cells have basal nuclei and cytoplasm filled with fine granules; their distal ends extend outward to a minute pore at the extremity of the flask. After the discharge of their contents the central cells appear shriveled, and it is probable that the whole organ is soon afterwards lost. Individuals lacking one or both flask-organs are frequently observed. After being lost, the structure is reformed in the same position. It arises as a conical thickening of the ectoderm, of which the central cells take on a glandular function, and the lateral ones form the epithelial covering. Similar organs have not been described as occurring in any other endoproct. The function of their secretion is unknown.

On the outer surface of each tentacle just at the margin of the lophophore there is a single large cell which forms a slight protuberance. Its nucleus is large and situated near the deeper surface; the cytoplasm shows a number of delicate lines extending through it perpendicularly toward the free surface, which is covered by a thickened portion of the cuticula, having the form of a flattened disk or of a saucer with its concave surface outward. The observation of the living animal shows that these structures are unicellular suckers or organs for attachment by means of which the little creature fixes itself by the margin of its expanded lophophore while changing the position of its foot attachment.

The reproductive system of *L. Davenporti* presents the rare condition of proterogynic hermaphroditism. Both kinds of sexual products arise in the single pair of gonads, the ova being formed before the sperm. The evidence for this consists in finding in the same individual a functional ovary on one side of the body, while the gonad of the other side contained, together with an evidently degenerating ovum, a mass of cells showing various stages of spermatogenesis up to the mature spermatozoa with tails. Animals which are functionally males are relatively few during the summer months.

Buds remain attached to the parent till well matured. They vary in number from 1 or 2 to 12. Abnormal buds lacking tentacles, digestive organs, reproductive system, etc., are not infrequently present. They consist of a small rounded body borne on a slender stalk. The proximal side of the lophophore margin forms a blunt projection against which the rest of the margin can be opposed, thus closing the atrial cavity. The epithelium lining the atrium is composed of large glandular cells. The relation of these buds to the parent is not different from that of the normal buds, nor does their attachment persist longer. They appear to be incapable of leading an independent existence and have no known function. They are probably manifestations of a tendency to produce modified members of the colony comparable with the avicularia of certain Ectoprocta, a tendency derived from stock-building ancestors and which has not yet been eliminated. According to this hypothesis we must regard the non-colonial habit of life of *Loxosoma* as secondarily acquired, perhaps in adaptation to its semi-parasitic or commensal mode of life, not, as has been assumed heretofore, as a primitive condition.

Embryos are present, attached to the 'mammary organ' of the parent during July and August. On the embryo a pair of buds arise very early and are fully formed by the time it becomes free from the parent. Soon after the buds separate from it the embryo perishes without undergoing a metamorphosis.

On the Motor Reactions of Paramecium. H. S. JENNINGS.

THE paper was an analysis of the mechanism of reactions to stimuli in the ciliate infusorian *Paramecium*. To all classes

of stimuli *Paramecium* responds with the same motor reaction, in greater or less intensity. The direction of motion after a stimulus is determined by the structure of the animal's body and has no relation to the localization of the stimulus. *Paramecia* are not directly attracted by any agent; they collect in the regions of certain conditions merely in virtue of the fact that these conditions cause no motor reactions, while the surrounding fluid causes a motor reaction that results in random movements, which must (through the laws of chance) eventually bring the animal into a region where these motors cease.

Phototaxis of Daphnia. C. B. Davenport and F. T. Lewis.

The problem is to determine the dependence of the degree of phototactic sensitiveness upon preceding conditions of illumination. Other conditions being similar, do *Daphnia* reared in the dark respond to a fainter illumination than those reared in the light? Special apparatus afforded a quantitative answer to this question. *Daphnia* reared in half-darkness moved, on the average, nearly three times as far toward a light of about minimal intensity as did *Daphnia* reared in the light. We may conclude: Those individuals reared in the dark have become attuned to a lower intensity than those reared in the light.

The minimum intensity inducing phototaxis was, in the more sensitive *Daphnia*, 0.002 candle power at a distance of 3.5 meters, or $\frac{0.002}{3.5^2} = 0.00016$ meter candles. The phototropic sensitiveness of *Daphnia* is quite equal to the phototropic sensitiveness of the most sensitive seedlings.

Early Development of Pennaria Tiarella. Chas. W. Hargitt.

The egg of *Pennaria* is of relatively large size and heavily yolk-ladened. In color it is of a light orange or pinkish hue. It is of ectodermal origin and grows by an active absorption of other ovarian cells. The egg is discharged almost immediately upon the liberation of the medusa, which takes place during the evening from seven to ten o'clock. Fertilization occurs very soon after the egg is discharged, or possibly in some cases before, since in many specimens the medusæ are never liberated, and the eggs seem to be discharged with difficulty and not infrequently exhibit segmentation phases while yet within the bell of the medusa. But so far as I have been able to note, the sperms always gain access to the egg from the outside.

The extrusion of the polar globules is only rarely to be noted, but occurs in an altogether normal way. Segmentation begins usually within fifteen minutes of the access of the spermatozoon. The first cleavage is usually into fairly normal two-celled forms, but seldom exactly in the same way, perhaps no two eggs exhibiting the same cleavage features. This is peculiarly the case in all the later phases. It is absolutely indeterminate and remarkably irregular and erratic. So much so was this that during the first series of observations the whole lot were discarded, as probably for some unknown reason abnormal or pathological. A second series taken the next night behaved in the same way, and while still thought to be somewhat abnormal were followed through to the completion of the irregular cleavage, and were found the following morning to have become perfectly normal planulæ.

That they were genuine cleavage phenomena was conclusively proved by sections of the various stages and the demonstration of mitotic figures in all phases of growth and decline.

Somewhat similar though incomparably less marked phenomena had been noted long ago by Wilson in the development of *Renilla*, and by Metschnikoff in *Rathkea* and