Life and Geologic Time

Geologic Time

- The appearance and disappearance of types of organisms throughout Earth's history give scientists data to mark important changes or geologic occurrences in time.
- Divide Earth's history into smaller units based on the types of life-forms living during certain periods.
- The division of Earth's history into smaller units makes up the geologic time scale.
- All the divisions in the geologic time scale are based on changes in fossil organisms.

Geologic Time

- Record of Earth's history, starting with Earth's formation about 4.6 billion years ago.
- Geologic time is divided into 3 subdivisions:
  - Eras
  - Periods
  - Epochs

Eons/Eras

- The largest units of geologic time is the eon. Eons are divided into Eras
- There are three eras, all different lengths:
  - Precambrian eon – the longest, 4 billion years.
  - Paleozoic era – “ancient life”
  - Mesozoic era – “middle life”
  - Cenozoic era – “recent life”
- Each era is determined by a change in life forms.

Periods

- Eras are subdivided into periods.
- Vary in length and determined by life forms and geologic events like mountain building.
- A unit of geologic time that is longer than an epoch but shorter than an era.

Epochs

- Smallest units of geologic time.
- Only used in the Cenozoic Era's periods and the Carboniferous Period where the rock record is most complete and least deformed.
- Subdivision of geologic time that is longer than an age but shorter than a period

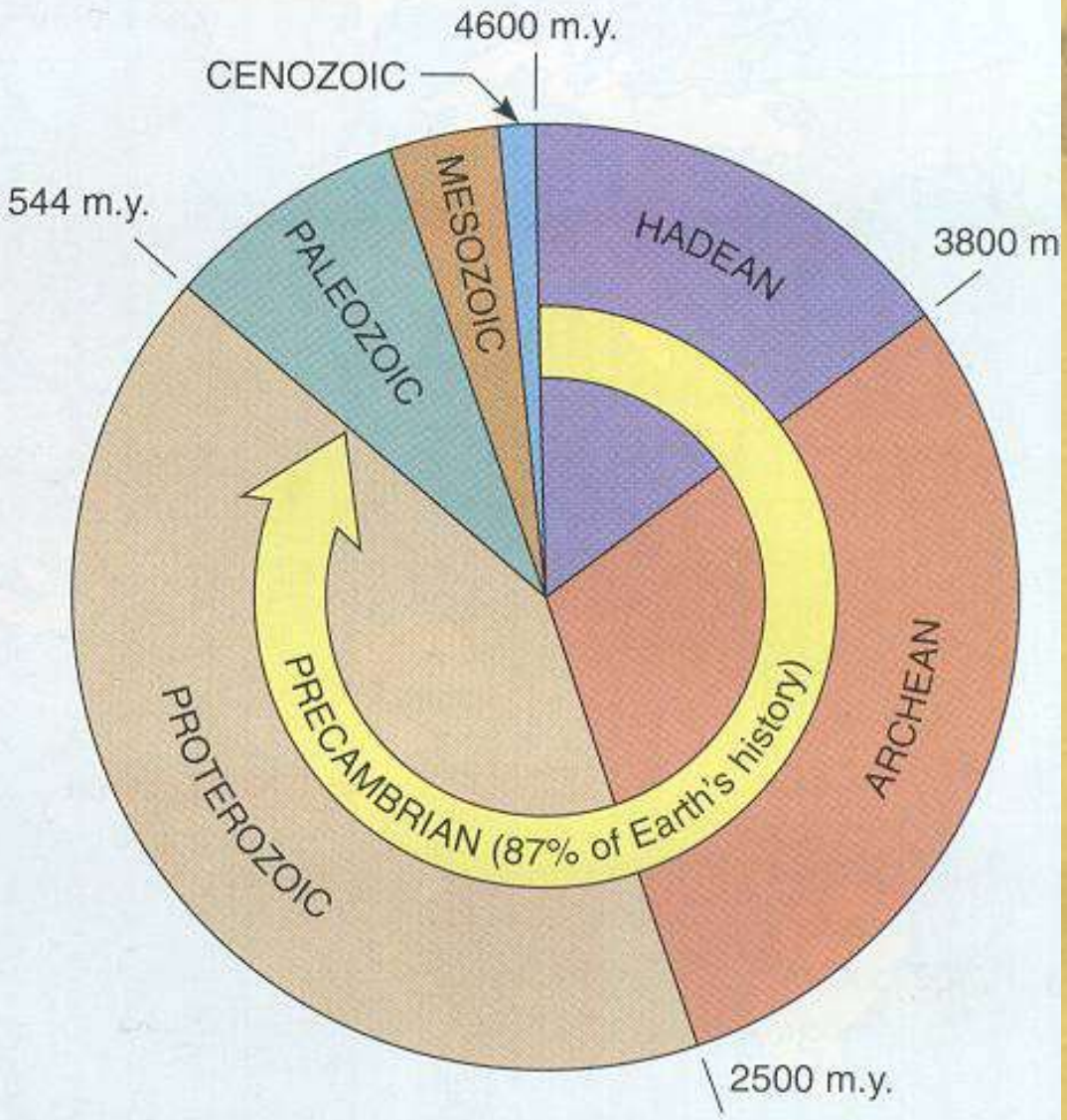
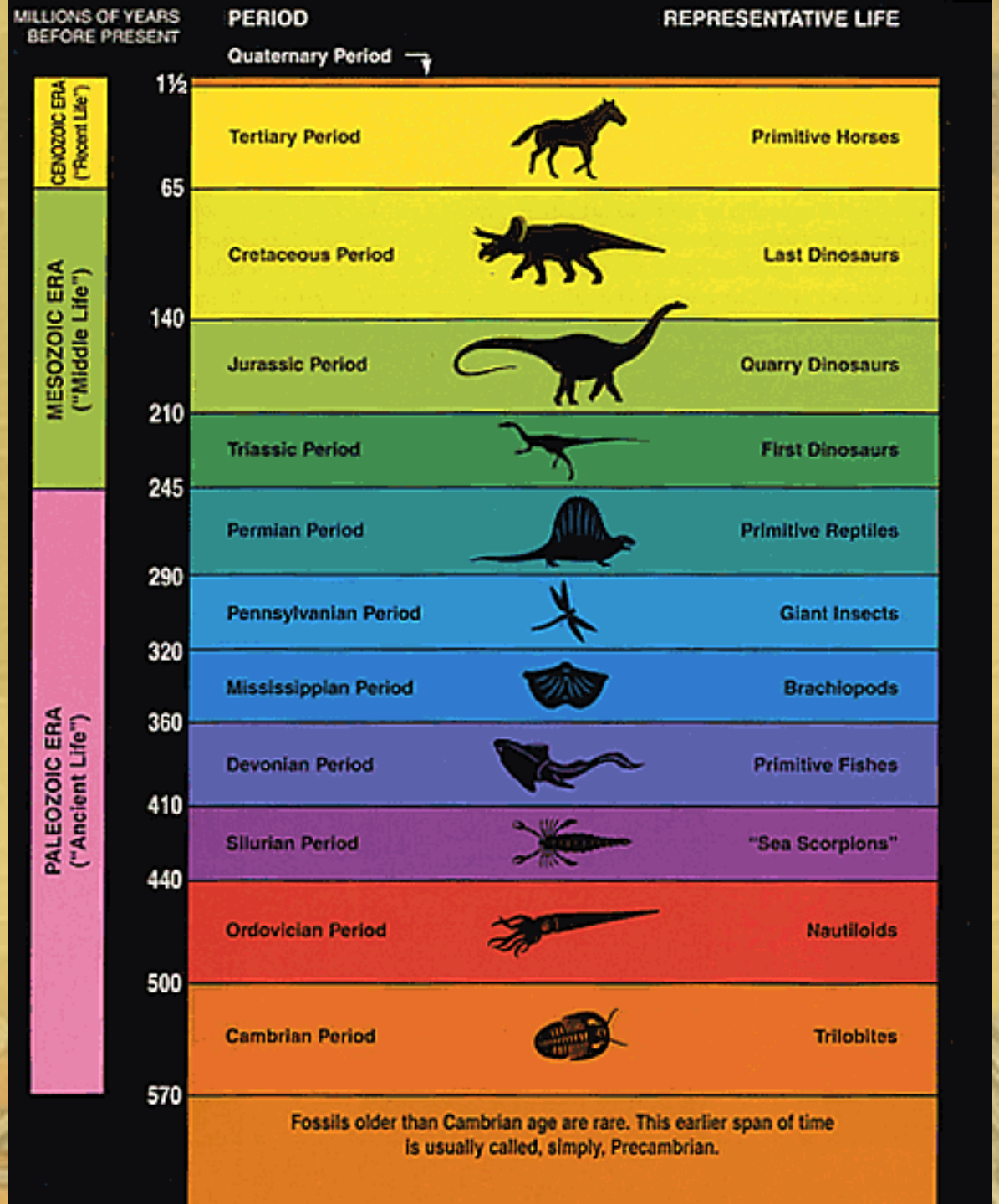


