# Notes on Plymouth Hydroids.

By

**C. C. Nutting.**

Professor of Systematic Zoology in the University of Iowa.

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THE following notes are based upon observations made during April and the first half of May, 1895. Although the *Plumularidæ* were the special objects of study, a number of facts concerning other forms were noticed, which, together with the discussion of certain matters brought out in the special study of the *Plumularidæ*, were considered by the Director to be of sufficient interest for publication in this Journal. It will be understood that no general discussion of the hydroids at Plymouth is attempted, nor is it my purpose to give a list of the hydroid forms of that exceedingly rich field, no species being mentioned unless some new fact has been observed concerning it.

EUDENDRIUM ALBUM, n. sp.*

*Habitat.* On stones in shallow water near Millbay Channel. The stones are often covered with a dense growth of this hydroid, which appears to the unaided eye like white cottony tufts or downy patches. The gonophores were abundant in April.

The distinguishing features of this species are the minuteness of the colony and of the individual hydranths, both of which are less than half the height of any other Eudendrium from British waters, and the very striking white colour of the hydranths, a feature not found in any other Eudendrium in that locality. *Eudendrium album* is one of the most abundant hydroids at Plymouth during the spring, where it has heretofore been regarded as *Eudendrium capillare*, Alder. It seemed, however, so different from the descriptions and figures of that species given by Alder, Hincks, and Allman, that specimens were sent to the veteran authority on hydroids—Professor Allman—who regarded it as probably new, and advised the writer to describe it as such.

* This is the species referred to by ALLEN, vol. iv. no. 1, p. 49, of this Journal. A full description, with figures, will shortly be published in *Ann. and Mag. Nat. Hist.*

CLYTEA JOHNSTONI, *Alder.* Medusæ of this species were produced in the aquaria in May.

OBELIA GENICULATA, *Linn.* Numbers of the medusæ of this species were bred in the tanks and bottles of the Laboratory during the latter part of April. They may be readily distinguished from the medusæ of *Obelia dichotoma*, which is very abundant at Plymouth, by the fact that the former have 24 marginal tentacles, while the latter has but 16 at the time of liberation. These small medusæ are readily preserved with the tentacles well expanded by stupefying with cocaine and passing through three or four grades of alcohol.

OBELIA LONGISSIMA, *Pallas?* A specimen brought to the Laboratory early in April is referred with some doubt to this species, which it closely resembled in all respects, except in the fact that the hydrothecæ were marked with regular longitudinal flutings, the ridges between the adjacent hollows terminating in blunt teeth at the margin. This beautiful ornamentation was quite constant in the hydrothecæ, and formed so striking a feature as to suggest a new species. The close agreement, however, of the specimen with Hincks' description and figures of *O. longissima*, taken together with the great delicacy of the hydrothecæ of the latter, render it probable that the form under consideration was *O. longissima*, with the delicate hydrothecæ shrunken so as to be thrown into longitudinal flutings. The gonosome was not present.

Secured in Millbay Channel from a depth of about eighteen fathoms.

CAMPANULARIA NEGLECTA, *Alder.* This very minute Campanularian was found growing on the stems of *Tubularia indivisa.* There were several gonangia present, but the acrocysts were not developed. So far as I can ascertain, *C. neglecta* has not been reported from Plymouth by previous observers, probably having been overlooked on account of its small size. It is only occasionally that the bimucronate ornamentation of the margin can be made out. The stem in its manner of branching and flexuose habit resembles a miniature *C. flexuosa.*

CAMPANULARIA FLEXUOSA, *Hincks.* This beautiful species was found with gonosome well developed, on May 1st. The gonangia differed from Hincks' description in being ornamented with shallow but regular annulations throughout their length. At first glance no indication of this annulation is seen, but with proper treatment of light the markings are plainly made out, and appear to be as symmetrical as those so beautifully shown in the gonangia of *Clytea Johnstoni.*

CAMPANULARIA FRAGILIS, *Hincks.* Not before reported from Plymouth. The single specimen secured from the rocks near Millbay Channel was destitute of gonosome, but showed the characteristic tubular plain-rimmed hydrothecæ of the species. The hydranths have about twenty tentacles, and the proboscis is ovate in outline when

the hydranth is expanded, thus differing from most of the *Campanularidæ*.

GONOTHYRÆA LOVÈNI, *Allman*. This is one of the most abundant species at Plymouth. A number of specimens of the genus that were brought in from time to time during April and May differed so materially from *G. lovèni*, and agreed so closely with the descriptions of *G. hyalina*, Hincks, that I regarded them as belonging to the latter species, and had so labelled them, when another batch of specimens was brought in which showed completely intergrading forms joining the typical *G. lovèni* with almost typical *G. hyalina*. There is a strong probability that these two so-called species are but varieties of one form, which should bear the name of *G. lovèni*, Allman.

