OBSERVATIONS ON THE

ILLINOIS MOLLUSCA

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General Character of Illinois Mollusca.

The Mississippi valley has peculiar adaptations for the growth of fresh-water mollusca. In no locality of the world have they attained so great and extensive a development as they have here. This is not however a growth of variety but rather one of individuals and species, producing but few very marked differences. These great North American rivers - the Mississippi and her tributaries - are indeed the home of the immense numbers of bivalves which inhabit their waters, and which are represented by but few species elsewhere. These fresh water species greatly resemble one another and so gradually do the characteristics of one species blend into those of another that the determination of species is in many cases almost impossible.

Nearly all of the several hundreds of species of bivalves are grouped under only three principal genera, those of other genera being small and unimportant. The majority of the union species found here are not confined especially to this locality as are many of the bivalves but are of the same species or genera as have been found distributed in all parts of the continent and even in Europe. Of these two classes - bivalves and univalves - the bivalves are the most numerous in species.

The shells of bivalves, the having a general resemblance to one another, have many particular points of difference by which species can be distinguished. When the animal is considered as separated from the shell the differences between species is not so marked or plain.
the distribution is so even that on almost any
of our large rivers nearly all the species of our
state can be found, and these include many
of those belonging to adjoining states.

Much labor has been put upon the subject
of classification, yet the lack of the subject from
being complete can be seen in the fact that
few if any authors agree in their systems.
Not only do authorities differ in respect to
species and genera but even as to families and
classes. However these shells have been class-
ified sufficiently definite for our purpose.
The classes of the Subkingdom Mollusca ar
as follows:

Class I Cephalopoda
  "  II Pteropoda
  "  III Gasteropoda
  "  IV Branchiopoda
  "  V Lamellibranchiata
  "  VI Tunicata.

Of these six classes only two, Gasteropoda
and Lamellibranchiata, have representatives
in Illinois. These two classes are divided into
orders as follows:

Class Gasteropoda,
  Order 1 Pectibranchiata,
    Family Neritacea,
      "  Pteronotana,
      "  Melaniacea,
      "  Gymnocata,
      "  Amnicola,
      "  Cycloptena,
      "  Calymenae,
      "  Limacina.

Order 2 Pleurobranchoiata
  "  3. Scissoceridae.
  "  4. Cyclobranchiata.
  "  5. Cirrobranchiata.
  "  6. Heterobranchiata.

Class Lamellibranchiata.
  Order Unimusculata.
    "  Bimusculata.
      Family Characea.
        "  Naiades.
        "  Conchacea.

Families containing land or fresh water
species are given in the above list but others
are not. This, after Reeves, is to show the relative
number of fresh water bearing orders to the marine
The gastropods are most numerous in species, the being of the genus Helix over 1400, but the lamellibranchia represented by the genus Unio are more numerous in individuals. Of this genus, the principal one of fresh-water bivalves, some over 620 species.

Localities

According to the localities in which the shells of our state are found they could be divided into three groups, 1. Those living permanently on the ground and never found in water, represented by the common snails and slugs. These are all gastropoda and the adaptation of the respiratory organs to their mode of life forms a basis for classification. All the living out of water they are never found in dry places. In the woods under moist rotten logs, and stones as favorite places for many of them during the day time and at night or during wet days they go out for food. To the same group belong the snails and slugs found in gardens but they are not so numerous.

The second group includes those living part of the time in water and spending the remainder of the year in a torpid state. These are represented by the small shells found in little ponds and ditches during the spring but which dry as the season advances. These are generally in the pond two broods of shells, an old and a young one. When the water is gone the old ones die and the young ones conceal themselves in the mud till the next year. These include of the class gastropoda, Physa Planorbulis Synnea, Anylus, with others in smaller numbers and also of the lamellibranchia, small species of Unio, Anodonta, Sphaerium, Pisidium and a few others.

