REPORT

ON THE

SPONGES

COLLECTED BY

PROFESSOR HERDMAN, AT CEYLON, IN 1902.

BY

ARTHUR DENDY, D.Sc., F.L.S.,

PROFESSOR OF ZOOLOGY IN THE SOUTH AFRICAN COLLEGE, CAPE TOWN.

[WITH PLATES I. TO XVI.]

INTRODUCTION.

CONSIDERING the frequent opportunities for collecting which have been afforded by the Pearl Fisheries of Ceylon, it is remarkable that our knowledge of the Sponge-Fauna of this locality, rich and varied as it is, should so long have remained in so backward a condition. In 1887, Mr. RIDLEY and I (1)* called attention to this fact in our Report on the Monaxonida collected by H.M.S. "Challenger," but as the "Challenger" unfortunately did not visit Ceylon, the results of that memorable voyage did nothing towards improving matters in this respect. In the same year, however, as that in which our "Challenger" Report was published, I was able to report (2) also upon a collection of sponges from Madras, made by Mr. EDGAR THURSTON, the Superintendent of the Government Central Museum, and again in 1889 I reported (3) on a second collection of sponges made by the same Zoologist in the Gulf of Manaar. In this way considerable additions were made to our knowledge of the Sponge-Fauna of Ceylon and Southern India, but Mr. CARTER'S papers (4, 5) on the sponges collected in the Gulf of Manaar by Captain W. H. CAWNE WARREN still remained the principal works on the subject; a very remarkable fact, when we remember the extraordinarily

* The numbers in brackets refer to the List of Literature at the end of the Report.

small bulk of the material which he investigated and amongst which he found altogether something like 70 species—a notable addition indeed to the 13 or so previously described from the same neighbourhood by Esper (6), Haeckel (7), Bowerbank (8), and Holdsworth (9).

The collection of sponges (146 species) made by Professor Herdman is, however, far more extensive than any previously obtained in Ceylon waters, and includes not only a large proportion of the species already described by the authors mentioned, but also a considerable number (77 species) of new ones, some of which are of very great interest. With the exception of the Calcarea, which are singularly few in number, and of the Hexactinellida, which are, of course, a deep-water group and not likely to be met with in the neighbourhood of the pearl banks, the collection contains representatives of practically all the important sub-divisions of the Phylum. In dealing with so large a mass of material, the question of classification has assumed a very formidable aspect, and I have found it desirable to make certain modifications in this respect which I hope may be regarded as improvements. These modifications will be duly explained, and I hope justified, in the proper place.

Since, in spite of the enormous advances which have been made during the last twenty years in our knowledge of the sponges, our ideas as to taxonomy are not yet by any means in a settled condition, I have considered it desirable to give brief diagnoses of the various sub-divisions with which I have to deal, in order that there may be no mistake as to the sense in which I employ them. We are, undoubtedly, progressing rapidly towards a satisfactory and natural classification of the group, but the problem is an extremely difficult one, and every new collection of any considerable extent, such as the present, must for a long time to come necessitate more or less modification of existing views. The classification which I have adopted may at present be regarded as the latest of these modifications, based principally upon the writings of Sollas, Ridley, Lendenfeld, Topsent, and myself. Topsent, in particular, has done much in the last few years both in arranging and classifying the chaotic mass of information left by earlier writers, and in making notable additions to our systematic knowledge of this difficult but interesting group.

In order to facilitate reference to the type specimens by future workers and to make the systematic portion of this report as precise as possible, I have adopted the system, already employed in my Catalogue of Non-Calcareous Sponges collected by J. Bracebridge Wilson, &c. (10), of giving at the end of the description of each species the Register Number (R.N.), which I have attached to each specimen. This method also has the great advantage of enabling one to refer readily to individual specimens in the text.

At the conclusion of the Report I propose to give as complete a list as possible of the Sponge-Fauna of Ceylon and to discuss the problem of Geographical Distribution. In the meantime I append a list of the principal memoirs dealing with the subject arranged in chronological order.

Special Bibliography of the Ceylon Sponge-Fauna.*

1798–1806. Esper.—"Fortsetzung der Pflanzenthiere," Part 2.

1870. Ehlers.—"Die Esper'schen Spongien." (In this memoir the author re-describes two Ceylon species.)

1872. Haeckel.—"Die Kalkschwämme." (This work includes descriptions of half a dozen species of Calcareous Sponges collected by Wright in Ceylon waters.)

1873. Bowerbank.—"Report on a Collection of Sponges found at Ceylon by E. W. H. Holdsworth, Esq.," 'Proc. Zool. Soc. Lond.,' 1873, p. 25. (This paper contains descriptions of only four species. It was criticized by Gray in 'Ann. and Mag. Nat. Hist.,' Ser. 4, vol. XII., p. 266.)

1873. Holdsworth.—"Note on the Occurrence of *Xenospongia patelliformis*, Gray, on the Coast of Ceylon," 'Proc. Zool. Soc. Lond.,' 1873, p. 32.

1880. Carter.—"Report on Specimens dredged up from the Gulf of Manaar and presented to the Liverpool Free Museum by Captain W. H. Cawne Warren," 'Ann. and Mag. Nat. Hist.,' Ser. 5, vol. V., p. 437; vol. VI., p. 35 and p. 129. (In this paper the author describes fifty-four species, the great majority new, from material which he tells us would hardly fill a quart measure, the largest of the specimens being not more than three inches in its longest diameter.)

1881. Carter.—"Supplementary Report on Specimens dredged up from the Gulf of Manaar, &c.," 'Ann. and Mag. Nat. Hist.,' Ser. 5, vol. VII., p. 361. (A considerable number of species are added to the previous list.)

1884. Ridley.—"Zoological Collections of H.M.S. 'Alert,'" British Museum. (The author refers incidentally to the Sponge-Fauna of Ceylon.)

1887. Dendy.—"The Sponge-Fauna of Madras. A Report on a Collection of Sponges obtained in the neighbourhood of Madras by Edgar Thurston, Esq.," 'Ann. and Mag. Nat. Hist.,' Ser. 5, vol. XX., p. 153.

1888. Sollas.—"Report on the Tetractinellida collected by H.M.S. 'Challenger.'" (In this work the author deals critically with the Tetractinellida described by Carter from the Gulf of Manaar.)

1889. Dendy.—"Report on a Second Collection of Sponges from the Gulf of Manaar." 'Ann. and Mag. Nat. Hist.,' Ser. 6, vol. III., p. 73. (The list of the Ceylon Sponge-Fauna is herein considerably extended, and the report contains records made by Mr. Thurston of the colours of many of the species when alive.)

1889. Lendenfeld.—"Monograph of the Horny Sponges," 'Royal Society.'

* This list includes only works which deal directly with Ceylon species, and was inserted here on account of its historical interest. In the course of the Report I shall have occasion to refer to many other memoirs, and, in order to conform with the system adopted in the other Reports of this series and to save space, I have decided to give a full list of the literature cited at the end of the work and to refer to it by means of numbers.

SYSTEMATIC DESCRIPTION OF THE GENERA AND SPECIES OF SPONGES IN PROFESSOR HERDMAN'S COLLECTION.

Phylum PORIFERA.

Class: NON-CALCAREA.

Porifera without calcareous spicules.

The non-calcareous sponges are divisible into four natural groups, for which I propose to use the names Myxospongida, Triaxonida, Tetraxonida, and Euceratosa respectively, and which may be conveniently regarded as of ordinal rank.

Order: MYXOSPONGIDA.

Non-calcarea which are primitively destitute of spicules and horny fibre; with simple canal system and usually large flagellate chambers.

In this order I include the genera *Halisarca*, *Bajalus*, *Hexadella*, and *Oscarella*, all of which appear to me to be nearly related to one another, so that it is hardly necessary to divide them, as is usually done, into two families, Halisarcidæ and Oscarellidæ. All of them are, I believe, primitive forms, and should therefore stand at the bottom of the series of non-calcareous sponges.

It is quite possible that Lendenfeld's "Hexaceratina" may be closely related to the "Halisarcidæ," as supposed by that author; but, if so, it appears to me that the Halisarcidæ are the more primitive forms, from which both Hexactinellida and Hexaceratina have been derived. Lendenfeld, on the other hand, appears to regard the Halisarcidæ as being derived from the Hexaceratina by loss of horny fibres, and in this opinion he is followed by Topsent (11), who observes "Dépourvu à la fois de spicules et de fibres cornés, le genre *Hexadella* est vraiment le dernier chaînon de la chaîne des Hexaceratina et doit occuper la place qu'on a parfois assignée, sans raison valable, aux *Halisarca*."

The Myxospongida may therefore be regarded as representing a common starting point, from which have originated the Triaxonida, the Tetraxonida, and the Euceratosa, and I cannot agree with Professor Minchin (12) in placing this order at the end of the siliceous series instead of at the beginning. The primitive character of the canal system argues strongly against the belief that they are forms in which the skeleton has been lost by gradual reduction, and the case is obviously quite different from that of *Chondrosia*, whose highly specialized canal-system, strongly developed cortex, and evident relationship to *Chondrilla*, afford good grounds for regarding it as a reduced siliceous sponge in which the absence of skeleton is a secondary and not a primary character.

Hexadella, Topsent.

Myxospongida with large, sac-shaped flagellate chambers and a distinctly differentiated, tough ectosome.

The description given by Topsent (*loc. cit.*, p. 119) of this genus and of the two species which he includes in it is evidently of a preliminary character and is unfortunately without illustrations. His own diagnosis of the genus runs, " Hexaceratina revêtantes, molles, sans spicules ni fibres cornés; un peu plus épais que dans les genres voisins, l'ectosome jouit seul de quelque consistance et sert, dans une certaine mesure, de squelette externe à la masse."

As the genus is as yet so little known, I shall postpone the discussion of its relationship until I have described in some detail the anatomy of the Ceylon species.

Hexadella indica, n. sp.—Plate I., figs. 1–3.

Sponge thin, encrusting; spreading extensively over masses of calcareous Polyzoa and other organisms, but usually only about 1 millim. in thickness. Colour in spirit, grey (in life, red ?). Surface smooth, glabrous, minutely reticulate. Vents few, minute, scattered. Consistence (in spirit) rather tough and membranous (owing chiefly to the ectosome), so that the sponge can be stripped off from the substratum like a skin.

The ectosome (Plate I., fig. 1, *Ect.*) forms a tough pellicle about 0·08 millim. thick, which can be stripped off from the underlying choanosome. The choanosome evidently consists of a thin lamella (fig. 1, *Ch.L.*, fig. 2), very much folded upon itself. The lamella itself is little, if any, thicker than the ectosome, and contains a single layer of large, sac-shaped flagellate chambers (figs. 1, 2, *F.C.*), whose arrangement, of course, follows the curvature of the lamella. The structure of the choanosome thus reminds one very strongly of what occurs in *Oscarella*, but there is no extensive internal portion free from flagellate chambers as in that genus.

Between the folds of the choanosomal lamella lie the primary inhalant (*P.I.C.*) and exhalant (*P.E.C.*) canals. The former expand at their outer ends into large, irregular crypts (fig. 1, *Cr.*), roofed over by the ectosome, which merges insensibly into the choanosome at the points of contact. These crypts, resembling subdermal cavities, may sometimes be seen from the surface, ramifying horizontally beneath the ectosome. The primary exhalant canals open at their inner ends into larger exhalant channels (fig. 1, *L.E.C.*).

Owing to the development of the ectosome, the water does not enter the primary inhalant canals directly, as in *Oscarella*, but by means of numerous well-developed "chones" (fig. 1, *Ch.*), which penetrate the ectosome at right angles to the surface. Each chone expands somewhat at its outer end in a trumpet-like manner, and is covered over by a membrane (fig. 3, *Mem.*) which doubtless contains the inhalant pores, but the pores are now all closed and cannot be recognised. I have, however,

seen indications, in the form of fine, slit-like canals in the closing membrane, of the existence of several minute pores in the roof of each chone.

From the primary inhalant canals the water reaches the flagellate chambers by fine, sometimes branching canaliculi of considerable length (fig. 2, *I.Ca.*). The chambers themselves (figs. 1, 2, *F.C.*) are sac-shaped, unbranched (at any rate usually) and up to about 0·098 millim. long, though usually less (say about 0·065 millim.). They open into the primary exhalant canals either directly (eurypylous) or through short exhalant canaliculi.

The mesoglœa, both of the ectosome and choanosome, is abundantly developed and chiefly collenchymatous, with a profusion of small connective-tissue cells (fig. 2, *C.T.C.*) with much-branched processes. The mesoglœa of the ectosome passes insensibly into that of the choanosome at the points of contact; the former, however, stains rather more darkly than the latter, and is often distinctly, though very finely, fibrillated.

In the mesoglœa we also find embedded a large number of small, darkly staining, spherical cells (figs. 1, 2, 3, *Sy.A.*), about 0·006 millim. in diameter, sometimes apparently with small central nuclei. These cells are most abundant around the various parts of the inhalant canal-system, and are congregated in immense numbers in the inner portion of the ectosome. They sometimes appear to be broken up into groups of smaller cells. They are in all probability symbiotic algæ, such as are known to occur frequently in sponges, a conclusion which is rendered almost certain by the fact that, when treated with iodine and sulphuric acid, they give a distinct purple coloration (although it must be admitted that when tested for starch with Schultze's solution, only negative results were obtained). These bodies are probably closely comparable to the "cellules sphéruleuses" to which Topsent (*loc. cit.*, p. 120) attributes the red colour of his *Hexadella racovitzai*, and which are also (in my opinion) probably symbiotic algæ. Unfortunately, I have no information as to the colour of *Hexadella indica* in life, but if, as seems just possible, it is identical with Carter's *Halisarca rubitingens*, it is also red, and the colour may likewise be attributable to the symbiotic algæ.

This very interesting sponge appears to form a connecting link between the three genera *Oscarella*, *Halisarca*, and *Hexadella*, to which latter genus I have referred it only after long hesitation. It resembles the first in the distinctly folded character of the choanosomal lamella and the arrangement of the flagellate chambers, which are, however, much larger and usually (though not always) eurypylous, while a more important distinction is introduced by the strong development of the ectosome. The structure of the ectosome, the absence of the curious connective-tissue fibres, and the unbranched character of the flagellate chambers, together with the less extensive development of the mesoglœa, separate it from *Halisarca*. The mesoglœa appears, however (as far as one can judge from Topsent's description), to be a good deal more extensively developed than in his species of *Hexadella*. Topsent says nothing about the existence of a distinctly folded choanosome lamella, or of inhalant chones, in his

species, and it is quite possible that a new genus may be necessary for the reception of the Ceylon sponge, but this is a point which cannot be decided until we have more information as to the European species.

Hexadella indica may, as I have already suggested, possibly be identical with Carter's *Halisarca rubitingens* (5), which was described from *dry* material from the Gulf of Manaar and referred to the genus *Halisarca* provisionally by its author. Having examined one of Mr. Carter's original preparations of *Halisarca rubitingens*, now in my possession, I have come to the conclusion that we cannot say for certain what that organism was, and that it will be best to abandon the name altogether.

R.N. 26, 46 (Gulf of Manaar), 254 (south of Adams Bridge, 5 fathoms).

Order: TRIAXONIDA (HEXACTINELLIDA).

Non-calcarea in which the skeleton is composed of siliceous spicules whose fundamental form is triaxonid and hexactinellid.

Owing, doubtless, to the collecting operations having been confined to comparatively shallow water, there are no representatives of the Hexactinellida in the collection. There are, however, a few specimens of the so-called Hexaceratina which may be found ultimately to belong here. As, however, I do not consider that their systematic position is yet definitely settled, I have decided to deal with them later on, in connection with the other horny sponges (see below, p. 200).

Order: TETRAXONIDA.

Non-calcarea in which the fundamental form of the spicule is tetraxonid and tetractinellid. The spicules may, however, be more or less reduced, and also to a greater or less extent replaced by spongin or even sand.

It will be seen that I use the term Tetraxonida in a wider sense than that in which it is employed, for example, by Minchin, in his admirable article in Lankester's 'Zoology.' It appears to me necessary to do this in order to bring out the most fundamental character of the group, viz., the primitively tetraxonid and tetractinellid character of the spicule, in contrast with the triaxonid and hexactinellid character of the spicule in the Triaxonida.* The term Tetractinellida may be reserved for those non-Lithistid Tetraxonida which retain to a greater or less extent the primitive spicule-form, a form which doubtless characterised the ancestors of all the Tetraxonida, but has been lost by reduction in many of the existing members of the group.

The Lithistida have evidently developed along special lines of their own, and

* The occurrence of triods in the most primitive family of the Tetraxonida (viz., Plakinidæ) suggests a triaxonid (and triradiate) precursor of the tetraxonid and tetractinellid spicule. The triaxonid spicule of the Plakinidæ is, however, a fundamentally different form from that of the Triaxonida (Hexactinellida).

include both tetractinellid and monaxonellid forms, they may therefore be most conveniently regarded as constituting a separate "grade." By this exclusion of the Lithistida, the term Tetractinellida is confined to SOLLAS's group "Choristida," a sense in which it has already been employed by LENDENFELD in his work on the Tetractinellida of the Adriatic (13).

Recent researches, however, have shown that the Tetractinellida, Lithistida, Monaxonellida, and certain horny sponges which I propose to call Pseudoceratosa, are so closely related to one another that they must certainly be included in one and the same order. Indeed, it is difficult to draw a hard and fast line between these sub-divisions, which merge very gradually into one another. It is certain that the Monaxonellida have been derived (probably polyphyletically) from ancestral Tetractinellida, and the Pseudoceratosa (or, at any rate, the great majority of them) from ancestral Monaxonellida (probably polyphyletically), while the Lithistida may also be of polyphyletic origin and are closely related to the Tetractinellida on the one hand and to the Monaxonellida on the other.

The sharp separation of these four groups is, therefore, to a large extent artificial, but must be retained as a matter of convenience till we know a good deal more about their phylogeny. It must, however, be clearly recognised that the groups Tetractinellida, Lithistida, Monaxonellida, and Pseudoceratosa simply represent stages in a complex evolutionary series, commencing with the first-named group, and that each of the later stages may possibly have been reached along more than one line of descent.

GRADE: TETRACTINELLIDA.

Tetraxonida in which the primitive tetraxonid and tetractinellid condition (or a possibly still more primitive triaxonid and triradiate condition) is retained by some at least of the spicules, while no desmas are developed.

SUB-ORDER: HOMOSCLEROPHORA.

Tetractinellida in which microscleres and megascleres are not yet sharply differentiated from one another and no triænes are developed.

I venture to propose the name Homosclerophora to replace the old name Microsclerophora of SOLLAS. The latter is very misleading in that it does not indicate the primitive undifferentiated character of the spicules as regards size, and leaves it to be inferred that microscleres, as distinct from megascleres, are present.

TOPSENT (14), followed by MINCHIN (12), associates the Homosclerophora (Microsclerophora) with the "Microtriænosa" and the "Oligosilicina" in one group, to which he gives the old name "Carnosa." This appears to me a most undesirable proceeding, for while the Homosclerophora (especially the Plakinidæ) are evidently primitive forms, as SOLLAS (15) long since pointed out and as is clearly shown by their anatomical

characters, the "Microtriænosa" are what MINCHIN terms "a heterogeneous collection of sponges of divers affinities," and the "Oligosilicina" ("Chondrosidæ," of SCHULZE) are simple only by the reduction of the skeleton and not primitively. I therefore consider that TOPSENT'S revived "Carnosa" should be again abandoned, the "Microtriænosa" placed amongst the other triæne-bearing Tetractinellida, and the "Oligosilicina" placed near the Tethyidæ, to which they are evidently allied by their corticate character, the general arrangement of their canal-system, and the astrose microscleres of Chondrilla.

The Homosclerophora are thus left as the natural starting point of the Tetraxonid series, a position already clearly indicated for them by LENDENFELD in his work on the Tetractinellida of the Adriatic. TOPSENT, it is true, fully recognises the artificial character of his "Carnosa" and places them after his "Tetractinellida." MINCHIN, on the other hand, places them first, a diversity of opinion which clearly indicates the impracticability of associating together such widely different forms as are included in the group.

Owing to their primitive character, the Homosclerophora form a very important and interesting sub-order, and it is here that we must seek for the origin, not only of the various types of canal-system, but also of the almost innumerable types of both micro- and megascleres met with amongst the Tetraxonida.

FAMILY: PLAKINIDÆ.

Homosclerophora in which no distinct cortex is developed.

This appears to be the most primitive family of the Tetraxonida. The genus *Plakinastrella*, formerly included herein, but possessing more or less well-developed triænes, finds a more natural position amongst the Pachastrellidæ.

Dercitopsis, n. gen.

Plakinidæ with calthrops, triods and smooth oxea, but no candelabra. The oxea vary greatly in size, and some of the smaller ones form a special dermal layer, in which they are commonly arranged at right angles to the surface.

It is, perhaps, doubtful whether this genus ought to be separated from *Plakortis*, but the species for which it is founded differs from the type species of *Plakortis* (*P. simplex*) in three respects:—(1) Calthrops are present as well as triods; (2) some of the oxea are so large as to deserve the name of megascleres, although they pass gradually into the smaller forms (microxea); (3) some of the microxea form a special dermal layer, in which they are commonly arranged at right angles to the surface.

In this genus we have a refutation of SOLLAS'S statement that "megascleres are absent" from the so-called "Microsclerophora" (including the Plakinidæ), and we

see very clearly how oxeote megascleres may be derived directly from primitive triaxon or tetraxon spicules by suppression of one or two actines (see Plate II., fig. 1). From the same source are derived microxea, and these, being frequently curved, have probably given rise to the sigmata and toxa and, perhaps, other curvilinear microscleres of higher groups. Increase in the number of actines of the primitive spicule, on the other hand, accompanied by other modifications, has probably given rise to the astrose series of microscleres. Thus *Dercitopsis* and its allies may be regarded as representing at the present day the common ancestors of both Astrophora and Sigmatophora.

Dercitopsis ceylonica, n. sp.—Plate II., fig. 1.

This species is represented in the collection by two small, flat pieces which have probably been encrusting and may have formed parts of the same specimen. One is about 22 millims. in length, 13 millims. in greatest breadth, and 7 millims. in greatest thickness. The other is about 26 millims. in length, 16 millims. in greatest breadth, and 7 millims. in greatest thickness. The surface is smooth but rather uneven. Colour in spirit, dark slate grey on the outside, dull yellow internally. Vents minute, scattered singly, with a tendency towards marginal arrangement or grouping on prominent parts. Inhalant pores dispersed abundantly over the surface, not in sieves.

Skeleton very dense, for the most part quite confused and irregular, but with the smallest microxea forming a thin dermal crust, in which they are commonly arranged at right angles to the surface.

Spicules.—(1.) Calthrops and triods (Plate II., fig. 1, *a–h*); rays smooth, sharply and gradually pointed, commonly about 0·033 millim. long by 0·005 millim. in maximum diameter, but subject to considerable variation, and occasionally exhibiting monstrous forms such as twins.

(2.) Oxea (fig. 1, *i–o*); varying enormously in size, but in such a perfectly graduated series between the smallest and the largest that they cannot be divided into mega- and microscleres. The dermal microxea measure only about 0·025 millim. by 0·002 millim., while the oxea in the deeper parts of the sponge frequently measure as much as 0·42 millim. by 0·012 millim. Both large and small oxea are smooth, gradually and finely pointed at each end, and frequently centrotylote. They often exhibit a curvature, which may be sigmoid or toxoid, and thus strongly support the conclusion arrived at by Sollas (*loc. cit.*, p. 109) to the effect that the toxa of *Dercitus* are probably microxea which have acquired a curvilinear growth. The same author has also pointed out that the spinose microrhabds of *Dercitus* originate as smooth centrotylote microxea, which he regards as diactinal asters. From a similar origin we get, in the case of *Dercitopsis ceylonica*, comparatively large oxeote megascleres, which seems to indicate that this common type of spicule may also have been derived from an aster. It also seems probable that the well-known sigmata, so

widely distributed in certain tetractinellid and monaxonid groups, may have originated from such microxea as we find here, in other words, from diactinal asters.

The distinction between ectosome and choanosome is not well-marked, and there is no properly defined cortex. The ectosome is, however, fairly thick (about 0·27 millim.), and much more densely spicular than the choanosome; it contains numerous small brown pigment cells (which are also met with in the outer part of the choanosome). There is no fibrous tissue in the ectosome, and what little mesoglœa there is between the densely packed spicules is probably collenchymatous. The mesoglœa of the choanosome is very finely and uniformly granular.

The dermal pores lead into short inhalant canals which penetrate the ectosome more or less vertically and, after uniting together to a greater or less extent, open beneath the ectosome into spacious "crypts," from which the inhalant canals of the choanosome take their origin. The flagellate chambers are rather large, pouch-shaped, about 0·04 millim. in longer diameter; eurypylous, or with short, wide exhalant canals.

R.N. 139, 235 (? Parts of the same specimen. From Station XLI., 12 miles off Galle, 100 fathoms).

Sub-order: ASTROPHORA.

Tetractinellida with triænes and with astrose microscleres; without sigmata.

Family: PACHASTRELLIDÆ.

Astrophora without long-shafted triænes and without sterrasters. Calthrops, in addition to short-shafted triænes resembling calthrops, may be present.

Plakinastrella, Schulze.

Pachastrellidæ with calthrops and (or) short-shafted triænes and oxea for megascleres; and oxyasters and microxea for microscleres; the microxea forming a special dermal skeleton.

This genus occupies an intermediate position between the Plakinidæ and the Stellettidæ, and probably indicates the first stage in the evolution of the long-shafted triæne from the calthrops. The relationship to the Plakinidæ is clearly shown by the form of the oxea, and the differentiation between megascleres and microscleres is not yet by any means complete.

Plakinastrella intermedia, n. sp.—Plate I., fig. 4; Plate II., fig. 2.

Specimen (Plate I., fig. 4) irregularly branched and shortly stalked; branches short, thick, irregularly nodose, spreading more or less horizontally, rounded at the extremities. Surface smooth but uneven, minutely porous in parts. Texture firm and incompressible, with many relatively large foreign bodies embedded in the substance

of the sponge and sometimes projecting beyond the surface. Vents small and few, on rounded ends of branches. Pores scattered in irregular groups; many in each group, easily visible under a pocket lens. Colour in spirit, greyish brown. Total height, 20 millims.; greatest breadth, 26 millims.

The skeleton is for the most part very confused. The choanosome is densely strewn with large oxea lying in every direction and occasionally aggregated in loose bundles; with these are mingled oxea of smaller size and a few tetract spicules, while the interspaces are filled in with immense numbers of oxyasters, uniformly and thickly scattered through the soft tissues. On the surface of the sponge is a dense layer of small oxea, tangentially disposed, and for the most part lying so close together as to touch one another and form a continuous crust, perforated by the numerous circular inhalant pores where these occur. Beneath this dermal crust are extended horizontally a number of the large oxea and the heads of the dichotriænes.

Spicules.—(1.) Dichotriænes (Plate II., fig. 2, *a–d*), with cladi extended beneath the dermal crust and shaft projecting inwards at right angles to the surface. The shaft is short, stout, and fairly gradually sharp-pointed, only about as long as the radius of the cladome (or even shorter), measuring, say, about 0·37 millim. by 0·055 millim. The protocladi are short and stout, about 0·092 millim. by 0·055 millim. The deuterocladi are about two and a half times as long as the protocladi, but variable; fairly gradually and sharply pointed, commonly slightly curved and often unequal. Boiled-out preparations show various monstrous forms of this spicule, *e.g.*, one with one cladus unbranched, another with one deuterocladus itself branched, another with the shaft branched, and also a number of very much slenderer forms of the same spicule which are probably not fully developed. Although these dichotriænes are essentially characteristic of the sub-dermal skeleton, yet we find a good many branching spicules scattered through the deeper parts of the sponge, which evidently belong to the same type.