OPERCULARELLA LACERATA, *Johnston*. Found growing on young stems of *Tubularia indivisa* from Millbay rocks, on April 26th. Other specimens were creeping over the stems of Eudendrium. This is, I believe, the first recorded occurrence of the species at Plymouth.

OPERCULARELLA HISPIDA, n. sp.*

This species bears some resemblance to *Calycella syringa*, Linn., from which it differs in having a much shorter pedicel, a not strictly tubular hydrotheca, a greater number of segments to the operculum, in the absence of the tubular extension of the operculum, and in a much thinner structure, the hydrothecæ being of glassy transparency in *O. hispida*, but of a decided brownish or yellowish horn colour in *C. syringa*. The most striking feature, however, of the present species is the remarkably hispid appearance of the tentacles, which appear to be made up of series of triangular segments on account of the formidable array of large nematocysts with which they are armed. While examining the expanded tentacles with a $\frac{1}{8}$ objective, I was so fortunate as to see these batteries of projectiles suddenly explode, sending out a perfect maze of barbed threads, which appeared to be larger and longer than those of any hydroid that I have seen, except *Nematophorus grandis*, Clarke.

In the absence of the gonosome, it is impossible to say with any certainty to which genus this interesting little species belongs. The general form of the hydrotheca, the cylindrical hydranth with conical proboscis, together with the convergent teeth, give a facies like that of the genus *Opercularella*, in which it is provisionally placed.

CALYCELLA SYRINGA, *Linn*. Found growing abundantly on young stems of *Tubularia indivisa*. The pedicels are often much longer than one would judge from Hincks' figure. The mass of root-stalks from this species running along in approximately parallel lines on the host, and giving off the peduncled hydrothecæ, afford a good idea of how the

* A detailed description, with figures, will appear in the *Ann. and Mag. Nat. Hist.*

fascicled stems of hydroids may have arisen. In some of the specimens the aggregation of root-stalks would doubtless be sufficiently rigid to support themselves in an erect position after the stem to which they cling had died, and we should then have a loosely put together, fascicled stem, which a little further differentiation would convert into a typical polysiphonic hydrocaulus.

The tubular extension of the hydrothecæ reminds one of similar structures in the genus *Cryptolaria*, which contains several species further related to the one under discussion, in having the operculum composed of convergent segments.

CUSPIDELLA GRANDIS, *Hincks.* In looking over my Plymouth series of hydroids after returning to America, I found specimens of this species growing over the stems of *Halecium tenellum*. A careful examination of the stems of the larger hydroids is frequently repaid by the discovery of one or more species of minute parasitic forms which escape the casual observer, and it is quite likely that a number of new species would reward the patience of any one who would devote himself for a time to a search for these forms on British coasts.

HALECIUM TENELLUM, *Hincks.* A number of colonies with female gonangia were taken from a depth of 18 fathoms on April 19th. These specimens closely resemble in several points miniature colonies of *H. labrosum*, Alder, especially in the shape of the gonangia and the wrinkled appearance of the stems, which, however, are monosiphonic. Indeed, one cannot wonder that Alder mistook *H. tenellum* for the young of *H. labrosum*. Out of a large number of colonies of *H. tenellum* from Plymouth, there are none over half an inch in height, and they very generally show the reduplication of the margins of the hydrophores, which Hincks mentions as a characteristic feature.

PLUMULARIA PINNATA, *Linn.* This is by far the most abundant Plumularian at Plymouth, and afforded an excellent opportunity to study the morphology and reproduction of the group.

*The Nematophores.* There is a great deal of confusion of terms regarding these structures. The name properly applies to both the sarcodal process and the chitinous receptacle into which it retracts, although it is often used to denote either one of these structures. The terms "sarcostyle," denoting the sarcodal process, and "sarcotheca," denoting the chitinous receptacle, have now come into general use. Hincks' description of *P. pinnata* is incomplete, in that it does not notice the sarcostyles which occur without the investing sarcothecæ. One pair of these naked sarcostyles is found in the usual position of the supracalycine nematophores, and another pair is in the axil of each hydrocladium.

The structure of the nematophores has been the subject of much

discussion, particularly by Hincks, Allman, Reichart, Merejkowsky, Weismann, and Jickeli. With the excellent facilities afforded by the Plymouth laboratory, and the valuable suggestions of its director, I secured a number of fortunate serial sections of the expanded sarcostyles of *P. pinnata*, and have been able to satisfy myself concerning the main points of their structure. The results of this study have corroborated the statements of Merejkowsky up to a certain point, including the following facts—

1. The greater part of the sarcostyle is composed of ectodermal cells.
2. There is a central endoderm core (or cylinder?) *
3. The cells on one side of this core are very large and quadrangular, while the cells on the other side and of the entire terminal portion of the sarcostyle are of ordinary size.
4. There are pseudopodia-like processes from the free surface of the sarcostyle.

