The Case For and Against Evolution

The Fossil Record and Evolution

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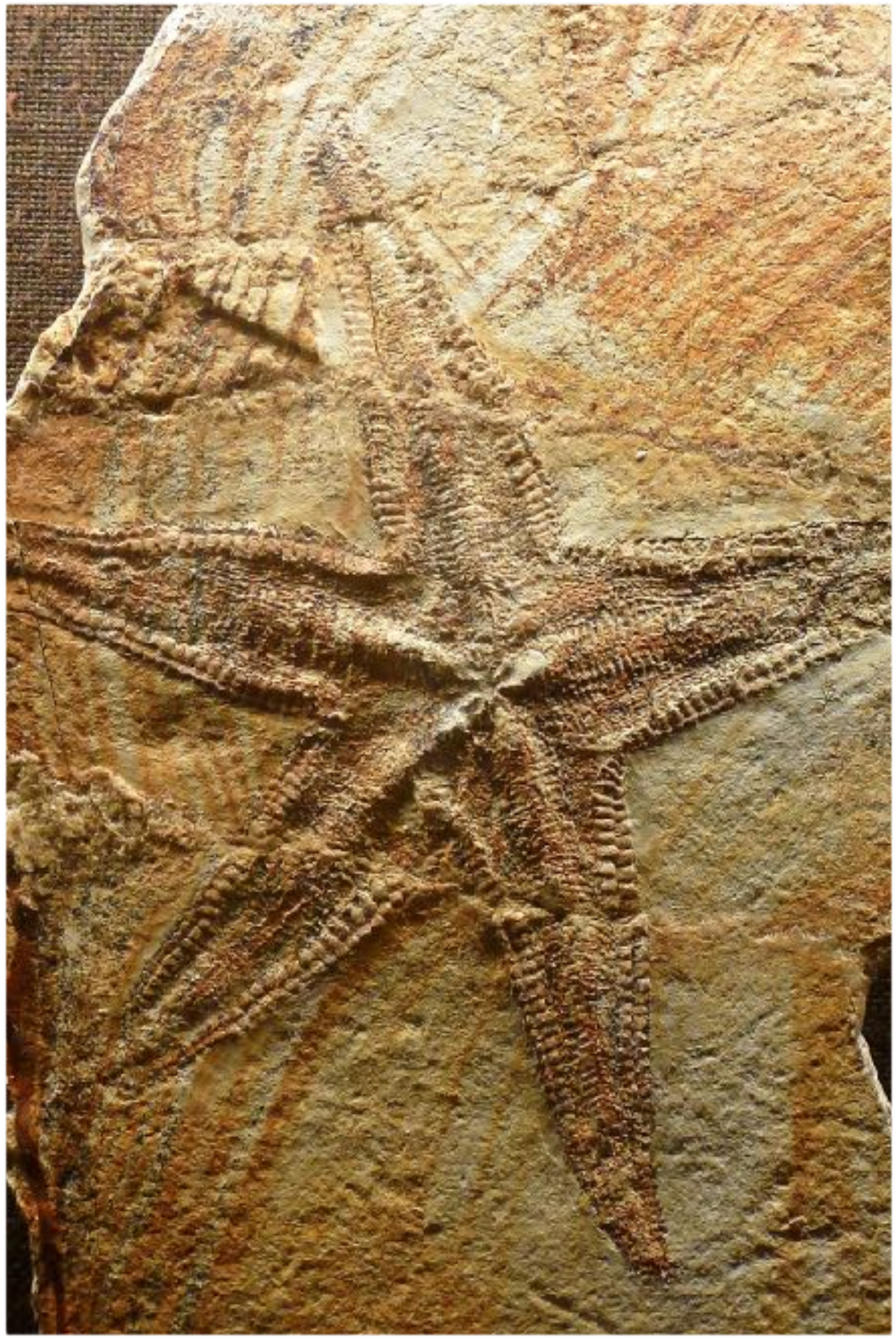
The Fossil Record

- Fossils are the mineralized remains or impressions of past organisms.
- There are two major groups of fossils:
  - Body fossils: *Actual parts* of plants, animals, or microorganisms.
  - Trace fossils (ichnofossils): traces of the *activities* of organisms: footprints, burrows, borings, etc.

Fossils of Skeletal Parts



Sea star (Echinoderm). Solnhofen Limestone, Germany. Jurassic

Dragonfly. Solnhofen Limestone, Germany. Jurassic

Exceptional fossilization of a frog. Miocene.

