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BRITISH MUSEUM (NATURAL HISTORY).

BRITISH ANTARCTIC ("TERRA NOVA") EXPEDITION, 1910.
NATURAL HISTORY REPORTS.

ZOOLOGY. VOL. V.

COELENTERATA.



LONDON:
PRINTED BY ORDER OF THE TRUSTEES OF THE BRITISH MUSEUM.

Sold by B. QUARITCH, LTD., 11, Grafton Street, New Bond Street, London, W.1;
DULAU & Co., LTD., 2, Stafford Street, London, W.1;
OXFORD UNIVERSITY PRESS, Warwick Square, London, E.C.4;

AND AT THE
BRITISH MUSEUM (NATURAL HISTORY), Cromwell Road, London, S.W.7.
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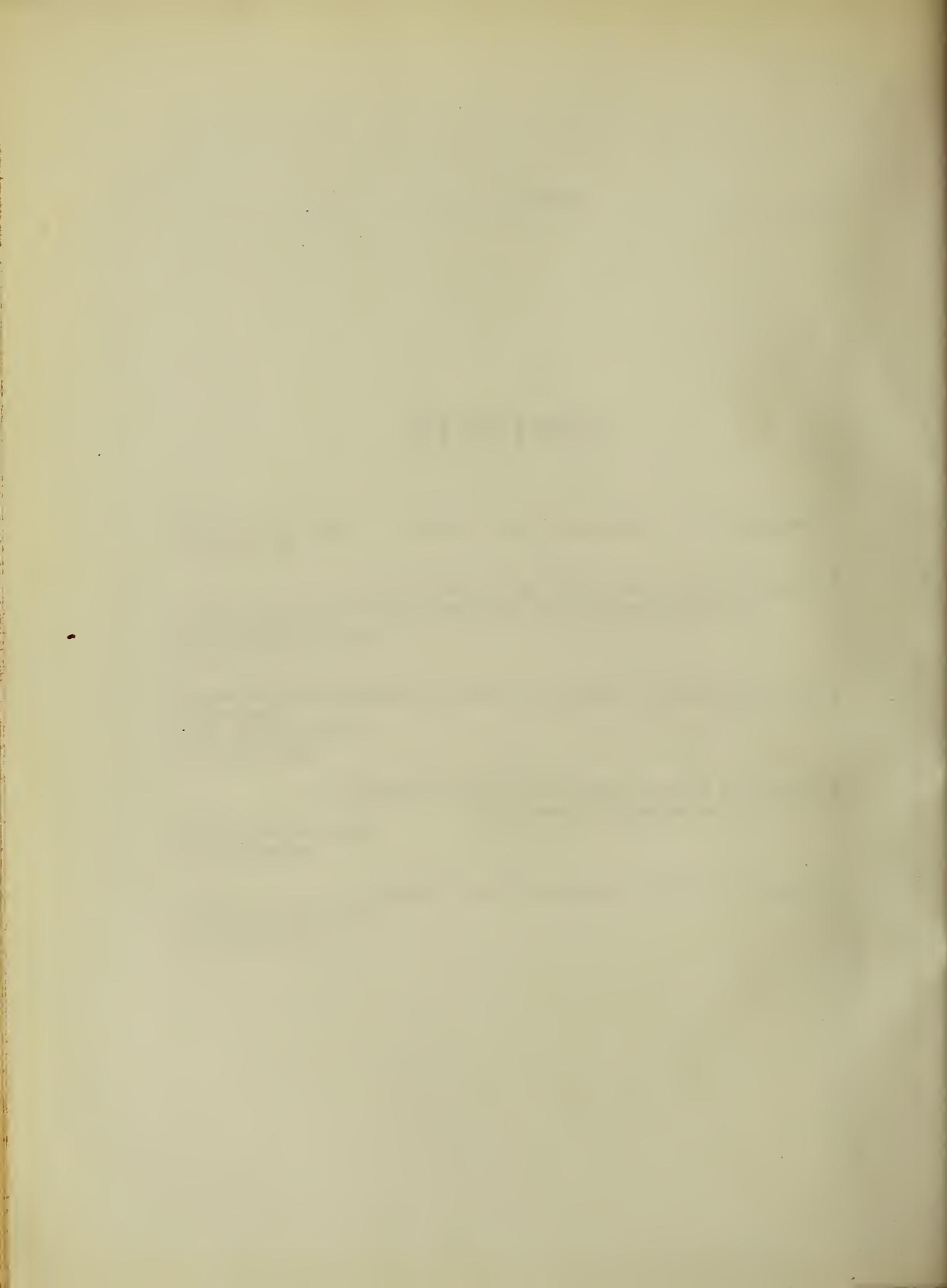
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This is No. 3 of 25 copies of
"Terra Nova" Zoology, Vol. V. Coelenterata Part I. — Actiniaria, printed on
Special Paper.

COELENTERATA.

PART I.—ACTINIARIA.

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WITH SIX PLATES.

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I.—INTRODUCTION.

THROUGH the kindness of Dr. S. F. Harmer, Keeper of Zoology, British Museum (Natural History), I have had the pleasure of studying the Actiniaria collected by the "Terra Nova" Expedition. The collection, though not a large one, contains representatives of eight families, so that the fifteen species which it includes show a fairly wide range of variation. All the species belong to the ACTINIINA, the STICHODACTYLINA being quite unrepresented, as are also the orders EDWARDSIARIA and ZOANTHINARIA.

The most interesting part of the collection was made in the Antarctic itself. In the vicinity of McMurdo Sound seven species were obtained—*Halcampoides aspera*, *Dactylanthe antarctica*, *Cymbactis selaginella*, *Lilliella lacunifera*, *Leptoteichus insignis*, *Hormosoma scotti* and *Artemidactis victrix*. Two of these species—namely, *Cymbactis selaginella* and *Artemidactis victrix*—were also obtained in Ross Sea. All were dredged from deep water, and most of them are animals with a thick, stiff body-wall. In addition to these, specimens were collected in the following localities:—

- | | |
|-------------------------------|-----------------------------------|
| 1. New Zealand, on shore. | <i>Aiptasia minima</i> . |
| | <i>Sagartia</i> , sp. |
| 2. Off New Zealand in 70 fms. | <i>Halcurias endocoelactis</i> . |
| | <i>Epiactis novo-zealandica</i> . |

- | | |
|-------------------------------------|-------------------------------|
| 3. Off Falkland Islands. | <i>Bolocera longicornis.</i> |
| 4. Off Rio de Janeiro. | <i>Calliactis reticulata.</i> |
| 5. Island of S. Trinidad, on shore. | <i>Phymactis clematis.</i> |
| | <i>Aiptasioides prima.</i> |

The majority of the specimens are excellently preserved in a state of expansion in formalin, and the large species make very fine specimens. On the other hand, two or three of the small ones are in such poor condition that it is impossible to make the descriptions of them complete. In preparing sections of the material I have used several methods of staining, but have found double-staining with haematoxylin and eosin by far the most useful for all purposes. The sections were immersed in a 2 per cent. solution of ammonia iron alum before staining with haematoxylin: they were allowed to remain in a .5 per cent. solution (or weaker) of haematoxylin for ten minutes or upwards, till they were a good deal overstained, and were then destained to the required shade with 2 per cent. ammonia iron alum. After clearing with xylol they were stained for about fifteen minutes with a saturated solution of eosin in clove oil, and mounted. This method brings out nuclei, nematocysts, gland-cells and musculature extremely well. Its general result may be seen from Plate II.

I have found it necessary to introduce five new genera and eleven new species. I have considered very carefully the propriety of instituting each one, and to the best of my belief they are valid.

With one exception (Pl. VI, fig. 16), the figures are all drawn from "Terra Nova" material.

I should like to offer my most sincere and hearty thanks to Dr. H. J. Fleure and Mr. C. L. Walton of this College, and also to Prof. J. Playfair McMurrich and Prof. G. C. Bourne, for the kindness and help which they have given me in various ways during the course of my work. Dr. Fleure in particular has been tireless in obtaining for me necessary notes from literature which I was unable to see myself: and Prof. McMurrich and Prof. Bourne have given me freely both information and their opinions on several points.

I have included a coloured figure of a preserved specimen of each species described (showing, of course, only what colour it retained in the preserved state) in order to facilitate identification.

II.—GENERAL NOTES.

A.

In a paper (54a)* on *Alcyonium digitatum* Miss Edith M. Pratt† has clearly shown that in that species (and probably in other Alcyonaria) the function of the curious stellate

* Numbers in parentheses refer to numbers of papers in the bibliography, to which reference should be made for details.

† Now Mrs. Musgrave.

cells forming the mesogloal cell-plexus is primarily nutritive, and probably secondarily nervous; and that they are amoeboid cells. She has also shown that the granular gland-cells of the actinopharynx and mesenterial filaments secrete a digestive fluid which acts on the food before it is ingested by the amoeboid endoderm cells. There seems no reason to doubt that the cells of the mesogloea of the Actiniaria (such as I have described in many of the species dealt with in this paper, and such as have been from time to time described by various authors) are similarly nutritive amoeboid cells, and their appearance often suggests that this is so: some contain what are very probably food-vacuoles and particles. In this case they are *not*, as has been supposed, either connective tissue cells or nerve-cells, though they have a secondary nervous function. In some cases I have found similar cells in the endoderm or ectoderm, but they do not seem to be conspicuous there.

B.

In three species I have noted a curious phenomenon. In *Leptoteichus insignis* and *Bolocera longicornis* there are numerous zooxanthellae in the gonads, lying round the testes. In *Cymbactis selaginella* they are even mixed up with the sperms, but lie outside the ova. It is interesting to note in this connection that in many animals the gonads tend to be placed in such positions that they obtain a good supply of oxygen. To take a few instances: in *Amphioxus* the gonads lie in the wall of the atrial cavity, where the stream of water passing out through the gill-slits reaches them; in *Balanoglossus* the arrangement is rather similar, the gonads being placed in genital wings on each side of the branchial region. In *Chiton*, they lie immediately against the aorta; while in many Decapod Crustacea they are immediately below the floor of the pericardial sinus. It seems fair to deduce, therefore, that the presence of zooxanthellae in the gonads of some Actiniaria may be useful to the gonad in a similar way, since the zooxanthellae give off oxygen. It is, of course, possible that in the female the ova may finally absorb some of these algal cells, as is the case in *Millepora* (36a), but of this there is at present no evidence.

C.

In the descriptions which follow I have omitted details of the basilar (not *parieto-basilar*) muscles in those species which possess them, and also exact measurements of cnidae and spirocysts, as those seem to me to be non-essential points. In the Plates, I have treated the musculature severely in black and white, not showing individual fibres as a rule, but only whole processes. As regards mesogloal sphincters, in each case I have given two figures—one to show the outline of the whole, another to show exactly the detail of a small part much enlarged. I hope this method will prove satisfactory, as it is difficult to give accurately the general appearance of a mesogloal sphincter when the fibres are so numerous that they cannot be drawn individually.

D.

It is often very difficult to know what characters are of most value as distinctions of families, genera, and species in dealing with Actiniaria—or indeed what characters are of any classificatory value at all. I have given some attention to discriminating between the relative values of different characters in this group, and one or two points have occurred to me as worth noting. It must of course be understood that here as elsewhere it is impossible to lay down hard and fast rules. The following remarks do not pretend to be anything like a thorough treatment of the subject, but I hope they may be of some use. There is no single character that is used in classifications of this group to which at least one exception cannot be found, but some are more constant than others. I hope to enter much more fully into this subject at an early date, giving the reasons for my conclusions in detail.

(i) *External characters.*—The possession by an anemone of acrorhagi, vesicles, a collar, or similar well-marked structures of course separates it from those sorts which either possess none of these structures, or possess different ones. And species, and often genera, may be easily distinguished by the arrangement and form of such structures when present. Then, again, sometimes the oral disc may be lobed, or it may widely exceed the column, as in *Artemidactis* and *Cereus*, and these features form sound characters of distinction. Capitular ridges seem variable, and of doubtful value. But there is one character which has sometimes been quoted in generic definitions which is emphatically of no value whatever, and that is the height of the body in relation to its width. If I may take one example, I will mention the case of *Parantheoides* Carlgren. In 1898, Carlgren (15) noted in generic definitions that *Parantheoides* has the body at most twice as high as broad, while in *Paranthus* it is several times as high as wide, with a weak base.

Now for some years I have studied living Actiniaria in their natural habitats, and have successfully kept numbers of them for periods exceeding a year in captivity. They impress one strongly with the fact that but for special features, such as those mentioned above, they *have no set form*. For instance, I have seen a specimen of *Sagartia miniata* assume almost every conceivable form within a day: it would close to a button, stand erect as a short thick pillar, become urn-shaped, vase-shaped, or constricted in the middle at one or even several points, like an hourglass. It could elongate itself till it became as narrow as a worm, and even assumed the shape characteristic of the genus *Kodioides*—that is to say, it developed a narrow stem not a quarter of an inch in thickness, with a great globular head at the end of it. If this specimen had been preserved it would naturally have become fixed in any position which it had happened to assume at the moment of death, or which any anaesthetic used had caused it to take up. On one occasion I preserved another specimen of the same species. While alive, it always remained flat and dish-like, and even after feeding (which is the time when anemones assume their finest shapes) it did not rise above a

very low pillar. But in this case, when preserved, it stretched itself out till it was as long and narrow as a thick worm. Similarly, *Anthopleura alfordi*, when alive, will change its shape within ten minutes from that of a flat crateriform dish, not half an inch thick though fully expanded, to that of a tall graceful pillar expanded at the top. *Sagartia viduata* may change from being five inches high, and shrink in one minute till it is only two or three millimetres high. Even the thick-walled *Urticina crassicornis* may extend its body into a tall pillar several times as high as wide, though it is not a frequent occurrence. My point is, that when a specimen is once preserved it may be fixed at any stage of extension, and it is not possible to tell how long it *could* be if it wished. So that although *Parantheoides* is doubtless distinct from *Paranthus*, the fact that when preserved one is twice, the other more than twice, as long as wide, seems an unsuitable character for generic distinction.

(ii) *Gonads*.—I have intentionally omitted any mention of these in my new generic definitions, but hope to enter into this question at a later date.

(iii) *Perfect mesenteries*.—Whether the anemone has only six pairs of perfect mesenteries or numerous perfect pairs seems on the whole a good and constant generic character. Even to this, *Dactylanthe antarctica* is an exception. The number of perfect mesenteries is erratic in the genus *Sagartia*, but that is a genus which has to be considered by itself as a special study, and it may be in a fluid state at the present time.

(iv) *Sphincter-muscles*.—Families are of course easily separated into two sets—those with mesogloal and those with endodermal sphincters. There are two exceptions to this (*Sagartiidae* and *Ilyanthidae*), but the character of the sphincter is an invariably good generic distinction. The sphincter may vary a good deal as to detail in one genus (*e.g.*, *Epiactis* and *Actinostola*), but as far as I am aware it is always the same (within narrow limits) for the various individuals of one species. So that if the sphincter of any given Paractid, say, is alveolar and vertically layered (as in *Cymbactis selaginella* and *Actinostola callosa*) that is a good specific character.

(v) *Tentacles*.—Speaking generally, forms with the longitudinal muscles of the tentacles ectodermal fall into different genera from those which have the muscles embedded in the mesogloea. There are one or two cases where some species have them ectodermal, some partly ectodermal and partly mesogloal. *Paractis*, as at present limited, seems to have both types.

(vi) *Mesenterial musculature*.—The shape of the retractor muscle may vary a good deal in one species, but generally two species may be distinguished by their retractors. Two very distinct types of retractor are found: those which are circumscribed, *i.e.*, have a reniform outline in transverse section; and those which are diffuse. These constitute stable and important characters for generic differentiation. The nature of the individual muscle-processes of a retractor muscle is a useful one for distinguishing species, though it can hardly be used as a generic character. Reference to the descriptions and figures of *Artemidactis*, *Leptoteichus*, *Halcampoides aspera* and *Cymbactis selaginella* will make clear some of the main types of muscle-processes.

(vii) As I have mentioned in connection with *Haleurias endocoelactis*, it does not seem to me that the possession by the body-wall ectoderm of spirocysts and musculature can be considered of more than specific or sometimes generic value. *Haleurias endocoelactis* has no ectoderm spirocysts in the body-wall, but they are found in *H. pilatus* and *H. carlgreni*. *Bolocera brevicornis* has muscles in the body-wall ectoderm, other species of *Bolocera* have not. *Boloceroidea* has this musculature also, but seems to me as nearly related to *Bolocera* as to *Protanthea*, so that there it is only of generic value, if any.

(viii) *Summary*.—It would seem then that the most generally reliable generic characters were to be found in external features of the body *other* than its length; in the number of perfect mesenteries; and in the musculature. That the position of the gonads, and the presence or absence of spirocysts and ectodermal musculature (though no doubt the latter represent primitiveness or the survival in some cases of primitive traits) in the body-wall, were less useful and of secondary value. And that, finally, the length of the body in proportion to its width is quite useless, unless the animal is studied alive, and it is proved that it *cannot* change its proportions. Of course in special families other characters come in, such as the distribution of cinclides in the Sagartiidae; but these hardly need enumeration. I do not make the above statements dogmatically, but have endeavoured to draw fair conclusions from the evidence at my disposal.

III.—DEFINITIONS OF TERMS.

Acontia.—Slender white or coloured threads attached to the borders of the mesenteries in some families of Actiniaria, just below the mesenterial filaments. They are loaded with nematocysts, and can be protruded through the mouth, and in some cases through special pores (cinclides) in the body-wall, for purposes of defence or to paralyse prey. In histological structure they differ completely from the mesenterial filaments.

Acrorhagi.—Marginal outgrowths of the body-wall found in some genera of Actiniaria, containing a strong concentration of nematocysts. They may be simple and spherical, slightly branched, or even frondose.

Actinopharynx.—The "gullet," "oesophagus," "pharynx" or "stomodaeum" of the Actiniaria.

Actinostome.—The mouth, or upper aperture of the actinopharynx, in the centre of the oral disc.

Alveolar.—In transverse section the mesogloal sphincters of many anemones are composed of numerous small more or less circular groups of muscle-fibres, these small circles having the appearance of alveoli. In a sphincter in which the "alveoli" are fairly scattered, the structure may be termed "alveolar." When the "alveoli" are

so close together that the strands of mesogloea between them are very reduced, and form a network, the structure may be termed "reticular."

Capitulum.—The bodies of some Actinaria show a distinction into three regions: the cylindrical central part of the body, which is often provided with a cuticle, is termed the "scapus." The distal extremity, which bears the tentacles, is termed the "capitulum"; it is not furnished with a cuticle, is usually rather different in structure from the scapus, and can be completely introverted, as a rule, into the latter. The aboral end of the body if rounded and swollen out into a bladder-like structure is called a "physa." Many species possess scapus and capitulum, but an ordinary pedal disc instead of a physa. In some cases a pedal disc can be temporarily inflated to form a physa.

Ciliated lobes of mesenterial filament.—In transverse section a simple filament presents a trefoil-like form: the two lateral lobes consist of plain ciliated cells, the central lobe consists of ciliated cells, but among them occur numerous gland-cells and often nematocysts. The central lobe is referred to in this report as the "glandular lobe," and the lateral lobes as the "ciliated lobes."

Circules.—Small apertures or pores in the body-wall of some Actinaria, through which the acontia, if present, may be protruded.

Cnidæ are the same as nematocysts.

Coelenteron.—The general cavity of the body of a Coelenterate.

Endocoel.—The space between two mesenteries of a pair.

Enterostome.—The lower or internal orifice of the actinopharynx, by which the cavity of the latter is put into communication with the coelenteron.

Exocoel.—The space between two pairs of mesenteries.

Fosse.—Some anemones have the margin of the body raised into a distinct rim, or parapet, outside the bases of the tentacles; the circular groove between this parapet and the tentacle-bases is known as a "fosse."

Glandular lobe of mesenterial filament. See "*Ciliated lobes*."

Limbus.—The margin of the pedal disc.

Marginal stomata.—Large or small apertures in large mesenteries (one aperture per mesentery), near the margin of the body, by means of which water may pass through the mesenteries.

Nematocysts.—Stinging capsules found in various parts of the bodies of most coelenterates, and contained in special cells known as nematoblasts.

Oral stomata.—Apertures in perfect mesenteries (one aperture per mesentery), in the angle formed by the oral disc and actinopharynx, by means of which water may pass through the mesenteries.

Pennon.—The retractor muscle of a mesentery in transverse section often has the form of a flag or a pennon, and is therefore referred to as the "muscle-pennon."

Perfect mesentery.—A mesentery whose distal edge (the edge furthest from the body-wall) is at least in part attached to the actinopharynx-wall.

Physa. See "*Capitulum*."

Pseudo-acrorhagi.—Marginal outgrowths of the body-wall of some Actiniaria, which have the appearance of acrorhagi (see above), but contain no nematocysts. They may be perforated.

Reticular. See "*Alveolar*."

Scapus.—See "*Capitulum*."

Spirocysts.—Thin-walled nematocysts containing a spirally arranged thread which is clearly visible through the wall of the capsule.

Verrucae.—Thick-walled, slightly hollow, muscular outgrowths of the body-wall, which often have the power of attaching themselves to foreign bodies.

Vesicles.—Thin-walled, bladder-like, often very hollow outgrowths of the body-wall. Not muscular (always?).

IV.—DESCRIPTIONS OF SPECIES.

SUB-ORDER ACTINIARIA.

I. ACTINIINA, M. Edw.

FAMILY ILYANTHIDAE, Gosse.

Actiniina with the aboral extremity of the body rounded, so that there is no pedal disc. No acontia.

I have ventured to enter into a certain amount of discussion of this family and some of the genera which it contains, and to go over again ground which has been partly covered by various authors, in the hope of simplifying matters a little.

I have retained the original family Ilyanthidae of Gosse (excepting of course *Edwardsia* and *Cerianthus*), in preference to the *three* families Halcampidae, Halcampomorphidae, and Ilyanthidae, as it seems to me unwise, considering the very close general relationships of the genera *Halcompa*, *Halcompoides*, and *Ilyanthus*, to place them in three different families on account of the differences in their sphincter-muscles. For although the character of the sphincter is as a rule a very reliable one, exceptions must be allowed. In the family Sagartiidae, although its members have almost universally a mesogloal sphincter, the genus *Aiptasia* includes forms with no sphincter, or a weak endodermal one. Again, most of the Boloceridae have a diffuse endodermal sphincter, but in *Bolocera pollens* it is strongly circumscribed. So that although *Halcompa* has a feeble mesogloal sphincter, *Halcompoides* a diffuse, and *Ilyanthus* a feebly circumscribed endodermal one, it seems to me advisable, on account of their close general affinities, to include them all in one family, retaining, however, Carlgren's sub-families Halcampinae and Halcampomorphinae.

A considerable amount of discussion has taken place from time to time in connection with the genera *Halcompa* and *Halcompoides*, but I think the question may now be satisfactorily settled. In 1893 Carlgren (8) described two species of

Halcompa, *H. duodecimcirrata* and *H. arctica*, and showed that they possessed mesogloal sphincters. He expressed the opinion that *H. chrysanthellum*, the type of the genus, would also be found to possess such a sphincter, and that therefore the genus *Halcompa* must be restricted to forms with a mesogloal circular muscle. For forms with an endodermal sphincter he proposed the name *Halcompomorpha*, with *H. clavus* Hertw. as its type. He further divided the family Ilyanthidae into two sub-families, according to the character of the sphincter-muscle—Halcompinae and Halcompomorphae (8, pp. 36–38).

In 1896 Kwietniewski pointed out that according to the observations of Haddon and Faurot, *H. chrysanthellum*, the type, had an endodermal sphincter: that therefore Carlgren's *Halcompomorpha* was a synonym of *Halcompa* Gosse: and that a new name was needed for forms with a mesogloal sphincter, for which he proposed *Halianthus*, and for the sub-family Halianthinae. Haddon later (28, pp. 412, 413) confirmed his observation regarding *H. chrysanthellum*.

In 1900, however, Carlgren (11) summarised this, and stated that he had been able to examine sections of *H. chrysanthellum*, and had found that his original surmise was correct, and that its sphincter was indeed mesogloal. It had been overlooked, as it was rather small.

I have made preparations of seven undoubted specimens of *H. chrysanthellum* from Plymouth, and can confirm Carlgren's remarks; there is certainly, in my opinion, a very distinct mesogloal muscle. (See Pl. VI, fig. 16, which shows its position.)

In 1896 Appellöf (4) showed that the type of the genus *Halcompomorpha* (*H. clavus* Hertw.) was really a *Halcompoides* Dan. (a fact which it was quite impossible for Carlgren to have known when he instituted *Halcompomorpha*), and that therefore *Halcompomorpha* must lapse; and he re-named the sub-family Halcompoidinae. But in 1900 (11) Carlgren pointed out that even if the two genera were synonymous there was no need to re-name the sub-family, since the name Halcompomorphae was not misleading, and was as good as Halcompoidinae, to which it had priority.

Kwietniewski proposed to separate forms with twelve tentacles from forms with more than twelve, and for forms with a mesogloal sphincter and more than twelve tentacles he proposed the genus *Halianthella*. But, as McMurrich remarked in 1905 (40), the number of tentacles alone is hardly a valid generic character; and it seems to me that there is absolutely no need to separate *Halianthella* from *Halianthus*. Acting on this principle, I have included my new *Halcompoides aspera* in the genus *Halcompoides*, although the forms hitherto referred to that genus have only twelve tentacles. There are no other differences to support this difference in the number of tentacles as a generic character.

There remains the question of *Halcompella* Andres. Hertwig's *H. maxima* is, in my opinion, a *Halcompoides*. The anatomy of the type, *H. endromitata*, is not yet known, but whether its sphincter proves to be mesogloal or endodermal, it must inevitably be included in either *Halcompa* or *Halcompoides*, since the fact that it has

more than twelve tentacles is not enough to separate it—that is to say, unless it should prove to possess other unsuspected characters which will quite remove it from the forms under discussion.

To summarise this, we have now reduced the number of genera to two, *Halcompa* and *Halcompoides*, and their synonymy is as follows:—

1. Sub-family *Halcompinae*, Carlgren.

= *Halianthinae*, Kwietniewski.

Ilyanthidae with a mesogloal sphincter-muscle.

Genus *Halcompa*, Gosse.

= *Halianthus*, Kwietniewski.

= *Halianthella*, Kwietniewski.

Halcompinae with eight, twelve, or more tentacles; not more than twelve perfect mesenteries; secondary imperfect mesenteries may be present. No conchula.

2. Sub-family *Halcompomorphinae*, Carlgren.

= *Halcompoidinae*, Appellöf.

= *Halcompinae*, Kwietniewski.

Ilyanthidae with the sphincter either absent, or if present endodermal.

Genus *Halcompoides*, Danielssen.

= *Halcompomorphe*, Carlgren, 1893.

= *Halcompa*, Kwietniewski.

= *Halcompella*, Hertwig.

Halcompomorphinae with twelve or more tentacles; twelve perfect mesenteries; secondary imperfect mesenteries may or may not be present. No conchula. Sphincter absent, or if present diffuse, not circumscribed.

3. Genus *Halcompella*, Andres.

Probably a synonym of *Halcompa* or *Halcompoides*.

HALCAMPOIDES, Danielssen.

1. *Halcompoides aspera*, n. sp. (Pl. I, fig. 1; Pl. III, figs. 1, 2, 3, 4; Pl. VI, fig. 13.)

One specimen. Station 314, 5 miles N. of Inaccessible Island, McMurdo Sound, 222–241 fathoms, Jan. 23, 1911. Agassiz trawl. Bottom—mud.

Measurements.—Total length (contracted), 2.5 cm. Diameter of crown, .9 cm.; of column, 1.2 cm.; of physa, 1.4 cm.

The single specimen of this species was strongly contracted, and its internal preservation extremely poor. It was thus too brittle to dissect, and I can describe its anatomy only from sections. The physa was damaged and imperfect.

External characters.—The body is longer than wide, and is broader at the aboral end than at the other. The aboral end is rounded, forming a physa which is not sharply marked off from the main body or scapus. I can give no details about it, as it is much

torn. The upper part of the column, or capitulum, is completely introverted, so that it is not visible till the animal is opened : in structure its wall is not different from that of the scapus. The capitulum is traversed by eight distinct but rather irregular longitudinal ridges, each of which divides into two at the margin of the scapus. The sixteen ridges run down the scapus, becoming less distinct at its aboral end, but they are extremely irregular and much interrupted by deep transverse wrinkles of the body-wall, due to contraction : they die out by the time the physa is reached. All are not equally distinctly developed. The body-surface has no verrucae, and there are no cinclides. The wall is hard and stiff, quite thin in the deepest furrows, but thick on the ridges. The ectoderm has been removed from a large portion of the surface, but where it is present it is rough, brown, and corrugated, and is mixed up to some extent with foreign bodies : a little cuticle is present in small patches. The surface of the capitulum does not differ from that of the scapus. For the general appearance, see Pl. I, fig. 1.

The oral disc and tentacles are completely hidden by the contracted state of the capitulum, and so far is this latter introverted that they lie about half-way down the length of the body. The disc is narrow and slightly developed. The tentacles are small, short, stiff, thick-walled, fairly slender, and bluntly pointed. It is impossible to enumerate them exactly without damaging the specimen, but there appear to be about thirty. From a study of sections, and from the number of mesenteries present, there are probably thirty-two.

Structure. (i) *Mesenteries.*—The total number of mesenteries is thirty-two. Of these, thirteen are large and perfect, and bear muscle-pennons : twelve of these form the usual first cycle of six pairs, including two pairs of directives. The thirteenth occurs in the left ventro-lateral exocoel, and its pennon is ventrally directed. It seems to me that since it is an odd mesentery, occurring on one side of the animal only (so that the animal is *not* bilaterally symmetrical), it is probably accidental, and not an important development. Gonads and mesenterial filaments are confined to these perfect mesenteries. The specimen is a female. The remaining nineteen mesenteries are small, and form the second cycle. They have neither muscle-pennons, gonads, nor filaments. Their exact arrangement between the pairs of perfect mesenteries I cannot give, on account of the bad state of preservation. The primary mesenteries join the oesophagus at various different levels. The muscle-pennons end at different levels in different mesenteries, some of them being very short indeed. In the highest section I have, only one is present : at a rather lower level, thirteen are visible : still lower, five : then three, and finally none. The mesenteries themselves are thin, the perfect ones bearing well-developed parietal muscles, as well as the large circumscribed pennons. These pennons vary as regards their exact shape and size in different mesenteries : they are sometimes round, sometimes a long irregular oblong, but always circumscribed : and in the case of one pair of directives (the ventral) the inequality in their size is very marked, one pennon being considerably larger than the other. The structure of a pennon is diagrammatically represented in Pl. III, fig. 3. In this particular mesentery it will be seen that there

are four stout main lamellae radiating from the centre, which have secondary and tertiary branches, giving them an arborescent appearance ; and a few smaller processes between the bases of these primary lamellae. The same general plan, with small variations in detail, is universal. The parietal muscle is strongly developed (Pl. III, fig. 2), and bears numerous fine processes on either side. These are simple or slightly branched where the mesentery leaves the body-wall, but many of them become higher and more branched at the outer edge of the muscle. In number they vary a good deal in individual mesenteries. Their exact number in the case figured may be seen from the figure. It will also be noticed that the processes of the parietal muscle are much finer than those of the pennon, even though fig. 2 was drawn under higher magnification than fig. 3. The imperfect mesenteries bear parietal muscles (which resemble those of the perfect mesenteries, but are larger) and nothing else. The mesenterial filaments bear well-developed ciliated lobes : where a filament-trefoil is accurately cut across, it presents a characteristic shape, the glandular lobe having a very stout, pillar-like stem, nearly as wide as its own diameter, the ciliated lobes being pushed rather far back, and separated by this wide stem. The nuclei of the ciliated lobes are mainly concentrated in a band in their inner parts. The glandular lobe contains fairly large, irregular, clearly granular gland-cells, which become, in the larger filaments, oval and compact like those of the actinopharynx-ectoderm. Rather short, narrow, but not quite needle-like thick walled cnidae, blunt ended, and with an unusual vacuolated appearance, also occur in the glandular parts of the filaments.

(ii) *Sphincter*.—This is endodermal, weak and attenuated. Its processes (Pl. III, fig. 1) are hardly better developed than those of the general body-wall circular muscle.

(iii) *Endoderm*.—The endoderm of the coelenteron is not particularly interesting : it is of a loose, spongy nature with a thicker crust.

(iv) *Mesogloea*.—This is almost homogeneous as regards the matrix, but more or less fibrous in places. It contains numerous cells showing wide variation in shape and size. Some are clear, some finely mealy or almost granular ; some are elongate and bipolar, some unipolar, some rounded and without the processes of the bipolar and unipolar ones. In some places there are clear spaces containing nuclei, and there are also large granular patches of indefinite shape and variable size : these latter are most numerous in the body-wall, whereas there are more of the cells in the mesenteries, actinopharynx, and ectoderm.

(v) *Ectoderm of body-wall*.—High. Contains many large, loose, irregular granular gland-cells, with large scattered granules, and medium sized thick walled, blunt-ended cnidae, not needle-like, but fairly narrow. The cnidae are few in number except in the upper part of the capitulum, where they are numerous. Many of the supporting cells contain brown pigment-granules. Foreign bodies, such as sand-grains and diatoms, are present, more or less mixed up with the ectoderm, and here and there are patches of cuticle.

(vi) *Actinopharynx*.—Much folded. The ectoderm with very numerous large, oval,

compact gland-cells with large granules, which are unlike those of any other part of the body, except the larger mesenterial filaments. Unfortunately, the preservation of the material allowed no dissection with regard to siphonoglyphes, so I can give no data : probably none.

(vii) *Tentacles*.—The proportions of the various layers of tissue may be seen from Pl. III, fig. 4. The longitudinal muscles are ectodermal, supported on very short, rather club-like, simple or slightly branched processes. Endoderm forming a fine and rather regular network. Nerve-layer of ectoderm broad and very well defined. Ectoderm with a dense battery of long, large, almost cylindrical spirocysts in its outer part, and a fairly well defined zone of irregularly shaped, finely granular gland-cells in its inner part ; these gland-cells are not like those of the actinopharynx, etc., being smaller and finer. Between the gland-cell and spirocyst zones the nuclei of the supporting cells are more numerous than elsewhere.

A point of interest in connection with this species is the presence of a parasite embedded in the mesenteries. The parasite is probably a Crustacean, but more than this I cannot certainly state. It seems to be surrounded by a sort of pocket, formed of the tissue of the anemone, probably a defensive measure on the part of the latter. Carlgren (15) has recorded (with more detail) a similar instance in the case of *Actinostola intermedia*.

I have named this species *aspera* on account of its rough external appearance and texture. It differs from *H. clavus* and *H. kerguelensis* in the possession of more than twelve tentacles and mesenteries. From *H. maxima* it is to be distinguished by its general build, and by the difference in the branching of the muscle-processes of the pennon. *H. minuta*, Wass., as Carlgren has pointed out (12), is a *Haloclava*. *Halcampella ostrooumowi* Wyragévitsch is a minute species living on mussel-shells, and though I have not seen an account of its anatomy, it is certainly distinct, by external characters and habitat, from *H. aspera*.

In Pl. VI, fig. 13, I have shown, very greatly enlarged, the tip of one of the processes of the mesenterial pennon. This shows clearly the typical arrangement of muscle-fibres (here seen in transverse section, of course) in the endoderm, supported by a finger of mesogloea. It also serves to emphasise the difference in appearance between an ordinary process and a process of *Cymbactis selaginella*, which is shown in fig. 14.

FAMILY ENDOCOELACTIDAE, Carlgren.

Actiniina with thin or thick, sometimes cartilaginous body-wall, without sphincter or fosse, and usually with spirocysts in the ectoderm of the body-wall and actinopharynx. Arrangement of mesenteries quite different from the normal Actiniarian type, owing to the development of the second and third orders of mesenteries in the endocoels. In consequence of this the arrangement of tentacles is very different from the normal type. (Among others, ten tentacles of the first cycle border immediately

on those of the second.) Sex-organs present on all the stronger mesenteries, including the directive mesenteries. True basilar muscles absent, base present.

The above definition is that given by Carlgren (12), with a few modifications. I have written "Actiniina" instead of "Athenaria," since I agree with McMurrich in keeping to the two old classes Actiniina and Stichodactylina rather than Carlgren's Protantheae and Nynantheae; for a discussion on this subject, see McMurrich (40). The other alterations are those necessitated by the facts that the new *Halcurias*, which is described below, possesses a thin body-wall, which has no spirocysts in its ectoderm.

HALCURIAS, McMurrich.

Endocoelactis, Carlgren.

Endocoelactidae with twenty large perfect mesenteries which extend from base to oral disc, and bear strong muscle-pennons. Mesenteries in four cycles, those of the third and fourth cycles being small and confined to the uppermost part of the body. Individual mesenteries of one pair equally developed. Tentacles not thickened outside. Spirocysts may or may not be present in the ectoderm of the body-wall and actinopharynx.

2. *Halcurias endocoelactis*, n. sp. (Pl. I, fig. 4; Pl. II, figs. 8, 9, 10, 11, 16; Pl. III, figs. 22, 23, 25, 26.)

One specimen. Station 96, seven miles E. of North Cape, New Zealand, 70 fathoms, Aug. 3, 1911. Agassiz trawl. Bottom—sand and rock.

Measurements.—Height of column, 4.8 cm. Least diameter of column, .7 cm. Greatest diameter of column, 1.5 cm. Diameter of pedal disc, 1 cm.; of tentacular crown, 1.5 cm.

External characters.—The general form may be seen from Pl. I, fig. 4. Pedal disc small, slightly exceeding the lowest part of the column, nearly circular, apparently incapable of strong adhesion; rather thin, wrinkled, much exceeded by the uppermost part of the column in width. Column several times higher than wide, rather worm-like, of different diameter at different heights. It is narrowest just above the limbus, and increases very slightly in width from there upwards, till at about two-thirds of the whole height it swells out rather suddenly into a bulbous portion, below the margin. This upper portion has a very thin collapsible wall, which is semi-transparent: below, the wall is rather thicker. Margin tentaculate. There is a strong fold just outside the bases of the tentacles, which in the figure has rather the appearance of a narrow collar; but it is only an accidental contraction-fold, and does not run round to the other side of the anemone. Surface soft and smooth, without verrucae, etc., but divided by many fine transverse and longitudinal furrows into small inconspicuous papilla-like areas, more prominent in some places than in others, and probably due to contraction. The oral disc is thin and smooth, and does

not exceed the column: radial grooves are present running from the bases of the inner tentacles towards the mouth, but they do not reach it. Mouth raised on a cone, with a prominent lip. The tentacles are short, stout, blunt and conical, rather thin walled, but erect and self-supporting, not flaccid. Their surface is transversely striated. In size they are irregular, the inner being on the whole the largest. Unfortunately, I can give only rather imperfect data as to their exact arrangement and relations to the mesenteries, as I had sectionised more than half of the upper part of the animal before I had identified it, and consequently was unaware of the interest involved. There are sixty tentacles, and eighteen of these are more internal than the others; of the remainder, thirty-nine communicate with the margin, and three do not. But since the arrangement of mesenteries is so irregular, that of all but the first cycle of eighteen must necessarily be very confused.

Structure. (i) *Mesenteries.*—There are twenty large mesenteries, which extend from base to oral disc, and which all bear strong muscle-pennons and are all fertile. These form the first two cycles, 6 p. + 4 p., comprising eight pairs and two pairs of normal directives, and in this respect the animal agrees with the two species of *Halcurias* hitherto described. But the arrangement of the third and fourth cycles is quite extraordinary. The mesenteries composing these cycles are very small and thin, and are attached to the oral disc on its underside. Those of the third cycle run a little way down the actinopharynx and body-wall, those of the fourth cycle do not reach the actinopharynx at all. Their arrangement is exceedingly irregular, not being the same in any two endocoels. But two characters they possess in common—they are all developed in the *endocoels* of the larger mesenteries: and *in every case they have the character of directives.* (They bear neither gonads nor filaments, and the longitudinal musculature is reduced to a low fringe of processes on one face of each mesentery.) That is to say, the longitudinal muscles of the two mesenteries of each pair *face away from each other.* In all members of the family previously studied these small mesenteries form normal pairs, with their muscles facing each other, and not directives as in this case. The exact arrangement of the mesenteries in one half of the animal is shown in Pl. III, fig. 26. On the other side, two endocoels were lost in longitudinal sections of the margin before I knew the animal's genus, but in the other two endocoels the arrangement was as follows:—

(1) One endocoel contained a single pair of tertiary and *no* quarternary mesenteries.

(2) The other contained one pair of tertiary besides one pair of quarternary mesenteries.

It will be further noted from Pl. III, fig. 26, that in one case a pair of small fourth-cycle mesenteries (without musculature of any sort) occurs between two mesenteries of a third-cycle pair: and that in another endocoel the small fourth-cycle pair is attached to the actinopharynx, but does not reach the disc or body-wall.

The state of affairs here described is extremely interesting, since it confirms and

adds to some of the ideas expressed by Carlgren (12) on the subject. Carlgren supposes that probably the first six pairs of mesenteries are formed in the usual way in this genus: that the second cycle to appear consists of four pairs having the character of directives, which form with the six original pairs ten apparently normal pairs, in whose endocoels the subsequent mesenteries grow. This is confirmed by the fact that in *II. endocoelactis*, the species under discussion, the tertiary and quaternary pairs of mesenteries, *as well as* the secondary ones, are formed as directives.

The specimen is a female. The large mesenteries themselves are very thin, mere films, but they bear very powerful muscle-pennons, and have enormous oral stomata in an unusual position, well below the mouth. Where each large mesentery leaves the body-wall it bears on each side an about equal development of rather short, fine, simple or slightly branched muscle-processes, so that it has the appearance of a parietal muscle (see Pl. III, fig. 23). These processes are very short where the mesentery joins the body-wall, becoming higher about the middle of the muscle, and then dying off again. Further out, each large mesentery bears a large pennon; this is circumscribed, but varies in shape according to the level at which sections are cut. In the region below the level of the actinopharynx, where the gonads and filaments are present, it has the form shown in Pl. III, fig. 22. The individual pennons vary of course to some extent in shape and size. The muscle-processes are fine and numerous (for exact number see plate), and some are simple, some a little branched, some much branched. The simple ones are as long as the others, and the compound ones often branch very near their origin, the various branches running nearly parallel with each other, so that there seem to be more simple processes than there really are. Above the level of the enterostome, on a level with the upper part of the actinopharynx, the pennons are stretched out straight, and cover most of the surface of the mesentery, starting immediately outside the actinopharynx. Their form here is elongate oblong, almost diffuse, and their processes are shorter than lower down. Their form changes gradually to the typical circumscribed outline as they reach lower levels. The mesenterial filaments are well developed. Their glandular portions contain gland-cells of two kinds—large granular ones of various shapes and sizes, and numerous small ones such as are characteristic of other parts of the animal. The endoderm of the body-wall contains these small gland-cells also, but they are absent from that of the greater part of the mesentery, which contains, however, numerous large dimly visible non-granular gland-cells, such as are found only here and there in the body-wall endoderm.

(ii) *Sphincter*.—Absent.

(iii) *Mesogloea*.—In longitudinal sections passing through the margin this has the appearance of a rough network with large meshes, being very fibrous. In the clearer parts lie numerous cells with processes, and large oval or rounded nuclei which (varying in size in different cases) are usually deeply stained with haematoxylin. A typical bipolar cell from this region is shown in Pl. II, fig. 16. In transverse sections lower down the fibrous nature of the matrix is less conspicuous, but the cells are extremely

interesting. Near the endodermal side of the mesogloea, which is more deeply stained with eosin than the ectodermal half, are very many small cells possessing apparently a large nucleus and very little protoplasm (Pl. II, fig. 11). These often lie in a clear cavity or capsule, distinctly shown in the figure, which reminds one of what Carlgren has described in *Bolocera longicornis* (for more detail see description of that species below), and which is probably a post-mortem development. In the central part of the mesogloea, and the part near the ectoderm, cells such as that shown in Pl. II, fig. 8, are very frequent. They consist of a large, clear, often mealy-looking nucleus, surrounded by a delicate vacuolated network of protoplasm, of different size and form in different cases. Thirdly, immediately below the ectoderm we find cells (Pl. II, figs. 9, 10) of a rounded form and bladder-like appearance, with indications of network within. It seems likely that the last two sorts of cell described represent different phases of the same thing, particularly if, as is probable, they are amœboid nutritive cells (see p. 2). Possibly this cell-plexus of the mesogloea of Actinians represents an early stage in the evolution of what has become connective tissue in higher animals, though it cannot be called connective tissue as it is.

(iv) *Ectoderm of body-wall*.—This is high and regular, and full of two sorts of gland-cells—the small sort found in the tentacles and elsewhere, and also large irregular ones with dimly defined, soft granules which do not absorb haematoxylin. I believe I can state with certainty that *no spirocysts are present*. I have taken the greatest care to confirm this statement by making four sets of preparations of different parts of the body, and by using four different methods of staining. I have stained with haematoxylin alone, with eosin alone, with the two together, and with Picrosäurefuchsin. The sections seem to be good ones, and I have searched them through and through for spirocysts, but there is no trace of one. Further, in sections which pass through the tentacles *and* the body-margin, the spirocysts are clearly seen crowding the tentacle-ectoderm, but die out at the edge of the body. So that I believe it to be a fair statement that spirocysts are absent from the ectoderm of the body-wall. (This applies also to that of the actinopharynx.) I have taken particular care in this case, because spirocysts have been demonstrated in the body-ectoderm of all members of the family hitherto described, and Carlgren has used this in characterising the family Endocoelactidae. It seems to me that this case shows that although spirocysts when present indicate primitiveness, their presence cannot be used as a classificatory character, since one member of a family (and genus) may retain them while another has lost them. With regard to the position of my species as a *Haleurias* there can be no doubt. It shows all the usual *Haleurias* characters *except* this one. It has ten pairs of large mesenteries, including two pairs of directives, two cycles of small ones developed in the endocoels and restricted to the upper part of the body: it has no sphincter and no basilar muscles, and has all the facies of a *Haleurias*. Its body-form is elongate, but I consider this of no importance in classification. I have elaborated this remark in a general note earlier in the paper (see p. 4).

As far as I can tell, the bases of the ectoderm cells are thickened as Carlgren (12) describes for *Porponia*, etc. At any rate, there is no indication of true ectodermal muscles in the body-wall, though in the pedal disc there are clearly visible fine short processes running from the mesogloea into the ectoderm, which *appear* to be muscular. It seems to me that the presence of ectodermal longitudinal muscle in the body-wall, though a primitive trait, cannot be used for classification any more than the presence of spirocysts, since McMurrich (38) has shown, and later (40) confirmed, that *Bolocera brevicornis* possesses this musculature, whereas other *Bolocera* do not. So that probably these two characters are not of more than specific value.

(v) *Actinopharynx*.—Well developed and much folded, running well down the coelenteron. One siphonoglyph. The ectoderm is very regular and well developed, and contains a very large number of closely packed gland-cells, so that it is nearly black. There are large very granular ones near the surface, and small ones (many times smaller than the granular ones) concentrated chiefly in the central zone of the layer. (See Tentacles.)

(vi) *Tentacles*.—Endoderm thin, mesogloea thicker, ectoderm thickest. The longitudinal musculature is ectodermal, and is supported on short, rather stout, simple and slightly branched processes (Pl. III, fig. 25), which vary in height in different parts of the same tentacle, but are usually less than one-third as high as the ectoderm. Nerve-layer distinct, broad, fine. The outer part of the ectoderm contains a battery of large rather stout spirocysts. The central part is densely crowded with the nuclei of the supporting cells, and with numerous small elongate regular cells which stain with haematoxylin less deeply than nuclei, and often seem faintly granular and mealy, but very finely so. They seem to be small gland-cells, but I will not emphasize that; I have referred to them in other parts of the body as "small gland-cells such as are found in the tentacles," but their nature remains rather uncertain. Cells very like them occur in the mesogloea of the tentacles.

This species is clearly distinguished from *H. pilatus* and *H. carlgreni* anatomically by the arrangement of the third and fourth cycle mesenteries and by the absence of spirocysts in the body-wall ectoderm. Its elongate form and short tentacles *may* be of specific value, but unless the animal is studied alive this is uncertain (see p. 4).

FAMILY PTYCHODACTIDAE, Appellöf.

Actiniina with weakly-developed longitudinal muscle- and nerve-layer in body-wall. No ciliated lobes to mesenterial filaments. No sphincter or a weak one. Sex-organs on proximal parts of mesenteries, glandular mesenterial filaments on distal parts. Actinopharynx variable, arrangements for circulation always strong. Character of incomplete mesenteries peculiar; they carry, beyond the glandular parts of the mesenterial filaments, curious structures giving the appearance of a half-funnel. Base present, sometimes feebly developed, basilar muscles absent. The above are the

characters given by Carlgren (14) for this family. I have written "Actiniina" instead of "Protactinina," and added "basilar muscles absent."

DACTYLANTHUS, Carlgren.

Cystiactis, pars, Clubb.

Ptychodactidae with the body provided with many conical or cylindrical outgrowths, one row to correspond to each mesenterial chamber. Outgrowths of body-wall are like the tentacles, and have spirocysts, which are absent from the rest of the body-wall. No sharp distinction between foot-disc and body-wall, or between body-wall and oral disc. No sphincter or a weak diffuse one. Actinopharynx strong, broad, two well-developed siphonoglyphes with long ends; with pocket-like outgrowths at insertions of perfect mesenteries. Few mesenteries, two cycles, all fertile. All or only the primaries perfect. Mesenterial muscles weak, filaments meandering. Imperfect mesenteries, with peculiar half-funnel-like arrangements along free edges beyond filaments. Proximal halves of the mesenteries mostly fused at their edges (constant for genus?).

The above list of characters is given for the genus by Carlgren (14).

3. *Dactylanthus antarcticus*, Clubb. (Pl. I, fig. 10.)

Cystiactis antarcticus, J. A. Clubb. "Actiniae." Reports, Nat. Antarctic Expedition, 1901-4 ("Discovery"); Nat. Hist., vol. IV. 1908.

One specimen. Station 338, 77° 13' S.; 164° 18' E., entrance to McMurdo Sound, 207 fathoms, Jan. 23, 1912. - Agassiz trawl. Bottom—mud.

Measurements.—Diameter of tentacular crown, 1.9 cm.; of pedal disc, 1.9 cm.; of column, 2.8 cm. Height of column, 3.2 cm. Length of one tentacle, about .2 cm.

This species has been completely described by Carlgren (14) and Clubb (18), so I will merely say that my specimen agrees with Carlgren's description in all respects. Tentacles 12 + 12 = 24. Twenty-four rows of body-tubercles, twelve complete, twelve running from base only part way up column. Mesenteries 6 p. + 6 p. = 12 p., first cycle perfect, all fertile. Fusion of mesenteries at base, pouches of actinopharynx, siphonoglyphes, curious free edges of imperfect mesenteries, etc., all clearly visible. Appearance shown on Pl. I, fig. 10.

FAMILY BOLOCERIDAE, McMurrich.

Actiniina with well-developed base and basilar muscles. Sphincter endodermal, variously developed, or absent; if present, may be diffuse or circumscribed. Usually numerous mesenteries perfect. Tentacles attached to the oral disc by a very short thin-walled neck, and usually provided each with a sphincter muscle above the neck, by means of which the neck may be torn, in which case the tentacle is lost.

The genera related to *Bolocera* have been referred to various families at different times. For instance, Carlgren included *Bolocera* in the Antheadae in 1891 and 1893,

and Gosse originally placed it in the Bunodidae. There can be no doubt, however, that a family Boloceridae is advisable. I consider that it should contain the genera *Bolocera*, *Boloceropsis*, and probably *Polystomidium* and *Polyopsis*. I cannot agree with Carlgren in placing *Boloceroides* in the Gonactiniidae, because it seems to me related as much to *Bolocera* as to *Gonactinia* and *Protanthea*, and I do not regard the fact that it possesses longitudinal ectodermal body-wall musculature as of great classificatory importance. But it is doubtful whether it can be included in the Boloceridae, and its position needs reconsideration. *Boloceropsis* has no tentacular sphincter, but the tentacles are typically Boloceroid in form, and have a short thin-walled neck attaching them to the oral disc.

BOLOCERA, Gosse.

Boloceridae with well-developed endodermal sphincter-muscle, which may be diffuse or circumscribed. Tentacles with well-developed sphincters.

4. *Bolocera longicornis*, Carlgren. (Pl. I, fig. 5 ; Pl. III, figs. 24, 27.)

Bolocera longicornis. ("Beiträge zur Kenntniss der Actinien-Gattung *Bolocera*, Gosse." Öfv. K. Vet.-Akad. Förh. No. 4, 1891.)

Five specimens. Station 38, off the Falkland Islands, 52° 23' S. ; 63° 50' W., 125 fathoms, April 13, 1913. Agassiz trawl.

Measurements (of the best specimen, a small one).—Diameter of oral disc and tentacles, 5.5 cm. ; of column, 2 cm. ; of pedal disc, 2 cm. Height of column, 2 cm. Length of a large tentacle, 2 cm.

In 1893 Carlgren (8, pp. 50–57) gave an excellent description of this species. I may thus merely add a few points as to its variation.

Firstly, I have been able to examine numerous specimens of this species (apart from the present collection) dredged off the West of Ireland. These agree perfectly with Carlgren's description on the whole ; I have not yet made a complete study of them, but I have examined two large specimens in detail. In one of these the last cycle of mesenteries is imperfect, in the other perfect ; the second being considerably larger than the first. One of these specimens was unusually well preserved, and bore gonads on the mesenteries of *all* cycles, those of the primary mesenteries being, however, small, few, and scattered. In the other, the last cycle was sterile, and one mesentery at least of the first cycle fertile. I sectionised the sphincter of one of these. It is perfectly regular and diffuse as shown in Carlgren's figure (Taf. VII, fig. 6), but the processes are coarser and more branched. Wassilieff (66) has noted this same thing with regard to Japanese specimens of *B. longicornis*, and the sphincter of my example is more like his figure than Carlgren's, which must have been drawn from a rather unusually delicate individual. Another interesting point is that in my specimen the gonads contain numerous small zooxanthellae, which lie round the testes. I have observed this phenomenon in several other species, and have referred to it in more detail earlier (see p. 3).

Secondly, as regards the "Terra Nova" specimens of *B. longicornis*:—These are from a widely different locality from that of any specimens of the species hitherto recorded, and differ from Northern specimens in a few minor directions, but I do not think they can be regarded as a separate species. The general form, the arrangement of tentacles and mesenteries, the number of perfect mesenteries, and the distribution of gonads are the same in both. In the "Terra Nova" specimens, of which all but one are much damaged and battered, and have lost most of their tentacles, the tentacles differ from those of Northern examples by being flaccid and thin-walled, and not fluted. But since most of their ectoderm has been scraped off by rough treatment, this is perhaps only to be expected. I have drawn the best specimen as it appeared in spirit (Pl. I, fig. 5), but although the liquid supports the tentacles, their ragged appearance is obvious. The figure shows a curious abnormality of this particular individual—a small bulge of the body-wall on the right, just below the margin. This is in reality a pouch pushed out from the coelenteron, and possibly the beginning of a bud. The sphincter of one of these specimens is shown in detail in Pl. III, fig. 27, which also shows half the tentacular sphincter. This figure agrees with the sphincter of my Northern specimen of *B. longicornis* and with Wassilieff's figure better than with Carlgren's, and I give it to show the possible variation from the originally described specimen. The sphincter reminds one strongly of that of *B. brevicornis*, as figured by McMurrich (38, Pl. XXIII, fig. 31).

Carlgren gave no figure of the muscle-pennon of the mesentery of *B. longicornis*, so I have drawn one (Pl. III, fig. 24), and will add a few details. In my opinion the form of the muscle-pennon, sphincter, and longitudinal muscle of the tentacles of any anemone are the most constant specific characters, in many cases the only ones, and should therefore always be figured when a new species is described. The whole muscular surface of the mesentery is occupied by longitudinal muscle on one face: this is supported on very short processes where it leaves the body-wall, and these increase very gradually in size, forming a low diffuse pennon. The manner in which this pennon ends at the edge furthest from the body-wall varies in individual mesenteries. Typically it ends quite abruptly, with little or no tapering, but in some cases it tapers off before ending, though not nearly so gradually as it does toward the body-wall. Sometimes the individual mesenteries of a pair are slightly unequal in length, and on one the pennon may end abruptly, while on the other it is tapering. The muscle-processes are rather similar to those of the sphincter, and are mostly a good deal branched. The parieto-basilar muscle is fairly developed, though feeble, and it varies greatly in different mesenteries. Its processes are short and simple or only very slightly branched; in some cases it has no clearly marked edge; in others the edge forms a slight prominence (as in Pl. III, fig. 24); again, it may have a slight but distinct free fold, or, lastly, often the free fold has joined up in process of growth with the body of the mesentery, and so encloses a cavity, rather as in *B. pannosa*.

In these specimens, as well as in the Northern one which I have mentioned above,

the gonads are crowded with zooxanthellae, which lie round the testes—the specimen investigated being a male.

Lastly, a few points about the cells of the mesogloea. Wassilieff (66) stated with regard to Japanese specimens of *B. longicornis* that the cells in the tentacle-mesogloea were less numerous than in the specimen figured by Carlgren (1893, Taf. VI, figs. 4, 5). In my preparations of both Northern and Southern forms of this species numerous cells are clearly visible in the mesogloea, but they are as plentiful in the other parts of the body as in the tentacles, and are similar in character to the mesogloecal cells of many other species. In my Northern specimen they are less numerous than in the Southern one, but in neither are they as crowded as in Carlgren's figure; which shows that their number varies a good deal. In my specimens these cells are of almost every conceivable shape, and their size varies greatly. Some are rounded, some rounded with one or two short projections, some pyriform, some spindle-shaped with a process at each end, some of irregular form with several processes; often they are strung together in chains with the tips of their processes touching each other, and, indeed, all seem more or less connected by fine strands of protoplasm. A few examples are shown on Pl. III, figs. 11, 12, 13, 14, 15 and 16. All those figured are from the mesogloea of a tentacle, but are quite similar to those of the body-wall. Carlgren describes his cells as lying in capsules (Kapseln). In my specimens many of the cells lie in clear spaces, which suggest the capsules shown in his figures. I have indicated the outlines of these spaces by dotted lines in the figures on Pl. III, but their actual appearance may be better understood by reference to figures of cells of other species (Pl. II, figs. 11, 13, 14). If these are indeed, as I suppose, the "capsules," then I think they are not capsules at all, but simply post-mortem splittings-away of the mesogloecal matrix from the cell. They seem to have no definite limiting membrane, and do not occur round more than about half the cells: also, they are often only on one side of the cell, as in Pl. III, fig. 16, which suggests strongly a slight drawing back or contraction of the matrix; as does fig. 11. I consider these cells to be probably amœboid cells carrying or transmitting nutriment, as Miss Pratt (54a) has proved to be the case in *Alcyonium*, and not connective-tissue cells (see p. 2). In my material they are rather more numerous near the ectoderm and endoderm in one case, evenly distributed in the other. This may be due to a difference in the time which has elapsed since the last meal. Note the strong suggestion of a food-carrying cell given by Pl. III, fig. 15.

Although it seems that the sphincter may be more branched than Carlgren at first thought, *Bolocera longicornis* may still be easily distinguished from other species of *Bolocera*. From *B. multicornis*, *B. pannosa*, *B. brevicornis*, and *B. africana* it differs in general form, and has far longer tentacles than any of them. From *B. pollens* it is marked off, since that has a circumscribed sphincter. In *B. kerguelensis* and *B. multipora* the sphincter though diffuse has a strong apical mesogloecal lamella, much larger and more branched than any of the others, in sections cut behind the insertion of a tentacle. (This is also the case in *B. pannosa*, and sometimes at any rate

in *B. multicornis*.) *B. norvegica* has only six, and *B. occidua* only twelve pairs of perfect mesenteries, whereas in *B. longicornis* all are perfect. The anatomy of *B. tuediae* is not yet fully known, but I hope to contribute a few notes on it before long.

B. longicornis, then, may be defined as follows:—Tentacles in six cycles (in well-grown specimens), the inner ones about as long as the height of the body. Sphincter diffuse, without any strong apical lamella, but varying in the amount of branching of its processes. Mesenteries all or nearly all perfect.

FAMILY ALICIIDAE, Duerden.

“Actiniina with an adherent base. Column-wall with simple or compound hollow tubercles, or with vesicular outgrowths. Sphincter endodermal, diffuse. Margin with or without acrorhagi. Tentacles simple. Mesenteries arranged in several cycles, of which usually more than one is perfect; longitudinal muscles diffuse; parieto-basilars and basilars unequally developed. No acontia.” (McMurrich, 40.)

PHYMACTIS, Milne-Edwards.

Aliciidae with the column-wall entirely covered with simple and compound vesicles, without definite arrangement. Acrorhagi present. Numerous perfect mesenteries.

5. *P. clematis*, Drayton. (Pl. I, fig. 6; Pl. VI, fig. 15.)

P. clematis, Drayton. Drayton in Dana. “Zoophytes.” U.S. Explor. Exped., Philadelphia, 1846.

Three specimens. Shore between tide-marks, South Trinidad Island, July 26, 1910.

Measurements.—(i) *Largest specimen*.—Greatest diameter, 4.2 cm. Diameter of oral opening, 2.3 cm.; of pedal disc, 2.1 cm. Length of a tentacle, .5 cm. Greatest height, 2.3 cm.

(ii) *Smallest specimen*.—Greatest diameter, 2.8 cm.

There is no need to describe this species, as that has been done fully by McMurrich (40) and Carlgren (15). I will merely add a point of interest which struck me. My specimens agree exactly with McMurrich's description, but that the mesenteries are thicker and more compact (perhaps due to contraction), and the vesicles of the column are inseparably fused together in a mass, some being more completely attached to each other than others. Prof. McMurrich assures me that this was the case in some of the specimens which he examined.

The mesenterial filaments present a point of unusual interest. The greater part of their *mesogloea* is crowded with small zooxanthellae (Pl. VI, fig. 15). I have not hitherto seen any record of zooxanthellae in the mesogloea of an anemone. It will be noted that there is a narrow area free from them at the back of the filament. Furthermore, the distribution of the nuclei of the endoderm-cells of the filament is rather striking, and this is also shown in the figure. In the ciliated lateral lobes some are scattered

throughout the height of the layer, but by far the greater number of them are concentrated in a dense zone in the inner part. In the glandular lobe of the filament, on the other hand, they are found in an irregular belt in the middle of the layer.

The general appearance of the largest specimen is shown in Pl. I, fig. 6.

FAMILY CRIBRINIDAE, McMurrich.

"Actiniina with an adherent base. The column usually more or less verrucose and frequently with acrorhagi at the margin, these, however, never being ramose or frondose. Sphincter endodermal, circumscribed. Usually more than the first cycle of mesenteries perfect. No acontia." (McMurrich, 40.)

EPIACTIS, Verrill.

Leiothealia, Hertwig.

Leiothealia, Hertwig. "Report on the Actiniaria dredged by H.M.S. 'Challenger.'" "Challenger" reports, Zoology, Vol. VI, 1882.

Cribrinidae with smooth body-wall, without verrucae or acrorhagi. Tentacles simple, in several cycles.

6. *E. novo-zealandica*, n. sp. (Pl. I, fig. 8; Pl. III, fig. 28; Pl. VI, figs. 3, 4.)

One specimen. Station 96, seven miles E. of North Cape, New Zealand, 70 fathoms, Aug. 3, 1911. Agassiz trawl. Bottom—sand and rock.

Measurements.—Diameter of crown, 2.1 cm.; of column, 2.3 cm.; of base, 2.3 cm. Height of column, 2.7 cm. Length of a large tentacle, .9 cm.

External characters.—Pedal disc irregular in outline, slightly exceeding the lower part of the column, without cuticle. It has been torn in detaching the animal, but where any ectoderm remains it is thick and firm, a little corrugated. The column is barrel-shaped, being slightly wider in the middle than above and below (Pl. I, fig. 8), a little higher than wide. Substance firm, tough, opaque and self-supporting. Colour of whole animal yellowish. Body-wall fairly thick. Margin a distinct parapet, within which is a deep fosse, the tentacles arising from the disc on the inner side of it. There are no verrucae or acrorhagi or pseudo-acrorhagi, but the whole surface of the column is so wrinkled in all directions that it has a corrugated appearance, as if covered with irregular papillae. Some of the wrinkles are so deep that in transverse section their ectoderm gets isolated in places, and little islands of it appear in the mesogloea, as Stuckey has recorded for *E. thompsoni*. Tentacles covering most of the disc, the inner a good deal larger than the outer on the whole, but the size rather irregular. They are stiff and self-supporting, fairly thick walled, fairly long, graceful, slender, tapering to a point. They are longitudinally and transversely striated, the longitudinal striation practically amounting to fluting. They are in four cycles—12, 12, 24, 48 = 96. Oral disc narrow, radially grooved as usual. Mouth wide open, with a corrugated lip.

Structure. (i) *Mesenteries.*—The specimen is not very well preserved, and is very brittle, so that the mesenteries are hard to count. There are at least forty pairs, in four cycles, and all are perfect. Probably the formula is $6 + 6 + 12 + 24 = 48$ (pairs). The mesenteries of the last cycle run about half-way down the actinopharynx. The specimen is infertile, and I can find no mesenterial stomata. The musculature of the mesenteries is strongly developed, and resembles that of *E. thompsoni*.

(a) A large mesentery (Pl. VI, fig. 4). There is a large, long, broad pennon, occupying half or more than half the muscular surface of the mesentery, and ending at both ends quite abruptly in a strong projection. There are cracks in its surface due to infolding of the endoderm. Its processes are very numerous, long and fine, and highly branched. The part of this side of the mesentery between the pennon and the body-wall is fringed with short simple or slightly branched processes of the longitudinal musculature, which are highest at a point about half-way between the pennon and the body-wall. The parieto-basilar muscle is very well developed, and has a strong free fold, quite a flap, often enclosing elongate cavities in the mesogloea of the mesentery. Its processes are low and simple or slightly branched: they cease at the apex of the fold. The mesentery is strong and firm, with thick mesogloea. The above remarks apply to all the larger mesenteries.

(b) The smaller mesenteries. In each succeeding cycle the pennon of course becomes shorter, as does the mesentery, but it does not become narrower, so that on the mesenteries of the last cycle the pennon has a rounded circumscribed form, without a large surface of attachment to the mesentery.

(ii) *Sphincter.*—This is very interesting. It not only forms a link between the sphincters of *E. prolifera* and *E. ritteri*, but seems to show an intermediate step between two stages of sphincter-evolution. It is strongly circumscribed (Pl. VI, fig. 3), but is attached to the wall by a sort of "tail," which tapers off gradually. It is sub-pinnate, the main lamella from which the processes arise being slender, and near one side of the muscle. The processes arise mainly from its end in a radiating manner, and are exceedingly fine and numerous: they are much branched, and a good deal of anastomosis takes place between them. The figure gives accurately the general appearance and approximate number of them, since it would be impossible to draw each process individually as in *Bolocera*, for instance. This sphincter differs from that of *E. ritteri* in having even finer and more numerous processes, and by being fastened to the wall by a "tail," thus having a much wider area of attachment. It rather resembles the sphincter of *E. thompsoni*, but again its processes are far more numerous and more anastomosing, and in *E. thompsoni* the main lamella is central and there is no tail. It does not resemble the sphincter of *E. prolifera* at all, and *E. nymphaea*, *E. badia*, *E. dubia*, *E. spetzbergensis* have quite a distinct type of sphincter with far fewer processes than the three above-mentioned species. *E. marsupialis* is insufficiently described. It seems to me that the sphincter-muscle of *E. novo-zealandica* represents a stage between, for instance, the two types of sphincter found in *Bolocera kerguelensis* and

Epiactis badia. In *B. kerguelensis* the sphincter is diffuse, but it has diverged from the truly and typically diffuse state, such as in *B. longicornis*, towards circumscription, by producing one large mesogloal lamella at the upper end, which far exceeds and is much more branched than the others. Then in *E. novo-zealandica* it seems as if this strong upper lamella had grown out enormously, and the lower diffuse part of the sphincter had shrivelled up like the tail of a tadpole; but still a small tail is left. In *E. badia*, on the other hand, even this little tail has gone, and the sphincter is attached to the wall by a short peduncle, and the lamella has become central with the processes truly pinnately arranged (McMurrich, 1893, Pl. XXXII, fig. 104).

(iii) *Endoderm*.—Endodermal circular muscle of body-wall well developed, on short stout processes almost approaching those of *Artemidactis victrix*, etc. Endoderm of body-wall low, with numerous small finely granular gland-cells in its outer part, varying in shapes and sizes as to detail. Endoderm of mesenteries rather better developed, and crowded with similar small gland-cells.

(iv) *Mesogloea*.—The matrix is finely fibrous. There are numerous cells, and in the body-wall and tentacles they are quite crowded—fewer in actinopharynx and mesenteries. Many lie in clear spaces, which I attribute to post-mortem contraction. Some are large and dim with clear nuclei, bipolar or stellate. Many are irregular and granular. The majority, however, are rather small and very clear, oval, rounded, pyriform or bipolar, deeply stained with haematoxylin, and often finely granular. It is possible that these are only large nuclei of invisible cells, but they are just like numerous small gland-cells of unusual sort occurring in the endoderm and ectoderm of the tentacles. There is often a darker spot which may be the nucleus, but on the other hand there sometimes seems to be some very dim protoplasm round them.

(v) *Ectoderm of body-wall*.—High; higher than the endoderm. With numerous small gland-cells and nuclei in the inner part, some of the former finely granular, but some not visibly so.

(vi) *Actinopharynx*.—Descending more than half-way down the coelenteron: finely ribbed and corrugated, but without distinct ridges. Two well-marked siphonoglyphes. Its ectoderm is densely crowded with small deeply staining finely granular gland-cells.

(vii) *Tentacles*.—Endoderm thin: mesogloea and ectoderm regularly folded by the longitudinal flutings (Pl. III, fig. 28). Mesogloea thin in the furrows, thick on the ridges, and where thick about equal to the ectoderm. Longitudinal muscles ectodermal, best developed on the ridges and weak in the furrows. The processes are rather scattered, fairly high, slender, simple or a little branched. In *E. thompsoni* they are higher, and the mesogloea is thinner. Endodermal circular muscle well developed. Endoderm with a thick belt in its central part of small regular cells, which I take to be unusual gland-cells, though they rather resemble large nuclei of various shapes. They are rounded or oval as a rule, or elongate, some finely granular, some not visibly so. The ectoderm has a striking appearance, being clearly divided into three zones of about equal width: the inner is the well-marked nerve-layer (broader than in *E. thompsoni*):

the next is composed of a crowd of the small gland-cells found in the endoderm, but their shapes are more various: the outer zone is a densely-packed battery of spirocysts. These latter are about as usual, large, long, subcylindric. Here and there occurs a thick walled nematocyst, rather narrower and shorter than the spirocysts. The outer half of the ectoderm is occupied by the nuclei of the supporting cells.

I have followed Torrey (60) in keeping to the genus *Epiactis*, which name has priority over Hertwig's *Leiothealia*. *Epiactis prolifera*, the type species of the genus, has certainly a rather different sphincter from all the other species, but some of the others have sphincters intermediate in type between that and *E. nymphaea*, which represents the opposite extreme. Furrows of the body-wall have no value to separate *E. nymphaea* generically, as Torrey pointed out, and the lower sphincter of its body is a very feeble and indefinite one. Moreover, in general, all the species described at various times under *Leiothealia* and *Epiactis* resemble each other considerably, and form one good genus. Therefore *Epiactis* contains the following species:—

<i>E. prolifera</i> , Verr.	<i>E. fecunda</i> , Verr.
<i>E. ritteri</i> , Torrey.	(= <i>E. regularis</i> , Verr.)
<i>E. thompsoni</i> , Stuckey.	<i>E. dubia</i> , Wassilieff.
<i>E. novo-zealandica</i> , n. sp.	<i>E. spetzbergensis</i> , Kwietn.
	<i>E. marsupialis</i> , Carlgr.
	<i>E. badia</i> , McMurrich.
	<i>E. nymphaea</i> , Hertwig.

It is possible, as Carlgren (15) has pointed out, that *E. badia* is identical with *Isotealia antarctica*, but as yet that is not proved.

E. novo-zealandica is at once divided from most of the above species by its sphincter. From *E. thompsoni* and *E. ritteri* its sphincter also divides it; *E. ritteri* differs from it, so far as one can tell from Torrey's description, in the pennons of the mesenteries, which in that species are flat; and *E. thompsoni* has also very stout instead of slender tentacles, which are arranged in a curious and quite unusual manner.

FAMILY PARACTIDAE, Hertwig.

Actiniina with well-developed base and basilar muscles. Sphincter mesogloal. Acontia absent.

Since I am introducing three new species (including two new genera) into this family, it is desirable to point out how they may be distinguished, by means of a key, from other members of the Paractidae, as that family is at present understood. I hope, at an early date, to completely revise the classification of Paractidae and Sagartiidae.

The family falls naturally into two divisions, the Actinostolinae and Paractinae: with the former we are not concerned.

In the Paractinae, two groups of genera at once distinguish themselves—firstly,

those which have a smooth body-wall, and secondly, those which are provided with papillae or verrucae.

I. *The smooth-walled genera.*

A. Here two genera are marked off by the possession of a cuticular covering—*Phelliopsis* Verrill and *Marsupifer* Carlgren, of which the former has a simple sphincter, while the latter has the sphincter doubled, and its female develops extraordinary brood-pouches.

B. Among the forms with no cuticle are many which have a perfectly smooth wall with no specialised margin and with normal tentacles.

a. But in *Sycyonis* R. Hertwig, the terminal openings of the tentacles are so large that the tentacles are almost reduced to collars. In *Pycnanthus* McMurrich there are capitular ridges. Here my first genus may be placed—*Hormosoma*, which has a well-marked collar at the margin of the body, lapping back over the column in expansion, as well as other striking characters (see below).

b. If we now consider the forms which have no specialised external features, the first to be separated off is *Antholoba* Hertwig, which has the disc lobed and the tentacles very small and numerous. Of the remainder with a non-lobed disc, *Alloactis* Verrill has specialised tentacles, while in the following genera they are quite normal. First, we have the genera with a thick body-wall—*Cymbactis* McMurrich, with numerous perfect mesenteries, longitudinal muscles of the tentacles mesogloal, and mesenterial musculature of the usual type. Secondly, we have the thin walled genera: *Paranthus*, which has only six pairs of perfect mesenteries, and the longitudinal muscles of the tentacles ectodermal (see Maguire, 46); and *Paractis* M.-Edwards, which should be confined to forms with numerous perfect mesenteries, longitudinal muscles of the tentacles ectodermal or mesogloal.

II. *The genera with papillae or verrucae.*

A. Genera with more or less cuticular covering. Here we have *Phelliomorpha* Carlgren with a true cuticular sheath, elongate body, papillae as in *Halcompa*, and a small sphincter lying directly at the bases of the tentacles; and my genus *Lilliella*, with a feebly developed and patchy encrustation, a large and well-developed sphincter, and in the mesogloea of the body-wall very numerous lacunae, some of which are so large and so near the surface that they form externally visible hollow papillae.

B. With the genera which have no cuticular covering we are not specially concerned here. There are several of them, none very well known, but they are easily distinguished from one another: *Cyathactis* Danielssen; *Cadosactis* Danielssen; *Tealidium* Hertwig; *Raphactis* Verrill; *Ammophilactis* Verrill.

III. There are several genera which I have not included in the above key, as the present knowledge of them is not complete enough to allow of assigning to them any definite positions—viz., *Parantheoides* Carlgren; *Paractinia* Andres; *Archactis* Verrill; and *Synanthus* Verrill.

SUB-FAMILY PARACTINAE (Carlgren).

Paractidae in which the individual mesenteries of each pair are typically equally developed; if any inequality occurs it is slight, and follows no definite rule as in the Actinostolinae, where the inequality is striking. I do not agree that the Paractinae and Actinostolinae should have higher rank than that of sub-families.

HORMOSOMA,* n. gen.

Paractinae with thick, smooth body-wall, without verrucae or capitular ridges, but with a prominent and well-developed marginal collar, which laps back over the column in expansion. Tentacles normal, their longitudinal muscles mesogloal. More than six pairs of mesenteries perfect. No cuticle. Sphincter simple. Margin not lobed. Mesenterial musculature extraordinary, supported on high ridges (see below), the retractors more or less circumscribed. Genotype, *H. scotti*, n. sp.

This genus differs from *Cymbactis* by the possession of a collar, from *Pycnanthus* by the absence of capitular ridges, and from *Paractis* and *Paranthus* by its thick wall and collar. It also differs from all anemones I have seen described in the character of the mesenteries: it is difficult to put this last character into two or three words for the generic definition, but reference to the figure and the description below will make it clear. I have honoured the species by calling it *Scotti*, after the heroic leader of the Expedition, the late Captain R. F. Scott, C.V.O.

7. *Hormosoma scotti*, n. sp. (Pl. II, figs. 2, 17, 18; Pl. III, figs. 17, 19, 21; Pl. IV, figs. 4, 7, 8, 9; Pl. VI, fig. 10.)

Three specimens. Station 338, 77° 13' S.; 164° 18' E., 207 fathoms, entrance to McMurdo Sound, Jan. 23, 1912. Agassiz trawl. Bottom—mud.

Measurements. (i) *Largest specimen (expanded).*—Diameter of oral disc and tentacles, 10·2 c.m.; of pedal disc, 6·2 cm.; of column, 4·8 cm. Height of column, 2·8 cm. Length of a large tentacle, 1·3 cm.

(ii) *Smaller expanded specimen.*—Oral disc and tentacles; diameter, 6·5 cm.

External characters.—Base well marked, broad, thick, its edges incurved in two specimens and in part of the third, expanded and exceeding the column in the other part of the third. Its outline undulate. Its ectoderm intact, resembling that of the column, much corrugated and radially furrowed, more distinctly in two than in the third. The column varies in shape according to the state of contraction. In the contracted specimen it is about as high as wide, in the expanded ones much wider than high, especially in the largest (Pl. II, fig. 2). The smallest specimen is not much smaller than the one figured. In the fully open specimen it is rather larger above than below, the disc being enormous. The wall is very thick. In the two smaller specimens most of the ectoderm has been rubbed off, but in the largest it is intact: it is rather

* ἄρμος, collar, and σῶμα, body: "with a collared body."

thick and soft, reddish brown, and much wrinkled and irregularly corrugated: it becomes thinner and smoother at the margin on the underside of the collar. The body has transverse contraction-folds, and many of the wrinkles take a longitudinal direction. The upper margin is developed into a very distinct and well-marked collar, quite as distinct as in *Metridium*, perhaps even more so. It has a thin edge, and its upper surface is lined by delicate smooth transparent capitular ectoderm, such as covers the disc and lines the broad fosse separating the collar from the outer tentacles. In the contracted specimen it is drawn round so as partly to cover and conceal the tentacles, and in the expanded one it laps back over the column. In the third specimen it is imperfect on one side of the animal, but the creature has clearly been damaged, so that an abnormal growth has taken place. Unfortunately the figure hardly shows a trace of the collar, as it is hidden by the downwardly pointing tentacles. The oral disc when fully expanded is very broad, and projects on all sides above the collar beyond the column, but it is perfectly circular in outline, not at all lobed or undulate. In the fully expanded specimen it is very thin, flabby and semi-transparent, in the contracted state of course it is rather thicker. It is convex, and forms a dome above the tentacles. It has shallow radial ridges running towards the mouth from the bases of all the tentacles, those running from the primary tentacles being of course the largest. The mouth is raised on a cone, is roughly circular, and has a prominent ridged lip. The tentacles are short, stout, and very blunt. Most of them are rather club-shaped (though a few are more conical), being rather narrower at the base than in the middle or near the tip. They are strongly longitudinally fluted, and also transversely striated, and are thick-walled, but not stiff enough to support themselves out of water if well expanded. The inner are a good deal longer than the outer. Their colour, like that of the disc, is a sort of pinkish buff. They are very contractile, and in the contracted state become mere knobs. The disc can be completely infolded, and the collar pulled in over the edges of the tentacles. The tentacles are large when well expanded. Sometimes the blunt tip is convex, sometimes there is a depression in it, but I cannot demonstrate any terminal pore. Tentacles regularly arranged in four cycles, $12 + 12 + 24 + 48 = 96$.

Structure. (i) *Mesenteries.*—These are in four cycles, $6 + 6 + 12 + 24 = 48$ (pairs). The first three cycles perfect. All are fertile. The mesenteries are thick below, thinner above, and they are strongly ridged. The ridges are clearly visible to the naked eye, and run longitudinally: in transverse section they form extraordinary lobes at each side of the mesentery, like those of a deeply cut oak-leaf (see Pl. IV, fig. 9). They are more prominent below than above. There is no trace of mesenterial stomata. The retractor-muscle forms a strong, rounded, prominent ridge on one side of the mesentery just behind the gonad, and the parieto-basilar muscle has a large free flap on the other surface, which can be pulled out with a pair of forceps: this muscle covers most of the surface of the mesentery and joins the body-wall just below the oral disc. As to the musculature, it would perhaps make it most clear if I first describe a single mesentery of one of the higher cycles, such as is shown in Pl. IV, fig. 9. The mesogloea is very

thin where the mesentery leaves the body-wall, but throughout most of the muscular part is extraordinarily thick. This section is taken about half-way up the mesentery. The longitudinal musculature covers the whole of one side of the mesentery behind the gonad, the parieto-basilar the whole of the other. The mesogloea of the mesentery sends out on each side huge lobe-like lamellae, which have thick lobe-like branches, and give the mesentery its extraordinary oak-leaf-like appearance. The longitudinal muscle-fibres, on the greater part of the surface of the mesentery, are borne on small, short, tertiary, simple or slightly branched processes, arising like a fringe round the lobes of mesogloea : but just behind the gonad the processes become high and ordinary and branched, and form a small, strong, circumscribed pennon. The opposite face of the mesentery is fringed with parieto-basilar muscle similar to the longitudinal, but opposite the pennon this muscle ends in a large free flap with higher processes fringing the finger of mesogloea which runs out into it. It can be seen from the figure that the outlines of the mesogloea lobes have a more spiky form on the parieto-basilar side of the mesentery than on the other. The narrow neck of mesogloea uniting the mesentery and the body-wall bears a few little processes on each side. In the small imperfect mesenteries the lobing in transverse section is not distinct, and there is no pennon : but the flap of the parieto-basilar muscle is well defined. Larger mesenteries than the one described present essentially the same characters. In some cases one mesentery of a pair is a little longer than its neighbour, but there is no consistent irregularity as in *Actinostola*, and when irregularity occurs it is not according to rule. I noticed the same thing in *Bolocera longicornis*, and it is perhaps faintly visible in *Cymbactis selaginella*.

(ii) *Sphincter*.—This has a very definite and characteristic outline in transverse section, rather like a bird's head (Pl. IV, fig. 7). It is rather similar in some respects to that of *Actinostola spetzbergensis* (Carlgren 1893, Taf. IX, fig. 1), but besides other differences its structure is even finer. Throughout its length one side of the sphincter lies up against the endoderm. Above, it fills the whole thickness of the mesogloea, running out into the collar and completely filling it. Below, it rapidly tapers off to a sharp point, and so does not run far down the wall. A very small portion of it is given in detail in Pl. IV, fig. 4, to show its minute structure. It will be seen that the mesogloea, which is dotted, is divided by numerous clear spaces into fine strands, which form a network, fringed by muscle-fibres. I propose to call this type of sphincter-structure "reticular" for convenience of reference, as opposed to the "alveolar" type shown in Pl. IV, fig. 15, for another species in which the spaces lie further apart and look rather like alveoli. A third type of sphincter-structure is shown for *Leptoteichus* in Pl. IV, fig. 2, in which the muscle-fibres are merely single or in small clumps.

In the case under discussion the whole sphincter is a network of exceedingly fine and numerous strands. The meshes are rather larger on the endodermal than on the ectodermal side. The general tendency of the stronger fibres is to radiate from the

basal point of the sphincter, and to sweep outwards into the collar, and this gives the sphincter a characteristic appearance, wavy and fibrous.

(iii) *Endoderm*.—That of the body-wall is higher than that of the muscular part of the mesenteries, and contains large granular gland-cells which are on the whole oval in shape, though varying in detail. These are not numerous in the endoderm of the mesenteries and body-wall, but are plentiful in the mesenterial filaments. The glandular lobes of the filaments are clearly marked off and have a rounded kidney-like outline with a very short stem. They contain two sorts of gland-cells: a fringe of the large coarse sort above mentioned, and also delicate, narrow, elongate ones such as are not found elsewhere in the endoderm. They have much smaller granules than the others, and though much longer are far narrower. Numerous spaces which have presumably contained gland-cells occur in the endoderm, and are perhaps empty. The endoderm everywhere has a tendency to be folded. The endodermal circular muscle of the wall is well developed.

(iv) *Mesogloea*.—The matrix is almost homogeneous, a little more fibrous in the mesenteries. Amœboid cells of all shapes and sizes are found in it. Examples are shown on Pl. III, figs. 17, 19, 21, and Pl. II, figs. 17, 18. The two kinds shown in Pl. II, fig. 18, and Pl. III, fig. 17, are particularly numerous in the mesenteries. All the cells seem connected together with very fine processes. Some are rounded, some bipolar, some stellate, often they are strung together in chains and groups. They possess, in this species, no hæmatoxylin-staining nuclei, but it seems as if their nuclei stained red with eosin only (see Pl. II, fig. 17).

(v) *Ectoderm of body-wall*.—This contains very numerous large gland-cells of various shapes, and often a deeply embedded cell has a clearly visible "duct." Many are superficial, many deeply embedded in the very thick ectoderm. The ectoderm of the fosse is more delicate than that of the rest of the body.

(vi) *Actinopharynx*.—With strong longitudinal ridges and slight transverse folds. Two large very clearly marked siphonoglyphes.

(vii) *Tentacles*.—Ectoderm rather higher than endoderm. Mesogloea in its thicker parts much thicker than either. The fluting of the tentacles causes deep folding of the ectoderm, so that alternating high places and valleys occur in section (Pl. IV, fig. 8). The longitudinal musculature is embedded in the mesogloea, and fills its outer half, lying against the inner side of the ectoderm, and separated from the endoderm by a broad belt of mesogloea. It is rather better developed in some parts of the tentacle than in others, and is poor in the furrows and strong on the ridges. The muscle-fibres are arranged in complete or incomplete rings which are compressed into various shapes. Towards the edges of the layer they become scattered in small feeble clumps (Pl. IV, fig. 8). The nerve-layer of the ectoderm is well defined, forming a faint open network. There are spirocysts in a dense battery in the outer part of the ectoderm, mostly; they are long and nearly cylindrical. Numerous coarse granular gland-cells are present, some among the cnidae of the battery, some below it. The endoderm contains a few

gland-cells, and certain cells with processes which resemble more or less the amœboid cells of the mesogloea (Pl. VI, fig. 10).

LILLIELLA,* n. gen.

Paractinae with thick body-wall which is feebly divided into scapus and capitulum. Scapus with a poorly developed patchy incrustation, not a cuticular sheath. The mesogloea of the scapus contains very numerous lacunae of all shapes and sizes, some of which are so large and so near the surface that they form externally visible papillae. Only six pairs of perfect mesenteries. Mesenterial musculature normal. Sphincter simple, large, and well developed. Longitudinal muscles of tentacles ectodermal? Genotype, *L. lacunifera*, n. sp.

I believe I am justified in establishing a new genus for the single badly preserved specimen which is described below, though it is possible that more and better preserved material would present differences. The lacunae which are its most striking character seem to be genuine normal structures with a cellular lining, and not due to bad preservation. Apart from its extraordinary lacunae, the genus differs from *Phelliomorpha* by the character of its sphincter and the absence of a true cuticle-sheath and delicate capitulum. *Cyathactis*, etc., have no incrustation at all, and possess numerous perfect mesenteries.

8. *Lilliella lacunifera*, n. sp. (Pl. I, fig. 13; Pl. II, figs. 12, 13, 14; Pl. III, fig. 5; Pl. IV, figs. 10, 11, 12, 13.)

The significance of the specific name is obvious, on account of the lacunae characteristic of the animal.

One specimen. Station 348, off Barne Glacier, McMurdo Sound, 200 fathoms, Feb. 13, 1912. Agassiz trawl. Bottom—mud.

Measurements.—Height of column, 7·3 cm. Diameter of column, 3·6 cm.; of pedal disc, 2·8 cm.; of capitulum, 2·8 cm.; of oral opening, 1·5 cm. Length of a tentacle, 1·5 cm.

External characters.—Unfortunately all but the body-wall and the frames of the mesenteries of the only specimen are absolutely decomposed into a homogeneous mass, so I cannot make a complete description.

Pedal disc roughly oval, the edges of the column a little inrolled over it. Traces of cuticle or mucus near its edge. It is smooth, whitish, thin and membranous.

Column much higher than wide. It has no definite shape, as it has been crushed (Pl. I, fig. 13). The base would slightly exceed it if the edges were unrolled. The column narrows slightly upwards, the summit being contracted, and only a few tentacles peeping out. The wall is thick, firm, and self-supporting. The uppermost portion, the capitulum, is smooth and devoid of ectoderm: it is not thinner or more

* Named in honour of Mr. D. G. Lillie, Biologist to the Expedition, to whose care and skill the formation of the collection and the excellent preservation of the specimens are due.

delicate than the scapus, if anything thicker: its margin is tentaculate. The scapus has a rough appearance from various causes. A good deal of the ectoderm has gone, but where it remains in patches or in cracks it is rough and brown and gritty, and when sectionised can be seen to be a good deal mixed up with sand-grains, mucus, and foreign bodies such as diatoms and spicules: so that although there is no true cuticle, the animal when whole must have had a good deal of incrustation.

The surface has more or less regular longitudinal and transverse furrows, dividing it up into numerous small rectangular or irregular areas. In addition to this, here and there, irregularly distributed but fairly numerous, are little irregularly shaped hollow vesicles or papillae: they are inconspicuous and do not project beyond the surface, and are by no means true verrucae or vesicles: if one is cut open, it is seen to be caused simply by a large lacuna lying in the mesogloea quite near the surface. What is visible of the oral disc is thin and radially grooved. Mouth and lip degenerated. The tentacles have lost all their ectoderm, and are brittle, flaccid, semi-transparent, long, tapering, and pointed. They are too disintegrated to count accurately, but there are over eighty in three or four cycles. Their arrangement may have been 12, 12, 24, 48 = 96.

Structure. (i) *Mesenteries.*—In four cycles. $6 + 6 + 12 + 24 = 48$ pairs. Those of the first cycle alone are perfect, and are connected with the actinopharynx throughout its length. Those of the last cycle are very small and hardly project beyond the endoderm. The filaments and gonads form a solid, brittle, structureless mass, so I can give no details of fertility. In sections, remains of ova, granular gland-cells, and filaments are distinguishable, but no trace of large nematocysts or acontia: from this I conclude the animal is a Paractid, but if acontia should turn up in better material the genus can easily be transferred to the Sagartiidae. I can give no description of musculature, as all has vanished, but what remains shows that it was not of the *Leptoteichus* or *Hormosoma* type.

(ii) *Sphincter.*—This is pretty well preserved. It is long, running through the whole thick wall of the capitulum and just into the top of the scapus. It does not at any point fill the whole mesogloea, but lies right up against the ectoderm, and is separated throughout by a broad band from the endoderm. Its shape is outlined in Pl. IV, fig. 13. The outer side is irregular and follows the depressions or elevations of the outer side of the mesogloea: about half-way down it begins to separate from the ectodermal side (the ectoderm itself has vanished), and gradually tapers off to a point lying in the middle of the mesogloea. Its structure is moderately clear, though the fibres are somewhat degenerated. A small portion is shown in Pl. IV, fig. 10. It is alveolar, but many of the alveoli have collapsed into clumps, particularly the larger ones—some more and some less. The development is best and densest a little below the margin, and the alveoli tend to an indistinct arrangement in transverse rows in the upper part. The general appearance is irregular and rough, the alveoli and clumps being often small and scattered, often massed together.

