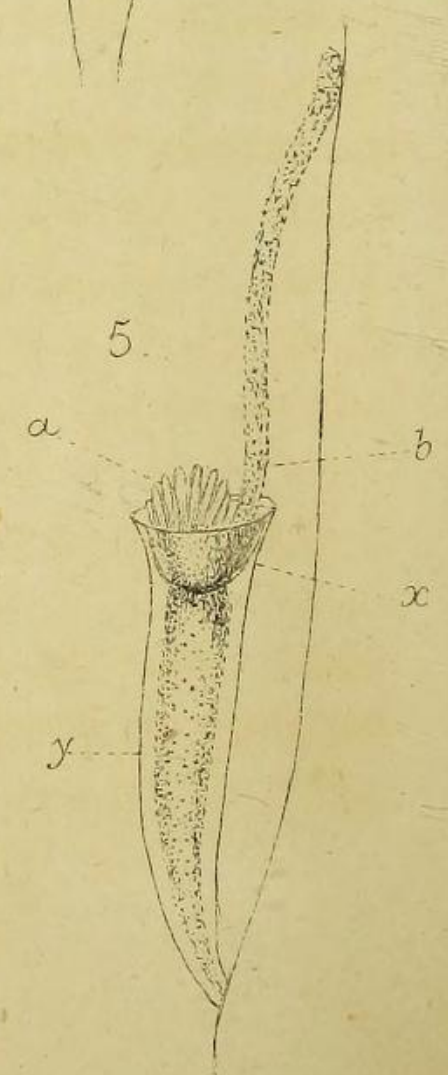
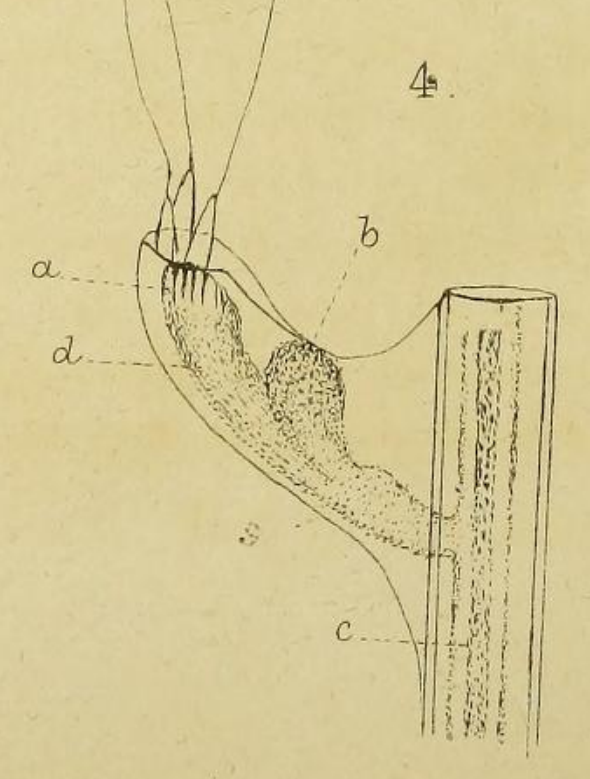
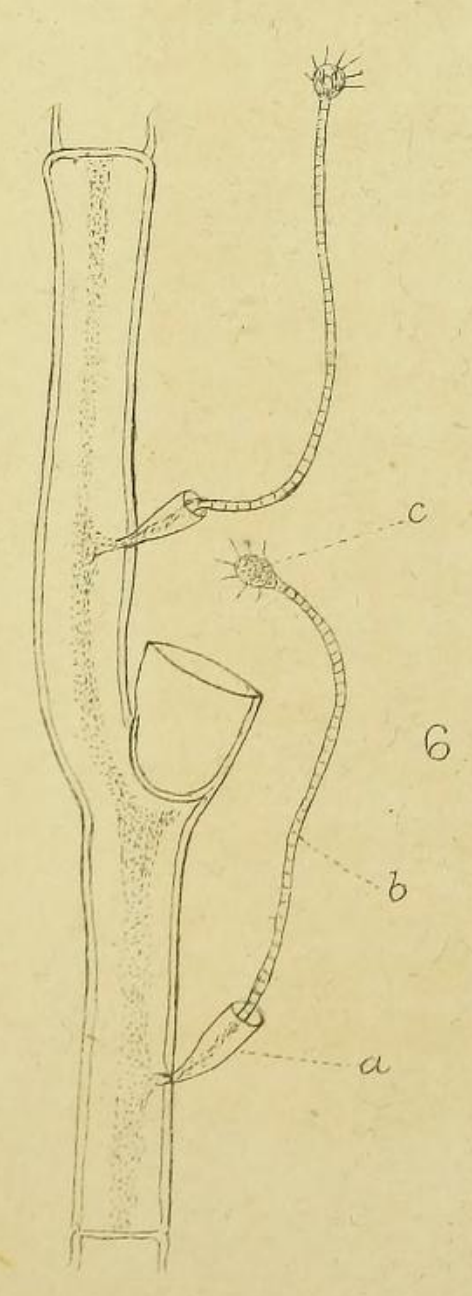