Psittacosaurus mongoliensis. Cretaceous, Mongolia

Fossil fish—*Pacgycormus curtus*. Solnhofen Limestone, Jurassic, Germany

Alligator prenasalis. Oligocene, North Dakota

Chasmosaurus

Pteranodon

Fossil whale. Pliocene, Peru

Mesohippus barbouri. Oligocene, Nebraska, USA

Rhinoceros Trigonias osborni. Eocene

Petrified tree logs, Peru

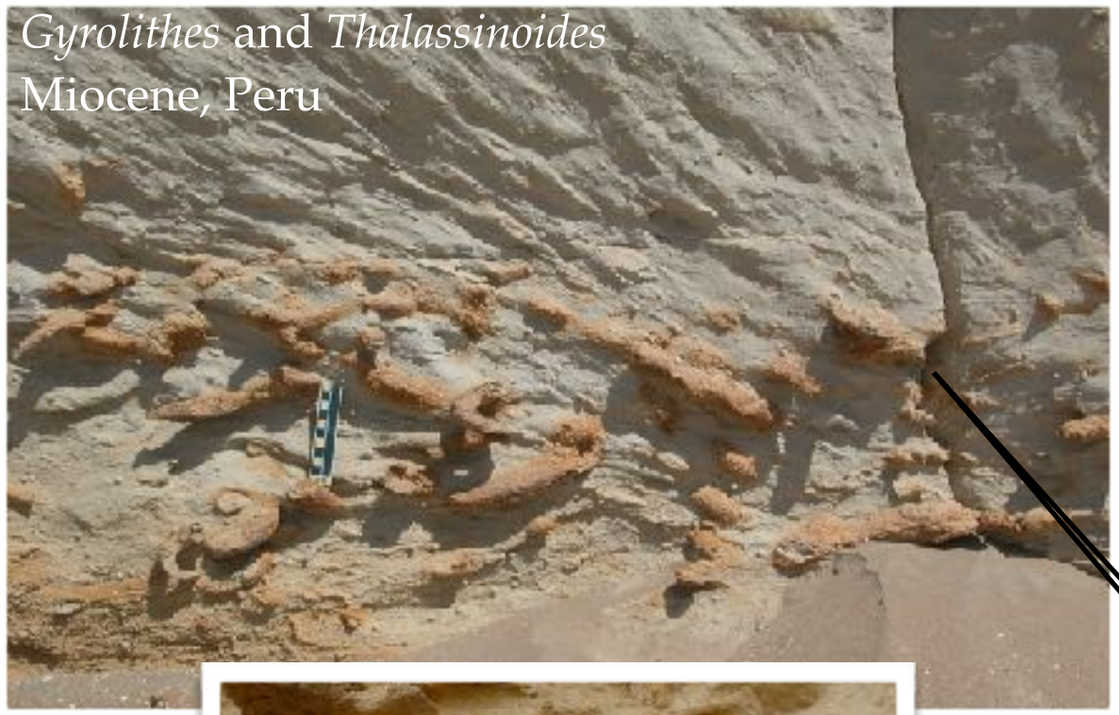
Acer pseudoplatanus

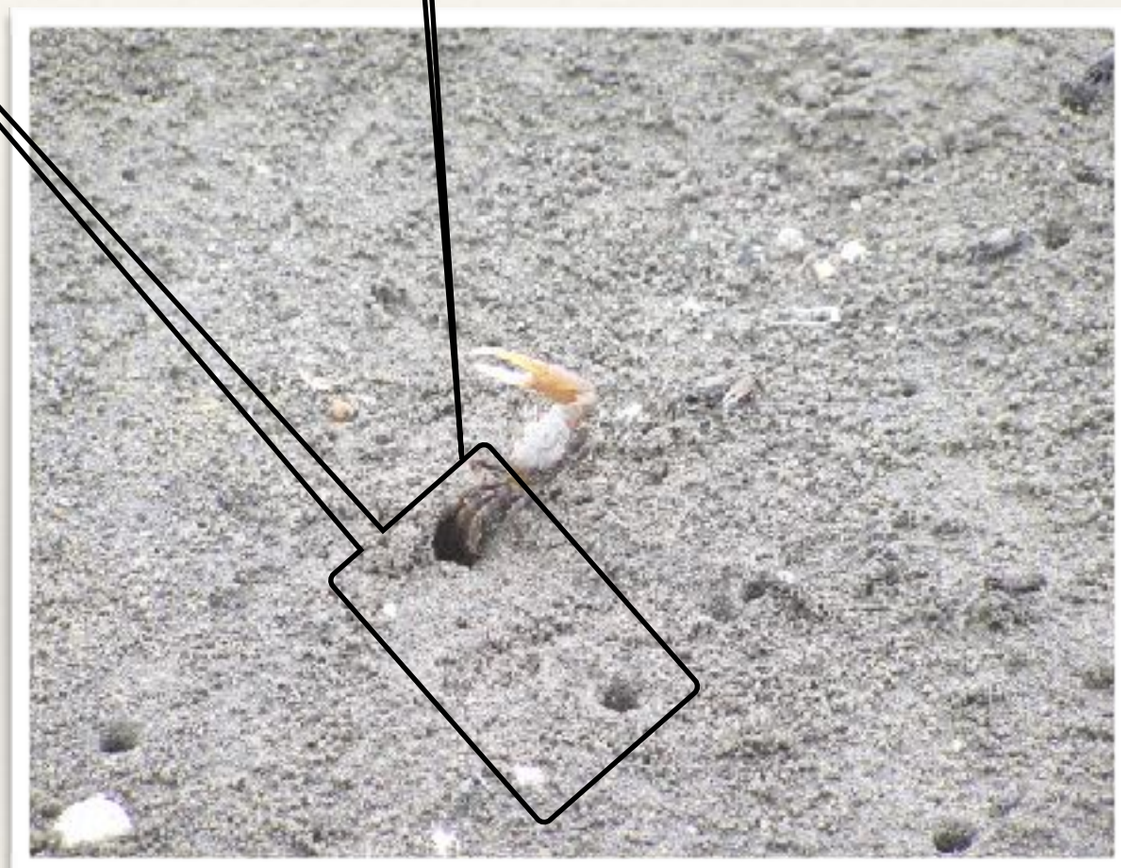
Perisphinctes maximus

Pecten

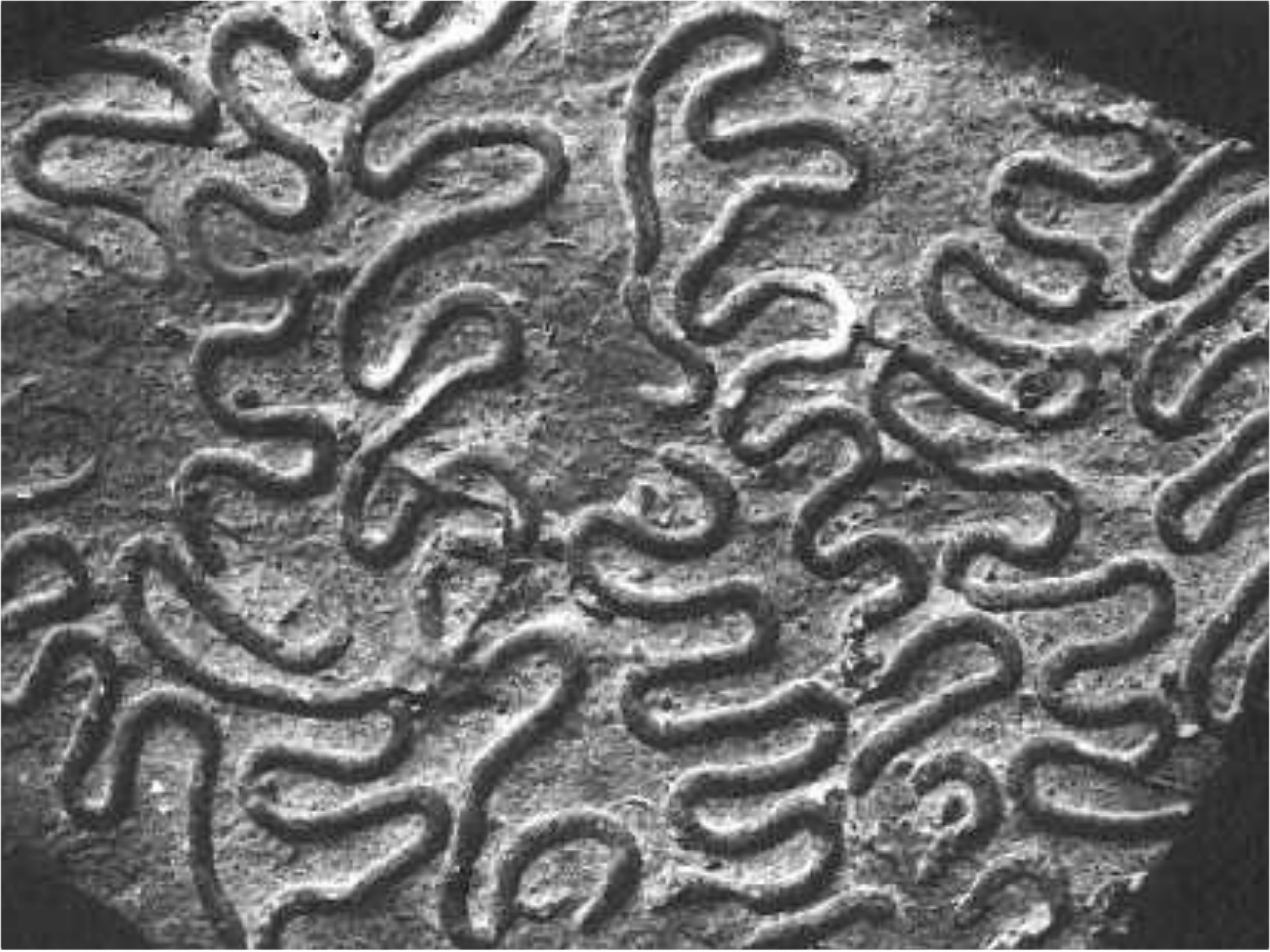
Aquatic plant

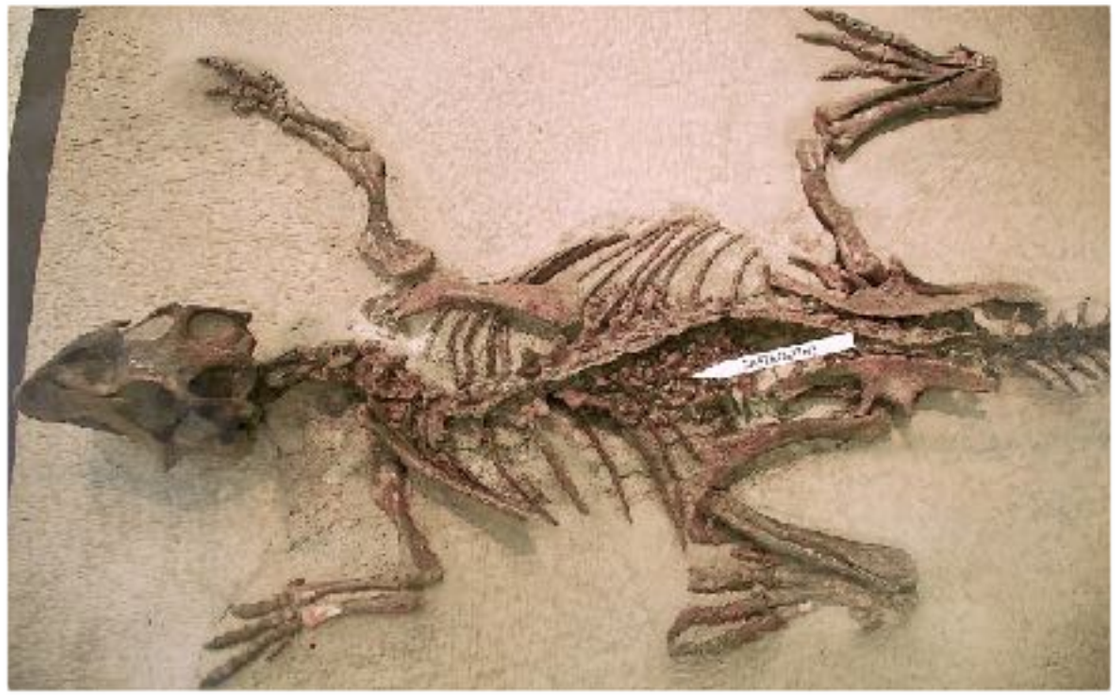
Trace Fossils





Sandy beach in southern Brazil.
The holes are made by violin crabs



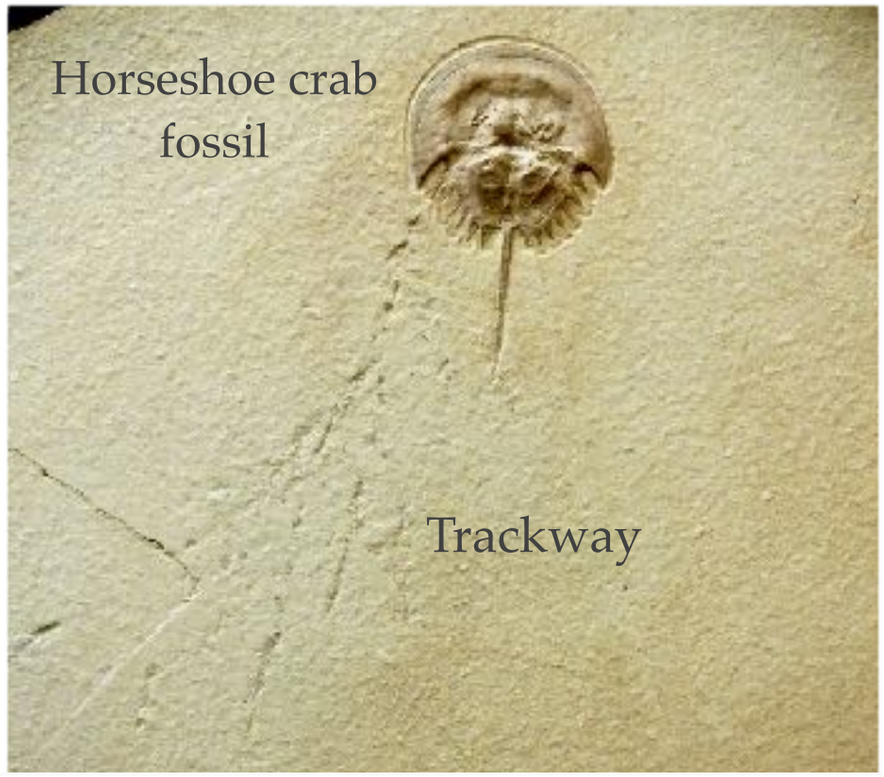


Gastrolith in *Psittacosaurus mongoliensis*

Feces of Galapagos tortoise

Dinosaur skin impression on the bones of the vertebral column

Coprolite of carnivore feces



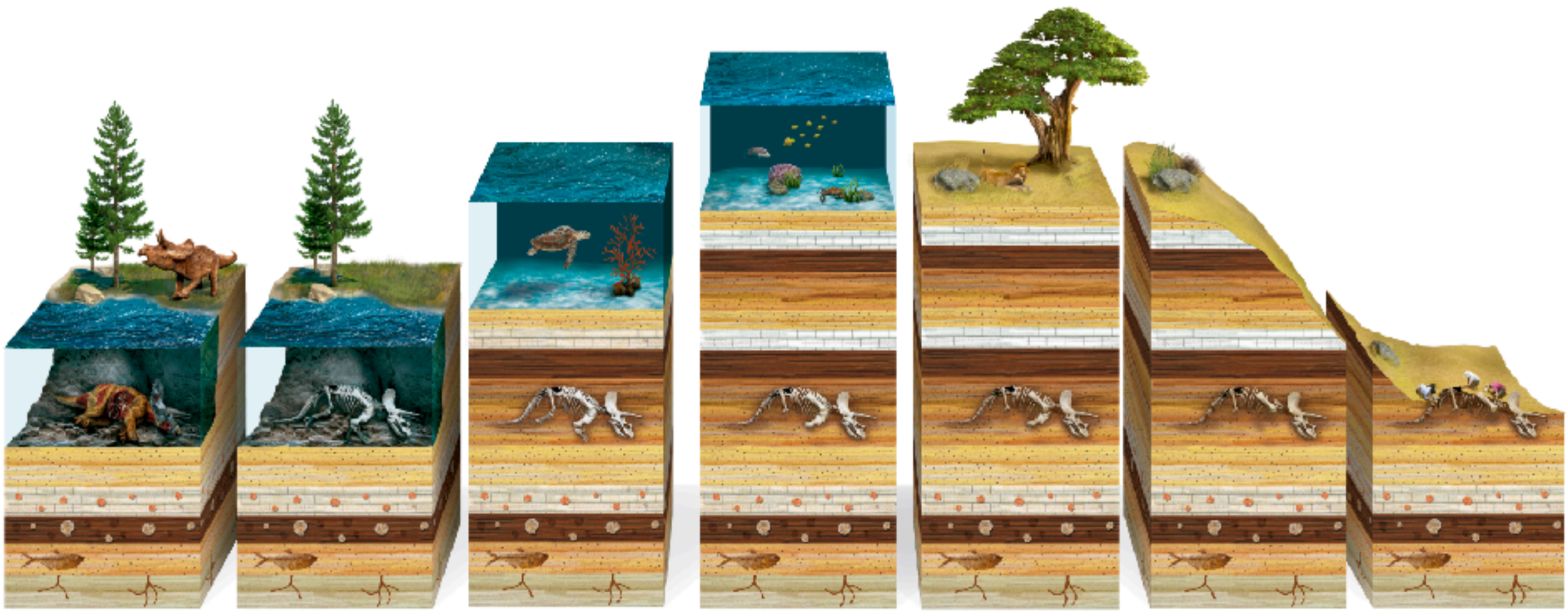
Shark tooth marks on a whale bone

Avian footprints

Dinosaur trackway (Plagne, France)

Dinosaur footprint (Enciso, Spain)

- The *fossil record* is the totality of fossils found in the rocks.
- Fossils are found in *sedimentary layers*.
- The stack of all the sedimentary layers and the fossils they contain is called the *geologic column*.



The Geological Column and the Fossil Record

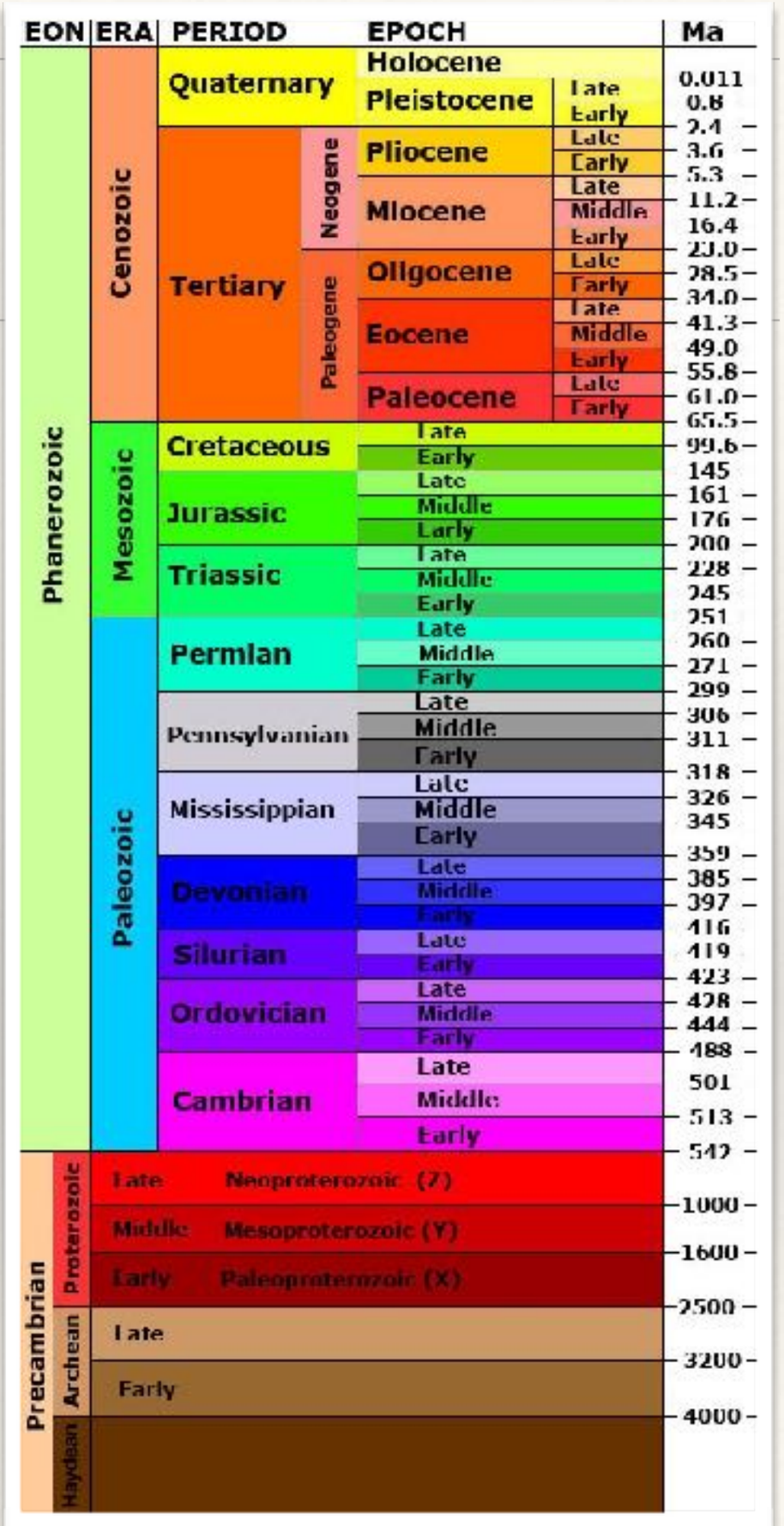
- Scientists have divided the strata in eras, periods and epochs based on their position and the fossil content.