(2.) Oxea (Plate II., fig. 2, *e–p*). *a*, large; more or less curved or even angulated in the middle; fusiform; usually gradually and fairly sharply pointed; size about 1·2 millims. by 0·037 millim. Occasionally a slightly curved stylote spicule may be observed, with one end broadly rounded; apparently derived from an oxeote by suppression of one ray. *b*, small; found chiefly in the dermal crust; fusiform, gradually and sharply pointed, slightly curved; varying very much in size; averaging, say, about 0·18 millim. by 0·01 millim., but ranging from about a third of these dimensions through intermediate sizes to the large forms.

(3.) Rather large oxyasters (Plate II., fig. 2, *q–v*), abundantly strewn through the choanosome; with usually about five long, slender and gradually sharp-pointed rays, which are smooth and up to about 0·025 millim. in length; there is no centrum.

Stained sections show that the ectosome is rather thin, apparently consisting only of the dense spicular crust and with no fibrous tissue except a little around the oscular tubes. The choanosome is gelatinous (collenchymatous). Both ectosome and

choanosome contain numerous pigment cells full of brown granules, especially in the walls of the canals. The material is not sufficiently well preserved to show the characters of the flagellate chambers. The inhalant pores, about 0·13 millim. in diameter, are the single openings of short cylindrical chones which penetrate the spicular dermal crust and are provided with well-developed sphincters near its inner limit; but there are no extensive subcortical crypts.

(A fragment of a large, massive anatriæne was found in a boiled-out preparation of the spicules of this sponge, but I could find no others, either in boiled-out preparations or in sections. Should this form of spicule prove to be proper to the species, it would necessitate its removal from the genus *Plakinastrella*).

R.N. 224 (from Station XLI., 12 miles off Galle, 100 fathoms).

Plakinastrella schulzei,* n. sp.—Plate II., fig. 3.

This well-characterised species is represented in the collection by an irregular massive specimen (or fragment) which has been cut off at the base from its attachment. The upper surface is strongly convex and is produced into irregular elevations. The specimen contains many foreign organisms, both internally and encrusting the surface (it is penetrated by the spiral shells of a species of *Tenagodes* (*Siliquaria*), a gastropod which habitually lives in sponges). The colour is purplish grey externally (owing to the presence of numerous granular pigment cells), yellowish within. The vents are irregularly scattered, well-defined circular openings, which may be crateriform; up to about 3 millims. in diameter, but usually a good deal smaller. Inhalant pores (?) are rather conspicuous on some parts of the surface, but irregularly scattered and varying much in size. The specimen measures about 50 millims. in length, 30 millims. in breadth, and 18 millims. in thickness.

The main skeleton is a very irregular interlacement of numerous large oxea and a few short-shafted triænes; the spicules occasionally forming loose wisps. The dermal skeleton is a dense feltwork of small oxea.

Spicules.—(1.) Short-shafted triænes (Plate II., fig. 3, *a–d*), resembling calthrops and subject to much variation in form; commonly with three rays long and bifid and the fourth short and simple, all fairly sharp-pointed; or all the rays may be simple; or one only may be bifid; or one may be trifid, and doubtless other variations could be found. Total diameter measured up to about 0·68 millim. from apex to apex of rays, with primary rays about 0·046 millim. thick.

(2.) Oxea (Plate II., fig. 3, *e–t*). The large oxea of the main skeleton (*e*) are stout, fusiform and gradually sharp-pointed at each end; more or less curved and occasionally slightly angulated at two points, but not centrotylote. They measure, when fully developed, about 1·3 millims. by 0·055 millim. The small dermal oxea (*r*, *s*, *t*) are commonly centrotylote, more or less sharply pointed at each end, and with the two terminal thirds bent upon the middle third at slight angles in the same direction;

* Named in honour of the most eminent of Spongologists, Professor F. E. Schulze.

they are quite smooth and measure about 0·35 millim. by 0·018 millim., but with considerable variation in size. Between the large and small oxea thus described we find so many intermediate in shape and size (*f*–*q*) that it is impossible to distinguish them as megascleres and microscleres respectively.

(3.) Oxyasters (Plate II., fig. 3, *r*-*x*) with smooth, slender, sharp-pointed rays and little or no centrum, are very abundant in the deeper parts of the sponge; they measure about 0·02 millim. in total diameter.

The irregular arrangement of the short-shafted triænes (which presumably originated phylogenetically at the surface of the sponge and acquired their characteristic form in direct relation to that position), and the absence or scarcity of typical calthrops, seem to indicate that this species is less primitive than the type of the genus (*P. copiosa*, Schulze), and, in fact, somewhat degenerate.

R.N. 149 (from Station XLI., 12 miles off Galle, 100 fathoms).

Stœba, Sollas.

Thin, encrusting Pachastrellidæ, with short-shafted triænes, resembling calthrops, for megascleres, and only spined microxea for microscleres.

In 1888 Sollas (*loc. cit.*, p. 102) proposed the genus *Stœba* for Carter's *Samus simplex* from the Gulf of Manaar, but Lendenfeld (13), followed by Topsent (14), has merged the genus in *Dercitus*. Inasmuch, however, as the type species of *Dercitus* (*D. bucklandi*, Bk. sp.) possesses toxa amongst its microscleres, while *Stœba* does not, it seems to me desirable to retain the distinction between the two, especially as we now know three more or less distinct species without toxa, viz., *Stœba simplex* (= *Samus simplex*, Carter; *Dercitus simplex*, Topsent); *Stœba plicata* (= *Corticium plicatum*, Schmidt; *Calcabrina plicata*, Sollas; *Dercitus plicatus*, Lendenfeld and Topsent), and *Stœba extensa*, n. sp.

Sollas's genus *Calcabrina*, founded for Schmidt's *Corticium plicatum*, must be regarded merely as a synonym of *Stœba*.

Stœba extensa, n. sp.—Plate V., fig. 1.

Sponge thin, encrusting, spreading extensively over the surface of and into the cavities of a mass of calcareous *débris* (Melobesia, Polyzoa, Coral, Worm-tubes, &c., mixed together). Surface for the most part smooth and sub-glabrous, slightly rugose in parts; consistence tough and rather fleshy; colour in spirit, pale grey. Vents and pores not seen. The exposed part of the sponge forms an almost uninterrupted sheet about 45 millims. by 33 millims. in extent, but of irregular outline.

The main skeleton consists of short-shafted triænes scattered abundantly, but quite irregularly through the choanosome, but very sparsely in the ectosome, and there is a thin dermal crust of microxea.

Spicules.—(1.) Triænes (Plate V., fig. 1); with short, stout, sharp-pointed shaft, measuring about 0·136 millim. by 0·02 millim. when fully developed, with cladome

about 0·2 millim. across; the cladi are usually extended nearly at right angles to the shaft; they are short and each usually divides into two short, sharp-pointed branches; occasionally, however, the cladi are unbranched and sometimes they are very irregular.

(2.) Spined microxea (Plate V., fig. 1); very slender, straight or very slightly curved, with spination minute but sharp and abundant and fairly uniform throughout the length, excepting that there is frequently a constriction in the middle of the spicule, in which the spination may be more or less wanting; size about 0·02 millim. by 0·00133 millim. (excluding spines). These spicules occur very abundantly in the dermal crust already mentioned and also scattered throughout the sponge.

The ectosome forms a cortex about 0·27 millim. thick, composed of large oval cystenchymatous cells with fibrous tissue between them, the fibres, for the most part at any rate, lying parallel with the surface. The cystenchyme cells measure about 0·06 millim. in longer diameter and are also abundant in the choanosome.

This species is obviously very closely related to the European *Stæba plicata*, on the one hand, and to *S. simplex*, from the Gulf of Manaar, on the other. From the former, which has been fully re-described by Topsent (**14**), it differs in its longer and slenderer and more sharply-pointed microxea, and in the fact that the triænes are nearly all dichotriænes. From the latter it differs in the smaller size of the triænes and the larger size of the microxea, and in the fact that the spines of the microxea are not "most prominent towards the ends," though, as I have pointed out above, they may be more or less absent from the middle of the spicule. It appears to be a good deal more robust in growth than either species. It is quite possible, however, that subsequent researches may make it possible to consider all three as mere varieties of one species, but for the present it seems desirable that they should be kept separate.

Topsent describes the ectosome of *Stæba plicata* as being collenchymatous, but he mentions and figures large "cellules sphéruleuses," which are evidently closely similar to the large cystenchyme cells of *S. extensa*. The partly fibrous cortex of the latter, almost devoid of megascleres, may possibly afford another means of specific distinction.

In external appearance (in spirit at any rate) *Stæba extensa* bears such a close resemblance to the thin encrusting form of *Chondrilla australiensis* that it is difficult, if not impossible, to distinguish the two without microscopical examination.

R.N. 167 (Station LXVI., off Mutwal Island, March 19, 1902, 10 to 35 fathoms).

Family: STELLETTIDÆ.

Astrophora with long-shafted triænes, without calthrops and without sterrasters.

Myriastra, Sollas.

Microsclere a euaster of one form only. Ectosome not a cortex.

Myriastra clavosa (RIDLEY).

1884, **Stelletta clavosa**, RIDLEY (**16**); 1888, **Myriastra clavosa**, SOLLAS (**15**).

I have no hesitation in referring to this species four small specimens from deep water off Galle. The specimens are approximately spherical in form and up to about 9 millims. in diameter. There is a single slightly depressed vent, which, in three of the specimens at any rate, has a membranous margin. The colour is grey-yellow. As this is an entirely new locality for the species, which has hitherto been obtained from waters north of Australia, I propose to give the details of spiculation of one specimen in justification of the identification.

Spicules.—(1.) Dichotriænes; shaft, 1·4 millim. by 0·025 millim., gradually and finely pointed; chord, 0·6 millim.; protocladi, 0·08 millim.; deuterocladi, 0·2 millim.

(2.) Anatriænes; shaft, 2·3 millims. by 0·02 millim., very finely and gradually pointed; chord, 0·1 millim.; cladi, 0·06 millim., rather stout; of the shape figured by RIDLEY.

(3.) Large oxea; fusiform, gradually and sharply pointed, 2·2 millims. by 0·025 millim.

(4.) Cloacal oxea; commonly 0·2 millim. by 0·004 millim., may be rather larger.

(5.) Chiasters; extremely minute, with no distinct centrum, and long, slender, tylote rays varying in number; total diameter, 0·01 millim.

It will be seen from the above that the shaft of the dichotriæne is a good deal shorter than in previously described specimens, but, considering the variation in this respect, we cannot regard this difference as being of specific importance.

R.N. 131, 132, 227, 228 (all from off Galle and onwards up the West Coast of Ceylon, depths up to 100 fathoms).

Myriastra tethyopsis (CARTER).

1880, **Stelletta tethyopsis**, CARTER (**4**); 1888, **Myriastra** (?) or **Anthastra** (?) **tethyopsis**, SOLLAS (**15**).

There are four specimens of this very remarkable sponge in the collection. SOLLAS regards the species as insufficiently characterised, but, as a matter of fact, CARTER's description is very good, and leaves no doubt as to the identification. The fact that SOLLAS was unable to assign it definitely to any of his genera tends rather to show the unsatisfactory nature of his system of classification than the insufficiency of the original description.

The specimens (in spirit) are light grey in colour. The smallest is about 10 millims. and the largest about 42 millims. in diameter. The shape is very characteristically turbinate, more or less flattened below, and conical above. The surface is harsh to the touch and finely granular, very minutely and rather sparsely hispid. In the larger specimens a dense mass of long, hair-like spicules projects from more or less of the lower surface. The larger specimens were evidently attached

below. The apparent total absence of vents is a remarkable feature. Only in the smallest specimen have I seen what looks like a small natural vent, and that is on the flattened (presumably lower) surface. Doubtless the exhalant apertures are completely concealed by contraction in preserved specimens. Owing to the enormously strong development of the dense radiating skeleton, and the manner in which the cladi of the triænes come close up to the surface (giving it its granular character), I have found it impossible to cut a tangential or surface section in the ordinary way in order to look for pores in the dermal membrane. On attempting to cut such a section the sponge splits up radially along the lines of the gigantic spicules.

The skeleton is remarkably strongly developed, the shafts of the huge oxea and triænes being arranged in dense bundles, which radiate from a central "nucleus" and leave only narrow interspaces between them; while the expanded cladi of the dichotriænes form a thin but dense dermal crust, in which innumerable very minute asters also occur.

Spicules.—(1.) Dichotriænes; shaft about 8·0 millims. long by 0·074 millim. thick a short way below the cladome, tapering very gradually to a narrow, long-drawn-out but rounded point; cladi short, stout, once-forked, expanded almost at right angles to the shaft; chord about 0·46 millim.

(2.) Protriænes; with long and very slender shafts and slender cladi about 0·05 millim. long, commonly projecting from the general surface. Much larger protriænes, with comparatively stout shafts and short stout cladi, occur in the anchoring tufts on the lower surface of the adult sponge.

(3.) Anatriænes; with long slender shafts, and rather stout cladi up to about 0·1 millim. long.

(4.) Oxea; associated in bundles with the shafts of the dichotriænes; fusiform, gradually and fairly sharply pointed at each end; size about 8·0 millims. by 0·073 millim.

(5.) Asters; very numerous at and near the surface of the sponge, with small centrum and numerous slender conical rays of equal length; total diameter about 0·01 millim. Such spicules are very rare in the deeper parts of the sponge, and those which I have seen do not differ in any important respect from the asters of the surface.

The smallest specimen possesses in one part, beneath the surface, in addition to the asters, numerous minute refractive globules, which look as if they might be siliceous.

Stained sections show that there is a very thick gelatinous (collenchymatous) ectosome, excavated by numerous large, irregular cavities, from which occasionally wide canals, provided with numerous transverse diaphragms, lead vertically inwards through the choanosome. Small dermal pores are scattered between the cladi of the dichotriænes. The choanosome is not sharply differentiated from the ectosome, but is finely granular. The flagellate chambers are oval and measure up to about

0·04 millim. in longer diameter; they are densely crowded together, and either eurypylous or with very short, wide exhalant canaliculi.

This species is so peculiar that it might almost form the type of a new genus, but I cannot fix upon characters which would separate it absolutely from Sollas's *Myriastra*. The sponge, however, is not exactly small, nor are the oscules distinct, nor are the pores in sieves, nor yet is the ectosome thin; all of which features are mentioned by Sollas as characters of *Myriastra*, though I should hardly consider them as being of generic value myself.

R.N. 128, 128A, 128B, 130 (Station XLI., 12 miles off Galle, 100 fathoms).

Pilochrota, Sollas.

Microsclere a euaster of one form only. Ectosome differentiated to form a cortex.

Pilochrota haeckeli, Sollas.—Plate II., fig. 4.

1888, **Pilochrota haeckeli**, Sollas (15).

There are eight specimens in the collection which agree so closely with Sollas's description as to leave no doubt of their specific identity with the "Challenger" species, represented in the "Challenger" collection by a single specimen from the Philippine Islands. The Ceylon specimens are irregularly spherical or oval in shape, and the largest is about 16 millims. in maximum diameter. The colour in spirit is grey. The vent (when visible) is single, small, and surrounded by a membranous lip, minutely hispid owing to projecting oxea. The inhalant pores are arranged in small sieves, which are irregularly scattered or situated in shallow meandering grooves. The sponge has a strong tendency to attach itself to foreign objects by means of short, root-like processes.

I subjoin the spicular measurements taken from one specimen (R.N. 127), in support of the identification:—

(1.) Orthotriænes (Plate II., fig. 4, *a*); shaft, 2·3 millims. by 0·074 millim., gradually and sharply pointed; cladi, 0·3 millim. long, stout, conical, sharp-pointed, expanded almost at right angles to the shaft, slightly recurved.

(2.) Anatriænes (Plate II., fig. 4, *c*); shaft, 2·8 millims. by 0·037 millim., long and slender, finely pointed; cladi, strongly recurved, fairly stout, sharp-pointed, 0·13 millim. long.

(3.) Somal oxea; fusiform, gradually and sharply pointed at each end, symmetrical, often slightly curved; measuring about 2·3 millims. by 0·04 millim.

(4.) Cloacal oxea; small and slender, about 0·2 millim. by 0·005 millim.

(5.) Chiasters, with very slender, tylote rays; total diameter about 0·012 millim., not very abundant.

(There are also a few curiously abnormal triænes with very short and stout shafts,

as shown in fig. 4, *b*, *d*, *e*, but I think that these must be regarded as monstrous forms of the orthotriænes and anatriænes, and not as having any taxonomic value.)

R.N. 127, 127*a*, 127*b*, 127*c*, 127*d* (all from deep water off Galle and onwards up the West Coast); 197 (no special locality); 215 (deep water outside the pearl banks, Gulf of Manaar); 225 (Station XLI., 12 miles off Galle, 100 fathoms).

Pilochrota hornelli, n. sp.—Plate II., fig. 5.

The single specimen is shaped like a somewhat elongated potato, with a fairly smooth but rather uneven and finely granular surface, to which a number of foreign bodies, such as shell-fragments, Foraminifera, &c., are attached. In its present condition it measures about 45 millims. by 33 millims. by 33 millims., but a small piece has been cut off from one end. The texture is somewhat spongy internally, but with a firm, dense outer crust nearly 1 millim. thick in places. The colour is light brown throughout. The inhalant pores are arranged in small groups (pore-sieves) thickly and generally scattered over what was probably the lower half of the sponge; they are also scattered singly on the upper part. There is a single large vent near one end of the upper surface, elongated transversely to the long axis of the sponge and with a narrow, thickened, smooth, fleshy margin. The vent measures about 6 millims. by 2 millims., and is the opening of a short, wide oscular tube formed by the union of a number of large exhalant canals.

The skeleton in the interior of the sponge is loose and irregular, composed principally of large, scattered oxea, not arranged in definite fibres. Towards the surface the spicules tend to collect together into fibres which end in dense brushes composed almost entirely of ortho- and anatriænes. These brushes separate the wide subcortical crypts from one another, but their expanded outer ends form a continuous spicular crust at the surface. The cladi of the orthotriænes are for the most part extended at the surface of the sponge, but do not project beyond it, those of the anatriænes lie somewhat deeper down in the cortex. There are also a large number of orthotriænes whose cladi lie beneath the subcortical crypts while their shafts project inwards into the choanosome.

Spicules.—(1.) Orthotriænes (Plate II., fig. 5, *a–d*); with stout shaft tapering very gradually to a narrow, bluntly rounded or sharp apex, and with short, stout, conical cladi extended almost at right angles to the shaft; two typical examples from a boiled-out preparation gave the following measurements:—(*a.*) Shaft, 1·5 millims. by 0·032 millim.; cladi, 0·123 millim. by 0·03 millim. (*b.*) Shaft, 1·017 millim. by 0·04 millim.; cladi, 0·115 millim. by 0·033 millim. In the dermal crust one or two of the cladi not infrequently become bifurcate, but this takes place very irregularly, and a good many monstrous forms occur.

(2.) Anatriænes (Plate II., fig. 5, *e*); shaft long and fairly stout, not tapering to hair-like dimensions, though, of course, much narrower at the proximal than at the distal extremity; bluntly or sharply pointed; cladi stout, strongly recurved, sharply

pointed; front of cladome flattened. A specimen from a boiled-out preparation, somewhat longer than usual, gave the following measurements:—Shaft, 1·96 millim. by 0·019 millim.; cladi, 0·0656 millim. by 0·0164 millim.

(3.) Oxea (Plate II., fig. 5, *f*); fairly stout, fusiform, gradually and usually fairly sharply pointed, gently curved, approximately iso-actinate, measuring about 1·3 millims. by 0·032 millim.

(4.) Chiasters (Plate II., fig. 5, *g*, *h*, *i*); with no centrum and very slender, slightly roughened and distinctly tylote rays; total diameter of spicule up to about 0·02 millim.; abundant, especially in the deeper parts of the sponge.

The histological structure of the strongly developed cortex agrees very closely in some respects with that described and figured by Sollas (*loc. cit.*, p. 122) for his *Pilochrota pachydermata*. The cortex itself, about 0·8 millim. in thickness, consists chiefly of very dense fibrous tissue, in which the fibres interlace in various directions. Imbedded in this tissue we find histological elements of two other kinds:—(1.) Large, rounded, deeply staining bodies up to about 0·2 millim. in diameter, each made up of an aggregation of much smaller bodies (cells?), and the whole very finely and uniformly granular. These remarkable bodies have a rather deep yellowish brown colour in unstained preparations, and they form a single layer beneath the surface in the outer part of the cortex. They are evidently homologous with what Sollas terms "oval or round clusters of granule-cells" in *P. pachydermata*. Sometimes the finely granular "cells" occur separately as well as aggregated in clusters, especially in the margin of the vent. (2.) Numerous irregularly scattered, small groups of faintly staining, homogeneous, spherical globules, varying in size in each group up to about 0·005 millim. in diameter; abundant in the deeper parts of the cortex and also in the choanosome. These bodies do not seem to have been observed in *P. pachydermata*.

Beneath the fibrous cortex lie extensive sub-cortical crypts, separated from one another by the radiating spicule bundles and a sparse development of ectosomal collenchyma.

The inhalant pore-sieves overlie well-developed chones which penetrate the fibrous cortex to reach the sub-cortical crypts, being provided with sphincters or diaphragms where they join the latter; the sphincters, however, do not lie quite so deeply as the lower limit of the fibrous cortex. From the sub-cortical crypts originate numerous fairly wide incurrent canals which penetrate the choanosome and sub-divide therein.

The choanosome is finely granular, and the flagellate chambers are approximately spherical, about 0·02 millim. in diameter, and apparently eurypylous.

It is not impossible that this species may be identical with Sollas's *Pilochrota cingalensis*, also from Galle, but the description of the latter (**15**), apparently based upon a mere fragment, for the author says "*Sponge* (?)," is too imperfect for safe recognition. Sollas, moreover, states that the cortex is thin, about 0·35 millim. in thickness, and all the megascleres seem to have their shafts characteristically bluntly

pointed or even strongylote, a condition to which there is only a tendency in our specimen. Our species is also very closely related to *Pilochrota pachydermata*, Sollas, from Tahiti, but differs in certain respects, such as the form of the chiaster, which is not tylote in *P. pachydermata*.

R.N. 176 (collected in the lagoon inside the reef, Galle, shallow water, by Mr. Hornell, after whom, on Professor Herdman's suggestion, I have much pleasure in naming the species).

Stelletta, Schmidt.

Microscleres euasters of two forms.

It might be advisable to sub-divide this genus according to whether or not a fibrous cortex is present, as Sollas has done in similar cases. *Stelletta herdmani* would then come under the first sub-division and *S. vestigium* under the second. I do not, however, think it would be desirable to take such a step until we know more about the value of this character in classification.

Stelletta herdmani, n. sp.—Plate II., fig, 6.

Sponge quite irregular in shape; sometimes vallate; sometimes with occasional digitiform or mammiform projections; often very much mixed up with coarse calcareous débris. Surface uneven, very harsh to the touch and striate owing to the presence of the huge megascleres immediately beneath the thin dermal membrane; not hispid except where apparently worn. Vents few, scattered on prominent parts, up to about 3 millims. in maximum diameter; leading out of deep cloacal tubes, which are of about the same diameter and lined by a sieve-membrane. Inhalant pores scattered in the dermal membrane. Colour (external) ranging from pale yellowish to slate-grey in the same specimen The largest specimen is about 55 millims. in greatest diameter, but is a good deal damaged and much mixed up with foreign matter.

Skeleton very dense and more or less confused; consisting of irregular bundles of huge oxea and triænes, for the most part radiating towards the surface, but lying tangentially beneath the dermal membrane and thus forming an ill-defined but dense spicular cortex about 0·36 millim. thick.

Spicules.—(1.) Plagio- or protriænes (Plate II., fig. 6, *a*, *b*, *c*.); with short, stumpy, conical cladi projecting more or less forwards, and stout shaft, usually somewhat curved, more or less swollen at some distance below the cladi and tapering gradually to a sharp point at the other end. Size somewhat variable, shaft up to about 1·2 millims. by 0·074 millim., with cladi 0·18 millim. long.

(2.) Oxea (Plate II., fig. 6, *d*.); fusiform, straight or slightly curved, tapering gradually to a sharp point at each end; size about 2·8 millims. by 0·09 millim.

(3.) Chiasters (Plate II., fig. 6, *e–h*); very abundant in the dermal membrane,

scarcer within; with numerous rather short, truncate conical rays, and often with a distinct but small centrum; total diameter about 0·012 millim. or less.

(4.) Oxyasters (Plate II., fig. 6, *i–k*); fairly numerous in the deeper parts, but may be difficult to find; with little or no centrum, and long, slender, conical, sharp-pointed, smooth rays, varying in number; total diameter about 0·029 millim.

Owing to the great size and abundance of the megascleres it is impossible to cut satisfactory sections by the ordinary paraffin method, but such as I have been able to obtain have yielded some interesting results. The ectosome is remarkably developed as a very thick gelatinous layer containing numerous stellate cells (collenchyma), and a thin layer of fibrous tissue (about 0·08 millim. thick), situated about 2·5 millims. beneath the surface and separating the gelatinous layer from the choanosome. The arrangement of the main skeleton appears to be in no way correlated with the differentiation between ectosome and choanosome, the large megascleres passing through the fibrous layer from one to the other without distinction. The mesoglœa of the choanosome ranges from collenchymatous to finely granular, and the flagellate chambers are more or less spherical and about 0·024 millim. in diameter.

There are six specimens of this sponge in the collection. The arrangement of the skeleton reminds one very strongly of Sollas's genus *Stryphnus*, but the absence of amphiasters or sanidasters prevents us from placing the species in that genus (according to Sollas's classification). The species also resembles to a considerable extent Kirkpatrick's *Stelletta* (*Astrella*) *horrens*, from South Africa (17), but is distinguished by its external form, by the arrangement of the pores and vents, and by the details of spiculation.

R.N. 66 (Gulf of Manaar); 89, 137, 137A, 157, 203 (all from off Galle and onwards up the West Coast, depths up to 100 fathoms).

Stelletta vestigium, n. sp.—Plate II., fig. 7.

Specimen irregular in shape, massive, encrusting, and containing many calcareous foreign bodies. (In the same mass as the two specimens of *Tethya lynceurium* var. *a*.) Maximum diameter about 23 millims. Colour in spirit, nearly black. Vents and pores not seen. No cortex.

The skeleton is a confused reticulation of megascleres, mingled with foreign bodies and sometimes collected into loose fibres; with a thin dermal crust of asters, also much mixed with foreign bodies.

Spicules.—(1.) Triænes (Plate II., fig. 7, *a–d*); with cladi reduced to three, two, or one mere spines or protuberances of varying size at the broad end of the spicule; the other end tapering gradually to a more or less sharp or irregular apex. These spicules are of about the same dimensions as the oxea.

(2.) Oxea (Plate II., fig. 7, *e*); rather slender, usually slightly curved; more or less gradually sharp-pointed or irregularly ended; measuring about 0·74 millim. by 0·016 millim.

(3.) Spherasters (Plate II., fig. 7, *f*, *g*); with well-developed centrum and sharp, conical rays; total diameter about 0·024 millim., with rays about 0·008 millim. long; most numerous in the dermal crust, but also abundant below. (A rather noteworthy feature of these spicules, in many cases, in the boiled-out preparations, is the conspicuous nature of the central canal in the rays, which gives the spicule a very peculiar appearance.)