(iii) *Mesogloea*.—This is well preserved in the body-wall, although most of the animal is badly preserved. Its matrix has a curious uneven appearance which is enhanced by the various structures which it contains. Firstly, there are numerous lacunae of all sizes and many shapes, many of them visible to the naked eye. A small portion of mesogloea is shown in Pl. IV, fig. 12 : this shows the lacunae, and the dotted portions inside them represent large masses of their lining. I do not think these lacunae can be merely accidental, or due to bad preservation, because they are so regularly and uniformly developed, and are lined or half full of some sort of epithelial lining : this consists of a fine protoplasmic network which stains more or less with haematoxylin, and contains numerous nuclei. This network may merely lie in a narrow band round the edge of the lacuna, or may partly or wholly fill it. A small portion of it is shown in Pl. IV, fig. 11. Although fig. 12 does not actually show one, it will be easily understood that when a large lacuna (many are considerably larger than those figured) occurs just below the surface, it produces one of the little blisters described above as being externally visible on the scapus. The lacunae occur less frequently in the capitulum amongst the sphincter than elsewhere, and do not there form blisters on the surface—nor do these latter occur in every part of the scapus equally. Secondly, here and there a little crack or pit in the body-surface becomes isolated in a section, so that it has the appearance of a small island of ectoderm near the surface of the mesogloea, but is of course not like a lacuna. Thirdly, the mesogloea between the lacunae contains many cells and curious blackish (probably haematoxylin-stained) networks ; the cells may be rounded or oval or amoeboid (see Pl. II, figs. 12, 13, 14). Often they are surrounded by a little of the curious black reticulum (Pl. II, figs. 13, 14), and often they lie in clear spaces, probably due to post-mortem contraction of the cell or the matrix. Very frequently the black networks occur free, and unconnected with a cell, as in Pl. III, fig. 5, which is a small example. Some of the cells are granular. Their nuclei are usually clear, and stain with haematoxylin. Lastly, the matrix does not stain equally deeply everywhere with eosin, but narrow bands lying just beneath the ectoderm and endoderm stain more darkly than the central part. The mesogloea of the mesenteries does not seem to contain any lacunae, but there are curious patches here and there of a coarse network not quite like that contained in the lacunae or surrounding cells : it occurs here and there in the body-wall also, and the patches look like “soft” spots, perhaps degenerated a little.

Tentacles.—There are remains of processes of the longitudinal muscle in a fringe on the outer side of the mesogloea, so that presumably it was ectodermal.

CYMBACTIS, McMurrich.

Paractinae with thick smooth body-wall, without verrucae, collar, or capitular ridges : margin tentaculate, not lobed. Tentacles normal, their longitudinal muscles mesogloea. No cuticle. Sphincter simple. More than six pairs of mesenteries perfect. Musculature of the mesenteries ordinary.

I have slightly widened the definition of this genus to include forms discovered since the species originally described by McMurrich in 1893. The genus at present contains the following species :—

- C. faeculenta*, McMurrich.
- C. actinostoloides*, Wassilieff.
- C. maxima*, Wassilieff.
- C. selaginella*, n. sp.

9. *Cymbactis selaginella*, n. sp. (Pl. I, figs. 7, 11 ; Pl. IV, figs. 14, 15 ; Pl. V, figs. 1, 2, 4 ; Pl. VI, fig. 14.)

I have given this species the name *selaginella* because of the characteristic appearance of the processes of its retractor-muscles (Pl. VI, fig. 14), which strongly remind one of a sprig of *Selaginella* or club-moss. Of course they are not necessarily confined to this species, but provide a convenient character to label it by.

In all there are seven specimens.

A. Five specimens. Station 294, Ross Sea, 74° 25' S. ; 179° 3' E., 158 fathoms, Jan. 15, 1913. Agassiz trawl.

B. One specimen. Station 338, entrance to McMurdo Sound, 77° 13' S. ; 164° 18' E., 207 fathoms, Jan. 23, 1912. Agassiz trawl. Bottom—mud.

C. One specimen. Station 339, entrance to McMurdo Sound, 77° 5' S. ; 164° 17' E., 140 fathoms, Jan. 24, 1912. Agassiz trawl. Bottom—mud.

Measurements. (i) *Largest specimen.*—Diameter of oral disc and tentacles, 4·5 cm. ; of column, 3·7 cm. Height of column, 4 cm. Length of a large tentacle, 1·2 cm. Diameter of pedal disc, 3·9 cm.

(ii) *Smallest specimen.*—Height of column, 1·7 cm. Diameter of column, 1·6 cm.

External characters.—Six of the seven specimens are similar in general aspect, but the seventh is more contracted, and in general appearance is so different that at first I thought it was another species. This difference will be apparent from a glance at Pl. I, figs. 7, 11, the larger of which is a typical specimen, the smaller the one least like it ; but in arrangement of tentacles, structure, and histology the two are identical, hardly the slightest difference occurring between them histologically, and certainly they are the same species. Pedal disc concave, rather drawn in at the edges ; if fully expanded would slightly exceed the column. It is thick and firm, though not as thick as the column, and is slightly wrinkled and furrowed, radially and otherwise. In five of the seven specimens it has a curious little mound arising from the concave centre, but the mound is imperforate. Only one specimen is at all contracted, the others being well open. In these six the column is a little broader than high, in the contracted one about as broad as high. When expanded, it is a little wider at the margin than just above the base. The largest specimen is flattened by pressure. Limbus thick-edged and well marked off. The wall is very thick and firm, tough and pliable ; in the smallest specimen its thickness in proportion to the size of the animal

is enormous. The margin has a very slightly thickened rim, but is truly tentaculate, without any parapet. There are no verrucae, capitular ridges, etc., but the surface is broken up by longitudinal and transverse furrows into low, irregular areas, sometimes like tubercles. In one specimen there is a perfectly circular deep constriction about half-way up the body, but this is only a "waist" such as a living anemone often produces for itself temporarily, and which soon passes off upwards. The mouth gapes, so that the oral disc is rather narrow. It is fairly thin, and has prominent radial ridges running from the bases of the tentacles inwards towards the mouth; these, of course, are larger for the tentacles of the first two cycles than for those of the third. The radii have fine transverse striations. The tentacles vary greatly in form in different specimens, and in different parts of the same specimen, according to the state of expansion. In Pl. I, fig. 7, they happen to be all a good deal contracted, and are then short and stout and conical, either blunt or with a tapering point; but in Pl. I, fig. 11, they are fully extended (though mostly hidden) and are quite long and slender, and rather flaccid. They are thick walled. In many cases they are half expanded, and then they have a stout base, but are on the whole moderately slender, and taper gracefully and regularly to a blunt point. In Pl. I, fig. 11, they are a little damaged. They are rather soft, and have a curious mealy appearance due to irregular longitudinal and transverse furrows, but are not distinctly fluted. I can demonstrate no terminal pores. They are arranged in three cycles close together at the edge of the disc; the typical formula is $16 + 16 + 32 = 64$, but in the smallest animal a tentacle of a fourth cycle has appeared here and there, and in one other case slight divergences from the regular arrangement are met with; but the arrangement is never hexamerous or decamerous. Three specimens have the body, disc, and tentacles pale flesh-buff, the tentacles a darker shade of the same. Four are pure cream-white, except that in one of them the actinopharynx is striped with brownish violet.

Structure. (i) *Mesenteries.*—These are thick and excessively flabby, so that it is hard to cut accurate sections of them. I can demonstrate no stomata. In the large specimen examined there are four cycles of mesenteries: each of the first two cycles contains eight pairs, and these are all perfect sterile. The third cycle contains seventeen imperfect fertile pairs, one extra pair being accidentally present in one exocoel. The fourth cycle consists of small *single* mesenteries, not pairs, alternating regularly with the other cycles. They are entirely confined to the proximal part of the body, and are fertile. From transverse sections it is evident that they are truly only single mesenteries, and there is no trace of a young partner not yet grown beyond the endoderm, as in the last cycle of mesenteries in some species of *Actinostola*. In the smallest specimen there are the first three cycles as before,—8 p. + 8 p. perfect and sterile, 16 p. imperfect and fertile, but the fourth cycle only appears here and there, as the anemone is very young. I will describe the musculature from sections of the smallest specimen, as in the larger ones the mesenteries are so twisted and flabby that good preparations cannot be made from them. The only difference is

that in the larger specimen the pennons are larger and broader. They are the same shape and have the same curious *Selaginella*-like processes. The longitudinal musculature occupies the whole of one surface of the muscular part of the mesentery, and forms a rather distinctly shaped diffuse pennon (Pl. V, fig. 4). It is narrow where it leaves the body-wall, but rapidly increases in breadth, so that at a very short distance from the wall it is quite wide, and this is the highest point. From here it tapers off very gradually to the other edge, and here and there its sequence is broken by depressions lined by endoderm, and caused by the irregular surface of the mesentery. The processes are rather fine, for the most part branched, and have the curious appearance of a club-moss or a *Selaginella*, the sharp fibres fringing them like pointed leaves. A small one is shown in Pl. VI, fig. 14, much enlarged. The parieto-basilar muscle is fairly developed, but where its processes are cut across squarely they are very low and simple or only a little branched. The muscle, however, encloses in the mesentery a series of cavities (clearly shown in the figure), presumably by developing a free edge and repeatedly joining up again with the body of the mesentery in course of growth. In the upper part of the mesentery, where this muscle covers only a part of the surface, these cavities never occur in the mesogloea beyond the point where it ends in a slight protuberance or faint free fold.

(ii) *Sphincter*.—I have figured the form of this in a large and small specimen, but it will be obvious that in Pl. V, fig. 2, the sphincter would be the same shape as in fig. 1 if it were straightened out—*i.e.*, if the animal were not wrinkled by contraction. The inner edge lies up against the endoderm throughout, the lower part passing insensibly into the ordinary endodermal circular muscle of the wall. It is wedge-shaped, almost filling the mesogloea at the broad top, and dying out very gradually and regularly below, and of course widely separated from the ectoderm throughout most of its length. In structure it is "alveolar" (in the small specimen; see Pl. IV, fig. 15, for exact detail of a small portion) to "alveolo-reticular" (in the larger specimen). The alveoli vary greatly in shape and size as to detail, but the largest ones occur on the upper and inner margins; they are very distinctly arranged in vertical rows, in the upper part, with clear bands free from muscle-fibres between the rows. This is shown in the small piece of detail in Pl. IV, fig. 15. That is to say, the sphincter is layered vertically. The majority of the alveoli are transversely elongate with a secondary tendency to be arranged in irregular transverse rows: this elongation being less distinct in the larger specimen than in the smaller.

(iii) *Endoderm*.—Endodermal circular muscle well developed. Body-wall endoderm high and deeply folded and devoid of granular gland-cells, though in one specimen there are certain mealy, indefinite bodies which *may* be mucus-cells. When a mesenterial filament has the simple trefoil-form it is fairly distinct, the three lobes being rather angular: the glandular lobe has a stout stem, and the ciliated lobes are well developed, with their nuclei concentrated in a dense zone in the inner part. The glandular lobe has numerous granular gland-cells, mainly superficial, and its nuclei are mostly

concentrated in two masses at the back of the lobe, one on each side of the stem. Gland-cells are present in the endoderm of the mesenteries, but whether they are granular or not I cannot be sure.

(iv) *Mesogloea*.—The matrix varies a great deal in different parts of the same section, often seeming homogeneous, often visibly and finely fibrous, sometimes strongly so, sometimes faintly. It stains with eosin in an interesting manner: in the sphincter-region, in one specimen, six distinct zones each stained a different depth can be made out: the deepest layers are those just outside the endoderm and inside the ectoderm. The cells are not particularly interesting: they are rather scattered, rather small, of all shapes and sizes as to detail. They may be bipolar or multipolar, or may form chains or lie in more or less definite clear spaces. Often they are surrounded by a complex network of very fine processes.

(v) *Ectoderm of body-wall*.—This is higher in the old specimen than in the young one: in this latter, where any ectoderm remains, it has the nuclei confined to the inner part, and forming a well-marked zone. The outer part contains numerous ill-defined gland-cells of all shapes, but typically large and oval: these are mostly stained with eosin and not haematoxylin, and though not definitely and clearly granular, look as if they might be so if one could see them more clearly. In the older specimen the ectoderm is very regular, the nuclei are well scattered, most numerous in the middle part, and there is a superficial band of gland-cells. These are fairly numerous, smaller than those of the filaments, in the lower part of the wall. But higher up they are larger, and the cells less regular. They are elongate and granular below, more various in shape above, and granular or not visibly so in different cases.

(vi) *Actinopharynx*.—Furrowed longitudinally and wrinkled transversely as usual, generally with a prominent lip, soft and rather thin. In all cases there are two well-marked siphonoglyphes.

(vii) *Tentacles*.—Ectoderm higher than endoderm: mesogloea in its thicker parts higher than either. All the layers are a good deal folded irregularly, by the wrinkling of the tentacle-surface, and so vary in thickness at alternating points. There are two quite distinct sets of longitudinal muscle: the main part of it is completely embedded in the mesogloea, filling up about half that layer, and varying in position, even in the same tentacle. Sometimes it lies in the outer half, only separated from the ectoderm by a narrow strip of clear mesogloea, sometimes it lies right in the middle of the mesogloea, separated about equally from ectoderm and endoderm (Pl. IV, fig. 14). It is formed of large oval or rounded alveoli of different sizes (lined by the muscle-fibres), which are so close together that they rather press each other out of shape and make the structure "reticular." But quite apart from this mesogloéal musculature, and not connected with it, is a secondary fringe of tiny muscle-processes projecting into the ectoderm. These are shown in the figure: they are very small, and simple for the most part. The nerve-layer of the ectoderm is narrow but clear. The outer part of the ectoderm has a dense battery of spirocysts, which are larger in the old specimen than

in the young one, and in the former are long, large, subcylindrical, and seem rather more narrow, tapering and pointed at one end than at the other. Nuclei of supporting cells most numerous in a belt inside the spirocyst-battery. In one specimen granular gland-cells can be made out superficially, but not in the other, except in the disc. But in both, there are curious homogeneous gland-cells just outside the nerve-layer; they are of various shapes and rather mealy-looking, and either remain grey or absorb eosin. In the larger specimen the endoderm is a fine open network, with a dense outer crust containing a few granular gland-cells and a large number of round oil-globules, which are either large and separate, or smaller and clustered.

(viii) Two specimens examined were female, a third male.

This species is easily to be distinguished from the other three species in the genus, as will be clear from reference to the plates and descriptions of them given by McMurrich (1893) and Wassilieff (1908). *C. selaginella* is characterised by the possession of few tentacles, which are octamerously arranged, as are also the mesenteries; by a well-developed, alveolar to alveolo-reticular, vertically layered sphincter; and by the distinct form of the retractor-muscle, and the curious club-moss-like appearance of its processes.

FAMILY SAGARTIIDAE, Gosse.

Actiniina with well-developed base and basilar muscles. Sphincter mesogloea in all genera but one. Acontia present. Cinclides present or absent.

SUB-FAMILY SAGARTIINAE, Verrill.

Sagartiidae with soft body-wall, possessing cinclides but no cuticle; sphincter present, mesogloea; more than six pairs of perfect mesenteries, of which the six pairs of primary mesenteries are fertile, except for the directives in some cases. Suckers may or may not be present.

ARTEMIDACTIS, n. gen.

Sagartiinae with thin body-wall (in proportion to the size of the animal), without verrucae or collar. Body cylindrical below, but widely expanded above, so that the disc greatly exceeds the column, although it is not lobed: margin tentaculate. Longitudinal muscles of the tentacles ectodermal. Musculature of mesenteries very weak, forming no distinct pennons; but borne on such stout lobe-like processes of the mesogloea that the musculature *appears* as if reversed, and apparently projects from endoderm to mesogloea. The mesenterial filament is confined to a certain definite area on each mesentery, the edge of the mesentery above and below being quite free. Tentacles very numerous. Cinclides irregularly distributed. Genotype, *A. victrix*, n. sp.

The only genus near this is *Cereus*. From *Sagartia*, etc., the widely expanded upper part of the body quite separates it. *Cereus* possesses this expanded part, but does not resemble *Artemidactis* in structure. *Cereus pedunculatus*, the type, is a

strongly muscular perfectly retractile animal, with strong muscle-pennons with processes of exactly the normal type. *Artemidactis* seems unable to shorten its body at all, from the absence of retractors, although the sphincter is strong enough to conceal the tentacles. Moreover, the restriction of the mesenterial filaments is curious (see below).

Even though the external appearance of this creature when dead may not be particularly fine, it is enough to give to anyone who has known anemones alive and healthy a key to the beauty which it would display in a free and living condition: and, even now, its histology is wonderful almost beyond imagination. The species is named after Diana, since we have to deal with a *large anemone*, which is evidently *numerous* in its own locality, and therefore presumably *successful*: and is not a large anemone a huntress?

10. *Artemidactis victrix*, n. sp. (Pl. II, figs. 1, 3, 7, 15; Pl. III, figs. 6, 7, 8, 9, 10; Pl. V, figs. 3, 5, 6, 7, 8; Pl. VI, figs. 5, 6, 7, 8, 9, 12.)

A. Eight specimens. Station 294, Ross Sea, $74^{\circ} 25' S.$; $179^{\circ} 3' E.$, 158 fathoms, Jan. 15, 1913. Agassiz trawl.

B. One specimen. Station 338, entrance to McMurdo Sound, $77^{\circ} 13' S.$; $164^{\circ} 18' E.$, 207 fathoms, Jan. 23, 1912. Agassiz trawl. Bottom—mud.

Measurements. (i) *Largest specimen.*—Diameter of tentacular crown, 8.4 cm. Length of a large tentacle, 2.1 cm. Diameter of extruded actinopharynx, 5.7 cm. Height of column, 8.8 cm. Diameter of lower part of column, 4.5 cm.; of pedal disc, 6.1 cm.

(ii) *Smallest specimen.*—Diameter of tentacular crown, 2.7 cm.—Total length, 5.2 cm.

External characters.—Most of the specimens are very large, several medium, and one small. A medium-sized one is shown in Pl. II, fig. 1. The pedal disc is thin, and secretes a sort of soft cuticle, formed by accumulated layers of mucus. It is often contracted and crumpled, with an irregular edge, but when expanded it well exceeds the column. In one case it was very firmly adherent to a large Tunicate. The column is more or less cylindrical throughout the lower and greater part, but above it suddenly dilates into a wide expanded umbrella-like portion, which is generally folded backwards so that it overlaps and hides the upper part of the column: the disc and puffed out actinopharynx in turn hide it, taking the form of a dome, so that the tentacles all point downwards, in a fringe at the edge of the disc. This is rather as in *Cereus pedunculatus*. The body is a good deal higher than wide, very much so if the disc be turned right way out. It does not seem, as far as one can tell from preserved material, as if the animal had strong enough retractor-muscles to shorten the long body: even in the one specimen in which the tentacles are retracted, and covered by the strong sphincter, the body is as long as ever; and all the other specimens are widely expanded. The wall is very thin and baggy for such a large animal, and cannot support its own weight out of spirit, but it is tough. It is smooth, without verrucae. The ectoderm is pale brown, but is

often gone from the surface, which is then pinkish buff in some specimens, cream-coloured in others. The margin varies in different specimens according to the state of its expansion. Often there is a very distinct parapet: in one case the margin is a little inflated and rounded: in some there is a parapet on one side and no parapet on the other. The part just below the margin has sometimes very inconspicuous low knobs or tubercles and very indistinct solid or more or less hollow short ridges, but they are of no importance. The cinclides are fairly numerous, scattered irregularly over the column, and possibly rather more numerous above than below. Often acontia are protruded through them. The oral disc greatly exceeds the column in expansion, but the actinopharynx is so much puffed out in all cases that the free surface of the disc is quite narrow. It slopes upwards from the tentacles to the edge of the actinopharynx. If at all inflated it is very thin, and has slight radial furrows running inwards from each side of the tentacles of the first three cycles. The extruded part of the actinopharynx is flabby, and forms two great rounded inflated lips, which are strongly and regularly ridged and furrowed. There are three alternating sets of these ridges, large, medium, and small—one ridge for every pair of mesenteries in the body: the siphonoglyphes interfere a little with the exact number. The tentacles have a graceful form, tapering from a broad base to a blunt or pointed end. They vary in size and in the thickness and stiffness of their wall, according to the amount of inflation. They are fairly large actually, but compared with the size of the body quite small. They are finely striated longitudinally and transversely. As far as I can tell, their ends are imperforate. They are arranged in four cycles in the smallest specimen— $24 + 24 + 48 +$ nearly $96 =$ nearly 192. In the larger specimens there are five cycles, in all cases twenty-four primary ones. In one specimen of which I made an exact count the arrangement was $24 + 24 + 48 + 96 + 100 = 292$. The first four cycles are perfectly regular, but the fifth is very unevenly distributed; it is evidently incomplete, and will grow to 192 when perfect. Two quarters of the animal had each twenty-four tentacles of this cycle, one had thirty, and the other twenty-two.

Structure. (i) *Mesenteries*—In the large specimen examined, as follows:—Six cycles— $6 + 6 + 12 + 24 + 48 + 96$ pairs = 192 pairs. The first three cycles are perfect: the mesenteries of the sixth cycle are small, and are entirely confined to the lowest part of the body. All cycles bear gonads, filaments, and acontia. Small internal stomata are present. The first two cycles are attached to the actinopharynx throughout its length, the third does not run so far down, the fourth does not reach it at all. The filaments and gonads are strictly confined to a certain small part of each mesentery, and the edge of the mesentery above and below that part is absolutely unbound by even the simplest strand of filament. The filaments of the perfect mesenteries form a large knot on the edge of the mesentery just after it leaves the actinopharynx, the short space between the knot and the edge of the gullet being bound by a simple bit of filament, which in the first and second cycles is continuous with a ridge of pharynx. Below this single knot there is no gonad or filament. In the

imperfect mesentery there is a short knotted filament and a row of gonads, above and below which there is nothing. But it is a curious fact that the mesenteries of each cycle have their knots of filament at a different level (the same for each member of the cycle), so that the various knots do not interfere with each other. Those of the sixth cycle are near the base, of the fifth half-way between base and lower end of actinopharynx, of the fourth partly above, partly below, the level of the bottom of the actinopharynx, of the perfect mesenteries between the zones of the fourth and fifth. This is diagrammatically represented in Pl. VI, fig. 12, which shows a small piece of wall, with some mesenteries of each cycle.* The thickened portion of each mesentery represents the filament and gonad, the line OE the base of the actinopharynx, and everything which in reality would be hidden by the latter is given in broken lines. In a smaller specimen examined the various notes given above hold good, but the zones of filament are rather more diffuse, and the zones of the fourth and fifth cycles more or less coincident, though that of the sixth is quite distinct. Now as to the musculature. A whole mesentery of the third cycle is shown in Pl. II, fig. 3. It will be seen that the greater part of the muscular portion of the mesentery (*i.e.*, the part between gonad and body-wall) is very thin—indeed, it is a mere flimsy, transparent membrane—but that where it joins the body-wall it is rather thicker. This broader basal part bears on each side an approximately equal development of very stout, lobe-like processes of the mesogloea, which have short stout primary and secondary branches, and are fringed by the muscle-fibres. They are generally rather larger on the longitudinal than on the parieto-basilar face of the mesentery. The main thin part between this and the gonad has practically no muscle, but just behind the gonad a few very low and inconspicuous rounded processes arise on the longitudinal side, but make no approach to a pennon. In sections taken through the part of a mesentery which has no filament or gonad, the thin portion ends in a slight spoon-shaped swelling with short stout processes all round the edge of it. In the mesenteries of all cycles the general arrangement is as in the case figured, the basal part near the body-wall, bearing the musculature, varying in extent according to cycle, but the processes are always very stout. The processes from one side of this part of a directive mesentery are shown in Pl. V, fig. 8, and it will be seen that they are similar to those of *Leptoteichus*, so much mesogloea being present that the processes seem reversed, and appear to project from endoderm to mesogloea. The letter *m* is in the mesogloea. In sections at a low level, the fibres of the parieto-basilar muscle run transversely of course. The parieto-basilar muscle is nowhere better developed than the basal part of the longitudinal muscle. In the largest mesenteries of all there is rather more attempt at a pennon than in Pl. II, fig. 3, the processes behind the gonad being a little larger and more numerous, but never do they reach the size of those on each side of the mesentery where it leaves the wall, and so no real pennon exists. The specimen sectioned is a female.

* It must be understood that this diagram shows the various details with considerably more regularity than does the actual specimen.

(ii) *Endoderm*.—The mesenterial filaments deserve special description in this species, as they are very beautiful (see Pl. II, fig. 3). If a simple filament be sectioned it represents, of course, the form of a single trefoil. The glandular lobe is transversely oval, with a very narrow stem connecting it to the other parts, and on each side of this stem is a kidney-shaped, curved, ciliated lobe, the two very near together. Proximal to each ciliated lobe is a delicate patch of network, which projects a little behind the trefoil on each side. The mesogloea of the mesentery sends a narrow strand into the back of the filament, which has a narrow branch to each lobe, and in the "pelvis" of each "kidney" this forms a small expansion. This, of course, is mostly only the typical structure of many Actinian filaments, but here the form, regular development, and colour when stained give it greater clearness than usual. The nuclei of the ciliated lobes are concentrated in their inner parts. The glandular lobe is evenly crowded with fairly large elongate granular gland-cells. When a compound filament is cut across, in many cases the individual trefoils remain distinct, and form beautiful bunches, such as are shown in fig. 3. In most species they lose all form, and the compound filament becomes a shapeless mass. In this species, when the trefoils do lose their form, a splendid folding of the ciliated parts becomes visible; this is not confined to this species, but is here better and more regularly developed than usual. A little of it is shown in Pl. II, fig. 7. This figure demonstrates the regular alternation of long lozenges of clear tissue, bounded by pillars of cells stained pale pink or lilac, and the pattern which the stain forms (in all cases the same) in the more deeply stained outer part. The endoderm of the body-wall is uninteresting: it is high, and contains very few gland-cells. That of the thin part of the mesenteries is low, with a few granular gland-cells. But that of the gonads and the part of the mesentery proximal to the filament-trefoils is high and beautifully developed. It is arranged in alternating low hills and valleys, and in many places is folded. It has throughout the character of a fine and rather regular close network, only clearly seen under high powers, and quite different from the network-lobes of the filaments. There are very numerous granular gland-cells which are large, and though various in form are mainly elongate and club-shaped (see Pl. II, fig. 3), and have a tendency to be radially arranged in the ridges and hillocks. Often ducts are traceable in such positions. The endoderm contains, here and there, curious amoeboid cells: these are only slightly stained and mostly dimly visible against the reticulate endoderm background, but I have managed to see two or three clearly enough to figure them (Pl. VI, figs. 7, 8, 9). In colour they are grey, often with vacuoles and a mealy appearance or a few granules. They are really almost exactly like the cells of the mesogloea, and it seems quite possible that they are food-transmitting cells such as occur in the endoderm of *Alcyonium*. A few odd scraps of gland-cells from this endoderm are figured on Pl. VI, figs. 5, 6.

(iii) *Mesogloea*.—The cell-plexus here is particularly well developed, more so in the mesenteries than elsewhere. The matrix is almost homogeneous in the mesenteries, more fibrous in the body-wall. The cells are unusually large and numerous: there are

two sorts—small transparent bipolar ones, and much larger, irregular, mealy grey ones. Many have very dim outlines. Some are rounded or oval, very irregularly, some bipolar, most are very amœboid, and they lie in strings and bunches and seem all connected by fine processes. A few examples are shown in Pl. II, fig. 15; Pl. III, figs. 6, 7, 8, 9, 10. Often no nuclei are distinguishable: sometimes there are round vacuoles. Some are almost granular. In the body-wall many are distinctly granular.

(iv) *Ectoderm of body-wall*.—High, well developed, with a smooth surface; rather higher than endoderm, where well developed, but neither as high as the mesogloea. With a distinct and dense superficial narrow zone of more or less oval granular gland-cells, whose “ducts” can often be traced inwards to the mesogloea. The inner part is of a firm consistency.

(v) *Actinopharynx*.—With two large and well-marked siphonoglyphes in all cases.

(vi) *Acontia*.—The shape in transverse section of one of these is shown in Pl. V, fig. 3. There is a three-lobed core of mesogloea; the smaller of the two main endoderm-divisions of the acontium is unspecialised; but the large kidney-shaped portion is crowded with gland-cells and cnidae. The gland-cells are granular and elongate, and penetrate the whole thickness of the endoderm. The cnidae are enormous. I have not observed such large ones in any part of any anemone except in acontia and acrorhagi, to which they seem restricted. They are long and canoe-like, blunt at both ends: there is a structure running along one side or down the middle which looks like a keel, and which is probably the narrow spiral thread contained by the cell, the individual coils not being visible: there is usually a twist, more marked in some cases than in others, near one end. A rather similar but smaller and less twisted cnida, from the acontium of another species, is figured in Pl. III, fig. 18.

(vii) *Tentacles*.—Ectoderm very high, much thicker than mesogloea or endoderm. Endoderm very narrow, folded; endodermal circular muscle feeble; endoderm dense externally, almost hollow below, with a few large granular gland-cells superficially, and here and there a keeled twisted cnida, similar in *form* to those of the acontia, but much smaller, and about the size of an ectodermal spirocyst. The longitudinal muscle is ectodermal, with a rather “reversed” appearance, in a dense layer about as thick as the mesogloea. The processes are very high and much branched, and although there is a fair amount of mesogloea in them, they are not nearly as stout as those of the mesenteries and body-wall circular muscle (which has processes as stout as those of the mesenteries). They are so numerous and closely packed that it is impossible to draw individuals: I have given the general appearance under a low power in Pl. V, fig. 7. Mesogloea a little thicker than endoderm. Ectoderm very regularly developed, deeply folded: nerve-layer narrow, distinct. There are gland-cells and spirocysts throughout the ectoderm more or less, but they are by far the most numerous superficially, where they form a dense distinct battery: spirocysts long and broad, subcylindrical, tapering a little more gradually internally than externally. The deeply embedded gland-cells are mostly diffuse and poor: but among the spirocyst-battery they are large and densely

granular, of various shapes, often with a duct inwards as well as outwards. Here and there occurs a thick-walled cnida such as is mentioned above for the endoderm. The oral disc has a similar structure to the tentacles.

(viii) *Sphincter*.—At the very top this almost fills the mesogloea, leaving only a very narrow band between itself and the ectoderm on one side and the endoderm on the other. These two bands gradually widen below, and the sphincter thus tapers off and its narrow lower part lies in the middle of the mesogloea (Pl. V, fig. 5). A small part of its exact structure much enlarged is shown in Pl. V, fig. 6. It is neither reticular nor alveolar; the processes are arranged in clumps of various sizes (shown as black blotches), and these in turn in larger clumps. These larger clumps tend to be arranged in transverse rows above, longitudinal ones below, but there is no distinct layering. The clumps are very irregular for the most part.

This species seems to me extraordinarily beautiful and interesting, and at any rate there should be no difficulty about its identification.

SAGARTIA, Gosse.

Sagartiinae with the body not widely expanded above: surface smooth or with small suckers: margin tentaculate, not lobed: base not specialised for clasping zoophytes: cinclides irregularly distributed.

11. *Sagartia*, sp. (Pl. I, fig. 12; Pl. II, fig. 19; Pl. III, fig. 18; Pl. V, figs. 12, 13, 15, 17.)

One specimen. Station 134, Spirits Bay, near North Cape, New Zealand, 11–20 fathoms, Aug. 31, 1911. Dredge. Bottom—shelly.

Measurements.—Diameter of oral disc and tentacles, 1.1 cm.; of column, .7 cm.; of pedal disc, .9 cm. Height of column, .5 cm.

External characters.—Colour wholly dull yellowish white in formalin. Pedal disc exceeding the column, almost circular in outline, rather thin and flaccid, semi-transparent, nearly smooth though a little irregularly radiately wrinkled and minutely corrugated. No cuticle. Column a little wider than high, irregular in shape, broad below, sloping inwards to a little below the margin, where there is a slight constriction, and then becoming a little broader again so that the oral disc is really as wide as the pedal. Wall thin but strong and tough, semi-transparent so that the insertions of the mesenteries show through in places. Margin tentaculate, with a very slight rim. Surface smooth but for a few irregular longitudinal wrinkles and numerous fine transverse striations. No verrucae, suckers, or *visible* cinclides. Oral disc small, cup-like, smooth, thin, flaccid and semi-transparent. Mouth slightly open with very distinctly tubercled lips. Tentacles rather short, conical, broad at the base, tapering to a sharp point, stiff enough to support themselves out of spirit, finely and regularly transversely striated. Inner much larger than outer on the whole, but irregularity of size occurs on account of different stages of contraction. Their arrangement is rather

irregular. The first three cycles are $6 + 6 + 12$, and the total is about 80. The arrangement is something like $6 + 6 + 12 + 24 + 40 = 88$.

Structure. (i) *Mesenteries.*—These are very irregularly arranged. Two pairs are directives. There are twenty-three perfect mesenteries arranged without any system (the animal is not bilaterally symmetrical), there are five large imperfect mesenteries, and the rest are very small, and occur singly or in pairs or triplets here and there. Total number about fifty-five mesenteries, in three extremely uneven cycles. Those of the first two bear pennons, which vary enormously in size and shape in individual cases. The third cycle mesenteries have no pennons. The pennons occupy only about one-third of the muscular surface of the mesentery, and are often very narrow. A large typical one is figured on Pl. V, fig. 17: it has had to be partially restored, as my sections of this species are poor and broken. As a rule the pennons are diffuse at the level of the actinopharynx, and end rather abruptly on the side nearest the body-wall, tapering off gradually in the other direction. Below the actinopharynx level they are various, but mostly broader and shorter, almost circumscribed. One pair of directives has better pennons than any of the other mesenteries, ending abruptly at both extremities, but the other pair has them reduced to practically nothing, so that they cannot really be called pennons. The processes are numerous, rather coarse, crowded, a good deal branched, the branches mainly short. The parieto-basilar muscle is very weak, forming no fold as far as I can see. No gonads.

(ii) *Sphincter.*—This is well developed. It lies right against the endoderm, but is throughout separated from the ectoderm by a narrow mesogloal band, filling nearly all the mesogloea above. It is long and rather narrow, broadest a little below the top, tapering off above, but much more gradually below (Pl. V, fig. 12). The body-wall is wrinkled, and the sphincter, of course, follows the wrinkles. As it tapers, so does the mesogloea. Its structure is coarsely reticular, not layered, and I have drawn part of it as accurately as I can from poor sections in Pl. V, fig. 13.

(iii) *Endoderm.*—In simple filaments, the ciliated lobes are well developed and bent back on themselves, and the glandular lobe has a fairly stout stem: in more complex filaments the ciliated lobes are regularly folded. The glandular lobes contain fairly elongate finely granular gland-cells and two sorts of thick walled cnidae, all small; some as in the body-wall, some much shorter and a little stouter so as to be almost oval. Endoderm of mesenteries and body-wall ordinary, with here and there a gland-cell, which is not visibly granular.

(iv) *Acontia.*—These have various shapes in transverse section. Most typically, they are a rounded pear-shape, the cnidae crowded in the rounded broad end, the gland-cells at the back on each side of the stem. The gland-cells are unusual: they are large and of a fairly regular oval-oblong, not granular, and they stain a curious bright blue with haematoxylin, with a black spot at the open end, which often has two horns. Some even have a short neck, so that they look like flasks. One of these is shown in Pl. II, fig. 19. I take them to be mucus-cells: perhaps the black spot is escaping

mucus. The cnidae are very large, long, broad and thick walled, keeled, with blunt ends, straight or curved, or with a slight twist (Pl. III, fig. 18).

(v) *Mesogloea*.—Thin and rather fibrous, with numerous small cells, many of them lying in clear spaces.

(vi) *Actinopharynx*.—I cannot give certain data about siphonoglyphes. If any, there are two. The ectoderm has numerous medium-sized deeply embedded and superficial granular gland-cells, and a few small thick walled cnidae like those of the body-wall.

(vii) *Ectoderm of body-wall*.—Higher than endoderm. With numerous large, elongate, irregularly shaped gland-cells, many of which run from one surface to the other, and which, although fairly deeply stained with haematoxylin, are not visibly granular. There are also a few small, short, blunt-ended, thick walled cnidae, narrow but not needle-like.

(viii) *Tentacles*.—Ectoderm higher than mesogloea and endoderm together. Longitudinal musculature ectodermal, on short simple or slightly branched processes (Pl. V, fig. 15). Nerve-layer well developed, fairly broad. The ectoderm contains a few thick walled cnidae like those of the body-wall, but rather larger and longer, though not nearly as large as those of the acontia. Here and there occur larger processes of longitudinal musculature on hills of mesogloea, so that a tufted appearance is produced. Spirocysts numerous in ectoderm, fairly broad, not large. There are scattered gland-cells, mainly superficial, not visibly granular.

I have not attempted to identify this *Sagartia* as regards its species: it is practically impossible to identify a small *Sagartia* on anatomical characters, from the very poor descriptions at present existing. It is very rarely that a description is sufficient for identification in the genus, as details and plates are necessary. McMurrich's descriptions are certainly an exception, especially in the case of *S. spongicola*, for instance, as of course are a few others.

SUB-FAMILY AIPTASIINAE, Simon.

Sagartiidae in which the sphincter-muscle is either absent, or, if present, weak, diffuse, endodermal. Not more than six pairs of mesenteries are perfect, and these are often fertile. Cinclides present.

AIPTASIA, Gosse.

With the characters of the Sub-family. Tentacles usually long. Cinclides usually in one or more horizontal rings round the middle of the body.

If *Aiptasia couchi*, Gosse, should prove to be provided with a mesogloea sphincter the name *Aiptasioides** will probably lapse; and that species, with *Aiptasioides prima* and *A. pallida*, may be included in *Aiptasia*. Another generic name may then have to be introduced for species (at present placed in *Aiptasia*) with the sphincter absent or endodermal.

* See below.

12. *Aiptasia minima*, n. sp. (Pl. I, figs. 2, 3; Pl. VI, fig. 1.)

Fourteen small specimens, adherent to small pieces of stone. Bay of Islands, New Zealand, Sept. 1912. Rock-pool.

Measurements. (i) *Largest specimen.*—Diameter of column, .7 cm.; of pedal disc, 1.1 cm.; of oral disc and tentacles, .7 cm. Length of a tentacle, .4 cm. Height of column, .4 cm.

(ii) *Smallest specimen.*—Diameter of pedal disc, about .15 cm.

External characters.—Two specimens, enlarged, are shown on Pl. I, figs. 2, 3, in different states of expansion. Pedal disc broad, much exceeding the column: smooth, with traces of mucus but no cuticle upon it. Its outline is regular in some specimens, irregular in others, in the largest case so much so that it is practically lacerate. Column a low cone, broader than high, with coarse ring-like transverse contraction-folds and fine longitudinal striations. Margin a distinct smooth parapet, not notched, and with no acrorhagi, enclosing a deep fosse. Oral disc small, thin: mouth with prominent ribbed lips, inner tentacles near mouth. Tentacles thin-walled: in most specimens they are only partially protruded and not properly inflated, though in none are they completely retracted. In one specimen, however, they are fully expanded, and in this case they are very large and long for the animal's size, and completely hide the column, spreading in all directions. They are stout at the base, tapering gradually to a point: they are flaccid out of spirit: the inner are much larger than the outer. In this fully expanded specimen the column is rather less conical than usual, naturally; but even then the base well exceeds the oral disc. The animal is so small that it is impossible to determine exactly the number and arrangement of the tentacles: there are about fifty, in four or five cycles, as far as I can make out.

Structure. (i) *Mesenteries.*—I am sorry that I am unable to give more figures of the anatomy of this species. It is a difficult one to sectionise, and the processes of the muscle-pennon are not individually clear in any of my preparations, so I can only indicate the shape of a mesentery generally (Pl. VI, fig. 1). Moreover, there is no sphincter, and the musculature of the tentacles is so excessively weak that it is hardly visible. In the case examined in detail the mesenteries are arranged in three cycles, not quite regularly. There are six large primary pairs, including two pairs of directives; these are all perfect, and all bear pennons, which are proportionately larger at the level of the actinopharynx than below that level. Of the six primary exocoels, four are normal, each containing a pair of imperfect secondary mesenteries, with a small pair of the third cycle on each side of it: but each of the other two exocoels (and these two are adjacent) contains two secondary imperfect pairs, and consequently three small third-cycle pairs. So the arrangement comes to be 6 p. + 8 p. + 14 p. = 28 p., the first cycle alone perfect, the first two cycles fertile. The mesenteries of the second cycle bear pennons, but in all but two cases these are very feebly developed, and found on the mesentery only at a certain level. The third-cycle mesenteries bear no pennons, but some of them have simple filaments. The mesogloea of the mesenteries is very

thin, but the endoderm is unusually thick and regular, giving them a very characteristic appearance. On the primary mesenteries the small pennon lies immediately behind the gonad; it only occupies a small part of the muscular surface of the mesenteries, and is circumscribed and fan-shaped. The outline of it is shown in the muscular part of a primary mesentery in Pl. VI, fig. 1. The processes are few, high, a good deal branched, and radiate rather as in a fan. The pennons of the directives are a little larger than the others. The rest of the muscular surface of the mesentery has a feeble fringe of low processes of the longitudinal muscle on one side, and of the very feeble unspecialised parieto-basilar muscle on the other: this latter ends in no fold or prominence of any sort. The specimen is a male.

(ii) *Sphincter*.—Quite absent. The general endodermal circular muscle of the body-wall is fairly developed.

(iii) *Endoderm*.—That of the body-wall lower than that of the mesenteries, which is a network in its inner part, rather denser in its outer, and contains a fair number of medium and large, finely granular gland-cells which are variously shaped but mostly deeply embedded and elongate. The body-wall endoderm is not interesting. The glandular lobes of the filaments contain large elongate coarsely granular gland-cells, and the nuclei of the supporting cells are mainly concentrated in two belts at the back, one on each side of the stem. The glandular lobe is almost sessile; the ciliated lobes are well developed, with the nuclei thickest in the inner part, and they tend to become folded in compound filaments.

(iv) *Body-wall*.—Mesogloea very thin, endoderm thicker, ectoderm thickest, very well developed. Ectoderm of base lower than that of column, practically devoid of gland-cells. Ectoderm thinnest in fosse. The ectoderm contains numerous gland-cells, near the surface or fairly deeply embedded, with ducts to the exterior: they are hardly granular. There are also, superficially, two kinds of thick walled cnidae, which are shorter than those of the tentacles. One kind is short and very broad, blunt at the ends—a long oval. The others are narrower and more cylindrical, similar to those of the tentacles, but shorter, often with a twist. The inner part of the ectoderm contains what *may* be small clear gland-cells.

(v) *Actinopharynx*.—Two siphonoglyphes. Ectoderm with many large and often elongate granular gland-cells, and seemingly also crowded with small ones. It has also thick walled cnidae, as large as the largest in the tentacles.

(vi) *Acontia*.—Oval in transverse section. They contain gland-cells and enormous thick walled cnidae, far larger than any others in the body, which are boat-shaped, keeled, with square ends and a hardly perceptible twist.

(vii) *Mesogloea* very thin, slightly fibrous, containing numerous small cells, often in clear spaces. Too small to make out details.

(viii) *Tentacles*.—Mesogloea thin, endoderm thicker, ectoderm thickest, but not as high as that of the body-wall. The endoderm contains zooxanthellae. The longitudinal musculature is excessively feeble, the short processes appearing as mere dots. In the

ectoderm the nuclei of the supporting cells are scattered: its inner part contains zooxanthellae, its outer part spirocysts and cnidae. The spirocysts are fairly numerous, of moderate length, stout, and, as far as I can see, rounded at the outer end and pointed at the inner. The thick walled cnidae are of two kinds: some are rather short, very narrow and needle-like: others are more various in length, the largest being as long as the ectoderm is thick. These latter are thick and blunt at both ends, and many are keeled and twisted.

SUB-FAMILY METRIDIINAE, Carlgren.

Sagartiidae with six (rarely a few more) pairs of perfect mesenteries, which are sterile; one or more siphonoglyphes; body-wall relatively thin, without a cuticle; cinclides present. Sphincter mesogloal.

AIPTASIOIDES, n. gen.

Metridiinae with thin body-wall and very feeble mesogloal sphincter. Only six pairs of mesenteries perfect. No collar. Disc not lobed. Base not specialised. Cinclides in a narrow belt about half-way up the body? Genotype, *A. Prima*, n. sp.

It seems necessary to establish a new genus for forms which resemble *Aiptasia*, but possess a mesogloal sphincter. Pax (49, p. 198) has limited the genus *Aiptasia* to forms possessing no sphincter; but of course *A. mutabilis*, if it does possess an endodermal one, must be included. But when the sphincter is mesogloal, that is another matter, and forms possessing it can hardly be included in *Aiptasia*. An endodermal sphincter is only the concentration of the ordinary circular muscle of the body-wall, but a mesogloal one is a more specialised structure. The new genus *Aiptasioides* will include *A. pallida* and the species described below, whose cinclides I cannot, unfortunately, exactly locate.

13. *Aiptasioides prima*, n. sp. (the first species described under the name *Aiptasioides*). (Pl. I, fig. 9; Pl. V, figs. 11, 14, 16; Pl. VI, fig. 11.)

Four specimens. Station 36, shore collection, S. Trinidad Island, July 26–30, 1910.

Measurements. (i) *Largest specimen.*—Diameter of tentacular crown, .9 cm.; of column, 1.2 cm.; of pedal disc, 1.7 cm. Height of column, 1.4 cm.

(ii) *Smallest specimen.*—Height, 1.2 cm.

External characters.—This is a very flimsy and brittle species, and it is almost impossible to obtain good preparations. I was unfortunately obliged to destroy two and a half specimens in order to obtain any data at all.

Pedal disc exceeding column, very irregular and lacerate in outline, not very thin, with bits of adherent brown cuticle. Column broader below than above, its wall extremely thin and delicate, but even more so above than below. A circular constriction (a temporary feature of the only sound individual remaining) divides the column more or less into scapus and capitulum. There is no cuticle. The lower

part of the scapus is finely striated transversely. The wall of the capitulum is excessively thin and flabby and semi-transparent, the mesenterial insertions showing through clearly. There is no distinct margin. Colour absent in formalin. About the top of the scapus are two irregular horizontal rows of small *vesicles* (clearly seen in Pl. I, fig. 9): these look at first like verrucae or suckers, they are so small; but they are merely little thin-walled outpushings of the coelenteron, and in sections it is seen that they have exactly the same thickness and structure as the rest of the wall. Some are perforated, but the perforations seem to me to be due to damage. It is, of course, quite possible that the cinclides, though they cannot be seen, are arranged on these little vesicles. I think living specimens would be necessary to make certain. Disc small, thin, concave, radially furrowed. Mouth with a smooth circular inconspicuous lip. Tentacles small, short, slender, pointed, all about the same size. The formula is 6, 6, 12, 24, 48 = 96: in some specimens the last cycle incomplete, even in the largest some tentacles have been removed from it by damage in some way.

Structure. (i) *Mesenteries.*—The coelenteron is a little decayed or diseased, and here and there occur bundles of fibres slightly suggesting Sporozoan parasites, but this is by no means certain. There are three cycles of mesenteries, the primaries alone (six pairs) perfect. Two pairs of directives. The first two cycles bear pennons, the third cycle mesenteries are very small, and do not. The third cycle is not complete. There are no gonads developed. The pennons of the primary mesenteries are broad and well developed (Pl. V, fig. 11); they fill more than half the mesentery at the level of the actinopharynx, and have both ends rather abrupt. The processes are fairly numerous, much branched, and high and fine; they are less crowded than usual. The pennons vary in shape considerably in different mesenteries, often ending abruptly at both extremities, sometimes less so, sometimes even tapering. The parieto-basilar muscle is feebly developed and forms no fold, and its processes (and those of the opposite side of the mesentery just where it leaves the body-wall) are short and simple or slightly branched.

(ii) *Sphincter.*—A *very* weak alveolar sphincter is present in the mesogloea. It fills the whole of the excessively thin mesogloea, which is *very* slightly expanded at the margin. It consists of a practically single row of large compressed alveoli fringed more or less with fibres in transverse section, and extends a good way down the wall. I have figured its upper part as accurately as possible in Pl. V, fig. 14. The "alveoli" in this case may conceivably be mere splits, in which case of course the sphincter could not be described as "alveolar," but they look genuine.

(iii) *Endoderm.*—That of the body-wall is fairly high, and is crowded with large zooxanthellae. That of the mesenteries is also high and full of zooxanthellae, is loose in texture, and here and there are also fairly large irregular granular gland-cells, which, too, are present in the glandular lobes of the filaments, where the latter can be identified. Circular muscle of the wall rather high and well developed, on branching processes.

(iv) *Acontia*.—Only degenerate remains of these and mesenterial filaments are present. They contain large pen-like cnidae, thick walled, long and fairly wide, straight or slightly twisted.

(v) *Mesogloea*.—So exceedingly thin in the body-wall that its structure cannot be seen. It is faintly thicker at the origins of mesenteries and at the margin, and here it is fibrous, and contains a fair number of cells, all of which are small.

(vi) *Ectoderm of body-wall*.—This is high in the lower part of the column, but low in the upper part. It is loose in structure, and contains sparsely small, short, blunt-ended, boat-shaped, thick-walled cnidae. It seems devoid of gland-cells.

(vii) *Actinopharynx*.—Siphonoglyphes? Ectoderm firmer than that of the body-wall, with numerous large coarsely granular gland-cells of many forms, but chiefly club-like.

(viii) *Tentacles*.—Endoderm thicker than mesogloea: ectoderm thicker still. Longitudinal musculature ectodermal, its processes very short and stumpy, simple or a little divided (Pl. V, fig. 16). Endoderm crowded with large zooxanthellae: the structure of two of these is shown in Pl. VI, fig. 11. Each contains what I take to be a nucleus, a pyrenoid, and sometimes vacuoles. Ectoderm not very well preserved. Nuclei of supporting cells scattered. Rather short stout spirocysts of moderate size are numerous: there are also a few thick-walled cnidae which are longer and narrower (proportionately) than those of the body-wall, but far smaller than those of the acontia. Small bits of scattered granular gland-cells are present. In the oral disc the mesogloea is thicker than elsewhere; the radial muscles are ectodermal, and better developed than the longitudinal muscles of the tentacles. The circular muscle is well developed, on short, stout, branched processes.

As far as I know, this species is not identical with any species previously described under *Aiptasia*: of course it is distinct from all forms with the sphincter endodermal or absent, but I have not been able to obtain notes of quite every species in the genus. The same applies to the last described, *Aiptasia minima*, but that is even less likely to be known.

CALLIACTIS, Verrill.

Metridiinae with smooth body-wall, except for the cinclidal tubercles in some species. Cinclides in horizontal rows at the base of the column. Six pairs of perfect mesenteries. No collar. Disc not lobed, though sometimes a little undulated in a living animal. Usually commensal with hermit-crabs.

14. *Calliactis reticulata*, n. sp. (Pl. I, fig. 15; Pl. V, figs. 9, 10; Pl. VI, fig. 2.)

I have called this species *reticulata* from the appearance of the surface of the body-wall.

Nine specimens. Station 42, 22° 56' S.; 41° 34' W., 40 fathoms, May 2, 1913. Agassiz trawl. Bottom—sandy.

Measurements. (i) *Largest specimen.*—Diameter of tentacular crown, 1.4 cm. Height of column, 2 cm. Diameter of pedal disc, 1.6 cm.; of column, 1.7 cm.

(ii) *Smallest specimen.*—Height, 1.6 cm.

External characters.—With two exceptions the specimens were not attached to anything: those two, one large and one small, were attached to a Gastropod shell inhabited by a hermit-crab, and are shown, with the shell, in Pl. I, fig. 15: the crab is practically hidden. In formalin, the colour is wholly dull greyish white, with a slight blue tinge. Base well exceeding the column, with a thin and well marked edge, and an entire outline, very little undulated. No trace of cuticle on the base, which is smooth and thin, faintly wrinkled, especially radially. The column is not far from cylindrical, being slightly barrel-shaped, considerably exceeded by the base, and slightly by the oral disc. It is a very little narrower just below where the disc expands, and becomes a little wider from here down, expanding more suddenly at the base. The wall is thin, but tough and self-supporting. The surface has no verrucae, etc., but has a very characteristic reticulate appearance. It is divided up into little flat, low, rectangular and rounded or irregular papillae of various sizes, with slight furrows between them. These are *not* mere areas isolated by longitudinal and transverse contraction-wrinkles, as in many species, but really papillae; not verrucae or suckers or tubercles, however. They are very fine near the limbus, most irregular at the margin, which is tentaculate with a slight indistinct rim. The arrangement of cinclides is not clear in many cases, though in all they are confined to a zone just above the limbus. In the best specimen, they are in three circles: the upper circle contains six large cinclides, the next four large cinclides, and the lowest one about seventeen smaller ones. The three rows alternate irregularly with one another. In some specimens the two upper circles appear more like one irregular circle. The number does not seem to be constant. The cinclides are not mounted on tubercles or elevations of any sort, but appear merely as small brown dots, flush with the surface of the column. The column-"papillae" do not show to any extent in the figure, as a glass is needed to see them clearly. The oral disc slightly exceeds the column, but is almost entirely covered with tentacles, so that the free area round the mouth is small. In all cases the inner tentacles are inturned over the disc. Lips prominently tubercled by the apices of the oesophageal ridges. Tentacles very small, short, conical, pointed, stiff, crowded, the inner a good deal larger than the outer: they are rather like teeth. The tentacles are too small to be exactly enumerated. But the smallest has about 100, the largest about 170, two others about 140-150. Arrangement probably 12, 12, 24, 48 + (48 to 96) as the animal grows, reaching finally 192.

Structure. (i) *Mesenteries.*—The primary mesenteries have large internal stomata. I can find no external ones. There are three cycles of mesenteries in small specimens, four cycles in older ones. Only the six primary pairs are perfect. All bear filaments. In one specimen the third and fourth cycles alone were fertile; in another the second and third cycles were fertile, the fourth cycle being too small to see. In all examined the

primaries are sterile. The mesenteries are very thin, delicate, transparent membranes, very hard to sectionise well. Those of the last cycle are very small, and bear no pennons. They have a rather stout base, where they leave the body-wall, with a few short stout processes, about the same on each side, and approaching almost, on a *far* smaller scale, those of *Leptoteichus*: some are a little branched. The mesenteries of the higher cycles all have a similar base, but they have pennons as well. The pennons are diffuse, and taper off at both ends. They are low, and have numerous rather stout processes with short rather stout branches. These cannot well be drawn individually, so I have given the general appearance of one pair of directives in Pl. VI, fig. 2. The other large mesenteries are much larger, and so the pennon occupies less of the surface. It lies about the middle of the muscular part in the first and second cycles, nearer the body-wall in the third. The parieto-basilar muscle is feeble and forms no fold, its processes nearly resembling those of the basal part of the longitudinal muscle.

(ii) *Sphincter*.—This is well developed. It is not very long, and though it nearly fills the mesogloea above, it is separated by a narrow band from the endoderm, which increases slightly and gradually in width lower down (Pl. V, fig. 9). At the top it is right up against the ectoderm, and gradually separates from it below, tailing off to a fine point lying nearer endoderm than ectoderm. Its shape is irregular, as it follows more or less the ectodermal side of the mesogloea, which is wrinkled. In some sections it is broadest at the top; in some, about the middle. Its structure resembles that of *Artemidactis victrix* in its detail (see Pl. V, fig. 6), the muscle-fibres being arranged in groups, which are of various shapes and sizes, and larger above than below. The bundles are arranged in more or less distinct transverse rows, and are densest in the upper part.

(iii) *Endoderm*.—That of the body-wall has here and there a fair-sized granular gland-cell. That of the mesenteries is thin, and has a few such gland-cells. The filament-trefoils have a characteristic shape, being much broader than long. The ciliated lobes are very large, and are not much exceeded by the glandular lobe, which has a narrow stem and is fig-shaped. The ciliated lobes are sickle-shaped, their nuclei chiefly concentrated in a dark zone in the inner part towards the tip of the sickle. Gland-cells occur in them occasionally towards the base. In the compound filaments they become beautifully folded, and the glandular lobes are better developed, rounded, with many large coarsely granular gland-cells, and I think small, narrow, thick walled enidae. Endodermal circular muscle of wall well developed, on short, stout, slightly branched processes.

(iv) *Mesogloea*.—Clear and homogeneous, with numerous cells of moderate size: these are very plentiful near the ectoderm at the margin, but in the disc they are simply packed, so numerous are they. They are fairly uniform in appearance, having large mealy nuclei surrounded by narrow clear protoplasm with fine processes. Shapes very various: bipolar, tripolar, multipolar, or in chains; some round, without processes.

(v) *Ectoderm of body-wall*.—Not nearly as thick as the mesogloea. It is firm, and has numerous large, irregular, elongate, narrow, granular gland-cells, many of which extend from base to surface. In the inner part there are also numerous little cells which seem about to migrate into the mesogloea, and here and there one seems to be in the very act of doing it.

(vi) *Actinopharynx*.—Descending about half-way down the coelenteron, ribbed, with two siphonoglyphes. Ectoderm high and well developed, with many gland-cells with very large granules, of various shapes, many elongate, some deeply embedded, and some superficial. There is a dense band of small bodies in the inner part which *may* be nuclei of the supporting cells, but look more like small cells of some other kind.

(vii) *Acontia*.—Kidney-shaped in transverse section. Front part with cnidae and regularly scattered nuclei, back part with a concentration of granular gland-cells. I cannot give details of the cnidae, except that they are much smaller than in the acontia of any other species with which I have had to do.

(viii) *Tentacles*.—Mesogloea and endoderm about equally high: ectoderm a good deal higher. Longitudinal musculature well developed, ectodermal, none of it embedded in the mesogloea as far as I can tell, filling about one-third of the ectoderm where best developed. Its general aspect is shown in Pl. V, fig. 10. It varies greatly in height in different parts of the same tentacle: the processes fairly stout, branched. Endodermal circular muscle not conspicuous. Endoderm with zooxanthellae, and a fair number of granular gland-cells. Ectoderm with broad well-developed nerve-layer: nuclei of supporting cells scattered. In the outer part, a dense spirocyst-battery: spirocysts of medium size, long and subcylindric. There are also a fair number of rather small not usually elongate granular gland-cells, some slightly embedded, some superficial (*i.e.*, immediately below the ectodermal surface). Radial muscles of disc ectodermal.

A careful anatomical comparison (or, better still, a comparison of living examples!) of the various species of the genus *Calliactis* is needed, as their structure is rather similar. *C. reticulata* differs from *C. tricolor* (= *C. bicolor* = *C. egletes*) in the nature of the sphincter, which in the latter is markedly reticulate, as well as in other details. It is quite distinct from the British *C. rondeletii* and also from *C. polypus*. (For one thing, in these last two, part of the longitudinal musculature of the tentacles is embedded in the mesogloea.) The anatomy of *C. miriam*, with its extremely widely expanded base and single circle of cinclides, is not known. Nor do we know the structure of *C. decorata* and *C. fusca*, but both of them have prominent cinclidal tubercles, which are totally absent in *C. reticulata*, which seems, further, characterised by its small size and finely papillate skin. Cinclidal tubercles become more prominent when a specimen is preserved—in fact, they are often quite absent in *C. rondeletii* when it is alive, but appear after death: so that since they do not appear in *C. reticulata* even when it is preserved, their absence may be taken as a specific character. *C. krøyeri*, although very large, has far fewer tentacles than *C. reticulata*, and from the arrangement of cinclides may even belong to another genus.

SUB-FAMILY CHONDRACTINIINAE, Haddon.

“Sagartiidae with only six pairs of perfect mesenteries, which alone of the well-developed mesenteries are sterile; two gonidial grooves and two pairs of directives; body-wall usually thick, with a cuticle, and often nodulated; cinclides absent(?); acontia rarely emitted, and then by the mouth only; strong mesogloal sphincter-muscle.” (Haddon, 1898, p. 458.)

LEPTOTEICHUS,* n. gen.

Chondractiniinae with more than two cycles of tentacles, which are devoid of basal swellings. Acontia rudimentary. Musculature of mesenteries tending to be peculiar. Body-wall smooth, without tubercles or cuticle, not divided into scapus and capitulum. Longitudinal muscles of the tentacles almost entirely ectodermal, radial muscles of the disc meso-ectodermal. Genotype, *L. insignis*, n. sp.

This genus is easily distinguished from others in the same sub-family by its rudimentary acontia, absence of cuticle, nodules, basal tentacular swellings, etc. To describe the curious form of the muscle-processes of the mesenteries, I have borrowed the word “reversed” from a letter from Prof. McMurrich, as a convenient one. See below.

15. *Leptoteichus insignis*, n. sp. (Pl. I, fig. 14; Pl. II, figs. 4, 5, 6; Pl. III, fig. 20; Pl. IV, figs. 1, 2, 3, 5, 6.)

“*Insignis*” because it is a very handsome anemone, and if it could be seen alive would no doubt be exceedingly so. There is very little resemblance between a live and a dead Actinian: some of them when alive are among the most exquisite creatures in existence.

One specimen. Station 338, 77° 13' S.; 164° 18' E., 207 fathoms, entrance to McMurdo Sound, Jan. 23, 1912. Agassiz trawl. Bottom—mud.

Measurements.—Diameter of tentacular crown, 10 cm.; of oral disc, 5.2 cm.; of mouth, 4.1 cm. Length of a large tentacle, 2.7 cm. Height of column, 7 cm. Diameter of column, 5.3 cm.; of pedal disc, 4.5 cm.

External characters.—The single specimen is excellently preserved. Pedal disc irregular in outline, smaller than the column, thinner than the body-wall, firmly adherent to several small pieces of stone. There is a certain amount of dirt and loose sloughed mucus about it. Column a little higher than wide, barrel-shaped, narrower at base and just below margin than in centre. At the margin itself it expands again very slightly, so that the disc exceeds the column a little. The margin is tentaculate, no trace of parapet or fosse. The surface is smooth and firm, with no trace of verrucae, etc., but it is deeply wrinkled transversely and less distinctly longitudinally, so that it is broken up into numerous little roughly rectangular areas. Most of the furrows are

*λεπτός, and τεῖχος, “with a smooth wall.”

probably due merely to contraction. The longitudinal ones are more or less continuous from top to bottom, but die out entirely in some places. Most of the ectoderm has been removed, but it remains here and there in patches and in cracks, and is thick, felty, much corrugated, and reddish. The mesogloea is pale, and a good deal of dirt is in some of the cracks. The body-wall is stiff and firm, and very thick. The oral disc is smooth, and thin in texture. From the base of each tentacle there runs a low rounded ridge, towards the mouth, near which it dies out. These ridges are of course bounded by furrows, those from the primary tentacles are very large, those from the secondary ones medium, and from the tertiary narrow. So that large, small, medium, etc., alternate in a regular manner. The mouth is nearly circular, and gaping, so as to reveal the coelenteron, but the actinopharynx is not everted. The lip is prominent, formed by the rather swollen apices of the ridges of the actinopharynx. These are rather damaged, but there seem to be about nine, and each is divided into two by a narrower ridge. There are exactly one hundred tentacles, in three cycles—25, 25, 50 = 100. Those of the first cycle are mostly very large, as are some of the second: those of the third are much smaller. They are rather irregular in size through being irregularly expanded. They are very beautiful organs, very broad and thick at the base, tapering gradually to an obtuse tip. They are thin walled, and flaccid when out of water, but fairly strong, and stand up well in spirit. In colour they and the disc are flesh-tint. They are finely transversely striated, but not fluted. The animal is well expanded, and the manner in which it carries its tentacles may be seen from Pl. I, fig. 14. The tentacles should be 24, 24, 48 = 96 in arrangement, but a small abnormality has occurred in one exocoel of the mesenteries, bringing with it four extra tentacles.

Structure. (i) *Mesenteries.*—There are four cycles. $6 + 7 + 13 + 26 p. = 52$ pairs. Only the six primary mesenteries are perfect, and they are much larger than the others, so that the animal is very hollow. In all exocoels but one they are normally arranged, each primary exocoel containing the secondary pair with a tertiary pair on each side of it, and four quarternary pairs alternating with these. In one lateral exocoel the arrangement is abnormal, causing the abnormality in the number of tentacles. All mesenteries bear filaments. The primary mesenteries run all the way down the actinopharynx. They bear immense knots of filament, and are sterile. The secondary have also large masses of filament low down, but this is simpler higher up, and here they bear gonads. The mesenteries of the other two cycles have simple filaments and are narrow and almost entirely covered with even rows of gonads. A shrimp was loose in the coelenteron. Internal stomata are present, but no external ones. Here and there a piece of filament has come loose from a mesentery, and rather resembles an acontium, but it is always attached at one or both ends to the edge of a piece of mesentery devoid of any other filament. These are *not* acontia, as I have made certain by sectionising the loosest of them, but the animal does possess true acontia, in a different position from these loose filaments. The mesenterial musculature

is extraordinary. I will first describe a typical mesentery of the fourth cycle, such as is figured (the whole muscular portion, behind* the gonad, is shown) in Pl. IV, fig. 5. The mesogloea of the whole mesentery is very thick, but where the mesentery leaves the body-wall it is extraordinarily so, and tapers off gradually. On each side it sends out an equal development of enormously stout lobe-like processes, with short, thick, rounded, lobe-like branches, which are fringed by the muscle-fibres. In the sections there is so much mesogloea that it *looks* as if the musculature were reversed, projecting as narrow branched processes of endoderm into the mesogloea: this is of course only *apparently* so, on account of the thickness of the true processes of mesogloea. On one side this constitutes longitudinal, on the other parieto-basilar muscle, both being about equally developed. The rest of the mesentery is short, and bears a low fringe of short thick processes of the longitudinal muscle. There is no pennon. If we now take a large mesentery of the second cycle a difference will be observed. The appearance of the mesentery where it leaves the body-wall is very much as in the small one above described; the thick processes have the same character, but instead of being equally developed on both faces, they are stronger and more numerous on the longitudinal than on the parieto-basilar side. The rest of the mesentery is, of course, much larger than before: its mesogloea is very thick, and one surface has a feeble fringe of parieto-basilar muscle all along it. About one-third of the opposite surface, however, is occupied by a weak diffuse pennon; between the large processes of the mesentery just where it leaves the body-wall, and the somewhat different processes of the pennon, is a weak low fringe. The pennon has no regular and definite shape, and its processes are fairly high and narrower than those near the body-wall, but they are closely packed against each other, and it is here that the "reversed" appearance is most striking. A few processes are exactly copied in Pl. IV, fig. 6. It will be obvious from this figure that it looks as if slender black processes were projecting in the ordinary way (from right to left) from the layer which is marked *en*. But this is not the case: the letter *m* is placed in the mesogloea, and the real processes are the great fingers of mesogloea projecting into the endoderm (from left to right), with the muscle-fibres (shown as a continuous black line) squeezed up between them and round their edges. The third-cycle mesenteries are intermediate between the two types described.

(ii) *Sphincter*.—This has no very definite form. Its outline is shown in Pl. IV, fig. 1. At the top it nearly fills the mesogloea. It is separated from the endoderm throughout by a band of mesogloea gradually widening downwards, and by a similar band from the ectodermal side. It is not very long, and tapers to a point below, which is about in the middle. The ectodermal side of the mesogloea is much folded, by contraction-wrinkles of the body, and the sphincter follows the folds and so has a serpentine outline. Spaces free from muscle-fibre, where the mesogloea is as usual, occur here and there in the middle of the sphincter, and in the figure two are indicated.

* *i.e.*, between the gonad and the body-wall.

The muscle-fibres are small, and are arranged in little clumps of various sizes, endless in number and various in shape, but all transversely elongate, and tending to be arranged in transverse rows. A small portion of the sphincter is shown exactly in Pl. IV, fig. 2: the portion shown covers nearly the whole width of a narrow section of sphincter near the bottom. The upper part of the sphincter has a patchy appearance, due to a very slight tendency to irregular vertical layering. The clumps are on the whole rather larger and more numerous below than above, and are very feeble on the ectodermal fringe of the muscle. It will be noted that here the structure of the sphincter is neither reticular nor alveolar (see p. 6).

(iii) *Endoderm*.—That of the mesenteries contains many large gland-cells of various shapes with large granules (Pl. III, fig. 20). Mostly these stain with haematoxylin as usual, but some miss staining and stay yellow, or take only eosin. There are very few of these cells in the body-wall endoderm. Here and there occurs a narrow needle-like thick walled cnida. The mesenterial filaments possess well-developed ciliated lobes, which in large filaments tend to be folded rather as in *Artemidactis* (see description of that genus). The glandular lobes of the larger filaments contain very many coarsely granular irregular gland-cells, mainly fringing their edges: in the smaller filaments these are smaller and more regular, some rounded, some long and narrow. The simple filaments of the smaller mesenteries have a trefoil form, the ciliated lobes being rounded, the glandular lobe having a narrow stem. The glandular lobes contain long, rather small, needle-like thick walled cnidae, and certain larger, broader, keeled, unstained, square-ended bodies, which may be curious cnidae, but are not improbably ingested diatoms: they are not very clearly visible.

(iv) *Mesogloea*.—Homogeneous. Contains many cells of various shapes and sizes. Many are small and bipolar with a clear nucleus. Some are large and irregular, and many are granular. They are not particularly interesting or much different from some of those figured for other species.

(v) *Ectoderm of body-wall*.—This, where it remains, is poorly preserved and not as high as that of the tentacles. Above its surface are bits of dirt in places and adherent sloughed mucus, but no cuticle. It contains numerous gland-cells, some superficial and some deeply embedded. In many cases the deep ones have a clearly stained duct.

(vi) *Actinopharynx*.—This runs more than half-way down the coelenteron, and is strong. It is grooved and wrinkled longitudinally and transversely, and has two well-marked siphonoglyphes, descending well below the general level.

(vii) *Tentacles*.—Endoderm a good deal thinner than the other layers, forming a very loose open network in its inner part, with a much denser crust containing here and there a coarsely granular gland-cell. The ectoderm and mesogloea vary in thickness, sometimes one and sometimes the other being the thicker. Endodermal circular muscle feeble. Longitudinal muscles almost entirely ectodermal, with a fibre here and there just embedded in the mesogloea (Pl. IV, fig. 3), this being more noticeable in some

parts than in others. The processes are short and very stout, simple or a little branched. The ectodermal nerve-layer forms a narrow distinct band just outside the musculature. The nuclei of the supporting cells are scattered. The outer part of the ectoderm is crowded with large subcylindrical spirocysts, which are broadest in the middle. Coarsely granular gland-cells like those of the mesenteries are present, but not in large numbers, mainly just below the surface. For a figure of this ectoderm see Pl. II, fig. 6. In this figure it happens that at the particular point selected the nerve-layer is not clear. The yellowish gland-cells which have missed staining may be seen about the middle, and also the characteristic appearance of spirocysts cut across.

(viii) *Gonads*.—The specimen is a male. The gonads are interesting in that each testis is surrounded by a number of zooxanthellae. The forms of the testes are more clearly visible than in many species. One is shown in Pl. II, fig. 5. This shows the structure of a typical Actinian testis. The spermatozoa are dark purple, and arranged in a fan-like manner. The zooxanthellae round them are brownish, and the whole testis is embedded in the mesogloea of the mesentery.

(ix) *Acontia*.—Attached to the edges of many of the large mesenteries, near their bases, and just below their large knots of mesenterial filament, are small acontia. Each consists of a tiny coil of several turns, attached to the mesentery at one end, free from it at the other, and differing entirely in appearance from the mesenterial filament. The largest coil is less than a quarter of an inch long, most are smaller. When sectionised, the acontium proves to be completely different in its histological elements from the mesenterial filament; the two chief points being that it contains more and larger granular gland-cells, and a dense battery of very large thick-walled nematocysts (rather like the one shown in Pl. III, fig. 18) which is absent from the filament. These nematocysts are blunt at one end and more pointed at the other. This case of acontia which are too small to be of any service to such a large animal, and must therefore be regarded as rudimentary, is very interesting. Whether they are incipient or degenerate I leave an open question, but I incline for various reasons to the idea that they are incipient. I may say that Prof. G. C. Bourne agrees with me in believing that the structures under discussion, though small, are truly acontia.

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Coelenterata, Part I.—Actiniaria, Pl. I.

PLATE I.

- FIG. 1.—*Halcampoides aspera*, n. sp. Nat. size.
FIG. 2.— }
FIG. 3.— } *Aiptasia minima*, n. sp. A little enlarged.
FIG. 4.—*Halcurias endocoelactis*, n. sp. Nat. size.
FIG. 5.—*Bolocera longicornis*, Carlgren. Small specimen. Nat. size.
FIG. 6.—*Phymactis clematis*, Drayton. Nat. size.
FIG. 7.—*Cymbactis selaginella*, n. sp. Nat. size.
FIG. 8.—*Epiactis novo-zealandica*, n. sp. Nat. size.
FIG. 9.—*Aiptasioides prima*, n. gen., n. sp. Nat. size.
FIG. 10.—*Dactylanthus antarcticus*, Carlgren. Small specimen. Nat. size.
FIG. 11.—*Cymbactis selaginella*, n. sp. Nat. size.
FIG. 12.—*Sagartia*, sp. Nat. size or a little enlarged.
FIG. 13.—*Lilliclla lacunifera*, n. gen., n. sp. Nat. size.
FIG. 14.—*Leptoteichus insignis*, n. gen., n. sp. Nat. size or a little less.
FIG. 15.—*Calliactis reticulata*, n. sp. Two specimens on gastropod shell. Nat. size.



1.



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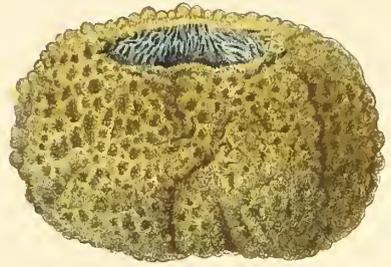
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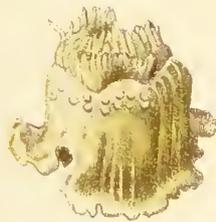
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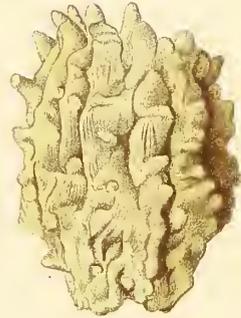
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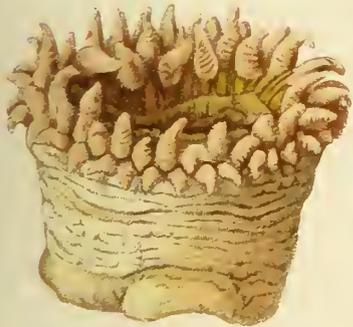
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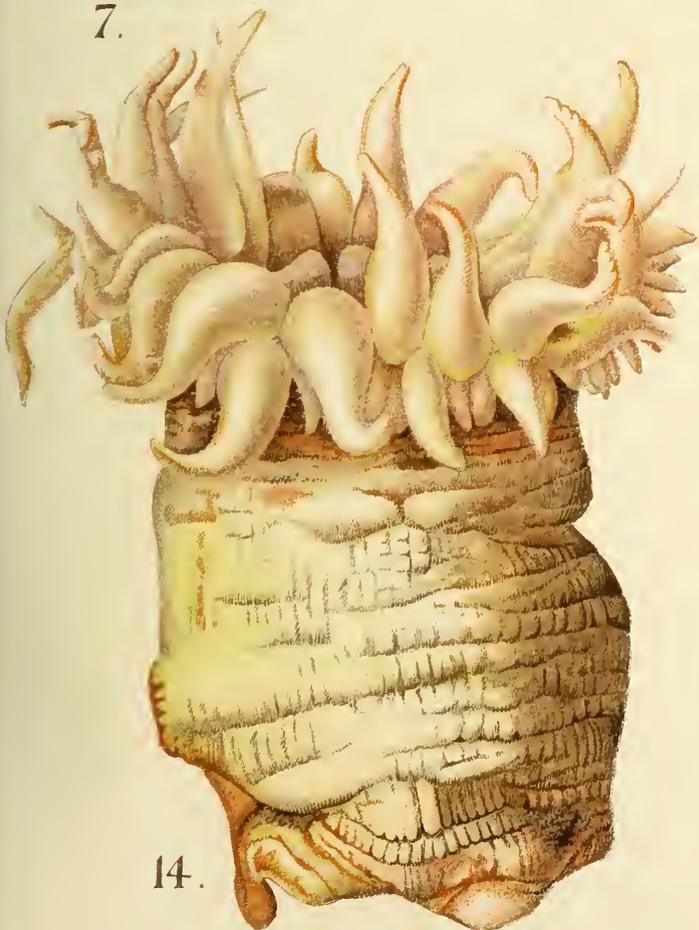
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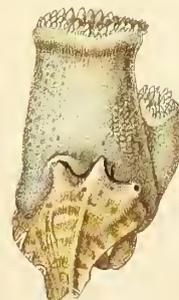
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Coelenterata, Part I.—Actiniaria, Pl. II.

PLATE II.

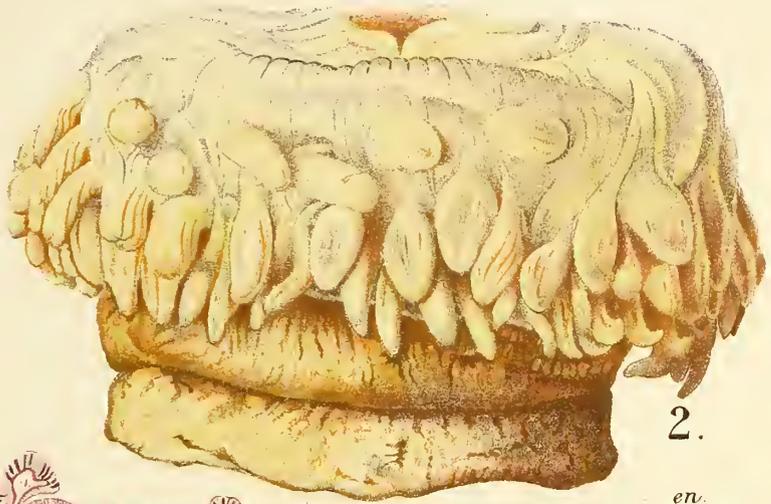
Artemidactis victrix. Figs. 1, 3, 7, 15.
Halcurias endocoelactis. Figs. 8-11, 16.
Hormosoma scotti. Figs. 2, 17, 18.
Leptocichus insignis. Figs. 4-6.
Lilliella lacunifera. Figs. 12-14.
Sagartia, sp. Fig. 19.

<i>b.en.</i> , body-wall endoderm.	<i>l.m.</i> , longitudinal musculature.
<i>c.l.</i> , ciliated lobe of mesenterial filament.	<i>m.</i> , mesogloea.
<i>c.m.</i> , circular muscle.	<i>m.f.</i> , muscle-fibres.
<i>ec.</i> , ectoderm.	<i>n.</i> , nucleus.
<i>en.</i> , endoderm.	<i>ov.</i> , ovum.
<i>g.b.</i> , granular gland-cell.	<i>sp.</i> , spirocyst.
<i>g.c.</i> , granular gland-cell.	<i>sp'</i> , spirocyst in transverse section.
<i>g.l.</i> , glandular lobe of mesenterial filament.	<i>spz.</i> , spermatozoa.

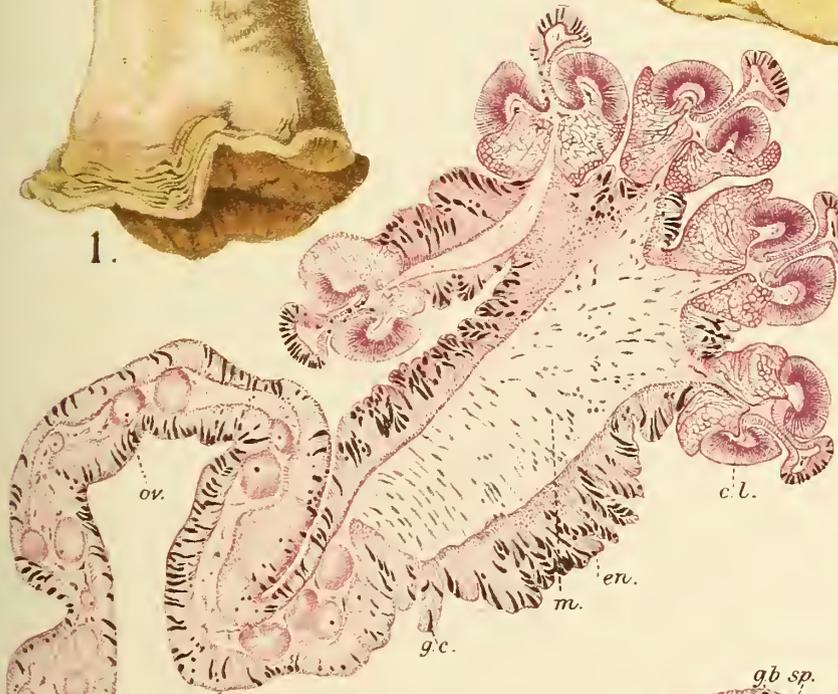
- FIG. 1.—*Artemidactis victrix*, n. gen., n. sp. Small specimen. Nat. size.
 FIG. 2.—*Hormosoma scotti*, n. gen., n. sp. Nat. size.
 FIG. 3.—*Artemidactis victrix*. A whole third cycle mesentery. Oc. 3, obj. $\frac{2}{3}$.
 FIG. 4.—*Leptocichus insignis*. Small portion of one side of the basal part of a fourth cycle mesentery, showing the character of the musculature. Oc. 3, obj. $\frac{1}{6}$.
 FIG. 5.— „ „ Single testis (in portion of mesentery). Oc. 3, obj. $\frac{1}{6}$.
 FIG. 6.— „ „ A small portion of the ectoderm of a tentacle. Oc. 3, obj. $\frac{1}{2}$.
 FIG. 7.—*Artemidactis victrix*. Small portion of the folded endoderm of the ciliated lobe of a large mesenterial filament-trefoil. Oc. 3, obj. $\frac{1}{6}$.
 FIG. 8.—
 FIG. 9.—
 FIG. 10.—
 FIG. 11.—
 FIG. 12.—
 FIG. 13.—
 FIG. 14.—
 FIG. 15.—*Artemidactis victrix*. Cell from mesogloea of mesentery. Oc. 3, obj. $\frac{1}{2}$.
 FIG. 16.—*Halcurias endocoelactis*. Cell from mesogloea of body-wall. Oc. 3, obj. $\frac{1}{2}$.
 FIG. 17.—
 FIG. 18.—
 FIG. 19.—*Sagartia*, sp. Homogeneous gland-cell from acontium. Oc. 3, obj. $\frac{1}{2}$.



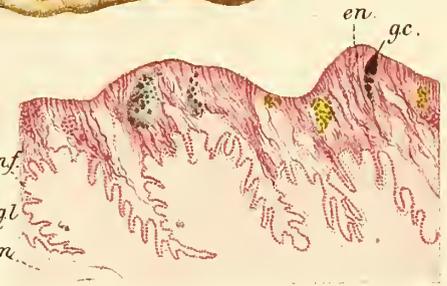
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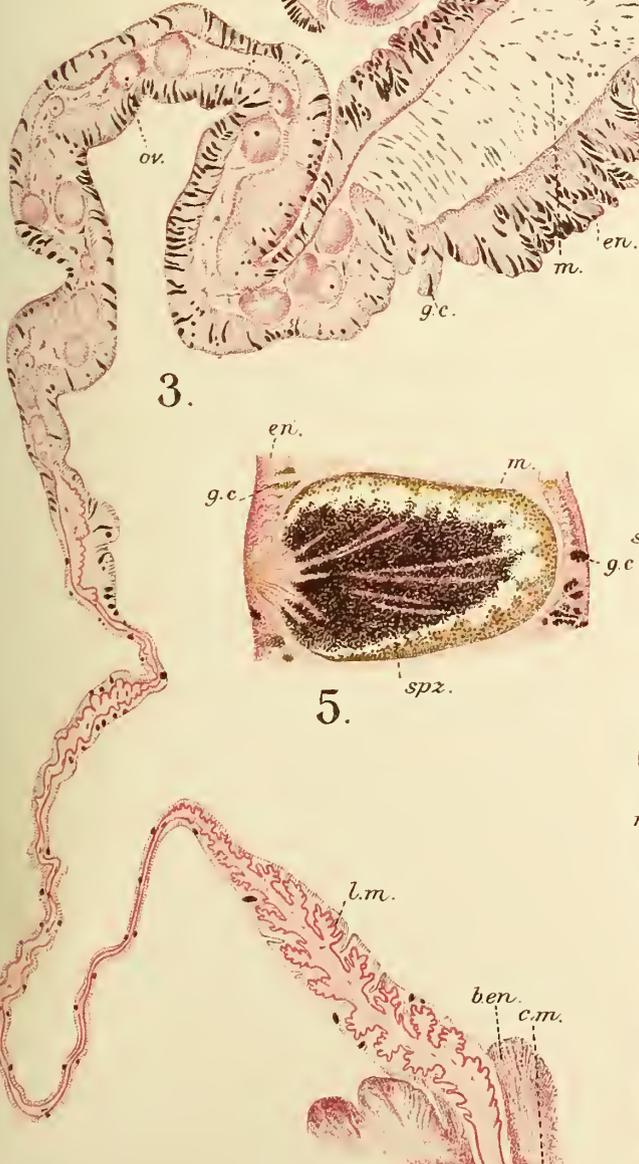
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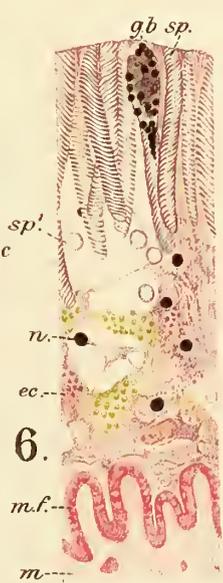
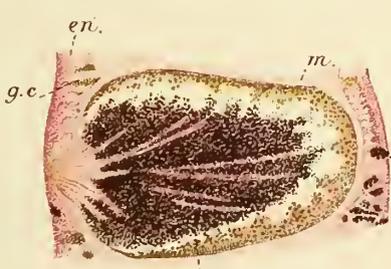
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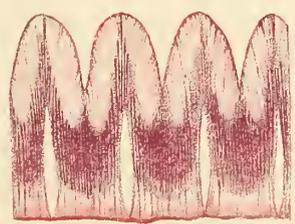
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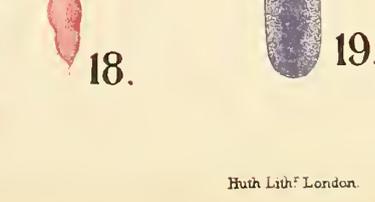
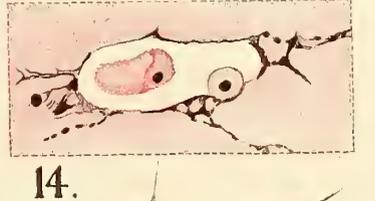
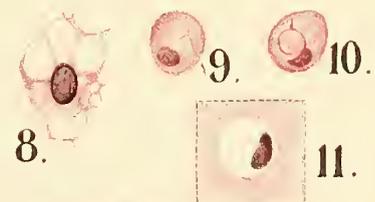
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7.



18.

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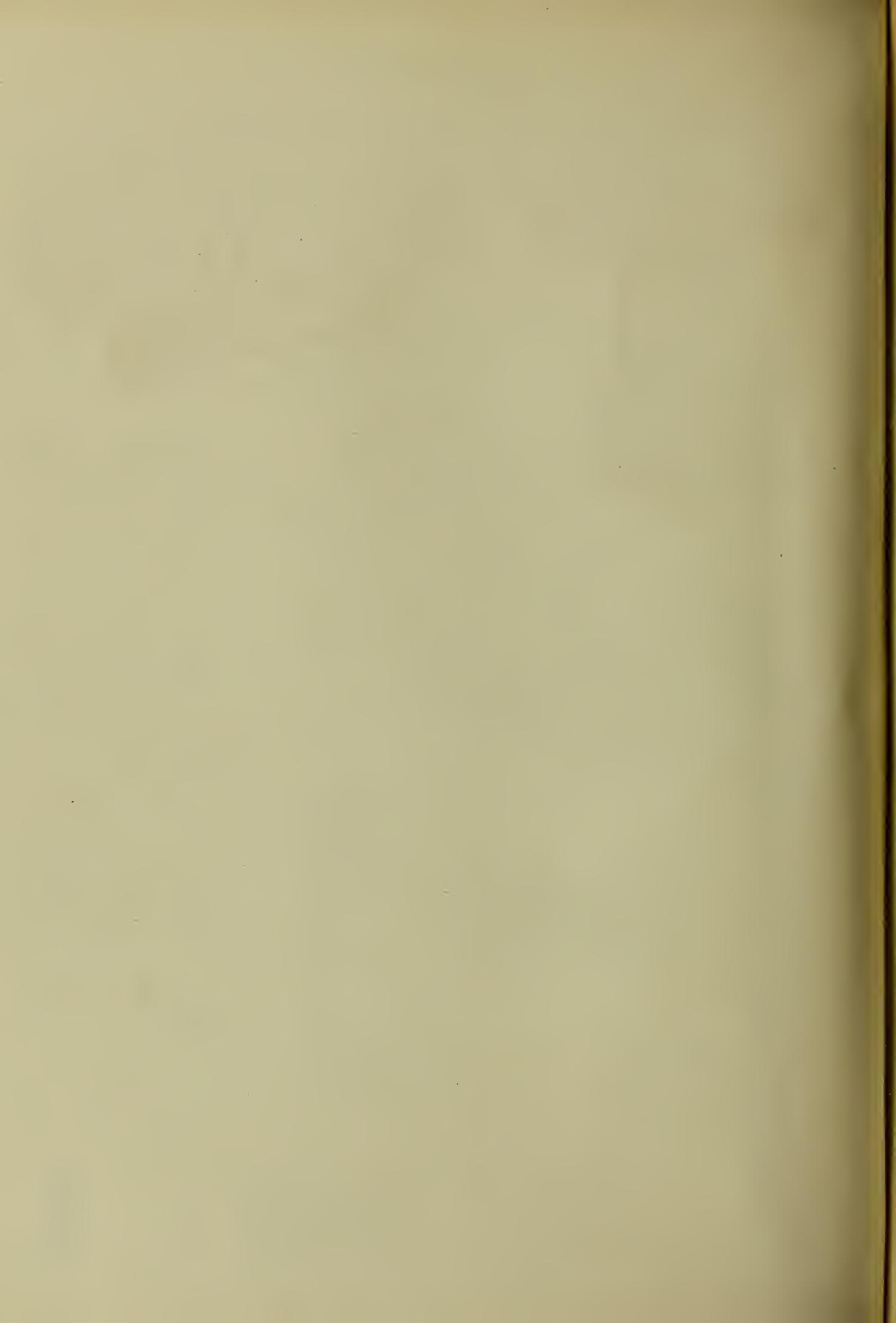
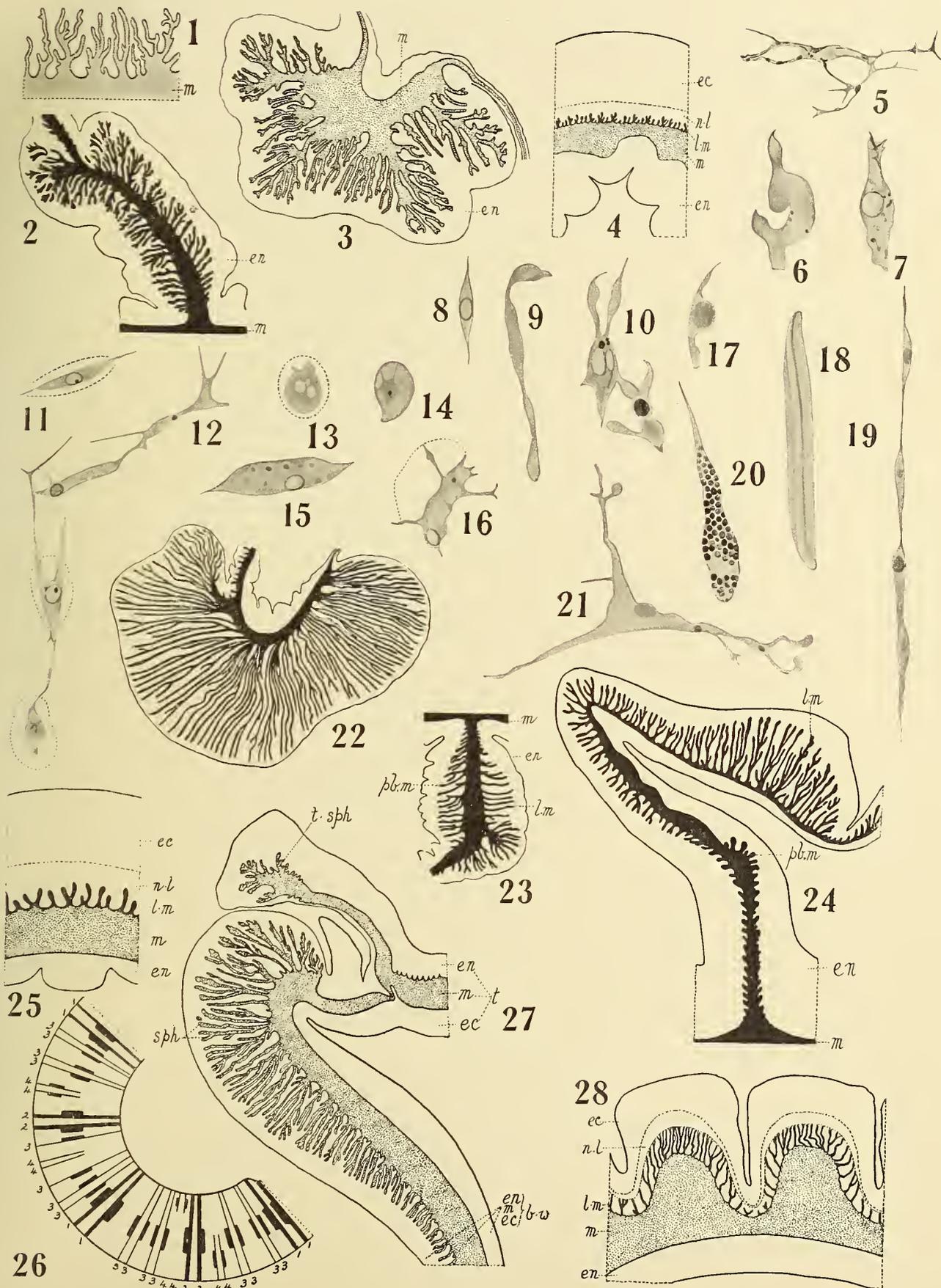


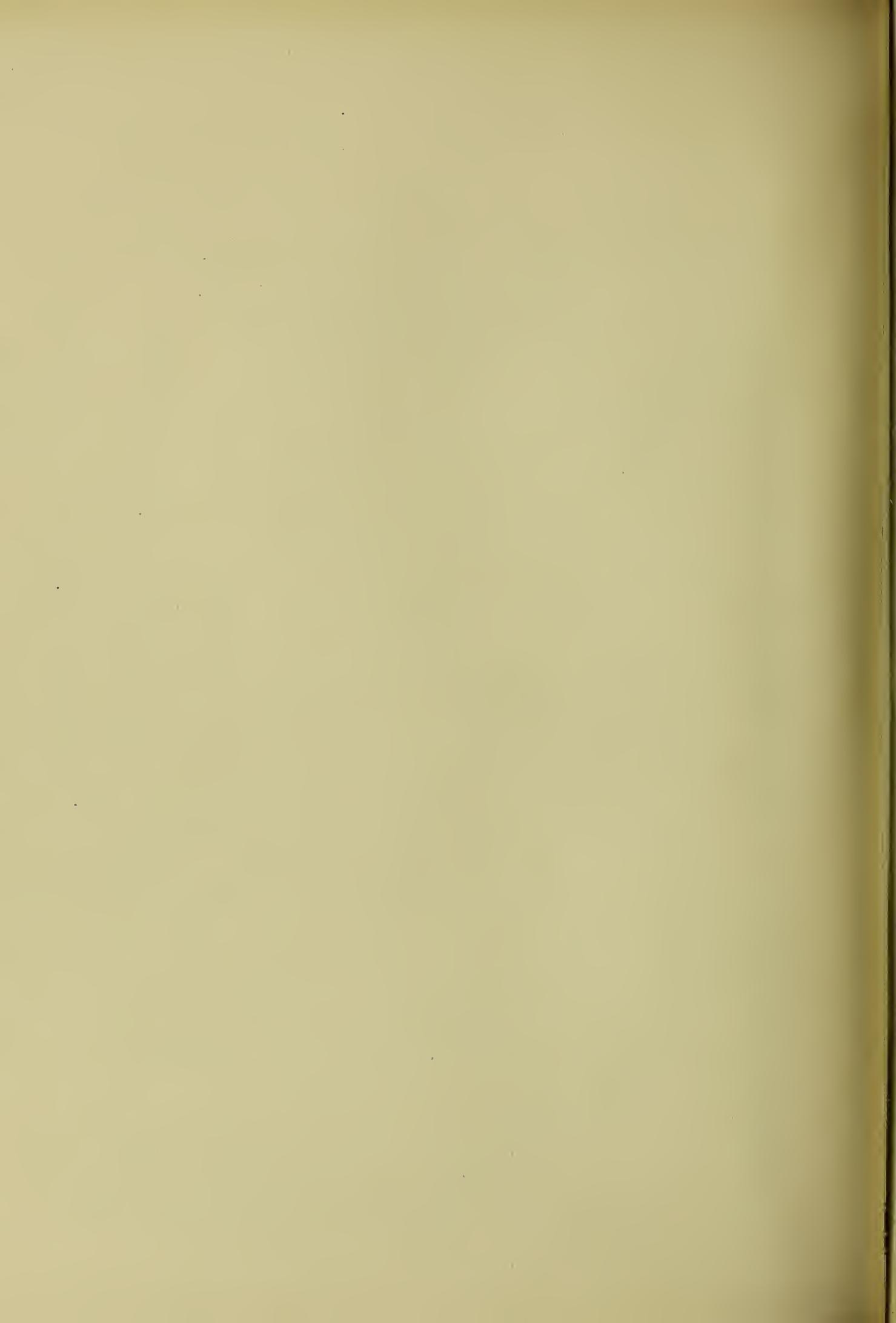
PLATE III.