FIGURE 6–14 Proportions of geologic time encompassed by the Precambrian and its divisions, the Hadean, Archean, and Proterozoic eons.

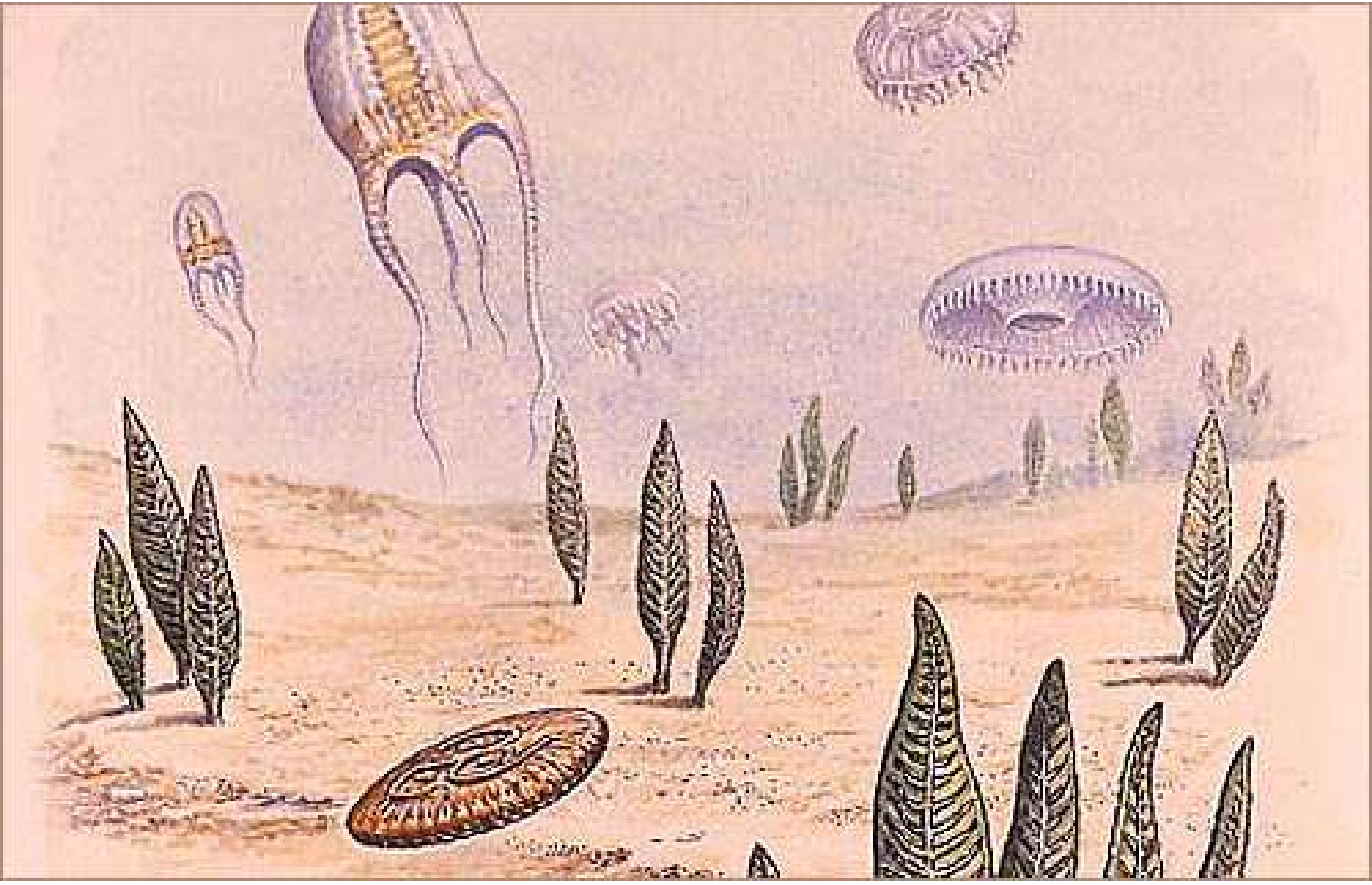

MILLIONS OF YEARS BEFORE PRESENT
PERIOD
REPRESENTATIVE LIFE
Quaternary Period
1½
CENOZOIC ERA ("Recent Life")
Tertiary Period
Primitive Horses
65
MESOZOIC ERA ("Middle Life")
Cretaceous Period
Last Dinosaurs
140
Jurassic Period
Quarry Dinosaurs
210
Triassic Period
First Dinosaurs
245
PALEOZOIC ERA ("Ancient Life")
Permian Period
Primitive Reptiles
290
Pennsylvanian Period
Giant Insects
320
Mississippian Period
Brachiopods
360
Devonian Period
Primitive Fishes
410
Silurian Period
"Sea Scorpions"
440
Ordovician Period
Nautiloids
500
Cambrian Period
Trilobites
570
Fossils older than Cambrian age are rare. This earlier span of time is usually called, simply, Precambrian.

Precambrian Eon

- Longest geologic time unit of Earth's history.
- 4.6 billion to about 542 million years ago.
- Relatively little is known about Earth and the organisms that lived during this time.
