Fossil Hunting in Louisiana Gravels

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Introduction

Gravel can be found in many places in Louisiana: it occurs naturally in stream and river banks and commonly is used as a building material for paving driveways and streets. For most of us, gravel is just a loose mixture of rock fragments or pebbles; we rarely wonder where it came from or how it was formed, and are even less likely (except as children) to sit down and sift through it looking for unusual shapes or colors. However, Louisiana gravel is more than just pebbles. It is made up of rock formed hundreds of millions of years ago on the sea bottom, and, if we look closely, we can often find within the pebbles distinct impressions (fossils) of ancient marine life: shellfish, corals, and other animals. The purpose of this handout is to help you learn to identify some of these fossils, and to describe the history of their journey from the northern and midwestern United States where they lived hundreds of millions of years ago, to the streams, roads and driveways of Louisiana where they rest today.

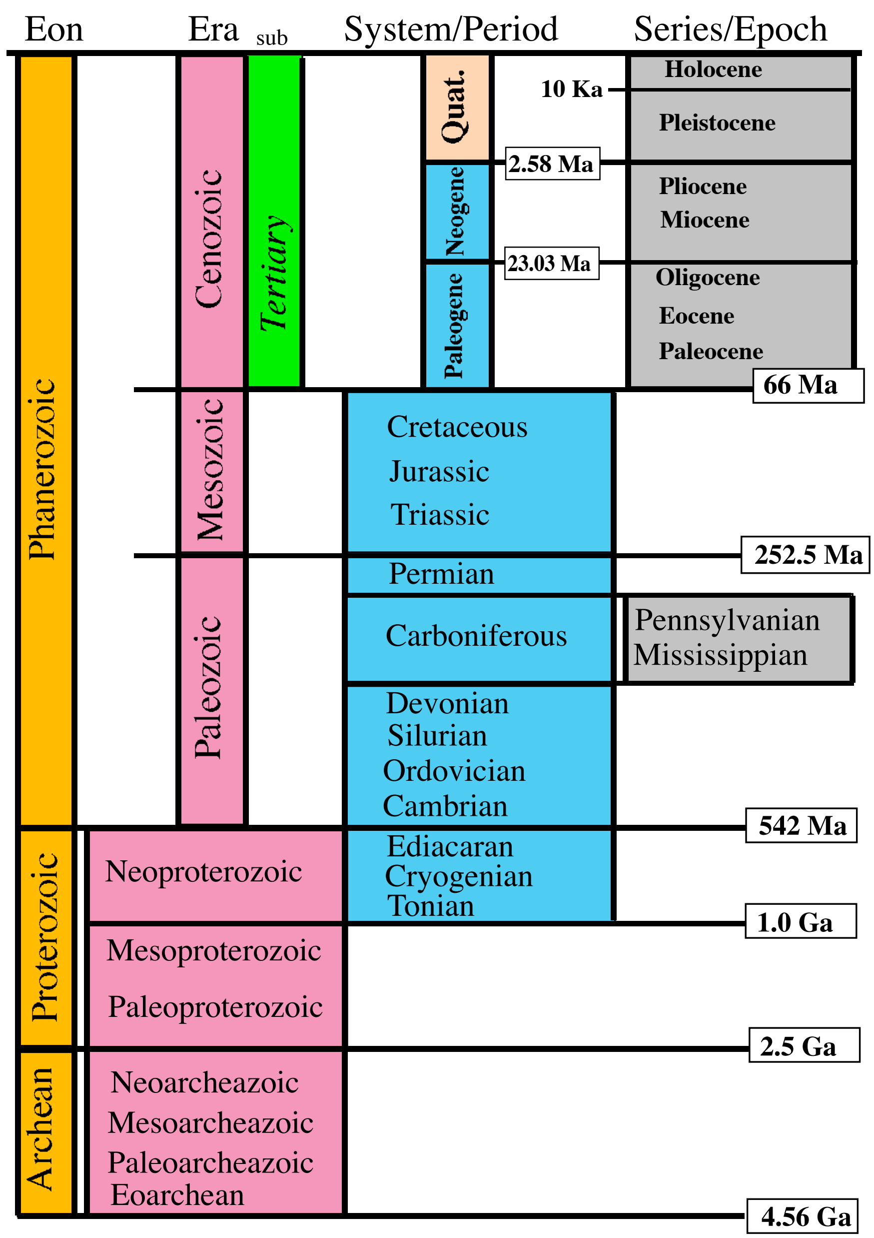


Figure 1: Geologic Time Scale (from B. Ellwood)