Artemidactis victrix. Figs. 6-10.
Bolocera longicornis. Figs. 11-16, 24, 27.
Epiactis novo-zealandica. Fig. 28.
Halcampoides aspera. Figs. 1-4.
Halcurias endocoelactis. Figs. 22, 23, 25, 26.
Hormosoma scotti. Figs. 17, 19, 21.
Leptoteichus insignis. Fig. 20.
Lilliella lacunifera. Fig. 5.
Sagartia, sp. Fig. 18.

<i>b.w.</i> , body-wall.	<i>n.l.</i> , nerve-layer.
<i>ec.</i> , ectoderm.	<i>pb.m.</i> , parieto-basilar muscle.
<i>en.</i> , endoderm.	<i>sph.</i> , sphincter.
<i>l.m.</i> , longitudinal musculature.	<i>t.</i> , tentacle.
<i>m.</i> , mesogloea.	1-4, cycles of mesenteries.

- FIG. 1.—*Halcampoides aspera*. A few processes of the sphincter muscle. Oc. 3, obj. $\frac{1}{6}$.
 FIG. 2.— " " Parietal muscle of perfect mesentery. Oc. 3, obj. $\frac{2}{3}$.
 FIG. 3.— " " Muscle-pennon of perfect mesentery. Oc. 3, obj. $1\frac{1}{2}$.
 FIG. 4.— " " Diagram of proportions of layers in part of transverse section of a tentacle. Oc. 3, obj. $\frac{2}{3}$.
 FIG. 5.—*Lilliella lacunifera*. Network from mesogloea of body-wall. Oc. 3, obj. $\frac{1}{2}$.
 FIG. 6.—
 FIG. 7.—
 FIG. 8.—
 FIG. 9.—
 FIG. 10.—
 FIG. 11.—
 FIG. 12.—
 FIG. 13.—
 FIG. 14.—
 FIG. 15.—
 FIG. 16.—
 FIG. 17.—*Hormosoma scotti*. Cell from mesogloea of body-wall. Oc. 3, obj. $\frac{1}{2}$.
 FIG. 18.—*Sagartia*, sp. Keeled thick walled nematocyst from acontium. Oc. 3, obj. $\frac{1}{2}$.
 FIG. 19.—*Hormosoma scotti*. Cell from mesogloea of body-wall. Oc. 3, obj. $\frac{1}{2}$.
 FIG. 20.—*Leptoteichus insignis*. Coarsely granular gland-cell from mesentery. Oc. 3, obj. $\frac{1}{2}$.
 FIG. 21.—*Hormosoma scotti*. Cell from mesogloea of body-wall. Oc. 3, obj. $\frac{1}{2}$.
 FIG. 22.—*Halcurias endocoelactis*. Pennon of large mesentery, below level of actinopharynx. Oc. 3, obj. $\frac{2}{3}$.
 FIG. 23.— " " Musculature of mesentery as it leaves body-wall. Oc. 3, obj. $\frac{2}{3}$.
 FIG. 24.—*Bolocera longicornis*. Muscular portion of a third-cycle mesentery. Oc. 3, obj. $\frac{2}{3}$.
 FIG. 25.—*Halcurias endocoelactis*. Diagram of part of transverse section of a tentacle. Oc. 3, obj. $\frac{1}{6}$.
 FIG. 26.— " " Diagram of arrangement of mesenteries in one-half of the specimen.
 FIG. 27.—*Bolocera longicornis*. Sphincter-muscle, and half tentacle-sphincter. Oc. 3, obj. $\frac{2}{3}$.
 FIG. 28.—*Epiactis novo-zealandica*. Diagram of part of transverse section of a tentacle. Oc. 3, obj. $\frac{1}{6}$.





Coelenterata, Part I.—Actiniaria, Pl. IV.

PLATE IV.

Cymbactis selaginella. Figs. 14, 15.

Hormosoma scotti. Figs. 4, 7-9.

Leptoteichus insignis. Figs. 1-3, 5, 6.

Lilliella lacunifera. Figs. 10-13.

<i>b.en.</i> , body-wall endoderm.	<i>m.</i> , mesogloea.
<i>ec.</i> , ectoderm.	<i>m.p.</i> , muscle-processes.
<i>e.c.m.</i> , endodermal circular muscle.	<i>n.l.</i> , nerve-layer.
<i>en.</i> , endoderm.	<i>pb.m.</i> , parieto-basilar muscle.
<i>g.</i> , gonad.	<i>sph.</i> , sphincter.
<i>lac.</i> , lacunae.	<i>t.</i> , tentacle.
<i>l.m.</i> , longitudinal musculature.	<i>t.m.</i> , tentacle-mesogloea.

- FIG. 1.—*Leptoteichus insignis*. Small-scale diagram to show shape of sphincter.
- FIG. 2.— " " Exact detail of a small portion of sphincter. Oc. 3, obj. $\frac{2}{3}$.
- FIG. 3.— " " Part of a transverse section of a tentacle. Oc. 3, obj. $\frac{1}{6}$.
- FIG. 4.—*Hormosoma scotti*. Exact detail of portion of sphincter. Oc. 3, obj. $\frac{1}{6}$.
- FIG. 5.—*Leptoteichus insignis*. Muscular portion of a last-cycle mesentery. Oc. 3, obj. $\frac{2}{3}$.
- FIG. 6.— " " Some processes of the muscle-pennon of a large mesentery, to show how they appear to project from the endoderm into the mesogloea. The letter *m* is placed in the mesogloea. Oc. 3, obj. $\frac{1}{6}$.
- FIG. 7.—*Hormosoma scotti*. Diagram to show shape of sphincter. Oc. 3, obj. $1\frac{1}{2}$.
- FIG. 8.— " " Part of transverse section of tentacle. Oc. 3, obj. $\frac{2}{3}$.
- FIG. 9.— " " Muscular part of a medium-sized mesentery. Oc. 3, obj. $1\frac{1}{2}$.
- FIG. 10.—*Lilliella lacunifera*. Detail of small portion of middle part of sphincter (exact). Oc. 3, obj. $\frac{2}{3}$.
- FIG. 11.— " " Small portion of the lining of a lacuna. Oc. 3, obj. $\frac{1}{12}$.
- FIG. 12.— " " Portion of body-wall mesogloea, showing lacunae: the dotted areas within the lacunae are patches of the network-lining. Oc. 3, obj. $\frac{2}{3}$.
- FIG. 13.— " " Diagram to show form of sphincter.
- FIG. 14.—*Cymbactis selaginella*. Part of transverse section of a tentacle. Oc. 3, obj. $\frac{2}{3}$. From a large specimen.
- FIG. 15.— " " Exact detail of small part of sphincter of small specimen. Oc. 3, obj. $\frac{1}{6}$.

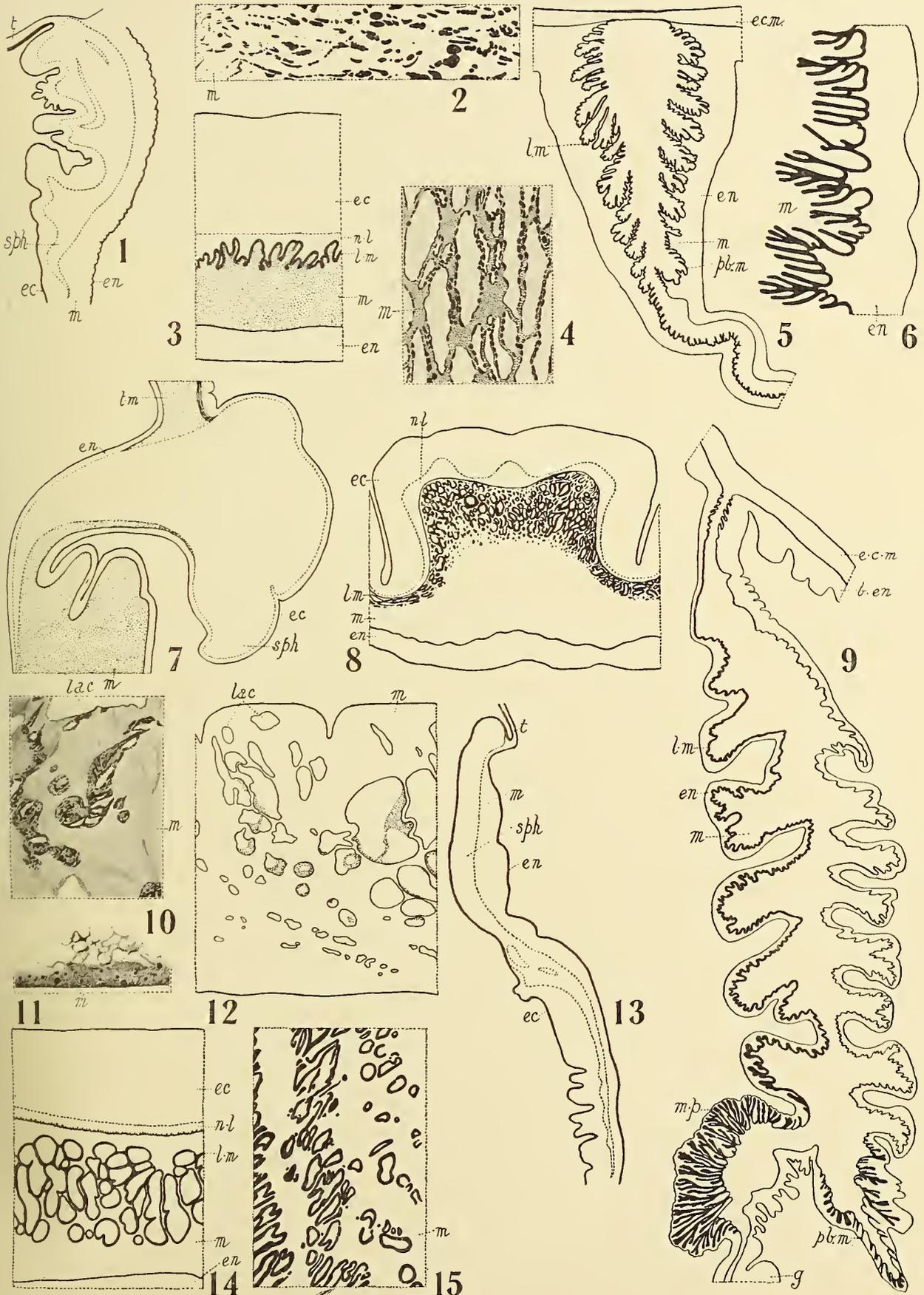
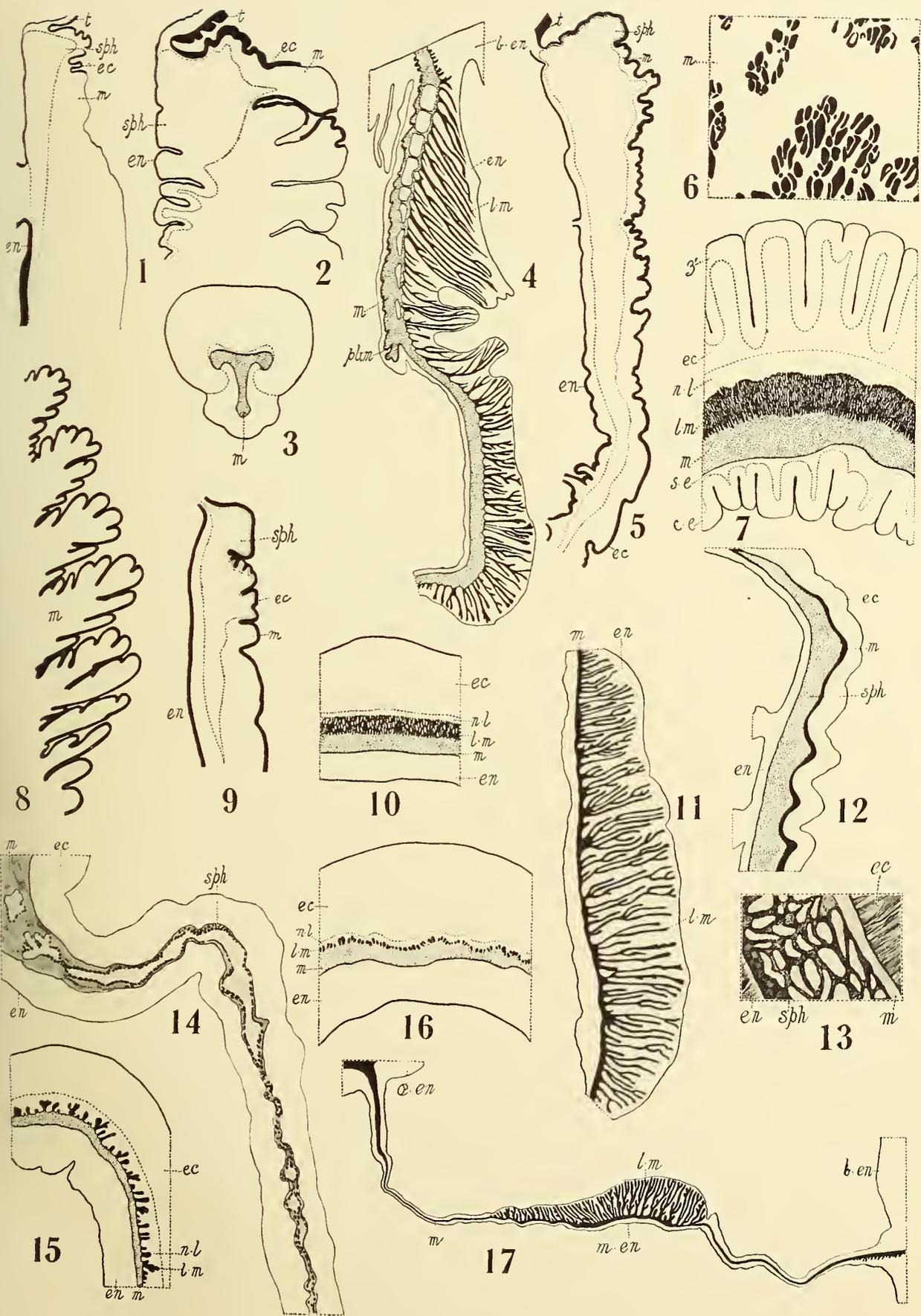


PLATE V.

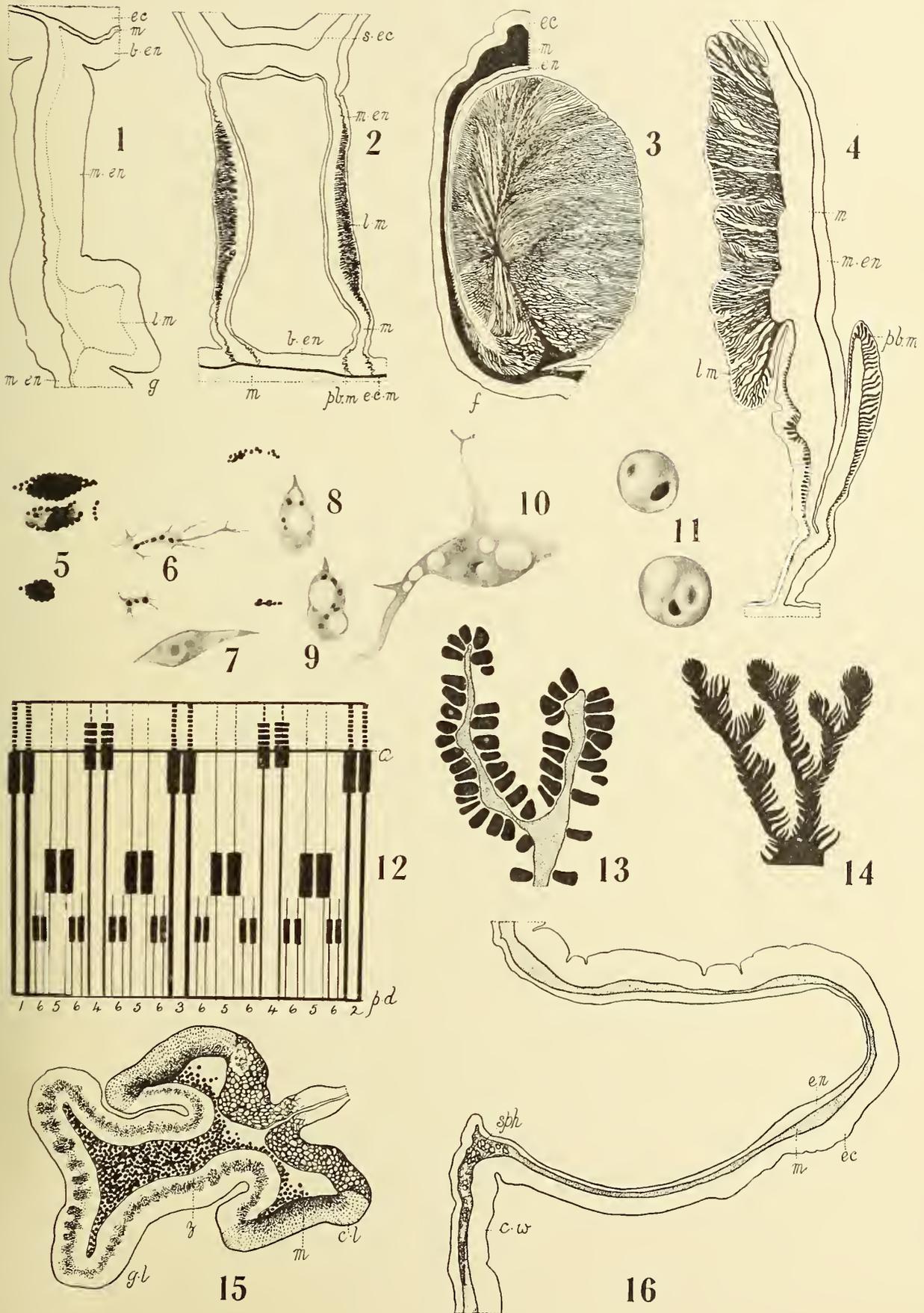
Aiptasioides prima. Figs. 11, 14, 16.
Artemidactis victrix. Figs. 3, 5-8.
Calliactis reticulata. Figs. 9, 10.
Cymbactis selaginella. Figs. 1, 2, 4.
Sagartia, sp. Figs. 12, 13, 15, 17.

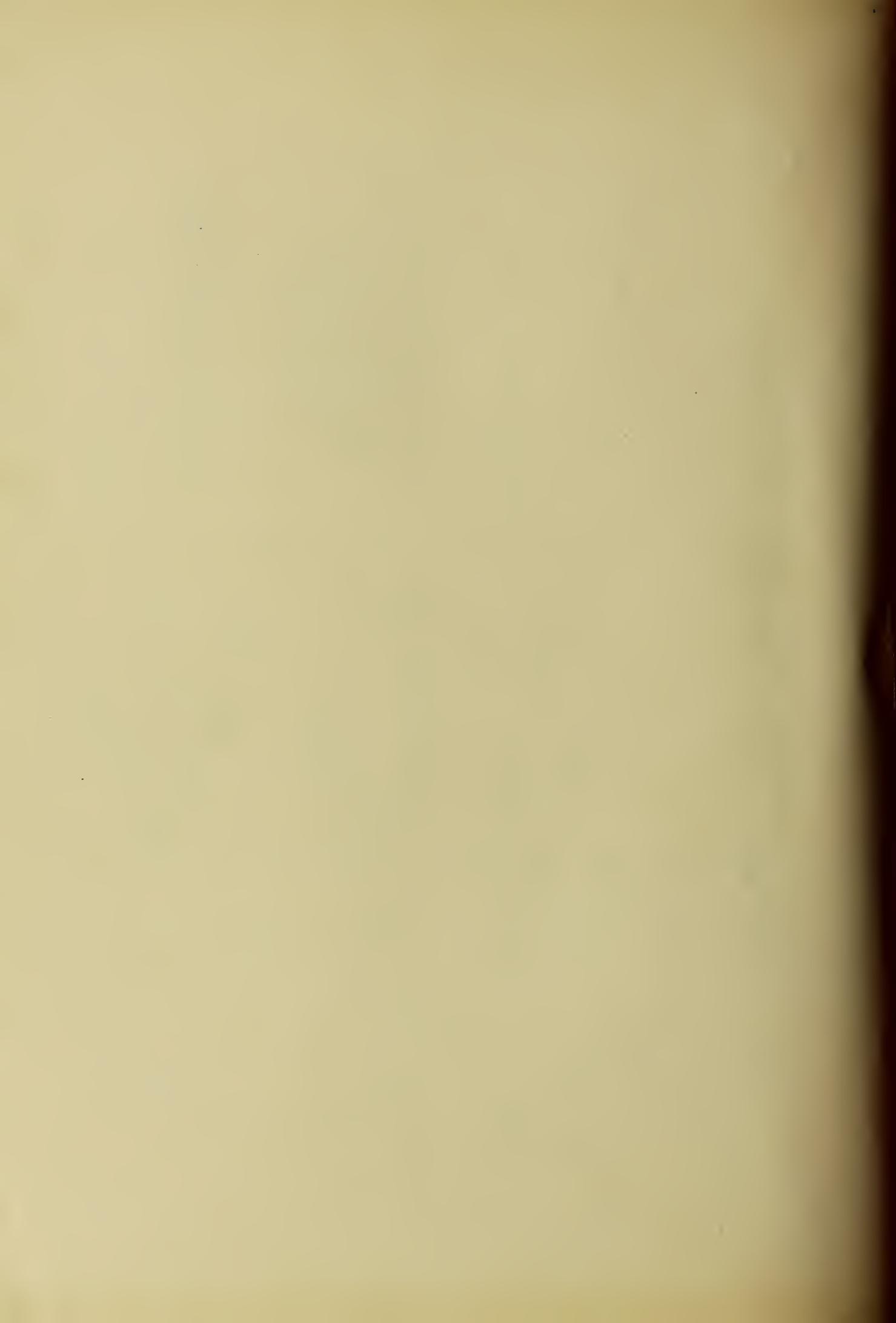
<i>b.en.</i> , body-wall endoderm.	<i>n.l.</i> , nerve-layer.
<i>c.e.</i> , firmer outer part of endoderm.	<i>oe.n.</i> , actinopharynx-endoderm.
<i>ec.</i> , ectoderm.	<i>pb.m.</i> , parieto-basilar muscle.
<i>en.</i> , endoderm.	<i>s.e.</i> , spongy part of endoderm.
<i>l.m.</i> , longitudinal musculature.	<i>sph.</i> , sphincter.
<i>m.</i> , mesogloea.	<i>t.</i> , tentacle.
<i>m.en.</i> , mesentery-endoderm.	<i>z'</i> , zone of spirocysts.

- FIG. 1.—*Cymbactis selaginella*. Diagram showing shape of sphincter of small specimen.
 FIG. 2.— " " Diagram showing form of sphincter of large specimen.
 FIG. 3.—*Artemidactis victrix*. Diagram showing shape and layering of transverse section of acontium. Oc. 3, obj. $\frac{1}{8}$.
 FIG. 4.—*Cymbactis selaginella*. Muscular part of a medium-sized mesentery. Oc. 3, obj. $\frac{2}{3}$. From small specimen.
 FIG. 5.—*Artemidactis victrix*. Diagram to show shape of sphincter.
 FIG. 6.— " " Exact detail of a small part of sphincter. Oc. 3, obj. $\frac{1}{8}$.
 FIG. 7.— " " Part of transverse section of a tentacle. Oc. 3, obj. $\frac{2}{3}$.
 FIG. 8.— " " Processes from basal part of a directive mesentery. The letter *m* is placed in the mesogloea. Oc. 3, obj. $\frac{2}{3}$.
 FIG. 9.—*Calliactis reticulata*. Diagram showing form of sphincter.
 FIG. 10.— " " Part of transverse section of a tentacle. Oc. 3, obj. $\frac{2}{3}$.
 FIG. 11.—*Aiptasioides prima*. Muscle-pennion of a perfect mesentery. Oc. 3, obj. $\frac{2}{3}$.
 FIG. 12.—*Sagartia*, sp. Diagram of shape of sphincter. Oc. 3, obj. $\frac{2}{3}$.
 FIG. 13.— " Detail of small portion of sphincter. Oc. 3, obj. $\frac{1}{2}$.
 FIG. 14.—*Aiptasioides prima*. Upper part of sphincter. Oc. 3, obj. $\frac{1}{8}$.
 FIG. 15.—*Sagartia*, sp. Part of transverse section of a tentacle. Oc. 3, obj. $\frac{1}{8}$.
 FIG. 16.—*Aiptasioides prima*. Part of transverse section of a tentacle. Oc. 3, obj. $\frac{1}{8}$.
 FIG. 17.—*Sagartia*, sp. Perfect mesentery, partially restored. Oc. 3, obj. $\frac{2}{3}$.



Coelenterata, Part I.—Actiniaria, Pl. VI.







British Museum (Natural History).

This is No. **3** of 25 copies of
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Part II., printed on Special paper.

12 FEB. 1920

COELENTERATA.

PART II.—MADREPORARIA.

(a) On *Favia conferta*, Verrill, with Notes on other Atlantic Species of *Favia*.*

BY GEORGE MATTHAI, M.A.,

*Professor of Zoology, Government College, Lahore, Punjab**(late Mackinnon Student of the Royal Society and sometime Research Student of Emmanuel College, Cambridge).*

WITH TWO FIGURES IN THE TEXT AND FOUR PLATES.

	PAGE
I.—Introduction	69
II.—Explanation of Nomenclature	70
III.—Colony-formation	73
IV.—Description of <i>Favia conferta</i> , Verrill	73
V.—Notes on other Atlantic Species of <i>Favia</i>	80
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I.—INTRODUCTION.

THE Astræid corals collected by the British Antarctic ("Terra Nova") Expedition, which Professor J. Stanley Gardiner, F.R.S., handed over to me for description, consisted of six specimens of moderate size (none of these were entire colonies), and a few smaller pieces in alcohol. These were all obtained at Station 37 (off South Trinidad, 20° 28' S., 29° 25' W.), and, though at first I had regarded them as referable to *Favia fragum* (Esper), they are, on further study, found to belong to the related species *Favia conferta*, Verrill. Three of the specimens were subsequently dried for their coralla (the largest being No. B, in table on p. 90); one containing a few polyps on part of its calicinal surface is still kept in alcohol, and the remainder have been decalcified for their polyps in 2 per cent. solution of nitric acid in 75 per cent. alcohol. Since the pieces had been plunged into alcohol without previous fixation,† the soft parts are not in as good

* This work was done by me as Mackinnon Student of the Royal Society, aided by grants from Emmanuel College, Cambridge, and from the Francis Maitland Balfour Fund of the University. [Manuscript received July 31, 1918.—S. F. Harmer.]

† According to information given by Mr. D. G. Lillie, member of the Expedition.

*condition for histological study as might be desired. Seven polyps were sectioned, viz., five transversely (table on p. 78) and two longitudinally. The morphology of the soft parts of this species is herein described for the first time.

Four additional species of *Favia* have been recorded from the Atlantic region, viz., *F. fragum* (Esper), *F. gravida*, Verrill, *F. leptophylla*, Verrill, and *F. whitfieldi*, Verrill, whilst a sixth species, which is an undoubted *Favia*, is *Orbicella aperta*, Verrill. In 1915, I was able to examine Verrill's types of all the Atlantic species of *Favia* in the Yale University Museum and in the American Museum of Natural History, New York, as well as the large collections of *F. fragum* in the United States National Museum, Washington. Among the exchange specimens for the University Museum, Cambridge, entrusted to me by Dr. Wayland Vaughan, are a dried corallum of *F. conferta*, and another of *F. gravida* from Brazil, described on p. 90.

In July, 1915, while at the Marine Biological Station, Tortugas, I had the opportunity of collecting a large number of colonies of *F. fragum* at different stages of growth, some thirty of which were fixed in 10 per cent. formaldehyde after narcotisation in a solution of magnesium sulphate in sea-water in a partially extended condition, and over a hundred were dried. Live colonies of this species were also kept under observation in aquaria of running sea-water, some of which extruded larvæ, but not in any abundance at that time of the year. In 1914, Professor Stanley Gardiner kindly placed at my disposal a well-preserved colony of *F. fragum*, which he had received from Dr. Wayland Vaughan, from South Bight, Andros Island, Bahamas. The whole of this colony has been decalcified, and seven series of sections were made, six transverse (table on p. 85) and one longitudinal. Thus, it has been possible to make a detailed comparison of the morphology of the hard and soft parts of *F. conferta* with that of *F. fragum*.

The probable relationships of the Atlantic species of *Favia*, based on data obtained from the above sources, are also discussed in this Report.

II.—EXPLANATION OF NOMENCLATURE.

Bilateral symmetry.—The lateral compression of the stomodæum of a polyp and the presence of a directive couple of mesenteries at each of its ends.

Body-wall.—The entire wall of a polyp surrounding the cœlenteric cavity, viz., the oral disc with the tentacles above, the basal disc below, and between these laterally the column-wall.

Bud.—A new polyp formed outside or inside the tentacular ring of an older polyp.

Calyx.—The cavity enclosed in a corallite.

Cœnosarc.—The soft parts of a colony overlying the peritheca.

Colline.—The calcareous partition between two adjacent valleys.

Colony.—The entire soft and hard parts of a Madreporarian coral containing more than one stomodæum.

Column-wall.—The vertical portion of the body-wall of a polyp, forming the lateral boundary of its cœlenteric cavity.

Corallite.—The part of the corallum in which a monostomodæal polyp lies.

Corallite-wall.—The wall of a corallite inclusive of theca and any perithecal deposit.

Corallum.—The hard parts of a Madreporarian colony.

Edge-zone.—The soft parts of a colony covering the outer free surface of the wall of one of its corallites; indistinguishable in some cases.

Enterostome.—The lower opening of the stomodæum into the cœlenteric cavity.

Entocœle.—The part of the cœlenteric cavity included within a couple of mesenteries.

Exocœle.—The part of the cœlenteric cavity included between two neighbouring couples of mesenteries.

Hexamerall symmetry.—The presence of six, or some multiple of six, mesenteries around the stomodæum of a polyp.

Interstomodæal septum.—A septum under the enterocœle of an interstomodæal couple of mesenteries.

Mesenteries :—

Principal mesenteries meet the stomodæum, *subsidiary mesenteries* do not.

Couple of mesenteries.—Two adjacent mesenteries of a polyp with the pleats of their middle lamina *vis-à-vis*.

In a *completely principal couple*, both the mesenteries meet the stomodæum; in an *incompletely principal couple*, one of the mesenteries meets the stomodæum whilst the other does not; in a *subsidiary couple*, neither of the mesenteries meets the stomodæum.

An *interstomodæal couple* lies between two adjacent stomodæa in a common tentacular ring, each mesentery being related to one of the stomodæa. Such a couple is *completely principal* when the two mesenteries are attached to their respective stomodæa, *incompletely principal* when only one of the mesenteries is attached to a stomodæum, or *subsidiary* when neither of the mesenteries is attached, their inner margins being free.

Middle lamina.—A descriptive name for the supporting lamella present between the ectoderm and endoderm of coral colonies, and forming the median core of the mesenteries.

Nematocysts.*—Minute structures occurring in the epithelia of Coelenterate animals and said to be used for stinging.

* For a full account of nematocysts in Astræid corals, *vide* 5, pp. 10–17.

In *type I*, otherwise known as the "tentacular type," the sac of the nematocyst is more or less trumpet-shaped and contains a filament spirally coiled against the inner surface of its membranous wall. The number of turns of the spiral varies in different species. From the base of the sac a slender process can be traced to the middle lamina. Nematocysts of this type attain their full size in the tentacular ectoderm, where they are closely arranged to form batteries, but are found more or less scattered in the edge-zone, oral disc, stomodæal ridges and the straight regions of the mesenterial filaments.

In *type II*, the sac is larger, broad at one end and bluntly pointed at the other. A narrow "axis" extends from the bluntly pointed end of the sac to about two-thirds its length, consisting of an "axial core" enclosed in a thin membranous sheath, against the inner service of which lies a close spiral. The axial core is usually straight, sometimes slightly bent, and tapers towards its pointed outer extremity. Found principally in the convoluted regions of the mesenterial filaments, where they may form batteries.

In *type IIIb*, the sac is much narrower and somewhat longer than in type II and the axis does not extend beyond a third of the length of the sac. Found in the terminal batteries of tentacles, interspersed among those of type I.

In *type III*, the sac is larger than in I or II, being broader in the middle than at the ends, and it contains a protoplasmic core staining more deeply than the rest of the contents. A long "thread" is spirally coiled along the inner surface of the membranous wall, thicker but with fewer turns of the spiral than in I. The thread consists of an "axial strand" enclosed in a thin membranous sheath, against the inner surface of which lies a fine closely wound spiral. Occurring mainly in the coils of the mesenterial filaments.

Oral disc.—The circumoral wall of a polyp bounded by the outermost cycle of tentacles.

Pali.—The upright calcareous rods arising from the basal plate of a corallite external to the columella.

Peristome.—The circumoral space of a polyp enclosed by the oral disc and tentacles.

Peritheca.—That part of the corallum of colonial Madreporaria which is deposited outside and subsequently to the theca.

Polyp.—Any part of the soft parts of a colony which has a distinct circumoral tentacular boundary.

Monostomodæal, distomodæal, or tristomodæal, when containing one, two or three stomodæa respectively within a common tentacular boundary.

An *intramural polystomodæal* polyp contains more than three stomodæa, arranged in a single row along its middle.

Mother-polyps are those polyps in which intratentacular buds are formed.

Valley.—Part of the corallum in which a polystomodæal polyp lies.

III.—COLONY-FORMATION.

It is now found that, in the Astræidæ, colony-formation takes place by extratentacular and intratentacular budding, i.e., by the formation of new stomodæa, hence of buds, outside or inside the tentacular rings of older polyps; in both cases new stomodæa arise afresh in diverticula (text-figs. 1 and 2) by invagination of the oral disc or by union of the margins of the broader mesenteries, without involving the longitudinal fission of existing stomodæa. In intratentacular budding one or more stomodæa arise within the same tentacular ring, and one or two couples of mesenteries between every two stomodæa (text-fig. 1, $a_1 a_2$, $b_1 b_2$, and $c_1 c_2$). The bud is separated from the mother polyp by the growth inwards and fusion of the parts of the column-wall over the interstomodæal septa (e.g., of those below the entocœles of $b_1 b_2$ and $c_1 c_2$), and of the latter to form a dividing wall between the bud and parent corallites (Pl. I, figs. 18 and 23).

In the genus *Favia* intratentacular budding results in distomodæal and tristomodæal polyps, i.e., polyps containing two and three stomodæa respectively. Tristomodæal polyps are *linear* when the two buds are formed at opposite ends, usually in the sagittal plane, of the mother-polyp (Pl. I, figs. 20–22), *triangular* when the two buds arise as a pair from neighbouring entocœles of the mother-polyp (Pl. I, figs. 16 and 17). Mono- and di-stomodæal polyps are more numerous in colonies than tristomodæal ones. Intramural polystomodæal polyps, i.e., polyps containing more than three stomodæa in a median row, when present, are short and few, and finally break up into mono-, di- or tri-stomodæal polyps. In all these cases, the planes of intratentacular buds not infrequently disagree with those of their mother-polyps (Pl. III, fig. 6), although the planes of oral disc areas invariably correspond with those of their respective stomodæa. While colony-formation in *Favia* is mainly by intratentacular budding, extratentacular budding unaccompanied by bilateral and hexamerous symmetries occurs at the growing edges of colonies.*

IV.—DESCRIPTION OF *FAVIA CONFERTA*, Verrill.

Favia † *conferta*, Verrill. (Text-fig. 1; Pl. I, figs. 1–27; Pl. II, figs. 1–3, 6, 10, 11; Pl. III, figs. 2, 8; Pl. IV, figs. 1, 3, 4, 7, 10.)

1868.—*Favia conferta*, Verrill, Trans. Conn. Acad., I, p. 355.

1902.—*Meandra conferta*, Verrill, Trans. Conn. Acad., XI, pp. 84 and 188.

1903.—*Meandra conferta*, Verrill, Zoology of Bermudas, I, pp. 84 and 188.

* A full account of Colony-formation in Astræid Corals will be given in another paper which, it is hoped, will be published in the near future.

† I have given a diagnosis of the Genus *Favia* on a previous occasion (5, pp. 77–79), to which I do not propose to add anything further in the present state of our knowledge of the Genus.

Localities.—"Terra Nova," Stat. 37, off South Trinidad (six specimens). *Other sources*, Abrolhos Reefs; Bahia and Fernando Noronha; Mar Grande, Bahia; Pernambuco. Cape Frio to Pernambuco, common in tide-pools (Verrill).

CORALLUM.

Sub-hemispherical, small, compact. Corallites oval in outline, or laterally compressed (when containing mono- and di-stomodæal polyps), or triangular (when containing tristomodæal polyps); width of their calices 2.5 mm. to 3 mm., depth 2.5 mm. In addition, a few short valleys which are irregularly linear or curved in shape and up to 15 mm. or 20 mm. in length. Walls solid in transverse section, about 1.25 mm. in thickness, often with shallow median furrows.

Septa in two alternating series of broad and narrow ones, with vertical inner margins; the former about .75 mm. apart (about 20 such septa in corallites of mono-stomodæal polyps), with spinulose sides and exsert to about .5 mm. These broad septa become perforated a short distance below corallite-rims, the perforations often breaking through inner margins, thus resulting in coarse irregular teeth which increase in length towards upper level of columella; the lower teeth tend to be obliquely raised, but do not form a definite palicrown. Most of the broad septa meeting the columella, the rest curve towards and fuse with the neighbouring septa meeting columella; exsert ends arched, dentate, meeting in notches along middle of walls. Narrow septa with irregularly toothed inner margins, slightly exsert, and often meeting over walls. Columella spongiform, composed of interlacing septal trabeculæ, and occupying inner one-third of width of calices; columellar centres often difficult to distinguish, since, in valleys, columellæ extend as ridges of more or less even thickness. Endothecal dissepiments concavo-convex (as seen in vertical section), .5 to .75 mm. apart.

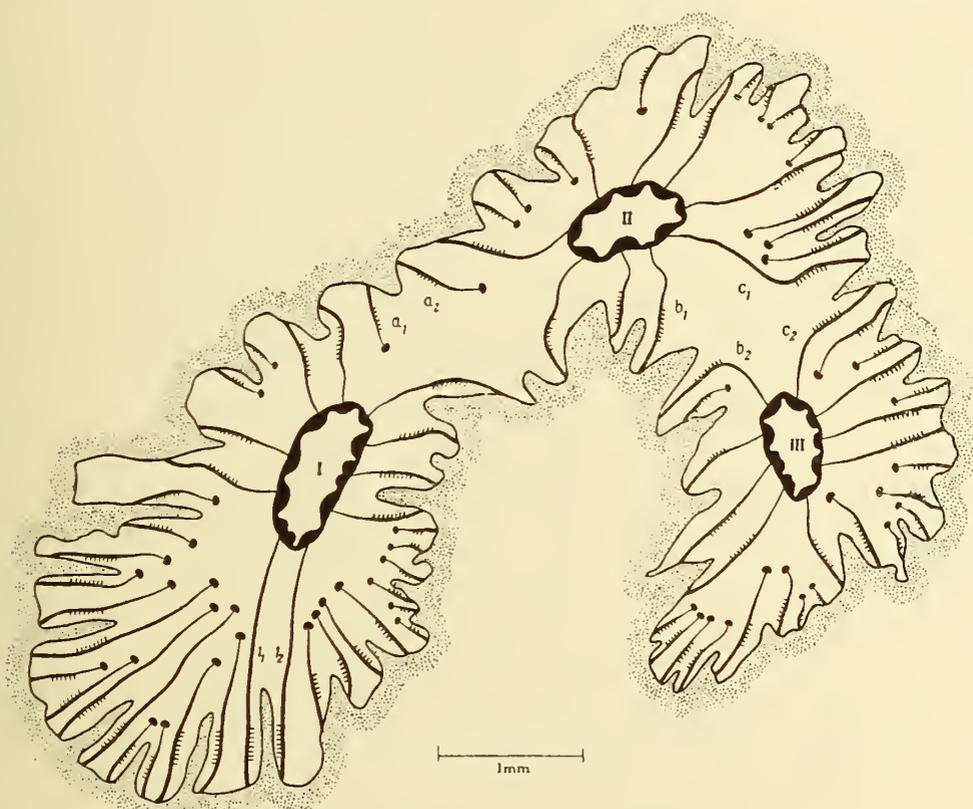
Verrill at first described this species under *Favia*, subsequently reclassifying it under *Mæandra*. But in all the specimens examined, corallites (of mono- and di-stomodæal polyps) are far more numerous than valleys, the latter being invariably short and tending to be divided into corallites by the formation of incipient transverse partitions. In the Yale University Museum are five dried specimens assigned by Verrill to *Favia conferta*, a list of which is given on p. 89. In addition to these, there are two more specimens belonging to *F. conferta*; one of them (without number) resembles Verrill's figured type but has thicker corallite-walls, in the other (Cat. No. 4519) corallite-rims tend to be elevated, thus making the inter-corallite grooves conspicuous, as in *Favia gravida*, Verrill.

POLYPS.

Polyps are mostly mono-, di- and tri-stomodæal, polystomodæal polyps being few and containing four to six stomodæa (Pl. I, figs. 1-25). Linear tristomodæal

and polystomodæal polyps are not infrequently curved in shape (text-fig. 1, Pl. I, figs. 26, 27).

Body-wall.—The ectoderm of the oral disc is of more or less uniform thickness (.025 mm. to .04 mm.)* over its entire extent, with a translucent free border, and it contains numerous elongated nuclei (mostly granular) along its middle. The outer half of the layer contains oval mucous vacuoles, whilst in the granular inner half a few round and oval nuclei lie scattered. Short nematocysts I with about twenty-five turns of the spiral are occasionally present in the ectoderm. The middle lamina is thin. The



TEXT-FIG. 1.—*Favia conferta*, Ver. Transverse section through the stomodæal region of a curved tristomodæal polyp. I, II, III, Stomodæa of polyp. $a_1, a_2, b_1, b_2, c_1, c_2$, Interstomodæal couples of mesenteries. Opposite stomodæum I are two terminal intratentacular diverticula, containing seven and five subsidiary couples of mesenteries separated by the mesenterial couple l_1, l_2 . Opposite stomodæum III is another terminal intratentacular diverticulum, containing four subsidiary couples of mesenteries. The hard parts are represented by dots. (Constructed from Camera lucida tracings of serial transverse sections of 400 VI, "Terra Nova.")

endoderm is thinner (.015 mm. thick) than the overlying ectoderm, somewhat lobulated but not vacuolated to the same extent as in *F. fragum*. The nuclei are round or oval, homogeneously stained dark in Heidenhain's iron hæmatoxylin, or with a dark central spot. Algæ are plentiful but are not massed.

* The histological measurements are all taken from sections.

Both entocœlic and exocœlic tentacles are uniformly short, being in sections about $\cdot 2$ to $\cdot 3$ mm. long and $\cdot 2$ mm. in diameter (Pl. II, fig. 6). Their terminal batteries are nearly semicircular in transverse section and are about $\cdot 06$ mm. in height. In the outer half of the terminal battery nematocysts I are massed. When fully formed these are nearly $\cdot 03$ mm. long and having a somewhat larger number of turns of the spiral than in *F. fragum*, viz., about 40. Among nematocysts I are a few II *b* ones, $\cdot 035$ mm. to $\cdot 04$ mm. in length and $\cdot 0075$ mm. in width, whose axis (stained dark in iron hæmatoxylin) extends to about one-third the length of the sacs, in which a faint coiled thread is visible. In the inner half of the battery lie numerous nuclei, the lower ones being round or oval and the upper ones elongated. Fibrils are distinctly seen in the lower half, becoming continuous with the underlying middle lamina. Sub-terminal batteries are not visible in longitudinal sections through any of the tentacles. The endoderm is swollen, tending to fill the lumina of the tentacles, and it contains numerous algæ.

The column-wall is quite thin in the upper half of the polyp. The calicoblastic ectoderm continues to the base of the polyp; in this region the endoderm is transparent and reticular, being swollen to $\cdot 07$ or $\cdot 08$ mm. thick, and its nuclei are gathered towards its periphery. Algæ are scarce in the endoderm.

Stomodæum (Pl. II, fig. 10).—In a distomodæal polyp 3 mm. in height (as seen in longitudinal section) the stomodæa are about $\cdot 5$ mm. long and are wider at the enterostome than at the mouth-opening, whilst in a monostomodæal polyp 2.5 mm. high the stomodæum is $\cdot 35$ mm. long. The stomodæal ectoderm is ciliated, as usual. Although the polyps are small, the stomodæa have well-developed ridges, which are about $\cdot 06$ mm. broad and twice as thick, and whose sides are sloping when wide apart or vertical when the ridges are approximated. The intervals between the ridges vary in the different stomodæa, doubtless due to the state of preservation and embedding. In the lower half of the stomodæum, shallow median grooves are present on the ridges. The intermesenterial parts are usually folded outwards. The histology of the stomodæal ectoderm is typical. The middle lamina is not thickened in the ridges. The endoderm is much thinner (about $\cdot 01$ mm.) than the ectoderm of the intermesenterial parts (about $\cdot 025$ mm.), and algæ are rare.

Mesenteries (Pl. II, fig. 10).—On an average nine to eleven mesenteries are present around a stomodæum. In the stomodæal region, entocœlic pleats extend over the outer two-thirds of width of principal mesenteries, not so close together as in *F. fragum*, gradually increasing in width towards the inner one-third of pleatal region where they are broad, somewhat constricted at their bases and knobbed at the tips, often sub-divided and slender in transverse section, then becoming narrower over the rest of the pleatal region. The mesenteries decrease in width from above downwards, most of them stopping short of the bases of polyps. The endoderm appears to increase in width from the column-wall to stomodæum. Below the stomodæal region entocœlic pleats extend over the greater part of the width of the mesenteries, as is usually

the case in the *Astræidæ*. Numerous algæ are present on the exocœlic side, massed in places.

Mesenterial filaments (Pl. III, fig. 8) are more or less semicircular in transverse section, in which granular vacuoles are seen. In their convolutions nematocysts III are present, having long narrow sacs ($\cdot 06$ mm. to $\cdot 065$ mm. long and $\cdot 01$ mm. to $\cdot 0125$ mm. broad), resembling those in *Goniastrea retiformis* (5, Pl. VI, fig. 61) with 15–20 turns of the thread which, in some nematocysts, is seen to be partially extruded. In the present histological condition of the soft parts it is difficult to determine if these nematocysts are arranged in specialised regions of the convolutions as in *F. fragum*, although in sections they do not appear to be so numerous as in the latter species. Nematocysts II occur in the convolutions as well as in the straight regions of the filaments, but appear mostly broken in the sections. Some parts of the convolutions are swollen, stained brown in Eosin, with nuclei lying somewhat wide apart along their middle, hence are probably glandular in nature. In the principal and the broader subsidiary mesenteries, the filament-epithelium usually extends down to the greater part of the distance below the stomodæal region, after which it disappears. The convolutions are not so scarce within the cœlenteric cavity as in *F. fragum*, perhaps because they are not protruded into the peristome to the same extent.

Gonads (Pl. II, figs. 1–3).—In nearly every polyp sectioned, male, female, and hermaphrodite mesenteries are present. In male mesenteries there are up to four or five small spermaries within spaces in the middle lamina. The minute, somewhat triangular heads of the spermatozoa are homogeneously stained dark in iron hæmatoxylin, but they are so massed in the spermaries that their tails cannot be detected in the sections. One to three groups (oval or circular in transverse section) of germ-cells are present in some of the mesenteries (about seven such mesenteries in polyp series 400 VII). Each germ-cell has a comparatively large nucleus consisting of a definite nuclear membrane enclosing somewhat granular contents, in which lie one or two nuclei stained dark in iron hæmatoxylin. When two nucleoli are present they appear to be connected by a fine curved strand, also stained dark. The cytoplasmic areas are not well defined in the existing state of fixation of the tissues. The mesenterial endoderm surrounding the groups of germ-cells is usually swollen and granular. Ova are small, about $\cdot 1$ mm. in diameter, lying within the middle lamina of mesenteries; occasionally three ova are seen in a mesentery at the same level pressed against one another. In mesenteries containing growing ova the endoderm surrounding them is swollen and granular, whilst in those containing ripe ova the endoderm returns to its original condition, being frequently thinned by the distension caused by the ova, as is better seen in the polyps of *F. fragum* that have been studied. Ova occur in some mesenteries containing spermatozoa, as well as in some others enclosing groups of germ-cells. Sexual products do not, as in the *Astræidæ* generally, appear in the mesenteries above the level of the enterostome, except in the case of some subsidiary mesenteries.

TABLE OF MESENTERIES OF POLYPS SECTIONED TRANSVERSELY.

m_1 = principal mesentery. m_2 = subsidiary mesentery. A, B, C, stomodæa of incipient buds.

Species.	Polyp series.	Locality.	Stomodæa.	No. of complete principal couples.	No. of incomplete principal couples.	Total No. of principal couples.	No. of subsidiary couples.	Total No. of couples.	Mesenteries of interstomodæal couples.	No. of principal mesenteries.	No. of subsidiary mesenteries.	Total No. of mesenteries.	Average No. of principal mesenteries.	Intratentacular diverticula.
<i>Favia conferta</i> , Verrill	400 III	Off South Trinidad, "Terra Nova" Stat. 37	I	3	4	7	3	10	$1m_1$ facing stom. II, $1m_1$ & $1m_2$ facing stom. A	12	11	23	10	One terminal diverticulum opposite stom. I, and two terminal diverticula separated by a principal couple of stom. II have just become buds.
			II	4	0	4	3	7	$1m_1$ facing stom. I	9	6	15		
			A	3	1	4	1	5	$2m_1$ facing stom. I	9	3	12		
			B	—	—	—	—	8	—	—	—	16		
			C	—	—	—	—	7	—	—	14	—		
<i>Favia conferta</i> , Verrill	400 IV	Off South Trinidad, "Terra Nova" Stat. 37	I	5	3	8	8	16		13	19	32	13	At one end are five contiguous subsidiary mesenteries, perhaps lying in an incipient diverticulum.
<i>Favia conferta</i> , Verrill	400 V	Off South Trinidad, "Terra Nova" Stat. 37	I	4	3	7	5	12	$1m_2$ facing stom. II	11	14	25	11	Opposite stom. II is the commencement of a terminal diverticulum containing three contiguous subsidiary couples of mesenteries.
			II	3	5	8	7	15	$1m_2$ facing stom. I	11	20	31		
<i>Favia conferta</i> , Verrill	400 VI	Off South Trinidad, "Terra Nova" Stat. 37	I	5	nil	5	13	18	$1m_2$ facing stom. II	10	27	37	9	Two terminal diverticula containing seven and five subsidiary couples separated by a principal couple of stom. I, and a terminal diverticulum containing four contiguous subsidiary couples opposite stom. III (text-fig. 1).
			II	2	3	5	4	9	$1m_2$ facing stom. I, $2m_1$ facing stom. III	9	12	21		
			III	2	3	5	7	12	$2m_1$ facing stom. II	9	17	26		
<i>Favia conferta</i> , Verrill	400 VII	Off South Trinidad, "Terra Nova" Stat. 37	I	3	3	6	4	10	$1m_2$ facing stom. II	9	12	21	11	Opposite stom. III are five contiguous subsidiary mesenteries, perhaps lying in an incipient terminal diverticulum.
			II	3	2	5	5	10	$1m_2$ facing stom. I, $1m_1$ & $1m_2$ facing stom. III	9	14	23		
			III	4	5	9	8	17	$1m_1$ & $1m_2$ facing stom. II	14	22	36		

The differences of specific value between *F. conferta* and *F. fragum* may be summarised as follows:—

<i>Favia conferta.</i>	<i>Favia fragum.</i>
<p><i>Polyps</i> :—</p> <ol style="list-style-type: none"> 1. A few intramural polystomodæal polyps present in colonies, containing four to six stomodæa. 2. Linear tristomodæal and polystomodæal polyps not infrequently curved in shape. 3. Both entocælic and exocælic tentacles uniformly short and without subterminal batteries. 4. Stomodæal ridges without nematocysts; middle lamina not thickened in ridges. 5. In stomodæal region, entocælic pleats extending over outer two-thirds of width of principal mesenteries, not so close together as in <i>F. fragum</i>, gradually increasing in width towards inner one-third of pleatal region. 6. Nematocysts III in convolutions of mesenterial filaments appearing to be less numerous than in <i>F. fragum</i>. 7. In the endoderm generally, numerous algæ are present. 	<ol style="list-style-type: none"> 1. Polystomodæal polyps almost absent. 2. Linear tristomodæal polyps, when present, rarely curved in shape. 3. Entocælic tentacles varying in length, the larger ones with six or seven subterminal batteries in a longitudinal section; exocælic tentacles uniformly short with three or four subterminal batteries. 4. Stomodæal ridges containing nematocysts III, up to ten, closely arranged in transverse section; middle lamina considerably thickened in ridges. 5. In stomodæal region, entocælic pleats not usually extending beyond outer half of width of principal mesenteries, arranged close together, gradually increasing in width from column-wall to middle of pleatal region. 6. Nematocysts III present in large numbers in convolutions of mesenteries. 7. In the endoderm, algæ are less numerous than in <i>F. conferta</i>.
<p><i>Corallum</i> :—</p> <ol style="list-style-type: none"> 1. A few short valleys present in Corallum. 2. A series of narrow septa regularly alternating with broad ones, hence as many as the latter. 3. Broad septa exsert to .5 mm. 4. Broad septa without definite paliform rods. 5. Broad septa not meeting columella, far fewer than those that meet, the former curving towards and fusing with the latter. 	<ol style="list-style-type: none"> 1. Valleys rare or absent. 2. Narrow septa not forming a regularly alternating series, hence fewer than broad ones. 3. Broad septa exsert to less than .5 mm. 4. Broad septa with rough upright paliform rods. 5. Broad septa not meeting columella, nearly as many as those that meet; the former curving towards and fusing with the latter or ending off with free margins.

NOTES ON POLYPS SECTIONED.

Favia conferta, Verrill.

Series of longitudinal sections :—

- (1) 400 I, a monostomodæal polyp.
- (2) 400 II, a distomodæal polyp, oral disc region between the two mouth-openings becoming constricted, being 4·5 mm. long and 2 mm. broad in alcohol.

Series of transverse sections :—

- (3) 400 III, a discontinuous polystomodæal polyp from edge of colony. Oral disc region between mouth-openings I and II becoming constricted, being 8 mm. long and 2·5–3 mm. broad in alcohol. Only one interstomodæal couple (completely principal)

present between stomodæa I and II at this late stage, hence it is unlikely that a second interstomodæal couple will be formed before division takes place where polyp is constricted. At one end (opposite stomodæum I) an intratentacular bud has arisen by the formation of a new stomodæum A to which nine mesenteries appear to have been joined. Stomodæa I and A appear to be connected by two interstomodæal couples (one completely principal and the other incompletely principal). At the other end (opposite stomodæum II, towards the edge of colony) a pair of intratentacular buds have arisen by the formation of two new stomodæa B and C. It is difficult to determine the number of mesenteries meeting stomodæa B and C, but obviously they will be related to stomodæum II on the triangular tristomodæal mode.

(4) 400 IV, a monostomodæal polyp.

(5) 400 V, a distomodæal polyp. Measurements in alcohol are : total length of oral disc, 6 mm. ; greatest width, 2 mm. ; oral disc region between the two mouth-openings, 2.25 mm. long and constricted to a width of 1 mm. Only one interstomodæal couple between stomodæa I and II (as between stomodæa I and II of 400 III), now subsidiary, which may or may not become principal before the polyp divides.

(6) 400 VI, a linear tristomodæal polyp having a curved shape. Distance between adjacent mouth-openings, 2.25 mm. Two interstomodæal couples (both completely principal) between stomodæa II and III, but only one such couple (subsidiary) between stomodæa II and I. As yet no indications of stomodæal formation in any of the three intratentacular diverticula (text-fig. 1).

(7) 400 VII, a linear tristomodæal polyp. A separate tentacular ring has been formed around stomodæum I, although the column-wall has not as yet begun to be divided. Only one interstomodæal couple (subsidiary) between stomodæa I and II, as between stomodæa I and II of 400 VI. The sagittal plane of stomodæum I (hence also of its oral disc region) lies more or less at right-angles to that of stomodæa II and III.—(Best specimen for histology.)

V.—NOTES ON OTHER ATLANTIC SPECIES OF *FAVIA*.

1. *FAVIA FRAGUM* (Esper).

(Text-fig. 2 ; Pl. I, figs. 28, 29 ; Pl. II, figs. 4, 5, 7, 8, 9 ; Pl. III, figs. 1, 3-7, 9 ; Pl. IV, figs. 5, 6, 9, 12.)

(For a discussion of the synonymy of this species, *vide* 7, pp. 34-40.)

The skeletal characters subject to variation in *F. fragum* are the growth-form of coralla, size of calices, thickness of corallite-walls, elevation of corallite-rims and consequent presence of intercorallite furrows, thickness of septa, dentition of inner margins of septa, shape of exsert ends of septa, and the degree of development of columellæ. These points are illustrated by three representative colonies E, F and G in table on p. 90, which are connected by numerous gradational forms in my collection

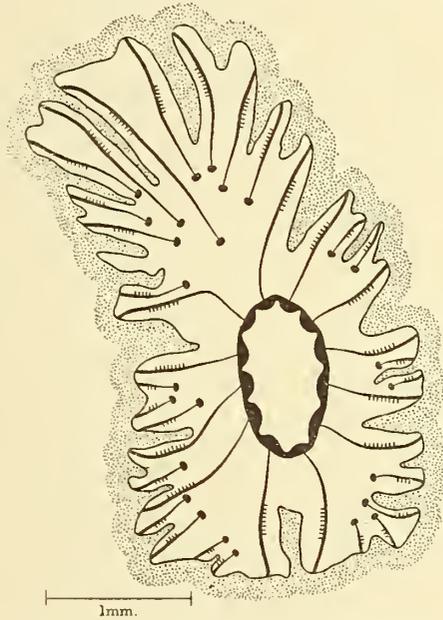
from Tortugas. Two to four colonies are sometimes united by their contiguous sides, thin epithelial rims being then visible over the line of union.

The largest example of *F. fragum* in the Cambridge University Museum is an entire more or less hemispherical colony from St. Vincent, 4·5 cm. high, 7 cm. long, and 5·5 cm. broad; corallites being present on its entire exposed surface. On one side of the specimen, corallite-walls are thin (1 mm. to 1·25 mm.) and ridged above, with septa meeting over the walls in gable-form (as in specimen E on p. 90). On the opposite side, corallite-walls are much thickened (up to 3 mm.), and more or less flat (as in specimen F on p. 90). Calices are shallower and paliform rods are well formed. There is a regularly alternating series of narrow septa in the corallites of this specimen, as in *F. conferta*.

Examples of *F. fragum* with thin ridged walls, pentagonal corallites and conspicuous paliform rods (as in No. E on p. 90) bear some resemblance to certain colonies of the Indo-Pacific *F. pentagona* (Esp.) (5, Pl. XXIV, fig. 3); but in the latter species, septa are farther apart, hence are fewer in corallites, calices deeper, septal sides much less rough, and the corallum appears to attain to a larger size.

Body-wall (Pl. II, fig. 9; Pl. III, figs. 4 and 6). Incompletely formed nematocysts II and short nematocysts I with about twenty turns of the spiral are occasionally present in the ectoderm. The nuclei of the endoderm, though generally scattered in its highly vacuolated protoplasm, tend to be gathered towards its free border. Algæ are neither abundant nor massed in the endoderm.

*Tentacles** (Pl. II, fig. 7) are usually found to decrease in length towards the ends of the longer diameter of the oral disc, being as short at the poles as the exocœlic tentacles. Nematocysts I of terminal batteries have about thirty-five turns of the spiral, among which are many nematocysts II *b*. Sub-terminal batteries are arranged more or less in rings around the tentacles, and are ·03 mm. to ·05 mm. in height; short nematocysts I, having about twenty-five turns of the spiral, are gathered in the middle of the outer half of each of these batteries, forming an outwardly diverging group, below which the ectoderm is granular and translucent, containing numerous elongated nuclei; on each side of the group of nematocysts the ectoderm is vacuolated,



TEXT-FIG. 2. — *Favia fragum* (Esp.). Transverse section through the stomodeal region of a monostomodeal polyp with a terminal intra-tentacular diverticulum, containing five subsidiary couples of mesenteries. The hard parts are represented by dots. (Constructed from Camera lucida tracings of transverse serial sections of 500, VI., South Bight, Andros Island, Bahamas.)

* In live colonies the tentacles appear to be transparent except the batteries which are white and opaque.

clear and with few nuclei. The endoderm is somewhat lobulated and thinner than the overlying ectoderm ($\cdot 02$ mm. to $\cdot 03$ mm. thick) in the sub-terminal region, in which algæ are not abundant. Both ectoderm and endoderm decrease in thickness towards the base of tentacles.

Owing to the better fixation of the polyps of this species, it was possible to make a more detailed study of the histology of the column-wall than could be done with *F. conferta*, but doubtless in this respect the latter species will be found to correspond with *F. fragum*. The column-wall is $\cdot 003$ mm. to $\cdot 005$ mm. thick in the upper half of polyp. The middle lamina is considerably attenuated, being absent in places where the calicoblastic ectoderm merges into the endoderm. The calicoblastic nuclei are wide apart and arranged tangentially in a row. Where the mesenteries join the column-wall, the calicoblastic layer frequently becomes vacuolated and swollen, and stages in the formation of the processes of attachment are commonly seen; here the calicoblast, in which nuclei lie scattered, is up to $\cdot 03$ mm. in thickness and the endoderm is about $\cdot 01$ mm. thick. The nuclei of the endoderm are round or oval and arranged horizontally. Algæ are almost absent everywhere from the column-wall endoderm.

Stomodæum (Pl. II, figs. 4 and 8; Pl. III, figs. 4 and 6). In some distomodæal polyps of colonies from Tortugas, new stomodæa are recognisable on a surface-view below the oral discs without corresponding mouth-openings. In such cases the new stomodæa are probably formed by the union of the margins of the broader mesenteries of diverticula and secondarily acquire external openings. In a distomodæal polyp, $3\cdot 25$ mm. in height (as seen in longitudinal section), the stomodæa which are 2 mm. apart are $\cdot 3$ mm. and $\cdot 25$ mm. long, becoming wider from mouth-opening to enterostome; in alcoholic specimens mouth-openings of distomodæal polyps are $2\cdot 5$ mm. to $3\cdot 5$ mm. apart. Nematocysts III in ridges are about $\cdot 033$ mm. long and $\cdot 01$ mm. broad, extending from below the striated border of the ridge to the greater part of its width. Nematocysts II are occasionally present in the ridges. Nuclei of the endoderm are gathered to form a peripheral layer.

Mesenteries (Pl. II, figs. 5, 8 and 9; Pl. III, fig. 5). The endoderm is of more or less even thickness over the greater part of the width of mesenteries, getting much attenuated for a short distance from column-wall, where the middle lamina is quite thin.

The endodermal pad behind the filament is well developed, being as large as, in transverse section, or larger than the filament itself. In the straight region of filaments nematocysts II ($\cdot 04$ mm. long) are present, whose axes extend beyond the middle of sacs, but not to two-thirds their length. Nematocysts III also occur, similar to those in the stomodæal ridges, but are fewer in number. In certain regions of the convolutions the filament-epithelium is vacuolated, swollen, somewhat transparent, and with comparatively few nuclei—resembling, in histological condition, the endoderm behind. In such parts of the filament-epithelium long narrow nematocysts III (similar to those described in *F. conferta*) are closely arranged, their threads having remained

coiled within the sacs; among these, nematocysts II are sometimes included. In some parts of the convolutions the swollen filament appears to consist of a row of narrow columnar bodies, radiating from its base to periphery, stained brown in Eosin and containing small globules. A somewhat similar condition has been noticed in *F. conferta*, being probably glandular in both cases. Sometimes dumb-bell shaped transverse sections are seen with this glandular epithelium at one end, and the swollen filament containing closely arranged nematocysts III at the other end (Pl. II, fig. 5). In mesenterial coils with normal filament (as in the straight region) nematocysts II are seen, nematocysts III, when present, resembling those in stomodæal ridges. In most of the polyps examined, convolutions of mesenteries are protruded through edge-zone, oral-disc, and mouth-opening, and lie in knots on the surface. Perhaps as a result of this, convolutions are scarce within the polyps, and are almost absent towards their base (Pl. III, figs. 4 and 6), the intermesenteric spaces appearing more or less empty in transverse section. In longitudinal sections the three layers are seen to end off at the openings through which convolutions are protruded, the ectoderm and endoderm narrowing towards them; if they were permanent pores (and not due to rupture), the ectoderm would be continuous through the openings with the endoderm (Pl. II, fig. 9).

Ova are present below the stomodæal region in up to ten mesenteries in a polyp, a single ovum occupying nearly the entire width of a mesentery, whose endoderm is then quite thin; rarely two ova occur in a mesentery at the same level. Spermaries were not found in any of the mesenteries, although Duerden records the presence of hermaphrodite mesenteries in this species (1, p. 572).

The histology of the middle lamina of Astræid Corals is clearly exemplified in the polyps of *F. fragum* that have been sectioned. The wavy unbranched fibres forming the mass of the middle lamina are evident in tangential sections (also in *F. conferta*). The plexus of branching fibres is well seen in the thickened regions at the stomodæal ridges, in which numerous nuclei lie scattered; each of these nuclei usually has a thin investment of granular cytoplasm, which is drawn out into filamentous processes, finally merging in the substance of the middle lamina (Pl. II, fig. 4). The plexus and nuclei are also apparent in sections through tentacles.

Solid embryos or planulæ have been found to lie free in the cœlenteric cavities of the sectioned polyps of *F. fragum* from Bahamas (Pl. III, figs. 4, 7 and 9). About eight or ten such embryos have been counted in polyp series 500_f III as well as in 500_f IV. In longitudinal section each of them is dome-shaped, perhaps owing to contraction (cf. 2, Pl. I, fig. 6). The middle lamina has appeared as a thin continuous fibrous membrane. An outer ectoderm is thus marked out which is of even thickness along the flat or somewhat concave aboral surface, but increases in thickness towards the oral end, and is provided with long cilia over its entire surface. The inner mass lies subjacent to the middle lamina, and consists of an endodermal stratum (thinner than the ectoderm) surrounding a central reticulum. Both the ectoderm and the endoderm are

stained pink in Eosin, nucleated and containing numerous particles of yolk obscuring the cytoplasm and nuclei. In contrast to these, the central reticulum appears more or less clear and sparsely nucleated, and is evidently breaking down to form a cœlenteric cavity. Algæ occur everywhere in the embryo, mainly in the endodermal stratum, whilst those in the ectoderm will presumably either disintegrate or migrate into the endoderm, since both in the free-swimming larva and in the polyp, algæ are entirely restricted to the endoderm lining the cœlenteric spaces. At the narrow end of the embryo is a blind invagination into the central reticulum, being the commencement of the stomodæum. Nowhere in the protoplasm of the embryo is there the slightest indication of cell-structure. Nematocysts have not arisen at this stage.

Some of the embryos in the polyps mark a stage before the commencement of invagination, but in every embryo examined the middle lamina has appeared as described above, and seems to increase in thickness at the expense of the adjacent protoplasm. In *Manicina areolata*, according to H. V. Wilson, the endodermal mass is formed by delamination from a hollow blastula (10, pp. 195-199)—a stage that has not been found in any of the sectioned polyps of *F. fragum*—whilst the correspondence between the central reticulum of the embryo and the vacuolated condition of the ripe ovum suggests that the former might be the result of the withdrawal of the egg-protoplasm towards the periphery, in which also come to lie the products of the repeated division of the egg-nucleus without corresponding division of the cytoplasm. By the complete vacuolisation of the central reticulum a cœlenteric cavity would result (Pl. III, figs. 1 and 3).

NOTES ON POLYPS SECTIONED.

Series of longitudinal sections :—

(1) 500_f V, a distomodæal polyp.

Series of transverse sections :—

(2) 500_f I, a piece from the edge of colony, containing a distomodæal polyp and two extratentacular buds, the latter being situated towards edge of colony. In the distomodæal polyp a thin ridge has appeared across the oral disc, between the two mouth-openings; the tentacles on each side of this ridge are getting directed towards the adjacent mouth-opening preparatory to the formation of two distinct tentacular rings. As many principal couples of mesenteries are present around stomodæum A as around I. Column-walls of extratentacular buds separate from each other and from that of distomodæal polyp. In each extratentacular bud, nearly as many principal mesenteries have appeared as around each stomodæum of distomodæal polyp.

(3) 500_f II, a triangular tristomodæal polyp from the edge of colony, the pair of buds being at the edge. Buds subequal in size; each of them though smaller than the mother-polyp has as many principal couples as the latter. Entocœlic tentacles appear (in alcohol) to decrease in length towards the two arms of the oral disc, being as short at the ends of the arms as exocœlic tentacles.

TABLE OF MESENTERIES SECTIONED TRANSVERSELY.

m_1 = principal mesentery. m_2 = subsidiary mesentery. A, B, stomodæa of incipient buds.

Species.	Polyp series.	Locality.	Stomodæa.	No. of complete principal couples.	No. of incomplete principal couples.	Total No. of principal couples.	No. of subsidiary couples.	Total No. of couples.	Mesenteries of interstomodæal couples.	No. of principal mesenteries.	No. of subsidiary mesenteries.	Total No. of mesenteries.	Average No. of principal mesenteries.	Intratentacular diverticula.
<i>Favia fragum</i> , Esper	500 _I	Andros Island, Bahamas, Brit. Mus. (Nat. Hist.)	I	3	3	6	9	15	1 m_1 & 1 m_2 facing stom. A	10	22	32	} 10	On one side of stom. I are three adjacent subsidiary couples, and on another side five contiguous subsidiary mesenteries which may mark the beginnings of two diverticula.
			A	3	3	6	5	11	1 m_1 & 1 m_2 facing stom. I.	10	14	24		
			III	4	2	6	4	10		10	10	20		
			IV	3	3	6	4	10		9	11	20		
<i>Favia fragum</i> , Esper	500 _{II}	Andros Island, Bahamas, Brit. Mus. (Nat. Hist.)	I	2	3	5	5	10	2 m_1 facing stom. A; 1 m_1 & 1 m_2 facing stom. B	10	14	24	} 10	Nil.
			A	3	3	6	2	8	1 m_1 & 1 m_2 facing stom. I	10	8	18		
			B	3	2	5	3	8	1 m_1 & 1 m_2 facing stom. I	9	9	18		
<i>Favia fragum</i> , Esper	500 _{III}	Andros Island, Bahamas, Brit. Mus. (Nat. Hist.)	I	4	3	7	10	17	1 m_1 & 1 m_2 facing stom. II	12	24	36	} 12	Three contiguous subsidiary couples of mesenteries on one side of stom. I, perhaps forming the commencement of a terminal diverticulum.
			II	5	2	7	6	13	1 m_1 & 1 m_2 facing stom. I	13	15	28		
<i>Favia fragum</i> , Esper	500 _{IV}	Andros Island, Bahamas, Brit. Mus. (Nat. Hist.)	I	3	1	4	6	10	2 m_1 facing stom. II	9	13	22	} 8	Opposite stom. I is an incipient terminal diverticulum containing three contiguous subsidiary couples of mesenteries.
			II	2	1	3	5	8	2 m_1 facing stom. I.	7	11	18		
<i>Favia fragum</i> , Esper	500 _{VI}	Andros Island, Bahamas, Brit. Mus. (Nat. Hist.)	I	4	2	6	9	15	1 m_1 & 1 m_2 facing stom. II	11	21	32	} 9	At one end of stom. III is a terminal diverticulum containing five contiguous subsidiary couples of mesenteries (text-fig. 2). On one side of stom. II are three contiguous subsidiary couples, perhaps forming the commencement of a terminal diverticulum.
			II	3	nil	3	6	9	1 m_1 & 1 m_2 facing stom. I	7	13	20		
			III	5	2	7	12	19		12	26	38		
<i>Favia fragum</i> , Esper	500 _{VII}	Andros Island, Bahamas, Brit. Mus. (Nat. Hist.)	I	3	4	7	8	15		10	20	30	10	At one end of polyp is an incipient diverticulum containing three contiguous subsidiary couples of mesenteries.

(4) 500_f III, a distomodæal polyp from the edge of colony. The sagittal plane of stomodæum II (also of its oral disc region) at right angles to that of stomodæum I as noted in 400 VII. Two interstomodæal couples (one completely principal and the other subsidiary) between the two stomodæa.

(5) 500_f IV, a distomodæal polyp. The incipient intratentacular diverticulum with an oblique direction of growth, which is indicated on surface by a similarly directed oral disc region. The latter with a bluntly pointed extremity towards which entocœlic tentacles decrease in length. Each of the tentacles over the interstomodæal couples being directed towards one of the mouth-openings. Two interstomodæal couples (both completely principal) connecting the two stomodæa. (Best specimen for histology.)

(6) 500_f VI, a piece containing a distomodæal and a monostomodæal polyp from the edge of colony. In the distomodæal polyp the sagittal plane of stomodæum II is nearly parallel with the transverse plane of stomodæum I; oral disc narrowing to a bluntly pointed end beyond mouth-opening II. Two interstomodæal couples (one completely principal and the other subsidiary) between stomodæa I and II. There is no sign as yet of the formation of a new stomodæum in the terminal intratentacular diverticulum next to stomodæum III.

(7) 500_f VII, a monostomodæal polyp.

Localities.—Azores (Quelch); Bermudas (Verrill); West Indian and Caribbean region, abundant on the Florida Reefs (Vaughan). Fossil in Curaçao; Arube; also in the elevated reefs of other West Indian Islands (Vaughan).

2. *FAVIA GRAVIDA*, Verrill.

Verrill (8, p. 354, 9, pp. 91, 188, Pl. XIII, fig. 3), differs from *F. conferta* in having fewer valleys, somewhat wider (3 to 3.5 mm.) and deeper (3 mm.) calices. The corallite-rims are elevated up to 3 mm. and the vesicular perithecal matter is increased up to a thickness of 3 or 4 mm., hence the intercorallite grooves are more conspicuous and neighbouring thecæ are not fused. The septa are somewhat thicker, with a greater number of teeth on their inner margins, rougher sides and are exert to .75 or 1 mm. The costæ are alternately broad and narrow (corresponding to the two series of septa within) with transversely extending granulations and meeting in intercorallite-furrows where the latter are not too wide. The columellæ are formed of closer texture. But these differences appear to be varietal and if, as is probable, future examination of the soft parts of *F. gravida* should reveal no greater differences, the two species would have to be combined under the earlier name *F. gravida*, as Vaughan (7, p. 40) suggested from a study of the hard parts of these species.

When corallite-rims are conspicuously elevated and are wide apart, the corallum of *F. gravida* appears to assume the facies of *Dichocænia*. The elevated corallite-rims bounding deep intercorallite-grooves, the two alternating series of broad and narrow

septa, and the two such series of costæ (with transversely extending granulations) meeting in the grooves, recall the Indo-Pacific species *F. wakayana* (Gard.) and *F. solidior* (Ed. and H.) (5, pp. 105 and 106).

Localities.—Abrolhos Reefs; Pernambuco and Bahia; Cape Frio to Pernambuco, common in tide-pools (Verrill).

It would appear from the above list of localities that *F. conferta* and *F. gravida*, and *F. fragum*, have a mutually exclusive distribution, i.e., the first two have been recorded only from the east coast of Brazil between Pernambuco and Cape Frio, whilst *F. fragum* has not been known south of the Caribbean Sea; St. Vincent being, up till the present, the southernmost limit of its recent members.

It is necessary to add that there is considerable difficulty in determining whether the *Favia fragum* of Vaughan and Verrill or the *Favia gravida* of Verrill corresponds to Esper's *Madrepora fragum*. For example, the statements in Esper's diagnosis that "die Sterne sind sehr erhöht" and "die Lamellen wechseln mit grössern und kleinern ab" (3, p. 79) would seem to be more applicable to *F. gravida*,* as also the appearance in his figures (Pl. LXIV, figs. 1 and 2) of conspicuous furrows between the raised corallite-rims. Since Esper remarks, in regard to his specimens, that "Ihr Aufenthalt ist in den südlichen Americanischen Meeren" (p. 80), whilst *F. fragum*, as defined by Vaughan and Verrill, has not yet been recorded south of the Caribbean Sea, in contrast to *F. conferta* and *F. gravida*, neither of which has been found north of Pernambuco on the Brazilian Coast, it still remains an open question whether Esper was not dealing with one of the two species subsequently constituted by Verrill. Till this point has been settled by actual reference to Esper's types, any discussion of the synonymy of these species cannot have more than provisional value.

The three Atlantic species, *F. conferta*, *F. gravida* and *F. fragum*, form a homogeneous sub-section within the genus *Favia*. The characters common to them may be stated as follows:—

Corallum.

1. Maximum growth-size comparatively small.†
2. Corallites never far apart, hence perithecal matter never abundant.
3. Calices of mono- and di-stomodæal polyps not more than 4·5 mm. wide and 3 mm. deep.
4. Both broad and narrow septa present.
5. Broad septa ·75 to 1 mm. apart, many of them meeting columella.
6. Columella spongiform, not more than one-third the width of calices.

* In one half of a small colony of *F. fragum* 2·5 cm. high, 3·5 cm. long, and 2·5 cm. broad, from Tortugas, the corallite-rims are raised to 1·5 or 2 mm., and costæ are present as in *F. gravida*, but the specimen is apparently an instance of abnormal skeletal variation.

† Colonies presumably die when the maximum growth-size has been reached, which in *F. fragum* appears to be somewhat less than in *F. conferta*. According to Verrill, colonies of *F. conferta* are two or four inches in diameter (8, p. 355). In all three species a strongly wrinkled epitheca is present on the free part of the under surface of colonies.

Polyps (as seen in *F. conferta* and *F. fragum*).

1. Polyps small, mostly mono-, di- and tri-stomodæal; polystomodæal polyps when present, few, short and temporary.

2. Although polyps are small, stomodæa have well-developed ridges which, in transverse section, are twice as thick as broad.

3. Average number of principal mesenteries around a stomodæum, nine to eleven.

4. Entocœlic pleats of principal mesenteries as seen in transverse sections extending to the middle or outer two-thirds of their width; gradually increasing in breadth towards the middle or inner one-third of the pleatal region where they are broad, somewhat constricted at their bases and knobbed at the tips, often subdivided and slender in transverse section, then becoming narrower over the rest of the pleatal region.

5. Convolutions of mesenteries never abundant.

6. Nematocysts III in coiled regions of mesenterial filaments long and narrow, each with 15–20 turns of the thread.

The soft parts of *F. fragum*, and to a less degree of *F. conferta*, bear some resemblance, in the following respects, to the Indo-Pacific species *F. pentagona* (Esper) (5, pp. 96 and 97). The polyps, though small, possess well-developed stomodæal ridges. The appearance of principal mesenteries in transverse section is somewhat similar—entocœlic pleats not extending beyond the outer two-thirds of the width of mesenteries, being broad, thin and sometimes subdivided in the middle of the pleatal region, elsewhere narrow. The comparative thinness of the endoderm and the fewness of algæ. Convolutions of mesenteries never abundant in the cœlenteric spaces, being almost absent towards the base of polyps. *F. fragum* agrees with the Indo-Pacific *Goniastrea retiformis* (*Id.*, p. 119) in the thinness of the endoderm, scarcity of mesenterial convolutions, number of principal mesenteries around a stomodæum, and in the presence of long narrow nematocysts III occurring in the coiled regions of mesenterial filaments.

In my study of Astræid corals different sexual conditions have been found, viz., (1) the presence of either ovaries or spermaries in any polyp of the same colony, as in *Cyphastrea serailia* (5, pp. 31 and 40); (2) the presence of both ova and spermatozoa in the same polyp within separate male and female mesenteries or within hermaphrodite mesenteries, all three kinds of mesenteries occurring in the same polyp, as in *Favia conferta*; (3) the presence of ova only in all polyps of the same colony,* as in *Favia favus*, *F. hululensis* (5, pp. 82, 88), etc.; (4) the absence of reproductive elements from all polyps of the same colony as noticed in many species of *Favia*, *Echinopora*, etc. From these records it would appear that in an Astræid colony there is no differentiation into sexual and asexual polyps, every polyp being capable of performing both the nutritive and generative functions. Nor is it unusual to find, in the same species, colonies of different sizes containing gonads, which may mean that in the same colony the sexual and nonsexual phases alternate more than once, or as Gardiner suggested that "in an

* I have not up till now found a colony in which only male elements are present in its polyps, although such a condition is not improbable.

area—owing probably to some change in the physical conditions of their environment—all the corals of some single species have been stimulated to ripen and dehisce their generative products at the same time, the act leading ultimately to their weakening and death" (4, p. 471). All available evidence seems further to indicate that in any one Astræid species there is a maximum size beyond which colonies do not grow, as is exemplified in *F. conferta*, and *F. fragum*, and as observed by Gardiner in *Flabellum* and other Madreporarian corals, but we have no direct evidence of the factors which determine the limit of growth of colonies.

LIST OF VERRILL'S SPECIMENS OF *F. CONFERTA*, *F. GRAVIDA* AND *F. FRAGUM* IN YALE UNIVERSITY MUSEUM.

Species.	Catalogue Number.	Locality.	Height in cm.	Length in cm.	Breadth in cm.	Remarks.
<i>Favia conferta</i> , Verrill	1466	Abrolhos Reefs, Brazil	2·5	6·5	4·5	Typical. Longest valley, 17 mm. in length. Edge-region of this specimen figured by Verrill (9, Pl. XIII, fig. 6).
<i>Favia conferta</i> , Verrill	1466	Abrolhos Reefs, Brazil	4·5	6·0	4·0	Corallum entire. Corallite-walls somewhat thicker than in the above specimen.
<i>Favia conferta</i> , Verrill	1466	Abrolhos Reefs, Brazil	—	6·0	3·5	Corallum incrusting.
<i>Favia conferta</i> , Verrill	4520	Mar Grande, Bahia, Brazil	3·0	10·5	7·0	
<i>Favia conferta</i> , Verrill	4546	Pernambuco, Brazil	3·5	5·0	4·0	
<i>Favia gravida</i> , Verrill	1465	Abrolhos Reefs, Brazil	—	5·0	4·75	Corallum entire, incrusting; one, sigmoid valley, in which beginnings of two transverse partitions are present. Edge-region of this specimen figured by Verrill (9, Pl. XIII, fig. 3).
<i>Favia gravida</i> , Verrill	4549	Pernambuco, Brazil	3·0	4·0	3·5	No valleys, but three or four corallites which appear to have contained tristomodæal polyps.
<i>Favia fragum</i> , (Esper)	6747	Bermudas .	2·0	4·5	4·0	Corallum entire. Corallite-walls thick, with shallow median furrows (9, Pl. XIII, fig. 2).
<i>Favia fragum</i> , (Esper)	6748	Bermudas .	—	4·75	4·5	Corallum entire and incrusting. Corallite-walls thin (9, Pl. XIII, fig. 1).

* TABLE SHOWING SKELETAL VARIATION IN *F. CONFERTA*, *F. GRAVIDA*, AND *F. FRAGUM*.

SPECIMENS.					VALLEYS.		CORALLITES OF MONO- AND DI-STOMODÆAL POLYPS.	
Species.	Number.	Locality.	Shape.	Measurements in cm.	Shape.	Measurements in mm.	Shape.	Average measurements in mm. of calices.
<i>Favia conferta</i> , Verrill. (Pl. IV, figs. 1, 7 and 10.)	A	Off South Trinidad. "Terra Nova" Stat. 37.	Corallum broken on one side along entire height, narrowing from top to bottom. Calicinal surface convex, restricted to head of specimen, with a narrow shallow depression along its middle.	h, 7.5 l, 5 greatest b, 4	Irregularly linear or curved.	Greatest l, 15 av. w., 2.5 to 3 av. d, 2.5	Oval or laterally compressed.	av. l, 4 to 6 av. w, 2.5 to 3 av. d, 2.5
<i>Favia conferta</i> , Verrill. (Pl. IV, figs. 3 and 4.)	B	Off South Trinidad. "Terra Nova" Stat. 37.	Corallum broken on every side, broader at bottom than at top, to which calicinal surface is restricted.	h, 7 l, 7 greatest b, 7	Two more or less linear valleys, the shorter bifurcated at one end.	l, 15 and 13.5 av. w, 2.5 av. d, 2.5	As in A.	As in A.
<i>Favia conferta</i> , Verrill.	C	Brazil. Exchange specimen from U.S. Nat. Museum, Washington.	Corallum entire, but greater part dead.	h, 4.5 l, 7.3 b, 3.7	Linear.	Greatest l, 20 av. w, 2 to 2.5 av. d, 2.5	As in A.	As in A.
<i>Favia gravida</i> , Verrill. (Pl. IV, figs. 2, 8 and 11.)	D	As in C.	Corallum entire, more or less hemispherical, calicinal surface partly destroyed in patches and with four or five bore-holes. Somewhat concave attached surface.	h, 4.5 l, 7 b, 6	As in A.	Greatest l, 14 av. w, 3 to 3.5 av. d, 3	As in A.	av. l, 4 to 6 av. w, 3 to 3.5 av. d, 3
<i>Favia fragum</i> (Esper). (Pl. IV, fig. 5.)	E	Tortugas.	Corallum entire, narrowing towards one end, slight depression across middle of calicinal surface, flat attached surface.	h, 3 l, 7 greatest b, 6	No valleys.		Often pentagonal.	av. l, 4 to 6 av. w, 3.5 to 4.5 av. d, 1.5
<i>Favia fragum</i> (Esper). (Pl. IV, fig. 6.)	F	As in E.	Corallum entire, incrusting, convex calicinal surface with a bore-hole. United with one side is a much smaller corallum, with thin epithecal rim visible over line of union.	l, 5 b, 3	One linear valley.	l, 12 w, 2.5 d, 2.5	Oval or laterally compressed.	av. l, 4 to 6 av. w, 2.5 av. d, 2.5
<i>Favia fragum</i> (Esper).	G	As in E.	Corallum entire, exposed surface evenly convex and covered with corallites.	h, 2.5 l, 5.5 b, 4.5	No valleys.		Often pentagonal.	av. l, 4 to 6 av. w, 3 to 3.5 av. d, 2.5 to 3

h = height; l = length; b = breadth; w = width; d = depth; av. l = average length;
av. w = average width; av. d = average depth.

* The specimens referred to in this table (pp. 90, 91) are in the collection of the British Museum (Natural History).

TABLE SHOWING SKELETAL VARIATION IN *F. CONFERTA*, *F. GRAVIDA*, AND *F. FRAGUM*.

CORALLITES OF MONO- AND DI-STOMODAEAL POLYPS.	SEPTA.			COLUMELLA.	REMARKS.
Walls.	Shape and Size.	Inner margins.	Exsert Ends.		
Average thickness, 1.25 mm. Greatest thickness, 2 mm. Solid, owing to fusion of neighbouring thecae. Median grooves when present shallow.	Two alternating series of broad and narrow septa; most of the former meeting columella, the rest curving towards and fusing with principal septa. Inner margins of both series vertical.	With coarse irregular teeth increasing in length towards level of columella, lower teeth obliquely raised. Narrow septa also with irregular marginal teeth.	.5 mm. Arched, dentate, meeting in notches over middle of collines.	Of spongy texture, about a third of width of corallites. Columellar centres not often distinguishable in valleys.	A species of Colonial Ascidian incrusting on parts of the dead surface of corallum.
In one half of specimen as in A; the other half having <i>gravidafacies</i> —i.e., corallite-rims raised up to 1 mm., and up to 2.5 mm. apart, with conspicuous grooves between them.	As in A.	As in A.	As in A.	Feeble, composed of a few loosely interlocking trabeculae, almost absent in a few corallites.	Distinct corallite-rims with conspicuous grooves between them are characteristic of this specimen. Incrusting on one side is a thin piece of a <i>Porites</i> , also a species of Colonial Ascidian and a few small Actinians. Largest specimens of <i>F. conferta</i> in "Terra Nova" collection.
Thickness as in A. Corallite-rims more distinct than in A, hence grooves better marked, but not so deep as in <i>F. gravida</i> .	Somewhat thicker than in A.	Larger number of teeth than in A.	.75 mm. Arched, dentate.	Well formed, of closely twisted trabeculae.	Three valleys stretch across existing calicinal surface, but transverse partitions being formed in them. This specimen approaches D in the presence of corallite-rims and grooves between them and in septal characters.
Owing to increase of perithecal matter, av. thickness 1.5 mm. to 2 mm. Greatest thickness 4 mm. Corallite-rims raised to 3 mm., with correspondingly deep grooves between them.	Somewhat thicker than in A.	Larger number of teeth than in A, owing to greater depth of calices; lower ones tending to be raised obliquely upwards, but not forming a palicrown.	.75 mm. to 1 mm. Arched, dentate.	Of closer texture than in A, but not to the same extent as in C.	Corallum lighter than in A owing to increase of vesicular perithecal matter. Corallites coarser owing to septa being somewhat thicker, with rougher sides, and to more marginal teeth. One region having <i>confertafacies</i> , since corallite-rims are slightly raised, walls 1 mm. thick, inter-corallite grooves narrow and shallow.
Av. thickness, 1 mm. Mostly thin and ridged above.	Broad septa sloping from walls for some distance into calices, then falling vertically to columellae.	Somewhat more irregular than in A. Rough upright paliform rods on broad septa.	Not quite so exsert as in A. Meeting over walls in gable-form.	Spongiform, one third width of calices, or somewhat less.	Walls thin and ridged, septa slightly exsert and meeting over walls in gable-form, and prominent paliform rods are characteristic of this specimen. Thin variety.
Av. thickness, 1.5 to 2 mm. Greatest thickness, 3 mm. Upper surface more or less flat, with a median row of low tubercles.	Somewhat thicker than in E. Broad septa falling vertically to columellae.	Less irregular than in E, with 2-4 short spiniform teeth. Paliform rods less conspicuous than in E.	More or less flat, with transversely extending granulations.	Less developed than in E, loosely spongy, but composed of thicker trabeculae.	Walls considerably thickened and flat above, exsert ends of septa more or less flat, calices deep but narrow, columellae of open texture, septal margins more or less definitely dentate are characteristic of this specimen. Thick variety.
Av. thickness, 1.25 or 1.5 mm. Shallow median grooves, except in certain parts.	Broad septa falling vertically to columellae.	In some corallites short spiniform teeth as in F, in others longer and irregular. Paliform rods better formed than in F, but less than in E.	Arched. Some of the broad septa more exsert than others, up to .5 mm.	Better developed than in F, but somewhat less than one-third width of calices.	Intermediate between E and F in most characters.

