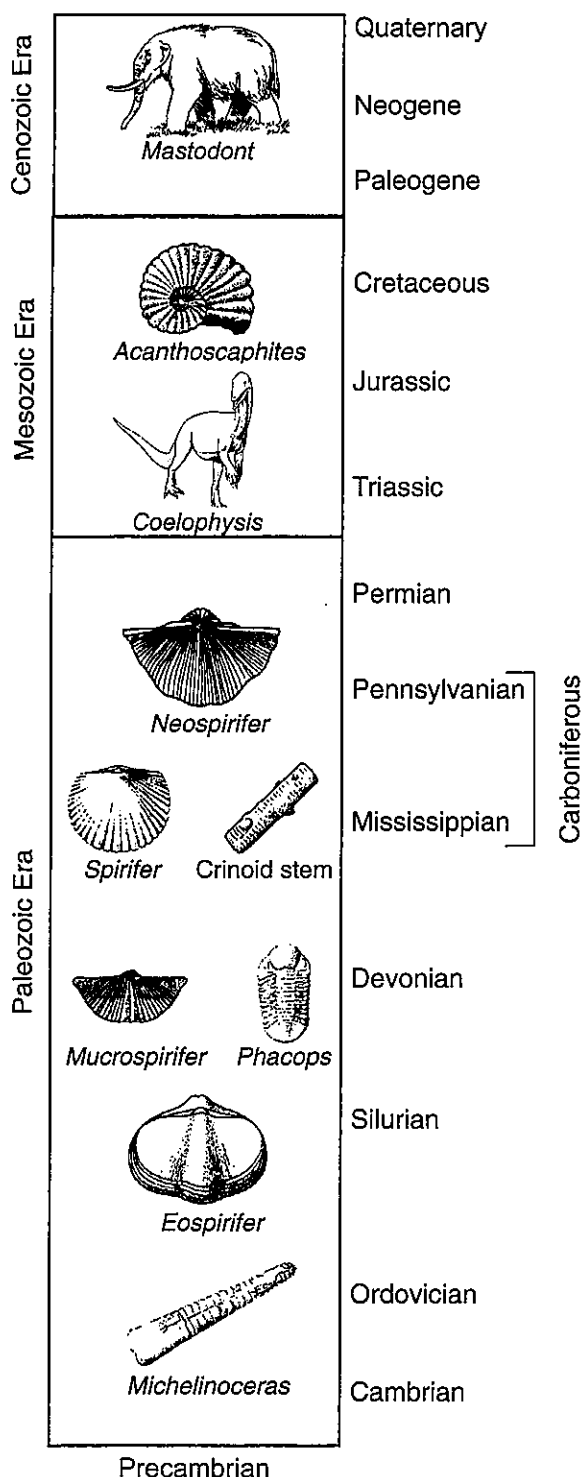


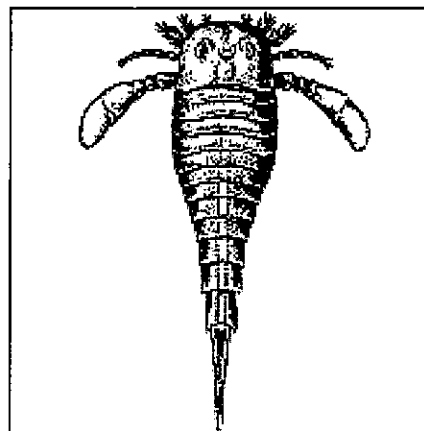
Geologic History of New York State



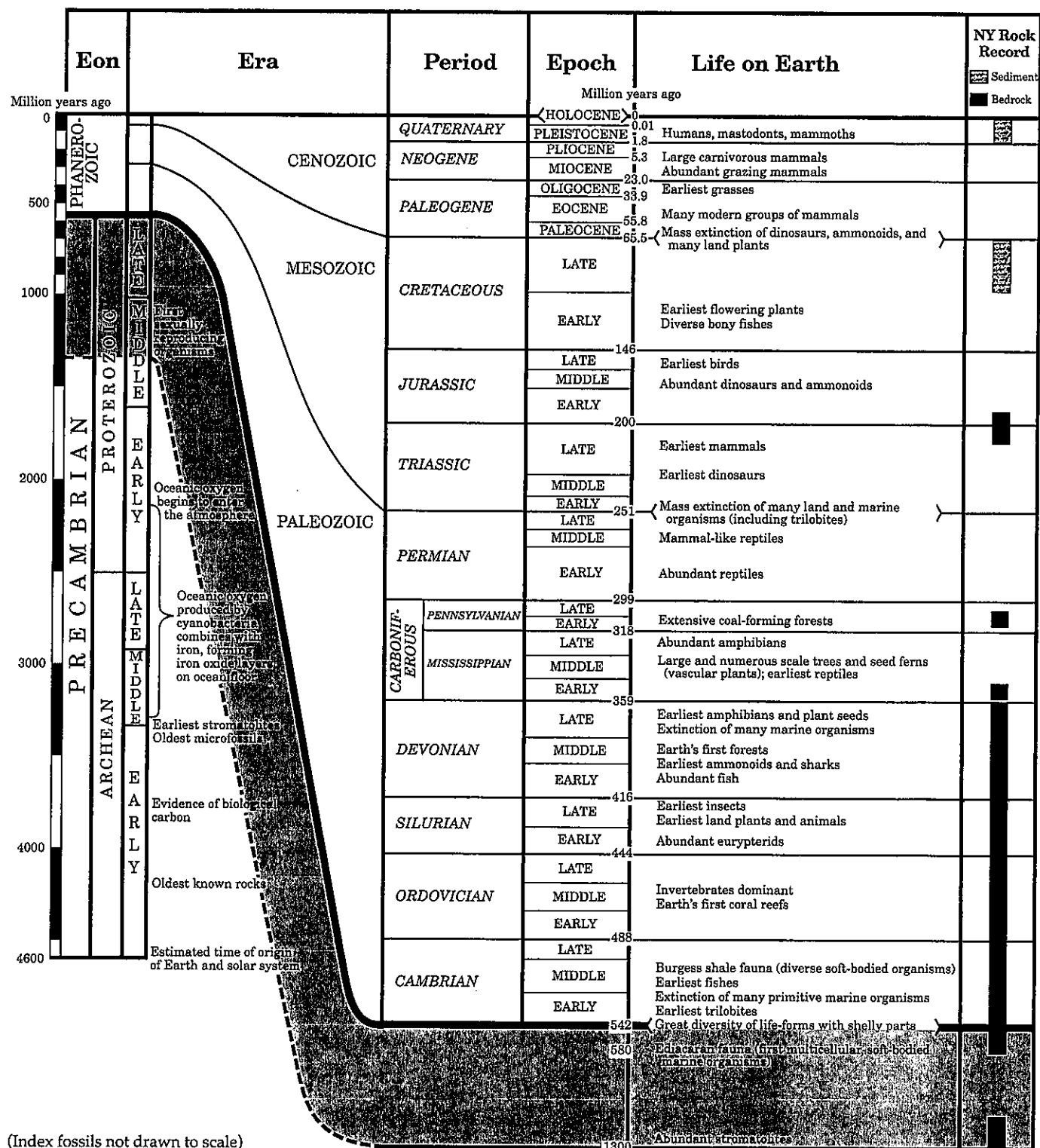
Overview:

Using radioactive dating, geologists tell us that the Earth is close to 4.6 billion years in age. By studying and dating fossils, a time line has been created detailing the great diversity of life forms this planet has supported. Fossils have also revealed that periods of major extinction have occurred throughout the history of this planet. Yet, during most of this 4.6 billion year time span, very little life existed. This section of time, lasting close to 4 billion years, is given the name Precambrian Eon, meaning "before life." Then, around 542 million years ago, abundant sea life organisms appeared. This started a new