Hydroids from Wood's Holl, Mass.

Hypolytus peregrinus, a New Unattached Marine Hydroid: Corynitis Agassizii and its Medusa.

By

L. Murbach.

With Plate 34.

Hypolytus peregrinus, a New Marine Hydroid.

Introductory.

During the last part of the summer of 1895, while searching for the larvæ of Gonionemus[1] in tow and dredgings from the eel pond at Wood's Holl, a curious little hydroid polyp was found. At the time it was sketched, and a few notes made on the supposition that it was the larval form of some other hydroid, perhaps a Tubularian. In the following summer forms of the same kind with gonophores were found. This left no doubt that it was after all a mature form, but the limited number of specimens warranted no further conclusion than that the animal would probably prove interesting on account of its unattached condition, a character which would not have been remarkable in a larval form. Nothing like a perisarc was at first thought to be present, for, as was after-

[1] Although this medusa breeds regularly every summer in the eel pond, yet after three summers of careful searching I have found only few metamorphosing larval stages, but have not been able to get the stages intermediate; nor have I been able to raise any beyond the stage of the polyp with four tentacles.

ward learned, there was simply a tubular secretion, only shreds of which remained on the captured polyps.

Last summer (1897) more specimens were obtained by allowing the tow-net to scrape gently over the eel-grass. These seemed to warrant my previous conjectures, and although specimens were sometimes taken in clear water, I now concluded that they usually are temporarily attached to submerged refuse, eel-grass, &c., by means of their perisarcal secretion.

The attached condition of marine hydroids is so universal, and those able to move from place to place are so few, that up to the present time not much stress has been laid on this characteristic. More cases of this kind would establish such character as very primitive or as reversion to an ancestral type, a free polyp, perhaps Actinula-like.

To the writer's knowledge there are only two marine forms so far known which may be considered free. They are Protohydra Leuckartii and Halermita cumulans.

The former, long ago discovered by Greeff,[1] was considered, as its name indicates, to be an ancestral form of hydroids, but its foot is adapted for fixation, and is therefore of permanent character. Furthermore, no sexual reproduction has up to the present time been observed, and partly for this reason Schaudinn[2] suggests that it may be the larval form of a more highly organised polyp.

Halermita, discovered by Schaudinn[2] in the Berlin Aquaria, is certainly a remarkable form, and as his report of the finding may not be accessible to all, I shall recount the principal features of the polyp. Its name indicates its solitary mode of life. In form it is short and conical (stumpf kegelförmig). There are no divisions into hydranth and hydrocaulus; the tentacles (the figures show only one circlet) are usually four in number, but never more than five, and these

[1] Greeff, R., "Protohydra Leuckartii," 'Zeitschr. f. Zool.,' Bd. xx, 1870.

[2] Schaudinn, F., "Halermita cumulans," 'Sitzber. d. Gesellsch. Nat. Freunde,' Berlin, 1894.

are not knobbed at the end. The pear-shaped nettling organs are of only one kind, and they are evenly distributed, i. e. not in groups. The longest tentacles are 8 mm.; the endoderm of the tentacles is a solid axis. From the paper I infer that the foot end is in no way modified for fixation, but simply sticks in the accumulated débris, hence its species name cumulans.

Schaudinn places Halermita between Hydridæ and all known hydroids, but this is only tentative, since he has not been able to observe the sexual reproduction; he admits that it may also be the larval form of a more specialised hydroid.

Up to the present time, then, all marine hydroids known to be adults are permanently fixed; and even if we consider Protohydra and Halermita to be mature forms, then the latter would be the only one so far recorded which does not seem to be specially modified at any point of its foot for fixation. Naturally the case of Corymorpha suggests itself as a form that might be an exception, but may be dismissed on account of the processes at its foot end, which are undoubtedly remnants of a Hydrorhiza.[1] To the new polyp found at Wood's Holl I have given the name Hypolytus peregrinus.[2]

General.

The polyps of Hypolytus peregrinus are found temporarily attached by the secretion of their ectoderm to some foreign object several feet below the surface of the water, or having become detached, probably by withdrawing from the perisarcal tube (in which case a new one is quickly secreted), they may be found floating at the surface of the water. This no doubt accounts for their being occasionally taken with the tow-net in clear water. Their temporary attachment is again

[1] Korschelt and Heider ('Comp. Embryology') suggest that these may indicate a previous colonial condition of Corymorpha.

[2] From ὑπό, under, below; and λύω, loosen; peregrinus, travelling. Should the name here proposed for this new genus be preoccupied, I propose instead Gonohypolytus.

easily effected anywhere along the tapering foot end. No other part of the hydrocaulus seems to be used to "make fast."

The predominant colour of the polyp is pale to bright pink, resembling many Tubularians in this respect. As commonly occurs elsewhere, the colour is localised mostly in the endoderm cells of the body, showing through the more transparent ectoderm of the periphery. In another part of this paper it will appear that greater activity in any part of the body is marked by greater depth of colour. In a general way this is evident in the more active digestive region of the hydranth. An apparent exception are the intense pigment spots at the free ends of the gonophores.