Geologic Time

According to geologists, the earth is much older than we might realize. By measuring the natural radioactivity of many rocks, it can be determined that the earth was formed approximately 4,600 million years ago. The period during which the fossils found in Louisiana gravels lived was between 408 million years ago and 330 million years ago (see **Figure 1**); man first appeared only 4 million years or so ago. Geologists have also divided the earth's history into a number of named intervals (**Figure 1**). The fossils in the Louisiana gravels lived during part of the Paleozoic Era, in the Silurian, Devonian, and Mississippian Periods.

Paleogeography (ancient geography)

By studying certain rocks, geologists can determine in what environment they were deposited. For example, they can recognize the deposits of rivers, beaches, and submarine environments. Studies of Paleozoic rocks show that the North America of those times was far different from that of today. For much of the Paleozoic Era, North America was covered by a shallow sea (see **Figure 2**); and in this sea, life proliferated—coral reefs, fields of sea lilies, shellfish, moss-like bryozoans, insect-like trilobites and many other animals and plants. **Figure 3** is a scene of how the sea bottom may have looked at this time.

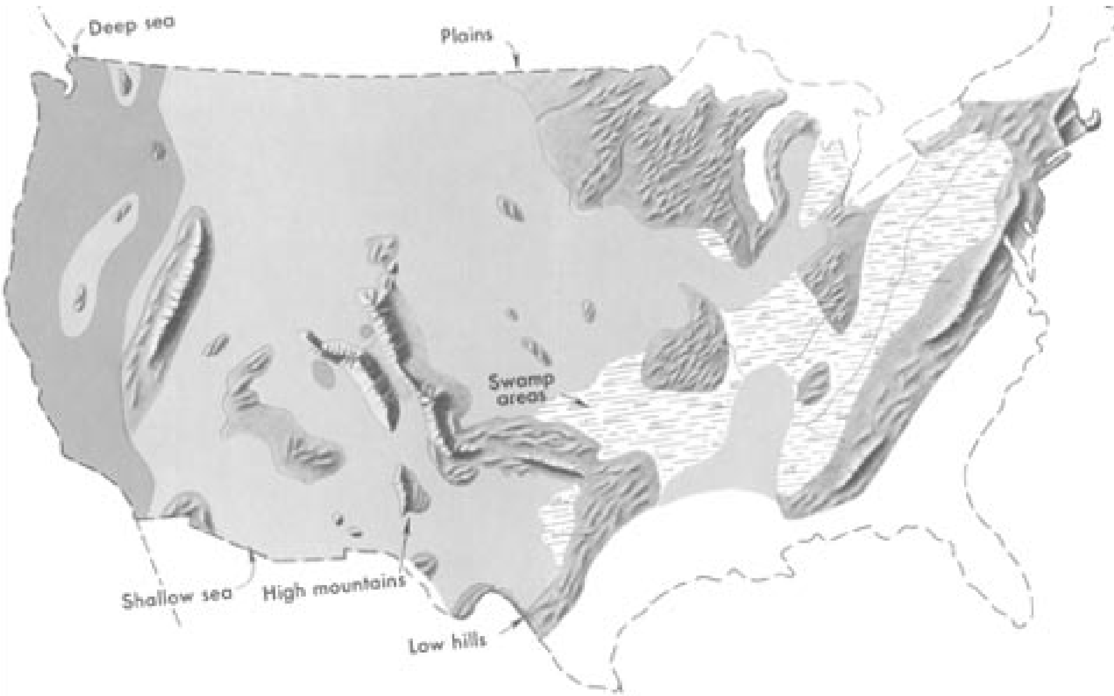


Figure 2: Paleogeography of North America during the middle part of the Paleozoic Era (from Wikimedia Commons).