(4.) Oxyasters (Plate II., fig. 7, *h*, *i*); with very small centrum and a rather small number of slender, finely-pointed, smooth rays; total diameter up to about 0·024 millim. Abundant in the choanosome.

This species is particularly interesting on account of the extreme reduction of the cladi of the triænes, affording an absolute transition from the tetractinellid to the monaxonellid condition. This vestigial condition of the cladi, an approach to which is already seen in *Stelletta herdmani*, appears to be associated in this genus with the irregularly scattered arrangement of the triænes (compare the vestigial condition of the cladi of the dermal anatriænes in *Geodia peruncinata*, described later on).

R.N. 200A (Station LXVII., off Talaivillu Paar, 10–14 fathoms).

Ecionema, Bowerbank.

The microscleres include microrhabds in addition to euasters; the former are commonly minutely spined or roughened, and usually form a dermal layer.

Ecionema carteri, n. sp.—Plate I., fig. 5; Plate III., fig. 1.

There are three specimens of this sponge in the collection. The largest and only well-developed example (R.N. 175, Plate I., fig. 5) may be taken as the type of the species. This specimen is massive and quite irregular in shape, with a number of foreign bodies attached to it. The maximum diameter is about 35 millims. The surface appears, in most places, distinctly porous, even to the naked eye, owing to the presence of very numerous, thickly scattered, small pore-sieves (Plate I., fig. 5, *p.s.*) containing the inhalant pores. It is also very minutely and sparsely hispid, at any rate in parts. The vents (Plate I., fig. 5, *o*) are rather numerous, without prominent margins; circular or oval openings varying up to about 2 millims. in diameter; mostly congregated in a depression on what was apparently the upper part of the sponge. They are the apertures of wide, diaphragm-bearing oscular tubes. The texture of the sponge is fairly firm, but compressible. The colour in spirit is pale grey.

Another specimen (R.N. 188) is almost spherical and only about 11 millims. in diameter, without visible vents; it is probably immature. The third (R.N. 259) is an irregular fragment.

The main skeleton in the interior of the sponge is an irregular interlacement of large oxea which, towards the surface, collect into loose radiating wisps, ending in

dense brushes of triænes whose cladomes lie at varying depths beneath the dermal membrane, but never very deeply. The dermal membrane is strengthened by a thin crust of spinose microstrongyles, interrupted by the very numerous dermal pores. The minutely hispid character of the surface is due to the presence of very slender, hair-like anatriænes projecting beyond the dermal membrane.

Spicules.—(1.) Plagiotriænes (almost orthotriænes) (Plate III., fig. 1, *a*, *b*); with long shaft tapering very gradually to a sometimes almost filiform extremity, and rather short, stout, sharply pointed or rather blunt cladi; shaft about 1·5 millims. by 0·033 millim., with cladi about 0·148 millim. by 0·027 millim.

(2.) Plagiotriænes (almost protriænes) (Plate III., fig. 1, *c*, *c'*); with long, slender shaft tapering to almost hair-like dimensions, and short conical cladi projecting forwards at an angle of about 45°; shaft about 1·8 millims. by 0·0094 millim.; cladi about 0·028 millim. by 0·008 millim. Not very numerous.

(3.) Anatriænes (Plate III., fig. 1, *d*, *d'*); with long, slender shaft and short, sharp-pointed, strongly recurved cladi; cladome somewhat flattened in front; shaft and cladi of about the same dimensions as in the preceding.

(4.) Very slender, hair-like anatriænes with minute cladomes projecting beyond the surface of the sponge. These spicules seem to be fairly numerous and characteristic, but the cladomes are nearly always broken off in the preparations.

(5.) Oxea (Plate III., fig. 1, *e*); long and comparatively slender, usually slightly curved; fusiform; gradually and usually sharply pointed at each end; measuring, when fully developed, about 1·8 millims. by 0·037 millim.

(6.) Chiasters (Plate III., fig. 1, *g*); with little or no centrum and very slender, cylindrical, very minutely roughened, tylote rays; total diameter up to about 0·016 millim.

(7.) Microstrongyla (Plate III., fig. 1, *f*); straight, rather slender and minutely spined or roughened; measuring up to about 0·02 millim. by 0·002 millim., most abundant in the dermal membrane, but also plentiful in the choanosome.

There is a well-developed cortex about 0·25 millim. thick, composed of a mixture of chondrenchymatous, collenchymatous, and fibrous tissue, the first-named developed chiefly towards the outside and the last towards the inside. The mesoglœa of the choanosome is finely granular, but with an admixture of collenchymatous and chondrenchymatous tissue. The flagellate chambers are approximately spherical, about 0·02 millim. in diameter, and eurypylous. The dermal pore-sieves form the thin roofs of wide chones, which pass vertically through the cortex and are continued directly into the inhalant canals of the choanosome, without any specially differentiated subcortical crypts.

The presence of a fibrous cortex, though not very strongly developed, seems to indicate Sollas's genus *Psammastra* for this species, which is nearly related to three sponges described by Mr. Carter under the names *Stelletta geodides* (18),* *Stelletta*

* *Vide* also Sollas, "Challenger" Tetractinellida, p. 200.

bacillifera (20) and *Stelletta bacillifera*, var. *robusta* (21),* the first and third from Australia and the second from the Mergui Archipelago. Sollas places the first in his genus *Psammastra*, while he places the last in *Ecionema*, which he distinguishes from *Psammastra* by the absence of cortex, but Mr. Carter's specimens of *Stelletta bacillifera*, var. *robusta*, were dry, and it is extremely probable that they possessed a fibrous cortex like that of *Ecionema carteri*; the type of *Stelletta bacillifera* from the Mergui Archipelago may also have been corticate for anything we know to the contrary, and it is almost certain that Carter's three sponges and the Ceylon species belong to the same genus. Moreover, we do not even know whether Bowerbank's original type of the genus *Ecionema* (*E. acervus*) was corticate or not, a question which it is impossible to decide without properly prepared sections of good material.

R.N. 175 (Lagoon inside reef, Galle, shallow water); 188 (Muttuvaratu Paar, Gulf of Manaar, 8 fathoms); 259 (Ceylon seas).

Ecionema laviniensis, n. sp.—Plate III., fig. 2.

The single specimen is somewhat finger-shaped, but flattened and slightly bifurcate at one (? the upper) end. It measures about 30 millims. in length and 13 millims. in breadth. The greater part of the surface is encrusted with coarse calcareous débris, chiefly Foraminifera and shell-fragments; where these bodies are absent there is a tendency to be minutely and sparsely hispid. In places there is a minutely porous appearance, easily visible under a pocket lens, due to the presence of small thickly scattered pore-sieves. The vents are probably very minute and scattered—I have only observed one. The colour in spirit is pale grey throughout, the texture firm and very compact.

The main skeleton is a confused interlacement of large oxea, towards the surface disposed more or less nearly at right angles to it and occasionally projecting beyond it. At the surface there is a spicular cortex, about 0·13 millim. thick, composed of microstrongyla with a thin layer of minute chiasters externally. Beneath the spicular cortex lie the cladomes of the comparatively few triænes, with their shafts penetrating the deeper parts of the sponge at right angles. (It is, perhaps, worth noting that in the deep groove at one end of the sponge, where it is beginning to bifurcate, the spicular cortex is not developed and there are apparently no triænes, but the large oxea project much further beyond the surface than they do elsewhere.) There are also a few slender anatriænes and protriænes (?) with cladomes projecting far beyond the surface.

Spicules.—(1.) Dichotriænes (Plate III., fig. 2, *a*, *b*); with stout shaft which typically tapers very gradually to a fine point, but may be blunted; protocladi short and stout; deuterocladi about the same length or a little longer or shorter, conical,

* *Vide* also Sollas, "Challenger" Tetractinellida, p. 197.

typically sharp-pointed, but may be blunted. A typical example gave the following measurements: shaft, 1·0 millim. by 0·0328 millim.; protocladus, 0·05 millim. by 0·027 millim.; deuterocladus, 0·065 millim. by 0·0164 millim.

(2.) Protriænes?

(3.) Anatriænes (Plate III., fig. 2, *c*, *c'*); with slender, often hair-like shaft and small, variable, often abnormal cladome, perhaps characteristically flattened in front. These spicules are evidently becoming vestigial and are so variable that it would be useless to give measurements; they are, however, still present in abundance.

(4.) Oxea (Plate III., fig. 2, *d*) large and usually stout; nearly always more or less curved, often strongly so, sometimes crooked; gradually and sharply pointed at each end, or more or less blunted; measuring up to about 1·4 millims. by 0·049 millim., but very variable in thickness.

(5.) Chiasters, with short, blunt, sub-cylindrical rays (Plate III., fig. 2, *e*), total diameter about 0·008 millim.; very abundant in the dermal membrane, and often met with in the choanosome, where they are commonly about half as large again and may vary into oxyasters (?) with very slender rays (Plate III., fig. 2, *f*).

(6.) Microstrongyla (Plate III., fig. 2, *g*) almost cylindrical, usually with rounded ends, but occasionally oxeote; minutely spined all over; usually slightly curved; sometimes centrotylote. A typical example measures about 0·1 millim. by 0·008 millim., but they are often much more slender. These spicules are found chiefly in the cortex, but may also be met with occasionally in the deeper parts of the sponge.

(A few slender, smooth microxea (Plate III., fig. 2, *h*) also occur, possibly young forms of other spicules.)

There is no distinct fibrous cortex, at any rate over the general surface, but a dense spicular cortex formed as described above. In the deep depression at the end of the sponge, however, where the spicular cortex is not developed, a certain amount of fibrous tissue is present in its place, and it is quite possible that such is also present concealed between the spicules of the spicular cortex elsewhere. (These facts serve to emphasise the unsatisfactoriness of the fibrous cortex as a generic distinction between *Ecionema* and *Psammastra*, to which attention has already been called under the head of *Ecionema carteri*.) The spicular cortex contains an immense number of rounded pigment cells filled with pigment granules of a rich brown colour.

Scattered abundantly throughout the choanosome are rounded groups of minute highly-refractive granules, staining with borax carmine, but in themselves practically colourless. These at first sight look like flagellate chambers, each group being about 0·02 millim. in diameter, but I do not think that they are really of that nature.

The species is evidently closely related to *Ecionema carteri* and its allies, but is well characterised by the dichotriænes and by the comparatively large size of the microstrongyles.

R.N. 265 (Station XLVI., off Mount Lavinia, 30 fathoms).

FAMILY: GEODIIDÆ.

Astrophora, in which the characteristic microsclere is a sterraster, forming a dense cortical layer.

Geodia, LAMARCK.

Geodiidæ, in which the somal microsclere is a polyactinose aster.

Geodia perarmata, BOWERBANK.

1873, **Geodia perarmatus**, BOWERBANK (22); 1880, **Geodia perarmata**, CARTER (4); 1888, **Geodia perarmata**, SOLLAS (15).

There is an interesting series of specimens belonging to this species in the collection. The smallest is only 13 millims. in diameter, and is approximately spherical in shape; unfortunately, the surface of this specimen is considerably abraded, and I have not been able to make out the arrangement of either inhalant or exhalant apertures. The next in size, about 18 millims. in diameter, is also too much injured to show the arrangement of the apertures satisfactorily. The next is more irregular in shape, about 28 millims. in diameter, and flattened on one side so as to form an approximately circular oscular area about 14 millims. in diameter, but not definitely bounded. This area is covered by a pore-bearing, cribriform membrane, with pores about 0·08 millim. in diameter, and few, if any, larger apertures. The remainder of the surface of the sponge, outside the oscular area, is covered with a cribriform dermal membrane containing thickly scattered inhalant pores of somewhat smaller diameter than the exhalant pores. The specimen next in size is also irregular in shape, closely resembling a potato, and about 45 millims. in diameter. The oscular area now forms an ill-defined, but rather deep concavity on one side, whose floor is covered, as before, by a cribriform membrane, but with a few larger openings where the pores have apparently become confluent and thus formed small "vents"; the maximum diameter of this basin-shaped oscular area, which is not quite circular, is about 17 millims. The largest specimen is a very fine one, irregularly rounded in shape, and about 75 millims. in greatest diameter; it has been attached below at only a few points to calcareous débris. The depressed oscular area occupies the greater part of the flattened upper surface of the sponge, and is about 38 millims. in greatest diameter, and irregularly oval in shape. The floor of the depression is somewhat flattened, but rises up in the middle; the margin is much better defined than in the smaller specimens, but rounded off, except on one side, where it actually overhangs slightly. The pore-bearing membrane presents the same appearance as in the last-described specimen, but the small "vents," due to confluence of the pores, are more numerous; they are hardly 0·5 millim. in diameter. As before, the general surface of the sponge is covered by a richly porous cribriform membrane. There is also in the collection an irregularly-shaped sub-cylindrical specimen, about 36 millims. in length and 18 millims. in diameter, which does not show any distinct oscular area.

It appears, then, that the basin-like character of the oscular area, which was figured by Bowerbank (22) in the type specimen, and which appears to form a characteristic feature of the adult sponge, is not developed until comparatively late in life, and it appears also that its development is due simply to more rapid growth of the surrounding parts. According to the classification adopted by Sollas in his work on the "Challenger" Tetractinellida, this mode of development would necessitate our placing the species in the genus *Cydonium*. Sollas himself, however, places the species in the genus *Geodia*, having been insufficiently acquainted with the characters in question. Lendenfeld, in his work on the Tetractinellida of the Adriatic, merges the genus *Cydonium* in *Geodia*, and in this I must agree with him, for the present instance demonstrates very clearly the impracticable character of a classification which involves a study of the development, at any rate until our knowledge is much more complete than at present.

The general surface of the sponge is smooth and, perhaps, even glabrous, where the dermal membrane is intact, but from a few points on the lower surface, in the immediate neighbourhood of the attachment, a few long, hair-like spicules (mostly anatriænes) project. The colour of the general surface (in spirit) is purplish brown, mottled with dull yellow, the pigment being lodged in an immense number of granular brown pigment cells which lie between the layer of sterrasters and the dermal membrane. Internally the sponge is nearly white.

The cortical layer of sterrasters is about 1·2 millim. thick in the largest specimen, and between this layer and the dermal membrane lies a zone about 0·27 millim. thick, in which the cladi of most of the triænes are found. The manner in which the shafts of these triænes pierce the layer of sterrasters, so that their cladi come to lie externally to it, is, as already pointed out by Bowerbank, very characteristic of the species, and forms a conspicuous feature even in the smallest specimen which I have seen.

The spiculation, as observed in the largest specimen, is as follows:—

(1.) Dichotriænes; shaft stout, about 3·2 millims. by 0·07 millim.; chord, 0·48 millim. to 0·64 millim.

(2.) Protriænes; scarce (seen only in another specimen); cladi about 0·075 millim. long.

(3.) Anatriænes; shaft slender, about 4·2 millims. long; cladi about 0·07 millim. long.

(4.) Somal oxea; about 2·67 millims. by 0·042 millim.

(5.) Cortical oxea; about 0·3 millim. by 0·0083 millim.

(6.) Sterrasters; about 0·13 millim. in diameter.

(7.) Somal chiasters or spherasters; about 0·009 millim. in diameter.

(8.) Choanosomal spherasters with spined rays; about 0·04 millim. in diameter.

The spherasters with spined rays are found just beneath the layer of sterrasters and appear to be characteristic of the species. The fact that the spination of the

rays is not figured by Bowerbank in his illustration, nor mentioned in the text, makes me a little doubtful of the identification of the Ceylon species with that originally described by Bowerbank (from an unknown locality). Carter, however, made the identification in the first instance and Sollas has accepted it; and the differences, if they really exist, must be extremely slight.

R.N. 119, 121, 124, 125, 126, 135. (All from deep water, up to 100 fathoms, off Galle and onwards up the West Coast of Ceylon.)

Geodia peruncinata, n. sp.—Plate III., figs. 3, 3A, 3B.

The single specimen in the collection is, unfortunately, only a fragment, amounting to probably somewhat more than half of a small spherical sponge, attached to a small calcareous nodule. The diameter of the specimen is about 11 millims. The colour in spirit is nearly white, both on the surface and in the interior. The cortex is rather thin and very brittle, and the interior of the sponge is soft and friable. It is impossible to make out the arrangement of the exhalant canal-system, but the thin dermal membrane contains numerous small pores, presumably inhalant.

The layer of sterrasters (Plate III., fig. 3, *c*, *c*) is about 0·33 millim. thick, and is separated from the dermal membrane by an interval of about 0·165 millim. occupied by extensive sub-dermal cavities. The dermal membrane is supported on the cladomes of dichotriænes (Plate III., fig. 3, *a'*), whose shafts pierce the layer of sterrasters and the zone of sub-dermal cavities; it is also strengthened and rendered hispid by the presence of immense numbers of short anatriænes which project from the surface at various angles (Plate III., fig. 3, *c*, *c*). Some of the dichotriænes (Plate III., fig. 3, *a*) have their cladi extended beneath the layer of sterrasters, and the remainder of the skeleton is arranged in the usual way, with radiate primary lines.

Spicules.—(1.) Dichotriænes (Plate III., fig. 3, *a*, *a'*); with stout shaft tapering gradually to a narrow, but blunt apex, and short cladi; the deuterocladi usually two or three times as long as the protocladi, but variable and often unequal, gradually and sharply pointed, slightly curved towards one another, or straight. Shaft measuring up to about 2·4 millims. by 0·044 millim., with cladome 0·62 millim. in total diameter and protocladi 0·038 millim. thick.

(2.) Protriænes; a few stout protriænes, more or less broken and sometimes with four cladi, occur amongst the mass of spicules projecting from the base of the sponge.

(3.) Anatriænes (Plate III., fig. 3, *b*); with well-developed cladome and very long, slender shaft. Shaft measured up to about 4·9 millims. in length (and then broken off), with a thickness of 0·016 millim. near the cladome, and cladi stout, conical, and about 0·057 millim. long. (Projecting from the base of the sponge one finds anatriænes with long, hair-like shafts and slender, very sharply recurved cladi.)

(4.) Anatriænes (Plate III., fig. 3, *c*; fig. 3A); with short, slender, fusiform shaft

and very small, often vestigial cladome, which may be reduced to a mere knob. The attachment of the cladome to the shaft is so slender that the former is generally broken off and the spicules then may easily be mistaken for the well-known dermal oxea of other species of *Geodia*. The proximal end of the shaft may be oxeote or rounded off, or even tylote. In a typical example the shaft measures about 0·21 millim. by 0·006 millim. The cladome varies so much in its degree of reduction that it is useless to attempt exact measurements, but is generally not more than 0·008 millim. in total diameter. These spicules are found for the most part hispidating the surface of the sponge, but a few occur beneath the layer of sterrasters. I have seen one example which appears to be a reduced protriæne, with a single remaining cladus, but the great majority are anatriænes.

(5.) Oxea (Plate III., fig. 3, *d*); very long and comparatively slender, frequently curved, sometimes very crooked; fairly gradually and sharply pointed; size variable, *e.g.*, 2·5 millims. by 0·029 millim.

(6.) Sterrasters (Plate III., fig. 3, *e*, *e'*; fig. 3B, *e*); markedly oval in shape and measuring about 0·12 millim. by 0·082 millim.

(7.) Small spherasters (or chiasters?) (Plate III., fig. 3B, *a*); with small centrum and numerous almost cylindrical or slightly tylote rays about as long as the diameter of the centrum; total diameter of the spicule about 0·008 millim. Most abundant in the dermal membrane, but plentiful also in the interior.

(8.) Comparatively large spherasters (Plate III., fig. 3, *f*; fig. 3B, *b*); with large centrum and very numerous short, conical rays, whose length is only about one-third the diameter of the centrum or a little more. Total diameter when fully grown about 0·024 millim. Sparsely scattered beneath the layer of sterrasters.

In the structure of the ectosome and the presence of dichotriænes this species is evidently closely related to *Geodia perarmata*. It is, however, distinguished by three characters: (1) the absence of brown pigment cells in the outer part of the cortex; (2) the form of the larger spheraster, which, in *G. perarmata*, has (? always) distinctly spined rays; (3) the presence of the numerous short-shafted, cortical anatriænes,* which are replaced in *G. perarmata* by cortical oxea, though I am inclined to think that a few of these oxea may still show a vestige of a cladome even in *G. perarmata*, while it is quite possible that a few true cortical oxea may occur amongst the reduced anatriænes in *G. peruncinata*.

The presence of the vestigial anatriænes is extremely interesting as indicating the anatriænal origin of the cortical oxea of *Geodia*. Sollas (*loc. cit.*, p. cxlvii) has already observed, in his general remarks on the family Geodiidæ, that "A second finer hispidation is frequently produced by small oxeas, which are confined to the cortex (cortical oxeas). Associated with these, in some few instances, are minute anatriænes, which much remind one of the cladose tylostyles described by Dendy and Ridley in *Proteleia sollasi*." We have here an admirable example of the evolution

* Very similar small cortical anatriænes occur in Lindgren's *Geodia arripiens* from Cochin China (86).

of a monaxonellid spicule from a tetractinellid form by subordination and final suppression of three of the rays.

R.N. 223 (Station XLI., 12 miles off Galle, 100 fathoms).

Geodia areolata, CARTER.

1880, Geodia areolata, CARTER (4); 1888, Geodia areolata, SOLLAS (15).

There are several specimens of this sponge in the collection. They are approximately spherical in shape, and in form and colour closely resemble young specimens of *G. perarmata*, but the largest sent to me is only 21 millims. in diameter. The surface of the sponge is smooth and characteristically marked out into small stellate areas of a pale yellow colour, separated from one another by a reticulation of chestnut-brown pigment. This pattern, however, is not recognisable everywhere. Numerous small apertures appear irregularly scattered over some parts of the surface, but with a tendency towards grouping. These frequently occupy the centres of the pale stellate areas, and they are often guarded by a fringe of convergent dermal oxea. They are frequently covered over by a reticulate dermal membrane. They are the openings of chones, which pierce the layer of sterrasters, but whether they are inhalant or exhalant, or both, I have been unable to decide.

The layer of sterrasters is about 0·46 millim. thick in the largest specimen. The triænes almost invariably extend their cladi beneath this layer, and do not pierce it to reach the dermal membrane. The dermal oxea are abundant and arranged more or less perpendicularly to the surface; they extend from the outer surface of the layer of sterrasters and project for a short distance beyond the dermal membrane. The granular brown pigment cells, to which the sponge owes its characteristic colour, are scattered in the ectosome outside the layer of sterrasters.

The spiculation is as follows:—

(1.) Orthotriænes; with shaft about 2·37 millims. by 0·06 millim.

(2.) Anatriænes; with very long and slender shaft and cladi about 0·054 millim. long.

(3.) Somal oxea; about 2·0 millims. by 0·029 millim.

(4.) Cortical oxea; about 0·2 millim. by 0·008 millim.

(5.) Sterrasters; about 0·08 millim. in diameter, oval or nearly spherical.

(6.) Somal chiasters or spherasters; about 0·0083 millim. in diameter.

(7.) Choanosomal oxyasters or spherasters; mostly with few long and slender, smooth rays; about 0·0165 millim. in total diameter.

No typical protriænes were seen, but only small plagiotriænes, which may be young forms of the large orthotriænes.

In this case, as in that of *G. perarmata*, we can include the species in the genus *Geodia* only by abandoning the restricted definition thereof given by SOLLAS.

The species, as already indicated, is at first sight easily confounded with *G. perarmata*. The specimens of the two were mixed together in the collection, and

only a part of the total number was forwarded to me for investigation, under the impression that they were all specifically identical. I am therefore unable to say how many of each were really collected by Professor HERDMAN and his assistants. Even small specimens are, however, very easily distinguished by microscopical examination, as will be evident from the above descriptions, and the species are not really even closely related.

Mr. CARTER received his material of this species from the Gulf of Manaar.

R.N. 120, 122, 123 (deep water off Galle, up to 100 fathoms).

Geodia ramodigitata, CARTER.

1880, **Geodia ramodigitata,** CARTER (4); 1888, **Geodia (?) ramodigitata,** SOLLAS (15).

There is one specimen in the collection which appears to be referable to this species. It is of remarkably irregular shape, with one strongly curved, finger-like projection or branch. Unfortunately the specimen is a good deal injured on one side, so that the exact shape cannot be determined. The maximum diameter of the specimen in its present condition is about 40 millims. The colour (in spirit) is pale grey, and a good many foreign bodies are attached to the surface here and there. The vents are minute, for the most part irregularly grouped over the ends of large exhalant canals, with which they communicate by means of narrow chones penetrating the cortex. The outer ends of these chones are usually covered over by a sieve-like dermal membrane which sub-divides the vent into a group of comparatively small pores. Inhalant pores irregularly scattered, perhaps sometimes in groups, but of the numerous pore-sieves present in the dermal membrane it is extremely difficult to say which are inhalant and which exhalant.

The layer of sterrasters is about 1 millim. thick and lies close up to the dermal membrane, with the cladi of the triænes spreading out beneath it. The dermal membrane is very minutely hispid with projecting oxea.

The spiculation is as follows:—(1.) Orthotriænes; shaft stout, gradually and finely pointed, about 2·5 millims. by 0·08 millim; cladi stout, sharp pointed, up to about 0·35 millim. long, extended nearly at right angles to the shaft. Sometimes one or more of the cladi undergoes reduction or may even become obsolete, leaving the spicule with two, one or no properly developed cladi, as the case may be.

(2.) Protriænes; shaft very long and slender, measured up to about 3·7 millims. by 0·023 millim., with sharp-pointed cladi about 0·18 millim. long.

(3.) Anatriænes; shaft very long and slender, measured up to 4·0 millims. by 0·018 millim.; with stout, recurved, sharp-pointed cladi about 0·09 millim. long; not very numerous.

(4.) Somal oxea; gradually and sharply-pointed at each end, about 2·57 millims. by 0·04 millim., often slightly curved.

(5.) Cortical oxea; about 0·2 millim. by 0·007 millim.

(6.) Sterrasters; about 0·09 millim. by 0·075 millim.

(7.) Chiasters; extremely minute, with short, truncate or slightly tylote rays; total diameter about 0·006 millim.; very abundant in the dermal membrane.

(8.) Oxyasters; of unusually large size, with no distinct centrum, with large, slender, smooth, sharp-pointed rays, rather few in number; total diameter about 0·066 millim.; very abundant in the deeper parts of the sponge.

There are two points in which the spiculation of Professor HERDMAN's specimen, as given above, differs considerably from that given by CARTER (4) for the type of the species. In the first place, CARTER mentions no cortical oxea, but he remarks that the surface is much worn, so that we need lay but little stress upon this difference. In the second place, the internal oxyasters appear to be twice as large in our specimen as in the type; this also I do not consider a very important difference, as the internal asters of *Geodia* are subject to much variation in size. Their form, on the other hand, agrees very closely in the two cases and appears to be characteristic. The other spicules, also, with the exception of the sterraster, appear to be somewhat larger in the present specimen; but on the whole there can be very little doubt of the correctness of the identification, especially when we remember that Mr. CARTER's type specimen came from the Gulf of Manaar.

R.N. 136 (Station XLI., 12 miles off Galle, 100 fathoms).

SUB-ORDER: SIGMATOPHORA.

Tetractinellida with triænes; with sigmata for microscleres (when present); without asters.

FAMILY: TETILLIDÆ.

Sigmatophora with well-developed protriænes and with skeleton usually strongly radiate in arrangement.

Tetilla, SCHMIDT.

Cortex absent or feebly developed; no special cortical skeleton.

