Mollusks

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The concept Mollusca brings together a great deal of information about animals that at first glance appear to be radically different from one another—snails, slugs, mussels, clams, oysters, octopuses, squids, and others. The diversity of the phylum is shown by at least eight known classes (cover). Estimates of the number of species alive today range from 50,000 to 130,000. Most of the shells found on the beaches of the modem world belong to mollusks and mollusks are probably the most abundant invertebrate animals in modern oceans.

Living mollusks range in size from microscopic snails and clams to almost 60 foot long (18 meters) squids. They live in most marine and freshwater environments, and some snails and slugs live on land. In the sea, mollusks range from the intertidal zone to the deepest ocean basins and they may be bottom-dwelling, swimming, or floating organisms. There are even some squids that glide through the air for short distances by means of enlarged fins on the sides of their bodies.

The word Mollusca is derived from Latin and refers to the soft body inside the shell of most species. The concept Mollusca is unified by anatomical similarities, by embryological similarities, and by evidence from fossils of the evolutionary history of the species placed within the phylum; all this information indicates a common ancestry for the groups placed in the phylum.

Most mollusks are free-living multicellular animals that have a multilayered calcareous shell or conch on their backs. This exoskeleton provides support for the soft organs including a muscular foot and the organs of digestion, respiration, excretion, reproduction, and others. Around all of the soft parts is a space called the mantle cavity, which is open to the outside. The mantle cavity is a passageway for incoming feeding and respiratory currents, and an exit for the discharge of wastes. The outer wall of the mantle cavity is a thin flap of tissue called the mantle, which secretes the shell. The outermost layer of the shell is organic and is called the periostracum. The shell is marked by growth lines formed at its leading edge as it grows and enlarges (Figure 1).

The conch, its impression in the rocks, or the internal mold-filling of the shell, is the part ordinarily available

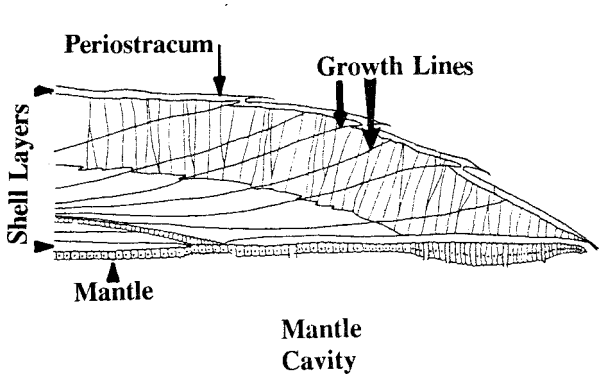

Figure 1. Schematic diagram of lower right valve of the shell growing edge of the fresh-water pelecypod mussel *Anodonta*. Highly modified from Taylor, and others, 1969, Bulletin of the British Museum (Natural History), Zoology, Supplement 3, p. 8.

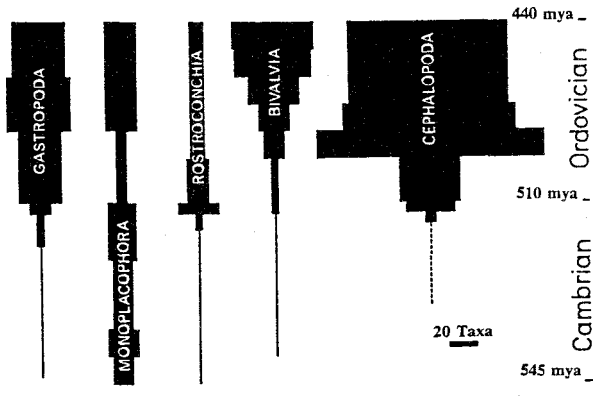

Figure 2. Time ranges and approximate specific diversity (Rostroconchia) and generic diversities (other classes) of major groups of shelled mollusks during Cambrian and Ordovician time. Adapted from Runnegar *in* Bottjer and others (1985). The bar scale represents 20 species or genera (taxa).

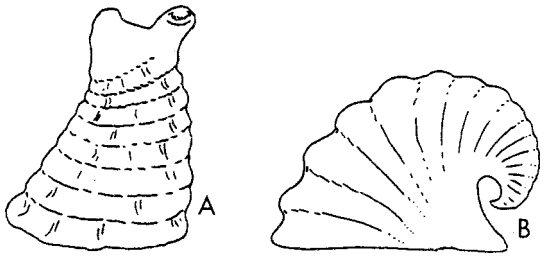

Figure 3. Middle Cambrian monoplacophorans from Australia. A. *Yochelcionella* (X9) and B. *Helcionella* (X4.5). From Pojeta *in* Bottjer and others (1985).

