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THE AUTHORS OF THE SEVERAL PAPERS ARE INDIVIDUALLY RESPONSIBLE FOR THE  
SOUNDNESS OF THE OPINIONS GIVEN AND FOR THE ACCURACY OF THE  
STATEMENTS MADE THEREIN.

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ART. XII.—*Further Notes on Australian Hydroids—IV.*

BY W. M. BALE, F.R.M.S.

(With Plates XVI. and XVII.).

[Read 10th October, 1918].

SILICULARIA UNDULATA (M. and T.)

*Eucopella undulata*, Mulder and Trebilcock, Geelong Naturalist (2), vi., 1914, p. 10, pl. ii., figs. 5-7.

*Silicularia undulata*, Bale, Proc. Roy. Soc. Vict., N.S., xxvii., 1914, p. 89.

I have to thank Mr. R. E. Trebilcock for specimens of this hydroid, stained and mounted in balsam, which have enabled me to examine the structure more satisfactorily than was possible with my specimens of *S. campanularia*, in which the hydranths were partly retracted, and blackened to almost complete opacity. In Mr. Trebilcock's specimens the hydranths were widely expanded, rendering the investigation of their structure comparatively easy.

The hydrothecae are similar to those of *S. campanularia*, and the lateral inflations of the hydranths are obvious; these, however, are not in any way to be regarded as distinct structures, the condition simply being that the body is "lop-sided," the inflated side occupying the space over the lower lip of the hydrotheca, while the distal portion of the hydranth leans over the opposite lip. The peduncles are spirally undulated, like those of *Orthopyxis caliculata*, and they are gradually enlarged at their junction with the hydrotheca, in marked contrast to those of *S. campanularia*, which have their thick walls narrowed in at the corresponding points. It is interesting to note the parallelism in regard to the peduncles of *Orthopyxis* and *Silicularia*, the massive thick-walled straight peduncles of *S. campanularia* having their counterparts in *O. compressa* and *O. angulata*, while the thin wavy stalks of *S. undulata* correspond similarly with those of *O. caliculata* and other species.

The point of most interest is the structure of the oral region, especially as this proves identical in its main features with that of *Orthopyxis caliculata*, and also with that of *Campanularia grandis* Allman, the latter of which has been made by Broch the type of a new family—the BONNEVIELLIDAE.

The salient character is in the origin of the proboscis, which is derived from the tentacles. These are united in the proximal portions, so as to form a calyx, lined by an endodermal layer, which extends to its margin, at which part the tentacles become free. From the edge of the calyx springs the proboscis, which is normally dome-shaped, with a small central aperture, but which, when the hydranths are fully expanded, stands erect and open, like the corona of a Narcissus. This corona is seen in optical section to consist of a mesosarc branching off from the united mesosarcs of the tentacular calyx, with, outside it, a thin pellicle of ectoderm, and inside a thick layer, presumably endodermal, which continues downward uninterruptedly into the layer of similar tissue which lines the calyx. As usual in the order, this tissue is denser and closer than the endoderm in the lower part of the body; it forms a layer with a well-defined inner boundary, and is uniform in thickness for most of its extent, but becomes thicker opposite the extreme bases of the tentacles, below which it gradually passes over into the ordinary endoderm of the body cavity.

The difference between this type of hydranth and that of a typical Campanularian, such as *Obelia*, is very marked. In *Obelia* it is true the basal portions of the tentacles are adherent, forming a calyx, but this is composed of the tentacles alone, which are borne on the hydranth quite apart from the large mobile proboscis, which they surround at some distance. In *Silicularia*, on the other hand, we have a hypostome of which the lower half is composed of the tentacular calyx, with its cellular lining, while the upper half (proboscis), is a free extension of this same calyx. The structure may probably be explained on the assumption that the ordinary proboscis has been modified by its proximal portion becoming completely adherent to the tentacular calyx (forming its lining), while the upper part remains free and retains its mobility.

The proboscis, or free portion of the hypostome, is encircled by a band of irregular rounded or convoluted masses of a special granular tissue, which project from its outer surface with a thickness about equal to that of the proboscis-wall itself. Their function is not obvious.

The hydranth-body is roughly globular, with a distinct salient angle which fits into a small sinuation in the hydrotheca. Its diameter, from the base to the root of the tentacles, averages about .22 mm., and the distance thence to the edge of the proboscis is about .15 mm. The proboscis, when erect, is about .20 across.

There are usually about 22 tentacles, which, fully expanded, reach about .60 mm. in length.

In my specimens of *S. campanularia* the proboscis, which I have described as an annular band bordering the calyx, is narrower than in the present species, and it is spread outward nearly horizontally; in those specimens, however, the tentacles are mostly reverted, besides being contracted, and I have had no opportunity of observing well-preserved specimens.

#### Note on the relationships of SILICULARIA, ORTHOPYXIS and BONNEVIELLA.

In the last paper of this series I have referred to the "annular band" of *Silicularia* as the homologue of the proboscis of *Orthopyxis*; the study of *S. undulata*, however, and comparison with several species of *Orthopyxis*, has satisfied me that the two genera are, in regard to the form of the hypostome, really identical in structure. The specimens of *Orthopyxis* which were most favourable for examination belonged to the form which I have called *O. angulata*, but I was able to satisfy myself that other species, including *O. caliculata*, were of the same type, the hypostome being formed, in its lower half, by the tentacular calyx, with its cellular lining, and in the upper half by the free extension or outgrowth of the same, which constitutes the proboscis. Whether the external band of granular material which I have noticed as encircling the proboscis in *S. undulata* is present in *Orthopyxis* was, however, not discernible in the specimens, which were by no means in so favourable a condition for examination as the *Silicularia*.

That so well known a species as *O. caliculata* should prove so different in the character of its hypostome from the other forms (such as *Obelia*) with which systematists generally class it, was an unexpected result, as even Agassiz, in his study of this species, states that the structural elements are the same as those of most campanularians (including *Obelia*). On referring, however, to Jickeli's second paper on "Der Bau der Hydroidpolyphen," which contains a careful study of *C. caliculata*, I find the remark "Der Raum zwischen Hypostom und Armen ist hier so reducirt das auf Langsschnitten die Wandung des ersteren nur wie eine Abzweigung der letzteren erscheint." This might seem to imply merely a close approximation between the hypostome and the tentacles; the figure of a longitudinal section shows distinctly, however, the mesosarc of the proboscis springing directly from that of the tentacles, and

agrees perfectly with the foregoing account of *S. undulata*. It is to be noted that Jickeli describes the lining of the hypostome as endodermal.

In 1909<sup>1</sup> Broch established the genus *Bonneviella* and the family BONNEVIELLIDAE for the *Campanularia grandis* of Allman, on characters which, he claimed, distinguish it sharply from all other Campanularians. These characters, however, are mainly those which Jickeli had already shown to exist in *C. caliculata*, with this exception, that the distal cavity which is enclosed above by the proboscis or corona (which he calls the *veloid*), is lined by ectoderm instead of endoderm, and is regarded by him as a pre-oral cavity, not as a hypostome. He says:—"The greatest difference from all other hydroids is found in the mouth-part of the hydranths. Right on the place of union of the tentacles, and on their inner side, is found a velum-like lamella, the "veloid." This veloid is extended like a disc over the whole mouth-part of the hydranths, and has only a small centrally situated hole through which admission is obtained to a pre-oral cavity. The veloid is composed of two ectodermal cell-layers, which are divided by a membrane, this membrane apparently springs directly from the stütz-membrane of the tentacles, and must be considered as a continuation of the same. Inside the veloid the ectoderm is continued as a single-layered cylinder-epithelium which, however, passes over into a cylinder-epithelium of several layers towards the bases of the tentacles. The transition from ectoderm to endoderm is found at the under side of the tentacle-bases, so that an ectodermal food-passage seems to be formed; whether, however, this is caused by the contraction of the hydranth I do not venture to decide with certainty.

Fam. BONNEVIELLIDAE.

"Thecate Hydroida provided with a veloid, so that a pre-oral cavity is constituted. The single known genus

BONNEVIELLA, nov. gen

"**Trophosome.** Hydranth with a single series of tentacles which are united together as far as the veloid. Ectoderm-lined food-passage.(?) Hydrothecae bell-shaped, with thin diaphragm. Erect colonies which spring from a rhizocaulon.

"**Gonosome.** Gonangia dispersed over the stem. Gonophores sessile. Colonies sexually distinct."

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1 *Nyt Magazin f. Naturvidensk.*, B. 47, 19 9, p. 195, fig. 1.

From the foregoing account, and from Broch's figure, it is obvious that in the most important feature—the form of the oral portion of the hydranth—the species described agrees absolutely with *Silicularia undulata* and *Orthopyxis caliculata*, as I have described them, and also with Jickeli's figure of the latter species. The likeness is emphasized in the description of *B. regia* by Nutting, who says that the "veloid" is dome-shaped, in which it agrees with the proboscis of the above-mentioned two species when not expanded.

We have therefore in *Bonneviella* and *Orthopyxis* precisely the same structure of the oral region, except that in the one case the proboscidial cavity is said to be lined with ectoderm, while in the other the lining membrane is described as endodermal; a difference which could hardly be demonstrated in the absence of sections. For it is recognized that in the ordinary Campanularian hydranth the hypostome is lined with a special endoderm, consisting of cylinder-cells smaller and with smaller nuclei than those of the main body-cavity (probably implying special functions), while Broch describes the ectodermal lining of the distal cavity in *Bonneviella* as also consisting of cylinder-epithelium. The thickening of the lining membrane opposite the bases of the tentacles is equally noticeable in *Bonneviella* and in *Silicularia*.

I have seen no sections, but on the authority of Jickeli I regard the proboscidial cavity of *Orthopyxis* as a true endoderm-lined hypostome, and the very close affinity existing between that genus and *Silicularia* seems to justify the ascription of the same character to the latter. The outstanding difference between the hydranths of these two genera is the unilateral inflation in *Silicularia*, which is correlated with the remarkable form of the hydrothecae.

A peculiarity of *Bonneviella* is the structure of the endoderm of the tentacles, the cells being in several series, a feature which Broch says is not found elsewhere among the Thecaphora.<sup>1</sup>

#### Note on the name ORTHOPYXIS.

Dr. Fraser, in a recently-published paper,<sup>2</sup> advocates the use of the name *Eucopella* in preference to *Orthopyxis*, on the ground that Agassiz failed to indicate the special characters which induced him to separate *O. caliculata* from other Campanularians. I do

<sup>1</sup> It may be noted that Stechow does not accept Broch's interpretation of the oral structure in *Bonneviella*, but considers that the figure indicates the existence of a conical hypostome, such as characterises the Lafosidae.—Hydroïdpolypen der japanischen Ostküste, ii., 1913, p. 23.