Tetilla hirsuta, DENDY.

1889, **Tetilla hirsuta**, DENDY (3).

This remarkable species is represented in the collection by three specimens which differ somewhat amongst themselves, but all agree in the possession of the highly characteristic, cup-shaped, poriferous pits. In all the surface is more or less strongly hispid from projecting spicules, and encrusted with a layer of dirt between, to which the colour of the surface is due, this colour varying with the nature of the foreign matter. Two of the specimens are more or less spherical, one (R.N. 129) being attached to a mass of Nullipore; the third (R.N. 241) is constricted and slightly elongated below, where it has been torn off from its attachment. In one specimen (R.N. 129) there are, in addition to the characteristic spicules, a fair number of quite small oxea, varying much in size, and irregularly scattered in the choanosome. Such small oxea do not appear to be present in the type, but, in view of their variability

in size and sporadic distribution, one can hardly regard their presence as constituting a specific or even varietal distinction. It should be noted, however, that very similar spicules appear to be characteristic of the next species (*T. poculifera*).

The arrangement of the pores and vents in this sponge is very peculiar and might be thought by some authorities to deserve generic recognition. The former are congregated in more or less deep, cup-shaped pits, guarded by very slender projecting protriænes and prodiænes; these pits occur, mostly, at any rate, on the lower parts of the sponge and may slope upwards. The vents (or better, cloacal cavities) are represented by pits containing the openings of excurrent canals. As Sollas has pointed out (**15**, p. cxxv), a somewhat similar arrangement is found in his genus *Cinachyra*, closely related to *Tetilla*, but that genus is also characterised by the presence of a thick cortex containing cortical oxea. In *Tetilla hirsuta* the cortex is only feebly developed, more or less fibrous, but without special cortical spicules.

For further specific details I must refer to the original description, to which I may add that the flagellate chambers are apparently eurypylous.

In the choanosome of R.N. 129 numerous minute and apparently siliceous spherules were observed, up to about 0·004 millim. in diameter. The nature of these bodies will be discussed under the head of *Tetilla anomala*, in which species they also occur.

R.N. 129 (deep water off Galle and onwards up West Coast); 177 (lagoon inside the reef, Galle, shallow water); 241 (Ceylon seas).

Tetilla poculifera, n. sp.—Plate I., fig. 6; Plate III., fig. 4.

The type specimen (R.N. 230, Plate I., fig. 6) is somewhat pear-shaped, with the broad end attached to a mass of calcareous organisms (Polyzoa, &c.). The apex of the sponge is occupied by a deep cup-shaped cloaca (Plate I., fig. 6, *Cl.*), whose margin is fringed with spicules, and whose floor is a sieve-membrane. The surface of the sponge is uneven, irregularly hispid, and thinly encrusted with sand-grains. Colour (in spirit) yellowish grey. Height of specimen 16 millims., transverse diameter 14 millims. Diameter of cloacal aperture 2·5 millims.

The skeleton consists chiefly of bands of large oxea radiating outwards from a central "nucleus"; the ends of these bands commonly project slightly beyond the surface.

Spicules.—(1.) Plagiotriænes (Plate III., fig. 4, *a*, *b*); few in number, but evidently proper to the sponge, though, perhaps, not specifically characteristic. A typical example from a boiled-out preparation has a fairly stout shaft, tapering gradually to a hair-like extremity, and about 1·3 millim. long by 0·0185 millim. thick below the cladome; cladi short and stout, about 0·13 millim. long, with apices fairly sharp and slightly incurved. (I have also seen fragments of two large dichotriænes, but it is doubtful whether these are proper to the sponge.)

(2.) Protriænes (Plate III., fig. 4, *d*, *d'*); with long, slender shaft, and long, slender, sharp-pointed cladi; conspicuous around the cloacal opening; size variable.

(3.) Anatriænes (Plate III., fig. 4, *c*, *c'*); of ordinary form, with short cladi and very long, slender, hair-like shaft. A specimen in a boiled-out preparation has cladi about 0·037 millim. long and shaft about 2·8 millims. long.

(4.) Oxea of the main skeleton (Plate III., fig. 4, *e*); stout, straight, fusiform, and tapering very gradually to the extremities, which may be sharply pointed, or rounded off or irregular; size about 3·1 millims. by 0·046 millim.

(5.) Sigmata (Plate III., fig. 4, *h*); slender, more or less contort, measuring about 0·017 millim. from bend to bend; abundant.

(6.) Small scattered oxea (microxea) (Plate III., fig. 4, *f*, *g*); straight or slightly curved; smooth, slender, fusiform, gradually and finely pointed at each end; size about 0·23 millim. by 0·005 millim. These spicules are scattered irregularly in enormous numbers throughout both choanosome and ectosome; in the latter position they may form quite a dense layer at the surface of the sponge, in which most of them lie tangentially. They may, perhaps, be regarded as microscleres.

Stained sections show that there is no cortex, and that the ectosome, though fairly thick, is not sharply differentiated from the choanosome. The material is not in a fit condition for minute histological investigation, but I have been able to make out that the flagellate chambers are oval and about 0·029 millim. in greater diameter. The inhalant pores are apparently scattered over the surface, and the inhalant canals appear to originate in irregular lacunar subdermal cavities. The larger exhalant canals are provided with numerous diaphragms, and terminate below the sieve-like floor of the cloaca.

The most characteristic features of this species are the structure of the cloaca and the presence of the very numerous smooth microxea. In *Tetilla* (?) *australiensis* (Carter) minutely spined microxea, 0·21 millim. long, are present, and Sollas (**15**, p. 43) observes of this species that the oxeote microscleres are almost unique amongst the Tetillidæ.* The case of *T. hirsuta*, described above, however, seems to show that in the oxea of this genus (as in *Plakinastrella*, &c.) it is impossible to draw a hard and fast line between mega- and microscleres.

In addition to the type described above, there are in the collection two other specimens which may be referred to the same species, viz., R.N. 189 and 205. Both are somewhat imperfect. R.N. 205 has several cup-shaped (cloacal ?) cavities, with sieve-like floors, irregularly distributed; the other is too imperfect to show the character of the vents.

R.N. 189 (Muttuvaratu Paar, Gulf of Manaar); 205 (Gulf of Manaar); 230 (deep water off Galle and onwards up West Coast of Ceylon).

Tetilla anomala, n. sp.—Plate III., fig. 5.

There are two specimens of this sponge in the collection, the larger of which (R.N. 153) may be regarded as the type. It appears to be a fragment, amounting to

* Oxeote microscleres occur also in the genus *Paratetilla* (*vide infrâ*).

nearly half, of an irregularly spherical sponge, about 35 millims. in greatest diameter. The surface is rather uneven, minutely hispid, and thinly encrusted with sand. Neither pores nor vents are visible externally. The colour, in spirit, is grey, the texture firm and compact and only slightly compressible.

The skeleton consists chiefly of stout bands of oxeote spicules radiating from a centrally (?) placed "nucleus" to the surface of the sponge. The outer portions of these bands are often abundantly echinated by the cladi of the anatriænes, lying chiefly in the ectosome.

Spicules.—(1.) Protriænes (Plate III., fig. 5, *a*); with rather short, stout cladi and fairly stout shaft, tapering to hair-like fineness. Shaft about 2·76 millims. by 0·015 millim. (at the thickest); cladi about 0·054 millim. by 0·00625 millim. The cladi may be slightly irregular, and I have seen one forked at the extremity. They are sometimes much longer than in the specimen measured. These spicules occur in positions similar to those of the anatriænes, but are very scarce.

(2.) Anatriænes (Plate III., fig. 5, *b*, *b'*); with fairly stout, sharp-pointed cladi and long hair-like shaft; length of shaft about 2·7 millims., of cladi about 0·058 millim. Abundant.

(3.) Oxea (Plate III., fig. 5, *c*); stout, fusiform, gradually and finely pointed at each end; size about 2·8 millims. by 0·046 millim.

(4.) Sigmata (Plate III., fig. 5, *d*); slender, usually contort; very numerous, especially in the walls of the inhalant canals; measuring up to about 0·01 millim. from bend to bend.

(5.) Spherules; smoothly rounded, but irregular in shape; up to about 0·004 millim. in diameter, but usually smaller. These bodies are enormously abundant in the choanosome, but are practically absent from the ectosome. In the type specimen they are thickly, but irregularly scattered; in R.N. 192 they are grouped in oval clusters about 0·11 millim. in longer diameter.

Stained sections show a fairly thick ectosome pretty sharply differentiated from the choanosome and, to some extent, fibrous, but composed chiefly of chondrenchyme with very numerous granular cells. The thickness of this ectosome, which almost amounts to a cortex, in the type specimen, is about 0·74 millim. It is penetrated here and there by narrow inhalant canals, leading almost vertically inwards from the surface. The flagellate chambers are oval or nearly spherical, up to about 0·033 millim. in diameter. Their mode of opening and the arrangement of the excurrent canal system have not been made out. The mesoderm of the choanosome ranges from collenchymatous to chondrenchymatous.

The extraordinary number of the siliceous spherules or globules in this sponge is very remarkable. In R.N. 192 they are, as already stated, grouped together in oval masses. They appear in this case to originate many together in special mother cells, in which they first appear as very minute, highly refringent points. The oval groups are probably still associated with the remains of the mother cells. The exact nature

of these bodies and their taxonomic value are extremely doubtful. Sollas (15) mentions that such bodies occur in the Tetillidæ associated with sigmaspires, but in *Cinachyra barbata*, where they are said to be as much as 0·0535 millim. in diameter, he regards them as "accessory or accidental" forms, and the only species of *Tetilla* in which they are mentioned appears to be *Tetilla arabica* (Carter), where they are of about the same size as in *T. anomala*. I myself have seen similar bodies in one specimen of *Tetilla hirsuta* (*vide supra*), but only very locally developed. That the spherules are really siliceous appears to be tolerably certain, for they appear abundantly in preparations of *T. anomala* which have been boiled out with nitric acid. Whether they can be regarded as definite and characteristic spicules is, however, another question, and it appears to me not impossible that they may be simply reserves of siliceous material destined to be re-absorbed later on and used for spicule formation. This view is strongly supported by their very sporadic distribution.

There is possibly a close relationship between *T. hirsuta*, *T. poculifera*, and *T. anomala*.

R.N. 153 (Station V., off Chilaw, 10 fathoms); 192 (Station LVII., outside Dutch Modragam Paar, 11½ to 36 fathoms).

Tetilla limicola, n. sp.—Plate I., fig. 7; Plate III., fig. 6.

Sponge (Plate I., fig. 7) somewhat fig-shaped, constricted below, broadly rounded above; may be slightly lobose; may be laterally compressed; anchored in the mud by a great mass of fine silky spicules attached to the base. Surface glabrous, but at the same time minutely and sparsely hispid above, more strongly hispid on the sides; also very minutely reticulate on the upper parts. Texture soft and spongy, but very compact, *i.e.*, without wide canals or cavities in the interior. Colour in life, pink; in spirit, grey. Vents (Plate I., fig. 7, *o*) of fair size, several, slit-like, in deep or shallow depressions on the upper part of the sponge; each leading into a wide but shallow cloacal cavity with an almost flat floor perforated by numerous minute openings of very narrow exhalant canals. Inhalant pores scattered between the surface tufts of spicules. A spirit specimen (exclusive of the root tuft) measures about 43 millims. in height, 48 millims. in greatest breadth, and 31 millims. in greatest thickness. The root-tuft (Plate I., fig. 7, *r.t.*) is nearly as large as the specimen itself, and in its present condition consists of a mass of soft mud held together by the extremely long and slender silky anchoring spicules, which individually are scarcely visible to the naked eye.

The skeleton consists of the following parts:—

(1.) Loose longitudinal bands of very long, slender oxea run almost parallel to one another throughout the body of the sponge. In a longitudinal section taken across the greatest breadth of the sponge these fibres are seen to converge towards a point situated at a short distance below the depressed apex of the sponge. Owing to the

constriction of the sponge below, the lower ends of these fibres approach the surface almost without diverging from one another.

(2.) More or less mingled with the foregoing in the lower parts of the sponge are long, silky bundles of the very long, sinuous, hair-like shafts of anatriænes, whose heads echinate the bundles at varying distances beneath the surface.

(3.) Dense surface brushes, composed partly of oxea which form the ends of the long fibres and partly of protriænes of hair-like thinness, whose cladomes project far beyond the surface.

(4.) Numerous oxea, much shorter than those of the fibres, scattered irregularly throughout the body of the sponge.

(5.) The root-tuft, composed of anatriænes with extremely long and slender shafts, irregularly matted together.

Spicules.—(1.) Protriænes (Plate III., fig. 6, *b.*), (and diænes); shaft and cladi often of hair-like thinness; cladi commonly of unequal length (one sometimes suppressed entirely), projecting forwards at only a very small angle with the shaft. In a perfect example in a boiled-out preparation the shaft is about 3·0 millims. long, about 0·004 millim. thick just below the cladi, and tapering to hair-like fineness at the other end. The longest of the cladi is about 0·05 millim. in length.

(2.) Anatriænes (Plate III., fig. 6, *a*); with extremely long, hair-like shafts, so long and slender that they appear to be invariably broken off even in boiled-out preparations, and I am therefore unable to give the measurements. The cladi are fairly stout, gradually sharp-pointed, recurved at a very acute angle to the shaft, and about 0·04 millim. long by 0·004 millim. thick at the base. In boiled-out preparations the shafts of these spicules stick together in silky wisps.

(3.) Oxea (Plate III., fig. 6, *c.*); long and slender, commonly slightly curved, very gradually and finely pointed, varying greatly in size according to position, measured up to about 2·1 millims. by 0·01 millim.

(4.) Sigmata (Plate III., fig. 6, *d*); slender and commonly contort, measuring about 0·008 millim. from bend to bend. Very numerous.

The material is hardly sufficiently well preserved for minute histological investigation, but the examination of sections prepared by the usual paraffin method shows us the following features. There is no cortex and no distinct dermal membrane, the ectosome not being sharply differentiated from the choanosome. The small inhalant pores, scattered between the dermal brushes of spicules, lead directly into narrow, elongated canals, which run inwards at right angles to the surface and unite below the spicular brushes in larger inhalant canals which penetrate the deeper parts of the sponge. The flagellate chambers are approximately spherical and about 0·025 millim. in diameter; they are probably eurypylous. The exhalant canals are all narrow, and converge towards the flask-shaped cloacal cavities already mentioned. Numerous large ova, many of them having very prominent pseudopodia, are scattered through the choanosome. These ova measure up to about 0·11 millim. in diameter. They

have uniformly granular cytoplasm and large, well-defined nuclei, each typically with a single darkly-staining nucleolus.

Of this remarkable sponge eight specimens were found, anchored in the soft mud at the bottom of Tamblegam Lake (a large inlet from Trincomalee Bay); but only one was forwarded to Cape Town for more minute investigation.

The species is evidently nearly related to *Tetilla dactyloidea* (Carter), which that author records (20, 34, 43) from the south-east coast of Arabia, Bombay, and the Mergui Archipelago. The principal difference apparently concerns the excurrent canal-system. In *T. dactyloidea* there appears to be a single vent at the summit of the sponge, and Mr. Carter observes that the terminal aperture divides into a number of branches, which, sub-dividing, permeate the mass generally down to its base. In *T. limicola*, as we have seen, the sponge is very compact throughout, and there are no wide tubes in it, the excurrent canals being very narrow and opening by numerous minute apertures in the floors of somewhat flask-shaped cloacæ with slit-like vents on the surface of the sponge. It is highly probable that this arrangement is a special adaptation to the conditions of life, serving to hinder the entrance of the very fine soft mud, in which it lives, into the interior of the sponge; even as it is, a considerable amount of mud may be seen in the excurrent canals just beneath the floor of the cloaca.

R.N. 70 (one of eight specimens from Tamblegam Lake, Trincomalee).

Craniella, Schmidt.

The ectosome is differentiated into an inner fibrous layer, containing more or less radially arranged cortical oxea, and an outer collenchymatous layer excavated by large subdermal cavities.

Craniella elegans, n. sp.—Plate IV., fig. 1.

Sponge free, irregularly spherical. Surface covered with close-set conuli; hispid with brushes of spicules projecting from the conuli; minutely reticulate between the conuli. Vents not visible in the type specimen. Pores in the thin dermal membrane stretched between the conuli. Colour, in spirit, purplish grey externally, yellow internally. Greatest diameter of type (R.N. 193) about 20 millims. Consistence firm and compact.

The main skeleton consists of stout bundles of spicules radiating from a central "nucleus" and ending in the brushes which project from the surface conuli (Plate IV., fig. 1). These radiating bundles (*r.b.*) are separated from one another by fairly wide intervals, and are composed of large oxea, with anatriænes and protriænes. The cladi of the anatriænes are, for the most part, situated in the outermost part of the choanosome, just beneath the cortex, while those of the protriænes mostly project beyond the surface of the sponge in the hispidating brushes. The special cortical skeleton is, as usual in *Craniella*, confined to the inner, fibrous layer of the cortex,

and is composed of stout oxea; these are not arranged strictly radially, but are inclined at various angles to the surface, with their outer extremities commonly abutting at more or less acute angles against the stout bundles of the main skeleton as the latter penetrate the cortex on their way to form the surface brushes.

Spicules.—(1.) Protriænes (Plate IV., fig. 1, *b*); with long shaft, rather stout distally but becoming setaceous proximally, and short, stout cladi of approximately equal length. Shaft in measured specimen 4·78 millims. by 0·0368 millim. (near cladome); cladi, 0·129 millim. long.

(2.) Anatriænes (Plate IV., fig. 1, *a*); with long and very slender, setaceous shafts, and short, stout, sharp-pointed cladi; shaft measured up to 4·87 millims. by 0·0138 millim. (near cladome), with cladi 0·0736 millim. long. Very numerous.

(3.) Oxea of the radiating bands (somal oxea); stout, aniso-actinate; more or less gradually sharp-pointed distally, but drawn out into long setaceous filaments proximally; size up to about 3·27 millims. by 0·046 millim.

(4.) Cortical oxea (Plate IV., fig. 1, *c.o.*); stout, fusiform, aniso-actinate, sharp-pointed at each end, the proximal end narrower than the distal, but not setaceous; commonly slightly curved; size about 1·0 millim. by 0·0368 millim.

(5.) Sigmata; slender, 0·0166 millim. from bend to bend.

The cortex of the type specimen measures, in places, as much as 1·8 millims. thick, and is very sharply differentiated into two layers, of which the outer appears to be usually somewhat thicker than the inner. The outer layer is excavated by very large subdermal (intra-cortical) cavities (Plate IV., fig. 1, *i.c.c.*), which occupy nearly all the space between the radiating spicule bundles of the main skeleton, with the thin dermal membrane stretched over them. The dermal membrane (*d.m.*), and also the deeper parts of the outer layer of the cortex, between the subdermal cavities, contain numerous small brown pigment granules grouped in more or less spherical cells. The inner layer of the cortex (*f.c.*) is densely fibrous and contains no pigment granules; it is strengthened by the special oxea above described, and the fibres lie, for the most part at any rate, parallel to the surface.

The flagellate chambers are about 0·02 millim. in diameter, spherical or oval, eurypylous or with short, wide excurrent canaliculi. The choanosome is crowded with large embryos (Plate IV., fig. 1, *emb.*).

In addition to the type above described, there is in the collection another very small specimen (R.N. 204) of pear-shaped form, with a single apical vent. The maximum diameter of this specimen is only about 8·5 millims. In the structure of the cortex and in the form and arrangement of the spicules, it agrees very well with the type, but the megascleres are all much smaller. This difference, however, is probably due to immaturity, the specimen being of very small size and containing no embryos, while the type, as we have seen, is crowded with them.

R.N. 193 (Station LVII., outside Dutch Modragam Paar, $11\frac{1}{2}$ to 36 fathoms); 204 (Gulf of Manaar).

Paratetilla, n. gen.

Tetillidæ with a special layer of modified triænes, resembling calthrops, lying at the junction between the ectosome and choanosome (or in the ectosome).

The discovery by Professor HERDMAN of another species of Tetillid which shares the remarkable skeletal peculiarities of CARTER'S *Tethya merguiensis* (21), appears to justify the establishment of a new genus for the reception of the two. *Paratetilla merguiensis* is, like our species, an inhabitant of the Indian Ocean (Mergui Archipelago), but its area of distribution extends, according to SOLLAS (15), as far as Torres Straits. The synonymy of this species is, however, somewhat involved, according to LINDGREN (86) and THIELE (87) it should be known as *Tetilla bacca* (SELENKA), with which, according to THIELE, KIESCHNICK'S *Tetilla ternatensis*, *T. amboinensis*, *T. violacea*, and *T. rubra* are again synonymous. If these identifications be correct the range of the species must be yet further extended.

Paratetilla cineriformis,* n. sp.—Plate III., fig. 7.

This species is represented in the collection by four specimens, ranging in diameter from about 12 millims. to about 41 millims. The shape is irregularly hemispherical. All but the smallest have been injured below by tearing off from the attachment, the base of the sponge having evidently been left behind. The smallest, which appears to be fairly perfect, is cushion-shaped, flat beneath and convex above. The surface is more or less uneven, and to some extent hispid, though not very markedly so; it may be very irregular. The consistence is rather soft and spongy. The colour externally (in spirit) is almost black; internally much paler, purplish grey. The arrangement of the vents and pores is very difficult to determine. A few small, pocket-like depressions, irregularly scattered over the surface, probably represent cloacal cavities; their floors are perforated by the numerous minute apertures of slender, exhalant (?) canals; their external openings may be narrow and slit-like. The inhalant pores are probably scattered irregularly over the surface, but I have not been able to make them out distinctly. Some of the specimens are infested by parasitic cirripedes, living beneath the surface in cavities whose external apertures simulate vents.

The main skeleton consists of stout bands of spicules radiating from a large central "nucleus." In addition to these there is the layer of modified triænes lying at the junction of ectosome and choanosome.

Spicules.—(1.) Modified triænes (Plate III., fig. 7, *a-d*), lying at the junction of ectosome and choanosome. These spicules are so irregular in size and shape that it is almost impossible to describe them; the following have been measured: (*a.*) with four simple unbranched rays, one much shorter than the others, resembling a plagiotriæne with shaft shorter than cladi; length of longest ray 0·165 millim., with two

* The specific name is derived from the close resemblance which the sponge bears to a black cinder.

others a little shorter, and the fourth much shorter; (*b.*) with one very short unbranched ray (shaft) and three much longer rays (cladi), of which two are forked; cladi of somewhat unequal length; maximum diameter of cladome from tip to tip of rays 0·276 millim.; maximum diameter of cladi about 0·0166 millim.; (*c.*) similar to (*a.*), but with cladi much curved; the very short shaft, as is commonly the case, rounded off at the extremity; (*d.*) with only three rays, two almost in the same straight line and the third, much shorter (? = shaft) at right angles to them; length of each of longer rays about 0·147 millim.; of short ray about 0·055 millim. The rays of these spicules are often irregularly bent or curved. They are probably, as pointed out by Carter and Sollas in the case of *P. merguiensis*, modified "zone-spicules" (plagiotriænes).

(2.) Protriænes (Plate III., fig. 7, *e*, *e'*); few in number and very variable in dimensions, with shaft and cladi all very slender or fairly stout, and cladome sometimes irregular. The cladome may or may not project beyond the surface.

(3.) Anatriænes (Plate III., fig. 7, *f*, *f''*); with short, stout cladi, and very long slender shaft, often inflated in a bulbous manner at a short distance below the cladome and tapering to hair-like dimensions at the other end. Length of shaft in measured specimen 3·3 millims.; diameter between bulb and cladome 0·007 millim.; length of cladi 0·027 millim. The cladomes of these spicules sometimes project beyond the surface of the sponge.

(4.) Oxea of the main skeleton (Plate III., fig. 7, *g*, *g'*, *g''*); stout, straight or nearly so; fusiform, with the ends gradually and finely pointed, or more or less irregular; size about 2·9 millims. by 0·0365 millim., but usually more slender. Numerous much smaller oxea, apparently young forms, also occur.

(5.) Sigmata (Plate III., fig. 7, *h*); extremely slender, frequently, if not always, contort, about 0·014 millim. from bend to bend; abundant.

In stained sections of the largest specimen the cortex measures up to about 0·28 millim. in thickness. It is composed of a compact tissue which appears to be cystenchymatous rather than collenchymatous, and the cells contain numerous minute brown pigment granules. The choanosome appears to be mostly collenchymatous and contains brown pigment granules similar to those of the cortex, but fewer in number. The flagellate chambers are oval or nearly spherical, up to about 0·0249 millim. in diameter.

This interesting sponge is evidently nearly related to Carter's *Tethya merguiensis* (21) (*Tetilla merguiensis* of Sollas) from the Mergui Archipelago, off the coast of Burmah, but differs to such an extent that there can hardly be any question of specific identity. The characteristic inhalant pore-sieves and dermal reticulation of Carter's species are not recognisable here; the dermal microxea are absent, and the modified "zone-spicules" appear to be much more irregular in shape.

R.N., 184, 187 (Stat. VI., Muttuvaratu Paar, Gulf of Manaar); 214 (deep water outside pearl banks, Gulf of Manaar); 245 (Ceylon seas).

Grade: LITHISTIDA.

Tetraxonida in which the megascleres form desmas, typically united with each other to form a continuous skeleton.

The relationships and classification of the Lithistida still require a great deal of investigation before we can consider our knowledge of the group as by any means satisfactory. They are, of course, usually considered as a sub-division of the Tetractinellida, but inasmuch as many of them have only monaxonid spicules this method of disposing of the group seems somewhat unjustifiable. There appear to be two logical alternatives. We may either regard the Lithistida as being of polyphyletic origin and partition them to the best of our ability amongst other groups, or we may regard them as representing another grade of evolution in a special direction and retain the group provisionally as a matter of convenience, without committing ourselves to an opinion as to whether it is a natural group or not. In the present state of our knowledge the latter appears to me the wisest course to adopt.

As regards the internal classification of the group, I have no doubt that important modifications of the existing arrangement of genera, which we owe to Sollas, must shortly be made. My own experience of the Lithistida is, however, so limited that I prefer not to experiment in this direction, but will content myself with a few critical remarks suggested by the investigation of certain species in Professor Herdman's collection.

Discodermia, Bocage.

Lithistida with tetracrepid desmas and ectosomal discotriænes, and with microscleres in the form of microxea or microstrongyla.

Discodermia emarginata, n. sp.—Plate IV., fig. 4.

The single specimen is of massive form with spreading base attached to a mass of calcareous worm-tubes. The upper surface is strongly convex, rising into two low, mammiform projections, from the broad apices of which (where the small vents are situated) radiate shallow grooves, the outward indications of convergent exhalant canals. Colour throughout (in spirit) pale yellow; texture compact and stony. Diameter of massive central portion about 12 millims., with the basal portion spreading a good deal further as a thin crust.

Skeleton composed of a close reticulation of firmly united tetracrepid desmas with a single layer of discotriænes on the surface. Below the surface are a few slender oxea, which become more numerous and are sometimes collected into loose fibres in the neighbourhood of the vent.

