CHAPTER XII

MOLLUSCA

PHYLUM — MOLLUSCA

General Characteristics. The word Mollusca is derived indirectly from a Latin word " molluscus," meaning " soft," referring to the soft body of these animals, which possess no true skeleton although most of them form a shell, chiefly calcium carbonate. The Mollusks are a group of triploblastic Metazoa, persisting from the Cambrian Period when they were already prominent. They are still represented by about 60,000 species divided into a number of groups which have little superficial resemblance to one another, but are all called Mollusca on account of common characteristics revealed by detailed embryological and anatomical investigations. They are not segmented as are the Annelids nor is the embryonic coelome prominent in the adult. For the most part they evolved a highly specialized body plan peculiar to themselves and are not easily connected to other phyla.

We study them because they are undoubtedly biologically successful and because they are of great economic importance. Two general characteristics are evident: first, a muscular organ of locomotion called a *foot*, which varies in form in different classes, and second, the *shell*. The shell encloses the internal organs. A membrane called the *mantle* secretes the shell and is found next to the inner surface of the shell. Some Mollusks have neither shell nor mantle. A simple type of heart is present. The respiratory system consists of membranous-like plates of soft tissue in the mantle cavity on either side and called the *gills*. In many land forms the mantle serves as a respiratory organ. The *eyes* are especially well developed in some groups. A complex digestive gland called a liver is connected with the digestive tract. They comprise the largest group outside the phylum Arthropoda. Common examples are the clam, snail, oyster, scallop, squid and octopus.

Unio, a Type. Unio (Fig. 174) is a fresh-water mussel and lives in the bed of lakes and streams. Carbonate of lime must be present in the waters inhabited by the mussel. It can *move* from place to place and *burrow* with its *foot* (Fig. 175), which it can project forward between the valves, anteriorly. From the opened shell at the posterior end extend two tubes called the *incurrent* and *excurrent siphons*. Water with oxygen and food is drawn *into* the ventral or *incurrent* siphon and wastes of metabolism are passed out of the dorsal or *excurrent* siphon. The shell consists of two *valves*, hinged together dorsally by an elastic ligament. The concentric lines on the surface of the valves indicate growth increments and mark former positions of the edge of the mantle. The hump or *umbo* near the anterior *dorsal* region marks the size of the *young* clam. The shell is made up of three layers: (*a*) an outer, thin and horny layer, protective in nature; (*b*) a middle layer of crystals of calcium carbonate and (*c*) the inner lining, the nacreous layer, composed of a number of thin layers formed by the entire outer surface of the mantle. This layer produces a prismatic effect on light and is called *mother-of-pearl*. Extension of shell is produced by secretions of mantle cells along the outer margin of the mantle folds along the edges of the valves. The valves are held together by two transverse muscles (Fig. 176). These are located near the dorsal surface at each end and are called the *anterior adductor* and the *posterior adductor* muscles. As the animal grows they are found farther and farther apart. The mantle folds are in contact with the inner surface of the valves. Enveloped by the mantle folds are the gills and the visceral mass composed of the foot, digestive tract, heart, blood vessels, blood, kidneys, nervous system and reproductive organs.

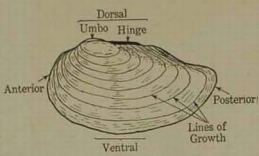

Fig. 174. — Unio.

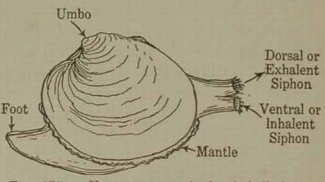

Fig. 175. — Venus mercenaria, hard-shell clam.