<sup>2</sup> Hydroids of Eastern Canada. Ottawa, 1918.

not think, however, that it is the practice of zoologists to reject a proposed genus or sub-genus merely because a formal diagnosis is wanting, when, as in this instance, a full description is supplied. The case is exactly parallel with that of *Ectopleura*, which also was established by Agassiz without a formal diagnosis. Allman complained that Agassiz had not definitely stated the points on which he founded the genus, but nevertheless, considering it valid, he unhesitatingly accepted Agassiz' name for it. Both Professor Nutting and Dr. Stechow agreed that *Eucopeella* should be cancelled in favour of *Orthopyxis*.

The fact, cited by Fraser, that Hincks did not accept Agassiz' name, does not bear upon the question. Hincks did not accept the genus itself as distinct from *Campanularia*; had he done so it is not conceivable that he would have rejected the name. I cannot agree with Fraser's statement that we "do not know, and never can know, that Agassiz had any such characters [as those of *Eucopeella*] in mind when he applied the subgeneric name *Orthopyxis* to his species *poterium*." Agassiz states expressly that he finds nothing in the trophosome to distinguish *Orthopyxis* from other Campanularians; we know, therefore, that his separation of it depends solely on the peculiar structure\* of the reproductive zooid, which is precisely the character on which *Eucopeella* was established.

#### SACCOLINA, n. gen.

———— n. gen. Bale., Proc. Roy. Soc. Vict., vi. (N.S.), 1893, p. 96.

?*Tibiana*, Lamarck, in part, An. s. Vert., ii., 1816, p. 149.

Hydrophyton an erect tube of irregular form; zooids produced from short tubular processes, which are borne on inflated areas on all sides of the hydrocaulus. Hydranths and gonozooids unknown.

The single species for which this genus is established, though so imperfectly known that we are quite in the dark as to its affinities, is readily identifiable, and as I have already published an account of it, but without name, and as it cannot be assigned to any known genus, I now propose for it the name *Saccolina*. This name is borrowed from Lamarck, who states that he at first intended applying it to the zoophyte (apparently very closely allied to the present species), for which he ultimately decided upon the name *Tibiana ramosa*.

Full particulars will be found under the specific description.

## SACCULINA ARENOSA, n. sp.

———, n. gen. et sp.?, Bale, Proc. Roy. Soc. Vict.,  
vi. (N.S.), 1893, p. 96, pl. iii., figs. 1, 2.

*Tibiana ramosa*, Lamarck, An. s. Vert., ii., 1816, p. 149.

Lamouroux, Hist. Polyp. Cor. Flex., 1816, p. 219.

Schweigger, Beobacht. auf. naturh. Reisen, 1819, pl.  
v., fig. 56.

This curious zoophyte, which was described by me in 1893, but not named, is so distinctive in character that there seems to be little doubt as to the propriety of assigning it to a separate genus, even though it is so imperfectly known that we are entirely ignorant regarding its position. In many respects it agrees with the *Tibiana ramosa* of Lamarck, an insufficiently described species not known to later observers.

The hydrocaulus consists of string-like stems, sometimes with a few ascending branches, which may be given off in a cluster, eight or nine inches, or perhaps more, in height, monosiphonic and not distinctly jointed; it differs markedly from the ordinary monosiphonic stem in the singular irregularity of its form, due to the presence of numerous swellings on all sides from which the polyp-tubes originate, and its strangely bent and contorted state in parts, especially near the summit. Its perisarc has a cartilaginous appearance, is of tough consistence, between dirty whitish and light brown in colour, and in the older portions very thick but not opaque; the surface showing innumerable markings such as irregular striations and wrinklings, with round spots somewhat resembling oil-globules.

The polyp-tubes are very narrow in proportion to the diameter of the hydrocaulus, springing from all sides and without regular order; those on the older portions of the polypary are mostly directed upwards from the stem-protuberances, from which they are not separated by any partition or constriction; while in the distal region, where there is the greatest irregularity of the stem, they are often more distinctly defined and more variable in their direction. In many of the older ones the central channel is not more than one-third of their total diameter. Some of these little tubes are short, their length about equalling their width, but more commonly they are two or three times as long. Close to the end they have an annular thickening, darker in colour than any other part of the perisarc, outside which the margin is quite sharp, often slightly ragged. Regenerations

are frequent, including two to four tubes in succession, and I have seen an instance where the regenerated tube was bifurcated. In several instances I observed just within the margin the remains of what seemed to be a septum with a small central aperture. In many portions of the polypary the central thread of coenosarc, or rather its disintegrated remains, persisted, with branches running off to the polyp-tubes; nowhere, however, were any hydranths to be found, nor any remnants of them, nor were any hydrothecae present.

In some instances the tubes bore small collapsed membranous-looking capsules, which seemed to be the earliest stages of the gonothecae. Two or three capsules were observed in a more advanced condition; these were about 1.2 mm. in length, of a compressed ovate form, and much resembling the male gonangia of *Halecium gracile*; they contained the remains of the zoids. On making a more extended examination of the material than I had previously done, in the hope of discovering the hydranths, I found several much larger receptacles, presumably adult gonangia. They were elliptic sacs of about 4-5 mm. in length, formed of an extremely thin, colourless perisarc, and having the whole external surface coated with grains of sand, Foraminifera, and calcareous fragments. These were firmly adherent, and on forcible removal with a needle left their impression on the perisarc. The capsules appeared empty, so far as could be observed through the interstices of the sand-grains, but no apertures were visible; it is quite possible, however, that ruptures might be present, but not traceable owing to the investment of foreign matters.

According to the descriptions of Lamarck and Lamouroux, the *Tibiana ramosa* of the former author would seem to be a form much resembling the present, but with the polyp-tubes less developed. In *Tibiana*, Lamarck comprised zoophytes presumably allied to *Tubularia*, but with the polyps borne laterally along the stem and branches instead of terminally. *T. fasciculata*, the type-species, has often been figured; it is acutely zig-zagged, with an aperture at each angle; it has not been identified, and is probably not a Hydroid. *T. ramosa*, according to Lamouroux, is most likely not a *Tibiana*, and, in fact, there is no reason to assume any relationship between the two species.

Schweigger has figured *T. ramosa*, but very crudely; the figure, however, shows all the irregularity which characterises the present species; some of the polyp-apertures seem merely holes in the perisarc, while others are situated in distinct protuberances. On

the whole, judging from the figure and the descriptions, the most that can be said is that they may just possibly be intended for the species before us.

The specimens of both species of *Tibiana* were said to be in the Museum d'histoire naturelle, but Billard does not refer to them in his revision of the Lamarck collection. *T. ramosa* is said to inhabit the seas of New Holland.

#### EUDENDRIUM GENERALE von Lendenfeld.

*Eudendrium generalis*, v. Lend., Proc. Lin. Soc. N.S.W., ix., 1884, p. 351, pl. vi. Kirkpatrick, Sci. Proc. Roy. Dubl. Soc., vi. (N.S.), 1890, p. 607, pl. xv., figs. 1-2.

*Eudendrium generale*, v. Lend., Proc. Lin. Soc. N.S.W., ix., 1884, p. 621.

Hydrosoma about 3 inches in height, stem fascicled at base, branched and re-branched pinnately, branches ascending, alternate, rather distant, both series borne towards the front; branches and branchlets irregularly annulated for a short distance above their origin, and occasionally elsewhere.

Hydranths large, with about 18-20 tentacles, 4-6 clusters of nematocysts forming a cirlet a little above the base.

Female gonophores about .4 mm. in diameter, 3-6 on a hydranth, crowned with a convex cap of nematocysts. Male gonophores moniliform, borne in verticils on the base of a hydranth. Hydranths which bear gonophores often more or less atrophied.

Specimens of this hydroid were dredged in Port Phillip by the late Mr. J. Bracebridge Wilson. Von Lendenfeld's figure shows four female gonophores (called by him the male) of equal size and symmetrically arranged around a hydranth; in my specimens there are from three to six, of varying size according to the order of development.

To the accounts of von Lendenfeld and Kirkpatrick it may be added that each hydranth is provided with about four to six small pads or cushions consisting of clusters of thread-cells, and that most of the female gonophores are surmounted by a cushion of the same kind, but usually larger, from which stream out tufts of filaments about 1 mm. in length, and slightly thickened at the ends. In *E. arbuscula* and *E. capillare* similar structures are found on the male gonophores.

## OPHIODES AUSTRALIS, n. sp. (Plate XVI., Fig. 1).

Hydrorhiza a network of stout tubes, becoming more or less fascicled; stem straight, polysiphonic, between one and two inches in height, branches short, straight, monosiphonic, divided into internodes by straight or very slightly oblique joints; each internode supporting a hydrophore close to the top.

Hydrophores (primary) alternate, seated on very short processes of the internodes, long, normally divided by a slight constriction into two parts—a proximal, which is cylindrical, and a distal, which is slightly expanding, with a narrow limbus and a circle of bright points. Secondary hydrophores when present given off laterally from the proximal portion of the primary one, a third and fourth sometimes present, each springing in the same way from its predecessor.

Sarcothecae small vase-shaped cups, springing from the sides of the primary hydrophores, or sometimes of the others.

Hydranths stout, constricted below the crown, with about 24-26 tentacles.

Gonangia barrel-shaped or nearly cylindrical above, tapering below; summit broad and flat; borne on the hydrorhiza.

Loc.—Port Phillip Heads (Mr. J. Bracebridge Wilson), Green Point, Port Jackson (Australian Museum).

The stems originate as small monosiphonic shoots, bearing hydrophores, but soon become polysiphonic by the addition of supplementary tubes which grow upwards from the hydrorhiza; sometimes also these tubes run for a short distance along the proximal parts of the branches. The latter may spring from the supplementary as well as from the primary stem-tubes.

In some cases the hydranths may be single, but more commonly they are borne two by two, each primary hydrophore giving origin to a secondary one from the side near the base, and both supporting hydranths at the same time. Less often three and four may be produced, each from the preceding one; this occurred on the older parts of a shoot. The hydrophores themselves are of the type usual in the family, but I saw no instance of the regeneration-growth so characteristic of most of the species.