era called the Paleozoic Era. As fossil evidence accumulated, eras were subdivided into smaller units of time called periods and then, even smaller sections called epochs, based on mass extinction, changes of life forms and/or major geologic events. The next era is the Mesozoic Era in which dinosaurs were "King of the Planet." The last era, being the most recent one, and the one we are living in, is named the Cenozoic Era - the age of the mammals. As you can see, this chart is the largest one in the reference table and contains the most information. We will not attempt to cover it all, instead we need to understand enough so that one knows where to look for the necessary information located on this chart.

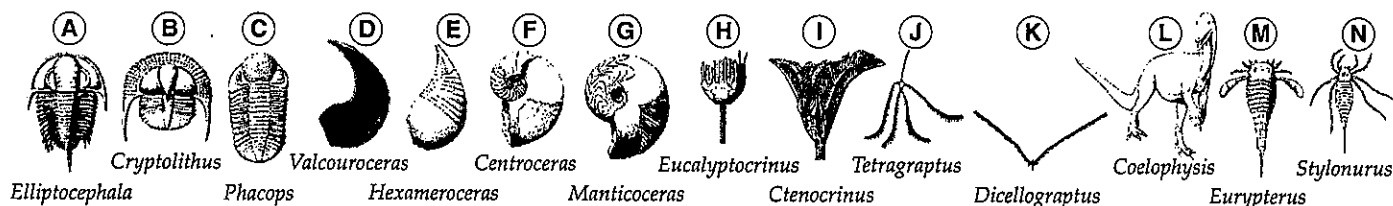
New York State Fossil *Eurypterus remipes*



