THE

VOYAGE OF H.M.S. CHALLENGER.

ZOOLOGY.

REPORT on the HYDROIDA dredged by H.M.S. Challenger during the years 1873–76. By Professor G. J. ALLMAN, M.D., LL.D., F.R.C.S.I., F.R.SS.L. & E., M.R.I.A., C.M.Z.S., &c.

PART I.—PLUMULARIDÆ.

INTRODUCTION.

In the descriptive zoology of the Plumularidæ a considerable amount of literature already exists. The British species have, in more recent times, been studied by several observers, and more especially by Hincks,[1] whose valuable History of the British Hydroid Zoophytes has greatly facilitated the labours of such zoologists as have since worked at species from other seas. Among the more important recent contributions to our knowledge of foreign forms must be mentioned the descriptions given by Busk,[2] of the species collected during the exploratory expedition of the "Rattlesnake"; the memoirs by Kirchenpauer,[3] in which a large number of new species contained in various continental collections has been described and figured; and that by G. Ossian Sars,[4] in which we find descriptions and figures of many new and interesting Plumularidæ from

[1] A History of the British Hydroid Zoophytes, by Thomas Hincks, London, Van Voorst, 1868.

[2] Narrative of the Voyage of H.M.S. "Rattlesnake," London, 1852. Account of the Polyzoa and Sertularian Zoophytes, by George Busk, Appendix, vol. i.

[3] Kirchenpauer, Ueber die Hydroidenfamilie Plumularidæ. *Abhandl. aus der Gebiete der Naturwiss. von dem naturwiss. Verein in Hamburg*, Bd. v., vi., 1872 and 1876.

[4] G. O. Sars, Bidrag til Kundskaben om Norges Hydroider. *Forhandl. Vidensk. Selsk. i Christinia*, Aar 1873.

the North Atlantic. Heller [1] has described several new Plumularidæ from the Adriatic. To Professor Millen Coughtrey,[2] of Otago, we owe descriptions of New Zealand species, and to Surgeon James Armstrong,[3] of the Indian Medical Department, descriptions of species collected by him on the eastern shores of India.

Besides the expedition of the Challenger, other recent exploratory expeditions have largely added to our knowledge of this group. The exploration of the Gulf Stream, by the United States Coast Survey,[4] has brought to light many new and beautiful forms, the voyages of the "Porcupine"[5] have made us acquainted with new species from the North Atlantic, and the explorations by the United States Coast Survey Steamer "Blake" in the Carribbean Sea and along the Atlantic Coast of the United States have brought to our knowledge the occurrence in those regions of a rich plumularian fauna, among which are several new and highly interesting forms.[6]

To the number of species thus determined and described the collection of hydroids brought home by the Challenger makes a large and valuable addition. Of this collection the family of the Plumularidæ forms a considerable proportion. Among these, four species, namely, *Acanthella effusa*, *Acanthocladium huxleyi*, *Aglaophenia macgillivrayi*, and *Lytocarpus longicornis* had been already described by Busk from the voyage of the "Rattlesnake," and one, namely, *Lytocarpus secundus*, by Kirchenpauer, from specimens brought home by Semper from the Pelew Islands. The Challenger also obtained from dredgings off Bermuda a species (*Aglaophenia ramosa*) already described in the Report on the Hydroida of the United States exploration of the Gulf Stream.

The only form which can be identified with a species occurring in the European seas is *Cladocarpus formosus*. This species was dredged by the "Porcupine" from the seas lying to the north of Scotland, and by the Challenger from the seas of Japan. The species is a well-marked one, and the great distance between the Atlantic and Pacific stations without any intermediate station having been discovered, is a remarkable and significant fact.

But by far the greater part of the Plumularidæ brought home by the Challenger consists of species new to science, while among these a considerable number must be assigned to

[1] Prof. C. Heller, Die Zoophyten und Echinodermen des adriatischen Meeres, Wien, 1868.

[2] Millen Coughtrey, Notes on the New Zealand Hyrdoida. *Journal of the New Zealand Institute*, vol. vii. 1874.

[3] Description of some new species of Hydroid Zoophytes from the Indian Coasts and Seas, by Surgeon James Armstrong, Marine Survey Department. *Journal of the Asiatic Society of Bengal*, vol. xlviii., 1879.

[4] Geo. J. Allman, Report on the Hydroida collected during the exploration of the Gulf Stream, by L. F. De Pourtalès, United States Coast Survey. *Mem. of Mus. Comp. Zool. at Harvard College*, vol. v., No. 2, 1877.

[5] Geo. J. Allman, Report on the Hydroida collected during the expeditions of H.M.S. "Porcupine." *Trans. Zool. Soc. Lond.*, 1873.

[6] Reports on the results of dredging under the supervision of Alexander Agassiz in the Caribbean Sea in 1878-79, and along the Atlantic Coast of the United States during the summer of 1880, by the U.S. Coast Survey Steamer "Blake," Commander J. R. Bartlett, U.S.N., commanding. Report on the Acalephæ by J. Walter Fewkes. *Bull. Mus. Comp. Zool. at Harvard College*, vol. viii. p. 127.

genera now specially constituted for their reception. Many are of great interest in the light they throw on the external morphology of the group, and in the aid which they afford towards a philosophic conception of the significance of parts otherwise enigmatical.

I believe, therefore, that the value of the collection will be enhanced, and its instructiveness made more available if the technical description of the species be preceded by a few introductory remarks on the general morphology of the Plumularidæ, more especially on such points as receive important illustration from the species described in the present Report.

General Morphology of the Plumularidæ.

The Plumularidæ constitute a very natural section of the Calyptoblastic Hydroids. Their hydrothecæ are always sessile, and are carried on one side only of the supporting ramulus. Nematophores of a definite form, and with a definite arrangement, are always present. The gonangia are either fully exposed and destitute of any special protective apparatus, or they are enclosed or otherwise protected by more or less modified portions of the hydrocaulus.[1]

The Plumularidæ admit of division into two primary sections, characterised by the condition of the nematophores. In one—the Eleutheroplea (Pls. I., II., &c.),—the nematophores are attached only by their proximal end, and in almost every case are to a certain extent moveable on their point of attachment. In a very few instances the moveable nematophores are associated with nematophores of the fixed type (Pl. VIII. figs. 1–3).

In another section—the Statoplea (Pls. XI., XII., XIII., &c.)—the nematophores are adnate to the chitinous periderm for a greater or less portion of their length, or are fixed by a base too wide to admit of movement on the surface of attachment. No nematophores of the moveable type ever occur in this section.

Each of these sections admits of a further division into two main groups—the Phylactocarpa (Pls. XI., XII., XIII., &c.),[2] in which the hydrocaulus has become modified so as to form a more or less complete protection for the gonangia, and the Gymnocarpa (Pls. II., III., IV., &c., and Pl. VIII. and Pl. XIX. figs. 1–3), in which no protective apparatus is present.

[1] For definitions of the terms here used see p. 17.

[2] The collection contains no example of the phylactocarpal Eleutheroplea. For our knowledge of the occurrence of phylactocarpal forms among the Eleutheroplean Plumularidæ, we are indebted to Mr. J. Walter Fewkes, who detected the presence of this condition in two Hydroids, *Hippurella annulata* and *Callicarpa gracilis*, obtained by the dredge of the U.S. Coast Survey Steamer "Blake." *Bull. Mus. Comp. Zool., loc. cit.*

In accordance with these differences, the great leading groups of the Plumularidæ may be systematically arranged as in the following scheme :—

PLUMULARIDÆ.

- Moveable nematophores always present, → ELEUTHEROPLEA.
  - Gonangia with special protective apparatus, → ELEUTHEROPLEA PHYLACTOCARPA.
  - Gonangia destitute of special protective apparatus, → ELEUTHEROPLEA GYMNOCARPA.
- Moveable nematophores never present, → STATOPLEA.
  - Gonangia with special protective apparatus, → STATOPLEA PHYLACTOCARPA.
  - Gonangia destitute of special protective apparatus, → STATOPLEA GYMNOCARPA.

The opportunities of examining the Hydroida in a living state, or even in dead specimens which have the soft parts sufficiently well preserved, are so comparatively few, that the systematist is compelled to have recourse to the chitinous periderm, as affording almost the only available grounds for determination and classification.

This chitinous external skeleton, however, presents so many points of high morphological interest, that the classification thus based upon it is by no means an arbitrary and artificial one.

A correct idea of the morphology of the chitinous skeleton in the Plumularidæ will be best obtained by comparing with one another the modifications of form which it presents when examined in the various parts of the colony or hydrophyton in the different groups.

Morphology of the Trophosome.

Hydrocaulus.—The hydrocaulus of the Plumularidæ, both in the Eleutheroplea and the Statoplea, may be formed either of a single tube (monosiphonic) or it may be fascicled or polysiphonic. The fascicled condition may exist in the main stem and in the principal branches, but the ultimate ramuli or hydrocladia are always monosiphonic. The polysiphonic condition gradually gives place to the monosiphonic in passing from the proximal to the distal parts of the colony, the fascicled stem sending off bundles of tubes to form the branches, and these again throwing off smaller bundles to form secondary branches, until finally, in the distal parts of the colony, the fasciculation has become exhausted, and a monosiphonic condition has taken its place.

The tubes which compose the fascicled portions of the hydrocaulus communicate laterally with one another. In *Aglaophenia coarctata* (Pl. XIX. figs. 7–9) this communication is plainly seen to be effected by very short tubular processes which are given off from

the component tubes, those of two juxtaposed tubes meeting one another and inosculating in such a way as to suggest the conjugation of a Zygnema (fig. 1).

Hydrothecæ.—In all the Plumularidæ hydrothecæ are borne on special ramuli, which are usually disposed in pinnæ, and for which the convenient term *hydrocladium*, as proposed by Kirchenpauer, may be adopted. In a few species (Pl. IV. figs. 3, 4) hydrothecæ are also carried directly by the stem.

In the Eleutheroplea the margin of the hydrotheca is, with, so far as I know, only one exception,[1] invariably destitute of all trace of serration. The peculiar ridge which I have termed the "intrathecal ridge," and which constitutes a characteristic feature in the Statoplea, is never present in the Eleutheroplea.

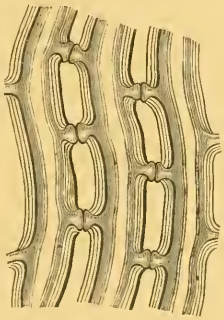


FIG. 1.—Longitudinal section of the polysiphonic stem of *Aglaophenia coarctata*, showing the lateral offsets through which the component tubes communicate with each other.

In the Statoplea the margin of the hydrotheca is in most instances deeply serrated (Pl. XI., &c.). In a few it presents only an indistinct crenation (Pl. XIV.), while in a few it is quite entire (Pl. XVII.). In almost every case there is present in the hydrotheca of the Statoplea a slightly projecting chitinous ridge (Pl. XI., &c.), which runs on the inner surface of the walls transversely from behind forwards, but with a more or less oblique direction, and which more or less completely encircles the cavity of the hydrotheca, thus forming an imperfect septum, which divides the hydrotheca into a proximal and a distal portion. This is the intrathecal ridge, which, as just said, is never present in the Eleutheroplea. In some species of Statoplea, what has the appearance of a similar ridge running from before backwards may be seen in the anterior portion of the hydrotheca (Pls. XV. and XVIII.). This, however, is only the optical expression of a fold in the walls of the hydrotheca.

[1] The exception here referred to is found in an Eleutheroplean Plumularidan not yet described. For an opportunity of examining it I am indebted to Miss Gatty. Among other very exceptional characters, the margin of the hydrotheca is here provided with a strong anterior mesial tooth, and with a strong lateral tooth on each side.

In one remarkable genus of Statoplea contained in the Challenger collection (*Diplocheilus* (Pl. VIII. figs. 4–7), the hydrotheca presents a double margin formed by the development of an external chitinous sheath round the upper third of the hydrotheca.

Nematophores.—The presence of nematophores, whether fixed or moveable, constitutes the most characteristic feature in the Plumularidæ. The nematophores are hollow chitinous bodies, more or less cup-shaped or tubular, and having their cavity in communication with that of various parts either of the trophosome or of the gonosome. Their contents consist of protoplasm, in which thread-cells are often immersed, and which has the faculty of emitting pseudopodial prolongations which often attain great development.

Those nematophores which belong to the fixed type are usually blunt spine-like bodies, with a continuous cavity and a terminal orifice, and with one or sometimes two lateral orifices. The terminal orifice is usually oblique or deeply emarginate.

The nematophores of the moveable type are more constant in form. They are funnel- or trumpet-shaped, and never provided with lateral orifices. They are mostly bi-thalamic, their cavity being divided into a proximal narrow chamber and a distal wide cup-shaped chamber, separated from one another by a transverse perforated septum. The distal chamber opens by a wide terminal orifice, which is usually deeply emarginate on one side.

Nematophores are either hydrocladial, hydrocauline, or gonosomal, according to the special part of the colony with which they are in immediate connection. An accurate knowledge of their arrangement and modifications will be best acquired by examining them separately in the two great Plumularian sections.[1]

[1] Bodies resembling the nematophores of the Plumularidæ have, however, been found in other Hydroids. Hincks (*loc. cit.*, p. 230, pls. i. iv. fig. 2) has constituted the genus *Ophiodes* for a remarkable Hydroid closely allied to *Halecium*, in which he had discovered certain singular bodies in the form of long cylindrical, very contractile tentacula-like appendages, each protected at its base by a small chitinous cup, through which it communicates with the cœnosarc of the colony, and terminating distally in a spherical capitulum, loaded with thread-cells. They occur here and there on the stem, at a slight distance below the hydrotheca, but are chiefly found scattered on the creeping stolon.

Bodies closely resembling these have been found by G. O. Sars (*loc. cit.*, p. 109, pl. iv. figs. 5–8) in a Hydroid which he refers to the genus *Ophiodes* of Hincks, under the name of *Ophiodes parasitica*. This determination is not accepted by Hincks, who proposes for Sars's Hydroid the new generic name of *Ophionema*, believing it to belong to the Plumularidæ instead of regarding it with Sars as a near ally of *Halecium*. Notwithstanding, however, the resemblance of Sars's figures to a Plumularian, it is plain to me that the affinities of his *Ophiodes parasitica* are really with *Halecium*, and that the Norwegian zoologist had a true conception of its nature when he referred it to Hincks's genus *Ophiodes*. The tentacula-like organs in *Ophiodes* would seem to take the place of the nematophores of the Eleutheroplean Plumularidæ. They appear, however, to stand on a much higher grade of development than true nematophores, and to have passed out of the condition of mere protoplasm into that of a multi-cellular organ. If this be so we should not be justified in assigning to both the same significance.

Belonging apparently to the same group of appendages are certain minute bodies which occur in *Oplorhiza parvula*, a little Hydroid allied to *Lafoëa*, obtained during the United States exploration of the Gulf Stream. They are here in the form of tubular receptacles, which are developed on the hydrorhizal network, and enclose a granular fleshy column, which supports a cluster of thread-cells (Hydroids of Gulf Stream, p. 14, pl. vii. figs. 1–3). In a nearly allied form, *Lafocina tenuis*, Sars, from the Norwegian seas, the hydrorhiza supports appendages which would seem to be essentially of the same kind (G. O. Sars, *loc. cit.*, p. 119, pl. v. figs. 1–5). Minute fleshy processes of doubtful significance have also

Nematophores in the Statoplea.

a. *Hydrocladial nematophores.*—These are arranged in two sets on every internode of the hydrocladium, and consist of an azygous or mesial nematophore and a pair of lateral nematophores. The mesial nematophore is in the form of a tubular process springing from a point of the hydrotheca-bearing internode immediately below the hydrotheca, to the front wall of which it becomes in almost every instance adnate for a greater or less extent of its length. In a very few cases the mesial nematophore of the Statoplean Plumularidæ, while fixed immovably by its base, remains free for the rest of its course, having no adhesion to the hydrotheca (Pl. XVI. figs 1–3). In a single instance (*Aglaophenia bispinosa* of the Gulf Stream Report[1]) a second mesial nematophore is developed in a longitudinal line behind the first.

The mesial nematophore communicates through its base with the cavity of the internode, just below the hydrotheca. In that portion of it which is adnate to the front of the hydrotheca it communicates by means of a longitudinal slit-like aperture with the cavity of the latter. It is always open at its distal extremity, where an aperture, usually very oblique, allows of the projection of its protoplasmic contents in the form of free pseudopodia. Besides the terminal and the longitudinal slit-like aperture there is also in many cases an aperture on its inner or hydrothecal side (Pl. XV.), just beyond the point where its distal portion becomes free from the walls of the hydrotheca. Occasionally an imperfect transverse septum exists in some part of its course (Pl. XX. figs. 4, 5).

The mesial nematophore is in a few cases adnate to the walls of the hydrotheca for its entire length. In most cases, however, its distal extremity is continued for some distance as a free process. This free distal portion of the mesial nematophore varies much in length. In *Aglaophenia* proper it is generally quite short, but in some other genera it attains a great length, being developed in the form of a long curved horn (Pl. XVIII.).

The lateral nematophores in the Statoplea are tubular, cup-shaped, or crescentic bodies, always two in number, situated symmetrically one on either side of the hydrotheca, nearly on a level with its orifice or thecostome. They spring from the hydrothecal internode with the cavity of which they communicate by their base. They terminate distally by

been described by G. O. Sars (*loc. cit.*, p. 112, pl. iv. fig. 10) as developed below the hydrothecæ in his *Halecium gorgonoide*.

Mr. Busk, in a letter which I have recently had from him, describes from a specimen in his collection but from an unknown locality a Hydroid whose affinities are with the Sertularidæ rather than with the Plumularidæ, and which yet carries on the front of every hydrotheca a small sessile nematophore-like body. Whether this is to be regarded as a true nematophore or not, can scarcely be asserted with confidence from the examination of a dried specimen. Its peculiar position, lying as it does on the front wall of the hydrotheca, without any apparently direct communication with the hydrocaulus, is certainly against placing it in the same category with the true nematophores. The Hydroid is also very exceptional in other respects, and Mr. Busk regards it as the type of a new genus, for which he proposes the name of *Greeneia*.

[1] Hydroids of the Gulf Stream, p. 46, pls. xxvii. xxviii.

an open orifice which is usually very oblique. In some very rare cases (Pl. VIII. figs. 4–7, and Pl. XIX. figs. 1–3) the lateral nematophores are absent.

In a singular and beautiful species (*Acanthocladium huxleyi*, Pl. IX.) contained in the Challenger collection, the hydrocladia become towards the dorsal extremities of the branches atrophied, lose their hydrothecæ, and are converted into spine-like appendages, which carry from base to apex two longitudinal alternate series of minute cup-shaped nematophores (Pl. XX. fig. 3).

b. *Cauline nematophores.*—These are usually small, cup-shaped bodies, situated on various parts of the hydrocaulus, with the cavity of which they communicate. They are generally disposed in linear series (Pl. XVII.) on the main stem and principal branches, and often form definite symmetrical groups of two at the points where the hydrocladia spring from the stem. Though quite different from the moveable nematophores of the Eleutheroplea,—being seated on a wide base which fixes them to the stem,—they would seem to be in many cases easily detached.

c. *Gonosomal nematophores.*—The system of nematophores attains in the gonosome of the Phylactocarpal Statoplea a remarkable development. The characteristic denticles which are found on the margins of the leaflets, which combine to form the walls of the corbula (Pls. XI. and XII.) in *Aglaophenia*, are only slightly modified nematophores. These denticles are tubular with a terminal orifice, and their cavity is in communication with that of the leaflet, while this opens into the common basal rachis of the corbula. In most cases a nematophore is specially developed at the base of each leaflet in the form of a spur. In one remarkable form (Pl. XX. fig. 6) branching chitinous ridges are developed on the walls of the corbula, and enclose cup-shaped nematophores in bifurcations of their branches.

But nematophores are largely developed not only in the corbula, but in the other forms of Phylactocarp, where they constitute a very characteristic feature. They occur in such cases along the branches of the Phylactocarp, or along the common basal rachis, and are usually present in the form of denticles or cup-shaped bodies, arranged in two opposite or alternate series. In *Lytocarpus spectabilis* (Pl. XV.) they are in the form of a pair of stout opposite spines on every internode of the phylactocarpal rachis, and are each provided with a terminal aperture and also with a lateral aperture close to the base (fig. 5). In *Lytocarpus racemifera* (Pl. XIII.) there is, in addition to the pair of opposite spine-like nematophores on each internode, an azygous spine on the front of the internode (figs. 4–6). A similar azygous spine-like nematophore is in *Lytocarpus spectabilis* carried by that internode of the rachis which supports a gonangium (fig. 2, p. 44).

Nematophores in the Eleutheroplea.

The nematophores here belong, in almost every instance, exclusively to the moveable type. In very rare cases (Pl. VIII. figs. 1–3) the moveable nematophore is associated with a fixed nematophore developed in other parts of the same colony.

a. *Hydrocladial nematophores.*—The hydrocladial nematophores in the Eleutheroplea are, as in the Statoplea, disposed in two sets—mesial and lateral. The mesial nematophore is never, as in the Statoplea, adnate to the front of the hydrotheca, and is almost always removed to a point at some distance from the hydrotheca at its proximal side. It is this azygous nematophore which in very rare cases differs from the others in being immovable. In one instance, that of *Schizotricha multifurcata* (Pl. VII. figs. 4, 5), the single mesial nematophore is replaced by a pair of nematophores, one on each side of the internode. In some cases an azygous nematophore is also found on the hydrothecal internode at the distal side of the hydrotheca, while in *Plumularia armata* (Pl. IV. figs. 3, 4) this part of the internode supports, instead of a single mesial nematophore, a pair of lateral nematophores.