- Precambrian rocks have been buried deeply and changed by heat and pressure. They have also been eroded more than younger rocks.
- Most fossils can't withstand the metamorphic and erosional processes that most Precambrian rocks have undergone.

Life Forms of the Precambrian

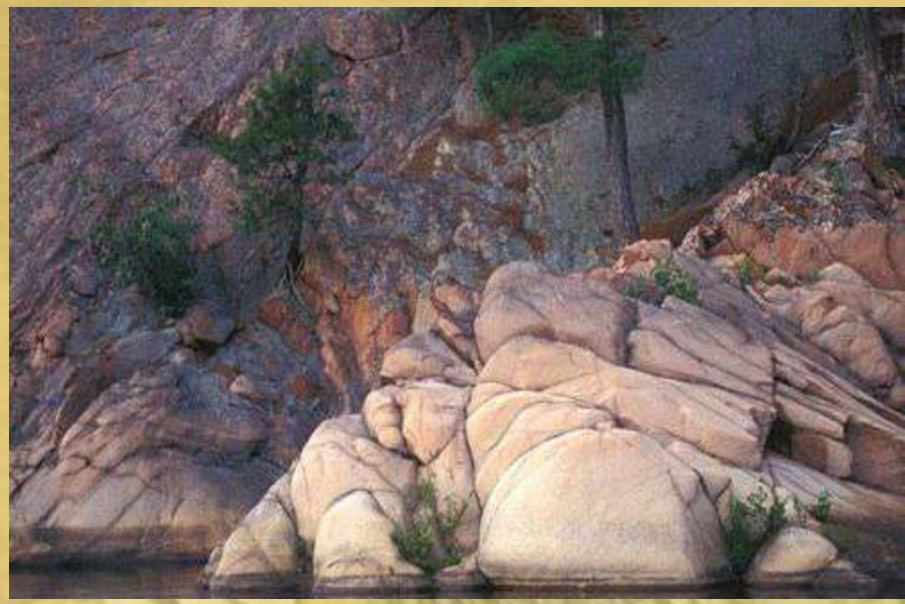
- All life was marine (ocean dwelling) and was soft bodied (no hard parts).
- The only plants were algae and fungi.
- Animal life included jellyfish, corals, and worms (invertebrates – no backbones).
- Following the appearance of cyanobacteria, oxygen became a major gas in Earth's atmosphere.



Rocks of the Precambrian

- Rock outcroppings of Precambrian rock are called shields.

- These rocks often contain large deposits of important metals like iron, copper, etc.



Paleozoic Era

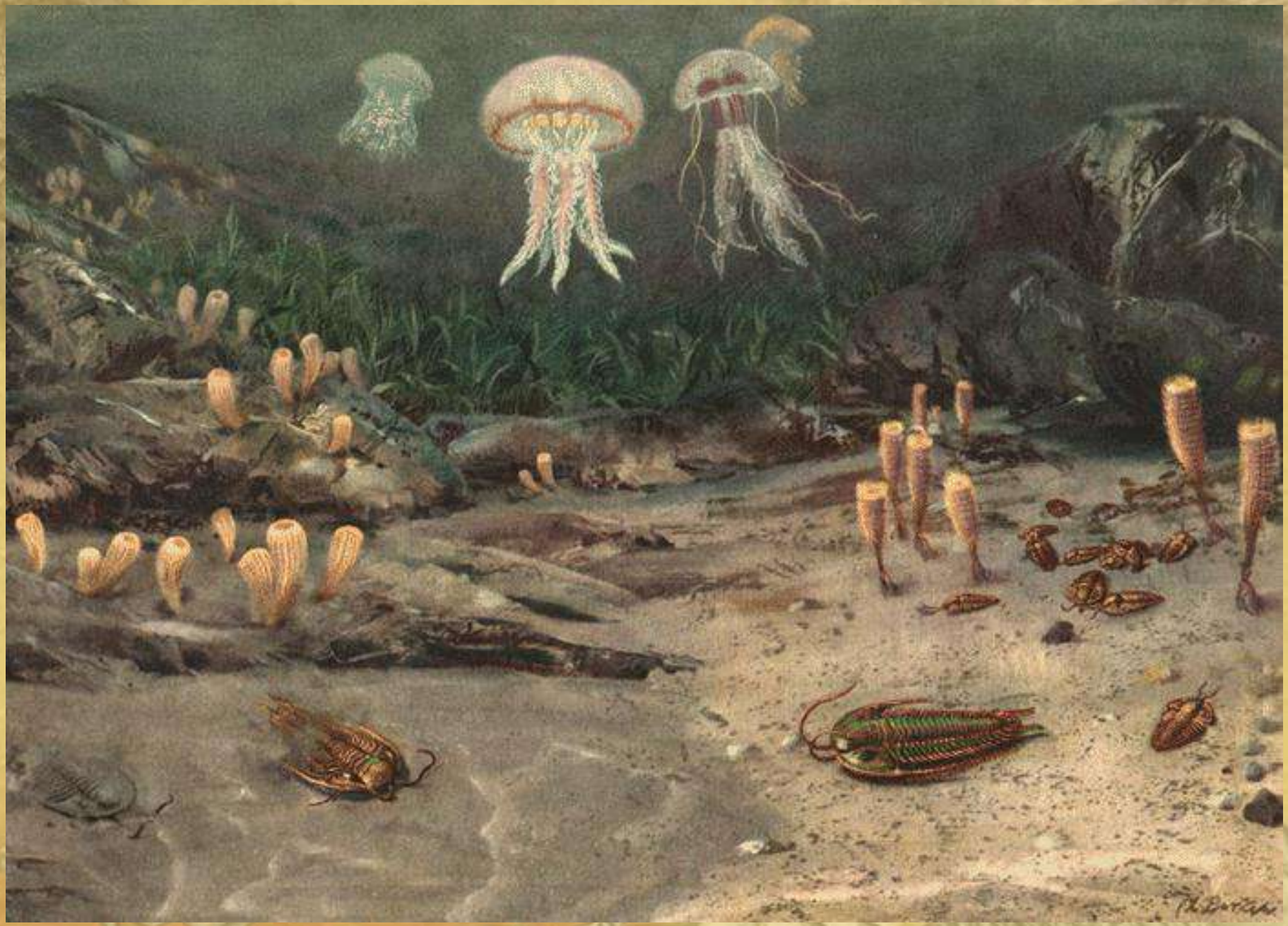
- Era of ancient life.
- Began about 542 million years ago.
- Beginning of the Paleozoic is marked by the presence of the first organisms with hard parts.
- Warm, shallow seas covered much of the Earth's surface. Most of the life-forms were marine.