Sarcothecae were not numerous, and did not occur with any regularity, most of the hydrophores not being provided with them.

## SERTULARELLA RENTONI Bartlett. (Plate XVI., Fig. 2).

*Sertularella rentoni*, Bartlett, Geol. Nat. (2), iii., 1907, p. 43, fig. —. Mulder and Trebilcock, Geol. Nat. (2), vi., 1914, p. 9, pl. i., fig. 4, pl. iii., fig. 1.

Hydrocaulus simple or pinnate, twisted at the base, about 6 mm. in height, divided by slender twisted joints into internodes, each bearing a hydrotheca about the middle or slightly above.

Hydrothecae tubular or sub-conical, adnate a little less than half their length, widely divergent and nearly in one plane, aperture not contracted, margin with three teeth, one superior and two lateral; no internal teeth.

Gonothecae springing from the base of the hydrocaulus, large, sub-globular, smooth; a short conical neck rising from within a slight depression at the summit, aperture small, entire.

Loc.—Queenscliff; Bream Creek; (Bartlett).

The trophosome of this species so closely resembles that of *S. pygmaea* that it would be no easy matter to distinguish between them with certainty in the absence of the gonangia, which, however, are entirely unlike, those of *S. pygmaea* being of the annulated type characteristic of *S. Johnstoni*. The hydrothecae of the present species seem to average slightly longer than those of *S. pygmaea*, in other respects, including the presence in many cases of a membranous oblique septum, they are alike, as are the angular strongly twisted internodes.

*S. unilateralis* (Lamouroux)<sup>1</sup> is like *S. rentoni* in the gonangia as well as in the trophosome, and seems to be distinguishable mainly by the presence of internal teeth in the hydrotheca.

## SERTULARELLA DIAPHANA Allman. (Plate XVI., Fig. 5).

*Sertularia tridentata*, Lamouroux, Hist. Polyp. Cor. Flex., 1816, p. 187.

*Thuiaria diaphana* (Busk. M.S.), Allman, Journ. Linn. Soc. Zool., xix., 1885, p. 145, pl. xviii., figs. 1-3.

*Thuiaria hyalina*, Allman, "Challenger" Hydroida, Pt. II., 1888, p. 69, pl. xxxiii., figs. 2-2a.

*Sertularella lata*, Nutting, Amer. Sert., 1904, p. 85, pl. xviii., fig. 10; Idem, Bull. U.S. Fish Comm., 1905, p. 948. Billard, Arch. de Zool. exp. et gén. (4), vii., 1907, p. 346, fig. 4.

<sup>1</sup> Billard, Ann. Sci. Nat. (9), ix., 1909, p. 315, figs. 3, 4.

- Sertularella Torreyi*, Nutting, Bull. U.S. Fish Comm., 1905, p. 949; pl. iv., fig. 4; pl. xi., figs. 2, 3.
- Sertularella speciosa*, Congdon, Proc. Amer. Acad. of Arts and Sci., xlii., 1907, p. 476, figs. 24-28.
- Sertularella tridentata*, Billard, Ann. Sci. Nat., Zool. (9), ix., 1909, p. 312; xi., 1910, p. 14. Stechow, Hydroid-polypen der jap. Ostküste, II., 1913, p. 137, figs. 111-113; (No. 17 *Thuiaria* sp., Inaba, Zool. Mag. Tokyo, 1890, figs. 46-48). Bale, "Endeavour" Report, Part III., 1915, p. 288.

In the "Endeavour" Report I have referred to this species (under the name of *S. tridentata*) when dealing with *S. lata*, which had been confused with it, pointing out that the two species agree so closely as to be easily mistaken for one another in the absence of the gonosome. I had not then seen the species described by Billard as *S. tridentata*, but have since, through the kindness of my friend, Mr. James Wilson, been furnished with fertile specimens collected by the Rev. Dr. Porter at Moreton Bay, from which locality Busk's specimens, described by Allman as *Thuiaria diaphana*, were also obtained.

In the above-cited paper are enumerated the main differences between the gonangia (which indeed are dissimilar in every particular), and I will only add that those of *S. lata* are very large (about 3.5 mm. in length), while those of the present species are smaller, more delicate, and hyaline. They are not so symmetrical as might be expected from the published figures, but apt to be rather irregular, with the longitudinal plications sometimes distinct, but often faintly marked, and in some cases entirely wanting.

But apart from the gonangia I found no difficulty in distinguishing the two species. It is true that many of the hydrothecae intergrade, but on comparing typical specimens, and especially the proximal portions of the pinnae, we find that in *S. lata* the hydrothecae are closer together, are less divergent laterally, and not turned so much to the front, and that the apertures are more nearly vertical. In all cases the figures cited in the list of synonyms agree in these particulars with the form before us rather than with *S. lata*. The differences are doubtless no more than might reasonably be expected to occur within the limits of a species, and observers meeting with infertile specimens would naturally associate them together. I have probably done this in regard to certain specimens from Port Stephens, which I considered

as a varietal form of *S. lata*; these agree so completely with my present specimens that I have now little doubt that they really belong to the same species. Of course if it should be found that the trophosomes of either or both species intergrade so far as to bridge the slight gap between them it will have to be recognised that certain identification will be possible only in the presence of the gonangia.

Whether the species before us is really the *S. tridentata* of Lamouroux is doubtful. The figure published by Billard in 1907 as *S. lata* undoubtedly belongs to the present species, but unfortunately Billard did not give a figure of Lamouroux' specimen in his revision of that author's collection; he mentions, however, that the hydrothecae were as closely set as in my figure of *S. lata*, a character which would tend to indicate that Lamouroux' specimens may belong to the true *S. lata*, or else that they may be, as to the trophosome, intermediate. If they are not sufficiently distinctive to be referred with certainty (the gonosome being absent) to either form they should be ignored; in any case unless they can be clearly identified with the present species the name of *S. diaphana* (Allman) must remain.

I follow Billard in associating *S. Torreyi* Nutting with his "*S. tridentata*," and I find nothing to distinguish *S. speciosa* Congdon from Nutting's species. *T. diaphana* Allman has also been associated with these by Billard, in this case after examining the original type. The gonangia were observed in all these forms. Allman's types of *T. hyalina*, in which the gonosome was wanting, have been examined by Billard and also by Nutting, who both considered the species the same as the present. Neither of these observers refers to the hydranths of *T. hyalina*, regarding which Allman says that the hydranth is quite unable, even when most fully retracted, to withdraw the tentacular crown into the hydrotheca, and that notwithstanding the complete development of the latter the hydranths derive almost as little protection from them as those of *Halecium* do from the hydrothecae in that genus. This description is not applicable to *S. lata*, as I have a specimen including the hydranths, which are fully retracted into the hydrothecae, and with ample space to spare. Congdon has observed the hydranths in his *S. speciosa*, and has figured them expanded, but says nothing as to their retractility.

## SERTULARIA MINUSCULA Bale, nom. nov.

*Sertularia minima*, Thompson, var. *tubatheca*, Mulder and Trebilcock, Geol. Nat. (2), vi., 1914, p. 40, pl. iv., figs. 1-1d.

*Sertularia pusilla*, Bale, "Endeavour" Rept., Pt. iii., 1915, p. 271, pl. xlvi., figs. 3-6.

Not *S. tubatheca*, Allman, Mem. Mus. Comp. Zool. Hav., v., 1877, p. 24, pl. xvi., figs. 5-6.

Not *S. pusilla*, Thornley, Willey's Zool. Results, Pt. IV., 1900, p. 455.

In naming this hydroid *S. pusilla*, I overlooked the fact that Miss Thornley had already applied that name to another species; the above name is therefore substituted.

## SERTULARIA MCCALLUMI Bartlett. (Plate XVI., Figs. 3-4).

*Sertularella McCallumi*, Bartlett, Geol. Nat. (2), iii., 1907, p. 62, fig. —. Mulder and Trebilcock, Geol. Nat. (2), vi., 1914, p. 7, pl. i., figs. 1-3.

Hydrocaulus simple, divided by oblique joints into short internodes, each bearing a hydrotheca about the middle, internodes with a septal ridge.

Hydrothecae long, conical, smooth, adnate for about one-third of their length, all springing from the front of the hydrocaulus but widely divergent alternately to right and left, aperture slightly expanding, with two large rounded lateral teeth or lobes.

Gonothecae ?

Loc.—Queenscliff; Bream Creek; (Bartlett).

In this curious species the hydrothecae are borne so much to the front as to recall (in side view) the arrangement in *Hydrallmania*, an appearance which is emphasised by the closeness of the hydrothecae, owing to the shortness of the internodes. The latter, separated by very oblique nodes, have a transverse fold at the back, accompanied by an internal ridge, less oblique than the nodes. The aperture of the hydrothecae resembles that of *S. macrocarpa*, and as in that species the adcauline wall is thickened up to the margin, which is firm and smoothly outlined.

In habit the species much resembles *Sertularella secunda* Kirchenpauer, which, however, differs in having a tridentate aperture, as in *S. Johnstoni*. According to Levinsen's system, *S. McCallumi* would be ranked under the genus *Odontotheca*.

## PLUMULARIA FILICAULIS Poëppig.

- Plumularia filicaulis*, Poëppig, Kirch., Abh. Nat. Ver. Hamb., vi., 1876, p. 47, pl. v., fig. 6. Bale, Cat. Aust. Hyd. Zooph., 1884, p. 134, pl. xi., figs. 6, 7, pl. xix., figs. 41, 42. Idem, Proc. Roy. Soc. Vict. (N.S.), vi., 1893, p. 115. Idem, "Endeavour" Report, iii., 1915, pp. 293, 295. Nutting, Amer. Plum., 1900, pp. 60, 76, pl. ii., fig. 6. Hartlaub, Zool. Jahrb., Suppl. vi., 1905, iii., p. 682, fig. M<sup>5</sup>. Mulder and Trebilcock, Geelong Nat. (2), iv., 1909, p. 34. Idem, Geel. Nat. (2), vi., 1915, p. 52. Idem, Geel. Nat. (2), vi., 1916, p. 80, pl. x., figs. 6a, 6b, pl. xi., figs. 3, 3a.
- Plumularia lucerna*, Mulder and Trebilcock, Geel. Nat. (2), iv., 1911, p. 122, pl. iii., fig. 4. Idem, Geel. Nat. (2), vi., 1915, p. 52.
- Antennella filicaulis*, Bedot, Rev. Suisse de Zool., xxv., 1917, pp. 111-124.