In every case the hydrothecæ of the Eleutheroplea are flanked, as in the Statoplea, by a pair of lateral nematophores.[1] Each of these is usually borne on the summit of a hollow chitinous process, which springs from the internode at either side of the hydrotheca. The process varies much in length, and is sometimes obsolete.

The hydrocladia of the Eleutheroplea differ from those of the Statoplea in being very often provided with internodes which do not carry hydrothecæ (Pl. I. figs. 1–4). The internodes thus destitute of hydrothecæ carry nematophores which are either solitary or are disposed in a longitudinal series on the front of the internode.

b. *Cauline nematophores.*—These are borne, generally in considerable numbers, along the stem and branches, and are often disposed in pairs close to the points from which the ultimate ramuli or hydrocladia spring (Pl. V.).

c. *Gonosomal nematophores.*—When these are present in the gymnocarpal Eleutheroplea they spring from the gonangium, where they are usually disposed in a symmetrical pair on its proximal end, and are here in connection with the base of the blastostyle (Pl. IV. figs. 2, 6). In some cases they are connected with other parts of the blastostyle, which is then pushed out of the axis of the gonangium, and lies in contact with its wall (Pl. IV. fig. 4). In such cases the wall of the gonangium is perforated along the course of the blastostyle, and the contents of the nematophores, which are developed externally, communicate through the perforations with the blastostyle.

In another very remarkable form (*Sciurella indivisa*, Pl. V.) the blastostyle is extensively ramified, and the ends of the ramification impinge on definite points sym-

[1] In the rare cases in which these lateral nematophores are stated to be absent, I believe that they have either been overlooked in consequence of their minuteness, or have fallen away from their points of attachment.

metrically disposed on the walls of the gonangium. Over each of these points a nematophore is developed externally, while a perforation in the chitinous walls allows of the free communication of the contents of the nematophore with the subjacent branch of the blastostyle.

In the only two known species of phylactocarpal Eleutheroplea the nematophores are developed in abundance along the sides of the appendages, which combine to form the peculiar phylactocarps of these Hydroids.[1]

That the nematophores play a very important part in the economy of the Plumularidæ would appear from the fact of their early appearance and of their persistence. In the development of the trophosome they are in many cases, if not in all, the first zooids of the colony to make their appearance, preceding the hydranths and hydrothecæ; while, as we shall afterwards see, they remain behind in certain cases in which the hydranth and hydrotheca, which would normally belong to them, have become entirely suppressed.

I have endeavoured to show elsewhere[2] that their phylogenetic or palæontological significance is scarcely less important, for I believe we have good grounds for maintaining that the ancient graptolites represent hydroid organisms, in which the nematophores were the only zooids of the trophosome which had been developed.

Morphology of the Gonosome in the Phylactocarpal Plumularidæ.

The gonosome in the phylactocarpal forms of the Plumularidæ is full of interest, presenting as it does some significant morphological facts, and affording instructive examples of the extent to which variation of form may exist consistently with the retention of homological identity.

The term *phylactocarp* may be used as a sufficiently convenient general expression for the various forms under which the apparatus destined for the protection of the gonangia shows itself in the phylactocarpal Plumularidæ. This apparatus is referrible to one or other of two types: it consists either of one or more variously modified hydrocladia, or of a separate appendage to the hydrocladium quite distinct from the hydrocladium itself.

The commonest and longest known form of phylactocarp is the corbula of *Aglaophenia* (Pls. XI. and XII.). This consists of a peculiarly modified hydrocladium, which supports on each side a row of ribs or costæ in the form of flattened leaf-like appendages, and between these two rows a row of gonangia. The leaflets of each side arch over the gonangia, and enclose them in a basket-shaped receptacle. They are furnished with numerous short teeth-like nematophores on one or both edges, recalling somewhat the

[1] See J. W. Fewkes, *Bull. Mus. Comp. Zool., loc. cit.*

[2] Gymnoblastic Hydroids, p. 179.

serrated margin of a leaf, and they are here usually adnate to one another, so as to form a completely closed case (Pl. XI. fig. 4, and Pl. XII. figs. 4 and 8). In other instances they contract no adhesion by their edges, and the corbula is then open (Pl. XI. figs. 5 and 9).

That the corbula is a modified hydrocladium there can be no doubt. It takes exactly the place of a hydrocladium, while its proximal end is in the form of a short peduncle, which holds it to the stem, and which still retains the normal condition of the ramulus, and carries a scarcely modified hydrotheca. The floor or rachis of the corbula is a simple continuation of this peduncle, with the hydrothecæ entirely suppressed.

In determining the morphological significance of the corbula, the meaning of the costæ or leaflet-like ribs becomes an element of primary importance. Now the key to this will be found in certain other forms of the protective apparatus, and I believe we shall be justified in regarding the costæ as the greatly modified mesial nematophores of the suppressed hydrothecæ, complicated by the development on them of secondary nematophores, and thrown alternately to the right and left in accordance with their new protective function. This will become apparent after an examination of the phylactocarpal apparatus in other genera.

The form of phylactocarp referrible to the type found in the *Lytocarpus* (*Aglaophenia*) *myriophyllum* of the European coasts, affords the means of clearing up this point in a way which will scarcely admit of doubt. Two beautiful species, *Lytocarpus* (*Aglaophenia*) *distans*, and *Lytocarpus* (*Aglaophenia*) *bispinosa*, obtained during the exploration of the Gulf Stream by the United States Survey,[1] are especially significant in the light they throw on the morphology of the corbula, while another beautiful species, *Acanthocladium huxleyi*, occurring in the Challenger collection (Pl. X., and Pl. XX. fig. 1), is scarcely less instructive.

In all these, as well as in *Lytocarpus myriophyllum*, the phylactocarp is, as in the true corbula, an obviously modified hydrocladium. After retaining for some distance from its point of origin the normal character of the hydrocladium, and supporting one or more hydrothecæ, each with its usual mesial and lateral nematophores, it is continued in an altered form, and develops a double series of long ribs, which carry numerous small nematophores along one or both edges, remain quite distinct from one another, and form the walls of an open basket or cage (Pl. XX. fig. 1), along whose floor the gonangia are distributed from the proximal to the distal end. Now, in this continuation of the hydrocladium the hydrothecæ are not, as in the true corbula, suppressed. We find, on the contrary, that every rib carries a hydrotheca at its base, the rib with its basal hydrotheca being raised on a peduncle from the rachis or floor of the cage. The pair of lateral nematophores belonging to each of these hydrothecæ may be recognised in nearly its usual condition, while the mesial nematophore, though holding its normal position with

[1] Hydroids of the Gulf Stream, pp. 44 and 46, pl. xxvi. figs. 1-8, and pls. xxvii. and xxviii.

regard to the hydrotheca, becomes much elongated and transformed into the great protective rib.

The whole morphology of the corbula thus becomes beautifully distinct. We have only to complete the transformation by supposing the costal hydrothecæ, with their peduncle and lateral nematophores to become suppressed, and the ribs to become confluent by their edges, in order to convert the curious open cage of *Lytocarpus myriophyllum*, and of the Gulf Stream and Challenger Plumularians, into the ordinary closed Aglaophenian corbula.

In the two species of the Gulf Stream exploration (*Lytocarpus distans* and *Lytocarpus bispinosa*), the hydrocladium, which is to become transformed into a phylactocarp, retains its normal condition for a greater distance than in *Acanthocladium huxleyi* continuing to bear from three to five scarcely altered hydrothecæ before the change begins which results in the formation of a phylactocarp.

An intermediate condition will be found in those instances of an open corbula (*Aglaophenia filicula* and *Aglaophenia attenuata*, Pl. XI. figs. 5 and 9), in which, while the hydrothecæ as in the ordinary closed corbula become suppressed, the leaflets remain distinct from one another.

A very interesting and instructive form of phylactocarp is found in *Lytocarpus racemiferus* (Pl. XIII.). In this beautiful Plumularidan, the hydrocladia on each side for a certain length of the principal branches become, as in the other instances, modified so as to form protective supports for the gonangia (fig. 4). The modification here consists in the entire suppression of the hydrothecæ, while the mesial and lateral nematophores are retained in a scarcely altered form. The hydrothecal internodes also continue distinct, and the places of the suppressed hydrothecæ are taken by the gonangia, which are thus disposed in a single series, one on each internode, from the proximal towards the distal end of the rachis. Near the distal end, however, the suppressed hydrothecæ are not replaced by gonangia, though here, on every internode, we still find the three nematophores, the mesial and the two lateral, of the absent hydrotheca. In this form of phylactocarp there are no rib-like appendages; and the mesial nematophores, which in other forms become converted into ribs, here retain their normal condition.

In *Lytocarpus spectabilis* (Pl. XV.) we have another instructive example of a phylactocarp in which no ribs are developed. Here, as in the instances already cited, the phylactocarps take the places of hydrocladia, of which they are obvious modifications (fig. 4). The proximal internode carries a hydrotheca with its normal mesial and lateral nematophores, but in all the other internodes the hydrothecæ with their mesial nematophores are suppressed, while the lateral nematophores are retained as a pair of strong blunt spines.

In the specimen from which the figures on Pl. XV. had been drawn, no gonangia were developed on the phylactocarps. In another, however, a gonangium (fig. 2, p. 44)

was present on the second internode, which was here larger than the others, and carried a mesial as well as a pair of lateral nematophores; while the continuation of the rachis was arched over the gonangium, and had the persistent lateral nematophores of each internode curved backwards so as to be directed towards the convex side of the arch. It would seem to be only on the second internode that a gonangium is borne, and here it takes the place of the hydrotheca, which, had it not been suppressed, would have belonged to this internode, while the mesial and lateral nematophores are retained.

In *Lytocarpus saccarius*, a species from Ceylon,[1] the gonangia are borne near the distal extremity of short ramuli, which are hydrocladia in which the transformation has been less complete than in the cases described above. In the specimens examined these ramuli were composed each of three internodes. The proximal two internodes carried hydrothecæ in all respects like the other hydrothecæ of the colony, but in the distal internode the hydrotheca was suppressed, while its mesial and lateral nematophores remained with but little modification, and the solitary gonangium occupied the place of the suppressed hydrotheca.

In *Lytocarpus secundus* (Pl. XIV.) certain hydrocladia undergo a remarkable modification in order to become converted into phylactocarps. Their internodes, which are reduced to seven or eight in number, lose their hydrothecæ entirely, and carry each a long curved spine-like appendage, which is supported on the end of a short process of the internode, and bears a double row of cup-like nematophores, several nematophores of a similar form being sessile on the internode itself (fig. 5).

Though no gonangia were developed in the specimens examined, it will scarcely admit of doubt that the hydrocladia thus modified are true phylactocarps. Analogy would, perhaps, justify us in regarding the spine-like appendages as the mesial nematophores of the suppressed hydrothecæ, while the lateral nematophores have left no representatives. A comparison of these appendages with the costæ of a true corbula at once suggests itself, nothwithstanding their disposition in a continuous series along the mesial line of the rachis, instead of being thrown alternately to the right and left. In the absence of gonangia, however, the exact relations of the parts of the phylactocarp to the gonangia, which may yet become developed on it, cannot be ascertained with certainty.

In the only known forms of Eleutheroplea in which phylactocarps have been detected these structures appear to be in all essential points modified hydrocladia, a number of which combine to form the phylactocarp. In *Hippurella annulata*, as described by Fewkes, the hydrocladia lose their hydrothecæ, and assume a verticillate disposition, arching over the gonangia, which are borne by the stem near their bases. In *Callicarpa gracilis*, Fewkes, the hydrocladia undergo a similar modification, and, moreover, become dichotomously branched.[2] This dichotomous division of a hydrocladium is not without analogy,

[1] *Linn. Soc. Journ. Zool.*, vol. xii. p. 277, pl. xxii. The species is there referred to the genus *Halicornaria*.

[2] *Bull. Mus. Comp. Zool.*, *loc. cit.*, p. 134, pls. i., ii.

for it has its representative in the condition of the ordinary hydrocladia in the Eleutheroplean genus *Schizotricha* of the present Report.

In all the instances now described, the phylactocarps must, as we have seen, be regarded as more or less modified hydrocladia. To those which remain for consideration we must assign an entirely different significance, for we now find them to be variously formed appendages, which though specially developed as in the former for the protection of the gonangia, are superadded to the hydrocladia, which retain their normal form.

In *Cladocarpus pectiniferus* (Pl. XVII.) the phylactocarp is a bifurcating branch which springs from the proximal end of a hydrocladium, and supports the gonangia along its sides. It is destitute of hydrothecæ, and carries along its entire length a double series of opposite nematophores, which have assumed the form of long, spine-like processes, giving a pectinated character to the phylactocarpal branches. In *Cladocarpus formosus* of the Challenger and "Porcupine" expeditions (Pl. XVI. figs. 4 and 5), and in *Cladocarpus paradiseus*, *Cladocarpus dolichotheca*, and *Cladocarpus ventricosus*, of the Gulf Stream exploration, we find a branched phylactocarp essentially similar to that just described.

The morphological significance of the phylactocarp in *Cladocarpus* is not so obvious as in that of other Plumularidæ. In *Cladocarpus pectiniferus* (Pl. XVII. fig. 3), *Cladocarpus formosus* (Pl. XVI. fig. 5), and in some other species, the mesial nematophore of the hydrotheca, immediately behind which the phylactocarp springs, is entirely absent; and this fact, supported by the analogy afforded by other forms of phylactocarp, would lead us to regard the phylactocarp here as representing in a greatly modified form the mesial nematophore of the proximal hydrotheca—a view which is scarcely invalidated by the fact that it springs from a point not absolutely in the mesial line of the internode.

There are, however, other cases in which the mesial nematophore of the proximal hydrothecæ is still present, and then we may perhaps regard the phylactocarp as representing the mesial nematophore of a hydrotheca which had been itself totally suppressed—a view which is justified by the analogy of other forms of phylactocarp, to the formation of which, as we have seen, the greatly modified mesial nematophores of suppressed hydrothecæ largely contribute.

In *Pleurocarpa ramosa*, a remarkable Statoplean from St. Vincent, Mr. Fewkes describes the phylactocarp as composed of a series of ribs which take the places of hydrocladia near the proximal end of a branch, the hydrocladia towards its distal end remaining in their normal condition.[1] Though no gonangia appear to have been present in the specimen, there can be no doubt of the structure in question being a true phylactocarp; and then I should regard the ribs as representing the phylactocarpal appendages in *Cladocarpus* with the hydrocladia, which in this genus carry them suppressed. They are described by Mr. Fewkes as carrying along their length long tubular nematophores, and,

[1] *Bul. Mus. Comp. Zool.*, *loc. cit.*, p. 136, pl. iii. fig. 2.

were it not for their unbranched condition, they would closely resemble the phylactocarpal appendages of *Cladocarpus pectiniferus* of the present Report. I have here taken for granted that the entire structure is, as interpreted by Mr. Fewkes, a modified branch rather than a hydrocladium, though the fact which he mentions of its carrying along its proximal portion, which forms a kind of peduncle for the phylactocarp, a series of hydrothecæ presents a difficulty in the acceptance of this view. Mr. Fewkes does not give a magnified figure, and it is possible that what look like hydrothecæ are really only large cauline nematophores.

Ramification.

The Plumularidæ present considerable differences in the details of their ramification. What may be regarded as the typical ramification in both the great sections of the Plumularidæ shows itself in a simple or branched stem, from two opposite sides of which the ultimate ramuli or hydrocladia are given off. These ramuli are thus disposed in a regularly pinnate manner, and give to the colony the elegantly plumose aspect by which the designation of the typical genus has been suggested. In most species the pinnæ are alternate, but in a few, as in *Plumularia catharina*, for example, they are opposite.

In some rare cases the hydrocladia are confined to one side of the stem (*Monostæchas dichotoma* of the Gulf Stream exploration [1]). In *Streptocaulus pulcherrimus* of the Challenger (Pl. XVI. fig. 1), they are disposed in a continuous spiral along a simple stem. Here, however, the hydrocladia really spring from one side only of the stem, and then, by a revolution of the stem round its axis, the lower end remaining fixed, the hydrocladia are thrown into the beautiful spiral characteristic of the genus. In *Antennularia antennina* of the European seas the hydrocladia are disposed in regular verticils round the stem, while in other species of *Antennularia* (Pl. IV. figs. 5, 6), the verticillate arrangement gives place to a scattered one. In *Sciurella indivisa* (Pl. V.) they are in four longitudinal alternating series. In *Hippurella* [2] they are pinnately disposed on the proximal portion of the branches, but distributed on all sides towards the distal extremities. In *Antennella* no proper stem is developed, and the hydrocladia are borne directly by the hydrorhiza.

The main stem may be quite simple, or it may be more or less branched. In the latter case the ramification is usually irregular, but it is sometimes regularly dichotomous (*Monostæchas dichotoma*). In some cases, as in *Lytocarpus spectabilis* (Pl. XV.) and *Aglaophenia macgillivrayi* (Pl. X.), the stem gives off branches, which, though destitute of hydrothecæ, are disposed in perfectly regular pinnæ. These primary pinnæ give support to the true hydrotheca-bearing pinnæ, and the ramification thus becomes doubly

[1] Hydroids of the Gulf Stream, p. 37, pl. xxii. figs. 1–5.
[2] Hydroids of the Gulf Stream, p. 36, pl. xxi. figs. 7, 8.

pinnate. In such forms of ramification the primary pinnæ are almost always opposite, while the ultimate pinnæ or hydrocladia are alternate. Sometimes, however (Pl. XIX. fig. 4), the primary pinnæ are also alternate.

In some rare cases (Pl. I. fig. 5) the hydrothecæ-bearing pinnæ are themselves pinnately branched, the branches also carrying hydrothecæ, like the pinnæ from which they spring.

Definitions of the principal terms used in the descriptive morphology of the Hydroida

Hydrosoma.—The entire hydroid colony.

Ectoderm.—The most external of the three organised layers of which the body of every hydroid is composed.

Endoderm.—The most internal of the three organised layers of which the body of every hydroid is composed.

Mesoderm.—An organised layer which lies between the ectoderm and endoderm. The above are the three embryonic layers which are persistent, and admit of being recognised during the life of the hydroid.

Perisarc.—The unorganised chitinous excretion by which the soft parts are to a greater or less extent invested.

Zooids.—The more or less independent products of non-sexual reproduction, forming by their association the hydroid colony.

Trophosome.—The entire assemblage of such zooids as are destined for the nutrition of the colony.

Gonosome.—The entire assemblage of such zooids as are destined for the sexual reproduction of the colony.

Hydranths.—The proper nutritive zooids, or those which carry the mouth and proper digestive cavity and which are almost always furnished with tentacles.

Hydrothecæ.—The cup-like chitinous receptacles which protect the hydranths in the calyptoblastic genera.

Thecostome.—The external orifice of the hydrotheca, which permits of the extrusion and retraction of the hydranth.

Intrathecal Ridge.—An imperfect septum by which, in many Plumularidæ, the cavity of the hydrotheca is transversely divided into a proximal and a distal portion.

Hydrophyton.—The common basis of the hydrosoma by which its zooids are connected into a single colony.

Hydrorhiza.—The proximal end of the hydrophyton by which the colony fixes itself to other bodies.

Hydrocaulus.—All that portion of the hydrophyton which intervenes between the hydrorhiza and the hydrothecæ or hydranths. It usually consists of a main stem and

branches. It is *polysiphonic* or fascicled, when it is composed of several mutually adherent tubes; *monosiphonic* when consisting of a single tube. In some species the cavity of its perisarc is constricted at intervals by annular ridges or imperfect septa—*intracauline ridges*.

Hydrocladia.—The hydrotheca-bearing ramuli—almost always the ultimate ramuli—of the hydrocaulus in the Plumularidæ.

Rachis.—That portion of the hydrocladium which supports the hydrothecæ. That portion of the phylactocarp which supports the costæ or their equivalents.

Internode.—The part of the hydrocaulus which intervenes between any two consecutive joints.

Cœnosarc.—The common organised fleshy portion of the hydrophyton; the living bond by which the zooids are organically united to one another.

Nematophores.—Peculiar bodies developed in certain genera from definite points of the hydrosoma, and consisting of a chitinous receptacle with protoplasmic contents, in which thread-cells are usually immersed. They are eminently characteristic of the Plumularidæ.

Gonophore.—The ultimate generative zooid which gives origin directly to the generative elements—ova or spermatozoa.

Gonangium.—An external chitinous receptacle within which in the calyptoblastic genera the gonophores are developed.

Blastostyle.—An extension of the cœnosarc through the axis of the gonangium in the form of a fleshy column from whose sides the gonophores are developed as buds.

Acrocyst.—An external sac which in certain hydroids is formed on the summit of the gonangium, where it constitutes a receptacle into which the ova are discharged in order to pass within it through some of the earlier stages of their development.

Phylactocarp.—A part of the gonosome specially modified for the protection of the gonangia in certain genera (phylactocarpal) of the Plumularidæ.

Corbula.—A form of phylactocarp constituting a basket-shaped receptacle which encloses groups of gonangia in certain phylactocarpal Plumularidæ.

Costæ.—Rib-like appendages which form part of the protective arrangement in certain phylactocarps.

Gymnoblastic.—The condition of a hydroid when no external receptacle (hydrotheca or gonangium) invests either nutritive or generative buds.

Calyptoblastic.—The condition of a hydroid when an external protective receptacle (hydrotheca or gonangium) invests either the nutritive or generative buds.

DESCRIPTION OF GENERA AND SPECIES.

PLUMULARIDÆ.

Sub-family—ELEUTHEROPLEA.

Plumularia, Lamk. (in part).

Plumularia, Lamarck, Hist. Nat. des An. sans Vert., 1st ed., 1815.
Aglaophenia, Lamouroux, Hist. des Pol. Coral. flex., 1816.