Geoscience Research Institute
www.grisda.org
11060 Campus St., Loma Linda, CA 92350

Era	System[1]	Series[2]	Representative Fossils
Phanerozoic Cenozoic	Neogene	Holocene	*Modern organisms*
		Pleistocene	*"Ice Age"- Large mammals*
		Pliocene	*Many mammals & birds*
		Miocene	*Many angiosperms, whales*
	Paleogene	Oligocene	*Apes, modern birds, insects*
		Eocene	*Mammals - bats & monkeys*
		Paleocene	*No dinosaurs or ammonoids*
Phanerozoic Mesozoic	Cretaceous[3]		*Dinosaurs, ammonoids, frogs, birds, mammals, cycads, & flowers*
	Jurassic		*Dinosaurs, trackways & ammonoids*
	Triassic		*Conifers, cycadeoids & diverse reptiles*
Phanerozoic Paleozoic	Permian		*Highest level of many marine organisms*
	Carboniferous		*Coal "forests," amphibia and reptiles*
	Devonian		*Abundant diverse fish, small plants, coal*
	Silurian		*Jawless fish, few vascular plants*
	Ordovician		*Many marine organisms including clams*
	Cambrian		*Many complex organisms e.g., Trilobites*
Precambrian	Proterozoic		*Rare odd marine animals (Ediacaran) Sparse fossils, few Cambrian taxa*
	Archean		*Very few fossils, all single-celled Some pseudofossils*

[1]Also referred to as Periods. [2]Also referred to as Epochs.
[3]The Cretaceous/Paleogene contact is commonly called the "KT boundary"

- Strata in each interval have characteristic fossils.
- Different groups of animals and plants appear in different strata or stratigraphic levels.
- Some groups go extinct and appear up to a certain stratigraphic level in the sedimentary record.
- Other groups, such as fish, molluscs, and many others, appear in the lower strata of the geological column and continue to appear in the rest of the strata.



From Wikimedia Commons

The Fossil Record and Evolution

- Evolutionists claim that the fossil record proves evolution.
- Books tend to have bold assertions like this by George G. Simpson:
  - “Currently it makes no sense to continue collecting and studying fossils simply to determine whether evolution is a fact. The question has been definitively answered in an affirmative way."

What Did Darwin See?

Darwin and the Fossil Record

- Darwin saw that the fossil record shows an ordered pattern of appearances and disappearances of species and entire groups of organisms.
- For example, trilobites are found first in the Lower Cambrian layers.
- When they appear they are fully formed, without intermediate or transitional ancestors.
- As we move upward in the sedimentary strata we continue to find trilobites, up to the Permian when they become extinct and never show up again in the layers above.
- Both their appearance and disappearance are abrupt s.

Arctinurus boltoni

Darwin and the Fossil Record

- Dinosaurs first appear in the Triassic strata and disappear in the Upper Cretaceous layers.
- Both their appearance and disappearance are sudden.
- The fossil record shows no ancestors; there are no known intermediate forms between a pre-dinosaur and a dinosaur.

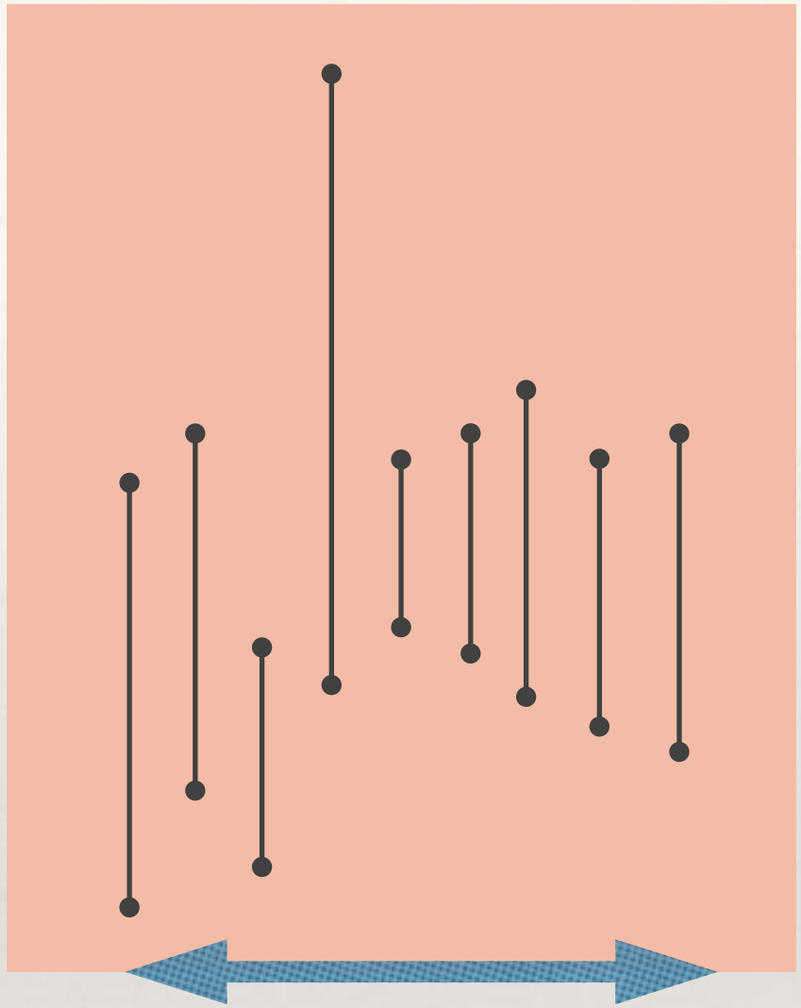
Darwin and the Fossil Record

- Mammals appear appear first in Triassic strata, well above the level of extinction of the trilobites.

Coelophysis bauri

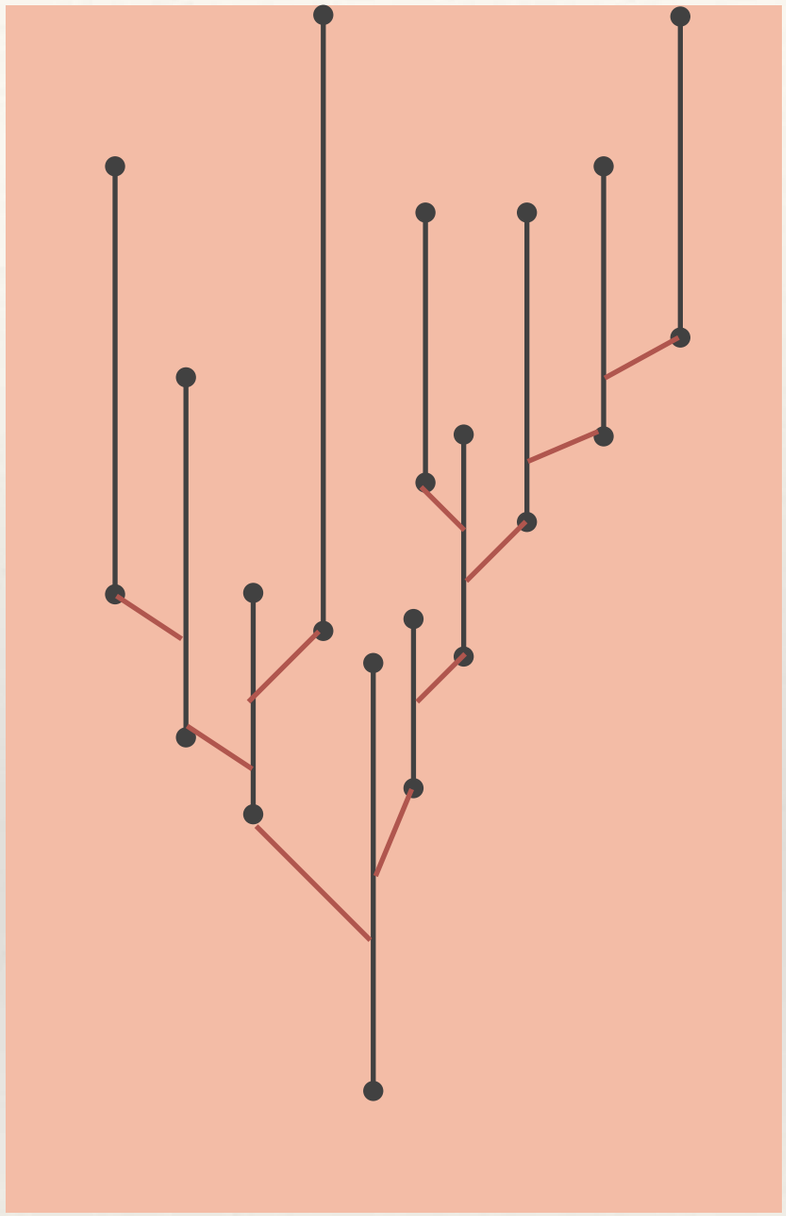
- Darwin saw a pattern of appearances and disappearances of fossil forms and he called it "geological succession", which is also called "succession of fossils."
- Darwin also saw a pattern of variation from simple to complex: the higher up in the sedimentary strata the more complex were organisms (fossils).
- He also saw a third pattern.

- He drew lines indicating appearance and disappearance of species.
- The longer the stratigraphic range of the species, the longer the line.
- When comparing two species of animals or plants, the farther apart one line is from another the greater is the difference in the morphology of the two.



Diference in morphology

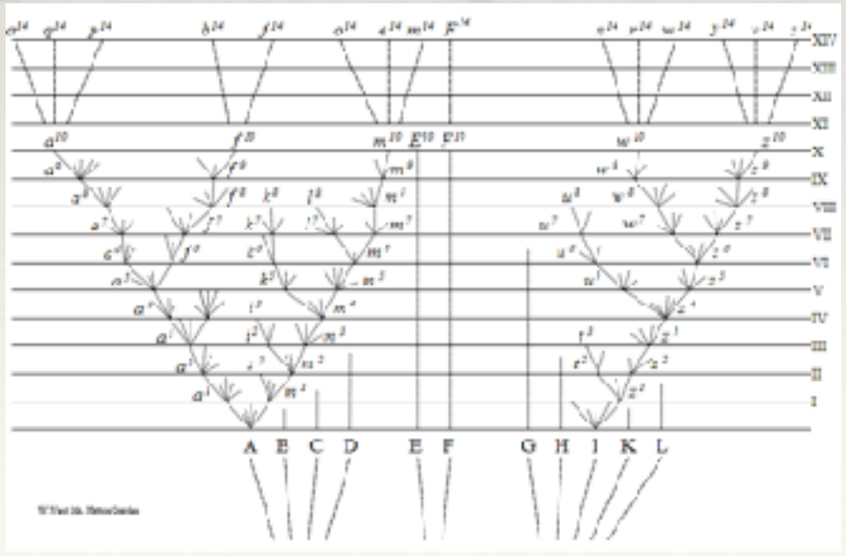
- Darwin connected the dots and he obtained a branching tree.
- He interpreted the tree as a relationship between younger and older forms, the former deriving from the latter.
- Lines that are close indicate relationship and a common intermediate ancestor.
- There is only one original form, called *Universal Common Ancestor*.



Darwin's Tree of Life

- Based on these connections and knowledge of the existing fossil record, Darwin suggested that the current biodiversity could be depicted as the development of a tree.
- The branches represent the different groups of organisms that emerged over time.
- All the branches (groups of organisms) derive from a common ancestor, which is the root.
- Darwin was proposing a *monophyletic* origin for the diversity of life.

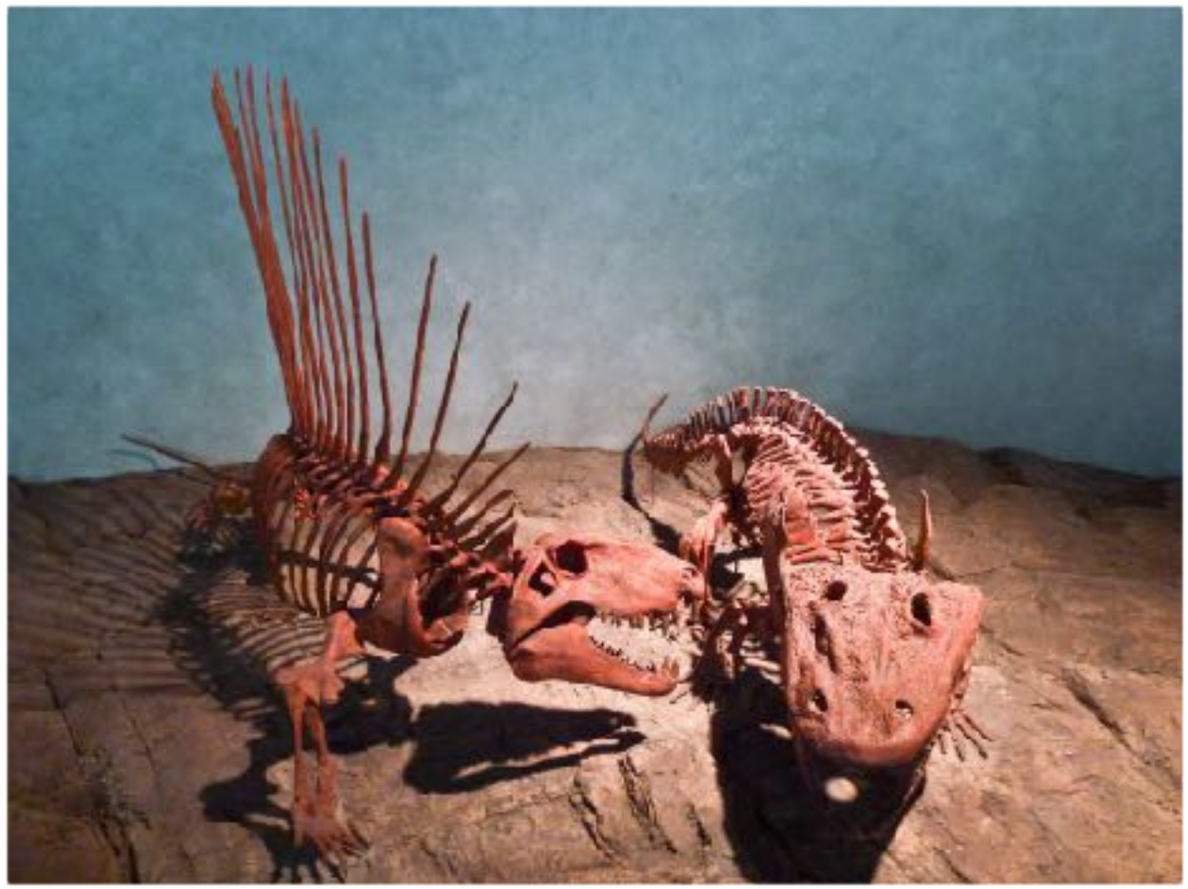
Darwin's first evolutionary tree of life drawn in his notebook in 1837, with the words "I think" scrawled above it. (From Darwin's Notebook B now stored in Cambridge University library)



Tree of life published by Darwin in the *Origin of Species*, in 1859. (from http://commons.wikimedia.org/wiki/File:Origin_of_Species.svg)

Intermediate Forms

- In order to make sense of the tree, Darwin postulated that there must have been thousands of *intermediate forms* (also called *transitional forms*) between one branch and another.
- Evolutionary scientists claim that such forms have, in fact, been found.
- For instance, the *mammal-like reptiles*, which appear in strata of the Permian and Triassic, seem to have reptilian traits with some mammalian characteristics.