3. *FAVIA LEPTOPHYLLA*, Verrill.

Verrill (8, p. 353, 9, p. 91, Pl. XIII, figs. 4 and 5). The type from Abrolhos Reefs, Brazil (Cat. No. 1517), in Yale University Museum, measures 6.5 cm. in height and 11 cm. in diameter. A piece (3.5 cm. broad) has been cut off from this specimen and mounted on a separate stand for the vertical view. In general appearance Verrill's type somewhat resembles dried colonies of the Indo-Pacific *Favia hululensis*, Gard., although it forms an entirely separate species (5, p. 87, and cf. Pl. XXII, fig. 6 and Pl. XXXV, fig. 1, with Verrill's figure). The principal characters of this specimen are as follows: calicinal surface convex, peritheca vesicular, hence corallum light, corallites narrower than in *F. hululensis*, corallite-rims distinct, the thin thecæ being elevated to a short height, septa thin, few and with highly exsert arched or truncated ends, costæ often meeting over the perithecal regions except when the latter are wide; an alternating series of very narrow septa present which have no costæ or only feebly marked costæ, columella loosely spongy. The vertical section of this specimen resembles that of the Indo-Pacific *F. clouei*, Val. (5, Pl. XXXIV, fig. 1), since the peritheca is highly vesicular in both species, and consequently the corallum is light.

4. *ORBICELLA APERTA*, Verrill.

Verrill (8, p. 356, 9, p. 103, Pl. XXXIII, figs. 1 and 1_a). The specimen in Yale University Museum on which this species is based is a large corallum from Abrolhos Reefs, Brazil, 15.5 cm. high, 20.5 cm. long, and 10.5 cm. broad (Cat. No. 1518), which appears to be only a skeletal variety of *F. leptophylla*, the main difference being that in *O. aperta* there is much more perithecal matter, hence the calices are wider apart. Such variation is found to occur in many species of *Favia*, e.g., *F. doreyensis*, Ed. and H. (9, pp. 84-87). On a humpy region at one end of the specimen the condition, owing to the narrower perithecal regions, is similar to that of Verrill's type of *F. leptophylla*. Towards the opposite end the perithecal regions are much wider, hence calices are far apart, and the costæ of neighbouring corallites become continuous over the perithecal areas as in some examples of *F. doreyensis*. The vertical section of *O. aperta* is identical with that of *F. leptophylla*.

5. *FAVIA WHITFIELDI*, Verrill.

Verrill (9, p. 132, Pl. XXV, fig. 5). The two specimens from Nassau, New Providence, now in the American Museum of Natural History (Cat. No. 543), which have been referred to this new species, have convex calicinal surfaces, the smaller one being Verrill's figured type. These coralla, while quite different from those of any other Atlantic species of *Favia*, so greatly resemble some examples of the

Indo-Pacific *Favia favaus*, Forsk. (5, Pl. XXI, fig. 1), that they would be brought under the latter species if the Atlantic corals were not, as a rule, specifically different from those of the Indo-Pacific region. In Verrill's types of *F. whitfieldi* the corallites are circular in outline when small, but become laterally compressed or somewhat triangular with growth; there is no definite pali-crown, the lower broader one-third of principal septa simulating such an appearance as in *F. favaus*, but unlike the latter species some of the principal septa are thicker and more exsert than others. In the figured specimen the corallite-rims are more sharply marked and elevated than in the other. In the same Museum there is a third specimen (from "West Indies or Central America") identical with the larger of Verrill's types of *F. whitfieldi*, and bearing the same number and specific name.

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Coelenterata, Part II.—Madreporaria, Pl. I.

PLATE I.

Views of polyps from decalcified colonies.

a. Oral view of polyp; b. basal view of same. $\times 3$.

FIGS. 1-27.—*Favia conferta*, Ver. Off South Trinidad. ("Terra Nova," Stat. 37.)

FIG. 1.—Monostomodæal polyp.

FIGS. 2-7.—Monostomodæal polyps showing stages of development of intratentacular diverticula. Fig. 7 showing curved oral disc.

FIGS. 8-13.—Distomodæal polyps, each with a single drawn out tentacular ring. In each polyp the mouth-openings lie towards the ends of the sagittal plane of the common oral disc.

FIG. 14.—Distomodæal polyp in which a distinct tentacular ring has been formed around each mouth-opening, but column-wall still undivided.

FIG. 15.—Distomodæal polyp with an intratentacular diverticulum at each end.

FIGS. 16 and 17.—Triangular tristomodæal polyps.

FIG. 18.—Distomodæal polyp in which the common tentacular ring is becoming constricted in the middle.

FIG. 19.—A short discontinuous polystomodæal polyp showing dichotomous branching at one end.

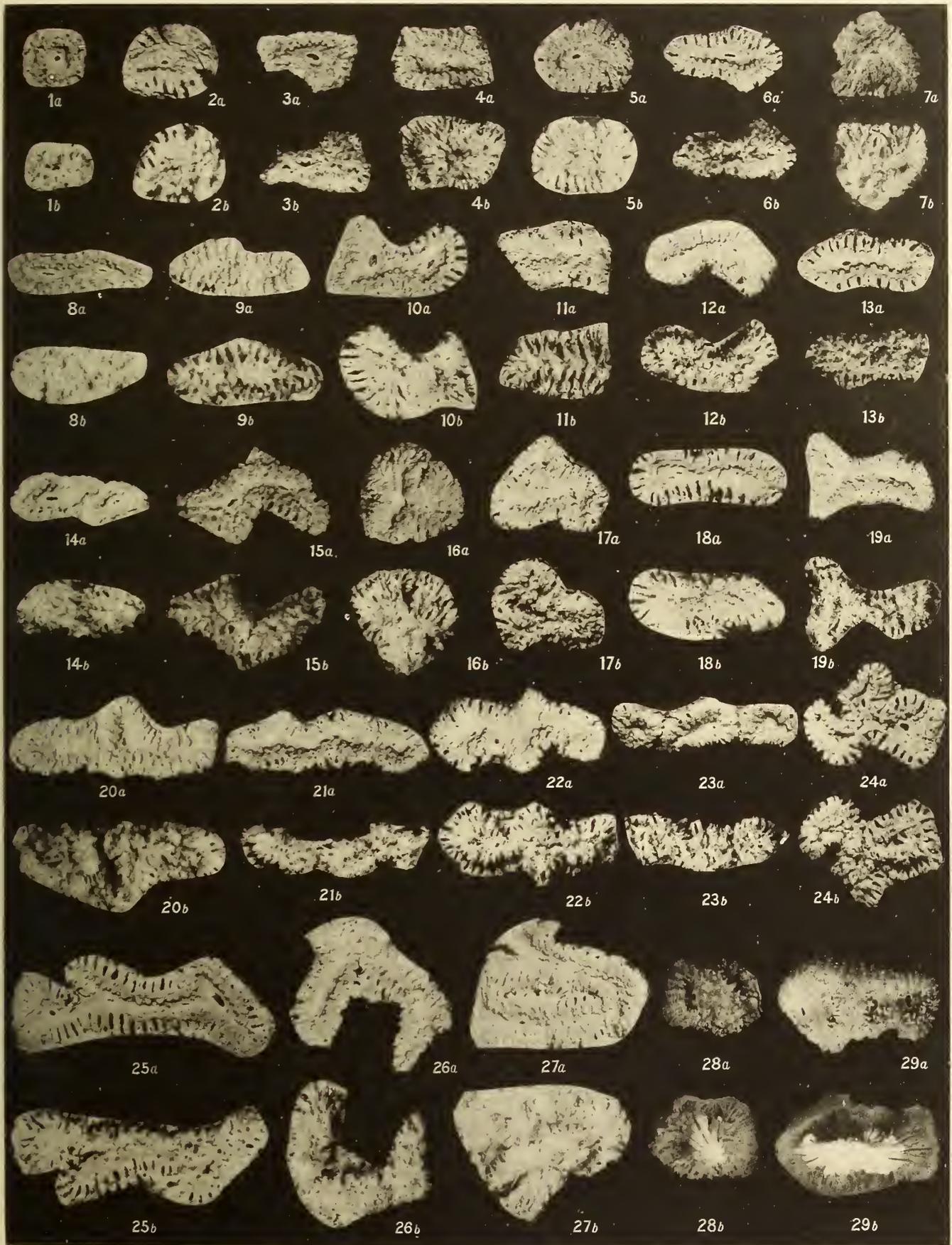
FIGS. 20-22.—Short discontinuous linear polystomodæal polyps.

FIG. 23.—Three monostomodæal polyps formed by the separation of mother-polyp and intratentacular buds of a linear tristomodæal polyp.

FIGS. 24 and 25.—Short discontinuous polystomodæal polyps showing lateral branching.

FIGS. 26 and 27.—Curved polystomodæal polyps.

FIGS. 28 and 29.—*Favia fragum* (Esp.). Tortugas. Early stages of colony, fig. 28 being younger than fig. 29.





Coelenterata, Part II.—Madreporaria, Pl. II.

PLATE II.

Lettering employed:—*alg.* Algal bodies. *cil.* Cilia. *edg.z.* Edge-zone. *end.* Endoderm. *g.c.* Germ-cells. *lg.f.* Longitudinal fibres (unbranched) of the middle lamina. *m.* Mesentery. *m.f.* Mesenterial filament. *m.l.* Middle lamina. *m.l.nu.* Nuclei in middle lamina. *n₃.* Type III nematocyst. *or.d.* Oral disc. *ov.* Ovum. *ov.nu.* Nucleus of ovum. *sp.* Spermary. *st.r.* Stomodæal ridge. *sub.b.* Subterminal battery. *ter.b.* Terminal battery.

- FIG. 1.—*Favia conferta*, Ver. Transverse section through a ♂ mesentery bearing four spermaries. Off South Trinidad ("Terra Nova"). (400 VII, S₁₁ 1₁)* × 300.
- FIG. 2.—*Favia conferta*, Ver. Transverse section through a ♀ mesentery bearing an ovum. The nucleus of the ovum is large and granular, containing a nucleolus stained uniformly dark in Heidenhain's iron hæmatoxylin. Off South Trinidad ("Terra Nova"). (400 VII, S₉ 2₂) × 300.
- FIG. 3.—*Favia conferta*, Ver. Transverse section through a mesentery containing three groups of germ-cells. Off South Trinidad ("Terra Nova"). (400 VII, S₉ 1₇) × 300.
- FIG. 4.—*Favia fragum* (Esp.). Transverse section through a stomodæal ridge and part of the mesentery meeting it. Part of an adjacent ridge is also figured to show the deep groove between the two ridges. Note the thickened middle lamina containing nuclei at the attachment of the mesentery to the stomodæum. Andros Island, Bahamas. (500, IV, S₁₀ 2₁) × 300.
- FIG. 5.—*Favia fragum* (Esp.). Transverse section through the convoluted region of a mesentery. At one end of the dumb-bell shaped structure the mesenterial filament (*m.f.*, resembling mesenterial endoderm) contains a battery of nematocysts III (*n₃*), while at the opposite end it consists of granular columns. (500, V, S₁₁ 2₄) Andros Island, Bahamas. × 300.
- FIG. 6.—*Favia conferta*, Ver. Longitudinal section through an exocælic tentacle. Off South Trinidad ("Terra Nova"). (400 VII, S₄ 1₂) × 160.
- FIG. 7.—*Favia fragum* (Esp.). Longitudinal section through an entocælic tentacle. Andros Island, Bahamas. (500, IV, S₃ 2₄) × 100.
- FIG. 8.—*Favia fragum* (Esp.). Transverse section through a principal mesentery and part of the stomodæal wall. Andros Island, Bahamas. (500, IV, S₁₀ 1₂) × 90.
- FIG. 9.—*Favia fragum* (Esp.). Longitudinal section through the edge-zone (*edg.z.*) and part of the oral disc (*or.d.*) of a polyp to show convolutions of mesenteries protruded through the edge-zone. Andros Island, Bahamas. (500, V, S₁₃ 2₃) × 50.
- FIG. 10.—*Favia conferta*, Ver. Transverse section through a principal mesentery and part of the stomodæal wall. Off South Trinidad ("Terra Nova"). (400 VII, S₆ 1₄) × 65.
- FIG. 11.—*Favia conferta*, Ver.—Tangential section through a mesentery to show the wavy longitudinal (unbranched) fibres of the middle lamina. Off South Trinidad ("Terra Nova"). (400 I, S₁₁ 2₁₁) × 120.

* 400 VII, No. of series. S₁₁ 1₁, eleventh slide and first section on first row.

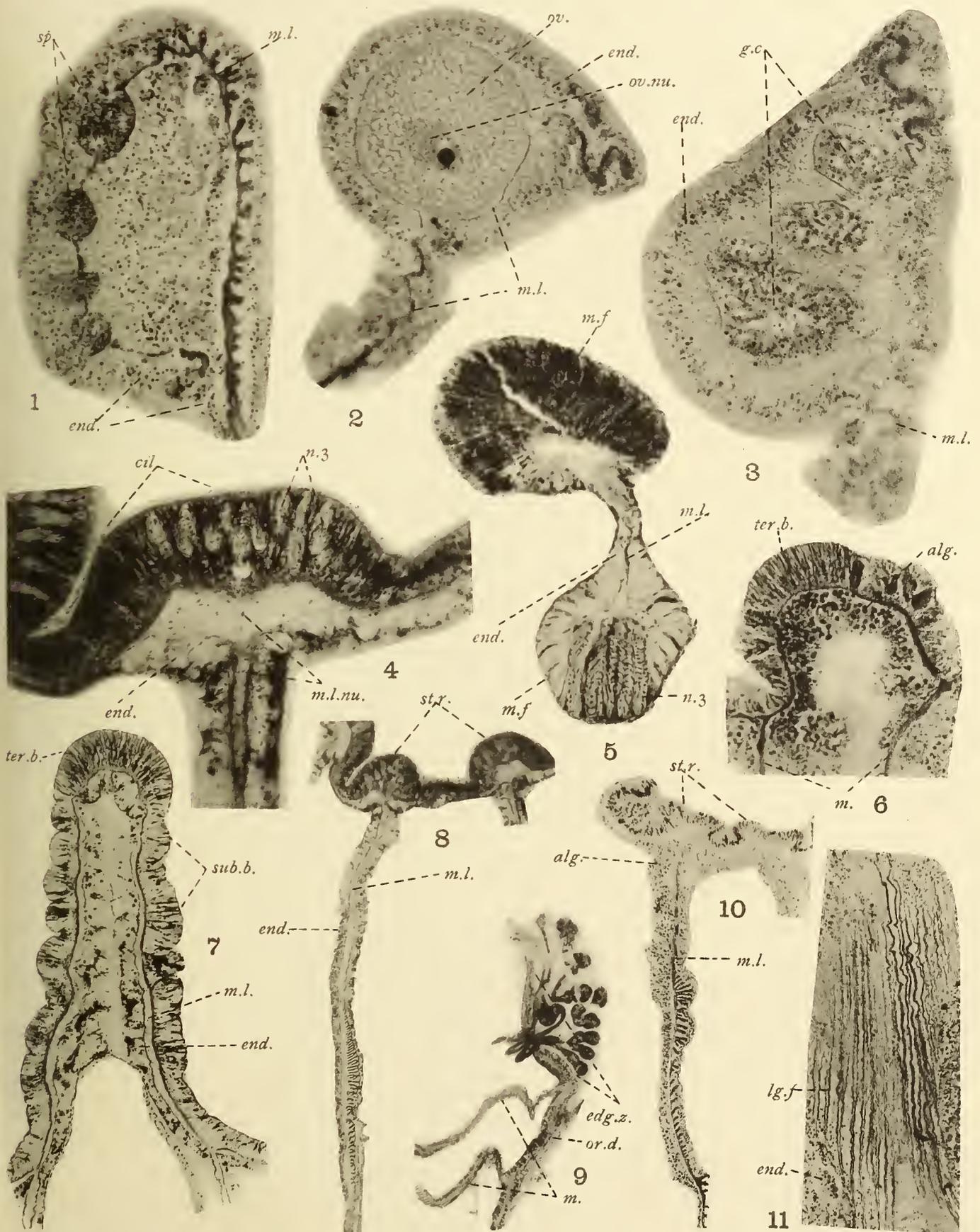
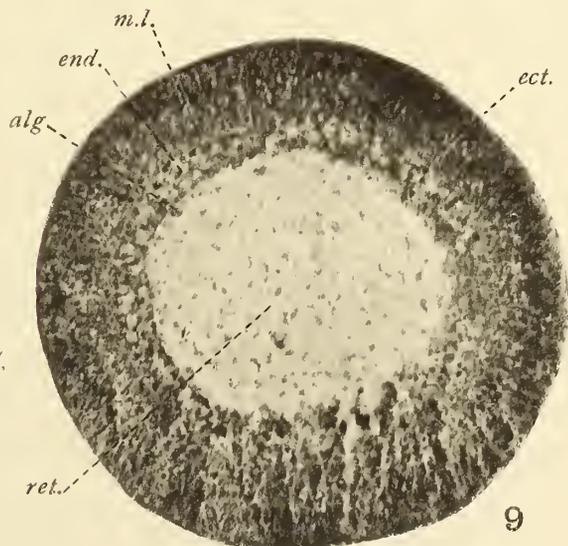
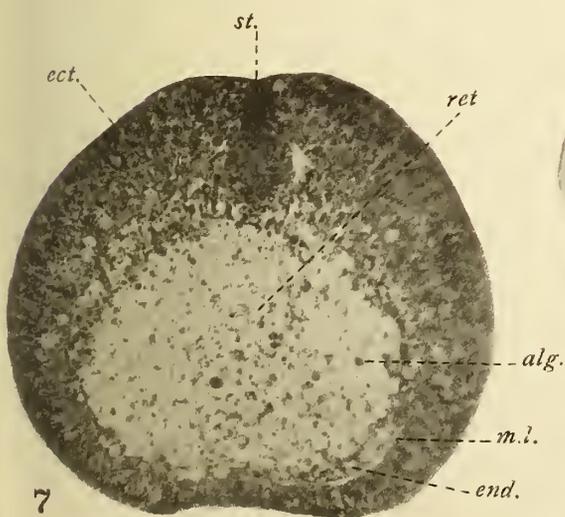
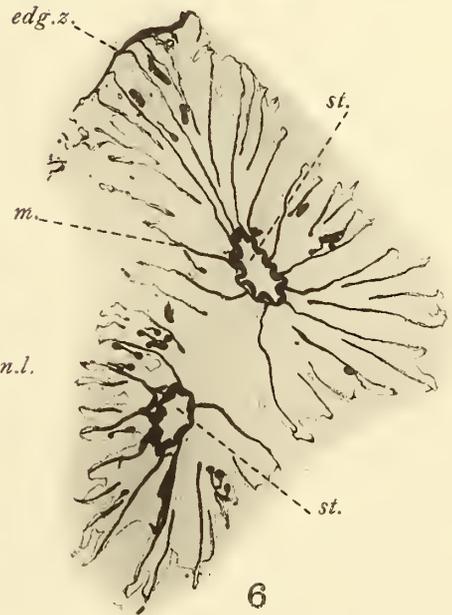
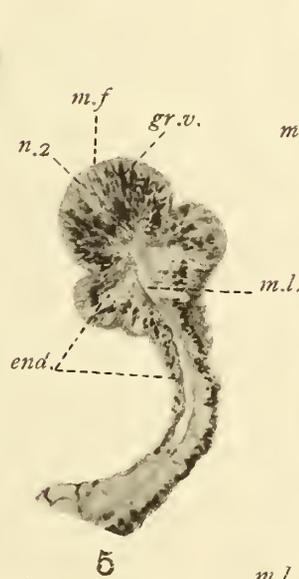
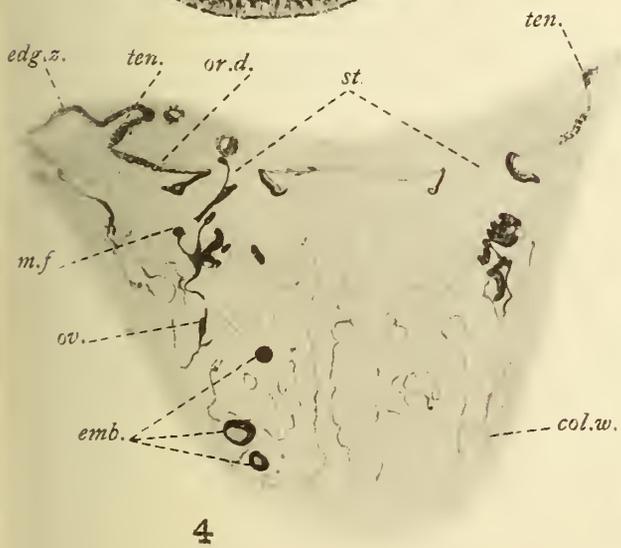
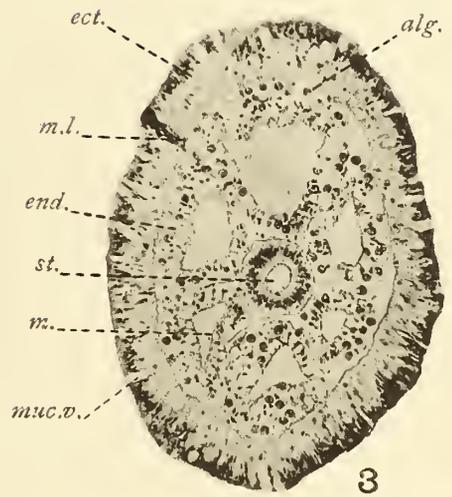
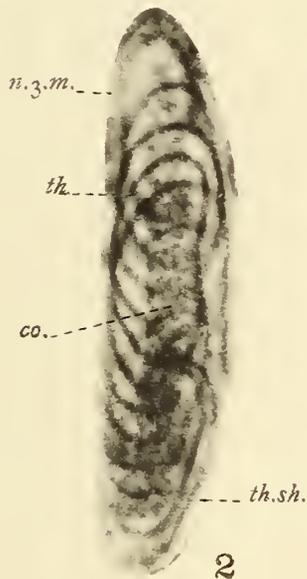
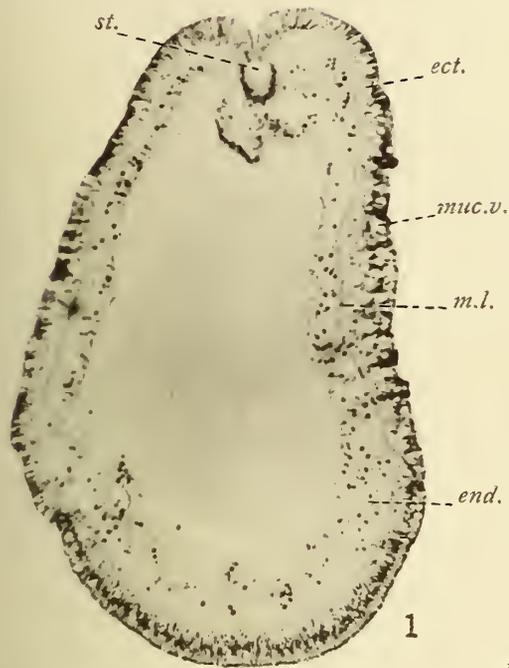




PLATE III.

Lettering employed:—*alg.* Algal bodies. *c.o.* More deeply staining core of nematocyst III. *col.w.* Column-wall of polyp. *ect.* Ectoderm. *edg.z.* Edge zone. *emb.* Embryo. *end.* Endoderm. *gr.v.* Granular vacuole. *m.* Mesentery. *m.f.* Mesenterial filament. *m.l.* Middle lamina. *muc.v.* Mucous vacuole. *n₃.m.* Membranous wall of nematocyst III. *or.d.* Oral disc. *ov.* Ovum. *ret.* Central reticulum of embryo. *st.* Stomodæum. *ten.* Tentacle. *th.* Thread of nematocyst III. *th.sh.* Sheath of thread of nematocyst III.

- FIG. 1.—*Favia fragum* (Esp.). Longitudinal section through a larva thirty-six hours after extrusion, showing stomodæal invagination (*st.*). The section has not passed through the thickened aboral region of the ectoderm. Tortugas. (A₄ 3, S₁ 3₂) × 185.
- FIG. 2.—*Favia conferta*, Ver. A nematocyst, type III, from the convoluted region of a mesenterial filament. In some of the turns of the thread the thin membranous sheath (*th.sh.*), with its closely wound inner spiral and the axial strand (stained dark in Iron Hæmatoxylin), are visible. (Cf. 5, Pl. VI, fig. 61.) Off South Trinidad ("Terra Nova"). (400 VII, S₉ 1₃) × 1250.
- FIG. 3.—*Favia fragum* (Esp.). Transverse section through a larva thirty-six hours after extrusion, in which six mesenteries (*m.*) have joined the stomodæum (*st.*). Tortugas. (A₄ 2, S₁ 2₁₁) × 185.
- FIG. 4.—*Favia fragum* (Esp.). Longitudinal section through a distomodæal polyp. Note convolutions of mesenterial filaments extruded through one of the stomodæa (*st.*), three embryos (*emb.*) in the cœlenteric cavity, and a mesentery bearing an ovum (*ov.*). Andros Island, Bahamas. (500_f V, S₁₇ 1₃) × 13.
- FIG. 5.—*Favia fragum* (Esp.). Transverse section through part of a mesentery below the stomodæal region, showing mesenterial filament (*m.f.*), and the swollen endodermal pad behind. Andros Island, Bahamas. (500_f IV, S₁₅ 1₅) × 250.
- FIG. 6.—*Favia fragum* (Esp.). Transverse section through a distomodæal polyp. Note that the sagittal planes of the two stomodæa do not agree. Andros Island, Bahamas. (500_f VI, S₃ 1₄, *vide* table on p. 85.) × 13.
- FIG. 7.—*Favia fragum* (Esp.). Longitudinal section through an embryo in which a stomodæal invagination is taking place at the upper end. Andros Island, Bahamas. (500_f V, S₁₆ 1₂) × 225.
- FIG. 8.—*Favia conferta*, Ver. Transverse section through part of a mesentery below the stomodæal region, showing the mesenterial filament. Off South Trinidad ("Terra Nova"). (400 VII, S₇ 1₄) × 250.
- FIG. 9.—*Favia fragum* (Esp.). Transverse section through another embryo at the same stage of development as the one represented in fig. 7. Andros Island, Bahamas. (500_f VI, S₂₆ 3₃) × 265.



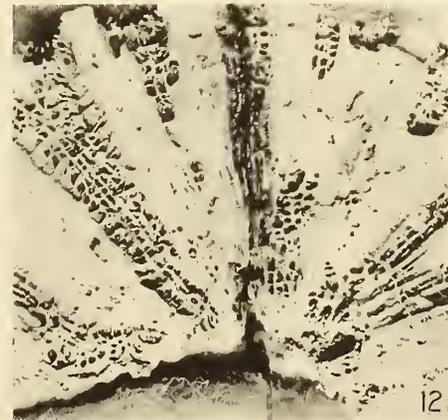
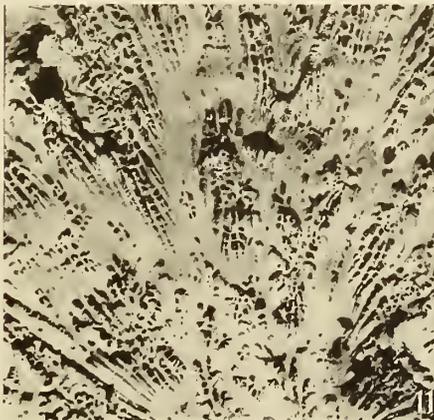
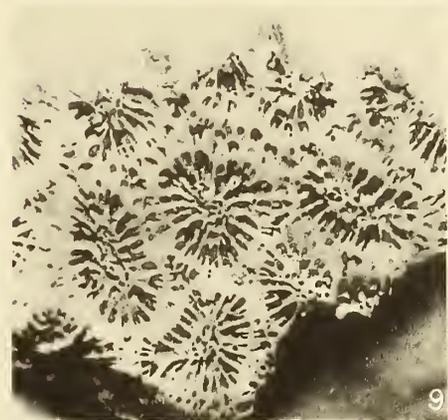
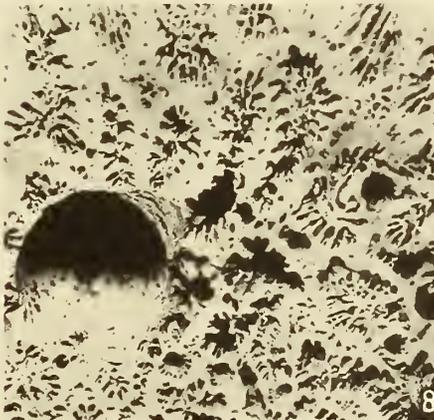
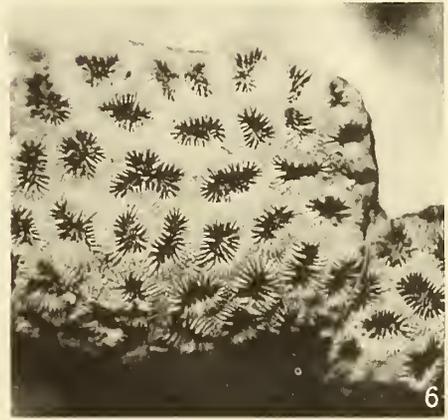
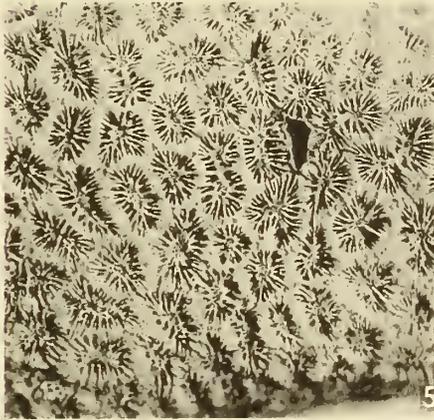
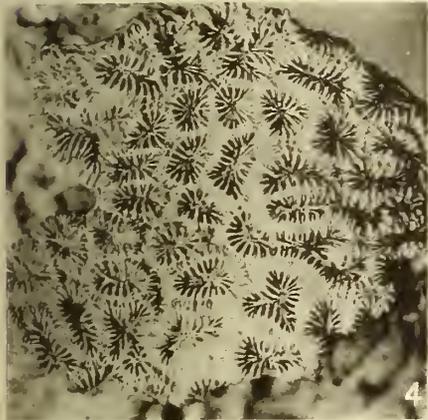
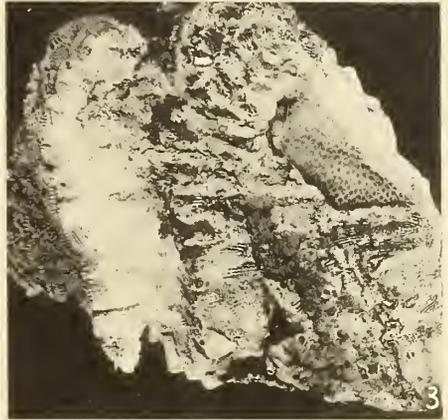
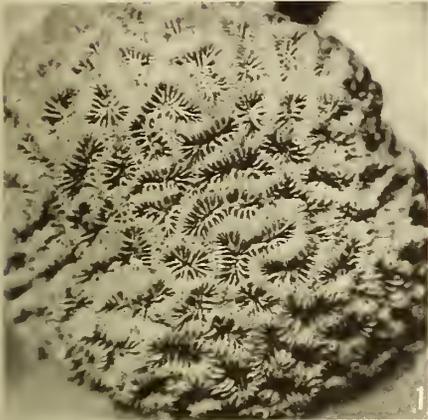
Coelenterata, Part II.—Madreporaria, Pl. IV.

PLATE IV.

Views of Coralla.

Figs. 1, 3, 4, 7 and 10 are taken from "Terra Nova" specimens of *Favia conferta*.
Off South Trinidad, Stat. 37.

- FIG. 1.—*Favia conferta*, Ver. Type, specimen A on p. 90. Off South Trinidad ("Terra Nova"). $\times 1\frac{3}{4}$.
FIG. 2.—*Favia gravida*, Ver. Specimen D on p. 90. Brazil. $\times 1\frac{3}{4}$.
FIG. 3.—*Favia conferta*, Ver. Specimen B on p. 90. Photographed in alcohol with the soft parts on its calicinal surface to show incrusting Tunicates, a Poritid coral, and an Actinian on the corallum. Off South Trinidad ("Terra Nova"). \times .
FIG. 4.—*Favia conferta*, Ver. Calicinal view of fig. 3. $\times 1\frac{3}{4}$.
FIG. 5.—*Favia fragum* (Esp.). Thin variety. Specimen E on p. 90. Tortugas. $\times 1\frac{3}{4}$.
FIG. 6.—*Favia fragum* (Esp.). Thick variety. Showing also fusion of two coralla. Specimen F on p. 90, Tortugas. $\times 1\frac{3}{4}$.
FIG. 7.—*Favia conferta*, Ver. Transverse section through fig. 1. $\times 2\frac{3}{4}$.
FIG. 8.—*Favia gravida*, Ver. Transverse section through fig. 2. $\times 2\frac{3}{4}$.
FIG. 9.—*Favia fragum* (Esp.). Transverse section through a corallum intermediate between fig. 5 and fig. 6. $\times 2\frac{3}{4}$.
FIG. 10.—*Favia conferta*, Ver. Vertical section through fig. 1. $\times 2\frac{3}{4}$.
FIG. 11.—*Favia gravida*, Ver. Vertical section through fig. 2. $\times 2\frac{3}{4}$.
FIG. 12.—*Favia fragum* (Esp.). Vertical section through another corallum of thick variety. $\times 2\frac{3}{4}$.





BRITISH MUSEUM (NATURAL HISTORY).

BRITISH ANTARCTIC ("TERRA NOVA") EXPEDITION, 1910
NATURAL HISTORY REPORT.

ZOOLOGY. VOL. V, No. 3 Pp. 97-120.

COELENTERATA.

PART III.—ANTIPATHARIA (and their Cirripede Commensals).

BY

A. KNIVETT TOTTON,

Assistant in the Department of Zoology, British Museum (Natural History).

WITH 15 FIGURES IN THE TEXT AND TWO PLATES.



LONDON:

PRINTED BY ORDER OF THE TRUSTEES OF THE BRITISH MUSEUM

WILLIAM COLLIERSON, Printer, 25, Abchurch Lane, E.C. 4; H. K. MULLEN, Ltd., 11, Bedford Street, New Bond Street, W. 1; GEORGE PAULSON & CO., Ltd., 25, Abchurch Lane, E.C. 4; W. L. GORDON, Printers, 1, Abchurch Lane, E.C. 4; H. K. MULLEN, Ltd., 11, Bedford Street, New Bond Street, W. 1; GEORGE PAULSON & CO., Ltd., 25, Abchurch Lane, E.C. 4; W. L. GORDON, Printers, 1, Abchurch Lane, E.C. 4.

1911.

British Museum (Natural History), Department of Zoology, London, E.C. 7.

1911.

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British Museum (Natural History).

*This is No. 3 of 25 copies of
"Terra Nova" Zoology, Vol. V., Coelenterata,
Part III., printed on Special paper.*

COELENTERATA.

PART III.—ANTIPATHARIA (AND THEIR CIRRIPEDE COMMENSALS).

BY A. KNYVETT TOTTON,

Assistant in the Zoological Department, British Museum (Natural History).

WITH EIGHTEEN FIGURES IN THE TEXT, AND TWO PLATES.

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I.—INTRODUCTION.

THE *Antipatharia* collected during the voyage of the "Terra Nova" were all obtained at Station 96, seven miles east of North Cape, New Zealand, at a depth of 70 fathoms. They belong to seven species, five of which are described below as new to science.

In the present state of our knowledge it is impossible to say what are the natural affinities of some of these species; in assigning them to genera I have followed the methods of recent workers, particularly Pesch.

Some new observations on the growth of the axis, branches, and spines, and on the origin of the axial canals, are recorded below.

The material includes examples of a new species of commensal Cirripede, which is described; some general notes on the commensals of *Antipatharia* are given.

When studying *Antipatharia* it has to be borne in mind that:—

1. The spines undergo considerable change in form with the addition of successive laminæ of chitin. For this reason those at the tip of a branch generally differ in form from those nearer the base, or on the older parts of the colony.

2. When the polyps are restricted to one side of the axis, it is generally found

that the spines on the polyp side are longer and are arranged in fewer longitudinal rows than those on the other side.

3. The number of longitudinal rows of spines that can be seen from one aspect of an axis may be quite different from that seen from the opposite side. In this report, when the number of longitudinal rows of spines is mentioned, it is to be understood that every row, counting right round the circumference, has been taken into account. This is the only satisfactory method.

II.—DESCRIPTIONS OF SPECIES.

1. *Bathypathes scoparia*, sp. n. (Pl. II, figs. 3, 4.)

Material.—Four pieces of the axis and branches of a large specimen, representing a length of over 42 cm. At the basal fracture the stem measures 3 mm. by 3.5 mm.; at the apical fracture it has a diameter of 0.5 mm.

Specific description.—**Colony** with main stem bearing four series of incurved* **branches**, an outer or more lateral pair set in planes which form an angle of about 100°, and an inner pair which meet at an angle of 35° (fig. 2, B, p. 100). The outer branches are set about 6.8 mm. apart in each series, and alternate with those of the other side; the inner branches also alternate, each being inserted 2 mm. below the outer branch of the same side. The outer branches are from 110 mm. to 180 mm. long, and the inner from 60 mm. to 155 mm. Each outer branch bears a unilateral series of about six smaller branches, from 110 mm. to 170 mm. in length, directed forwards, inwards, and upwards; at angles of from 15° to 20° from the branch that bears them, these branches of the second order may bear others, of third and even fourth orders, of a maximum length of 70 mm., arranged in a similar way, but in number only two or three. The inner series of paired branches are also compound, generally bearing two or three smaller branches from 50 mm. to 140 mm. long; these are mostly simple. **Axial chambers** † from 0.50 mm to 2.1 mm. (generally about 1.15 mm.) long. Towards the pointed tips of these chambers there appear, on the inner wall, certain circular ridges or incomplete septa. The septa dividing the chambers persist for a long time, but eventually break down and give rise to axial canals, which increase in diameter from 0.175 mm., in a branch 0.515 mm. in diameter, to 0.24 mm. in a branch 0.865 mm. in diameter.

Spines on stem and branches in ten longitudinal rows (text-fig. 1), short, simple, triangular, from 0.36 mm. to 0.075 mm. in length, and 0.450 mm. apart in the same row. **Polyps** borne on that side of the stem which bears branches, and on the inner-upper sides of the branches, elongated in the direction of the axes which bear them,

* The curvature of the branches may be in part due to the small size of the jar in which the specimen was packed. Pesch (1914) is inclined to think that the rolled-up condition of the type specimen of *Aphanipathes reticulata* may be due to a similar cause.

† See p. 110.

2.8 mm. to 3.4 mm. long, 0.3 mm. to 0.6 mm. apart, with tentacles in three pairs about 2.2 mm. long (exclusive of basal bulbous parts).

Remarks.—This species appears to have certain affinities with *Schizopathes conferta*, Brook, which bear numerous, simple, long, somewhat irregularly arranged antero-lateral branches. It is by no means certain that these branches all belong to one series. Indeed, on the unique specimen of *S. conferta* there are indications that an original series of alternate outer branches may have become masked, as the growth of the colony proceeded, by the addition of a more irregularly disposed secondary inner series. Externally the polyps of the two forms are similar, and are intermediate between the extreme “*Schizopathes-type*” found in *S. crassa*, Brook, where they are very much crowded, and the extreme “*Bathypathes-type*” found in *B. patula*, Brook, where the pairs of tentacles are widely separated. The most marked difference between the two forms is the compound nature of the branches found in *B. scoparia*; but this may not be a very profound one, and in my opinion is much less important than the difference between the branching-systems of *B. scoparia* and of a complexly-branched form such as *Taxipathes recta*, that has a complicated system of small off-shoots, which are developed into big branches that repeat the structure and arrangement of the main stem.

Three other forms are known to produce two paired series of antero-lateral branches, namely, *Eubathypathes quadribrachiata*, Pesch, *Aphanipathes alata*, Brook, and *Antipathes lilliei*, sp. n.

The only specimen of *E. quadribrachiata* at present known is one, complete with basal plate, only 2.8 cm. long and, therefore, most probably a young specimen. It would be inadvisable to base any conclusion on a comparison between a mature colony and such a young specimen. The obvious differences are that in *E. quadribrachiata* the branches are set very much more closely together, the inner branches are comparatively small, and all the branches are simple (text-fig. 2). Further growth might alter the characters of the specimen considerably. In *A. lilliei*, sp. n., and *Aphanipathes alata*, Brook, the branches remain simple throughout life, except the few that are developed into big branches.

One other form, *Bathypathes lyra*, Brook, must be mentioned because it develops on the anterior side of the stem a series of relatively short (3 mm. to 5 mm. long) branches, which are hollow and bear spines. Pesch has stated that they are not more than a large sort of spine, but no spines bear other spines, nor are any hollow, except for a very short distance at their bases. That they are developed much later than the long paired branches can be assumed from the fact that the thickness of chitin which separates their bases from the axial canal of the main stem is much

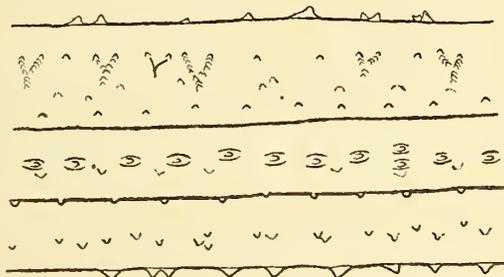


FIG. 1.—*Bathypathes scoparia*. Arrangement of spines in longitudinal rows on branch ($\times 17.5$).

greater than that which separates the bases of the long paired branches from the axial canal of the stem. These short branches on *B. lyra* appear to be arranged in one median row, but only an examination of a long series of specimens will show whether they are really arranged in two rows separated by a small angle. In *B. lyra* all the branches remain simple.

B. scoparia differs from all other species of the genus, as emended by Pesch, in having compound branches, which are arranged in two paired series. It agrees with them in that none of the branchlets are ever hypertrophied into large branches which, in the arrangement of the branchlets borne on them, repeat the character of the main stem, and in the shape and distribution of the polyps.

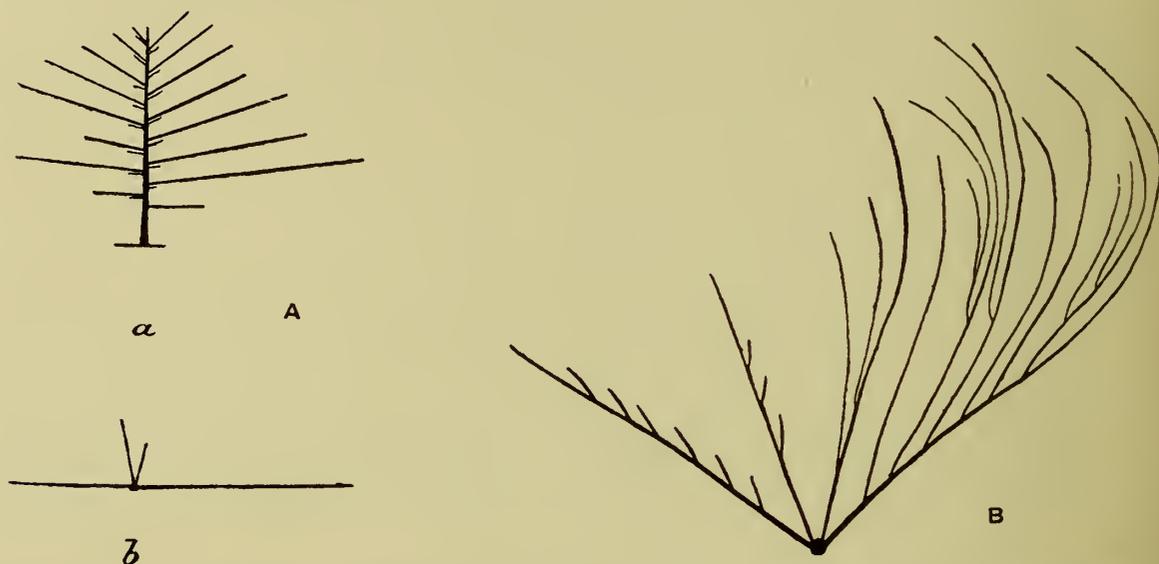


FIG. 2.—A. *Eubathypathes quadribrachiata*, Pesch (nat. size). Diagrammatic reconstructions from original description: Projections of branches on (a) a vertical, (b) a horizontal plane.

B. *Bathypathes scoparia*: Projection of branches on a horizontal plane.

As Gravier remarks (1921), the genus *Bathypathes* seems to be confined to the great depths (1,055 fathoms to 2,975 fathoms), except for *B. patula* and *B. alternata*, which have been recorded in 55 fathoms on the Burdwood Bank, south of the Falklands, where temperature conditions approximate to those in the depths of the Atlantic. *Bathypathes scoparia* and the following species *B. platycaulus*, coming from a depth of only 70 fathoms on the fringe of the tropical zone, are as well distinguished by their habitat as by their structure from the other species of this genus.

2. *Bathypathes platycaulus*, sp. n. (Pl. I, fig. 6.)

Material.—139 mm. of the apical part of a specimen, and 105 mm. of a more basal part of what was probably the same specimen, preserved in spirit. The specimens appear to have been partially dried at some time.

Description.—At the basal fracture the **axis** of the main stem is nearly cylindrical, with a diameter of 1.5 mm. It increases in width to 1.75 mm. in the next 7 cm., after which it tapers away gradually, the diameter at the distal fracture of the apical part being 0.28 mm. In the middle part the stem is flattened on one side, bearing on either edge of this flattened region a row of simple branches, the distance apart of which averages 3 mm. **Branches** alternating, ascending at an angle of 30°, in planes which intersect at an angle of 120°; distal portions curved downwards towards the base. The longest branch measures 8.8 cm. Signs of regeneration appear at irregular intervals. The central canal of the branches measures about 0.15 mm. in diameter. There are no septa except at points where regeneration has taken place. Within the canal are foreign particles.* **Spines** in 10 or 11 longitudinal rows, 6 or 7 on one side and 4 on the other, 0.13 mm. apart in the same row, 0.04 mm. long. The number of rows at the apex of a branch is small. New rows are intercalated at a distance of 1 mm. or 2 mm. from the tip. **Polyps** about 2 mm. long in the direction of their supporting axes, 1 mm. apart, sharply divided into three regions, with pairs of tentacles 0.85 mm. apart and 0.5 mm. long, and possessing prominent oral cones.

Remarks.—This species differs from those previously described in the relative position of the branches, and in the angle between them and the stem. The broadening of the main axis in the middle region is peculiar.

3. *Antipathes lilliei*, sp. n. (Pl. I, figs. 1-3.)

Material.—A magnificent dried colony, 90 cm. by 70 cm. by 50 cm.

Description.—**Colony** bilaterally symmetrical, multipinnate, with main branches directed to one side of the stem. Axis with four series of **branches** (Pl. I, fig. 3), mostly simple, slender, recurved, from 9 cm. to 11 cm. long. Outer series opposite, set in planes which intersect at an angle of nearly 180°, alternating, \pm 3.2 mm. apart on each side, forming an angle of \pm 60° with the axis. Inner (anterior) series (undeveloped in youngest branches), in planes which form nearly a right angle, inserted 1.5 mm. below the branch of the outer series on the same side. Branches of either series may be hypertrophied, and may even be as stout and as long as the stem beyond their point of origin. These hypertrophied branches bear series of branchlets arranged like the branches on the stem; some of these again may be enlarged and bear branchlets. The diameter of the simple branches increases from 0.077 mm. at the tip (exclusive of spines) to 0.585 mm. proximally. The diameter of the axial canal increases from 0.066 mm. at the tip to 0.128 mm. in a branch with an external diameter (exclusive of spines) of 0.571 mm. **Spines** smooth, triangular (text-fig. 3), in from 7 (on younger parts of branchlets) to 10 longitudinal rows, 0.15 mm. to 0.26 mm. (usually 0.195 mm.) apart, connected in some degree by ridges (text-fig. 16, p. 112); 0.065 mm. long on the polyp side and 0.05 mm. long on the other. **Polyps** slightly elongated in

* See footnote, p. 105.

the direction of the axis which bears them, from 1.86 mm. to 2.33 mm. long, and about 3.21 mm. apart. The length of the lateral tentacles (macerated in water) is 0.6 mm.

Remarks.—The curved axis, which is 1.5 metres long and 2 cm. in diameter at its thickest, springs from a bell-shaped base (Pl. I, fig. 2). The hypertrophied branches, which may reach a length of 1.29 metres, occur at irregular intervals. Two pairs of hypertrophied inner branches and a pair and a half of outer ones arise close together at a point half a metre from the base. Lower down two more inner branches have been enlarged, one (Pl. I, fig. 2) bearing branchlets of the second, third, and fourth orders. Most of the other branches are simple or bear only small branches. Seventeen polyps were counted on a length of 3.5 cm. of a branchlet. A metre's length of an enlarged branch carries about 1,200 branchlets in all, and, in the case of a well-grown one, would carry as many as sixty thousand polyps. It has been calculated that the present colony, when alive, consisted of over 400,000 polyps.

On the distal ends of some branchlets is well illustrated the homology of spines

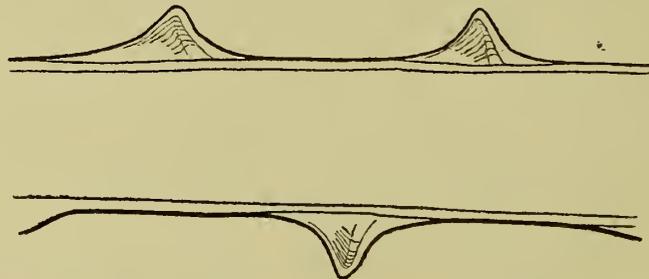


FIG. 3.—*Antipathes lilliei*. Young branchlet, showing hollow, chambered spines ($\times 219$).

and branches (text-fig. 16). In their early stages the spines (text-fig. 3) are hollow, just like the branches. As usual in dried *Antipatharia*, during the process of drying many of the branchlets have become stuck together at the tips (Pl. I, fig. 1). The condition described by F. Cooper (1909), and considered to be concrecence, may be nothing more than an adhesion brought about by temporary drying.*

At rare intervals there are present on the branchlets curved, horn-shaped, chitinous projections. They prove to be the chitinous sheaths laid down by the tissues of the antipatharian round the peduncles of commensal cirripedes of the genus *Oxynaspis*. Only two of the capitula of these cirripedes were preserved, and they form the subject of a special section of this report. The lower part of the stem and some of the branches bear numerous specimens of other cirripedes, but they are not dealt with because they appear to fall into the category of chance associations, and not of true commensals or definite associations.

Affinities.—The only mature specimen of an antipatharian known to the writer that has a habit at all similar is *Aphanipathes alata*, Brook, from Mauritius; but the present species is a giant in comparison, and the spination is quite unlike that of *A.*

* F. Cooper says that "concrecence" is accompanied by a good deal of breaking down of tissue elements, but gives no histological figures.

alata. There are certain resemblances between *A. lilliei* and a young specimen, 2.8 cm. long, described by Pesch (1914) as *Eubathypathes quadribrachiata*. This young colony differs from the present one chiefly in the relative shortness of the inner series of branches, and in that they form an acute angle (about 25°) with one another. The branchlets are set more closely in *E. quadribrachiata* (2.9 mm. apart) than in *A. lilliei* (3.2 mm. apart). The spines in *E. quadribrachiata* are 0.015 mm. and 0.03 mm. long and are not connected, whereas in *A. lilliei* they are twice the length and are connected by longitudinal ridges. It is possible that a mature specimen of *E. quadribrachiata* might show all the characters of *A. lilliei*, but on the other hand a mature specimen might be found retaining all the characters of the young *E. quadribrachiata*, and it has seemed best to form a new species *A. lilliei*, about the sum of the characters of which there is no doubt.

It is convenient for the present to assign this species to the genus *Antipathes*, because that one seems to be the most heterogeneous, and the species does not appear to belong to any of the others recognized by Pesch. In particular it is excluded from *Bathypathes*, Brook, because the species described by him are all relatively small forms with simple branches, and never have larger branches that repeat the characters of the main stem.

4. *Antipathes aperta*, sp. n. (Pl. II, figs. 1, 2.)

Material.—Five smaller fragments, and one larger, 13 cm. over all, broken from the basal part of a colony, and without the base of attachment.

Description.—**Main Stem** irregularly branched in many planes, multipinnate. Ultimate **branches** 1 cm. or 2 cm. long, alternate, occasionally opposite, 2.5 mm. to 3 mm. apart on same side; diameter of axial canal from 0.014 mm. (at tip of branch) to 0.05 mm. (in branchlet 0.57 mm. diam.). Stretching across the axial canal in younger parts of the colony are frequent domed septa, indicating discontinuous growth. **Spines** in from 7 longitudinal rows (at tip of branch, text-fig. 4, B) to 10 (on branchlet 0.25 mm. in diameter, text-fig. 4, A); on older branches very numerous and irregularly arranged, dichotomously branched, antler-like, and 1.1 mm. in length (text-fig. 5); at tips of ultimate branches bracket-shaped and 0.017 mm. in length (text-fig. 4, B); intermediately (branch 0.61 mm. in diameter) needle-shaped and 0.15 mm. long, interspersed with secondary, shorter spines of very irregular form (text-fig. 6). These secondary spines are irregularly distributed, and sometimes appear at an early growth-stage of a branch. **Polyps** slightly elongated, 0.80 mm. long, 0.50 mm. apart, and with tentacles (contracted) 0.13 mm. long.

Remarks.—Presumably the colony at first was simply pinnate. By the subsequent hypertrophy of certain branches on which developed yet others again, came about the irregular branching system of the old colony. Two specimens of an Oxynaspid Cirripede, one large and the other smaller, are attached in the region of the lower branches (Pl. II, fig. 2). On many parts of the colony there is an irregular

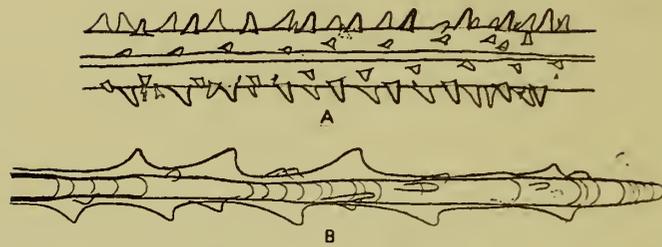


FIG. 4.—*Antipathes aperta*. A. Branchlet, showing regular arrangement of spines in longitudinal rows with slight dextrorse spiral twist ($\times 30$). The spines on the other side are arranged irregularly in three main rows. A few scattered secondary spines may be seen. B. Tip of an ultimate branchlet, with an alternating series of spines ($\times 230$). The chambered structure of the axial canal is shown. Proximally two regenerations have taken place.

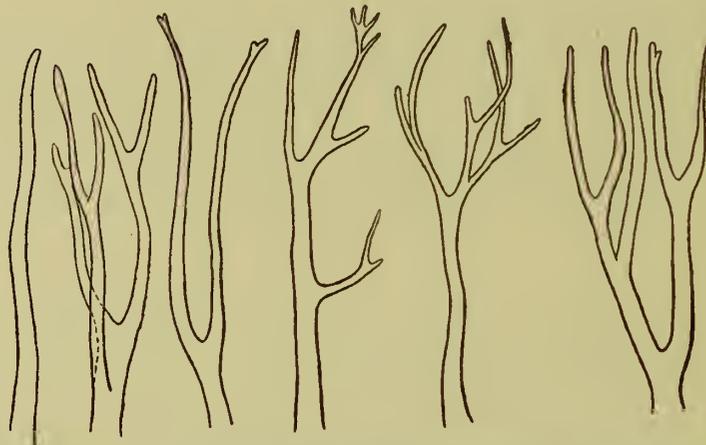


FIG. 5.—*Antipathes aperta*. Antler-like spines from a branch 2.4 mm. in diameter (exclusive of spines) ($\times 50$).

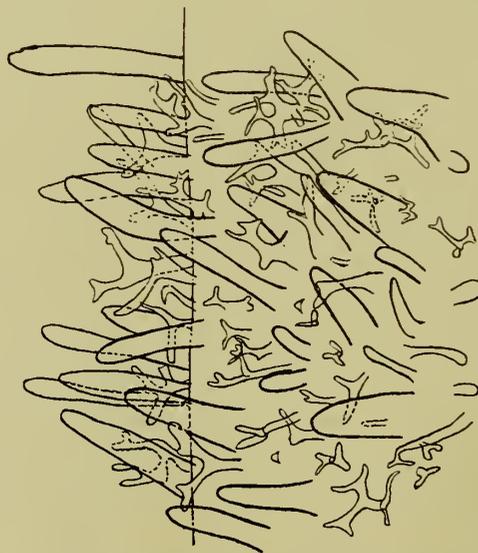


FIG. 6.—*Antipathes aperta*. Spines from a branch 0.61 mm. in diameter ($\times 151$). Scattered amongst the needle-shaped primary spines are numerous irregular secondary ones.

investing sheath of chitin laid down over some organism, whose nature has not been determined.

In shape the specimen recalls *Aphanipathes somervillei*, Forster Cooper (1909), which also has spines 1 mm. long and closely set together on the stem. The description does not give the shape of any of the spines; but a figure (1909, 7, A) appears to represent them as needle-shaped and not antler-shaped.

5. *Antipathes glutinata*, sp. n. (Pl. I, fig. 5.)

Material.—A loose plexus of the distal pieces of coalescing branches and branchlets, measuring 6 cm. by 2 cm.; evidently separated from a larger colony, which presumably was flattened in one plane. Cœnosarc macerated.

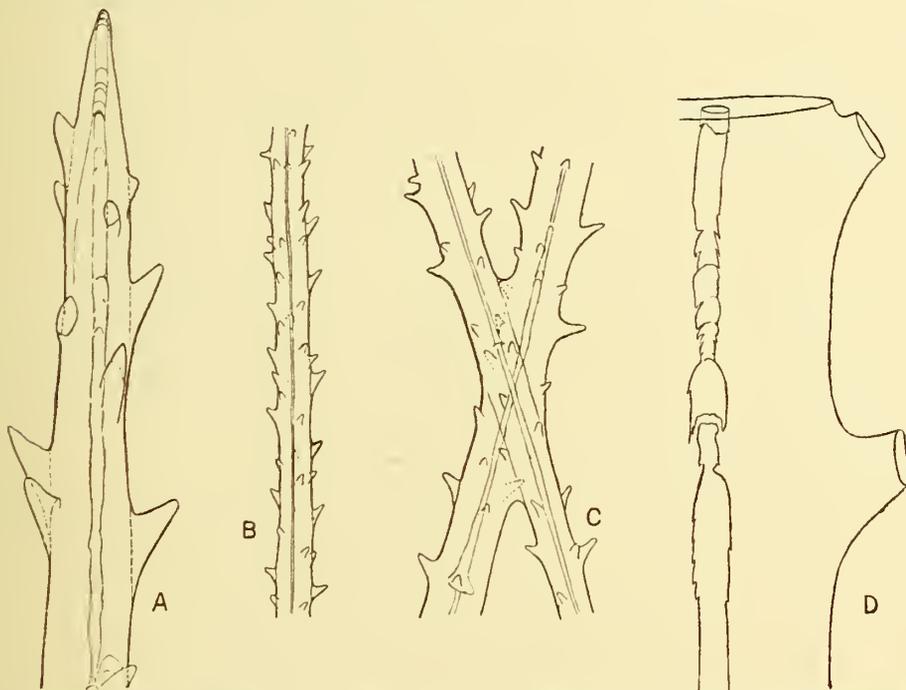


FIG. 7.—*Antipathes glutinata*. A. The tip of a branchlet ($\times 138$). B. A branchlet, showing arrangement of spines in longitudinal rows ($\times 19.5$). C. A coalescence between two branchlets ($\times 48$). D. A branchlet, showing the incomplete septa of the axial canal ($\times 251$).

Description.—Multipinnate (mode of branching obscured by coalescence), flattened in one plane; **branchlets** usually coalescing wherever contact between them takes place (text-fig. 7, c). Regeneration frequent. Ultimate branchlets directed to one face of the colony, 1 cm. to 2.5 cm. long, 0.125 mm. in diameter. **Axial canal** 0.0113 mm. in diameter (at tips of branchlets) to 0.018 mm. (in branchlets 0.203 mm. in diameter); very irregular in outline (text-fig. 7, D) and traversed by complete and incomplete septa at regular intervals. The lumen is partly or wholly occluded at frequent intervals by crystalline bodies.* **Spines** in 6 or 7 longitudinal rows (text-

* These bodies appear to be very fine-grained aggregates. Under crossed Nicols the distribution of interference colours indicates a radial structure. It is possible that they are sea-salts.

fig. 7, B), 0.23 mm. to 0.32 mm. apart in same row, maximum length 0.10 mm.; at tips of branchlets inclined distad at an angle of 35° to 40° from the axis (text-fig. 7, A), proximally at a more obtuse angle (60° on branchlets 0.18 mm. in diameter), on older branches (0.45 mm. in diameter) projecting for 0.08 mm. at right angles to the axis (text-fig. 8). Diameter of axial canal at tip of branchlet about one-fifth of that of branchlet.

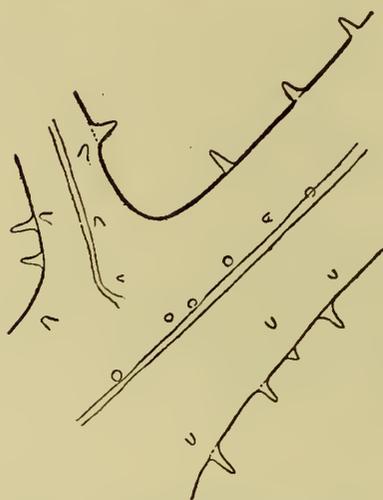


FIG. 8.—*Antipathes glutinata*. A branch with spines that project at right angles ($\times 48$).

Remarks.—In general form and in some details of spination this species resembles the form described by Pesch (1914) as *Euantipathes plana* (Forster Cooper); in that form, however, the ultimate branchlets, which also are all directed more or less towards the anterior side of the colony, are quite short (a few mm. in length).

6. *Parantipathes tenuispina*, Silberfeld. (Pl. II, fig. 5.)

Material.—Two specimens without polyps; a larger imperfect one 18 cm. in length, with remains of a basal plate of attachment, which is about 2 mm. thick; and a smaller, more perfect one, 12 cm. in length, with stem 1.14 mm. in diameter, complete except for basal plate. Both specimens contain worm-runs. The following description is based on the smaller, more perfect specimen.

Description.—**Colony** bottle-brush shaped, oval in section, in the middle region measuring 16 mm. by 25 mm. In the apical region pinnate; in the middle and basal region with a second series of paired branches. **Branches** of the first series alternate, from 1.7 mm. to 2.8 mm. (average 2.18 mm.) apart, set on to the stem at angles of from 70° to 85° . These branches themselves are alternately pinnate in the middle regions of the colony. Those of opposite sides set on to the stem in planes which intersect at angles of from 120° to 150° . The inner proximal branchlets of the main series of branches unite, either by themselves or by their smaller branchlets (text-fig. 10) with those of the other side to form arches—the framework of a worm-run.* Small irregularly disposed branchlets, running roughly parallel with the main axis, link up these arches to form a complicated lattice-work tube (text-fig. 9), 3 mm. in diameter at the base, increasing to 4 mm. at the tip. On the opposite side of the stem is the second series of paired branches, which appears to develop a little later. The planes in which the rows of these branches of the second series lie intersect at angles of from 60° to 90° . These branches may be simple at the base of the colony, but in the middle region may develop a maximum of six alternate branchlets, which

* The arrangement in *Aphanipathes barbadensis*, Brook, is similar (Pl. I, fig. 4), but there is little coalescence, and the individual arches are not linked up by branchlets running parallel to the main axis.

may again bear two or three smaller branchlets. These small branchlets of the second and third order do not always appear to be alternate, because supernumerary irregular branchlets are developed. In both series of larger branches—the main one,

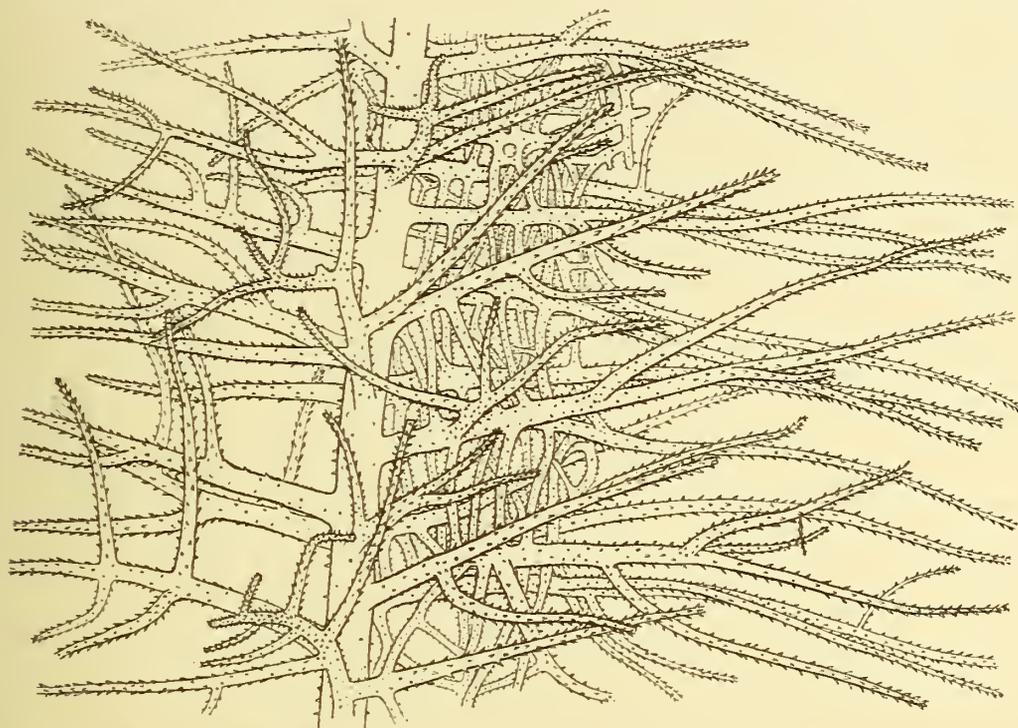


FIG. 9.—*Parantipathes tenuispina*. Postero-lateral view of part of colony, showing the interlacing of branchlets to form the "worm-run" ($\times 8$).

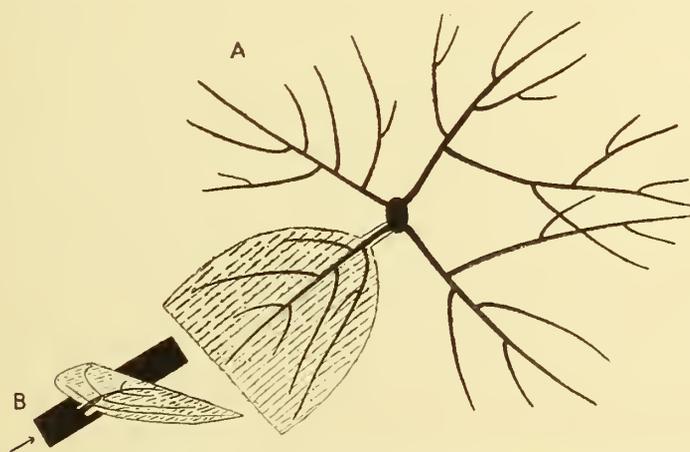


FIG. 10.—*Parantipathes tenuispina*. A. A diagrammatic projection of the branches on a horizontal plane. B. A diagrammatic elevation of part of the stem and one branch of the second series, to illustrate the tilting of the branching planes.

which forms the worm-run, and the series on the opposite side of the stem—the planes in which the alternate or sub-opposite branchlets of the second order lie are not quite horizontal. The branches themselves are inclined upwards (distad), and

the upper surfaces of the branching-planes of those of opposite sides are tilted towards each other, each plane generally intersecting the main axis of the stem at an angle of about 80° in the main series, and 50° in the series on the opposite side of the stem (text-fig. 10, B). The length of the branches of the main series is from 9 mm. to 12 mm. The branchlets borne by them are, proximally 7 mm., distally 1.75 mm., to 3.5 mm. long. The branches of the second series on the side of the stem opposite to the worm-run have a maximum length of about 9 mm. In both series branchlets of second or third orders, after growing out at an obtuse angle, curve upwards (distad) and run more or less parallel with the branches (text-fig. 10, A). This arrangement has been noted by Pesch in *Euantipathes plana*, F. Cooper.

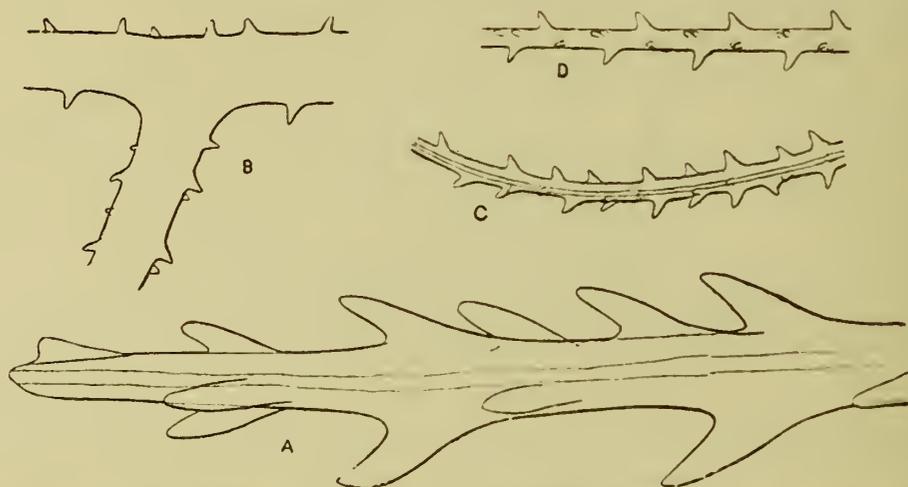


FIG. 11.—*Parantipathes tenuispina*. A. Tip of a branchlet ($\times 180$). B. The spines on an older branchlet ($\times 38$). C, D. Two views of part of branchlet with spines in six longitudinal rows.

The **axial canal** increases in diameter from 0.01 mm. at the tips of branchlets (0.05 mm. in diameter) to 0.0225 mm. in branchlets measuring 0.3 mm. in diameter. Septa and incomplete septa traverse the lumen of the canal at irregular intervals. **Spines.**—At the extreme tips of branchlets the spines are inclined distad at an angle of from 25° to 30° from the axis. They are longest at a little distance (1 mm. to 2 mm.) from the tips, being 0.12 mm. long and inclined distad at an angle of 45° (text-fig. 11, A). At the bases of the branches only 0.075 mm. of the length of the spines projects, and that almost at right angles (text-fig. 11, B). At the base of the main axis this length is reduced to 0.04 mm. This is about the length of the largest spines on the small supernumerary branchlets of 0.075 mm. diameter. On the branchlets the spines are arranged in six equidistant longitudinal rows (text-fig. 11, C-D) and are from 0.18 mm. to 0.28 mm. (average 0.23 mm.) apart in the same row.

No details of the macerated cœnosarc can be seen.

7. *Stichopathes variabilis*, Pesch, var. *lissispina*, Pesch.

Material.—Five fragments of a simple, spirally coiled stem.* What appears to be the more basal fragment, though without the plate of attachment, is 17 cm. long and forms a segment of a circle with a radius of 8 cm. On to this join two separate coils 11 cm. in diameter, a smaller irregular coil 6.5 cm. in diameter with a peripheral length of 34 cm., and the most distal part, which is 53 cm. long when straightened out and forms three irregular coils from 4 cm. to 6 cm. in diameter. The apical portion of the colony is missing.

Description.—The specimen must have had a total length of over 150 centimetres—this being the combined length of the fragments, which increase in diameter (exclusive of spines) from 0.32 mm. to 1 mm. There is a corresponding increase in the diameter of the axial canal, from 0.26 mm. distally to 0.59 mm. proximally. The **spines** (text-fig. 12) are arranged in from 12 to 16 longitudinal rows, which are

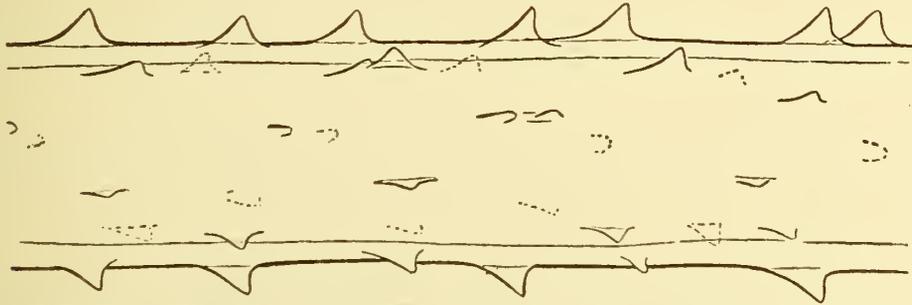


FIG. 12.—*Stichopathes variabilis*, var. *lissispina*, showing twelve longitudinal rows of spines ($\times 48$).

wound in a very gradual and hardly perceptible dextrorse spiral, those on the same side as the polyps being more distant from one another and consisting of shorter spines than those of the other side. Their distance apart in one and the same row is from 0.38 mm. to 0.46 mm.; and their length 0.14 mm. on the polyp side, but only 0.07 mm. on the other. The smaller spines especially are often bifid. The **polyps** are on one side only, crowded, occasionally as much as 0.75 mm. apart, of various sizes—largest 1.65 mm. long; mouth elongated in a sagittal direction; sagittal tentacles at a lower level than the laterals. In the larger polyps the sagittal tentacles are about 1.5 mm. long and the laterals 0.71 mm. The state of preservation is bad, the specimens having been allowed to dry at some time.

Nomenclature.—It has been a matter of great difficulty to find a name that could satisfactorily be applied to this specimen. Old specific descriptions do not mention the total number of longitudinal rows of spines, nor do they give adequate measurements of spines and axial canals. The types of *S. gracilis*, Gray, *S. echinulata*, Brook, and *S. occidentalis*, Brook, have been closely examined afresh and have yielded the following data, which diverge considerably from those given by Pesch (1914).

* The spiral is sinistrorse, seen from the centre.

<i>Stichopathes.</i>	<i>gracilis</i> , Gray. Type.	<i>occidentalis</i> , Brook. Type.	<i>echinulata</i> , Brook. Type.	<i>variabilis</i> , Pesch. "Terra Nova" Specimen.
Diameter of stem (excluding spines)	1.71 mm.	0.488 mm. 0.525 mm.	0.775 mm.	0.5 mm. 1.0 mm.
Diameter of axial canal *	0.43 mm.	0.375 mm. 0.425 mm.	0.475 mm.	0.35 mm. 0.59 mm.
No. of rows of spines (longitudinal)	16	15	18	16
Distance between spines, same row	0.38-0.81 mm. 0.8 mm.	0.375 mm.	0.45-0.675 mm. 0.575 mm.	0.38-0.46 mm.
Length of spines— Polyp side	0.18 mm.	0.15 mm.	0.15 mm.	0.14 mm.
Other side	0.13 mm.	0.075 mm.	0.075 mm.	0.07 mm.

* Where two values are given for diameter of stem and of axial canal, the first of one corresponds with the first of the other.

This table shows that great caution must be observed when using numerical values as a criterion for specific distinction. This is borne out by Pesch's diagnosis of his very variable species *variabilis*. As yet we know very little about the value to be attached to the shape of the colony, whether it be straight, sinuous, a dextrorse or a sinistrorse spiral, and whether the spiral coils have a large or small diameter. Much may be learned in the future from detailed examination of groups of specimens attached to one small area such as the group of 120 specimens attached to a stony mass measuring 10 in. by 5 in. mentioned by Johnson (1899).

III.—STRUCTURE AND GROWTH OF AXIS, BRANCHES, AND SPINES.

It is probable that spines and branches are homologous. They are both produced by series of hollow, superimposed chambers; but at a very early stage the spines become solid owing to the fact that there ceases to be any chamber between the successive laminæ of chitin.

The mode of growth appears to be very similar to that observed in *Gorgonia cavolinii* by von Koch (1887). After settling down and secreting a basal chitinous plate (text-fig. 13), the base of an antipatharian planula probably becomes invaginated, thereafter secreting a fresh chitinous dome-shaped plate (text-fig. 13, A). The ectoderm lining the invagination withdraws by successive stages from the last chitinous deposit, whilst the upper end of the animal continues to grow. By a continuation of this type of growth (text-fig. 14) a cylindrical axis, formed of domed chambers, is built up.

When, at certain points on the wall of this axis, the ectoderm withdraws, either spines or branches are developed by a similar process.*

Although very early growth-stages of *Antipatharia* do not appear to have been observed, some of the specimens contained in this collection, particularly those of *B. scoparia*, sp. n., very clearly demonstrate the method of growth, especially the origin of the axial canals. In this species forty-one chambers were counted in the distal 51 mm. of a branch (text-fig. 15), so that each chamber is relatively very long. As a rule the transverse walls appear to break down eventually, leaving a continuous axial canal, which increases slightly in diameter with age.* The canals in the bases of spines and in branches (text-fig. 16) never communicate with one another in any specimens that have been

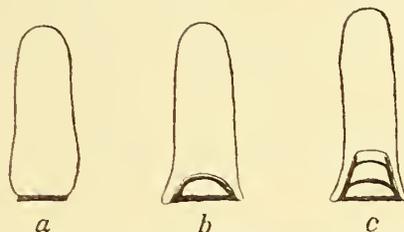


FIG. 13.—Hypothetical stages in the early development of *Antipatharia*. **A.** The planula has secreted a basal plate of chitin. **B.** The base of the animal has become invaginated, and has secreted a dome-shaped septum. **C.** A second septum and a further part of the cylindrical wall of the axis has been laid down.

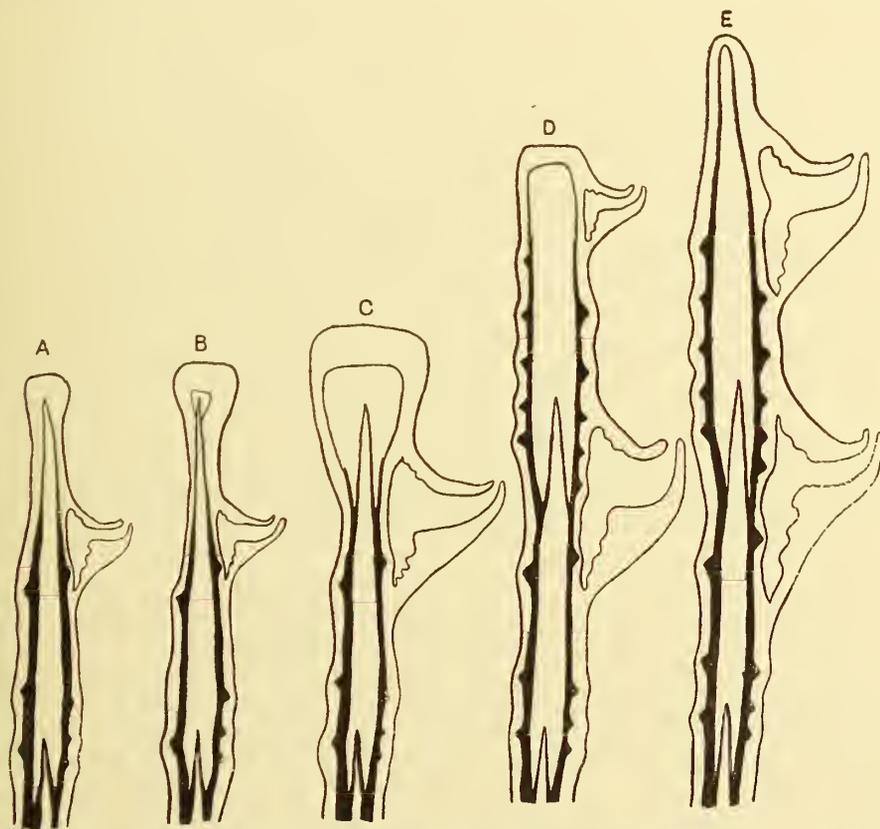


FIG. 14.—Diagrams to illustrate hypothetical growth of forms like *B. scoparia*. **A.** The cœnosarc is in contact with the tip of the axis. **B.** Incipient withdrawal of cœnosarc from the tip of the axis. **C, D.** Formation of the next axial chamber. **E.** A pause in the growth of the cœnosarc, which is now forming the apical part of the chitinous axial chamber.

* Dantan (1920) states that the axis is secreted by mesenchym, and is originally solid.

examined by the author ; but Forster Cooper (1909) makes a contrary statement in his description of *A. heterorhodzos*. The hollowness of spines is well shown in *A. lilliei*, sp. n. (text-fig. 3). When examining a thick antipatharian pinnule mounted as a transparency, it may often be noticed that there are a number of dark spots on the walls of the central canal, corresponding to the spines. These are the hollow spaces in the bases of the spines.

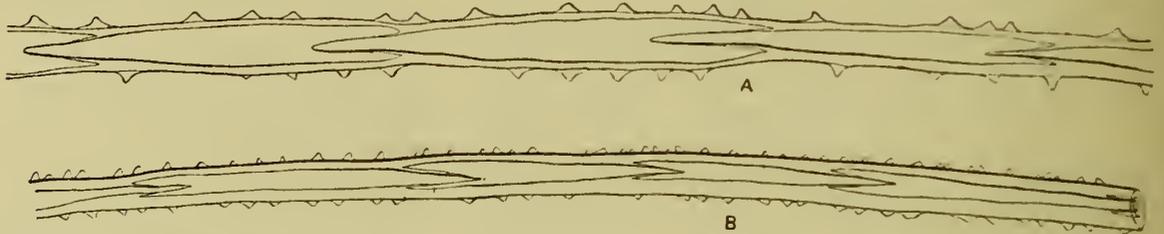


FIG. 15.—*Bathypathes scoparia*. A. Young branchlet ($\times 40$), showing spindle-shaped swellings. B. Branchlet, showing cylindrical outline, after further deposition of chitin ($\times 16$).

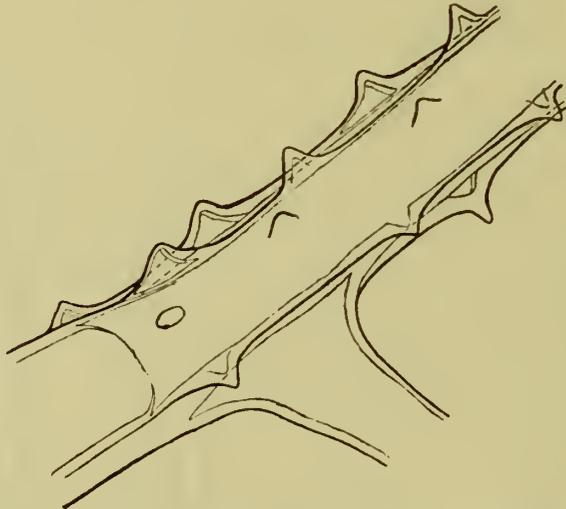


FIG. 16.—*A. lilliei*. Branchlet ($\times 135$), showing discontinuity between cavities in the hollow spines and the axial canal. The spines are connected by longitudinal ridges.



FIG. 17.—Diagrammatic section of the chitinous axial wall of an antipatharian to illustrate the cause of the varying degrees of diminution of the diameter of the axis following regeneration. The black sections show the thickness of the axial wall at the times of two different fractures.

Antipatharia, whose young branches show no traces of axial chambers, must be supposed to grow continuously, laying down chitin internally from the sides of the growing cylinder of cœnosarc, without a check in growth and consequent formation of end-walls or septa:

Roule (1905) observed and figured at the extreme tip of the conical end of

a branch of *Stichopathes*, sp., an open thin-walled cylindrical expansion of the axis. It is probable that the cœnosarc cap had been worn away from the tip of this axis.

Fracture of off-shoots takes place frequently, and is followed by regeneration. The truncated tube of cœnosarc covering the truncated axis probably forms an undifferentiated end-cap, which then grows as before and adds a new series of axial chambers to the truncated axis. Depending on the thickness of the axial wall at the time of fracture the decrease in the diameter of the regenerated off-shoot is more or less marked (text-fig. 17).

IV.—POLYCHÆTE COMMENSALS OF *ANTIPATHARIA*; WITH OBSERVATIONS ON COELENTERATE GALL- STRUCTURES.

An examination of numbers of *Antipatharia* from all seas shows that there are two classes of animals which commonly live domiciled on them, namely, *Cirripedia* and *Polychæta*: Steenstrup (1851) has described a mollusc, *Rhizochilus antipathum*, which attaches itself to an antipatharian, and thereafter becomes much modified; but this mollusc does not appear to be so common as the other two classes of commensal. Forming a secondary association, and living in the worm-“run” of certain forms, may be found small porcellanid crabs.* The type specimen of *Aphanipathes barbadensis*, Brook, bears, beside two specimens of these crabs, both cirripede and polychæte commensals.

Pourtalès (1867) described an association between a polychæte, *Marphysa antipathum*, and a pinnate antipatharian, *Antipathes filix*, along whose stem the worm builds a parchment-like tube armed with sponge spicules. In 1878 he described another antipatharian, *A. abietina*, which was constantly associated with a worm-tube. Brook (1889) described a further form, *A. cylindrica*, resembling in growth *A. abies* (Linn.), with horny worm-tubes somewhat like those of *Eunice tibiana* incorporated in the stem. In none of these does the antipatharian form reticulated worm-“runs”. In 1870 Duchassaing described a species, *Arachnopathes* (*Parantipathes*) *columnaris*, from Guadeloupe, which possessed a cylindrical reticulum, the nature of which he appears not to have understood. Pourtalès (1874) gave a further description and figure of a specimen from Barbados, pointing out that the reticulum was the habitation of an annelid and noting similar occurrences of “parasitic” annelids in *Lophohelia*, *Stylaster*, and *Allopora*. The collections of the U.S. S. “Blake” from N.E. of Cuba included more specimens of *A. columnaris*, which were described by Pourtalès (1878). He says, “Two specimens in the number are destitute of the parasitic worm and of the tube produced by it; their branchlets are more spiny, but the general shape is the same.” Brook (1889) described and figured *Antipathella*

* Hornell (1922) says that Porcellanids occur also as commensals on the Alcyonarian *Spongodes* in Indian seas, along with Galatheids, Synalpheids, and a Dromiid crab.

contorta and *Tylopathes crispera*, along parts of the stems of which are reticular "runs" inhabited by polychætes. Silberfeld (1909) gave descriptions and photographs of worm-"runs" in *Parantipathes tenuispina* from Sagami Bay, and Pesch (1914) gave further details of the "runs" in *P. columnaris* (Duchass.), Brook, mentioning that he observed several annelids in the lower half of one tube in this species and also in a specimen of *P. tenuispina* which he examined.

There is no evidence of parasitism; and it is difficult to imagine that the Antipatharians profit by the presence of the worms, which they are powerless to repel.

The question of interest in connexion with these reticulated worm-"runs" is whether or not they are merely abnormal growths solely due to the presence of commensal epizoites, and, if so, what the normal growth forms of the Antipatharians concerned is like. Pourtalès (1878) described two specimens of *A. (Parantipathes) columnaris* which lacked both commensal and reticulum, the general shape of the colony being otherwise the same as in those with reticula. In *Tylopathes crispera*, Brook (1889), the reticula on a specimen are localized, and we can see at once that they are solely due to the commensal worms: where the reticulations are absent there is merely a clear passage-way along the branches. In *A. myriophylla*, and other species which do not appear to have commensal worms, this passage-way is converted into an open channel, walled in at the sides by short processes standing out on each side from the lateral branchlets: in *A. spinescens*, Gray, these outstanding processes give rise to others, some of which arch over the channels, turning them into covered-in tunnels; as there is no sign of commensal worms, we suppose that this is the natural growth form of the Antipatharian.

Probably, in nature, active wandering polychætes roam about on the sea-bottom and explore the stems of organisms growing on it. In creeping about the branches of *Antipatharia* and *Alcyonaria* they find a very favourable habitat. In many *Antipatharia* there is a clear passage-way along the branches, which in some species is converted into an open channel or even a covered-in tunnel. On such forms the worms have made permanent homes* and have produced the reticulated runs, which may be regarded as abnormal growths or galls.

Similar associations between polychæte worms and Primnoid *Alcyonaria* have been noted from time to time, and are more common than is generally known. Analogous, too, are the tubular structures in *Solenocaulon* inhabited by Alpheid *Crustacea*, structures which Hickson (1903) suggests are of the nature of galls; the similar tubular structures on the stems of *Pennatula fimbriata*, Herklots, occupied by polychæte worms and described by Hickson (1916); and also the coral galls formed by females of the small crab *Hapalocarcinus marsupialis* on branches of *Seriatopora* and *Pocillopora*, described by Semper (1883).

In all these instances there seems to be an abnormal growth of the coelenterate

* Compare the occurrence of polychætes in the gastral cavities of Euretoid and other sponges, where the association has led to the remarkable modification of the worm seen in *Syllis ramosa*, McIntosh (1879).

associated with the presence of a commensal, which is analogous to the gall-formation in plants associated with insects, mites, and fungi. The difference between plant galls and the analogous structures in Cœlenterates is that in most of the latter the domiciled organism is constantly extending the field of stimulation; for example, there is in the collections of the British Museum a specimen of a Parantipathid with a reticulum no less than 35 centimetres long. In the case of cœlenterate gall-structures we do not know by what means the commensal influences the growth of its host; but in view of the fact that both are bathed in sea-water the influence is more likely to be mechanical than chemical, unless, indeed, mucus may prevent toxic substances from being washed away.

V.—CIRRIPEDE COMMENSALS OF *ANTIPATHARIA*; WITH DESCRIPTION OF A NEW SPECIES OF PEDUNCULATE CIRRIPEDE.

Darwin (1851) described the first cirripepe commensal with an Antipatharian, naming it *Oxynaspis celata*. Four other species of this genus have been described, namely, *O. patens*, Aurivillius (1894), *O. aurivillii*, Stebbing (1900), *O. indica*, Annandale (1914), and *O. bocki*, Nilsson-Cantell (1921). There are further species in the collections of the British Museum, in addition to the new species *O. terræ-novæ* described below. Species of *Oxynaspis* occur at Madeira, West Indies, Red Sea, Mauritius, Ceylon (Thomson and Simpson, 1905), Bay of Bengal (Annandale, 1909), Penang, Kei Islands, Tizard Bank (China Sea), Japan (Nilsson-Cantell, 1921), New Britain (Stebbing, 1900), Torres Straits, and off North Cape, New Zealand. It is noteworthy that, with the exception of *Dichelaspis tydemani*, Hoek* (1907), all the *Cirripehia Pedunculata* so far found upon *Antipatharia* belong to the genus *Oxynaspis*, species of which have not been found attached to anything but an antipatharian. Species of *Oxynaspis* are not confined to one genus of *Antipatharia*, but there are certain genera, such as *Schizopathes*, on which they have not yet been found.

Darwin's statement that the spiny membrane which covers the external surface of specimens of *Oxynaspis* is a continuation of the "horny muricated bark" of the Antipatharian has been doubted by several authors (Aurivillius 1894, Annandale 1909, Nilsson-Cantell 1921), but I can confirm in *Aphanipathes alata*, Brook, the statement by Annandale (1914) that the membrane may give off small, but normal branches of the Antipatharian, so that its nature seems to be beyond doubt.

* It is almost certain that this species was found upon an Antipatharian. The description reads, "The specimens are attached to long, yellowish-brown hairs or spines, which are hollow and bear triangular pointed teeth placed in irregular rows. They were taken, October 1899, near Saleyer anchorage, at a depth of 10-25 m."

