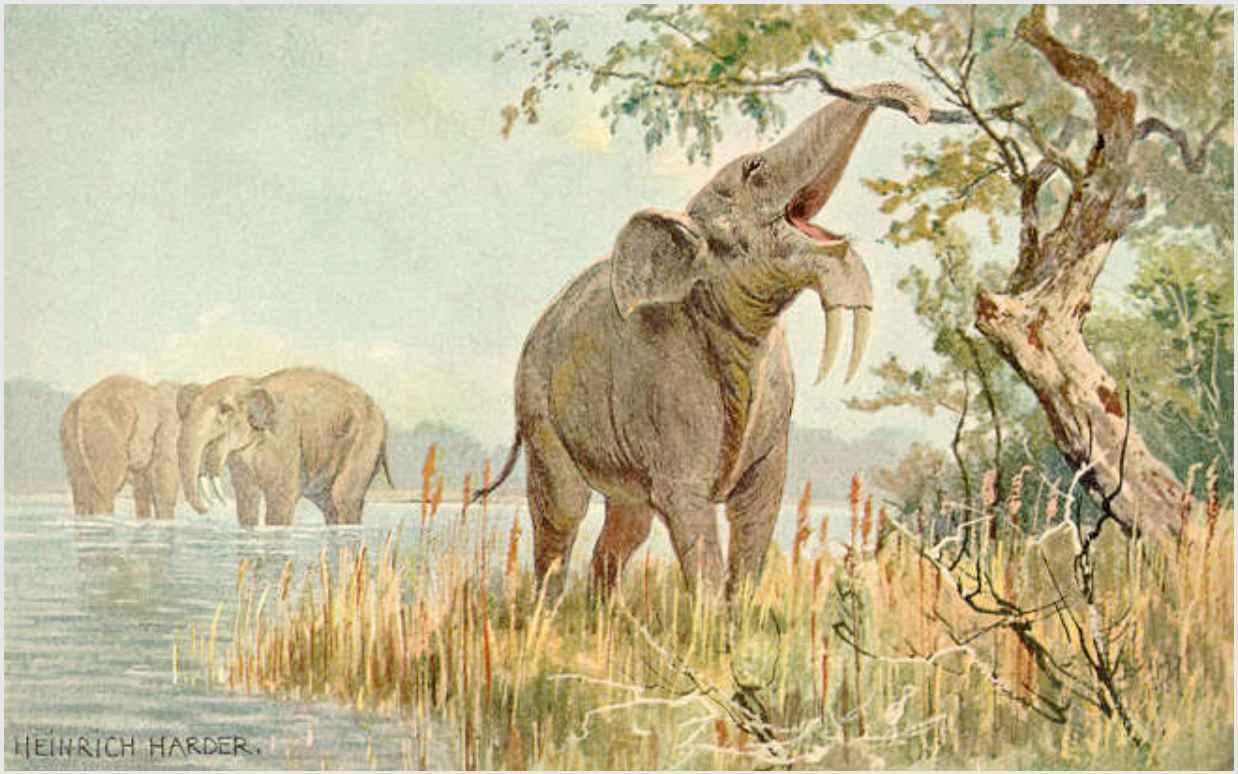


https://evolution.berkeley.edu/evolibrary/article/evograms_03

Eocene 55.5-33.7 mya First marine and large terrestrial mammals, horses, whales, monkeys

Oligocene 33.7-23.8 mya First grasses, apes, anthropoids

http://www.pbs.org/wgbh/nova/link/hist_nf.html



Miocene 23.8-5.3 mya: Trunked elephants http://www.pbs.org/wgbh/nova/link/hist_nf.html

Karen Carr

Pliocene 5.3-1.8 mya: terror birds in North America

http://www.pbs.org/wgbh/nova/link/hist_nf.html

Pleistocene 1.8 mya-12,000 ya Mammoths, mastodons, Neanderthals

http://www.pbs.org/wgbh/nova/link/hist_nf.html

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http://www.pbs.org/wgbh/nova/link/hist_nf.html