Plumularia flabellum, n. sp. (Pl. I. figs. 1–4).

Trophosome.—Colony attaining a height of about five inches, stem springing from a dense mass of entangled filaments, much branched, branches pinnately disposed, main stem and principal branches strongly fascicled, hydrocladia alternate, averaging about three-tenths of an inch in length; hydrotheca-bearing internodes separated from one another by a single internode destitute of hydrotheca. Hydrotheca adnate by its entire height to its internode; hydrothecal internode carrying, besides the pair of lateral nematophores, a single mesial nematophore, which springs from a point at some distance below the hydrotheca; intervening internodes carrying a single mesial nematophore.

Gonosome not known.

Plumularia flabellum is a very beautiful Hydroid. Its primary branches, which are of unequal length, and given off at irregular distances, are pinnately disposed and set with hydrocladia, while many of the primary branches also send off pinnately-disposed ramuli, which, like the primary branches, are themselves destitute of hydrothecæ, but carry pinnately-disposed hydrocladia. Hydrocladia are also borne by the main stem in the intervals of the branches. The pinnate disposition of all the branches and ramuli, and the fact of their lying in one and the same plane, confer upon the colony the flabelliform habit which has suggested the specific name.

This fine species was dredged off Marion Island, 26th December 1873, from a depth of 50–75 fathoms.

Plumularia laxa, n. sp. (Pl. I. figs. 5, 6).

Trophosome.—Colony attaining a height of about four inches, stem much and irregularly branched, rooted by a dense mass of entangled filaments, main stem and principal

branches fascicled, hydrocladia springing from the branches at distant and irregular intervals, and being themselves set with rather distant, pinnately-disposed alternate hydrocladia. Hydrothecæ campanulate, every internode of the hydrocladia carrying a hydrotheca, which is adnate to the supporting internode for about two-thirds of its height; lateral nematophores very short, cup-shaped, not reaching the margin of the hydrotheca; mesial nematophores like the lateral in form, one borne by every internode at the proximal, and one at the distal side of the hydrotheca.

Gonosome not known.

Plumularia laxa is a very remarkable form, rendered striking by its somewhat diffuse habit, and by the doubly pinnate arrangement of its hydrotheca-bearing ramuli.

In this doubly pinnate condition of the hydrocladia we have a very exceptional character, for though it is not unusual among the Plumularidæ for the ultimate hydrothecal pinnæ to be borne by ramuli also pinnately disposed on the main stem or primary branches, such ramuli rarely carry hydrothecæ. The primary hydrocladia of the present species vary in length from about three-tenths to six-tenths of an inch; the secondary hydrocladia attain a nearly constant length of about two-tenths of an inch.

Dredged in Station 163, April 4, 1874, lat. 36° 56′ S., long. 150° 30′ E.; 120 fathoms.

Plumularia dolichotheca, n. sp. (Pl. I. figs. 7, 8).

Trophosome.—Colony attaining a height of about three inches, stem irregularly branched, monosiphonic, hydrocladia alternate, about two-tenths of an inch in length, divided into internodes of unequal length, each carrying one, two, or three hydrothecæ. Hydrothecæ deep, thimble-shaped, adnate to their internodes by their entire height, and with the lateral nematophores springing from a point close to the margin of the hydrotheca; mesial nematophore sub-calicine only, and found only below the proximal hydrotheca of the internode.

Gonosome not known.

Plumularia dolichotheca presents several very unusual characters. It is, with the exception of *Plumularia frutescens* of the European shores, the only Plumularian with which I am acquainted in which more than one hydrotheca is carried by one and the same internode. While in the present species some of the internodes of a hydrocladium carry as usual only one hydrotheca, others carry two, or even three. When two or more hydrothecæ are carried by a single internode, it is only the proximal hydrotheca which is subtended by a nematophore. This nematophore is supported on a small tubercle-like process of the internode, while the corresponding points below the more distal hydrothecæ show no trace of the tubercle, a fact which affords evidence that the absence of the nematophore is not due to its having been accidentally detached.

Under the name of *Plumularia cylindrica*, Kirchenpauer describes a species—also from

Zamboanga—which in the form of the hydrothecæ and in the general habit of the colony closely approaches *Plumularia dolichotheca*. It differs from it, however, in every internode of the hydrothecal pinnæ carrying only one hydrotheca, and in the opposite instead of alternate disposition of these pinnæ.

Plumularia dolichotheca was dredged off Zamboanga, Philippines, 30th January 1875, from a depth of 10 fathoms.

Plumularia insignis, n. sp. (Pl. II.).

Trophosome.—Colony attaining a height of about eighteen inches, main stem fascicled, sending off in all directions simple jointed branches, along whose entire length the hydrothecal pinnæ, about two-tenths of an inch in length, are alternately disposed. Hydrothecæ deep conical, adnate by their entire height to the supporting internodes, which are separated from one another by an intervening much shorter internode, destitute of hydrotheca; mesial nematophores situated one on the hydrothecal internode at the proximal side of the hydrotheca, and one on each of the intervening internodes.

Gonosome.—Gonangia situated on the hydrocladia-bearing branches, each at the base of a hydrocladium.

This very beautiful species is rendered especially striking by its large size and its plume-like ramification. The gonangia present in the specimen seem to be young, and to have scarcely yet attained their ultimate form. Several specimens of a little isopodous crustacean continued to adhere to the stem, and are represented in the drawing.

Station 145, December 27, 1873, lat. 46° 40′ S., long. 37° 50′ E.; depth, 310 and 150 fathoms.

Plumularia abietina, n. sp. (Pl. III.).

Trophosome.—Colony attaining a height of about nine inches, main stem fascicled for some distance from its root, and sending off scattered, usually simple jointed branches, which carry alternate hydrothecal pinnæ, rather less than two-tenths of an inch in length, and commencing from a point at some distance from the origin of the branch. Hydrothecæ deep conical, adnate by their entire height to the supporting internodes, which are separated from one another by an intervening much shorter internode, destitute of hydrotheca; a single mesial nematophore, borne by the hydrothecal internode at the proximal side of the hydrotheca, and another on each of the intervening internodes.

Gonosome.—Gonangia ovate, borne by the hydrocladia-bearing branches, each close to the origin of a hydrocladium.

The Hydroid here described comes very near to *Plumularia insignis*; indeed, so nearly related are the two forms, that we should almost be justified in regarding the difference between them as merely varietal.

Plumularia insignis, however, is altogether a larger and much more robust form, while the hydrocladia are longer and occupy a greater length of their supporting branches, extending from the distal extremity of these nearly to the base. In *Plumularia abietina*, on the other hand, a considerable portion of the branch towards its proximal end is destitute of hydrocladia.

The specimen had numerous individuals of an Avicula-like fry adhering to it, a feature which has been reproduced in the drawing.

Dredged off Prince Edward's Island, from a depth of 150 fathoms (?).

Plumularia stylifera, n. sp. (Pl. IV. figs. 1, 2).

Trophosome.—Colony attaining a height of about an inch and a half, stem simple monosiphonic, hydrocladia alternate, about one-tenth of an inch in length, and with the hydrotheca-bearing internodes usually separated by an intervening internode which does not carry a hydrotheca. Hydrothecæ rather large, adnate only by their base to the supporting internode, flanked on each side by a long slender process, which springs from the internode and carries a lateral nematophore on its summit; a single mesial nematophore borne by the hydrothecal internode at the proximal side of the hydrotheca, and another by the intervening internode.

Gonosome.—Gonangia springing from the hydrothecal internodes at the proximal side of the hydrotheca, ellipsoidal, with a truncated summit which opens by a lid, and with a pair of nematophores carried near its proximal end.

The great length of the process which supports the lateral nematophore on each side of the hydrotheca presents a striking feature. The present species, however, is not the only one in which this process attains a considerable length. It is nearly as long in the European *Plumularia catharina* and in other species closely allied to the latter, as well as in *Antennularia fascicularis* of the present Report.

Plumularia stylifera has many points of affinity with *Plumularia catharina*, which it resembles not only in the long style-like process which supports the lateral nematophore, but in the presence of a pair of nematophores on the proximal end of the gonangium, and in the general form of the hydrothecæ and their supporting pinnæ. Indeed, it differs from it mainly in its more delicate habit and shorter and more approximated hydrocladia, which are disposed alternately on the stem instead of being opposite, as in *Plumularia catharina*.

Dredged off Nightingale Island, Tristan d'Acunha, Station 135, from a depth of 100–150 fathoms.

Plumularia armata, n. sp. (Pl. IV. figs. 3, 4).

Trophosome.—Colony attaining a height of about two inches; stem monosiphonic irregularly and sparingly branched, divided into internodes, each of which carries a hydro-

theca; hydrocladia alternate, rather more than one-tenth of an inch in length, arising one from every internode of the stem close to the base of a hydrotheca. Hydrothecæ deep, conical in front view, cylindrical in profile, adnate by somewhat more than half their height to the supporting internode, flanked on either side by a short tooth-like process, which carries a long lateral nematophore; a single mesial nematophore borne by the hydrothecal internode at the proximal side of the hydrotheca, and another at its distal side in the hydrocladia, while in the stem the single mesial nematophore is replaced in the distal portion of each internode by a pair of lateral nematophores.

Gonosome.—Female gonangia borne along the stem, each springing by a very short peduncle from a point opposite to the origin of a hydrocladium, large, ovate with truncated summit, carrying from base to summit along one side a single linear series of nematophores.

Male gonangia developed in the same colony with the female, and borne exclusively by the internodes of the hydrocladia, springing by a short peduncle from the internode at the proximal side of its hydrotheca, very much smaller than the female, crescentic in form, destitute of nematophores, and with rounded summit curved towards the supporting internode.

Plumularia armata is a small and delicate Hydroid. The condition of the gonosome is very exceptional. The nematophores, which are developed on the outside of the female gonangium, constitute in themselves a very unusual and striking feature. These extend in a continuous series along the course of the blastostyle, with which they communicate through perforations in the chitinous walls of the gonangium. In order to allow of this communication, the blastostyle is thrown out of the axis of the gonangium, and lies against the inner surface of its walls, immediately under the series of nematophores.

In *Sciurella indivisa* of the present Report we also find the gonangium carrying numerous nematophores. Here, however, the nematophores are not arranged in a single series, but form symmetrically disposed groups.

Striking, however, as is the development of gonangial nematophores in these instances, it is only an extreme case of what occurs in several other Eleutheroplean Plumularidæ, as in *Plumularia catharina* and allied species, and in *Antennularia fasciculatis*, and the two species of *Schizotricha* described in the present Report. In all these a pair of nematophores is developed from the base of the gonangium, and there communicates with the proximal end of the blastostyle.

Another very exceptional, though by no means unique character, is found in the presence of both male and female gonangia in the same colony. These differ not only in form but in situation. The large ovate female gonangia, with their series of parietal nematophores, are borne exclusively on the stem, which, like the hydrocladia, is composed of a series of hydrotheca-bearing internodes, while the very much smaller crescentic male gonangia are confined to the hydrocladia.

Notwithstanding the many exceptional characters of this curious Plumularian, I believe it will be better to keep it in the genus *Plumularia*, rather than construct for it a new one.

Under the name of *Plumularia obconica*, Kirchenpauer describes a Plumularian from the Gulf of St. Vincent, Australia, which in many respects resembles the present species. Its female gonangium carries, as in this, on the outer surface of its walls, a longitudinal series of nematophores. Like *Plumularia armata*, also, the species is monœcious, carrying male and female gonangia in the same colony, while the main stem is divided into internodes, each carrying a hydrotheca, as in *Plumularia armata*. It differs, however, from *Plumularia armata* in its shallower hydrotheca, with plicated margin, and in the conical roof of its female gonangium, while the stem is unbranched, and carries the hydrocladia in such a way as to give them an obviously secund disposition. Kirchenpauer, moreover, describes the nematophores of the trophosome as monothalamic, those of the gonosome being of the usual bithalamic type. In *Plumularia armata* both sets of nematophores are bithalamic.

The collection contains but a single specimen of *Plumularia armata*. It was dredged at Station 163A, off Port Jackson; depth, 30–35 fathoms; bottom, red clay.

Antennularia, Lamk.

Antennularia, Lamarck, Hist. Nat. des An. sans Vert., 1st ed., 1815.
Nemertesia, Lamouroux, Hist. des Pol. Coral. flex., 1816.

Antennularia fascicularis, n. sp. (Pl. IV. figs. 5, 6).

Trophosome.—Colony attaining a height of upwards of three inches; stem thick, sub-dichotomously branched, formed of a multitude of coalesced tubes, which give off on all sides irregularly scattered hydrocladia, which carry the hydrothecæ on alternate internodes, and are about two-tenths of an inch in length. Hydrothecæ rather large, campanuliform, adnate by their base only to the supporting internode, flanked on each side by a long style-like process, which supports on its summit a lateral nematophore; one mesial nematophore carried by the hydrothecal internode near its proximal end, and three by the intervening internode.

Gonosome.—Gonangia springing laterally from the hydrothecal internodes each at the proximal side of a hydrotheca, obovate, supported on a short stalk and carrying a pair of nematophores close to its proximal end.

A more extended comparison of *Antennularia antennina* of our own shores, in which the hydrocladia are verticillate, with those forms in which they are more or less scattered, has led me to regard this difference as of less systematic importance than I had formerly believed, and has induced me to assign to it a specific rather than a generic value. When,

therefore, no other difference of greater importance exists, I believe it will be best to follow the earlier systematists, and combine all such forms under a single genus, of which the well-known *Antennularia antennina* may be taken as the type.

The hydrocladia of *Antennularia fascicularis* spring from the outer tubes of the polysiphonic stem, each hydrocladium being supported on a short process from the tube, and having at its proximal end two short internodes followed by a long one, all three destitute of hydrothecæ. In the deep hydrothecæ, *Antennularia fascicularis* further contrasts with the typical *Antennulariæ*, whose small shallow hydrothecæ are, as a rule, characteristic of the genus; while the position of the gonangia on the hydrothecal internodes, instead of being borne in the axils of the hydrocladia, affords another distinctive feature.

The proximal end of the specimen in the collection had been broken off, so that nothing can be asserted with exactness regarding the height attainable by the colony or the characters of the hydrorhiza.

Antennularia fascicularis is wanting in the graceful habit by which most of the Plumularidæ are characterised, the thick strongly fascicled stem, and the irregularity of the fine hair-like ramuli, giving it a somewhat inelegant habit, which contrasts with the lightness and grace of most other species.

Dredged off Nightingale Island, Tristan d'Acunha, from a depth of 100–150 fathoms.

Sciurella, nov. gen.

Name, a diminutive noun formed from *Sciurus*, a squirrel, in allusion to the squirrel-tail-like disposition of the hydrocladia.

Generic Character. *Trophosome.*—Hydrocladia not disposed in pinnæ, but springing from many points round the circumference of chord-like stems.

Gonosome.—Gonangia situated in the axils of the hydrocladia, provided with symmetrically disposed horn-like processes, and enclosing a ramified blastostyle, whose branches are in connection with movable nematophores distributed over the surface of the gonangium.

The species on which the genus *Sciurella* has been founded has the general aspect of *Antennularia antennina*. From this, however, it differs not only in the disposition of the hydrotheca-bearing ramuli, but in the much more important character presented by the remarkable gonangia with their ramified blastostyle, their horn-like processes, and the nematophores carried on their walls. These nematophores belong to the ordinary movable type, and communicate through perforations in the walls of the gonangium with the prolongations of the ramified blastostyle.

Sciurella indivisa, n. sp. (Pl. V.).

Trophosome.—Colony attaining a height of ten inches; stem simple, monosiphonic, springing in clusters from the hydrorhiza; hydrocladia closely set, about two-tenths of an inch in length, arranged in four longitudinal alternating series, which extend from the summit of the stems to within a short distance of the base. Hydrothecæ deep, nearly cylindrical, adnate by their entire height to the supporting internode, every internode of the hydrocladium carrying a hydrotheca, and having, in addition to the lateral nematophores, a single mesial nematophore near its proximal end.

Gonosome.—Gonangia in pairs from the axils of the hydrocladia, urn-shaped in front view, with two symmetrically placed hollow lateral processes near the distal end; gonangial nematophores carried by the lateral processes, by the summit of the gonangium, and by its sides near the base.

As already stated (*see* p. 22), I am not disposed to regard a scattered or multiserial disposition of the hydrocladia as affording sufficient grounds for generic separation from those forms of *Antennularia* in which the hydrocladia are verticillate. While, however, the disposition of the hydrocladia in *Sciurella indivisa* would thus not in itself afford a character by which this species could be generically separated from *Antennularia*, such a character is found in the remarkable form of the gonangia, with their branching blastostyle and the nematophores to which their walls give support.

The general resemblance of *Sciurella indivisa* to *Antennularia antennina* is so close, that, without the aid of a lens, a specimen of one of these hydroids might be easily mistaken for the other. The gonangium, though urn-shaped when viewed in front, is compressed laterally, and when viewed in profile is seen to have its axis curved backwards nearly in a semicircle.

The ramification of the blastostyle in the gonangium presents considerable symmetry, and was similar in every instance examined. A strong branch is sent off on each side into the lateral projections, and each of these branches sends out three short processes and one long one, which all pass directly to the perforations in the walls of the gonangium, in order to communicate with the corresponding nematophores which lie free on the outer surface of the walls. The short processes pass to nematophores which lie near the distal end of the gonangium, while the long processes pass down, one on each side, to communicate with two nematophores situated near the base of the gonangium.

The deep hydrothecæ of *Sciurella indivisa* contrast with the small shallow hydrothecæ by which most species of *Antennularia* are characterised.

Dredged off Somerset Island Cape York, Torres Strait; 5–10 fathoms.

Acanthella, nov. gen.

Name, a diminutive noun formed from ἄκανθα, a thorn, in allusion to the spine-bearing terminations of the branches.

Generic Character. *Trophosome.*—Hydrocladia pinnately disposed; hydrocladia-bearing branches terminating in simple jointed prolongations in which the places of the hydrocladia are taken by spine-like appendages.

Gonosome not known.

The genus *Acanthella*, so far as regards its trophosome, represents among the Eleutheroplean section of the Plumularidæ the genus *Acanthocladium* of the Statoplea. The peculiar terminations of the branches are essentially the same in both, and the lateral spines which these support are in both cases the morphological equivalents of hydrocladia. No part of the gonosome was present in the specimens of the only species referrible to *Acanthella*.

Acanthella effusa, Busk, sp. (Pl. VI.).

Plumularia effusa, Busk, Voyage of the "Rattlesnake," 1852, vol. i. p. 400.

Trophosome.—Colony attaining a height of twelve inches; main stem springing from a dense mass of entangled filaments, monosiphonic, giving off a multitude of scattered subdivided branches, which carry the hydrocladia, every subdivision ending in a spine-like continuation which is composed of numerous internodes, each internode supporting two or more stout blunt spines; hydrocladia one-tenth of an inch in length. Hydrothecæ pitcher-shaped, with entire margin, adnate by their whole height to the rachis; mesial nematophore single, springing from a point close to the base of the hydrotheca, lateral nematophores springing from points close to its margin; hydrocladial internodes separated from one another by a very well-marked joint, and each carrying a hydrotheca.

Gonosome not known.

Acanthella effusa is a remarkable and beautiful species, and, like *Acanthocladium* affords in the curious terminations of its branches an example of the extent to which the hydrocladia may be modified, and yet allow of the recognition of their homological significance.

A very obvious transition may be traced from the simple spines, which occur towards the distal extremity of the branch, backwards into the true hydrotheca-bearing ramuli. In fact some of the posterior or more proximal spines still carry near the base a single hydrotheca, with its mesial and lateral nematophores. These spines are also borne on the summit of a thick process from the internode, while the more distal spines are not only quite destitute of hydrothecæ, but are directly confluent by their base with the internodes which carry them. In the angle between these more distal spines and the sup-

porting internode, two small nematophores of the ordinary Eleutheroplean type are developed.

The close proximity of the mesial nematophore to the base of the hydrotheca, as seen in the present species, is also a very unusual feature in the Eleutheroplea.

Kirchenpauer[1] describes and figures a Plumularian brought by von Martens from the Philippine Islands. He refers it to the *Plumularia effusa* of Busk, a species obtained in Torres Strait during the exploratory voyage of the "Rattlesnake."[2] In the form of the hydrothecæ, and of their supporting pinnæ, and in the form and arrangement of the nematophores, the species figured by Kirchenpauer agrees closely with that here described. No notice, however, is taken of the series of spine-bearing internodes in which the branches of *Acanthella* terminate. Specimens of the present species from the collection of the Challenger have been examined by Mr. Busk, and referred by him to the *Plumularia effusa* of the voyage of the "Rattlesnake," and an opportunity he has given me of comparing the Challenger Hydroid with authentic specimens of his *Plumularia effusa*, has convinced me of the justice of this identification.

Acanthella effusa was dredged off Cape York, Torres Strait, and also from reefs off Zamboanga, at a depth of 10 fathoms.

Schizotricha, nov. gen.

Name from σχίζω, to divide, and θρὶξ, a hair, in allusion to the bifurcation of the hydrocladia.

Generic Character. *Trophosome.*—Hydrocladia pinnately disposed, once, twice, or oftener bifurcating.

Gonosome—Gonangia springing from the hydrocladia.

The genus *Schizotricha* is essentially characterised by the bifurcation of its hydrotheca-bearing ramuli. The collection contains two species, in one of which the ramuli bifurcate only once, while in the other, three, four, or probably a greater number of bifurcations are present.

Schizotricha unifurcata, n. sp. (Pl. VII. figs. 1–3).