The regions of the body are well marked into hydranth, bearing besides the mouth two circlets of tentacles and the gonophores, and into hydrocaulus (cf. fig. 1). At the union of these two main divisions of the body there is a thickened collar-like portion studded with nettling organs. From this structure to the free rounded foot end the hydrocaulus is covered with a kind of rudimentary perisarc. The hydrocaulus is never branched.

In size the average adult animal is from 1 to $1\frac{1}{2}$ cm. long, and 1 to $1\frac{1}{2}$ mm. thick. Of course the size varies with the degree of expansion or contraction; the measurements were therefore made from a moderately expanded animal.

Locomotion is slow though definite, and not very extensive. The animal seems to progress by leaving its tubular secretion behind, stepping on it, as it were, so that a relatively long piece of the tube, plainly marked by adhering foreign matter, indicates its progress. The movements of parts of the body are slow,—its tentacles, for example, swaying to and fro in search of prey. When disturbed the hydranth and tentacles contract first, and if the irritation is continued the whole animal contracts into a small mass.

General Anatomy.

The hydranth is terminated at its free end by the usually conical hypostome, containing considerable pigment at its highest point (fig. 1, *h.*). It is pierced by a small mouth-opening leading directly into the cœlenteron. Immediately below the hypostome is the set of oral tentacles, ten in number, and placed at regular intervals like radii (fig. 1, *o. t.*). Ten being the largest number commonly present, I take it to be the normal. These tentacles are one third to one half shorter than those of the lower circle, but are otherwise of the same shape and structure. There are no scattered tentacles on the hydranth, and the lower or aboral set occurs nearly two thirds the length of the whole hydranth from the oral one. They are in no way different from those of the oral circle except that they are longer. There are usually fourteen, though frequently a smaller number has been observed (fig. 1, *a. t.*).

In general the tentacles are stouter in appearance than is usually the case in such small polyps. They are slightly enlarged at the end, though there is no knob present except in the young animal, where they are somewhat knobbed. The larger appearance of the tentacles is no doubt due to the prominent ridges of nettling organs which run in circles and short spirals, pushing their cnidocils considerably above the surface. The ectoderm of the tentacles is very transparent, and not easily separated from the mesoglœa. The endoderm forms a solid axis through the centre of the tentacle, and in polyps somewhat reduced by fasting, much black pigment collects in these cells, giving the tentacles the appearance of being hollow; even in ordinary specimens some pigment may be present.

The gonophores (fig. 1, *g.*) spring from the hydranth just above the aboral circle of tentacles, and number in adult polyps from one to three, never more than three having been observed. They present some peculiar features, which will be more fully described under reproduction.

The predominant colour of the hydranth is located in its endoderm, the ectoderm being quite clear. Both these layers as well as the mesoglœa have the typical cœlenterate character, and will not need further notice.

The hydranth does not terminate immediately below the aboral tentacles, but, as is evident from its internal and its external character, it extends over one third its length farther down to where it unites with the body. Just below the point where the aboral tentacles are attached there is an enlargement in the digestive cavity, looking like a deeply pigmented band running across the cœlenteron, for which I have so far found no adequate explanation. Where the hydranth joins the hydrocaulus there is a ring-like expansion, which gives the appearance of the former being stuck on to or slipped over the end of the latter, like a collar or flange (fig. 1, *c.*). In an expanded condition of the body it is nearly obliterated, becoming more prominent again after contraction has returned the body to its normal. It marks the upper limit of the perisarcal tube, and this being a rather tightly fitting structure may in part account for the changeable character of the collar.

Large numbers of nettling organs are present in the lower edge of the collar, and although they are apparently complete for use are nevertheless not destined to be used here, for there are no cnidocils present. They migrate from the collar toward the tentacles, and are of no service until they reach these and become erect. Of the nettling organs in general it may be here added that there are at least two kinds, similar in shape but differing in size and structure. They are very short ovals.

The hydrocaulus is somewhat more slender than the adjacent portion of the hydranth, and gradually narrows down to the taper-pointed foot end, which is generally curved and forms a better rest for the polyp (fig. 1, *h. c.*). The character of its layers is practically the same as that of the hydranth, added only to this that the ectoderm cells differ physiologically in that they secrete the perisarc-like tube. A portion of the foot end is frequently of a deeper pink hue, indicating greater activity here; but as this has to do with reproduction it will be again referred to under that head. There is no special differentiation at the end for attaching the animal. The cœlenteric cavity extends to the tip of the foot end, and in it constant circulation may be seen, due to the flagella on the endoderm cells.