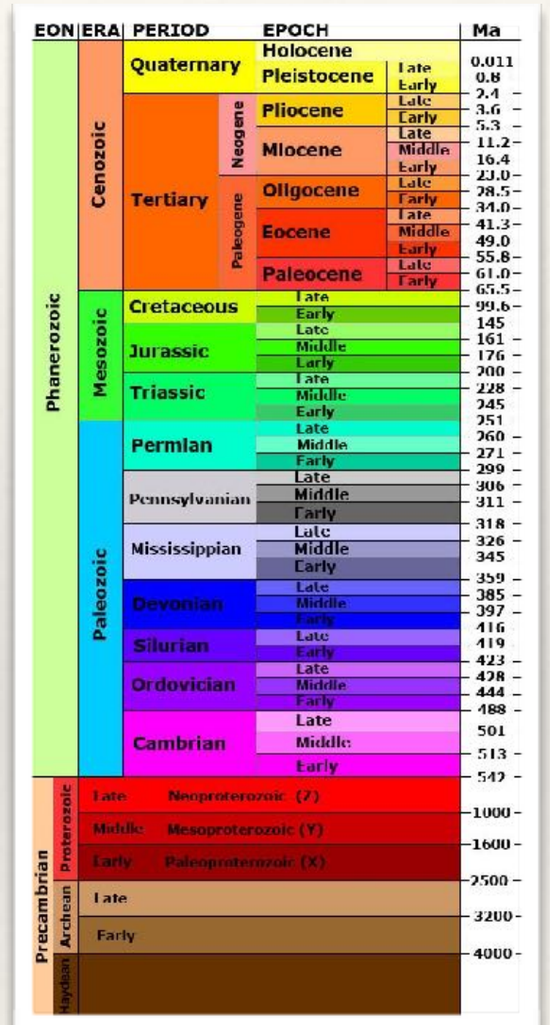
Dimetrodon (left, an alleged mammal-like intermediate), and *Eryops* (right, an amphibian)

Archaeopteryx

- In Darwin's time, the only alleged transitional form was *Archaeopteryx*.
- The first specimen was found in 1861, just two years after Darwin published his book *On the Origin of Species*.
- *Archaeopteryx* was a bird with a toothed jaw like a reptile, but with true feathers, brain and skeleton like a modern bird.

The Expected Fossil Record According to the Theory of Evolution

- If biological evolution occurred in a continuous and gradual way over many millions of years we should see in the sedimentary record (geological column):
  - Few fossil forms (*low diversity*) in the lower layers of the sedimentary record or geologic column.
  - More diversity as we move upward in the geologic column: increase of diversity toward the upper strata.
- Lower biological specialization in the lower strata: the earliest forms should be more generalist and simple, not highly specialized.
- Greater specialization in the organisms of the upper layers.
- Fossil forms replacing ancestral forms, with evidence of gradual change (intermediate or transitional organisms).
- Limited geographic distribution of the first fossils.
- Evidence of a common ancestor.



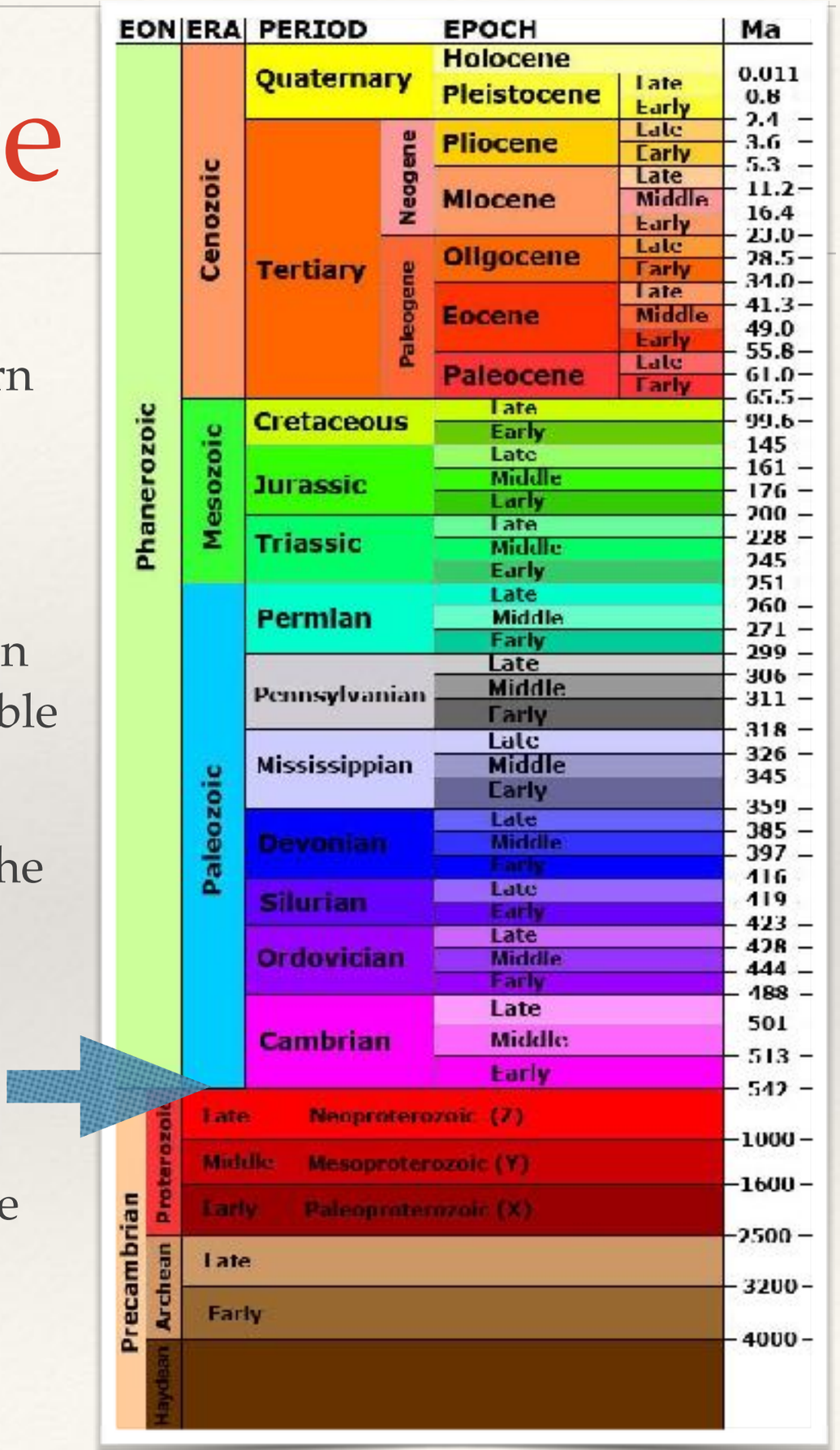
Does the Fossil Record Really Suggest Evolution from a Common Ancestor?

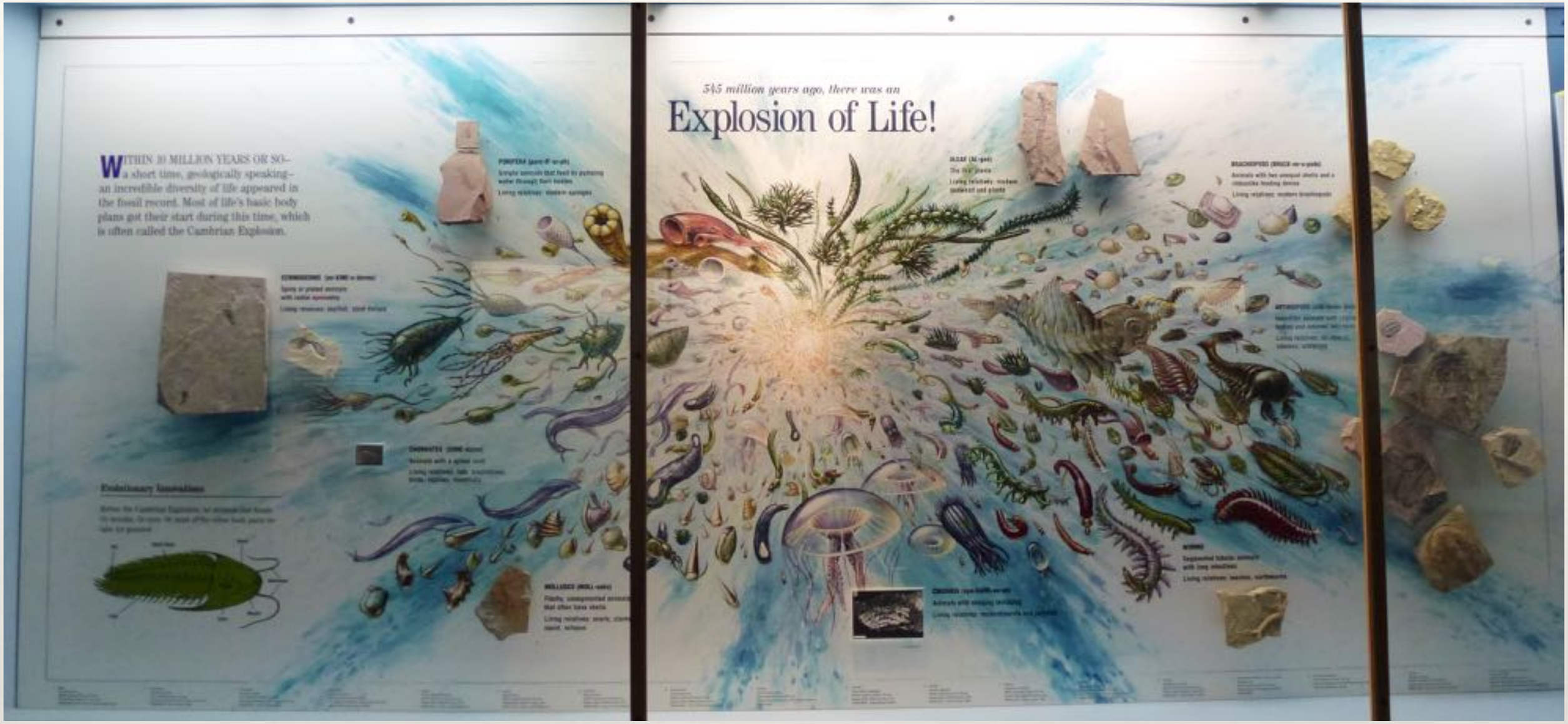
- Most critics of the argument of fossil succession agree that:
  - The succession of fossils in the record is real.
  - The fossil record shows differences as the fossils accumulated.
    - They also accept that the forms found higher up in the strata are relatively more complex than those in the lower strata.
- However, evolution is an interpretation.

- These critics contend that the overall pattern of fossil evidence contradicts the evolutionary theory in five important aspects.
  - The various groups of organisms do not appear gradually, but suddenly in the rock record.
  - The very first organisms in the fossil record already show high diversity and complexity.
  - The various groups appear widely spread geographically.
  - Once they appear in the rock record, they do not show gradual change over time, but *stasis*.
  - Very few good examples of transitional forms exist, and those that are claimed as transitional are indeed questionable.

Abrupt Appearance

- First, paleontologists describe the common pattern of the fossil record as the *abrupt appearance of new forms*.
- The new forms appear suddenly in the strata without any connections to the forms that occur in layers below, with the exception of a few disputable intermediate forms.
- The most remarkable appearance is recorded in the Lower Cambrian layers (about 530 million years ago, in the evolutionary time scale), where more than half of the major phyla of animals appear suddenly.
- Paleontologists call this sudden appearance as the *Cambrian explosion*.





Denver Museum of Nature and Science. Photo by Raúl Esperante

- This diagram represents the ‘explosion’ of life in the lower Cambrian layers.
- Most of the modern phyla appeared suddenly without any ancestor.
- The organisms are fully formed, complex and diverse.
- Note that the diagram is somehow deceiving, because it seems to represent a ‘gradual’ explosion of life forms, more according to what the theory of evolution requires.