7Periods of the Paleozoic

- Cambrian
- Ordovician
- Silurian
- Devonian
- Mississippian
- Pennsylvanian
- Permian

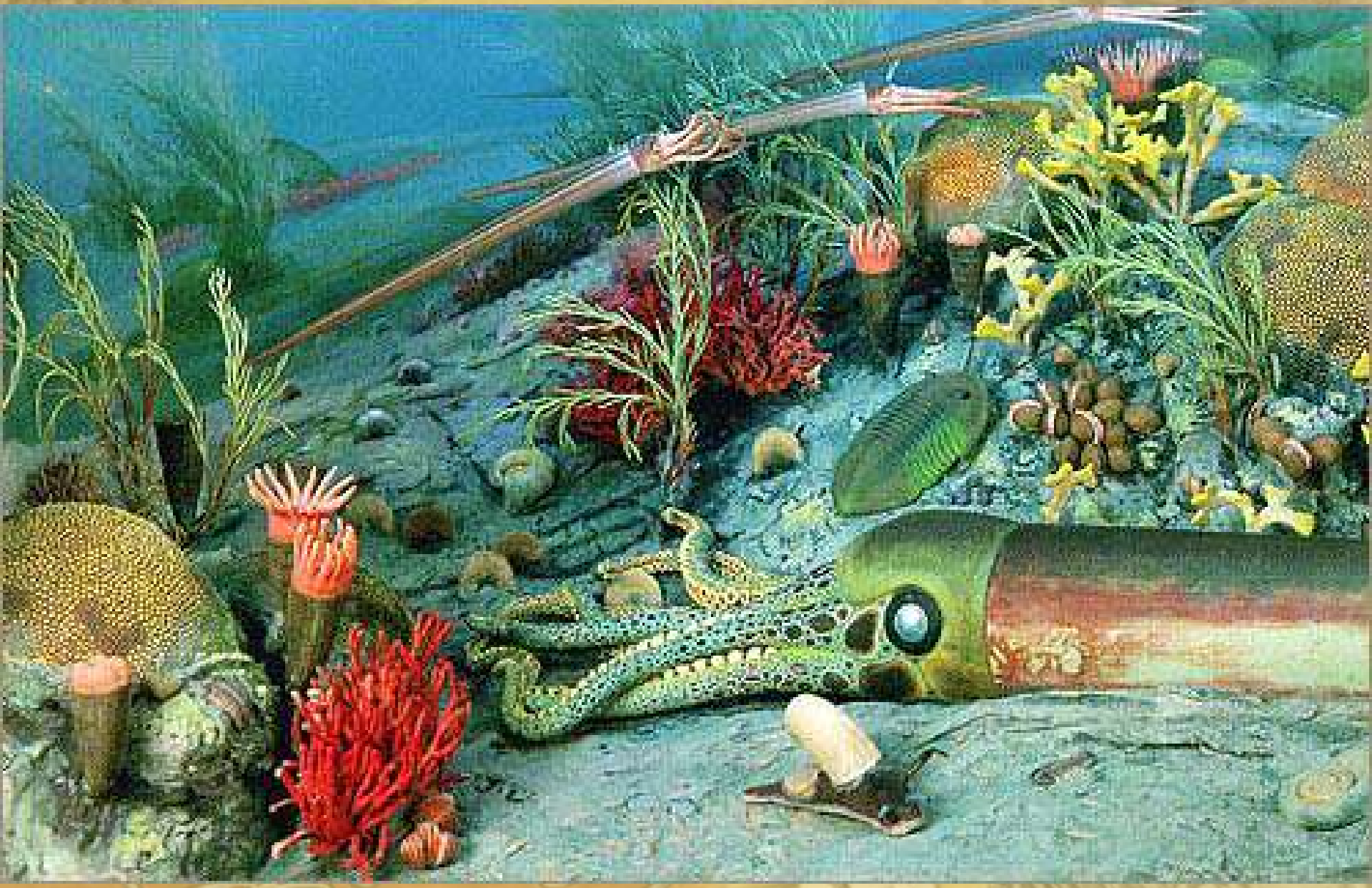
Cambrian Period

- 600 to 500 million years ago.
- Marks the appearance of marine animals with hard parts.
- Life Forms:
  - Algae and seaweed were the dominant plants.
  - Animals found in the Cambrian include trilobites, jellyfish, corals, snails, sponges, and worms.
  - The dominant animal was the trilobite, an arthropod, who appeared at the beginning of the Cambrian and was the first animal with hard parts.
  - Snails also first appeared during the Cambrian.
- Georgia was under water during the Cambrian period. We have Cambrian deposits in our area.