Many of the branchlets of *Antipathes lilliei* at their proximal ends bear specimens of an Oxynaspid, which seems to be distinct from the five species hitherto known.

Oxynaspis terræ-novæ, sp. n.

Description.—**Valves** partly separated (text-fig. 18, A), a distinct interspace between middle lobe of scutum and basal part of tergum, and between scutum and upper (tergal) limb of carina. **Tergum** with basal (scuto-carinal) angle rounded. **Scutum** trilobed; rostral angle produced into a short spur, which forms the basal lobe; middle lobe largest, rounded, undivided, reaching lower (scutal) limb of carina; umbo slightly above middle of occludent margin; part above the umbo narrowed to form upper (tergal) lobe, which meets the tergum for a quarter of the length of its scutal margin; a furrow extending from the umbo to a notch which separates the rostral angle (basal lobe) from the middle lobe. **Carina** with umbo well below middle, distal (tergal) limb being $2\frac{1}{2}$ or more times the length of basal limb. **Peduncle** about the same length as capitulum, finely corrugated, springing from flared opening of tubular sheath, formed on chitinous axis of a branchlet of *Antipathes lilliei*. Capitulum and peduncle overgrown by antipatharian tissues, which cover the cirripede with a thin chitinous membrane bearing spines. **Caudal appendages** vestigial (text-fig. 18, c), each with two setæ. **Filamentary appendages**: dorsal absent, one pair at base of first pair of cirri (text-fig. 18, B). **Mandible** (text-fig. 18, E) with four teeth and an acute, serrated proximal angle. **Maxillula** (text-fig. 18, F) with inner edge hardly emarginate, with group of strong spines distally, and with very prominent spinose proximal angle. **Cirri** with long setæ on protuberances on basal segments except on basal parts of those of first pair, where they are reduced to short spinules (text-fig. 18, D). Two small conical bosses covered with short spinules present between bases of first cirri. **Ovigerous frena** finger-shaped (text-fig. 18, B) provided with a row of processes.

Remarks.—Only two complete specimens were found, of which one, the holotype, has been dissected, the valves and body being preserved in spirit, and certain appendages being mounted as microscopical slides. The paratype remains dry, and attached to a separated branch of the antipatharian. The size of some of the sheaths, from which the cirripedes have become detached, indicates that the holotype may be only half grown. The gross measurements of the holotype are as follows:—

Length over all (exclusive of sheath), 15.6 mm.

Length of peduncle, from sheath to middle lobe of scutum, 6.8 mm.

Length of capitulum, from apex of tergum to base of carina, 10.6 mm.

Width of capitulum (maximum), 6 mm.

Externally this species most nearly resembles *O. bocki*, Nilsson-Cantell, from which it differs in having an undivided and relatively larger central lobe to the scutum. The presence of filamentary appendages is noteworthy. Darwin (1851) said

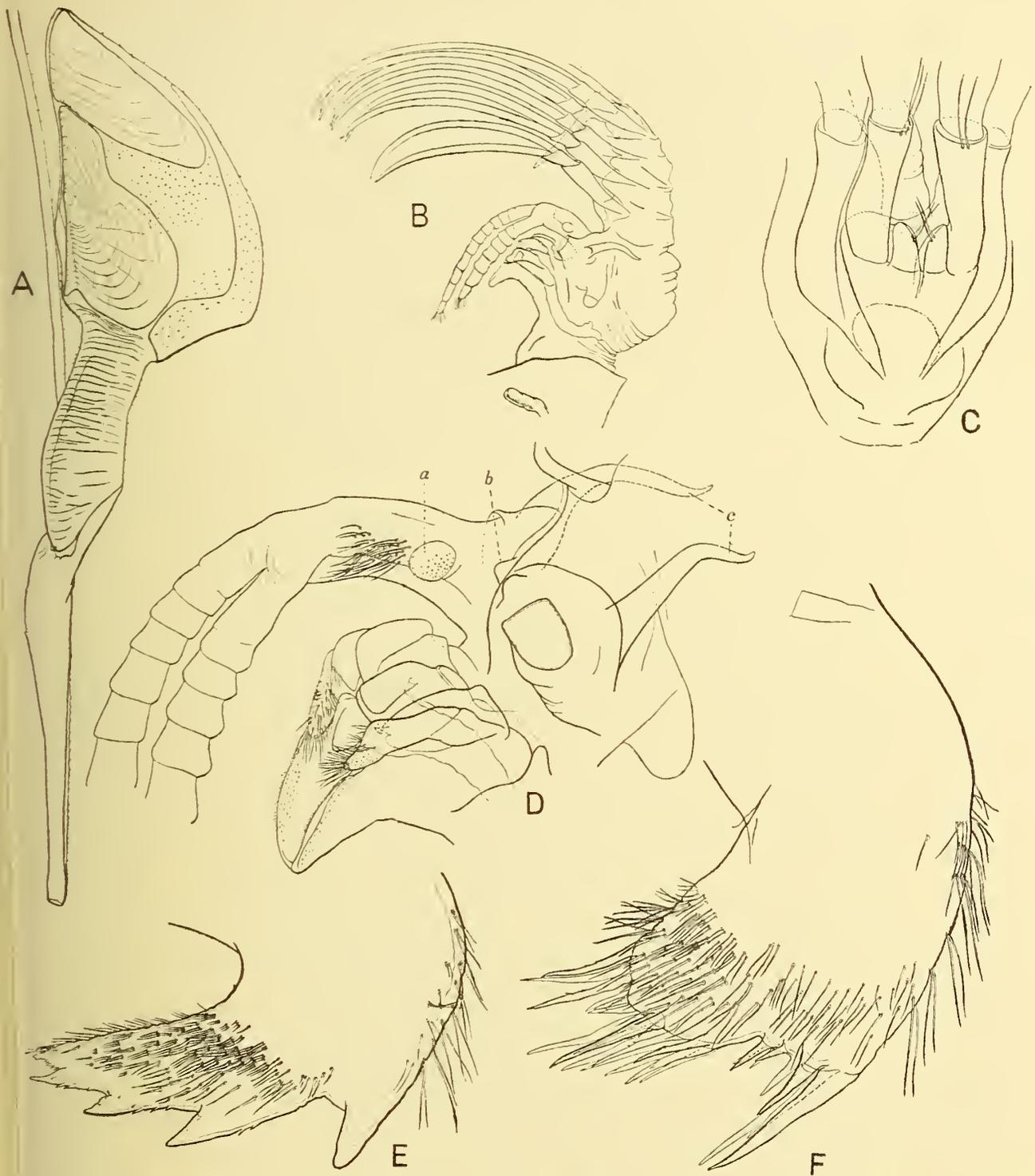


FIG. 18.—*Oxyaspsis terra-nova*. A. Holotype ($\times 5\frac{3}{4}$). The spiny chitinous antipatharian sheath investing the peduncle and capitulum is only partly indicated. B. The body removed from the valves ($\times 9$), to show the relative proportions of the cirri, filamentary appendage, and ovigerous frenum of the right side. C. Hind view of the body of the holotype ($\times 35$). Each caudal appendage bears two setae. D. The region of the bases of the first cirri ($\times 32$), showing the general arrangement of the mouth-parts, the short spinules on the basal part of the protolerance (a) on the proximal segment of the first cirrus, the bosses (b) between the bases of the first cirri, and the filamentary appendages (c). E. The right mandible ($\times 125$), inner surface, showing groups of setae set in depressions of the surface. F. Right maxillula ($\times 192$), inner face, showing double row of enlarged setae on the edge.

that in *O. celata* there appeared to be no filamentary appendages; but examples of this species from an antipatharian in the British Museum, which in all probability is the specimen from which Darwin removed his types, possess each a pair at the bases of the first cirri. On specimens of an unnamed species from the holotype of *Aphanipathes alata*, Brook, two dorsal appendages are present in addition. Accordingly the diagnosis of the family *Oxyrnaspidæ* given by Nilsson-Cantell (1921) needs revision.

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Cœlenterata, Part III.—Antipatharia, Pl. I.

PLATE I.

- FIG. 1.—*Antipathes lilliei*, sp. n. (nat. size); young branch, showing only one series of branchlets.
- FIG. 2.—*A. lilliei*; ($\times \frac{2}{15}$). Lateral view of holotype.
- FIG. 3.—*A. lilliei*; end view of branch ($\times \frac{1}{2}$) to show the four series of branchlets.
- FIG. 4.—*Aphanipathes barbadensis*, Brook; end view of the stem of the holotype ($\times 2\frac{1}{2}$), to show the formation of a 'worm-run' by overarching of the branchlets. (Cf. text-fig. 10, A).
- FIG. 5.—*Antipathes glutinata*, sp. n.; holotype (nat. size).
- FIG. 6.—*Bathypathes platycaulus*, sp. n.; the two holotype fragments ($\times \frac{2}{3}$). The tip of the apical portion on the right is recurved.



1.



2.



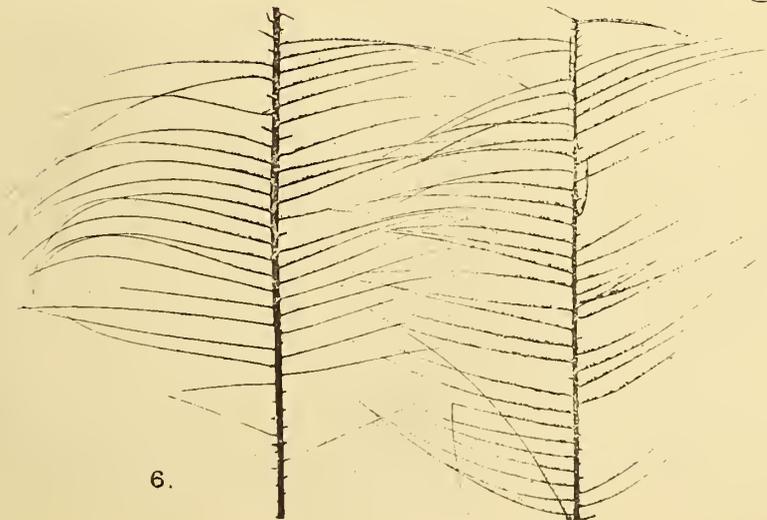
4.



3.



5.



6.

PLATE II.

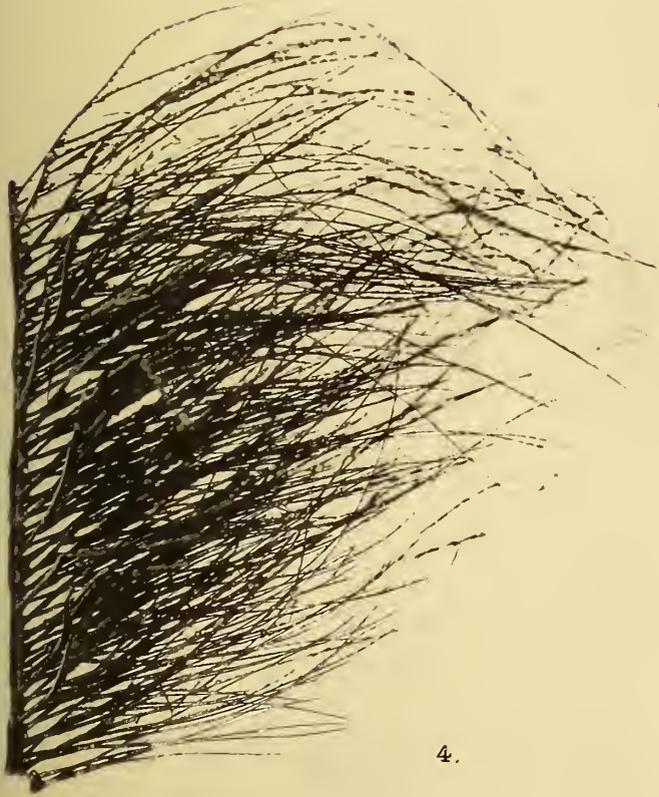
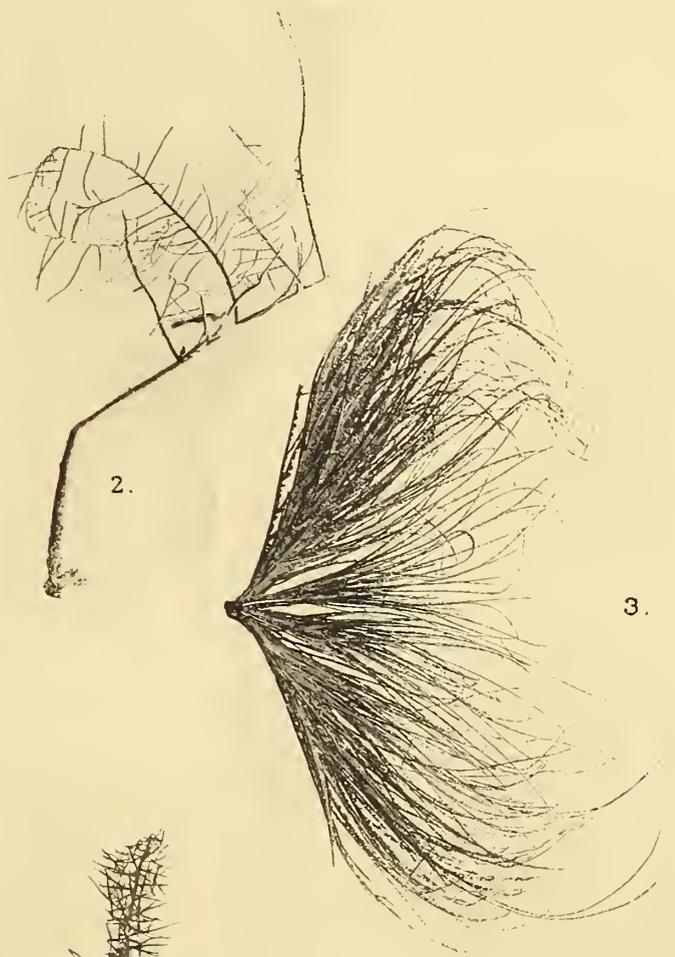
FIG. 1.—*Antipathes aperta*, sp. n. ; fragments of the holotype (nat. size).

FIG. 2.—*A. aperta* ; reconstructed holotype ($\times \frac{2}{3}$). Two commensal cirripedes may be seen at the bases of the lower branches.

FIG. 3.—*Bathypathes scoparia*, sp. n. ; fragment of the stem with four series of branches ($\times \frac{1}{2}$).

FIG. 4.—*B. scoparia* ; fragment of stem with branches ($\times \frac{1}{2}$) ; lateral view.

FIG. 5.—*Parantipathes tenuispina*, Silberfeld ; ($\times \frac{1}{1\frac{1}{2}}$).



BRITISH MUSEUM (NATURAL HISTORY).

BRITISH ANTARCTIC ("TERRA NOVA") EXPEDITION, 1910
NATURAL HISTORY REPORT.

ZOOLOGY. VOL. V, No. 4. Pp. 121-130.

COELENTERATA.
PART IV.—MADREPORARIA.
(b) Turbinolidae and Eupsammidae.

BY

J. STANLEY GARDINER, M.A., F.R.S., F.L.S.

WITH ONE PLATE.



LONDON:

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OLIVER & BOYD, TWEEDDALE COURT, EDINBURGH

AND AT

THE BRITISH MUSEUM (NATURAL HISTORY), CROMWELL ROAD, S.W.7

1929

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*This is No. 3 of 25 copies of
"Terra Nova" Zoology, Vol. V., No. 4,
Coelenterata, printed on Special paper.*

3 SEP 1929
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COELENTERATA.

PART IV.—MADREPORARIA.

(b) TURBINOLIDAE AND EUPSAMMIDAE.

BY J. STANLEY GARDINER, M.A., F.R.S., F.L.S.

WITH ONE PLATE.

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I. INTRODUCTION.

OF the Madreporarian corals obtained by the "Terra Nova" Expedition, those from the Atlantic Ocean and belonging to the genus *Favia* have been reported on by Prof. George Matthai (Zoology, Vol. V, No. 2, 1919). The remainder are discussed in this report.

The specimens were obtained in two widely distant areas, the Antarctic (Glacial) area of the Ross sea, and the temperate area north of New Zealand.

The following is a list of the species :—

ANTARCTIC

- Gardineria antarctica*, sp. n.
- „ *lilliei*, sp. n.
- Balanophyllia*, sp. ?
- Thecopsammia*, sp. ?

NEW ZEALAND

Flabellum harmeri, sp. n.*Gardineria*, sp. ?*Desmophyllum crista-galli* E. & H.*Caryophyllia profunda* Moseley.*Trochocyathus* [*Thecocyathus*], sp.*Dendrophyllia japonica* Rehb.

NOTES ON COLLECTING AND PRESERVATION.

The examination of large numbers of specimens of these deep sea and mostly solitary corals is exceedingly desirable, so that the criteria for species determination can be ascertained in each genus. Hence collectors should obtain as many specimens as possible. Indeed, in little-known seas I would submit that it would frequently be of more scientific value to put down the nets a second time on an area proved to be rich in organisms than to seek to explore a new line. Isolated hauls of dredge or trawl allow no certain deductions as to the nature of the bottom.

Solitary corals may all be preserved in the flesh, while for colonial corals I recommend drying, with a single piece of each mass, and with duplicate label, preserved. In the field, killing and preserving is usually one process. Clean and dirty alcohol and, to a lesser degree, different percentages of alcohols show different histological results, while iron salts produce abnormal appearances in the fibrillation, perhaps different coagulation appearances. Formalin tends to get acid and damages the corallum. On the whole I prefer spirit, and I think it as well to drop all corals into pure spirit 75–80 per cent., the bulk of spirit at least three times that of the corals, changed once before being finally stored. The flesh alters little or not at all in 30 years, provided that the corals are kept in the dark.

The research on corals of the last 30 years, particularly the lately issued catalogue of the British Museum, emphasizes the importance of the preservation and examination of the coral polyps. As there is a danger of going too far—and hence becoming unpractical—I record my opinion that, if the limits of one species of a genus are worked out on both soft and hard parts, the limits of all other species in the same genus will be found deducible with considerable certainty from hard parts alone. Pure histological studies had better be made in equipped laboratories rather than on the collections of expeditions not preserved for such purposes.

SYSTEMATIC NOTES AND DESCRIPTION OF NEW SPECIES.

Flabellum harmeri, n. sp. (Pl. I, figs. 19, 20.)

There are three specimens of which only one is adult. It has the same number of septa as *F. curvatum* Moseley but a very different shape. In this respect it is much

closer to *F. transversale* Moseley, but the latter is dense and heavy. The young forms have points of resemblance to *F. patagonichum* Moseley, but the adult is more compressed and there are 5 cycles of septa. These with *F. multifore* Gardiner and certain other species, the types of which I have not seen, seem to represent a form of growth, other forms being represented by *F. pavoninum*, *F. rubrum* and *F. japonicum*. Of these we have some knowledge of the *rubrum* and of the *pavoninum* forms,* but all others require to be correlated by a re-examination of the types and all other available material. A tentative description of the present species follows:—

The corallum is elongated, compressed, conical with rounded ends, the angle of the ends to the base of attachment being about 45°. Epitheca thin, transparent, with transverse growth rings outside and with little emphasis of septal ridges.

The mouth of the calicle is oval, the longer axis about double the shorter and the summit of the side wall about 1 cm. higher than at the ends. The septa are not exsert and slope inwards at an angle of less than 45° before they drop perpendicularly to the columellar junctions of the septa, which are situated about half-way down in the calicle. There are 5 complete cycles of septa with some septa of cycle VI. Three cycles fuse to form the trabecular columella, together with such septa of cycle IV as have septa of cycle VI in their part of the corallum. The septa are thin and delicate and tend to chip, giving an appearance of irregular teeth. Growth lines are visible on the septa, parallel to their edges and each covered with a line of spines.

Largest specimen 50 mm. high, with calicle 42 × 21 mm. A second dead specimen was clearly a little larger. Two young specimens 16 and 12 mm. high, with calicles about 13 × 9 mm. and 3 × 6 mm., have 12 septa fusing to form the columella, and most of the septa of cycles 3 and 4 are developed.

Station 91. Near Great King Island, N.Z., 300 fms.

GENUS GARDINERIA Vaughan.

Duncania, Pourtalès, Illustr. Cat. Mus. Comp. Zool., Harvard, VIII, 1874, p. 44; Duncan, Journ. Linn. Soc. Zool., XVIII, p. 32, 1885; Gardiner, Marine Investigations in S. Africa, III, p. 120, 1904. *Gardineria*, Vaughan, U.S. Nat. Mus., Bull. LIX, p. 65, 1907.

I accept Vaughan's statement that de Koninck in 1872 proposed the name *Duncania* for a carboniferous coral and only regret that Vaughan did not suggest a new generic name for Pourtalès' species. He unfortunately described a new genus, *Gardineria*, on a single specimen, giving as a character that "new coralla arise from the old by internal gemmation," a phenomenon which may be found in any of these solitary corals but presents rather a different appearance in the epithecate-walled coralla of *Rhizotrochus* and *Flabellum* to the coralla of *Desmophyllum*, etc., which are covered over by living tissues and are therefore thecate. I have already expressed my views on "stereoplasma." Any Turbinolid coral if growing under unfavourable conditions

* See especially Gardiner, Marine Investigations in S. Africa, II, pp. 114–154, 1902, and Vaughan, U.S. Nat. Mus., Bull. 59, pp. 48–64, 1907.

on the calicular surface tends to show such deposition of corallum filling in the inter-septal chambers. The contrast of the "multiple pillared columella" of Pourtalès with the "weak false columella" of Vaughan breaks down when the present specimens are examined. Clearly Vaughan's name must be adopted for the genus, with which *Rhizotrochus*, *Flabellum* and *Haplophyllia* are related, so far as the coralla are concerned.

Gardineria antarctica, n. sp. (Pl. I, figs. 11-18.)

The corallum is cylindrical with a widely open rounded calicle. It is sometimes obliquely attached and sometimes freed by the wearing away of its wall and base of attachment. The wall is a relatively thick epitheca, sometimes with circular growth markings (often overgrown by Polyzoa, worms, etc.), but where bare commonly showing low ridges over the attached edges of the septa. By secondary deposition of corallum within the cup, the wall and all calcareous structures are thickened as growth proceeds.

Twelve septa meet in the centre, each having 2 or 3 blunted teeth, otherwise their edges being smooth and straight. These are alternated by other 12 septa, which reach about half-way to the centre and then slope perpendicularly to the bottom of the cup. Between these there are a further 24 smaller septa, and there are some others of cycle V (20 in a corallum of 19 mm. diameter, while this cycle is nearly complete in a specimen of 26 mm.). The septa do not project above the edge of the epitheca, so that the saucer shape of the surface defined by their oral edges is conspicuous.

In the younger stages the first 6 septa meet in the centre of the corallum and may be joined by their twisted and folded edges. In the older stages there are 12 septa so joined and on this trabecular columella arise about 6 rather irregular pillars.

Station 314. Near Inaccessible Island, McMurdo Sound, 222-241 fms. 4 specimens measuring 26, 20, 19 and 17 mm. in diameter, by 28, 26, 22 and 21 mm. high, the first and last dead when obtained, the last an unattached cone.

Station 349, McMurdo Sound, 80 fms. 3 specimens 19, 17 and 11 mm. diameter by 20, 15 and 12 mm. high; the third dead, the second obviously immature in spite of its size with as yet no septa of cycle V and the columella rods not properly formed. I have also examined a broken-up specimen from the upthrust sea-muds S.E. of Mt. Larsen, collected in 1907 (?) by Prof. David (G 12103) and 2 fine specimens collected by Mr. R. Priestley at Evans Cove, Victoria Land, in a glacier 30 feet above the sea.

The coralla show considerable variation correlated with shape of growth, and this may affect the internal septa causing irregularities in their edges, particularly, as in a cornute form, where peculiarly rapid growth is required on one side, so that the polyp mouth may remain horizontal and rise above the bottom of the sea and its deposits, etc. The first teeth of the larger septa will probably be found at times to simulate pali, but the specimens before me are all clearly distinct from *D. capensis*, the type of

which is placed with them in the British Museum. The rings on the outside seem to be largely due to spurts in growth. An account of the polyp's anatomy is given below.

Gardineria lilliei, n. sp. (Pl. I, figs. 3-10.)

The corallum is similar to the last but the epitheca is an exceedingly thin wall, without much internal thickening by deposition of corallum, and the circular growth markings are more conspicuous and numerous.

The maximum number of septa meeting in the centre is 10 and the maximal total number is 34. They slope at an acute angle into the cup, the columella in which lies at a depth of the half at least of its diameter. The edges of the septa are generally smooth with few or no teeth, but they may be wrinkled. The sides of the septa are as in the last species smooth.

The fusion of the larger septa in the centre of the cup, forming a twisted mass of plates, may have upstanding plates or pillars; the whole forms a trabecular columella.

Station 194. Off Oates Land, 180-200 fms. The specimens are as follows: 13 mm. diameter \times 17 mm. high, 34 septa; 11 \times 17, 28; 10 \times 11, 32; 6 \times 22, 16; 12 \times 17, 31 (top partially broken); 10 \times 13, 32.

Gardineria, sp.

There are 3 further specimens from Station 96, New Zealand, 70 fms., of similar sizes and of similar delicacy. They differ in having the 4th cycle of septa more complete, the septal sides studded with low blunt spines and the septal edges at the level of the upstanding trabecular columella much twisted, the whole thus presenting a peculiarly rough appearance. There is also a specimen from Station 90 off Three Kings Islands, 100 fms., a bent horn 32 mm. maximal height with diameter of calicle about 11 mm. A further specimen from the same station, now much broken, was approximately 23 mm. in diameter by the same in height. It has similarly rough, twisted and spiny septa, and of these there are four full cycles (48) and a few septa of cycle V. I regard these 5 specimens as likely to prove to belong to the same species, and that may be an undescribed one for there are no clear intermediates to *D. lilliei*. I am not, however, going to give them a name for they may be 2 species—or even, a most unlikely supposition so far as the large form is concerned, growths under unfavourable conditions of *D. lilliei*.

Desmophyllum crista-galli Ed. & H.

Milne Edwards and Haime, Ann. Sci. Nat., Paris, IX, p. 253, pl. 7, fig. 10, 1848. See also for figures: Duncan, Trans. Zool. Soc., London, VIII, p. 321, pl. XLI, figs. 10-15, 1873; and Marenzeller, "Steinkorallen," Wiss. Ergebn. "Valdivia," VII, p. 267, pl. XV, fig. 2, 1904.

Two dried specimens, the second dead when dredged and a block growing with a species of *Stylaster*, retained in spirit. The largest calicle is 43 mm. long by 32 mm.

broad and about 65 mm. high. Both specimens show a number of small attached coralla. Some of these are *Desmophyllum*, collectively showing stages from 6 to 48 septa, 1 to 4 cycles; I think they are all *D. crista-galli*, believing the great exertness of its septa to be a gradual and later development. Other attached forms are young *Caryophyllia*. There is no columella of any sort, this with size being the chief difference from *D. ingens* Moseley.

Station 91. Near Great King Island, N.Z., 300 fms.

Caryophyllia profunda Moseley.

Report Sci. Res. H.M.S. "Challenger," Zoology II, Part III, 1881, pl. I, fig. 6.

There is a single corallum 24 × 16 mm. by 32 mm. high, which clearly belongs to the *clavus*-group. Perhaps it is that fossil species, but here it is assigned to *C. profunda*.

There is a number of young coralla from this station, some of which are young *Caryophyllia*, which at times is said to be exceedingly abundant, particularly between 100 and 200 fms. A large collection of any species would be of immense value so as to obtain the species-criteria for the genus.

Station 91. Off Great King Island, N.Z., 300 fms.

Trochocyathus [*Thecocyathus*], sp. ?

A single little cone, 10 mm. high, with calicle 7.5 mm. in diameter must be referred to this genus. It has theca and epitheca with growths of other organisms on the latter. I cannot judge whether this epitheca is a normal structure or not. Any polyp may form corallum for protection over any part of its ectoderm outside the tentacular ring. If it has a theca, a foraminiferan, a worm or a polyzoan may settle and kill the polyp tissues outside the same, the power of resistance to such varying very greatly in different polyps. Where the costae are conspicuously high, there are endoderm-lined tubes extending down between them, and the ectodermal tissues, for protection from such sedentary organisms, may form an extra epithecal wall, as perhaps may be the case here.

Station 91, off Three Kings Islands, N.Z., 300 fms. 1 specimen.

Thecopsammia, sp. ? *Balanophyllia*, sp. ?

There are six specimens from Station 91, three of which are covered by epitheca extending close up to the edge of the calicle (*Thecopsammia*), while the other three are smaller, more turbinate in shape, with only basal epitheca (*Balanophyllia*). A true epitheca, if theca be present, shows intercostal spaces, and this is true of some *Thecopsammia*. In *Balanophyllia* it is not unusual to find the base of the polyp killed by mud, etc., which sweeps over its tissues. The tissues join up and retract inwards depositing corallum between them and the mud, etc., usually retiring within the theca, the holes in which are completely blocked by the new corallum thus formed; the

resulting surface appearance of the corallum is such as to simulate true epithecal structures. The basal part of the corallum is, by a similar process, blocked up with solid corallum as the polyp grows and raises itself on its cup.

Unfortunately, neither species is identifiable with certainty, the species of both genera requiring thorough revision.

Station 191. Bay of Whales, 194-250 fms.

Dendrophyllia japonica Rehberg. (Pl. I, figs. 1, 2.)

Rehberg, "Neue und wenig bekannte Korallen," Abh. Naturw. Hamburg. XII, 1892, p. 28, pl. IV, fig. 4; van der Horst, Trans. Linn. Soc. Zool., XIX, p. 44, pl. 3, figs. 4-5, 1926.

The chief specimen is a colony 20 × 16 cm. diameter × 13 cm. high and consists of about forty corallites, which vary in size from 5 mm. diameter to 36 mm. diameter. It is formed entirely by low branchings on the outer surface of a giant corallite, and subsequently additional branchings from the corallites first formed. It was apparently lying freely on the bottom, its base being dead and largely overgrown by worm tubes. The photograph here published replaces further description.

There were also 3 single corallites obtained in the same dredging, one dead and two either dead or moribund; these were sent to Dr. van der Horst, who identified them as above, having compared them with Rehberg's type. He remarked, "In type specimens the calices are more oval and ribs better than in these dead pieces"; and these are characters which apply to the large colony. The septa number 6, 6, 12, 24, 48, by cycles, and seldom exceed these numbers. In the smallest calices there are 6 large septa and in the largest 24 of almost equal size, ordinary calices showing about 12. The smaller calices, even up to 12 mm. diameter, would be described as having no columella, whereas in the largest oval-shaped calices it extends to about 40 per cent. of the length of the calice, being 2-4 mm. broad and of a spongy texture.

These and other points in the skeletal structure lead me to doubt whether this species is not a synonym of a previously described species, but such points can only be determined on a large number of specimens. The polyp characters as seen in one series of sections show that it belongs to the same genus as *Dendrophyllia aurea* (Q. & G.) = *Coenopsammia willeyi* Gardiner, but the specimen was so hardened and stained by iron from the can that I am uncertain whether certain histological differences are not due to peculiar coagulation products resulting from the iron salts present in the spirit.

Station 91. Off Great King Island, N.Z., 300 fms.

NOTE ON THE ANATOMY OF GARDINERIA ANTARCTICA.

I have had cut serial transverse sections of a polyp of the above from station 314, 222-241 fms.; these are deposited in the British Museum for subsequent reference. The coral was 12 mm. across the calicle and the cut polyp measures 10 mm. in diameter. The general description of the polyp in relation to the corallum given by me for *Duncania* (now *Gardineria*) *capensis* * applies to this specimen. The differences lie in that the present species has 24 instead of 12 tentacles, and there are rather diffusely scattered circular muscular fibres, not a massed sphincter muscle. The common characters are no edge zone, mesenteries twice the number of septa, which hence are all entocoelic, 12 mesenteries reaching the stomodoeum, similar nematocysts to those found in the external ectoderm and in the ectoderm of the mesenterial filaments, no "nematocysts" in the endoderm, acontia present and generative organs in mesenteries of cycles I, II and III; most of these should prove to be generic characters.

The general structure of the polyps as well as its relationship to the corallum is so close to that of *Flabellum* that detailed description and figures are unnecessary. The 12 septa of cycles I and II are of equal size and are only separable in the fact that the mesenteries bounding half of them (cycle II) do not reach the stomodoeum; the directive mesenteries are clear but with fewer muscular fibres and less pleating than the others. There are 12 septa and 12 couples of mesenteries of cycle III and 5 septa and 5 couples of cycle IV. The tentacles lie over the septa and would seem to form 2 rings of 12 each, those over septa I and II slightly external in the expanded polyp. The couples of mesenteries concerned with each tentacle clearly extend for some distance, which I should estimate at something under 25 per cent. of its length, into each tentacle when fully expanded. Thickenings with nematocysts suggest the commencing formation of tentacles over the 5 septa of cycle IV. The polyp is female, but there are few eggs, usually 1 or 2 in a mesentery, most mesenteries without eggs; however, they occur in cycles I, II and III.

The polyp was not sufficiently well preserved to justify histological description, but it may be mentioned that the calicoblastic layer is everywhere well defined and similar to that described in *Flabellum*,† as are also the processes of attachment of the mesenteries to the corallum. The ridges in the stomodoeum over the mesenterial attachments of cycle I and the mesenterial filaments have the same histological elements and hence presumably the same functions, though in different degrees; their nematocysts are very sparingly present. The muscular fibres are well defined and the pleated mass of muscle in the middle of each mesentery is large; there are more muscular fibres on the opposite sides of the mesenteries than is usual in corals. The histological

* Gardiner, Marine Invest. S. Africa, III, pp. 106-127, 1904.

† Gardiner, Marine Invest. S. Africa, II, pp. 137-143, 1902.

appearance of the structureless lamella or mesogloea is such that I was impelled to re-examine this "layer" in a series of genera of solitary corals. I find, even in the same species, wide differences in the appearances after different methods of preservation. Cells that have taken up isolated positions in it are found in all the Zoantharia, but I can find no connectives between them. Some of the "fibres" seem to me to be tendinous in function, but others to be only explicable as coagulation products and hence not existent in the living polyps; I await further histological examination based on living corals before accepting Matthai's views.* I think the technique elaborated in the Madrid school of Ramón y Cajal is likely to yield valuable results.

There are throughout the endoderm of this polyp (not mesenterial filaments) round bodies, which are of the shape and size of the commensal algae found in similar positions in the reef corals, giving to these their characteristic green coloration and assisting in their respiration and feeding. They are generally round, and they possess a stained nucleus. The one or two vacuoles, characteristic of the reef commensals, are not usually present, but there is generally indication of one such space in a lighter area as the organism is focussed. For the rest their contents are little granular. While most are round, odd ones look as if they were disintegrating, being irregular, often rather oval. They are found everywhere in the above layer, and they are literally scattered not massed, their numbers in any part being proportional to the bulk of the endoderm that is present. I have found none in any part of the ectoderm, with which I include stomodoeum and mesenterial filaments, though a very few odd round similar-sized cells were found as inclusions in the latter.

There is no possibility of confusing the above bodies with nuclei or other tissue elements. Accordingly, we must regard them either as parasites, or as food cells or organisms carried into the coelenteron of the animal and absorbed into its endoderm. Their whole appearance is of plant cells, and they do not look like plant organisms or cells, which were in suspension in the water and have sunk about 200 fms. from the light zone so as to be available as food for our polyp. Such ingested food in reef and solitary corals is usually, if in the solid state, massed in the thick endodermal ridges behind and supporting the filaments †; and this is not the case here. While a very few of these cells may possibly be being digested, this is not a general but a very rare phenomenon.‡

Under these circumstances I am impelled to suggest that these small bodies are algae related to or the same as the commensal forms found in so many corals. If so,

* Quart. J. Micr. Sci. London, 67, pp. 103-122, 1923.

† Large masses of tissue are commonly held in the stomodoeum or between the mesenterial filaments, where they gradually break up into fine particles which are ingested by the endoderm of any part but mainly near the attachments of the filaments.

‡ In reef corals, if zooxanthellae are to be digested, this may be effected *in situ* in the endoderm, but in two cases I have seen they were cast out into the coelenteron as a preliminary to this process; the first change was the loss of their chlorophyll; the second a loss of their vacuole; and the third a crinkling and irregularity of their wall.

they have lost their chlorophyll and have hence become parasites upon our polyp. There is no difficulty in respect to the infection of new generations, since commensal algae in corals usually penetrate the young polyp either as an egg or in the early stages of its development, these being passed in the coelenteron of the mother. They are clearly not "the yellowish-green corpuscles of irregular shape" mentioned by Boschma as occurring in the endoderm of *Dendrophyllia micranthus* (Ehrb.) and *D. coccinea* (Ehrb.) *; I have failed to find these corpuscles or bodies similar to those now mentioned in *D. aurea* (Q. & G.) = *Coenopsammia willeyi* Gard., which is widely distributed over coral reefs, living generally in dark spaces under stones and in crevices of surface reefs, often between tide marks. As against this suggestion that these are algae, I have not found them in any of the *Flabellum* and other Turbinolidae from S. Africa (*loc. cit.*), amongst which *Heterocyathus aequicostatus* (Ed. and H.), 36-90 fms., is included. However, in one set of sections of the latter from the Ceylon Pearl Banks, about 5 fms., I have found similar bodies; they are nowhere numerous or massed, but they are mainly in the endoderm which immediately underlies the external ectoderm, the proper position for commensal algae.

* Boschma, Proc. Koninklijke Akad. Amsterdam, XXVII, p. 21, 1924; Gardiner, Willey's Zool. Results, pp. 357-80, 1900; van der Horst, Trans. Linn. Soc. Zool., XIX (I), p. 47, 1926.



PLATE I.

Dendrophyllia japonica Rehberg.

FIG. 1.—View of whole corallum. $\times \frac{7}{10}$

„ 2.—Oral view of the uppermost calice in Fig. 1. Below it is a small calice in which the columella is not yet developed. Nat. size.

Gardineria lilliei, sp. nov.

FIGS. 3-6.—Lateral view of four specimens. Nat. size.

„ 7-10.—Oral view of same specimens in same order. $\times 2$.

Gardineria antarctica, sp. nov.

FIGS. 11-12.—Oral view of specimens from Station 349. $\times 2$.

„ 13-14.—Oral view of specimens from Station 314. $\times 2$.

„ 15-16.—Lateral view of specimens shown in Figs. 11 and 12 respectively. Nat. size.

„ 17-18.—Lateral view of specimens shown in Figs. 13 and 14 respectively. Nat. size.

Flabellum harmeri, sp. nov.

FIG. 19.—Oral view. Nat. size.

„ 20.—Lateral view. Nat. size.





BRITISH MUSEUM (NATURAL HISTORY).

BRITISH ANTARCTIC ("TERRA NOVA") EXPEDITION, 1910
NATURAL HISTORY REPORT.

ZOOLOGY. VOL. V, No. 5. Pp. 131-252.

COELENTERATA.
PART V.—HYDROIDA.

BY

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WITH SEVENTY TEXT-FIGURES AND THREE PLATES.



LONDON:

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AND AT

THE BRITISH MUSEUM (NATURAL HISTORY), CROMWELL ROAD, S.W.7

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This is No. **3.** of 25 copies of
"Terra Nova" Zoology, Vol. V., No. 5,
Coelenterata, printed on Special paper.



HYDROIDA.

BY A. K. TOTTON.

Assistant Keeper in the Zoological Department, British Museum (Natural History).

WITH SEVENTY FIGURES IN THE TEXT, AND THREE PLATES.

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I. INTRODUCTION.

THE Hydroida collected during the voyage of the "Terra Nova" in the years 1910-13 were obtained in three widely distant areas: the Temperate area of Northern New Zealand; the Subantarctic (Magellan) area west of the Falkland Islands; and the Antarctic (Glacial) area of the Ross Sea and off the coast of Oates Land.

The dredge, trawl or tangle were used at 25 stations in all: Hydroids were taken at 16 of them. At these the bottom was either shingle, rock, rock and sand, shell, "undecomposed animal remains" or, as in the five McMurdo Sound stations, mud. At four of the remaining eleven stations where hydroids were not taken the bottom was mud, and at two others, sand.

Descriptions of the hydroids of the Ross Sea area have been given by Hickson and Gravely (1907), Ritchie (1913), and Jäderholm (1926). Although the hydroid fauna of the Antarctic is characteristic of, and to a great extent restricted to that area, we have not found as evidence for the long duration of this isolation that the hydroids have split up into a large number of greatly different types.

In general the Antarctic hydroid species are known with certainty only from the Antarctic or Subantarctic areas. Three of the Lafooid species are alleged to be more

nearly cosmopolitan, but the accurate delimitation of many Lafooid species is not at the moment possible, and the statement may not be correct.

The Expedition brought back only one new Antarctic hydroid, though it has been found necessary to give new names and specific descriptions for three forms already known from that area, but assigned to species to which they do not belong. Much additional information is given about most of the known species.

The cosmopolitan genus *Symplectoscyphus* is well represented in the Antarctic and Subantarctic areas, but other Sertulariid genera are absent.* There are no Antarctic Statoplean *Plumulariidae*, and the *Eleutheroplea* are represented only by the primitive genus *Oswaldella*, which is endemic and has two well separated species, and the cosmopolitan genus *Schizotricha*.

References to all the hitherto known hydroids of New Zealand, about 120 in number, can be found in four papers by Busk (1857), Jäderholm (1917), Bale (1924), and Trebilcock (1928). To this list have to be added twenty-seven new species and three old species. The Museum is fortunately rich in types of New Zealand species of Busk and Allman, several of them having been found and recognised for the first time during the preparation of this report.

As a result of the study of the collection it appears that sexual dimorphism is common amongst hydroids. In the genus *Symplectoscyphus*, for instance, it is important from a systematic point of view to note the shapes of the gonothecae of the two sexes. It is possible that in the past the two sexes of a single species have been described as distinct species.

It is desirable in making systematic studies of Hydroida to take measurements of the chitinous perisarc, and the points of reference used in making measurements should conform to a standard for each genus. The fact that all the repeated parts that go to form a colony may not be of one size must be allowed for. Presumably this variation in size is correlated with change of rate of growth from region to region. Again, in some species polyps periodically drop from their pedicels to be replaced by successively larger ones; whilst in racemose species the terminal polyps, which increase in size as growth proceeds, are much larger than those budded laterally from them. In pinnate species there is often a graded change in form and size from the proximal to the distal parts of any particular pinna. The basal theca of the hydroclade of a much ornamented species is often simpler and of ancestral type.

Attention may be directed here to the structure and homologies of corbulae. Billard (1913) rightly expressed the opinion that they were secondarily branched hydrocladia, but confirmed Allman's statement that the distal part of the costa was a replacement of the median nematotheca found below the theca (when present) on the basal part of the costa. Further study indicates that the primary hydroclade of the gonosome, which may be termed the *gonocladium*, may bear several orders of branches.

* *Selaginopsis pachyclada*, Jäderholm, appears to be a species of the Antarctic genus *Staurotheca*.

First of all there are the *gonohydrocladia*, known also as the *crêtes basales*, which often bear hydrothecae, and whose distal parts may be prolonged into small leaflets bearing nematothecae. The branches of the next order may be termed the *costae*. They arise from the gonohydrocladia at points between the infrathecal nematothecae and the hydrothecae. They form the main part of the corbulae and are provided with numerous nematothecae as a rule. The gaps between the bases of these costae are often filled up by a final order of branch, the *costal apophyses*, at the bases of which may be seen traces of the usual three nematothecae which surround a hydrotheca. The significance of these is that branches as a rule arise from the bases of hydrothecae.

Observations on the situation of nodes in the stems of *Sertularia marginata* have suggested an hypothesis which makes it possible to link up primitive species of *Sertularia* with those which show more advanced colonial characters.

In the course of a discussion of many questions of nomenclature in Part IV of this report, a selection of the genotypes of the following nine genera has been made:—*Atractylis*, Wright, 1858 (p. 139); *Stegopoma*, Levinsen, 1893 (p. 154); *Grammaria*, Stimpson, 1854 (p. 161); *Lictorella*, Allman, 1888 (p. 166); *Abietinella*, Levinsen, 1913 (p. 166); *Perisiphonia*, Allman, 1888 (p. 166); *Hincksella*, Billard, 1925 (p. 151); *Pycnotheca*, Stechow, 1919 (p. 214); and *Thecocalus*, Bale, 1915 (p. 217).

II. LIST OF SPECIES.

IN the following list the areas Antarctic (Glacial), Antarctic (Magellan), and Northern New Zealand are indicated by the initial letters A, M, and N.Z. respectively.

ATHECATA.

BOUGAINVILLIIDAE.

- A. *Hydronema angustum* (Hartlaub, 1904).
- A. *Gravelya antarctica* (Hickson and Gravelly, 1907).

EUDENDRIIDAE.

- A. *Eudendrium antarcticum*, nom. nov. (For *E. ramosum*, Hartlaub, 1904, not *E. ramosum* (L.) 1758).
- N.Z. *Eudendrium*, sp.

THECATA.

HALECIIDAE.

- A. *Ophiodissa arborea* (Allman, 1888).
- N.Z. *Ophiodissa armata*, sp. nov.
- A. *Halecium ovatum*, sp. nov.
- A. *Halecium antarcticum*, Vanhöffen, 1910.

CAMPANULARIIDAE.

- N.Z. *Tulpa diverticulata*, sp. nov.
 N.Z. *Clytia compressa*, sp. nov.
 A. *Campanularia hicksoni*, nom. nov. (For *C. laevis*, Hickson and G.,
 1907, not *C. laevis*, Hartlaub, 1905.)
 N.Z. *Billardia novae-zealandiae*, sp. nov.
 M.; A. *Billardia subrufa* (Jäderholm, 1904).

CAMPANULINIDAE.

- A. *Campanulina belgicac*, Hartlaub, 1904.
 A. *Stegella grandis* (Hickson and Gravely, 1907).
 N.Z. *Stegolaria irregularis*, sp. nov.
 N.Z. *Stegopoma fastigiatum* (Alder, 1860).

LAFOEIDAE.

- M. *Hebella striata*, Allman, 1888.
 A. *Hebella plana* (Ritchie). (For *H. striata*, Allm. var. *plana*, Ritchie,
 1907.)
 M. *Lafoca fruticosa*, Sars, 1862.
 A. *Lafoca dumosa* (Fleming, 1828).
 A. *Lafoca gracillima* (Alder, 1856).
 A. *Lafoca gaussica*, Vanhöffen, 1910.
 A. *Reticularia antarctica* (Hartlaub, 1904).
 N.Z. *Acryptolaria minima*, sp. nov.
 N.Z. *Acryptolaria conferta* (Allman, 1877), var. *australis* (Ritchie, 1911).
 N.Z. *Zygophylax unilateralis*, sp. nov.
 N.Z. *Zygophylax sibogac*, Billard, 1918.

SYNTHECIIDAE.

- N.Z. *Synthecium ramosum*, Allman, 1885.
 N.Z. *Synthecium carinatum*, sp. nov.
 N.Z. *Synthecium robustum*, sp. nov.
 N.Z. *Synthecium longithecum*, sp. nov.
 A. *Staurotheca dichotoma*, Allman, 1888.
 A. *Staurotheca antarctica*, Hartlaub, 1904.

SERTULARIIDAE.

- N.Z. *Parascyphus simplex* (Lamouroux, 1816).
 N.Z. *Symplectoscyphus columnarius* (Briggs, 1914).
 N.Z. *Symplectoscyphus constrictus*, sp. nov.
 N.Z. *Symplectoscyphus johnstoni* (Gray, 1843).
 N.Z. *Symplectoscyphus delicatulus* (Hutton, 1872).
 N.Z. *Symplectoscyphus spiritualis*, sp. nov.
 N.Z. *Symplectoscyphus confusus*, sp. nov.

- N.Z. *Symplectoscyphus epizooticus*, sp. nov.
 N.Z. *Symplectoscyphus tuba*, sp. nov.
 A. *Symplectoscyphus vanhoeffeni*, nom. nov. (For *Sertularella subdichotoma*, Vanh., 1910, not *S. subdichotoma*, Kirchenpauer, 1884.)
 A. *Symplectoscyphus glacialis* (Jäderholm).
 A. *Symplectoscyphus curvatus* (Jäderholm, 1917).
 A. *Symplectoscyphus plectilis* (Hickson and Gravely, 1907).
 M. *Symplectoscyphus filiformis* (Allman, 1888).
 N.Z. *Sertularella robusta*, Coughtrey, 1876.
 N.Z. *Sertularella geodiae*, sp. nov.
 N.Z. *Sertularella spiralis*, Hickson and Gravely, 1907.
 A. *Sertularella elongata*, Jäderholm, 1904.
 A. *Sertularella biformis*, Jäderholm, 1905.
 N.Z. *Sertularella edentula*, Bale, 1924.
 N.Z. *Dictyocladium moniliferum* (Hutton, 1873).
 N.Z. *Sertularia unguiculata*, Busk, 1852.
 N.Z. *Sertularia marginata* (Kirchenpauer, 1864).
 N.Z. *Crateritheca zelandica* (Gray, 1843).

PLUMULARIIDAE.

- A. *Oswaldella bifurca* (Hartlaub, 1904).
 A. *Oswaldella antarctica* (Jäderholm, 1904).
 N.Z. *Antennella ritchiei*, sp. nov.
 N.Z. *Antennella serrata*, sp. nov.
 N.Z. *Pycnotheca mirabilis* (Allman, 1883).
 N.Z. *Halopteris constricta*, sp. nov.
 N.Z. *Halopteris heterogona* (Bale, 1924).
 N.Z. *Halopteris campanula* (Busk), var. *zelandica*, var. nov.
 N.Z. *Plumularia pulchella*, Bale, 1862.
 N.Z. *Plumularia diploptera*, sp. nov.
 N.Z. *Plumularia spirocladia*, sp. nov.
 N.Z. *Plumularia triangulata*, sp. nov.
 N.Z. *Plumularia brachiata*, sp. nov.
 N.Z. *Plumularia tenuissima*, sp. nov.
 N.Z. *Nemertesia elongata*, sp. nov.
 A. *Schizotricha unifurcata*, Allman, 1883.
 N.Z. *Aglaophenia laxa*, Allman, 1876.
 N.Z. *Thecocarpus ctenatus*, sp. nov.
 N.Z. *Thecocarpus rostratus* (Bale, 1924).
 N.Z. *Thecocarpus spiralis*, sp. nov.
 N.Z. *Thecocarpus chiltoni*, Bale, 1924.
 N.Z. *Halicornaria regalis*, sp. nov.

III. LIST OF STATIONS.

THE following is a list of the localities at which Hydroida were collected by the Expedition, with the nature of the bottom and the gear used at each.

Station 38. West of Falkland Islands, April 13, 1913; lat. 52° 23' S., long. 63° 50' W.; depth 125 fathoms (229 m.). Agassiz trawl.

<i>Billardia subrufa.</i>	<i>Stegella grandis.</i>
<i>Hebella striata.</i>	<i>Staurotheca antarctica.</i>
<i>Lafaea fruticosa.</i>	<i>Symplectoscyphus filiformis.</i>

Station 90. Off Northern New Zealand, July 25, 1911; from Summit, Great King, Three Kings Islands, S. 14° W., 8 miles; depth 100 fathoms (183 m.); bottom, rock. Dredge.

<i>Billardia novae-zealandiae.</i>	<i>Pycnotheca mirabilis.</i>
<i>Symplectoscyphus columnarius.</i>	<i>Halopteris heterogona.</i>
<i>Symplectoscyphus tuba.</i>	<i>Nemertesia elongata.</i>
<i>Sertularella geodiae.</i>	<i>Thecocarpus rostratus.</i>
<i>Sertularella edentula.</i>	<i>Thecocarpus spiralis.</i>
<i>Dictyocladium moniliferum.</i>	<i>Thecocarpus chiltoni.</i>
<i>Crateriheca zelandica.</i>	<i>Halicornaria regalis.</i>
<i>Antennella serrata.</i>	

Station 91. Off Northern New Zealand, July 26, 1911; from Summit, Great King, Three Kings Islands, S. 10° W., 25 miles; depth 300 fathoms (549 m.); bottom, rock. Dredge.

<i>Ophiodissa armata.</i>	<i>Symplectoscyphus confusus.</i>
<i>Tulpa diverticulata.</i>	<i>Symplectoscyphus epizooticus.</i>
<i>Stegopoma fastigiatum.</i>	<i>Antennella ritchiei.</i>
<i>Reticularia, sp.</i>	<i>Halopteris campanula, var. zelanica.</i>
<i>Acryptolaria conferta.</i>	<i>Plumularia triangulata.</i>
<i>Zygophylax unilateralis.</i>	<i>Plumularia tenuissima.</i>
<i>Zygophylax sibogae.</i>	<i>Thecocarpus ctenatus.</i>
<i>Synthecium longithecum.</i>	<i>Thecocarpus chiltoni.</i>
<i>Symplectoscyphus constrictus.</i>	

Station 96. Off Northern New Zealand, August 3, 1911; 7 miles East of North Cape; depth 70 fathoms (128 m.); bottom, sand and rock. Agassiz trawl.

<i>Stegolaria irregularis.</i>	<i>Sertularella geodiae.</i>
<i>Acryptolaria conferta var. australis.</i>	<i>Plumularia brachiata.</i>

Station 134. Off Northern New Zealand, August 31, 1911; Spirits Bay, near North Cape; depth 11-20 fathoms (20-37 m.); bottom, shelly. Dredge.

<i>Eudendrium, sp.</i>	<i>Sertularia unguiculata.</i>
<i>Clytia compressa.</i>	<i>Sertularia marginata.</i>
<i>Acryptolaria minima.</i>	<i>Pycnotheca mirabilis.</i>
<i>Synthecium carinatum.</i>	<i>Halopteris campanula, var. zelanica.</i>
<i>Synthecium robustum.</i>	<i>Plumularia pulchella.</i>
<i>Symplectoscyphus spiritualis.</i>	<i>Plumularia diploptera.</i>
<i>Sertularella robusta.</i>	<i>Plumularia spirocladia.</i>
<i>Dictyocladium moniliferum.</i>	<i>Aglaophenia laxa.</i>
<i>Parascyphus simplex.</i>	

Station 144. Off Northern New Zealand, September 13, 1911; from Cape Maria van Diemen, West by South, 7 miles (true bearing); depth 35–40 fathoms (64–73 m.); bottom, rock. Dredge.

<i>Billardia novae-zealandiae.</i>	<i>Antennella serrata.</i>
<i>Acryptolaria minima.</i>	<i>Pyrotheca mirabilis.</i>
<i>Synthecium carinatum.</i>	<i>Halopteris constricta.</i>
<i>Synthecium ramosum.</i>	<i>Halopteris heterogona.</i>
<i>Symplectoscyphus johnstoni.</i>	<i>Plumularia diploptera.</i>
<i>Symplectoscyphus delicatulus.</i>	<i>Plumularia spirocladia.</i>
<i>Symplectoscyphus spiritalis.</i>	<i>Aglaophenia laxa.</i>
<i>Sertularia unguiculata.</i>	<i>Thecocarpus rostratus.</i>
<i>Crateritheca zelandica.</i>	<i>Thecocarpus chiltoni.</i>

Station 194. Off Oates Land, February 22, 1911; lat. 69° 43' S., long. 163° 24' E.; depth 180–200 fathoms (329–366 m.); bottom, undecomposed animal debris. Agassiz trawl.

<i>Eudendrium antarcticum.</i>	<i>Staurotheca dichotoma.</i>
<i>Hebella striata.</i>	<i>Staurotheca antarctica.</i>
<i>Lafoea dumosa.</i>	<i>Symplectoscyphus (?) glacialis.</i>
<i>Lafoea gaussica.</i>	<i>Sertularella spiralis.</i>

Station 220. Off Cape Adare, January 3, 1912; mouth of Robertson's Bay; depth 45–50 fathoms (82–92 m.); bottom, shingle. Agassiz trawl.

<i>Gravelya antarctica.</i>	<i>Symplectoscyphus glacialis.</i>
<i>Halecium ovatum.</i>	<i>Symplectoscyphus curvatus.</i>
<i>Campanularia hicksoni.</i>	<i>Symplectoscyphus biformis.</i>
<i>Lafoea gracillima.</i>	<i>Sertularella spiralis.</i>
<i>Reticularia antarctica.</i>	<i>Oswaldella antarctica.</i>
<i>Staurotheca dichotoma.</i>	<i>Schizotricha unifurcata.</i>
<i>Symplectoscyphus vanhoeffeni.</i>	

Station 294. Ross Sea, January 15, 1913; lat. 74° 25' S., long. 179° 3' E.; depth 158 fathoms (289 m.); bottom (?). Agassiz trawl.

Halecium antarcticum.

Station 316. McMurdo Sound, February 9, 1911; off Glacier Tongue, about 8 miles North of Hut Point; depth 190–250 fathoms (348–457 m.); bottom, mud and undecomposed animal remains. Agassiz trawl.

<i>Gravelya antarctica.</i>	<i>Symplectoscyphus glacialis.</i>
<i>Reticularia antarctica.</i>	<i>Symplectoscyphus plectilis.</i>
<i>Staurotheca dichotoma.</i>	<i>Schizotricha unifurcata.</i>
<i>Staurotheca antarctica.</i>	

Station 331. McMurdo Sound, January 14, 1912; off Cape Bird Peninsula; depth 250 fathoms (457 m.); bottom, mud. Dredge.

Ophiodissa arborea.
Symplectoscyphus plectilis.

Station 338. McMurdo Sound, January 23, 1912; lat. 77° 13' S., long. 164° 18' E.; depth 207 fathoms (379 m.); bottom, mud. Agassiz trawl.

<i>Billardia subrufa.</i>	<i>Staurotheca antarctica.</i>
<i>Campanulina belgicae.</i>	<i>Sertularella spiralis.</i>
<i>Hebella plana.</i>	

Station 339. McMurdo Sound, January 24, 1912; lat. 77° 5' S., long. 164° 17' E.; depth 140 fathoms (256 m.); bottom, mud. Agassiz trawl.

<i>Eudendrium antarcticum.</i>	<i>Staurotheca antarctica.</i>
<i>Halecium antarcticum.</i>	<i>Symplectoscyphus vanhoeffeni.</i>
<i>Billardia subrufa.</i>	<i>Symplectoscyphus plectilis.</i>
<i>Lafoea gaussica.</i>	<i>Sertularella elongata.</i>
<i>Reticularia antarctica.</i>	<i>Oswaldella bifurca.</i>

Station 340. McMurdo Sound, January 25, 1912; lat. 76° 56' S., long. 164° 12' E.; depth 160 fathoms (293 m.); bottom, mud. Agassiz trawl.

<i>Stegella grandis.</i>	<i>Symplectoscyphus vanhoeffeni.</i>
<i>Staurotheca antarctica.</i>	<i>Oswaldella bifurca.</i>

Station 355. McMurdo Sound, January 20, 1913; lat. 77° 46' S., long. 166° 8' E.; depth 300 fathoms (549 m.); bottom (?). Agassiz trawl.

<i>Ophiodissa arborea.</i>	<i>Hebella plana.</i>
----------------------------	-----------------------

Station 356. Entrance to McMurdo Sound, January 22, 1913; off Granite Harbour; depth 50 fathoms (92 m.); bottom, mud. Agassiz trawl.

<i>Hydronema angustum.</i>	<i>Lafoea gracillima.</i>
<i>Gravelya antarctica.</i>	<i>Staurotheca dichotoma.</i>
<i>Eudendrium antarcticum.</i>	<i>Symplectoscyphus glacialis.</i>
<i>Ophiodissa arborea.</i>	<i>Symplectoscyphus vanhoeffeni.</i>
<i>Campanularia hicksoni.</i>	<i>Symplectoscyphus plectilis.</i>
<i>Campanulina belgicae.</i>	

IV. DESCRIPTION OF GENERA AND SPECIES.

BOUGAINVILLIIDAE.

Hydronema angustum (Hartlaub).

Hydractinia angusta, Hartlaub, 1904, p. 7, pl. IV, figs. 1-7; *H. dendritica*, Hickson and Gravelly, 1907, p. 9, pl. II, figs. 7-10; *Hydronema dendriticum*, Stechow, 1921, p. 252; 1923 c, p. 67, fig. F.; *Hydronema angustum*, Stechow, 1923 c, p. 67.

Material.—A small quantity without gonophores, encrusting *Symplectoscyphus vanhoeffeni* from Station 356, McMurdo Sound, 50 fathoms, Jan. 22, 1913.

Remarks.—The material is badly preserved, and most of the polyps are retracted. Some small blastostyles with two or three tentacles are present, but there is no trace of gonophores or dactylozooids. Since Hickson and Gravelly's "specimen A" and "specimen B" of *H. dendritica* are so different from one another, though indubitably belonging to the same species, it seems reasonable to suppose that Hartlaub's *H. angusta* falls within the range of variation and is conspecific. I have re-examined the specimens of *H. dendritica*. They are very well preserved, though Hickson and Gravelly's interesting figured specimen which links the two facies together, and which I hereby

select as the holotype of *H. dendritica*, H. and G., has become badly discoloured by cork. The basal encrusting piece ("facies A") and free branching piece ("facies B") have become separated, though there are still portions of the two facies united.

In several polyps there has been a partial division of the oral region, some having two mouths, and one at least having three heads. The blastostyles may have as few as two tentacles, and there does not appear to be a complete discontinuity between small blastostyles and large gastrozooids.

Parts of "specimen A" are encrusting a slender branching undescribed Axinellid sponge. I regard it as an encrusting facies. Stechow (1923) is of the same opinion.

GENUS GRAVELYA, gen. nov.

Genotype.—*Perigonimus antarcticus*, Hickson and Gravely, 1907, p. 4, pl. I, figs. 1-3, pl. IV, fig. 32.

Description.—Monoecious *Bougainvillidae* with numerous dimorphic cryptome-dusoid gonophores scattered over the hydrorhiza.

Remarks.—The genotype was referred by Vanhöffen (1910) to the genus *Atractylis*, Wright, 1858, genosyntypes: *Eudendrium ramosum*, van Bened., 1844 (non *E. ramosum*, L.) = *Bougainvillia ramosum* (v. Bened.); *Eudendrium repens*, Wright, 1858 = *Perigonimus repens* (Wright); and *Eudendrium sessile*, Wright, 1857 = *Perigonimus sessilis* (Wright). I select *Eudendrium ramosum*, van Beneden, 1844, as the genotype of *Atractylis*, Wright, 1858. *Atractylis* is now sunk in the synonymy of *Bougainvillia*, Lesson, 1836. *Atractylis arenosa*, Alder, 1862, needs a new generic name. Allman (1872) had restricted *Atractylis* to this same species which is not a genosynotype. At the same time he needlessly rejected *Atractylis* as preoccupied for a plant by Linnaeus, and replaced it by *Wrightia*. But this name also was preoccupied by Agassiz, 1862. It can be used only for one of its three genosyntypes, *Sertularia syringa*, L., *Laomedea acuminata*, Alder, and *L. lacerta*, Wright.

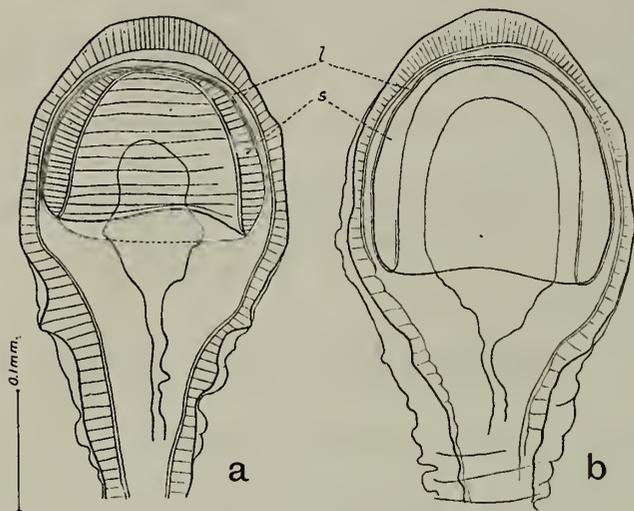
Perigonimus antarcticus, H. and G., 1907, does not appear to be congeneric with either *P. muscoides*, Sars, the genotype of *Perigonimus*, or *Atractylis arenosa*, Alder. I take it as the genotype of a new genus *Gravelya*, and as the holotype I select a specimen marked Brit. Mus. Reg. No. 07.8.20.1.

Gravelya antarctica (Hickson and Gravely). (Text-fig. 1, a-b.)

Perigonimus, sp., Hartlaub, 1904, p. 8, pl. I, fig. 2; *P. antarcticus*, Hickson and Gravely, 1907, p. 4, pl. I, figs. 1-3, pl. IV, fig. 32; *Atractylis antarctica*, Vanhöffen, 1910, p. 283, fig. 8; *Atractylis antarcticus*, Ritchie, 1913, p. 11.

Material.—Numerous hydranths and male gonophores arising from stocks that creep over *Ophiodissa*, *Symplectoscyphus* and other hydroids from Station 356, entrance to McMurdo Sound, 50 fathoms; and from Station 220, off Cape Adare, 45-50 fathoms. A few hydranths and gonophores on *S. glacialis* from Station 316, McMurdo Sound, 190-250 fathoms.

Description.—Mature male gonophores have a length of 0.61 mm., half of which represents the pedicel, and a greatest diameter of 0.24 mm. In comparison with that



TEXT-FIG. 1.—*Gravellya antarctica* (Hickson and Gravelly). Male gonophores showing thimble-shaped spermary *s*, and endoderm lamella *l*. $\times 32$.

figured by Hickson (1907) the pedicel is longer and the passage of pedicel into gonophore is more abrupt, often being marked by a distinct shoulder. The ectoderm bears numerous nematocystae and is thickened to form an apical pad. The pedicel is surrounded by a loose folded perisarc, which thins out and becomes invisible distally.

In young stages what appears to be a "glockenkern" is visible. In maturer forms a thimble-shaped spermary can be seen seated on the endodermal spadix, which is short and broad with a distinct cavity.

In optical section there appears to be a continuous endodermal lamella surrounding the spermary and there are indications of a slit-like subumbrella cavity.

The male gonosome, according to this interpretation of its structure, would therefore be a transition between a lowly cryptomedusoid and a styloid form; but the material is hardly well enough preserved for the study of its minute structure.

EUDENDRIIDAE.

Eudendrium antarcticum, nom. n.

E. ramosum, Hartlaub, 1904, pl. I, fig. 3; *E. capillare*, Billard, 1906, p. 4; *E. insigne*, Hickson and Gravelly, 1907, p. 7, pl. I, fig. 4; *E. ramosum*, Vanhöffen, 1910, p. 288, fig. 13; *E. ramosum*, Ritchie, 1913, p. 12; *E. ramosum*, Billard, 1914, p. 2; *E. capillare*, Billard, 1914, p. 2; ? *E. rameum*, Jäderholm, 1905, p. 10.

Material.—Three branched fragments up to 1.5 cm. in length, with contracted hydranths but no gonophores, from Station 356, entrance to McMurdo Sound, 50 fathoms; a few specimens from Station 339, McMurdo Sound, 140 fathoms; and a small branched specimen 3 cm. in height from Station 194, off Oates Land, 180–200 fathoms.

Description.—Stem fascicled by addition of stolons, except in young specimens not exceeding 2.5 cm. in height. Branching irregular and lax. Perisarc regularly ringed at bases of branches, and irregularly for short distances in other parts of stem and branches. An annular constriction in the base of the hydranth, with a narrowed pedicel joining hydranth to ramulus. Ramuli of hydranths that bear female gono-

phores short and irregularly ringed. Female gonophores irregularly distributed on hydranth, which retains its tentacles. Hydranths with from 15 to 30 contractile filiform tentacles.

Measurements :

Hydranth, without tentacles—										mm.
length	..	..	..	..	..	..	..	..	..	0.37-0.56
diameter	..	..	..	..	..	..	..	..	..	0.17-0.22
Hydrocaulus, diameter	..	..	..	..	..	..	..	..	..	0.10-0.12

Remarks.—There appears to be only one delicate little species of *Eudendrium* so far recorded from the glacial Antarctic waters. Although it has been assigned to several species it is very doubtful whether it is conspecific with any of them. From Vanhöffen's summary of our knowledge of it the above description has been drawn. He assigns it to *E. ramosum* (L.) because of its fascicled creeping stem, the restriction of perisarcal rings to short stretches, especially at the bases of branches, the loose branching system and the presence of tentacles on the hydranth that bears the female gonophores. But *E. ramosum* (L.) seems to be a much more robust and more regularly branched species.

It will be convenient therefore to give to the present form a new name and description. I select as holotype of *E. antarcticum* a specimen bearing the British Museum register number 07.8.20.3. It was taken by the "Discovery" expedition of 1901-04 and described by Hickson and Gravely as *E. insigne*, Hincks.

An annular groove near the base of the hydranth, first noticed in *E. insigne* by Hincks and later referred to by Hickson and Gravely in this Antarctic species is present also in other species. Further investigation of well preserved specimens will probably show that this is a generic character.

In giving measurements of the hydranths of *Eudendrium* it must be remembered that recently budded hydranths are very much smaller than the terminal hydranths of older branches.

Eudendrium, sp.

? *E. novae-zelandiae*, Markt. T. 1890, p. 201, pl. III, fig. 21.

Material.—A young sterile specimen 5.5 cm. in height from St. 134, near North Cape, N.Z., 11-20 fathoms.

Remarks.—It is very difficult to select characters for the critical diagnosis of species of this easily recognisable genus.

The form under report has a polysiphonic stem, which is not annulated throughout.

Only one record of a specimen of *Eudendrium* appears to have been made from N. Zealand, and that in 1890 by Marktanner-Turneretscher for a new species *E. novae-zelandiae*. It was of the same size as the "Terra Nova" specimen, which may perhaps belong to the same species. It is difficult, however, to extract from the original description any diagnostic specific characters.

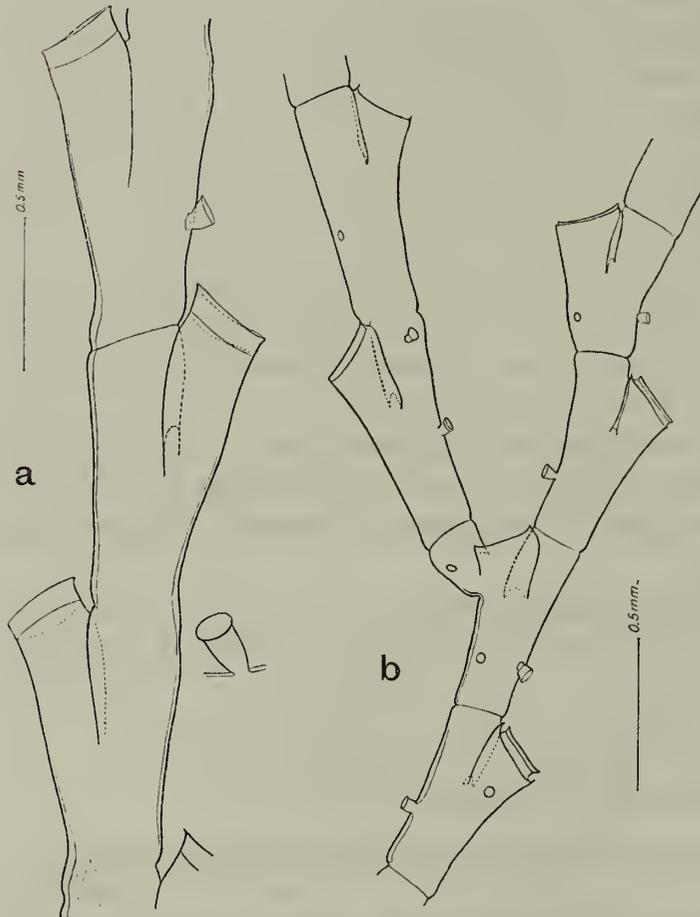
HALECIIDAE.

Ophiodissa arborea (Allman, 1888). (Text-fig. 2, a.)

Halecium robustum, Allman, 1888, p. 10, pl. IV, figs. 1-3 (not *H. robustum*, Verrill, 1873, p. 9; Pieper 1884, p. 166; Ritchie, 1907, p. 524; Vanhöffen, 1910, p. 319, fig. 35); *H. arboreum*, Allman, 1888, p. 98; *H. arboreum*, Hickson and Gravely, 1907, p. 27, pl. IV, figs. 27-29, not *H. arboreum*, Jäderholm, 1905, p. 11, pl. V, fig. 4; *Ophiodes arboreus*, Billard, 1910, p. 4; Ritchie, 1913, p. 15, figs. 2-3; Billard, 1914, p. 8; *Ophiodissa arborea*, Stechow, 1919 a, p. 42.

Material.—A quantity of broken stems and branches up to 25 cm. in length and 5 mm. in diameter, with several ovoid "scapus" masses of gonothecae measuring 4 cm. \times 1.5 cm., from Station 331, at the entrance to McMurdo Sound, 250 fathoms; a quantity of broken branches up to 9 cm. in length from Station 355, McMurdo Sound, 300 fathoms; and fragments from Station 356, entrance to McMurdo Sound, 50 fathoms.

Remarks.—The species has been recorded four times by Allman (material redescribed by Billard), Hickson and Gravely, Ritchie, and Billard; but no record has been published of a supplementary "Challenger" specimen from Prince Edward Island, which bears a characteristic "scapus" mass. The known distribution of this species is as follows: off Kerguelen Island, 105 fathoms; off Prince Edward Island, 310 fathoms; McMurdo Sound, 10-250 fathoms; Cape Royds, 20-80 fathoms; Palmer Archipelago,



TEXT-FIG. 2.—a, *Ophiodissa arborea* (Allman), \times 39;
b, *O. armata*, sp. n., \times 39.

off Graham Land, 50 fathoms. Gonangia were found in McMurdo Sound on July 6 and Jan. 14, off Cape Royds on Aug. 20 and off Prince Edward Island on Dec. 27.

Ophiodissa armata, sp. n. (Text-fig. 2, b.)

Material.—Five specimens up to 5 cm. in length, without gonothecae; from Station 91, off Three Kings Islands, N.Z., 300 fathoms.

Description.—Stems fascicled, branched mostly in one plane, with nematothecae on accessory tubes. Hydrothecae shallow expanding, margins not everted but markedly oblique to axis of internodes, primary ones sessile. A nematotheca on proximal part of each internode on side opposite hydrotheca, and others scattered irregularly.

Remarks.—Resembles *O. arboreum*, Allm. of Kerguelen and Antarctic area in having nematothecae; but they are much smaller, and less restricted. Differs in having relatively shorter adnate hydrophore wall, with scarcely any free part below the level of diaphragm, shallower thecae with more oblique margins, and generally more slender proportions.

Measurements :

Internode,								mm.
width at base	..	..	..	..	..	..	..	0.18-0.21
length	..	..	..	..	..	..	..	0.60-0.76
Hydrotheca,								
depth (margin to line of puncta)	..	..	..	..	..	..	..	0.02-0.05
mean	..	..	..	..	..	..	..	0.03

The dried holotype, Brit. Mus. Reg. No. 29.10.10.15, consists of two stems 5 cm. long growing from a common root stock.

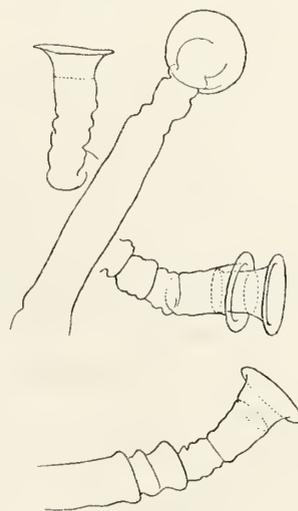
Halecium ovatum, sp. n. (Text-fig. 3.)

Material.—Numerous specimens up to 2.5 cm. in length, with both spent and young gonothecae, growing in dense tufts on the stems of other hydroids and worm tubes; from Station 220, off Cape Adare, 45-50 fathoms.

Description.—Stems scorpioid cymes, a pair of branches similar to stem arising below each hydrotheca, themselves rebranching in a similar way. Each successive series of branches and thecae of smaller proportions than the preceding. Hydrothecae deep, with flared opening, with a circle of puncta in the middle region. Polyps with about 26 tentacles in two rows alternately raised and depressed. Gonothecae replacing all polyps of triple branched hydrophores, mature ones (? female) ovate, their terminal circular apertures with thickened collars, immature ones (? male) flattened, kidney shaped.

Measurements :

Hydrocaulus, diameter,								mm.
Primary series,								
proximal internodes	..	..	..	..	..	..	..	0.150
mid-stem	..	..	..	..	..	..	..	0.195-0.225
secondary series	..	..	..	..	..	..	..	0.175-0.200
tertiary series	..	..	..	..	..	..	..	0.150



TEXT-FIG. 3.—*Halecium ovatum*, sp. n., $\times 35$.

Hydrotheca,									
limbus diameter,									
primary series,									mm.
terminal theca									0.325
other than terminal theca									0.300
secondary series									0.275
tertiary series									0.250
margin to line of puncta									0.100
Gonotheca (mature)									
length									1.09-1.22
diameter (maximum)									0.78-0.83

Remarks.—The species somewhat resembles *H. cymiforme*, Allman, in habitus, but is more robust and of larger proportions. The mature gonothecae are not compressed. The type specimen of *H. cymiforme* is imperfect, and the branching system was not well figured. Its gonothecae are of two types, the smaller male ones measuring 0.75×0.5 mm. with aperture 0.05 mm. in diameter, and the females 1.25×0.65 mm. with aperture 0.1 mm. in diameter.

I select as the holotype of *H. ovatum* a tuft of stems, Brit. Mus. Reg. No. 29.10.10.1, bearing many spent gonothecae and a few immature ones, growing on a piece of a stem of *Oswaldella antarctica* 4.5 cm. in length.

Halecium antarcticum, Vanhöffen. (Text-fig. 4.)

Halecium antarcticum, Vanhöffen, 1910, p. 317, fig. 34; ? *H. flexile*, Allman, 1888, p. 11, pl. V, figs 2, 2a.

Material.—Many straggling anastomosed delicate specimens up to 3 cm. in height, with immature gonothecae, on a worm tube from Station 339, McMurdo Sound, 140 fathoms; a few small specimens with immature gonothecae on a polyzoan, from Station 294, Ross Sea, 158 fathoms.

Description.—Stem fascicled below, a helicoid cyme with long irregular unpaired anastomosing branches. Hydrocaulus smooth, a few constrictions at bases of internodes. Hydrophores well separated from hydrocaulus, with flared and recurved margin. Gonothecae smooth, compressed, on short stalks from below hydrophores.

Measurements :

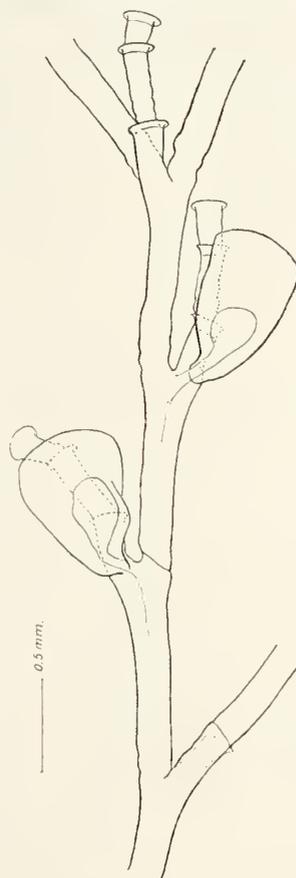
Hydrocaulus, diameter,									mm.
secondary series									0.17-0.20
Internode, length									1.10-1.34
Limbus to internode									0.37-0.41
Limbus, diameter,									
secondary series									0.22-0.25
Margin to line of puncta									0.05-0.07

Remarks.—The habitus of this species with its long anastomosing unpaired branches distinguishes it from *H. ovatum*, which has regularly paired branches. The proportions of the hydrophore are different too, being distinctly less in the present form. None of the gonothecae are mature, but they are of the same type as those of *H. ovatum*,

H. cyniforme and *H. flexile*. The measurements correspond so closely with those of Vanhöffen's species that I assign the specimens to it. An important measurement in any species of *Halecium*, the distance from the place of attachment (line of puncta) of the polyp to the margin of the hydrophore, was not given by Vanhöffen, but judging from his figure the "Terra Nova" and "Gauss" specimens are of similar proportions. The gonothecae of the "Gauss" specimens were likewise immature.

I have made a careful study and measurements of *H. flexile*, Allm., 1888, which is a closely allied, if not identical, species. I select as the holotype of *H. flexile*, Allman, the specimen, Brit. Mus. Reg. No. 88.11.13.6, from Marion Island. The syntype from Patagonia is similar to it but the hydranths are larger and the distal part of the hydrophore is deeper, measuring 0.075 mm. compared with 0.050 mm.; and it lacks gonothecae. We know the mature male gonothecae only of *H. flexile*, and neither mature male nor female gonothecae of *H. antarcticum*. It seems premature therefore to sink *H. antarcticum* in the synonymy of *H. flexile*.

Hartlaub (1905) considers *H. gracile*, Bale, 1888, and *H. flexile* synonymous; but by deduction from Bale's figures *H. gracile* is of smaller proportions, and the male gonothecae are considerably smaller and of different shape. I therefore reject Hartlaub's suggestion, basing my opinion on the type figures of *H. gracile* and leaving out of account specimens assigned to this species by others, which do not agree amongst themselves in measurement. There is need of more critical and statistical work on these and similar species of *Halecium*.



TEXT-FIG. 4. — *Halecium antarcticum*, Vanhöffen, with immature gonothecae, $\times 24$.

CAMPANULARIIDAE.

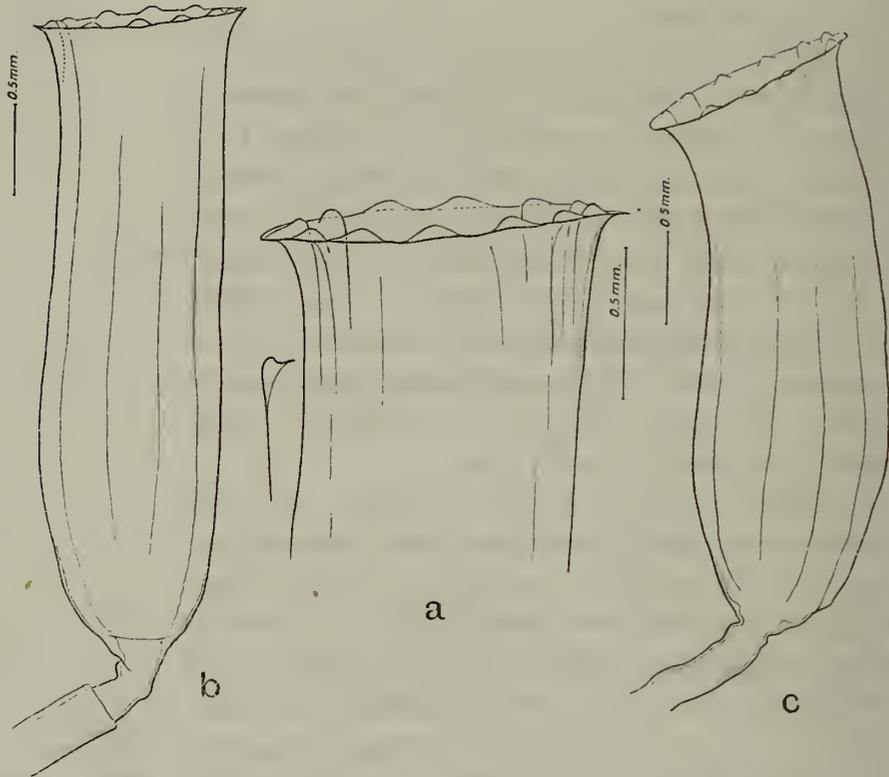
Tulpa diverticulata, sp. n. (Text-fig. 5, a-c.)

Material.—Two dozen specimens arising from a stock that creeps over a fragmentary hydroid stem. Gonothecae absent. Station 91, off Three Kings Islands, N.Z., 300 fathoms.

Description.—Pedicels straight, becoming irregular just below thecae. Thecae very large, slightly curved, narrowing below aperture, walls having from 9–11 longitudinal ridges with concave facets between. Distally the ends of these fluted facets appear as slight bosses that rise above the level of the entire, everted, slightly oblique margin. A thickened ring below forms a diaphragm.

Measurements :

										mm.
Pedichel	"	..	..	..	..	..	..	..	..	0.2-0.23
"	length	..	..	..	..	..	..	..	..	1.5-9.0
Hydrotheca	"	..	..	..	..	..	..	..	..	3.5-4.0
"	diameter,									
	below	..	..	..	..	..	..	..	..	1.2
	above	..	..	..	..	..	..	..	..	1.0
	at margin	..	..	..	..	..	..	..	..	1.2-1.4



TEXT-FIG. 5.—*Tulpa diverticulata*, sp. n. *a*, $\times 39$; *b*, *c*, $\times 24$. To the left of *a* one of the external diverticula is shown in optical section.

Clytia compressa, sp. n. (Text-fig. 6, *a-c*.)

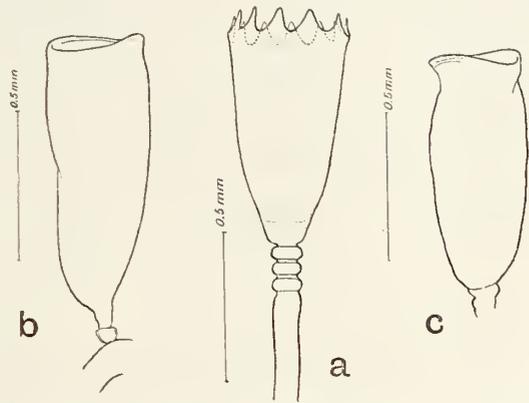
? *Clytia johnstoni*, Hartlaub, 1901, p. 350, not *Clytia johnstoni* (Alder, 1856), p. 359, pl. XIII, fig. 8.

Material.—A dozen pedicels and a single gonotheca, on a stock that creeps over an alga in association with *Sertularella robusta* and *Sertularia marginata*; and numerous other pedicels and gonothecae growing on a small branched alga attached to a Gasteropod shell, from Station 134, near North Cape, New Zealand, 11-20 fathoms.

Description.—Hydrorhiza flattened on attached side. Pedicels very variable in length, with a dozen or more fine annulations at base and usually three or four coarser ones forming "spherules" below thecae: the distal "spherules" better marked off and more flattened. The middle part of the pedicels normally smooth, but often

bearing irregular annulations. Hydrothecae campanulate or cylindrical, not compressed, wall smooth, margin slightly folded and very slightly everted, with from seven to thirteen pointed teeth, the ends of teeth being noticeably less rounded than the emarginations. Polyps with trumpet-shaped proboscis.

Gonothecae not regularly annulated, generally smooth, often irregularly folded, compressed; in broad aspect barrel-shaped, slightly constricted just below the truncated oval or circular distal end, tapering below to a short conical pedicel.



TEXT-FIG. 6.—*Clytia compressa*, sp. n. a, hydrotheca, $\times 39$; b, c, gonothecae; $\times 39$.

Measurements :

	mm.
Pedicel length	1-6
Hydrotheca,	
length	0.46-0.81
diam. at margin	0.18-0.56
Gonotheca,	
length	0.76-1.0
breadth	0.38
diam. at end	0.33-0.36

Mean length and diameter in millimetres of hydrothecae with several numbers of marginal teeth :

No. of Teeth.	Length.	Diameter.
7	0.46	0.18
8	0.49	0.25
9	0.61	0.31
10	0.56	0.33
11	0.62	0.36
12	0.68	0.40
13	0.75	0.46

One theca only of the first four categories was available for measurement, and seven, nine and eight respectively of the others.

Two abnormal eight-toothed thecae of large size 0.66 mm. \times 0.49 mm. with much broader teeth were observed.

Remarks.—The species is clearly very closely related to *C. johnstoni* (Alder), from which it is to be distinguished readily by the shape of the marginal hydrothecal teeth and of the gonothecae. These points may appear to be insignificant but they are of the kind of specific differences to be expected.

Marktanner's ? *Clytia elongata* 1890 seems to be distinct. I suspect that Hartlaub (1901) had this new species before him from French Pass, New Zealand.

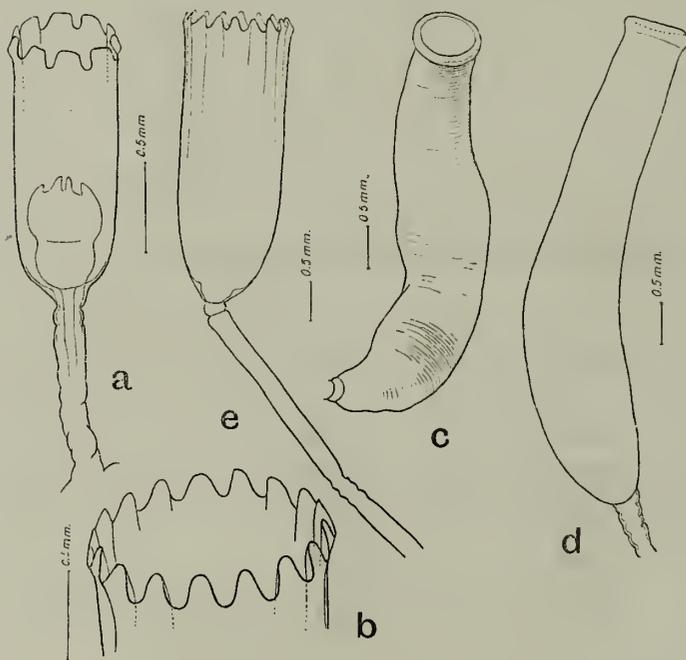
In living specimens of *C. johnstoni* I have counted two whorls of from nine to thirteen tentacles alternately raised and depressed. It seems likely that the number of marginal teeth is correlated with the number of tentacles in the lower whorl.

It is probable that the differences between the numbers of teeth of various hydrothecae, and the discrepancy in size are to be explained as due to enlargement of successively produced polyps and not to specific variation.

Campanularia hicksoni, nom. n. (Text-fig. 7, a-e.)

Campanularia laevis; Hickson and Gravely, 1907, p. 25, pl. IV, fig. 26; *Campanularia laevis*, Ritchie, 1913, p. 19, fig. 5; *Campanularia laevis*, Vanhöffen, 1910, p. 298, fig. 18 (not *C. laevis*, Hartlaub, 1905, p. 565, fig. P. 1); ? *C. volubilis* var. *antarctica*, Ritchie, 1913, p. 22, fig. 6; ? *C. antarctica*, Stechow, 1922a, p. 96.

Material.—Hundreds of stalked thecae up to 35 mm. in height, with a few gonothecae, growing on *Schizotricha*, and a young specimen on the back of a Caprellid, from Station 220, off Cape Adare, 45-50 fathoms; numerous specimens of a smaller race, with gonothecae, from Station 356, off entrance to McMurdo Sound, 50 fathoms.



TEXT-FIG. 7.—*Campanularia hicksoni*, sp. n. a, young hydrotheca, with truncated teeth, $\times 24$; b, margin of old hydrotheca, $\times 24$; c, d, gonothecae, $\times 10$; e, hydrotheca and pedicel, $\times 10$.

Description.—Normal unre-generated pedicels of very variable length, smooth or slightly sinuous, generally with from one to six broad annulations at origin from hydrorhiza, and a single well marked spherule below the theca. Hydrothecae of very variable size, deep, cylindrical; larger ones with longitudinal folds passing down from the emarginations of the folded and sinuous margin, which has up to 20 rounded teeth of the same shape as that of the depressions between. Smaller

specimens with margin less folded; teeth much larger than intervening spaces with flatter tops and from 9 upwards in number. Gonothecae on short twisted pedicels, very large, elongated, cylindrical, smooth walled, a little narrowed and truncated at distal end tapering off to pedicel below. There is sometimes a slight annular dilatation of the wall just below the margin.

Measurements in millimetres :

	Station 220.	Station 356.
Pedichel,		
length	0.68-35.0	0.65-5.0
diameter	0.16-0.36	0.06-0.10
Hydrotheca,		
length	1.07-3.53	0.68-1.22
diameter (over all at margin)	0.48-1.4	0.30-0.61
Gonotheca,		
length	-6.6	2.68-3.30
breadth	-1.2	
diameter of aperture ..	0.65-0.85	0.29-0.31
Number of Hydrothecal teeth ..	9-20	11-18

Mean lengths and diameters in millimetres of hydrothecae, with several numbers of marginal teeth.

SPECIMENS FROM STATION 220.

Pedicel.		Theca.		
Length.	Diameter.	No. of Teeth.	Length.	Diameter.
0.85	0.17	9	1.07	0.48
1.41	0.17	10	1.51	0.61
1.22	0.17	11	1.7	0.66
1.75	0.18	12	1.7	0.63
7.0	0.22	15	3.0	1.12
8.81	—	17	3.53	1.36-1.4
—	0.24	18	2.8	1.22

SPECIMENS FROM STATION 356.

1.08	0.07	11	0.73	0.33
5.0	0.10	16	1.10	0.55
—	—	18	1.22	0.61

Remarks.—Hartlaub's species *C. laevis* with which Hickson identified the present, appears to be a smaller one with differently shaped teeth and gonothecae. It appears, too, to have no annulations at the bases of the pedicels. Hartlaub did not give the minute detail of the marginal teeth, but he figures adult hydrothecae with truncated teeth; and no folding of the wall is shown. It seems best therefore to give a new name to this species which was first dealt with by Hickson. In dealing with Campanularians of this type we have to remember that the pedicels and thecae are of various sizes and that the number of teeth increases generally with size. The smallest forms with nine square teeth and short pedicels are solitary, have large discs of attachment and have evidently developed from planules. The largest forms arise from previously developed hydrorhizal tubes. Some pedicels show signs of regeneration. It seems probable that the thecae fall from time to time with the polyp, and that new and larger ones are developed after increase of length of pedicels.