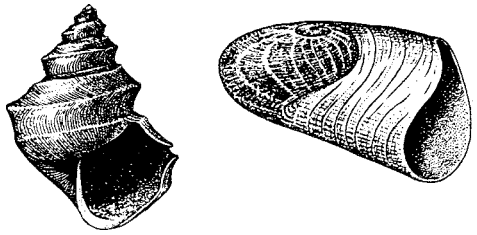

Figure 4. Ordovician gastropods from New York and Ohio. A. *Lophospira* (Xl) and B. *Dyeria* (X0.75). From Moore (1960), Pt. I.

for paleontologists to study, and it shows considerable variation in form (Figure 9, Figures 3-7). The shell ordinarily is bilaterally symmetrical, except in snails. Univalved shells are in one piece (Cephalopoda, Monoplacophora, Gastropoda, and Scaphopoda). Bivalved shells consist of two pieces that are on the right and left sides of the animal and are held together over the back by an elastic ligament (Pelecypoda). One group of mollusks has a pseudobivalved shell that is univalved in the larval stage and bivalved in the adult stage (Rostroconchia). Another group has an eight-part shell over the back of the animal, such shells are multivalved (Polyplacophora). Some mollusks lack a shell but have the body covered with calcareous spicules (Aplacophora). The calcareous mineralogy of the shell is variable, but most often it is composed of the mineral aragonite. Various living mollusks, such as slugs, octopuses (Figure 9, Cephalopoda), squids, and some snails that evolved from shelled ancestors have lost the shell, reduced it in size, or internalized it.

Mollusks have been diverse and abundant animals since earliest Cambrian time (about 545 million years ago = mya), and predate the appearance of trilobites in the fossil record. Early and Middle Cambrian mollusks include many unfamiliar and extinct species, but by Late Cambrian time (515 mya) most living classes of mollusks occur in the fossil record. By the end of Ordovican time (440 mya) at least 5,000 species of mollusks are known and all modern classes of mollusks occur in the fossil record (Figure 2).

During the later Paleozoic, Mesozoic, and Cenozoic, mollusks continued to diversify to their present level of at least 50,000 species.

One way to understand the diversity of mollusks through time, is to discuss the major classes that make up most of the fossil record of the phylum. These are the univalved classes Monoplacophora, Gastropoda, and Cephalopoda, the bivalved class Pelecypoda (=Bivalvia), and the pseudobivalved class Rostroconchia. The other classes have poor to nonexistent fossil records.

Monoplacophorans (no common name) are probably the ultimate evolutionary ancestors of all univalved, pseudobivalved, and bivalved mollusks. Monoplacophorans first appear in the fossil record in the oldest Cambrian rocks (545 mya) and are still found in modern oceans in relatively deep to very deep cold waters below the depths to which light penetrates. Their Cambrian and Ordovician ancestors are found in shallow-water rocks that were deposited in tropical to temperate climate regimes (Figure 3).

Gastropods (snails and slugs) usually have asymmetric shells (Figure 4). They are the most diverse mollusks in modern oceans and are the only known terrestrial mollusks. They also live in fresh-water lakes and streams.

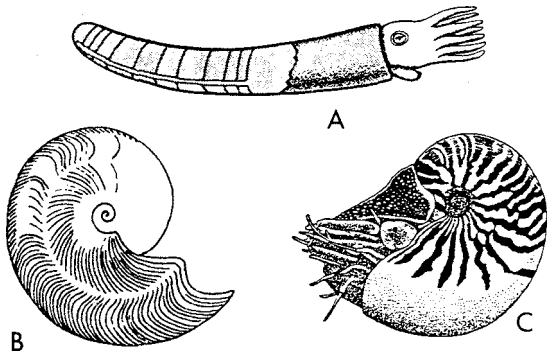

Figure 5. Cephalopods. A. Reconstruction of the curved young shell of the Upper Silurian nautiloid *Glossoceras* (X2), from Sweden. Back part of the shell shown in section so that the internal chambers and siphuncle can be seen. B. The Middle Cretaceous ammonite *Falciferrella* (Xl .5), from England. C. The living shelled nautiloid *Nautilus* (X0.2), from New Caledonia. All figures from Moore (1957 & 1964), Pts. K&L.

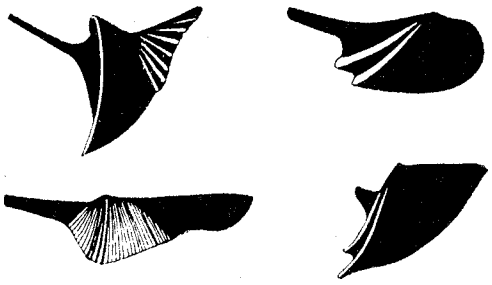

Figure 6. Rostroconchs — Exterior of the right valve. A. *Hippocardia* (X0.5) from Lower Mississippian rocks of Ireland. B. *Technophorus* (Xl) from Upper Ordovician rocks of Ohio. C. *Conocardium* (Xl) from Mississippian rocks of England. D. *Bigalea* (Xl .5) from Middle Devonian rocks of Michigan. Modified from Runnegar (1978), Philosophical Transactions, Royal Society of London, B, v. 284, p. 320.