Experience has shown that it is quite usual in this species for pinnate stems and simple hydrocladia to spring from the same hydrorhiza; the var. *indivisa*, therefore, which I formerly proposed, cannot be maintained.

In a colony which was growing on *Laminaria* I found that from certain points the hydrorhiza radiated in four directions at right angles to each other. From the central point sprang a pinnate shoot, while the shoots which originated from other parts of the hydrorhiza were usually (but not invariably) simple hydrocladia.

An interesting feature is the thin and delicate condition of the lateral sarcothecae, a character which is no doubt correlated with their protected situation partly behind the lateral webs which join the hydrotheca to the hydrocladium. Not only is the sarcotheca-wall thin and towards the base even flaccid, but the septum which in sarcothecae of this type usually divides the cavity into two loculi, is in most cases quite obsolete, so that the sarcotheca is practically monothalamic. But here and there one finds a sarcotheca in which the septum persists in a vestigial condition, being reduced to a very slight annular ridge.

The delicate nature of the lateral sarcothecae no doubt renders them very liable to detachment, and so accounts for the occasional occurrence of specimens in which these appendages are entirely wanting.

In a paper by Bedot, just to hand, the species is referred to the genus *Antennella*.

## PLUMULARIA SCABRA Lamarck. (Plate XVII., Figs. 4-5).

- Plumularia scabra*, Lamarck, An. s. Vert., 1816, p. 127.  
Blainville, Man. d'Act., 1834-7, p. 478. Bale, Cat. Aust Hydr. Zooph., 1884, p. 145. Billard, Ann. Sci. Nat. (9), v., 1907, p. 322. Idem, Ann. Sci. Nat. (9), xi., 1910, p. 36. Idem, Siboga-Exp. i., Plum., 1913, p. 47.
- Plumularia effusa*, Busk, Voy. of Rattlesn., i., 1852, p. 400. Kirchenpauer, Abh. Nat. Ver. Hamb., vi, 1876, p. 46, pls. i., v., figs. 4, 4b. Bale, Cat. Aust. Hyd. Zooph., 1884, p. 129, pl. xviii., fig. 5. Idem, Trans. and Proc. Roy. Soc. Vict., xxiii., 1887, p. 94.
- Acanthella effusa*, Allman, Rept. Chall. Plum., 1883, p. 27, pl. vi., figs. 1-4. Marktanner-Turneretscher, Ann. k.k. naturh. Hofmuseums, v., 1890, p. 260. Kirkpatrick, Sci. Proc. Roy. Dublin Soc., vi. (N.S.), 1890, p. 610, pl. xiv., fig. 4. Campenhausen, Abh. d. Senckenb. naturf. Gesellsch. Frankfurt-a-M., xxiii., 1897, p. 315.

I have been favoured by Dr. Kirkpatrick with fragments of both Busk's and Allman's specimens of this species, which I had not previously seen. It is very closely allied to *P. badia* Kirchenpauer (*P. Ramsayi* Bale), and some of the points of contrast between them to which I referred in the "Catalogue" do not exist, but were due to errors in Kirchenpauer's figures and description. The hydrocladia in *P. scabra* are borne on stout bracket-like apophyses exactly as in *P. badia*, but in all the specimens which I have seen they spring more from the front of the hydrocaulus (a feature also noted by Kirchenpauer). The two species are so much alike that small specimens cannot be differentiated by the naked eye, but they differ noticeably in the form of the hydrothecae, and the position of the anterior sarcothecae, as well as in the spinous processes which distinguish *P. scabra*.

One of Kirchenpauer's figures—Pl. v., fig. 4b.—is good, only erring in showing a septal ridge on the proximal side of the anterior sarcotheca, instead of between it and the hydrotheca. As Allman has already noted, the stout spines which towards the tips of the branches replace the hydrocladia, are not, like the latter, jointed to the bracket-like apophyses, but are continuous with them. Between these and the ordinary hydrocladia, however, transition forms are found, which, commencing as hydrocladia, terminate in the characteristic spines.

The hydrocladia are so delicate as to appear like a fringe of fine cilia, and the hydrothecae far too small to be conspicuous to the naked eye; the habit is correctly shown in Kirchenpauer's figure (which agrees exactly with a drawing by Mr. Busk), and therefore differs widely from Allman's figure.

PLUMULARIA ROTUNDA M. and T. (Plate XVII, Fig. 1)

*Plumularia delicatula* var. *rotunda*, Mulder and Trebilcock, Geol. Nat. (2), iv., 1911, p. 116, pl. ii., fig. 2.

Hydrocaulus monosiphonic, pinnate, stem divided into long internodes, each bearing a hydrocladium but no hydrothecae. Hydrocladia alternate, borne near the summit of the stem-internodes, the first internode short, without appendages, the others alternately long and short, only the former bearing hydrothecae.

Hydrothecae elliptic, lying along the internode, front wall arched, becoming thicker towards the aperture, where it is incurved; aperture small, oblique, margin concave at the sides, not everted, back entire, free.

Sarcothecae bithalamic, canaliculate, one below each hydrotheca and two lateral above, one on each intermediate internode, one (or two?) in each axil, and one on the lower part of each stem-internode, median ones stout and fixed, laterals thinner, moveable?

Gonosome.?

Loc.—Bream Creek, Pt. Phillip, (M. and T.).

I have only seen one specimen, which was about 3 mm. in height, but was incomplete. It is most nearly related to *P. delicatula* and *P. setaceoides* so far as the trophosome is concerned. The portion of the hydrothecal internode above the hydrotheca is often divided off by a distinct constriction.

The most characteristic feature is the form of the hydrothecae, which in side view are considerably stouter than those of *P. delicatula*, with the base more elevated; while the incurved thickened lip is also peculiar. In *P. delicatula* the border is convex at the sides, in *P. rotunda* it is concave, and more contracted. Only one sarcotheca was seen in each axil, but as in one case it was at the back instead of in front, it is not unlikely that there may have been originally two. On the processes supporting the hydrocladia thin places could be detected, with apparent apertures, but not forming distinct mammilliform prominences, as in many species.

PLUMULARIA EVERTA M. and T. (Plate XVII., Fig. 2).

*Plumularia everta*, Mulder and Trebilcock, Geel, Nat. (2), iv., 1909, p. 31, pl. i., fig. 5.

Hydrocaulus monosiphonic, pinnate, lower part with stout perisarc, divided by indistinct transverse joints at irregular intervals, and bearing sarcothecae only; upper part thin, divided by long oblique joints into internodes, each bearing a hydrocladium and a hydrotheca. Hydrocladia alternate, the first internode (or two internodes) very short, without appendages, the rest alternately long and short, only the former bearing hydrothecae.

Hydrothecae swollen and rounded below, strongly contracted on the adcauline side a little below the aperture, which is entire and slightly everted at the back.

Sarcothecae bithalamic, canaliculate, one below each hydrotheca and two lateral above (pedunculate), one midway between every two hydrothecae, on the intermediate internode (or, on the stem, on the same internode as the lower), two in line on each of the lower stem-internodes, and a few on the hydrorhiza; those in front of the hydrothecae stout and fixed, the rest moveable.

Gonosome?

Loc.—Torquay, Vic. (M. and T.).

Readily distinguished by the peculiar form of the hydrothecae. These have the adcauline side, where it is recurved under the everted margin, much thickened and in certain positions of the hydrotheca it looks like an intrathecal ridge.

Most commonly the intermediate internodes on the pinnae are distinct, but sometimes the nodes are wanting, so that the superior sarcotheca is on the hydrothecal internode, and this is normally the case with the stem. The robust lower part of the stem, with its transverse nodes, contrasts strongly with the delicate oblique-jointed upper part, which, in the only specimen I possess, is only about half the total height (5 mm.). I quote from Mulder and Trebilcock in regard to the sarcothecae of the lower stem, and of the hydrorhiza, which I have not seen. On the hydrocladia the first internode after the basal ones supports a sarcotheca only.

PLUMULARIA BALEI Bartlett. (Plate XVII., Fig. 6).

*Plumularia balei*, Bartlett, Geel. Nat. (2), iii., 1907, p. 65, fig. —. Mulder and Trebilcock, Geel. Nat. (2), iv., 1909, p. 29, pl. i., figs. 1-3. Briggs, Records Aust. Mus., xii., 1918, p. 41, pl. v., fig. 8-10.

Not *Plumularia balei*, Billard, Arch. de Zool. exp. et. gén. (5), viii., 1911, p. lxiii., fig. 3.

Hydrocaulus monosiphonic, pinnate, about 8 mm. in height, two or three indistinctly divided internodes at the base of the stem without pinnae, the rest divided by oblique joints into short internodes, each of which bears a hydrotheca and a hydrocladium. Hydrocladia alternate, the first internode (or two internodes) very short, without appendages, the others alternately short and long, only the latter bearing hydrothecae.

Hydrothecae reflexed, a strong inflexion in front partly filled up by perisarc externally, and extended into an intrathecal ridge reaching half through the hydrotheca; aperture large, margin produced into a long pointed peak in front, the sides elevated into two broad convex lobes, back forming a smaller lobe, free, a small, narrow lobe behind each lateral sarcotheca.

Sarcothecae bithalamic, canaliculate, one below each hydrotheca and two lateral above, one at the back of each hydrotheca on the pinnae, and two abreast in the corresponding position on the stem, one midway between every two cladial hydrothecae, on the intermediate internode, and a few on the lower part of the stem; all sarcothecae rigid, the laterals mounted on very long peduncles which run up the sides of the hydrotheca nearly to the margin.

Gonothecae—female, broad, pyriform, truncate a little above the widest part, operculate, margin with a thickened band, about three or four sarcothecae near the base; male, much smaller, ovate, with one sarcotheca; both sexes on the same hydrocaulus, but the female on the lower cladial portion and the male higher up.

Loc.—Bream Creek (Bartlett), Queenscliff (Mrs. Bartlett), Airey's Inlet (Mulder).

A remarkable species, possessing the extreme development of the lateral peduncles which characterises the genus *Halopteris* of Allman, not generally accepted. The lateral sarcothecae, which are stout and rigid, and entirely open on one side, are consequently elevated above the hydrotheca. The fixed anterior sarcothecae are strongly curved over towards the hydrothecae, as in *P. buski*, etc. The internodes of the stem, in front view, have a more or less fusiform shape. The intermediate internodes of the hydrocladia are shorter than I have seen them in any other species, and the joints above them are very oblique.