The gonothecae were first figured at all well by Ritchie.

The species is known only from McMurdo Sound and doubtfully from off Kaiser Wilhelm II Land.

I have included under this name two races, a large one from Station 220 and a smaller one from Station 356. They both bear female gonothecae, and were taken in January of 1912 and 1913 respectively. Apart from differences in size, and judged stage for stage according to the number of teeth, there is little reason for regarding them as distinct species. The forms Ritchie (1913) described as *C. volubilis* var. *antarctica* I am inclined to regard as the male colonies of this small race. Referring to his measurements it will be seen that the trophosome in the 10–13 tooth stage corresponds in size as well as shape with those of a similar stage from Station 356. The gonangia are a little smaller and have narrower openings, features that might be expected of males. It remains for a future expedition to say whether or not the two forms can be linked up, and if they can whether they are to be regarded as a separate species.

GENUS BILLARDIA,* gen. nov.

Genotype.—*Billardia novae-zealandiae*, sp. nov.

Simple or branched *Campanulariidae*. Older stems fascicled. Hydrothecae from one to three on an internode, alternating, rising from short apophyses on sympodial stem and branches. Branches alternate, one from below proximal theca of each stem internode. No sarcothecae. Hydrothecae long, abruptly curved at base, inoperculate, with basal septum, adnate for a very short distance or entirely free. Margins entire and circular.

Gonothecae replacing hydrothecae smooth and compressed, or annulated.

Species included: *Billardia novae-zealandiae*, sp. n.; *Campanularia subrufa*, Jäderholm, 1905.

Billardia novae-zealandiae, sp. n. (Text-fig. 8, a.)

Material.—Two branched stems 2.5 cm. and 3 cm. in length rising from a few rooting tubes without gonothecae, from Station 90, Three Kings Islands, New Zealand, 100 fathoms; and two dozen simple shoots up to 1.7 cm. in length with gonothecae, on polyzoa from Station 144, off Cape Maria van Diemen, New Zealand, 35–40 fathoms.

Description.—Hydrothecae tubular with abrupt bend near base, without perisarcular thickening at this point, slightly curved up at distal end; aperture at slight angle to thecal axis.

Gonothecae † in place of hydrothecae, compressed, twice as long as hydrothecae,

* Dedicated to Professor Armand Billard of Poitiers.

† It is possible that these are only parasitised and hypertrophied hydrothecae.

appressed to hydrocaulus, with slit-like irregular distal aperture and a basal flexure similar to that of hydrothecae.

Measurements :

Stem,										mm.
diameter	..	..	..	..	..	..	..	..	..	0.39
internode length	..	..	..	..	..	..	..	..	..	1.83
Branch,										
diameter	..	..	..	..	..	..	..	..	..	0.22
internode length	..	..	..	..	..	..	..	..	..	1.51
Hydrotheca,										
length	..	..	..	..	..	..	..	..	..	0.98
diameter	..	..	..	..	..	..	..	..	..	0.24

Two branched stems, Brit. Mus. Reg. No. 29.10.10.12, form the holotype of the genotype.

Remarks.—The resemblances between the trophosomes of *B. novae-zealandiae* and *Campanularia subrufa*, Jäderholm, are so striking that in spite of the differences between gonothecae it seems certain that they are closely related. The abrupt, basal bend of the hydrothecae is characteristic. In the second species this angle is filled in with a perisarcular thickening and disguised.

Specimens from shallow water are unbranched. The affinities of the genus are not at present clear. Perhaps it is related to *Hincksella*, Billard,

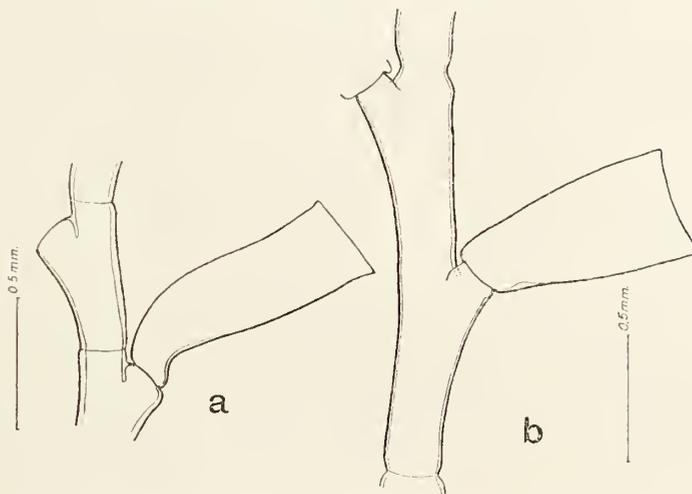
1925, as the genotype of which genus I select the species *H. sibogae*, Billard.

I have named this genus after Professor Armand Billard of Poitiers, whose critical work on the Hydroida during the past quarter of a century has greatly extended our knowledge of this group.

Billardia subrufa (Jäderholm). (Text-fig. 8, b.)

Campanularia subrufa, Jäderholm, 1904, p. v; 1905, p. 15, pl. VI, figs. 4–6.

Material.—A few branching stems up to 8 cm. in length with gonothecae, on a worm tube from Station 339, McMurdo Sound, 140 fathoms. A few small non-fasciated shoots without gonothecae from Station 338, McMurdo Sound, 207 fathoms; and a number of fine branched specimens growing on other organisms, with both polyps and gonothecae, from Station 38, S.W. of the Falkland Islands, 175 fathoms.



TEXT-FIG. 8.—a, *Billardia novae-zealandiae*, sp. n. Hydrotheca, $\times 34$ b, *B. subrufa* (Jäderholm), $\times 34$.

Description.—The abcauline wall of the hydrotheca shorter than the adcauline with a short internal transverse chitinous ridge of varying thickness at its base. Theca and apophysis joined by thin-walled narrow neck. In contraction hydrotheca generally telescoped onto apophysis, which has a subterminal thickened ring. Polyp has thirty solid tentacles with thickened bases and a rounded dome shaped proboscis. There do not appear to be any processes of attachment to the theca. Both branches and gonothecae replace hydrothecae.

Gonothecae spindle shaped, with from 12 to 20 circular thickened rings without free frills. There is much variation in size and shape. The majority have a smooth conical apex without visible opening. The largest gonothecae have 20 annulations and are without the conical apex, having instead a dished apical segment 0.4 mm. in diameter. This is sometimes 3 or 4 lobed, instead of annular. There is not sufficient evidence to show whether the gonothecae are sexually dimorphic.

Measurements :

Hydrotheca,										mm.
length	..	..	..	..	..	..	..	..	..	0.86-0.93
diameter at margin		..	..	..	..	..	..	..	..	0.39-0.46
distance apart	..	..	..	..	..	..	..	..	..	1.59
Internode,										
diameter	..	..	..	..	..	..	..	..	..	0.17-0.30
Gonotheca,										
length	..	..	..	..	..	..	..	..	..	1.15-3.70
diameter	..	..	..	..	..	..	..	..	..	0.80-1.30

This species was taken once before, though not recorded, from McMurdo Sound at the east end of the Great Ice Barrier by "Discovery" in 100 fathoms. The only other records are off Joinville, Seymour and Snow Hill Islands in the Graham Land Region; and from Shag Rocks, W. of South Georgia (Swedish Southpolar Expedition).

CAMPANULINIDAE.

Campanulina belgicae, Hartlaub. (Text-fig. 9.)

Campanulina belgicae, Hartlaub, 1904, p. 10, pl. I, figs. 8-9.

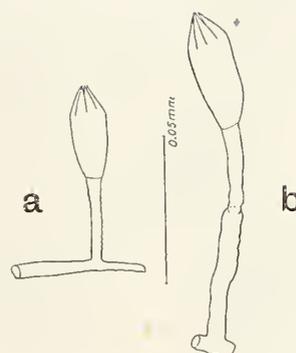
Material.—Numerous specimens without gonothecae growing on *Halecium*, sp. from Station 338, McMurdo Sound, 207 fathoms; a few dozen specimens, also without gonothecae from Station 356, entrance to McMurdo Sound, 50 fathoms.

Remarks.—Although in lateral view the operculum sometimes appears to resemble that of *Stegopoma* spp. as illustrated by Vanhöffen (1910) and remarked on by Ritchie (1913), this is an illusion, for the segments are large and about eight in number. The pedicel is generally ringed, and often shows signs of regeneration.

Measurements:

Pedicle,						mm.
length .. .. .	..	..	..	..	..	0.15-0.54
diameter .. .. .	..	..	..	..	..	0.04-0.05
Hydrotheca,						
length over all ..	..	..	..	..	..	0.32
greatest diameter ..	..	..	..	..	..	0.12

This record shows that the species is not confined to deep water as suggested by Vanhöffen.



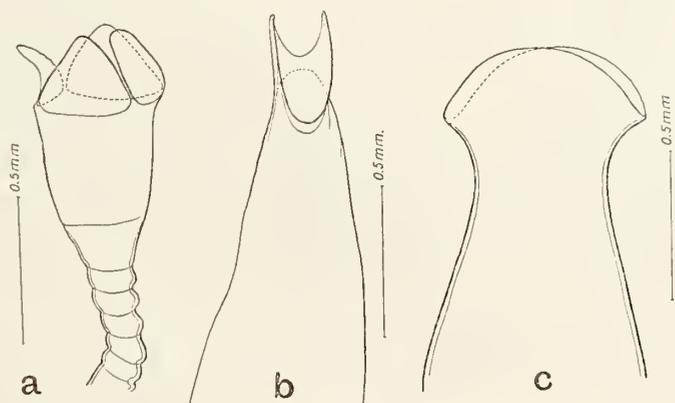
TEXT-FIG. 9.—*Campanulina belgicae*, Hartlaub, $\times 39$.

Stegella grandis (Hickson and Gravely). (Text-fig. 10, a-c.)

Campanularia verticillata, var. *grandis*, Hickson and Gravely, 1907, p. 23, pl. IV, fig. 25; *C. lobata*, Vanhöffen, 1910, p. 294, fig. 15; *C. lobata*, Ritchie, 1913, p. 21; *Stegella grandis*, Stechow, 1919, p. 852; 1920, p. 17; 1923, p. 119, fig. P; *Stegella grandis*, Jäderholm, 1926, p. 3.

Material.—A single badly preserved fragment 3.4 cm. in length without gonothecae, from Station 340, Ross Sea, 160 fathoms.

Remarks.—This interesting form has been taken by four other Expeditions, viz., by "Discovery" in McMurdo Sound in 20 fathoms, Feb. 20, 1902, and Jan., 1903 (with gonothecae)*; by "Gauss" off Kaiser Wilhelm II Land in 385 metres, June 14, 1902, Dec. 17, 1902 (with gonothecae), and Feb. 8, 1903; by "Nimrod" in McMurdo Sound in 7-8 fathoms, June, 1908, and 20-30 fathoms, July, 1908; and by C. A. Larsen's Ross Sea Exped. 1923-4 in Discovery Inlet, Ross Sea, 550 metres, March 5, 1924. On most occasions the specimens have been fragmentary.



TEXT-FIG. 10.—*Stegella grandis* (Hickson & Gravely). a, hydrotheca; b, aperture of gonotheca in lateral view; c, the same in frontal view. All figures magnified, $\times 39$.

A re-examination of the types shows that the gonothecae are of the form illustrated by Vanhöffen (1910). They have a terminal slit-like opening between the two parallel flattened and rounded terminal plates; the hydrothecae have four-lobed margins beyond which the polyps can be greatly extended. The rather small mouth is on a dome-shaped prominence. Measurements have been given by Ritchie (1913). Stechow has pointed out that this species is a Campanulinid and not a Campanulariid.

* The specimens were not kept separate.

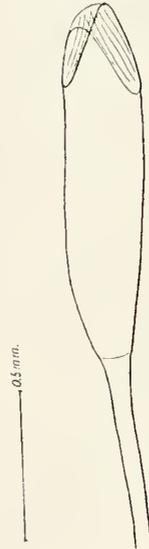
I select the larger specimen, Brit. Mus. Reg. No. 29.10.10.16, as holotype of the species.

Stegopoma fastigiatum (Alder, 1860). (Text-fig. 11.)

Campanularia fastigiata, Alder, 1860, p. 73, pl. V, fig. 1; *Stegopoma fastigiatum*, Stechow, 1914, p. 135, fig. 9.

Material.—Two dozen specimens growing on *Plumularia tenuissima* and *Halecium armatum* from Station 91, off Three Kings Islands, N.Z., 300 fathoms.

Remarks.—There is much variation in the size of the thecae and length of pedicels, as was pointed out by Stechow (1914) in material from Trondhjem Fjord. This common North Atlantic species has been reported also in Hawaii and Japan, but is new to New Zealand. The free pedicellate gonotheca has an operculum of the pent-roof type.



TEXT-FIG. 11.—*Stegopoma fastigiatum* (Alder). Hydrotheca, $\times 39$.

LAFOEIDAE.

GENUS HEBELLA, Allman.

Hebella, Allman, 1888, p. 29; Syn. *Hebellopsis*, Hadzi, 1913.

Genotype.—*H. striata*, Allman, 1888, p. 30, pl. XV, figs. 3, 3a.

Hadzi (1913) described in Kroatian a new genus *Hebellopsis* which differs from his conception of *Hebella* in having short-pedicelled hydrothecae, with no annular thecal thickening but a stout diaphragm. He says that in *Hebella* there is a ring and a thin diaphragm. I re-examined whole mounts of the holotypes of the genotype *H. striata*, Allm., but saw no trace of either ring or diaphragm. The thecal walls are of almost uniform thickness in the basal region. It seems, then, permissible to retain *Hebellopsis* in the genus *Hebella*, Allm.

The gonosomes of five species of *Hebella* have been partially described. In *H. calcarata* both A. Agassiz (1865) and Nutting (1901) have described the medusa, but neither of them described the margin of the gonotheca. The medusa appears to have two long tentacles and six tentacular buds, all with basal pigment spots, but no cirrhi. Bale (1888) described the gonotheca of *H. scandens* as having 3–4 emarginations of the rim, but did not mention the operculum. There were two medusae. Pictet (1893) figured three medusa-buds in the gonotheca of *H. cylindrica*, v. Lend, but did not describe emarginations or operculum. Ritchie (1909) described the immature medusae of *H. crateroides* as having 4 stout tentacles, but there is no mention of emarginations of rim of gonotheca or operculum.

Levinsen (1913) described the 4–6 opercular valves of the gonotheca of *H. contorta*, Markt., but did not mention the medusa-buds; and finally Stechow and Müller (1923) figured the 4-valved operculum and large medusa of the gonothecae of ? *Hebellopsis*

contorta (Markt.). The medusa appears to have four small tentacles and four rows of reproductive organs on the radial canals.

Hebella striata, Allman.

Hebella striata, Allman, 1888, p. 30, pl. XV, figs. 3-3a.

Material.—Many specimens without gonothecae, adhering to specimens of *Lafoea fruticosa* and *Symplectoscyphus fliformis*, Allm., from Station 38, S.W. of Falkland Is., 125 fathoms. A few specimens on fragments of *Symplectoscyphus* (?) *glacialis*, from Station 194, off Oates Land, 180-200 fathoms.

Description.—The polyps have a conical or rounded proboscis and about 16 tentacles. No chitinous ring has been observed at the base of the hydrotheca. Occasionally the striation of the thecal wall is very indistinctly marked.

Measurements :

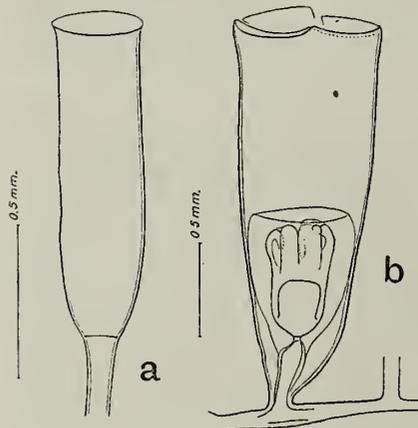
(10 specimens)		
Pedichel,		mm.
length	.. .. .	0.23 (0.07-0.42)
Hydrotheca,		
length	.. .. .	0.79 (0.61-0.97)
diameter at margin	.. .. .	0.23 (0.17-0.25)

Remarks.—Allman's figures give a reliable idea of the form. The gonothecae of this species have not yet been found. The specimens have been compared and agree with the type material.

Hebella plana, Ritchie. (Text-fig. 12, a-b.)

Hebella striata (Allm.) var. *plana*, Ritchie, 1907, p. 530, pl. I, fig. 8.

I raise Ritchie's variety to specific rank. The hydrothecae are not striated; and are longer and have longer pedicels than those of *H. striata*.



TEXT-FIG. 12.—*Hebella plana*, Ritchie, sp. n. a, hydrotheca, $\times 40$; b, gonotheca containing a single medusa bud, $\times 24$.

Material.—Innumerable hydrothecae and several gonothecae growing on *Halecium arboreum* from Station 355, McMurdo Sound, 300 fathoms; some specimens on *Staurrotheca antarctica*, from Station 338, McMurdo Sound, 207 fathoms.

Description.—Gonothecae borne singly on hydro-rhiza, much larger than hydrothecae, cylindrical, tapering gradually below, with a square, slightly embayed margin provided with a three- to five-flapped operculum. The blastostyle bears two, possibly three, medusae which escape from the gonotheca. While still attached the medusa appears to have 4 larger inrolled tentacles and ? 4-12 tentacular buds and short manubrium. No pigment spots observed.

No pigment spots observed.

Measurements :

Pedichel,									mm.
length	..	..	..	..	..	..	..	..	0.20-0.74
Hydrotheca,									
length	..	..	..	..	..	..	..	..	1.26-1.36
diameter at margin	..	..	..	..	..	..	..	..	0.27-0.33
Gonotheca,									
length	..	..	..	..	..	..	..	..	1.98-2.08
diameter at margin	..	..	..	..	..	..	..	..	0.66-0.74

Remarks.—This is the first Antarctic hydroid in which production of medusae has been observed. It has been recorded before by Jäderholm (1926) from Ross Sea, 550 metres, without gonothecae on March 5, 1924; by Billard (1914) from off Graham Land, 176 metres, without gonothecae on Jan. 20, 1909; by Ritchie (1907) from the Weddell Sea, 161 fathoms, without gonothecae on March 12, 1904; and by Vanhöffen (1910) from off Kaiser Wilhelm II Land, 350-400 metres. The present specimens with gonothecae were taken on Jan. 20, 1913. The number of gonothecae is small, but the medusa buds will be available for examination by workers on Antarctic medusae.

Lafocia fruticosa, Sars. (Text-fig. 13.)

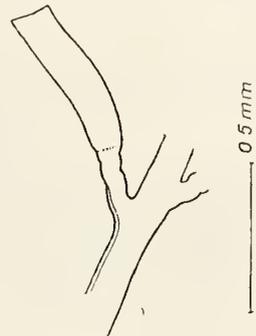
Lafocia fruticosa, Sars, 1851, p. 138; *L. fruticosa*, Allman, Report Sci. Res. H.M.S. "Challenger" . . . Zoology XXIII, 1888, p. 34, pl. XVI, fig. 2.

Material.—A few small specimens, branched and unbranched, without gonosome, from Station 38, W. of Falkland Is., 125 fathoms.

Description.—Hydrothecae slender, tubular, doubly curved on both sides, with aperture often slightly oblique. Pedicel with two twists.

Measurements :

Hydrotheca,						mm.
length	..	..	..	..	..	0.50 (0.44-0.52)
diameter at margin	..	..	..	..	..	0.12
Pedicel,						
length	..	..	..	..	..	0.22 (0.20-0.25)



TEXT-FIG. 13.—*Lafocia fruticosa*, Sars. Hydrotheca, $\times 39$.

Remarks.—The form described and figured by Allman (1888) from Magellan Strait, $53^{\circ} 37' S.$, $70^{\circ} 56' W.$, 9-15 fathoms, is identical in every way with this one. Allman's figure 2a, plate XVI, is magnified about 35 times and not 15 as stated. The hydrotheca generally has a distal upward bend with an oblique aperture, as illustrated here for the "Terra Nova" specimens; and the pedicel twists are not so open as Allman's figures suggest.

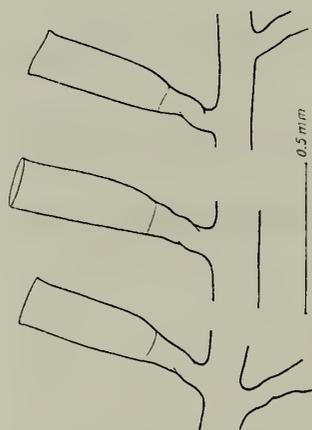
Large coppinia masses, unnoticed by Allman, are present on the "Challenger" specimen. Many of the closely packed pentagonal or hexagonal gonothecae bear acrocysts.

Measurements :

Gonothecae,								mm.
length	..	..	..	..	..	..	..	0.49-0.61
diameter	..	..	..	..	..	..	..	0.10-0.11
mouth tube,								
length	..	..	..	..	..	..	..	0.05-0.08
diameter	..	..	..	..	..	..	..	0.08
Accessory tubes,								
length (projecting)	..	..	..	..	..	..	..	1.23-1.35
diameter	..	..	..	..	..	..	..	0.08-0.10

Lafoea dumosa (Fleming). (Text-fig. 14.)*Sertularia dumosa*, Fleming, 1820, p. 83.

Material.—A fine irregularly branched specimen measuring 7 cm. × 6 cm., with coppinia masses on some of the older branches, from Station 194, off Oates Land, 180-200 fathoms.



TEXT-FIG. 14.—*Lafoea dumosa* (Fleming). Hydrothecae, × 39.

Measurements :

Hydrotheca,							mm.
length	..	..	..	..	..	..	0.45-0.47
diameter at margin	..	..	..	..	..	..	0.16-0.17
Pedicel,							
length	..	..	..	..	..	..	0.19-0.22

Remarks.—The shortened, little twisted pedicels lead me to assign the specimens to *L. dumosa*. The classification and nomenclature of species of *Lafoea*, which appear to be very variable, is in an unsatisfactory condition.

The specimen may possibly be conspecific with those called *L. gracillima*, Alder, by Vanhöffen (1910) and Billard (1914).

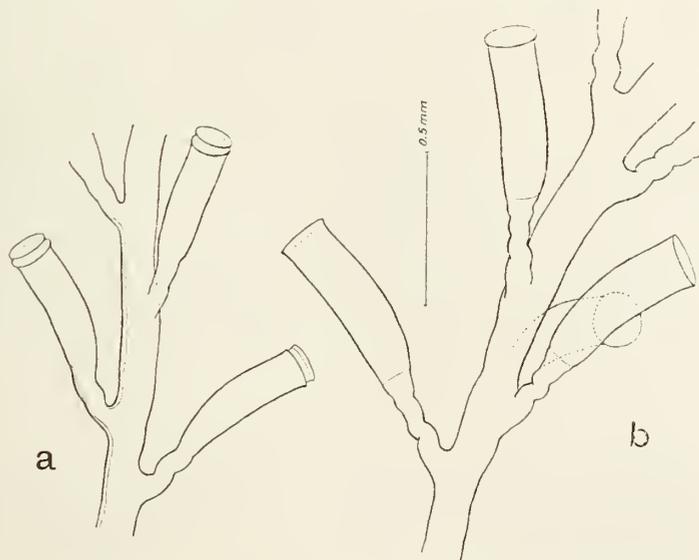
Lafoea gracillima (Alder). (Text-fig. 15, a-b.)*Campanularia gracillima*, Alder, 1856, p. 361, pl. XIV, figs. 5-6.

Material.—A branched fragment 15 mm. in length over all without gonosome, from Station 220, off Cape Adare, Ross Sea, 45-50 fathoms; and a small specimen, creeping over a *Staurotheca*, with two short simple erect stems, but no gonosome, from Station 356, Granite Harbour, McMurdo Sound, 50 fathoms.

Measurements in millimetres :

	Station 220.	Station 356.
Hydrotheca,		
length	0.59	0.61-0.72
diameter at margin	0.17-0.19	0.15-0.20
Pedicle,		
length	0.29-0.39	0.15-0.22

Remarks.—I have examined a specimen of *L. gracillima* that Alder sent to the Museum in 1856, just after establishing the species. In ignorance of the designation of any other, I select this specimen, Brit. Mus. Reg. No. 57.8.3.51, as the holotype of the species. This holotype is indistinguishable from British specimens that have been assigned, perhaps erroneously, to *L. fruticosa*, M. Sars. Broch (1918) states that G. O. Sars's (1873) figs. 17-18, Tab. IV, are undoubtedly based on M. Sars's type speci-



TEXT-FIG. 15.—*Lafaea gracillima*, Alder. *a*, Part of Holotype (Brit. Mus. Reg. No. 57.8.3.51); *b*, Part of specimen from Station 220. Both figures magnified, $\times 40$.

mens of *L. fruticosa*, Sars. If this is so they differ a good deal from the holotype of *L. gracillima*, Alder, which closely resembles G. O. Sars's fig. 20. For this reason I hesitate to sink *L. gracillima*, Alder 1856, with established holotype, in the synonymy of *L. fruticosa*, M. Sars, of which no holotype appears to have been selected, and of which our ideas are not very clear.

The hydrothecae of the holotype are a little smaller than those of the "Terra Nova" specimens.

Lafaea gaussica, Vanhöffen. (Text-fig. 16, *a-b*.)

Lafaea gaussica, Vanhöffen, 1910, p. 312, fig. 32.

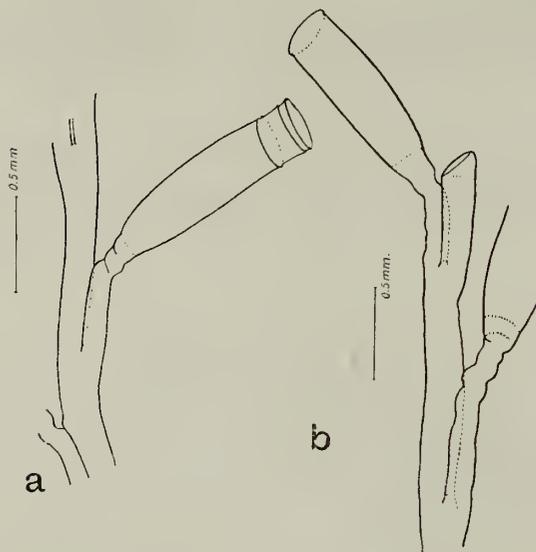
Material.—An irregularly branched specimen measuring 3 cm. \times 3 cm., without gonosome, from Station 339, McMurdo Sound, 140 fathoms; and fragments from Station 194, off Oates Land, 180-200 fathoms.

Description.—The pedicel may be adnate to the hydrocaulus for more than half its length. The margin of the hydrotheca is slightly everted.

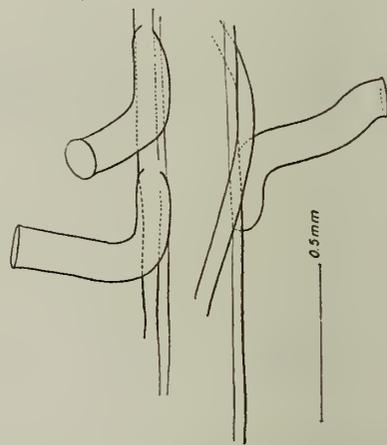
Measurements :

Hydrotheca,										mm.
length	..	..	..	..	..	..	..	..	..	0.83–0.90
diameter at margin	..	..	..	..	..	..	..	..	..	0.26–0.31
Pedicel,										
length	..	..	..	..	..	..	..	..	..	0.38–0.93

Remarks.—This species is readily distinguishable from other Antarctic species of *Lafaea* by its large, almost symmetrical hydrothecae, and adnate pedicels.



TEXT-FIG. 16.—*Lafaea gaussica*, Vanhöffen, $\times 24$, to show adnate pedicels.



TEXT-FIG. 17.—*Reticularia antarctica*, (Hartlaub). $\times 41$.

Reticularia antarctica (Hartlaub). (Text-fig. 17.)

Lafaea antarctica, Hartlaub, 1904, p. 11, pl. II, fig. 2; *L. antarctica*, Vanhöffen, 1910, p. 311, fig. 31; ? *Filellum antarcticum*, Stechow, 1913, p. 111; 1925, p. 214.

Material.—Innumerable hydrothecae with some coppinia masses attached to other hydroids, from Station 220, off Cape Adare, Ross Sea, 45–50 fathoms; a few hydrothecae from Station 339, McMurdo Sound, 140 fathoms; from Station 316, McMurdo Sound, 190–250 fathoms; and from Station 38, West of Falkland Islands, 125 fathoms.

Description.—The hydrothecae, whose margins are 0.15 mm. in diameter, project, excluding reduplications, 0.30–0.40 mm. from the basis to which they are attached, the length of the adnate part being about the same. Many hydrothecae enclose poorly preserved hydroid polyps. The gonosome consists of small coppinia aggregates, in which the fused accessory tubes surround and arch over the gonothecae and their acrocysts, so as to form a marsupium or corbula.

Remarks.—There is little, if anything, to distinguish the hydrosome from that of *Campanularia serpens*, Hassal, 1848. The systematic position of these species has not

been stabilised. Wyville Thomson (1853) established the genus *Reticularia* for Hassal's species which is the genotype. Hincks (1868) needlessly substituted a new name *Filellum* because *Reticularia* had been used for a fungus. More recently authors have used for Hassal's species the generic name *Grammaria*, Stimpson, 1854, as genotype of which I select *G. robusta*, Stimpson. There are a few hydrothecae of a species of *Reticularia* on the base of specimens of *Halecium armatum* from Station 91, off Three Kings Islands, N. Zealand, 300 fathoms.

GENUS ACRYPTOLARIA, Norman.

Acryptolaria, Norman, 1875, p. 172; *Scapus*, Norman, 1875, p. 173; *Cryptolaria*, auct., nec Busk, 1857, p. 173; *Oswaldaria*, Stechow, 1923 (c), p. 147; not *Perisiphonia*, Allman, 1888, p. 43.

Genotype.—*Acryptolaria andersoni* nom. nov. (= *A. exserta*, Norman, 1875, p. 172, pl. XII, figs. 1–2, not *Cryptolaria exserta*, Busk, 1858, p. 130, pl. XIX, fig. 3).

Nomenclature.—Norman (1875), when he instituted *Acryptolaria*, showed that *Cryptolaria exserta*, Busk, 1858, was not congeneric with *C. prima*, Busk, 1857, the genotype of *Cryptolaria*. At the same time he was wrongly assigning specimens to *C. exserta*, Busk. Stechow (1923 c.) pointed out that *C. prima* was not congeneric with any of the later authors' *Cryptolaria* spp., three of which he then took as the genotypes of new genera *Stegolaria*, *Cryptolarella* and *Parathecium*. For the remainder he instituted *Oswaldaria*, on the assumption that Norman's *Acryptolaria* was congeneric and synonymous with *Perisiphonia*, Allman, 1888, an assumption which proves to be unfounded.

The holotype of *C. prima* is in the British Museum. The species has been re-described recently by Trebilcock (1928) under a new name *Perisiphonia quadriseriata*. It is certainly not congeneric with the specimens wrongly assigned by Norman to *C. exserta*, Busk, the type of which species unfortunately is unknown. I take as the holotype of the species which Norman described, but wrongly named *C. exserta*, Busk, a specimen, Brit. Mus. Reg. No. 99.5.1.218. To this species, the genotype of the monotypic genus *Acryptolaria*, Norman, I give the new name *andersoni* in place of the one wrongly applied to it by Norman in 1875. It is possible that *Acryptolaria andersoni* (nom. nov. = *A. exserta*, Allman, nec Busk) is conspecific with *A. humilis*, Allman, 1888, but since the short description of *A. humilis* can hardly be regarded as a specific diagnosis and the figured holotype specimen of that species is such a poor mutilated one, and finally since many of Allman's figures of hydroids have proved to be inaccurate, this question of conspecificity cannot be settled with any degree of satisfaction.

The specimen of *Acryptolaria andersoni* came to the Museum with the Hincks collection, and is labelled as having been attached to one of the Atlantic cables 150 [miles] off Lands End, in 200 fathoms. It bears Sir James Anderson's name and a note initialled by Hincks "a form allied to *Salacia*, *Cryptolaria exserta*." There is little doubt that it is one of the specimens described by Norman as coming from the

Falmouth and Lisbon Cable between N. Lat. $47^{\circ} 58'$ and $47^{\circ} 35'$, and in W. Long. $7^{\circ} 6'$ at a depth between 89 and 205 fathoms. Norman pointed out that the specimens were much less regularly branched than in *Perisiphonia exserta* (Busk), a characteristic difference between the genera *Acryptolaria* and *Perisiphonia*. Norman's figures on plate 12 of his publication leave no doubt at all as to the generic association of this species. He made a mistake in identifying the specimen as *C. exserta*, Busk. As in other cases of this sort, we recognise as the genotype of the newly instituted genus the renamed species to which the described but misidentified specimen belonged rather than the species to which it was first of all wrongly assigned.

Stechow's name *Oswaldaria*, 1923, must be sunk in synonymy, since *Acryptolaria andersoni*, nom. nov. and *Oswaldaria crassicaulis*, Allman, the two genotypes, appear to be congeneric, *Acryptolaria* having priority.

Amended Generic diagnosis.—*Lafoeidae* without a thecal diaphragm (Sub-fam. *Lafoeinae*).

Multipinnate. Branches of hydrocaulus alternate from every fourth theca on each side, in one plane, with irregular branches in other planes from accessory tubules. Hydrocaulus of stem and branches with a pair of main accessory tubes, one dorsal and the other ventral. On branches accessory tubes arise from level of proximal theca, and later give off from point of origin descending tubes, ventral ones descending stem, dorsal turning up stem. Branches of hydrocauli originate at level of mouths of thecae; adnate to level of mouth of next distal theca they then diverge from stem. A foramen and coenenchymal connection formed at point of divergence. Mature specimens have stems composed of a great number of accessory tubes. These give rise to gonosome (*Scapus*, Norman, 1875) in form of closely packed flask-shaped gonothecae with short tubular mouths, surrounding stem for distances of two or three centimetres. No nematothecae, but smaller simple hydrothecae produced by accessory tubes.

Remarks.—We may perhaps trace the origin of the small nematothecae borne by the accessory tubes on genera of the Sub-family *Zygophylacinae*, Stechow, 1921, in the smaller simple hydrothecae found on the accessory tubes of the more primitive genus *Acryptolaria*.

One New Zealand species of the genus *A. gracilis* (Allman, 1888) has been described from 700 fathoms off East Cape. The "Terra Nova" species is of much smaller proportions and is regarded as new.

Acryptolaria minima, sp. n. (Text-fig. 18, a-b.)

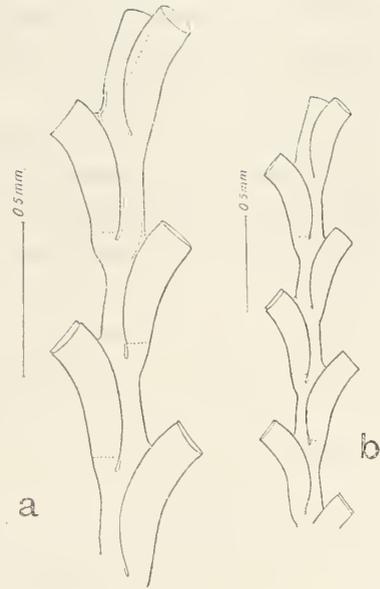
Material.—Two larger fertile specimens 7 cm. and 9 cm. in height, and two smaller specimens, from St. 134, near North Cape, N.Z., 11–20 fathoms; one fertile specimen 8.5 cm. in height from St. 144, off Cape Maria van Diemen, New Zealand, 35–40 fathoms.

Description.—Hydrothecae overlapping, short, little curved; margin not everted the plane in which it lies turned out at 45° to the horizontal. There is a distinct con-

vexity in the abaxial wall of the pedicel opposite the "arris,"* and a row of bright puncta marks the division between hydrotheca proper and the pedicel, about 0.05 mm. above the lateral part of the "arris."

Measurements :

Hydrothecae,				mm.
distance apart	..	..	..	0.68 (0.61-0.73)
length,				
total	..	..	..	0.52
free part	..	..	..	0.07-0.11
diameter at mouth	..	..	..	0.13-0.15
Gonothecae,				
length	..	..	..	0.61-0.73
diameter	..	..	..	0.12
neck, length	..	..	..	0.12
mouth, diameter	..	..	..	0.05



TEXT-FIG. 18.—*Acryptolaria minima*, sp. n. Part of Holotype. a, × 41; b, × 25.

Type.—The holotype is the largest fertile specimen, Brit. Mus. Reg. No. 29.10.10.3, from Station 134.

Acryptolaria conferta, Allman, var. *australis*, Ritchie. (Text-fig. 19, c-e.)

? *Cryptolaria conferta*, Allman, 1877, p. 17, pl. XII, figs. 6-10; ? *Cryptolaria conferta*, Clarke, 1879 (in part), p. 244, pl. III, fig. 20; *Cryptolaria conferta* var. *australis*, Ritchie, 1911, p. 826, pl. LXXXIV, fig. 2, pl. LXXXVII, fig. 1.

Material.—A small specimen without gonothecae from Station 91, off Three Kings Islands, N. Zealand, 300 fathoms.

Description.—The hydrothecae are less curved than in Ritchie's schizotype, Brit. Mus. Reg. No. 10.10.4.19, and the plane of the hydrothecal margin less nearly vertical.

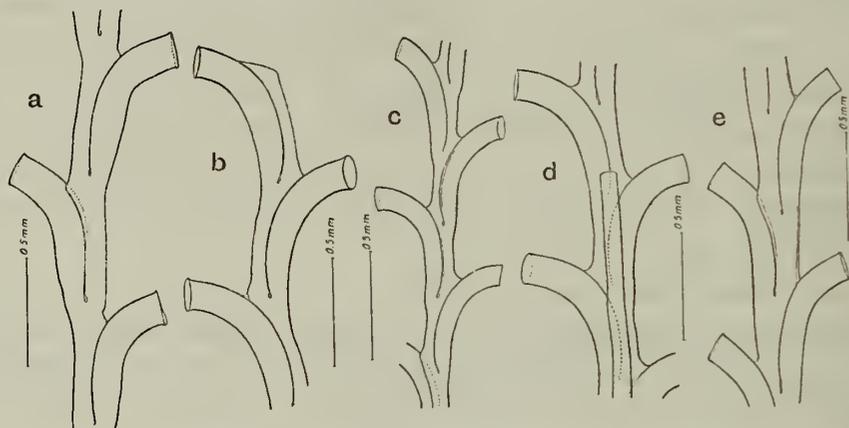
Measurements :

Hydrothecae,					mm.
distance apart	..	..	..	..	0.72-0.90
length	..	..	..	..	0.72
diameter at margin	..	..	..	..	0.15

Remarks.—The specimen resembles Ritchie's in having an evenly curved concave abaxial wall from the row of puncta to the margin, and in that the lateral parts of the "arris" extend down below the level at which the preceding hydrotheca becomes free from the hydrocaulus, and in having only a very slightly emarginated rim. Allman (1877) does not figure the adaxial wall fully as it stops at the line of puncta, but I estimate that the termination would have been just below the point of emergence of the hydrotheca. In Clarke's figure of the type the wall comes down just about as far

* The term "arris" is introduced for the internal perisarcal ridge formed at the intersection of the distal wall of the thecal pedicel and the hydrocaulus. It is close to this spot that the thecal floor is laid down in those forms that have one.

as this level or a little short of it. The abaxial hydrothecal wall in Clarke's figure of Allman's type appears to be slightly convex above the line of puncta, and to make an angle with the upper part. There is an Atlantic species (Madeira, Brit. Mus. Reg. No. 19.8.15.4) with hydrothecae not overlapping, and lower abaxial hydrothecal wall convex, making an angle with the upper part, growing alongside a species of much the same dimensions (Brit. Mus. Reg. No. 19.8.15.4a) which has overlapping hydrothecae and evenly curved concave abaxial hydrothecal wall.



TEXT-FIG. 19.—*Acryptolaria conferta* (Allman). *a*, specimen (Brit. Mus. Reg. No. 19.8.15.4), from Porto Santo Island, 60 faths.; *b*, variety from same locality; *c*, var. *australis*, from "Terra Nova" Station 96; *d*, var. *australis* (Brit. Mus. Reg. No. 10.10.4.19), from "Thetis" Station 42; *e*, the same. All figures magnified, $\times 29$.

It is therefore desirable to have a more critical specific description of Allman's type material before we can with certainty cite the Australian and New Zealand specimens as varieties of this species. Two dozen small branched specimens up to 1.5 cm. in height on a fistule of a sponge *Phloeodictyon*, sp. from Station 96, off North Cape, New Zealand, 70 fathoms, possibly belong to this species. Their measurements are:

Hydrothecae,		mm.
distance apart	.. .. .	0.68
length	.. .. .	0.55-0.60
diameter at mouth	.. .. .	0.10

If these two groups of specimens belong to the same species the variation in size may possibly be correlated with depth. The specimens with the largest hydrothecae come from the greater depth.

GENUS ZYGOPHYLAX, Quelch.

Genotype.—*Zygophylax profunda*, Quelch, 1885, p. 4, pl. I, fig. 4.

Specimens of two species of this rare genus were taken in New Zealand waters, *Z. sibogae*, Billard, and a new one which is obviously related to "*Lafœa*" *convallaria*, Allman, "*Lictorella*" *cervicornis*, Nutting, and "*Lictorella*" *concinna*, Ritchie. Specimens of the gonosome of *Z. sibogae*, briefly described by Billard and lent to the Museum

by him, furnish the clue for connecting the majority of *Zygophylax* species with the genotype *Z. profunda*, Quelch—a form that has a peculiar gonosome, which at first sight is very unlike that of other species.

A fragment without gonosome mounted as a microscopical slide is all that appears to remain of the type specimen of the genotype *Z. profunda*, Quelch. However, other Atlantic specimens have been taken which seem to be conspecific. Of these one, Brit. Mus. Reg. No. 19.8.15.2, has a gonosome consisting of conjoined gonothecae of irregular shape and with a varying number of tubular openings provided with flared mouths. It is assumed, because of resemblances between the respective trophosomes, that this is the type of gonosome borne by the genotype. *Z. sibogae*, Billard, has a similar gonosome in which, however, some of the gonothecae are quite separate; and these show obvious resemblances to the normally separated gonothecae of such species as "*Lictorella*" *cervicornis*, Nutting, "*Lictorella*" *concinna*, Ritchie, "*Lafoea*" *pinnata*, Sars, and "*Lafoea*" *convallaria*, Allman. Eighteen species of this genus have been described as follows: *pinnata* (Sars), 1874; *convallaria* (Allman), 1877; *profunda*, Quelch, 1885; *tizardensis*, Kirkpatrick, 1890; *cervicornis* (Nutting), 1905; *biarmata*, Billard, 1906; *armata* (Ritchie), 1907; *levinseni* (Saemundsson), 1911; *carolina* (Fraser), 1911; *concinna* (Ritchie), 1911; *curvitheca*, Stechow, 1913; *sibogae*, Billard, 1918; *brevitheca*, Jäderholm, 1919; *pacifica*, Stechow, 1920; *recta*, Jarvis, 1922; *africana*, Stechow, 1923; *valdiviae*, Stechow, 1923b; *brownei*, Billard, 1924.

The first, *Lafoea pinnata*, Sars, has never been included in the genus because the criterion has always been held to be the presence of nematothecae. Apart from this difference from the genotype and most other species of the genus, *L. pinnata* cannot be excluded; and since both a more southerly species *Z. brownei*, Billard, and a more northerly one *Z. levinseni* (Saemundsson), which are very closely related to *L. pinnata*, both have nematothecae, the absence of them in *L. pinnata* and in *L. concinna*, Ritchie, cannot be regarded as a reason for exclusion from the genus.

Since the generic name *Lictorella* has been used for species of *Zygophylax* it will be as well to look into the history of this and other closely related genera which are somewhat ill-defined. About *Lictorella* there is great confusion. No genotype appears to have been fixed. When instituting the genus in 1888 Allman had before him specimens of two species which appear to be congeneric. He did not notice the gonosome of either, nor did he observe the nematothecae of the hydrothecal peduncles of one of them, *L. cyathifera*. Ever since then the absence of nematothecae from forms of this group in which there is a floor to the hydrotheca has been held to be the criterion for inclusion in the genus *Lictorella*; but I have seen nematothecae in *L. antipathes* (Lk) and *L. cyathifera*, Allm.; and Bale has described them in what is probably a third species, *L. rufa* (Bale), 1884. To the "Challenger" Torres Straits specimens Allman wrongly applied the name *halecioides* which he had given in 1874 to an Atlantic species, probably the *Lafoea pinnata* of Sars. These Torres Straits specimens, however, appear to agree in all respects with the Indo-Pacific *Sertularia antipathes*

of Lamarck and I select this species, *L. halecioides*, Allm. 1888=*L. antipathes* (Lk) (non *L. halecioides*, Allm. 1874=*L. pinnata*, Sars), as the genotype of *Lictorella*, Allman. The gonosome, first noticed by Trebilcock, is a coppinia mass of closely packed and conjoined gonothecae having hooded apertures much as in *Perisiphonia*, but without nematotheca bearing ramules. Broch (1909) says that the genus *Lictorella* was set up for *Lafoea pinnata*, Sars.*

Abietinella, Levinsen, 1913, is the only one of the related genera in question in which an operculum has been observed. I select *Zygophylax operculata*, Jäderholm, 1903, as its genotype. Whether, as suggested by Vanhöffen (1910), any species of *Zygophylax* besides *Z. operculata*, Jäderh., and *Z. grandis*, Vanhöffen, have opercula is uncertain, though no such structures appear to have been seen in the many specimens examined. The gonosome of *Z. operculata* is unknown.

Another closely related genus is *Perisiphonia*, Allman, 1888. As its genotype I select *P. pectinata*, Allm. 1888, with holotype, Brit. Mus. Reg. No. 88.11.13.34, from New Zealand. The species seems to agree very closely with one that occurs at Madeira, and has been described and figured by Stechow (1925). The gonosome of the genotype was first noticed by Trebilcock whilst examining "Challenger" types during the War. Stechow's figures are characteristic. The gonosome figured by Stechow is sexually dimorphic, but in each sex is a coppinia composed of adherent gonothecae, with hooded apertures.

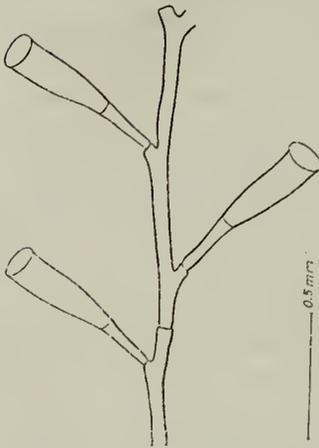
The genotype of *Brucella* has a compact gonosome of the coppinia type with short tubular apertures. We do not know whether the gonosome is sexually dimorphic.

Still another genus that appears to be related must be considered here, namely *Cryptolaria*, Busk (nec auctt.). The holotype of the genotype *C. prima*, Busk, is Brit. Mus. Reg. No. 57.1.2.86. It appears never to have received a critical examination.† I find that the axial tube bears four rows of hydrothecae in decussating pairs, each hydrotheca separated off proximally by a floor. The four rows are so arranged that two rows of apertures are more or less on the upper, and the other two on the lower side of the hydrocladia. Lying next the axial tube, one on each of its two opposite sides, are a pair of accessory tubes furnished with nematothecae which possibly remain at the surface; and the whole is overlain on all sides by a number of other accessory tubes, some of which at any rate originate as branches of the axial tube. In the unique dried type specimen from New Zealand the hydrothecal orifices are flush with the general surface of the stem and hydrocladia. The branches are sub-opposite. I know of no other species obviously congeneric with *C. prima*, Bk; and consider it would be premature to say that the species of *Perisiphonia* are congeneric.

* We take the view that Allman was establishing a new genus for the species to which belonged specimens lying before him. To them he wrongly applied an existing specific name. In consequence, instead of taking for the genotype the species rightly bearing that misapplied name, we must take the species of which specimens were in front of Allman; at the same time giving it its first available name *antipathes*, Lamarck.

† The species has been described by Trebilcock (1928) as a new species *Perisiphonia quadriseriata*.

								mm.
Hydrotheca, length ..	..	..	..	..	..	..	..	0.34
diameter at mouth ..	..	..	..	..	..	..	..	0.12
peduncle, length..	..	..	..	..	..	..	..	0.34-0.44
Nematotheca, length..	..	..	..	..	..	..	..	0.05-0.1
diameter ..	..	..	..	..	..	..	..	0.02



TEXT-FIG. 21.—*Zygophylax sibogae*, Billard. $\times 33$.

Remarks.—The species appears to be related to *Zygophylax tizardensis*, Kirkpatrick, to *Z. curvitheca*, Stechow, and to a fourth undescribed species from the Timor Sea that has short pedicels and less curved hydrothecae, more than to other species that has been included in this genus. *Z. sibogae* differs from *Z. tizardensis* in having no second re-entrant angle and thickening on the convex side of the hydrotheca; and in having the mouth turned upwards and towards the stem. It differs from the other species in having very long hydrothecal pedicels.

Two unfascicled stems 5 mm. in length growing on *Acryptolaria conferta* var. *australis* from Station 91 have less curved hydrothecae, but probably belong to the same species.

SYNTHECIIDAE.

GENUS SYNTHECIUM, Allman.

Genotype.—*Synthecium elegans*, Allman, 1872, p. 229, fig. 1.

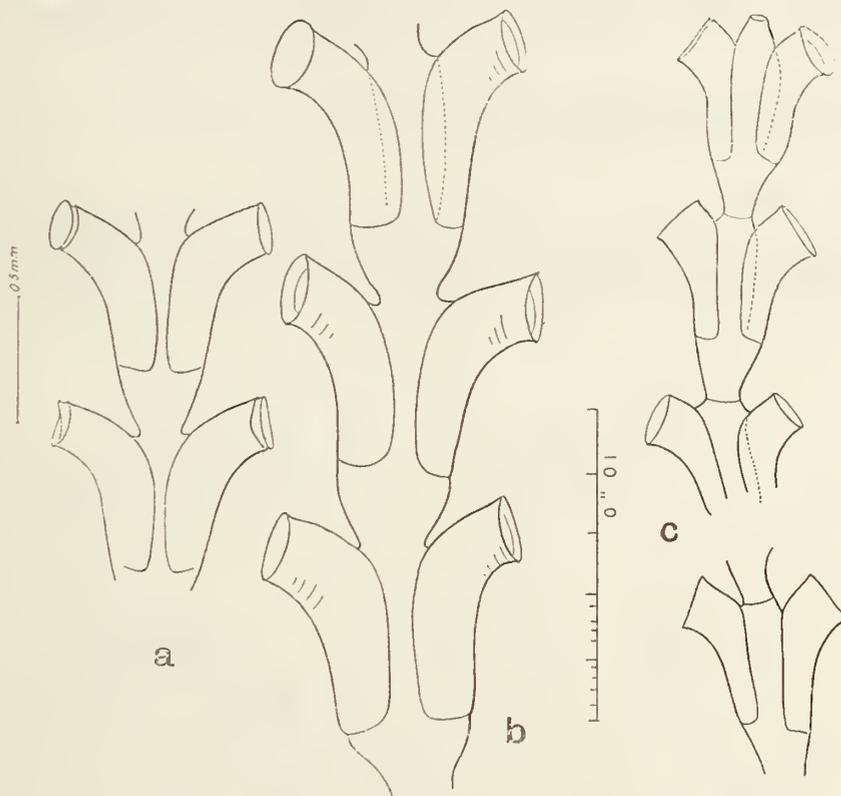
There are two facts which at present make the identification of Australian and N. Zealand species of *Synthecium* a very difficult matter. In the first place there is reason to believe that the dimensions of male and female specimens of any species are different, the female being sometimes the larger and sometimes the smaller; and, secondly, the types of the five first known species whose names are so often mentioned in synonymy lists: *S. elegans*, Allm., *S. patulum* (Busk), *S. orthogonium* (Busk), *S. ramosum*, Allm., and *S. campylocarpum*, Allm., have been lost or are in a poor state of preservation.

No type specimen of *S. patulum* (Busk) is known to exist. We must therefore base our ideas of the species on Busk's sketch which is reproduced here. It resembles Bale's fig. 10, pl. V (1884), but unfortunately is not accompanied by any indication of the scale to which it was drawn.

The specimen of *S. elegans* figured by Allman in 1876 is not known to exist. Therefore I select as lectotype of this genotype another dried New Zealand specimen from the Busk Collection, Brit. Mus. Reg. No. 99.7.1.6746, which is almost certainly part of the original material. The gonangia figured by Allman (1876) were artificially flattened from side to side.

The only original material of *S. orthogonium* known to exist is a slide in the Busk Collection, Brit. Mus. Reg. No. 99.7.1.6367. This specimen is the holotype of the species.

The syntypes of *S. campylocarpum*, Allman, consist of a figured group of six or seven male stems arising from a hydrorhiza, a group of four female stems attached to barnacles, and five detached specimens. One of these, 3.5 cm. in length, consists of two secondarily connected female stems arising from a hydrorhizal tube overgrown by a polyzoan. I select it as the holotype of the species. The female specimens are of smaller dimensions.



TEXT-FIG. 22.—*a*, *Synthecium elegans*, Allman, lectotype (Brit. Mus. Reg. No. 99.7.1.6746), (?) ♂, $\times 33$; *b*, enlarged reproduction of Busk's sketch of same species with scale, $\times 32$ (?); *c*, *S. patulum* (Busk), enlarged reproduction of Busk's sketch (scale unknown, sketch enlarged half as much as original of *b*).

Specimens of *Synthecium* species were taken at Stations 91, 134 and 144 off Northern New Zealand, and fall into six categories according to dimensions.

Two groups of "Terra Nova" material from Stations 134 and 144 form a category with the smallest dimensions. The size of the specimens is about the same as that of *S. orthogonium*. They are regarded as types of a new species *S. carinatum*. Two other specimens from Station 144 fall into a category of specimens about the size of *S. ramosum*, one probably being female and the other male. Four others from Station 134 form a group resembling none of the types mentioned very closely, three specimens of one

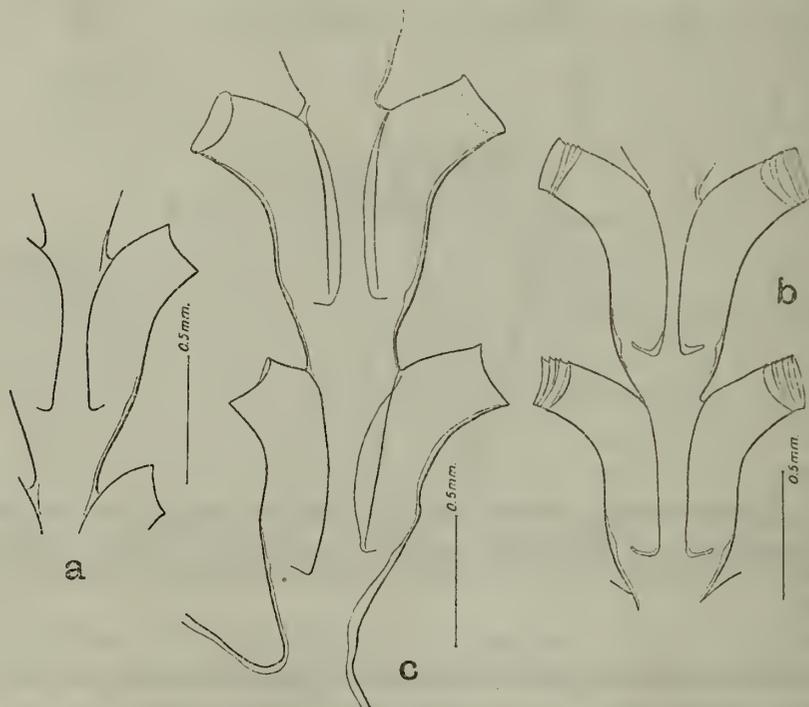
size being of one sex probably and the remaining one representing the other. A single fragment of larger dimensions from Station 91 agrees with an unnamed specimen taken by Haddon in Torres Straits and is regarded as a new species. The species of *Synthecium* require working out in detail. Meanwhile the "Terra Nova" material is dealt with as tentatively suggested above.

It is usual to find in specimens of *Synthecium* spp. that the two hydrothecae forming the basal pair of any hydroclade are not alike. The base of the upper one is nearer the axis of the stem, and its free adcauline wall is noticeably shorter than that of others. Also the length of the free adcauline wall of the proximal pair of each successive series of stem hydrothecae is less than that of the following pair or pairs.

Synthecium ramosum, Allman. (Text-fig. 23, a-c.)

Synthecium ramosum, Allman, 1885, p. 137, pl. XII, figs. 3-4.

Material.—Three branched stems, without gonothecae, one 1.5 cm. in length with larger unreduplicated hydrothecae, and two 2.1 cm. and 2.5 cm. in length with smaller reduplicated thecae, from Station 144, off Cape Maria van Diemen, N.Z., 35-40 fathoms.



TEXT-FIG. 23.—*Synthecium ramosum*, Allman. a, Schizotype (Brit. Mus. Reg. No. 86.2.19.12-13), ♀; b, (?) ♀ from Station 144; c, (?) ♂ from Station 144. All figures magnified $\times 33$.

Description.—The specimens of smaller dimensions correspond closely with the dried and flattened holotype of *S. ramosum*, Brit. Mus. Reg. No. 86.2.19.12-13, both in shape and size. Judging by *S. campylocarpum* these smaller specimens are males.

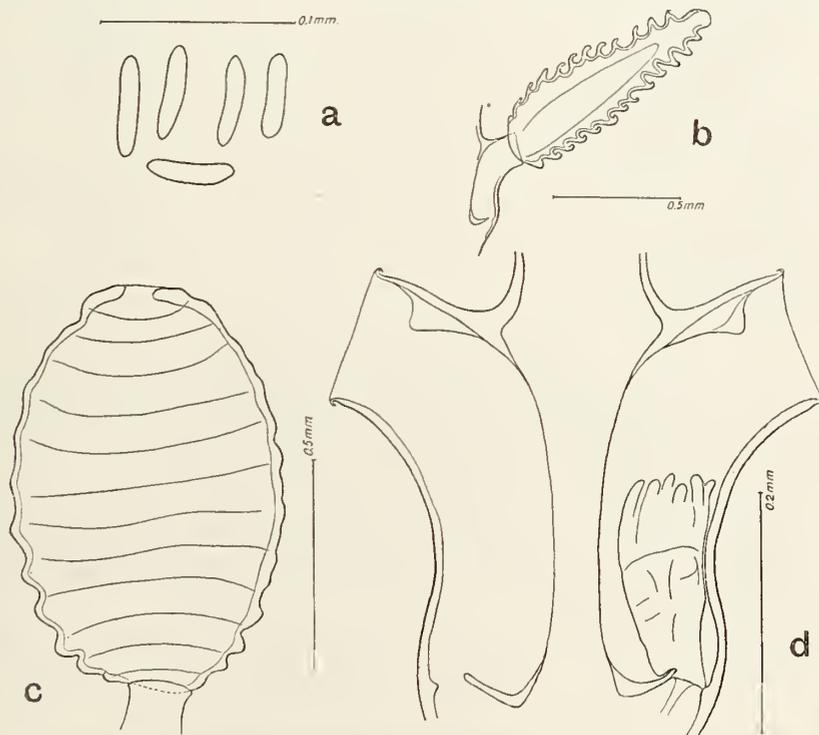
Measurements in millimetres :

Hydrotheca, length,		♂	♀
fused part	.. .. .	0.74	0.62
free part	.. .. .	0.32	0.29-0.32
over all	.. .. .	0.93	0.80-0.85
diameter			
at margin	.. .. .	0.27	0.21

Remarks.—The hydrothecae of the holotype of *S. ramosum* differ from those of the type of *S. elegans* in having a larger free adcauline wall, a wider orifice and the plane of opening less nearly vertical. Billard (1910), who did not state what particular specimens he was examining, found himself unable to keep the two species apart. In view of the unsatisfactory nature of the dried and distorted types I prefer to leave the question open.

Synthecium carinatum, sp. n. (Text-fig. 24, a-d.)

Material.—A flattened tuft of 4 cm. long stems, about 5 cm. in width, growing on a sponge from Station 134 in 11-20 fathoms; another irregular tuft of 2 cm. long



TEXT-FIG. 24.—*Synthecium carinatum*, sp. n. a, nematocysts, $\times 255$; b, lateral view of gonotheca in optical section, $\times 33$; c, gonotheca, (?) ♂, $\times 55$; d, a pair of hydrothecae from holotype (Brit. Mus. Reg. No. 29.10.10.10), from Station 134, showing internal teeth, $\times 158$.

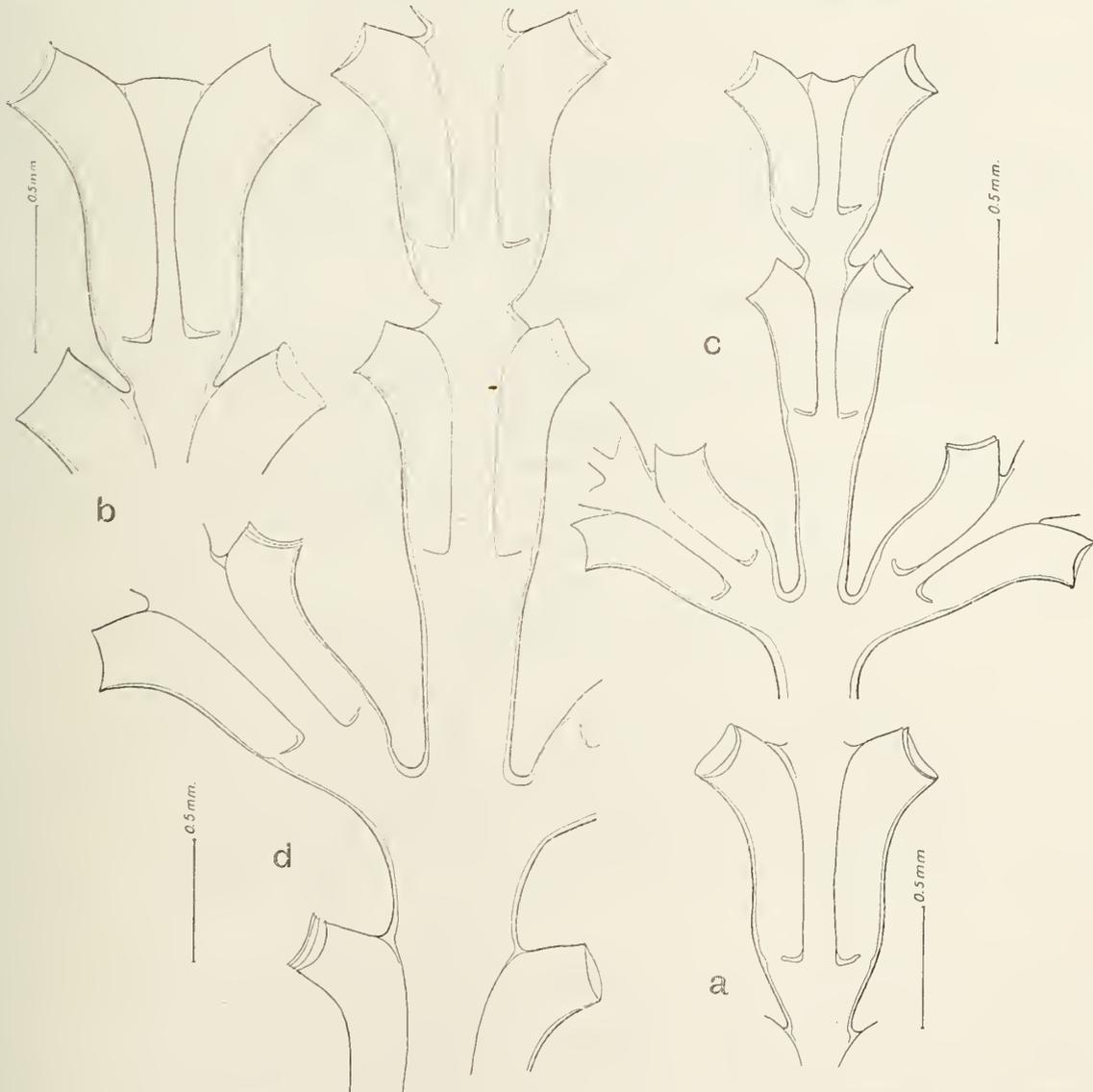
stems growing on a sponge and a polyzoan from Station 144, off Cape Maria van Diemen, N. Zealand, 35-40 fathoms.

Reduplications, which considerably lengthen the free part of the hydrotheca, have not been taken into account.

The possibility must not be overlooked that, in view of the disparity in size between the sexes in *S. samauense*, Billard, *S. carinatum* and *S. dentigerum* or *S. singulare* might prove to be the two sexes of one and the same species.

Syntheceium robustum, sp. n. (Text-fig. 25, a-d.)

Material.—A specimen complete with gonothecae, 5.5 cm. in height, having larger hydrothecae; and two specimens 2 cm. and 2.5 cm. in height without gonothecae and



TEXT-FIG. 25.—*Syntheceium robustum*, sp. n. a, b, d, Schizoholotypes, (?) ♀, from Station 134; c, Paratype. (?) ♂, from Station 134. All figures magnified $\times 33$.

with smaller hydrothecae, the larger of these two consisting of four stems arising from a common root stock; from Station 134, off North Cape, N. Zealand, 11–20 fathoms.

Description.—One-fourth part of adcauline wall of hydrotheca free, distal end of theca bending away at angle of 40° from axis. No internal hydrothecal teeth. Gonothecae ovoid, compressed at right angles to plane of branching, with from eleven to twelve transverse thickened folds, upturned at the free edge, and apical aperture.

Measurements :

Hydrotheca, length,						Holotype. mm.	Paratype. mm.
fused part .. .. .	..	..	..	..	..	0.82-0.92	0.57
free part .. .. .	..	..	..	..	..	0.25-0.30	0.17-0.20
diameter at orifice	..	..	..	..	..	0.25-0.26	0.20-0.21
Gonotheca, length .. .. .	..	..	..	..	..	1.45-2.0	
breadth .. .. .	..	..	..	..	..	1.15-1.25	
thickness .. .. .	..	..	..	..	..	0.70-0.80	

Remarks.—The large complete specimen, Brit. Mus. Reg. No. 29.10.10.5, is the holotype. If the paratype belongs to the same species it is probably of the other sex.

Syntheccium longithecum, sp. n. (Text-fig. 26.)

Material.—A branched fragment 12 mm. in length, without gonothecae, from Station 91, off Three Kings Islands, N. Zealand, 300 fathoms.

Description.—Hydrothecae strongly curved out so that the orifice is nearly vertical, two-thirds of length being free.

Measurements :

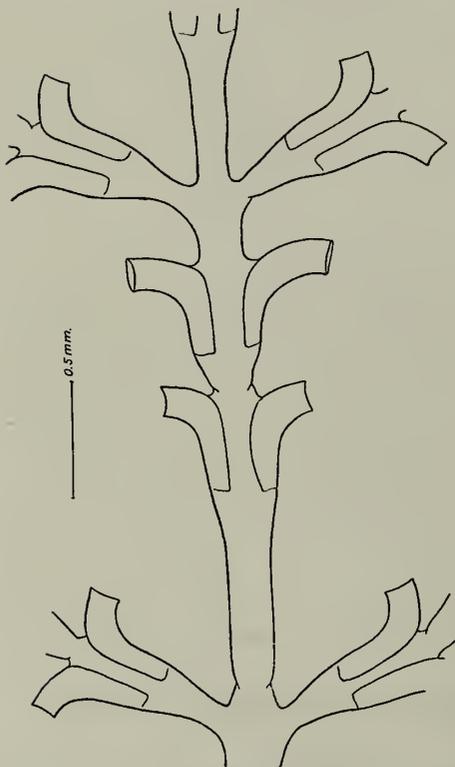
Hydrotheca, length,			mm.
fused part .. .. .	..	..	0.84-0.90
free part .. .. .	..	..	0.47-0.57
diameter at orifice	..	..	0.25-0.26

The measurements of three stem hydrothecae with their positions on the internodes are :—

length,	Proximal. mm.	Intermediate. mm.	Distal. mm.
fused part ..	0.90	0.84	0.76
free part ..	0.25	0.45	0.79

The diameter of the orifice of the stem hydrothecae may be as great as 0.31 mm.

Remarks.—There is a very similar species at Murray Island, Torres Straits. A specimen, Brit. Mus. Reg. No. 20.2.27.2, bears a single smooth cylindrical gonotheca 1.25 mm. in length and 0.6 mm. in diameter.



TEXT-FIG. 26.—*Syntheccium longithecum*, sp. n. Holotype, $\times 30$.

GENUS STAUROTHECA, Allman.

Genotype.—*S. dichotoma*, Allman, 1888, p. 76, pl. XXXVI, figs. 1-1a.

Billard (1914) has given as a definition of the genus, a slight modification of Ritchie's (1907). *Staurotheca* is dioecious; and, as Billard long ago suspected, sexual dimorphism is a generic character: the gonothecae are occasionally ornamented instead of simple.

It is interesting to recall that the first specimen of any *Staurotheca* species known to have been taken was a female *S. dichotoma*, Allman, taken in Antarctic waters by H.M. Ships "Erebus" and "Terror" in the years 1839-43.

Allman (1888) did not record all the specimens taken by H.M.S. "Challenger." From off Marion Island came both male and female (unrecorded) specimens of the genotype. I select the male specimen figured and described by Allman as the holotype of the genotype. The female specimens were first noticed by Trebilcock about ten years ago. Billard (1914) assigned to *S. affinis*, Jäderholm, the female specimens taken by H.M.S. "Challenger" off Prince Edward Island. The same vessel took a male specimen of *Staurotheca*, sp. from Station 232 off Japan and a batch of male specimens hitherto unrecorded from off Heard Island.

The following are the characters upon which classification has been based:—

1. Nature of stem, whether fasciculated or not.
2. Grouping of hydrothecae, whether in decussating pairs or in whorls of three or more.
3. Shape of gonangia.
4. Size.
5. Nature of coenosarc, whether formed of one or many tubes.
6. Relative length of free portion of hydrotheca.

Taking these seriatim:—1. Fasciculation appears to depend on whether the colony has reached a sufficient size to need secondary support in the stem.

2. On one branch of a specimen of the type of *Dictyocladium fuscum* the hydrothecae are arranged in decussating pairs: this branch grows out of another on which the thecae are whorled; and vice versa. This variation probably depends on a change of rate of metabolism: the whorled arrangement is often correlated with luxuriant growth.

3. Taking all species, two main types of gonangia have been described. Specimens hitherto described have either been sterile or else borne gonothecae of one or the other type. The only histological evidence of the sex of any of these specimens is that given by Billard (1914), who has observed ova in the coenosarc of the "Challenger" material coming from Prince Edward Island. The gonothecae on these specimens are of the urn-shaped type and have relatively large openings. No further histological evidence will be brought forward in this report, but the circumstantial evidence is almost con-

clusive for saying that the known species of *Staurotheca* are sexually dimorphic. The fact that the gonothecae of any specimen are urn-shaped or spindle-shaped is not a specific criterion.

4. With regard to the size of specimens there is a marked division between those of larger and those of smaller dimensions. In the first category come those attributed to *S. dichotoma*, *S. affinis*, Jäderholm, and *Dictyocladium fuscum*, Hickson and Gravelly. In the second comes *S. antarctica*, Hartlaub. This latter species can be distinguished from other species by its relatively small dimensions, as well as by its peculiar female gonothecae. A study of the comparative table of dimensions which follows will show that the specimens from the Graham Land region and Cumberland Bay, S. Georgia, named by Jäderholm "*dichotoma*," are of smaller size than those of that species; and that they should probably be assigned to *S. antarctica*, Hartlaub.

Selaginopsis pachyclada, Jäderholm, 1904, may prove to be a *Staurotheca* species. It has neither operculum nor marginal teeth.

The "Terra Nova" *Staurotheca* material comes from three localities: one off Oates Land to the North of Lillie Glacier Tongue and Mount Bruce, another some seven or eight degrees further South, between Granite Harbour and Glacier Tongue, McMurdo Sound, and the third West of the Falkland Islands.

The following is a list of the specimens:—

Station. No.	Species.	Sex.	Remarks.
38	antarctica	(sterile)	fragments
194	dichotoma antarctica	male and female " " "	dioecious "
220	dichotoma	(sterile)	
316	dichotoma antarctica	(sterile) (,)	1 fragment only fragments only
338	antarctica	male	
339	antarctica	female	
340	antarctica	female	
356	dichotoma	sterile	overgrown fragments

SUMMARY OF MEASUREMENTS OF RECORDED SPECIMENS OF *STAUROTHECA*.

Staurotheca dichotoma, Allman.

Material.	Obtained by.	Diameter of hydrocaulus (monosiphonic part).	Hydrotheca.			Gonotheca.					
			Length.		Diameter of orifice.	Male.		Female.			
			Adnate part.	Free part.		Length.	Width.	Length.	Width.	Diameter of orifice.	
Allman's types from Marion Island	"Challenger"		675	100-150	300-325	1400-1500	700-775	100-150	1772	1088-1139	607
Holotype from Marion Island. Billard's measurements . . .	"Challenger"	490-630	700-740	110-190	290-325	1400-1500	740-780	130-160	Not measured.		
From Prince Edward Island. Billard's measurements . . .	"Challenger"		770-860	0-135	310-325		None		1500-1700	1150-1250	550-590
<i>Dictyalidium fuscum</i> types . .	"Discovery" 1901-4	556	580-755	150-329	272-303		None			None	
From Station 194, N.Z. . .	"Terra Nova"	506	582-759	177-354	278-329	1012-1265	531-708	101-151	1518-1772	1291-1518	734-886

Staurotheca antarctica, Hartlaub.

<i>S. antarctica</i> . Vanhöffen's measurements	"Belgica"		230	(250)	140		None			None	
Jäderholm's figures of <i>S. dichotoma</i>	"Antarctica"	260	370	74-111	150-180		None			None	
<i>S. reticulata</i> . Ritchie's measurements of holotypes	"Scotia"	500	400	(100)		700-800	450			None	
<i>S. antarctica</i> . Vanhöffen's measurements	"Gauss"		200-400	500	240-260	1100-1260	480-500			None	
Vanhöffen's figures of <i>S. antarctica</i>	"Gauss"	400	480	240-360	200	1000-1280	440-520	80		None	
<i>S. antarctica</i> . Billard's measurements	"Pourquoi Pas?"	230-280	350-420	230-310	150-190		None			None	
From Station 338	"Terra Nova"	400	450-620	250-(500)	220	1250	500	100		None	
From Station 329	"Terra Nova"	303	420-506	253-(379)	151-177		None		1316-1392	658-734	

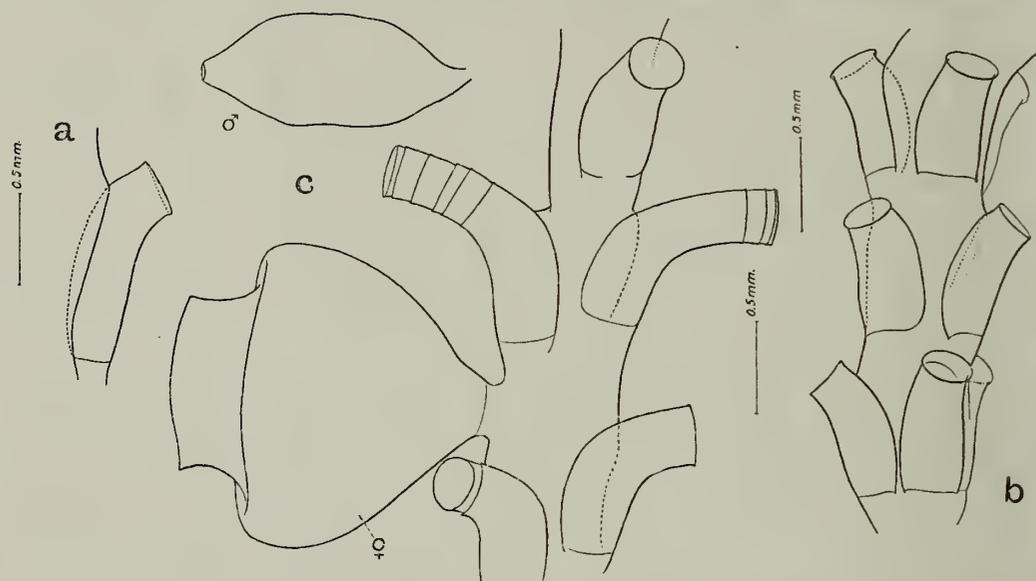
Figures placed within brackets relate to reduplicated thecae. The unit of measurement is one micron.

Staurotheca dichotoma, Allman. (Pl. II, fig. 9; text-fig. 27, a-c.)

Staurotheca dichotoma, Allman, 1888, p. 76, pl. XXXVI, figs. 1-1a; *Selaginopsis affinis*, Jäderholm, 1904, p. XI; *Dictyocladium fuscum*, Hickson and Gravelly, 1907, p. 21, pl. III, fig. 22.

Material.—A number of branched fragments up to 4 cm. in length, with male and female gonothecae, from Station 194, off Oates Land, 180-200 fathoms; part of a sterile colony 9 cm. in length from Station 220, off Cape Adare, 45-50 fathoms; a minute sterile fragment from Station 316, off Glacier Tongue, McMurdo Sound, 190-250 fathoms; and some overgrown sterile fragments from Station 356, entrance to McMurdo Sound, 50 fathoms.

Description.—Dioecious; female gonothecae vase-shaped, tapering below, with aperture at end of short wide cylindrical collar that arises from broad shoulders.



TEXT-FIG. 27.—*Staurotheca dichotoma*, Allman. a, hydrotheca from Station 316; b, specimen from Station 220 to show three rows of hydrothecae; c, male and female gonothecae from Station 194. All figures magnified $\times 24$.

Remarks.—This appears to be a very variable species, but is easily distinguished from the only other well defined one by its greater size and plain vase-shaped female gonothecae.

The specimen from Station 220 closely resembles Hickson and Gravelly's types of *Dictyocladium fuscum*. Since the gonothecae of this form were not found it may best be included in *S. dichotoma*.

Staurotheca antarctica, Hartlaub. (Pl. II, fig. 6; text-fig. 28.)

Staurotheca antarctica, Hartlaub, 1904, p. 16, pls. I, fig. 4, II, fig. 4; *S. dichotoma*, Jäderholm, 1905, p. 33, pl. XIV, figs. 1-2 (not *S. dichotoma*, Allman, 1888, p. 76, pl. XXXVI, figs. 1-1a); ? *S. reticulata*, Ritchie, 1907, p. 538, pl. I, figs. 1-1b.

Material.—Fragments up to 2 cm. in length with male and female gonothecae from Station 194, off Oates Land, 180-200 fathoms; a few fragments 1.5 cm. in length

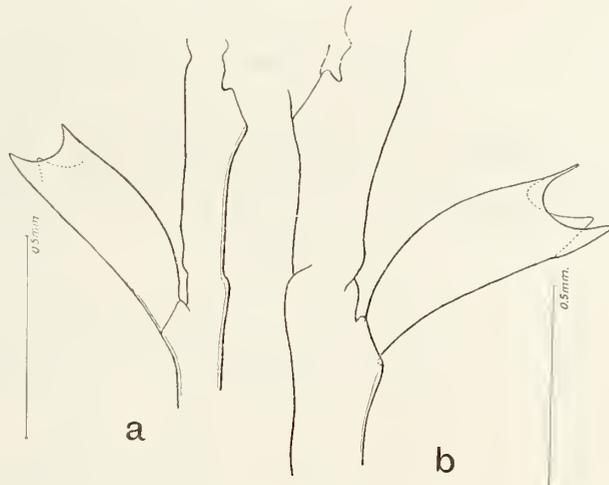
without gonothecae from Station 316, McMurdo Sound, 190–250 fathoms; a tangle of anastomosing specimens 11 cm. in height bearing male gonothecae, from Station 338, McMurdo Sound, 207 fathoms; branched fragments 3–4 cm. in length bearing female gonothecae from Station 339, McMurdo Sound, 140 fathoms; branched fragments up to 5.5 cm. in length with female gonothecae, from Station 340, McMurdo Sound, 160 fathoms; and a fragment 3 cm. in length from Station 38, West of Falkland Islands, 125 fathoms.

Description.—Diocious; male gonothecae like those of *S. dichotoma* but smaller. Female gonotheca covered in its distal half with longitudinal rows of irregular or finger-like processes except on the outer side, where there is a round aperture, which is guarded by a curved and often bifid finger-shaped process standing out horizontally from the hydrocaulus, from the upper side of which process the gonotheca itself arises. One large rounded ovum or embryo lies against the operculum.

Remarks.—Measurements for this species have been given on p. 177. It is a much smaller species than the only other well defined one, *S. dichotoma*, Allman, and is distinguished readily by its peculiar female gonothecae.



TEXT-FIG. 28.—*Staurothecca antarctica*, Hartlaub. Female gonotheca, $\times 34$.



TEXT-FIG. 29.—*Parascyphus simplex* (Lx.). *a*, from "Terra Nova" Station 134; *b* (Brit. Mus. Reg. No. 10.10.17.2-7), from Victoria-Tasman cable. Both sketches magnified $\times 53$.

SERTULARIIDAE.

Parascyphus simplex (Lamouroux). (Text-fig. 29, *a-b*.)

Laomedea simplex, Lamouroux, 1816, p. 207. For synonymy see: Stechow (1925), p. 224; and Spletstösser (1929), p. 126.

Material.—Five or six dozen stems from a stolon creeping over an old Gasteropod shell, from Station 134, off North Cape, New Zealand, 11–20 fathoms.

Description.—Nine or ten of the specimens bear a single short branch in the middle region. Branches have not been seen before. There are no gonothecae.

*Measurements :

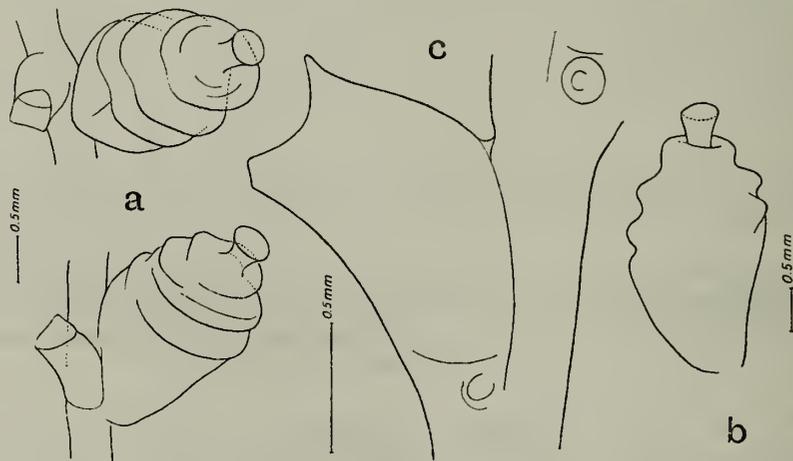
	mm.
Colony, height	8-12
Stolon, diameter	0.18-0.25
Hydrocaulus, diameter	0.12-0.22
Internode, length	0.42-0.55
Hydrothecae,	
distance apart	1.0
length (to apophysis)	0.55
maximum breadth	0.20

Remarks.—This little-known hydroid has been recorded before from the West Coast of Scotland, Gough Island, South Coast of Australia, Tasmania, and New Zealand; but never in any abundance. Neither when taken in December/January (New Zealand and Tasmania), in April (Gough Island), nor at the end of August (New Zealand), were any gonothecae found. The gonothecae have been described once by Bale (1915); but the season when they were found was not indicated. This genus represents the survival of a stage in the evolution of *Symplectoscyphus*. The diaphragm or floor of the hydrotheca, which appears late in the ontogeny of species that possess it, is small and incomplete.

Symplectoscyphus columnarius (Briggs). (Pl. I, fig. 10; text-fig. 30, a-c.)

Sertularella columnaria, Briggs, 1914, p. 293, fig. 1; *Sertularella columnaria*, Bale, 1924, p. 239.

Material.—A branched polysiphonic fragment four centimetres long bearing gonothecae, from Station 90, off Three Kings Islands, N.Z., 100 fathoms.



TEXT-FIG. 30.—*Symplectoscyphus columnarius*, Briggs. a, b, gonothecae, $\times 11$; c, hydrotheca, $\times 33$.

Description.—The dimensions of branch internode diameter and of hydrothecae correspond with those given for the species by Briggs. The gonothecae, which have not been described before, are much like those of *S. meridionalis*, Nutting, except that the terminal portion flares open gradually, there being no distinct intermediate tubular portion. They are somewhat flattened, and have three distal corrugations.

* See Ritchie (1909a, 1911), Billard (1909), Briggs (1914), Bale (1915).

Measurements :

Gonotheca,	mm.
length	3.19
greatest diameters	1.30 × 1.68
opening, diameter	0.45
terminal tube, length	0.55

Remarks.—The fragment looks like a detached branch, in which case the original description of the stem applies also to the branches, which may bear secondary branches 15 mm. long. The species has already been recorded from an undetermined locality in New Zealand by Bale (1924).

Symplectoseyphus constrictus, sp. n. (Pl. I, fig. 3 ; text-fig. 31.)

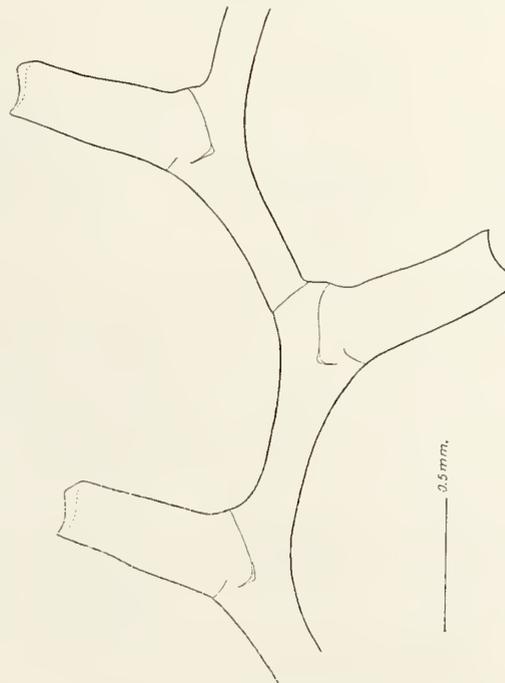
Material.—Parts of four specimens, the largest 7.5 cm. long, from Station 91, off Three Kings Islands, New Zealand, 300 fathoms.

Description.—A branched species, with a trophosome resembling that of *Sertularella macrocarpa*, Billard, and *S. pedunculata*, Billard, only larger. Stem with a few accessory tubes in the basal part and with regularly alternate pinnae. Separating each alternating pair of pinnae is a pair of alternating hydrothecae, and in the axil of each pinna a hydrotheca.

Hydrotheca tubular, free part about twice the length of adnate, with three small teeth. On the adcauline side of the free portion there is a characteristic constriction close to the cauline wall. Internodes of pinnae fine, equal in length to hydrothecae or up to a third longer, forming a zig-zag. Gonothecae absent. Polyps with prominent hypostome and about sixteen tentacles.

Measurements :

Hydrothecae,	mm.
length	0.76
orifice diameter	0.24



TEXT-FIG. 31.—*Symplectoseyphus constrictus*,
sp. n. × 35.

Symplectoseyphus johnstoni (Gray). (Text-fig. 32, a-c.)

Sertularia johnstoni, Gray, 1843, p. 294 ; *Sertularella johnstoni*, Allman, 1876, p. 261, pl. XIII, figs. 1-2 ; *Sertularella johnstoni*, Bale, 1924, p. 239 ; ? *Sertularella australis*, Marktanner-Turneretscher, 1890, p. 226 ; not *Sertularia dchicatulata*, Hutton, 1872, p. 256.

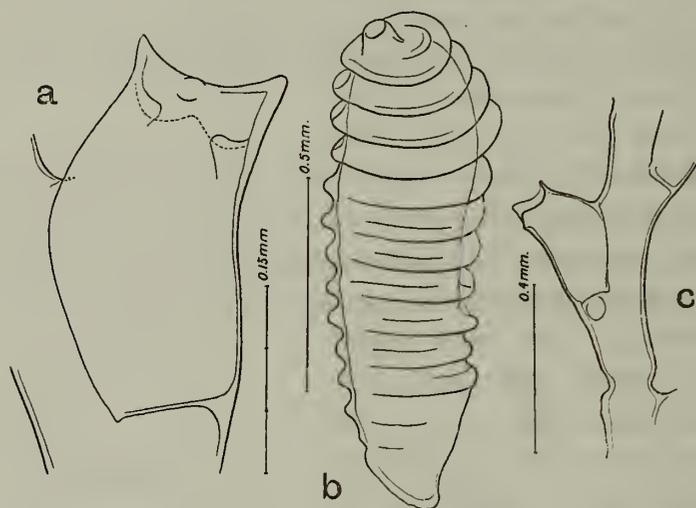
Material.—A small tuft of stems one and a quarter inches in height attached to each other by tendrils. The specimens are covered with Polyzoa and a Campanularian

hydroid. Very few gonothecae are present; from Station 144, off Cape Maria van Diemen, N.Z., 35-40 fathoms.

Description.—The nodes are scarcely visible. The hydrothecae have three internal teeth—a very rare phenomenon for species of *Symplectoscyphus*. These internal teeth are small and papilliform, one abcauline and two lateral.

Measurements :

Hydrotheca,										mm.
length	..	..	..	..	..	..	..	..	..	0.3
diameter	..	..	..	..	..	..	..	..	..	0.15
Gonotheca,										
length	..	..	..	..	..	..	..	..	..	1.15
width	..	..	..	..	..	..	..	..	..	0.34
aperture, diameter	..	..	..	..	..	..	..	..	..	0.07
annulations	..	..	..	..	..	..	..	..	..	14



TEXT-FIG. 32.—*Symplectoscyphus johnstoni* (Gray). *a*, hydrotheca with internal teeth, $\times 163$; *b*, gonotheca, $\times 56$; *c*, hydrotheca, $\times 55$.

Remarks.—Two of Gray's sixteen dried syntypes, collected by Dr. A. Sinclair, have been prepared as microscopic transparencies. Internal hydrothecal teeth are present, though not so well seen as in fresh material. The measurements of the hydrothecae agree with those given above. Some of the gonothecae are rather larger than those whose measurements are given above, and the aperture is usually 0.1 mm. in diameter. The annulations number twelve or thirteen. The compressed gonothecae with corrugations and stout, tubular, wide-mouthed apertures are quite distinct from those of allied species. The best figures have been given by Allman (1876) and Bale (1914, pl. II, fig. 10).

The species is quite distinct from *Sertularella divaricata*, Busk, the holotype of which I found in 1922. *Symplectoscyphus divaricatus* (Busk) is a species allied to *Symplectoscyphus subarticulatus* (Coughtrey), and has a fascicled stem.

Symplectoscyphus delicatulus (Hutton). (Text-fig. 33.)

Sertularella delicatula, Hutton, 1872, p. 256; *Sertularella capillaris*, Allman, 1885, p. 133, pl. VIII, figs. 1-3; not *Sertularella johnstoni* (Gray), 1843, p. 294.

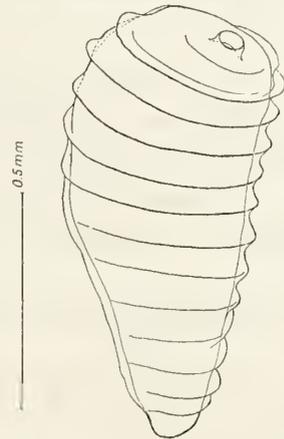
Material.—A tuft of intertwining stems one and a half inches high, with gonothecae, from Station 144, off Cape Maria van Diemen, N.Z., 35-40 fathoms.

Description.—Stems monosiphonic, pinnate or doubly pinnate, interconnected by tendrils. Nodes sometimes slightly or not at all marked. Hydrothecae inclined to one side. Three-toothed orifices inclined slightly upwards, free part of adcauline side equal to fused part, no internal teeth. Gonothecae adnate except at distal end which is inflated, with from ten to twelve annulations not produced into free frilly margins, and not always marked on the proximal part; apertures on short truncated cones, eccentric.