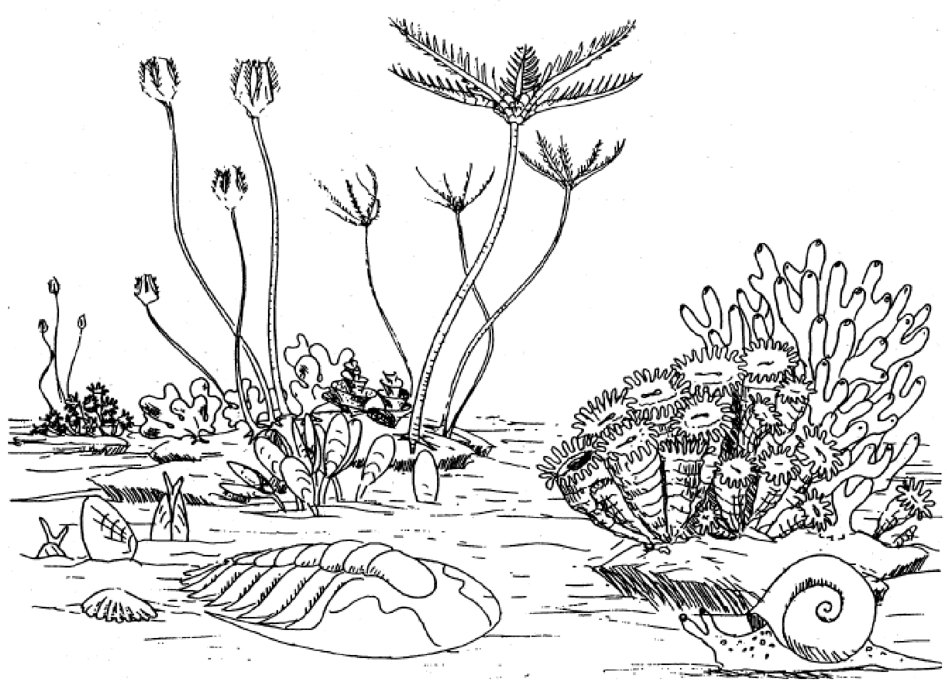


Figure 3: Paleozoic sea floor life

Fossilization

OR...

What happened to these organisms when they died? How were they preserved?

The process by which organisms are preserved and entombed in rock is called fossilization. After they die, organisms on the sea floor are slowly buried as sand, mud, and other organisms are deposited on top of them. During burial, the material surrounding the organisms is compacted and cemented to form rock. A number of processes may affect the dead organisms—or fossils as they would now be called—at this time or later:

1) some fossils represent the hard parts of the original organism, preserved exactly as at the time of death,
2) soft parts are rarely preserved except as impressions in the surrounding rock,
3) others may be altered (mineralized) to form different material,
4) still others may be molds—the hollow impression left when the original material is dissolved by fluids circulating through the rock,
5) other are preserved as casts—the forms created by material infilling an empty mold.

Examples of all these types of fossilization may be found in the Louisiana gravels.