The third group, by far the largest comprises the river shells and those living permanently in the water. We find here that locality has much to do with the shell. Some species are found only in shallow water, as Anodonta which are seldom found in the deep river bed. Unio cornutus cannot be found except in deep water while Unio littoralis does not seem to be affected
in this respect but is found indifferently in shallow and deep water. Gastropoda are not generally found in deep water. The depth of the water affects the shell for those in deep water have a shell very much thicker in proportion to the size of the animal than those growing near the shore as shown this multiplicata, cornutus, postulatus, and others. Also in most instances the shell has a denser structure and does not show so plainly the presence of animal matter. Still more obvious is the effect of the character of the river on the shell. When the bed of the stream is soft, made of mud or fine sand, the shells are not much worn and the surface is smooth and glossy. Where the stream is swift and the bed is of gravel the shells are found to be very much worn and corroded, especially near the mouth. This is illustrated in the case of the Mackinaw and Illinois rivers in Saginaw county. The Mackinaw has a bed of coarse gravel, the stream being swift after every heavy rain, while the Illinois at this place has a bed of soft mud and fine sand flats along by the banks. The shells of the former have smooth, perfect surfaces while those of the latter are in nearly every case so worn as to be almost useless to the collector. It is supposed the wear in this way is due, to a great extent, to the presence of acids in the water. Although most worn are found in rivers having rocky beds and therefore having less of organic acids in solution it is evident that only in such rivers can the epidermis be worn away faster than the animal can renew it. The parts worn also show a smooth surface as if eroded by acid, the epidermis having been first destroyed.

Anatomy.

The shell. The markings and structure of the shell have received much attention as they are the points upon which the classification was based. The shell of a lamellibranch is composed of what is known as Mother of Pearl, but when alive this pearly luster is entirely hidden by the layer of epidermis with which the outside is coated. The thickness of the shell
as stated before varies greatly. In Unio multiplicata they are each as thick as the animal. The shell of the genus Anodonta is very thin, seldom more than 1 mm in a shell of 15 cm in length. The exterior of shells has often various markings on them as the multiplica which has deep wavy indentations or the conus which has high knobs on the sides of the valves. Many as the modula are smooth. The lucidulus has streaks of green color extending from the umbos, but these are only superficial and do not affect the structure. The color is nearly the same in all our species but it changes in each one, becoming darker with the age of the animal. Yellow, olive green, brown and black are the leading colors and appear in all varieties of shades. There remains to be noticed the dorsal ligament, which consists of elastic, horny fibers extending from one valve to the other. They are not supplied with nerves and have no power of motion in themselves but act as springs to keep the shell open.

The interior of a valve when the animal is removed exhibits a pearly luster; sometimes white, often rose colored as in Unio alatus. These peculiar colors are known as the "naucor us-luster." In all lamellibranchs there can be seen a fine indented line which runs near the outer edge of the shell from the cardinal teeth to the second adductor muscle. This is called the "pallial line" and is the mark left by the attachment of the mantle to the shell (Fig. 1a).

In Unio and Margaritavana there are just below the apex in each valve a pair or more of teeth which keep the two valves in place by fitting into each other. Continued from these teeth backwards under the ligament is a long groove in one valve and a corresponding projection in the other (Fig. 1b and c). Toward each end of the shell there is usually left a scar upon which the adductor muscles were attached (Fig. 1d).

Sometimes one may be wanting, when there are two, the shell is designated "dimyana," when one."
The genus Anodonta has the pallial line and the scars but no teeth or grooves, the two valves of the shell being held together by the dorsal ligament only.

Gastropoda have shells similar to one another in structure but present great differences in form. They are known as univalves, from the shells consisting of a single chamber which chamber is spiral in all genera except Anodonta. In Planorbis it is coiled around the aperture in the same plane, but in all other genera the apex is above the larger whorls of the spiral, so that it forms a spire. In the genus Helix there is often in the back of the shell a corresponding depression to the spire, which may extend in the shell nearly coinciding with the upper surface. In Lymnea the axis of the whorls is very much elongated. In Pleuroceras the whorls are so close upon one another that there is no depression between them, leaving the sides of the shell straight like a cone. The shells of the land and smaller species are thin and light. The color varies from dark brown to a very light yellow and is often to some extent transparent.