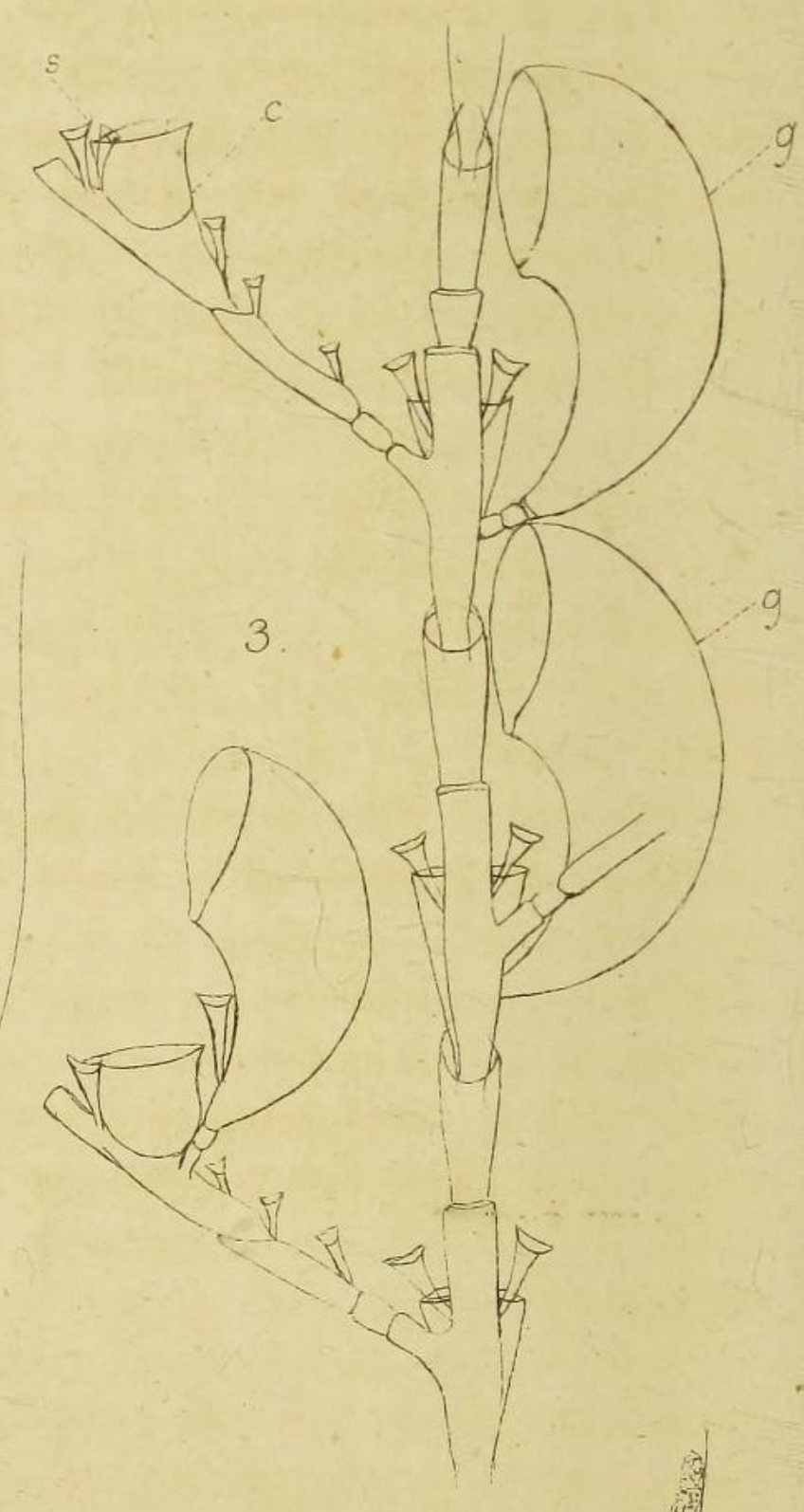
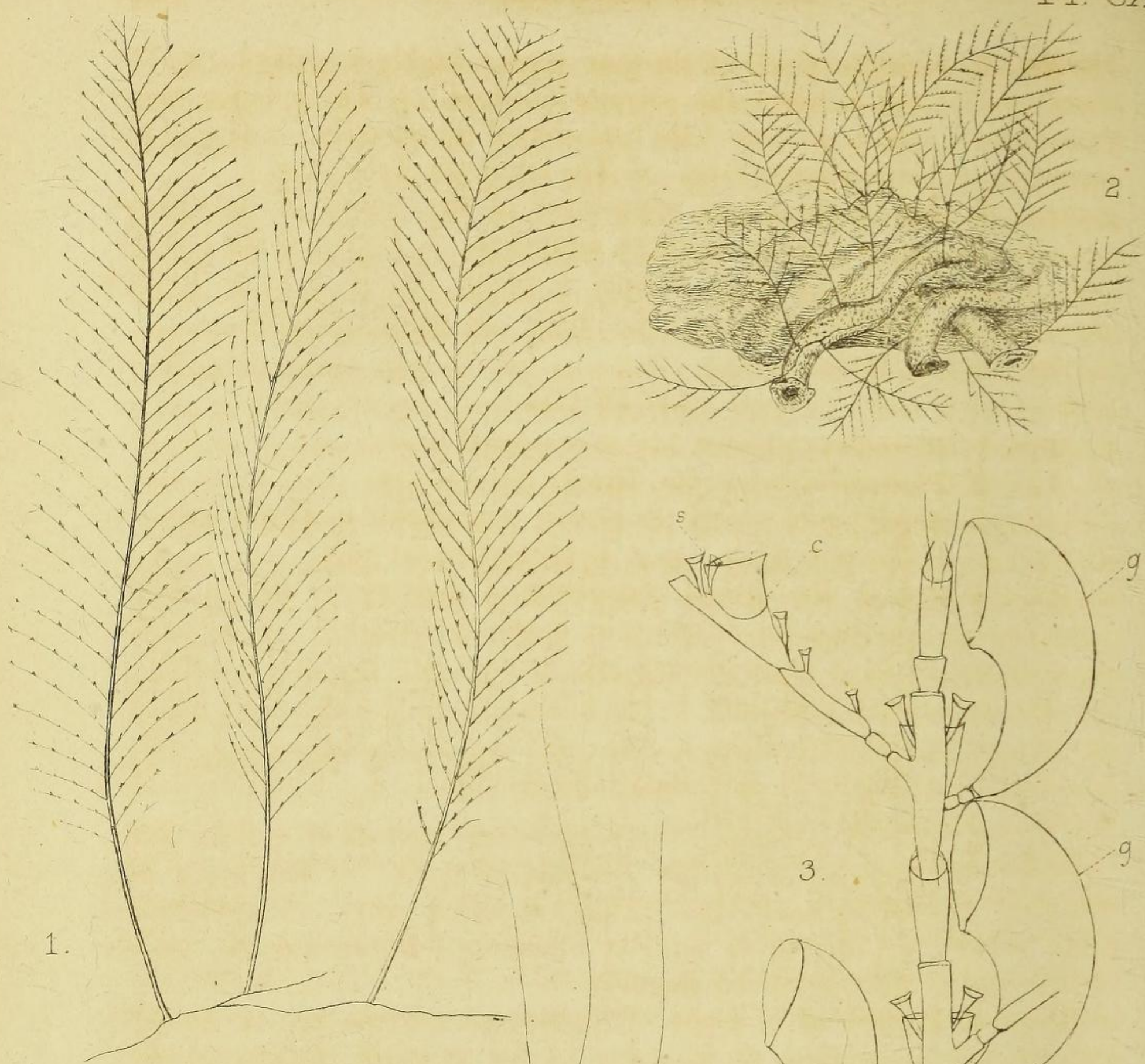