Ordovician Period

- 500 to 440 million years ago.
- Start of Ordovician is marked by the beginning of the Appalachian Mountain-building process.
- Plants: algae, seaweed, fungi.
- The first vertebrates – animals with backbones.
- Animals: brachiopods, bryozoans, cephalopods, corals, crinoids, snails, pelecypods (clams), sponges, trilobites, primitive fish.
- During the Ordovician Period, the cephalopods replaced the trilobites as the dominant form of life. Some of the cephalopods grew shells up to 30 feet long.
- The first vertebrate, an ancient fish, made its appearance during the Ordovician Period.

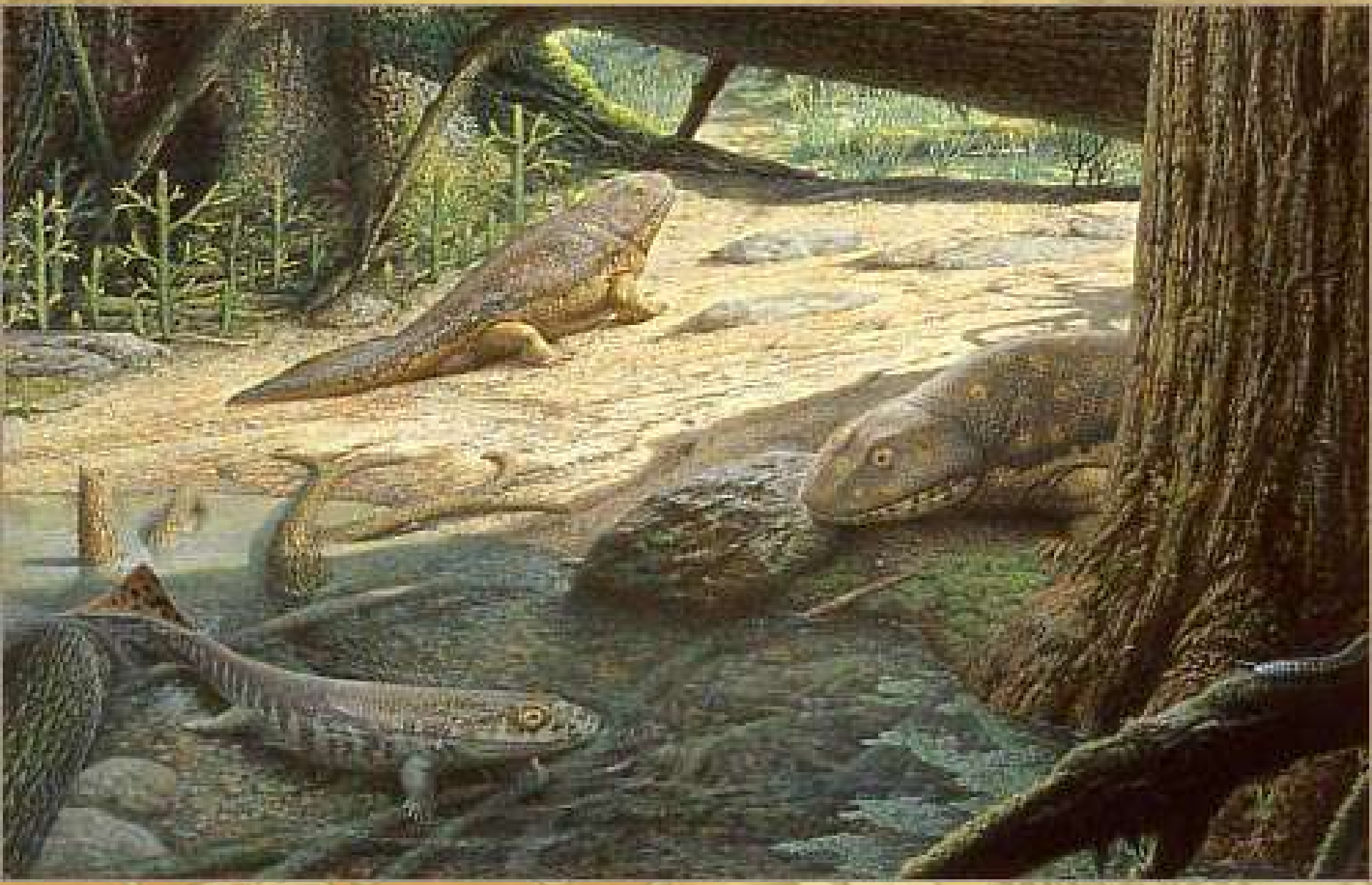


Silurian Period

- 440 to 400 million years ago.
- Plants: algae, lichens, mosses.
- Animals: many arthropods were found (trilobites, spiders, millipedes, scorpions), brachiopods, bryozoans, cephalopods, echinoderms (crinoids), snails, clams, sponges.
- During the Silurian Period the first true land plants appeared along the shores.

Devonian Period

- 400 to 350 million years ago.
- New plants: ferns, rushes, early trees.
- New animals: early amphibians, bony fishes, lung-fish.
- During the Devonian, woody plants developed.
- The fish were the dominant life-form – thus the Devonian is called the “Age of Fishes”. Some fish had the ability to crawl out to the land and the early amphibians developed.
- Some parts of the Appalachians were raised.



Mississippian Period

- 350 to 330 million years ago.
- Warm seas and swampy conditions existed over much of North America.
- The land plants grew rapidly in size and numbers.
- Amphibians became abundant and were the highest life form.
- There was also an increase in numbers and types of fish.

Pennsylvanian Period

- 330 to 270 million years ago.
- The early conifer plants developed during this period.
- Insects developed and expanded very rapidly.
- The first reptiles also appeared during this time.
- It was at this time that the great swamps with much plant growth began what today we have as coal beds.
- The Mississippian and Pennsylvanian Periods together are called the Carboniferous Periods.