There is a certain similarity between this species and the *P. conspecta*<sup>1</sup> of Billard; in the latter, however, there are no intermediate internodes on the pinnae, but every internode (except the first) supports a hydrotheca, there is no intrathecal ridge, and the arrangement of the sarcothecae is different.

*P. balei* Billard, is a different species, also of the *Halopteris*-type. It is now referred to the genus *Antennella*.

PLUMULARIA CORRUGATISSIMA M. and T. (Plate XVII, Fig. 3).

*Plumularia setaceoides*, var. *corrugata*, Mulder and Trebilcock, Geel. Nat. (2), iv., 1911, p. 118, pl. ii., fig. 8.

*Plumularia corrugata*, Mulder and Trebilcock, Geel, Nat. (2), vi., 1914, p. 43, pl. v., fig. 3.

*Plumularia corrugatissima*, Mulder and Trebilcock, Geel, Nat. (2), vi., 1915, p. 53.

Not *Plumularia corrugata*, Nutting, Amer. Plum., 1900, p. 64, pl. vi., figs. 1-3.

Hydrocaulus monosiphonic, pinnate, about 12 mm. in height, stem divided by oblique joints into short internodes, each supporting a hydrocladium but no hydrothecae; hydrocladia alternate, borne about the middle of the stem-internodes, the first internode short, without appendages, the others alternately long and short, only the former bearing hydrothecae.

Hydrothecae very small, cup-shaped, with the front contracted below the everted lip; aperture entire, somewhat oblique, back adnate as far as the margin.

Sarcothecae bithalamic, canaliculate, one below each hydrotheca and two lateral above, one midway between every two hydrothecae, on the intermediate internode, two in each axil, and one just above the base of each pinna, all rather thin-stemmed and apparently moveable.

Gonosome?

Loc.—Torquay, Barwon Heads, Spring Creek, (M. and T.).

A small form not closely related to any of our known species. The hydrothecae differ from those of *P. setaceoides* in not being free at the back, and rather resemble those of *P. scabra*, but it is doubtful to what extent the contraction below the lip exists in life, as the specimen shows apparent sign of shrinkage at that part. The strong development of the internal ridges of the perisarc gives to the species a very characteristic corrugated appearance.

1 Arch. de Zool. exp. et gén. (4), vii., 1907, p. 362, fig. xi.

## PLUMULARIA LAGENIFERA Allman.

- Plumularia lagenifera*, Allman, Journ. Lin. Soc., Zool., xix., 1885, p. 157, pl. xxvi., figs. 1-3. Nutting, Amer. Plum., 1900, p. 65, pl. vi., figs. 6-10. Torrey, Univ. of Calif. Publ., Zool., i., 1902, p. 77; var. *septifera*, p. 78, pl. xi., figs. 101, 102. Fraser, Bull. State Univ. Iowa, vi., 1911, p. 82.
- Plumularia turgida*, Bale, Proc. Linn. Soc. N.S.W. (2), iii., 1888, p. 779, pl. xx., figs. 12, 13.
- Plumularia californica*, Marktanner-Turneretscher, Ann. naturh. Hofmus., v., 1890, p. 255, pl. vi., figs. 4, 4a.
- Plumularia setacea*, Clark, Trans. Conn. Acad., iii., 1876, p. 261, pl. xli., figs. 1, 2.

The *P. lagenifera* of Allman, as well as *P. multinoda*, described in the same paper, was represented as possessing several short internodes, instead of one, between every two hydrothecae. Nutting, however, who has examined Allman's types, finds that this supposed character is by no means constant, but that the hydrocladia in the specimens which he examined are composed of alternately long and short internodes, just as in *P. setacea*, etc. As *P. turgida*, though certainly not agreeing with Allman's description, seems to differ in no essential from the form described by Professor Nutting, I exchanged specimens with that gentleman, who considers the two forms to be referable to the same species. *P. californica* M.-T., is, according to Nutting, *P. lagenifera* with the septal ridges well developed, as in Torrey's var. *septifera*. Torrey finds in *P. lagenifera* 1-4 short internodes at the base of the hydrocladia, and 1-3 between the hydrothecal internodes; but he says that in var. *septifera* the intermediate internodes are single. Fraser finds that some specimens have 2-3 short internodes at the base of the hydrocladia, and occasionally more than one intermediate. But in all cases where more than one occur together only one of them bears a sarcotheca. In the few specimens which I have seen from California and Australia, I have not met with any instance of this repetition of the short internodes.

The strong development of the septal ridges is not invariable; in some specimens it is not much more pronounced than in *P. setacea*; often, however, these ridges are more thickened, quite encircling the interior of the internodes, and sometimes being accompanied by external constrictions which add to the charac-

*lagenifera*, and, as seen laterally, are not so wide proportionately at the base, nor are the internodes supporting them so turgid.

Inaba's description agrees precisely in all particulars of specific value with my specimens, allowance being made for his use of the term "joint" for the areas between the septal ridges as well as those between the true nodes. Thus when he says that there are three joints in the stem between two successive branches, it is meant that the internode is divided into three parts by two septal ridges. It is to be noted, however, that the intermediate internodes of the hydrocladia sometimes have really a secondary node dividing them into two, and this would seem to have been more frequently the case in Inaba's specimen than in my own, since he refers to it as the normal condition.

Inaba says: "This species is very small, being less than 10 mm. high, the branches are short, and being all of about the same length this species can easily be distinguished from *P. setacea* by its general form. On a closer examination, however, the number and arrangement of the nematophores are found to be exactly the same as in *P. setacea*. If in *P. setacea* each joint of the stem were divided into three, and each short joint of the branches into two, the arrangement would be exactly what we find in the present species. Moreover the joints do not appear to be absolutely fixed in this species, being sometimes irregular; in the lower part of the stem particularly three joints are frequently united into one.

"The more minute differences from *P. setacea* are as follows:—The comparative shortness of the stem, the comparative thickness of the perisarc, the comparatively small size and greater number of the joints, the comparative shallowness of the bowl-shaped hydrothecae, and the fact that there are always two on each branch."

The last-mentioned character is, as might be expected, not invariable; in some of my specimens the hydrothecae are limited to two on a hydrocladium, in others there are three.

The gonangia are about .55 mm. in length, the male form has sides straight, so that the width is about the same throughout except at the base and the summit; the terminal portion is blunt, directed to one side and sometimes slightly narrowed, with an oblique aperture. Female capsules observed were somewhat widened in the middle, and very broad at the extremity; these were, however, probably immature, as other specimens were seen, empty, which were more contracted towards the aperture. Inaba's specimens were without the gonosome

## NEMERTESIA CYLINDRICA Kirch.

- Plumularia cylindrica*, Kirch., Abh. Nat. Ver. Hamb., vi., 1876, p. 45, pl. i., fig. 1, pl. iv., figs. 1, 1b.
- Antennularia cylindrica*, Bale, Cat. Aust. Hydr. Zooph., 1884, p. 146, pl. x., fig. 7.
- Sciurella indivisa*, Allman, Chall. Plum., 1883, p. 26, pl. v., figs. 1-4. Kirkpatrick, Sci. Proc. Roy. Dubl. Soc. (N.S.), vi., 1890, p. 609. Billard, C.R. Acad. d. Sci., cxlvii., 1908, p. 759.
- Nemertesia indivisa*, Billard, Ann. Sci. Nat. (9), xi., 1910, p. 38. *Idem*, Siboga-Exp., 1913, p. 60, fig. 5.

This species has been referred to different genera on account of variations in the arrangement of the hydrocladia in different specimens, or even in various parts of the same specimen. Kirchenpauer described his *P. cylindrica* as having a doubly pinnate arrangement, one pinna standing in front of another on each side of the rachis. Kirkpatrick says—"At first the arrangement of the ramules is bipinnate, each half of the pinna being composed of ramules arranged two deep. Higher up the bipinnate arrangement is obscured, the ramules growing along three or four sides of the stem, as in *Antennularia*." Allman says that the hydrocladia are "in four longitudinal alternating series"; in other words, that they are in alternating opposite pairs, as in *N. decussata*. I find, however, in a fragment of his material (for which I am indebted to Dr. Kirkpatrick), that they are in sets of three, alternating with those above and below, so that there are six longitudinal series, and all my own specimens are similar to the last.

There is no doubt as to the identity of *A. cylindrica* and *S. indivisa*, Dr. Kirkpatrick having compared type specimens of both; and there seems no reason to doubt that Kirchenpauer has described the same species. Kirkpatrick has remarked that Kirchenpauer's figure shows the superacalycine sarcothecae as lower down than those of *S. indivisa*, but the difference is very slight, especially in Kirchenpauer's Plate IV.; moreover, it is accentuated by the calycle-margin being shown too high, as Kirchenpauer, like Allman, fails to notice the slight sinuations of the border where it joins the hydrocladium. As Billard has observed, the sarcothecae spring from just *inside* the hydrotheca-margin.

The British Museum specimen includes several gonangia, which are irregularly lobed, as shown by Billard in his "Siboga" Report, and not as figured by Allman. In all the specimens

The gonocladia occur at somewhat irregular intervals, taking the place of hydrocladia. In the female there are usually about 6-10 internodes, two, or sometimes only one, of which bear gonangia. The others bear mostly three sarcothecae, apparently representing those of the suppressed hydrothecae; but they are often quite irregular. There is a hydrotheca on the proximal part of the gonocladium, and generally one or two abortive ones also. In the male the gonocladium, according to Kirchenpauer, bears one gonangium, immediately above which it is abbreviated. In most instances, however, I found one or two internodes above the gonangium, with sarcothecae similar to those on the female. The proximal hydrotheca seems absent in most cases. The condition is analogous to that of many of the *Aglaopheniae*, in which the protective structures surrounding the gonangia are more developed in the female than in the male, though similar in kind.

In these specimens the thread-cells are large and numerous, and are found abundantly in the interior of the tubes of the perisarc, just as in my former specimens of *L. phillipinus*. Kirchenpauer figures these bodies in that species, but does not mention their presence in his description of *L. urens*. He refers, however, to the powerful urticating properties of both forms.

Congdon's "*L. phillipinus*" has no resemblance to Kirchenpauer's species.