T. Hincks del.

Plumularians.

W. West & C^o sc.



T. Hincks del.

V. West & Co. sc.

Plumularians.

PLUMULARIANS.

BY THE REV. THOMAS HINCKS, B.A., F.R.S.

[PLATES CX., CXI.]



THE *Plumularians* constitute a natural and strongly marked group of hydroid zoophytes. To the systematist they present salient structural characteristics; to the biologist obscure and fascinating problems; while they delight the eye of the least scientific observer by the gracefulness and delicacy of their feathery forms. Not only are the features of the family sharply cut and of very definite type, not only are its habit and expression singularly distinctive, but it also offers to us some morphological peculiarities, which, as it were, isolate it amongst its recent kindred. A sketch of this most exquisite and original group, as free as may be from the technicalities of the mere specialist, may possibly have some interest even for those who are not themselves students of the Hydroida, and fittingly find a place in the pages of the POPULAR SCIENCE REVIEW.

The most obvious character of the family, suggested at once by the name, is the plumous habit, which gives it its peculiar beauty. Each colony consists of a number of elegant plume-like shoots, delicately wrought in chitine, which either spring singly from the trailing fibre that binds them to weed or stone, or, borne on erect and branching stems, form large and composite growths which are almost like miniature palms in general aspect. Our British species are for the most part of the simpler habit and of humble size; but in the warmer seas the family is represented by lovely arborescent forms which sometimes attain gigantic proportions. Another salient character of the Plumularian family is found in the disposition of the calyces, or dwellings of the polypites, on one side of the ramules only, instead of on two sides, as in the allied family of the Sertularians. Each of the delicate pinnæ of the plumule bears on its anterior aspect a single line of these little cup-like receptacles, exhibiting in the

various species many quaint and elegant forms, hyaline or amber-tinted, and often adorned with curiously crenated or spinous margins. In one section the calyces are set close together in a continuous series (Pl. CX., fig. 1); in another they are more or less remote (Pl. CXI., fig. 1); and this apparently trivial distinction is associated with other more important differences which divide the family into two well-marked groups. Of these I shall have more to say hereafter.

A dry account of the structural features and the arrangement of parts, however accurate, can give no idea of the living beauty of these exquisite organisms. The grace of their curves, the hyaline delicacy of their texture, the nameless charm of their entire figure cannot be expressed in a diagnosis. In the attempt to render them the pencil is at fault—much more the pen. Yet I must endeavour to give a general notion of a characteristic form in the living state, and to suggest the principal elements of the beauty that is common to the entire family before proceeding to the special points of structure to which this paper will be chiefly devoted.

I shall select as an illustration one of the smaller British species (Pl. CXI., fig. 2), which is neither better nor worse than its kindred, but a fair average specimen of its race. Imagine, then, a piece of rock, the surface of which and of the sinuous tubes of the *Serpula* incrusting it, is netted over by the finest of fibres, from which rises a whole forest of exquisite plumes. The tallest of them is less than an inch in height; they are all but colourless, so delicate is the horny material composing them, and their slender, shadowy forms are only distinguishable in a strong light. The trailing tubular thread from which they spring may remind us of the *rhizome* that gives origin to the fronds of the fern; it is the common base of the Plumularian commonwealth, holding its many families in organic union, and binding them to the surface over which they spread. Each plume* was pushed forth as a bud from the prolific pulp pervading it, and is itself a branching tube inclosing an offset from the common flesh.