Holocene 12,000 ya-present First modern human beings

http://www.pbs.org/wgbh/nova/link/hist_nf.html

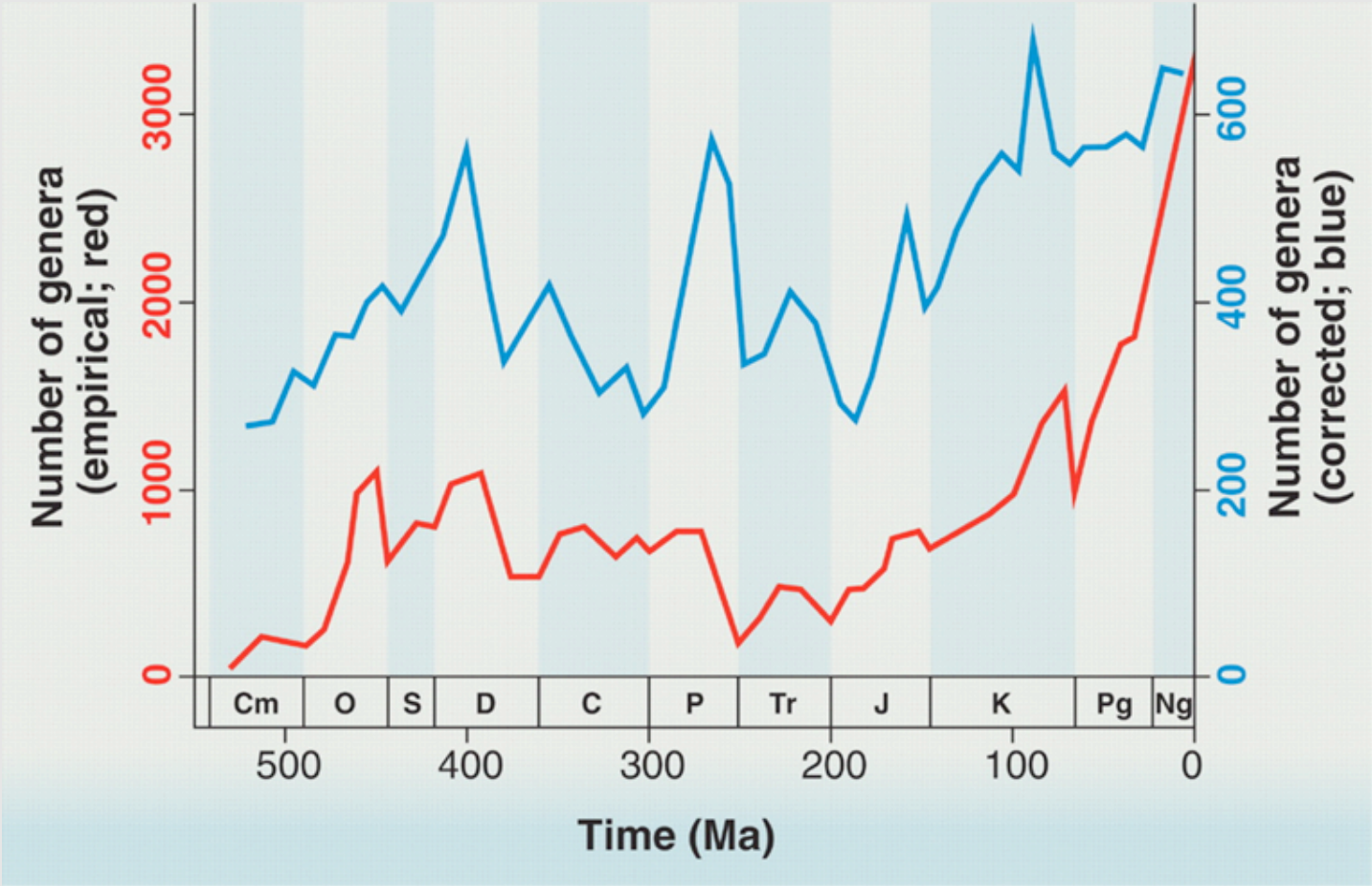
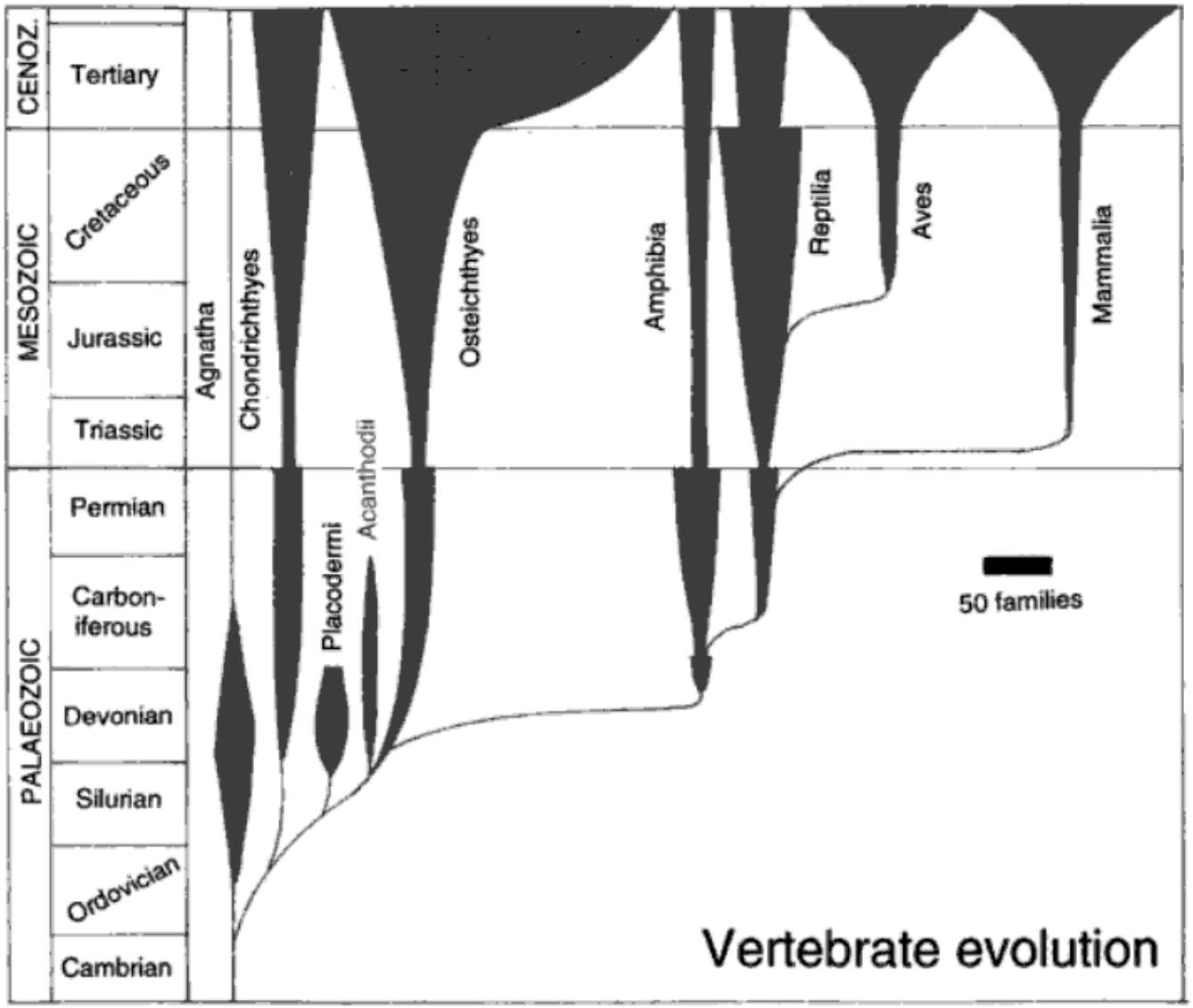