#### AGLAOPHENIA SINUOSA Bale.

*Aglaophenia sinuosa*, Bale, Proc. Linn. Soc. N.S.W. (2), iii., 1888; p. 790, pl. xxi., figs. 1, 2.

*A. sinuosa* and the species or variety next to be described are somewhat exceptional among the Australian species in the monosiphonic habit, a feature more common among the *Halicornariae*, as also is the possession of a cauline sarcotheca situated at the back of each axil.

The lower part of the stem bears sarcothecae but no hydrocladia, and when the stem bifurcates, as is often the case, the cladiate portion commences only above the bifurcation. One specimen has the stem divided at about 5 mm. above the base, and each branch again subdivides about 2 mm. higher, while in another only one of the primary branches is again divided, but in none of the specimens observed are hydrocladia found below any of the bifurcations.

The corbulae observed (or some of them) were female, free planulae being present in one or two instances. The corbulae

average about 2.5 mm. in length, with the rachis straight and the front arched, the rows of sarcothecae strongly oblique, and each consisting of about six sarcothecae of some .148 mm. in length; the colour rather dark red-brown.

AGLAOPHENIA BAKERI, n. sp. (Plate XVII., Fig. 7-8).

This species, which was collected at Western Port by Mr. F. H. Baker, is an extremely close ally of *A. sinuosa*, of which it may perhaps prove to be a variety. The structure as regards the stem and branches is identical, but the hydrocladia are less divergent in the present form than in *A. sinuosa*, where they stand off at a rather wide angle, with the two cauline sarcothecae in a line about at right angles to the base of the hydrocladium, and therefore diagonal to the stem-internode. In *A. bakeri* these sarcothecae are in a line very oblique to the hydrocladium, and much more nearly parallel with the axis of the stem.

In the number and form of the hydrotheca-teeth the two species are nearly alike, but in *A. sinuosa* (as seen in exact profile) the first tooth on each side appears narrow, the second and third wider and nearer together, and the fourth very narrow; while in *A. bakeri* the first looks wider, the second rather smaller, and the third about as large as the first, the fourth being very minute or obsolete. This description applies to typical hydrothecae, but the characters are rather inconstant.

There is a difference in the posterior intrathecal ridge, which in *A. sinuosa* extends half through the hydrotheca, but in *A. bakeri* is narrower. But the most patent distinction is in the lateral sarcothecae, which, as seen in the front view of *A. sinuosa*, are very large and prominent, a feature not found in the present species.

Only two corbulae were observed, both on the same branch, and the sex was not determinable. They are about 3 mm., in length, and therefore somewhat longer than those of *A. sinuosa*, lighter in colour, with about eleven pairs of leaflets. The rows of sarcothecae are less oblique than those of *A. sinuosa*, and the sarcothecae themselves are smaller (about .104 mm.). In contrast to the condition in *A. sinuosa*, where the front of the corbula is regularly arched, so that it becomes gradually narrower towards the ends, these corbulae are widest near the ends, and they are somewhat constricted at two places near the middle, at which part the form of the leaflets and the arrangement of the sarcothecae become irregular. But possibly these peculiarities may be merely abnormal.

## AGLAOPHENIA BRACHIATA (Lamarck).

- Plumularia brachiata*, Lamarck, An. s. Vert., ii., 1816, p. 126. Blainville, Man. d'Act., 1834, p. 478.
- Aglaophenia crucialis*, Kirchenpauer, Abh. Nat. Ver. Hamb., v., 1872, p. 26, pl. i., fig. 8. Bale, Cat. Aust. Hyd. Zooph., 1884, p. 168, pl. xviii., fig. 8.
- Thecocarpus crucialis*, Billard, Ann. Sci. Nat. (9), v., 1907, p. 328, figs. 3, 4.
- Aglaophenia carinata*, Bale, Proc. Roy. Soc. Vict. (N.S.), vi., 1893, p. 105, pl. vi., figs. 1.3.
- Thecocarpus brachiatus*, Billard, C.R. Acad. d. Sci., cxlviii., 1909, p. 1064; Idem, Ann. Sci. Nat. (9), ix., 1909, p. 331.

My best specimen of this species is about 10 inches high by four wide, and as each of the main branches has its minor branches in the same plane the whole polypary forms a flattened frond. It is very freely branched and rebranched from the base up. Another specimen differs so much in general appearance that without microscopical examination it might be supposed a different species; this is owing to its irregular and bushy habit, the branches being much contorted and tangled-looking; it also has extremely short hydrocladia. But I can find no difference in the form of the hydrothecae or other minute structure.

There is nothing specially noteworthy in the method of branching, such as might be inferred from Lamarck's description, the branches being given off mostly in pairs from two successive internodes of the primary stem-tube, just as in the *crucialis* group, and therefore taking the place of two hydrocladia. But they are more numerous and closely set than I have observed them in *A. macrocarpa* and its allies, where they are usually more distant and straggling.

The corbulae seen are of similar type to those of the *crucialis* group, closed, but having a series of openings at the bases of the leaflets, over which project the lateral spurs given off from the leaflets next behind. These spurs are stout but short, and for the most part support only two receptacles, terminal in position; the inferior is a conical sarcotheca, rather narrower than those on the ribs, the superior, which projects rather beyond it, is mostly broader and is considered by Billard to be a hydrotheca. It does not appear so to me, and it is generally only about the middle of the

corbula that these cups are notably different from the ordinary sarcothecae; on the first leaflet or two they are usually quite similar, both in form and size, to the sarcothecae of the ribs; the succeeding ones are progressively broader, to about the middle of the corbula, while at the distal end they are again reduced to nearly the size and form of the ordinary sarcothecae. Often after attaining the maximum size the next one is bifurcated, forming two cups, as shown by Billard, who recognises that in this case they are true sarcothecae. Usually the spur of the first leaflet (as well as of the supernumerary one which is generally present) bears only one sarcotheca instead of two; the next spur may have both the upper and the lower sarcotheca about equal in size, and then the gradual increase of the superior receptacles commences. The transition from the undoubted sarcothecae at the ends of the corbula to the largest of the cups near the middle is so gradual that I can find no line of demarcation such as we should expect if some of them were sarcothecae and others hydrothecae. The large cups are very irregular in the form of the border, but they have a deep marginal situation, a character common to all the sarcothecae, but not found in hydrothecae.

According to Billard the spurs support inferiorly a pair of sarcothecae, which he considers represent the laterals of the assumed hydrothecae; I cannot find any instance of this in my specimens, in which the inferior sarcotheca is single, and situated centrally, not laterally. In one or two instances I have seen this sarcotheca bifurcated, one branch then being above the other. The inferior sarcotheca is united by a web of perisarc to the superior cup.

The corbulae may very probably present sexual differences, but I have no means of ascertaining whether this is so, as all the corbulae observed by me were from the same colony. The sex was not determinable.

#### CLADOCARPELLA, Bale.

I have followed Nutting in regarding the genus *Cladocarpus* as characterized by the possession of phylactocarps which are limited to a single one on a hydrocladium, always springing from the base or the proximal internode; consequently on meeting with a species with the phylactocarps not limited to that position, but occurring on several internodes of the same hydrocladium, I proposed for it the genus *Cladocarpella*. The distinction is not very strong, and it is to be observed that Allman's original diagnosis of the genus *Cladocarpus* is wide enough to embrace such forms, and that

Billard has first made known one such (*C. sibogae*). Probably, therefore, many observers will prefer to regard *Cladocarpella* as at most a sub-genus.

Out of fourteen species of *Cladocarpus* included by Nutting among the American Plumulariidae, twelve have the characteristic gonosome as described above; in the other two it is unknown. A later species described by Allman—*C. pectiniferus*—has also the typical gonosome. In *Cladocarpella* a single hydrocladium may give origin to several phylactocarps consisting of distinct internodes, of which from one to three bear gonangia, while the remainder support only sarcothecae.

#### CLADOCARPELLA MULTISEPTATA Bale.

*Cladocarpella multiseptata*, Bale, "Endeavour" Rept., Part iii., 1915, p. 304, pl. xlvii., figs. 1-5.

In the original description I have indicated the distinctions between this species and *Cladocarpus* (?) *bathyzonatus*, Ritchie, a closely allied form; and the *Cladocarpus sibogae* of Billard's "Siboga" Report is equally nearly related to the present species. In *C. sibogae* the hydrothecae seem in lateral view more gradually enlarged towards the aperture, and a more noticeable difference is in the septal ridges, which in *C. sibogae* number two to five, while in *C. multiseptata* there are about nine to fourteen. Billard says that these ridges are found only in certain internodes, and according to his figures these may be the most recently formed ones; but in *C. multiseptata* their presence or absence seems to be a matter of age, the proximal internodes having them, while those nearer the ends of the hydrocladia show no trace of them.

*C. sibogae* is said to have two to four sarcothecae between two hydrocladia, in *C. multiseptata* there are usually nine to twelve.

*Cladocarpus multiapertus*, Billard ("Siboga" Report) is sufficiently distinguished from these species by the sarcothecae, which are mostly provided with two orifices in addition to the lateral one. Its gonosome has not been observed.

#### HYDRA, sp.

The brown hydra commonly found about Melbourne has been hitherto generally referred to *H. oligactis*, the only species which, according to Hincks, agrees with it in regard to the so-called "stalked" condition. Later researches, however, especially by

Dr. A. Brauer,<sup>1</sup> have established the fact that another European species exists, sharing with *H. oligactis* the stalked condition, but differing from it in several particulars not recognised by the older observers; and the description renders it probable that our common species may be associated with this new form, unless, which is not unlikely, it may prove distinct from both. It is also possible that more than one species may be represented among the forms which we have been accustomed to call *H. oligactis*.

Trembley, in his famous memoir, described three species, which he called the first, second, and third species (according to the order in which he observed them), and to British observers, at least from Johnston onwards, these have been known respectively as *H. viridis*, *H. vulgaris*, and *H. oligactis*. Continental observers have more commonly, in disregard of priority, referred to the two last as *H. grisea* and *H. fusca*; in many cases, however, they have confused the species, and, as Bedot remarks, have named their specimens solely according to their colour or their abundance, calling them *grisea*, *fusca*, or *carnea*, according as they are grey, brown, or rose, and *vulgaris* when they are very abundant. Brauer<sup>2</sup> himself, in an earlier paper, referred to the species subsequently found by him to be new, as *H. fusca*, and called the true *H. fusca* or *H. oligactis*, *H. sp.* In his later paper he corrects this, and reduces the European species to four, namely, *H. viridissima*, *H. vulgaris*, *H. oligactis*, and *H. polypus*. In regard to the first three, therefore, he comes into line with British observers, except that he errs in using the name *H. viridissima* instead of *H. viridis*. The newly established species, which he calls *H. polypus* Lin., is not Linné's *H. polypus*, as shown by Bedot,<sup>3</sup> who names the species *H. braueri*.