Permian Period

- 270 to 225 million years ago.
- During this period the amphibians continued to be very successful but were being replaced by reptiles as the most successful form.
- The Permian was one of the most violent periods of the earth's history.
  - Near the end of the Permian, a single landmass called Pangaea was formed and major glaciers formed.
  - The Appalachian mountains were built up at this time. The uplift of the land caused drainage of much of the water from the land, creating desert like conditions.
  - Because of the drastic climate changes, many forms of life died out, such as the trilobites, and also many types of amphibians and plants. The reptiles adapted to the changes better than other animals and became the dominant form as the next era, the Mesozoic began.
  - At the end of this period 90% of marine organisms and more than 70% of land organisms died. This is called a mass extinction.

Mesozoic Era

- Era of middle life.
- Began about 251 million years ago.
- Pangaea broke into smaller continents, the tectonic plates drifted and collided. Mountain ranges as well as shallow seas and marshes covered much of the land.
- In general climate was warm and humid.
- Era is commonly called “Age of the Reptiles”

Periods of the Mesozoic Era

- Triassic – Dinosaurs appeared
- Jurassic- Dinosaurs became dominant life-form during this period.
- Cretaceous-Dinosaurs continued to dominate Earth, but plant life became very sophisticated and the first angiosperms appeared during this period.

Triassic Period

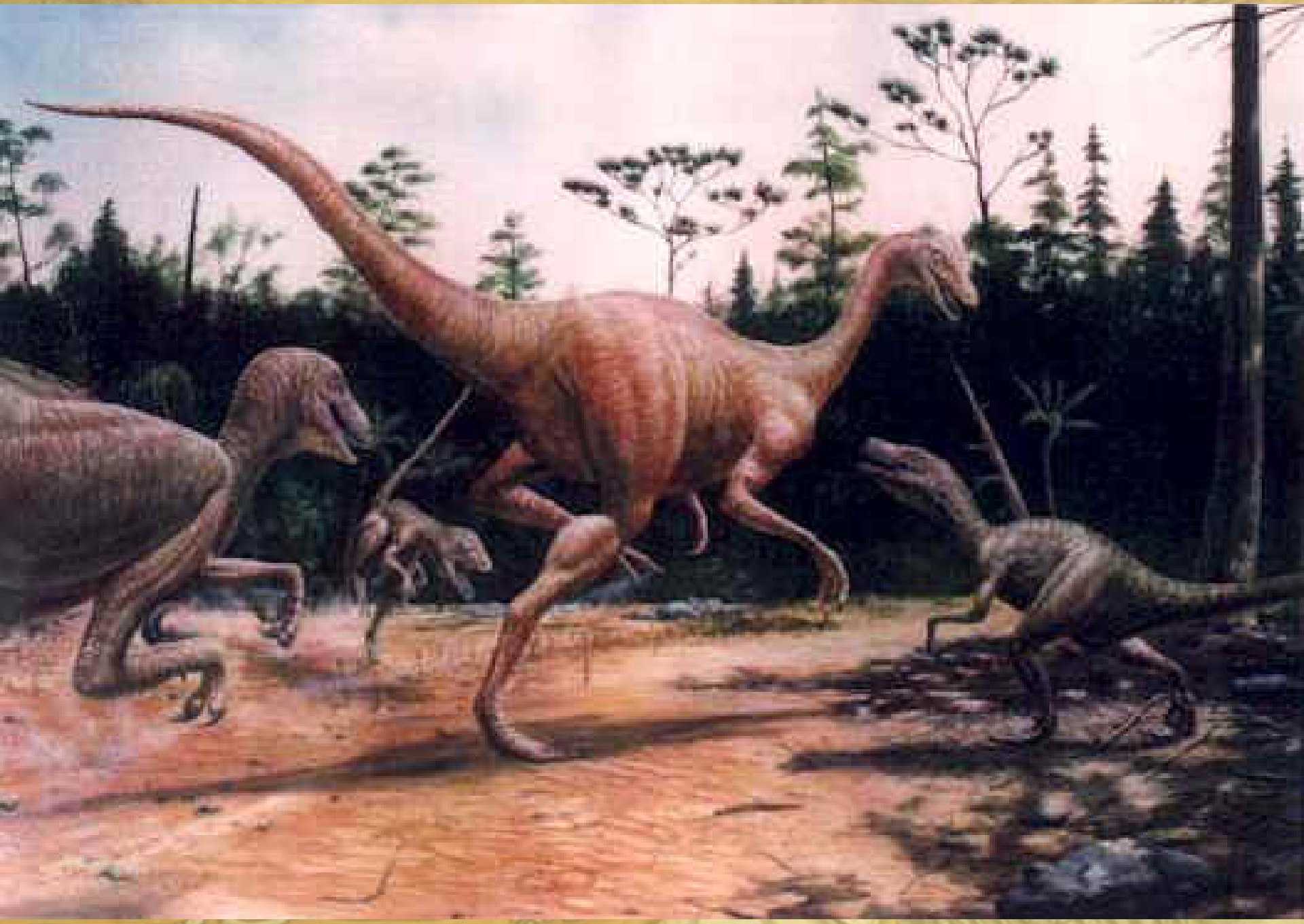
- 225 to 180 million years ago.
- Pangaea separated into two large landmasses:
  - Northern mass was *Laurasia*
  - Southern mass was *Gondwanaland*
- Because of the drastic changes in climate, the reptiles replaced the amphibians as the dominant form of life.
- The first dinosaurs were small, and developed during this period.
- Conifer plants flourished.
- Most of North America was dry during the Triassic.

Jurassic Period

- 180 to 135 million years ago.
- This was the “Age of Reptiles”.
- Dinosaurs were the dominant form of life.
  - There were flying reptiles as well as many reptile forms in the sea.
  - Common dinosaurs were Tyrannasaurus Rex, Allosaurus, Stegosaurus, Brontosaurus.
- The first mammals appeared as well as the first true bird – Archaeopteryx.
- The Sierra Nevada Mountains were formed at this time.

Cretaceous Period

- 135 to 70 million years ago.
- Dinosaurs continued to rule the earth during this period.
- Mammals were small and relatively unimportant.
- Modern flowering plants appeared during this time and many of the forms are still with us today. These plant types became the most important of all plants.
- At the close of the Cretaceous, widespread changes produced the Rocky Mountains and also led to the end of many life forms, including the dinosaurs (except for their descendents, the birds).