A very delicate perisarcal envelope covers the whole hydrocaulus from the collar to the foot end, or it may even extend farther beyond in a collapsed condition, adhering to foreign objects, showing the distance the animal has travelled. It invests the body so closely and is so thin that it can scarcely be distinguished from the transparent ectoderm which secretes it, except when favourable conditions of illumination show it thrown into folds on the concave side of the body as the latter bends in any direction. When polyps are roughly handled with the pipette it is torn into shreds; in such specimens it first came to my notice. Of course indisputable evidence of its presence and its tubular nature is found in the remains left behind on which foreign matter has collected. Frequently several of these may be found radiating from near the same point, usually a mass of débris, which then marks the place where several polyps from one parent leaving these tubes originally stood (cf. fig. 10).

The temporary nature of the perisarcal tube, which is easily lost or even left, and quickly replaced, indicates that it simply is a somewhat hardened mucous secretion serving for support and protection, and not a true chitinous perisarc, such as other hydroids usually possess.

Sexual Reproduction.

In Hypolytus the sexes are separate, and the males seem to preponderate. Sexual reproduction probably takes place in the latter part of summer, for by the middle of August sperm and ova were just beginning to mature in some individuals. Only one specimen was found with what appeared to be nearly mature ova, and an attempt was made to fertilise them, but was not successful (fig. 1 *a*, *g'''*).

The gonophores (fig. 1, *g'*, *g''*) are limited to a narrow zone just above the aboral set of tentacles, standing at unequal distances apart, and were not more than three in number on any of the individuals observed. The first sign of a budding gonophore is a slight elevation with a deep pink pigment-spot on the hydranth. Both older and younger stages have a spindle or elongated oval form, which in the mature ones becomes distorted by the growth and aggregation of the sexual products in the ectoderm of the outer wall (fig. 1, *g'*). The general hue of the gonophores is bright pink. In length the older ones equal the part of the hydranth between the two circles of tentacles, but being less contractile may appear longer.

A narrow neck connects the gonophore with the hydranth, and just at the junction there is a small curved process directed aborally (fig. 1, *p.*). It is hollow, and appears to belong to the gonophore, its cavity being connected with that leading from the gonophore into the cœlenteron of the hydranth. In small specimens these processes are not yet present. Their nature and significance have remained an enigma to me. I do not know of a homologue anywhere among the hydroid polyps. The cœlenteron is continued through the gonophore to its tip, where a bit of bright pigment is visible. Active circulation may be observed in gonophores as well as in processes at their proximal ends.

Asexual Reproduction.

My attention was first attracted to the remarkable mode of asexual reproduction by the peculiar appearance of the foot end of a few specimens in a lot of about twenty, taken July 26th. One or two constrictions (cf. fig. 2) marked off deeper pink portions of greater diameter. When these segments were freed from the body of the adult they looked not unlike the large planulæ of Pennaria, obtained at the time in considerable numbers. Indeed, the same day such a planula-like body was found in the tow. It was isolated and watched, to determine if it were the detached foot end of Hypolytus or a planula. It moved about for some time, and then slowly erecting itself, attached by its narrow end (making it at once evident that it was not the planula of a hydroid), and developed into a young Hypolytus, thus settling the question beyond a doubt.

As the segments freed from the foot end of Hypolytus are destined to form new polyps directly, and differ from any kind of bud heretofore described, as will be shown later, I shall call them blastolytes.

From a large number of cases of asexual reproduction observed, the following record of the typical course of events is made.

The first signs of the process are seen in the deeper hue taken on by the free end of the polyp, which is no doubt due to the concentration of material for future use. A slight thickening also takes place at this time, and both these phenomena may be due to a very slow mass-contraction at the foot end, or they may be due to constructive metabolism. This point is an important one, but must be deferred until microscopic examination of tissues is made. Next a constriction is seen about two and a half times its diameter from the foot end (fig. 2, *b*). The fact that it forms very gradually and without any marked contraction of the body at this point warrants the conclusion that this and the subsequent process of complete fission are purely cellular activities. Frequently before the first blastolyte is entirely constricted off a second circular groove marks off another blastolyte (fig. 2, *a*); and even a third has been seen in close succession to the other two, but not more than two have been observed at one time.

Just as soon as one blastolyte is freed, its oral end (its polarity, judging from all my observations, remains the same as that of the parent) becomes rounded and somewhat thicker, while the aboral is drawn out to be more slender,—probably a shifting of material to a point where it will be soon needed for the rapid development of the two sets of tentacles, the first necessary organs for securing food.

From the usually curved position of the foot, as indicated in the anatomical portion, the blastolyte lies almost horizontal or at most somewhat inclined. From this position it rises up as soon as free, and apparently dissolves the portion of the perisarcal tube immediately above. In specimens kept in glass dishes the whole process of fission took place in about six hours. The blastolytes given off by specimens in confinement did not show much disposition to move about, as did one found free in some tow. After rising up on the pointed end the tentacles begin to bud out on the enlarged upper end as minute knobs (figs. 5, 6), generally two oral ones first, then two aboral, and almost simultaneously with the two aboral ones the second pair of oral tentacles develops.

