Pontoporeia Hoyi Smith, has, I think, been reported only from Lake Superior and Lake Michigan, and the only American locality for *Mysis relicta*, Loven, has been these same lakes. In fact, a comparison of this list with those published by Smith and Forbes of the fauna of the Great Lakes shows that the fauna of the deep water of Green Lake is almost identical with that of Lake Michigan.

Ripon, Wis., U. S. A., May 18, 1891.

4. Preliminary Note on the Anatomy and Histology of Serpula dianthus (Verrill).

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eingeg. 2. Juni 1891.

The following observations were made on specimens collected during July and August, 1890, while at work in the Biological Laboratory at Cold Spring Harbor, Long Island. They were preserved by immersion in picric acid for from 15—20 minutes, followed by alcohol of the various grades up to 85%, in which they were finally preserved. The internal anatomy was studied entirely by means of serial sections, the specimens being too small to admit of gross dissection.

Serpula dianthus is one of the commonest sedentary annelids of the New England coast, living below low water mark, when its long calcareous tubes may be found attached to stones, oyster shells etc. It was first described by Prof. Verrill[1].

There is, however, one slight error in Prof. Verrill's description. He has throughout confounded the dorsal with the ventral side. Thus, the mantle is attached to the ventral, rather than the dorsal, side, and the clumps of large setae are directed upward, rather than downward. Owing to the extraordinary development of the dorsal longitudinal muscles the animal when coiled has its dorsal side concave, rather than convex, as in other annelids. This may have led to the error.

An operculum is always present, attached to the dorsal outer end of the base of the branchiae, on one side of the body. This is sometimes developed on the right side, and sometimes on the left.

Occupying a corresponding position on the opposite side of the body from the operculum, is the small rudimentary pseudoperculum. This is sometimes a mere knob, but in other individuals it undergoes a considerable development. It never attains, however, more than half

[1] U. S. Fish Commission Report. 1872. »Invertebrates of Vineyard Sound.«

the length of the true operculum. From the abundance of nerve branches in the tip of this pseudoperculum, I am inclined to regard it as sensory in nature.

The internal anatomy of the European species of sedentary annelids has been very completely worked out by Claparède[2] and others, and in the following note I shall describe simply those points in which *S. dianthus* differs essentially from allied annelids.

The cuticle covers only the most exposed parts of the body being entirely absent in those portions which are normally protected by the shell.

In its thickest parts it is made up of several distinct laminae, but exhibits no other internal structure. I could find no trace of cilia on its external surface, as Claparède has figured for allied annelids. Like those, however, it is pierced by numerous channels, the openings for the mucous glands.

The hypoderm covers the whole body, and agrees closely with Souliers[3] description of it in other Serpulae. I could find no trace of »stellar« sub-hypodermal tissue, nor of the »islands« of hypodermal tissue scattered among the muscles, as Claparède has described, and do not think they are present in this annelid. From the appearance of the »sub-hypodermal« layer I am inclined to agree with Soulier that it is transformed connective tissue.

The muscular, circulatory, and digestive systems, and the connective tissue, peritoneum, and cartilages of the body cavity, agree essentially with those of »*Spirographis Spallanzani*« as described by Claparède and I need say very little about them here.

The largest muscles, as stated above, are the longitudinal dorsal muscles, which extend nearly the whole length of the body. They are quite thick, together making up more than half the diameter of the body in its median portions.

The food of the animal is evidently made up largely, if not entirely, of diatoms, as the alimentary canal in all the specimens examined was filled with broken down shells of these minute plants.

Nervous System.

The nervous system is quite highly developed, the cerebral ganglion attaining a diameter of 5 mm in specimens whose whole body diameter was 1,4 mm. This ganglion gives off in front two large branchial nerves, which supply the branchiae, and two smaller nerves

[2] Recherches sur la structure des Annelides sédentaires. Geneva, 1873.

[3] Soulier, Comptes Rendus. T. CVIII. p. 460. 1889.

running to the oesophagus. A single nerve from its posterior, ventral, median edge runs to the posterior part of the oesophagus.

Each branchial nerve divides into two soon after it leaves the cerebral ganglion. The outer division sends two branches into the outer part of each branchia, and to the operculum and pseudoperculum stems; the inner bears a large ganglion soon after it leaves the outer division, and sends one nerve to the inner side of each branchia. I could find no nerves given off from this division to the operculum and pseudoperculum.

The cerebral ganglion gives off, on either side, a large commissure, which passes down around the oesophagus, and into the large ventral ganglion of the corresponding side.

The ventral nervous system is made up of two long nerves, one on either side of the body, running to its extreme posterior end. In each segment the chain is swollen into a ganglion, the anterior pair of ganglia — those which receive the oesophageal commissures —, being much the largest of any.

From then backward, the ganglia gradually decrease in size. The anterior pair are connected with each other by three cross commissures, while each segment behind this, as far back, at least, as the middle of the body, has one commissure. Farther back than this I was unable to trace them. the small size of the nerves together with their resistance to coloring reagents, rendering their detection very difficult. Nerves are given off to the hypoderm, the mantle etc. from these ganglia.