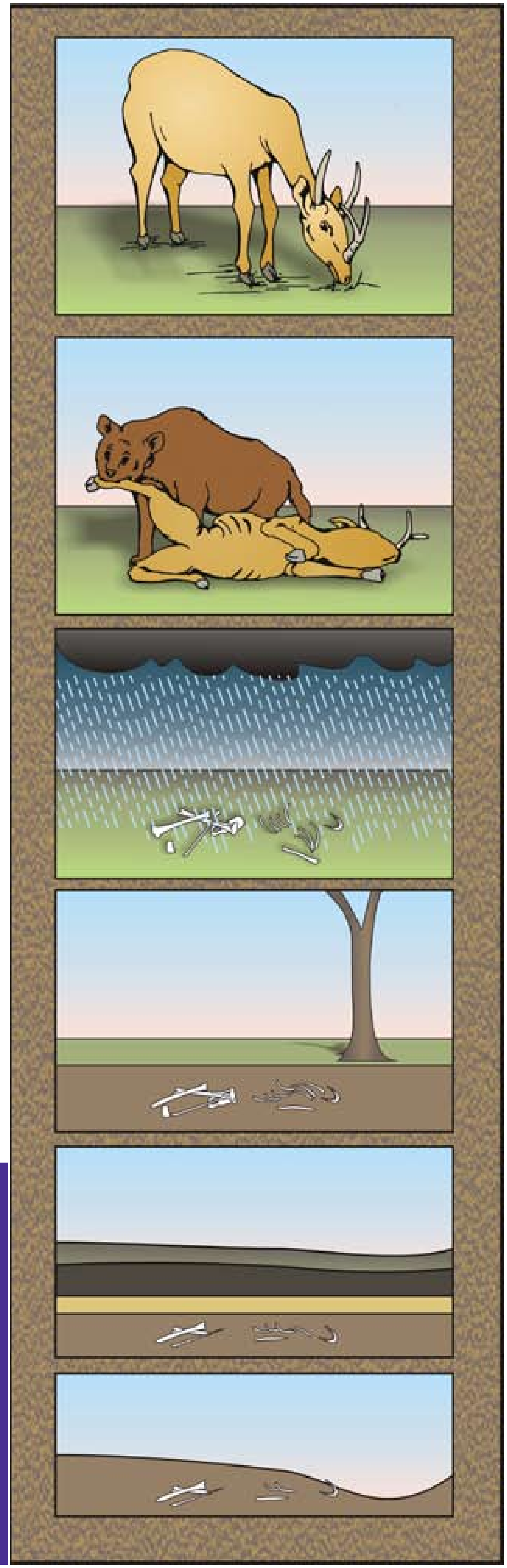


Figure 3 bis: Example of fossilization process. This is not an example for the fossils you will find in Louisiana gravels as the fossils you will find are those of aquatic creatures, but the process is similar, although these fossils are preserved in sediments that are deposited under water. This figure shows the type of events that may affect land animal remains after death. Predators, sediment input, weathering, chemical interactions with fluids and minerals in the soil, or erosion, all play their role. (Image credit: Mary Lee Eggart, LSU)

Uplift, Erosion, and Transport

How did these fossils, which were buried hundreds of millions of years ago in the northern and midwestern United States, arrive as gravels in Louisiana today?

Periodic movements of the earth's crust may lift buried rocks to the surface. Once at the surface, these rocks are subject to weathering and breakup (erosion) by wind, water, and ice. Ice in the form of glaciers is particularly effective in breaking up rocks (see **Figure 4**). Between about 1.8 million years ago and 10,000 years ago (the Pleistocene Epoch- **Figure 1**), the earth underwent a number of periods of very cold climate. At these times, ice covered much of North America (see **Figure 5**), and large volumes of rock were eroded. Some of the Paleozoic rock of the northern and midwestern states was broken up by ice at this time and was transported south to Louisiana by rivers when the ice melted.

Figure 4: Top left: Canada Glacier in the Taylor Valley, Victoria Land, Antarctica. Photograph by: Tracy Szela from http://photolibrary.usap.gov/. Top right: Sediments deposited through the action or contact with glacial ice, this moraine is from Bucher Glacier, Coast Mountains, Tongass National Forest, Alaska. Photograph from http://pubs.usgs.gov/of/2004/1216/