Trophosome.—Colony attaining a height of about five inches; stem irregularly branched, fascicled, rooted by a dense mass of entangled filaments; hydrocladia alternate, about seven-tenths of an inch in length, dividing each into two similar branches at a short distance from its origin. Hydrothecæ with even margin, rather deep, adnate to the supporting internode by their entire height; besides the pair of lateral nematophores, there is a single mesial nematophore carried by the internode near its proximal end; a hydrotheca without nematophores carried in the angle of the bifurcation.

[1] Kirchenpauer, *loc. cit.*, Band vi.

[2] Voyage of "Rattlesnake," vol. i. p. 400.

Gonosome.—Gonangia carried by each branch of the hydrocladia near to the bifurcation, pyriform, supported on a short peduncle, and with a basal segment which carries a pair of laterally placed nematophores.

This fine species forms wide flabelliform tufts with rather rigid stems, and with the hydrocladia nearly an inch in length. The hydrocladia are each supported on a short process of the stem; to this is articulated the first segment of the hydrocladium; this segment is very short, is destitute of hydrotheca, and is immediately followed by a long segment in which the bifurcation takes place, and which carries in the angle of bifurcation a hydrotheca without nematophores. One branch of the bifurcation always commences by a short internode destitute of hydrotheca; every other internode of the branches carries a hydrotheca.

Besides the form here described, there occurs also a variety (see fig. 3), in which the hydrothecal ramuli scarcely exceed half the length attained by these ramuli in the typical form.

The typical form was dredged in Christmas Harbour, Kerguelen, from a depth of 100 fathoms. The variety with short hydrocladia was dredged also off Kerguelen Island, from a depth of 10 to 60 fathoms.

Schizotricha multifurcata, n. sp. (Pl. VII. figs. 4, 5).

Trophosome.—Colony attaining a height of about nine inches; stem sparingly branched, fascicled, rooted by a mass of entangled filaments; hydrocladia alternate, attaining about four-tenths of an inch in length, bifurcating three, four, or a greater number of times. Hydrothecæ with even margin adnate to the internode by their entire height, flanked by a pair of lateral nematophores, and also subtended by a similar pair of nematophores on the same internode, a hydrotheca without nematophores carried in the angle of every bifurcation.

Gonosome.—Gonangia carried by the internodes of the hydrocladia, each springing from a point situated laterally, and just below a hydrotheca, pyriform, supported on a very short peduncle, and having a wide basal segment which carries a pair of nematophores.

This is a very graceful species, with flexile stems much longer and less profusely branched, and with shorter hydrocladia than in *Schizotricha unifurcata*. A remarkable feature in the specimen examined consisted in the hydrothecal internodes, carrying at the proximal side of the hydrotheca a pair of laterally situated nematophores, instead of the azygous mesial nematophore usual in the Eleutheroplean Plumularidæ. The gonangia also, besides the two nematophores which were always present on its basal segment, often carried here a third one. This fact, however, scarcely seems to be constant.

In every bifurcation one of the branches is connected with the internode from which it springs, by a short internode destitute of hydrotheca, but carrying a pair of nematophores.

Here, as in *Schizotricha unifurcata*, the first bifurcation takes place in the second segment of the hydrocladium, this segment carrying a hydrotheca without nematophores in the angle of the bifurcation, and being preceded by a very short segment destitute of hydrotheca.

Dredged at Station 151, February 7, 1874, off Heard Island; depth, 75 fathoms; bottom, mud.

Polyplumaria, G. O. Sars.

Polyplumaria, G. O. Sars, Forhandl. Vidensk. Selsk. i. Christiania, 1873.
Diplopteron, Allman, Trans. Zool. Soc. Lond., 1873.

Generic Character. *Trophosome.*—Hydrocladia each with an accessory hydrotheca, bearing ramulus, which springs from its proximal internode.

Gonosome.—Gonangia borne by the basal segment of the primary pinnæ.

In a report on the Hydroids collected during the expeditions of H.M.S. "Porcupine," read at a meeting of the Zoological Society of London in February 1873, I described as a new genus and species, under the name of *Diplopteron insigne*, a very beautiful Plumularian dredged off the north-west coast of Spain, from a depth of 364 fathoms, during one of these expeditions.[1]

G. O. Sars had, however, in the same month, but a few days earlier, described under the generic name of *Polyplumaria*, a Hydroid from the Norwegian Seas, which I believe must be generically associated with the Hydroid of the "Porcupine."[2] The priority of description thus lies with Sars, and though he does not appear to me to have seized on the essential characters of the genus, the name *Diplopteron* must sink into a mere synonym of *Polyplumaria*.

I have here modified the diagnosis of *Diplopteron* as originally given, a diagnosis which, founded as it was on a single species, was too exclusive to admit forms which ought not to be generically separated. In the three species of which the genus *Polyplumaria* now consists, the most striking feature is the accessory ramulus, to which the hydrothecal pinnæ give origin. This ramulus springs from every hydrothecal pinna near to its origin, and is itself composed of internodes which carry hydrothecæ similar to those of the pinna from which it springs.

Sars, it is true, does not describe the accessory ramulus as constant, but as it was never wanting in any of the specimens examined by me, being, on the contrary, always very characteristic, I cannot but regard its absence from some of the branches in Sar's specimens as accidental.

[1] Report on the Hydroids collected during the expeditions of H.M.S. "Porcupine." *Trans. Zool. Soc. Lond.*, vol. viii. p. 8.

[2] G. O. Sars, Bidrag til Kundskaben om Norges Hydroida. *Forhandl. Vidensk. Selsk. i. Christiania*, 1873.

Polyplumaria pumila, n. sp. (Pl. IV. figs. 7, 8).

Trophosome.—Colony attaining a height of one or possibly two inches; stem strongly fascicled and giving off opposite pinnæ, which do not carry hydrothecæ, and are also fascicled; hydrocladia alternate, scarcely exceeding one-twentieth of an inch in length, borne on the main stem and primary pinnæ, each giving off its accessory ramulus from a point close to the base of the proximal hydrotheca; hydrothecal internodes continuous. Hydrothecæ cylindrical, rather distant, adnate only by their base to the rachis, and with the internodes which support them carrying besides the lateral nematophores a single mesial nematophore at the proximal, and another at the distal side of the hydrotheca.

Gonosome.—Gonangia pyriform, with obliquely truncated summit.

The specimens were fragmentary, and did not afford sufficient evidence of the size attained by the perfect colony; but it is probable that it reaches a height of between one and two inches. It is thus a very much smaller, and altogether more delicate species than the *Diplopteron insigne* of the "Porcupine," which attains a height of about six inches.

The accessory ramuli carry one, two, or three (possibly in some cases more) hydrothecæ, and have a rather long proximal internode, which is always destitute of hydrotheca.

I was unable to find in the present species the second pair of minute lateral nematophores which in *Polyplumaria* (*Diplopteron*) *insignis* is developed at the distal side of the hydrotheca. *Polyplumaria pumila* is further distinguished from *Polyplumaria insignis* by the more cylindrical form of the hydrothecæ, which do not present the slightly everted margin which gives a somewhat campanulate form to the hydrothecæ of *Polyplumaria insignis*. All the known species are doubly pinnate.

The gonangium is borne on a short cylindrical peduncle, and has a truncated summit and a short transverse segment at its very much contracted base.

All the species as yet discovered are inhabitants of the deeper sea zones.

Dredged at Station 75, July 2, 1873; lat. 38° 37′ N., long. 28° 30′ W.; depth, 450 fathoms; bottom, sand.

Heteroplon, nov. gen.

Name, from ἕτερος, dissimilar, and ὅπλον, a weapon, in allusion to the presence of two different kinds of nematophores.

Generic Character. *Trophosome.*—Hydrocladia pinnate; hydrothecal internode with the lateral nematophores moveable, and with a mesial fixed spine-like nematophore below the hydrotheca.

Gonosome not known.

The genus *Heteroplon* combines the characters of the Eleutheroplean with those of the Statoplean Plumularidæ. The hydrothecæ are flanked each by a pair of moveable nematophores of precisely the same kind as in the typical Eleutheroplea, while the mesial

nematophore which lies below the hydrotheca is fixed, and resembles that of the ordinary Statoplean genera in all respects, except in the fact of its being quite detached from the hydrotheca, and in the presence of an imperfect septum close to its distal extremity, thus showing a tendency to the bithalamic form of the Eleutheroplean nematophore.

In all other important points the species on which the genus *Heteroplon* has been founded presents the essential features of the Eleutheroplea, with which, notwithstanding the presence of a fixed nematophore, it must be associated.

Heteroplon pluma, n. sp. (Pl. VIII. figs. 1–3).

Trophosome.—Colony attaining a height of about four inches; stems sparingly branched monosiphonic, springing in groups from a creeping stolon; hydrocladia about one-fourth of an inch in length, carrying a hydrotheca on every internode, a hydrotheca also carried by the stem close to the origin of every hydrocladium, stem with groups of two or three short internodes at irregular intervals. Hydrothecæ with entire margin, adnate to the rachis by about three-fourths of their height; lateral nematophores borne each on a short process of the hydrothecal internode; hydrothecal internode also carrying a single moveable nematophore at the distal side of the hydrotheca; mesial fixed nematophore close to the proximal end of the internode, in the form of a short, blunt, somewhat curved spine, with an oblique terminal orifice.

The hydrothecal pinnæ of the present species are closely set along the stem, and the general habit of the colony is more that of an *Aglaophenia* than of a *Plumularia*—a feature which is not without interest when viewed in connection with the presence of the fixed nematophore. Notwithstanding, however, the presence of a fixed nematophore, and the Aglaophenia-like habit of the species, the whole assemblage of characters is so decidedly that of the Eleutheroplean Plumularidæ, that there need be no hesitation in assigning it to this group.

The specimen was dredged at Station 162, April 2, 1874, off East Moncœur Island, Bass Strait, from a depth of 38 to 40 fathoms; bottom, sandy.

Sub-family—Statoplea.

Section—Phylactocarpa.

Acanthocladium, nov. gen.

Name from ἄκανθα, a thorn, and κλάδος, branch, in allusion to the spiny terminations of the branches.

Generic Character. *Trophosome.*—Distal portion of branches destitute of hydrocladia, whose places are taken by a long, spine-like appendage on each internode.

Gonosome.—Phylactocarp replacing a hydrocladium, and consisting of a rachis with

two series of pinnately-disposed, alternate, free ribs, each rib carrying near its base a hydrotheca. Gonangia springing from the rachis.

The remarkable mode in which the branches of *Acanthocladium* terminate, recalls the very similar condition presented by the genus *Acanthella*; but while *Acanthocladium* is a Statoplean form, *Acanthella* belongs to the Eleutheroplea. The gonosome of *Acanthella* is unknown, but the specimens of *Acanthocladium huxleyi* the only species of the genus as yet discovered, are, on the contrary, abundantly provided with this important element of the colony. The phylactocarp of *Acanthocladium* belongs to the same type as that of the *Aglaophenia distans* and *Aglaophenia bispinosa* of the Gulf Stream Report,[1] every rib carrying, as in these last, near its base a modified hydrotheca. The distal portion of the rib is in all these cases the greatly modified mesial nematophore of this hydrotheca, while the proximal portion is a peduncle which springs from the rachis and supports the modified hydrotheca and its appendages. (*See* p. 11).

Acanthocladium huxleyi, Busk, sp. (Pls. IX. and XX. figs. 1–3).

Plumularia huxleyi, Busk, Voyage of the "Rattlesnake," vol. i. p. 395, 1852.

Trophosome.—Colony attaining a height of fifteen inches; stem fascicled, springing from a dense cushion of fine entangled tubes, undulated, giving off pinnately-disposed alternate simple branches about two inches in length, which carry the hydrocladia and terminate each in a jointed prolongation which is composed of numerous (twelve to sixteen) internodes, every internode carrying a slightly curved spine, which is supported on the extremity of a short process from alternate sides of the internode, and carries two rows of small cup-shaped nematophores; hydrocladia alternate, short, about one-tenth of an inch in length. Hydrothecæ approximated, wide and rather shallow, with an anterior parietal fold and a very short intrathecal ridge; orifice of hydrotheca with its plane parallel to the axis of the short internode, margin crenate; mesial nematophore adnate to the entire height of the hydrotheca wall, and then continued as a long, free, curved spine which arches over the orifice of the hydrotheca; lateral nematophores short, crescentic.

Gonosome.—Phylactocarps developed in a continuous series on each side of the branches near their middle, every series having the unmodified hydrocladia at its proximal and usually also at its distal side; costæ of phylactocarp twenty-six to thirty in number springing alternately from the sides of the rachis, over which they arch, each carrying a double row of cup-shaped nematophores, and at about one-third of its length from the base, a single small deep hydrotheca. Gonangia ovoid, springing from the rachis, each close to the origin of a costa.

The long flexile undulating stem and simple plume-like branches of *Acanthocladium*

[1] Allman, Report on the Hydroida collected during the exploration of the Gulf Stream, by L. F. De Pourtalès, United States Coast Survey, 1877, p. 44, pl. xxvi. figs. 1–8, and p. 46, pls. xxvii., xxviii.

huxleyi confer upon this beautiful species an aspect which in gracefulness is perhaps not surpassed by any other Plumularian.

The hydrothecæ are remarkable from the way in which the orifice lies in a plane parallel to the axis of the supporting internode, instead of being, as in most cases, nearly at right angles to it. The internodes are very short, and the hydrothecæ are consequently brought unusually near to one another. The deep serration of the hydrotheca margin usual in the Statoplean section, here gives place to a shallow crenation, and the very long curved continuation of the mesial nematophore beyond the orifice contributes still further to the singular aspect of the hydrotheca. In the front of the hydrotheca is a strong parietal fold, having some resemblance to an anterior intrathecal ridge, while the true intrathecal ridge is nearly obsolete.

The stem and branches, notwithstanding their slenderness, are polysiphonic, the accessory tubes ceasing a little before the distal termination of the branches, which then become monosiphonic for the remainder of their course.

The gonophore can be seen through the walls of the gonangium to be encircled just below its summit by a wreath of refringent spherules, similar to those to which Kirchenpauer first drew attention in the gonophore of his macrorhynchial section of *Aglaophenia*. He believed them to be confined to this group, and incorrectly regarded them as ova.[1]

The phylactocarps are for the most part longer than the hydrocladia, and with the symmetrical arrangement of their parts are objects of great beauty, while they are full of interest in the evidence they afford of the extent to which various parts of an organism may become modified in order to fit them for a change of function.[2]

Mr. Busk has identified the present species with the *Plumularia huxleyi* of the voyage of the "Rattlesnake,"[3] and a comparison of the Challenger Hydroid with authentic specimens from the collection made during that voyage, has enabled me to confirm this determination.

Dredged at Station 188, September 10, 1874, lat. 9° 59′ S., long. 139° 42′ E.; depth, 28 fathoms; bottom, mud. Also at Station 190, September 12, 1874, lat. 8° 56′ S., long. 136° 5′ E.; depth, 49 fathoms; bottom temperature 23°·9 C; bottom, mud.

Aglaophenia, Lamouroux (in part).

Plumularia, Lamarck, Hist. Nat. des An. sans Vert., 1815.
Aglaophenia, Lamouroux, Hist. des Pol. Coral. flex., 1816.

Aglaophenia macgillivrayi, Busk, sp. (Pls. X. and XX. figs. 4–6).

Plumularia macgillivrayi, Busk, Voyage of the "Rattlesnake," vol. i. p. 400, 1852.

Trophosome.—Colony attaining a height of upwards of fifteen inches; stem fascicled,

[1] Kirchenpauer, *loc. cit.*, Band v., Ueber die Hydroidenfamilie Plumulariдæ, p. 16.
[2] See general remarks on the morphology of the Phylactocarp, p. 10.
[3] Busk, Voyage of the "Rattlesnake," vol. i. p. 395.

sending off closely-set opposite primary pinnæ, which are destitute of hydrothecæ, but carry from end to end the proper hydrotheca-bearing pinnæ, which are about one-tenth of an inch in length, alternately disposed, and borne also by the main stem in the intervals of the primary pinnæ. Hydrothecæ closely approximated, rather deep, with a well-marked intrathecal ridge, margin entire, sigmoidally curved; mesial nematophore adnate by its whole length to the hydrotheca, with its sides parallel in profile, diverging from below upwards in front view, its distal end terminating close to the margin of the hydrotheca by a wide orifice, a short distance behind which is a transverse septum-like fold; lateral nematophores wide, overtopping the hydrotheca; hydrothecal internode with strong obliquely-directed intra-cauline ridges.

Gonosome.—Costæ of phylactocarp intimately fused together, so as to form a long nearly cylindrical, completely closed corbula, whose sides support seven or eight transverse series of slightly elevated ramified ridges, with every branch supporting a wide cup-shaped nematophore, and with a strong spur-like nematophore at the base of each series.

Aglaophenia macgillivrayi presents many features in which it differs from the typical *Aglaopheniæ*. Its doubly pinnate ramification affords in itself a character which contrasts markedly with the ramification of nearly all the other known species. This character shows itself in the thick, strongly-fascicled stem being closely set with opposite pinnæ, which are themselves destitute of hydrothecæ, but give support to the proper hydrocladia, which are disposed in alternate pinnæ from end to end of the opposite or primary pinnæ. Here and there the primary pinnæ become developed into long branches, which then repeat in all respects the ramification of the stem. The absence of true serration in the margin of the hydrotheca, and the bithalamic condition conferred on the mesial nematophore by the presence of an imperfect septum, are other important points in which *Aglaophenia macgillivrayi* differs from the typical *Aglaopheniæ*; while in the corbula, with its parietal ramifying ridges, we find a still further distinctive feature.

A comparison of the Plumularidan here described with authentic specimens of *Plumularia macgillivrayi*, Busk, brought home by the "Rattlesnake,"[1] establishes the identity of the "Rattlesnake" species with that of the Challenger. Kirchenpauer places it in his special section or sub-genus of *Aglaophenia*, to which he gives the name of *Pachyrhynchia*, and which he bases on the supposed excessive width of the mesial nematophore, believing the nematophore to surpass in this respect the hydrotheca to which it belongs.[2] I am unable, however, to accept this character as a ground for the establishment of a distinct group, more especially as its reality is not borne out by an examination of well-preserved specimens, and Kirchenpauer's figures seem to have been made from specimens whose bad state of preservation rendered them deceptive. The mesial

[1] Voyage of H.M.S. "Rattlesnake," vol. i. p. 400.

[2] Kirchenpauer, *loc. cit.*, p. 20.

nematophore of *Aglaophenia macgillivrayi*, though large, is very far from attaining the width of the hydrotheca to which it is attached, and does not, either in size or form, depart so much from the normal condition as to justify us in assuming it as the ground on which to base a distinct section of the phylactocarpal *Plumularidæ* (*Aglaophenia* of Kirchenpauer in its widest sense); and the remaining small number of species which Kirchenpauer places in his *Pachyrhynchia* do not seem to afford any stronger grounds than *Aglaophenia macgillivrayi* for the creation of a separate systematic group. In the long corbula, with its closely adnate costæ and parietal ridges, and in the even margin of the hydrotheca, more important differences may perhaps be recognised, but still nothing to demand a separation from the other members of the genus.

A closely allied if not identical form—the *Aglaophenia cupressina* of Lamouroux, has been identified by Kirchenpauer with a Plumularian brought by Semper from the Pelew Islands, where, according to Semper, it is known by a vernacular name suggested by its stinging properties. Another of the Challenger species (*Lytocarpus secundus*, see below, p. 42), likewise brought by Semper from the Pelew Islands, would seem, according to the report of it given by this zoologist to Kirchenpauer, to be also one of those Hydroids whose formidable stinging powers cause it to be dreaded by the natives.

Aglaophenia macgillivrayi attains a size greater than that of any other *Aglaophenia* with which I am acquainted. Though the specimen from which the drawing has been made had lost a portion of its proximal end, what remains of the colony measures in height fifteen inches.

Dredged at Zamboanga, Philippines, 30th January 1875, from a depth of 10 fathoms.

Aglaophenia filicula, n. sp. (Pl. XI. figs. 1–6).

Trophosome.—Colony attaining a height of about three inches; stem monosiphonic, simple, rooted by a creeping tubular fibre; hydrocladia about one-fourth of an inch in length, alternate. Hydrothecæ deep, thimble-shaped, margin serrated, with the median tooth slightly longer than the lateral teeth; intrathecal ridge near the base of the hydrotheca, extending obliquely forwards and upwards; mesial nematophore adnate to the walls of the hydrotheca for about three-fourths of their height, and then becoming free as a beak-like process which scarcely overtops the margin; lateral nematophores tubular, overtopping the margin of the hydrotheca.

Gonosome.—Corbulæ somewhat crescentic, with about seven pairs of costæ, which are adnate to one another by their edges, with a row of tubular denticles at the lines of junction, and with a spur-like denticle at the proximal end of each row; a single free costa with dentated edges at the proximal end of the corbula.

Other corbulæ having the costæ all free occur in the same colony.

The simple stems of *Aglaophenia filicula* spring from the creeping hydrorhiza, in

groups of closely approximated plumes. The mesial nematophore is provided with an imperfect septum near its distal extremity. The most remarkable fact, however, connected with the species is the occurrence of two different forms of corbula—a closed and an open—in the same colony. The closed corbula is rather short, and with its rachis so curved as to give it a somewhat crescentic form, with the concavity looking downwards. The curvature of the open corbula is less marked. In the open form the costæ are entirely distinct from one another; they are oval in outline, each margin set with tubular denticles, and every costa having a tubular spur-like denticle at its base. On the proximal margin of every costa in the open corbula, and close to its origin, is a slit-like aperture which leads into its cavity.