When about 2 mm. in length the mouth opening is present and the nematocyst collar begins to show. There are five oral and nine aboral tentacles, all somewhat knobbed. The odd number of tentacles shows that after the first two they do not continue to develop in pairs. At this stage the foot end rests curved like in adults, a character which is also evinced by the larvæ of other hydroids. The perisarcal tube is present, being fully developed up to the collar. The tentacles are solid at a very early stage.

When several blastolytes are given off in succession, a group of polyps may arise, and remain close together for some time. So situated, débris collects on the remnants of the perisarc, and the individuals seem to stick in the accumulated mass. The parent meanwhile has moved a considerable distance from its offspring.

This is a brief account of the normal process of asexual reproduction as it takes place in the larger number of cases; but in some, such a pronounced modification was observed as to warrant a separate description.

In the first case noticed (fig. 4) the constricting mass, the second of two starting out apparently normally, began to show a decided lateral thickening, evidently an accumulation of material for some future use. The first blastolyte continued its normal development, while the enlargement on the second one increased, evidently at the expense of the two ends, for which their attenuation speaks (fig. 4, *a*). At this point my notes read:—After 9.20 a.m., or about two and a half hours after the first blastolyte was seen free, the second one came off from the polyp and, shortening somewhat, became arched (fig. 5, *a*), and as it was before thickened in the middle, the two ends approached more and more, and formed the foot end of the polyp. Even the next day the forked foot of this little animal could be plainly seen (fig. 5, *b*). Here, then, the anterior or oral end had formed from the side of the parent. On the next day I saw the same result accomplished in another way (figs. 7—9). A constricting segment was found at the end of the nearly severed parent, and it had a large hump on one side. This lateral protuberance became larger as the constriction proceeded, then it grew still more at the expense of the foot end, being now severed from the parent; it became the greater bulk, and the former foot-mass became a narrow process (fig. 9, *b'*). The constricted end was also gradually drawn in until the whole assumed the shape of the ordinary blastolyte (9, *b''*). Here again the oral end of the blastolyte was formed from the side of the parent polyp, and as a lateral outgrowth.[1]

The normal process of asexual reproduction of Hypolytus is different from any of the cases of fission described among hydroids. Comparison with strobilation as it occurs among the Scyphozoa, as furnishing a parallel case among the Hydrozoa, seems too strained, especially since it is at the wrong pole, and the resulting products are different.[2] It is different from the frustulation of Schizocladium ramosum described by Allman,[3] since there fission takes place at what would be the oral end.

The sacculæ of Schaudinn's Halermita represent freed lateral buds, and resemble the blastolytes of Hypolytus only in that

[1] Not thinking of the possible significance of these phenomena, no attention was paid to the relative time it took such a blastolyte to produce tentacles, and it is reserved for future observation to see if the explanation given on another page will be borne out.

[2] The well-known phenomenon of "decapitation" among hydroids does not come into consideration here, since it is not a process of reproduction.

[3] Allman, G. J., 'A Monograph of Gymnoblastic or Tubularian Hydroids,' 1871-2.

they may develop directly into polyps. The processes constricted off at the basal end of Corymorpha, which, according to Allman,[1] develop into new polyps, if not the remnants of a Hydrorhiza might correctly be compared with the blastolytes.

Nearest of all, perhaps, comes the asexual reproduction of Protohydra, L., recently more fully investigated by Chun.[2] But this polyp is more primitive, and fission takes place at almost any point on the body, the fission zone not being constant as it is in Hypolytus.

Normal asexual reproduction in Hypolytus by spontaneous fission of a definite portion of the free foot end is unlike any reproductive process heretofore described among Hydrozoa, and since it precludes an attached condition it probably represents an ancestral mode retained by this form. It may have gone through some such stage as Protohydra now does.

The modification of the normal process described under asexual reproduction remains unexplained, and I offer the following as a possible one. It would be of great advantage to the young polyp to have the organs for obtaining a livelihood developed as early as possible. If, now, the material from which the hydranth and the tentacles are to be developed can be accumulated and differentiated (the lateral enlargement) while constriction and fission are going on, the young polyp at the close of this operation could the sooner be ready for the activities of life. This involves formation of a hydranth from a lateral portion of the hydrocaulus instead of from the axial; in fact, just what does take place in Hypolytus. It furthermore suggests a possible explanation of the origin of lateral budding among marine hydroids, by assuming that the precocious development of a hydranth made the separation from the parent unnecessary.

To account for the unattached condition of Hypolytus we may assume that it is secondary, or, on the other hand, that it

[1] 'A Monograph of Gymnoblastic or Tubularian Hydroids,' 1871–2.

[2] Chun, Carl, 'Bronn's Klassen u. Ordnungen d. Thierreichs,' Bd. ii, p. 115.

is primitive. In the first case it would have been preceded by a fixed condition of the polyp. Then the polyp by some process of fission managed to sever itself from a part of its foot end, and attaching itself again went through the same process until fixation was entirely dispensed with, and thus reverted to the ancestral free form.[1] This is, however, without parallel, unless the case of Corymorpha furnish one. One other consideration seems to outweigh the above, viz. that the peculiar mode of asexual reproduction in Hypolytus involves fission of the free end of the parent. It seems to me, then, that it is a phylogenetic character.