The nerves are composed entirely of nerve fibres: the ganglia, of nerve fibres, with more or fewer nerve cells. About two thirds of the mass of the cerebral ganglion is made up of cells, while the inner portion is composed of fibres. The other ganglia contain but a few cells, arranged on their outer surface.

The tubular fibres are not so highly developed in *S. dianthus*, as in allied annelids. Instead of running through the first pair of ventral ganglia, and through the cross commissures connecting them, they reach only to the posterior end of these ganglia, when they thin out and disappear. Toward the posterior end of the body, however, they have a diameter nearly twice as great as the nerve cord proper.

At its posterior end, the dorsal portion of the cerebral ganglion is prolonged into a most remarkable process; from the dorsal, posterior corner on either side, a large lobe passes outward and backward, for a short distance, and then, bending suddenly downward, passes into the first ventral ganglion. The diagrams, Figs. 1 and 2, show the relations of the various parts. Fig. 1 is a diagram of the ganglion and

commissures, seen from the dorsal side, and Fig. 2 a lateral view of the same. *Br* represents the cerebral ganglion, *BrN* and *OeN* the branchial and oesophageal nerves respectively, *OeC* the oesophageal commissure, *G* the first ventral ganglia with the cross commissures *Com* connecting them, *Vc* the ventral nerve cord, and *L* the lobes in question. The figures are diagrammatic.

It will be seen that we have here, in reality, two pairs of oesophageal commissures. One pair anterior, in the usual position, and the other, the posterior pair, formed by these lobes from the end of the cerebral ganglion. The former are made up entirely of nerve fibres; the latter, of nerve cells, with only a very few fibres at their posterior end. So far as I could discover, these lobes give rise to no nerves.

Fig. 1.

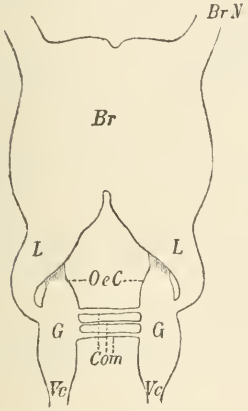
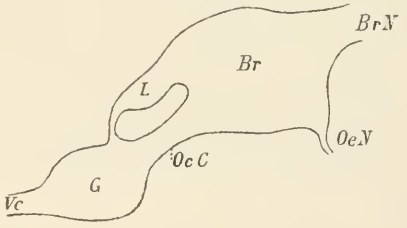


Fig. 2.



I have never seen these peculiar lobes described by other observers, and have no suggestions to offer concerning their function.

Tubiparous Glands.

The only segmental organs are the tubiparous glands, which lie, one on either side in the first body segment. They open through a common duct, at the end of a little papilla on the extreme anterior, dorsal end of the body, the duct lying in a little channel on the dorsal side of the cerebral ganglion.

The glands are very much convoluted, and extend back to about the middle of the second segment. Their external duct rises at the anterior end of the gland, and runs backward for a short distance, uniting with its fellow of the opposite side to form the common external duct, at a point posterior to its point of origin from the gland.

The internal duct is a small tube, smaller than the external duct, and rises from the extreme posterior end of the gland. It runs forward, closely adherent to the ventral side of the gland, to its anterior end, where the duct opens into the body cavity. Its anterior portion is expanded into the form of an elongated funnel, and is ciliated on the interior (?). The cells lining the gland and ducts, are exactly similar to those described by Haswell[4], for some australian species.

The outside of the gland is covered by a layer of peritoneum continuous with that lining the interior of the hypoderm of the first segment.

Sexual Products.

The ovaries are small rounded bodies, one on either side in each segment behind the middle of the body, close against the dissepiment separating that segment from the one in front of it. The ova lie loose in the body cavity, completely filling it toward the posterior end.

The external openings for the sexual bodies are in the posterior part of each segment, opposite the ovaries. They are small round openings, surrounded by a thin lip, which is made up of the three body layers, hypoderm, muscles, and peritoneum, greatly reduced in thickness, and containing also a special layer of circular muscles, surrounding the opening. The arrangement of the parts is such that a contraction of the body muscles would open, and a contraction of these circular muscles would close, this opening.

All of the specimens examined proved to be female; hence further study will be necessary to determine the structure of the male sexual organs.

5. Zur Entwicklung von Paludina vivipara.

(Vorläufige Mittheilung.)

Von Dr. R. v. Erlanger aus dem Zoologischen Institut zu Heidelberg.

II. Theil.

eingeg. 3. Juni 1891.

Im Besitz eines reichen Materials, sowie einer großen Anzahl von Praeparaten und Schnittserien, habe ich es für zweckmäßig gehalten, die bisher nicht berücksichtigten Puncte in der Entwicklungsgeschichte von *Paludina* eingehender zu studieren.

Ich beabsichtige im Folgenden die Entwicklung der Sinnesorgane, des Gefäßsystems und des Geschlechtsapparates kurz zu besprechen.

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[4] »Marine Annelids of order Serpulae.« Proc. Linn. Soc. N. S. Wales. Vol. IX. p. 649. 1884.