I am unable to assign a meaning to the presence of two different kinds of corbula in one and the same colony, and I do not know of a similar occurrence in any other species. That the two kinds of corbula are not different stages in the development of a single form would appear from their similarity in size, and the apparently mature condition of both, with their thick chitinous periderm; nor is it likely that at the time of maturity the closed corbula had become converted into the very differently formed open one by a process of dehiscence. Though in none of the open corbulæ could I find gonangia, it is yet possible that the difference may indicate a difference of sex. It is also possible that the open form may be an abnormal and imperfect condition of the corbula, not essential to the species, or universally occurring in it. With this uncertainty I have deemed it better not to include the presence of two forms of corbula as an essential character in the diagnosis of the species.

Aglaophenia filicula is an inhabitant of the deeper sea zones, having been dredged along with *Aglaophenia acacia*, at Station 75, July 2, 1873, lat. 38° 37′ N., long. 28° 30′ W.; depth, 450 fathoms; bottom, sandy.

Aglaophenia attenuata, n. sp. (Pl. XI. figs. 7–9).

Trophosome.—Colony attaining a height of about two inches; stem slender, monosiphonic, slightly and irregularly branched; hydrocladia very short, scarcely exceeding one-twentieth of an inch in length, alternate. Hydrothecæ closely approximate, deep, margin deeply dentate, with the mesial tooth bifid, anterior wall depressed just below the margin; intrathecal ridge well marked, extending transversely across the hydrotheca, at the junction of the lower and middle third of its walls; mesial nematophore stout, adnate to the walls of the hydrotheca for somewhat more than half their height, and then extending as a short, thick, free beak, which does not reach the margin of the hydrotheca; lateral nematophores stout, reaching the level of the hydrotheca margin.

Gonosome.—Corbula open, with about seven pairs of costæ, which are quite distinct from one another, and carry a row of tubular denticles on each margin; rachis with a spur-like denticle at the base of each costa.

Aglaophenia attenuata is a small and delicate species. The anterior bifid tooth of the hydrotheca and the open corbula afford good diagnostic characters. The spur-like nematophores at the base of the costæ are well developed.

A comparison of the open corbula of *Aglaophenia attenuata* with the proper Lytocarpal phylactocarp, as, for example, that of *Lytocarpus myriophyllum*, or of *Lytocarpus racemiferus*, and *Acanthocladium huxleyi* of the present Report will show that the mere fact of the costæ not being adnate by their edges affords no sufficient ground for generic separation from *Aglaophenia*, more especially as in one species at least (*Aglaophenia filicula*, see p. 36) closed and open corbulæ are borne by the same colony; in *Aglaophenia*, however, the costæ of the corbula, whether open or closed, are always more or less in the form of flat serrated leaflets, without hydrothecæ or other appendages; while in such open forms of phylactocarp as occur in the genera *Lytocarpus* and *Acanthocladium* the costæ are either long, curved, rod-like or sabre-shaped appendages, each carrying a hydrotheca, or are in the form of a series of strong spines without hydrothecæ, or are simply replaced by a series of large nematophores.

Dredged in Simon's Bay, Cape of Good Hope; depth, 10–20 fathoms.

Aglaophenia acacia, n. sp. (Pl. XII. figs. 1–4).

Trophosome.—Colony attaining a height of about six inches; stem monosiphonic, pinnately branched, branches opposite or sub-opposite, rather distant, carrying the hydrocladia, which are about two-tenths of an inch in length, and are also borne by the main stem in the intervals of the branches. Hydrothecæ deep, with deeply serrated margin. intrathecal ridge very short, situated just above the fundus of the hydrotheca; mesial nematophore adnate to the wall of the hydrotheca for about one-half their height, and then terminating as a free short spine which does not reach the level of the hydrotheca margin; lateral nematophores stout, slightly overtopping the margin.

Gonosome.—Corbulæ rather short and deep, with about six pairs of closely adnate costæ.

The habit of *Aglaophenia acacia* is somewhat loose and spreading. The main stems continue unbranched for four or five inches from the root, and then give off opposite or nearly opposite branches, which confer on the species a very distinctive aspect. The disposition of the primary branches is truly pinnate, while these again carry the pinnately disposed hydrocladia. The ramification is thus properly bipinnate, though the distances between the primary branches and between the hydrothecal ramuli give to it an aspect very different from that of *Aglaophenia macgillivrayi*, and of other bipinnate *Plumularidæ* with their closely approximated branches and hydrocladia.

Aglaophenia acacia is a deep-water species, having been dredged along with *Aglaophenia filicula*, at Station 75, July 2, 1873, lat. 38° 37′ N., long. 28° 30′ W.; depth, 450 fathoms; bottom, sandy.

Aglaophenia calamus, n. sp. (Pl. XII. figs. 5–8).

Trophosome.—Colony attaining a height of about five inches; stem monosiphonic, simple, or with a few branches springing from its anterior aspect; hydrocladia rather close, about two-tenths of an inch in length. Hydrothecæ with the margin deeply serrated; intrathecal ridge short, near the floor of the hydrotheca; mesial nematophore adnate to the walls of the hydrotheca for about half their height, and then continued as a short spur-like process, which does not reach the level of the hydrotheca margin; lateral nematophores somewhat flask-shaped, slightly overtopping the margin.

Gonosome.—Corbula rather long, cylindrical, with about seven pairs of adnate costæ, each costa carrying four or five tubular denticles, and with a spur-like denticle at its base.

Aglaophenia calamus shows no divergence from the typical *Aglaopheniæ*. It is a species with rather close-set hydrocladia, and with a tendency to send off short branches from the anterior side of the plume.

Dredged off Bahia, from a depth of 10 to 20 fathoms.

Aglaophenia coarctata, n. sp. (Pl. XIX. figs. 7–9).

Trophosome.—Hydrophyton attaining a height of upwards of six inches; stem fascicled, sending off alternate rather distant branches, along which the hydrocladia are disposed in alternate pinnæ, which scarcely attain a length of two-tenths of an inch. Hydrothecæ closely approximated, deep, with the margin crenate, and with a prominent tooth in front; mesial nematophore strong, adnate to the hydrotheca walls for about two-thirds of the height of the walls, and thence continued as a short free process, which does not reach the level of the hydrotheca margin, and with a wide emarginate orifice; lateral nematophores thick, tubular, not overtopping the hydrotheca.

Gonosome not known.

The hydrothecæ of the present species are so closely approximated that the lower end of each is included in the orifice of that which lies at its proximal end. They are unusually deep, and the margin, instead of presenting the ordinary dentate condition, is merely crenate, with an anterior mesial point in the form of a sharp tooth. The branches which support the hydrocladia are divided by oblique joints into a series of wedge-shaped internodes, each internode sending off a single hydrocladium. The main stem is strongly fascicled, and the nature of the communication between its component tubes may be easily seen. These communicate with one another by very short lateral offsets, each tube emitting numerous such offsets, whose ends meet those of corresponding offsets from the neighbouring tubes (fig. 1, p. 5).

No part of the gonosome was present in the specimen, and there is perhaps no better reason for assigning it to *Aglaophenia* than to other genera of Statoplean *Plumularidæ*.

Aglaophenia, however, being the longest-established and the largest of the Statoplean genera, may, in the absence of any strong reason to the contrary, be made to receive it until the discovery of the gonosome shall decide its true generic allocation.

The specimen is fragmentary, the hydrorhizal extremity being absent.

Dredged off Zamboanga, Philippines, January 30, 1875, from a depth of 10 fathoms.

Lytocarpus, Kirchenpauer.

Aglaophenia (section *Lytocarpia*), Kirchenpauer, Abhandl. aus dem Gebiete der Naturwiss. von dem naturwiss. Verein in Hamburg, Band v. 1872.

Generic Character. *Trophosome.*—Stem doubly or singly pinnate. Hydrothecæ with serrated or undulated margin, and with the mesial nematophore opening externally by one or two orifices.

Gonosome.—Phylactocarps always open, consisting of modified hydrocladia which never form corbulæ.

Kirchenpauer has given the name of *Lytocarpia* to a group of phylactocarpal Plumularidæ, which he regards as a subordinate section or sub-genus of *Aglaophenia*, while he takes as a type of the section the *Aglaophenia myriophyllum*, Linn.[1] The forms thus separated possess very definite characters, and I believe it will be better to regard them as constituting a true genus of equal value with *Aglaophenia*. As such I have here united a number of Challenger species, which I believe may be properly associated with those brought together by Kirchenpauer in his section *Lytocarpia*. I have found it, however, necessary to modify, to a certain extent, Kirchenpauer's definition, and have changed the termination of the name so as to bring it more into accordance with the usual form of generic designations.

The *Plumularidæ* belonging to the genus *Lytocarpus*, while their trophosomes rarely differ from those of the *Aglaopheniæ*, have very differently formed gonosomes. In both *Aglaophenia* and *Lytocarpus* the phylactocarp is a modified hydrocladium. In *Aglaophenia* the modification results in the formation of two series of flat leaflets, which almost always become intimately united by their edges, so as to form a closed corbula in which the gonangia are included, or, if not actually united, still lie so close to one another that the corbula thus produced forms a sort of cage in which the gonangia are contained exactly as in the closed form. In *Lytocarpus*, on the other hand, true corbulæ do not occur, and the leaflets of the latter are replaced by more or less cylindrical or sabre-shaped or spine-like appendages, which are never united to one another so as to form a closed chamber.

[1] Kirchenpauer, *loc. cit.*, p. 20.

Lytocarpus racemiferus, n. sp. (Pl. XIII.).

Trophosome.—Colony attaining the height of about twelve inches; stem fascicled, much and irregularly branched, main branches all directed towards one side of the stem; hydrocladia alternate, scarcely exceeding one-tenth of an inch in length. Hydrothecæ rather deep, margin serrated, teeth blunt; intrathecal ridge well marked, situated near the fundus of the hydrotheca; mesial nematophore adnate to the walls of the hydrotheca for nearly their entire height, and then continued as a short, blunt beak, which scarcely overtops the hydrotheca and has both a terminal and a lateral orifice; lateral nematophores slightly overtopping the hydrotheca.

Gonosome.—Phylactocarps in the form of long racemes, laden with gonangia, springing from certain branches of the trophosome at points near the origin of the branches from the stem, and there taking the places of the proximal four or six hydrocladia, consisting of a series of internodes having every internode provided with one median and two lateral spines, each of the proximal five to eight internodes carrying also an ovate pedunculated gonangium.

Lytocarpus racemiferus is an exceedingly beautiful species. The direction of the principal branches from one side only of the main stem give it a habit not usual among the *Plumularidæ*. The phylactocarps, with their pedunculated gonangia, form elegant racemes, grouped near the proximal ends of the branches, where they replace the hydrocladia of this part of the branch. Towards its distal end the branch carries the ordinary unmodified hydrocladia, which are continued to its extremity.

The phylactocarps are, in the present species, of much morphological significance, and must be viewed as hydrocladia modified by the suppression of the hydrothecæ, whose places are taken towards the proximal end of the phylactocarp by the gonangia, and whose mesial and lateral nematophores have undergone but little change, and are represented by the three spines carried by each internode. These spines retain their essential character as nematophores, and are each provided with a terminal oblique orifice. Several of the more distal internodes are destitute of gonangia and carry only the spines.

The gonangia are supported on rather long peduncles, which spring from between the bases of the two lateral spines, and are subtended by the mesial spine. The gonophore occupies the centre of the gonangium, from whose walls it is separated by a clear space, across which may be seen a wreath of highly refringent spherules, by which the summit of the gonophore is encircled. The sex could not be determined with certainty.

Dredged off Bahia. Depth 10–20 fathoms.

Lytocarpus secundus, Kirchen. (Pl. XIV.).

Aglaophenia (section *Lytocarpia*) *secunda*, Kirchenpauer, Abhandl. aus dem Gebiete der Naturwiss. von dem naturwiss. Verein in Hamburg, Band v. 1872.

Trophosome.—Colony attaining a height of more than two and a half feet; main stem fascicled, rooted by an entangled mass of fibres, and emitting, along nearly its entire length, short branches which carry the hydrocladia, and which, though regularly disposed in alternate pinnæ, are all directed towards the same side of the stem; hydrocladia about two-tenths of an inch in length. Hydrothecæ rather deep, with crenate margin; hydrothecal ridge short and broad, situated near the base of the hydrotheca; mesial nematophore adnate to the hydrotheca walls for about two-thirds of the height of the walls, and terminating as a short, free, blunt spine, which does not reach the level of the hydrotheca margin; lateral nematophores thick, spout-shaped processes not overtopping the hydrotheca.

Gonosome.—Phylactocarps replacing the hydrocladia at short intervals along the hydrocladia-bearing branches, each consisting of a jointed rachis, supporting on every alternate internode a long curved spine, which carries from its base to its apex a double series of wide cup-shaped nematophores, similar nematophores being also borne by the rachis.

No gonangia were present in the specimens.

Lytocarpus secundus is a remarkable and beautiful Hydroid, rendered very striking by its large size, and by its regularly disposed primary branches. These are each about two inches in length, and though at their origin given off as pinnæ from opposite sides of the stem, become all directed towards one side, thus giving a secund character to the ramification. In some of the larger specimens a few branches are given off irregularly towards the base of the stem.

Another very striking feature is found in the curious comb-like phylactocarps. These are shorter than the hydrocladia, generally about half their length, and their rachis, like that of the hydrocladia, consists of a consecutive series of nearly equal internodes, which in the phylactocarp are about eighteen or twenty in number. From the same side of every alternate internode there is sent off a short thick process which supports the long slightly curved spine, the spines thus carried in a single series along the rachis giving to the phylactocarp its resemblance to a comb. Large regularly disposed cup-shaped nematophores are arranged from the base to the apex of the spine in two alternate or sub-opposite series. The spine is itself hollow, with a terminal orifice. Nematophores entirely similar to those of the spine are scattered over the rachis.

Though no gonangia were developed in the specimens, I take it for granted that the comb-like organs are true phylactocarps. The spine-like appendages (the teeth of the comb) are probably the representatives of the mesial nematophores of suppressed hydrothecæ.

In all the specimens examined the phylactocarps were enveloped in a glairy mass, insoluble in boiling water, but completely soluble in a solution of caustic potash. I have no doubt of this being the remains of the protoplasmic contents of the nematophores, and that in the living state it had been emitted as pseudopodial outflows from the cup-shaped nematophores here so largely developed.

I believe that the present species must be identified with the *Aglaophenia* (*Lytocarpia*) *secunda* of Kirchenpauer,[1] though in some points, especially in the form of the hydrotheca and of the comb-like phylactocarps, it can scarcely be brought into complete accordance with Kirchenpauer's figures. Kirchenpauer's specimens were obtained in the South Sea, the China Sea, and the Pelew Islands. From the last-named locality they were brought by Semper, who, according to Kirchenpauer, regarded the species as one of those so much dreaded by the natives on account of its stinging properties.

The limits of the plate would not allow a figure to be given of more than a portion of the entire Hydroid. The Challenger collection contains a specimen which is more than two and a half feet in length.

Dredged off Zamboanga, Philippines, 30th January 1875, from a depth of 10 fathoms.

Lytocarpus spectabilis, n. sp. (Pl. XV.).

Trophosome.—Colony attaining a height of five inches; main stem strongly fascicled sub-dichotomously branched, the branches closely set with opposite primary pinnæ, which are fascicled at their origin, and destitute of hydrothecæ, but which carry the alternately disposed hydrocladial pinnæ; hydrocladia about one-tenth of an inch in length, borne also by the main stem in the intervals of the primary pinnæ. Hydrothecæ wide, with undulated margin, an anterior parietal fold, and a very short intrathecal ridge; mesial nematophore thick, adnate to the hydrotheca walls for somewhat more than half their height, and then continued as a strong, free, spine-like process, which slightly overtops the hydrotheca margin, and has a lateral as well as a terminal aperture; lateral nematophores spine-like, conical, overtopping the hydrotheca.

Gonosome.—Phylactocarps given off at intervals among the hydrocladia, each replacing a hydrocladium, and consisting of a jointed rachis composed of some eight or nine internodes, the proximal internode carrying an ordinary hydrotheca, and each of the following internodes sending off two opposite, strong, conical spine-like processes, each with a terminal and a lateral orifice. Gonangium nearly sessile, borne by the modified second internode of the rachis.

Lytocarpus spectabilis is a beautiful bipinnate form, and presents in its details several features of interest. The margin of the hydrotheca, instead of presenting the serrated condition usual among the phylactocarpal *Plumularidæ*, is merely sinuous, while the

[1] Kirchenpauer, *loc. cit.*, p. 35, pls. i.–iii. fig. 15.

anterior fold in its walls confers on the hydrotheca an aspect which, though not confined to the present species, is by no means common. Besides its terminal orifice, the mesial nematophore is provided with a very distinct lateral orifice, close to the point at which it ceases to be adnate to the hydrotheca.

In the specimen from which the drawings in the plate had been made, no gonangia were developed on the phylactocarps. The collection, however, contains another specimen in which they are present, and here they were always found singly on the inter-

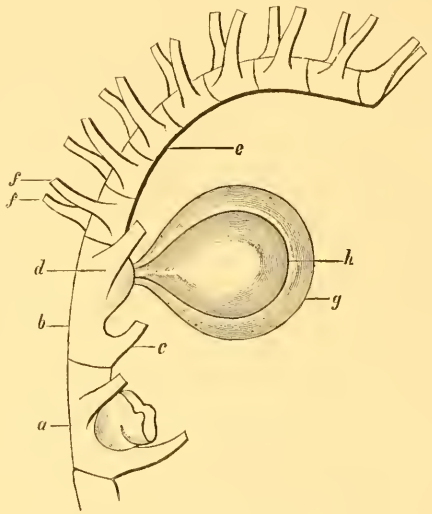


FIG. 2.—Phylactocarp of *Lytocarpus spectabilis*.

a. Proximal internode carrying a hydrotheca.
b. Second internode carrying a gonangium.
c. Representative of the mesial nematophore of this internode.
d. Representative of lateral nematophore.
e. Continuation of the phylactocarp beyond the gonangium-bearing internode.
f,f. Representatives of the lateral nematophores belonging to the internodes of this continuation.
g. Gonangium.
h. Gonophore.

node which immediately succeeded the proximal or hydrotheca-bearing internode of the rachis. The phylactocarps which thus carried gonangia had also undergone a peculiar modification, which consisted partly in an enlargement both in length and width of the gonangium-bearing internode, the solitary gonangium being borne by a rounded prominence which lay between the two lateral spines of the internode, while in this internode there also existed a small mesial spine, by which the gonangium was subtended, and which did not exist in the others. Further, the whole of the more

distal portion of the phylactocarp was curved over the gonangium and its supporting internode, while its lateral spines were all directed backwards away from the concavity of the curve.

The morphological significance of the phylactocarp is here sufficiently obvious. There can be no hesitation in recognising in it a modified hydrocladium, in which all the hydrothecæ, except that borne by the proximal internode, have been suppressed. It is also evident that the pair of lateral spines carried by every other internode represents the lateral nematophores of the suppressed hydrotheca. Except on the proximal or hydrotheca-bearing internode, and on that on which a gonangium is developed, no representative of the mesial nematophore is to be found. On the gonangium-bearing internode, however, a mesial spine is carried by the front of the internode, at a short distance behind the gonangium, and this plainly represents the mesial nematophore of the suppressed hydrotheca. The gonangium here takes precisely the place which would have been occupied by a hydrotheca had this been developed.

It may be a question whether the phylactocarps described above, which when examined were found destitute of gonangia, are provided with gonangia at other times, or whether they are really sterile ramuli, with some other physiological significance; at all events, the difference between them and those on which gonangia were present is very remarkable, and it is difficult to see how, after they have attained the form described, they could undergo such modification as would convert them into the fertile phylactocarp. The two forms, however, may be of different sexes, and be both equally destined to carry gonangia.

Lytocarpus spectabilis comes near to *Aglaophenia rostrata* of Kirchenpauer, a species which Kirchenpauer, who has not seen its gonosome, places in his section *Macrorhynchia*. The present species, however, is a much stronger form, and with longer hydrocladia. The hydrocladia, moreover, are alternate in *Lytocarpus spectabilis*, while in *Aglaophenia rostrata* they are described as opposite.

Dredged at Zamboanga, Philippines, 30th January 1875, from a depth of 10 fathoms; also at Station 186, Torres Strait, September 8, 1874; lat. 10° 30′ S., long. 142° 18′ E; depth, 8 fathoms; bottom, coral sand.

Lytocarpus longicornis, Busk, sp. (Pl. XIX. figs. 4–6).

Plumularia longicornis, Busk, Voyage of the "Rattlesnake," vol. i. p. 399, 1852.

Trophosome.—Colony attaining a height of about three inches; stem fascicled, irregularly branched, supporting closely set pinnately arranged alternate monosiphonic ramuli, which are themselves destitute of hydrothecæ, but give off all along their length the very short hydrothecæ-bearing ramuli, which are close set, alternate, about one-twentieth of

an inch in length, and though pinnate at their origin, are all directed unilaterally towards the distal ends of the main stems. Hydrothecæ deep, flask-shaped, with a deep antero-posterior constriction just below the margin ; margin entire, directed forwards ; mesial nematophore adnate to the hydrotheca wall for nearly half the height of the wall, and then continued for about the same distance as a free beak-like process, which is provided with a lateral as well as a terminal orifice ; lateral nematophores in the form of long tubular cylindrical processes, which project far beyond the margin of the hydrotheca.

Gonosome not known.

The type of form presented by the hydrotheca of the present species is very remarkable. The deep antero-posterior constriction, the nearly vertical direction of the hydrotheca mouth, with its even margin, so exceptional among the Statoplean Plumularidæ, and the long cylindrical lateral nematophores which project like a pair of ears over the margin, confer on it an aspect singular and striking. The constriction below the hydrotheca mouth is entirely confined to the antero-posterior direction, so that though very striking in profile, it is not apparent in a front view of the hydrotheca.