The End of the Mesozoic Era

- Pangaea broke up during the Mesozoic Era, and continents continued to move toward their present positions.
- The end of the Mesozoic Era brought about the extinction of many plants and animals. Some think as much as 75% of the life forms died out. We most often think of this time as the end of the dinosaurs.
- The cause of this widespread extinction is not known, but many theories have been presented.

Theories of Extinction

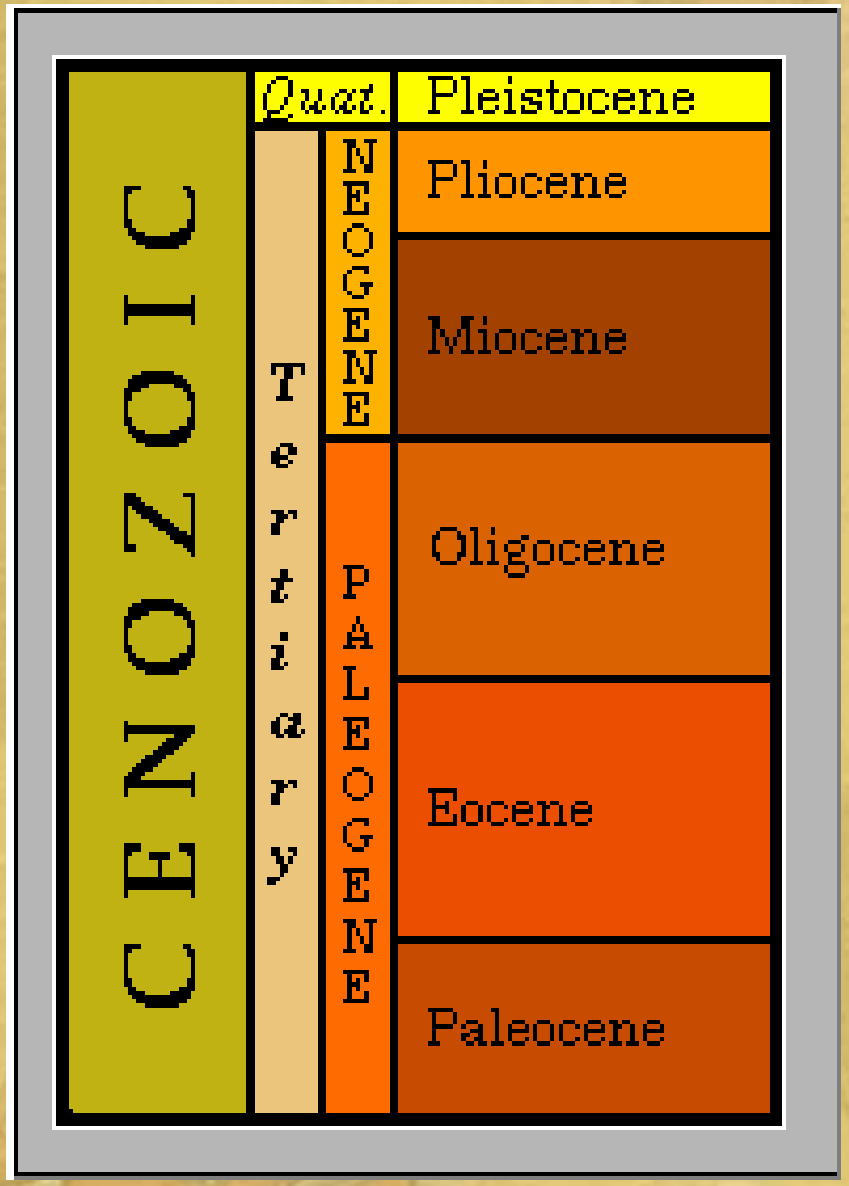
- *Greenhouse Effect* – because of a decrease in plant life, CO_2 levels became high in the atmosphere, thus raising the temperature too high.
- *Nutrition* – because of abundant moisture, too much calcium was leached out of the soil so that plants didn't have enough to keep the dinosaurs healthy.
- *Exploding Star* – the ozone layer of the atmosphere was destroyed by the radiation from an exploding star, thereby exposing life forms to strong cosmic rays.
- *Egg Eating Mammals* – dinosaur eggs were eaten by mammals.
- *Impact Hypothesis*-Giant meteorite crashed into Earth, impact raised enough dust to block the sun's rays for many years
- Other theories state that dinosaurs froze from coming Ice Ages, died because they were so dumb, were killed from disease, etc.

Cenozoic Era

- Era of recent life.
- Began about 65 million years ago.
- The Cenozoic is sometimes called the “Age of Mammals”, because the largest land animals have been mammals during that time.
- Geologically, the Cenozoic is the era when continents moved into their current positions.
- Many of the mountain ranges throughout North and South America began to form at this time.
- Climate became cooler and ice ages occurred.