The Cambrian Explosion

- The Cambrian explosion was already perplexing for Darwin, who stated:
  - "To the question why we do not find rich fossiliferous deposits belonging to these assumed earliest periods prior to the Cambrian system, I can give no satisfactory answer."

The Origin of Species, 6th ed. Chapter 10.

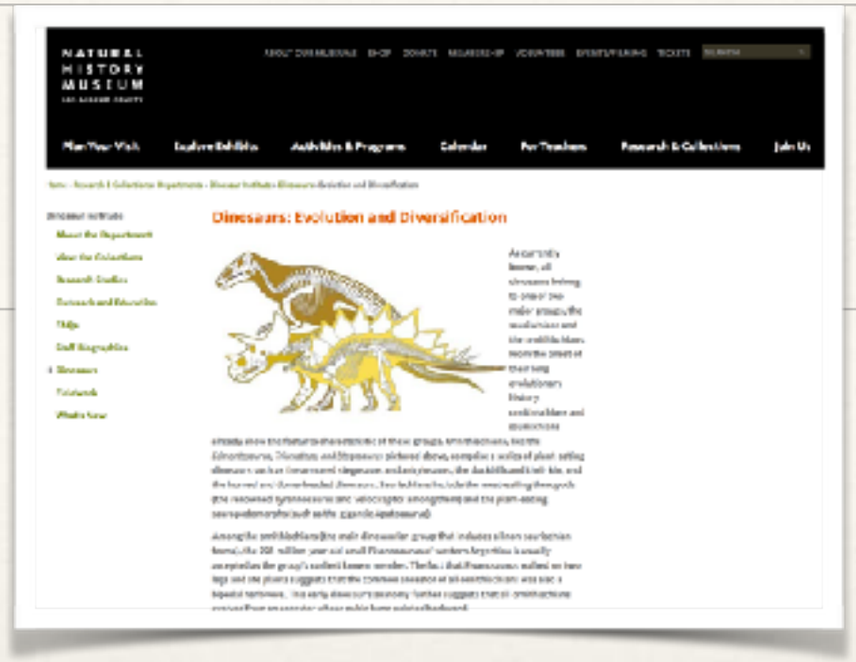
- Many scientists think that the sudden appearance of many of the major groups of organisms in the Lower Cambrian strata contradicts Darwin's postulate that new forms would arise gradually from a Common Ancestor over long periods of time.
- Because of the high diversity and complexity of the Lower Cambrian fauna, the Cambrian Explosion also contradicts the evolutionary postulate that the first organisms would show low diversity and complexity.
- Moreover, the Lower Cambrian fossils appear widely spread geographically.

- What is true of the phyla (the highest animal classification) is also true of the middle and lower classification (classes, orders, families)
- They also appear suddenly.
- For example, in the Paleocene epoch, 15 mammalian orders suddenly appear in the fossil record.
- These orders include the Carnivora (canids, cats, etc.), the Chiroptera (bats), the Perissodactyla (horses.), etc., all of them in the mammalian class.
- Scientists call this sudden appearance the *mammalian radiation*.
- This sudden appearance is not consistent with a scenario of gradual evolution.

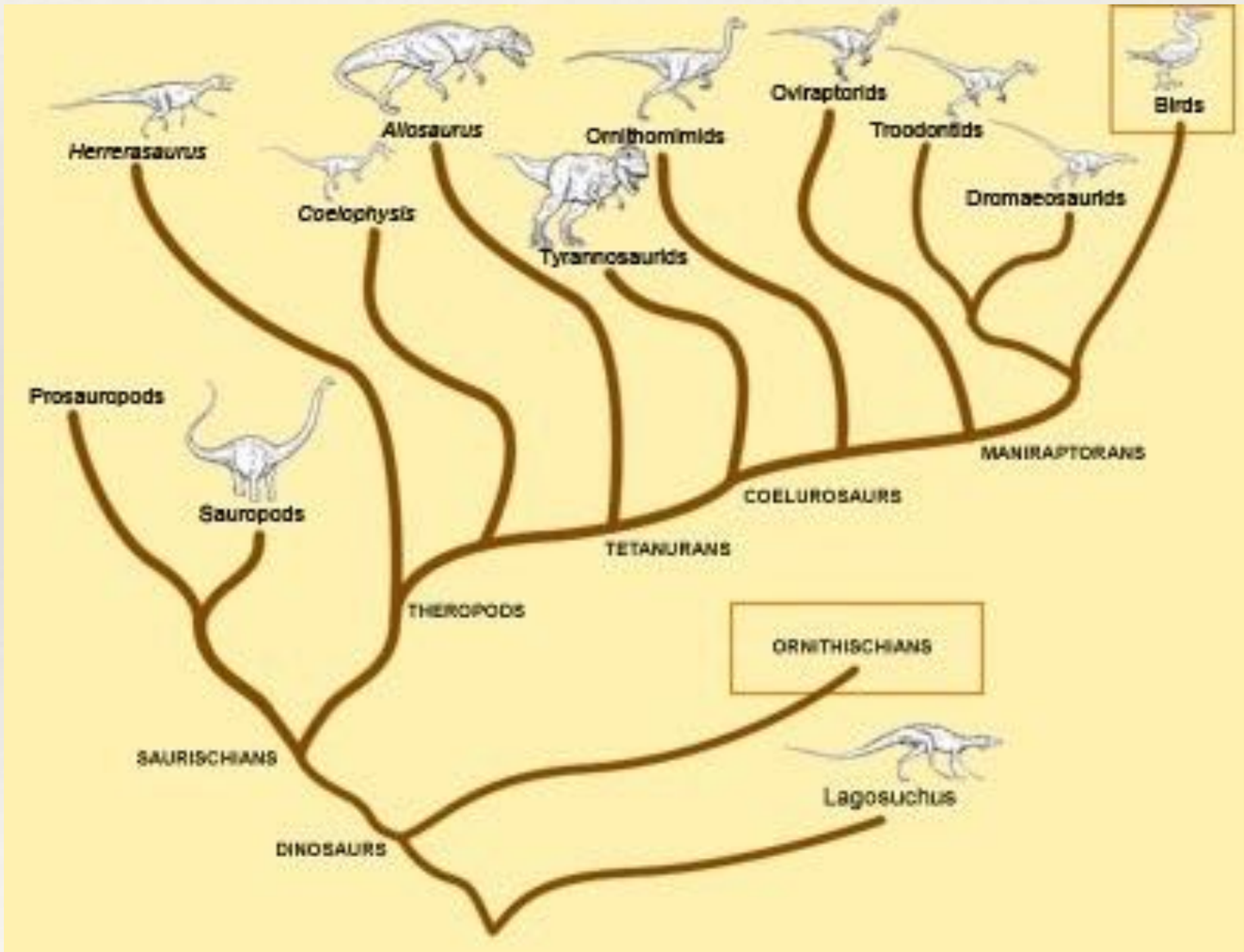
Mammalian Radiation

- Not only new mammalian orders appear suddenly, but when they appear they are already separated into their distinctive forms.
- For example, the first known fossil bat (Order Chiroptera) appear in Eocene strata and is fully formed, without any ancestral transitional form.

Dinosaurs



- Dinosaurs appear suddenly in the fossil record in the Triassic.
- The phylogeny of dinosaurs is commonly depicted with thick lines connecting the different groups.
- But no intermediate is indicated.
- All the groups of dinosaurs appear suddenly int he record without any transitional forms.

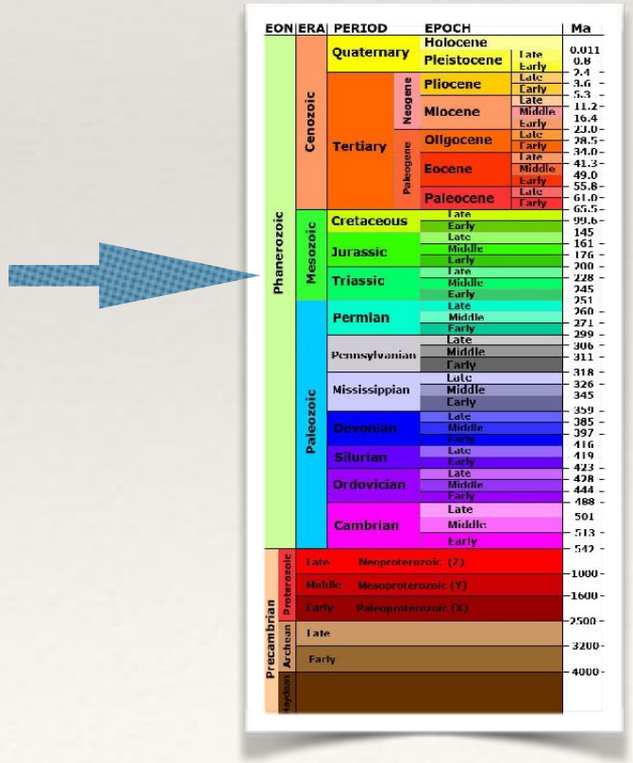


Suggested phylogeny of theropod dinosaurs

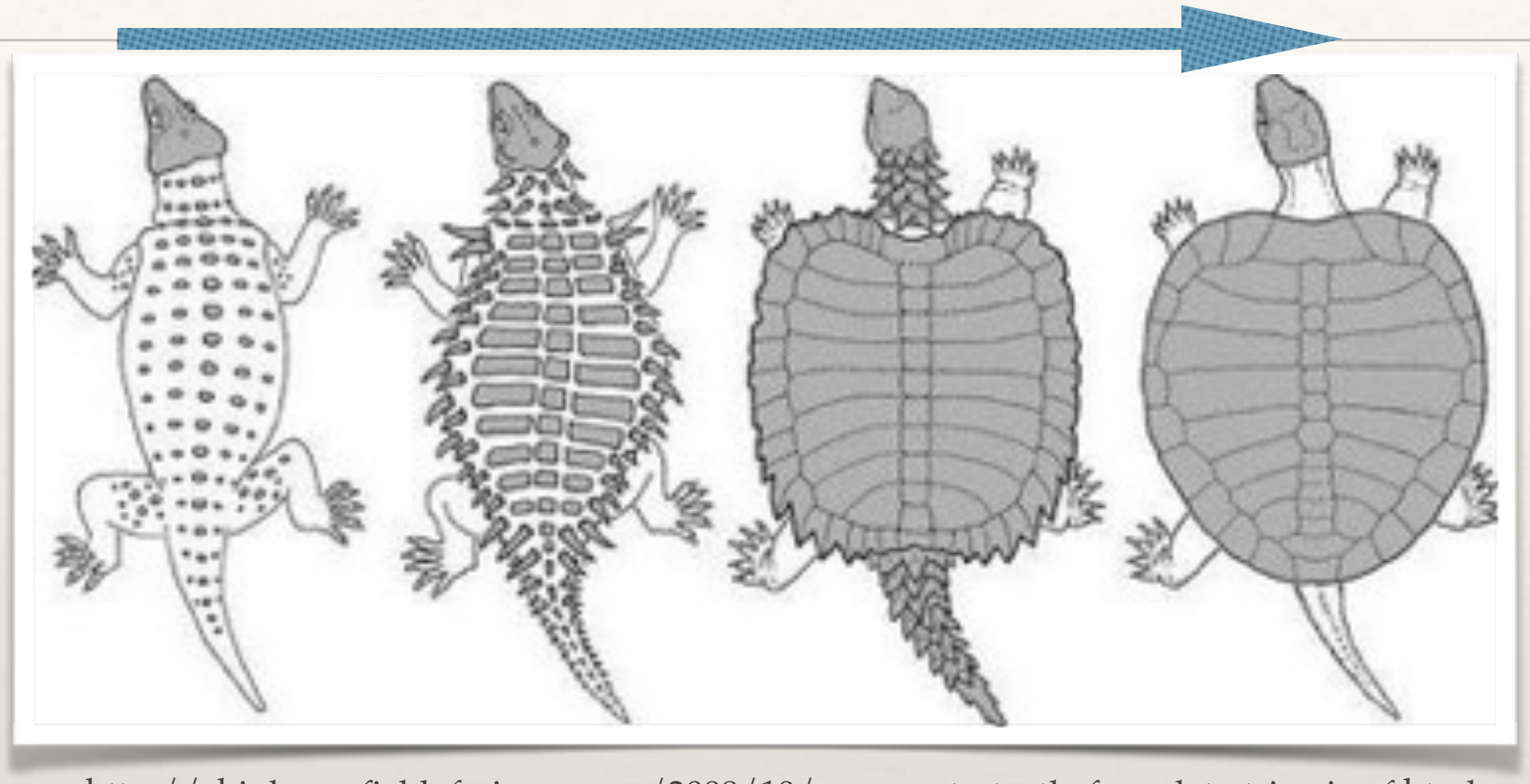
Turtles

- The first fossil turtle appear in Upper Triassic strata.
- These ‘oldest’ turtles already show their body plan fully developed.
- They appear in the fossil record without ancestral intermediates.
- Turtles that appear in upper strata have the same body plan, with only small modifications.