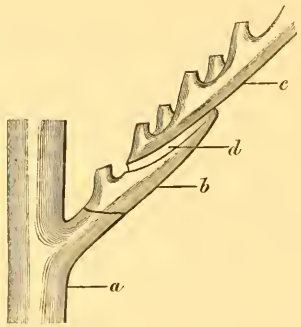


Fig. 3. Origin of a primary pinna in *Lytocarpus longicornis*, showing the splice-like joint near the proximal end of the pinna.

a. Main stem.
b. Proximal portion of pinna.
c. Distal portion. The bases of the secondary pinnæ or hydrocladia are seen with a secund disposition, along the length of the primary pinnæ.
d. Splice-like joint separating the proximal from the distal portion of the primary pinna, and filled with a colourless chitin.

The doubly pinnate ramification of the colony, with the unilateral direction of the very short hydrocladia, afford other striking characters. The hydrocladia are carried each on the summit of a strong process of the primary pinnæ, and being all directed towards one side of these, their really pinnate disposition may be easily overlooked. The basal process on which each stands has on its inner side a tubular nematophore.

The primary pinnæ, or those which being themselves destitute of hydrothecæ support

the hydrocladia, are alternate, a very unusual condition in the bipinnate *Plumularidæ*, in which the primary pinnæ are almost always opposite.

Each primary pinna is supported on a short process of the stem, and its proximal end is separated from the remainder of the pinna by a very oblique joint, and forms an acute wedge-shaped segment, on which the distal portion is, as it were, *spliced* (see woodcut). The joint is occupied by a colourless chitin, and when viewed in profile appears as a broad transparent line, which strongly contrasts with the opaque brown periderm of the rest of the pinna. The curious splice-like joint thus formed is very striking and characteristic.

Among the *Plumularidæ* described and figured by Kirchenpauer,[1] are three—*Aglaophenia philippina*, *Aglaophenia urens*, and one which he believes he can identify with the *Plumularia longicornis* of Busk. The hydrothecæ of all these resemble in many points those of the present species, though the habit of the colonies is entirely different. In two of them, *Aglaophenia philippina* and *Aglaophenia urens*, he has observed the gonosome.

Kirchenpauer refers them all to *Aglaophenia* in the wide sense in which he would understand this genus, and places them in a subordinate section or sub-genus of *Aglaophenia*, to which he gives the name of *Macrorhynchia*. The group *Macrorhynchia*, however, as defined by Kirchenpauer, can scarcely be accepted, for there may be found Statoplean Plumularidæ which agree in having the long two-apertured mesial nematophore on which the group has been founded, and whose gonosomes are yet so different as to render it impossible to associate them in the same genus. Indeed, the form of gonosome which Kirchenpauer assigns to his *Macrorhynchia* may well be referred to the type which characterises his *Lytocarpia*.

The absence of gonosome in the specimens obtained by the Challenger renders it impossible to assign the present species with certainty to a definite genus, but the close resemblance of its hydrothecæ to those of the three species just mentioned, in two of which the gonosome has been observed, will perhaps justify us in giving it a place in the genus *Lytocarpus*,—a position, however, which, until its gonosome has been examined, must have a purely provisional value.

Mr. Busk's specimens of his *Plumularia longicornis* were obtained during the expedition of the "Rattlesnake,"[2] and the species defined in the account given of the Hydroids brought home by that expedition. From a comparison of authentic specimens in Mr. Busk's possession, with the *Lytocarpus longicornis* of the present Report, I have satisfied myself of the specific identity of the two forms.

Dredged at Zamboanga, Philippines, January 30, 1875, from a depth of 10 fathoms.

[1] Kirchenpauer, *loc. cit.*, pp. 45–47.

[2] Busk, Voyage of the "Rattlesnake," vol. i. p. 399.

Streptocaulus, nov. gen.

Name from στρεπτὸς, twisted, and καυλὸς, a stem, in allusion to the torsion of the stem round its axis.

Generic Character. *Trophosome.*—Hydrocladia disposed in a continuous spiral round the stem. Hydrothecæ with entire margin. Mesial nematophore not adnate to the walls of the hydrotheca.

Gonosome not known.

The species on which the genus *Streptocaulus* has been founded is rendered very striking by the spiral instead of pinnate disposition of its hydrocladia. Even here, however, we may regard the hydrocladia as having primarily a semi-pinnate arrangement, or as being confined to one side of the stem, while a torsion of the stem round its axis—the proximal end remaining fixed—causes the hydrocladia to fall into a continuous spiral. So remarkable a form of ramification may well be assumed as affording a character of generic value. The absence of serration in the margin of the hydrotheca, and still more the detachment of the mesial nematophore from the hydrotheca, are also characters very unusual among the Statoplean *Plumularidæ*.

Streptocaulus pulcherrimus, n. sp. (Pl. XVI. figs. 1–3).

Trophosome.—Colony attaining a height of about nine inches; stem simple, fascicled, wavy; hydrocladia nearly an inch in length, occupying about the distal half of the stem. Hydrothecæ deep, thimble-shaped, margin with a single tooth-like extension in front; mesial nematophore in the form of a free conical spine, with a terminal and a lateral aperture, springing from a point of the hydrothecal internode immediately below the hydrotheca; lateral nematophores pyriform, overtopping the hydrotheca.

The habit of this beautiful Hydroid is very different from that of every other known species. Among Statoplean forms it is the only species as yet discovered in which the disposition of the hydrocladia is not strictly pinnate.

Dredged in Porto Praya, St Jago, from a depth of 100 fathoms.

Diplocheilus, nov. gen.

Name from διπλόος, double, and χεῖλος, a lip, in allusion to the duplicature of the hydrotheca margin.

Generic Character. *Trophosome.*—Hydrotheca with a duplicature of its walls forming an external calycine envelope, which surrounds the hydrotheca for some distance behind the orifice. Mesial nematophore in the form of a shield-like process not adnate to the hydrotheca; lateral nematophores absent.

Gonosome not known.

In the external calyx-like duplicature of the hydrotheca walls of the remarkable Plumularian on which the genus *Diplocheilus* has been founded, we have a character which is absolutely unique among known Plumularians. A scarcely less exceptional character is found in the absence of lateral nematophores, and in the reduction of the mesial nematophore to a sessile, shield-like process unconnected with the hydrotheca.

Diplocheilus mirabilis, n. sp. (Pl. VIII. figs. 4–7).

Trophosome.—Colony attaining a height of two or three inches, sparingly branched; stem monosiphonic, divided into internodes by oblique joints; hydrocladia about two-tenths of an inch in length, having their internodes separated by very oblique joints. Hydrothecæ widening from below upwards, and with the margin everted; mesial nematophore very short and wide, forming a concave shield-like process, with a central perforation at a short distance below the hydrotheca.

Gonosome not known.

Diplocheilus mirabilis presents unmistakable points of affinity with both Eleutheroplean and Statoplean Plumularidæ. To the Statoplean forms it is connected by its fixed nematophores, and this character is presented not only by the mesial nematophore of the hydrothecal internode, but by certain cauline nematophores which are developed on the internodes of the stem. To the Eleutheroplea it shows an affinity by the non-serrated margin of its hydrotheca, and by the very oblique joints which separate the internodes of the hydrocladia, a character which specially recalls a similar condition in the Catharina group of the Eleutheroplea.

Its position among the Statoplean rather than among the Eleutheroplean Plumularidæ must be regarded as decided by the entire absence of moveable nematophores.

Diplocheilus mirabilis—the only known species of its genus—is represented in the collection only by a fragmentary specimen.

Dredged at Station 162, April 2, 1874, off Monœeur Island, Bass Strait; depth, 38–40 fathoms; bottom, sandy.

Cladocarpus, Allm.

Cladocarpus, Allman, Trans. Zool. Soc. Lond., vol. viii., 1873.

Generic Character. *Trophosome.*—A simple or branched hydrosoma, with pinnately disposed hydrocladia.

Gonosome.—Gonangia not included in corbulæ, or protected by any other form of modified hydrocladium, but borne on the sides or at the base of special protective branches, which are appendages of the hydrocladia.

The genus *Cladocarpus* was founded for a Hydroid obtained in the eastern part of the North Atlantic, during one of the expeditions of H.M.S. "Porcupine."[1] The same species also occurs in the collection of the Challenger. The essential characters of the genus are found in the nature of the phylactocarp, which differs from that of every other phylactocarpal Plumularidan in the fact of its not being a transformed hydrocladium, but a special appendage which springs from the hydrocladium. The hydrocladium itself has undergone no essential modification, the greatest change which in any case takes place consists in a greater or less diminution of its length, caused by a reduction in the number of its internodes and hydrothecæ.

In all the species of *Cladocarpus* at present known, the phylactocarps are twig-like appendages, more or less ramified, destitute of hydrothecæ, but richly provided with more or less modified nematophores. In every instance known they spring from a hydrocladium immediately behind its first or proximal hydrotheca, and the gonangia they are destined to protect are borne either by the phylactocarp itself or by the common stem close to the origin of the hydrocladium from which the phylactocarp springs.

Besides *Cladocarpus formosus*, the original species of the "Porcupine," the Challenger collection contains another fine species. Three other species of the genus are among the Hydroids dredged during the exploration of the Gulf Stream by the United States Coast Survey,[2] while to the same genus I must refer a Plumularidan dredged by G. O. Sars in the North Atlantic, and described by him under the name of *Aglaophenia bicuspis*.[3] They appear to be all inhabitants of deep water.

Cladocarpus pectiniferus, n. sp. (Pl. XVII.).

Trophosome.—Colony attaining a height of about six inches; stem slender, monosiphonic, simple, springing from a tuft of tubular filaments; hydrocladia alternate, distant, attaining the length of an inch. Hydrothecæ distant, deep, narrow, nearly cylindrical, with entire margin, and destitute of intrathecal ridge; mesial nematophore small, quite detached from the hydrotheca; lateral nematophores cylindrical, overtopping the hydrotheca.

Gonosome.—Phylactocarp springing from the proximal internode of the hydrothecal ramulus, and consisting of a very short stem, which immediately divides into two jointed and pectinated branches which carry the gonangia on their sides.

The present species is closely allied to *Cladocarpus dolichotheca* and *Cladocarpus ventricosus* of the Gulf Stream exploration. From both these species it differs in the single bifurcation and pectinated branches of the phylactocarp, and in the fact that the

[1] Report on the Hydroida collected during the Expeditions of H.M.S. "Porcupine." *Trans. Zool. Soc. Lond.*, 1873, vol. viii. part 8.

[2] Hydroids of the Gulf Stream, p. 49, pls. xxx.–xxxiii.

[3] G. O. Sars, *loc. cit.*, p. 98, tab. ii. figs. 7–10.

gonangia are borne on the branches of the phylactocarp instead of being carried at its base by the stem. From *Cladocarpus ventricosus* it further differs in the cylindrical instead of ventricose form of the hydrotheca.

The pectination of the branches of the phylactocarp is due to the presence of nematophores, which are disposed in two opposite series from the base to the summit of the branch, and which, instead of remaining in the usual condition of small sessile cups, have become developed into long cylindrical tubes. In *Cladocarpus dolichotheca* and *Cladocarpus ventricosus*, the nematophores, which are also present on the branches of the phylactocarp, are disposed in a single series, and retain their normal form.

The hydrocladial internodes of *Cladocarpus pectiniferus* are provided with numerous transverse intra-cauline ridges, situated at equal distances from one another. Owing to the transparency of the chitinous periderm, these are very distinct, and give to the internode the appearance of being divided into distinct chambers by regular septa—a character which is very obvious and striking.

The hydrotheca of the internode, from which the phylactocarp springs, is destitute of mesial nematophore, and the phylactocarp springs not exactly from the mesial line of the internode, but from a point a little to the side of this, just below the hydrotheca. The absence of a mesial nematophore, in its normal form, is here not without significance, and affords grounds for believing that the phylactocarp, notwithstanding its slight displacement, is its homological representative.

Cauline nematophores are borne in a single series along the front of the stem, and give to its lower end, where this is destitute of pinnæ, an appearance easily comparable to that of some of the single-sided graptolites. Like most deep-water species, *Cladocarpus pectiniferus* is distinguished by the delicacy and transparency of its chitinous periderm.

Dredged at Station 76, July 3, 1873, lat. 38° 11′ N., long. 27° 9′ W.; depth, 900 fathoms; bottom temperature, 4°·2 C.; bottom, globigerina ooze.

Cladocarpus formosus, Allm. (Pl. XVI. figs. 4, 5).

Cladocarpus formosus, Allman, Trans. Zool. Soc. Lond., vol. viii., 1873.

Trophosome.—Colony attaining a height of about four inches; stem simple or very sparingly branched, fascicled below, becoming monosiphonic distally, springing from a tuft of delicate tubular filaments; hydrocladia alternate, attaining a length of about one inch. Hydrothecæ cylindrical, with crenate margin; mesial nematophore divided by an imperfect transverse septum into a proximal and a distal half, adnate for somewhat more than half its length to the hydrotheca, then becoming free, attaining the level of about half the height of the hydrotheca, and opening by a wide terminal emarginate orifice; lateral nematophores short, cup-shaped, very slightly overtopping the hydrotheca.

Gonosome.—Phylactocarp in the form of a slender branch, which springs from the

proximal internode of a hydrocladium, bifurcating three or four times, and carrying an ovate, nearly sessile gonangium at the angle of every bifurcation; branches of the phylactocarp set with two series of alternately disposed cup-shaped nematophores.

Cladocarpus formosus was also obtained during one of the expeditions of H.M.S. "Porcupine," and has been described in the Report on the Hydroids then collected.[1] The specimen in the Challenger collection is a very fine one, and with its long flexile pinnæ and its phylactocarps clustered in a continuous series along their bases, forms a striking and beautiful object.

The condition of the mesial nematophore of the hydrothecal internode is exceptional. This nematophore consists of two portions—a proximal or basal portion, which, like the mesial nematophore, as usually seen, is simply continuous with the internode, and a distal portion, which is separated from the proximal by a transverse joint.

No mesial nematophore is present on the internode which carries the phylactocarp. This springs from the internode somewhat out of the mesial line, and just below the hydrotheca. *Cladocarpus formosus* thus agrees with *Cladocarpus pectiniferus* in the evidence it affords as to the homological significance of the phylactocarp.

Dredged at Station 236, June 5, 1875; lat. 34° 58′ N., long. 139° 30′ E.; depth, 775–420 fathoms; bottom temperature, 2°·8 C.; bottom, mud.

Sub-family—Statoplea.

Section—Gymnocarpa.

Halicornaria, Busk, M.S. (in part).

Generic Character. *Trophosome.*—Hydrocladia pinnately disposed. Hydrothecæ with mesial and lateral nematophores.

Gonosome.—Gonangia destitute of special protective apparatus.

The genus *Halicornaria* was instituted by Busk, who included under it all the then known Plumularian forms whose gonangia were not protected by corbulæ. It is here used in a more restricted sense, and is confined to such Plumularidæ as have their trophosome constructed on the general plan of *Aglaophenia*, but whose gonosomes never develop any form of phylactocarpal apparatus.

Halicornaria plumosa, n. sp. (Pl. XVIII.).

Trophosome.—Colony attaining a height of six inches; stem simple, monosiphonic, springing at intervals from a creeping ramified fibre; hydrocladia about half an inch in length, alternate. Hydrothecæ wide, with a deep lateral notch and a strong anterior

[1] *Loc. cit.*, p. 478, pl. lxviii.

parietal fold; intrathecal ridge obsolete; mesial nematophore adnate to the hydrothecal walls for the entire height of the walls, and then projected as a strong curved spine for about the same height; lateral nematophores wide, conical.

Gonosome not known.

Halicornaria plumosa is a singularly beautiful species. Though it is highly probable that I have correctly referred it to the genus *Halicornaria*, this determination cannot, in the absence of the gonosome, be regarded as otherwise than provisional.

One of its most striking features is seen in the very long mesial nematophore, which is adnate to the anterior wall of the hydrotheca for its entire height, and is then continued as a long, curved, horn-like spine for nearly the same distance. The margin of the hydrotheca, instead of presenting the serrated condition usual in the Statoplean Plumularidæ, is seen, when viewed in profile, to have a deep obliquely-directed notch on each side, but is otherwise destitute of serration. The deep fold in the anterior walls of the hydrotheca, though occurring in other species, is also characteristic.

In its long mesial nematophore it presents a character in which it would agree with Kirchenpauer's *Macrorhynchia* section or sub-genus of *Aglaophenia*. For reasons, however, already mentioned,[1] the *Macrorhynchia* of Kirchenpauer can scarcely be accepted as a definite group.

The present species appears to come near to the *Halicornaria speciosa* of the Gulf Stream exploration.[2] In general habit there is a close agreement between the two, while in both the wide hydrotheca has an anterior parietal fold, and its margin—though in the Gulf Stream species this does not present the deep lateral notch of *Halicornaria plumosa*—is in both destitute of true serration, being in *Halicornaria speciosa* merely crenate. The mesial nematophore, however, in *Halicornaria speciosa* is not continued beyond the margin of the hydrotheca in the form of the long, curved, beak-like process seen in *Halicornaria plumosa*.

That the Gulf Stream species is a true *Halicornaria* there is no doubt, for the gonosome was present in the specimens examined, and removed all difficulty as to generic identification.

Dredged at Station 122, September 10, 1873, off Barra Grande, Brazil, from a depth of 32 fathoms.

Azygoplon, nov. gen.

Name from ἄζυγος, unpaired, and ὅπλον, a weapon, in allusion to the absence of the lateral nematophores.

Generic Character. *Trophosome.*—Hydrocladia pinnately disposed. Mesial nematophore adnate to the walls of the hydrotheca; no lateral nematophores.

[1] *See* above, p. 47.

[2] Hydroids of Gulf Stream, p. 54, pl. xxxiv.

Gonosome.—Gonangia springing from the stem, and destitute of special protective apparatus.

The genus *Azygoplon* is essentially characterised by the very exceptional condition of having no lateral nematophores—a condition which, except in *Diplocheilus*, does not occur elsewhere among the known genera of Plumularidæ. So far as is yet known, *Azygoplon* is represented by one species only.

Azygoplon rostratum, n. sp. (Pl. XIX. figs. 1–3).

Trophosome.—Colony attaining a height of upwards of three inches; stem much and irregularly branched, monosiphonic; hydrocladia about two-tenths of an inch in length. Hydrothecæ rather shallow, with one strong marginal tooth on each side, and a long beak-like process in front; mesial nematophore adnate for its entire length to the anterior wall of the hydrotheca, and then bearing on its summit a free membranous scoop-shaped appendage.

Gonosome.—Gonangium nearly spherical, narrowed into a short stalk at its point of attachment to the stem close to the base of a hydrocladium.

This is a very remarkable Hydroid. The form of the hydrotheca is exceptionally striking, for instead of the serrated margin usual in the Statoplean Plumularidæ, this condition is here replaced by a single strong tooth on each side and a long beak-like projection of the margin in front. The mesial nematophore—the only one present in the genus—is divided into two portions by a transverse joint; the proximal portion is the proper nematophore, and is, as in the mesial nematophore of other Statoplean forms, a simple continuous projection of the hydrothecal internode, and is adnate for its entire length to the anterior walls of the hydrotheca; the distal portion consists of a free membrane bent into a scoop-shaped form, the concavity of which is turned towards the hydrotheca and embraces its anterior wall.

The stem is divided into internodes by transverse joints, and every internode gives off from alternate sides a hydrocladium. The joints by which the internodes of the hydrocladia are separated from one another are unusually well marked—a feature in which *Azygoplon rostratum* approaches the Eleutheroplean rather than the Statoplean forms.

The specimen had been broken away from its hydrorhizal end, and on this account no exact assertion can be made of the height which the species may attain.

Azygoplon rostratum comes very near to a species described and figured by Kirchenpauer under the name of *Aglaophenia avicularis*, from specimens brought from Bass Strait. If it were not for the very different form of the mesial nematophore, I should have regarded the Challenger species as identical with that of Kirchenpauer.

Dredged at Station 161, April 1, 1874, off the entrance to Port Philip; depth, 38 fathoms; bottom, sandy.

GEOGRAPHICAL AND BATHYMETRICAL DISTRIBUTION.

We do not yet possess the data necessary for a complete exposition of the geographical distribution of the Plumularidæ. It may be generally asserted of this group that it attains its greatest development in the warmer seas of both hemispheres, and that in tropical and sub-tropical regions it has its maximum in multiplicity of form, in the size of the colonies, and in individual profusion.

The dredgings of the Challenger and of the United States Exploration of the Gulf Stream would further seem to point to two centres of maximum development within the area thus indicated,—an eastern centre, which is situated in the warm seas around the Philippines and other islands of the East Indian Archipelago, and a western centre, which will be found in those which lie around the West Indian Islands, and bathe the eastern shores of Central and Equinoctial America. From these two centres the largest known Plumularian colonies have been obtained, and we learn, on the authority of Semper, that the natives of the Philippine Islands regard with dread, in consequence of their formidable stinging powers, some of the great Plumularians which occur around their shores.

These eastern and western centres of Plumularian distribution remind us of the two great centres in which the Cheiroptera have their maximum development, as seen in the gigantic bats of both hemispheres,—centres of Cheiropteran distribution which are nearly coincident with these regions of maximum development in the Plumularidæ.