Annandale,<sup>4</sup> in his paper on the common hydra of Bengal, has described under the name of *H. orientalis* a species which he finds very nearly allied to *H. oligactis* (called by him *H. diaecia*), but which he considers distinct. It is abundant in India, and is the only species which he has found there.

Von Lendenfeld,<sup>5</sup> in 1885, described *H. hexactinella* from a pool

1 A. Brauer—Die Benennung und Unterscheidung der *Hydra*-arten. Zool. Anz., Bd. xxxiii., S. 790, 1908.

2 A. Brauer—Über die Entwicklung von *Hydra*. Zeitsch. f. wissensch. Zoologie, lli. 2, S. 169. 1891.

3 M. Bedot. Sur la Nomenclature des Hydres. Zool. Anzeig., Bd. xxxix., No. 19/20, 1912.

4 N. Annandale. The Common *Hydra* of Bengal. Mem. Asiatic Soc. of Bengal, I., No. 16, p. 339, 1906.

5 R. von Lendenfeld. *Hydra hexactinella*, nova species. Proc. Linn. Soc. N.S.W., x., pt. 4, p. 679, 1885.

at Moore Park, near Sydney, but the characters given do not suffice for identification.

The characters made use of by Brauer in discriminating the species include, in addition to those recognized by the older observers, the sexual condition, the form of the egg, and the number of distinct forms of nematocysts present. Without these details identification is uncertain.

For the assistance of observers who may engage in the study of our local species, I append the following diagnoses, compiled from the descriptions of Brauer and Annandale and other authors.

*H. viridis* Lin.—Body cylindrical or gradually more slender towards the lower extremity, not stalked. Tentacles 6-10, shorter than the body. Three sorts of nematocysts. Hermaphrodite. Egg spherical, with reticulated, nearly smooth surface. Colour grass-green. Syn.—*H. viridissima* Pallas; *H. gracilis* Agassiz.

*H. vulgaris* Pallas.—Body cylindrical, not stalked. Tentacles 7-12, little longer or not longer than the body. Four sorts of nematocysts. Hermaphrodite. Egg spherical, set with coarse spines which are expanded or bifid at the tips, deciduous. Colour brown, orange, gray, reddish, yellowish. Syn.—*H. grisea* Lin., *H. attenuata* Pallas,? *H. aurantiaca* Ehrenberg, *H. rubra* Lewes, *H. brunnea* Templeton, *H. trembleyi* Haacke.

*H. oligactis* Pallas.—Body "stalked," 2-3 cm. long. Tentacles 6-8, long, capable of great extension to several times as long as the body. Three sorts of nematocysts. Dioecious. Gonads on the whole body except on the stalk-like part. Eggs mostly adherent in groups, subspherical, with very short simple spines. Colour, gray, brown, reddish. Syn.—*H. fusca* Lin., *H. carnea* Agassiz, *H. rhaetica* Asper, *H. roeseli* Haacke, *H. rhistica* Asper, *H. verrucosa* Templeton, *H. dioecia* Downing.

*H. braueri* Bedot. Body "stalked," not more than 2 cm. long, mostly 1-1½. Tentacles much longer than the body. Four sorts of nematocysts. Hermaphrodite. Gonads borne only on the distal part of the body. Eggs attached singly, convex above, with short simple spines, flat and smooth below. Colour, gray, brown. Syn.—*H. polypus* Brauer (not Lin.)

*H. orientalis* Annandale.—Body "stalked," 1½-3 cm, long. Tentacles 5-6, long, capable of great extension (to 3-6 times as long as the body). Three sorts of nematocysts. Dioecious. Gonads confined to the upper part of the body. Normal eggs spherical, set with fine spines which are bifid or expanded at the tip. Abnormal

eggs (pathological) smooth, with a small projection at the distal pole. Colour, orange-brown to deep olive-green.

*H. attenuata* Pallas.—Brauer says that this is Rösel's "straw-yellow polyp," that it has never been found again, and that it is probably only a colour-variety of *H. vulgaris*: Brauer strangely overlooks the remarks of Johnston, who observed this form. He says: "This, which is represented very exactly in the plates of Rösel's beautiful work, is a larger animal than *H. vulgaris*, and comparatively rare, less sensible to external impressions, and of a more gracile form. Its colour is a dilute olive-green, with paler tentacula, which are considerably longer than the body, and hang like silken threads in the water waving to and fro without assuming that regular circular disposition which they commonly do in the *H. viridis*." Hincks, however, like Brauer and Bedot, thinks it is probably a variety of *H. vulgaris*. Syn.—*H. pallens* Lin.

*H. hexactinella* von Lendenfeld.—Von Lendenfeld describes the body as perfectly cylindrical, and 15 mm. in length, while the tentacles when fully extended, are said to reach only 5 mm. The body is colourless, and there are two sorts of nematocysts. "It can be distinguished from other Hydras by the constancy in the number of arms, which is invariably six. These tentacles are all equal in length and thickness, and the angles between them are perfectly equal, measuring 60°. Such regularity has been observed in no other species. It appears that in this respect our Hydra is more highly developed than the others, as the number of antimeres has been defined."

The "stalked" condition referred to in these descriptions is not a permanent character, but is merely a distension resulting from recent feeding, which affects only the upper part of the body, so that the lower part has by comparison a stalk-like appearance. The young *Hydra*, so long as the body-cavity communicates with that of the parent, assumes a similar form when food has been taken by the latter. This differentiation of the alimentary tract, practically into stomach and intestine, marks a higher stage of development than that attained by such forms as *H. viridis*.

Jickeli, in his paper on *Hydra*<sup>1</sup> figures the four different forms of nematocysts found in the genus. First we have the large form, which has a stout ovate capsule, truncate at the smaller end, with a

1 C. F. Jickeli. Ueber den histologischen Bau von *Eudendrium* Ehrb. und *Hydra* L. Morpholog. Jahrb., Bd. viii., p. 373, T. xviii., figs. 1-3. (In fig. 3 the lettering is evidently wrong, the letters  $\beta$  and  $\gamma$ —called *b* and *c* in the text—should be transposed).

thread many times the length of the capsule, barbed, and coiled round the longitudinal axis. Secondly, the small form, nearly round, containing a short smooth thread, which forms a spiral or one coil only. These two types are found in all the species. In *H. oligactis* (called by Jickeli *H. vulgaris*) is found a third sort, consisting of an oblong or elliptic capsule, as long as the large form, but much narrower, with a barbed thread which forms two or three loose loops running lengthwise. *H. vulgaris* (*H. grisea* of Jickeli) also has this type, and in addition a fourth form, of medium size, with a barbed thread coiled about the longitudinal axis. The last form occurs in *H. viridis* also. According to Jickeli's figures the large nematocysts of *H. vulgaris* much exceed in size those of the other species figured by him. Brauer, in his paper of 1908, describes his *H. polypus* (*H. braueri*) as having, like *H. vulgaris*, four sorts of nematocysts, and remarks particularly that the large form is much larger than the corresponding form in *H. oligactis*. In *H. orientalis*, according to Annandale, there occurs occasionally a form intermediate in size between the large and the small forms, but whether of the third or the fourth type mentioned above is not stated. Von Lendenfeld says that *H. hexactinella* has two sorts of cnidoblasts, with different cnidocells.

Brauer, in his paper of 1891, figures the eggs of the four European species admitted by him. *H. oligactis* is there called *H. sp.?*, *H. vulgaris* is called *H. grisea*, and the form now named *H. braueri* is called *H. fusca*.

I am not aware of any observations on Australian Hydras covering the features which, according to the foregoing descriptions, are necessary to be considered in discriminating the species. All the brown hydras which I have seen agree in the so-called "stalked" condition. When empty and fully extended the body may attain quite an inch in length. Specimens which I collected at Williamstown many years ago, after being kept some time, were found capable of extending the tentacles to three inches in length; others found more recently at Kew did not display this character during the short time they lived. The number of tentacles varied between 5 and 8, but in the great majority of cases there were six. I have not observed the eggs in any case.

The character upon which von Lendenfeld founds his *H. hexactinella* is unreliable, as the mere fact that a number of specimens from a single pool agreed in possessing six tentacles cannot prove the invariability of the species in this respect. In a

slide of *H. hexactinella* sent to me by Mr. Whitelegge, who first observed it, two hydranths out of seven possessed five tentacles only. Sexual products were apparently not observed.

I have seen only the two usual forms of nematocysts in such Hydras as I have examined, but I should hesitate, in the absence of full series of sections, to decide that no others were present, as the intermediate types appear much less common, and more likely, from their delicate structure, to be overlooked. In the specimens of *H. hexactinella* I find the large form in two distinct sizes, averaging respectively about  $13\mu$  and  $10\mu$  in length, both sizes being very abundant, while intermediate ones are very rare. In some sections of the common species which I have seen the large nematocysts measured about  $15\mu$ .

Judging from Mr. Whitelegge's specimens I have no doubt that *H. hexactinella* is one of the "stalked" forms, and I think that Von Lendenfeld was mistaken in stating the length of the tentacles, when fully extended, as only 5 mm., or one-third the length of the body. The figure shows the body very long and slender, and the tentacles short, but the case is probably similar to that of *H. orientalis*, of which Annandale says that when the body is very much elongated, the tentacles are never fully extended.

## EXPLANATION OF PLATES.

## PLATE XVI.

- Fig. 1.—*Ophiodes australis*, n.sp.  
 Fig. 2.—*Sertularella rentoni* Bartlett.  
 Fig. 3.—*Sertularia McCallumi* (Bartlett).  
 Fig. 4.—*Sertularia McCallumi* (Bartlett).  
 Fig. 5.—*Sertularella diaphana* (Allman).  
 × 40.

## PLATE XVII.

- Fig. 1.—*Plumularia rotunda* Mulder and Trebilcock.  
 Fig. 2.—*Plumularia everta* Mulder and Trebilcock.  
 Fig. 3.—*Plumularia corrugatissima* Mulder and Trebilcock.  
 Fig. 4.—*Plumularia scabra* Lamarck.  
 Fig. 5.—*Plumularia scabra* Lamarck.  
 Fig. 6.—*Plumularia balei* Bartlett.  
 Fig. 7.—*Aglaophenia bakeri*, n. sp.  
 Fig. 8.—*Aglaophenia bakeri*, n. sp.  
 × 80.