Measurements :

Hydrotheca,								mm.
maximum length ..	..	..	..	..	..	..	..	0.27-0.29
maximum width ..	..	..	..	..	..	..	..	0.15
Gonotheca,								
length ..	..	..	..	..	..	..	..	1.1-1.22
width ..	..	..	..	..	..	..	..	0.51-0.57
diameter of external aperture ..	..	..	..	..	..	..	..	0.06-0.07
number of annulations ..	..	..	..	..	..	..	..	10-12

Remarks.—There are in the British Museum four type specimens received from Prof. Hutton in 1875. I select specimen Brit. Mus. Reg. No. 75.1.5.57A as holotype. It is a dried tuft of stems about one and a quarter inches long bearing very numerous gonothecae. Hutton (1872) described the gonotheca as having an acutely toothed crown. Probably the tooth was the eccentric terminal tube. The "Terra Nova" material agrees closely with the type; and so do the small dried types of *S. capillaris*, Allman. In these types of Allman the diameter of the terminal tubes of the gonothecae is slightly larger than in *S. delicatulus*, being from 0.09-0.1 mm. The shape and size of the terminal tubes of the gonothecae probably differs in the two sexes, as in those of related forms. Sexual dimorphism makes the determination of the numerous closely related species a matter of some difficulty at the moment, as the specific differences between the trophosomes are not very marked. *S. delicatulus* and *S. johnstoni* appear to grow alongside one another. The "Terra Nova" specimens did, and specimens taken by Farquhar in Ohiro Bay, New Zealand, appear to have done so too. The species may be separated at once by their gonothecae, and by the presence or absence of internal hydrothecal teeth.

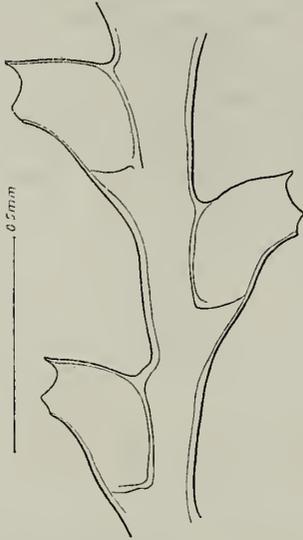


TEXT-FIG. 33. — *Symplectoscyphus delicatulus*, Hutton. Gonotheca, × 56.

Symplectoscyphus spiritualis, sp. n. (Text-fig. 34.)

Material.—A tuft of intertwining stems up to one and a half inches in length growing on a tubular sponge, from Station 144, N.Z., 35–40 fathoms. A doubly pinnate stem and a tuft of stems from Station 134, off North Cape, N.Z., 11–20 fathoms.

Description.—Stems monosiphonic, straggling, pinnate, sometimes bipinnate, interconnected by tendrils. Nodes scarcely or not at all marked. Hydrothecae lateral, three-toothed, orifices lateral, free part of adcauline side equal in length to fused part, no internal teeth or thickened margins. Gonothecae adnate except distal end, laterally compressed, with from 16–18 annulations covering entire length, distal two or three only with free frilled margins; distal ends not enlarged, aperture funnel-shaped, slightly flaring, eccentric.



TEXT-FIG. 34.—*Symplectoscyphus spiritualis*, sp. n.
× 56.

Measurements :

Hydrotheca,				mm.
maximum length	..	..	..	0.37
maximum width	..	..	..	0.17
Gonotheca,				
length	..	..	..	1.27–1.54
width	..	..	..	0.55
diameter of aperture,				
internal	..	..	..	0.06
external	..	..	..	0.15
number of annulations	..	..	..	16–18

Three stems only from Station 144, and none from Station 134 bore gonothecae.

Remarks.—The large number of annulations on the gonothecae distinguishes this species from forms previously described as varieties of *S. divaricatus* by Bale (1914).

A stem with gonothecae has been selected as holotype and mounted on a slide, Brit. Mus. Reg. No. 29.10.10.11.

Symplectoscyphus confusus, sp. n. (Pl. I, figs. 4, 6; text-fig. 35.)

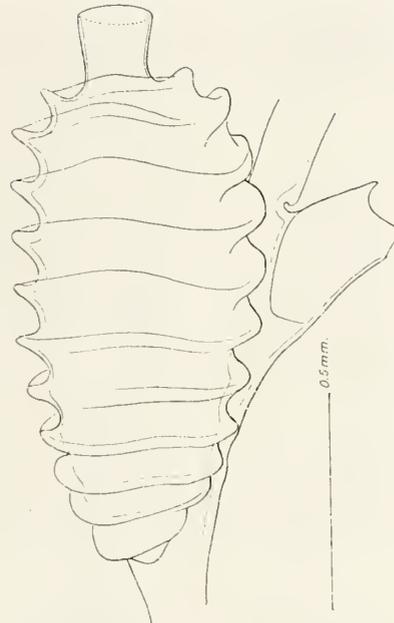
Material.—Three tufts of stems about one and a half inches long, growing on pieces of primnoid Alcyonarians, from Station 91, off Three Kings Islands, N.Z., 300 fathoms.

Description.—Stems monosiphonic, pinnate or doubly pinnate. Nodes faintly marked. Hydrothecae lateral, three-toothed, without internal teeth; free part of adcauline side equal to or a little less in length than fused part, orifices inclined upwards. Gonothecae not compressed laterally, annulated except where they are adnate to pinna for two-thirds of their length; annulations from eleven to twelve in number well marked and over entire length, margins not produced into free frills. Apertures on cylindrical tubes, equal in diameter to length of tubes; proximal aperture of tube a little smaller than external one.

Measurements :

Hydrotheca,		mm.
maximum length	.. ..	0.37
maximum width	.. ..	0.19
Gonotheca,		
length	.. ..	1.25-1.34
width	.. ..	0.59
diameter of external aperture		0.17
,, internal	.. ..	0.13-0.14
number of annulations	.. ..	11-12

Remarks.—I have not observed any dimorphism of gonothecae; but I believe the gonads are all of one sex. The species appears to be nearest *S. filiformis* (Allman). That species has dimorphic gonothecae, the female having stouter terminal tubes which were not described by Allman. As holotype of *S. confusus* I select a tuft of stems, Brit. Mus. Reg. No. 29.10.10.6, growing on a primnoid stem 43 mm. long, the whole measuring about 8 × 6 × 3 cm.



TEXT-FIG. 35. — *Symplectoscyphus confusus*, sp. n. Gonotheca from Holotype, × 56.

Symplectoscyphus epizooticus, sp. n. (Pl. I, figs. 5, 6; text-fig. 36, a-b.)

Material.—Epizootic on *S. confusus*, sp. n., from Station 91, off Three Kings Islands, N.Z., 300 fathoms.

Description.—Stems simple or occasionally pinnate, about 5 mm. long, internodes long and very slender. Hydrothecae three-toothed, apertures inclined upwards, without internal teeth. Gonothecae small, flattened, smooth or irregularly undulating, aperture central, on short tube.

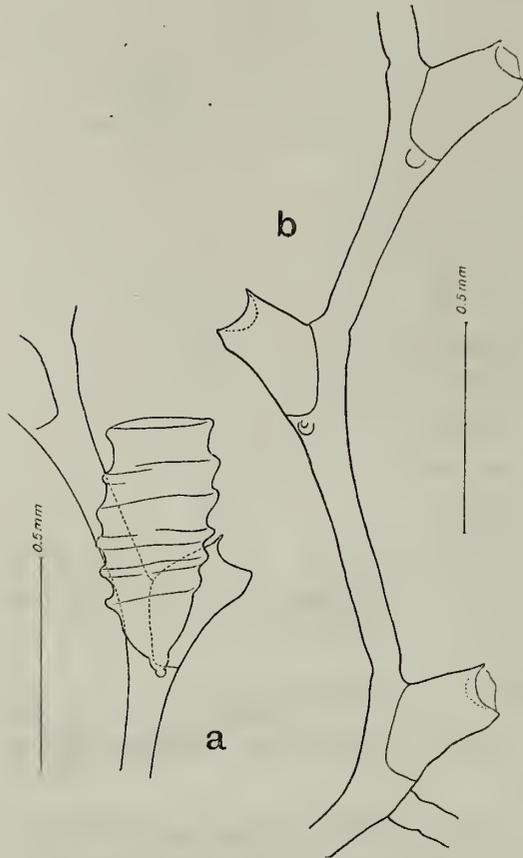
Measurements :

Hydrotheca,		mm.
maximum length	.. ..	0.32
maximum width	.. ..	0.15
Gonotheca,		
length	.. ..	0.66
width	.. ..	0.34
diameter of aperture	.. ..	0.07
annulations	.. ..	vestigial

Remarks.—Very few gonothecae were observed. Specimens (? juv.) generally spring from a rounded foot plate about half a millimetre in diameter.

As holotype I have selected a specimen, Brit. Mus. Reg. No. 29.10.10.7, mounted as a microscopical preparation. From a footplate arises one simple stem which consists of six internodes. Another stem issues from the basal plate and remains attached for a short distance to a specimen of *S. confusus*. It gives rise to a third simple stem, consisting of ten internodes, and a fourth of seven. From below the distal hydrotheca

on the fourth stem two short simple pinnae arise. From the penultimate hydrotheca a single gonotheca is developed.

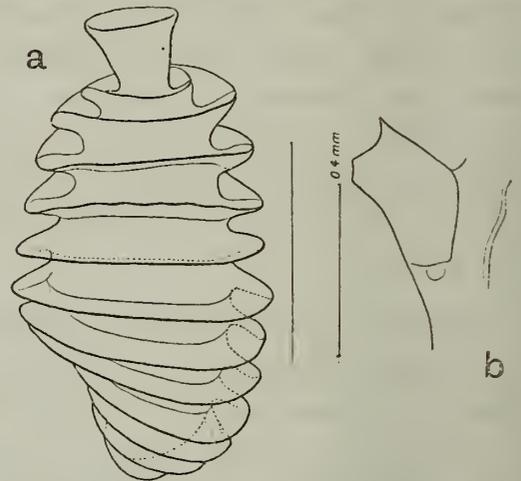


TEXT-FIG. 36.—*Symplectoscyphus epizooticus*, sp. n. *a*, immature gonotheca; *b*, hydrotheca. Both figures magnified $\times 55$.

Symplectoscyphus tuba, sp. n. (Text-fig. 37, *a-b*.)

Material.—A small tuft, measuring one inch square by half an inch, attached to a polyzoan, from Station 90, off Three Kings Islands, N.Z., 100 fathoms.

Description.—Stem monosiphonic, straggling, multipinnate. Internodes long and



TEXT-FIG. 37.—*Symplectoscyphus tuba*, sp. n. *a*, gonotheca, $\times 56$; *b*, hydrotheca, $\times 45$.

slender. Hydrothecae three-toothed, aperture inclined upwards, no internal teeth, free part of adcauline wall equal to fused part. Gonothecae ovate with 11 or 12 well marked annulations; terminal tube central, flared, like the mouth-piece of a telephone.

Measurements :

Hydrotheca,									mm.
maximum length	..	..	..	..	..	..	..	..	0.34
maximum width	..	..	..	..	..	..	..	..	0.17
Gonotheca,									
length	..	..	..	..	..	..	..	..	1.10
maximum diameter	..	..	..	..	..	..	..	..	0.59
diameter of external opening	..	..	..	..	..	..	..	..	0.25
,, internal ,,	..	..	..	..	..	..	..	..	0.11
number of annulations	..	..	..	..	..	..	..	..	11-12

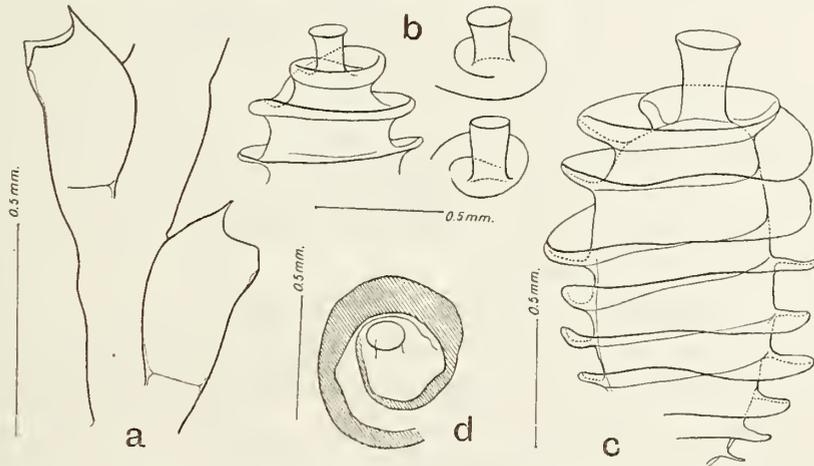
Remarks.—This species resembles *Symplectoscyphus confusus*, sp. n., but the hydrothecae are a little smaller and the gonangia are shorter and have a different terminal tube. The tuft itself is the holotype specimen.

Symplectoscyphus vanhoeffeni, nom. n. (Text-fig. 38, a-d.)

Sertularella subdichotoma, Vanhöffen, 1910, p. 326, fig. 41, a-e (not *Sertularella subdichotoma*, Kirchenpauer, 1884, p. 46, pl. XVI, figs. 1-1b); not *Sertularia divaricata*, Busk, 1852, p. 388; not *Sertularella cumberlandica*, Jäderholm, 1905, p. 27, pl. X, figs. 8-11. The synonymy of *S. divaricata* auct. (nec Busk) has not been set in order.

Material.—Tufts of specimens up to a length of 6 or 7 cm., with immature and spent gonothecae, in association with those of *S. glacialis* on the main stems of *Schizotricha unifurcata*, on polyzoa and on Terebellid worm tubes, from Station 220, off Cape Adare, 45-50 fathoms; some branched fragments 3 cm. in length, with immature gonothecae from Station 339, McMurdo Sound, 140 fathoms; a tangle of specimens with immature gonothecae from Station 356, off Granite Harbour, 50 fathoms; and a tangle of specimens from Station 340, McMurdo Sound, 160 fathoms.

Description.—Stems non-fascicled, straggling, up to 6 or 7 cm. long, branching by false dichotomy and anastomosing. Distal branches pinnate. Hydrocaulus tending



TEXT-FIG. 38.—*Symplectoscyphus vanhoeffeni*, nom. n. a, hydrothecae, $\times 55$; b, terminal tubes of male gonothecae, $\times 33$; c, spent female gonotheca, $\times 33$; d, distal end of spiral fold of gonotheca, $\times 32$.

not to form distinct nodes. Hydrothecae usually a length apart, short, with about half length free.

Gonothecae obovate, narrowed and tubular at distal end, with flared opening, spirally folded walls forming a frill with about eight turns; dimorphic, one, probably the female, with larger mouth tube and deeper frills.

Measurements :

Hydrotheca,						mm.	
length .. .. .	..	..	..	..	..	0.33	
diameter .. .. .	..	..	..	..	..	0.20	
Gonotheca,							Male. Female.
length .. .. .	..	..	..	..	..	1.63	
diameter .. .. .	..	..	..	..	..	0.75	
tube,							mm.
length .. .. .	..	..	..	..	..	0.15-0.18	0.30-0.37
diameter at margin	..	..	..	..	..	0.15-0.16	0.25-0.28
frill depth .. .. .	..	..	..	..	..	0.13	0.18-0.23

Remarks.—In a smaller variety from Granite Harbour, McMurdo Sound, the hydrothecae are more distant.

Through the kindness of Dr. Thiel of the Hamburg Museum I have been able to re-examine Kirchenpauer's syntypes of *S. subdichotoma*. They have been previously re-examined by Hartlaub and mentioned in his "Revision der Sertularella-Arten." Hartlaub did not redescribe the original of Kirchenpauer's figure of *S. subdichotoma* which, in the absence of a selection by Kirchenpauer, I now select as the holotype; nor did he redescribe the syntypes. He gave a general description both of the syntypes and of a quantity of material in the Hamburg Museum which he ascribed to Kirchenpauer's species, at the same time expressing his unwillingness to decide whether the Australian and S. American forms were the same. This is not the occasion to publish a redescription of Kirchenpauer's species, but it is to be recorded that I have since identified by many fine details the roughly figured specimen from Australia, the holotype of the species, Hamburg Museum number C 4311. In *S. subdichotoma* the free part of the hydrotheca is shorter than in *S. vanhoeffeni*, there are no free frills to the gonotheca and the mouth of the gonotheca is on a very short and wide tube. The species is distinct from the Antarctic one.

I have found at last the original specimen of Busk's *S. divaricata*, of which sketches are already known. I select this specimen, Brit. Mus. Reg. No. 99.7.1.6624, as the holotype of the species. It is closely related to Coughtrey's *Thuiaria subarticulata*, but not to the Antarctic *S. vanhoeffeni*.

As to all the varieties ascribed by Bale and other authors to Busk's species *divaricata*, until they have been classified and named, and a new description of *S. divaricatus* is published, there will be much confusion. I do not think that any of them belongs to the Antarctic species. Both Vanhöffen and I have noticed the association between this species, *S. vanhoeffeni*, and *S. glacialis*.

It is remarkable that the collection contains no specimens with fascicled stems that can be assigned to *S. cumberlandica*, Jäderholm, which is a closely related species. I was able to make careful re-examination and sketches of the type slides of that species.

What we desire now is a careful comparison of the two species showing how to differentiate between them. It is possible that they will turn out to be synonymous.

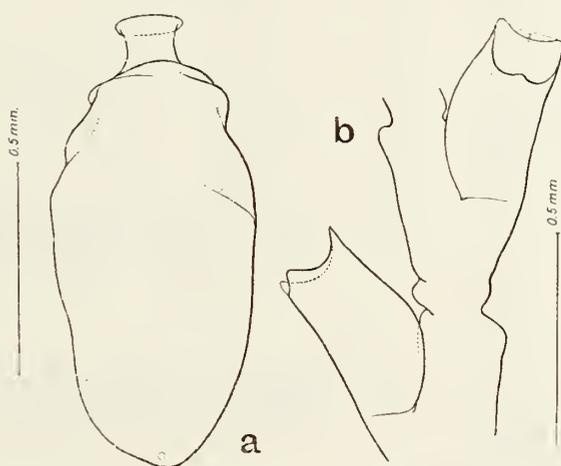
Symplectoscyphus glacialis (Jäderholm). (Pls. I, figs. 8, 9; II, fig. 7; text-fig. 39, a-b.)

Sertularella glacialis, Jäderholm, 1904, p. 9; 1905, p. 26, pl. X, figs. 3-7; *idem*, Ritchie, 1913, p. 29, fig. 10; *idem*, Billard, 1914, p. 23; *idem*, Jäderholm, 1917, p. IX, pl. I, fig. 9; *Symplectoscyphus glacialis*, Stechow, 1922, p. 148; 1923, p. 174; *Sertularella glacialis*, Jäderholm, 1926, p. 5 (not *S. glacialis*, Vanhöffen, 1910, p. 325 = *S. plectilis*, Hickson and Gravelly).

Material.—Two small tufts up to 2 cm. in length from Station 316, McMurdo Sound, 190-250 fathoms; several tufts of multipinnate stems up to 6 cm. in length

with gonothecae, growing on other hydroids, from Station 220, off Cape Adare, 45–50 fathoms; and from Station 356, entrance to McMurdo Sound, 50 fathoms. A few fragments with rather larger hydrothecae coming from Station 194 off Oates Land, 180–200 fathoms, may belong to this species.

Remarks.—It has been stated by Ritchie (1913) that there is little difference between the trophosomes of *Sertularella glacialis* and of “*Sertularella subdichotoma*” (= *Symplectoscyphus vanhoeffeni*, nom. n.). It is, indeed, often a matter of great difficulty to determine specimens of these two species in bulk, especially when the two are growing side by side. But while in the abcauline wall of the hydrothecae of *S. vanhoeffeni* there is a pronounced re-entrant angle, which makes them gibbous below,



TEXT-FIG. 39.—*Symplectoscyphus glacialis* (Jäderholm). a, gonotheca, $\times 56$; b, hydrothecae, $\times 56$.

those of *S. glacialis* are generally without it, and in form are more nearly tubular. Attention has already been drawn by Ritchie (1913) and Jäderholm (1905) to the proportions of the “free” and “adnate” portions of the thecal walls. Half, or more than half, of the hydrothecal wall in *S. glacialis* is said to be free. This is not constantly so, for I find that the average length of the free part of 16 hydrothecae of a toptype is distinctly less than that of the adnate part. Measurements of 41 hydrothecae on different parts of a specimen from Station 220 give the same result. The average measurements of 9 hydrothecae on a fragment from Gauss Station give an inverse proportion, however. I have tabulated measurements below. Table I gives, in addition to new measurements, some of the figures previously published. Table II gives an analysis of the measurements of one specimen. From this it will be seen that the mean measurements of similar lengths from successive series in one specimen decrease distalwards.

Symplectoscyphus glacialis, Jäderholm.

Table of Measurements I. Unit: 1 micron.

Nature of the material.		Internode.		Hydrotheca.			Gonotheca.			
		Length.	Diameter.	Length.		Diameter.	Length.	Diameter.	Diameter of orifice.	
				Adnate part.	Free part.				Inter-nal.	Exter-nal.
1. Jäderholm's type (<i>teste</i> Jäderholm).	minimum	440		290			770	370		
	maximum	600		370			1000	480		
	number measured									
	mean					150				
2. Small fragment (topo-type) from Graham Land. Swedish Antarctic Exp., Brit. Mus. Reg. No.	minimum	405		202	215	126				
	maximum	886		265	265	151				
	number measured	(19)		(16)	(16)	(11)				
	mean	607	151	254	239	144	481	430	(Immature)	
3. Small specimen from Gauss Station, German Antarctic Exp., Brit. Mus. Reg.No.11.12.8.6.	minimum	405		189	253	101		481		
	maximum	734		240	278			506		
	number measured	(19)		(9)	(9)			(2)		
	mean	531	126	213	267	126	708	493	101	151
4. Specimens from Gauss Station (<i>teste</i> Vanhöffen).	minimum			340		160	800	440		
	maximum			400		200	1000	620		
	number measured									
	mean	500								
5. Specimens from Cape Royds, Br. Antarctic Exp., 1908 (<i>teste</i> Ritchie).	minimum	640	140	200	240	170	None			
	maximum	1150	160	270	300	200				
	number measured									
	mean	895	150	235	270	185				
6. Specimens from Graham Land, "Pourquoi Pas?" Exped., <i>teste</i> Billard.	minimum	610	135	230	215	135	None			
	maximum	840	160	270	270	150				
7. Fragment, 9 mm. × 8 mm. Station 220, "Terra Nova" Exp., <i>Forma typica</i> .	minimum	683	215	266	278	165	None			
	maximum	405	158	177	190	139				
	number measured	(46)	(33)	(41)	(40)	(45)				
	mean	505	188	227	224	149				
8. Fragment, Station 220, "Terra Nova" Exp., <i>Forma typica</i> .	minimum	329					1013	481	101	165
	maximum	658							127	177
	number measured	(32)	Not measured				(2)	(1)	(2)	(2)
	mean	484							114	171
9. Fragment, Station 220, "Terra Nova" Exp., <i>Forma elongata</i> .	minimum	633		203	228		None			
	maximum	1392		241	278					
	number measured	(19)		(24)	(20)					
	mean	950		228	248					
10. All recorded specimens of " <i>forma typica</i> " including previously published figures.										
	mean	525	155	256	243	150	797	472	108	161
11. "Terra Nova" and "Nimrod" specimens of " <i>forma elongata</i> ."										
	mean	972	150	231	259	185				

Symplectoscyphus glacialis, Jäderholm.

Table of Measurements II. Unit: 1 micron.

Specimen from Station 220 "Terra Nova" 1910 Expedition (9 mm. long).		Internode.		Hydrotheca.		
		Length.	Diameter.	Length.		Diameter.
				Adnate part.	Free part.	
Main stem	minimum	430	176	203	203	146
	maximum	683	203	266	278	164
	number	15	7	11	11	12
	mean	598	202	240	234	152
Branch No. 1,* penultimate series ..	minimum	506	176	228	203	152
	maximum	506	203	241	215	152
	number	2	3	2	2	3
	mean	506	200	234	209	152
Branch No. 2, penultimate series (8 mm. long).	minimum	456	177	177	203	127
	maximum	633	215	241	253	177
	number	13	7	12	12	14
	mean	526	196	225	230	152
Branch No. 2a, ultimate series (3 mm. long).	minimum	456	177	177	190	127
	maximum	506	203	228	253	152
	number	6	4	6	6	5
	mean	468	190	213	222	149
Branch No. 2b, ultimate series (2 mm. long).	minimum	405	158	—	—	127
	maximum	456	184	—	—	152
	number	2	3	0	0	3
	mean	430	173	—	—	148
Branch No. 3, penultimate series (4 mm. long).	minimum	456	171	215	209	127
	maximum	532	203	241	253	152
	number	7	7	8	7	8
	mean	532	185	229	233	147
Branch No. 3a, ultimate series	minimum	506	164	203	203	127
	maximum	506	177	241	228	152
	number	1	2	2	2	2
	mean	506	171	222	215	146
Main stem	mean	598	202	240	234	152
3 Branches penultimate series	mean	521	194	231	224	150
3 Branches ultimate series	mean	468	178	218	219	148
Main stem and all branches	mean	529	191	230	226	150

* Branch No. 1 is proximal to Nos. 2 and 3. Secondary branch *a* is proximal to *b*.

Hydroid colonies appear to be able to adjust their growth-form to the environment with rapidity, as more than one form may occur in different parts of one specimen. The elongated form included in Table I appears to be the same as that recorded by Ritchie (1913) from Cape Royds. The mean value* for the length of the internodes is 0.972 mm. compared with 0.525 mm. for the typical form noted in Table I.

There has been some confusion in the past between *S. plectilis*, Hickson and Gravely, and *S. glacialis*, Jäderholm. Having compared a specimen brought back by the German Antarctic Expedition from Gauss Station, Brit. Mus. Reg. No. 11.12.8.6, with a topotype of *S. glacialis* brought back by the Swedish Expedition from South of Snow Hill, Graham Land, Brit. Mus. Reg. No. 19.12.10.1, I have no hesitation at all in saying that although *S. glacialis* was collected at Gauss Station, the specimens described by Vanhöffen (1910, p. 325) are not *S. glacialis*, but *S. plectilis* as suggested by Ritchie (1913).† Vanhöffen's suggestion (1910) that the type of *S. plectilis* is only a specimen of *S. glacialis* is rejected, since re-examination of the type of *S. plectilis* confirms all that has been said by Ritchie (1913) to show that it is a distinct species: Vanhöffen appears to have confused the two. The gonothecae of the two, apart from the hydrothecae, are quite distinct, as the text-figures will show. Vanhöffen's figure 40 (1910) depicts a characteristic fragment of *S. plectilis*, but the orifice of the gonotheca does not bear the distinctive marks of either *S. glacialis* or *S. plectilis*. It seems highly improbable that the two can represent the two sexes of one and the same species. Ritchie has even figured (1913) the gonothecae of the two sexes of *S. plectilis*, but without histological evidence to support his statements. For the sake of convenience the two described variations may be referred to in future as *forma typica* and *forma elongata*. They do not appear to be very stable.

Symplectoscyphus curvatus (Jäderholm). (Pl. II, figs. 1, 2, 3; text-fig. 40, a-b.)

Sertularella curvata, Jäderholm, 1917, p. XI, pl. I, figs. 10-11.

Material.—A dozen pinnately branched specimens, up to 5.5 cm. in length, bearing gonothecae on the branches; hydrorhiza creeping up stems of *Schizotricha unifurcata*, from Station 220, off Cape Adare, 45-50 fathoms.

Description.—There are three or four twists where the short bases of the stems spring from the hydrorhiza. Main branches pinnate, in one plane, secondary branches irregular. Gonothecae borne only on branches, large, elongate-ovate, with ten deep independent circular frills not forming a spiral. Aperture borne on a short wide cylindrical tube, hardly projecting beyond rim of distal frill.

Measurements :

Hydrorhiza, diameter	.. .. .	mm.
Base of stem,		0.37
length	.. .. .	0.5-0.9
diameter	.. .. .	0.37

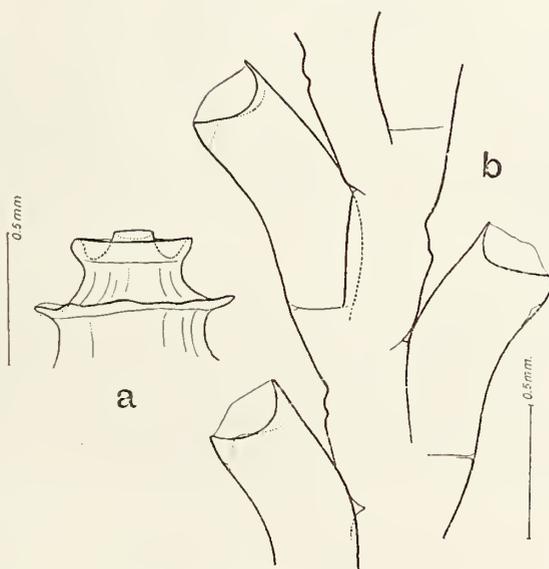
* This was obtained by combining figures for Ritchie's material from Cape Royds and for "Terra Nova" material.

† This is denied by Stechow (1923c).

Internode,								mm.
length (over all)	..	..	..	..	..	..	..	0.73-1.10
diameter at base of hydrotheca	..	..	..	..	..	..	..	0.44-0.56
Hydrotheca,								
length, adnate	..	..	..	..	..	..	..	0.30-0.46
„ free	..	..	..	..	..	..	..	0.56-0.66
breadth	..	..	..	..	..	..	..	0.29-0.34
distance apart	..	..	..	..	..	..	..	1.10-1.59
Gonotheca,								
length	..	..	..	..	..	..	..	1.83-1.96
breadth (over all)	..	..	..	..	..	..	..	0.98-0.10
mouth tube,								
length	..	..	..	..	..	..	..	0.075-0.10
diameter	..	..	..	..	..	..	..	0.15-0.20

A serious discrepancy will be noticed between the diameters of the gonothecae of the Swedish and British specimens: Jäderholm gives the diameter of gonothecae as 1.5 mm. The other measurements correspond well enough.

Remarks.—This species was described in a supplementary report on the hydroids of the Swedish Antarctic Expedition published in the yearly report of Norrköping Higher School, Sweden. Only two half-grown gonothecae were described. The only two records of this species are from the Graham Land region and the Ross Sea.



TEXT-FIG. 40.—*Symplectoscyphus curvatus* (Jäderholm). *a*, distal end of gonotheca, $\times 35$; *b*, hydrothecae, $\times 35$.

Symplectoscyphus plectilis (Hickson and Gravely). (Pl. II, figs. 4, 5; text-fig. 41.)

Sertularella plectilis, Hickson and Gravely, 1907, p. 20, pl. III, fig. 21; *Sertularella plectilis*, Ritchie, 1913, p. 30, figs. 8-9; *Sertularella glacialis*, Vanhöffen, 1910, p. 325, fig. 40, *a-c* (not *S. glacialis*, Jäderh., 1904, p. 9); *Sertularella plectilis*, Jäderholm, 1917, p. VIII, pl. I, fig. 8; 1926, p. 5.

Material.—Inextricably tangled, non-fascicled, branched and anastomosing stems with gonothecae from Station 316, McMurdo Sound, 190-250 fathoms; and Stations 331, 339 and 356 at entrance to McMurdo Sound, 190-250, 140 and 50 fathoms. From the last station come a few young stems.

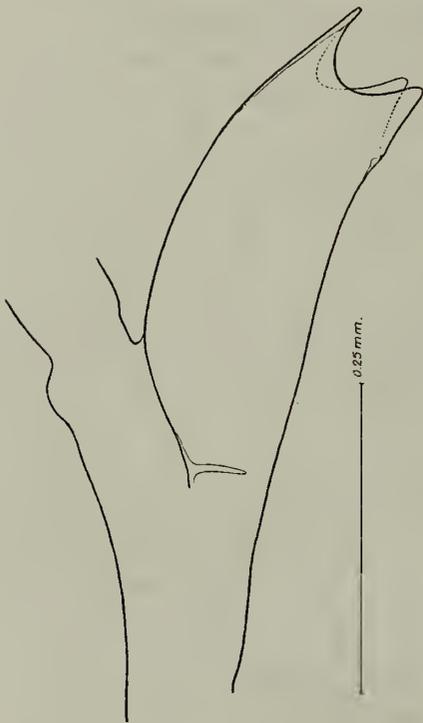
Remarks.—Sound and critical notes on this species were given by Ritchie (1913). A study of new material and of the types of this species and of *S. glacialis* enables me to endorse Ritchie's remarks. The adcauline marginal hydrothecal tooth in *S. glacialis*

is generally recurved, whereas in *S. plectilis* it is only the extreme tip that is ever, if at all, slightly recurved.

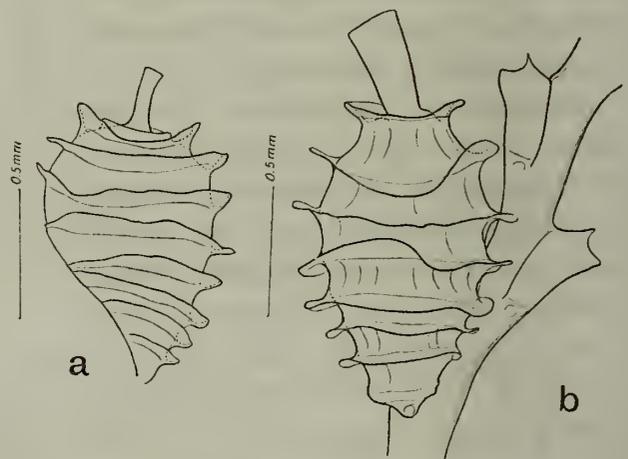
The hydrothecae of *S. plectilis* are, generally speaking, more distant than those of *S. glacialis*, but specimens of each can be selected in which the reverse holds true. The proportions of the neck and aperture of the gonothecae of the two species are quite different, as pointed out by Ritchie.

The original description did not mention the few fully formed gonothecae present on the types. Ritchie's description and figures hold good for them.

The few specimens taken on Feb. 9 from Station 316 are light brown in colour and bear a few fully formed gonothecae. Those taken on Jan. 14 had numerous immature gonothecae. Ritchie recorded male gonothecae in June, and female in July and August. Jäderholm recorded male, but no female gonothecae on Feb. 10.



TEXT-FIG. 41.—*Symplectoscyphus plectilis* (Hickson and Gravely). Hydrotheca, $\times 160$.



TEXT-FIG. 42.—*Symplectoscyphus filiformis* (Allman). *a*, male gonotheca; *b*, female gonotheca. Both magnified $\times 34$.

Symplectoscyphus filiformis (Allman). (Pl. III, fig. 9; text-fig. 42, *a-b*.)

Sertularia gracilis, Allman, 1888, p. 51, pl. XXIV, figs. 1-1*a* (not *S. gracilis*, Hassal, 1884, p. 2223); *S. filiformis*, Allman, 1888, Expl. pl. XXIV.

Material.—A tangled mass measuring 7 mm. \times 7 mm. \times 7 mm., with a few gonothecae, from Station 38, S.W. of Falkland Islands, 125 fathoms.

Description.—The hydrothecae have one adaxial and two lateral marginal cusps as in other species. Gonothecae sexually dimorphic, females longer, broader, usually with one or two more annulations, with a longer and wider distal tube, and containing two gonophores; male containing one spermary.

Measurements (of types) :

Hydrothecae,		mm.	mm.
distance apart .. .. .		.. .. .	0.85-1.10
length of adaxial wall,			
adnate part .. .. .		.. .. .	0.25-0.30
free part .. .. .		.. .. .	0.17
Gonothecae,		Male.	Female.
length		1.40	1.98
		(1.07-1.55)	(1.87-2.23)
diameter (maximum)		0.70	0.77
		(0.62-0.76)	(0.69-0.84)
tube,			
length		0.25	0.35
		(0.17-0.25)	(0.32-0.37)
diameter at margin		0.11	0.24
		(0.10-0.12)	(0.21-0.26)

Remarks.—The type specimens (Challenger Expedition) were taken on Jan. 13, 1876, and at that date bore gonothecae containing ripe sperms and eggs, the discharge of which had not then begun. In the specimen taken on April 13, 1912, the discharge had taken place and most of the gonothecae had fallen off. A careful search revealed a few empty ones of either sex.

Allman's description of the male gonotheca is misleading. The "short wide neck" needs no special mention, as it is merely the distal part of the gonotheca, not differentiated in any way. The "saucer-shaped summit" is the last frilled annulation which may be more or less marked. The narrow cylindrical tube does not broaden out at its base as Allman represented it. The hydrothecae, too, were incorrectly drawn.

Sertularella robusta, Coughtrey.

S. robusta, Coughtrey, 1876, p. 300; *S. microgona*, v. Lendenfeld, 1884, p. 416, pl. VII, figs. 1-3; *S. angulosa*, Bale, 1894, p. 102, pl. IV, fig. 6; *S. robusta*, Trebilcock, 1928, p. 16, pl. VI, fig. 3; not *Sertularia tenella*, Alder, 1856, p. 357, pl. XIII, figs. 3-6.

Material.—Fifteen small unbranched shoots, without gonothecae, from a stock associated with *Sertularia marginata*, creeping over an alga from Station 134, near North Cape, New Zealand, 11-20 fathoms.

Remarks.—The hydrothecal walls show distinct transverse undulations and three internal denticles are present. None of the shoots bears more than five or six hydrothecae, and in several cases one only is present.

This species, which was treated by Hartlaub (1901) and Bedot (1912) as synonymous with *S. tenella* (Alder), has been redescribed and figured with two new varieties by Trebilcock (1928). It differs from *S. tenella*, as pointed out by Hartlaub (1901) and Bale (1924), in having three internal hydrothecal denticles, and also in its smaller size. Comparison with v. Lendenfeld's types of *S. microgona* in the British Museum shows that *S. robusta* and *S. microgona* are identical.

Internode,									
length,									mm.
branch	..	..	..	..	..	..	..	..	1.22
hydrocaulus	..	..	..	..	..	..	..	..	1.28-1.39
diameter,									
branch	..	..	..	..	..	..	..	..	0.31
hydrocaulus	..	..	..	..	..	..	..	..	0.33-0.39
Gonotheca,									
length	..	..	..	..	..	..	..	..	2.0-2.04
diameter (maximum)	..	..	..	..	..	..	..	..	0.89-1.03

Sertularella spiralis, Hickson and Gravely. (Pls. I, fig. 7; III, fig. 5; text-fig. 44, b-d.)

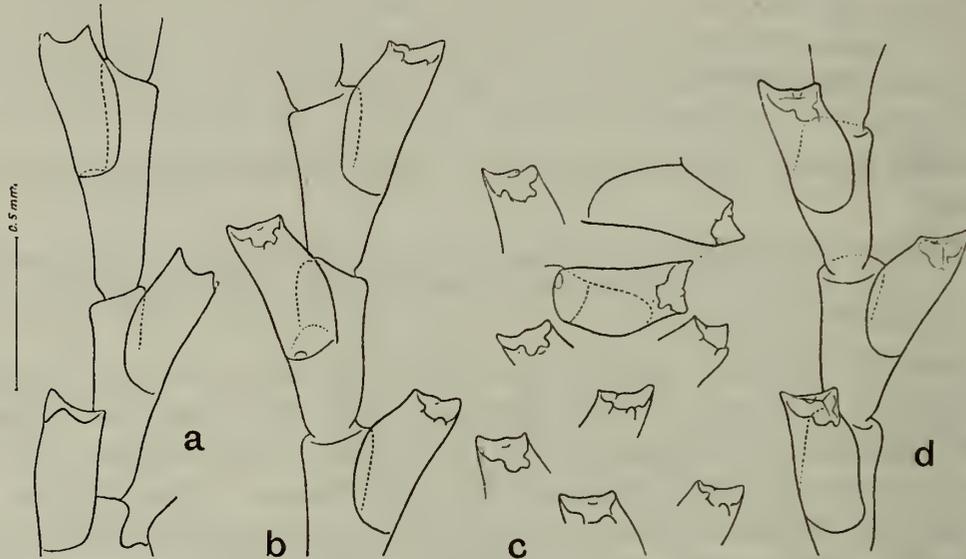
Sertularella spiralis, Hickson and Gravely, 1907, p. 19, pl. III, figs. 19-20; *S. bifurca*, Billard, 1914, p. 22, fig. 13; ? *S. articulata*, Allman, 1888, p. 61, pl. XXIX, figs. 3-3a; ? *S. elongata*, Jäderholm, 1904, p. X.

Material.—Unattached branching specimens up to nine centimetres in length and four centimetres in diameter without gonothecae, attached to stems of *Polyplumaria antarctica* (Jäderh.) from Station 220, off Cape Adare, 45-50 fathoms; also broken specimens from Station 338, McMurdo Sound, 207 fathoms. From Station 194 off Oates Land, 180-200 fathoms, there are two characteristic fragments of stems.

Description.—The stems remain non-fascicled through life. The internodes of the main stem and branches are progressively hypertrophied, at the base of a specimen measuring 0.95 mm. × 0.21 mm., and at the distal end 4.23 mm. × 0.48 mm. The stem forms a gentle spiral, one turn in a length of ten, twenty, thirty or even more internodes. The paired branches may rebranch as many as six times, at every third internode, alternately to right and left; but occasionally all the branchlets form on one side, giving rise to a scorpioid sympodium. The ends of branches freely stolonise. In case of a break any branch may become hypertrophied and behave as the main stem, with elongated internodes and paired branches below each newly formed hydrotheca. The hydrothecae are generally inclined to one side of branches and pinnules, and have triangular mouth openings with a well-marked intrathecal tooth in the shallow embayment between each tooth.

The polyp has an oblique annular attachment which, viewed in optical section from the side, runs from a point about or a little below the middle of the abaxial thecal wall, where there is generally a slight re-entrant angle, to the inner angle of the floor of the theca. In extension that part of the polyp within the theca is narrow and tubular, spreading out below to its attachment, and with the curious ectodermal sheath noted by Hickson. The cavity of the polyp appears not to be continuous with that of the hydrocaulus, but there is a small excentric fibrillar connection from the polyp base through the foramen at the outer side of the thecal floor to the stem apophysis. In retraction the polyp folds in the form of the letter "S." Hickson's original figure 19 does not adequately represent the arrangement. There were no gonothecae on these

specimens collected on January 3rd and 23rd respectively, but those of the “Discovery” types taken on July 3rd bore acrocyts. The gonothecae are smooth-walled, elongate-ovate in shape, with tapered base but no distinct pedicel, and rounded apical end. There is a thickened margin to the aperture but no collar or projection. Acrocyts are formed as described by Hickson.



TEXT-FIG. 44.—a, *Sertularella articulata*, Allman. Schizoholotype (Brit. Mus. Reg. No. 88.11.13.49); b, c, d, *Sertularella spiralis*, Hickson and Gravely, showing internal hydrothecal teeth. All figures magnified $\times 40$.

Measurements :

Hydrotheca,									
length,									mm.
	abaxial wall . . . . .	..	..	..	..	..	..	..	0.40-0.42
	adaxial wall, free part . . . . .	..	..	..	..	..	..	..	0.21-0.26
	" " fused part . . . . .	..	..	..	..	..	..	..	0.29
	diameter at orifice . . . . .	..	..	..	..	..	..	..	0.14-0.15
Internode,									
length,									
	branch . . . . .	..	..	..	..	..	..	..	0.75
	hydrocaulus . . . . .	..	..	..	..	..	..	..	0.95-4.23
diameter,									
	branch . . . . .	..	..	..	..	..	..	..	0.12-0.18
	hydrocaulus . . . . .	..	..	..	..	..	..	..	0.21-0.48
Gonotheca, (? ♀) of types,									
	length . . . . .	..	..	..	..	..	..	..	1.13
	diameter (maximum) . . . . .	..	..	..	..	..	..	..	0.40-0.45
	diameter of aperture . . . . .	..	..	..	..	..	..	..	0.17

Remarks.—The original description does not mention the internal hydrothecal teeth, which are present in the types and indicated in the original figures. They are alluded to by Billard (1914) in his description of *S. bifurca* which appears to be a synonym.

This species appears to be related to *S. neglecta*, Thompson, and its associated group of species.

The "Terra Nova" specimens were taken farther north in the Ross Sea than the "Discovery" types, and off Oates Land. The "Pourquoi Pas?" specimens came from off the coast of Graham Land. Its further distribution is for the present doubtful.

Jäderholm's *S. elongata*, 1904, is very close to if not identical with this species. The habitus of the two is the same, and the only known differential character of *elongata* is that it has no internal hydrothecal teeth. In 1905 Jäderholm sank *S. elongata* in the synonymy of *S. articulata*, Allman, 1888. Allman's fragmentary specimen (text-fig. 44, *a*) is probably a small branch; and until the species has been taken again at Kerguelen and described it would be best not to use the name. It was badly figured and described.

Jäderholm did not say whether the hydrothecae of *S. elongata* were bilateral as in *articulata* or inclined to one side as in *spiralis*. From "Terra Nova" Station 339, McMurdo Sound, 140 fathoms, come some pieces of stem with branches that correspond with Jäderholm's description. The hydrothecae are bilateral and have no internal teeth, and the stem internodes are longer than in typical *S. spiralis*. However, there are specimens that may be considered intermediate between those that I identify with Jäderholm's *S. elongata* and *S. spiralis*. They come from Station 338, off the entrance to McMurdo Sound, 207 fathoms. The hydrothecae are bilateral, but internal teeth are present.

It is possible, therefore, that *S. spiralis* sometimes grows without internal hydrothecal teeth. We already know of anomalies concerning these teeth in other species.

Sertularella elongata, Jäderholm.

Sertularella elongata, Jäderholm, 1904, p. X; *S. articulata*, Vanhöffen, 1910, p. 328, fig. 42, *a-d*; ? *Sertularia articulata*, Allman, 1888, p. 61, pl. XXIX, figs. 3-3*a*; ? *Sertularella spiralis*, Hickson, 1907, p. 19, pl. III, figs. 19-20.

Material.—Fragments of branched stems without gonothecae, from Station 339, McMurdo Sound, 140 fathoms.

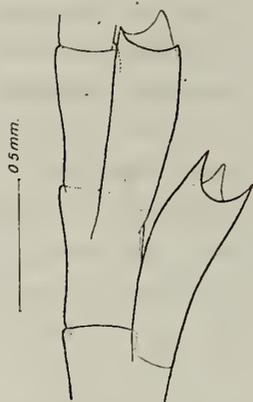
Remarks.—This species has been dealt with under *S. spiralis*, Hickson, above. If it can be shown that the two species are really one, the name *elongata* will have priority. This may eventually prove to be a synonym of *articulata*, Allman, but fresh material from Kerguelen must first be studied. Vanhöffen's specimens had hydrothecae which were entirely free, a characteristic of *S. biformis*, Jäderh., but in that species the hydrothecae are unilateral.

Sertularella biformis, Jäderholm. (Pl. II, fig. 8; text-fig. 45.)

Sertularella biformis, Jäderholm, 1905, p. 28, pl. XI, figs. 1-3.

Material.—The apical three centimetres of two stems, without gonothecae, with close-set spreading branches giving the specimens a diameter of 2.5 cm., from Station 220, off Cape Adare, 45-50 fathoms.

Description.—Hydrocaulus a non-fascicled sympodium of short, stout internodes with alternate hydrothecae. From the base of each hydrotheca arises a pair of branches which bifurcate three or four times. The stem is thus surrounded by whorls of branchlets. Hydrothecae unilateral, to a large extent if not entirely free from internodes.



TEXT-FIG. 45.—*Sertularella biformis*, Jäderholm. Hydrothecae, $\times 34$.

Measurements:

Stem internode,					mm.
length	..	..	..	..	2.45
diameter	..	..	..	..	0.98-1.0
Hydrotheca,					
length	..	..	..	..	0.76-0.83
diameter (maximum)	..	..	..	..	0.27

Remarks.—There seems little doubt that these specimens would correspond with the apical part missing from Jäderholm's type from Graham Land. If so this species shows an interesting series of growth-stages, progressing in complexity from base to apex. In the type the paired lateral buds arise from points slightly distal to the stem hydrothecae, but further growth makes the original hydrothecae appear to lie between the paired branches. The mode of growth in many ways resembles that of *S. elongata* and *S. spiralis*, which form part of the "*neglecta*" group of *Sertularella* species.

Sertularella edentula, Bale. (Pl. III, fig. 6; text-fig. 46.)

Sertularella edentula, Bale, 1924, p. 237, fig. 6.



TEXT-FIG. 46.—*Sertularella edentula*, Bale. Hydrotheca showing lateral folds round hypopore, $\times 54$.

Material.—A small unbranched fragment 8 mm. in length without gonothecae; from Station 90, off Three Kings Islands, N. Zealand, 100 fathoms.

Description.—Hydrothecae projecting slightly from hydrocaulus, inoperculate, margins entire. Floor of theca rising slightly from "arris" to abcauline side, with two lateral dependent folds flanking the hypopore.

Remarks.—This fragment is of interest because although it is without doubt to be referred to Bale's *S. edentula* it varies from the original in having slightly projecting hydrothecae.

The dependent folds flanking the hypopore are indicated in Bale's figure, but received no mention. They form a readily recognisable specific character.

GENUS DICTYOCLADIUM, Allman.

Genotype.—*D. dichotomum*, Allman, 1888, p. 77, pl. XXXVI, figs. 2, 2a.

Dictyocladium, Allman, 1888, p. 76; *Dictyocladium*, Stechow, 1923, p. 169; not *Selaginopsis*, Allman, 1876, p. 272.

Billard and Bale both assign species of *Dictyocladium* to the genus *Selaginopsis*. The hydrothecae of the holotype of the genotype of *Selaginopsis*, *S. allmani*, Norman, do not have the tripartite operculum to be found in *Dictyocladium* and *Symplectoscyphus*. In *S. allmani* there are two large adcauline lateral flaps and possibly a very narrow abcauline flap. The habitus of this species is not like that of species of *Dictyocladium*, and there seems no reason for uniting the genera. In both genera the hydrothecae, which are really on opposite sides of the hydrocaulus, are alternately staggered to "front" and "back," a fact which has led some observers to say that the hydrothecae are in several rows. The original arrangement is best seen near the growing points of the branches. As growth proceeds this arrangement of hydrothecae is masked.

Bale (1915) rejects the genus *Dictyocladium* because he considers that it is not sufficiently characterised. Although its species have affinities with *Symplectoscyphus* spp. I think that they are so distinct that it is convenient to retain the generic name *Dictyocladium* for them. The distinctive features in this genus are the shape and situation of the gonothecae, and the twist of the axis between successive pairs of hydrothecae alternately to right and left, so that only those of every other pair are in alignment and there appear to be four longitudinal rows. There does not appear to be any subsequent interpolation of new rows of hydrothecae. Parallelisms occur in other genera.

The genotype is *D. dichotomum*, Allman. *S. reticulata*, Krpr., 1884, is obviously referable to the genus, and may be conspecific.

Nutting's *D. flabellum* should be re-examined. It is said to have a four-flapped operculum, but otherwise would be included in the genus. As Bale has pointed out *D. fuscum*, Hickson and Gravely, must be excluded: it should be assigned to *Staurotheca*.

For the New Zealand species there have been used the names *monilifera*, Hutton, 1873, and *cerastium* (Allm., 1876). Bale (1924) maintains that these are synonyms of *dichotomum*, Allm., but further study of the forms is required before this view can be accepted. The gonothecae of both Australian and New Zealand specimens are of two kinds, and the old problem arises whether we are dealing with two species or with a single sexually dimorphic one. In one kind, which is typical of *dichotomum*, the spiral fold of the wall makes about eight turns, is deep, and nearly conceals the terminal cylindrical tube, the penultimate coil making a relatively wide turn; whereas in the other kind, typical of *cerastium*, the spiral fold is shallow and makes from 17–21 turns, the last two being of small diameter and not concealing the flared terminal tube. The first kind is generally more robust and of greater proportions.

From the Australian region the British Museum collection contains, besides the types of *dichotomum*, and another specimen of this species from off South Cape,

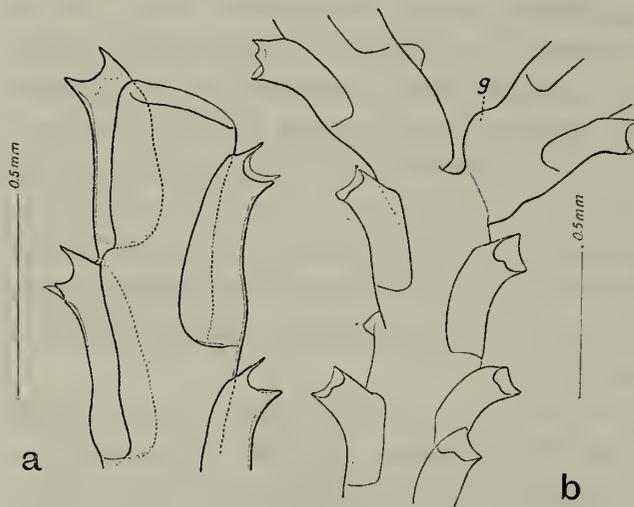
Tasmania, presented by Bale, some fine dried specimens of the other (*cerastium*) form collected by Flower in 1850. From New Zealand, beside the types of *cerastium* from North Island and other *cerastium* forms from Palliser Bay, Wairarapa, collected by Miss Rye in 1890, it contains specimens of the *dichotomum* form from Wellington. The two forms do not appear to have been taken together, but very little material has been collected.

I shall follow Bale in regarding *cerastium*, Allm., as a synonym of *moniliferum*, Hutton, but I think that it is premature to state that *dichotomum*, Allman, is only one sex of *moniliferum*. It is to this latter form that the “Terra Nova” specimens belong.

Dictyocladium moniliferum, Hutton. (Text-fig. 47, a-b.)

Dictyocladium moniliferum, Hutton, 1873, p. 257; *Thuiaria cerastium*, Allman, 1874, p. 179; *idem*, Allman, 1876, p. 271, pl. XVIII, figs. 3-4; *Dictyocladium dichotomum*, Allman, 1888, p. 77, pl. XXXVI, fig. 2; *Selaginopsis dichotoma*, Bale, 1915, p. 266; *S. monilifera*, Bale, 1924, p. 237; *idem*, Trebilcock, 1928, p. 9, pl. IV, fig. 4.

Material.—Four small fertile fragments, each about one square inch in size, from Station 134, off North Cape, New Zealand, 11-20 fathoms, and a sterile fragment from Station 90, off Three Kings Islands, 100 fathoms.



TEXT-FIG. 47.—*Dictyocladium moniliferum*, Hutton. *a*, specimen from Station 90, $\times 53$; *b*, specimen from Station 134, showing origin of branch and seat of gonotheca, *g*, $\times 39$.

Description.—Specimens are said to branch in a truly dichotomous fashion, but it appears to be a false dichotomy, the branch being given off at an angle rather more acute than that at which the main axis diverges at that point. It is the branch that bears at its base on the inner side a rounded tubercle from which later the gonotheca develops. On occasions a free hydrotheca develops from this tubercle.

In specimens from Palliser Bay the gonothecae are sometimes developed in addition from hydro-

thecae. On younger parts of branches, where reduplication of hydrothecal margins has not yet taken place, the original shape of the hydrotheca margin can be seen well. It is just like that found in the genus *Symplectoscyphus*.

Measurements :

Hydrothecae,	mm.
distance apart	0.75-0.8
length, adnate part	0.37
,, free part	0.12
,, (with reduplications)	0.25-0.3
diameter	0.12

Gonotheca,		mm.
length .. .. .	.. .. .	2.0-2.65
diameter .. .. .	.. .. .	1.1-1.45
No. of turns of spiral fold	.. .. .	17-21
height of fold .. .. .	.. .. .	0.07
terminal tube.		
length .. .. .	.. .. .	0.91
diameter, prox. end .. .. .	.. .. .	0.2
,, distal end .. .. .	.. .. .	0.35

Sertularia unguiculata, Busk. (Text-fig. 48, a.)

Sertularia unguiculata, Busk, 1852, p. 394; ? *S. divergens*, Busk, 1852, p. 392 (= *Tridentata xantha*, Stechow, 1923, p. 12); not *S. divergens*, Lx., 1816 (= *S. bicuspidata*, Lk., 1816, II, p. 121); *Dynamena australis*, Kirchenpauer, 1864, p. 11; *Thuiaria ambigua*, Thompson, 1879, p. 111, pl. XIX, figs. 2-2a; ? *Sertularia australis*, Thompson, 1879, p. 105, pl. XVII, figs. 4-4a (not *S. australis*, Bale, 1887, p. 93 = *Desmoscyphus inflatus*, Versluys, 1899, p. 42); *Desmoscyphus unguiculata*, Allman, 1885, p. 144, pl. XVII, figs. 5-7; ? *Thuiaria heteromorpha*, Allman, 1885, p. 147, pl. XX, figs. 1-5; *Desmoscyphus pectinatus*, Allman, 1888, p. 71, pl. XXXIV, figs. 1, 1a-b (in part); *Sertularia challengerii*, Nutting, 1904, p. 54, pl. II, figs. 1-2; *Sertularia challengerii*, Billard, 1910, p. 19, fig. 6; *Amphisbetia unguiculata*, Stechow, 1921, p. 258; ? *Tridentata xantha*, Stechow, 1923, p. 12.

Material.—A group of fifteen stems about 7 cm. in height growing on a sponge, from Station 144, off Cape Maria van Diemen, N.Z., 35-40 fathoms; and a group of a dozen stems 3.5 cm. in height, from Station 134, off North Cape, New Zealand, 11-20 fathoms. Gonothecae absent.

Remarks.—The specimens from Station 144 closely resemble Busk's type material in every way. Others from Station 134 and 144 are more slender in form, have more distant pinnae and more widely separated hydrothecae, in which the adnate portion is very much shorter than the free part. In typical specimens the adnate and free parts of the hydrothecae are equal in length. An examination of a fertile toptype of *D. australis* named by Kirchenpauer, Brit. Mus. Reg. No. 90.8.27.15, enables me to confirm Bale's opinion that that species is synonymous. The holotype of *Thuiaria heteromorpha*, Allman, Brit. Mus. Reg. No. 27.1.1.7, is a typical *S. unguiculata*, and cannot be distinguished by any peculiarities of the hydrotheca. Allman's enlarged figures of this species are misleading.

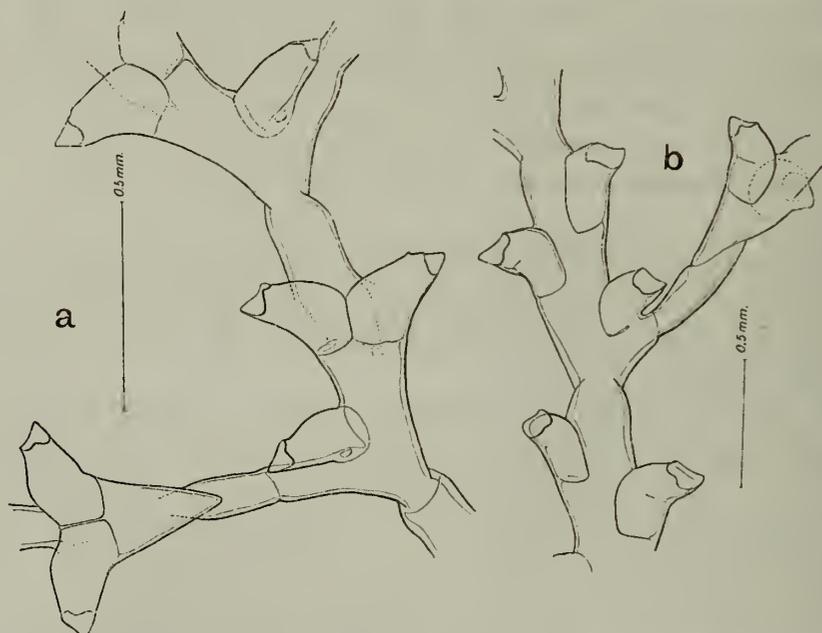
Tridentata xantha, Stechow (= *S. divergens*, Busk, non *S. divergens*, Lx.), appears to be a smaller form of the same species.

D'Arcy Thompson (1879) described several forms closely related to *S. unguiculata*, namely *S. australis*, *S. flosculus*, *S. pulchella* and *S. flexilis*. *S. flosculus* is almost certainly a synonym of *S. marginata* (Krpr.), and *S. australis* a synonym of *S. unguiculata*. Further study of this most variable of species is desirable before its synonymy can be finally settled.

Sertularia marginata (Kirchenpauer.) (Text-fig. 48, b.)

Dynamena marginata, Kirchenpauer, 1864, p. 13, fig. 8; *Sertularia flosculus*, Thompson, 1879, p. 104, pl. XVII, fig. 2; *Desmoscyphus gracilis*, Allman, 1888, p. 71, pl. XXXIV, figs 2, 2a-c; *Desmoscyphus pectinatus*, Allman, 1888, p. 71 (part); *Sertularia versluysi*, Nutting, 1904, p. 53 (part); *Sertularia pluma*, Hartlaub, 1905, p. 661; *Sertularia versluysi*, Ritchie, 1907, p. 505, fig. 144; *Sertularia marginata*, Bale, 1913 (part), p. 125, pl. XII, fig. 9; pl. XXIV, figs. 2-6; *Amphisbetia marginata*, Stechow, 1921, p. 258; not *Sertularia marginata*, Allman, 1877, p. 23 (= *S. striata*, nom. nov.); not *Sertularia amplectens*, Allman, 1885, p. 141, pl. XVI, figs. 3-4; not *Desmoscyphus inflatus*, Versluys, 1889, p. 42, figs. 11-13.

Material.—Numerous pinnate and simple specimens up to 2.5 cm. in height on a shell and organisms growing thereon, also two dozen small unbranched specimens from 7-8 mm. in height without gonothecae, associated with *Sertularella robusta*, on an alga, all from Station 134, off North Cape, New Zealand, 11-20 fathoms.



TEXT-FIG. 48.—a, *Sertularia unguiculata*, Busk, $\times 54$; b, *Sertularia marginata*, Kirchenpauer, $\times 33$.

Description.—Between the hinge-joint at the base of the stem and the lowermost branch there are from one to five pairs of hydrothecae. They are opposite below, but become alternate above. At the distal end of specimens, beyond the last pinna, the hydrothecae are arranged in pairs again, as on the pinnae. Intermediately the arrangement is a pinna and three hydrothecae to each internode. On the simple stems there is no displacement of members of a pair of hydrothecae.

Remarks.—An analysis of the hydrothecal arrangement indicates that the nodes are determined by the position of the pinnae. A subopposite or alternate pair of hydrothecae, from the bases of which no pinna arises, alternates with two pairs of hydrothecae from whose bases pinnae do arise, one from each pair alternately

left and right. It thus happens that the nodes separate the members of every third pair of hydrothecae, which have become displaced and alternate.

This hypothesis enables us to link up forms whose stem articles bear three hydrothecae with the more simple and primitive forms like *Sertularia desmoides*, Torrey, in which no displacement of members of pairs of stem hydrothecae takes place, and in which the branching arrangement of pinnae has not become regular.

The specimens are scarcely distinguishable from the types of *D. gracilis*, Allman, from Bermuda, and closely resemble Kirchenpauer's figured holotype of the species, Hamburg Museum, C. 3910; but differ from the types of *S. amplexens*, Allman, which Bale (1913) cites as a synonym. In *S. amplexens* the proximal part of the stem up to the centre of the hinge-joint is from 0.45–0.7 mm. in length, whilst in *D. gracilis* and the "Terra Nova" specimens it is from 2.5–3.6 mm. In *S. amplexens* it is rare to find any hydrothecae on the stem below the proximal pinna, and then only one pair. In *S. marginata* it is usual to find many pairs. In size *S. amplexens* is smaller in every way, stems often being less than 1 cm. in height, although Nutting (1904) assigns to it specimens as tall as 2 inches taken on Gulf Weed by "Albatross." It seems doubtful whether *S. amplexens* should be regarded as a synonym of *S. marginata*. The holotype of *D. inflatus*, Versluys, is very like *S. amplexens*, except that the basal part of the stem is stated to be 4 mm. long. In *S. versluysi*, Ritchie (1907), from Cape Verde Islands this part of the stem was from 3 mm. to 10 mm. long. *S. versluysi*, Nutting (1904) taken on Gulf Weed by "Albatross," must certainly be the same species as *S. amplexens*, Allman, but it is doubtful whether it is conspecific with *D. gracilis*, Allman.

The syntypes of *Desmoscyphus pectinatus*, Allman, 1888, belong to two species. Those from Bahia are to be assigned to *S. marginata*, Kirchenpauer. They bear gonothecae like those described by Ritchie (1907) for *S. versluysi*, and, like them, are male. They differ in having no stalk. There is an additional ridge nearer the base, and the ridges are generally produced into slightly upstanding free membranous edges. There is no trace of the toothed slit-like aperture. There are two gonophores, one larger than the other, consisting of central column and spermary, but no blastostyle remains. The state of preservation is not good. Kirchenpauer's MS. name *pluma* has found its way into literature (Hartlaub, 1905). Kirchenpauer later changed the word to *marginata*. The specimen Brit. Mus. Reg. No. 90.8.27.17 bearing Kirchenpauer's MS. name *pluma* is part of the holotype of his *D. marginata*.

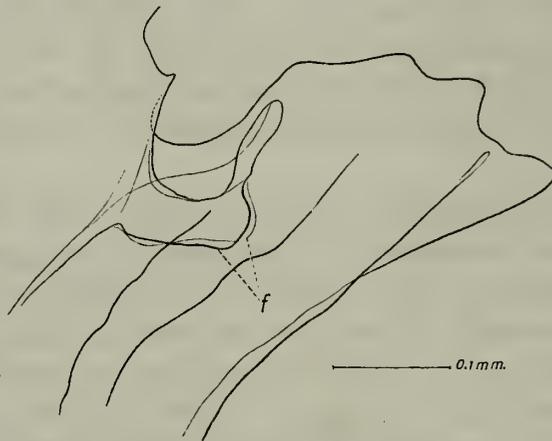
Nomenclature.—Synonymies for the many allied forms, both simple and pinnate, have been suggested by Billard (1910) and amended by Bale (1913), who recognises as distinct two simple forms *S. turbinata*, Lx. (including *S. loculosa*, Busk), and a species to which he gives the homonym *S. loculosa*, Bale. Although *S. loculosa*, Busk, for the present may be regarded as a synonym of *S. turbinata*, Lx., it may be necessary to separate the two later on. For this reason the homonym *S. loculosa*, Bale, 1913, cannot be retained. I give to Bale's species the new name *Sertularia restricta* (nom. n.=

Sertularia loculosa, Bale, 1913, nec Busk, 1852). For the pinnate forms of this group Bale uses Kirchenpauer's specific name *marginata*. This necessitates the institution of a new name for the little known *Sertularia marginata*, Allman, 1877, which I rename *Sertularia striata*, nom. n. (= *Sertularia marginata*, Allman, 1877, nec Kirchenpauer, 1864).

Crateritheca zelandica (Gray). (Pl. III, figs. 1, 2, 3; text-fig. 49.)

Thuiaria zelandica, Gray, 1843, p. 294; *T. dolichocarpa*, Allman, 1876, p. 270, pl. XIX, figs. 3, 4-4a; *T. zelandica*, var. *valida*, Quelch, 1883, p. 249; *T. hippisleyana*, Allman, 1885, p. 146, pl. XIX, figs. 1-3; *T. zelandica*, Farquhar, 1896, p. 464; *T. zelandica*, Billard, 1910, p. 15; *Stereotheca zelandica*, Bale, 1924, p. 251.

Material.—A specimen 13.5 cm. in height, torn away from its root stock, bearing ten gonothecae of the female type, from Station 90, off Three Kings Islands, New Zealand, 100 fathoms; and two sterile specimens from Station 144, off Cape Maria van Diemen, N. Zealand, 35-40 fathoms. Of these two one is 12 cm. in height, complete with small footplate; it bears on its lower half, which is free from pinnae and stem hydrothecae, three incomplete branches. The other is 7 cm. in height and incomplete. The spread of the pinnae may be as much as 4 cm.



TEXT-FIG. 49.—*Crateritheca zelandica* (Gray). Distal end of hydrotheca, showing internal folds, *f*,
× 155.

Description.—The margins of the stem hydrothecae and of the proximal thecae of the branches are entire. Passing from the base to the tip of a branch one sees a gradual change from an entire margin, through a sinuous form to the definitely toothed one.

The gonothecae are from 7-8 mm. in length, tubular, rather less than 1 mm. in diameter in the middle and tapering gradually towards each end, with a flattened, truncated slightly recurved orifice about 1 mm. wide. One side is notched, and has below the notch on the inside a projection. The notch and projection resemble the adcauline sinus and projection of the hydrotheca. The single gonotheca of the "Terra

Nova" material contains six eggs, and three more appear to have been extruded. Some dry specimens in the Museum collection from Palliser Bay bear many gonothecae of a different type, presumably male. They are of the same diameter as the female ones, about 3.5 mm. in length and with obovate terminal ends, in each of which there is a small circular pore flush with the surface.

Remarks.—There is evidence to show that Gray's, Allman's and Quelch's types, which are now in the British Museum, were all collected by Dr. Andrew Sinclair in North Island, New Zealand. In my opinion they should not be separated, but should all bear Gray's specific name. Mrs. Eden (*née* Gatty) recently presented the holotype of *T. hippisleyana*, Allman, to Sheffield Museum, whence it has been transferred to the British Museum, together with a number of other type specimens of Hydroida described by Allman at the same time. This species of Allman does not differ appreciably from *T. zelandica*, Gray. The early figures of Allman are not reliable.

Bale has used for this form the generic name *Stereotheca*, Stechow (genotype *Sertularia elongata*, Lx.). In my opinion these two species of Lamouroux and Gray have no affinities. There is no significance in the fact that the margins of the hydrothecae in both are toothed, for the arrangement of teeth in the one is entirely different from that in the other. It is true that in both forms the fully developed hydrothecae are inoperculate.

Neither Gray's nor Quelch's types nor Allman's of *T. hippisleyana* bear gonothecae, but the holotype of *T. dolichocarpa* does, as also do some small specimens in the British Museum Collection from Palliser Bay, Wairarapa, New Zealand, and the "Terra Nova" material. Allman appears to have been misled by irregular growth marks on some of the gonothecae into thinking that they had narrowed tubular distal ends. In his figure he has wrongly reconstructed the dried terminal part, which he represents as having a circular aperture. Re-examination shows that the terminal parts of these same gonothecae agree with those of the "Terra Nova" material.

I have examined the holotype of *Pericladium novae-zelandiae*, Thompson, 1879 (genotype of *Crateritheca*, Stechow, 1921), and consider it to be congeneric with this species of Gray. Its hydrothecae are smaller and arranged in many rows on stem and branches.

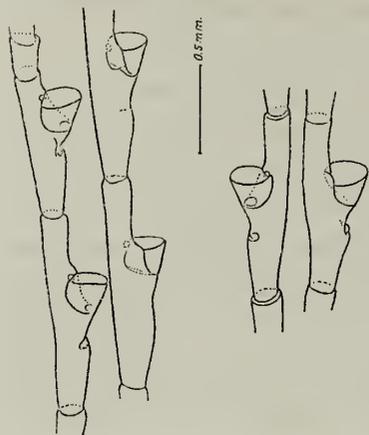
Gray's species in habitus resembles *D. pinaster*, and in its longitudinal ridges recalls *D. scalariformis*, Kirkpatrick. *Crateritheca* and *Diphasia* appear to have diverged from a common ancestral stock.

PLUMULARIIDAE.

Oswaldella bifurca (Hartlaub). (Text-fig. 50.)

Schizotricha bifurca, Hartlaub, 1904, p. 16, pl. III, figs. 4-8; *Oswaldella bifurca*, Stechow, 1919, p. 40 (32).

Material.—Three rooted tufts of stems with hydrocladia, bearing mature male gonothecae, from Station 340, entrance to McMurdo Sound, 160 fathoms; also a rooted tuft of six stems, with gonothecae, 24 cm. in length, from Station 339, McMurdo Sound, 140 fathoms.



TEXT-FIG. 50.—*Oswaldella bifurca* (Hartlaub). $\times 23$.

Description.—Stem nodes may not be marked at all. Hydrocladia homomerous, either unbranched or with a single branch which is usually of same size as hydroclade: small intermediate articles present following fractures. Hydrothecae of hydroclade and branch not strictly opposed, but facing slightly upwards.

Two axial nematophoral foramina present on upper surface of base of apophysis. A large median foramen behind margin of each hydrotheca, and a small, shallow, scoop-shaped infrathecal nematotheca on a process of each hydrothecate article except the basal one: here the process is not at all or only very slightly marked.

Gonothecae (male) without nematothecae, compressed, bean-shaped, without pedicel; vertical adaxial side becoming concave distally, where there is a subterminal, oval, thin area or operculum; abaxial wall first horizontal, then turning up parallel with other wall; distal end broadly rounded; origin in median line, from large area below infra-thecal nematotheca.

Measurements :

Stem,									mm.
diameter	..	..	..	..	..	..	..	..	0.69-0.83
Branch internode,									
length*	..	..	..	..	..	..	..	..	0.95-1.35
breadth	..	..	..	..	..	..	..	..	0.13-0.18
Hydrotheca,									
length (abaxial wall)	..	..	..	..	..	..	..	..	0.15-0.18
breadth at margin,									
dorso-ventral	..	..	..	..	..	..	..	..	0.20
latero-lateral	..	..	..	..	..	..	..	..	0.22
breadth at base,									
dorso-ventral	..	..	..	..	..	..	..	..	0.10
latero-lateral	..	..	..	..	..	..	..	..	0.20

* The length of proximal internodes is commonly between 1.25 mm. and 1.30 mm. Distally they often measure only 1.05 mm. in length.

Gonotheca, male,									mm.
length ..	..	..	..	..	..	..	..	..	1.54-1.83
breadth ..	..	..	..	..	..	..	..	..	0.51-0.59
thickness ..	..	..	..	..	..	..	..	..	0.30-0.37
opercular area ..	..	..	..	..	..	..	..	..	0.30 × 0.32

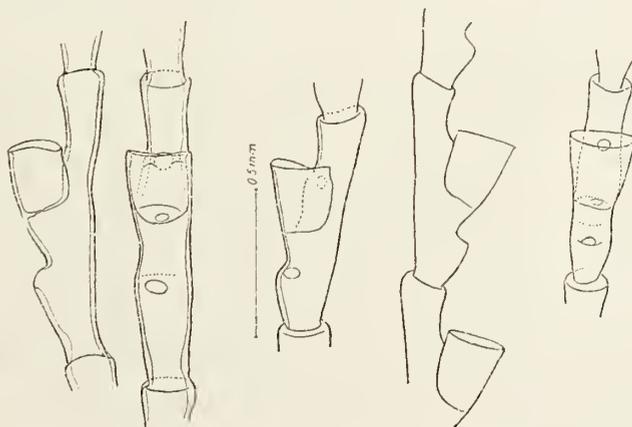
Remarks.—This species, the genotype of *Oswaldella*, Stechow (1919), has been recorded only once before. It was taken by "Belgica" on Nov. 29, 1898, in 459 metres at 70° 20' S., 83° 23' W. The gonothecae were at that time spent.

Some important modifications of and additions to Hartlaub's original description are given above. It is distinguished at once from the related species *O. antarctica* (Jäderholm) by the once-branched hydrocladia, absence of infrathecal nematotheca and process from proximal hydrothecate article of each hydroclade; and in many other ways.

Oswaldella antarctica (Jäderholm). (Text-fig. 51.)

Schizotricha antarctica, Jäderholm, 1904, p. 12; 1905, p. 35, pl. XIV, figs. 6-8; *Schizotricha antarctica*, Billard, 1906, p. 14; *Schizotricha antarctica*, Vanhöffen, 1910, p. 336, fig. 48; *Polyplumaria antarctica*, Billard, 1914, p. 28, fig. 17; *Oswaldella antarctica*, Stechow, 1919, p. 40 (32); *Polyplumaria antarctica*, Jäderholm, 1926, p. 6.

Material.—Two tufts of from one to two dozen stems up to 350 mm. in height with immature gonothecae, from Station 220, off Cape Adare, Ross Sea, 45-50 fathoms.



TEXT-FIG. 51.—*Oswaldella antarctica* (Jäderholm). × 39.

Description.—From the bases of some of the older stems other younger stems arise, with the result that the stems form tufts. Both the hydroclade and its first branch, which diverge from one another, rebranch unilaterally two or three times; branches face each other and arise from lower sides of hydrothecae of primary hydroclade and its first branch, the hydrothecae facing each other. The main stem is thus not hidden when viewed in a plane at right angles to the branching plane. The infra-

thecal nematotheca and process of the internode are present on the proximal internode of each hydroclade as well as on all the others. A pair of lateral "mamelons" present on the upper surface of each stem apophysis. There is a characteristic step down on the dorsal side from the distal end of one internode to the proximal end of the next. It is much more marked in this species than in *O. bifurca* (Hartl.). There is a slightly thickened margin to the hydrotheca which, in these specimens, is not narrowed as illustrated by Billard (1914). The gonothecae were immature on January 3rd. They spring from the middle line of the basal hydrothecate articles of the main branches, and are distal to the infrathecal nematophores. Mature gonothecae have not yet been recorded. They have been found only between the end of November and the middle of February.

Measurements :

Stem,									mm.
diameter	..	..	..	..	..	..	..	..	1.10-1.22
Branch internode,									
length	..	..	..	..	..	..	..	..	0.63-0.75
breadth	..	..	..	..	..	..	..	..	0.10-0.22
Hydrotheca,									
length (abaxial wall)	..	..	..	..	..	..	..	..	0.20-0.26
breadth at margin,									
dorso-ventral	..	..	..	..	..	..	..	..	0.17-0.20
lateral	..	..	..	..	..	..	..	..	0.22-0.23
breadth at base,									
dorso-ventral	..	..	..	..	..	..	..	..	0.17
lateral	..	..	..	..	..	..	..	..	0.17

Remarks.—Comparison with the figure 17 of Billard (1914) shows that if the specimens taken by the "Terra Nova" and "Pourquoi Pas?" belong to one and the same species there is a large amount of variation in the shape of the hydrotheca. The "Terra Nova" specimens appear to resemble closely figures of Jäderholm's types.

Billard (1914) refers to the two lateral foramina mentioned by Vanhöffen (1910) in the "Belgica" report and says that they are absent from the "Pourquoi Pas?" specimens. They are not the paired supracalycine nematothecae, but are the duplicated median supracalycine foramina to be found in *Oswaldella* species at the forking of the primary hydroclade and the first secondary branch. Elsewhere there is a single median supracalycine foramen (dactylotrème).

GENUS ANTENNELLA, Allman.

Antennella, Allman, 1877, p. 38.

It is still convenient to retain this name for a group of unbranched or little-branched Plumularians, although a study of their minute structure does not afford grounds for considering them to form a monophyletic group.

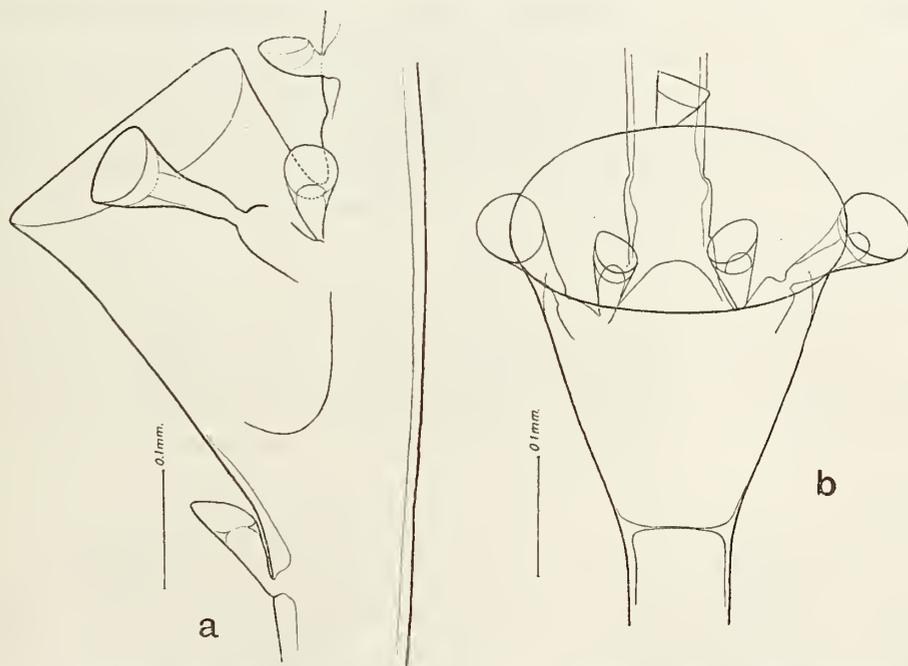
The characters used for differentiation of species are :

1. Fusion with or freedom from hydroclade of adaxial wall of theca.
2. Presence or absence of second pair of pleurohydrothecal nematothecae.
3. Whether or not the nematothecae, including infrathecal one, are paired.
4. Degree of obliteration of nodes.
5. Presence or absence of median nematotheca on distal end of hydrothecate article, and the length of this part of the article.
6. Relative length of intermediate article and number of nematothecae borne on it.

The gonothecae are in some, probably all, cases sexually dimorphic, the male being smaller and having a smaller distal aperture. Both kinds are found on a single hydroclade.

Antennella ritchiei, sp. n. (Text-fig. 52, a-b.)

Material.—A specimen, with immature gonothecae, consisting of 70 stems, each about 1 cm. long, which spring from a stem-like bundle of thirty hydrorhizal tubes



TEXT-FIG. 52.—*Antennella ritchiei*, sp. n. Hydrotheca of holotype, a, lateral view, b, frontal view, $\times 156$.

7 cm. in length ; and a fragment, consisting of a bundle of 7 tubes measuring 0.4 mm. in diameter and 6 mm. in length, bearing a dozen hydroclades ; from Station 91, off Three Kings Islands, 300 fathoms.

Description.—A heteromerous species of *Antennella* with two pairs of pleurohydrothecal nematothecae and with most of the nodes obliterated, the intermediate inter-

nodes being short and bearing two nematothecae. A well-marked oblique hinge-joint below the first two hydrothecae; elsewhere oblique joints seldom to be seen. The second pair of pleurohydrothecal nematothecae very short. Hydrothecae close together with flared margins projecting well out from axis, slightly compressed dorso-ventrally, nearly cylindrical when viewed laterally. Early stages in the development of gonothecae are present on some stems, each having a pair of nematothecae near the base.

Measurements:

Thecate internode,									
length *	..	..	..	..	..	..	..	..	mm.
									0.4-0.45
Intermediate internode,									
length	..	..	..	..	..	..	..	..	0.52
breadth	..	..	..	..	..	..	..	..	0.10
Hydrotheca,									
depth	..	..	..	..	..	..	..	..	0.25
diameter at margin	..	..	..	..	..	..	..	..	0.22-0.25 × 0.23-0.28
Length of basal part of hydroclade,									
in Holotype.	..	..	..	..	..	..	..	..	1.5-2.75
in Paratype	..	..	..	..	..	..	..	..	1.25-1.5

The species is close to *A. quadriaurita*, Ritchie, but the thecae are closer together and project further; the intermediate internodes are shorter and bear only two nematothecae; and the supernumerary pleurohydrothecal nematotheca are shorter. The measurements, except those of internode lengths, exceed those of *A. quadriaurita*. The larger specimen, Brit. Mus. Reg. No. 29.10.10.13, is selected as holotype.

Antennella serrata, sp. n. (Text-fig. 53.)

Material.—Sixty shoots 10–12 mm. in length, springing from a plexus of hydro-rhizal tubes which cover a sponge, from Station 90, Three Kings Islands, N. Zealand, 100 fathoms; and three dozen shoots growing on sponges at the base of a group of stems of *S. unguiculata*, from Station 144, off Cape Maria van Diemen, N.Z., 35–40 fathoms.

Description.—A heteromerous species of *Antennella* with two pairs of pleurohydrothecal nematothecae, intermediate articles bearing a single nematotheca or occasionally two. Rhizal plexus bears numerous scattered, narrow, funnel-shaped nematothecae. Shoots divided into two parts. The proximal millimetre or two without hydrothecae, but with one or two transverse nodes, and often some nematothecae; these are either normal ones, or of the type found on the rhizo-plexus. The distal hydrothecate part of the shoot is separated from the proximal part by an oblique node or hinge-joint. Another oblique node regularly appears below the second hydrotheca. There are oblique nodes between every two or three successive hydrothecate articles; and the distal part of each is generally separated off by inconspicuous trans-

* I have made measurements similar to those Ritchie (1909a) made of *A. quadriaurita*.

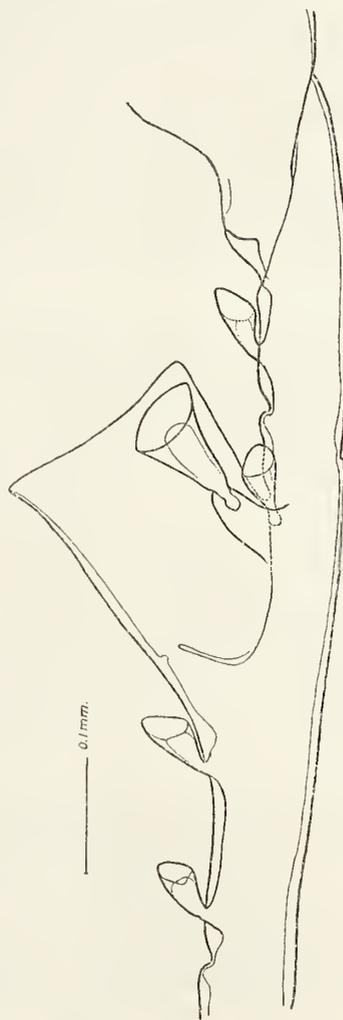
verse nodes as an intermediate article bearing one or, in some specimens, two nematothecae. There may be as many as two dozen hydrothecae on a shoot. Hydrothecae with abaxial and adaxial sides parallel, free part of adaxial wall slightly longer than diameter at margin. Floor of theca curved up on abaxial side so as to be at right angles to axis of hydroclade. Besides the usual three nematothecae round each hydrotheca there is a pair of small nematothecae springing from the bases of the lateral nematothecal apophyses, as in *A. quadriaurita*, Ritchie. The nematothecae on the hydrocladia have the adaxial side shorter than the abaxial.

Measurements in millimetres :

	Station 96.	Station 144.
Thecate article, length ..	0.33-0.43	0.38-0.48
Intermediate article, length ..	0.35-0.43	0.30-0.58
" " breadth..	0.08	0.08
Hydrotheca, depth	0.20	0.18-0.23
" diameter at margin	0.16-0.20	0.19-0.20 × 0.23

Remarks.—Broch (1914) has recorded specimens, which he names *A. quadriaurita*, Ritchie, forma *africana*, that have only one nematotheca on each intermediate article. But as this is the only precise information which he gives about the specimens it has seemed to me preferable to regard this form, raised to specific rank by Stechow (1923) and figured by him (1925), as incompletely described, and to give the "Terra Nova" specimens a new specific name. Subsequent examination will show whether or not the W. African and N. Zealand forms belong to the same species. I think that the close approximation of the hydrothecae is sufficient to distinguish a separate species, especially as Ritchie's is an Atlantic one.

The specimens from the deeper water station, number 90, constantly bear single nematothecae on the intermediate articles, but those from the shallower water station, number 144, bear sometimes two. In these latter specimens, too, there is rather more difference between the distances apart of hydrothecae at the proximal and distal ends of a shoot. At the base the distance is 0.7 mm. and at the tip 0.43 mm. In the specimens from Station 90 the respective distances are 0.58 mm. and 0.45 mm. The group of hydroclades from Station 90, Brit. Mus. Reg. No. 29.10.10.8, have been chosen as the holotypes.



TEXT-FIG. 53.—*Antennella serrata*, sp. n. Schizoholotype, × 155.

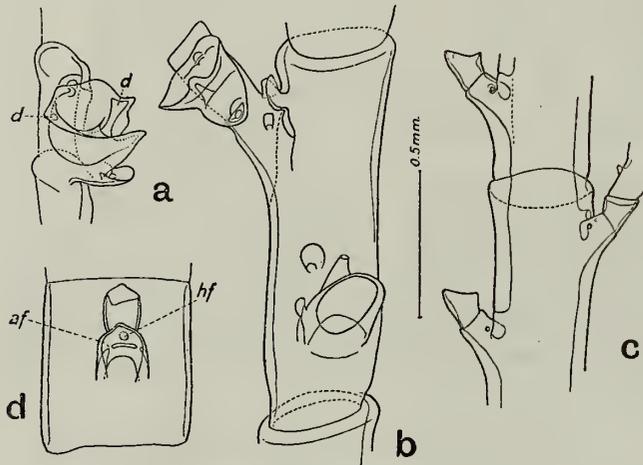
GENUS PYCNOTHECA, Stechow.

Genotype.—*Diplocheilus mirabilis*, Allman, 1883, p. 49, pl. VIII, figs. 4-7.

Pycnotheca, Stechow, 1919, p. 110; *Diplocheilus*, Allman, 1883, p. 48 (preoccupied by v. Hasselt, 1823).

Pycnotheca, as the genotype of which I select the species *mirabilis*, Allman, appears to be closely related to the genus *Halicornopsis*, Bale, 1882, genotype *elegans*, and only distantly to *Kirchenpaueria*, Jickeli, 1883, as the genotype of which I accept *Sertularia pinnata*, 1758, of Linnaeus. It will be as well to recognise all three genera as distinct.

In *Pycnotheca* and *Halicornopsis* there is an intrathecal fold on the fore-side of the hydrotheca, or in other words, there is a secondary theca external to the true opercular opening. In *Halicornopsis* the true thecal cavity sends diverticula into the

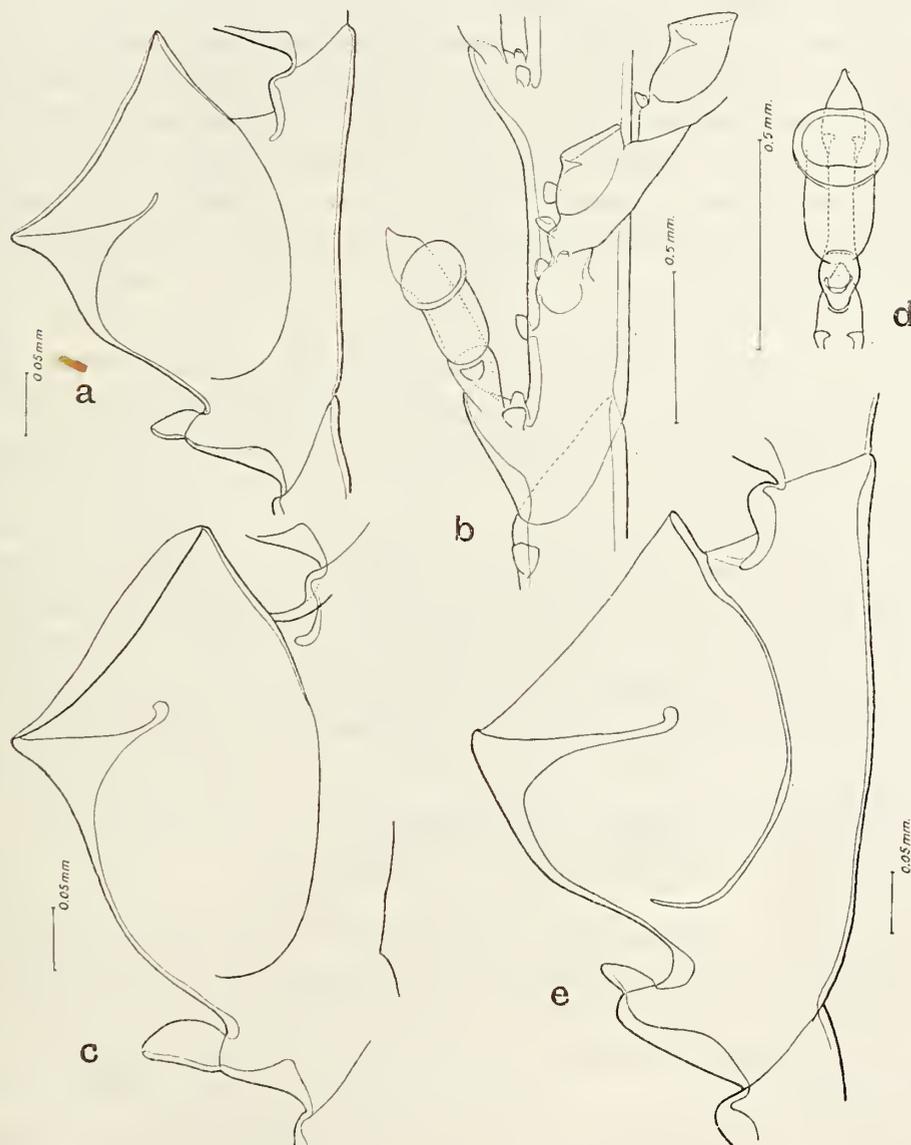


TEXT-FIG. 54.—*a*, *Halicornopsis elegans* (Brit. Mus. Reg. No. 88.11.13.97), showing diverticula, *d*, of thecal cavity; *b*, the same, showing tubular mamelon in axil of branch; *c*, *Kirchenpaueria pinnata*, Linn., axils of three branches, showing the three foramina; *d*, the same, lateral view of axil of branch, showing two foramina of apophysis, *af*, in optical section, and the foramen in hydrocaulus, *hf*. All figures magnified $\times 38$.

two lateral and the single median marginal teeth (text-fig. 54, *a*); but it should be noted that in the basal theca of each hydroclade the marginal teeth and the diverticula contained in them are much less pronounced than elsewhere, giving the theca more the appearance of those of *Pycnotheca*, which is probably the more primitive form. In *Pycnotheca* I have observed the operculum in situ in immature thecae; and in suitably stained preparations the scar of the line of attachment can be seen at all stages after the loss of the operculum. In these two genera, again, there is a structure in the axils of the branches which is absent in *Kirchenpaueria*. This is a tubular

"mamelon" (text-figs. 54, *b*, 55, *b*) resembling that found in *Nemertesia* and other genera. The growth-form and arrangement of branching and nodes are comparable in the two genera, but differ from those in *Kirchenpaueria*. By carefully cleaning, staining and dissecting the perisarc of *K. pinnata* it can be seen that there is no "mamelon" in the axil; but that there is a large foramen in the side of the stem for the exit of a long protrusible nematophore, and two smaller ones on the hydrocladial apophysis (figs. 54, *c-d*). At present there is no evidence that a nematophore protrudes from the tubular "mamelon" in *Pycnotheca* and *Halicornopsis*, though the "mamelon" has a large pore.