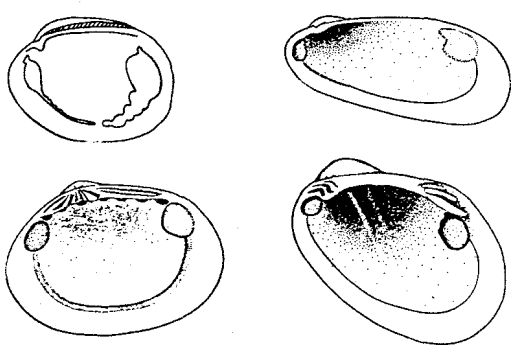

Figure 7. Cambrian and Ordovician pelecypods showing variation in shell form and internal features of the right valve. A. Fordilla (X4.5), from Lower Cambrian rocks of New York. B. Pholadomorpha (X0.5), from Upper Ordovician rocks of Ohio. C. Cycloconcha (X2), from Upper Ordovician rocks of Ohio. D. Cyrtodonta (X0.6), from Middle Ordovician rocks of Kentucky.

Various marine and terrestrial gastropods have internalized the shell or lost it entirely.

Cephalopods (*Nautilus*, ammonites, squids, octopuses, and cuttlefish) mostly are represented in modern seas by species that lack a shell or have an internal shell remnant. However, from their origin in Late Cambrian time (515 mya) through the Mesozoic (65 mya) most cephalopods had external shells. In modern seas, only the pearly or chambered *Nautilus* has an external shell (Figure 5). A special structure in the external shell, called the siphuncle, allows gas or sea water to be added to or removed from the chambers of the shell; this helps permit the animal to move up and down in the water column, much as a submarine does.

Rostroconchs (no common name) are extinct and none is

ERA	PERIOD	
	Quaternary	
Cenozoic	Tertiary	
		65 mya
	Cretaceous	
Mesozoic	Jurassic	
	Triassic	
		245 mya
	Permian	
	Pennsylvanian	
	Mississippian	
Paleozoic	Devonian	
	Silurian	
	Ordovician	
	Cambrian	
		545 mya

Figure 8. Simplified geologic time scale. (mya = Million years ago)

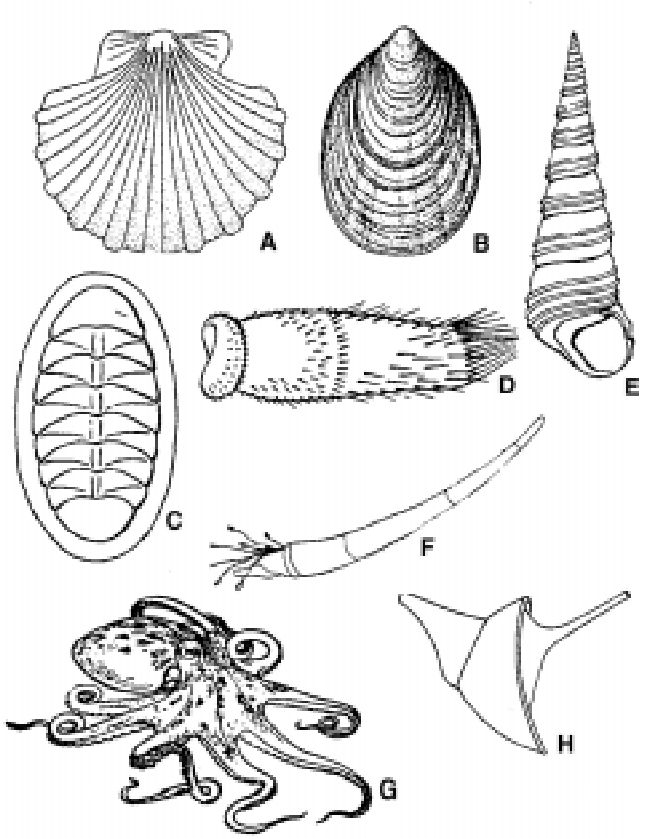

Figure 9. A. *Pelecypoda*, B. *Monoplacophora*, C. *Polyplacophora*, D. *Aplacophora*, E. *Gastropoda*, F. *Scaphopoda*, G. *Cepha-lopoda*, H. *Rostroconchia*

known after Paleozoic time (245 mya). Rostroconchs are the probable ancestors of pelecypods in Early Cambrian time (540 mya), and scaphopods in Middle Ordovician time (450 mya). Some of the unfamiliar shell forms of rostroconchs are shown in Figure 6.

Pelecypods (bivalves, clams, scallops, mussels, cockles) have been a highly successful diverse group of marine mollusks since early Middle Ordovician time (465 mya) (Figure 7); they invaded fresh- water environments in Middle Devonian time (380 mya).

Suggested Readings

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