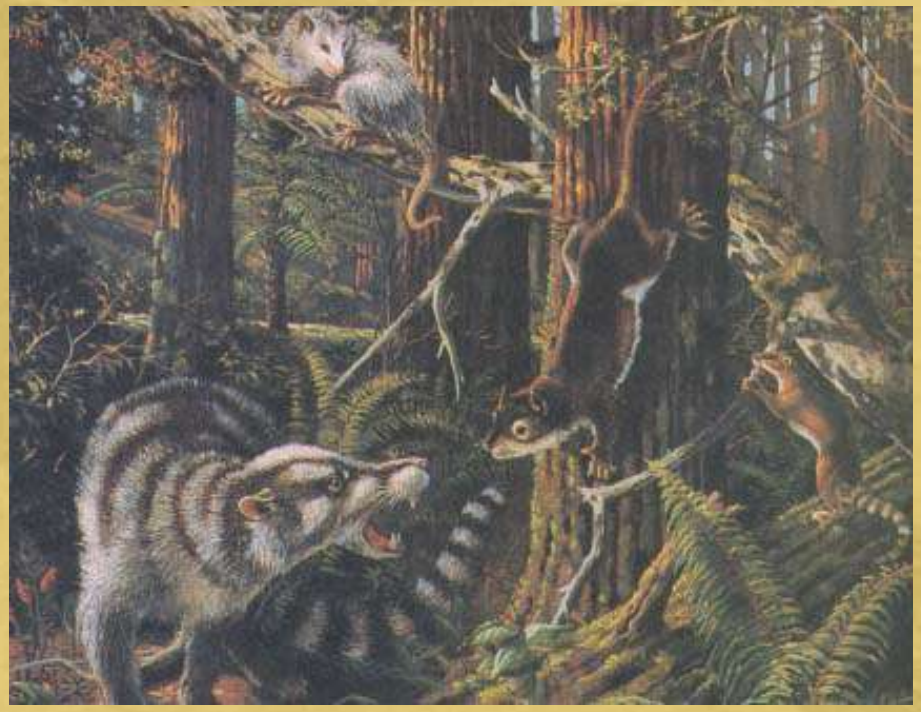
Periods of the Cenozoic Era

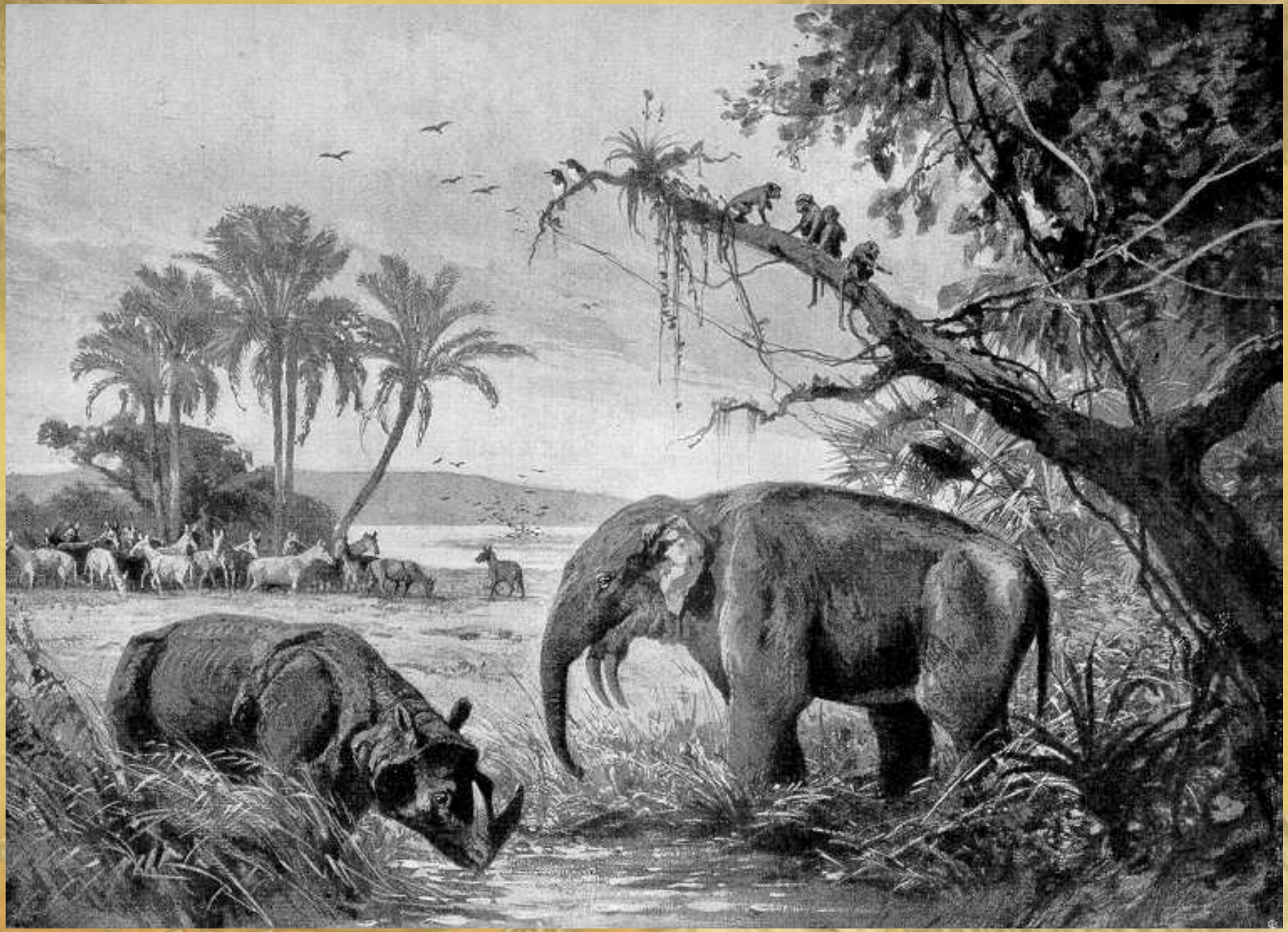
- Tertiary - 65 million years ago to 1.8 million years ago.
- Quaternary - includes only the last 1.8 million years.
  - We live in the Holocene epoch, which began about 11,000 years ago.


CENOZOIC
Quat.
Pleistocene
Tertiary
NEOGENE
Pliocene
Miocene
PALEOGENE
Oligocene
Eocene
Paleocene

Cenozoic Mammals

- Mammals diverged from a few small, simple, generalized forms into a diverse collection of terrestrial, marine, and flying animals.
- Presence of distinctive large land mammals and birds:
  - Mammoths
  - Longhorned bison
  - Sabre-toothed cats
  - Horses
  - Camels
  - Teratorn birds (25-foot wingspans)
- The Cenozoic is just as much the age of flowering plants and insects.





Cenozoic Era

- As the number of flowering plants increased, their pollen and fruit provided food for the many insects and small, plant-eating mammals.
- The plant-eating mammals provided food for meat-eating mammals.
- Many kinds of mammals evolved into larger life-forms.

Cenozoic Geography

- The Panamanian land-bridge between North and South America appeared during the Pliocene, allowing migrations of plants and animals into new habitats.
- Of even greater impact was the accumulation of ice at the poles, which would lead to the extinction of most species living there, as well as the advance of glaciers and ice ages of the Late Pliocene and the following Pleistocene.

Homo sapiens

- Appeared about 500,000 years ago but became a dominant animal only about 10,000 years ago.
- As the climate remained cool and dry, many of the larger mammals became extinct.
- As human population grew, they competed for food that other animals relied upon. They may have contributed to extinctions by overkill.