Summing up the characters of Hypolytus peregrinus, we have—a single unbranched polyp of the Tubularian type, with two circles of tentacles, ten in the upper and fourteen in the lower; a primitive perisarc enveloping the hydrocaulus, at whose free end buds are given off by spontaneous fission, and these in turn develop into polyps like the parent directly; sexual reproduction by means of ova and spermatozoa, developed in gonophores situated just above the aboral circle of tentacles; on account of its unattached condition it is free to move from place to place, which it does slowly. These and some minor ones are characters that will have bearing on the ultimate classification of our animal, which is not attempted in this report. It is intended to bring out only those characters that have to do with phylogeny and some other problems, such as fission and budding.

DETROIT, MICHIGAN; *March*, 1898.

[1] In this case we might expect the progeny to form at least a temporary hydrorhiza, which, however, does not take place here as it does in Corymorpha. It may be that the embryology of Hypolytus may furnish some further evidence on this point. Another way of looking at the same question is, that Hypolytus was an attached colonial form, in which spontaneous fission took place first just below and then above a lateral bud, and this becoming permanent the lateral thickenings on the blastolytes are to be interpreted as the last remains of budding.

Corynitis Agassizii, McCrady, and its Medusa, Gemmaria.

Last summer, while examining some sargassum driven into Vineyard Sound from the Gulf Stream, I found a small polyp which proved to be Corynitis Agassizii, McCrady. In his description of Halocharis (Corynitis), Agassiz[1] says the medusoid stage was not found, but later he found his Halocharis identical with Corynitis of McCrady, who had observed the medusæ. But according to Allman[2] the medusa ascribed to Corynitis by both McCrady and Agassiz has four marginal tentacles, each with a clavate extremity beset by nodulated pads of thread-cells, and "four overarched spaces between the roots of the radiating canals," while the immature medusa possesses only two tentacles and no "overarched spaces." Allman accepts the general correctness of McCrady's observations with some reservation, pointing out that McCrady captured his four-tentacled medusa in the open sea. He, therefore, has inferred its relationship to Corynitis by intermediate stages.

As my polyps possessed numerous medusa buds, they were kept under observation to determine the question raised by Allman, and finding no previous record of the occurrence of Corynitis in the vicinity of Wood's Holl, I append a short description of the polyps to better establish their identity, and to add a few new points.

They are found most abundant on Membranipora incrustations below the low water mark, probably because on the reddish calcareous deposit they have very good colour protection, as is evident from the difficulty of readily seeing them.

The hydrorhiza is deep pink, while the tiny hydranths have a delicate, translucent, white shade enveloping body and tentacles, with pink between the lighter edges. The hydrorhiza is slender and thread-like, and anastomoses frequently, form-

[1] Agassiz, L., 'Contr. Nat. Hist. U.S.,' vol. iv, pp. 239, 240, 1862.

[2] Allman, G. J., 'A Monograph of the Gymnoblastic or Tubularian Hydroids,' p. 286, 1870–72.

ing a coarse network. The polyps generally arise singly from the hydrorhiza, and do not branch. While the hydrorhiza is covered with a delicate perisarc, I could not demonstrate it with certainty on any part of the polyps, and so cannot verify Allman's prediction that a rudimentary hydrocaulus will be found in Corynitis.[1]

As a rule the polyps are slender club-shaped bodies, from $1\frac{1}{2}$ to 2 mm. in length (fig. 12). There is no marked division into hydranth and hydrocaulus, as Agassiz has pointed out, except that the proximal third is free from tentacles. The oral end is quite blunt, but the hypostome as well as the body is flexible and contractile. Distally the polyp is beset by from thirty to forty-five short knobbed tentacles, which are not arranged in regular circles, but in somewhat oblique rows, giving rise to the spiral arrangement described by Agassiz. The longest tentacles are not more than $\frac{1}{10}$ mm. in length, being nearest the oral end, while the aboral ones are represented by mere elevations on the body. The upper tentacles do not form a circlet around the hypostome, there being a single one higher than the rest. The longer tentacles bear definite large nettling knobs at their ends; a solid row of endoderm cells forms their axes. Nettling organs are also found in the ectoderm of the body migrating[2] toward the tentacles from the base of the polyp where they are developed.

Medusa buds appear most numerous in a zone where the rudimentary tentacles are, though scattered ones may also be

[1] This summer I have found what appears to be a second species of Corynitis. It differs from C. Agassizii in the presence of a well-developed perisarc on the hydrorhiza and the short hydrocaulus, forming imperfectly annulated cups about one fourth the length of the polyp, and in the fact that the medusa-buds are on branched stalks. The colony was not in good enough condition to be sketched, and no medusæ were freed, so it must be left for future observation to determine its relationship.