Spicules:—(1.) Stout tetracrepid desmas (Plate IV., fig. 4, *a–e*), more or less tuberculated, especially at the ends of the branches, which proliferate into numerous rounded tubercles, by the interlocking of which the union of adjacent desmas is

effected. There are no transitional forms intermediate between these desmas and the discotriænes of the surface, such as Mr. Carter describes (4), and the desmas are evidently not derived from discotriænes. Each originates from a tetract crepis (calthrops) by branching of the actines and secondary deposition of siliceous material. The initial stages in the development of the desmas are to be found in abundance just beneath the superficial layer of discotriænes, where the skeleton is evidently growing. The young crepis (Plate IV., fig. 4, *a*) is a regular tetract calthrops with minutely roughened surface. In one of the youngest I have seen, the actines measure about 0·04 millim. by 0·004 millim. One actine may be longer than the other three; they are sometimes conical and suddenly constricted at the base. Having attained a length of about 0·08 millim., or it may be less, the actines swell out at their ends and begin to branch irregularly (Plate VII., fig. 4, *c*). Presently the original minute roughening of the surface is covered over by smooth secondary deposits of silica, and the adult, much larger tuberculation appears, though the more central portions of the spicule may often be nearly smooth when fully developed. The diameter of the actines of the fully formed spicule ("epactines" of Sollas), between the centre and the point where they commence to branch, is about 0·036 millim. This account of the development of the desmas, while differing widely from that given by Carter, agrees with the views expressed by Sollas in his "Challenger" report.

(2.) Discotriænes (Plate IV., fig. 4, *f*, *g*); disk flat, about 0·23 millim. in diameter; outer surface beset with numerous minute, conical papillæ; margin approximately circular, but minutely crenulated and usually strongly emarginate at one, two or three places, so as to form semi-circular bays or indentations; shaft well developed, stout, conical, fairly sharp-pointed, up to about 0·147 millim. long. These spicules form a single layer on the surface, with overlapping disks. The youngest stage I have recognised in their development is shown in Plate IV., fig. 4, *f*.

(3.) Monaxonid spicules (rhabdi); probably oxeote; long and slender, and commonly tapering very gradually to a fine point. These spicules are so long and slender and so interwoven with the desmas that I have never succeeded in seeing both ends of the same spicule *in situ*, and even in boiled-out preparations they are always broken. They are particularly numerous in the neighbourhood of the vent, but do not, at any rate usually, project beyond the surface. I have measured one up to a length of about 1·2 millims., with a maximum diameter of about 0·006 millim.

(4.) Microrhabds (Plate IV., fig. 4, *h*); usually fusiform and strongylote, with very minutely roughened surface; sometimes slightly curved; size about 0·016 millim. by 0·0027 millim. These spicules are very abundant beneath the layer of discotriænes; and especially in the membrane which immediately surrounds the vent, where they form a continuous layer, the discotriænes being absent.

It is with some reluctance that I have been constrained to add another species of *Discodermia* to the six already described by Mr. Carter (4, 5) from the Gulf of Manaar (*D. papillata*, *D. aspera*, *D. spinispirulifera*, *D. lævidiscus*, *D. sinuosa*, and

D. sceptrellifera), but I cannot identify Professor HERDMAN'S specimen, from deep water off Galle, with any of these. The richness of the Ceylon seas in species of *Discodermia* is very remarkable. It is strange that I have not been able to find any of Mr. CARTER'S species in Professor HERDMAN'S collection, but they are apparently all small forms, which would not be likely to attract the attention of a collector.

R.N. 234 (Station XLI., 12 miles off Galle, 100 fathoms).

Aciculites, SCHMIDT.

Lithistida with monocrepid desmas and rhabdi, the latter forming a special dermal layer. Without microscleres.

SOLLAS, in his report on the "Challenger" Tetractinellida, places this genus in his family Scleritodermidæ in the "Sub-order" Hoplophora, but it seems to me that it would fall more naturally amongst the Azoricidæ (in the Sub-order Anoplia of SOLLAS). The fact that some of the rhabdi form a dermal layer can hardly be of sufficient importance to justify us in placing the genus not only in a different family, but even in a different "sub-order" from the Azoricidæ, to which it is naturally allied by the form of the desma, the presence of rhabdi, and the absence of microscleres.

Aciculites orientalis, n. sp.—Plate IV., fig. 3.

The single specimen is massive, compact, cushion-shaped, rather irregular, but with rounded outlines, somewhat flattened above and attached below by a broad base to a mass of calcareous débris. Height about 28 millims.; greatest breadth, 38 millims. Texture compact and stony, but with a comparatively soft dermal membrane, which, on the upper surface of the sponge, is easily separable from the underlying part. Vents numerous, minute (say about 0·2 millim. in diameter, but varying), scattered over the upper surface.* Pores scattered. Surface, in parts at any rate, slightly corrugated, with narrow, ramifying and meandering canals showing through the dermal membrane. Colour in spirit grey, both internally and externally.

The main skeleton is a very close and compact reticulation of monocrepid desmas, intermingled more or less abundantly with strongyla. In the dermal membrane the strongyla are very abundant and lie for the most part tangentially, forming a more or less continuous dermal skeleton. Beneath the dermal membrane, where the main skeleton is growing, the desmas are found in various stages of development, not as yet connected with one another.

Spicules.—(1.) Monocrepid desmas (Plate IV., fig. 3, *a*–*d*). The young spicule (*a*) is an irregular, elongated rod, with minutely roughened surface, which soon begins to branch. The fully grown spicule (*d*) usually consists of a strongly curved main axis with branches coming off chiefly on the convex side. These branches proliferate and

* One much larger opening looks as if it might be artificial.

end in rather sharp, conical papillæ. Similar papillæ may occur on the main axis, but when this is strongly curved they are usually absent from the concave side. The fully developed desma measures about 0·328 millim. in maximum length in a straight line from point to point.

(2.) Strongyla (Plate IV., fig. 3, *e*, *f*); slightly curved and a good deal broader at one end than at the other. The broad end, which may be slightly tylote, is covered with minute spines, while the narrow end is smooth, or nearly so, though often with a very few minute projections. Size, commonly about 0·328 millim. by 0·009 millim. (in the middle).

So far as I am aware, the only other species of *Aciculites* hitherto described is the type of the genus, *Aciculites higginsii*, Schmidt (44), from Havanna. Our species is evidently very closely related to the West Indian form, which has fortunately been re-examined and described by Sollas (15, p. 347). In fact, the only specific difference which the description of the latter has enabled me to detect lies in the fact that in the Ceylon species the vents are not protected by tent-like arrangements of radiating rhabdi as described by Sollas. Probably, however, other specific differences will be found to exist in the form of the desmas, &c.

We have here an interesting case of apparently discontinuous generic distribution, though the imperfect state of our knowledge of the sponge-fauna of intermediate localities makes it possible that the discontinuity is apparent rather than real.

It may be noted that Topsent's *Aciculites incrustans* has now been recognised by that author as belonging to a totally distinct genus, *Desmanthus* (14).

R.N. 150 (Ceylon seas).

Taprobane,* n. gen.

Lithistida of plate-like or cup-shaped form, with minute sphinctrate apertures abundantly scattered on each side of the plate; with monocrepid, tuberculate desmas and long, slender oxea; without special ectosomal spicules and with microscleres in the form of sigmata only.

We have here another proof of the artificial character of Sollas's classification of the Lithistida. It will be seen from the diagnosis that the sponge upon which the genus *Taprobane* is based might be regarded either as a Scleritodermid without ectosomal spicules or as an Azoricid with sigmata; it is thus very closely related on the one hand to *Scleritoderma*, and on the other to *Azorica*. We have already had occasion to notice, in speaking of the genus *Aciculites*, that Sollas places *Scleritoderma* and *Azorica* in different "sub-orders," his Hoplophora and Anoplia respectively, but the discovery of *Taprobane*, combining characters of these two groups, viz., the absence of special ectosomal spicules and the presence of microscleres, alone seems sufficient to necessitate a revision of Sollas's scheme.

* So called from the old Greek name for the Island of Ceylon.

Taprobane herdmani, n. sp.—Plate I., fig. 8; Plate IV., fig. 2.

Specimen (Plate I., fig. 8) consisting of a stout, erect plate or lamella, strongly curved (almost into the shape of a cup). Surfaces more or less uneven, especially on the outside (which bears numerous galls due to parasitic barnacles). The upper edge is broadly rounded, and the base of attachment is slightly expanded, like the foot of a cup. Both surfaces are slightly and unevenly hispid, the hispidation being almost confined to the more depressed portions. Both surfaces are thickly studded with minute, pustule-like, circular areas, hardly visible to the naked eye. These areas are only about 0·3 millim. in diameter, and each bears the single aperture of an incurrent or excurrent canal surrounded by a well-developed sphincter membrane. The colour (in spirit) is dirty grey; the texture compact and stony. Greatest height about 70 millims.; thickness of lamella about 15 millims.

The main skeleton is a very dense and compact reticulation of desmas, together with loose wisps or brushes of long, slender oxea running at right angles to the surface, beyond which their ends project so as to give rise to the hispidation. The oxea seem to disappear more or less completely from the deeper parts of the sponge, while around the apertures of the canal system, at any rate on the outer surface, they may project as a scanty fringe.

Spicules.—(1.) Desmas (Plate IV., fig. 2); monocrepid and rather sparingly branched, the branches usually coming off almost exclusively from one side of the main axis, which is usually more or less strongly curved. Main axis and branches more or less abundantly ornamented with rounded tubercles; branches (? always) terminating in conical papillæ, which may be bifid at the apex. The union of these desmas is so close and compact that it seems almost impossible to isolate an adult spicule for measurement; but the total length, measured in a straight line from point to point, appears to be about 0·36 millim. The thickness of the main axis, exclusive of tubercles, is about 0·028 millim.

(2.) Oxea; very long and slender, gradually and sharply pointed at each end; commonly more or less curved or crooked; size variable; they are usually broken, but two complete spicules measured about 1·0 millim. by 0·008 millim. and 1·88 millim. by 0·008 millim. respectively.

(3.) Sigmata; slender, contort; total length in a straight line from bend to bend, about 0·01 millim.; abundant throughout the sponge.

One of the most characteristic features of this species is the arrangement of the apertures of the canal system. These appear to be identical in form and arrangement on the two sides of the sponge, but we may conclude from the analogy of other plate-like and cup-shaped sponges that the apertures on the outer side are inhalant pores, and those on the inner side vents. Each aperture, whether pore or vent, lies in the middle of a circular area, sharply defined by the sudden cessation of the reticulation of desmas at its margin. This area is occupied by a very well developed, iris-like diaphragm, with abundant circularly and perhaps also radially arranged myocytes,

the contraction of the former of which has, in almost all cases, completely closed the aperture. The diaphragm contains sigmata, but no other spicules. A similar arrangement of the external apertures of the canal-system appears to be characteristic both of *Azorica* and *Scleritoderma*; indeed, our Ceylon species, except for the absence of microstrongyles, resembles very closely indeed SCHMIDT'S *Scleritoderma packardi* from the Gulf of Mexico, as described and figured by SOLLAS in his work on the "Challenger" Tetractinellida.

R.N. 40 (Stat. XV., Periya Paar, Gulf of Manaar, 9 fathoms).

Petromica, TOPSENT.

Lithistida of massive form; with scattered pores and vents; with thin dermal membrane destitute of special skeleton; with monocrepid desmas feebly united or quite separate; with monaxonid rhabdi often collected in fibres which may terminate in surface conuli; without microscleres.

This genus was founded by TOPSENT in 1898 (**45**) for a new Lithistid sponge from the Azores, very closely related to *Azorica*. TOPSENT gives the following diagnosis:—"Azoricidæ massives, en forme de cônes dressés, à surface conuleuse, à pores dispersés, à oscules membraneux, à ectosome dévellopé aspiculeux, à desmas peu ornés et faiblement reliés entre eux."

The discovery of a second species in Ceylon waters, closely related to the type of the genus, forms a further justification for separating *Petromica* from the other Azoricidæ.

Petromica massalis, n. sp.—Plate IV., fig. 5.

Sponge massive, may be attached by a broad base, may be compressed vertically or horizontally. Vents usually numerous, rather small, but variable in size; scattered on the upper part of the sponge, each forming the termination of a vertical oscular tube. Pores scattered. Surface uneven, variable, more or less corrugated; in places covered with a thin, reticulate, pore-bearing dermal membrane overlying large sub-dermal cavities and supported on bundles of large monaxonid spicules which sometimes terminate in conuli. Texture incompressible, but friable; colour (in spirit) yellowish grey throughout. The type specimen (R.N. 257) measures about 37 millims. in height, the same in breadth, and 24 millims. in thickness.

The main skeleton is a reticulation (sometimes close and sometimes so loose that the desmas do not touch one another) of much-branched monocrepid desmas, intermingled with numerous large monaxonid spicules which are partly collected together in coarse fibres (without being united together by any cementing substance). These fibres, as already noticed, sometimes terminate in surface conuli. There is no special dermal skeleton.

Spicules.—(1.) Monocrepid desmas (Plate IV., fig. 5, *a*); much and very irregularly branched; not tuberculate (or very slightly so); branches usually terminating in short, blunt, conical points, or in curved flattened expansions pressed against other

desmas. Maximum length from apex to apex of branches about 0·74 millim., with main axis about 0·06 millim. thick.

(2.) Stout and slender monaxonid spicules (Plate IV., fig. 5, *b–e*); more or less curved and variously ended, ranging from oxeote to strongylote and stylote; size about 0·98 millim. by 0·0369 millim., 1·2 millims. by 0·0246 millim., 1·28 millims. by 0·0328 millim., &c.; very variable.

The most interesting feature of this sponge is the strong development of the monaxonid spicules (rhabdi), which, in three out of the four specimens (the fourth being dead and infested by another sponge), play an equal part with the desmas in the composition of the skeleton. This condition of the skeleton suggests that certain Monaxonellid sponges usually associated with the Axinellidæ may be derived from Lithistid ancestors by the suppression of the desmas, or that certain Lithistids with monocrepid desmas may possibly be derived from Monaxonellid ancestors.

Petromica massalis is evidently very closely related to Topsent's *P. grimaldii*, the type of the genus, from the Azores. The principal difference appears to concern the ornamentation of the desmas, which, in *P. grimaldii*, are ornamented at the extremities with little conical tubercles, not pointed. These are absent or very feebly developed in the Ceylon species, but subsequent researches may make it desirable to unite the two.

R.N. 198; 216 (dead, and infested by another sponge; deep water outside pearl banks, Gulf of Manaar); 257 (type); 269 (young; deep water off Galle and onwards up West Coast of Ceylon).

Grade: MONAXONELLIDA.

Tetraxonida in which the primitive tetraxonid and tetractinellid condition of the megascleres has been entirely lost and none but monaxonellid megascleres remain. No desmas are developed.

With the recognition of the true nature of the monaxonellid sponges as reduced Tetraxonida, it becomes once more desirable to modify the name of the group. The old name, "Monactinellidæ," which we owe to Zittel, was objectionable because implying that the spicules are necessarily monactinal (one-rayed), while, as a matter of fact, they may be also diactinal (two-rayed). Sollas therefore altered the name to "Monaxonidæ," which was afterwards altered to "Monaxonida," under which name the group appears in the '"Challenger" Reports' and other recent works.

The name "Monaxonida," however, becomes distinctly objectionable when used for a mere sub-division of the order Tetraxonida, contrasted with the Tetractinellida; and I therefore propose to again modify the name of the group, choosing this time the term "Monaxonellida," which is, I believe, both correct in meaning and in harmony with the scheme of classification adopted.

The Monaxonellida form, however, an unnatural group of polyphyletic origin, which we can only retain as a matter of convenience until we know more about their

phylogeny. They are evidently descended from more than one group of tetractinellid ancestors by degeneration of the tetraxon megascleres, and have branched off into an immense number of genera and species, the classification of which, as in the case of all reduced forms, is extremely difficult.

We have seen that the two chief tetractinellid sub-orders are distinguished mainly by the form of the microscleres, the "Astrophora" possessing some form of aster and the "Sigmatophora" sigmata. This same distinction, broadly speaking, runs through the Monaxonellida also, and may be used as the basis of their sub-division into "Astromonaxonellida" and "Sigmatomonaxonellida," names which I now propose as the most appropriate for the two great groups into which the "Monaxonellida" are by general consent divided, and approximately equivalent to the "Clavulina" and "Halichondrina" of Vosmaer and of Ridley and Dendy, and to the "Hadromerina" and "Halichondrina" of Topsent, &c.

These two groups are sharply distinguished from one another. As far as I am aware, there are only three cases on record of the occurrence of astrose microscleres in association with sigmata or chelæ, and all three are probably to be explained as due to mixture of the spiculation of two distinct sponges—a very frequent occurrence.*

We may regard these two great monaxonellid sub-orders as being descended from the two corresponding tetractinellid sub-orders, though this is no doubt but a crude way of looking at the problem, and it may well be that some of the forms which we find most difficult to classify are descended directly from the Homosclerophora, and others from the Lithistida.

The great difficulty in following out this system of classification to its logical conclusions lies in the fact that in many cases the microscleres, as well as the tetract megascleres, have entirely disappeared, apparently by degeneration, and we are then dependent upon the much less trustworthy guidance of other characters. Thus the genera *Halichondria*, *Reniera*, *Axinella*, *Suberites*, &c., with a very simple spiculation composed exclusively of monaxonid megascleres, are in reality more modified forms than *Gellius*, *Sigmaxinella*, *Hymedesmia*, *Spirastrella*, and so on, which have not lost their microscleres.

Sub-Order: ASTROMONAXONELLIDA.

Monaxonellida in which the microsclere, when present, is some form of aster.

This sub-order is practically equivalent to the Hadromerina of Topsent, which

* The cases in question are Schmidt's *Sceptrella regalis* (23), p. 58 [*vide* also Ridley and Dendy (1), p. lxii., footnote]; Fristedt's *Desmacella peachii* var. *stellifera* (24); and Topsent's *Hymeraphia loureti* (25); all very doubtful cases. The so-called amphiasters (or "birotulates") of certain Desmacidonidæ (*e.g.*, *Axoniderma*, *Iotrochota*, *Amphiastrella*) are not true asters at all, but merely modified isochelæ. [Further discussion on this subject, necessitated by the appearance of Topsent's great work on the Sponges of the Azores (62), will be found in the general remarks on the sub-order Sigmatomonaxonellida.]

that author sub-divides into two sections, according to the prevailing form of megasclere, viz., "Clavulida" and "Aciculida." This sub-division, however, appears to me to be both unnecessary and unnatural, especially when its originator places the genus *Tethya*, with its stylote megascleres, in the division "Aciculida," which is characterized by oxeote megascleres.* I therefore propose to divide the sub-order immediately into families. Of these TOPSENT (26) makes nine, of which five are represented in the present collection.

In addition to these, I here include the family Chondrosidæ, which have completely lost their megascleres, and, in the genus *Chondrosia* itself, their microscleres also. Some of the old group Axinellidæ (*e.g.*, *Vibulinus*, with astrose microscleres) must likewise be included in this sub-order, and it may prove necessary to institute a new family—Astraxinellidæ—for their reception.

On the other hand, I am inclined to think that some of TOPSENT's families will prove to be superfluous. Thus I propose to abandon his "Coppatiidæ" and "Streptasteridæ" in favour of the older "Epipolasidæ" of SOLLAS.

FAMILY: EPIPOLASIDÆ.

Astromonaxonellida with oxeote megascleres, and usually euasters for microscleres.

This family, founded by SOLLAS (15) for the reception of the genera *Amphius*, *Coppatias*, and *Asteropus*, is, at any rate as regards what we may consider to be its typical representatives, evidently very closely related to the Stellettidæ, a fact which has already been recognised by previous writers. In short, we may safely regard these forms as reduced Stellettids which have lost their tetraxon megascleres, and SOLLAS himself placed the family next to the Stellettidæ as an appendix to the Euastrosa, though apparently with some doubt.

TOPSENT divided the genera of SOLLAS's Epipolasidæ between his own families Coppatiidæ and Streptasteridæ. In the Coppatiidæ he also includes certain genera, such as *Spongosorites*, which have no microscleres at all. *Spongosorites* is well represented in the Sponge-Fauna of Ceylon, but, for reasons which will appear subsequently, I find it desirable to remove it to the Axinellidæ.

Coppatias, SOLLAS (15).

Epipolasidæ with the skeleton composed of an irregular interlacement of oxea, and microscleres in the form of euasters only.

This genus is almost synonymous with the genus *Stellettinopsis* as employed by CARTER.

* It should be pointed out, however, that SOLLAS and TOPSENT regard the megascleres of *Tethya* as modified oxea, which they term strongyloxea, but it is impossible to distinguish these from styli.

Coppatias reptans, n. sp.—Plate V., fig. 2.

The single specimen is much elongated, irregularly sub-cylindrical, creeping over and to a slight extent encrusted by calcareous débris. It has apparently lain horizontally. The total length is about 11 centims., and the maximum thickness about 14 millims. One end is much narrower and forms a free digitiform process, strongly curved. The surface is slightly rugose, minutely conulose and minutely and slightly hispid. The colour (in spirit) is dark purplish-grey, paler below and internally. Vents small (mostly minute), numerous, scattered on the upper surface. Inhalant pores abundantly scattered.

The main skeleton is a very confused reticulation of oxeote megascleres, here and there collected into loose bundles. There is no special dermal layer of tangentially disposed oxea, but the surface is rendered more or less hispid by the projecting points of oxea which lie below it. There is, however, a thin dermal layer of densely crowded asters.

Spicules.—(1.) Oxea (Plate V., fig. 2, *a*, *b*, *c*) slightly curved and gradually and sharply pointed; varying a good deal in diameter; about 1·0 millim. by 0·022 millim. when fully grown.

(2.) Chiasters (Plate V., fig. 2, *d*); very minute, with rather numerous, slender, cylindrical rays and little or no distinct centrum; total diameter about 0·006 millim. (sometimes a little more); most abundant at the surface, but also plentiful in the choanosome.

The ectosome is fairly thick, but is excavated by numerous irregular, spacious sub-dermal cavities, into which the inhalant pores open and from which the inhalant canals of the choanosome take their origin. It is clearly differentiated into two layers: an inner, comparatively thin and densely fibrous layer, with the fibres mostly lying parallel to the surface, and an outer, much thicker layer composed of collenchyma with a considerable admixture of fibrous tissue, but with the fibres running irregularly in all directions.

It is a noteworthy fact that the fibrous cells of the ectosome contain a large proportion of the pigment to which the sponge owes its dark colour, arranged in them in the form of minute spherical granules. Similar pigment granules also occur in some of the ordinary stellate cells of the collenchyma, of which the fibre-cells are but a slight modification.

The outer part of the ectosome also contains immense numbers of large, spherical, darkly staining cells, crowded together in large groups or loosely scattered. Similar cells also occur very abundantly, scattered singly or grouped in dense masses, in the choanosome. They remind one strongly of the symbiotic Algæ of *Hexadella* and the corresponding cells of *Asteropus haeckeli*, and are probably of a similar nature. Their immense numbers and their occurrence in such dense masses in both ectosome and choanosome are alone enough to suggest that they are not true constituents of the sponge-tissues.

This species appears to be very closely related to Carter's *Stellettinopsis* (*Coppatias*) *tuberculata* (18), an Australian species from which the Ceylon sponge differs chiefly in its external form and reptant habit.

R.N. 242 (Stat. XXVII., Cod Bay, Trincomalee, 5 fathoms).

Asteropus, Sollas (15).

Epipolasidæ with two sorts of asters, oxyasters and sanidasters.

Asteropus haeckeli, n. sp.—Plate V., fig. 3.

The single specimen is a small, irregular crust which has probably been attached by the base, to which fragments of calcareous débris are still adherent. The upper surface rises up into a broad, low, mammiform projection, with a single, rather large vent (about 2·5 millims. in diameter) at its apex. Surface smooth, but uneven and harsh to the touch, owing to the presence of huge oxea lying tangentially beneath the surface or projecting slightly beyond it. Colour (in spirit) pale grey. Texture internally coarse and cavernous, owing to the large exhalant canals.* Inhalant pores scattered. The specimen may be only a fragment of a much larger crust; its maximum breadth is about 25 millims., and its greatest height (where the vent is situated) about 11 millims.

The skeleton is a very dense and very confused interlacement of huge oxea, sometimes collected into very loose, ill-defined, coarse strands, which run towards the surface.

Spicules.—(1.) Oxea (Plate V., fig. 3, *a*); usually large and stout, fusiform, gradually and fairly sharply pointed at each end; curved; varying much in size, up to about 1·9 millims. by 0·065 millim. Numerous much shorter and more slender forms also occur, which may be immature.

(2.) Sanidasters (Plate V., fig. 3, *c*, *d*); with straight, slender axis dividing into two spines at each end, and with two irregular whorls of spines dividing the total length into three approximately equal parts; or with the axis irregularly spined, and perhaps angulated, so that the whole closely resembles a *Spirastrella* microsclere; total length up to about 0·016 millim. These spicules are very abundant at the surface and also common in the interior.

(3.) Oxyasters (Plate V., fig. 3, *b*); with few, slender, very slightly spined or roughened (? sometimes smooth), sharp-pointed rays and no distinct centrum; total diameter measured up to about 0·04 millim. These spicules are found in the interior of the sponge, but are scarce and easily overlooked.

The ectosome is very thick, and composed of a mixture of cystenchymatous and collenchymatous tissue, slightly fibrous in places, and with numerous darkly staining, oval cells scattered through it, which somewhat resemble the symbiotic Algæ of *Hexadella*, and are probably of a similar nature.

* The oscular tube is occupied by a Polychæte worm.

This species is closely related to Carter's "*Stellettinopsis simplex*," from Australia (Fremantle and Port Phillip Heads),* for which Sollas (15) established the genus *Asteropus*, and which, with the doubtful exception of Schmidt's *Stellettinopsis annulata*, has, up to the present time, remained the only described species of the genus. (Topsent has shown (28) that Lendenfeld's *Asteropus incrustans* is not referable to the genus *Asteropus* at all.)

The occurrence of another species in Ceylon waters is extremely interesting and affords a good illustration of the close relationship which exists between the Sponge-Fauna of this region and that of Australia. That the two species are not identical I have been able to convince myself by personal examination of a fragment of an Australian specimen kindly forwarded to me some years ago by the authorities of the British Museum (Natural History). The differences concern chiefly the arrangement of the vents, the colour (tawny-brown in the Australian species), and the size of the oxea (which are considerably more robust in the Ceylon species). Still, it is possible that the future discovery of intermediate forms may justify us in uniting the two.

I have taken the liberty of naming this species in honour of the most distinguished author of 'Die Kalkschwämme.'

R.N. 219 (deep water outside pearl banks, Gulf of Manaar).

Cryptotethya, n. gen.

Epipolasidæ in which the ectosome is differentiated into a thin, inner fibrous layer, very dense, and a thick, outer, more or less gelatinous layer. The outer layer is produced into more or less elongated, finger-like projections, between the bases of which the more or less spherical body of the sponge is largely concealed by agglutinated foreign bodies. The main skeleton is radially arranged, consisting of large oxea extending through choanosome and ectosome alike. The microscleres are euasters.

As regards its spiculation, this genus agrees very closely with *Coppatias*, and, like the latter, is evidently very nearly related to *Stelletta*. In the structure of the ectosome it makes a close approach to *Stelletta herdmani*, in which also the triænes have undergone considerable reduction. In fact, *Cryptotethya* may be regarded as derived from some such form as *Stelletta herdmani* by further reduction of the triænes and by the outgrowth of the ectosome into finger-like processes. In the spherical form of the body, and the radial arrangement of the skeleton, it is also related to *Tethya*, but perhaps its nearest ally is Sollas's genus *Magog*, established (15) for the reception of Carter's *Chondrilla sacciformis*, from Mauritius, and included by Sollas amongst the Tethyidæ. In *Cryptotethya*, however, the oxea are not confined to the choanosome as in *Magog*. Both genera appear to me to come most naturally amongst the Epipolasidæ, though they certainly seem to indicate the manner in

* Mr. Carter (27) also records the species from Hayti, but the Haytian form is very likely specifically distinct from the Australian.

which the Tethyidæ may have originated, through the Epipolasidæ, from stellettid ancestors.