None of these have a nacreous luster. A few have markings on them, as Helix alternata which has handsome dark spots on the upper surface. Others have dark lines running longitudinally with the whorls. The larger species, those growing in rivers, have shells that are hard and solid as Pleuroceras and Ponderosa. These do not otherwise differ much from the smaller species except in the shell being of a more stouter type. The interesting genus Anodonta is the only gastropod in our state which has a shell not spiral. It has the same form as many of the marine limpets, viz. oval conical, the sides straight and meeting at the apex in a sharp point. All of this genus are very small species, seldom reaching 13 mm in length.

The Animal.

The Muscular System is indistinct in our mollusca since nearly all parts of the integument seem capable of serving as muscle. The sedentary life of the animals when compared with others, calls into play but few special ones.
In lamellibranchiate the most important muscles are those of the foot and the adductors. Of the adductors there may be either one or two. They are very tough and compact and of great length in proportion to the width. The bundles of fibers can be readily distinguished by the naked eye, but for the detection of the separate fibers a high magnifying power is needed. Fig 2 represents the fibers of the adductor of a Unio. They present no cross markings or structure of any kind on the surface. Instead of being round they seem to have been flattened slightly. The muscle is very pure white and its compactness gives it a glistering hue. The end adheres with great tenacity to the shell after the animal is dead and can hardly be loosened from it unless prepared artificially. The next series of muscles are those of the foot. The foot of a Unio presents a very smooth white surface, translucent if thin and showing no indications of any fibers. The facility with which the foot can be extended from the shell in all directions shows a wonderful mechanism difficult to conceive when we remember that inside the shell there is nothing answering to a skeleton.

A section of the foot (Fig 4.) shows a fissure extending almost to its tip. This is crossed in different directions by slight fibers, and its sides are made up of layers of muscular fibers. The first layer on the outside is epidemis, transparent (Fig 4a). The second (b) is a layer of short fibers, diagonal and at right angles with the surface, principally the latter, very thin and compact. There is a layer of bundles of fibers, crossing and interlacing in all directions (c). This layer the thicker than the former is less compact.
Third is a layer of fibers running parallel with the sides of the foot (a). These extend from the body of the animal to very near the extremity of the foot where they are lost among the other fibers. Between these is an open network of muscular fibers (c), uniting the two sides of the foot which is thus seen to be hollow. These two groups—the adductors and the foot-muscles or the only ones our lamellibranchia has, when considered in the same sense as muscles of the higher animals. The mantle and other soft parts have the of moving to some extent at the will of the animal but these parts cannot be called muscles since they have no definite fibers. Still we do find indications of a muscular system among the Gastropoda. The microscope shows the foot of Plancus to be not composed of fibers at all and with entire body scarcely any fibers at all found. Still the head and neck of a gastropod are capable of a greater variety of motions than the foot of a lamellibranch. The flesh is composed of a very tough gelatinous-like substance.

The outer folds of the mantle have the same character but over the air sacs is only a membrance covered thickly with the dark brown pigment spots. When a piece of the foot is laid for the microscope there can be seen with a high power, a few very fine hair-like substances in the gelatinous substance, but these are much too fine and scarce to make it probable that they have any use as muscles. In fact there has been replaced in these animals, for what correspond to the muscles of higher classes, a substance of a different character and no doubt for them much superior. The snail does not travel by the expansion and contraction of its foot but the foot makes a steady wave-like motion—a quality had by no other class of animals. In most of the gastropoda there is on the side of the body forming the interior of the whorls a white cartilage. This is below the mantle and the thin and flexible has sufficient firmness to keep the softer part of the body in place after the shell has been removed from a specimen. It is probable
that this is its function when the animal is living but it has the additional property of being elastic and moving as the head is drawn in and out. It is not attached to the shell, this in contact with it in its full length.