Odontochelys semitestacea



Hypothesized Turtle Evolution

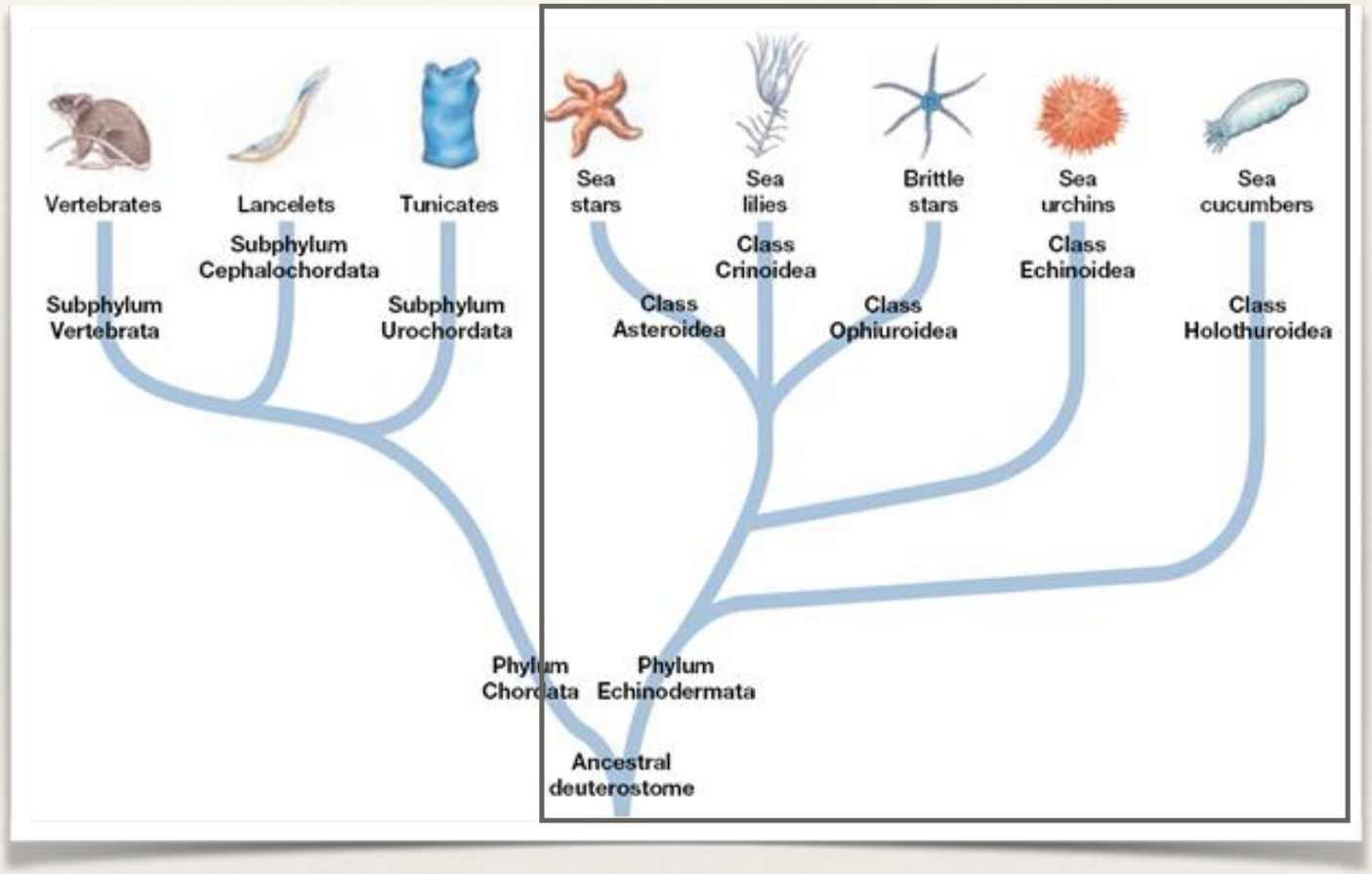


http://chinleana.fieldofscience.com/2008/10/new-proto-turtle-from-late-triassic-of.html

- This figure illustrates what paleontologists think turtle evolution was like.
- Ancestral forms did not have a carapace, but developed it gradually.
- But no intermediate form has been found in the fossil record.
- In reality, only the far right fossil is known.
- No ancestors or intermediates are known.

Evolution of Echinoderms According to a Textbook

- Diagram of the alleged evolution of the phylum Echinodermata.
- The thick connecting lines intend to indicate the phylogenetic (evolutionary) relationships between the different groups of the phylum.
- However, no transitional form or ancestor is suggested.
- That is because no one is known. They do not exist.



http://biologydiva.pbworks.com/w/page/14797002/Zoology%20Chapter%2032

Stratigraphic Range and Abundance of Echinoderms

- This diagram represents the actual stratigraphic range and abundance of three subphyla of Echinoderms.
- Some groups apear first in Lower Cambrian strata and others in the Lower Ordovician.
- All groups appear abruptly in the fossil record, without any common ancestor.

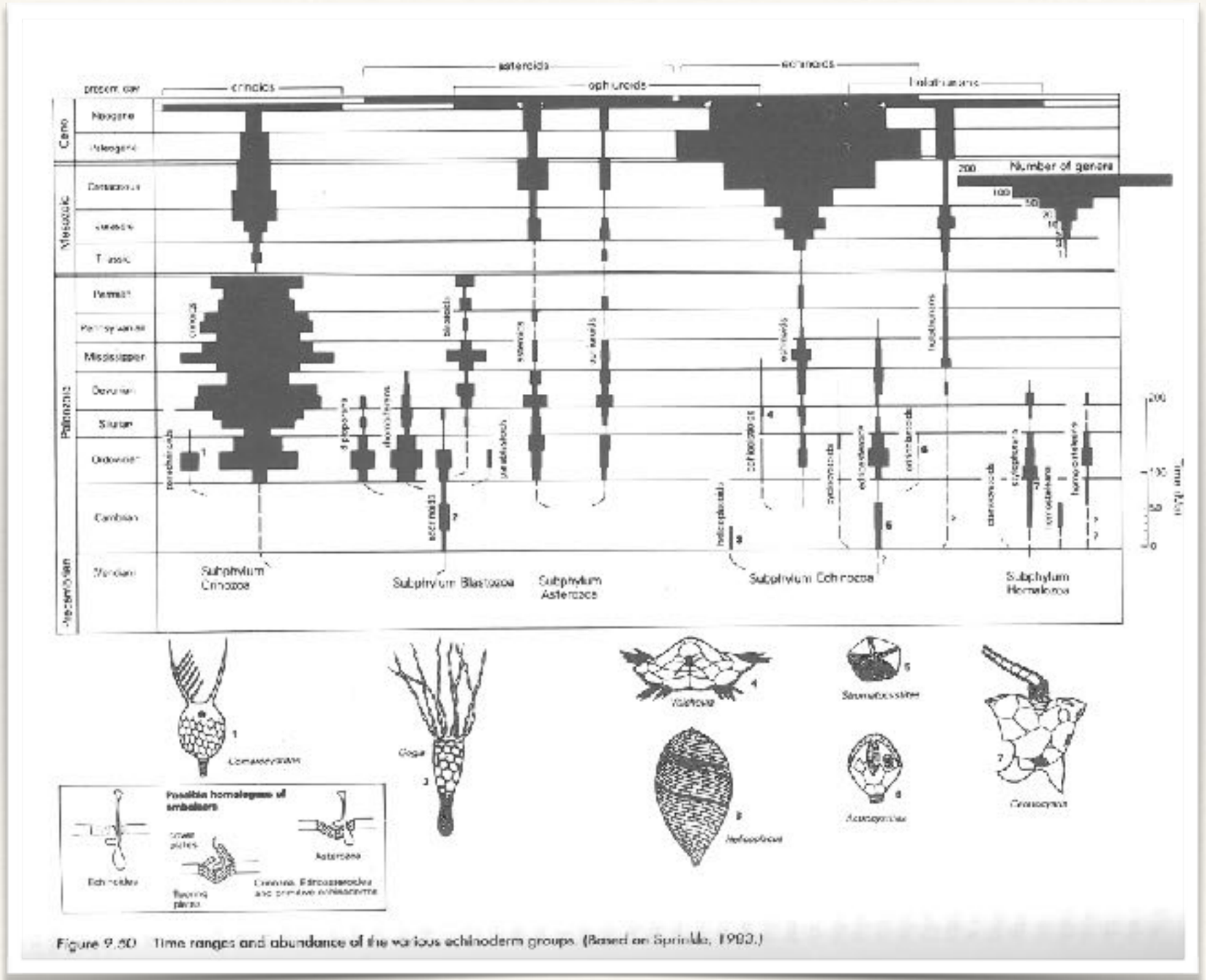


Figure 9.50 Time ranges and abundance of the various echinoderm groups. (Based on Sprinkle, 1993.)

Clarkson 1998, p. 310

Stratigraphic Range and Abundance of Cephalopods

- This diagram depicts the stratigraphic range and abundance of three subclasses of Cephalopods.
- This is an objetive representation of the Cephalopod fossil record:
  - No lines connecting the subclasses and the orders in each subclass.
  - No suggestion of common ancestor or possible evolutionary relationships.

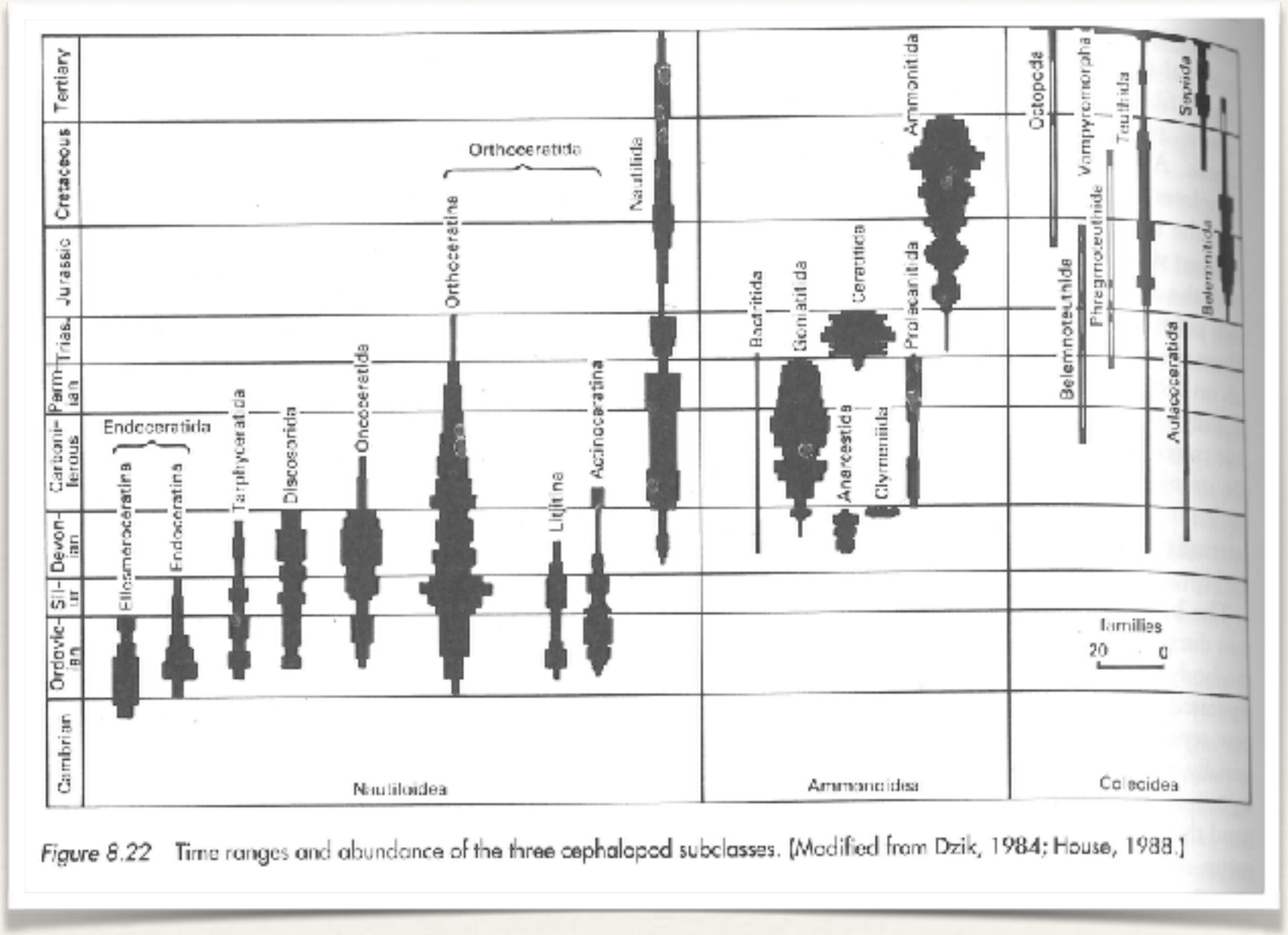


Figure 8.22 Time ranges and abundance of the three cephalopod subclasses. [Modified from Dzik, 1984; House, 1988.]

Clarkson 1998, p. 234

Time Range and Abundance of Mammals

- The fossil record of mammals also lacks transitional forms.
- Each group (order) of mammals is clearly different from the others from the beginning.
- The dotted lines indicate lack of "connecting" forms.
- However, it still depicts the idea that scientists have been able to relate the different groups.