The plume is a colony, sharing the life of a great commonwealth and helping to nourish and enlarge it. The delicate pinnæ, set for the most part alternately along its main stem, bear at intervals minute transparent cups (Pl. CXI., fig. 3 c), the homes of as many hydræ which expand above them their wreaths of slender, beaded arms, all of them bound together as one organism by the ramified thread of flesh pervading the structure. In this section of the Plumularian family, the polypites are not wholly retractile within the calyx; only the base of

* Except the first, which is developed immediately from the embryo.

the body is protected by it, the rest is always exposed. In the present species a conspicuous band of opaque-white encircles the body, like a girdle, a little below the tentacles, and adds much to the beauty of a colony in full life and activity, when its many polypites are in eager pursuit of prey, stretching themselves forward, and casting forth their flower-like wreaths, now suddenly clasping their arms together, and then as suddenly flinging them back; now holding them motionless, the tips elegantly recurved, and then on some alarm shrinking into half their size, and folding them together like flowers closing their petals when the sun is gone. Distributed over the stem and branches are a number of smaller cups (*calicetti*, the Italians call them) of peculiar form and structure, which contain, not hydræ, but zooids of another kind, of which I shall have much to say (Pl. CXI., fig. 3 s). They are very characteristic of the Plumularian family, and, as we shall see, suggest some curious speculations; and, it may be, afford a clue to the genealogy of the tribe.

And if in the polypites, with their wreathed arms, which stud the surface of these vegetative animals, we may fancy a resemblance to the flowers of the plant, we may also find the counterpart of the seed-vessel in the elegant reproductive capsules scattered throughout the colony. In the species now under consideration (*Plumularia cornucopiæ*) they assume the shape of an inverted horn, and are formed of material translucent as the finest glass. Each of them, in fact, is a little crystal cornucopia, in which is lodged one of the reproductive members of the commonwealth, a class totally distinct from that which is charged with the function of alimentation. These graceful receptacles are several times larger than the calyces, from the base of which they spring, singly or in pairs, and within them the ova are produced and the embryos matured which are to give rise to new colonies. (Pl. CXI., fig. 3 g.)

It must be noted in passing that there is nothing stiff or angular in these beautiful organisms; no awkward attitude or graceless line. They are flexible and wavy; the mid-rib of the plumes is bent into the prettiest curves, and the pinnæ are elegantly arched. They are like the Birch amongst trees, in lightness, delicacy, and grace.

Plumularia cornucopiæ belongs, as I have said, to the section of the family in which the calyces are more or less remote from one another, and the polypites only partially retractile. In this division the "calicetti" * are distributed at

* I do not know whether my readers will thank me for informing them that these "little cups" have been named "Nematophores" and "Sarcothecæ" by writers on the Hydroida.

intervals along the stem and branches, and the reproductive capsules are unprotected. In the other principal section, the calyces are ranged close together in a continuous series, and the polypites can withdraw themselves wholly into their little dwellings; the "calicetti" are disposed in definite and constant order round the calyces, and the reproductive capsules are either collected in groups and inclosed in a pod-like case, or all but universally associated with some kind of protective appendage. In Plate CX., fig. 1, a member of this section is represented, and a glance at it will show that, however it may differ in minute structure from the form which I have just described, it presents the same general habit, and is as conspicuous for grace of figure and delicacy of detail. Two of the ribbed and crested cases which shelter the reproductive capsules are shown standing out from the mid-rib amongst the pinnæ, and will at once attract attention from the singularity of their form.

A familiar member of this section of the Plumularian group is the common "Podded Coralline," which overspreads some of the larger Fuci, covering them with its network of fibres, and hanging on every spray a multitude of its amber plumes. What masses I have seen of the "podded weed" (*Halidrys siliquosa*) invested throughout by this elegant hydroid, overgrown by the ramifying thread, which had pushed its way over stem, branch, and branchlet, and sent up at all points hundreds of the plumous shoots, each of which bore aloft a company of polypites, a vast parasitic population!

Such a commonwealth is a wonderfully complex unity; a single germ its origin; a single life pervading it; thousands of *quasi* independent elements included in its manifold individuality. A single plume of *A. pennatula* (Pl. CX., fig. 3) of moderate size may bear some fifteen hundred hydræ; and a plume is but one state of a great federation. Dana reckons the number of polypites on a single specimen of a large foreign species, which reaches a height of three feet, at not less than eight millions; and this is but a pigmy compared with the gigantic form from the Pelew Islands, described by Semper, which attains a height of five or six feet and spreads as a veritable forest over the bed of the sea.

We are not acquainted with many variations upon the Plumularian type; the family has hitherto included few genera, but the number will probably increase considerably as we become more familiar with the modifications of the reproductive system. Two of the sub-groups I have already briefly characterised; in the "Sea-beard" (*Antennularia*), one of the commonest waifs on our sandy shores, the pinnæ are ranged round the stem in whorls, and the plumose appearance is lost. The divergence from the normal arrangement in this case is apparently great,

but the gap between this and the common pattern is bridged over by intermediate forms. In yet another section, the pinnæ are shortened, and carry only a single calycle and hydra, and here again the feathery character is less distinct; but the loss in this respect is compensated for by other elements of beauty. A single species of this section (*Plumularia obliqua*) is found on our shores, a fairy-like form of exquisite delicacy and grace; and, strange to say, it is equally at home at the Antipodes. I have masses of Australian algæ over which it spreads in extraordinary luxuriance, as though the habitat were thoroughly congenial to it. From the same region I have obtained another and very remarkable form (still undescribed) which is referable to this section. Other sub-divisions of the Plumularian family are founded, as I have said, on differences in the reproductive system, with a single exception, to which I shall refer more particularly hereafter. The principal varieties in external aspect have now been noted, and it will be seen that the main features of form and habit are strongly marked, and very constant throughout the tribe.

