March 6.

Mr. Thomas Meehan, Vice-President, in the chair.

Twenty-nine persons present.

Action of Hydrofluoric Acid on a Sphere of Quartz.—Dr. Otto Meyer reported an experiment, which he had undertaken in connection with Mr. Sam'l. L. Penfield. A sphere of quartz was subjected to the action of hydrofluoric acid for more than two months. The acid dissolved the quartz, principally in the direction of the main axis and thus flattened the sphere. In the direction of the lateral axes the etching action proceeded with much less activity and at three places on the periphery the acid had not eaten away any of the material, but left the original surface of the sphere intact. These three places were situated at *one end* of each of the lateral axes, the result being a triangular disc. This experiment shows that a mineral may be soluble in a liquid in certain directions and on certain planes while at the same time insoluble in other directions and on other planes. Dr. Meyer exhibited the result, the object resembling a three cornered lens.—A more detailed account will be given elsewhere.

Remarks on the Phylogeny of the Lamellibranchiata.—Dr. Benjamin Sharp brought forward some points regarding the classification of the Lamellibranchiata, and stated that in considering this group, a diversity of type was to be found that is equal to, if not greater than that found in any class of the animal kingdom, with the possible exception of the Hexipoda.

In examining the different forms, he pointed out two well marked extremes, *Ostrea* and *Aspergillum*. In the former as is well known, the two large unequal shells entirely cover the body, and they are closed by one large muscle, the adductor. The large and important organ, so common in the Lamellibranchiata generally, the foot, is entirely absent. The mantle edges are separated for nearly their whole extent, and there is no indication whatever of the mantle uniting to form a siphon.

In *Aspergillum*, on the other hand, the two shells are so diminutive, that they only cover an exceedingly small area of the animal's body, the siphon is enormously developed, and it is protected by a secretion of carbonate of lime, in which the shells are immovably embedded; the mantle is closed throughout its entire length, except at the anterior end, where there is a minute opening, and at the mouths of the two siphonal tubes.

His object in making the communication was to prove that these two very marked and different types of Lamellibranchiata arose

from a common or what might be called a central type, and that a divergence from some cause set in, producing on one side the *Ostrea*, and on the other the *Aspergillum*.

As regards the whole class, he said there is no doubt, in his mind at least, that it is a degenerate one. Many anatomical and embryological facts, as well as their life habits, point to this, it being an acknowledged fact that fixed or stationary animals are as a rule degenerate. The loss of the head in all adult forms, the presence of eyes in the head area of some free swimming embryos, and their later total disappearence, are some facts that point unquestionably to the degenerate condition of the whole group.

As to the facts of geology pointing to this conclusion, he quoted from Prof. Heilprin's work on the "Distribution of Animals," p. 265. "Almost everywhere, the Cephalophora, or head-bearing mollusks, antedate by one full period the Acephala, or headless forms, which indisputably represent a lower grade of organism." By considering the group as degenerate, the conditions of the case are answered, for the Lamellibranchiata certainly came off from the Gastropoda, after the latter had become well established, as the anatomical and embryological facts show, and the geological evidence would seem to indicate this to be the case.

Assuming then, that the Lamellibranchiata have come off from the Gastropoda, Dr. Sharp then considered what was the form of the primitive type. It probably had a more or less developed foot, an organ that is present in all the Gastropoda, that it possessed gills on each side of the foot, that the mantle edges were separate and that two adductors were present of about equal size. This type has survived to the present day and, according to Lankaster (Art. Mollusca, Brit. Encl. p. 685), is represented by forms like *Nucula* and *Trigonia*. The former belongs to the family Arcidae (*Claus*) which is the oldest type that we know of, being found in the Silurian and Devonian. The shells of this family are equal; the adductor muscles of the same size, the mantle free, not being closed to form tubes like a siphon, foot well developed. The fulcrum of the shell is about equi-distant from the adductors. In following one branch from this toward *Ostrea*, it is found that one muscle, the anterior, gradually gets smaller, as is the case in *Mytilis*, and exceedingly small in *Pinna*, until in *Ostrea* but one muscle is present. From the fact that in this advance the animal becomes more and more fixed first by a secretion of the foot, the byssus, then by the shell itself, the foot gradually is less and less used as an organ of locomotion, until it entirely disappears in *Ostrea*. The retractor muscles of the foot, now practically useless organs, are however, still present.