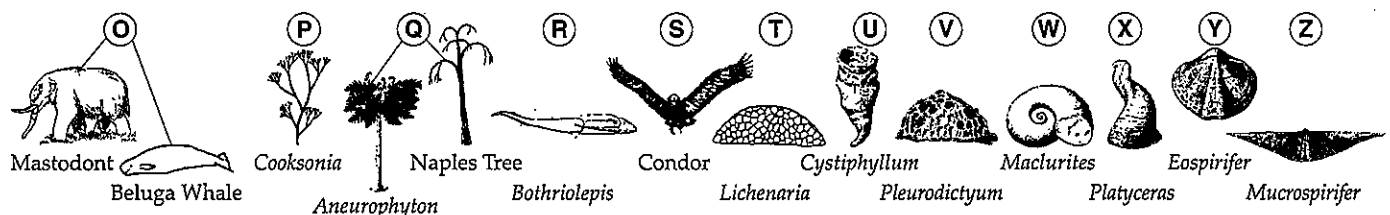
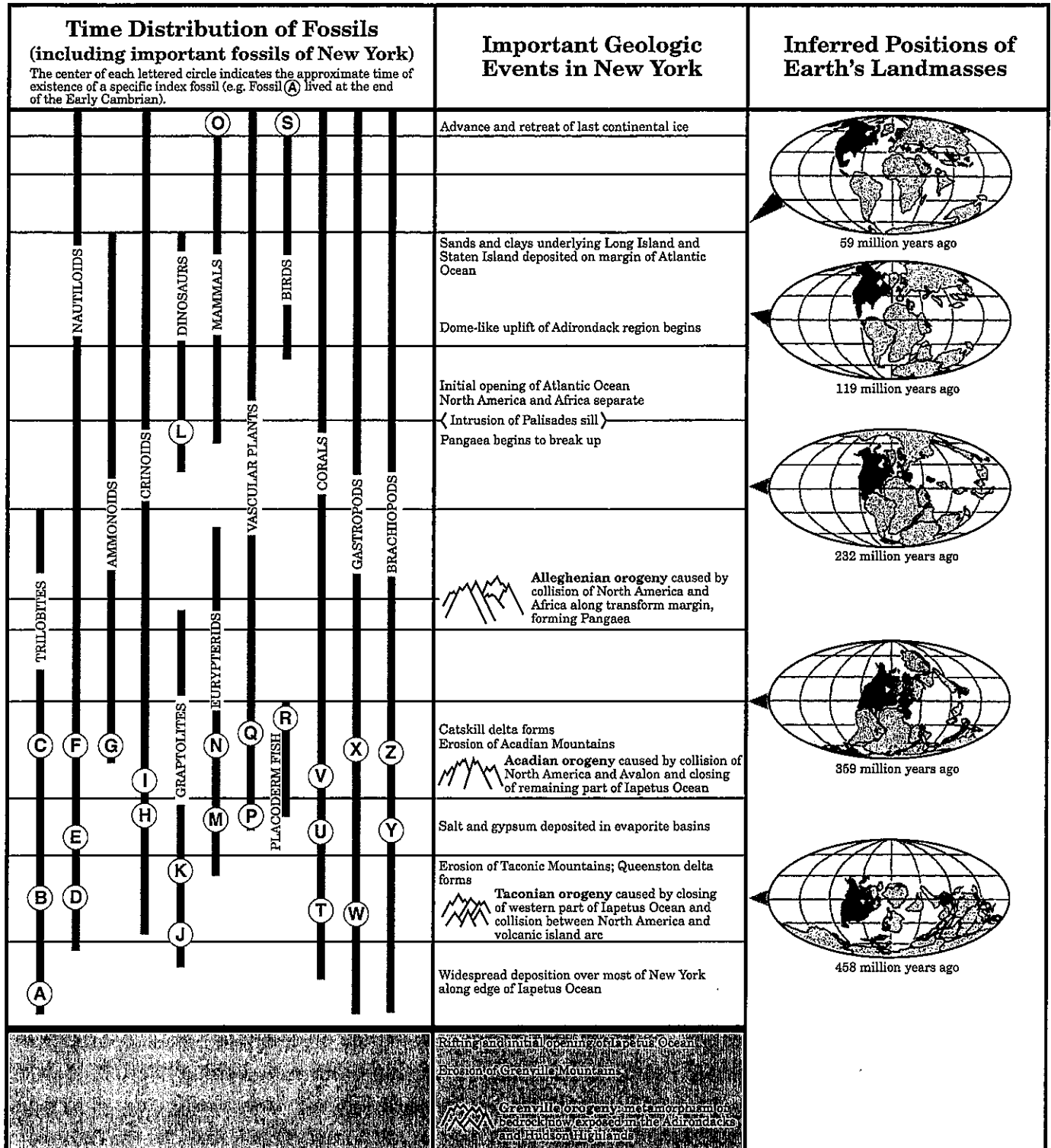
Geologic History of New York State