I proceed to notice some very interesting points of structure, which are peculiar to this family and have no parallel amongst recent hydroid zoophytes. Allusion has frequently been made to the "calicetti," which occur on the Plumularian colonies, in addition to the calycles in which the hydræ are lodged. They exhibit various forms, being sometimes tubular (Pl. CXI., fig. 4) and sometimes cup-shaped; they sometimes consist of a single chamber and sometimes of two chambers, placed one above the other. In the latter case the lower portion is tubular (Pl. CXI., fig. 5), while the upper expands into a hemispherical bowl; the whole may be compared to a goblet on a stand. These curious appendages are, like the calycles, an extension of the horny covering which invests the whole of the common flesh of the hydroid. In one section of the family their disposition is invariably the same; two stand out laterally, one on each side of the calycle, and one, which is often of considerable length, is adherent to the front of it, and has the appearance of supporting it like a bracket (Pl. CX., fig. 6). In the other section there is no such uniformity of arrangement; the "calicetti," which are here of the cup-shaped type (Pl. CXI., fig. 3), are distributed, often profusely, over the colony, in the neighbourhood of the calycles, along the course of the pinnæ, on the central stem, and even at times on the creeping fibre. They are very useful to the systematist, supplying him with good criteria for the discrimination of species. But their chief interest lies in the nature of their contents.

When examined in the living state, they are found to inclose an offshoot from the common flesh, or rather from the outer-

most layer of the common flesh (Pl. CXI., fig. 4 *d*). This offshoot is composed of a soft granular substance, devoid of definite structure—the “sarcode” of physiologists; the kind of material of which the humble rhizopod is made; a pulpy, semifluid mass, without consistency or stability, capable of the strangest behaviour, and actually “behaving” like a creature of much lower rank than the organism with which it is associated. In the compound sarcotheca (I must abandon the elegant Italian for the more cumbrous Greek designation) a column of sarcode pervades the lower and tubular chamber (Pl. CXI., fig. 5 *y*), and on passing into the terminal cup divides, in most cases, into two lobes, which are charged with different functions. From the inferior lobes (Pl. CXI., fig. 5 *b*), when the Plumularian is in healthy and vigorous condition, long filamentary processes are emitted, extensions of the sarcode mass, bearing the closest resemblance to those which an *Amœba* pushes forth as it moves sluggishly along in search of food. From the top of every cup these threads of sarcode stream forth, slowly lengthening as they follow the course of the stem or branch, until the plume is invested by the living gossamer. The extremity of the extensile process is usually closely appressed to the surface of the stem, over which it glides almost imperceptibly. In some cases the sarcotheca is furnished with two apertures, one terminal and the other opening into the calycle, and through the latter these strange protoplasmic offshoots are discharged. I think we must regard these curious structures as distinct zooids in the hydroid commonwealth; a band of stealthy workers, presenting a striking contrast to the vivacious hydræ, stealing along on their mysterious errands, and almost unperceived enveloping the colony with their slender threads. There seems to be a pretty constant efflux and reflux of these streams of sarcode. After a time the outflow is stayed, and as slowly as they had advanced, the processes are withdrawn, until they disappear altogether in the lobes which originated them. This may truly be called a marvellous structure, or assemblage of structures. It is as though a complex Rhizopodal and a complex Cœlenterate organism were bound up together. We have here amœboids and hydræ fraternizing in one and the same commonwealth!

The upper lobe of the column of sarcode pervading the tubular case (Pl. CXI., figs. 4 *a* and 5 *a*) plays a very different part. It emits no amœboid processes wrought out of its substance, but it bears a special apparatus of its own. It incloses a number of long, slender, somewhat bean-shaped thread cells, disposed in a cluster within the sarcode a little below the summit. From these, when the apparatus is in action, long, delicate threads are discharged, that stream upwards from the extremity of the sarcotheca. These fine extensile lines are

cast out to enormous distances, intertwining and waving about in the water. At times a tuft may be seen slowly contracting, and I have observed one dragging down with it a mass of stuff which it had collected.* A specimen which I possess of an Australian Plumularian preserved in fluid, exhibits a really wonderful display of these thread-like organs, sheaves of which surmount a large proportion of the multitudinous "calicetti," and quite change the aspect of the hydroid (Pl. CX., fig. 5). The Italian naturalist Meneghini, who first figured these organs (so far as I know), represents them in this condition. From the aperture of every cup rises (in his figure) a tuft of very numerous tentaculoid appendages. The whole structure is not unlike a very delicate polypite, and as such he seems to have regarded it.

No description can give an adequate idea of this wonderful apparatus as it appears when in full action. The Plumularian colony, indeed, offers us a remarkable combination of vital movements in the play of the polypites as they seek their food, the stealthy outgoings of the amœboid processes as they slowly traverse the stems, and the rapid emission and extension of the waving threads.

I may mention in passing that the thread-cell, which is eminently characteristic of Cœlenterate organisms, has also been detected in some of the Protozoa.