On the other hand, I have been entirely unable to find any trace of the "interstitial protoplasm" described by Merejkowsky, in which he claims that the ectodermal cells are imbedded. Weismann† boldly suggests that this "interstitial protoplasm" is owing to an assumed necessity for free sarcode to explain the pseudopodia-like processes on the free surfaces of the sarcostyles. It seems to me that there is no logical demand for free protoplasm to explain the great extensibility of these organs. The possible tenuity of the walls of ectoderm cells can be appreciated by any one who has made a study of nematocysts, and a careful examination of the sarcostyles, both living and in serial sections, has failed to afford any evidence of free protoplasm, and this negative result is not antagonized by any physical necessity for free protoplasm in organisms which can construct endoderm cell-walls of the marvellous tenuity and extensibility of the nematocysts.

The function of the nematophores is in more doubt than their structure, and is not yet understood. It is practically certain that they are more or less degraded "persons" of the colony which have come to subserve definite functions of great service, judging from the prevalence of these structures throughout the *Plumularidæ*. So far as the species under consideration is concerned, it is safe to say that the sarcostyles are not "fighting persons" or "machopolyps," because they are not armed with any considerable number of nematocysts, the special weapons of hydroids. An examination of the living and active sarcostyles establishes the following facts—

1. The almost incredible extensibility of these organs, which wind

* While at Naples, the writer was able to demonstrate that this structure, in another species, has a central cavity.

† *Die Entstehung der Sexualzellen bei den Hydromedusen*, p. 176.

around the stem, branches, hydrothecæ, and gonangia, in a perfect maze of threads, or even flattened lobate masses.

2. In retraction, the movement is not comparable to the flowing of pseudopodia, but is effected by decided, quick, jerky retraction, giving an idea of definite outlines and cohesion. To use a crude comparison, the sarcostyle contracts much as if it was made of stretched india-rubber and not of a fluid. It it also worthy of note that there is no mechanical entanglement of the various extensions of the sarcostyles, although they appear to be hopelessly intertwined.

3. The sarcostyles are particularly active in the vicinity of mutilated or dead hydranths and gonophores, particularly the latter, and seem to have a definite object in climbing over the sides and into the interior of hydrothecæ and gonangia. There is no evidence that they are able to repair damaged parts.

4. An examination of living sarcostyles, under a high magnification, disclosed certain cells on the distal surface which had the characteristic outlines and movements of amœboid cells, and contained foreign particles.

It would seem from the foregoing observations that the sarcostyles of *P. pinnata* are primarily neither fighting persons, nor persons concerned in the repair of mutilated or diseased parts. It is probable, on the other hand, that they do remove extraneous matter, or dead organic material from the interior of the hydrothecæ* and gonangia, and that they may aid in the capture and ingestion of food for the colony.

*Origin of the sex-cells.* This species is an excellent one for the demonstration of the cœnosarcal origin of the sex-cells in the *Plumularidæ* as first announced by Weismann.† The gonangia are so excessively numerous that a single series of sections may often be obtained which will show nearly all stages of this interesting process. The course of events in *P. pinnata* agrees very closely with Weismann's description of the origin of the sex-cells in *P. echinulata*, both ova and spermatoblasts, arising in the endoderm of the stem and afterwards migrating into the gonophores, ultimately appearing as ova, or sperm, masses in the matured structures. The ova break through the "stutzlamella" and are fertilized and undergo segmentation between the stutzlamella and the ectoderm. Although the ultimate division of the spermatoblasts may take place in the ectoderm, the primary divisions occur in the endoderm. I have been unable to find any cells recognisable as spermatoblasts in the ectoderm, although very satisfactory serial

* E. METSCHNIKOFF, *Quart. Jour. Micr. Sci.* no. 93.

† See *Die Enstehung der Sexualzellen bei den Hydromedusen*, by Dr. August Weismann. The first announcement was in *Zool. Anzeig.* no. 75, 1880.

sections were made of the male gonophores. It may be, however, that my specimens were too near maturity to furnish conclusive evidence in this matter. In living specimens a division of sperm-cells with partially-developed flagella was observed in the ectoderm.

*Asexual multiplication of P. pinnata.* On April 23rd several colonies of this species were brought in, which were peculiar in having the ends of a number of hydrocladia greatly elongated, destitute of hydrothecæ and nematophores, and distinctly clavate at the tips. Such specimens were brought in almost daily for some time, whenever the boat went out for collecting. The first colonies found were isolated and kept under observation. They rapidly increased in length, and the terminal turgescence became more prominent. In three or four days it was noticed that these enlarged ends were forking and commencing to branch.