(Index fossils not drawn to scale)



Geologic History of New York State



The Chart:

Eons and Eras – On the far left is the main time line. At the bottom it states, “Estimated time of origin of Earth and solar system” and is dated as 4600 million years, which equals 4.6 billion years. This starts the Precambrian Eon, which is divided into two sections - the older Archean and the younger Proterozoic Eon. Next to each is important information on major events that occurred during this large time span. Notice the gray area, representing the upper Proterozoic, extends across the bottom of the chart and contains additional information. Since not much is known about the Precambrian, relatively little information is given for an eon that lasted close to 4 billion years covering almost 90% of the entire geologic history of our planet. But, during this eon, free oxygen was produced by cyanobacteria, which entered the oceans and eventually being released into the atmosphere, making marine and terrestrial life possible. The next three eras are expanded to a larger size in order to include the many events that have occurred in each.



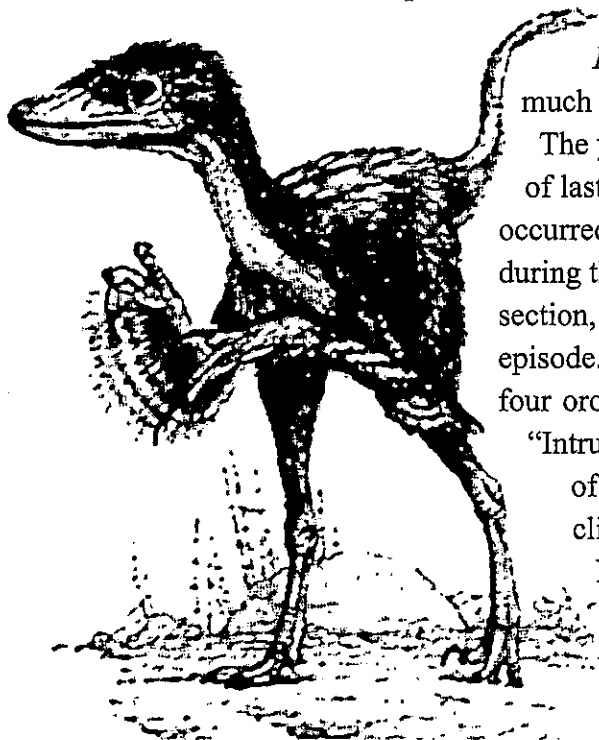
Paleozoic Era

Periods and Epochs – The Paleozoic Era is divided into six periods and many smaller epochs. Just to the right of the epochs is another time line having more accurate dates. As shown here the Paleozoic Era started 542 mya (million years ago) and ended 251 mya. This ending is the start of the next era, the Mesozoic Era in which dinosaurs lived along with smaller mammals. This era consists of three periods, of which the Jurassic is known to all movie goers – Jurassic Park. Dinosaurs lived during all three periods with the largest ones living during the Cretaceous Period. The last era, the Cenozoic Era continues today and includes three periods and seven epochs having specific names. Being the youngest era, much information has been well preserved, especially during the Pleistocene Epoch.

Life on Earth – In this section the different life forms are placed in the correct period according to when they first appeared, based on fossil evidence. Starting in the gray area of the Precambrian, some simple life flourished. In the Cambrian Period, the earliest period of the Paleozoic, is where great diversity of sea life started. Moving upward through the Paleozoic, many “Earliest” species are listed. A notable one is the marine organism, the trilobite – a hard-shelled, segmented marine organism that existed throughout the Paleozoic Era. At the end of the Paleozoic Era, which is the top of the Late Permian Period, it states “Mass extinction of many land and marine organisms (including trilobites).” Mass extinction closes out eras (periods and epochs at times), with the introduction of new life forms. This is true for the Mesozoic Era, with the introduction of dinosaurs. But, earliest mammals, birds and earliest flowering plants also had their beginning in the Mesozoic Era. The extinction of dinosaurs, along with many other species, ended this era. Life on Earth in the Cenozoic Era is about the rise and diversification of mammals as the dominant life form. At the very top, a relatively new species appeared – Humans. This occurred in the Pleistocene Epoch. We have been here, truly, a very short time when viewed by the geologic time line.

NY Rock Record – A dark bar means that this period bedrock is present somewhere in NYS. A light color bar indicates that sediments from a specific geologic age is found somewhere within NYS. The absence of a bar indicates that this age bedrock/sediment is not found in NYS, indicating a time of uplift and erosion of this bedrock. For example, the Permian Period has no dark bar meaning that this period's bedrock is not found in NYS; it has been eroded away. Notice that the rock record is well preserved for the Paleozoic Era. NYS is famous for its Paleozoic fossils. As shown by the bars, Mesozoic rocks are few in NYS. This is the reason why no dinosaur bones have ever been found here, although some footprints have been preserved.