Cryptotethya agglutinans, n. sp.—Plate V., figs. 4, 5.

The single specimen (Plate V., fig. 4) consists of a more or less spherical body from which radiate irregular finger-like processes of varying shape, long or short, cylindrical or flattened, and sometimes expanded at the free end. Between these projections the surface of the sponge is for the most part concealed by a great quantity of calcareous débris which firmly adheres to the sponge, including melobesian nodules of considerable size, worm-tubes, Foraminifera, &c., the whole forming an irregular mass in the midst of which the body of the sponge is scarcely recognisable. Calcareous débris may also be found in the interior of the sponge, even within the choanosome. I have not succeeded in making out the arrangement of the vents and pores. Some small openings on the ends of some of the projections resemble vents, but on close examination are found to be merely the apertures of cavities inhabited by parasitic barnacles. One at least of the shorter projections (fig. 4, *x*), however, contains longitudinal canals which are evidently either inhalant or exhalant canals proper to the sponge. The surface of the sponge, where exposed, is very uneven and very harsh to the touch, owing to the projection of the large oxea, which readily break off in one's skin and thus make the sponge very unpleasant to handle. The colour of the surface and of the thick outer layer of the ectosome (in spirit) is grey, of the thin fibrous layer of the ectosome white, and of the choanosome nearly white. The maximum diameter of the body of the sponge is about 40 millims., the length of the longest projection about 25 millims.

In the body of the sponge the huge oxea of which the skeleton is composed are for the most part arranged radially and without any distinction between choanosome and ectosome, passing indifferently from one to the other through the dense fibrous layer. Some of the oxea are associated in loose bands which spread out in brushes as they approach the surface. In the projections the oxea naturally lie for the most part longitudinally, but at the expanded end of a broad projection (containing longitudinal canals) I have found a good many placed tangentially at or near the surface. The asters are for the most part arranged (very abundantly) in a thin dermal layer, through which the points of the oxea may project for a short distance.

Spicules.—(1.) Oxea (Plate V., fig. 5, *a*, *b*); stout, fusiform, usually gradually and fairly sharply pointed, but subject to some irregularity at the ends and occasionally stylote. Size very variable, say about 2·5 millims. by 0·073 millim. when fully grown, but often less.

(2.) Chiasters (Plate V., fig. 5, *c*), with little or no centrum and smooth, slender, sub-cylindrical rays, ending bluntly, but not tylote; total diameter commonly about 0·012 millim. These spicules are most abundant at or near the surface of the sponge, but a few precisely similar forms occur in the choanosome.

Owing, on the one hand, to the enormous quantity of foreign matter adhering to the surface, and, on the other, to the great size of the megascleres, which interfere greatly with the cutting of thin sections, the investigation of the canal system of this sponge is attended with exceptional difficulties, and I have come to no satisfactory conclusions on the subject.

One of the most striking features of the sponge is the dense fibrous layer of the ectosome, which, when the sponge is cut in half, is conspicuous even to the naked eye as a white layer about 0·4 millim. thick, dividing the body into inner and outer portions, and forcibly calling to mind the similar layer of fibrous tissue in *Stelletta herdmani*. This dense fibrous layer consists of bundles of fine fibres closely matted together and running in all directions. It does not, perhaps, form quite the innermost portion of the ectosome, for beneath it lies a thin gelatinous layer containing subcortical crypts, from which the inhalant canals of the choanosome probably take their origin.

The outer layer of the ectosome varies much in thickness. It is partly collenchymatous, consisting of a clear gelatinous matrix with an immense number of large granular stellate cells embedded in it, and partly fibrous, the fibrous condition being apparently arrived at by elongation of similar cells in a direction parallel to the surface. Roughly speaking, this fibrous tissue may be said to occur between two layers of the collenchyma, but the two kinds of tissue are not sharply differentiated from one another, and the fibrous layer is not nearly so well defined or so dense as the inner fibrous layer already described. The outer layer of the ectosome alone takes part in the formation of the finger-like projections on the surface of the sponge, the inner fibrous layer not being continued into these.

The choanosome is rather compact and finely granular, but, owing perhaps to want of penetration by the preserving medium, my sections do not enable me to make out details of the histology or the arrangement of the flagellate chambers.

R.N. 62 (Gulf of Manaar).

Family: TETHYIDÆ.

Astromonaxonellida with stylote megascleres and euasters for microscleres; with strongly developed fibrous cortex and radially arranged skeleton.

I have discussed the probable origin of this family in speaking of the genus *Cryptotethya*.

Tethya, Lamarck.

More or less spherical Tethyidæ, without highly specialised pore-bearing grooves and without a sand-layer in the choanosome.

Tethya lyncurium, Lin.

There are in the collection a number of specimens of *Tethya* which have given me a great deal of trouble as regards their correct nomenclature. I have finally decided to

regard them as belonging to three varieties of the well-known and extremely variable *Tethya lyncurium* of European waters. For convenience of reference we may distinguish the Ceylon varieties as *a*, *b*, and *c* respectively.

Tethya lyncurium, Lin., var. *a*.

This variety is represented by two approximately spherical specimens growing side by side on a mass of calcareous and other débris. The larger of the two is about 20 millims. in diameter, the other only a little less. The colour in spirit is dull yellowish-grey. The surface is irregularly conulose and gemmiparous, not distinctly tessellated, and to a considerable extent covered by adherent foreign matter. Each has a single prominent and widely open vent, about 2 millims. in diameter, at the summit of a thin-walled tubular projection. The pore-sieves between the conuli are for the most part inconspicuous.

The cortex is very dense and more or less fibrous throughout, but the fibrous tissue is most strongly developed in its deeper portion. The inhalant canals in the cortex are lacunar near the surface and constricted into definite canals deeper down.

The main skeleton consists of stout radiating bundles of megascleres, breaking up into divergent brushes in the cortex. In the choanosome (but not in the cortex) loose spicules of similar form are abundantly scattered (mostly lengthwise) between the bundles.

The megascleres are rather slender, faintly tylote styli, of the ordinary *Tethya* form. The feebly developed head is narrower than the middle of the shaft, and the apex is gradually and more or less sharply pointed. These spicules measure about 1·3 millims. by 0·02 millim. in the main fibres, but are much smaller in the surface brushes, while between the main fibres, in the choanosome, the sizes are mixed.

The microscleres are of two forms only, spherasters and chiasters. The spherasters are mostly found in the cortex, where they are rather sparingly scattered. The centrum is fairly large, and they have sharp-pointed conical rays which may be (rarely) spined or branched. The rays are about 12 in number, and nearly or quite touch one another at their bases. Total diameter about 0·076 millim., with rays 0·02 millim. long. In the cortex the chiasters are most abundant at the surface and in the walls of the inhalant canals; they are also numerous in the choanosome. They have no centrum and about from 6 to 9 distinctly tylote, rather slender rays. The total diameter of the chiaster is about 0·012 millim. Those of the choanosome are commonly six-rayed, and the rays are occasionally more elongated and proportionately more slender than in the ordinary form, but they are almost always distinctly tylote, and the whole spicule is never more than about 0·02 millim. in diameter.

I am convinced that the two specimens described above cannot be distinguished more than varietally from the common European species. The chiasters are, it is true, more distinctly tylote than is usually the case in *T. lyncurium*, but I cannot regard this character as of specific value, for in a specimen from Budleigh Salterton,

in Mr. CARTER'S collection (now in my possession), the rays of the chiasters are occasionally tylote, though not nearly so strongly as in the Ceylon specimens.*

R.N. 199, 200 (Stat. LXVII., off Talaivillu Paar, 10 to 14 fath., Gulf of Manaar).

Tethya lyncurium, LIN., var. *b*.

There are five specimens in the collection which may be referred to this variety, differing from the foregoing in the following respects:—

(1) There are no prominent vents.

(2) The surface is more or less distinctly tessellated.

(3) The spherasters are considerably larger and more numerous, and have more numerous rays and larger centra. Total diameter up to about 0·1 millim., with rays about 0·024 millim. long; sometimes they are a little smaller; usually they are densely crowded in the cortex; the number of rays appears to be usually about 25.

(4) The chiasters are more distinctly differentiated into two kinds, the rays of those of the choanosome showing a strong tendency to lose their tylote character and become strongylote or even oxeote, while at the same time elongating somewhat (but not much) and being (? always) slightly roughened.

The largest of the five specimens is only about 21 millims. in diameter. The colour in spirit is dull grey.

R.N. 180, 180A, 180B (all from Lagoon, Galle); 196; 211 (Gulf of Manaar).

Tethya lyncurium, LIN., var. *c*.

This variety is represented by a single specimen, about 24 millims. in maximum diameter, with very strongly tessellated surface and one prominent vent. The cortex is very lacunar between the polygonal, flattened tesseræ.

As regards spiculation, this variety differs from the preceding only in the presence of numerous well-developed oxyasters, chiefly in the choanosome. These spicules have little or no centrum and usually six rays. The rays are rather slender and sharp-pointed, sometimes slightly roughened, but very rarely spined or branched; usually straight or nearly so. Total diameter of the oxyaster about 0·04 millim.

This variety might be justifiably identified either with SELENKA'S *Tethya maza* or with PERCIVAL WRIGHT'S *T. seychellensis*, but the two preceding varieties unite it so closely with *T. lyncurium* that it seems to me quite unnecessary to make a specific distinction.

R.N. 19 (Gulf of Manaar).

The occurrence of these three varieties of *Tethya lyncurium* within the same limited area is a very interesting fact, and their discovery is likely to be of great assistance in elucidating the relationship of the so-called species of this extremely difficult genus. In this connection it is interesting to note that WILSON (29) has lately recorded the occurrence of both *T. lyncurium* and *T. seychellensis* in Porto Rico.

* TOPSENT, however, entertains (14) a different view as to the taxonomic value of the tylote character.

Xenospongia, Gray.

Tethyidæ of discoidal form. Choanosome containing much sand in its deeper parts. Inhalant pores localized in well-defined grooves, partly concentric and partly radial in arrangement. Vents on slight prominences. Surface tuberculate. Skeleton composed of bundles of styli ending in brushes, which project from the surface tubercles and also form a slight marginal fringe. Microscleres euasters of various forms and sizes, forming a dense cortical layer, and also abundantly scattered in the choanosome.

The genus *Xenospongia* was established by Gray (30) as far back as 1858 for the reception of two remarkable sponges from Torres Straits, of which he gave a very poor description accompanied by excellent figures of the external characters only. He made no attempt to describe the spiculation, and, although this defect was partially remedied by Carter in 1882, our knowledge of the sponge has remained singularly incomplete up to the present day. The genus has only been recorded once since its original discovery, viz., by Holdsworth (9) from the Ceylon pearl banks in 1873. No description, however, has ever been published of Holdsworth's specimen, and the identification with Gray's species, though doubtless correct, was quite unsupported by evidence. Holdsworth's record and specimen (which appears to have been forwarded to Gray for further investigation) both seem to have been lost sight of by subsequent writers.

Under the circumstances, it is not remarkable that the systematic position of *Xenospongia* has hitherto remained doubtful. Gray himself, in 1868 (31), made it the type of a new family, for which he proposed the name "Xenospongiadæ." Carter, in 1875 (32), referred it to his group "Donatina," along with *Tethya lyncurium*, but expressed the opinion that it might ultimately have to come amongst the "Suberitida." In 1882, however, this author (33) reverted to Gray's opinion, and proposed "a group named Xenospongina = Xenospongiadæ, Gray." Sollas, in 1888 (15), referred the genus doubtfully to the Tethyidæ, pending further information. Topsent, in 1898 (26), made a new departure by referring it to the Spirastrellidæ, though, as it seems to me, with very slight justification.

The minute investigation which I have been able to make of Professor Herdman's well-preserved specimen proves beyond doubt that the opinion of Sollas is correct, and that *Xenospongia* is very closely related to *Tethya* itself, alike in spiculation, skeleton arrangement, histology, and canal system, although the external form and the arrangement of the inhalant pores are very peculiar. Even the surface tubercles or conuli, and the somewhat pinkish colour in spirit, remind one strongly of the genus *Tethya*. In *Tethya* also one sometimes sees the beginning of the development of pore-bearing grooves between the conuli, and the branching of the rays of the asters, which takes place so extensively in *Xenospongia*, may also be observed occasionally.

Xenospongia patelliformis, Gray—Plate VI.

1858, **Xenospongia patelliformis**, Gray (**30**); 1867, **Xenospongia patelliformis**, Gray (**31**); 1873, **Xenospongia patelliformis**, Holdsworth (**9**); 1875, **Xenospongia patelliformis**, Carter (**32**); 1882, **Xenospongia patelliformis**, Carter (**33**); 1888, **Xenospongia patelliformis**, Sollas (**15**); 1898, **Xenospongia patelliformis**, Topsent (**26**).

The single specimen in the collection (Plate VI., fig. 1) has the form of an almost circular disk, about 28 millims. in diameter, with convex upper and slightly concave lower surface and rather thin and slightly undulating margin. The lower surface is formed by the agglutinated sand which makes up the greater part of the thickness of the disk. The upper surface is covered with rather small, rounded tubercles or conuli, thickly scattered at fairly regular intervals. These tubercles are about 1 millim. in diameter, and are normally hispid from the projection of the ends of large spicules, now generally broken off short. The margin of the sponge is also very shortly hispid from the same cause (figs. 1, 2, *m.f.*). Just above the margin two narrow grooves (figs. 1, 2, *m.p.g.*) run round the disk, separated from one another by an interval of about 1·5 millim., across which they occasionally communicate with one another by oblique connecting grooves. The width of the grooves varies up to about 0·5 millim., and the floor is crossed at right angles by narrow parallel bands of fibrous tissue of a whitish appearance, arranged very regularly at short intervals. The inhalant pores are very minute and arranged in transverse rows between the fibrous bands in the floor of the grooves (fig. 2). (In the specimens described by Gray similar grooves radiate more or less abundantly from near the centre of the disk towards the margin; in our specimen these radiating grooves are very feebly developed and recognizable in only a few places. fig. 1, *r.p.g.*) The vents, now more or less closed, are situated at the apices of three low, monticular elevations near the centre of the disk (figs. 1, 2, *o*); these elevations are not very conspicuous and are apparently formed each by the agglomeration of three or four of the surface conuli.* (Dr. Gray appears to have mistaken the inhalant pores, or groups of pores, for vents; some of the prominent elevations figured by him on his larger specimen probably bear the true vents, though one, at least, of these elevations appears to contain a parasitic barnacle; there appear to be no barnacles in our specimen, but a parasitic worm occupied one of the larger exhalant canals.)

The colour of the sponge on the upper surface (in spirit) is pale yellowish grey, with a faint pinkish tinge in places, reminding one much of *Tethya*. The texture is firm and compact, leathery above, but the greater part of the thickness of the disk is composed almost entirely of coarse sand (fig. 2, *s.g.*), firmly cemented together by the tissues of the sponge. This sand is exposed only on the lower surface. The total thickness of the disk in the middle is about 6 millims.

The main skeleton consists in the lower two-thirds of the thickness of the disk, or

* In addition to the vent-bearing elevations, there is one larger, wart-like protuberance containing some hard foreign body (fig. 1, *a*).

thereabouts, of the above-mentioned sand-grains, between which there are also numerous styli, arranged, partly at any rate, in irregular bundles, and various forms of asters. The upper third of the thickness of the disk is free from sand, and includes a considerable thickness of the choanosome as well as the cortex. Here the main skeleton is formed by stout bundles of styli running vertically to the surface and entering the tubercles, from which they project as dermal brushes (fig. 2, *d*, *b*). These vertical bundles of styli are crossed at right angles by similar bundles which lie near the inner limit of the sand-free layer of the choanosome and terminate in the feebly-developed spicular fringe (*m.f.*) at the margin of the disk.

The cortex (figs. 2, 3, *cort.*) is strengthened by an immense number of asters of various shapes and sizes, forming a very dense skeleton, especially towards the surface. Asters of various kinds are also very abundantly scattered through all parts of the choanosome.

Spicules.—(1.) Styli (Plate VI., fig. 4); long, slender, nearly straight, evenly rounded off at the base and tapering very gradually to the apex. The size of these spicules is so variable that it seems almost useless to give measurements. The largest are so long that it is difficult to get them unbroken; 1·7 millims. by 0·012 millim. is perhaps a fair average size for the full-grown spicule, but considerably stouter (and presumably also longer) examples frequently occur (broken) in boiled-out preparations, while the styli which fringe the edges of the pore-bearing grooves, for example, are, on the other hand, very much smaller than the measurements given above.

(2.) Euasters (Plate VI., figs. 5, 6); enormously abundant and varying so greatly in form and size that it is impossible to separate the different kinds sharply from one another. The following may, however, be regarded as the principal types:—

(*a.*) Spherasters with very small centrum and long, conical, stout, sharply and gradually pointed, often slightly curved actines, about 11 in number; total diameter of spicule about 0·1 millim., with centrum 0·02 millim. in diameter and actines 0·044 millim. long. These asters pass gradually on the one hand into smaller oxyasters, and on the other into larger forms with very irregularly curved and more or less (often much) branched actines; the most copiously branched forms appear to be characteristic of the sandy layer of the choanosome, where they may attain a total diameter of as much as 0·18 millim.

(*b.*) Minute chiasters, with about 8 fairly stout, sub-cylindrical, tylote actines; total diameter about 0·008 millim.

(*c.*) Oxyasters or spherasters, with small centrum and about 11 slender, conical, oxeote, minutely spined actines; total diameter about 0·02 millim. The actines are occasionally branched.

(*d.*) Similar to (*c.*), but with tylote actines; this is perhaps the most uncommon form of the aster.

After carefully removing the sand-grains from below, it is possible to prepare microtome sections of the outer portion of the sponge, including the cortex and that

portion of the choanosome which is free from sand. The cortex (Plate VI., figs. 2, 3, *cort.*) is about 0·13 millim. thick between the surface tubercles, but much thicker in the tubercles themselves, which are composed exclusively of cortical tissue and spicules. The greater part of the substance of the cortex is made up of asters of various forms and their accompanying scleroblasts, but it also contains bands of fibrous tissue running in various directions. Stout bands of dense fibrous tissue (figs. 2, 3, *f.b.*) also run vertically inwards from the cortex through the outer part of the choanosome to the sandy layer, where they appear to assist in binding the sand-grains together. The vertical spicule-bundles which run into the surface tubercles are also accompanied by similar bands of fibrous tissue (fig. 2), and the same kind of tissue is also developed in connection with the vents and the pore-bearing grooves.

A noteworthy feature of the cortex is the presence of the very numerous, approximately spherical, vesicular scleroblasts (fig. 3, *scl.*), about 0·016 millim. in diameter; each resembles a cystenchyme cell and encloses one of the smaller asters, the ends of whose actines abut against the thin limiting membrane of the cell, or perhaps sometimes project beyond it. Similar scleroblasts may be observed in the choanosome. The outermost part of the cortex is composed of small-celled chondrenchymatous tissue; the inner part is more or less fibrous, and between the two we find collenchyma with stellate connective-tissue cells.

The flagellate chambers (fig. 3, *fl.c.*) are oval or nearly spherical, closely crowded together in the choanosome and about 0·028 millim. in diameter where least contracted by shrinkage. The state of preservation is not sufficiently good to enable me to make out minute details very satisfactorily, but the chambers are apparently eurypylous.

The inhalant pores are, as I have already observed, minute openings in the floor of the pore-bearing grooves (fig. 2, *m.p.g.*). They are very numerous, and 10 or more may be indicated in a single transverse section of the groove. From each pore a very narrow inhalant canal runs vertically inwards and opens, with its fellows, into a system of irregular crypts which lie beneath the thick floor of the groove and from which wider inhalant canals take their origin and run inwards to the choanosome, in which they sub-divide into smaller branches. Stout bands of dense fibrous tissue run across in the floor of the groove from side to side, between the transverse rows of inhalant pores and pore-canals. Probably, by the contraction of these bands of fibrous tissue, the prominent lips of the groove can be brought together and the groove thus closed.*

The main exhalant canals are only moderately wide and converge towards the vents. Owing to the state of contraction I am unable to say whether there is a single large vent or a group of small ones on each of the vent-bearing prominences. Sections indicate that there may also be small vents between the conuli, and it appears as if one exhalant canal sometimes opens through several small apertures.

* A very similar arrangement is found in a very different sponge, *Esperella murrayi*, as described in the Report on the 'Challenger' Monaxonida.

The geographical distribution of *Xenospongia patelliformis* is, as pointed out by Holdsworth (9), very interesting; the only records up to the present time being Torres Straits and Ceylon. That the specimens met with in these two localities are specifically identical, I have little doubt. Gray, in describing the species from Torres Straits, gave no description of the spicules, and did not even mention the occurrence of asters. Carter, to some extent, remedied this defect in 1882 (33), but he only figured two forms of aster, and those not very characteristic. His microscopical preparations, however, which are now in my possession and which were presumably made from one of the Torres Straits specimens (for Holdsworth's specimen and record from Ceylon appear to have been entirely lost sight of ever since his note on the subject was published), show both large and small asters of various forms, and the actines of the large ones may occasionally branch. Mr. Carter's preparations are only teased; had they been boiled out from all parts of the sponge, they would probably have shown all the forms of aster described above from Professor Herdman's example.

The external form is, of course, extremely characteristic, and so little does it look like a sponge that the specimen described above was in the first instance placed amongst the Clypeastroids.

R.N. 375. (Stat. 1. First haul of trawl, off Negombo, 12 to 20 fathoms, January 31, 1902.)

Family: SPIRASTRELLIDÆ.

Astromonaxonellida usually of massive or encrusting form. Skeleton usually irregular or reticulate, at any rate internally. Megascleres usually stylote or tylostylote. Microscleres asters of various forms.

Hymedesmia, Bowerbank.

Thin encrusting Spirastrellidæ whose spiculation consists of smooth tylostyli and euasters of various forms (occasionally passing into spirasters).

Topsent has given an excellent account of the literary history of this genus in his Monograph of the Sponges of France (14). A very large proportion of the known species come from the Gulf of Manaar, and were described by Mr. Carter (4) in 1880: viz., *H. stellivarians*, *H. moorei*, *H. spinatostellifera*, *H. capitatostellifera*, and *H. trigonostellata*. Of these five species I have only met with one in Professor Herdman's collection.

The genus is an extremely interesting one from the phylogenetic point of view, for we see here, in the first place, the first appearance of the characteristic suberitid "pin-head" spicule (tylostyle), and, in the second place, the evolution of the typical spirastrellid microsclere from the euaster.

Hymedesmia forms a connecting link between *Coppatias* and *Spirastrella*,

Coppatias, as we have already seen, is simply a reduced Stellettid in which the cladi of the triænes have become completely aborted, and the megascleres now consist solely of oxea. From the oxeote to the tylostylote form appears at first sight a big jump, but I think it is evident that the pin-headed type in *Hymedesmia* is simply the result of the thinly encrusting habit. The megascleres in this genus are typically arranged at right angles to the base of support, with their apices projecting outwards, often beyond the surface of the sponge, an arrangement which is admirably adapted both to support the soft tissues and to protect the sponge from the attacks of parasitic Crustaceans or other enemies. In this position the proximal end of the megasclere, pressed against the hard base of attachment, is unable to elongate in the normal manner, and siliceous material, which would otherwise have been devoted to its elongation, is accumulated in a swelling or knob—the "pin-head."

Such is, I believe, the origin of the spirastrellid and suberitid tylostyle, and an exactly analogous process appears to have taken place in the echinating spicules of the Ectyoninæ, which are commonly swollen into a "head" at the end which abuts against the skeleton fibre. The at first sight tempting idea that the head of the tylostyle is the vestige of the cladome of a triæne is put completely out of court by the fact that it lies at the wrong end of the spicule, viz., the proximal instead of the distal end.

The evolution of the typical spirastrellid spiraster from the euaster has evidently taken place by elongation and bending of the centrum of the latter, and various stages of the process may be seen in different species of *Hymedesmia*; indeed, the two forms of aster pass so insensibly into one another that it is impossible to base a generic distinction upon their character alone. In the spirastrellid spiraster the rays (actines) are commonly reduced to mere spines or minute blunt projections.

Hymedesmia stellivarians, Carter.

1880, **Hymedesmia stellivarians**, Carter (4).

The single specimen forms a thin yellowish crust, attached to a small melobesian nodule, in company with *Paresperella serratohamata*, &c. In spite of the somewhat meagre character of Mr. Carter's description and figures, I think there can be little doubt of the correctness of the identification, especially as Mr. Carter's specimen also came from Ceylon waters.

All three forms of aster mentioned by Mr. Carter are present, but they are not all of the same size, as might, perhaps, be inferred from his description and figures. Moreover, in our specimen the megascleres are usually a good deal longer in proportion to their thickness than Mr. Carter's figure indicates, but they are also very variable in dimensions.

Under the circumstances it seems desirable to give the following particulars as to the spiculation:—

(1.) Tylostyli; only slightly curved, if at all; with oval head at one end and

gradually and more or less sharply pointed at the other; size variable, up to about 0·47 millim. by 0·01 millim.

(2.) Spherasters; (*a*) comparatively large, with large centrum and stout, smooth, conical, sharply pointed rays; closely resembling the large spherasters of *Tethya*; total diameter about 0·02 millim.; (*b*) of medium size, with moderately developed centrum and stout, sub-cylindrical, very distinctly tylote rays (? heads sometimes roughened), about as long as the diameter of the centrum; total diameter of spicule about 0·012 millim.; (*c*) small, with very small centrum and comparatively long, slender, sharp-pointed rays; total diameter about 0·008 millim. (possibly young forms of one or both of the others).

R.N. 220B (deep water off Galle and onwards up West Coast of Ceylon).

Hymedesmia curvistellifera, n. sp.—Plate V., fig. 6.

Sponge thin, encrusting. (The single specimen has evidently been removed from the surface of some Alcyonarian, the large calcareous spicules of which still adhere in great numbers to the base of the sponge.) Surface uneven, corrugated, very slightly hispid. Colour (in spirit) light brown; texture rather friable. Vents and pores not seen. Average thickness of specimen about 0·5 millim.

The main skeleton consists of loose fascicles of tylostyles, springing from the base of attachment and running to the surface, where they spread out in loose brushes and give rise to the more or less hispid character.

Spicules.—(1.) Tylostyli (Plate V., fig. 6, *a*); straight, or nearly so, with large, oval or sub-globular heads and rather slender, sub-fusiform shafts, gradually and usually finely pointed at the apex. Size, when fully developed, about 0·38 millim. by 0·006 millim. Many much more slender forms, with proportionally larger heads, sometimes pear-shaped, also occur; these I take to be immature spicules.

(2.) Asters (Plate V., fig. 6, *b*, *c*, *d*); with strongly-curved centrum and stout, conical, sharp-pointed, smooth spines (rays). The spines show a tendency in some cases to arrange themselves in three groups, one group at each end of the centrum and one in the middle, on the convex side of the curve. The middle of the concave side of the centrum is free from spines, but the curvature is so great that this part of the centrum is often concealed from view, and the spicule then resembles a spheraster. The total diameter of the aster, when fully developed, is about 0·032 millim., but numerous smaller (young) forms also occur. The asters are most abundant in the dermal layer, where they form an almost continuous crust.