[2] In a recent article, 'Biol. Centralblatt,' Bd. xvii, No. 13, 1897, v. Lendenfeld has thrown doubt on the fact of the migration of nettling organs. In this connection it is sufficient to state that for several summers in succession this phenomenon has been observed on fresh Pennaria by our students in the laboratory here.

found higher up on the polyp. The largest, and therefore the oldest buds are borne below the middle of the length of the body on single short stalks. From one to ten buds may be found on one polyp.

Scattered everywhere among the polyps bearing medusa buds are others that appear to be sterile individuals. When there are only a few of them they are not conspicuous, and at a time when none of the polyps of a group had any medusa buds they might not at all be noticed. They resemble the others in all respects except that they are more slender and taller, being often 2 to 3 mm. in height, and that they lack any traces of medusa buds, while those around them are very prolific. I cannot understand this sterility of individuals so nearly like the reproductive ones, unless it be a functional one, and is to be interpreted as the beginning of a division of labour in these simple polyps, which in time will lead to a more striking polymorphism. Allman[1] in his Gemmaria implexa has observed a similar difference, of which he says, "In no case can it be regarded as reducing the hydranth to the condition of a blastostyle."

Shortly before the Corynitis polyps were found here I had been taking in the tow a small medusa bearing on its two tentacles some peculiar stalked organs, not unlike stalked Protozoa. When I found them to be an integral part of the tentacles it became evident that the medusa before me was Gemmaria, especially since other characters agreed. The explanation of the presence of this form in our harbour was soon apparent when the medusæ, freed from the Corynitis polyps, were found to have exactly the same characters, and so proved to be Gemmaria. To leave no doubt whatever, one medusa was observed continuously while freeing itself from its polyp nurse by repeated contractions, and until it had sufficiently expanded to recognise its distinctive characteristics. Its umbrella was more spherical, and its tentacles more contracted —one shorter than the other,—as were also its stalked organs

[1] 'A Monograph of Gymnoblastic or Tubularian Hydroids,' 1871–2.

on the tentacles, than is usually the case in older medusæ. Ova were present on the manubrium.

Older medusæ (cf. fig. 11) measure from 1 to 2 mm. in diameter; the umbrella is obovate, deeper than broad, the walls rather thin. Just opposite the four radial canals on the outside of the bell, and extending up about one fifth its meridian, are swellings (fusiform sacs of Allman, p. 224), filled with large nettling organs. The manubrium, extending through over half the length of the bell, is cylindrical, becoming conical when its walls are distended with sexual products. The velum is well developed, with opening rather small. The two tentacles on opposite perradii are quite long and slender when fully expanded, and are provided with long slender filaments, bearing thick-walled oval capsules, each of which contains from three to five oval glistening bodies, and is beset by stiff hair-like processes. At least the proximal portion of each tentacle is hollow, as is evident from the circulation of food particles, while farther out there appear to be separate vacuoles, each containing minute granules exhibiting active Brownian movement. The bases of the two tentacles are enlarged, and bear irregular pigment masses. At the two remaining perradii are slight prominences (below the swellings before mentioned) filled with small nettling organs and some pigment, representing, no doubt, two rudimentary tentacles.

The very unique feature of the genus Gemmaria, as Allman[1] has pointed out, is the stalked organs on the tentacles. These organs one is tempted to compare with the nettling batteries of some of the Siphonophora, not only on account of their containing a number of nematocysts[2] in one receptacle,

[1] Ibid., p. 225.

[2] Although each nematocyst showed a central body looking like folded barbs, I was at first inclined to doubt their nettling function; for while all other nematocysts of the medusa responded to mechanical or chemical stimuli, these were most obdurate. But finally I succeeded in causing threads to be discharged, and now the evaginated thread showed that the appearance in the intact capsule was due to a number of small folded barbs occurring just below a vesicular enlargement of the thread (cf. fig. 13). Allman (ibid., pl. viii) has also figured such a nematocyst from his Gemmaria polyp.

but because the stalks themselves resemble very much the elastic filaments found in nettling batteries.

In the contracted condition the stalked organs seem to beset the tentacles on all sides, but during expansion they are all directed more or less aborally. The nematocysts in the stalked organs are developed in the bases of the tentacles, and migrate outward to where the capsules of the stalked organs arise as evaginations of the ectoderm (fig. 14). At such points the ectoderm is already supplied with the hair-like processes which later stand on the capsules.

When somewhat expanded the stalks are thick and have a wavy outline, while, expanding still more, they look not unlike an unfolding zigzag line or spiral. This gives rise to the granular appearance described by Allman (p. 225), and is in all probability due to optical sections of the joints or spirals of the unfolding stalks.

Finally, there is a very fine smooth filament, not much thicker than a nettling thread, and about as long as the diameter of the medusa, bearing the quivering capsule on its end. During contraction these several appearances occur in reversed order.