The Circulatory System is not very definitive either lamellibranchs or gastropods. In the former there is a heart containing two cavities. The principal veins as they begin to separate soon lost in the tissues. In place of capillaries it is believed that the blood flows thru the muscles and other tissues. The blood is colorless. In gastropoda the circulatory system is in some respects clearer. The heart is distinct and has two cavities. It can be best seen perhaps in a young animal while the shell is still transparent and all the organs are performing their natural functions. For this purpose Placoorbis or Placo when a few days old if put under a microscope of not very high power will give the best results. If there are capillaries they have not yet been discovered. The blood is of a pale red color and coagulates like any other. As an example of the globules those of Placoorbis can be taken.

They are very similar to the white globules of human blood. They have an amoeboid motion and change their form rapidly by sending out filaments in all directions which are smooth and transparent. The interior or globular part is made of a granular structure which keeps the same form and does not run out in the filaments. There is a nucleus in each globule.

The Digestive System is more prominent than the circulatory system and as in other of the lower animals occupies a large part of the body. In lamellibranchiathe principal organ or concealed in the upper part of the foot and form the greater part of what is known as the body of the animal. The mouth is in an anterior part of the structure and can be distinguished readily by two pairs of palpi which are membraneous and soft, very much like a smaller pair of gills. The mouth is at the base of the
The mouth contains no teeth, it being simply a muscular opening. The mouth opens into the stomach which occupies the greater part of the body. From this cavity there is a duct leading to the posterior edge of the mantle and there opening near the excurrent siphon of the respiratory system. The interior of the stomach is more or less folded and it is thickly covered with short thread-like palpi which give it the appearance of coarse velvet. A well-developed liver is present which either allows its secretion to pass directly into the stomach or into the duct leading from it a short distance below. There is no system of blood vessels to take the digested portions of the food from the intestine below the stomach, a large part of this being performed by the walls of the stomach itself, and the remainder going through the tissues in no particular channel.

In gastropoda this system is more complicated. First there is a definite mouth which in some of the aquatic species is provided with a set of teeth but which has none in the land species. The form of the mouth is peculiar in aquatic species, there being a complete upper jaw but the lower jaw is in two parts formed by a fissure separating them at right angles to the upper one. Each half of the lower works not only against the upper one but has a lateral motion of its own. This motion is shown as clear as anywhere in Physa and Planorbis. In the mouth of the land snails the upper is of a hard horny texture and the tusk which takes the place of the lower jaw has the same character. Aside from these there is nothing that answers for teeth. The mouth opens into a duct which passes through the neck of the animal and enters the stomach. This organ is smooth on the outside and is large in proportion to the size of the animal. The intestine which leads from the stomach seems to be distinct and not connected with the blood vessels. It makes one fold upon itself and terminates at the outer edge of the mouth opposite to the side on which the air sacs or branches are located. Among those having no teeth there are in place of the stomach two organs corresponding.
ing to the crop and gizzard in birds. The liver is a dark yellow substance of a granular texture extending from the apex of the shell and it occupies several complete whorls. It seems to contain a large number of minute air bubbles in its texture when seen with the microscope.

The Respiratory System in the bivalves includes some of the most complicated parts of the structure. All that can generally be seen of it in the living animal are two orifices (Fig. 3 a) which look like two very short membranous tubes. The upper one is circular while the lower one is circular above and the sides as continued down towards the ventral margin of the shell. Both have around the edge a row of hair-like projections which are soft and flexible, their object being to keep out grani of foreign matter. The water enters through one of these little tubes and passes out through the other, but at will or when a coarse particle enters the animal is able to send a strong stream of water out from both.

If now the shell be removed there may be seen extending under the mantle almost the whole length of the shell and about one-third its width, two soft membranous plates, these are the gills over which the water passes. There are four of them in all, two on each side. If examined closely it will be seen to be marked by two sets of lines, the first transverse and the second longitudinal (Fig. 6). These are color lines and do not seem to affect the structure, but if the piece of gill be examined still more closely there may be detected a third series of lines parallel with the first. These however are made of the structure of the gill and appear as very fine grooves. When magnified their true structure appears as shown in Fig. 7. The gill consists of a membrane (Fig. 7 c) and embedded in the arc minute stiff tubes, made flexible in the aggregate by being joined together at the ends by a flexible material and held in position side by side by the membrane. The longitudinal lines of the gill are the result of the membrane at the