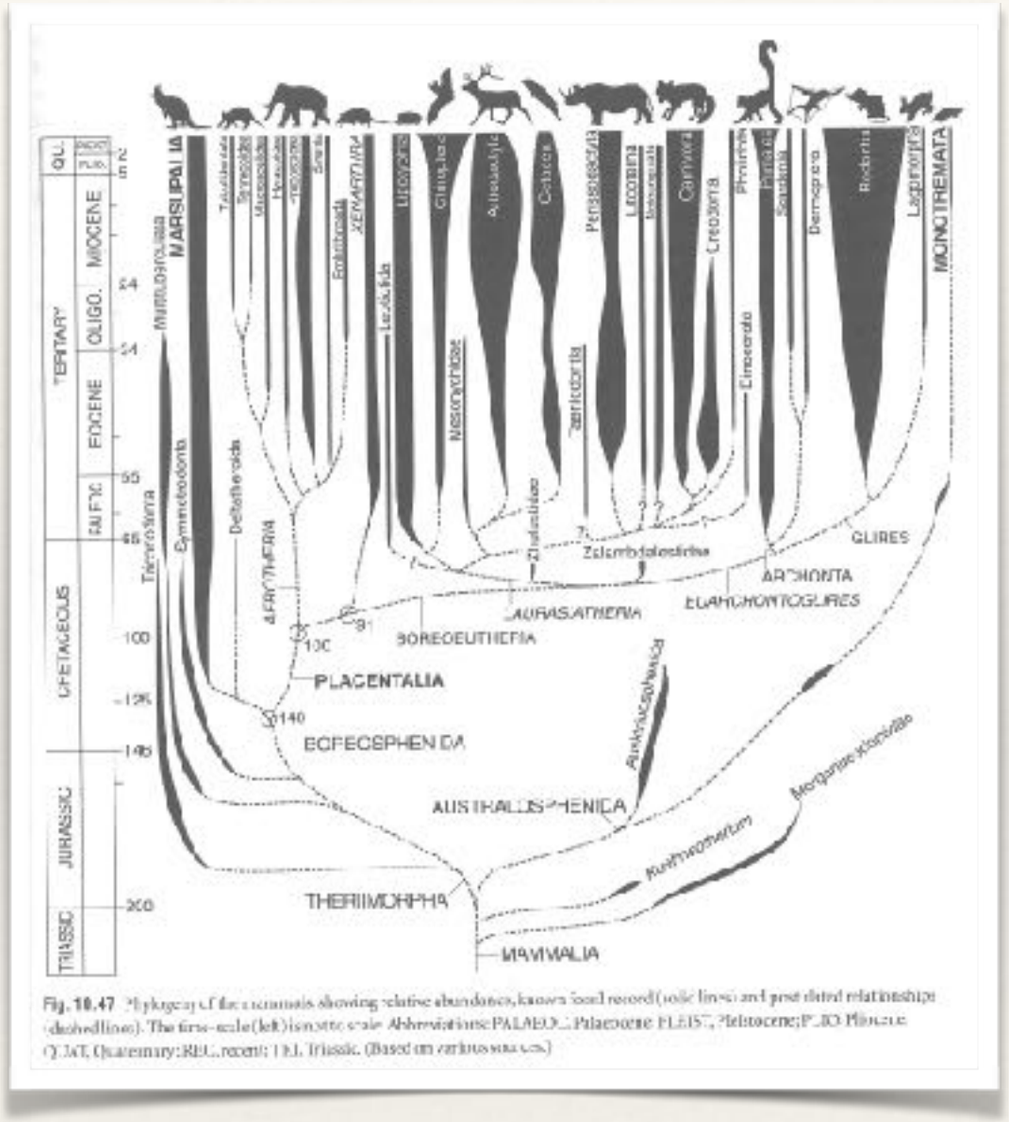
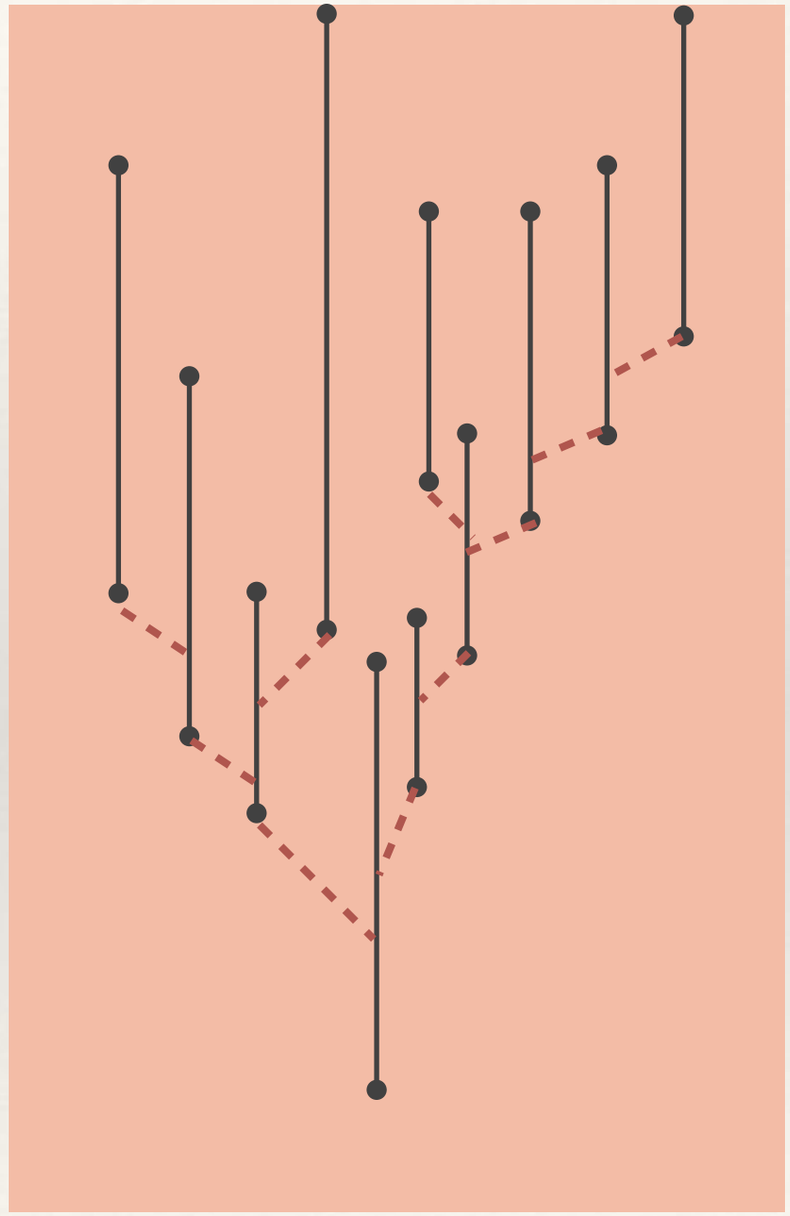


Fig. 10.47 Phylogeny of the mammals showing relative abundance, known fossil record (solid lines) and postulated relationships (dashed lines). The time-scale (left) is not to scale. Abbreviations: PALAEO., Palaeocene; PLEIST., Pleistocene; PLIO. Pliocene; QU.AT, Quaternary; REC., recent; TRI. Triassic. (Based on various sources.)

Phylogeny of mammals, according to Denton, 2005.

Evolutionary Trees

- The theory of evolution postulates that the different groups of organisms are linked together by transitional forms that should be found in the fossil record.
- Evolutionary biologists acknowledge that many gaps remain unfilled in the fossil record.
- Serious evolutionary tree diagrams represent these gaps with dotted lines, or no lines at all.
- This is a serious drawback for the theory of evolution, which requires the existence of intermediate fossils.



Sudden Appearance

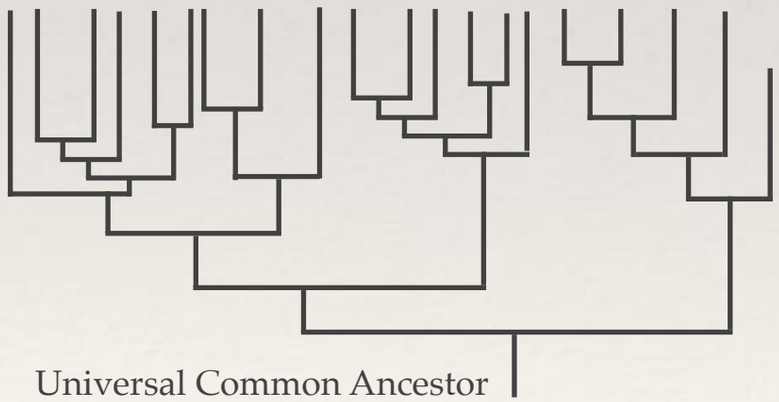
- The pattern of sudden appearance and the absence of good intermediate forms are common features of the fossil record: many types of birds, insects, crustaceans, echinoderms, mollusks appear abruptly without any ancestor.
- This is also true for plants.
- Flowering plants (angiosperms) appear suddenly in the Lower Cretaceous strata, without any obvious ancestor.
- This sudden appearance was so perplexing that Darwin himself referred to it as “an abominable mystery.”

- This pattern of sudden appearance of the different animal and plant forms does not support the Darwinian picture of a gradually branching tree.
  - Instead, it suggests a series of independent beginnings.
  - A forest of trees, instead of a single branching tree.

This is what Darwin's theory of evolution postulates

Monophyletic tree

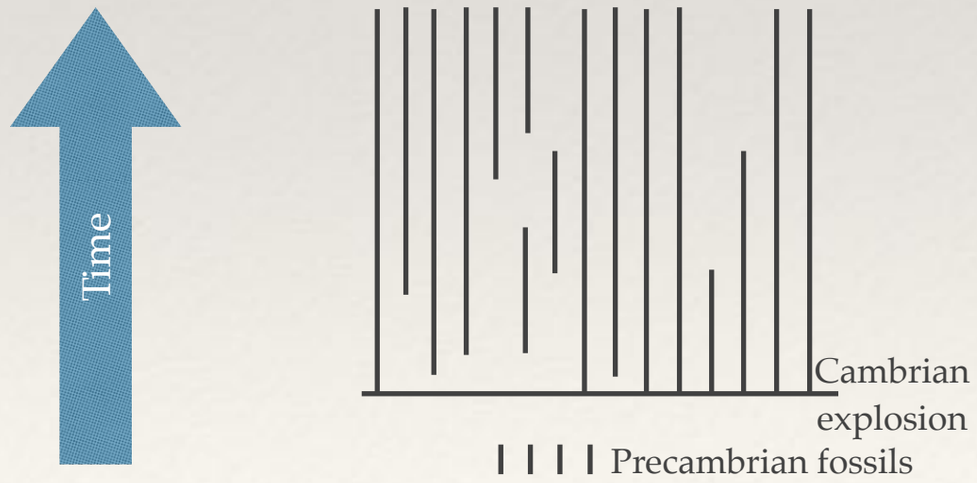
Gradual appearance of the different groups and many intermediate forms



This is what the fossil record shows

Polyphyletic "forest"

Groups appear abruptly in the fossil record and there are no transitional forms

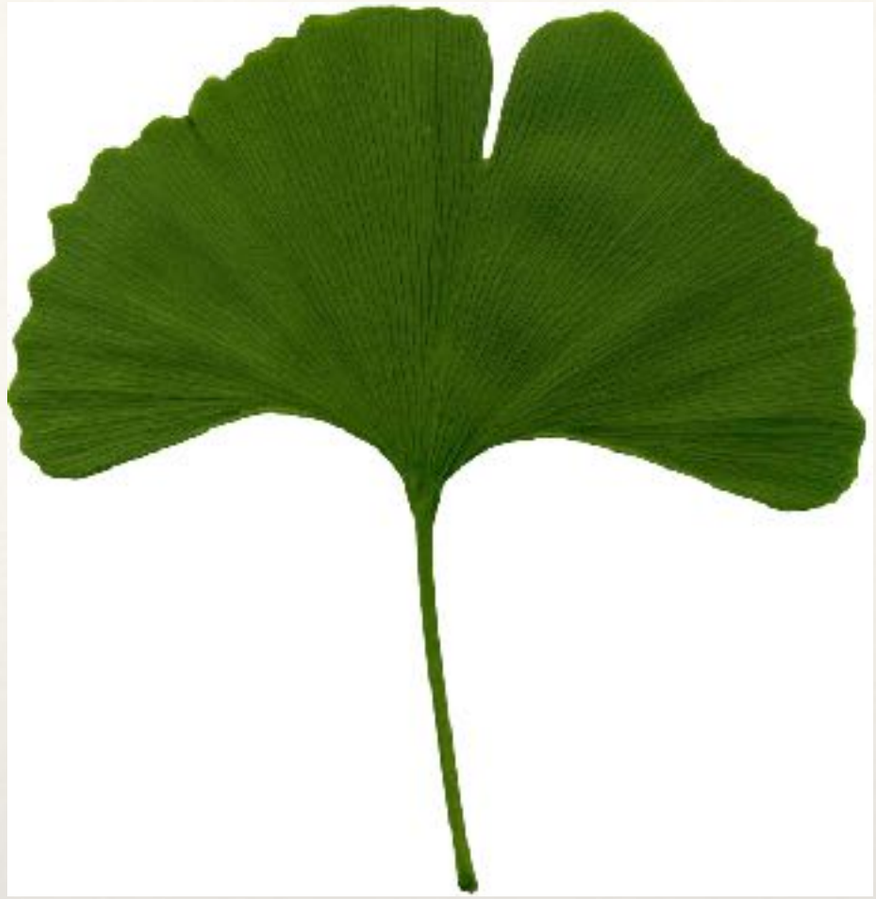


- Darwin acknowledged that the lack of intermediate forms was the most important objection to his theory of gradual evolution:
  - "... The number of intermediate varieties, which have formerly existed on the earth, (must) be truly enormous. Why then is not every geological formation and every stratum full of such intermediate links? 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." (Darwin, 1859, p. 292).