In bathymetrical distribution the Plumularidæ present considerable variation. Among the species described in the present Report some are quite littoral, having been dredged from depths ranging between 8 and 20 fathoms. The greater number however of the Challenger species have been obtained from depths between 20 and 150 fathoms, while the dredge has brought up three species, *Aglaophenia filicula*, *Aglaophenia acacia*, and *Polyplumaria pumila*, from a depth of 450 fathoms. The striking and beautiful genus *Cladocarpus* consists of eminently deep water forms, and of the two species here described one, *Cladocarpus formosus*, was obtained in the Japan Seas from a depth varying between 420 and 775 fathoms—the same species having been dredged by the "Porcupine" in the seas lying to the north of Scotland from 167, 560, and 632 fathoms —while *Cladocarpus pectiniferus* was dredged by the Challenger off the Azores from 900 fathoms. This last is the greatest depth from which any Plumularidan is known to have been obtained.

PLATE I.

PLATE I.

Figs. 1–4.—*Plumularia flabellum.*

Fig. 1.—Natural size.

Fig. 2.—Portion of a hydrocladium magnified; lateral view.

Fig. 3.—Same; front view.

Fig. 4.—Portion of branch, with origin of hydrocladia.

Figs. 5, 6.—*Plumularia laxa.*

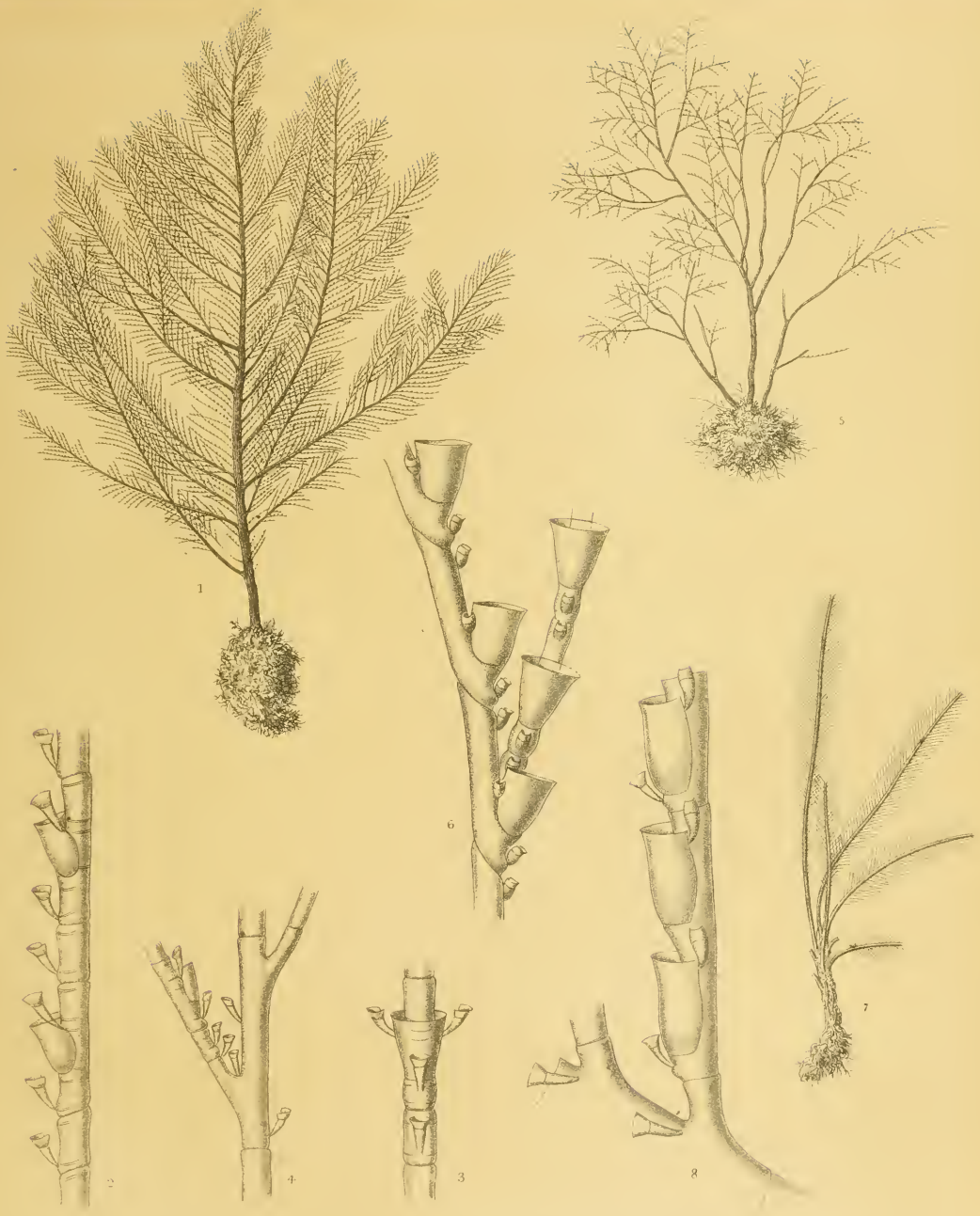
Fig. 5.—Natural size.

Fig. 6.—Portion of hydrocladium giving origin to a secondary hydrotheca-bearing ramulus; magnified.

Figs. 7, 8.—*Plumularia dolichotheca.*

Fig. 7.—Natural size.

Fig. 8.—Portion of hydrocladium; magnified.



1_4 PLUMULARIA FLABELLUM. 5_6 PLUMULARIA LAXA
7_8 PLUMULARIA DOLICHOTHECA.

PLATE II.

PLATE II.

Figs. 1–4.—*Plumularia insignis.*

Fig. 1.—Natural size.

Fig. 2.—Portion of hydrocladium, magnified ; lateral view.

Fig. 3.—Same ; front view.

Fig. 4.—Portion of branch with immature gonangia.

W. Purkis lith.

PLUMULARIA INSIGNIS.

PLATE III.

PLATE III.

Figs. 1–4.—*Plumularia abietina.*

Fig. 1.—Natural size, with young Avicula-like Mollusca attached to the stem and branches.

Fig 2.—Portion of hydrocladium magnified; lateral view.

Fig. 3.—Same; front view.

Fig. 4.—Portion of a branch with gonangium.

PLUMULARIA ABIETINA.

PLATE IV.

PLATE IV.

Figs. 1, 2.—*Plumularia stylifera.*

Fig. 1.—Natural size.

Fig. 2.—Portion of a hydroeladium with gonangium ; magnified.

Figs. 3, 4.—*Plumularia armata.*

Fig. 3.—Natural size.

Fig. 4.—Portion of stem with hydrocladia and male and female gonangia ; magnified.

Figs. 5, 6.—*Antennularia fascicularis.*

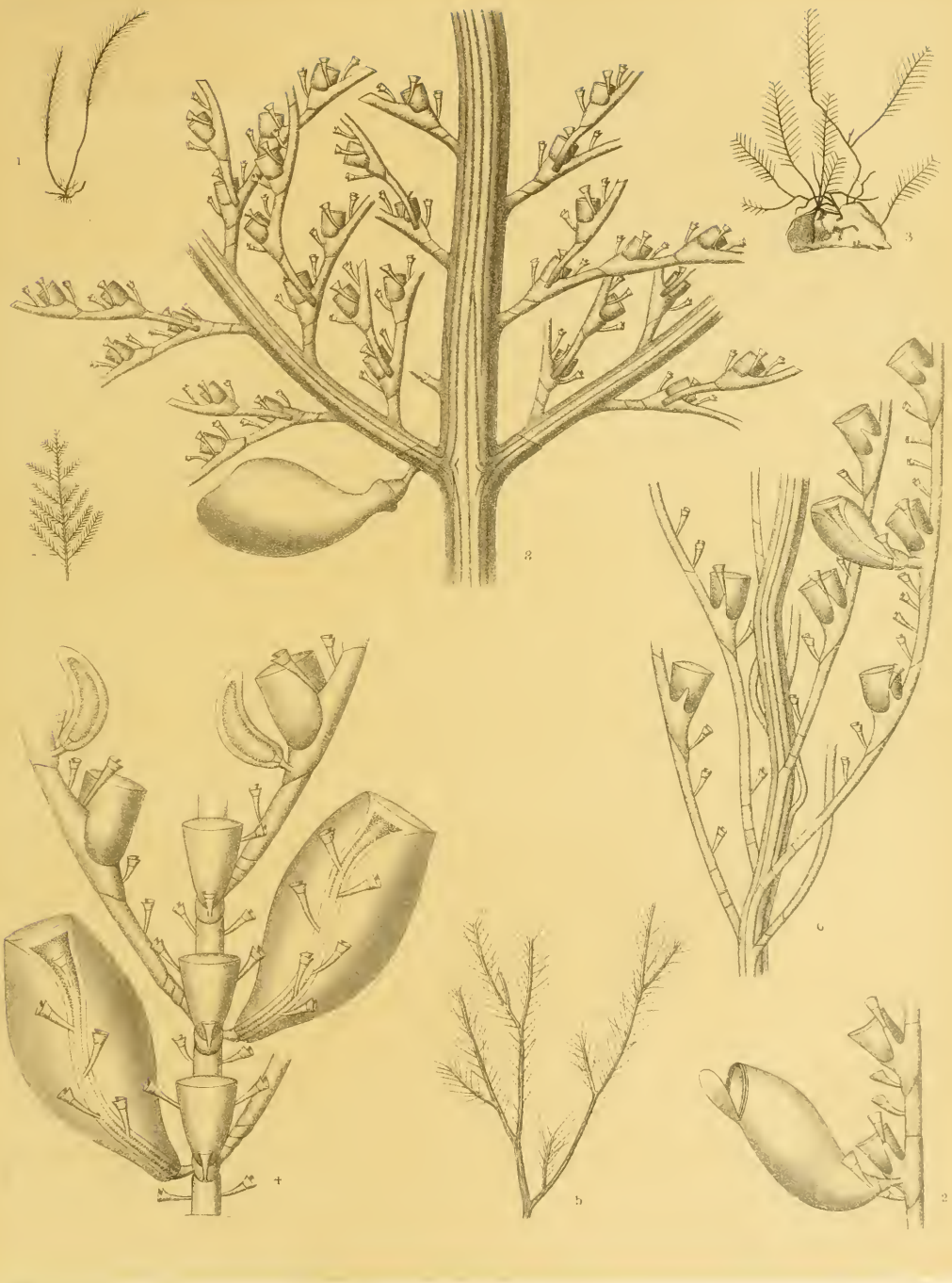
Fig. 5.—Natural size.

Fig. 6.—Portion of stem with hydrocladia and gonangium ; magnified.

Figs. 7, 8.—*Polyplumaria pumila.*

Fig. 7.—Natural size.

Fig. 8.—Portion of main stem, with two primary pinnæ and hydrocladia ; magnified. One of the primary pinnæ carries a gonangium, and every hydrocladium bears an accessory ramulus.



1, 2 PLUMULARIA STYLIFERA 3, 4 PLUMULARIA ARMATA
5, 6 ANTENNULARIA FASCICULARIS 7, 8 POLYPLUMARIA PUMILA.

PLATE V.

PLATE V.

Figs. 1–4.—*Sciurella indivisa.*

Fig. 1.—Natural size.

Fig. 2.—Portion of hydrocladium, magnified; lateral view.

Fig. 3.—Same; front view with gonangia.

Fig. 4.—Internode of stem with origins of hydrocladia.

SCIURELLA INDIVISA.

PLATE VI.

PLATE VI.

Figs. 1–4.—*Acanthella effusa.*

Fig. 1.—Natural size.

Fig. 2.—Portion of hydrocladium, magnified; lateral view.

Fig. 3.—Same; front view.

Fig. 4.—Portion of branch, near its distal end, showing the spine-like appendages carried by every internode, and here replacing the hydrocladia.

ACANTHELLA EFFUSA

PLATE VII.

PLATE VII.

Figs. 1–3.—*Schizotricha unifurcata.*

Fig. 1.—Natural size.

Fig. 2.—Portion of a hydrocladium, magnified; showing its single bifurcation and the gonangia carried by the ramuli.

Fig. 3.—Variety of same species with short hydrocladia; natural size.

Figs. 4, 5.—*Schizotricha multifurcata.*

Fig. 4.—Natural size.

Fig. 5.—Portion of a hydrocladium, magnified; showing three bifurcations and the gonangia borne by the ramuli.

1–3 SCHIZOTRICHA UNIFURCATA. 4,5 SCHIZOTRICHA MULTIFURCATA.

PLATE VIII.

PLATE VIII.

Figs. 1–3.—*Heteroplon pluma.*

Fig. 1.—Natural size.

Fig. 2.—Portion of hydrocladium, magnified; front view.

Fig. 3.—Portion of stem with hydrocladia; lateral view.

Figs. 4–7.—*Diplocheilus mirabilis.*

Fig. 4.—Natural size.

Fig. 5.—Portion of stem with two hydrocladia, magnified; showing front and back views of hydrothecæ.

Fig. 6.—Internode of a hydrocladium with its hydrotheca; half profile.

Fig. 7.—Portion of hydrocladium consisting of two internodes, each with its hydrotheca; half profile.

1_3 HETEROPLON PLUMA. 4_7 DIPLOCHEILUS MIRABILIS.

PLATE IX.

PLATE IX.

Acanthocladium huxleyi; natural size.

For magnified details see Plate XX. figs. 1–3.

W. Purkiss, del. et lith.

Harrison, imp.

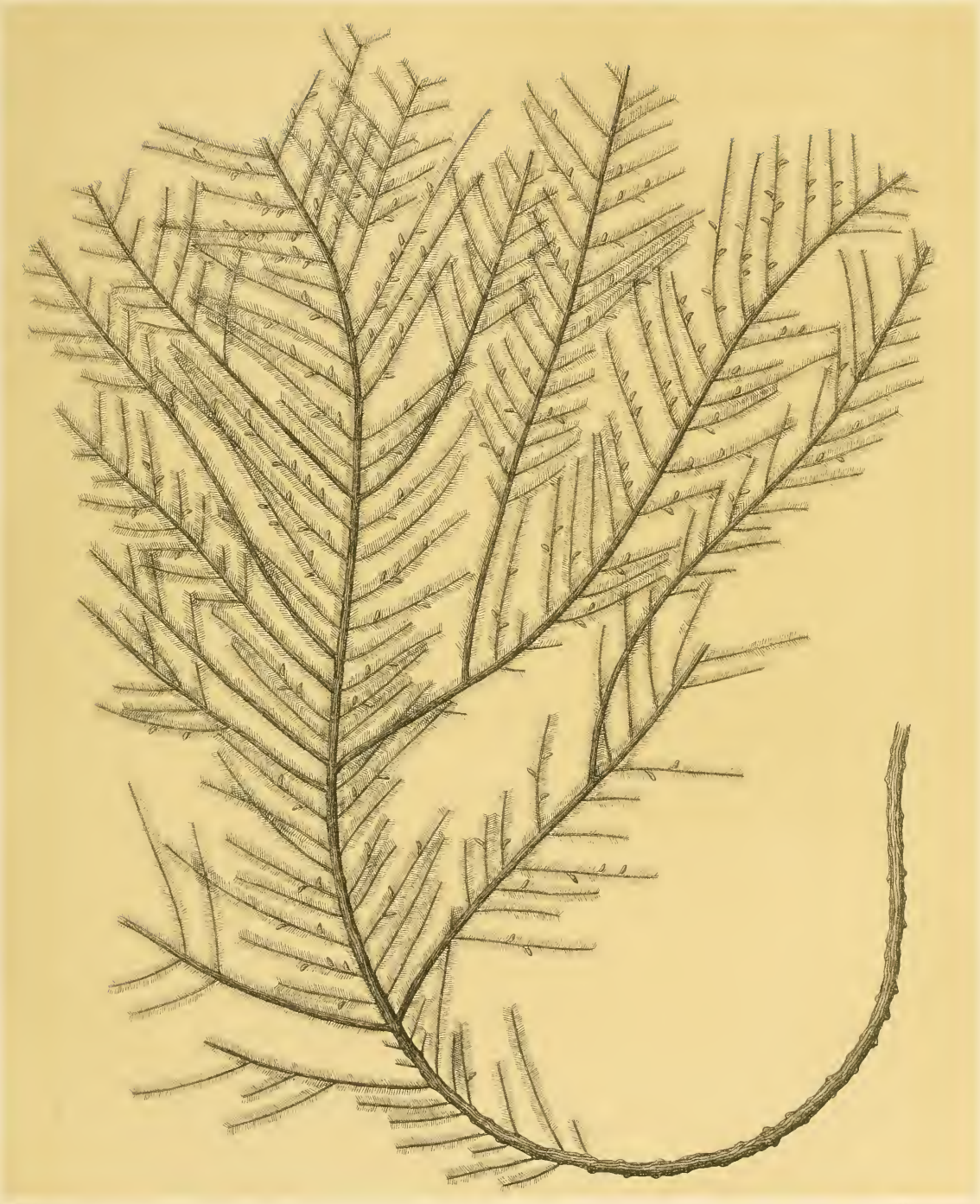
ACANTHOCLADIUM HUXLEYI.

PLATE X.

PLATE X.

Aglaophenia macgillivrayi; natural size.

For magnified details see Plate XX. figs. 4–6.



AGLAOPHENIA MACGILLIVRAYI.

PLATE XI.

PLATE XI.

Figs. 1–6.—*Aglaophenia filicula.*

Fig. 1.—Natural size.

Fig. 2.—Portion of hydrocladium, magnified; lateral view.

Fig. 3.—Same; front view.

Fig. 4.—Corbula, closed form.

Fig. 5.—Corbula, open form.

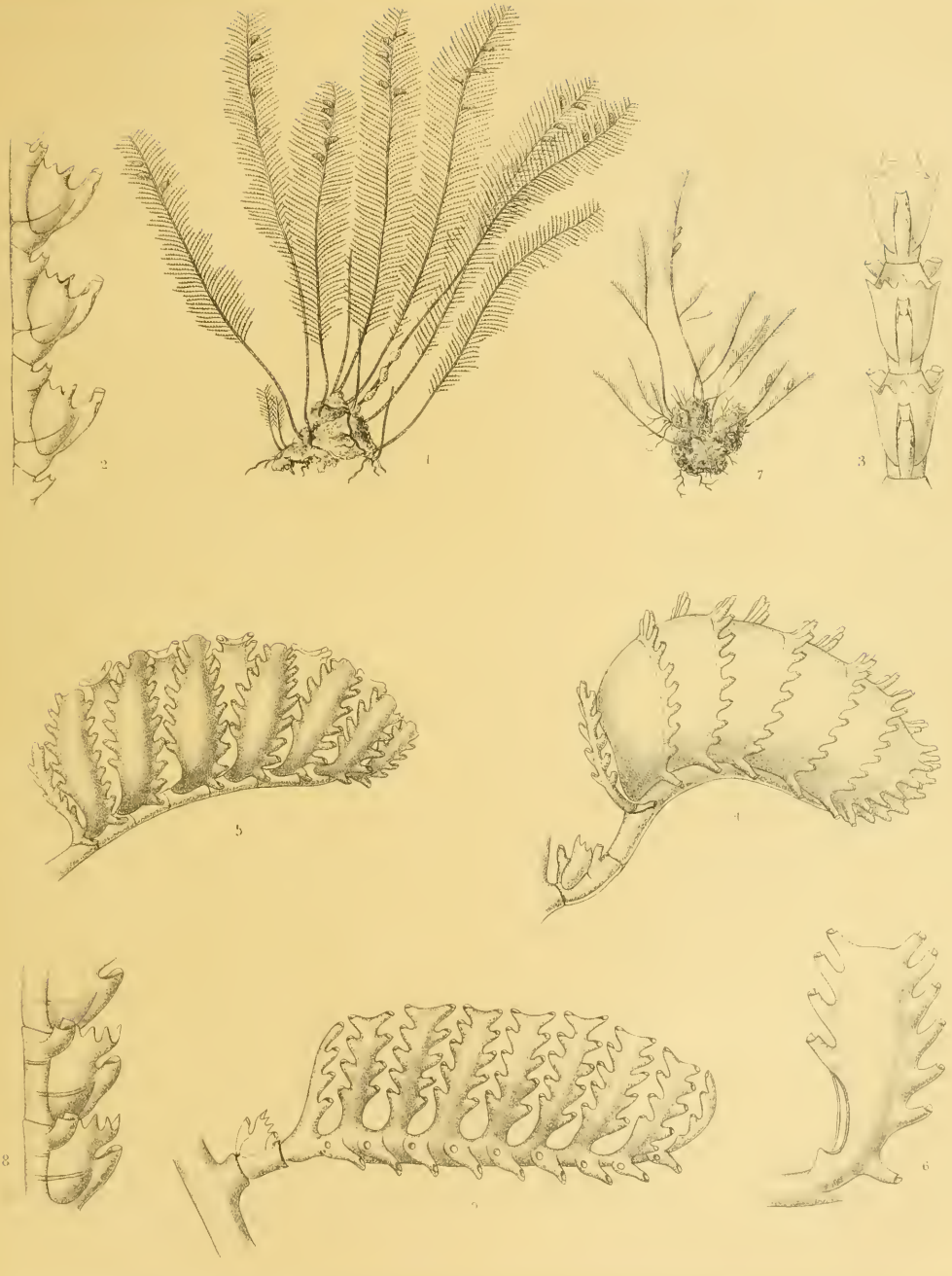
Fig. 6.—One of the costæ of the open form of corbula, showing the slit-like orifice near its base.

Figs. 7–9.—*Aglaophenia attenuata.*

Fig. 7.—Natural size.

Fig. 8.—Portion of a hydrocladium; magnified.

Fig. 9.—Corbula.



1–6 AGLAOPHENIA FILICULA. 7–9 AGLAOPHENIA ATTENUATA.

PLATE XII.

PLATE XII.

Figs. 1–4.—*Aglaophenia acacia.*

Fig. 1.—Natural size.

Fig. 2.—Portion of hydrocladium, magnified ; lateral view.

Fig. 3.—Same ; front view.

Fig. 4.—Corbula.