Fig. 2. Patterns of marine animal genus diversification through the past 530 My, the Phanerozoic. The two lines compare current estimates from the empirical (uncorrected) Sepkoski database (red line) and sampling-standardized (corrected) analysis of the Paleobiology Database (blue line). The empirical curve (red line) suggests that global marine diversity reached a possible plateau through the Paleozoic (450 to 250 Ma) and has risen, apparently exponentially, ever since. The sampling-standardized curve (blue line) suggests that global marine diversity reached near-modern levels some 400 Ma and there has been only modest increase since then.

Benton. The Red Queen and the Court Jester: species diversity and the role of biotic and abiotic factors through time. Science (2009) vol. 323 (5915) pp. 728-32



The pattern of evolution of the vertebrates, showing the relative importance of the major groups through time. This is a 'spindle diagram', in which the vertical axis represents time, and the horizontal axis represents the importance of the group. In this case, the horizontal dimension is proportional to the number of families of each group, based on data compiled by various authors in Benton (1993). Mass extinctions show up in the Late Devonian, end-Permian and end-Cretaceous.

Benton, Vertebrate Paleontology 2000

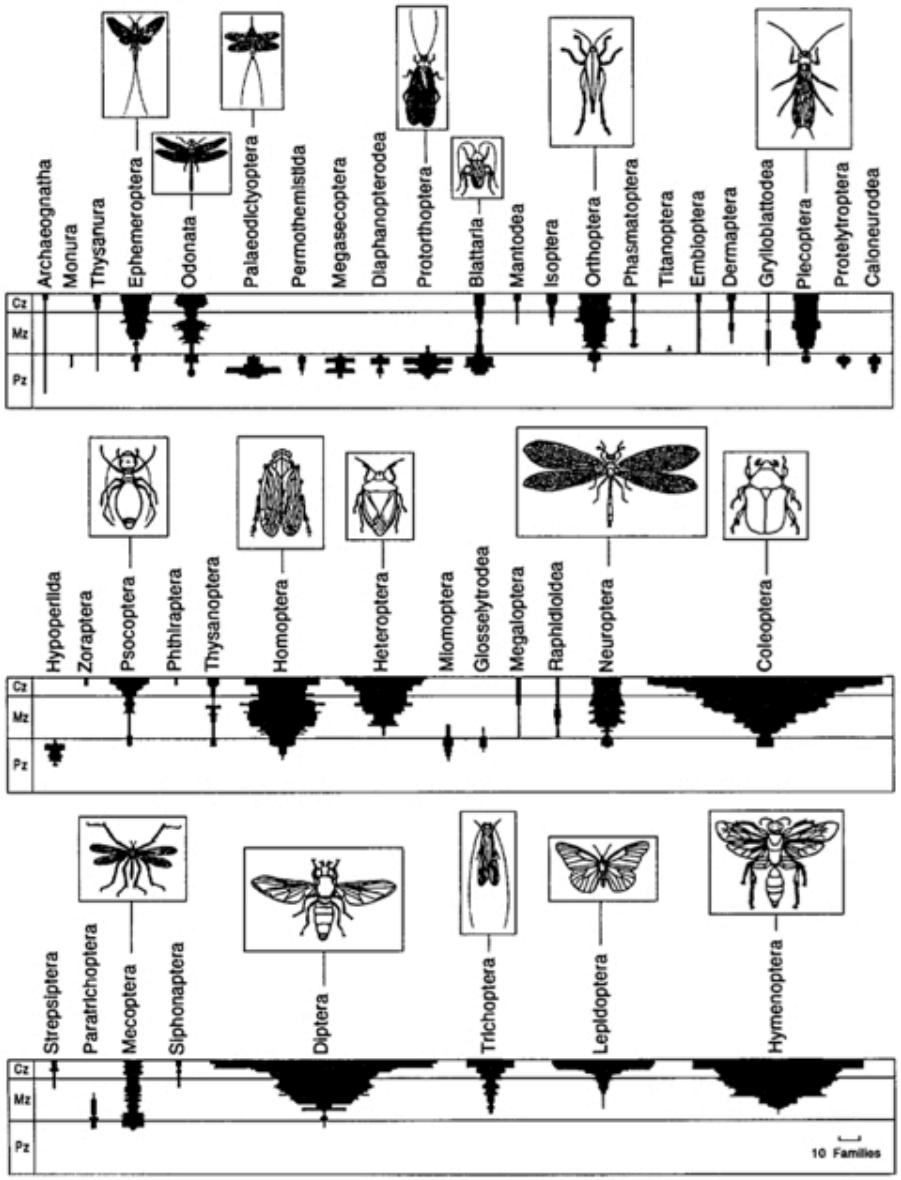


Fig. 2. Spindle diagrams displaying diversities of fossil families within insect orders in stratigraphic stages of the Phanerozoic. A scale bar is shown in the lower right. Abbreviations are Pz, Paleozoic (Silurian through Permian); Mz, Mesozoic; and Cz, Cenozoic. Boxed illustrations (not to scale) depict typical adult representatives of the more important orders. Angiospermous plants make their fossil appearance approximately two-thirds of the way up the band for the Mesozoic (that is, just above the "M" in Mz).

Labandeira and Sepkoski. Insect diversity in the fossil record. Science (1993) vol. 261 (5119) pp. 310-5

Learning outcomes

- Understand major events in metazoan life
- Be able to explain endosymbiosis
- Start to consider explanations for patterns