Mussels are usually dioecious, that is, the sexes are separate. The reproductive glands are located in the visceral mass. The spermatozoa are carried out through the dorsal siphon of the male

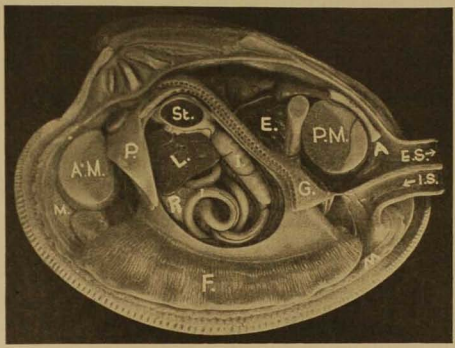

Fig. 176. — Anatomy of Venus, the hard-shell clam. E. S. Exhalent siphon; I. S. Inhalent siphon; A. Anus; P. M. Posterior adductor muscle; A. M. Anterior adductor muscle; P. Palp; L. Liver; St. Stomach; R. Gonad; I. Intestine; G. Gill; F. Foot; M. Mantle; E. Excretory Gland. (From photo of model. Courtesy American Museum Natural History.)

and are drawn into the ventral siphon of the female. The eggs pass out of the genital aperture and are caught by the gills at many places. Here they are fertilized by the sperm. The fertilized egg undergoes cleavage and passes through a blastula and gastrula stage.

Fig. 177. — Glochidium of Lampsilis alata, a fresh-water mussel. (Lefevre and Curtis, U. S. B. F.)

A unique feature is the development of a larva called a *glochidium* (Fig. 177). This is a small bi-valved form. A relatively strong adductor muscle closes the valves under conditions to be stated presently. Development proceeds as far as the glochidium stage in the gills of the female Unio. The larvae are discharged into the water in the early autumn. If water containing glochidia is taken in by a fish, many of the glochidia become attached as the water containing them passes the gills in respiration. Contact with the fish gill stimulates the muscles of the glochidia

to contract and the valves close, holding the larvae in place on the gill. Wherever the fish travels, there travel the young Unios. The larvae remain parasitic on the fish gill until the adult Unio organs develop. Then the young mussels are freed. Bi-valve Mollusks have poorly developed organs of locomotion. The interposition of the glochidium stage attached to the body of a form like a fish which travels far and wide in search of better feeding or breeding grounds is favorable to the Unio since it may be set free in a favorable locality not yet occupied by Unios.

Classification

There are a number of classes of *Mollusca*. Among these are the Gastropoda, the Pelecypoda and Cephalopoda.

Class I. The Gastropoda number about 49,000 known species. They are commonly called snails (Fig. 178), which name is applied to the aquatic marine forms as well as to the land forms. The body is asymmetrical, with a spirally coiled shell. This spiral twisting causes a rearrangement of the internal organs and the loss of the left member of paired organs. In most snails the spiral turns to the right. The head bears tentacles and eyes and there is a foot on the ventral side of the body. Most snails are *oviparous*, laying their eggs in various kinds of egg cases, and most of them are aquatic.

Fig. 178. — Natica, a marine gastropod.

Class II. The Pelecypoda (Fig. 179) (*Lamellibranchiata*) number about 11,000 species living today. These are symmetrical bi-valved Mollusks without any head. The anatomy of the Pelecypoda is indicated by the description of Unio. They are all aquatic and mostly marine, many being found in shallow waters. In the Pacific Ocean is found a giant clam, *Tridacna gigas*, sometimes over three feet long and weighing 250 pounds. On the other hand, the small, fresh-water *Pisidium* is but a few millimeters in length.

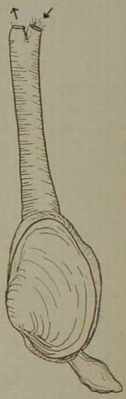

Fig. 179. — Mya arenaria, soft-shell clam.

Pelecypoda are of great economic value. The oyster fishery is a leading sea-food industry.

Taking of oysters from natural beds and placing them in waters where they would be more protected and more available was practiced in Italy, long before the founding of the Roman Empire. It is also said that oysters were shipped to Rome from England in the days of the Caesars. There are oyster fisheries today in Europe, Asia, Africa, Australia and the Americas. In the United States most of the oysters are obtained along the seashore from Massachusetts to Texas. Oyster farming is most successfully practiced in an artificial way in France. It cannot be said that the oyster is of high food value although it does contain some protein and considerable glycogen or animal starch. It is easily digested and has an appetizing flavor.