The capsules (fig. 13) are thick-walled and somewhat wavy in outline, as if they were made up of segments, and are pierced by a number of openings for the emission of the threads from the contained nematocysts. Covering at least two thirds of the outer portion of each capsule are stiff hairs capable of vibrating so as to impart a peculiar quivering motion to the capsule. They do not wave as cilia usually do, and so can hardly be compared with them. Allman has called them vibratile cilia, and Agassiz [1] does not mention or figure them. The function of the vibratile cilia may be to move the capsules through more space, or may also be tactile.

As to the identity of our medusa with Gemmaria gemmosa, McCrady, there can be no doubt, and that it agrees as nearly with the European form as with the one figured and described by Agassiz [1] may be attributed to age, sex, and condition of expansion of parts.

[1] Agassiz, A., 'Ill. Cat. N. A. Acalephæ,' p. 184, 1865.

The polyps of the European and American Gemmaria, however, exhibit differences enough to remain generically separate; such are the form of the polyp, the degree of differentiation into hydranth and hydrocaulus, the relative development of perisarc, and the arrangement of tentacles. Here, again, as has been pointed out by others, we are confronted by the anomalous condition of two medusæ, almost identical, being produced from polyps generically separated.

MARINE BIOLOGICAL LABORATORY,
WOOD'S HOLL, MASS.; August, 1898.

EXPLANATION OF PLATE 34,

Illustrating Mr. L. Murbach's paper on "Hydroids from Wood's Holl, Mass."

HYPOLYTUS.

Figures 1—10 are eight times enlarged.

FIG. 1.—Adult male polyp. *a.t.* Aboral tentacles. *c.* Nettle collar. *g''.* An immature gonophore. *g'.* Gonophore with sperm nearly ripe. *hc.* Hydrocaulus. *h.* Hypostome. *hy.* Hydranth. *o.t.* Oral tentacles. *p.* Processes at the bases of the gonophores.

FIG. 1 *a—g'''.* A female gonophore. *o.* Ova. *p.* The process at the base.

FIG. 2.—Foot end of a polyp showing constrictions (*a*, *b*) preceding fission.

FIG. 3.—The same with one blastolyte (*b*) free, and the other (*a*) showing a lateral thickening.

FIG. 4.—The same with both blastolytes free.

FIG. 5.—The same showing the hydranth of the young polyp (*b*) formed from the side of the adult. The forked foot was formed by approximation of tapering ends of the blastolyte (*a*).

FIG. 6.—Young polyp normally formed from the blastolyte (*b*).

FIG. 7.—Foot end of another polyp (*a*) showing lateral thickening on blastolyte (*b*).

FIG. 8.—The same (*a*) with freed blastolyte (*b*) showing increasing lateral thickening.

FIG. 9.—*b'*. The same blastolyte as *b*, Fig. 8, showing the increased growth of the lateral thickening. *b''*. Final result of *b*, Fig. 7.

FIG. 10.—Portion of hydrocaulus showing perisarcal secretion.

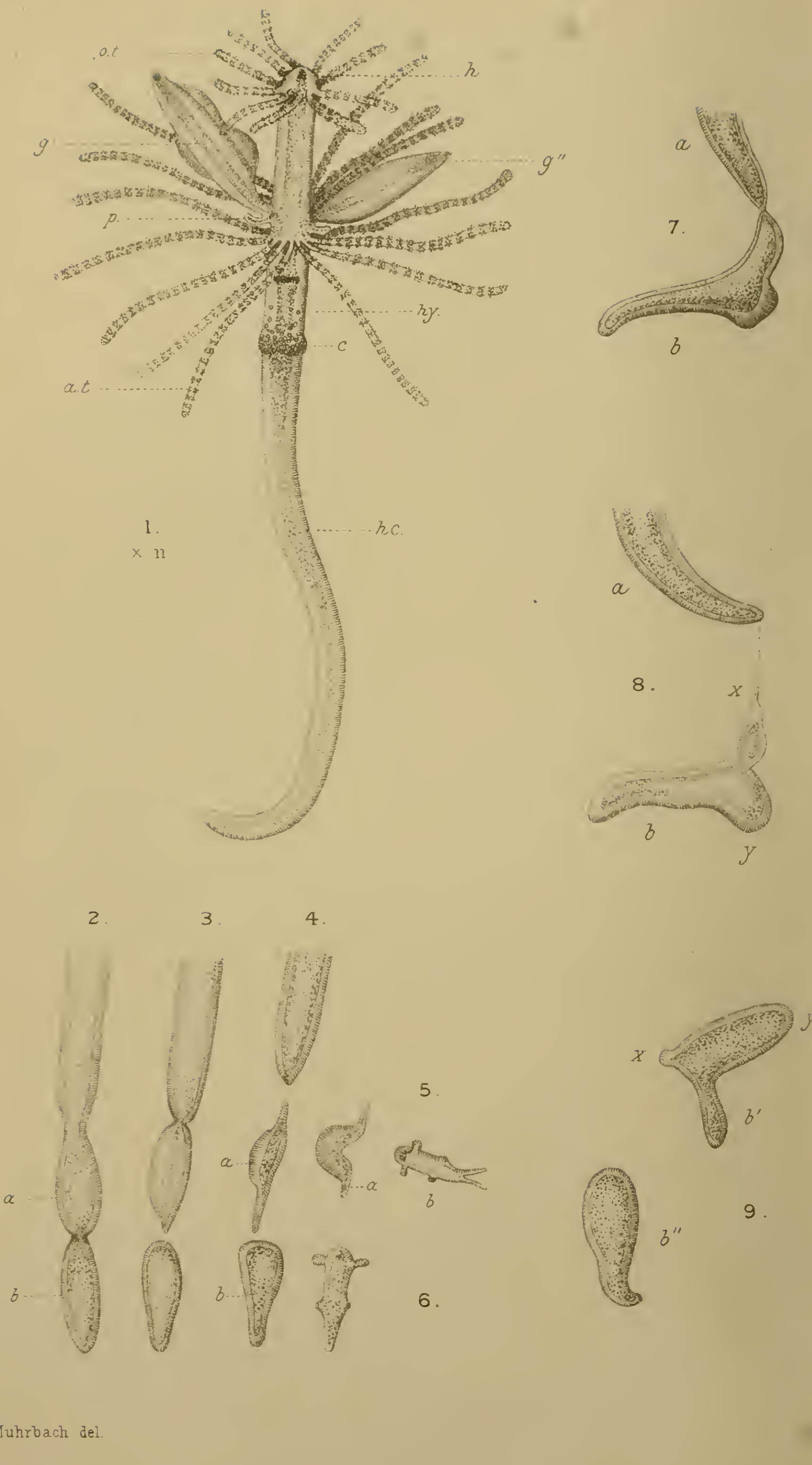
CORYNITIS AND GEMMARIA.