Time Distribution of Fossils – This section contains bars spanning time periods that certain species existed. For example the first bar, the Trilobites bar, shows that the trilobites came into existence during the Early Cambrian Period, existing until the end of the Permian Period. The letters located on the bars indicate when specific index fossils lived. These letters correspond to the diagrammed fossils at the bottom of this chart. Check out letter L. The bar shows that this dinosaur, Coelophysis, lived during the Late Triassic Period and its footprint has been found in NYS.



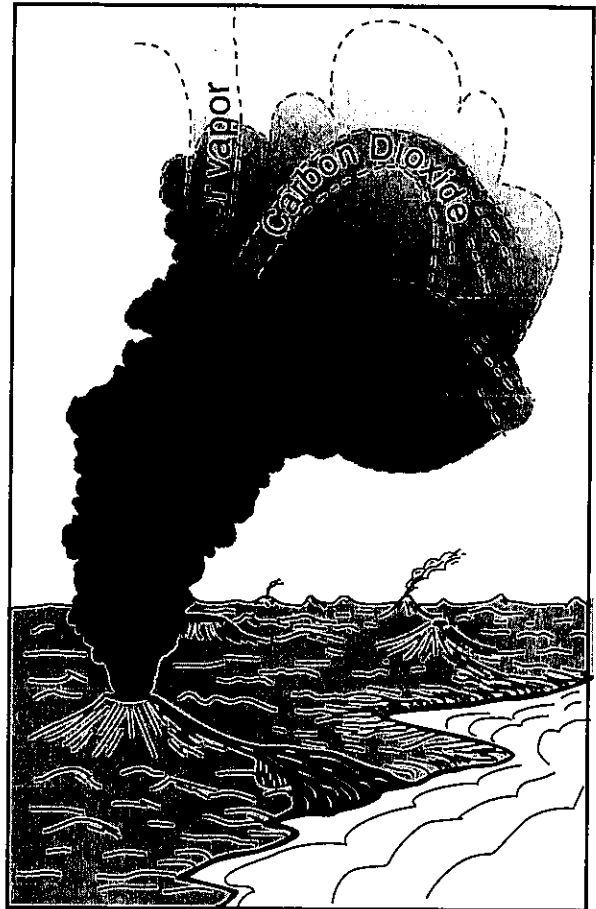
Dromaeosaur
a "feathered" fast-running dinosaur
related to velociraptor

Important Geologic Events in New York – This section has much information of the geologic events that occurred in NYS. The youngest geologic event listed here is "Advance and retreat of last continental ice." Following this row to the left, this event occurred during the Pleistocene Epoch. Humans were around during this event. The oldest event, located in the gray Precambrian section, is the Grenville orogeny. An orogeny is a mountain building episode. As shown by the diagrammed mountains, there were four orogenies affecting NYS. Let's review one other event – the "Intrusion of Palisades sill". This event occurred during the end of the Triassic Period and the intrusion is now exposed forming cliffs along the west side of the Hudson River, across from New York City.

Inferred Position of Earth's Landmasses – This chart shows the inferred positions of the continents as they drifted due to plate tectonics. These diagrammed globes are lined-up to their respective time period. The small gray arrow directs you to the correct time period. Under the globe is given the time period that the globe represents. Notice that North America started to break away from Pangaea during the Triassic Period.

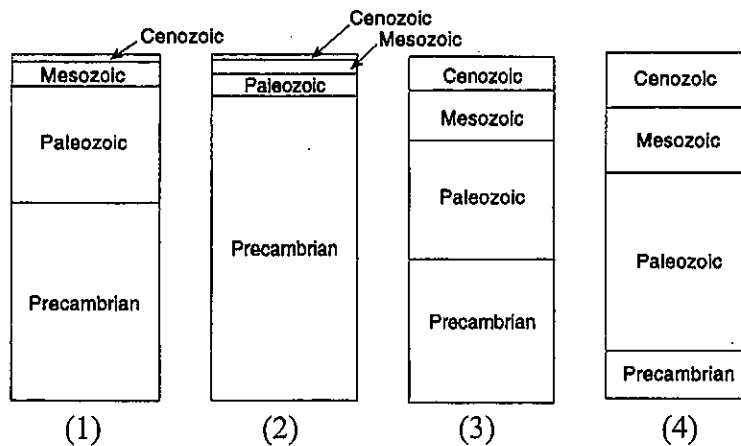
Additional Information:

- Mastodonts are related to the Mammoths. Mastodonts have been found in NYS.
- The Adirondacks are listed twice in the Geologic Events section, once in the Precambrian and again in the Cretaceous Period.
- This chart is often used with the Bedrock and the Landscape of NYS charts.
- The Earth's earliest atmosphere was formed during the Archean Eon. This poisonous, non-oxygen atmosphere evolved as gases escaped from the Earth's interior – known as outgassing. These gases were probably similar to the poisonous gases that presently escape from volcanoes. During the Proterozoic Eon, oxygen produced by the process of photosynthesis by cyanobacteria - one of the earliest blue-green algae to exist on our planet – slowly entered the atmosphere. Stromatolites are rock-like structures formed from the remains of cyanobacteria and the precipitation of minerals. Some fossilized stromatolites have been dated back to the Archean Eon.



Set 1 — Geologic History of New York State

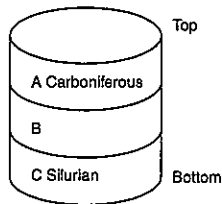
1. Which column best represents the relative lengths of time of the major intervals of geologic history?



1 _____

2. The geologic drill core below shows bedrock layers *A*, *B*, and *C* that have not been overturned. The geological age of layer *B* is

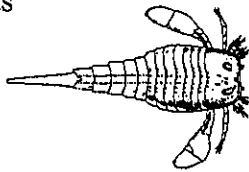
- (1) Cambrian
- (3) Devonian
- (2) Ordovician
- (4) Permian



2 _____

3. The index fossil below was found in surface bedrock in New York State. This index fossil is representative of a group of invertebrate animals known as

- (1) trilobites
- (2) stromatolites
- (3) brachiopods
- (4) eurypterids



3 _____

4. Which important New York State fossil is most likely to be found in the Triassic Age rocks in the Newark Lowlands?

- (1) eurypterid
- (2) mastodont
- (3) coelophysis
- (4) Naples tree

4 _____

5. Trilobite fossils were recently discovered in Himalayan Mountain bedrock. During which geologic period could this bedrock have been formed?

- (1) Neogene (3) Triassic
- (2) Cretaceous (4) Cambrian

5 _____

6. During which geologic time period was *Stylonurus* alive and abundant?

- (1) Cambrian (3) Silurian
- (2) Jurassic (4) Devonian

6 _____

7. Which major mountain-building episode is most recent?

- (1) Grenville orogeny
- (2) Taconian orogeny
- (3) Acadian orogeny
- (4) Alleghenian orogeny

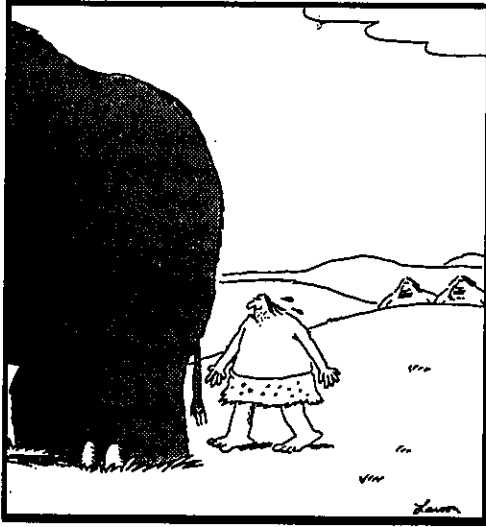
7 _____

8. During which era did the initial opening of the present-day Atlantic Ocean most likely occur?

- (1) Cenozoic (3) Late Proterozoic
- (2) Mesozoic (4) Paleozoic

8 _____

The cartoon below illustrates possible interaction between humans and mammoths.



The primitive game of "Pull the mammoth's tail and run"

9. During which geologic timespan could this "game" have occurred?

(1) Pleistocene Epoch
 (2) Pennsylvanian Epoch
 (3) Precambrian Era
 (4) Paleozoic Era

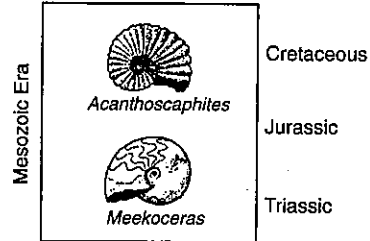
9 _____

10. During which geologic epoch did the glacier retreat from New York State?

(1) Pleistocene
 (2) Eocene
 (3) Late Pennsylvanian
 (4) Early Mississippian

10 _____

Base your answers to question 11 on the chart below, which shows the geologic ages of some well known fossils