ART. XIII.—*Notes on Eucalypt Leaves occurring in the Tertiary Beds at Bulla.*

By R. T. PATTON, B.Sc.

(With One Text Figure).

[Read 7th November, 1918].

The fossils occur in a fine mudstone beneath the newer basalt. These leaf beds were found by Mr. James, B.Sc., last year, and contain many other leaves besides those of Eucalypts. These leaves are small, narrow and pointed, which indicates rather adverse conditions of life. These leaves are too simple for any identification work. Besides the leaves, casts were found which appeared to be of a lycopodiaceous character, and other casts appeared to be those of crushed stems. The beds appear to have been laid down along the banks of the stream. The Eucalypt leaves appear to belong to one general type. We must bear in mind, when dealing with fossil Eucalypts, the wide variability of the genus at the present day, and although we cannot say whether this variability existed in geological times, still it must not be left out of account. It is recognised that to differentiate Eucalypts on herbarium material is often impossible.

In the Geol. Survey Records, Vol. I., are given, by H Deane, M.A., some figures of fossil Eucalypt leaves from Berwick. Some of these do not possess sufficient differences to be classified as different species. These belong more or less to two general types of leaves. *Eucalyptus præcoriacea* forms an exception. This is a very doubtful Eucalypt.

All of the leaves from Bulla belong to one general type. I do not think we are justified in making species out of material which all conforms to a general type.

The leaves are moderately broad, lanceolate and slightly falcate. The marginal vein is moderately removed from the edge, and is only slightly indented. The lateral veins diverge at an angle of about 50°, and are not widely distant apart. The leaf is approximately symmetrical. The margins gradually fade into the petiole and do not meet it abruptly.

Taking these casts generally they do not differ very much from those figured in Vol. I., Geological Survey Records. The Bulla leaves bear a resemblance to those of *E. rostrata*, which is found

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Transactions. Vols. 1-4.

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ROYAL SOCIETY OF VICTORIA.  
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Transactions. (4to). Vols. 1, 2, 3 (Pt. 1 only was published), 4, 5, 6—1888—  
Proceedings (New Series). (8vo). Vols. 1—1888—

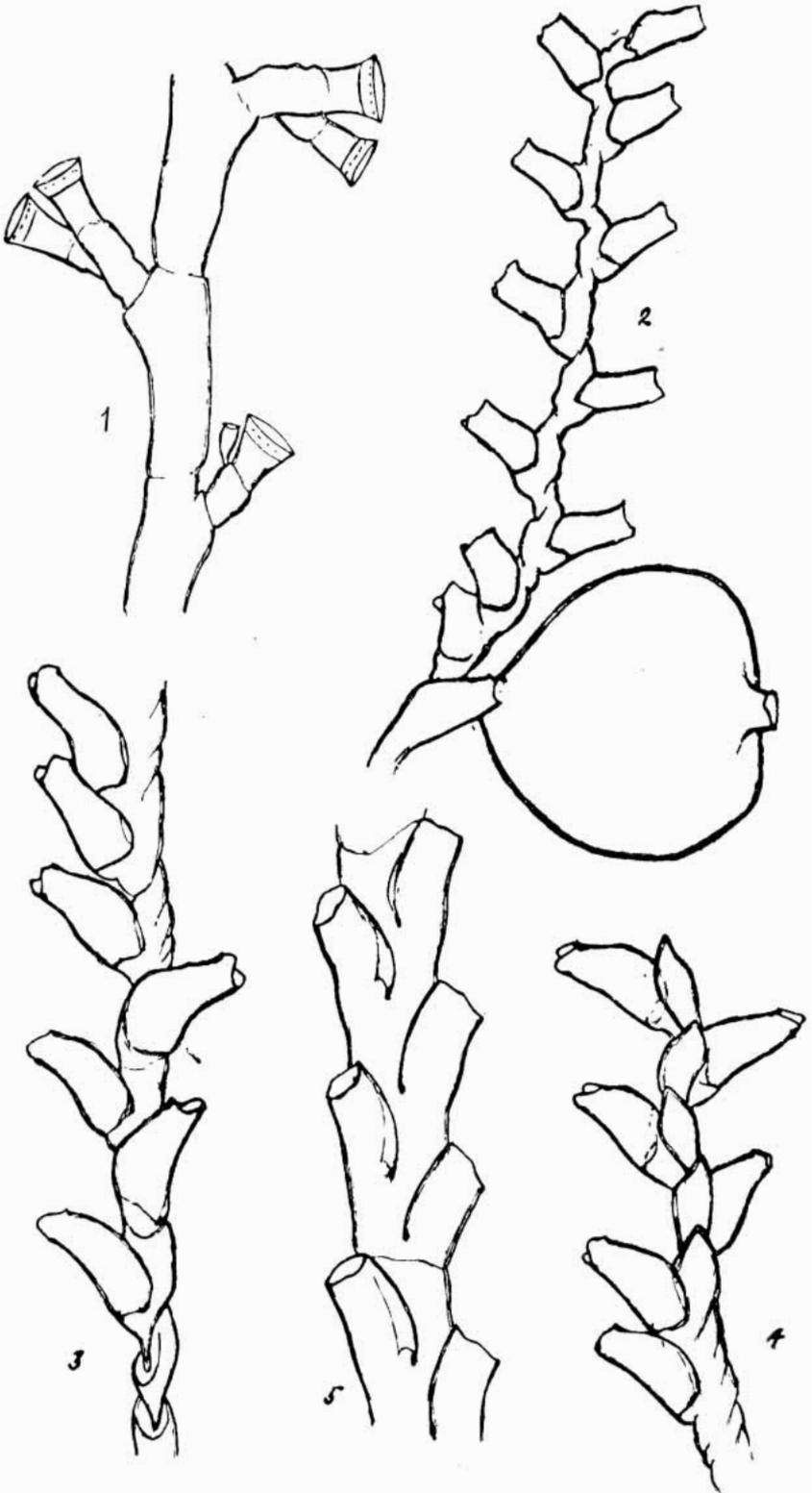
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(Pts. 1 to 4), 2 (Pt. 1), title page and index [*all published*]. 1879-82.

[*The Society then combined with the ROYAL SOCIETY OF VICTORIA*].

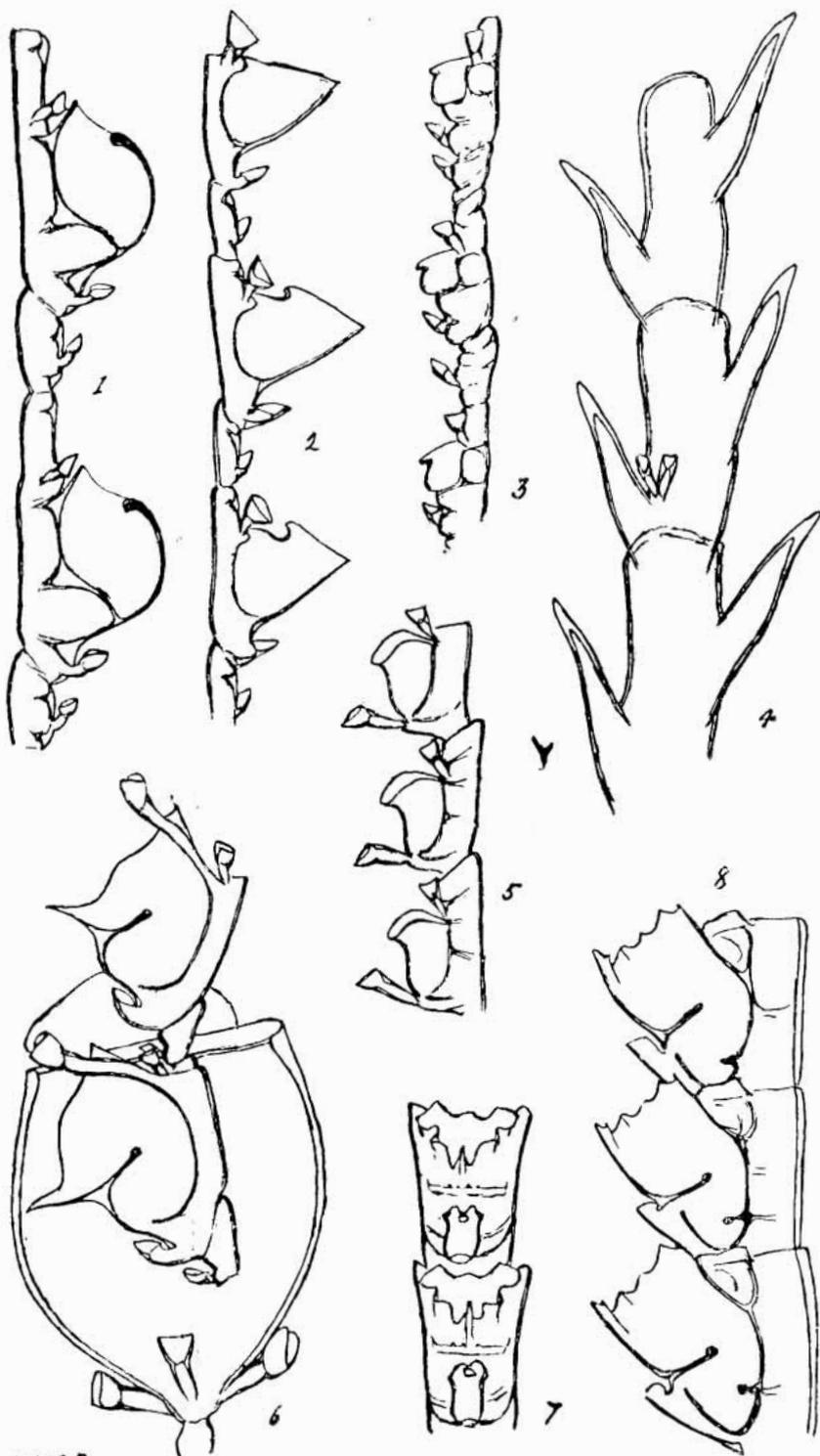
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NOTE.—*Most of the volumes published before 1890 are out of print.*



W.M.B.

( $\times 40$ ).



WMB

(x 80).