At the present time two Australasian species are recognised, *P. producta* (Bale) and *P. mirabilis* (Allman). The chief differences between them are that in *P. mirabilis* (1) the theca is much deeper from centre of margin to floor, being 0.30 mm. compared with 0.25 mm. ; (2) the free back of the theca is longer—0.10 mm : 0.05 mm. ;



TEXT-FIG. 55.—*a-d*, *Pycnotheca mirabilis* (Allman). *a*, subspecies *warreni*, nov. (Brit. Mus. Reg. No. 22.3.6.140), $\times 166$; *b*, axils of branches of specimen from Station 134, $\times 39$, to show mamelon and cauline nematothecae; *c*, the same, lateral view of hydrotheca, $\times 166$; *d*, the same, frontal view, $\times 55$; *e*, *Pycnotheca producta* (Bale) from Botany Bay (Brit. Mus. Reg. No. 99.5.1.308b), $\times 160$.

(3) the theca proper has a lesser maximum depth below the ridge from front to back—0.15 mm. : 0.20 mm. ; (4) the portion on which the infrathecal nematotheca is seated is less prominent, the opening or foramen in the wall being in a vertical plane, whilst in *producta* it is in a horizontal one, and seated on a distinct prominence : in the last

respect the S. African form is intermediate; (5) the marginal opening is circular rather than elliptical; (6) the fore edge of the intrathecal ridge seen from the side is relatively deeper than in *P. producta*. *P. mirabilis* reaches a height of three inches, whilst *P. producta* is a dwarf, with a maximum height of about one-third of an inch. Bale (1894) has alluded to differences in the gonothecae.

Whether we are dealing with varieties of one species, *producta*, or whether we have two species is not clear. Two atypical forms have been described, one by Ritchie (1911) which resembles *mirabilis* but has the ridge of *producta*, and the other by Inaba (1890, 1892) and Stechow (1909, 1913) which resembles *producta* but has a longer free dorsal wall to the theca. Torrey's *P. allmani* seems to resemble the Japanese form except in size. It is smaller even than the S. African form. This latter, studied by Warren (1908), appears to me to be a distinct geographical race and may be known as *P. mirabilis* (Allman) subspecies *warreni* nom. nov.* It is a pigmy form and its hydrothecae have a characteristic shape (text-fig. 55, a).

Warren states that the anterior flexure is not completely filled in with solid perisarc. His figure "C" may not represent a sagittal section, for the filling in can be seen clearly in whole mounts.

To sum up it appears probable that we have several geographical races of these two species. Though we still need further data there is some evidence to justify us in naming a S. African race, *P. mirabilis warreni* nom. nov., two N. Pacific races, *P. producta allmani* (Torrey) (for *Diplocheilus allmani*, Torrey, 1904) and *P. producta inabai* nom. nov. (for *Plumularia producta*, Inaba 1890, 1892).

The "Terra Nova" specimens closely resemble Allman's Challenger ones.

Pycnotheca mirabilis (Allman). (Text-fig. 55, a-e.)

Diplocheilus mirabilis, Allman, 1883, p. 49, pl. VIII, figs. 4-7.

Material.—Fifty shoots up to five centimetres in length, growing on an eroded shell from Station 134, near North Cape, New Zealand, 11-20 fathoms; three small shoots on a shell from Station 90, off Three Kings Islands, New Zealand, 100 fathoms; a single stem 3 cm. long from Station 144, off Cape Maria van Diemen, 35-40 fathoms. Gonosome absent.

Description.—There is little to add to what has been published. In the holotype an occasional branch springs from the mid-ventral line just below an apophysis. There are two short, bare internodes at its base. The normal arrangement of cauline nematothecae is that there is a simple scoop- or cowl-shaped nematotheca near the distal end of each internode, even if the node is not marked, *i.e.* there is one to each hydroclade. There is another on the antero-superior side of the apophysis, and a tubular mamelon in the axil on the postero-superior side of the apophysis (text-fig. 55, b).

* Stechow (1925) has published a name *robusta* for a new variety of *P. mirabilis* from South-West Australia, and has referred to the Natal race by this varietal name.

GENUS HALOPTERIS, Allman.

Genotype.—*Halopteris carinata*, Allman, 1877, p. 33, pl. XIX, figs. 3-7.

Halopteris, Allman, 1877, p. 32; *Thecocalus*, Bale, 1915.

I select *Plumularia catharina*, Johnston, as the holotype of *Thecocalus*, Bale, 1915. I regard the words of Bale (1915, p. 294) as a characterisation and establishment of a genus *Thecocalus* separated or excluded from *Plumularia* sensu stricto; and ascribe the genus to Bale rather than to Bedot (1921), who excluded from it both *P. catharina* and *P. campanula* which Bale considered typical. Both *P. catharina* and *Halopteris carinata* have cauline thecae and a second pair of pleurohydrothecal nematothecae. I consider that they are congeneric, and therefore sink *Thecocalus*, Bale, in the synonymy of *Halopteris*, Allman.

Halopteris constricta, sp. n. (Text-fig. 56, a.)

Material.—Half a dozen branched stems up to 9 mm. in height, without gonosome, from Station 144, off Cape Maria van Diemen, N. Zealand, 35-40 fathoms.

Description.—Basal millimetre of stem without hydrothecae, but with a few median nematothecae and a distal oblique hinge-joint. Upper part of stem and branches heteromerous, longer hydrothecate articles with basal oblique and distal transverse nodes alternating with articles bearing a single median nematotheca. An apophysis without nematothecae at origins of branches which have from one to four hydrothecae, usually three. First intermediate article of branch longer than rest and with nematotheca near proximal end. Supracalycine nematothecae raised on finger-like processes, and reaching margin of hydrothecae. Infrathecal nematothecae with little or no free adcauline wall. All nematothecae scoop-shaped. Hydrothecae free in distal half, nearly cylindrical, slightly constricted just below top of adcauline and lateral walls.

Remarks.—The species resembles Nutting's *P. alternitheca*, but its hydrothecae differ in shape and the nematothecae of *constricta* are larger in proportion and differently shaped.

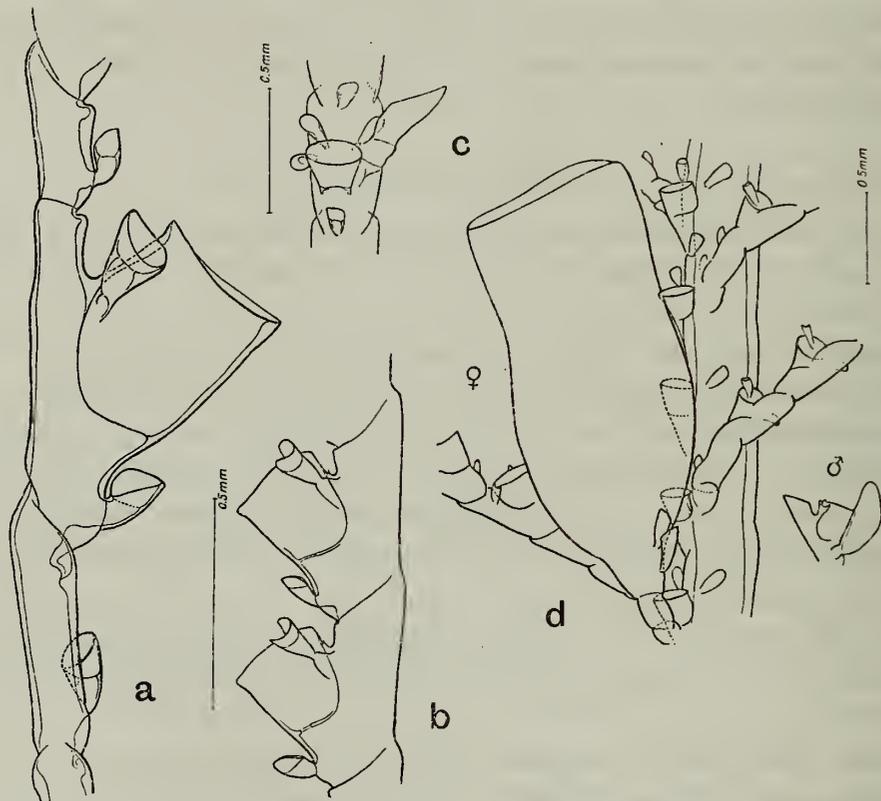
Halopteris heterogona (Bale). (Text-fig. 56, b-d.)

Thecocalus heterogona, Bale, 1924, p. 255, fig. 13.

Material.—Two large tufts of about sixty stems, and one or two small ones, from Station 144, off Cape Maria van Diemen, N. Zealand, 35-40 fathoms; three tufts of from two to six stems up to 12 cm. in length, from Station 90, off Three Kings Islands, 100 fathoms. Gonothecae present.

Description.—There are some important points to add to or to amend in Bale's description. On the main stem the regular supracalycine pair of nematophores is said to be wanting; but they are present in the distal region. The lower part of the stem, which bears neither hydrothecae nor hydrocladia, has two or three transverse

nodes. At a distance of about 1.5 cm. from the base there are two very oblique nodes close together. These act as hinges to allow the distal part of the stem a certain amount of rotary motion on a nearly vertical axis. Similar structures are common elsewhere, especially in the *Plumulariidae*, and have been referred to by Nutting (1900), but their function appears not to have been understood. Nutting refers to them as "pinched places." In its most highly developed form a structure of this sort consists of an upper and a lower articulation of the point-and-socket type with two opposed oblique knife-edges between them. There is often a complete interruption of the



TEXT-FIG. 56.—*a*, *Halopteris constricta*, sp. n. Base of a pinna from holotype, $\times 156$; *b*, *Halopteris heterogona* (Bale). Lateral view of hydrothecae, showing minute median supracalycine nematothecae, $\times 55$; *c*, the same, frontal view of axil of branch, showing nematothecae, $\times 32$; *d*, the same, male and female gonothecae, $\times 24$.

coenosarc at such points. I refer to them as *hinge-joints*. Between the two hinge-joints is the first cauline hydrotheca. As in *T. simplex* (Warren) and in *T. polymorpha* (Billard) the first cauline hydrotheca is the point of origin of a pair of hydrocladia. In *T. simplex*, however, the first cauline hydrotheca does not lie between the two hinge-joints but above them. In *T. heterogona* there is a series of about five mesial nematophores below the proximal hinge-joint, and two or three between the first cauline hydrotheca and the uppermost hinge-joint. Distally to this joint each internode at first bears the usual three nematophores round a hydrotheca, and an apophysis

from which springs a branch alternately to left and right. The supracalycine nematophore in the axil of the branch is much smaller than its opposite number, and later on one or both of them may fall off. In addition there is a minute median supracalycine nematotheca, with a second and occasionally a third pair of supracalycine ones at a short distance from the theca on the stem as Bale has described. Bale does not appear to have seen the median nematophore above each hydrotheca of the hydrocladia, at the junction between theca and hydroclade. It is necessary to free the chitinous parts from organic matter and to stain before all the nematothecae and pores can be seen satisfactorily. As in many other hydroids there is a progressive change in shape of the articles, hydrothecae and nematothecae of the hydrocladia when followed from base to tip. At the distal ends the supracalycine nematothecae are larger and closer together than in the proximal region. Bale says that in the condition of the anterior (median infrathecal) sarcothecae the species is a marked exception to the general rule in *Thecocalculus*. Either the species that I am describing is not the same one as Bale's, which I doubt, or else the species is not an exception, for in the "Terra Nova" specimens, which have been carefully cleared and stained, these nematothecae are quite plainly not funnel-shaped with truncate top as drawn by Bale, but short and scoop-shaped, the adaxial side of the distal chamber, which is flattened, being cut away much more than in the other nematothecae. The type specimens should be re-examined to determine this point.

The female gonotheca is flattened and somewhat truncated. The operculum is not circular, as described by Bale, but elliptical. The nematophores at its base are arranged in a transverse arc. There are usually three or four, but occasionally five.

Specimens are found growing in tufts, formed by the connection of the lower parts of neighbouring stems by lateral anastomosing hydrorhizal tubes.

Remarks.—This striking species has been described, since the return of the Expedition, from Chilton's specimens at Canterbury College, N.Z. They were taken at a spot some eight miles a little West of North from the locality from which the "Terra Nova" specimens came.

Halopteris campanula (Busk), var. *zelandica*, var. nov.

Plumularia campanula, Busk, 1852, p. 401.

Material.—A fine group of specimens growing on a mollusc shell from Station 134, near North Cape, N. Zealand, 11–20 fathoms; and a young specimen growing on *P. tenuissima* from Station 91, off Three Kings Islands, N. Zealand, 300 fathoms.

Description.—The "Terra Nova" specimens differ from the type in that (1) the abcauline wall of the theca and its continuation down to the mesial nematophore is distinctly thickened; (2) the free part of the adcauline wall of the theca is longer and diverges more from the hydroclade; (3) the distal ends of all the nematothecae are rounded off and scoop-shaped, and not truncated with inrolled sides as in the type.

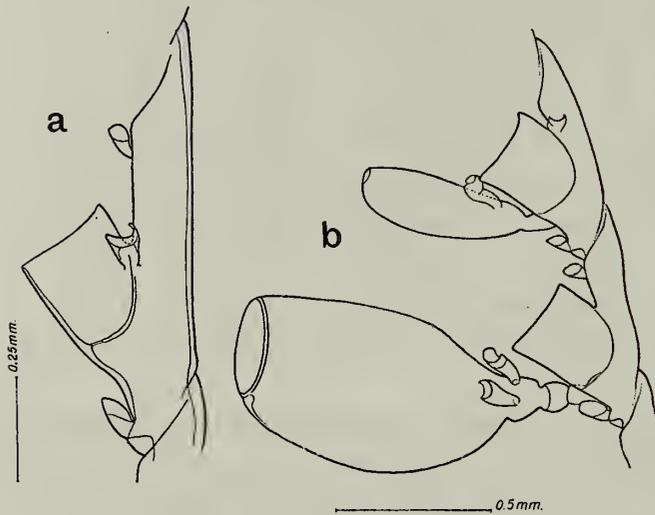
Lastly each stem article regularly bears two suprathecal mesial nematothecae, whereas this is only rarely seen in the type. On account of these differences it is advisable to establish a new variety, *H. campanula* (Busk), var. *zelandica* var. n., characterised above.

Remarks.—The differences between these specimens and the types are not sufficient to warrant specific separation, although Busk had long ago received specimens from N. Zealand from a Capt. Bolton and given them the MS. name *neozelanica*.

There are still in existence at the British Museum several of Busk's type specimens and sketches of this species, as well as specimens labelled by him as coming from other

than the type locality. More than one species was labelled with this name by Busk, one of them being a *Monostaechas*. I have selected as holotype a dried specimen from the type locality, Brit. Mus. Reg. No. 99.7.1.6626.

The specimens bear no gonothecae, the breeding season probably being over at the time of capture. We are without data concerning the gonothecae of this species, so that it may be useful to give some for a specimen, Brit. Mus. Reg. No. 88.4.16.41, coming from Port Phillip, Australia. They are dimorphic and both sexes are borne on the same shoot. The



TEXT-FIG. 57.—*Halopteris campanula* (Busk). *a*, var. *zelandica*, var. n., lateral view of hydrotheca, $\times 54$; *b*, male and female gonothecae of specimen (Brit. Mus. Reg. No. 88.4.16.41) from Port Phillip, Australia, $\times 40$.

female is larger with a truncated end, a large operculum, and two nematophores at the base, whilst the male is much smaller, oblong, with a minute operculum and only a single nematophore. There is a single embryo in the female gonotheca. It seems to undergo a development similar to that described by Warren (1914) for *Thecocaulus simplex* (Warren), a very minute species from Pondoland. At any rate the specimens from Port Phillip show a stage in which there is a large single embryo with lateral walls closely appressed to the gonothecal walls, and partly surrounded by the two horns of the blastostyle. Warren did not observe later stages than this. Here there is another stage with what appears to be vestigial or reduced blastostylic horns and a small free embryo: the operculum is still attached at this stage. It is desirable to get fresh material with gonophores so that the final stages of development and liberation can be followed. The material in the Museum does not enable me to seriate the stages of development.

Plumularia pulchella, Bale. (Text-fig. 58, a-d.)

Plumularia pulchella, Bale, 1882, p. 42 (30), pl. XV, fig. 6; *Plumularia flexuosa*, Bale, 1894, p. 115, pl. 5, figs. 6-10; *P. pulchella*, Trebilcock, 1928, p. 24.

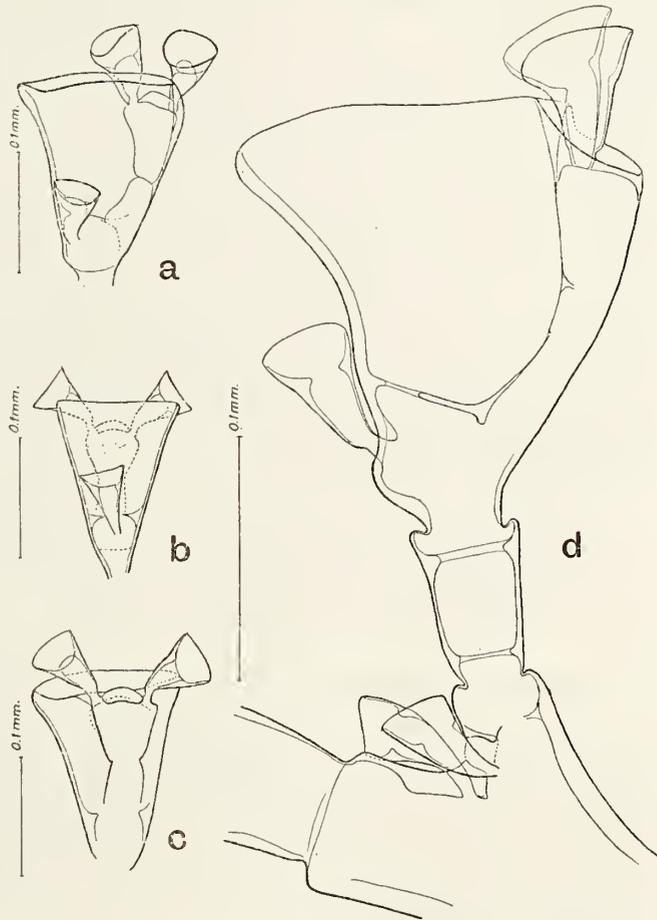
Material.—A dense growth of stems about half an inch long covering a gasteropod shell; and a small tuft on a fragment of an alga, from Station 134, off North Cape, New Zealand, 11-20 fathoms.

Description.—These specimens correspond in all details with specimens from Port Phillip, Australia. There are no gonothecae, but occasional branches are present; and one hydroclade which was broken off has been replaced by a branch with three hydrocladia.

There is little to add to previous descriptions. The distal end of the hydroclade bears a thickened chitinous cap which is kidney-shaped in optical section when viewed from the posterior side. The specimens are twice the size of those described by Bale, some being half an inch in height and bearing 48 hydrocladia. There is a "mamelon" on one side of the upper face of the stem apophysis and a nematotheca on the other, with its opening directed towards the hydrotheca. There is a second nematotheca on the stem article on a level with the "mamelon" and on the same side. It is curved so that its opening is facing up the stem. There is a third in the middle of the article, in line with the opposite row of apophyses.

Some of the stems in one clump are finer and flexuous, while others are stouter and straight. The base of a stem may be from 0.25-0.6 mm. in length, and consists of two or more irregular articles separated by transverse nodes. They appear to be devoid of nematothecae. The hydrorhizal plexus bears irregularly disposed nematothecae not arranged in pairs.

The coenosarc is not preserved, but a closely allied and undescribed species that occurs on the Atlantic Gulf Weed has polyps with a circle of twelve tentacles and an



TEXT-FIG. 58.—*Plumularia pulchella*, Bale. Hydrothecae seen from different view points; a, b, c, $\times 155$; d, $\times 320$.

adcauline blind-sac. This Gulf Weed species has been confused with *P. obliqua* (Johnston), 1847, but is distinct.

Remarks.—Nutting (1900) raised Kirchenpauer's subgenus *Monopyxis*, 1876 (name preoccupied; genotype *obliqua*, Johnston) to generic rank and renamed it *Monotheca* because the hydrocladia of this and other species, which he considered to be congeneric, bore only a single hydrotheca each. Now Motz-Kossowska (1903) has shown that at Banyuls *P. obliqua*, one of these monothecate forms, grows on plants in rough water, and that where most exposed the perisarc is thinnest. It is known also that these monothecate forms are very flexible and have weak nodes. It seems probable, therefore, that this habitus has been adopted by more than one race in response to environmental stimuli, and that it does not necessarily indicate very close relationship. Motz-Kossowska (1907) has shown that *P. obliqua* has a single free-swimming, though reduced, medusoid gonophore of an interesting type. We are without information on this point for the other monothecate forms of *Plumularia*, and it will be as well to retain them for the present in this polyphyletic group. It is probable, also, that many of these forms, like some specimens in the British Museum from Tasmania, are parasitic. These Tasmanian specimens bear numerous short stems from 3–4 mm. in length which arise from hydrorhiza embedded in an alga, as in *Thecocarpus parasiticus* (Warren), but to what extent this habit can be correlated with reduction of hydrocladia we cannot say.

P. flexuosa, Bale, 1894, whose trophosome is smaller, though very much like that of *P. pulchella*, and whose gonosome is slightly different, appears to fall well within the range of variation of this species. For this reason the older specific name has been used, in spite of the absence of the gonosome.

Plumularia diploptera, sp. n. (Text-fig. 59, a–b.)

Material.—Three small groups of stems up to 3.5 cm. long, growing on a small nodule of shell and sand, another on a fragmentary hydroid stem, and a third on a polyzoan, the groups consisting of three, seven and two stems respectively, from Station 144, off Cape Maria van Diemen, N. Zealand, 35–40 fathoms; also numbers of stems 2.5 cm. in length, with gonothecae, from Station 134, off North Cape, N. Zealand, 11–20 fathoms.

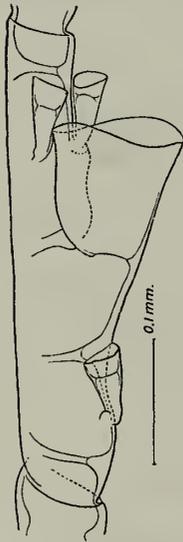
Description.—Stem non-fasciculate, cymose. The stem apophyses, which bear each a small "mamelon" on the "dorsal" or upper surface, midway between stem and apophysial ring, have a pair of nematothecae flanking the axil, and a sub-terminal thickened ring. They give rise to delicate heteromerous hydrocladia of about six hydrothecate articles. The first of the intermediate articles is shorter than the rest, and has a thickened ring in the middle but no nematothecae. The other intermediate articles have a sub-basal and sub-terminal ring with a nematotheca in the middle. The hydrothecate articles have the theca and its usual complement of nematothecae in the middle, the supracalycines not reaching the distal end of the article. None of

This species is closely allied to *P. setacea* (Ellis) but is distinct in having constantly a second lateral nematotheca on the "mamelon" side of the apophysis. Examination of specimens of *P. setacea* from different localities round Britain shows that there is regularly only one axillary nematotheca. Bedot (1921) whilst admitting that this is generally so yet states that very often there are two, so that he is unable to accept this point as a specific character. There are, of course, other species of this group that constantly have two axillary nematothecae, among them one collected by Lendenfeld at Lyttelton, New Zealand, and labelled *P. tripartita*, Brit. Mus. Reg. No. 86.6.8.73. No part of this material, which belongs to two distinct species, can be the type of *P. tripartita* since the material comes from Lyttelton instead of Timaru.

It is desirable to have further information on the following points in the morphology of *P. setacea*:—(1) Are the branches ever on opposite sides of stem, or do they always come off to one side? (2) Is there always a ring at the basal end of the stem internodes? (3) Is a sub-hydrothecal ring always present on the first and second hydrothecate articles but absent from the distal ones? (4) Is there only one lateral axial nematotheca?

Plumularia spirocladia, sp. n. (Text-fig. 60.)

Material.—Four complete shoots, the largest 5.5 cm. in length, with five or six smaller shoots that have settled down upon it, all bearing female gonothecae, and fragments; from Station 134, near North Cape, New Zealand, 11–20 fathoms. Also a fragment from Station 144, off Cape Maria van Diemen, N. Zealand, 35–40 fathoms.



TEXT-FIG. 60.—*Plumularia spirocladia*, sp. n. Part of hydroclade of paratype from Station 134, $\times 160$.

Description.—Stem simple, articles two or three times as long as broad, each bearing at distal end one or sometimes two apophyses, and single nematotheca facing hydroclade at a point one-third of distance from base. Apophyses at base alternate: distally, arranged in an open right-hand* spiral, five apophyses in two turns, the sixth being in line with the first. Each bears a small "mamelon" in the centre of the upper and inner surface, and a pair of lateral nematothecae at the base. Hydrocladia heteromerous; articles as in *P. setacea*, but there is a second ordinary intermediate internode between the short basal internode and the first hydrothecate one of each hydroclade. In hydrothecate internode a distinct protuberance between the basal and the sub-hydrothecal thickenings of the wall, superior nematothecae nearly reaching end of article. Hydrothecal margin not level but dipping down to meet hydrocladial wall. Gonothecae as in *P. setacea*, arising from sides of apophyses.

* Ascending to right, looking from inside.

Measurements :

Hydrocaulus,								mm.
diameter	..	..	..	..	..	..	..	0.175-0.28
internode length	..	..	..	..	..	..	..	0.57
apophysis length	..	..	..	..	..	..	..	0.12
Hydrocladia,								
internode diameter,								
proximal	..	..	..	..	..	..	..	0.10
distal	..	..	..	..	..	..	..	0.06
internode length,								
non-thecate,								
basal	..	..	..	..	..	..	..	0.10
proximal	..	..	..	..	..	..	..	0.27
distal	..	..	..	..	..	..	..	0.19
hydrothecate,								
proximal	..	..	..	..	..	..	..	0.52
distal	..	..	..	..	..	..	..	0.32
Hydrotheca,								
length	..	..	..	..	..	..	..	0.10
width (lateral view),								
at margin	..	..	..	..	..	..	..	0.11
at base	..	..	..	..	..	..	..	0.06
Nematotheca,								
length	..	..	..	..	..	..	..	0.067-0.070
diameter (maximum)	..	..	..	..	..	..	..	0.032-0.035
Gonotheca,								
female,								
length	..	..	..	..	..	..	..	1.24-1.40
breadth (maximum)	..	..	..	..	..	..	..	0.32-0.37
aperture, diameter	..	..	..	..	..	..	..	0.10-0.11
(?) male,								
length	..	..	..	..	..	..	..	0.98-1.20
breadth (maximum)	..	..	..	..	..	..	..	0.30
aperture, diameter	..	..	..	..	..	..	..	0.05

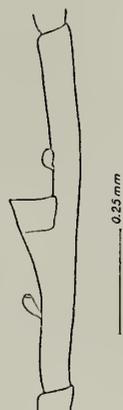
Plumularia triangulata, sp. n. (Text-fig. 61.)

Material.—Half a dozen short stems, some unbranched, up to 7 mm. in height, one bearing two gonothecae, arising from a hydrorhiza that creeps over the stem of *Plumularia tenuissima*, from Station 91, off Three Kings Islands, New Zealand, 300 fathoms.

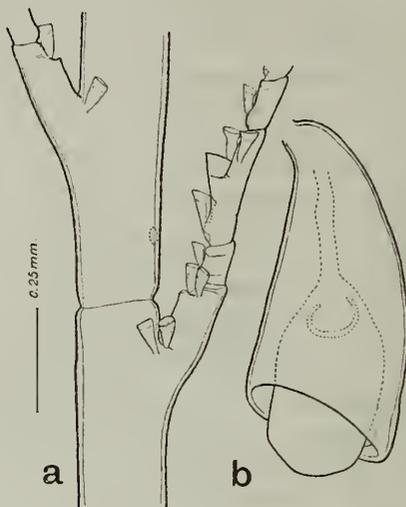
Description.—Stem apophyses with “mamelon” and one (occasionally two) nematotheca near distal end, bearing homonomous hydrocladia without basal article. All nematothecae monothalamic, straight on inner, convex on outer side, with oblique orifice; one near each end of stem article, one infrathecal, one median supracalycine. Distal parts of articles very long. Hydrotheca with rim very slightly everted, diameter greater than depth. Gonothecae triangular in section, two and a half times as long as stem articles, inserted on apophyses on side opposite “mamelon,” and lying parallel to stem.

Remarks.—This species most nearly resembles Billard's *P. ventruosa*, but differs

in having no basal article to the hydrocladia, and nematothecae with straight inner side and oblique orifice. One gonotheca was immature, and the other was somewhat damaged at the distal end, so that a full description cannot be given.



TEXT-FIG. 61.—*Plumularia triangulata*, sp. n. Part of holotype, showing median supra- and infra-thecal nematothecae, $\times 54$.



TEXT-FIG. 62.—*Plumularia brachiata*, sp. n. *a*, stem and branches; *b*, gonotheca, both figures magnified $\times 54$.

Plumularia brachiata, sp. n. (Text-fig. 62, *a-b*.)

Material.—The apical part of a large specimen, 30 cm. in length, and smaller detached branches, with gonothecae, from Station 96, off North Cape, N. Zealand, 70 fathoms.

Description.—Stem a fasciculate irregular sympodium, irregularly branched in one plane, branches ascending close alongside the stem, often 15 cm. long and themselves with very few branchlets. The original stem is surrounded by innumerable secondary tubules, which arise from the axils of the hydrocladia, and, higher up, themselves may be transformed into branches which repeat the characters of the main stem. The secondary tubules have on either side a row of nematothecae. Hydrocladia alternate, on opposite sides, about 5 mm. long, very delicate, borne on stem apophyses, the abaxial sides of which become greatly thickened. The secondary tubules for the most part run along the two sides of the stem which do not bear the hydrocladia, a section of the stem being in the form of an ellipse. The stem is irregularly marked by nodes, internodes bearing from one to four apophyses. There is often a lateral nematophore just above the origin of the hydroclade. There is a pair of nematothecae on the stem flanking the upper part of each apophysis, on which, at some little distance from the stem, is an upwardly directed open tubular "mamelon." Distal to the "mamelon" is a pair of nematothecae. The apophysis has a subterminal thickened ring. Gonangia borne singly on sides of stem apophyses, lying close alongside stem, short, cornuate, obliquely truncate, with wide circular operculum. Hydrocladia heteromerous. The

intermediate articles have a sub-basal and a sub-terminal thickened band with a median nematotheca on a small projection just above the sub-basal one. The first (proximal) intermediate article is shorter than the rest and may be duplicated. The hydrothecate articles, too, have a sub-basal and a sub-terminal thickening with a median basal infrathecal nematotheca. The theca is in the middle of the article, and is accompanied by a pair of longer supracalycine nematothecae which reach the distal end of the article. Between the theca and the basal nematophore is a thickened ring. There is a second on a level with the hydropore, and another slightly above the hydrothecal margin. The hydrotheca is adnate, deeper at the margin than at the base, and with the abcauline side rather longer than the adcauline one, the margin being slightly everted, and dipping down to meet the internode.

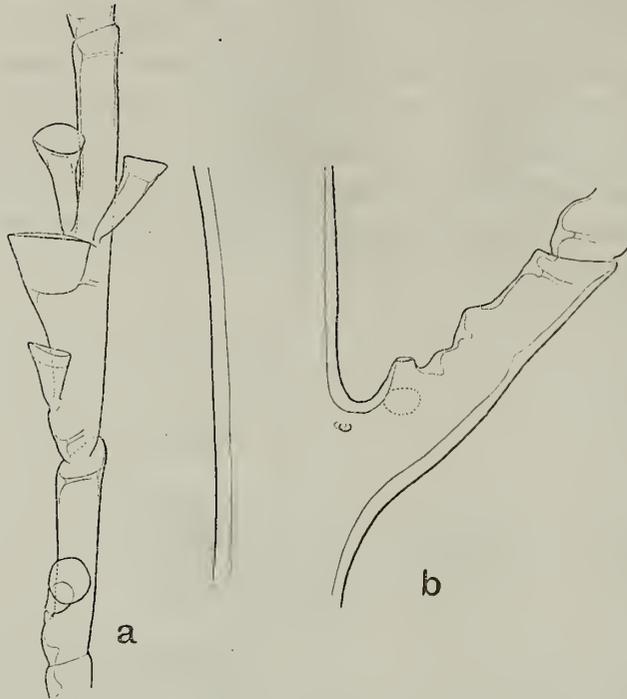
Measurements :

	mm.								
Stem diameters	3 × 4
Hydrocaulus,									
diameter	0.18-0.20
internode length,									
1 hydroclade	0.82-0.99
4 hydroclades	1.88
apophysis and basal article, length	0.20-0.22
Hydrocladia,									
diameter,									
proximal part	0.06-0.07
distal part	0.05
internode length,									
non-thecate,									
proximal part	0.11-0.16
distal part	0.11-0.16
hydrothecate,									
proximal part	0.30-0.32
distal part	0.20-0.22
Hydrotheca,									
length	0.070-0.073
breadth (lateral view),									
at margin	0.077-0.080
base	0.055
Nematotheca,									
length,									
supracalycine	0.080
intermediate	0.110
breadth (maximum),									
supracalycine	0.040
intermediate	0.050
Gonotheca,									
length	0.77-0.89
diameter (maximum)	0.32-0.37

Plumularia tenuissima, sp. n. (Text-fig. 63, a-b.)

Material.—A fragment, 1 cm. in length, of a fascicled stem 0.75 mm. in diameter, branched and rebranched in one plane, with vestiges of gonothecae; from Station 91, off Three Kings Islands, N. Zealand, 300 fathoms.

Description.—Resembling *P. brachiata*, but with finer branches and hydrocladia, smaller thecae and more elongated internodes. Hydrocaulus unjointed and without nematothecae except laterals on apophysis. Heteromorous hydrocladia alternate at distal ends of branches, in places becoming sub-opposite and decussate. The basal intermediate article bears a nematotheca on a basal boss, but is not divided from the stem apophysis. This bears a prominent tubular "mamelon," but no distal nematothecae. Accessory tubules, bearing nematothecae, arise from sides of apophyses. The arrangement of nematothecae in the axils of hydrocladia cannot be ascertained with



TEXT-FIG. 63.—*Plumularia tenuissima*, sp. n. Holotype. a, part of hydroclade, $\times 155$; b, axil of hydroclade, $\times 155$.

certainly, but in some axils one nematotheca can be seen, and in one a pair. The normal arrangement is probably a pair. Gonothecae incomplete, without nematothecae, straight, compressed, distal end truncated, with wide aperture.

Measurements :

	mm.
Hydrocaulus, diameter	0.11
Hydrocladia	0.04
Internode, length,	
hydrothecate	0.37
intermediate	0.19
1st intermediate	0.11
apophysis	0.15
Hydrotheca,	
length	0.05
width (lateral view)	0.06
Nematotheca,	
length	0.07
diameter, maximum	0.45
Gonotheca,	
length	0.33
breadth, maximum	0.18
at aperture	0.15

Nemertesia elongata, sp. n. (Text-fig. 64.)

Material.—Two complete specimens with rooting masses, 27.5 cm. and 59 cm. in length respectively, from Station 90, off Three Kings Islands, N. Zealand, 100 fathoms.

Description.—A fasciculate cymose stem, rising from a mass of fine hydrorhizal tubes, gives rise irregularly, at intervals of from one to two centimetres, to simple fasciculated branches, which may reach a length of 9 cm. and very occasionally rebranch. The branches in the lower region are shed as growth proceeds. The hydrocladia on the stem and branches are arranged in alternating whorls of four, and reach a length of about 6 mm. On the branches they are so arranged that a transverse section of the space that they occupy is ovoid. In the hydrocladia there is a node at the base of each hydrothecate article, but generally none to mark off the intermediate articles. The stem apophysis, which probably includes a fused intermediate article bearing no nematotheca, has a flanking pair of nematothecae in the axil, a pronounced distally directed tubular "mamelon," characteristic of the genus, in the centre of the upper surface, with a pair of supracalyceine nematothecae just above it. The apophysis is followed by the first of the hydrothecate articles of the hydroclade, to each of which is fused the intermediate article with its single nematotheca. The gonothecae are borne on the branch apophyses and slightly exceed in length the distance between successive whorls. They are slightly curved, narrow at the base and obliquely truncate above, with wide circular aperture, the rim of which dips somewhat on the adcauline side.

The most distinctive character is the general growth form.

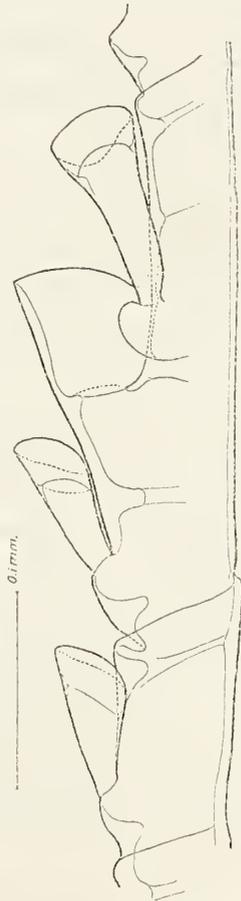
Remarks.—I select the larger specimen, Brit. Mus. Reg. No. 29.10.10.9, as the holotype.

GENUS SCHIZOTRICHA, Allman.

Genotype.—*S. unifurcata*, Allman, 1883, p. 28, pl. VII, figs. 1-3.

Schizotricha, Allman, 1883, p. 28.

Diagnosis.—*Eleutheroplea* with homomerous, often branched, hydrothecate stem and accessory supporting stem. This is formed by nematotheca-bearing tubules, which arise from out of the older proximal stem hydrothecae. Each stem article bears a long apophysis growing out alternately left and right from below the hydrothecae.



TEXT-FIG. 64.—*Nemertesia elongata*, sp. n. Lateral view of hydrotheca from apical part of a hydroclade, $\times 255$.

The supracalcine pairs of nematothecae of the stem hydrothecae are thus found in the axils of the apophyses. From the apophyses grow out homonomous hydrocladia which branch unilaterally and fanwise, forming scorioid sympodia. These primary hydrocladia may rebranch as many as fifteen times. The main axis of a branch is formed usually not by the primary hydroclade but by a series of successive apophyses together with the proximal parts of the basal articles of the successive hydrocladia of higher orders.

Hydrothecae deep, tapering below with abaxial edge of margin projecting beyond level of adaxial edge. Dioecious, gonangia of heteromedusoid type, gonothecae cornucopia-shaped, borne immediately below hydrothecae on branches, with basal nematothecae and below them a small basal article.

Remarks.—The following species should be assigned to the genus:—

Sertularia frutescens, Ellis and Solander, 1786; *Schizotricha unifurcata*, Allman, 1883; *S. multifurcata*, Allman, 1883; *Plumularia variabilis*, Bonnevie, 1899; *P. profunda*, Nutting, 1900; *Schizotricha dichotoma*, Nutting, 1900; *S. anderssoni*, Jäderholm, 1904; *S. turqueti*, Billard, 1906; and *Plumularia glacialis*, Hickson and Gravely, 1907.

Diplopteron grande, Nutting, 1900, and *D. longipinna*, Nutting, 1900, should probably be included too. In a fragment of *D. grande*, Brit. Mus. Reg. No. 02.6.6.16, there appear to be no cauline hydrothecae, although Nutting says there is a hydrotheca at base of each hydroclade; but in other respects it resembles typical *Schizotricha* species. The stem hydrothecae have probably been overgrown by accessory tubules. In *S. grande* (Nutting) the reduced secondary hydrocladia are tending to become specialised as phylactogonia and are losing their hydrothecae. One remains in the axil of each successive forking. The main branch axis is formed by the primary hydroclade.

To be excluded from the genus are the following species which have from time to time been assigned to it: *Plumularia sulcata*, Lamarck, 1816 (genotype of *Heterotheca*, Stechow, 1921); *P. catharina*, Johnston, 1833 (genotype of *Thecocalus*, Bale, 1915); *P. campanula*, Busk, 1852; *P. diaphana*, Heller, 1868; *P. gracillima*, Sars, 1873; *P. tenella*, Verrill, 1873; *P. buski*, Bale, 1884; *P. liechtensterni*, Marktanner, 1890; *Diplopteron quadricorne*, Nutting, 1900; *Plumularia parvula*, Nutting, 1900; *Schizotricha bifurca*, Hartlaub, 1904; *Schizotricha antarctica*, Jäderholm, 1904; *Schizotricha simplex*, Warren, 1914; and *Plumularia zygocladia*, Bale, 1914.

Bifurcation of hydrocladia is found in several widely separated forms which Bedot (1921) has grouped together under *Schizotricha*; but a number of common features characterises the group of species which includes the genotype of *Schizotricha*. Only this group should bear that generic name.

There is an evident connection between this genus and *Nuditheca*, Nutting, 1900.

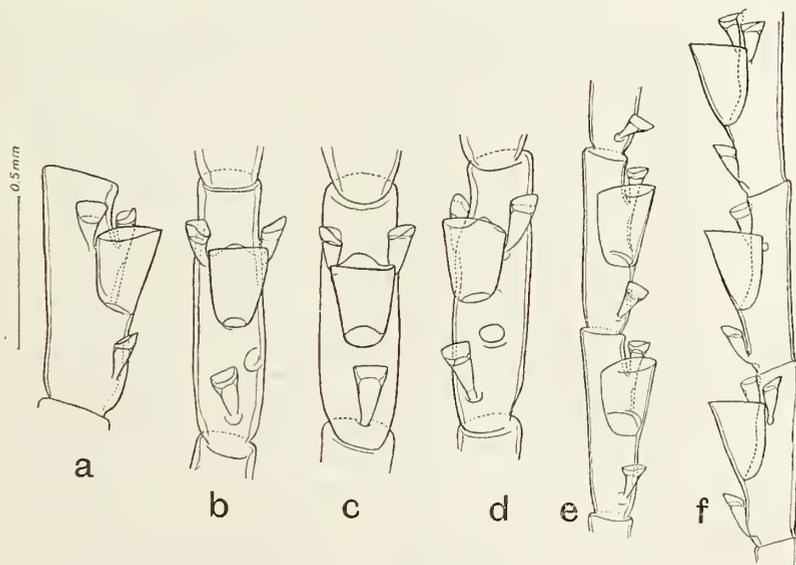
Distribution.—There are three Antarctic and four N. Atlantic species, but none in the Arctic area. There are three isolated records of the N. Atlantic species *S. frutescens* from the northern part of the Adriatic, another isolated one from the

Bay of Biscay, and one by Krauss from Algoa Bay. The only temperature records appear to be 3.5° C. for the N. Atlantic species *S. variabilis* and 2.4° C. for *S. profunda* in Davis Strait.

Schizotricha unifurcata, Allman. (Pl. III, fig. 4; text-fig. 65, a-f.)

Schizotricha unifurcata, Allman, 1883, p. 28, pl. VII, figs. 1-3; *S. multifurcata*, Allman, 1883, p. 29, pl. VII, figs. 4-5; *S. turqueti*, Billard, 1906, p. 15, fig. 5; ? *Plumularia glacialis*, Hickson and Gravely, 1907, p. 22, pl. III, figs. 23-24.

Material.—Many broken stems up to 21 cm. in length bearing male and female gonothecae; and root masses measuring up to 3 cm. in diameter, from Station 220, off Cape Adare, Ross Sea, 45-50 fathoms; also the distal 5 cm. of two branched stems with immature male gonothecae from Station 316, off Glacier Tongue, McMurdo Sound, 190-250 fathoms.



TEXT-FIG. 65.—*Schizotricha unifurcata*, Allman. a-d, from "Terra Nova" Station 220; e, f, parts of holotype (Brit. Mus. Reg. No. 88.11.13.78), from off Kerguelen Island, Challenger Expedition. All figures magnified $\times 40$.

The specimens were broken up by the Agassiz trawl. A reconstructed tuft would be about 30 cm. in height and would consist of a dozen or more tapering stems rising from a compact root-mass.

Description.—The primary hydrocladium arises below and to one side of the stem hydrotheca, and each successive branchlet arises from a similar point below the hydrotheca of the basal article of the preceding branchlet. The sagittal plane of the hydrothecae of the branchlets is rotated gradually clockwise through about 90 degrees in a series of 10 branchlets, while at the same time the direction of the branchlets changes from "latero-dorsal" to "dorso-ventral." All branchlets are elevated some 45 degrees from the horizontal. The nematothecae are horn-shaped with an emargination

on the adaxial side. In their arrangement there is much variation. Three nematophores are usually present on the basal article of each branchlet, two infrathecal, a proximal ventro-lateral and a lateral, homologous with the two median infrathecal, described by Allman for ordinary articles in *S. unifurcata*, and a third on the proximal part of the apophysis; all three being on the upper side. In the proximal and older regions of a branch one or two additional nematophores may arise near any of these three characteristic ones, it being quite usual to find a second one on the distal part of the apophysis of the basal articles.

The proximal parts of two neighbouring branches are nearly at right angles to one another; but the axes gradually curve round towards each other on the ventral side like ribs. The branchlets are arranged tangentially on the axes which consist of the series of successive apophyses and proximal parts of basal articles of the branchlets which grow from these apophyses.

Mature male gonangia have been obtained, but only immature female ones. The species appears to be dioecious. Gonangia of both sexes are of the heteromedusoid



TEXT-FIG. 66.—*Schizotrichaturqueti*, Billard.
Nematotheca from
holotype, $\times 75$.

type, and similar to that which is found in many species of *Halecium* and in *Sertularia argentea*. The single egg in the female and the spermatocyst in the male is borne on a process of the blastostyle, and is covered by a mantle of ectoderm. It has not been possible to determine whether there are other layers of ectoderm inside the mantle. In the earlier stages of development at any rate the distal end of the blastostyle is produced into a flattened endplate which lies under the blastogenic layer of ectoderm which secretes the chitin. At a later period all these tissues seem to be absorbed, leaving only

the egg or sperms inside the perisarc. This latter is of the well-known pear-shape in the mature gonotheca, and has a circular terminal or sub-terminal operculum and generally two proximal nematophores: one or two additional ones may be present, but they are not always perfectly formed.

The gonangia grow out from a point between the infra-hydrothecal nematophores and the hydrothecae of the ordinary articles of the branches, or from just below the hydrothecae of the basal articles. Sometimes additional gonothecae are present in these regions. There is always a node at a short distance from the point of origin.

The mature male gonothecae appear to be indistinguishable from those of *S. glacialis* (Hickson and Gravely).

Measurements.—The average length of 126 branch internodes of a specimen from off Glacier Tongue, McMurdo Bay, is 0.765 mm. Below is a table of some of the chief measurements in microns compared with those of two other Antarctic species.

Species.	Ordinary Branch internode.		Hydrotheca.	
	Length.	Breadth.	Length.	Breadth.
<i>S. unifurcata</i> , Allm. "Terra Nova," 1910-13	544-965	227-297	260-300	190-210
<i>S. unifurcata</i> , Allm. "Challenger," 1873-6..	506-1013	135-150	285-310	200-215
<i>S. multifurcata</i> , Allm. "Challenger," 1873-6	660-780	135-160	230-310	160-200
<i>S. unifurcata</i> , Allm., var. <i>turqueti</i> , Billard ..	770-860	160-175	280-315	175-190
<i>S. anderssoni</i> , Jäderh. "Antarctica," 1901-3	730-1100	129-148	280-350	150-180
<i>S. glacialis</i> , H. & G. "Discovery," 1901-3..	—	198	334	210

Range of Variation.—Every article on three separate branches of Allman's type of *S. unifurcata* was measured, with startling results; for in one branch the range of variation in length of the ordinary hydrothecate articles was from 0.506-0.727 mm. and the maximum length for a basal article was 0.776 mm.; while in another branch the range was from 0.810-1.013 mm. and the maximum length of a basal article was no less than 1.443 mm. The figures given for the length of the ordinary branch internode of *Schizotricha unifurcata* are based on a series of 105 articles from three branches.

Remarks.—It is not possible to say what difference there is between Allman's two species *E. unifurcata* and *S. multifurcata*. In both the primary hydroclade may rebranch several times. The types of *unifurcata* show as many as six branchlets. The arrangement of nematophores in one does not seem to differ characteristically from that in the other.

The ways in which the "Terra Nova" specimens vary from the types are: in having no node to separate off what Billard (1910) calls the "article basal" from the apophysis of either stem article or first hydrothecate article of a branchlet; in that the ordinary branch articles (*i.e.* excluding basal articles) with one exception have but one infrathecal nematophore; and in having rather broader branch internodes.

Hickson and Gravely's types of *P. glacialis*, Brit. Mus. Reg. No. 07.8.20.37, include male and female specimens. The long branches generally carry each a long secondary branch, but more material is needed before we can decide how many species of *Schizotricha* there are in the Antarctic area.

Aglaophenia laxa, Allman. (Text-figs. 67, 68.)

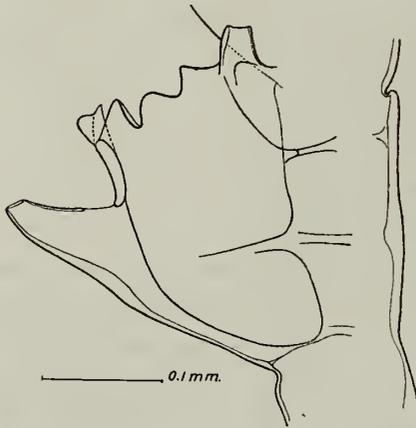
Aglaophenia laxa, Allman, 1876, p. 275, pl. XXI, figs. 5-7; *A. laxa*, Bale, 1924, p. 260, fig. 15; *idem*, Trebilcock, 1928, p. 25, pl. V, fig. 5; not *Thecocarpus laxis*, Billard, 1913, p. 98.

Material.—Six tufted colonies from two to three inches in height and fragments, all bearing mature corbulae, growing on a shelly bottom, from Station 134, near North

Cape, N. Zealand, 11–20 fathoms; also a small group of specimens with corbulae, and a branched specimen without corbulae, 4.5 cm. in height, anchored by rooting processes to a mass of shells and sand, from Station 144, off Cape Maria van Diemen, N. Zealand, 40 fathoms.

Only one new record, Trebilcock (1928), has been made of the capture of this New Zealand species during the period of fifty years that has elapsed since Allman described it. Specimens have been taken from time to time and the British Museum collection contains a large fertile specimen from Wellington, N.Z., which formed part of the Hincks collection, a fertile specimen from Lyall Bay, near Wellington, N.Z., sent to the Museum in 1898 by Farquhar, and another specimen taken by Haddon in Torres Straits.

Description.—In the largest "Terra Nova" specimen, seven stems up to 6 cm. in length rise from the centre, and several other smaller ones from the margin of the tangled mass of hydrorhiza. This is 4 cm. in diameter, and is attached to shell fragments. The only branching *sensu stricto* that takes place is in the formation of hydrocladia and the gonosome. In addition to this, however, hydrorhizal tubes grow up the stems, occasionally proceeding from the stems themselves, and from them at intervals spring other secondary stems. There is intercommunication between stem and hydrorhizal tubes by means of ostia in the adjacent walls. This system of false branching seems to be confined to the *Hydroida*.



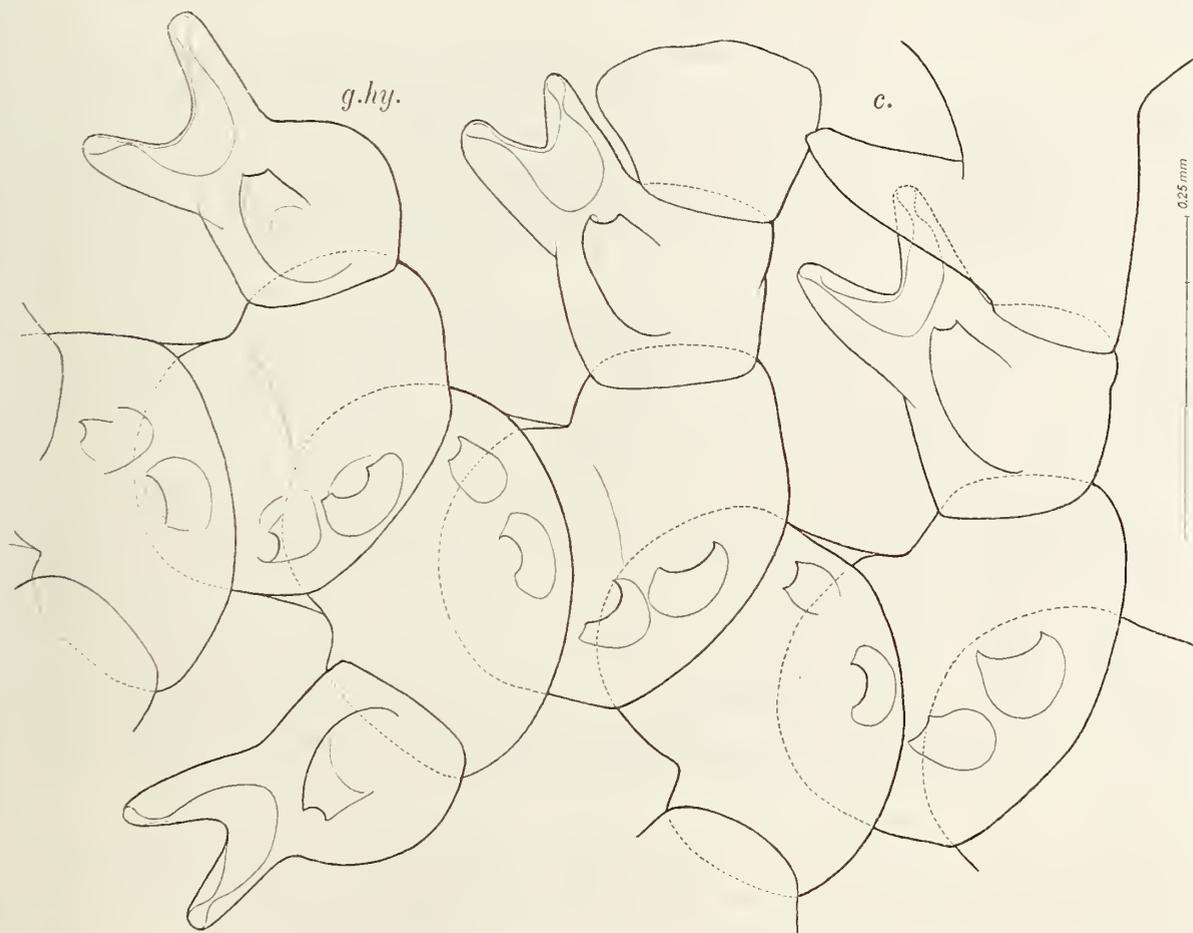
TEXT-FIG. 67.—*Aglaophenia laxa*, Allman. $\times 158$.

For the first two or three millimetres the primary stems are smooth; the next portion, of variable length, bears a row of nematothecae, doubtless homologous with the mesial infrathecal nematothecae. After this the distal part is regularly segmented, each internode having a mesial and an external lateral nematotheca of normal size. The hydrocladia spring from fronto-lateral apophyses which do not develop a "mamelon." One centimetre's length of the stem bears on either side about two and twenty hydrocladia, which have a length of from 4 mm. to 6 mm. For the proximal 2 mm. or 3 mm. the secondary stems are more or less regularly segmented, each internode bearing a single median nematotheca.

The gonosome consists of a number of modified, branched hydrocladia, termed *gonocladia*. When fully formed each *gonocladium* is 6 mm. long, and generally turned up parallel with the stem. Each bears seventeen branches or costae on either side, and is of the type described by Allman for *A. acanthocarpa*.

The term "corbula" may be applied to each of these branching gonocladia which bear and enclose the gonangia. These structures are not strictly comparable with the somewhat similar phylactocarps of *Lytocarpus ramosus*, Fewkes, where we find the

hydrocladia on the proximal parts of branches modified to form what at first sight look like the costae of a corbula. In *A. laxa* the peduncle of the corbula bears a single hydrotheca, and each of the short, broad internodes of the rachis is provided with a median infrathecal and an inner lateral nematotheca like the stem. There is no outer lateral nematotheca and no "mamelon." There is a rounded fronto-lateral eminence on each internode of the rachis, and from the outer side thereof arises a vestigial branch, which we may term the *gonohydrocladium*. In species of *Thecocarpus* it is well



TEXT-FIG. 68.—*Aglaophenia laxa*, Allman. Apical end of immature corbula, showing gonohydrocladia, *g.hy.*, and costae, *c.*, $\times 168$.

developed, but here it is nothing more than a short process bearing on its distal end a pair of generally asymmetrical nematothecae, a small median infrathecal nematotheca and a lateral rounded eminence, from which the final order of branch—the costa—arises. Each costa is segmented. Every internode except the first, which bears only one, is provided with a pair of opposite nematothecae. The gonangia arise from the rachis in the axils of the branches. They are shaped like doubly convex lenses.

I am unable to find any reliable point of difference between the corbulae of *A. acanthocarpa*, of which I have examined the types, and *A. laxa*. The corbulae of

the types of *acanthocarpa* have as many as five and twenty pairs of costae, whereas those of *laxa* have not more than seventeen in specimens that I have examined. In *acanthocarpa* corbulae there is usually only one of the pair of lateral suprathecal nematothecae on the gonohydrocladium, whereas in *laxa* both of them are nearly always present. But little stress can be laid on the first of these points unless we know whether the corbulae are fully grown or not. The presence of ripe gonangia is no criterion because these are present at an early stage. As to the second point, there is much variation from corbula to corbula.

I have noted an interesting branched corbula, a thing not unknown in other species. One costa has become a secondary rachis, and one or two of the neighbouring costae are abnormal. In one of these the gonohydrocladium bearing it and its proximal internode are normal, but the second internode, instead of bearing a pair of opposite nematothecae, bears a vestigial hydrotheca with its median infrathecal and paired lateral suprathecal nematothecae. The infrathecal nematotheca is similar in all respects to the other costal nematothecae. In *Thecocarpus laxus*, Billard, I have seen a corbula in which the proximal gonohydrocladium consists of a succession of normal hydrothecae instead of a single one, and bears no costa. The very next gonohydrocladium of this same corbula bears a costa which is transformed into a secondary normal corbula similar to the one I have described above.

Gonangia bearing spermatic masses are in corbulae separate from those bearing the gonangia in which the eggs are produced, six or seven in each gonangium. Corbulae of the two kinds appear not to be borne on the same stem. There is no appreciable difference between the two kinds of corbulae.

From Station 134 comes a specimen which is growing in the midst of a tuft of *Sertularella* sp. A careful examination of the latter revealed some very interesting developmental stages of *A. laxa*, presumably springing from recently settled planulae. Each has a rounded footplate, and from it springs a stem bearing hydrothecae. There is a bare proximal article 0.27 mm. long over all, followed by a still shorter one 0.15 mm. over all, which has a single median nematotheca. The nodes at each extremity of this short article are of the oblique hinge type. Following this we find from three to four normal hydrothecae, hydrocladia being developed at an early stage from the second or third and successive articles. The point of interest is that after the third or fourth hydrothecate stem articles the hydrothecae are suppressed, leaving only the infrathecal and the outer supracalycinal nematothecae. This primitive arrangement of hydrothecae is only to be seen at the bases of stems arising directly from planulae, and not in those springing from subsequently formed hydrorhizal tubes. A similar arrangement has been described by Bedot (1919) for *A. kirchenpaueri* and *A. pluma*, but in both forms the hydrocladia were only produced from articles formed subsequently to the hydrothecate ones. There is no evidence that these hydrothecae disappear later on; but old stems arising directly from the larval *rosette* or footplate are seldom met with or recorded.

Remarks.—Nothing was added to Allman's description till 1924, when Bale figured and described some type material that I had sent him together with some notes for this purpose. In 1921 I was fortunate enough to be able to identify the figured holotype and paratypes of the species in a packet of New Zealand hydroids in Busk's collection, which had been presented to the British Museum in 1899. The specimens bore no specific name. The gonosome was overlooked by Allman. The figured holotype bears eleven incompletely developed gonocladia of the type predicted by Bale.

Thecocarpus ctenatus, sp. n. (Text-fig. 69, a.)

Material.—A small complete colony, three centimetres in length with branched rooting fibres but no gonosome, from unknown locality; and the lower five and a half centimetres of the stem and hydrocladia of a specimen without rooting mass, bearing an open corbula without gonangia, from Station 91, off Three Kings Islands, N. Zealand, 300 fathoms.

Description.—Stem polysiphonic, unbranched, the accessory tubes being constricted diagonally at intervals to allow the stem to twist. Hydrocladia very long, up to 3.5 cm. Full complement of three cauline nematophores, all of which are simple and gutter-shaped. Hydrothecae of an aberrant type with intrathecal ridges on both abcauline and adcauline sides; margin with three pairs of inconspicuous teeth and a small anterior one. Median nematothecae adnate up to abcauline ridge, with septum at base and thickening on abcauline side near apex, single gutter-like opening, and not communicating with theca. Gonosome an open corbula of seventeen pairs of short gonohydroclades without theca. Gonohydroclades give rise to longer costae, and have three dorsal nematothecae and one median below origins of costae. Costae with five pairs of nematothecae and one apical. Gonoclade with two nematothecae to each article representing infrathecal and interior supracalycine, and single dorsal one.

Thecocarpus rostratus (Bale). (Text-fig. 69, b.)

Halicornaria rostrata, Bale, 1924, p. 264, fig. 18; *Thecocarpus formosus* (Busk), var. *inarmatus*, Trebilcock, 1928, p. 26, pl. V, fig. 6; not *Plumularia formosa*, Busk, 1851, p. 118.

Material.—Thirty stems, up to 11.5 cm. in length, growing in tufts, their bases encrusted with polyzoa and other organisms, from Station 90, off Three Kings Islands, N. Zealand, 100 fathoms; and a number of stems up to 7 cm. in length, growing on sponges and other organisms, from Station 144, off Cape Maria van Diemen, N. Zealand, 35–40 fathoms.

Description.—Stems up to 10 cm. long, unbranched except for hydrocladia and occasional abnormal regenerations. Basal five or six millimetres devoid of hydrocladia. A short, smooth portion is followed by five or six internodes each bearing a double mesial nematotheca. Thereafter about twelve hydrocladia a side in each centimetre of stem, the hydrocladia being about 1 cm. long. The stem internodes have the full

complement of nematothecae and a "mamelon." Hydrothecae in middle of hydrocladia with prominent median and four pairs of lateral pointed teeth, a pointed prominence at the base of the median one. First and third lateral teeth prominent and everted, fourth reduced, especially at distal ends of hydrocladia, where the third lateral teeth are particularly strongly developed. First and second laterals single and not double as in *T. formosus*. Median prominence hollow and in open communication with hydrotheca. Median and lateral nematothecae with gutter-shaped openings. The paired supracalcine nematothecae become progressively larger and more prominent distally. The proximal hydrotheca has a small median prominence, and its mesial nematotheca, instead of projecting, lies close to the theca. Corbulae not present.

Remarks.—The trophosome of this species differs from that of *T. formosus* (Busk) in that its hydrocladia are longer, more distant from one another, and do not terminate in spines. The hollow prominence at the base of the median hydrothecal tooth is markedly shorter than in that species. The arrangement of the marginal teeth, too, is different. As lectotype of *T. formosus* (Busk) I have taken two stems 4.5 cm. long arising from a small rooting mass which is provided with short processes on its under surface, indicating a parasitic habit. The stems bear about twenty-seven hydrocladia on each side to every centimetre. The hydrocladia are about 4 mm. long. The specimen, Brit. Mus. Reg. No. 99.7.1.6115, which bears closed corbulae varying from 2.5 mm. to 5 mm. in length, comes from Algoa Bay, S. Africa. I agree with Marktanner and differ from Billard in recognising four pairs of lateral teeth in *T. formosus*. The projections, well figured by Billard (1907) on the ventral edges of the first and second lateral teeth of the thecae of *T. formosus*, and making these teeth appear to be divided into two, are absent in *Thecocarpus rostratus*, Bale.

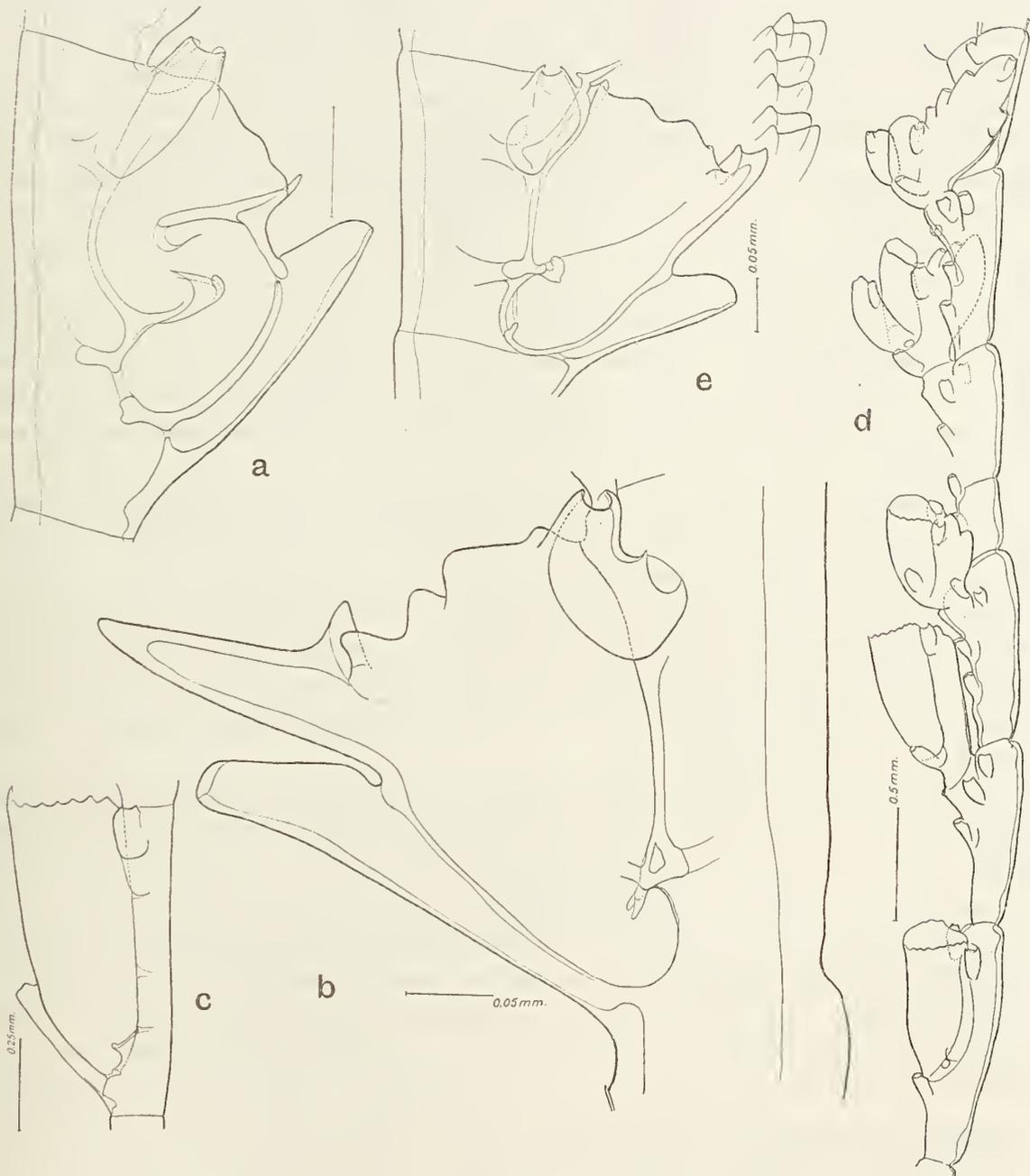
Because of its simple lateral marginal teeth, and lack of terminal spines I regard Trebilcock's *T. formosus* var. *inarmatus*, 1928, as a variety of *T. rostratus*, Bale, rather than of *T. formosus*, Busk. The distribution of the two species makes this seem probable.

Thecocarpus spiralis, sp. n. (Text-fig. 69, c-d.)

Material.—Two colonies 16 cm. over all, complete with rooting masses and branches, one with a single corbula, from Station 90, off Three Kings Islands, N. Zealand, 100 fathoms.

Description.—Colonies forming dextral scorpioid cymes. Stems from 2 mm. to 3 mm. in diameter at base, fascicled, lower 8 cm. or 9 cm. without branches, remainder giving off pinnate branches from 3 cm. to 4 cm. long in a loose spiral, six branches to each revolution. The branches all originate from the stem and not from the accessory tubes, which grow up over them. There are secondary communications between the stem and accessory tubes. Origin of accessory tubes undetermined. Hydrocladia 1.5 mm. apart, up to 14 mm. in length, with twelve hydrothecae to a centimetre. Hydrothecae of the elongated cylindrical type, the mesial nematotheca arising at an

angle of 45° from the internode, and projecting only a short way beyond the thecal wall, paired supracalcyne nematothecae not reaching margin of theca. All three



TEXT-FIG. 69.—*a*, *Thecocarpus clenatus*, sp. n., $\times 160$; *b*, *Thecocarpus rostratus* (Bale), $\times 250$; *c*, *d*, *Thecocarpus spiralis*, sp. n. hydrotheca, $\times 54$; *d*, the same, proximal part of gonoclade, $\times 35$; *e*, *Thecocarpus chiltoni*, Bale. Lateral view of hydrotheca, $\times 150$, showing variations in profile of median hydrothecal tooth further enlarged.

nematothecae openly canaliculate. A pronounced median, and seven pairs of small pointed lateral marginal teeth. Two or three internodal thickening beside one at the

level of the paired nematothecae, and another at the level of the *arris*.^{*} Full complement of cauline nematothecae and a "mamelon." There is an additional median nematotheca below the usual one. The corbulae are of an interesting type, showing transition from a normal hydroclade in the proximal region, to a stem with triply branched hydrocladia in which the thecae are suppressed and the branches form a closed corbula, in the distal part. In the intermediate region they have the form of a simply branched stem, with cauline thecae suppressed, and with progressively reduced thecae one on each of four secondary hydrocladia, the distal two of which each have a tertiary branch. The supernumerary mesial nematotheca found on the main stem is present on some articles of the corbula rachis. Each gonohydroclade or branch of the corbula rachis, apart from four proximal ones, which do not form part of the corbula, consists of a flat expansion—the "lateral spur." This represents the growing point of a hydroclade, and generally bears on its distal edge three nematothecae, as well as from one to five on the other. On each lateral spur may be seen the three nematothecae which always accompany a theca, but the thecae themselves are suppressed.

From each "lateral spur" (gonohydroclade) arises a branch to form the broad corbula "leaflet" (costa) provided with nematothecae on its distal edge. Close to the point of origin of each secondary branch and on its distal edge, arises a small tertiary branch (costal apophysis) surrounded by three thecal nematothecae. Each tertiary branch fuses with the proximal edge of the corbula "leaflet" in front, and a secondary communication is established in this way between the interiors of the leaflets. Fusion between the distal ends of leaflets takes place in such a way that small free expansions are left.

Remarks.—This species is closely allied to *Aglaophenia tenuissima*, Bale, 1914. Colonies of both species form cymes, the hydrothecae are of the same type, although differing in size and in number of marginal teeth, and the corbulae are similar. *A. tenuissima* still retains reduced hydrothecae on the gonohydrocladia, whereas in the distal region of the corbula of *T. spiralis* they are suppressed. The arrangement of cauline nematothecae is the same in both, save for the presence of a supernumerary mesial one in the "Terra Nova" species. These facts show what an unnatural group is formed by giving the generic name *Thecocarpus* to all forms which have corbular thecae.

Thecocarpus chiltoni, Bale. (Text-fig. 69, e.)

Thecocarpus chiltoni, Bale, 1924, p. 261, fig. 16.

Material.—Eight specimens bearing corbulae, some complete with rooting masses and up to nine inches in height, from Station 90, off Three Kings Islands, N. Zealand, 100 fathoms; and fragments bearing corbulae, from Station 144, off Cape Maria van Diemen, N. Zealand, 40 fathoms. A fragment also from Station 91.

* See footnote, p. 163.

Description.—From a vertically elongated rooting mass of hydrorhiza springs a stout fascicled cymous stem, as much as 3 mm. in diameter at the base, branched and rebranched pinnately in one plane as many as four times. The branches all arise from the stem and not from the supporting tubes. One main supporting tube grows out on the dorsal surface of each branch at an early stage, and later is accompanied by subsidiary ones. Branches about 1 cm. apart. Stem and branches provided with the full complement of nematothecae and “mamelon.” Proximal parts of branches with five normal hydrothecate internodes, after which the arrangement is as described for stem and branches. Corbula peduncle with two normal hydrothecate internodes, arrangement on rachis being similar to that on stem and branches. Corbulae closed, about 5 mm. long inclusive of peduncle, consisting of about ten pairs of leaflets. The rachis bears three orders of branches, the gonohydroclade, the costa and the costal apophysis, the base of each being surrounded by the usual three nematothecae. The internodes of the rachis are not all alike in this respect. The first three have the normal complement of nematothecae, but distally all except the median infrathecal one are suppressed. The gonohydroclade bears one hydrotheca with its three nematothecae and a distal median supracalycine nematotheca. The costa or corbula-leaflet grows out from between the hydrotheca and the mesial infrathecal nematotheca, and its distal edge bears seven or eight normal hydrothecae. The costal apophysis is small and triangular. It grows out from the base of the distal edge of the costa and is surrounded by the usual three nematothecae. It unites with the hinder edge of the base of the costa distal to it, filling up a space in this region. Hydrothecae with a pronounced median and four lateral pairs of teeth, none of them everted. The median tooth bears a short finger-like hollow process. First tooth small, second most pronounced. Mesial nematotheca short, openings of all of them gutter-like. Infrathecal ridge small with lateral uprising sinuous processes. Two internodal thickenings. Opening from internode into hydrotheca small and oval.

Halicornaria regalis, sp. n. (Text-fig. 70.)

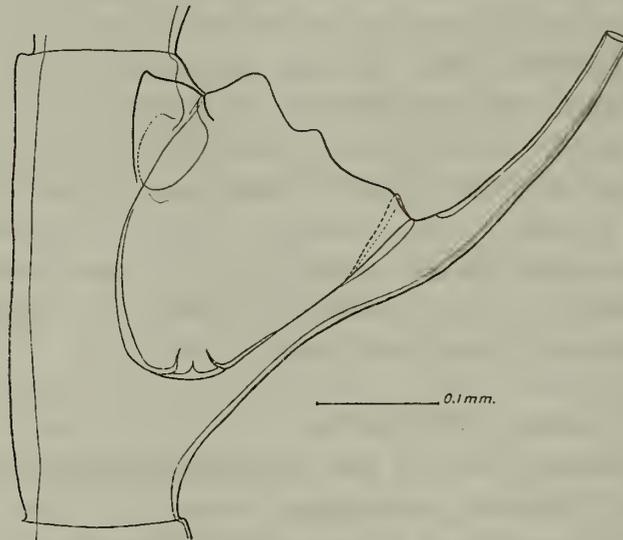
Material.—One detached branch two centimetres in length from Station 90, off Three Kings Islands, N. Zealand, 100 fathoms.

Description.—Full complement of three simple gutter or scoop-shaped cauline thecal nematothecae present. Calicles not closely approximated; margin with a very small anterior, three pairs of lateral, short, simple, broadly pointed teeth, the second everted, and a rounded posterior notch. No intrathecal ridge. Supracalycine nematothecae small, simple, gutter-shaped. Mesial nematotheca nearly straight, adnate right up to anterior tooth, with terminal pore and larger, though rather small, basal opening; length of free part about two-thirds of the distance from the margin to the hydropore in the base of the theca. Gonothecae pedicellate, sub-cylindrical, longer than broad, arising singly from anterior surface of branch apophyses, each containing a single basal sporosac enclosed in a fine chitinous membrane.

Measurements :

Stem,									mm.
diameter .. .. .	..	..	..	..	..	..	..	..	0.25
internode, length ..	..	..	..	..	..	..	..	..	0.43
Pinna,									
length (15 thecae)	..	..	..	..	..	..	..	..	6.3
diameter .. .. .	..	..	..	..	..	..	..	..	0.07-0.10
internode length ..	..	..	..	..	..	..	..	..	0.40
Hydrotheca,									
length .. .. .	..	..	..	..	..	..	..	..	0.22
diameter at mouth,									
frontal view .. ..	..	..	..	..	..	..	..	..	0.25
lateral view .. ..	..	..	..	..	..	..	..	..	0.17
mesial sarcotheca,									
free part, length ..	..	..	..	..	..	..	..	..	0.20
Gonotheca,									
diameter .. .. .	..	..	..	..	..	..	..	..	0.32

Remarks.—This species is allied to *H. humilis*, Bale, and to *H. prolifera*, Bale. From the former it differs in that its mesial nematothecae are adnate as far as the anterior tooth, and in the smaller size of this tooth. From *H. prolifera* it differs in



TEXT-FIG. 70.—*Halicornaria regalis*, sp. n. Schizoholotype, $\times 160$.

its smaller supracalycine nematothecae, its finer and straighter mesial nematothecae, less strongly everted lateral marginal teeth and smaller anterior tooth, as well as by having more distant hydrothecae. The holotype is the single specimen, Brit. Mus. Reg. No. 29.10.10.14.

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Coelenterata, Part V.—Hydroida, Pl. I.

PLATE I.

- FIG. 1.—*Zygophylax unilateralis*, sp. n., $\times 5$; stem and branches.
FIG. 2.—*Zygophylax unilateralis*, sp. n., $\times 12.4$; branch.
FIG. 3.—*Symplectoscyphus constrictus*, sp. n., $\times 6.2$.
FIG. 4.—*Symplectoscyphus confusus*, sp. n., $\times 3.9$.
FIG. 5.—*Symplectoscyphus epizooticus*, sp. n., $\times 13.8$.
FIG. 6.—*Symplectoscyphus epizooticus*, sp. n., growing upon *S. confusus*, sp. n., $\times 6.6$.
FIG. 7.—*Sertularella spiralis*, Hickson and Gravely, Schizoholotype, McMurdo Bay, "Discovery" Expedition 1901-4, $\times 16.3$.
FIG. 8.—*Symplectoscyphus glacialis*, Jäderh., forma *elongata*, $\times 12.7$.
FIG. 9.—*Symplectoscyphus glacialis*, Jäderh., showing gonothecae, $\times 12.7$.
FIG. 10.—*Symplectoscyphus columnarius* (Briggs), $\times 6.3$.

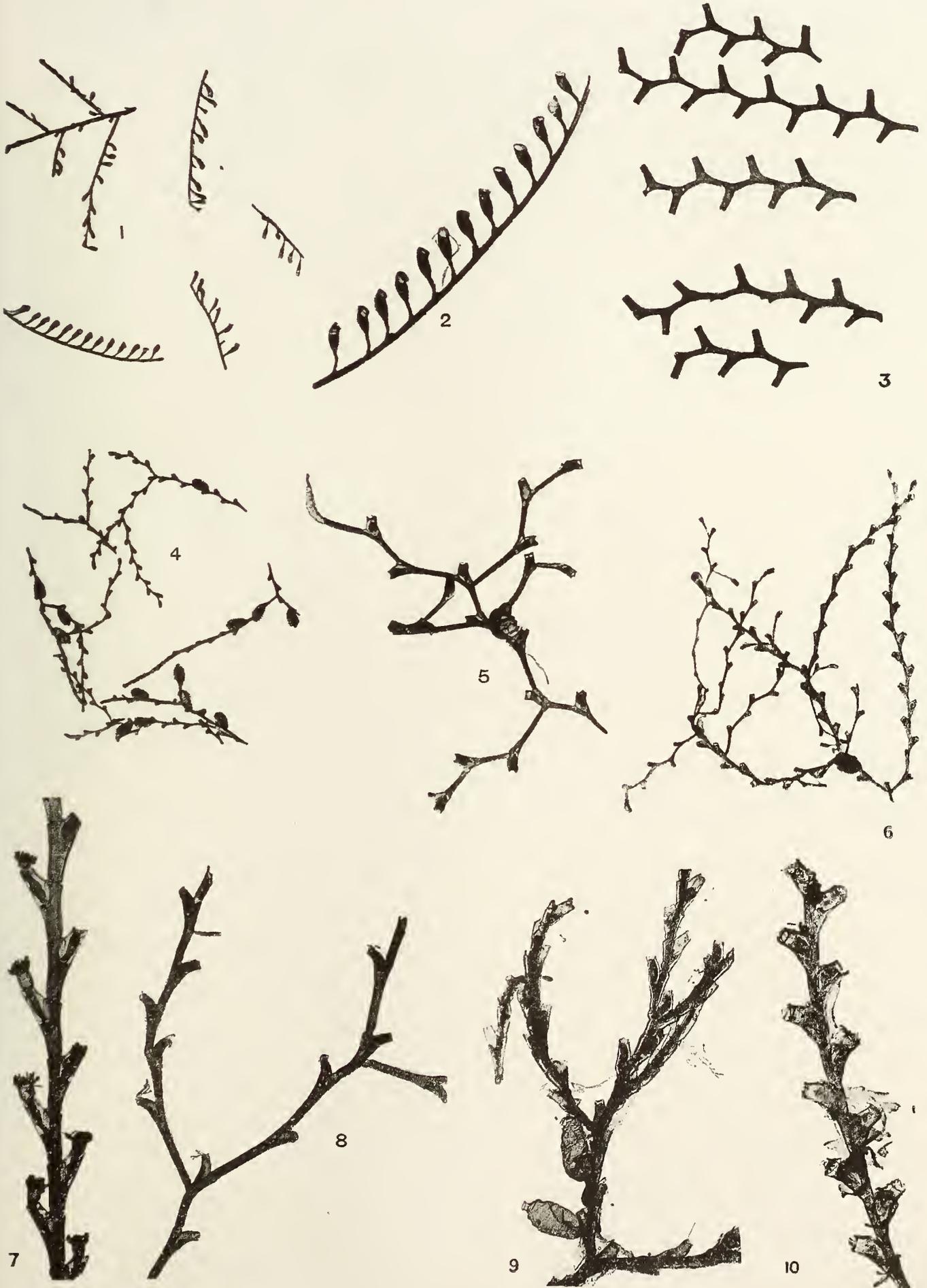




PLATE II.

- FIG. 1.—*Symplectoscyphus curvatus* (Jäderh.), $\times 10.4$.
FIG. 2.—*Symplectoscyphus curvatus* (Jäderh.), $\times 13.5$; showing gonothecae.
FIG. 3.—*Symplectoscyphus curvatus* (Jäderh.), $\times 9$.
FIG. 4.—*Symplectoscyphus plectilis*, Hickson and Gravely, $\times 13$; "Discovery" Expedition, 1901-4;
to show form of gonothecae.
FIG. 5.—*Symplectoscyphus plectilis*, Hickson and Gravely, $\times 11.9$.
FIG. 6.—*Staurotheca antarctica*, Hartlaub, $\times 11.6$; to show form of female gonotheca.
FIG. 7.—*Symplectoscyphus glacialis* (Jäderh.), $\times 16.9$.
FIG. 8.—*Symplectoscyphus biformis* (Jäderh.), $\times 11$.
FIG. 9.—*Staurotheca dichtooma*, Allman, $\times 7.8$; Marion Island, "Challenger" Expedition; to show
form of male gonothecae.



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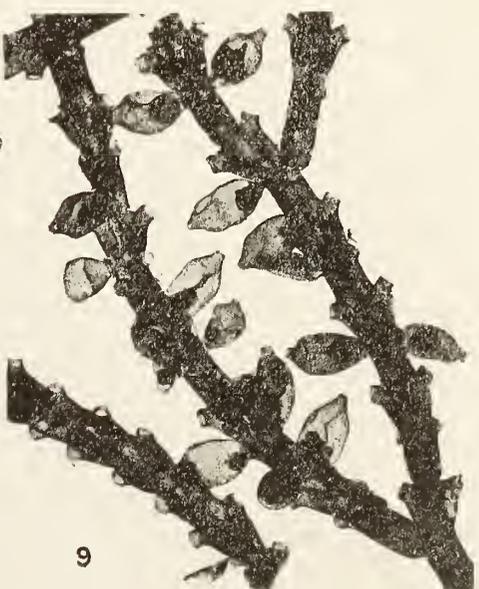
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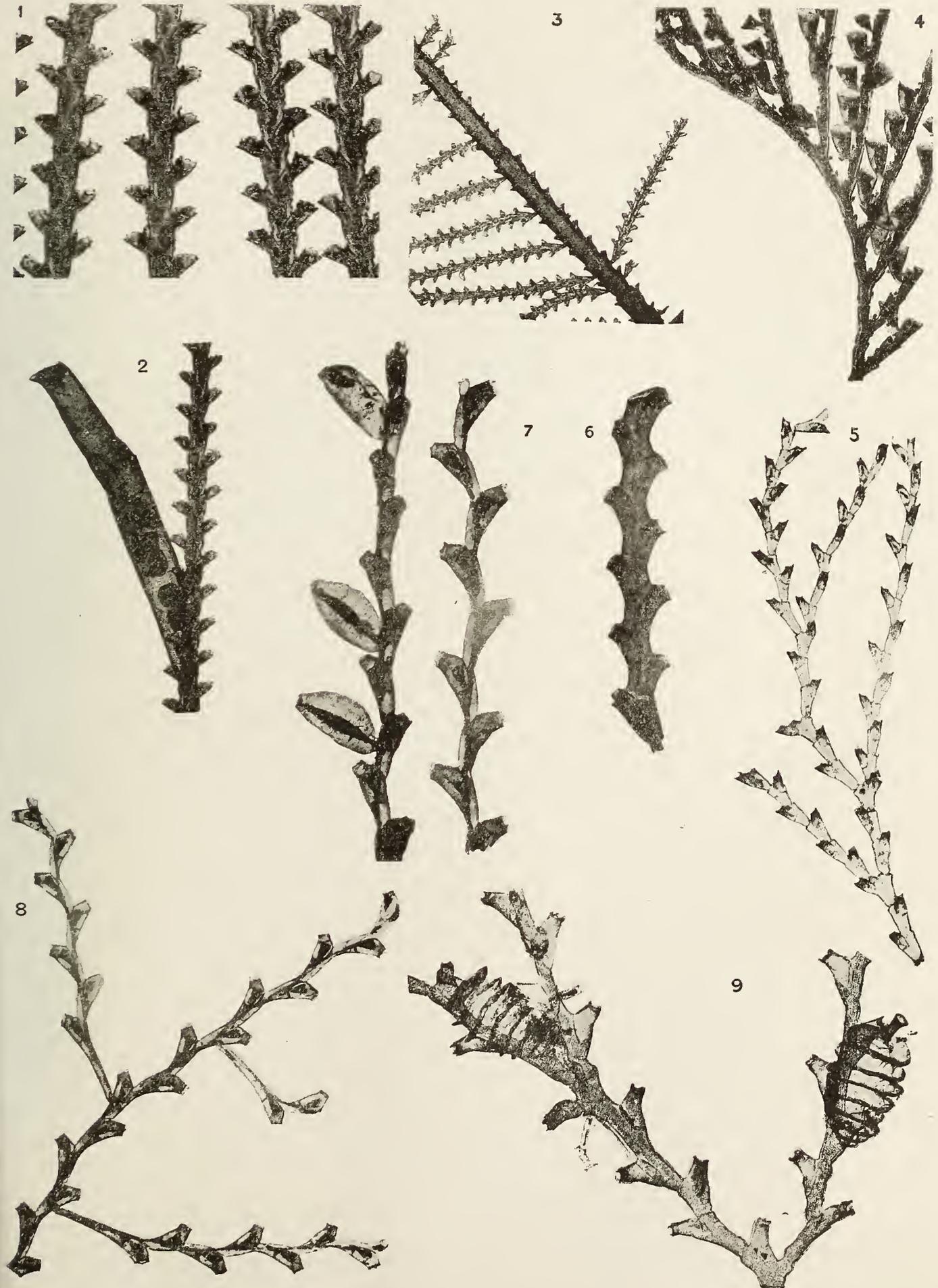


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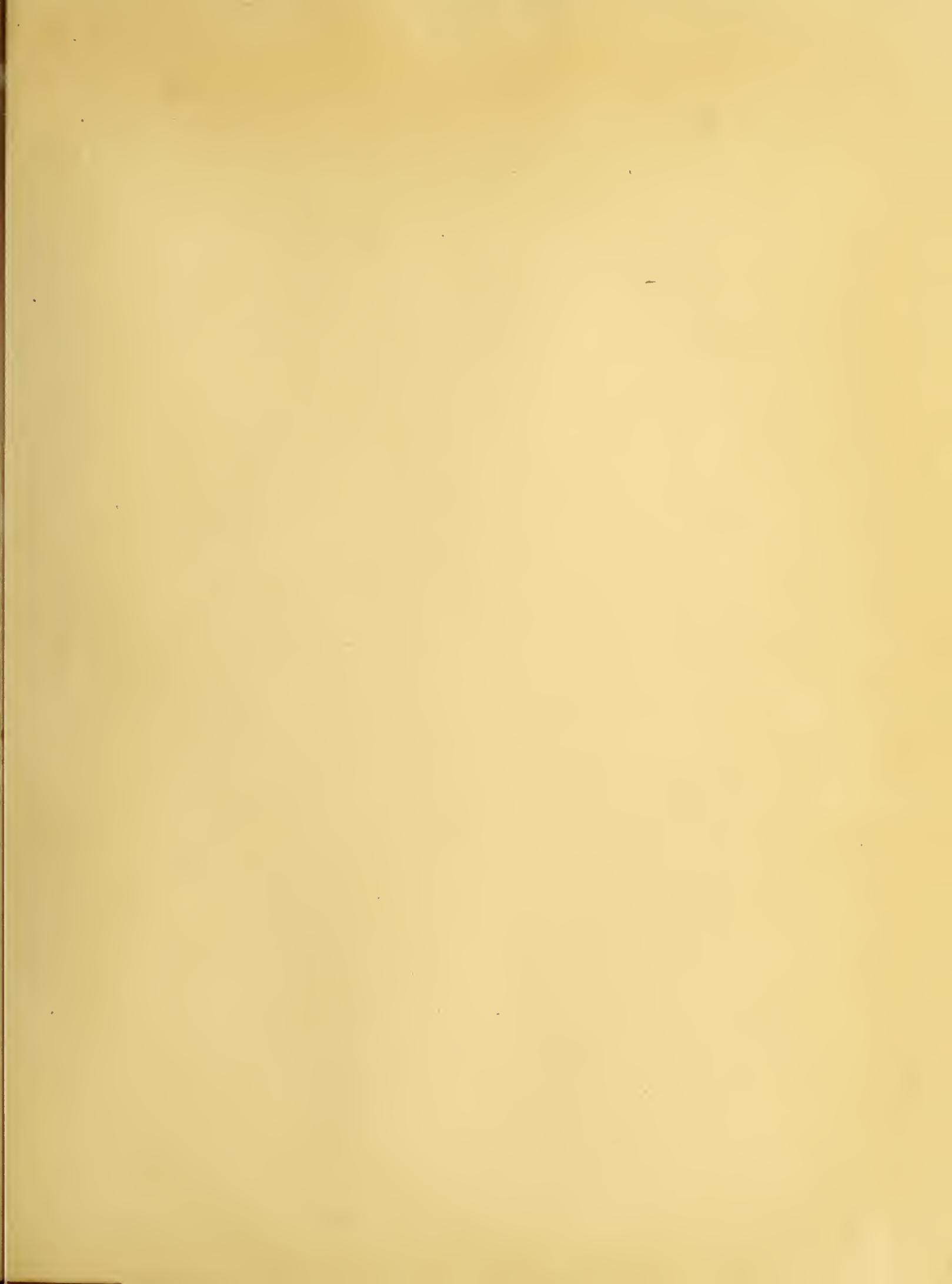


PLATE III.

- FIG. 1.—*Crateritheca zelandica* (Gray), $\times 15.5$.
FIG. 2.—*Crateritheca zelandica* (Gray), $\times 6.3$; stem and hydrocladia.
FIG. 3.—*Crateritheca zelandica* (Gray), $\times 10.2$; with a single gonotheca.
FIG. 4.—*Schizotricha unifurcata*, Allman, $\times 8.5$.
FIG. 5.—*Sertularella spiralis*, Hickson and Gravely, $\times 9$.
FIG. 6.—*Sertularella edentula*, Bale, $\times 9.1$; the single fragment from Station 90.
FIG. 7.—*Sertularella geodiae*, sp. n., $\times 9.1$; to show form of gonothecae.
FIG. 8.—*Sertularella geodiae*, sp. n., $\times 6.2$.
FIG. 9.—*Symplectoscyphus filiformis*, Allman; to show form of female gonothecae.







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