The loss of one adductor muscle can probably be referred to mechanical causes. In studying the change of relation of the fulcrum to the adductors, he found that as the fulcrum moved forward (anteriorly) it increased the distance from the posterior, and lessened the the distance from the anterior muscle. As this took place, the muscle

farthest from the fulcrum was always the larger, in fact it must of necessity be so, as more power was needed at this point, while the near one, from the fact that it does not require much power, diminishes in size. In *Pinna*, one muscle is very much, in fact four or five times, larger than the other; the smaller being close to the apex of the shell, in other words, close to the fulcrum,

As the fulcrum passes still farther forward, a point is soon reached when both muscles come in line with the fulcrum, the larger one in this case takes all the work from the smaller one, which from its now useless position degenerates to disappearance.

A proceedure from regular to irregular shell is to be seen in the fresh water forms. *Unio*, he held, is probably a fresh water *Mytilis*, which does not have any byssus present in the adult, but has one in the embryo. A form that closely resembles the oyster can be traced through *Aetheria* to *Muelleria*, the so-called fresh-water oyster. The later has both adductors in the embryo, but only one, like *Ostrea*, in the adult.

In passing now in the other direction, Dr. Sharp pointed out the stages connecting the central type to the extreme in *Aspergillum*.

In passing out from the central type, the Arcas, the group known as the Syphonata appear, where besides the large foot, it is found that the aboral portion of the mantle has united at two or three points, forming one or two tubes. In some forms of *Lucina*, by the union of the mantle a single tube is formed, the so-called anal siphon, which corresponds to the superior one when two are present; through this passes the water outwards, the inflowing water passing in through the large space between the mantle edges, as in the asiphonated forms. In this form of *Lucina*, specialization has only determined the direction of the out-flowing current, which carries off the deoxygenated water and the excreta.

In *Cardium* the siphon is made up of two tubes; in other words, the ingoing and ontgoing currents are now determined. The edges of the mantle commence to adhere, leaving room only for the protrusion of the foot. In *Venus* the arrangement is practically the same:—a well developed siphon, large wedge-like foot, which is a locomotor organ, a shell entirely covering the animal when it is closed and two well developed adductors, equal in size. The specialization in this line of development is in the direction of the siphon and closure of the mantle. *Mya* would represent a form, leading to *Solen*, here the siphon is large, the mantle more or less adherent, but the foot has degenerated to a useless organ and the form of the body still some what resembles *Venus*, the shell, however, gaping at the aboral or siphonal end.

In *Solen* the edges of the shells cannot be brought together, or they gape, as it is said. In this form the new type has become established, and the animal resembles a cylinder; the large siphon fills up the aboral or gaping portion of the shell, while the boring foot fills up the oral pole of the shell, the mantle being nearly closed between the foot and the siphonal openings.

The shells of *Macha* are small for the body, and the siphons are so large that they cannot in any way be drawn into the shell, a large portion of the mantle also is without the limits of the shell, so that the edges of the shell do not even touch in life.

In *Teredo*, no hinge teeth are present, nor is even a ligament formed, an organ that is present in all other Lamellibranchs, except the members of this family and the next one to be considered; besides this a new element is found, namely accessory shell pieces. The enormously developed siphon, is four or five times the size of the rest of the body. The mantle edges are firmly united except at the oral pole where the boring foot protrudes, and at the openings of the siphon. The true shells as well as the accessory pieces are movable, that is, not united with the calcareous secretion of the mantle.

In *Gastrochaena* the shells are very small, but still movable, the animal being enclosed in a calcareous shell, the secretion of the siphon. In *Clavagella*, a similar form, one shell is welded to the siphon shell, the right one only being free, and in the extreme form of *Aspergillum*, both shells are immovably fixed in the shelly tube that encloses the animal.

The fresh-water forms *Cyclas*, *Cyprina etc.*, are probably related to *Cardium* and have received their new forms by moving into fresh water.

In summing up, Dr. Sharp showed two branches in the Lamellibranchiata, one going off from a form related to *Arca* the other toward *Ostrea*, the fulcrum moving from a position between the two equally large adductors, toward the oral pole of the body. This brought the anterior adductor in a line with the fulcrum and posterior adductor, where, being of no use, it disappeared.

In the other direction, development is in the antero-posterior direction, the shell, however, not taking part in the growth until a form is reached where the shell is exceedingly small and the animal protected by a supplementary deposit of carbonate of lime.

March 13.

Mr. Charles Roberts, in the chair.

Seven persons present.

March 20.

The President, Dr. Joseph Leidy, in the chair.

Habit of Cirolana concharum.—Prof. Leidy said that he yesterday went to Atlantic City, in the expectation of finding interesting specimens cast ashore in the recent storm; but there proved to be nothing.