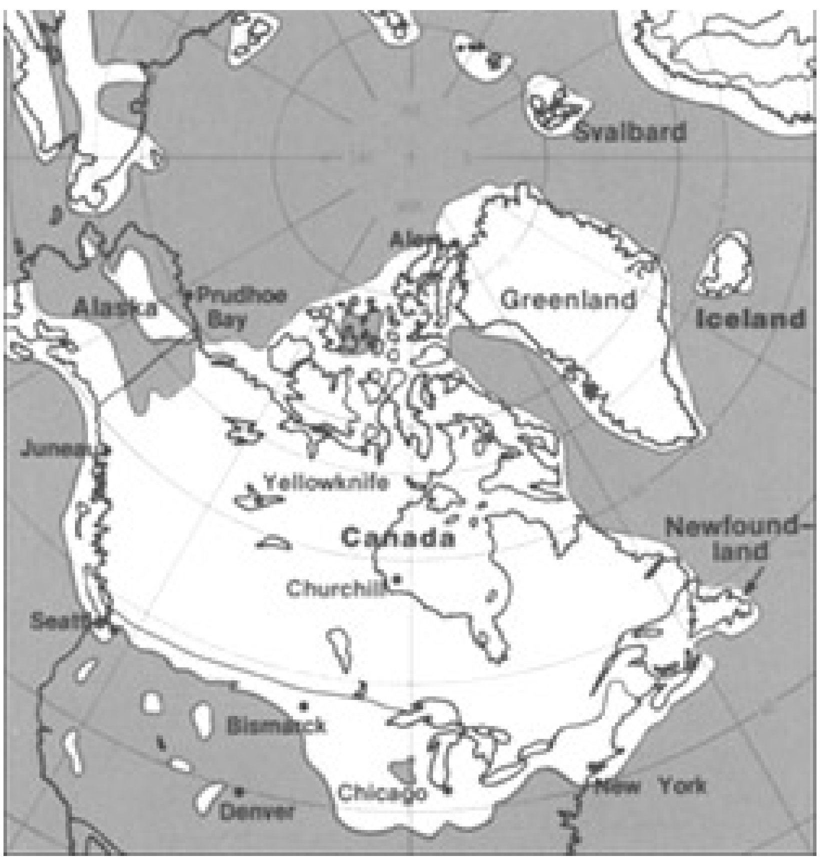


Figure 5: Maximum extent of ice in North America during the Pleistocene Epoch. Figure from Wikimedia Commons.

Classification of Fossils

Living and extinct organisms are divided into two main groups or "kingdoms"—animals and plants. Within the animal kingdom, organisms are divided into a number of groups called "phyla." The animals of each "phylum" all possess a body plan or arrangement of parts which is unique to the phylum. For example, one of the unique characteristics of the Phylum Echinodermata, which includes sand dollars, starfish, and sea lilies, is that their bodies have a five-fold symmetry. Phyla are further subdivided into sub-phyla, classes, orders, families, genera, and species. An example of how the domestic dog is classified within this system is given below.

GROUP	EXAMPLE (domestic dog)	MEANING
Kingdom	Animalia	animals
Phylum	Chordata	chordates
Sub-Phylum	Vertebrata	vertebrates
Class	Mammalia	mammals
Order	Carnivora	meat-eaters
Family	Canidae	dog-like
Genus	*Canis*	dogs
Species	*Canis familiaris*	domestic dogs
Individual	Bowser	your dog

The Louisiana gravel fossils are mostly animals. They fall into six phyla:

PHYLUM	MODERN AND ANCIENT EXAMPLES
Arthropoda	insects, trilobites, crabs
Brachiopoda	lamp shells
Bryozoa	moss-like animals
Cnidaria	corals, jellyfish
Echinodermata	sand dollars, sea lilies, starfish
Mollusca	clams, snails

Identification of Fossils

The shape, structure, and markings of a fossil are the characteristics used to classify it according to the system shown above. Because Louisiana gravels contain relatively few different types of fossil (at least down to the Class level), it is simpler to show what each of the fossil types looks like and to list some of the more obvious characteristics rather than going into great detail on the diagnostic features of each group. For those who are interested in more detail, there are a number of good books available on fossil collecting and identification.

The next few pages show pictures and short descriptions of the fossils commonly found in the Louisiana gravels. Also available are some examples of these fossils which you can look at and some gravel in which you can search for fossils yourself.

HAPPY HUNTING!

Phylum Echinodermata
Class Crinoidea
Range: Ordovician to Present

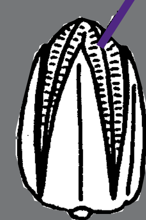
arms

arms broken off

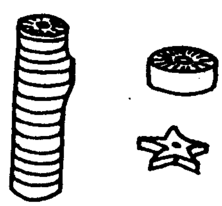
Crinoid cups have 5-fold radial symmetry and are made of regular interlocking plates.

Crinoid remains preserved in gravel are mostly hollow molds or infilled molds (casts) of ossicles. Look for circular shapes with a central hole or nub and fine radiating grooves. Look also for rectangular and columnar shapes, sometimes stacked.

amb (arms broken off)



Similiar to crinoids are the blastoids. They can be told apart by the form of the cup or theca.



Crinoid stems are made up of individual 'ossicles'. They are a common component of limestones.

Crinoid remains in the gravel are mostly hollow molds.

Phylum Cnidaria
Class Anthozoa
Subclass Zooantheria

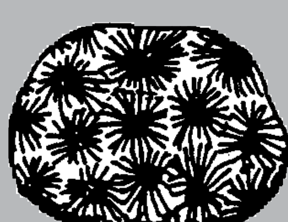
MNH, University of Michigan exhibit. A Middle Devonian reef featuring the crinoid *Dolatocrinus*, a tabulate coral (*Favosites*), a trilobite, and Rugose corals. The giant one in the center is probably *Siphonophrentis gigantea*. The squat white ones at the middle right would be *Heterophrentis prolifica*. The cluster of yellow ones in the middle foreground are a colonial corals of the genus *Eridophyllum*.