When we come to inquire into the function of the curious structures which I have just described, we are very much at fault. As the thread-cells are stinging organs, the superior lobes of the sarcode mass (or sarcostyle) may naturally be regarded as so many forts with heavy armature placed for the defence of the colony. They may help to keep off carnivorous enemies, such as the naked molluscs (*Nudibranchs*), which are fond of browsing on the polypites of the Hydroida. But what of the amœboid processes emitted from the lower lobe? It seems not improbable that they may be subservient in some way to the work of nutrition; or if not, they may be instrumental in keeping the surface of the plume free from impurities and foreign growths which might be detrimental to the well-being of the colony. Considering the immense number of the sarcothecæ and the various structures and activities connected with them, it is impossible to doubt that they must bear some important relation to the life of the hydroid.

We may regard the amœboid processes, I think—and this is their most interesting aspect—as a clue to the genealogy of the Hydroida, as evidence of a time when there was a much closer

* *Vide* a paper by the author, entitled *Contributions to the History of the Hydroida*, "Annals of Nat. Hist." for Nov. 1872.

relationship between them and the Rhizopods than now exists ; as 'survivals,' indeed, from a remote and very early stage in the evolution of the Order. They indicate the line of development along which the Hydroida have passed, and throw a light on the cradle of the race. If we may accept Professor Allman's ingenious interpretation of the Graptolites, a tribe of Silurian fossils, which has been bandied about from one division of the animal kingdom to another, but has now settled down amongst the Hydroida, we shall have still more direct testimony to the same effect. The Graptolite consists of a tubular stem, carrying a series of tubular offsets on one side of it, or on two opposite sides, and inclosing a solid rod or axis. It bears a sufficiently close resemblance to the Hydroida in general aspect and arrangement of parts to justify its association with them, notwithstanding certain points of divergence. The tubular offsets have been usually regarded as equivalent to the calyces in the recent species ; but Allman, from an examination of their structure, has come to the conclusion that they represent sarcothecæ rather than the dwellings of the polypites. To him the Graptolite is a Plumularian *minus* calyces and (probably) polypites ; a Plumularian hardly distinguishable from a composite Rhizopod, reduced to a level with this humble type in its ways of life, and dependent for its nutriment on the movements of its protoplasm. The Graptolite, we may say, according to this view of it, indicates the transition from the Protozoan to the Cœlenterate structure. It can hardly be admitted that there is as yet an adequate foundation for this ingenious theory,* but whether we accept or not the conjecture of the accomplished biologist, I should be inclined to hold that the mere presence of the amœboid bodies in organic connection with the Plumularian, side by side with the polypites, as associated zooids in one and the same colony, is in itself no obscure indication of a genealogical relationship between Rhizopod and Cœlenterate and of their primitive affinity.

* Allman grounds his view of the morphology of the Graptolites, mainly on the peculiar structure of their supposed calyces, which differ essentially, he thinks, from those of all recent hydroids. Their cavity is uninterruptedly continuous with that of the main stem, and there is no constriction or partition of any kind at the base ; and in this they agree perfectly with the sarcothecæ, whereas, in the living hydroids, the calyx is marked off, more or less distinctly, as a proper chamber, by a constriction or imperfect diaphragm. But it may be remarked on this, that the latter character is by no means universal. In the genus *Salacia*, for instance, the calyces are not separated from the stem by any constriction, and the polypites when contracted can withdraw themselves wholly from them into the tube of the stem. In the genus *Cuspidella* there is also an absence of all constriction at the base of the calyces ; so that this characteristic of the Graptolite is not so significant as is assumed.

The sarcothecæ, so far as their amœboid element is concerned, are peculiar to the Plumularian family. But beyond its limits we meet with some curious structures, which remind us of the apparatus of thread-cells, with which they are also furnished. Thus in a most interesting form (*Lafœina*) obtained from great depths by the distinguished Norwegian biologist, Sars, the creeping stem gives origin to a multitude of slender tubular cases, each of which incloses a thread of sarcode, terminating above in an enlarged capitulum, in which a number of thread-cells are immersed. A small orifice at the summit of the horny tube, protecting this curious piece of structure, gives a passage to the thread-like darts, which are emitted from the cells. These defensive zooids, if such be their nature, are thickly distributed amongst the polypites, which are completely environed by their strange protectors. They remind us forcibly of "calicetti" deprived of their extensile lobes. Another appendage of still more extraordinary character occurs in the genus *Ophiodes*, and marks an advance on the primitive structures I have been describing. And it is a fact of no little interest that an appendage strictly identical with this is met with on a Plumularian lately obtained from great depths off the coast of Norway,* occupying, as it seems, the place of the ordinary sarcothecæ, which are wanting.

This appendage (Pl. CXI., fig. 6) is a tentaculoid organ of very snake-like appearance, attached below to the common flesh of the zoophyte, and terminating above in an enlarged head, bearing numerous thread-cells, from which long, barbed threads are emitted. It is very extensile, and capable of the most vigorous movements. The base is protected by a small chitinous cup, but the main trunk is naked. One or two of these strange organs are always stationed like watchful sentinels near each calycle, around which they execute the most energetic movements, twisting themselves in all directions, and casting forth their lasso-like threads. Their appearance in a Plumularian, as a substitute for the usual "calicetti," is significant; they are probably an advanced modification of the simpler structure. Their occurrence in identical form on two species belonging to different families is certainly remarkable, and points probably to a common ancestor from which both are descended.