This species finds a near relative in Topsent's *Hymedesmia tristellata* (14), from Banyuls and the Azores. Closely similar asters occur in that species, but their rays are often covered with minute spines, which I have never seen in the Ceylonese form. I cannot agree with Topsent's view that the "triple spherasters" (as he terms them) have resulted from the concrescence of three centra covered with actines; it appears to me, on the other hand, that they have arisen by elongation of the centrum and

grouping of the actines, and that we have here the first stage in the evolution of the typical *Spirastrella* microsclere. From this point of view it is of great interest to compare RIDLEY's *Spirastrella transitoria* (16), from the Amirante Group. This is a thinly encrusting species, with "spinispirular, extremely concentrated, composed of only one entire bend," in fact, very closely resembling the aster of *Hymedesmia curvistellifera*. As RIDLEY further observes, "in *S. transitoria* we have the spinispirular almost in the form of the stellate, with which SCHMIDT . . . . . and CARTER . . . . . consider it to be homologous."

S. transitoria is evidently closely related to *S. curvistellifera*, but differs in the proportions of the spicules. Both species, together with *H. tristellata*, and possibly some others, undoubtedly occupy a position intermediate between the typical species of *Hymedesmia* on the one hand and of *Spirastrella* on the other, so that they might, with almost equal propriety, be referred to either genus.

R.N. 320 (Ceylon seas).

Spirastrella, SCHMIDT.

Massive Spirastrellidæ with styli or tylostyli for megascleres and spirasters for microscleres; the spirasters usually forming a dermal crust.

Spirastrella vagabunda, RIDLEY.

1884, **Spirastrella vagabunda**, RIDLEY (16).

There are in the collection a number of specimens which, while differing greatly in external form, agree so closely in spiculation that I am obliged to regard them merely as varieties of one and the same species, which appears to be identical with RIDLEY's *Spirastrella vagabunda*. This species was originally described by RIDLEY from Torres Straits, but at the same time he assigned to it certain specimens in the British Museum Collection which came from Trincomalee and the Galle Coast, Ceylon, a fact which, of course, strongly supports my identification of Professor HERDMAN's specimens. The Trincomalee specimen referred to was very briefly described by CARTER (33) under the name "*Suberites* ? sp." RIDLEY, having examined the same specimen, suggested (*loc. cit.*) that it should be distinguished as "*S. vagabunda* var. *trincomaliensis*," on account of certain slight differences in spiculation. In Mr. CARTER's cabinet, now in my possession, there is a preparation, labelled in his handwriting "*Suberites trincomaliensis*," which is evidently from the specimen examined and described by him. Subsequently, in 1886, Mr. CARTER (20) described a sponge from the Mergui Archipelago under the name *Suberites trincomaliensis*, identifying it with the Ceylonese form.

Spirastrella vagabunda thus appears to be a widely-distributed and variable species. RIDLEY's *Spirastrella congenera*, from Torres Straits, is probably a mere variety of the same, and perhaps, also, his *S. punctulata*, from Mozambique and Mauritius. The principal characters of the species appear to be the dense, confused

arrangement of the main skeleton, the usually stout and distinctly headed tylostyles, and the slender, more or less elongated spirasters.

I propose to regard Professor HERDMAN's specimens as belonging to four varieties of the species, which may be distinguished as *trincomaliensis*, *tubulodigitata*, *fungoides*, and *gallensis* respectively.

Spirastrella vagabunda, var. **trincomaliensis**, RIDLEY.

1882, "**Suberites**, ? sp., undescribed, Trincomalee," CARTER (**33**); 1884, **Spirastrella vagabunda**, var. **trincomaliensis**, RIDLEY (**16**); 1886, **Suberites trincomaliensis**, CARTER (**20**).

The single specimen in the collection evidently agrees very closely with the specimen examined by CARTER and RIDLEY. It consists of a massive base rising up into a few short, stout, finger-shaped processes. The surface is sub-glabrous, but slightly corrugated vertically; not warty as described by CARTER (this character having probably been due to drying). The colour (in spirit) externally is nearly black, with a greenish tinge, internally dark greenish-brown. Texture compact throughout, but fleshy and fairly compressible, with little or no imbedded foreign matter. The exhalant canals are (in spirit) extremely narrow and surrounded by gelatinous tissue almost free from spicules; they run vertically upwards through the finger-shaped processes in considerable numbers and probably open by minute vents (now nearly all closed) at the apices of these projections. Greatest height of specimen 56 millims.; greatest breadth of massive base 52 millims.; length of finger-shaped projections about 23 millims.

The skeleton is a very dense and confused reticulation of megascleres, interlaced in all directions. On the surface some of them form, in places at any rate, very poorly developed surface brushes.

Spicules.—(1.) Styli and tylostyli; moderately stout, usually more or less curved or crooked; apices, and heads when developed, very variable and apt to be irregular; size of fully grown spicule about 0·62 millim. by 0·009 millim., but variable.

(2.) Spirasters; not very abundant and varying in form from the ordinary zig-zag to one with a simply but strongly curved axis with blunt projections on the convex side; length about 0·012 millim. These spicules agree closely in form and size with those in Mr. CARTER's preparation, although a good deal shorter than in the type of the species (according to RIDLEY's measurements).

R.N. 52 (Gulf of Manaar).

Spirastrella vagabunda, var. **tubulodigitata**, nov.

In this variety the sponge consists of hollow, finger-shaped processes or "fistulæ" rising from a sandy base to a total height of about 50 millims. Each process contains several wide, longitudinal exhalant canals, separated from one another by narrow partitions, and usually ends in a single conspicuous vent. The colour varies from light to dark grey.

The skeleton arrangement and spiculation agree closely with those of the last-named variety. The surface brushes of megascleres may or may not be well-developed in different parts of the same specimen.

In one specimen (R.N. 246) a single finger-shaped process swells up at its free end into an irregular nodular mass, and thus makes an approach to the variety *fungoides*.

In R.N. 218 the spirasters are rather longer and the megascleres have better developed heads, and are perhaps usually somewhat stouter than in the type of the variety.

R.N. 154 (type of variety); 218 (deep water outside pearl banks, Gulf of Manaar); 246; 352 (Ceylon seas).

Spirastrella vagabunda, var. **fungoides**, nov.

The type of this variety is an extremely irregular, massive specimen, growing amongst a quantity of nullipore and other calcareous débris. It is characterised especially by the presence of definite porous areas, either forming irregular depressions on the surface, like large pock-marks, or on the flattened tops of fungoid outgrowths. These are probably inhalant pore-areas, for there are at least two fairly large vents forming the outlets of wide oscular tubes; one of these vents is situated on a level with the general surface of the sponge, and the other on a low mammiform projection. The structure internally is somewhat cavernous, and the specimen contains a great deal of imbedded foreign matter. The size of the entire mass is about 88 millims. by 47 millims. by 47 millims., but a large proportion of it consists of nullipore, &c. The colour in spirit is pale yellowish-grey.

The main skeleton is dense and confused; surface brushes are developed in the pore-areas and, as usual, many at any rate of the spicules in these brushes are much smaller than those of the main skeleton.

Spicules.—(1.) Tylostyli; usually slightly curved; with stout fusiform shafts, well-developed, oval heads and finely and evenly pointed apices; size in main skeleton about 0·5 millim. by 0·0167 millim.

(2.) Spirasters; mostly long, slender and zig-zag; occasionally up to as much as 0·048 millim. long, but usually much shorter. Rarely more than 0·002 millim. thick, exclusive of spines; occasionally nearly straight.

In the possession of the occasionally much elongated spirasters this variety resembles Ridley and Dendy's *Spirastrella solida* (1) from the Philippine Islands, which should perhaps be regarded merely as another variety of *S. vagabunda*.

R.N. 54 (type of variety, Gulf of Manaar); 253 (Ceylon seas).

Spirastrella vagabunda, var. **gallensis**, nov.

The larger of the two fragments by which this variety is represented in the collection is an irregularly cylindrical piece, about 52 millims. in length, and varying in diameter from about 10 millims. to about 19 millims. The texture is compact and

firm and the specimen contains a good deal of coarse sand imbedded in it. The colour (in spirit) is pale yellowish-grey. The surface is smooth, but rather uneven. No vents visible. Pores scattered in small groups ?

The main skeleton is a very dense and confused reticulation of stout megascleres. The preparation only shows very feebly developed surface brushes.

Spicules.—(1.) Tylostyli; usually curved, with stout, fusiform or sub-fusiform shafts and well-developed ovoid heads; apex gradually and evenly and fairly sharply pointed. Size when full grown about 0·5 millim. by 0·019 millim.

(2.) Spirasters; short and slender, closely resembling those of var. *trincomaliensis;* about 0·012 millim. long; not very abundant.

R.N. 178 (type of variety), 179 (both from Lagoon, Galle, June, 1902).

Spirastrella tentorioides, n. sp.—Plate V., fig. 7.

The single specimen bears a striking resemblance in external form to *Tentorium semisuberites*, consisting of a short columnar body ending above in a strongly convex and sharply-defined pore- and vent-bearing area of darker colour* than the remainder of the surface. The surface of the column is subglabrous and irregularly furrowed longitudinally. On one side a much smaller column is given off as a vertical offshoot, terminating above like the large one. The specimen is attached below to a mass of calcareous débris by a broad base and narrows somewhat towards the apex of the column. Total height about 24 millims. Diameter of the column in the middle about 15 millims. Colour (in spirit) light grey. There are several wide exhalant canals running vertically through the column, and probably several smallish vents at the apex. Only one vent, however, is now visible, forming the outlet of the largest canal, and measuring only about 1·5 millim. in diameter. The inhalant pores are scattered between the surface brushes of spicules on the rounded apex of the column, around the vents.

The main skeleton is a very dense, confused reticulation of megascleres, permeating the whole of the soft tissues, close up to the walls of the canals, on the one hand, and to the dermal surface on the other. In this reticulation the spicules lie in all directions, but around the inhalant canals they are mostly placed lengthwise, with their apices pointing upwards. Surface brushes are confined to the rounded summit of the column, where they are well-developed.

Spicules.—(1.) Tylostyli (Plate V., fig. 7, *a*, *b*); straight or slightly curved, with stout, sub-fusiform shafts gradually and sharply pointed at the apex, and well-developed oval heads; size when full grown about 0·66 millim. by 0·0164 millim., but much smaller in the surface brushes.

(2.) Spirasters (Plate V., fig. 7, *c–g*); varying much in shape and size, usually slender, but sometimes stout; *e.g.*, (*a*) short, slender, simply curved, with projections (hardly spines) on the convex side; length about 0·008 millim.; (*b*) short, slender,

* The darker colour is due to the entanglement of dirt amongst the spicule-brushes.

zig-zag, with projections on all sides; length about 0·016 millim., thickness about 0·002 millim. (excluding projections); (*c*) long, slender, zig-zag or crooked, with small, sharp spines on all sides; size about 0·048 millim. by 0·0027 millim. (excluding spines); (*d*) short, stout, zig-zag, with stout conical spines on all sides; size about 0·022 millim. by 0·004 millim. (excluding spines), with spines about 0·006 millim. long. The spirasters are abundant and form a thin dermal crust.

The canal system of this sponge is somewhat remarkable and, like the external form, reminds one of *Tentorium*. The wide exhalant canals, running vertically upwards to the apex of the sponge, have already been noticed. The inhalant pores, situated also at the summit of the sponge, lead into subdermal cavities from which very narrow inhalant canals run vertically downwards, more or less parallel with the oscular tubes. These canals unite together as they descend and, even in hand-cut and unstained sections, can be easily traced by the brown colour of their walls.

Considering the extraordinary variation which the species of *Spirastrella* exhibit, alike in external form and in the arrangement of pores and vents, I should hardly have considered characters of this nature alone sufficient to justify the establishment of a new one, but should have regarded this form as yet another variety of *Spirastrella vagabunda*. We have here, however, a stout form of the spiraster which is, perhaps, not represented in any of the varieties of that species, and this fact, taken in conjunction with the other characters, seems to me to justify a specific separation.

R.N. 239 (Ceylon seas).

Placospongia, Gray.

Spirastrellidæ with a stony spicular axis and a similar cortex, both composed of closely packed sterrospiræ; with bundles of tylostyles radiating from the axis towards the periphery. Cortex divided into polygonal areas by grooves containing the inhalant and exhalant apertures.

Placospongia carinata (Bowerbank).

[For Literature and Synonymy, see Vosmaer and Vernhout (35).]

In view of the very recent publication of the elaborate monograph on the genus *Placospongia*, by Vosmaer and Vernhout, it is unnecessary to say much about this interesting species. The presence of numerous parenchymatous spirasters ("spinispiræ"), and the fact that the dermal spicule is a microspire, justify the specific identification according to the views of the authors quoted. I also agree with Keller in placing the genus amongst the Spirastrellidæ, it having been shown that the "sterraster" of this sponge is a modified spiraster.

Carter (4) has described a species of *Placospongia* from the Gulf of Manaar which he identified as *P. melobesioides*, and this identification will no doubt hold good, for he expressly mentions the absence of spirasters ("spinispirulæ"). He has also (5)

recorded the same species from the vicinity of the Basse Rocks, off the south-east coast of Ceylon. It appears, therefore, that the two species, *melobesioides* and *carinata*, both occur in Ceylon waters.

R.N. 118 (Stat. V., off Chilaw, 10 fathoms).

Negombo, n. gen.

Spirastrellidæ consisting (? always) of tubular processes (? arising from a common base). Megascleres smooth styli; microscleres sanidasters.

This genus may, perhaps, have arisen independently from some sanidastrose form of Tetractinellid, but as regards its existing characters it is so closely related to *Spirastrella* that it may be included in the same family. It is also quite possible that its sanidaster may be merely a modified spiraster.

Negombo tenuistellata, n. sp.—Plate V., fig. 8.

Sponge consisting of a group of short, rather thin-walled tubes of very variable diameter, growing up close together, side by side, and more or less fused with one another laterally. Each tube ends above in a single widely-open vent, ranging in diameter from about 3 millims. to about 8 millims. All the tubes are broken off and widely open below, so that it is impossible to say whether or not there was a basal mass from which they sprung, but probably there was. The walls of the tubes contain a great number of large sand-grains embedded rather sparsely in them. The colour (in spirit) is pale yellowish-grey, translucent; the texture rather soft and flexible, but fairly tough. The tubes do not vary greatly in height, the height of the longest being about 31 millims., while its width in the middle is about 6 millims.; the tube next to it is of about the same height, but as much as 12 millims. wide in the middle. The walls of the tubes are scarcely 2 millims. thick in the middle, thinning out somewhat towards the margin of the vent and thickening slightly towards the base. The outer surface of the tube-wall is rough, with more or less embedded sand-grains, and also, between the grains, irregularly reticulate with slightly-projecting ridges; I have not been able to find dermal pores in it. The inner surface of the tube-wall, on the other hand, is covered by a kind of dermal membrane, strengthened by a reticulation of megascleres, and bearing numerous small pores, resembling dermal pores but presumably exhalant, in the interstices of this reticulation.

The main skeleton consists of long styli, not forming definite fibres but sometimes collected into loose wisps. They mostly lie lengthwise in the thickness of the tube-wall and are more abundant in the middle of its thickness than elsewhere. On the inside of the tube-wall there is, as already indicated, a well-developed "dermal" reticulation of styli, crossing one another singly, or in twos or threes, in all directions parallel with the surface. On the outer surface of the tube-wall the dermal membrane contains very numerous microscleres and the megascleres lie at a slightly lower level. On both surfaces the dermal membrane is supported to some extent on

the outer ends of very loose, irregular wisps of styli which come off from the dense central portion of the main skeleton.

Spicules.—(1.) Styli (Plate V., fig. 8, *a*, *b*, *c*); rather long and rather slender, subfusiform, with the base rather narrower than the middle and the apex fairly gradually sharp-pointed; usually slightly curved; size about 0·54 millim. by 0·012 millim., but variable. The apices have a tendency to be irregular and occasionally the spicule becomes oxeote.

(2.) Sanidasters (Plate V., fig. 8, *d*); each in the form of a very slender rod, straight or slightly crooked, terminating at each end in a slight swelling or, perhaps, a couple of small spines, and bearing very slender spines along its length, usually most strongly developed in, or perhaps even confined to, a whorl on each side of the middle of the spicule. Total length about 0·012 millim.; maximum diameter, including spines, about 0·004 millim. These spicules appear to be almost, if not quite, confined to the dermal membrane on the outer surface of the sponge.

R.N. 362 (Stat. I., hauls 1–4, January 31, 1902, off Negombo, 12 to 20 fathoms).

Family: CLIONIDÆ.

Astromonaxonellida of boring habit; forming excavations in the shells of Mollusca and other calcareous bodies.

Cliona, Grant.

Clionidæ of which the complete spiculation is composed of tylostyli, oxea, and spirasters. One or two of these forms of spicule may be absent by atrophy.

It will be seen that I have adopted Topsent's views (**36**, **37**) as to this genus and its systematic position, in preference to those expressed in the Report on the "Challenger" Monaxonida.

Cliona margaritiferæ, n. sp.—Plate V., fig. 9.

The specimens in the collection consist of pieces of the shell of *Margaritifera vulgaris* (the Ceylon Pearl Oyster), abundantly excavated by the sponge. The chambers which it makes are rounded or oval in form, more or less crowded together, according to age, and connected with one another by narrow tunnels. From the inner sides of the chambers slender, elongated, conical canals radiate at various angles towards the inner surface of the shell. These outgrowths are shaped like spines, and, as in certain other species which I shall refer to later on, give the chambers a very characteristic appearance when viewed by transmitted light. From the outer side of each chamber are given off usually about two cylindrical canals, which perforate the outer layer of the shell at right angles to the surface and terminate in circular vents or pore-areas (fig. 2, on p. 144, shows a shell excavated by this sponge).

The walls of the excavations have a finely granulated or, under the microscope, frothy appearance, due to the presence of innumerable shallow, conchoidal depressions, which are in contact with one another all over the surfaces of the walls.

There is only room in the thickness of the shell for a single layer of chambers. When these have attained their full size, their transverse diameter is about 1·5 millims., but they may be considerably elongated. The diameter of the cylindrical canals which terminate on the outer surface of the shell varies up to about 0·65 millim. The outer end of each is closed, completely or partially, by a thin membrane containing numerous micro- and megascleres. Where the membrane in question stretches completely across the end of the canal, I assume it to be an inhalant pore-sieve, though the pores cannot now be seen; such a membrane may be supported by bundles of tylostyles converging towards the centre. The vents, on the other hand, are more or less widely open and surrounded by a thin, membranous diaphragm, also supported by tylostyles.

The body of the sponge itself (in spirit) forms for the most part a very thin lining (of a pale yellowish-brown colour) to the chambers.

Spicules.—(1.) Tylostyli (Plate V., fig. 9, *a*); straight, or nearly so, slender, very gradually and sharply pointed, and with well-developed globular heads; size about 0·25 millim. by 0·004 millim., with head about 0·006 millim. in diameter. These spicules occur scattered generally, as well as in the neighbourhood of the vents and pores.

(2.) Spirasters (Plate V., fig. 9, *b*, *c*, *d*); usually with about four angulations, fairly stout, and abundantly but rather minutely spinous, size about 0·024 millim. by 0·004 millim., but variable. These spicules pass by transitional forms (Plate V., fig. 9, *e*, *f*, *g*) into

(3.) Spined microxea (Plate V., fig. 9, *h*, *k*); usually bent or angulated in the middle, and measuring about 0·06 millim. by 0·0027 millim., but variable. These forms are extremely numerous in the deeper parts of the sponge. The gradual transition between spirasters and microxea in this species is extremely interesting.

The excavations made by *Cliona margaritiferæ*, even down to the spine-shaped outgrowths of the chambers, are closely similar to those of Hancock's *Cliona spinosa* (38) and *Thoosa cactoides* (38), but the spiculation is very different. *Cliona spinosa* occurs in shells of *Perna* and *Placuna*, and *Thoosa cactoides* in shells of *Meleagrina margaritifera*. Another distinct species, of closely similar form, occurs in shells of *Meleagrina albina?* and has been described by the same author (38) under the name *Cliona cervina*; the spiculation of this species makes a much closer approach to that of *C. margaritiferæ*, but the two appear to be quite distinct.

Topsent (37) has already described, under the name *Cliona indica*, a boring sponge infesting a pearl oyster from Ceylon. This species is evidently nearly related to ours, but the describer gives no information as to the character of the excavations or apertures, and the spiculation differs so much from that of our species that it is

impossible to suppose that the two are identical. Both belong, however, to TOPSENT's third division of the genus *Cliona*.

THIELE's *Cliona concharum* (39), from Japan, perhaps comes nearer to our species than any other, at any rate so far as the spiculation is concerned, the differences in this respect being so slight that subsequent researches may make it desirable to consider the two as being only varietally distinct. In the Japanese form, however, the chambers excavated by the sponge seem to be much smaller, while the spined microxea are a good deal longer (0·09 millim.), than in that from Ceylon.

CARTER's *Cliona warreni* (5), also from the Gulf of Manaar, on the other hand, is a very different species, and, according to TOPSENT (37), is identical with the European *Cliona celata*.

R.N. 261 (Gulf of Manaar—very abundant, and destructive, on the pearl banks).

FAMILY: SUBERITIDÆ.

Astromonaxonellida in which the megascleres are styli or tylostyli, and the microscleres have completely disappeared.

Suberites, NARDO.

Suberitidæ of varying form, but without mammiform projections on the surface. Spicules tylostylote (nearly always). Skeleton usually arranged radially, with surface brushes of spicules smaller than those of the main skeleton.

The genus *Suberites*, at any rate so far as its typical species are concerned, for it may possibly be of polyphyletic origin, is, as I have already indicated, probably derived from *Spirastrella* by loss of the spirasters. CARTER even admitted into the genus certain species with spirasters.

It is remarkable that there is only one species of the genus, and of that only a single specimen, in the present collection. In making my preliminary examination in Liverpool (which had to be done very hastily), I identified one of the specimens as *Suberites inconstans*, var. *digitata*, a form previously described by me from near Ceylon, but more careful examination subsequently revealed the presence of spirasters and thus proved that the specimen was really a *Spirastrella*.

Curiously enough, THIELE (39) has come to the conclusion that *Suberites inconstans* is in reality a *Spirastrella* in which I have overlooked the spirasters, these being, according to him, small and scarce. This is, of course, possible, but it is by no means proved. THIELE has apparently never seen specimens from Ceylon or India, but identifies certain specimens from Celebes with the species, under the name *Spirastrella inconstans*. Unfortunately I am unable to re-examine the types of the species here in South Africa, as the original specimens and preparations remained in the British Museum.

TOPSENT has sub-divided the old genus *Suberites* into a number of separate genera,

and there is a great deal to be said in favour of such a proceeding, though it is doubtful whether all of his distinctions can be maintained. *Suberites cruciatus*, for example, combines certain characters of TOPSENT'S *Laxosuberites* and *Axosuberites* with peculiarities of its own, and I prefer to make use of the old generic name in this instance.

Suberites cruciatus, n. sp.—Plate V., fig. 10.

Specimen consisting of a number of long, slender, flattened branches, springing from a short pedicel of similar structure to themselves and branching in an almost dichotomous manner, but with some of the branches fusing together again higher up. Total height of specimen about 91 millims.; length of pedicel to first fork about 14 millims., breadth 3·5 millims., thickness 2 millims.; breadth of separate branches about 2·5 millims.; thickness about 1·5 millims. Surface rather uneven, very minutely hispid, and beset with very numerous small rounded translucent areas, apparently pore-areas. Vents probably minute and scattered. Colour (in spirit) pale brown; consistence soft and very flexible.

The main skeleton consists of numerous loose bands of tylostyles running lengthwise through the sponge; with numerous similar spicules scattered between in a loose, irregular reticulation. I have not detected any spongin cement. Towards the surface this arrangement gives place to radiating brushes of tylostyles, whose apices project slightly beyond the dermal membrane. Between these brushes lie the fairly extensive sub-dermal cavities.

Spicules.—Tylostyli (Plate V., fig. 10), of rather peculiar form. Usually straight, slender, gradually and finely pointed at the apex: with heads usually elongated transversely at a little distance from the base of the spicule, so as to form a cross. This cruciate character is most pronounced in the youngest and slenderest spicules; in the mature forms the arms of the cross form rounded knobs projecting from the shaft usually at a very slight distance from the base; occasionally there are three of these knobs instead of two. The full-sized spicules measure about 0·31 millim. by 0·005 millim., with head about 0·0093 millim. across.

The shape of the tylostyle in this curious little sponge reminds one of the corresponding spicule in CARTER'S *Hymedesmia spinatostellifera* (4).

R.N. 315 (Stat. LV., outside Periya Paar, 24 fathoms).

FAMILY: CHONDROSIIDÆ.

Corticate Astromonaxonellida with complex canal system and small flagellate chambers. Without megascleres.

These sponges appear to be Astromonaxonellida in which the megascleres (and in the case of *Chondrosia* the microscleres also) have been lost by degeneration. Their strongly developed cortex and complex canal system show that they are not primitively simple forms like the Myxospongida, and, as the megascleres probably passed

through a monaxonellid condition before finally disappearing, we may include the family in the monaxonellid rather than in the tetractinellid grade, though, perhaps, logically speaking, it ought to occupy a distinct grade of its own. The form of the microscleres (when present) and the corticate character suggest a close relationship with the Tethyidæ.

The family will always be historically interesting as having formed the subject of one of F. E. SCHULZE's classical memoirs (40).

Chondrilla, SCHMIDT.

Chondrosiidæ with microscleres in the form of euasters of various kinds.

Chondrilla australiensis, CARTER.

1873, **Chondrilla australiensis**, CARTER (41); 1885, **Chondrilla australiensis**, LENDENFELD (42).

The specimens of this sponge form thin crusts of a greyish colour (in spirit) and irregular outline, spreading over masses of calcareous débris. One large specimen is about 80 millims. in greatest breadth. The surface is smooth and sometimes glabrous; it may be minutely reticulate when seen under a lens, and in one specimen (R.N. 185) it is very minutely papillate, with the spherasters so thickly aggregated in the papillæ that they touch one another. The vents are minute and scattered.

Having in my possession several of Mr. CARTER's own microscopical preparations of this species, evidently from the original types, I have been able to make a direct comparison and to assure myself of the correctness of the identification. In both Mr. CARTER's and Professor HERDMAN's specimens the spheraster, with smooth conical rays, measures about 0·028 millim. in diameter, and the oxyaster, with minutely spined rays, sometimes branched at the ends, measures nearly as much. In a Ceylonese specimen I find that neither spicule is strictly confined to either the cortex or the interior of the sponge, but while the spherasters are much more abundant in the cortex, the oxyasters are much more abundant in the interior.

It is noteworthy that Mr. CARTER has recorded (5) the occurrence of *Chondrilla nucula*, the common European species, from the Gulf of Manaar. This species appears to be of very wide distribution.

R.N. 17 (Gulf of Manaar); 185 (Donnan's Paar); 251; 376 (encrusting a shell of *Margaritifera vulgaris*, Cheval Paar).

Chondrilla australiensis, var. lobata, nov.

This variety is represented by two specimens (apparently obtained together) which differ conspicuously from the thin, encrusting form above described, being massively lobose, with comparatively large vents placed singly on the top of the lobes. The base of attachment is constricted to a few narrow projections on the lower surface, and the entire body of the sponge exhibits a swollen, tumid appearance. The vents measure up to 2 millims. in diameter, and each is surrounded by a thick, membranous margin, which, in its turn, is usually surrounded by a shallow groove. The surface

is sub-glabrous, but uneven and very minutely reticulate. The colour below (in spirit) is very pale grey, but on the upper parts of the lobes the grey is mottled with brown. The texture is compact and fleshy; compressible.