FIG. 11.—Gemmaria gemmosa, representing one tentacle fully expanded.

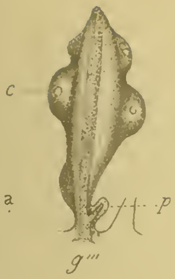
FIG. 12.—Polyp of Corynitis Agassizii without medusa buds.

FIG. 13.—(*a*) Capsule of one of the stalked organs, from the tentacle of medusa, showing one nematocyst discharged; (*b*) large nematocyst discharged from one of the swellings on the bell.

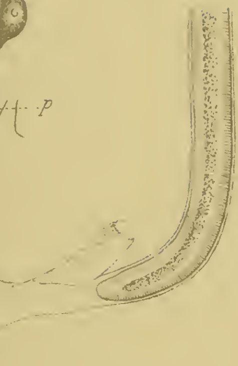
FIG. 14.—Portion of tentacle, showing origin of stalked capsules and vacuoles in the axis.



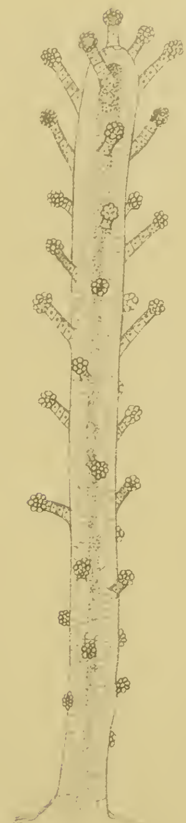
L. Muhrbach del.



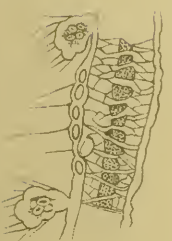
1a.



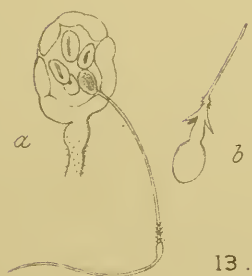
10.



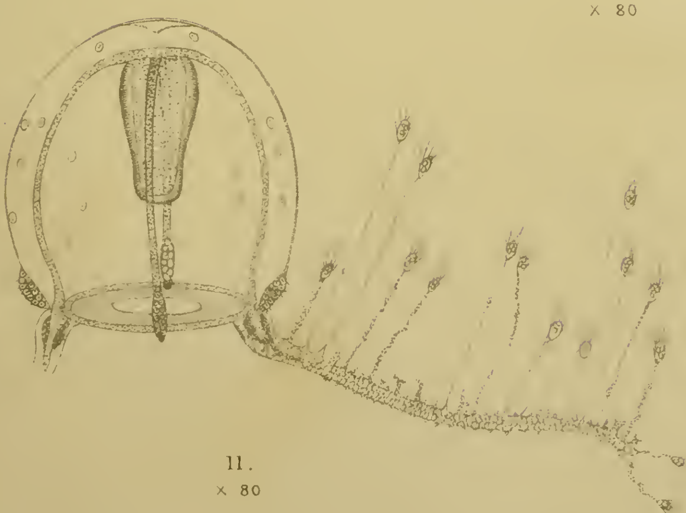
12.
× 80



14.
× 256



13.
× 450



11.
× 80

F Huth, Lith^r Edin^r