I cannot pursue the history of these curious structures further, but merely remark that they seem to replace the more primitive forms, with which the protoplasmic movements are associated, and which, so far as we know, are absolutely confined to the Plumularian family.

* This is the exceptional Plumularian (*Ophionema mihi*) to which I have referred before.

I pass on to notice briefly another structural feature, which is peculiar to the family, and, indeed, to one section of it. Reference has already been made to the elegant vase-like receptacles within which the ova are matured in one of the principal divisions of the Hydroida. They are usually distributed singly over the colony, or massed together on certain portions of the stem. In some of the Plumularians, however, they are collected in small groups, which are inclosed in a curious pod-like case (Pl. CX., fig. 4). These *corbulæ* (baskets), as they are called, are intercalated amongst the pinnæ, and in fact take the place of a pinna (Pl. CX., fig. 1). They consist of a mid-rib, from which a number of curved and serrated appendages are given off on opposite sides, the extremities of which meet above, while the spaces between them are filled in by a delicate chitinous expansion, and the whole forms a closed receptacle, giving shelter to the reproductive capsules. The latter are borne on the mid-rib, near the base of the lateral appendages. This well-developed pod-like structure occurs only on a limited number of species; but less highly differentiated protective contrivances are met with on other members of the family, which clearly represent earlier stages in the process of its evolution. By collating these we are able to trace the whole course of its history from the first slight modification of the normal elements to the perfect *corbula*. The morphological record is complete, and we have the organ before us both in its infancy and in its maturity. I may state, to begin with, that the *corbula* is a metamorphosed plumule; a secondary plume modified to form a protective covering for the reproductive capsules. The mid-rib (Pl. CX., fig. 4 *a*) is homologous with the main stem of the plume; the lateral appendages (Pl. CX., fig. 4 *b b*) constituting the framework of the case are homologous with the pinnæ, which, however, have undergone a change adapting them to their new office. The calyces are suppressed, and only the "calicetti," sometimes the two lateral and sometimes the anterior, remain. These often attain an abnormally large size, and give to the structure its crested and serrated appearance. In this way the pinna is transformed into a support for the chitinous wall of the *corbula*.

The course of development that has resulted in the formation of this curious receptacle can be clearly traced. I shall give a few of the principal modifications which have led up to it. One species of Plumularian at least, belonging to the section of the family in which the *corbula* or an equivalent is usually present, is altogether destitute of any trace of this organ. Its reproductive capsules are unprotected as amongst the Hydroida generally, and are borne on the main stem or towards the base of the pinnæ (Pl. CX., fig. 3). In a beautiful Australian form,

however, we find a deviation from this primitive arrangement. In this species the primary plume gives off at intervals a number of secondary plumes or plumules, which occupy the place of ordinary pinnæ, and in this way a ramified composite structure is formed. Some of these plumules exhibit a curious peculiarity; every here and there a pinna occurs, which is destitute of calyces, but carries a line of sarcothecæ on each side (Pl. CX., fig. 5 b b), and near the base a single reproductive capsule. Such abnormal pinnæ are always curved inwards, so as to bend over and in some measure shield the capsule. They occur at intervals, and alternately on each side of the plume, two of the ordinary pinnæ intervening between each pair. In other respects the plumule is perfectly normal.

In another species (African *) these modified pinnæ alternate on both sides of the plumule with the ordinary pinnæ. In yet another form (Australian) † all the pinnæ on the plumules producing the reproductive bodies are thus modified; the calyces with their polypites have altogether disappeared, and only the lateral "calicetti," much elongated, remain. All the pinnæ are now reduced to the condition of serrated appendages, which bend forward to meet one another, and overarch the capsules at their base. In this case the plumule is a *corbula*, minus the membrane which unites the lateral appendages. In our own "Podded Coralline" (*Aglaophenia pluma*), this element is supplied; a horny outgrowth from the modified pinnæ binds them all together, and completes the closed casket in which the reproductive members of the colony are lodged (Pl. CX., fig. 4).

The various stages in the evolutionary process are here clearly traceable. We may note the plumule changing its character little by little through a series of intermediary forms, until at length it passes into the *corbula*, and so follow the organ step by step from its rudiments to its perfect state. We have first an occasional pinna modified as a support and shelter for a reproductive capsule; then the number of such pinnæ increases until the entire plumule is involved in the change and becomes altogether subservient to the protective function; then the pinnæ, hitherto disjunct and independent, unite, and the plumule, as it were, disappears in the pod-like *corbula*. There is no serious gap in the morphological record.

One or two variations upon the ordinary structure occur. Thus in the finest of our British Plumularians the "Sea-Palm" (*Aglaophenia myriophyllum*), the lateral appendages of the beautiful open *corbula* with which it is furnished differ in

* *Aglaophenia patula*, Kirchenpauer.

† *Aglaophenia ramosa*, Busk.

some degree from those which have been described. Each of them consists of a short stem bearing a single calycle, clearly the equivalent of the ordinary pinna (Pl. CX., fig. 7 *p*), and *between* the front of this calycle and the sarcotheca which usually adheres closely to it, rises a tall recurved appendage, bearing along one edge a line of "calicetti," which give it the appearance of being serrated like a saw (Pl. CX., fig. 7 *a*). These secondary appendages bend inwards, their extremities crossing above, and constitute the protective portions of the *corbula*. The exact significance of these structures I cannot determine; they do not *take the place* of the anterior sarcotheca, which is present as usual, but spring, as I have already stated, from the stem supporting the calycle between the latter and the sarcotheca; and as in some cases after reaching a certain height they give origin to a second calycle (Pl. CX., fig. 7 *c'*), bearing a similar appendage similarly placed, they must, I think, be regarded as of the nature of *ramules*, though abnormally developed. But into such detail I do not propose to enter here. I merely wish to direct attention to the developmental history of the *corbula* as fully unfolded to us in the series of existing specific forms.