Order Rugosa
Range: Ordovician to Permian

Rugose corals are either solitary or colonial. The solitary rugose corals are also called "horn corals" because of their shape. The Rugosa are an extinct group of corals that were abundant in Middle Ordovician to Late Permian seas. Some solitary rugosans reached nearly a meter in length.

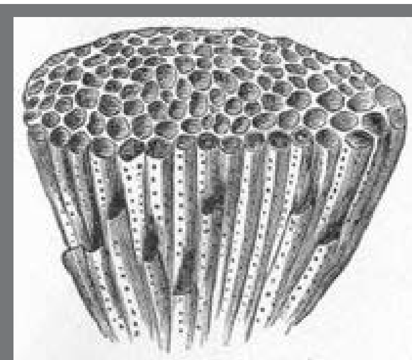
These radiating plates are called Septa

The solitary forms are the most common rugose corals found within the gravels.



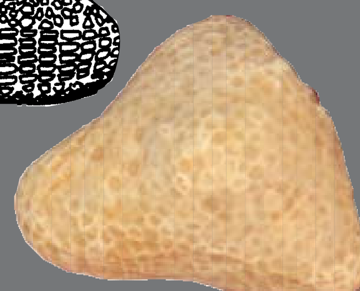
Colonial rugose corals could form large colonies.

Order Tabulata
Range: Ordovician to Permian



Faveolites
(from Wikimedia Commons)

Tabulate corals are the type of coral most commonly found in the gravels. They differ from rugose corals in that a) they are all colonial; b) the radiating septa are reduced or absent and the main structural elements are the horizontal plate or 'tabulae'. Look for a characteristic 'honeycomb' appearance. Most tabulates were colonial, with some forming substantial reefs.

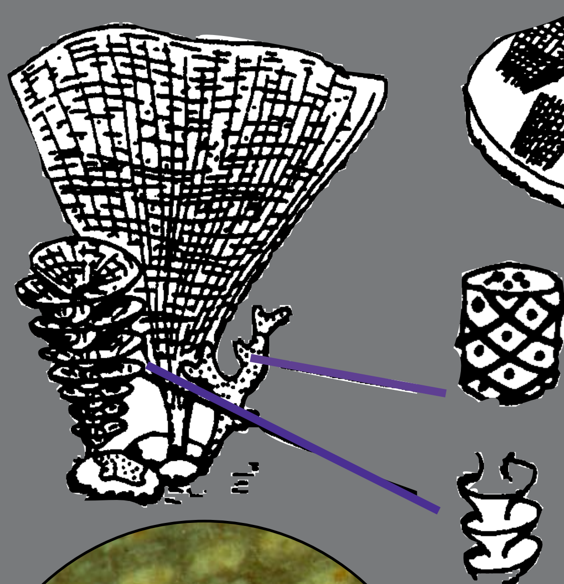


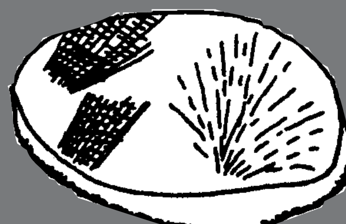
Phylum Bryozoa Range: Cambrian to Recent

Bryozoans are moss-like animals which grow in fan-shaped, branching, or encrusting colonies. They may look somewhat like corals; however, they tend to be more delicately built.

The fan-shaped bryozoans are most common in gravels. Look for delicate fanshapes.

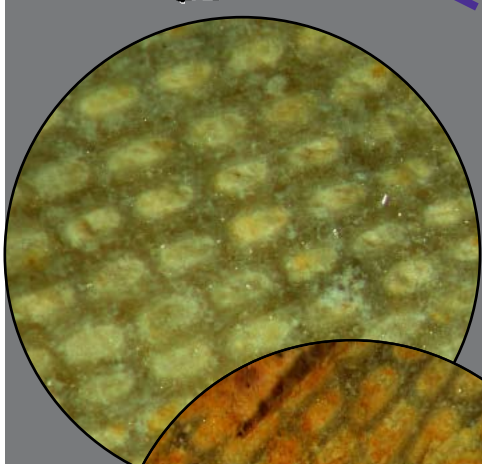
Miocene Bryozoa: *Celleporaria*, Miocene of Torquay, Australia (courtesy of Phil Bock)