In about a week after the first specimens were noticed, it was found that the side of the jar in which the colonies were confined was marked with closely adhering thread-like filaments, which, on examination, proved to be the greatly produced hydrocladial extensions mentioned above, and they were still connected with the colonies from which they sprung. From these adherent extensions were growing new colonies of *P. pinnata* in various stages of development.

After a time the connection between the parent colonies and the young was severed by atrophy of the connecting hydrocladial extension, rootlets were put forth from the adherent portion or end of the original hydrocladia, and thus young and perfectly independent colonies were produced which grew rapidly during the next few weeks. Another group of colonies showing the hydrocladial extensions was so placed that the extensions could not touch the sides of the bottle in which they were kept. In this case the hydrocladia grew and forked as before, and new colonies arose from the forked ends of the hydrocladia. The parent stalks afterwards died and fell to the bottom, giving the young colonies a chance to attach themselves to the glass.

This process reminds one so forcibly of the sending out of stolons from which new shoots arise, as seen in many plants, that I have proposed the name of stoloniferous reproduction for the asexual multiplication of *P. pinnata* as above described.* It is the first recorded instance of the kind among the Hydroida so far as I can find, although it bears considerable resemblance to the fissiparous formation of frustules as recorded by Allman.†

PLUMULARIA HALECIOIDES, *Alder.* This minute Plumularian was found parasitic on *Antennularia.* The gonosome was not present.

* See *American Naturalist*, November, 1895.

† *Gymnoblastic Hydroids*, p. 152.

PLUMULARIA ALLENI,* n. sp.

*Habitat.* Found growing on *Antennularia ramosa.* This delicate species bears considerable general resemblance in size, form, and parasitic habit to *P. halecioides.* It differs, however, in having a non-fascicled stem, smaller hydrothecæ, more numerous nematophores, and especially in the gonangia, which are greatly unlike the annulated structure of *P. halecioides.*

AGLAOPHENIA PLUMA, *Linn.* In studying the development of the corbulæ of this species, an interesting fact regarding the sarcostyles was noticed. A young corbula was under examination, the leaves or ribs of which had not yet coalesced, and the sarcostyles of one leaf were seen to stretch across and attach themselves to the next leaf in front, and remain for some time in that position. It appeared as if these sarcostyles served as temporary attachments to hold the edges of the two leaves together, while they were connected by trabiculæ of coenosarc, which rapidly formed a stronger and permanent connection. The perisarc of the edges of the leaves seemed exceedingly thin, and in places appeared to be wanting. A contact having been established between the edges of adjacent leaves, the permanent attachment was soon formed, and the coelomic cavities of the leaves established connections at these points. A little later, currents of water bearing granules were seen to flow in active streams from one leaf to the other. In their incipient stages it is difficult to tell the difference between sarcostyles and gonophores, and they make their appearance at about the same period in the development of the corbulæ.

AGLAOPHENIA HELLERI, *Marktanner-Turneretscher.*† This is the form collected by Mr. Allen from Eddystone Rocks, and mentioned by him on page 49, volume iv., No. 1 of this Journal. This being the first record of *A. helleri* on British shores, the following description is given for the benefit of those who may not have access to the original—

*Trophosome.* Colony unbranched, attaining a height of three-quarters of an inch. Stem monosiphonic, divided by very deep nodes into short internodes, each bearing a hydrocladium springing from its antero-lateral aspect. Hydrocladia alternate, closely-set, divided into internodes, each bearing a hydrotheca, and partly divided by two imperfect transverse septa. Nodes very distinct. Hydrothecæ obconic, about as deep as the aperture is wide. Marginal teeth nine, unequal in size, the anterior one often being slightly incurved, and rather longer and more pointed than the others; the second and fourth teeth, counting

* Named in honour of the Director of the Plymouth Laboratory, an enthusiastic worker in marine zoology. Detailed description with figures will be published in *Ann. and Mag. Nat. Hist.*

† *Die Hydroiden des K. K. Naturhistorischen Hofmuseums*, Vienna, 1890, p. 271, plate vii.

from behind, are larger than the first and third. There is no apparent intrathecal ridge. Supracalycine nematophores rather small, stout, reaching to the level of the hydrothecal margin; the mesial nematophore springs from just below the margin of the hydrotheca, and projects straight upward and outward, its truncated end reaching to the level of the longest marginal teeth. There are two modified nematophores on each hydrocladium near its base.

*Gonosome.* (Description from Naples specimen.) Corbula thick and short, with the leaves or ribs more closely soldered together than in other small British species. Ribs six on each side, with a row of nematophores on their distal edges.

*Habitat.* Found growing on thick roots of marine plants taken from Eddystone Rocks.

*Distribution.* Naples and Rovigno (Marktanner-Turneretscher), and Plymouth, England.