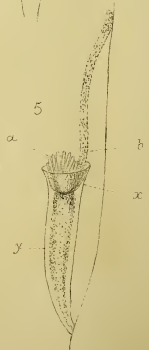
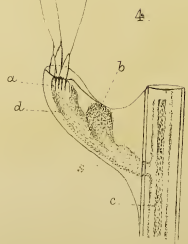
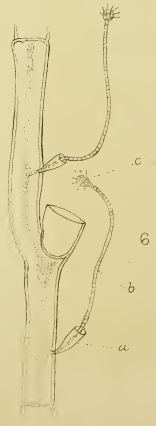
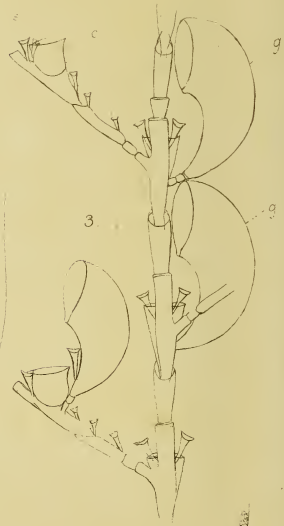
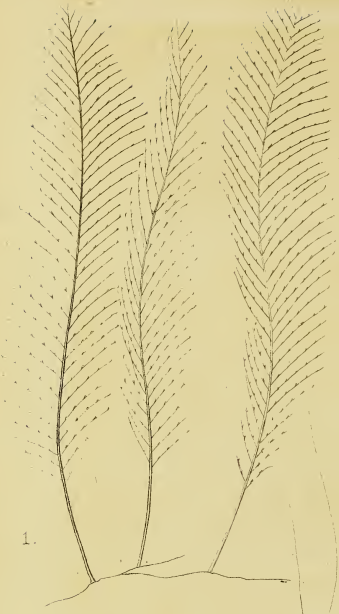
I have thus endeavoured, with as little use of technical phraseology as possible, to indicate the chief characteristics of the Plumularian family, the most significant points in its history, and the leading traits of its remarkable beauty. I have only to suggest in closing that those who seek rest and health at this season by the seaside may readily find some members of the tribe that I have attempted to sketch, amongst the waifs on the beach or in the charming nooks and corners of the tidal pools, and may study them at first-hand with much delight and profit to themselves.

DESCRIPTION OF THE PLATES.

PLATE CX.

- FIG. 1. *Aglaophenia tubulifera*, Hincks, of the natural size.
 „ 2. *Plumularia Cætharina*, Johnston, of the natural size.
 „ 3. *Aglaophenia pennatula*, Ellis and Solander, natural size.
 „ 4. The *corbula* of *Aglaophenia pluma*, Linnæus, magnified. *a*. The mid-rib. *b, b*. Lateral appendages. *c*. One of the reproductive capsules.
 „ 5. Portion of a plumule of an Australian species, bearing modified pinnæ. *a, a*. Normal pinnæ, with calycles. *b, b*. Modified pinnæ, with sarcothecæ, but without calycles, supporting reproductive capsules.





H. H. H. de.

Plumularians.

.V West & C^o sc

- FIG. 6. A single calycle of the same species, highly magnified. *a.* The cup in which the polypite is lodged. *b.* The anterior sarcotheca. *b'*. One of the bean-shaped thread-cells. *c.* One of the lateral sarcothecæ. *d.* The internode of the stem.
- „ 7. One of the lateral appendages of the *corbula* of *Aglaophenia myriophyllum*, Linnæus, magnified. *b.* Portion of the mid-rib. *p.* Short stem, bearing a single calycle (*c*). *a.* Curved appendage bearing sarcothecæ. *c'*. Second calycle.

PLATE CXI.

- FIG. 1. *Plumularia pinnata*, Linnæus, natural size.
- „ 2. *Plumularia cornucopiæ*, Hincks, natural size.
- „ 3. A portion of one of the plumes magnified. *c.* The calycle. *s.* The sarcotheca. *g, g.* Reproductive capsules.
- „ 4. One of the lateral sarcothecæ of *Aglaophenia p'uma*, Linn., showing the thread-cells in action, magnified. *a.* The upper lobe of the contained sarcoderm-mass (the sarcostyle, *s*) bearing the thread-cells. *b.* The lower lobe, from which the amœboid processes arise. *c.* The common flesh, from the outer layer of which the sarcostyle takes its origin. *d.* The chitinous case of the sarcotheca.
- „ 5. The two-chambered sarcotheca of *Plumularia setacea*, Ellis, showing one of the amœboid processes. *a.* The upper lobe with thread-cells. *b.* The extensile process. *x.* The terminal cup-shaped chamber in which the lobes are lodged. *y.* The inferior tubular chamber.
- „ 6. Portion of a pinna of *Ophionema parasiticum*, G. O. Sars, magnified, showing two of the snakelike organs, one above and one below the calycle. *a.* The small chitinous cup. *b.* The flexible and extensile trunk. *c.* The enlarged capitulum, containing thread-cells.

This figure is after G. O. Sars.