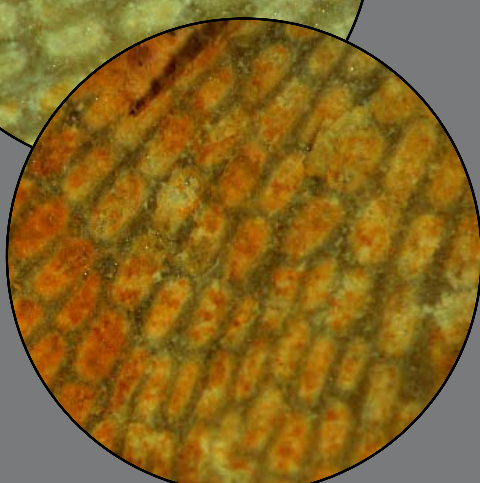




Detail of branching bryozoa

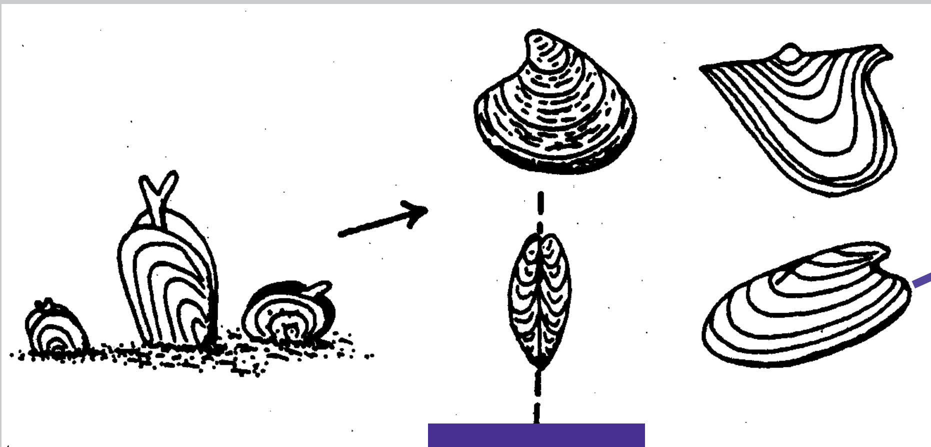
The bryozoan *Archimedes*

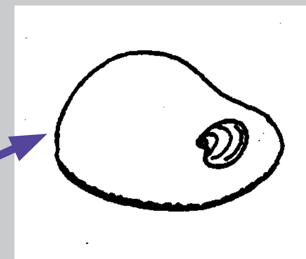




Phylum Mollusca
Class Bivalva
Range: Cambrian to Recent

This class includes clams, oysters, mussels, etc. The shells of bivalves include two pieces- valves- that are joined together with an elastic ligament. The shells are mirror images of each other, giving them bilateral symmetry. In some rare instances, bivalves may not show symmetry of form. If they have symmetry it is between the two valves (1/2 shells), unlike the brachiopods in which each valve is bilaterally symetrical.



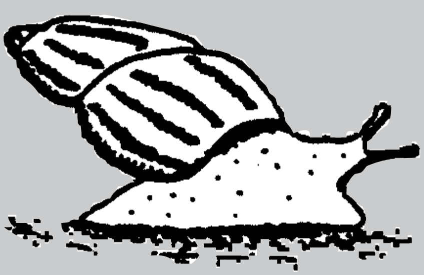


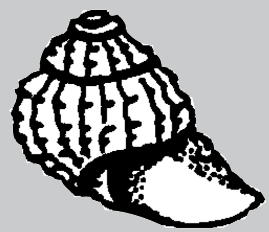
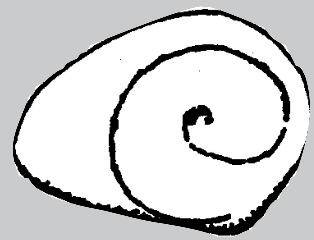
Plane of symmetry

One valve is often noticeable in the gravels.

Phylum Mollusca
Class Gastropoda
Range: Cambrian to Recent

Gastropods have a soft body and a large foot that is enclosed in a single, non-chambered, coiled shell. The shells may be dome- cap- or cone-shaped. The gravels usually contain casts of the inside coils of the gastropods. Look for these coiled cross-sections.