Figs. 5–8.—*Aglaophenia calamus.*

Fig. 5.—Natural size.

Fig. 6.—Portion of hydrocladium, magnified ; lateral view.

Fig. 7.—Same ; front view.

Fig. 8—Corbula.

1_4 AGLAOPHENIA ACACIA. 5_8 AGLAOPHENIA CALAMUS.

PLATE XIII.

PLATE XIII.

Figs. 1–6.—*Lytocarpus racemiferus.*

Fig. 1.—Natural size.

Fig. 2.—Portion of hydrocladium, magnified ; lateral view.

Fig. 3.—Same ; front view.

Fig. 4.—A branch with phylactocarps loaded with gonangia.

Fig. 5.—Portion of a phylactocarp still further magnified.

Fig. 6.—Distal end of phylactocarp.

LYTOCARPUS RACEMIFERUS.

PLATE XIV.

PLATE XIV.

Figs. 1–5.—*Lytocarpus secundus.*

Fig. 1.—Natural size.

Fig. 2.—Portion of hydrocladium, magnified; lateral view.

Fig. 3.—Same; front view.

Fig. 4.—Portion of a branch with hydrocladia and phylactocarps.

Fig. 5.—Portion of a phylactocarp, still further magnified.

LYTOCARPUS SECUNDUS.

PLATE XV.

PLATE XV.

Figs. 1–5.—*Lytocarpus spectabilis.*

Fig. 1.—Natural size.

Fig. 2.—Portion of hydrocladium, magnified; front view.

Fig. 3.—Same; lateral view.

Fig. 4.—Portion of a branch near its distal end where it has become monosiphonic, with hydrocladia and phylactocarps.

Fig. 5.—Distal end of a phylactocarp.

LYTOCARPUS SPECTABILIS.

PLATE XVI.

PLATE XVI.

Figs. 1–3.—*Streptocaulus pulcherrimus.*

Fig. 1.—Natural size.

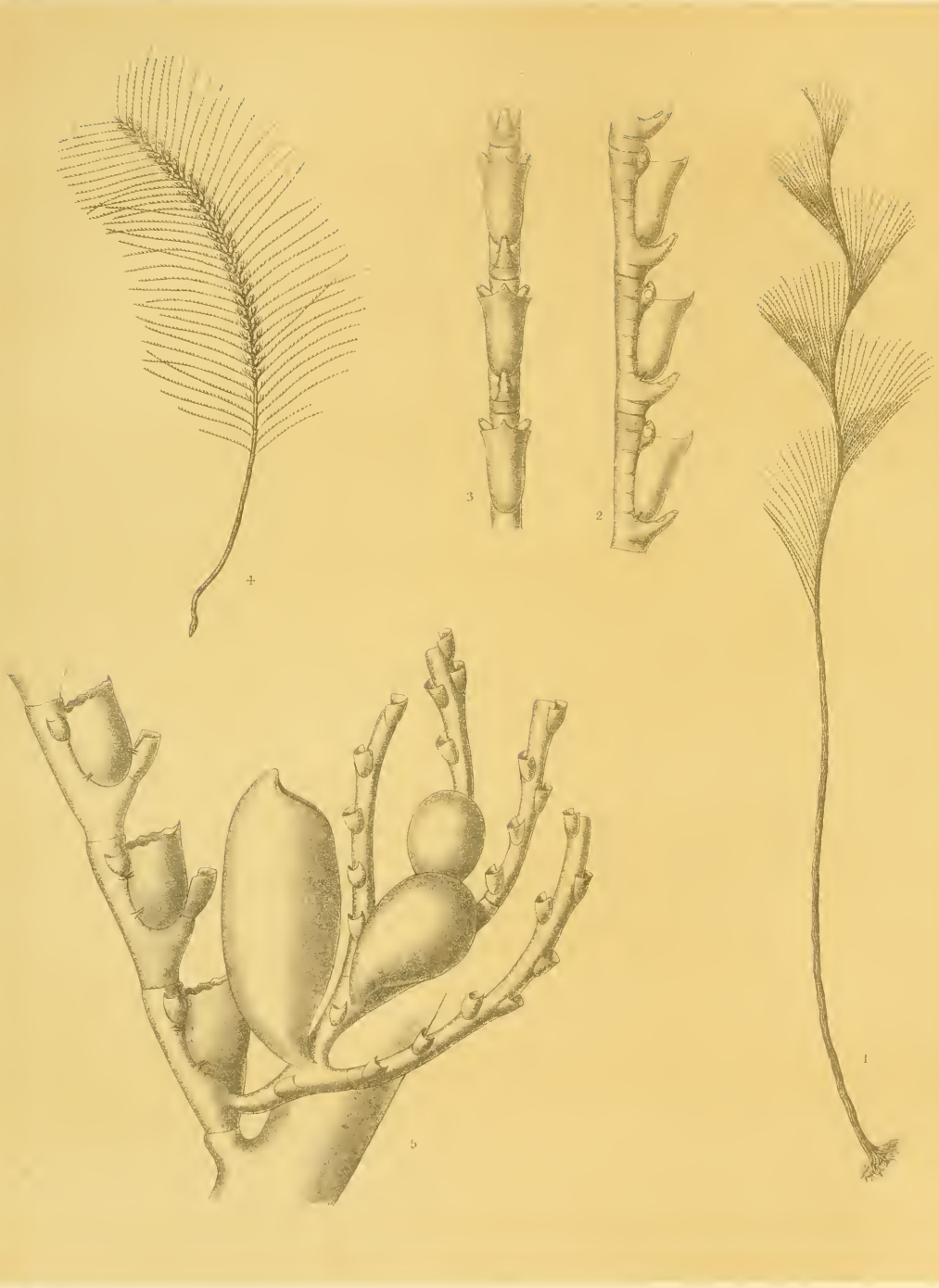
Fig. 2.—Portion of hydrocladium, magnified; lateral view.

Fig. 3.—Same; front view.

Figs. 4, 5.—*Cladocarpus formosus.*

Fig. 4.—Natural size.

Fig. 5.—Portion of stem carrying a hydrocladium with phylactocarp and gonangia; magnified.



1-3 STREPTOCAULUS PULCHERRIMUS.
4-5 CLADOCARPUS FORMOSUS

PLATE XVII.

PLATE XVII.

Figs. 1–5.—*Cladocarpus pectiniferus.*

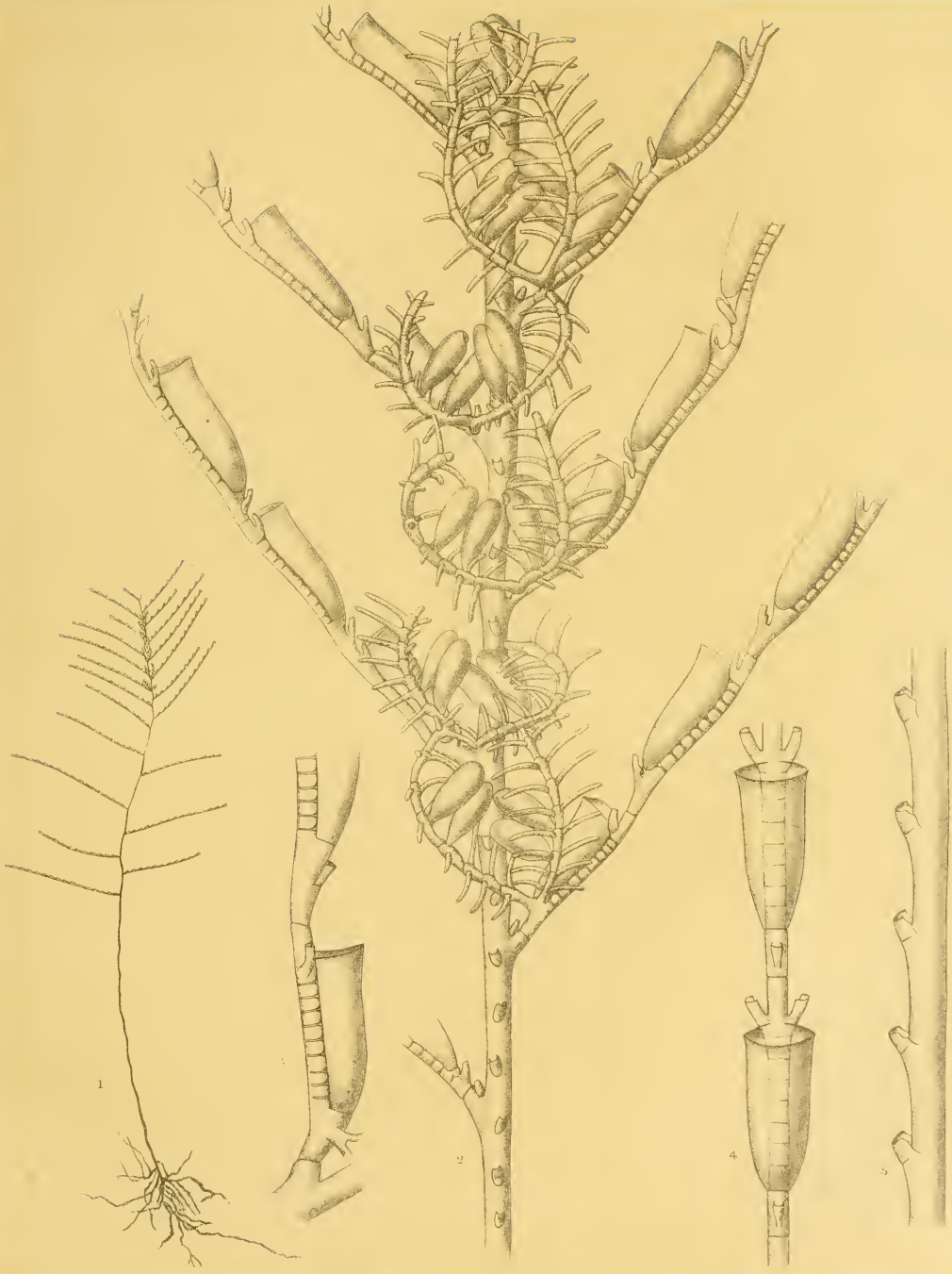
Fig. 1.—Natural size.

Fig. 2.—Portion of a colony, taken from near the distal end, with phylactocarps and gonangia; magnified.

Fig. 3.—Portion of a hydrocladium, still further magnified; lateral view. The origin of a phylactocarp is seen close to its proximal end.

Fig. 4.—Same; front view.

Fig. 5.—Part of the stem near its proximal end; showing cauline nematophores arranged in a single linear series.



CLADOCARPUS PECTINIFERUS.

PLATE XVIII.

PLATE XVIII.

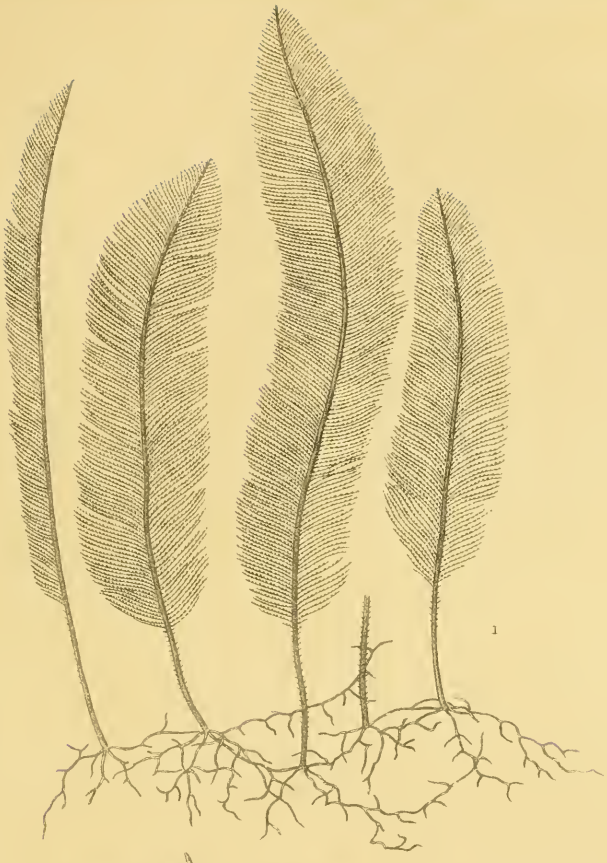
Figs. 1–4.—*Halicornaria plumosa.*

Fig. 1.—Natural size.

Fig. 2.—Portion of stem with hydrocladia; magnified.

Fig. 3.—Portion of hydrocladium, still further magnified; lateral view.

Fig. 4.—Same; front view.



HALICORNARIA PLUMOSA.

PLATE XIX.

PLATE XIX.

Figs. 1–3.—*Azygoplon rostratum.*

Fig. 1.—Natural size.

Fig. 2.—Portion of a hydrocladium, magnified; lateral view.

Fig. 3.—Portion of stem with hydrocladia and gonangia; front view.

Figs. 4–6.—*Lytocarpus longicornis.*

Fig. 4.—Natural size.

Fig. 5.—Portion of hydrocladium; magnified.

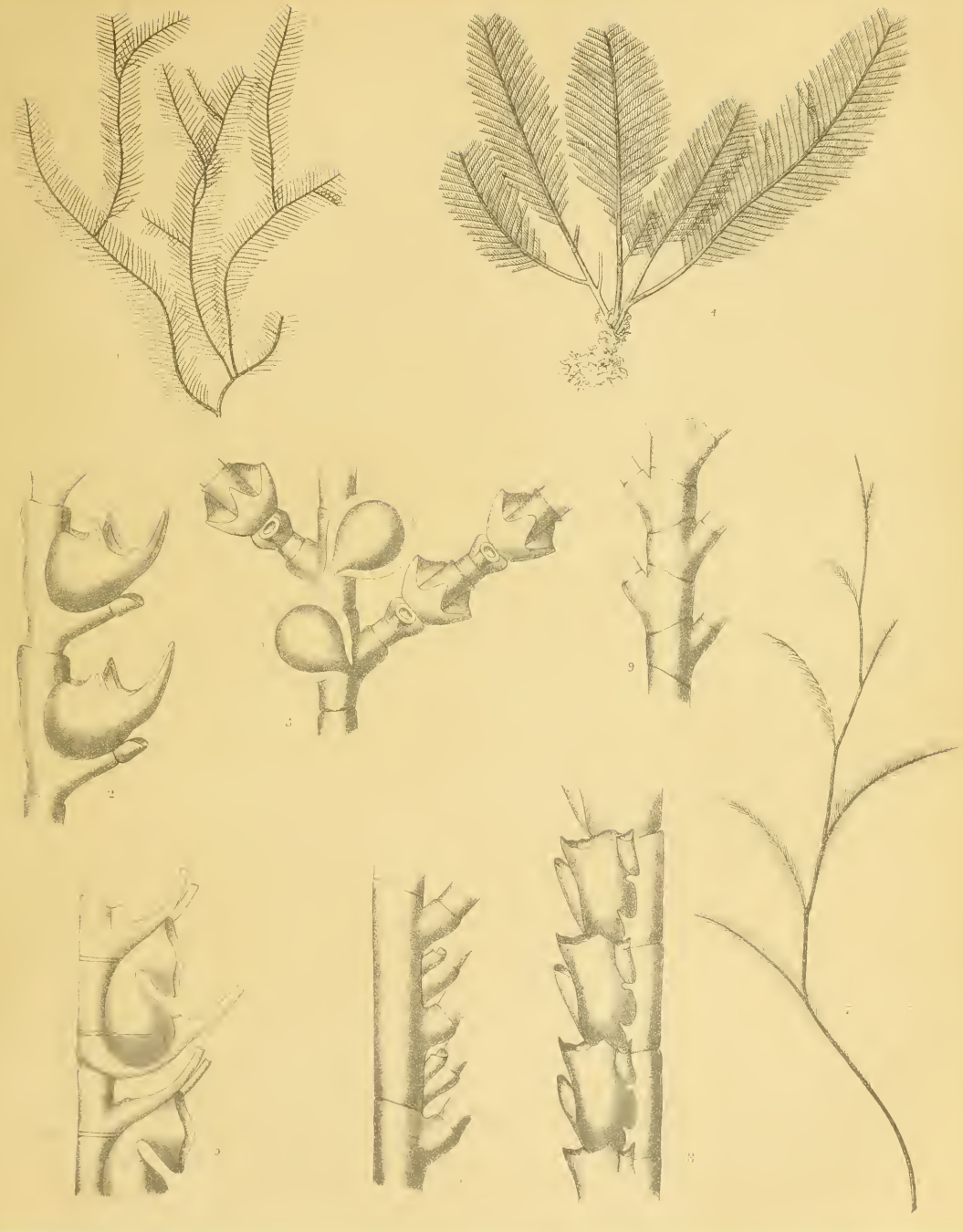
Fig. 6.—Portion of a primary pinna, with origins of hydrocladia.

Figs. 7–9.—*Aglaophenia coarctata.*

Fig. 7.—Natural size.

Fig. 8.—Portion of hydrocladium; magnified.

Fig. 9.—Portion of a branch with origins of hydrocladia, showing wedge-shaped internodes.



1–3 AZYGOPLON ROSTRATUM. 4–6 LYTOCARPUS LONGICORNIS.
7–9 AGLAOPHENIA COARCTATA.

PLATE XX.

PLATE XX.

Figs. 1–3.—*Acanthocladium huxleyi.* Magnified details.

Fig. 1.— Portion of a phylactocarp with a gonangium. The points from which the other gonangia had been detached are seen close to the bases of the costæ.

Fig. 2.—Portion of a hydrocladium with two hydrothecæ; lateral view.

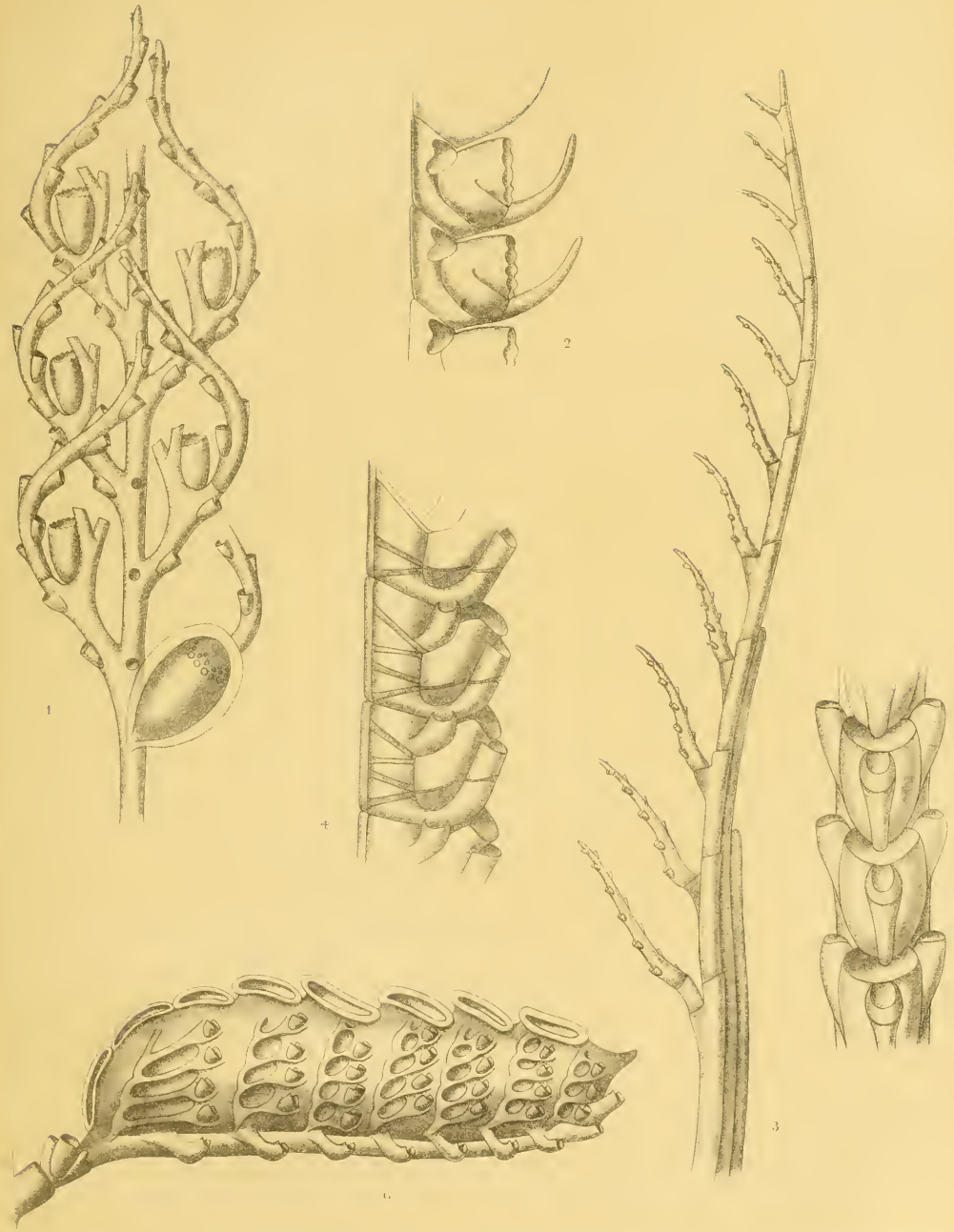
Fig. 3.—Distal extremity of a branch, showing the spine-like appendages by which the hydrocladia are here replaced.

Figs. 4–6.—*Aglaophenia macgillivrayi.* Magnified details.

Fig. 4.—Portion of a hydrocladium; lateral view.

Fig. 5.—Same; front view.

Fig. 6.—Corbula.



1_3 ACANTHOCLADIUM HUXLEYI. 4_6 AGLAOPHENIA MACGILLIVRAYI.