The Stability of Life Forms

- In addition to sudden appearance of animal and plant groups, the fossil succession shows that the groups or organisms remain stable throughout their occurrence in the strata.
- Paleontologists call this stability of form *stasis* when it occurs at the species level.
- But stability also characterize the higher categories of life (orders, classes, phyla).
- David Raup, a paleontologist of the University of Chicago stated that "what geologists of Darwin's time, and geologists of the present day actually find is a highly uneven or jerky record; that is, species appear in the sequence very suddenly, show little or no change during their existence, then abruptly go out of the record." (Raup 1979)

Wikipedia, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=6532895



https://commons.wikimedia.org/wiki/File%3AGinkgo_biloba_scanned_leaf.jpg

- The left photo shows a fossilized *Ginkgo biloba* leaf, and the right photo shows a modern *Ginkgo* leaf, showing virtually no change in morphology in allegedly 135 million years.
- This is what paleontologists call *stasis*.

And the Transitional Forms?

- But what about the transitional forms like the mammal-like reptiles and *Archaeopteryx*?
- Don't they suggest that Darwin's model of gradual evolution was right?
- They don't. The prevailing pattern in the fossil record is that of sudden appearance followed by stasis.
- The alleged transitional forms are the rare exception, and many of them are disputable, including those mentioned.

More Problems with Transitional Forms

- There are statistical reasons to suspect that that the few transitional sequences that have been found are not relevant in the whole scheme of the theory.
- Millions of different fossil forms have been found, and we would expect to find at least a few fossil forms that could be arranged in a plausible evolutionary sequence.
- Is it possible that the mammal-like reptile sequence is a statistical anomaly rather than a legitimate sequence of ancestors and descendants?

The Problem of Time

- The evolutionary sequences presented in textbooks imply that the successive fossil forms appear in the fossil record in the predicted time and stratigraphical position according to cladograms.
- However, that's often not the case.
- The fossil record does not show such precision.
- Some skeletons, including the mammal-like reptiles, were not found in the predicted stratigraphic order.
- Some supposed ancestors and descendants appear in widely separated strata, theoretically representing tens of millions of years.

- In this sense, zoologist Henry Gee (1999) points out,
  - “The intervals of time that separate the fossils are so huge that we cannot say anything definitive about their possible connection through ancestry and descent.”
- The same author, referring to the sequence of hominids that allegedly supports evolution of humans from apes, states,
  - “New fossil discoveries are fitted into this [evolutionary] preexisting story. We call these new discoveries 'missing links', as if the chain of ancestry and descent were a real object for our contemplation, and not what it really is: a completely human invention created after the fact, shaped to accord with human prejudices. In reality, the physical record of human evolution is more modest. Each fossil represents an isolated point, with no knowable connection to any other given fossil, and all float around in an overwhelming sea of gaps.”

The Problem of the Stratigraphic Order

- Another problem is that fossils do not always appear in the stratigraphic order that the theory of evolution predicts.
- Evolutionary biologists analyze the morphological characters of organisms looking for similarities.
- Then they generate hypothetical branching-tree diagrams, called *cladograms,* which represent the alleged evolutionary pathway for that group of organisms.
- These diagrams are used to predict which organisms should appear in the fossil record and their order in the stratigraphic column.

- Sometimes the organisms appear in the predicted order, but often they do not match the predictions.
- Many “older” organisms (as depicted in cladograms) appear above, not below the supposedly “younger” ones in the stratigraphic column.
- This is the case with the primate fossil record, which poorly reflects the predicted evolutionary theory.
- The problem is not as serious with the sequence of mammal-like reptiles.
- However, five of the intermediate forms that the cladograms predict should appear in sequence over a long time actually appear suddenly at the same time in the stratigraphic record.
- The sequence predicted by the cladograms does not match the real sequence in the fossil record.

The Problem of Size

- Some textbooks alter the size of pictures showing the order of appearance of groups such as the mammal-like reptiles.
- This practice creates the impression of a close genealogical relationship and a gradual phylogenetic transition.
- This is the case of the representations of the mammal-like reptiles.

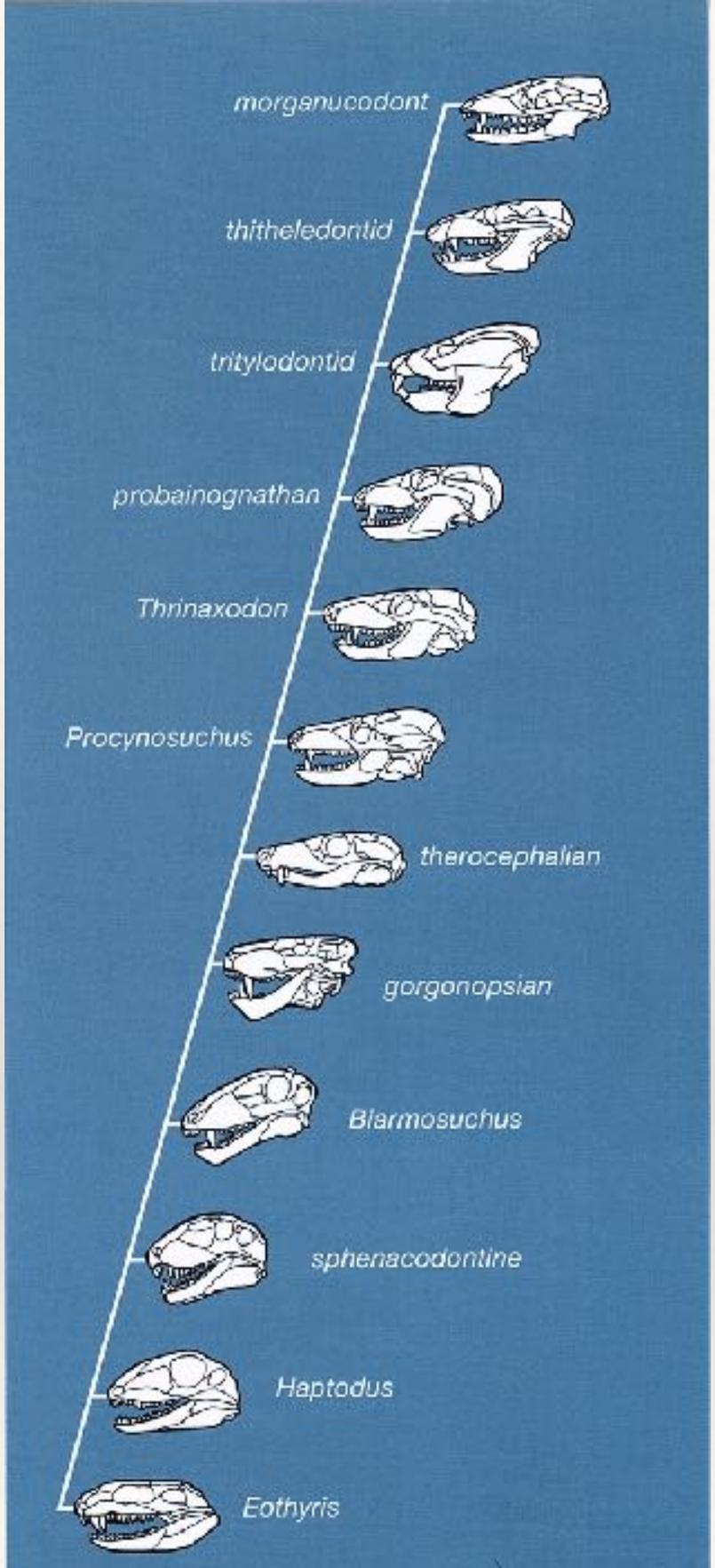


Figure 1:6 Sequence of Mammal-like reptiles as typically presented in textbooks.
From T.S. Kemp, The Origin & Evolution of Mammals (2005): 89.

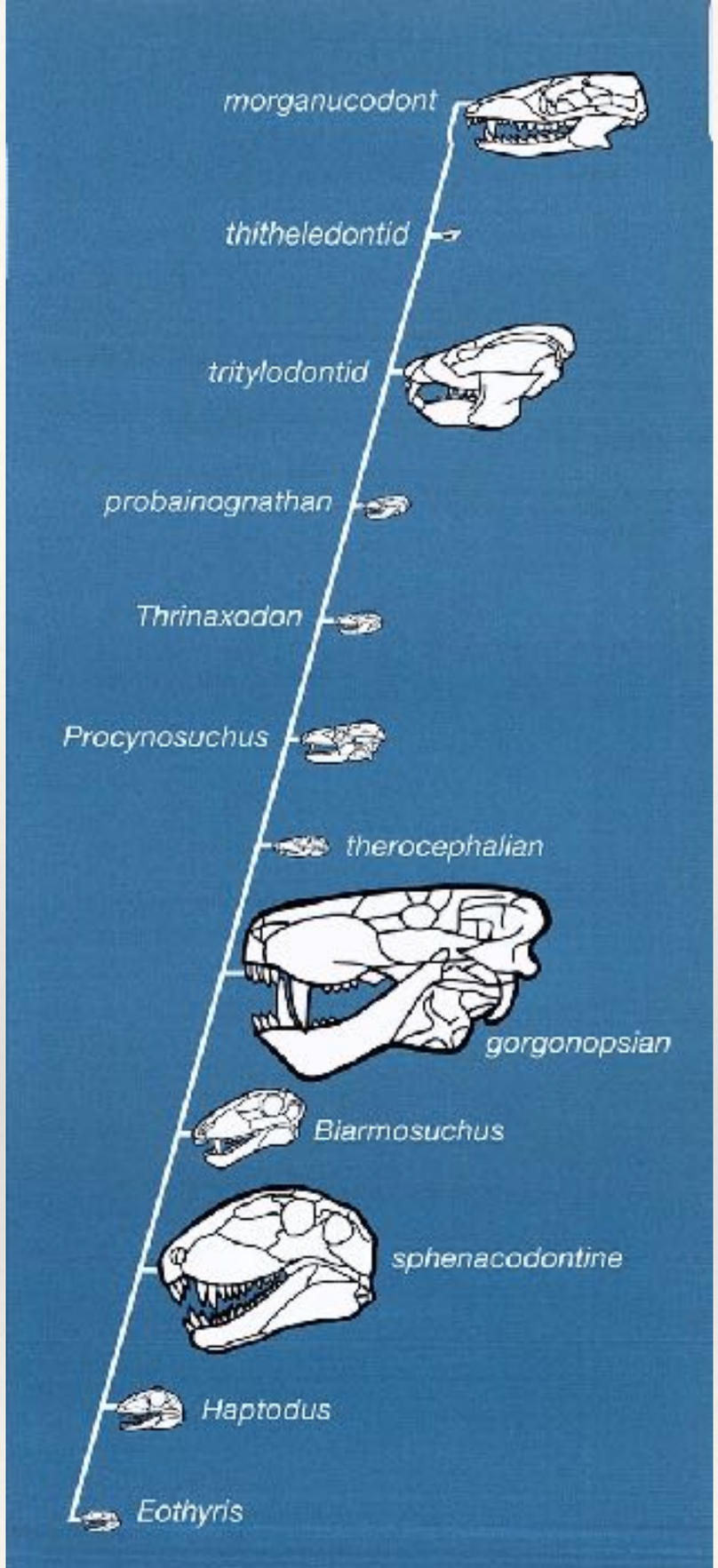


Figure 1:8 Sequence of Mammal-like reptiles, shown to scale (compare to Figure 1:6 on page 21).
Recalculated, from T.S. Kemp, The Origin & Evolution of Mammals (2005).

The Fossil Record and Evolution

- Evolutionists claim that the fossil record proves evolution.
- As seen earlier, some authors make bold assertions:
  - "Currently it makes no sense to continue collecting and studying fossils simply to determine whether evolution is a fact. The question has been definitively answered in affirmative way." (George G. Simpson)
- However, other authors indicate that the fossil record is not fully supportive of evolution,
  - "The observed fossil pattern is invariably not compatible with a gradualistic evolutionary process." (Kemp 1996)

Conclusion

- Fossils are not randomly distributed in the geological column.
- A superficial look at the fossil record seems to suggest gradual appearance of the major groups of animals and plants.
- This seems to fit the theory of gradual evolution of life.
- However, a detailed analysis shows that this is not the case.

Conclusion

- Several patterns of the fossil record are contrary to what we expect based on the Darwinian gradual evolution:
  - The scarcity of good transitional forms between the different orders or families of organisms.
  - The abrupt appearance of new groups of organisms (plants and animals).
  - The Cambrian Explosion, in which the majority of the groups of animals arise abruptly fully formed and highly complex without ancestors.
  - Other sudden appearances in the fossil record above the Cambrian.
  - High morphological and functional disparity at the Cambrian explosion.
  - High biological and ecologic specialization from the very beginning.
  - High biological diversity from the beginning.

Conclusion

- Sedimentary rocks do not contain a detailed record of organisms that show a gradual evolution from "simple" organisms to more complex.
- Plant and animal fossils do not form a continuous change as Darwin suggested, but are discrete elements.
- There seems to be either a problem with the fossil record or with the idea of gradual evolution.
- Maybe evolution is not the best model to explain the fossil record.
- The absence of clear and abundant transitional forms is exactly what we would expect to find in a creation model.

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