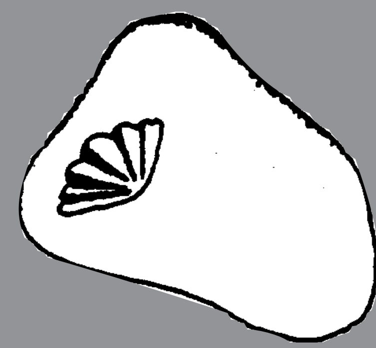



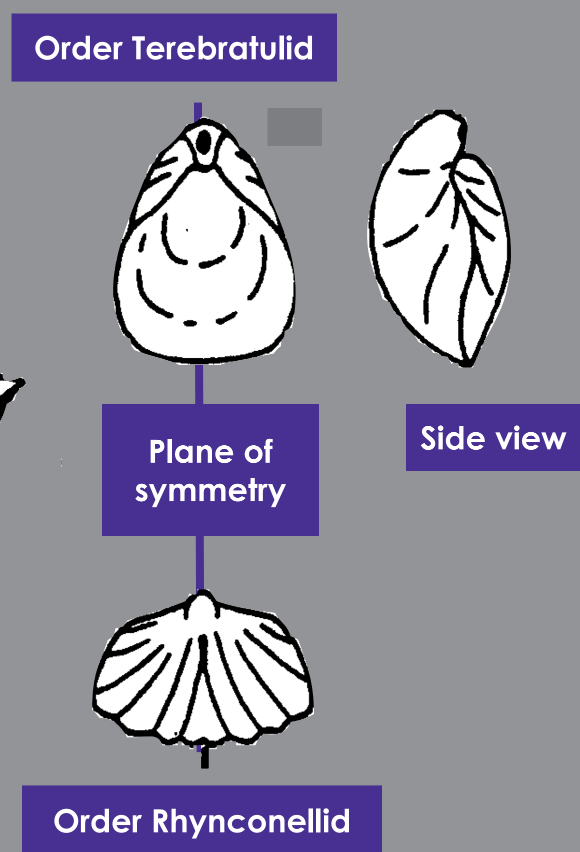




Phylum Brachiopods
Range: Cambrian to Recent

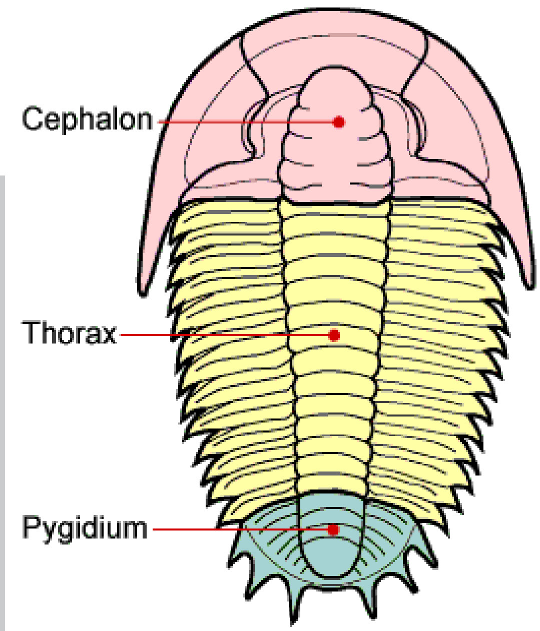
In life, brachiopods (also known as lamp shells) attached themselves to the sea bottom by a fleshy stalk or pedicle. A hole through which this stalk passed can often be seen on the larger of the two valves (1/2 shells). It can sometimes be difficult to tell the difference between brachiopods and bivalves; however, brachiopods always have different sized valves, and each valve is bilaterally symmetrical. Also, bivalves do not have a pedicle hole.





**The gravels usually contain either molds or casts of brachiopods.
Look for symmetrical shells and pedicle holes.**

Phylum Arthropoda
Class Trilobita
Range: Cambrian to Permian



The trilobite body is divided into 3 sections:
1) a cephalon with eyes, mouthparts and sensory organs such as antennae,
2) a thorax of multiple similar segments,
3) a pygidium, or tail section
(illustration from Wikipedia).

The trilobites are extinct marine arthropods (insect-like animals) which lived on the seafloor. They have a distinctive three-part body plan that consists of a cephalon (head), a thorax, and a pygidium (tail) with a chitinous exoskeloton. The thorax is fairly flexible and when preserved, the trilobites are often found curled up like modern rolly-pollies.They are rarely found preserved in gravels.