The sexes are separate in the Atlantic coast oyster. The female develops annually millions of eggs, which are microscopic in size, while many more sperm are produced by the males. Discharged into the water in the spring, when the water temperatures are rising, the sperm swim about until they come in contact with an egg and fertilization takes place. In a few hours a swimming embryo is developed. The shell gradually forms, and by the time the animal is fully surrounded by the valves, the yolk is all used up. At this time, from one to two days after fertilization, the animal becomes a larva, in which condition it swims about after food. The left valve now gradually grows more rapidly than the right, and in about two weeks, still very small, the young oyster attaches itself to an old shell or rock, becoming the " set " or " spat " stage. In about four or five years, it is marketable. Oyster fishermen, in " farming " oysters, provide a bed of clean old shells on which the " setting " can take place. Spawning occurs after the first year. Oysters feed on the minute organisms or *plankton* of the sea water. If the waters in which they are grown contain sewage, there is danger of contamination with microorganisms from the human intestine — possibly with pathogenic forms. In general, today, ordinances enforced by boards of health protect the consumer from these dangers. Chemical wastes from industrial plants along shores near oyster beds are injurious. Oysters have a number of animal enemies, some of which consume the free-swimming oyster embryos. The adult oyster is eaten by starfishes and by the oyster drill, Urosalpinx, a boring marine snail.

The marketing of clams is another important sea-food industry. Millions of pearl buttons are made from clam shells.

"The pearl," says G. F. Kunz, "is the most precious, costly, richest and most beautiful of all objects of human adornment." Sometimes a boring sponge or small worm will bore through the outer layers of an oyster shell. Possibly grains of sand get in between the mantle and inner layer of shell. The oyster then deposits mother-of-pearl at this point to allay the irritation. A little mound collects and so a "blister pearl" is formed. They are used in the manufacture of jewelry. Sometimes, an irritating object gets into the connective tissue of the mantle and around this object successive layers of *nacre* are secreted until a *pearl* is formed. Various foreign objects may stimulate pearl formation. The surface of the pearl is crumpled and corrugated and the edges have tooth-like outlines. Rays of light reflected from the surface are broken up into prismatic colors, much as light is reflected from a soap bubble so that an iridescent effect is produced. Important pearl fisheries are located near Bahrein Island in the Persian Gulf, where pearls have been obtained for over twenty centuries.

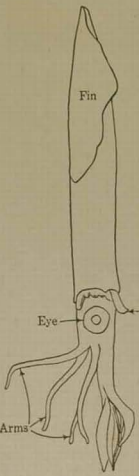

FIG. 180. — Loligo, the squid, a Cephalopod. After Drew.

At the Mikomoto Pearl Fisheries in Japan, expert workmen introduce some foreign body into three-year-old oysters, which are then placed in wire baskets. The latter, suspended from a raft, are sunk 15–20 feet below the surface of the bay and left for about five years. The oysters are then examined for pearls, which are found in about half the specimens.

Class III. Cephalopoda. These are Mollusca having a head provided with well-developed eyes. The foot is modified into tentacles which possess suckers. Examples of Cephalopods are squid (Fig. 180), Octopus and Nautilus. The squid is an active swimmer. It can capture a fish with its tentacles, hold it with the suckers and tear out pieces of flesh with its beak-like jaws. It has an ink sac, and

when the ink is discharged, a black cloud of water hides the squid from its enemies. Fresh and dried squid and octopus are considered good food by many peoples. The Nautilus (Fig. 181) has a shell with spirally arranged compartments formed yearly, one after the other, to accommodate the growing animal, which occupies the outermost and latest chamber.

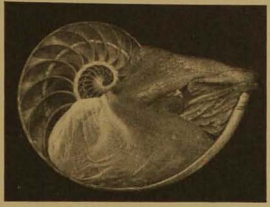

FIG. 181. — Nautilus. Shell sectioned showing location of organs. (Courtesy Am. Mus. Nat. Hist.)

Summary of Molluscan Characteristics : (*a*) Triploblastic; (*b*) Coelome restricted in adult; (*c*) body unsegmented; (*d*) no serially repeated appendages as in Arthropods; (*e*) various specialized organs, such as the foot, gills, heart, etc. (*f*) The embryological history of many forms has a larval stage known as a *trochophore*. A larva similar to this is found among marine Annelids (Fig. 173). This similarity is regarded as indicating phylogenetic relations between Annelids and Mollusks. (*g*) On the whole, adult Mollusca show little relationship with other phyla. They are a specialized and divergent group.

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