11. Which New York State fossil is found in rocks of the same period of geologic history as Meekoceras?

(1) Condor
 (2) Eurypterus
 (3) Placoderm fish
 (4) Coelophysis

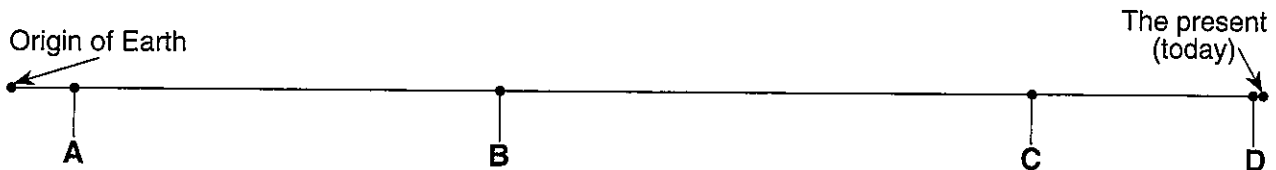
11 _____

12. Bedrock of which four consecutive geologic periods is best preserved in New York State?

(1) Cambrian, Ordovician, Silurian, Devonian
 (2) Devonian, Carboniferous, Permian, Triassic
 (3) Permian, Triassic, Jurassic, Cretaceous
 (4) Jurassic, Cretaceous, Paleogene, Quaternary

12 _____

13. The time line below represents the entire geologic history of Earth.

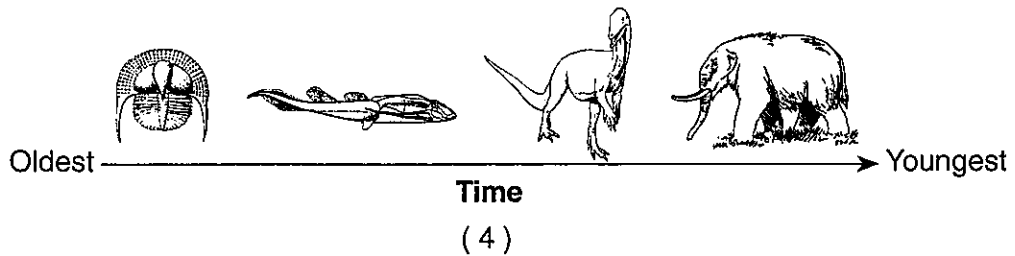
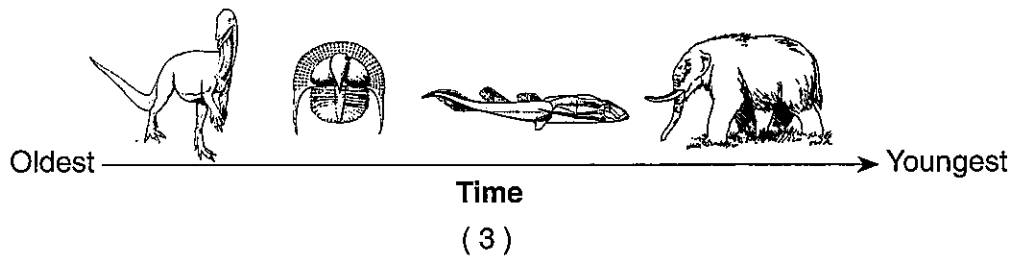
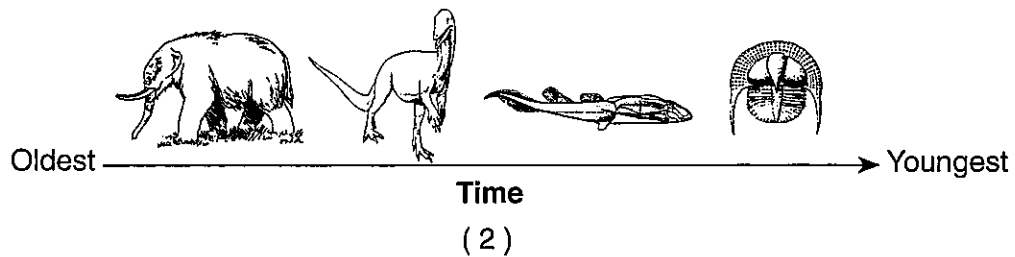
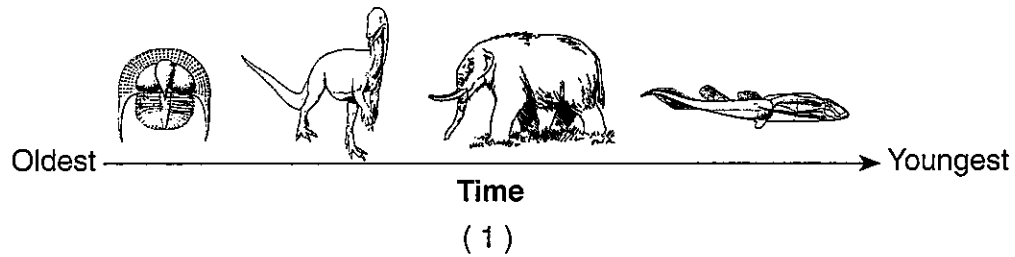


Which letter best represents the first appearance of humans on Earth?

(1) A (2) B (3) C (4) D

13 _____

14. Which sequence of New York State index fossils shows the order in which the organisms appeared on Earth?



14 _____

15. State one tectonic event affecting North America that occurred near the same time as the intrusion of the Palisade Sill.

16. According to the geologic record, during which geologic time period were the sands and clays underlying Long Island and Staten Island deposited?

17. Trilobite fossil remains are most likely to be found in bedrock of

- (1) Precambrian age near Mt. Marcy
- (2) Cretaceous age on Long Island
- (3) Cretaceous age northwest of New York City
- (4) Ordovician age near Plattsburgh

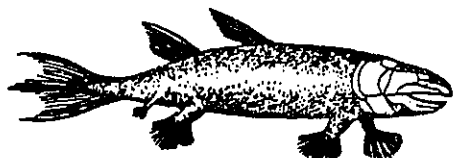
17 _____

18. Which mountain range resulted from the collision of North America and Africa, as parts of Pangea joined together in the late Pennsylvanian Period?

- (1) Alleghenian Mountains
- (2) Acadian Mountains
- (3) Taconic Mountains
- (4) Grenville Mountains

18 _____

19. The primitive lobe-finned fish shown below is thought to be an ancestor of early amphibians.



This evolutionary development from fish to amphibian is believed to have occurred during the

- (1) Triassic Period
- (2) Devonian Period
- (3) Tertiary Period
- (4) Permian Period

19 _____

20. Based on the theory of plate tectonics, it is inferred that over the past 250 million years North America has moved toward the

- (1) northwest
- (2) southwest
- (3) southeast
- (4) northeast

20 _____

21. According to available fossil evidence, which set of events is listed in the correct order from earliest to most recent?

- (1) extinction of trilobites, appearance of earliest fishes, extinction of dinosaurs
- (2) appearance of first corals, appearance of earliest insects, abundant reptiles
- (3) appearance of dinosaurs, appearance of earliest amphibians, appearance of earliest grasses
- (4) abundant eurypterids, appearance of earliest birds, appearance of first coral reefs

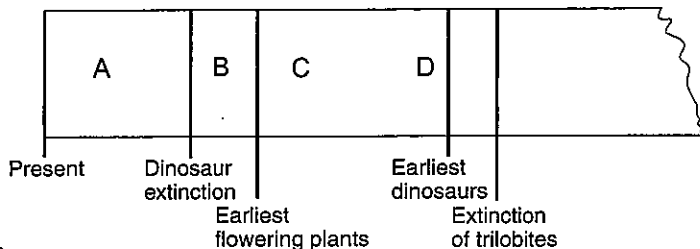
21 _____

22. Which group of organisms is inferred to have existed for the least amount of time in geologic history?

- (1) trilobites
- (2) dinosaurs
- (3) eurypterids
- (4) placoderm fish

22 _____

23. The diagram below is a portion of a geologic time line. Letters *A* through *D* represent the time intervals between the labeled events, as estimated by some scientists.



a) Fossil evidence indicates that the earliest birds developed during which time interval?

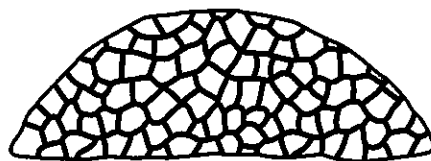
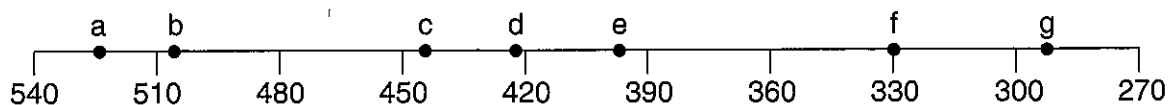
- (1) *A* (2) *B* (3) *C* (4) *D* 23 a) _____

b) Earliest mammals developed during which time interval?

- (1) *A* (2) *B* (3) *C* (4) *D* 23 b) _____

Base your answers to questions 24 through 28 on the geologic time line shown below.

Geologic Time Line (millions of years ago)



24. Place an **X** on the geologic time line, so that the center of the **X** shows the time that the coral index fossil *Lichenaria* shown above existed on Earth.

25. *Letter a* indicates a specific time during which geologic period? _____ Period

26. Identify the mountain building event (orogeny) that was occurring in eastern North America at the time represented by *letter g*.

27. Identify *one* letter that indicates a time for which there is no rock record in New York State.

28. Name a brachiopod that existed during the time indicated by letter *d*.