The two specimens are of about equal size; the one selected for measurement is about 42 millims. in length, 17 millims. in breadth, and 18 millims. in height. The cortex is about 0·164 millim. thick.

The spicules agree closely in form with those of the thin, encrusting variety. The spherasters are, however, rather smaller. They have, in both varieties, a strongly marked tendency for their rays to be reduced to low warts or even, perhaps, to disappear, so that in some cases the large centrum is left almost smooth, as in KELLER's *C. globulifera*, which is, however, specifically distinct.

A lobate variety of *C. australiensis* occurs also in Australia.

R.N. 286, 286A (deep water off Galle and onwards to Colombo. Hauls off Kaltura and off Mount Lavinia, 20 to 30 fathoms, February 19, 1902).

Chondrosia, NARDO.

Chondrosiidæ in which all the spicules have completely disappeared.

Chondrosia reniformis, NARDO.

This well-known Mediterranean species is represented in the collection by two specimens, both attached to the same fragment of a horny sponge. Each is roughly hemispherical in form, with wide base spreading out into a broad, thin "stolon" on one side. The surface is covered with low, irregular tubercles, which may be due in part to contraction. The vents are small and difficult to make out, sometimes, at any rate, on low mammiform projections. The structure of the dense fibrous cortex, with its pigment cells, and that of the choanosome, agree very closely, so far as can be made out in the material at my disposal, with SCHULZE's classical description (40). The pigment cells, however, appear to be mostly in the inner part of the cortex, instead of in the outer part as figured by SCHULZE; but this is not an important difference. Each specimen is about 13 millims. in diameter, and the colour (in spirit) is mottled grey and brown on the surface, and pale greyish-yellow internally.

R.N. 226 (two specimens; deep water off Galle and onwards up West Coast of Ceylon).

SUB-ORDER: SIGMATOMONAXONELLIDA.

Monaxonellida in which the typical microscleres are sigmata, or forms derived therefrom, normal astrose microscleres being absent.

The sponges which comprise this large sub-order may be regarded as descended from the tetractinellid sub-order Sigmatophora (family Tetillidæ) by reduction of the megascleres, in the same way that the Astromonaxonellida may be regarded as being derived from the tetractinellid Astrophora.

In dealing with the Astromonaxonellida I have already had occasion to point out that no reliable instance of the occurrence of true astrose microscleres in conjunction with sigmatose forms has ever been recorded, a fact which argues very strongly in favour of the primary cleavage of the Monaxonellida into two great groups corresponding to the tetractinellid sub-orders Astrophora and Sigmatophora. Since that part of my report was completed, however, and sent to England, TOPSENT's latest work on the 'Sponges of the Azores' (62), has been received here. In this work the author describes two apparent Sigmatomonaxonellida in which asters were met with, viz., *Vvesia alecto* and *Leptosastra constellata*, but in neither of these are other microscleres present.

In *Vvesia alecto* the asters are, as TOPSENT himself shows, simply transformed megascleres (spined oxea) with the spines greatly developed, so that they are clearly of secondary origin. It may be pointed out, further, that an analogous transformation takes place in the echinating megascleres of the genus *Cyamon*,* and, probably, also in the genus *Trikentrion*, giving rise to spicules which simulate true asters. It appears, therefore, that in certain Sigmatomonaxonellida astrose spicules have arisen secondarily by transformation of spined megascleres. It is obvious, however, that these cases do not affect the primary division of the Monaxonellida here adopted.

The case of *Leptosastra constellata* offers a more serious difficulty, for here there is no indication that the asters, which form a superficial crust, are other than true astrose microscleres. It is, however, a suggestive fact that the sponge in which they occur is an Ectyonine with spined styli. Two explanations appear to me possible:— (1.) The asters may not belong to the same sponge as the megascleres. Considering the well-known and frequent accidental admixture of the spicules of different species, caused either by the sponges growing over one another or by the taking in of foreign spicules in the same way that grains of sand are taken in, and especially in view of the fact that only a single specimen of the sponge has been obtained; although TOPSENT has assured himself to the contrary, I venture to think that we may be here dealing with a composite spiculation. (2.) It is not impossible that the asters, if proper to the sponge, may be derived secondarily from the spined styli, in much the same way as in the genus *Cyamon*. Their position at the surface of the sponge, however, and their apparently normal form, are opposed to this view. However, until we have further evidence before us, it is quite unnecessary to allow this isolated case of a single specimen to make us alter our views on the classification of the Monaxonellida.

Assuming then that the Sigmatomonaxonellida are derived from the tetractinellid Sigmatophora, the question arises where are we to seek for the point of contact between the two groups? The answer to this question is easily given, for in the genus *Gellius* we have a near approach to the massive species of *Tetilla*, such as *T. limicola*. The replacement of the tetractinellid megascleres by oxea in a massive

* See later under *Cyamon*.

Tetilla, accompanied by the complete loss of the radiate skeleton arrangement, both of which changes are already partially accomplished in such forms as *T. limicola*, would give us a typical *Gellius*, and in *Gellius* I believe we have the starting point of the entire sigmatomonaxonellid series.

From this starting point the Sigmatomonaxonellida have branched off in various directions in the course of their evolution. Total loss of microscleres has given rise to forms with the spiculation composed entirely of oxeote megascleres, constituting the family Homorrhaphidæ of Ridley and Dendy, and the strong development of spongin cement has led to the evolution of the very large sub-family Chalininæ, from which in turn some of the so-called Ceratosa have been derived by total suppression of the spicules and their replacement by horny fibre. The arrangement of the megascleres in a characteristic plumose fashion, accompanied in most cases by the replacement of many of the oxea by styli and the loss of microscleres, has given rise to the family Axinellidæ. The development of a new type of microsclere—the chela—by modification of the sigma, has given rise to the great family group Desmacidonidæ, within which the Ectyoninæ have arisen by development of spined echinating spicules.

In the Report on the "Challenger" Monaxonida, published 17 years ago, Mr. Ridley and I proposed to divide the Sigmatomonaxonellida (= Halichondrina) into four families, viz., Homorrhaphidæ, Heterorrhaphidæ, Desmacidonidæ and Axinellidæ, an arrangement which has been variously modified by subsequent writers, chief amongst whom is Topsent. This author (59) has united our Homorrhaphidæ and Heterorrhaphidæ in one family which he terms "Haploscleridæ," a proceeding which appears to me justifiable in view of the obviously close relationship between the two, and especially in view of the fact that the Renierinæ and Chalininæ have very probably arisen independently from different though closely related genera, the Renierinæ from *Gellius* (and perhaps other genera), and the Chalininæ from *Gelliodes* and *Toxochalina*, as well as, perhaps, in some cases from Renierinæ.

Topsent has also proposed the name "Pœciloscleridæ" in replacement of "Desmacidonidæ"—a proceeding which appears quite unnecessary, although the extent of his family is not quite the same as that of ours.

I therefore propose in this Report to sub-divide the Sigmatomonaxonellida amongst three families, viz., Haploscleridæ (including the Homorrhaphidæ and Heterorrhaphidæ of Ridley and Dendy), Desmacidonidæ and Axinellidæ. The Haploscleridæ, there can be little doubt, should stand first, and indeed occupy the position of a parent group from which the other two families have descended.

Family: HAPLOSCLERIDÆ.

Sigmatomonaxonellida in which microscleres when present are usually in the form of sigmata, or derivatives thereof, but never chelæ. The skeleton is reticulate and the fibre is typically not plumose. The megascleres are usually diactinal.

The most primitive sub-family of this group is undoubtedly the Gelliinæ, from which the Renierinæ and Chalininæ are clearly derived. The other sub-families may be in part Desmacidonidæ which have lost their chelæ; this I am able in the present Report to demonstrate pretty clearly in the case of the Phlœodictyinæ, which I have accordingly removed. Topsent has already removed the Tedaniinæ, Desmacellinæ, and Hamacanthinæ as being Desmacidonidæ without chelæ; this may be quite right, but until clear evidence that they are descended from chela-bearing forms is forthcoming, it seems to me equally justifiable to leave them in the parent group. A *Desmacella*, for example, may very well be an *Esperella* which has lost its chelæ, but it seems at least equally probable that it has never reached the stage of having any.

Sub-family: GELLIINÆ.

Haploscleridæ with diactinal megascleres, and sigmata or toxa or microxea for microscleres.

Gellius, Gray.

Gelliinæ with little or no spongin, the main skeleton being formed by a reticulation of oxea.

Gellius fibulatus (Schmidt).

1862, **Reniera fibulata**, Schmidt (47); 1880, **Reniera fibulifera**, Carter (4); 1892, **Gellius fibulatus**, Topsent (48).

There is in the collection a considerable quantity of this sponge growing amongst the branches of a Floridean Alga. I identify it with the European species by direct comparison with a preparation from a specimen from Budleigh Salterton in Mr. Carter's cabinet. The differences in spiculation are very slight. In our specimen the slightly curved and gradually sharp-pointed oxea measure about 0·184 millim. by 0·007 millim., and the sigmata about 0·02 millim. from bend to bend.

R.N. 51 (Gulf of Manaar); 299; 348; 350 (all growing in association with apparently the same kind of alga; the last three probably fragments of one and the same specimen).

Gellius angulatus (Bowerbank), var. **canaliculata**, nov.—Plate IX., fig. 7.

[For synonymy and references *vide* Ridley and Dendy (1)].

The single specimen is massive, rounded and slightly elongated, about 18 millims. long by 12 millims. in transverse diameter. It was probably attached by one end, and bears a group of vents at the other. The surface is even and smooth, conspicuously veined by ramifying exhalant canals, which run towards the (upper ?) end of the specimen and open there by means of the moderate-sized vents. Many of these exhalant canals lie just beneath the surface and are covered over only by a thin, translucent membrane, which easily gets rubbed off, leaving the canals as open

grooves. Between the exhalant canals there is no separable dermal membrane, and there are no conspicuous sub-dermal cavities. Texture between the canals very compact, but not very hard and rather friable. Colour (in spirit) very pale grey.

The skeleton is a very close and pretty uniform reticulation of single oxea, crossing one another in every direction. The dermal skeleton consists only of scattered oxea placed tangentially.

Spicules.—(1.) Oxea (Plate IX., fig. 7, *a*); rather slender, slightly curved, usually somewhat abruptly or even hastately pointed; about 0·25 millim. by 0·008 millim. to 0·01 millim.

(2.) Sigmata (Plate IX., fig. 7, *b*); slender, C-shaped, with shortly and sharply incurved and sharply pointed ends; often with a slight indication of enlargement or angulation near the middle; measuring about 0·028 millim. from bend to bend when full grown.

(3.) Toxa (Plate IX., fig. 7, *c*); rather short and moderately stout; sharply angulated in the middle and only slightly recurved at the extremities; length up to about 0·044 millim.

This is a pretty little sponge, evidently very nearly related to the European *Gellius angulatus*, from which it differs in the somewhat shorter oxea, the considerably larger sigmata, and the much shorter toxa. It is possible also that the arrangement of the exhalant canals may be characteristic. It is interesting as indicating that sigmata and toxa are simply slightly different modifications of the same form of microsclere.

R.N. 140 (deep water off Galle and onwards up West Coast of Ceylon).

Gelliodes, Ridley.

Gelliinæ with much spongin, more or less completely enveloping or even replacing the megascleres and forming distinct fibres. The microscleres are sigmata.

Gelliodes carnosa, Dendy—Plate VII., fig. 5.

1889, **Gelliodes carnosa,** Dendy (3).

There is one fine specimen of this sponge in the collection, easily recognized by its characteristic external form (Plate VII., fig. 5). The megascleres are much slenderer than in the types and appear to be becoming vestigial, as in so many chalinine sponges, being functionally replaced by the strongly developed horny fibre. The sigmata are still numerous, about 0·02 millim. long, but very slender.

This species forms a conspicuous feature of the Ceylon Sponge-Fauna.

R.N. 69 (Stat. XXVII., Cod Bay, Trincomalee, 5 fathoms; also Gulf of Manaar).

Gelliodes incrustans, n. sp.—Plate IX., fig. 6.

Sponge thin, encrusting; the single specimen growing over both valves of a *Pecten* (which was evidently alive when collected). Maximum thickness about 7 millims.

Surface smooth, but rather uneven. Vents numerous and conspicuous, circular, from about 1 millim. to 2·5 millims. in diameter; mostly flush with the surface, but occasionally on low prominences. Colour (dry) dull greyish-brown, with a purplish tinge in places, which seems to indicate that it was purple in life. Texture (dry) compressible and resilient, but rather stiff.

The main skeleton is a rectangular-meshed network of horny fibre cored by spicules, in which the meshes vary greatly in size. The principal fibres are about 0·033 millim. in diameter, and contain a multispicular core of small oxea which occupy only about one-third (or less) of the total thickness of the fibre. The secondary fibres are more slender and contain fewer spicules. The dermal skeleton (Plate IX., fig. 6) is, for the most part, a unispicular reticulation of oxea with comparatively little spongin; sometimes one sees brushes of projecting oxea, but I am not sure how far these are proper to the dermal skeleton.

Spicules.—(1.) Oxea (Plate IX., fig. 6, *o*); short, slender, slightly curved, subfusiform, gradually and sharply pointed at each end; size about 0·1 millim. by 0·004 millim. A number of very slender, hair-like oxea, probably young or vestigial forms, also occur.

(2.) Sigmata (Plate IX., fig. 6, *s*); very slender and hair-like, C-shaped, up to about 0·02 millim. from bend to bend. Abundant.

This species is nearly related to *Gelliodes lichenifórmis* (Lamarck),* but differs, at any rate from the "Challenger" specimen of that species, both in external form and in the much smaller size of the spicules and more regular arrangement of the skeleton.

R.N. 112 (Gulf of Manaar, dry).

Gelliodes petrosioides, n. sp.—Plate IX., fig. 3.

Sponge massive, depressed, cushion-shaped; flattened below, where it has apparently been attached by a broad base; evenly rounded off and strongly convex above. Surface coarsely granular, not hispid. Vents not visible. Pores numerous, scattered in the thin dermal membrane which roofs over the numerous small, rounded subdermal cavities. Colour (in spirit) pale yellowish-grey. Texture compact; hard and almost stony. Greatest diameter of specimen, which is irregularly rounded in outline, about 24 millims.

The main skeleton is a very dense but quite irregular reticulation of very coarse, stout, densely spicular fibre, with a great many loose megascleres scattered between. The stout fibres have a thickness of about 0·164 millim., and probably contain a certain amount of spongin, which, however, is not visible in ordinary sections. The dermal skeleton cannot be sharply distinguished from the main skeleton, and consists of an irregular reticulation of coarse spicular fibre, the interspaces in which are occupied by the thin, pore-bearing dermal membrane.

* *Vide* Ridley and Dendy, '"Challenger" Monaxonida,' p. 48.

Spicules.—(1.) Short, stout, fusiform, slightly curved oxea (Plate IX., fig. 3, *a*, *b*, *c*), usually sharply and fairly gradually pointed at each end (often becoming strongylote or stylote); measuring about 0·25 millim. by 0·017 millim., but varying a good deal in thickness.

(2.) Sigmata (Plate IX., fig. 3, *d*); slender, C-shaped or contort, about 0·022 millim. from bend to bend; very numerous.

Were it not for the presence of the sigmata, this species would be a typical *Petrosia*. It appears to be very nearly related to Topsent's *Gelliodes fayalensis*,* from the Straits of Pico-Fayal, but is distinguished by the absence of the large oscula, and, perhaps, by other characters.

R.N. 146 (deep water off Galle and onwards up West Coast of Ceylon).

Gelliodes petrosioides, var. **fibrosa**, nov.

I propose this name, at any rate provisionally, for a single small, much-damaged specimen of irregular shape and cavernous structure, with large exhalant canals and vents (?) and very soft, fibrous texture; agreeing very closely with the type of the species in spiculation and in the structure of the main skeleton fibres, but with the fibres better defined and the meshes of the reticulation mostly very wide and not filled up by scattered spicules. The soft texture of the specimen, which is in striking contrast with the hardness and density of the type, is due simply to this greater laxity in the skeleton arrangement.

Except for the presence of the sigmata, this variety closely resembles a *Pachychalina*. It may ultimately, when better specimens are forthcoming, have to be considered as a distinct species.

R.N. 272 (deep water off Galle and onwards up West Coast of Ceylon).

Toxochalina, Ridley.

Gelliinæ with much spongin, more or less completely enveloping or even replacing the megascleres, and forming distinct fibres. The microscleres are toxa.

This genus differs from *Gelliodes* only in the replacement of the sigmata by toxa, and in view of the occurrence of both these forms in the same species of *Gellius* (*vide* under *Gellius angulatus*, var. *canaliculata*), it may be questioned whether the two should be kept distinct. They are interesting as forming an obvious starting point in the evolution of the great sub-family Chalininæ.

Toxochalina robusta, Ridley.

1884, **Toxochalina robusta**, Ridley (**16**).

There are a number of specimens of this sponge in the collection, agreeing closely, both as regards external form and skeletal characters, with Ridley's description of the type from Port Jackson. It is perhaps noteworthy, however, that the megascleres

* Topsent (**48**), p. 78.

are abundant *between* the stout horny fibres, as well as (sometimes) in their axes. The species has also been recorded from off Bahia (" Challenger ").

R.N. 8, 9, 38 (all three from Gulf of Manaar); 351 (Ceylon seas).

Toxochalina robusta, var. **ridleyi**, nov.—Plate IX., fig. 2.

The type specimen is very irregular in shape; massive and angular, with a slight tendency towards branching. It has evidently been attached by a broad base to one valve of a Lamellibranch shell (? *Margaritifera vulgaris*), the impress of which is still clearly visible. The surface is smooth and sub-glabrous, but uneven and very distinctly granular when viewed under a lens. The vents are rather numerous (five), about 4 millims. in diameter, with very prominent margins; each is the opening of a wide, deep oscular tube of the same diameter as itself. The texture (in spirit) is compressible and resilient, but stiff and tough. Colour, pale brown. The specimen is about 66 millims. long, 38 millims. broad, and 31 millims. high.

The main skeleton is a reticulation of horny fibre, with very few and slender spicules (Plate IX., fig. 2). The primary fibres are very stout, sometimes as much as 0·164 millim. in diameter, but very variable; typically they run at right angles to the surface and are united by short secondaries to form rectangular meshes, but the network often becomes very irregular and the size of the meshes is very variable. The secondary fibres are usually, but not always, more slender than the primaries. The primaries are cored by a multispicular axis of slender oxea arranged in a plumose manner (as in typical Axinellidæ), but all entirely enveloped in spongin to such an extent that the entire column of spicules only occupies one-third (or less) of the thickness of the fibre. The secondary fibres contain only a few isolated spicules arranged uniserially.

The dermal skeleton consists of a rather close-meshed reticulation of rather slender, unispicular horny fibre. From the nodes of this reticulation brushes of oxeote spicules project vertically. In certain places this dermal skeleton appears to become many layers deep, and the vertical brushes of oxea are continued inwards as more or less plumose columns enveloped in spongin and connected by numerous unispicular cross-fibres, so as to form a close skeleton network beneath the surface, very conspicuous in vertical section, and strongly contrasted with the much coarser, more widely meshed and less abundantly spicular main skeleton below it.

Spicules.—(1.) Oxea (Plate IX., fig. 2, *o*); short and rather slender, slightly curved, fairly gradually sharp-pointed at each end; measuring about 0·08 millim. by 0·004 millim. near the surface, but usually smaller, and especially more slender, in the fibres of the main skeleton. These spicules—at any rate, in the main skeleton—are evidently becoming vestigial.

(2.) Toxa (Plate IX., fig. 2, *t*); slender, more or less strongly curved in the middle, very slightly re-curved at the apices; sometimes slightly roughened in the middle, gradually sharp pointed at the ends; size varying up to about 0·08 millim. (in a

straight line from end to end) by 0·002 millim. (in the middle); very abundantly distributed through the soft tissues in association with scattered oxea.

R.N. 109 (Gulf of Manaar. Type); 306 (Stat. XXIV., off Trincomalee).

Strongylophora, n. gen.

Gelliinæ with the skeleton composed of a reticulation of strongyla of various sizes, partly collected in fibres, but with little (if any) spongin. With microscleres in the form of smooth microxea, chiefly found in the dermal membrane.

This is a remarkable genus of somewhat doubtful systematic position. The presence of the fusiform (and often angulated) dermal microxea suggests an affinity with the Homosclerophora and Pachastrellidæ amongst the Tetractinellida, rather than with the Sigmatophora. We cannot, however, lay very much stress upon this character when we remember the generalized character of microxea and the fact that such spicules also occur in the Ectyonine genus *Fusifer* (*vide* Dendy, **10**).

Strongylophora durissima, n. sp.—Plate IX., fig. 1.

Sponge massive, irregular; may be depressed and cake-like or subcylindrical and slightly ramose. Surface very uneven, sometimes with angular grooves and ridges, giving it a curious crumpled appearance; minutely and uniformly granular. Vents few, scattered; circular and often rather large, up to about 4 millims. in diameter; each the opening of a wide cylindrical oscular tube which runs vertically inwards for a considerable distance. Inhalant pores minute, abundantly scattered in the meshes of the dermal reticulation. Colour (in spirit) greyish-brown throughout. Texture hard and stony, but brittle, and rather cavernous internally owing to the presence of the numerous canals of varying diameter. The larger of the two specimens measures about 45 millims. in maximum diameter.

The main skeleton is an irregular but fairly close-meshed and, towards the surface, sub-rectangular reticulation of more or less stout spicular fibre composed of closely packed strongyla, with numerous loose strongyla scattered between the fibres. The dermal skeleton (Plate IX., fig. 1) is a reticulation of mostly large and single strongyla; their ends come in contact with one another, many together, at the principal nodes of the reticulation, from which they radiate, and at each of these nodes there is also a little heap of very short strongyla. The presence of these nodal heaps gives the characteristic granular appearance to the surface of the sponge.

Spicules.—(1.) Strongyla (Plate IX., fig. 1, *s.*); usually stout, more or less curved or angulated in the middle; evenly rounded off at each end; ranging in size from about 0·026 millim. by 0·006 millim. (or perhaps even less) to about 0·26 millim. by 0·02 millim. (A few long and very slender spicules, oxeote and strongylote, occur in the interior of the sponge; they are probably abnormal forms of the strongyla, with which they are connected by intermediates.)

(2.) Microxea (Plate IX., fig. 1, *m.*); fusiform and usually angulated in the middle,

from which they taper gradually to a very sharp point at each end; size fairly uniform, about 0·028 millim. by 0·002 millim. Very abundant in the thin transparent dermal membrane in the meshes of the dermal skeleton; also found less frequently in the interior of the sponge.

R.N. 156; 244 (Ceylon seas).

Sub-Family: RENIERINÆ.

Haplosclerida in which the microscleres have entirely disappeared and the skeleton consists of a reticulation of oxeote megascleres with little or no spongin.

This sub-family is apparently derived from the Gelliinæ by loss of microscleres. Inasmuch, however, as the microscleres constitute the most important guides to the classification of monaxonellid sponges, their total loss may in certain cases leave one in considerable doubt as to the true systematic position of the species concerned. The close relationship of *Reniera* to *Gellius* I take to be fully established by the form of the megascleres and by their arrangement. In the genus *Halichondria*, on the other hand, there appears to me to be less certainty, and the long, slender, slightly curved form and confused arrangement of the oxea suggest a possible origin from some astromonaxonellid genus, such as *Coppatias*, by loss of the astrose microscleres. It is impossible in the present state of our knowledge to decide this question definitely, but it is quite likely that, as regards the genera *Reniera* and *Halichondria*, we are dealing with a case of convergent evolution rather than of close genetic relationship.

Reniera, Nardo.

Renierinæ in which the skeleton is composed of a close reticulation of usually single megascleres, each forming one side of a rectangular, triangular or polygonal mesh. Spicules short, oxeote or strongylote, usually united together at the ends only by spongin cement.

Reniera implexa, Schmidt.

1868, **Reniera implexa**, Schmidt (**50**); 1887, **Reniera implexa**, Ridley and Dendy (**1**).

I identify with this species a single small specimen consisting of a few irregularly branched tubes, mostly about 5 millims. in diameter and widely open at the end. The surface has a minutely reticulate or porous appearance. The colour (in spirit) is brownish-yellow, and the consistence very soft, compressible and tender.

The skeleton is a rather irregular, triangular-meshed reticulation, for the most part of single spicules, with occasional loose plurispicular bands feebly developed.

The spicules are slender, slightly curved oxea, gradually sharp-pointed at each end and measuring up to about 0·136 millim. by 0·004 millim., usually perhaps a little less.

This species has been recorded from the Adriatic by Schmidt, and from the Azores by Ridley and Dendy (**1**) and Topsent (**62**).

R.N. 201 (Stat. LXIV., south of Modragam Paar, 5 fathoms, March 17, 1902).

Reniera pigmentifera, n. sp.—Plate IX., fig. 10.

This species is represented in the collection by a large number of small fragments which may perhaps represent only a single specimen. The external form appears to have been more or less flabellate, with rounded margin. The vents are about 2 millims. in diameter and appear to have been scattered singly along the margin (and elsewhere ?). The surface has a porous appearance to the naked eye, and is very minutely hispid. The colour (in spirit) is dark brown throughout, sometimes with a purplish tint, and the texture is very soft and crumbling.

The skeleton is an irregular "Isodictyal" network of short spicules, sometimes connected together at their ends by spongin cement; primary fibres, from one to about three spicules in thickness, are recognisable in places. There is no distinct dermal skeleton.

Spicules.—(1.) Oxea (Plate IX., fig. 10, *a*); slightly curved and gradually sharp pointed at each end; measuring about 0·144 millim. by 0·007 millim., but often much more slender.

(2.) Strongyla (Plate IX., fig. 10, *b*); stout, very slightly curved, broadly rounded off at each end; variable in length, up to about 0·12 millim. by 0·009 millim.; may be shorter and at the same time somewhat stouter.

(3.) Styli (Plate IX., fig. 10, *c*, *d*); short and stout, very similar in size and shape to the strongyla, but pointed at one end. Of course, intermediate forms of spicules also occur.

A remarkable feature of this sponge is the immense number of granular, brown or purple-coloured pigment cells which it contains. These cells are rounded in outline and about 0·002 millim. in diameter, and are thickly scattered all through the sponge.

R.N. 290 (numerous fragments. Jokkenpiddi Paar, 10 fathoms).

Reniera zoologica, n. sp.—Plate IX., fig. 8.

The single specimen appears to be half of a pear-shaped sponge which has been torn in two longitudinally. It has probably been fixed by the narrower end, and bears a single rather large vent (?) opening out of a wide oscular tube near the broad upper end. The surface is encrusted with large Foraminifera and sand-grains. The colour (in spirit) is pale grey, and the texture (internally) crumb-of-bread-like. Total height of specimen 34 millims., greatest breadth about 20 millims.

The main skeleton is an irregular network of spicules, partly arranged singly in an "Isodictyal" manner and partly collected in irregular multispicular bands. No spongin cement is recognisable in my preparation.

The dermal skeleton is a dense but thin layer of oxea, lying very close together and crossing one another in all directions parallel with the surface.

Spicules.—Oxea (Plate IX., fig. 8); moderately stout, slightly curved, gradually sharp pointed at each end; size when fully developed about 0·18 millim. by 0·007 millim. Numerous very slender forms, probably young, also occur.

R.N. 262 (Gulf of Manaar).

Reniera, sp. ?

A small massive specimen with a couple of short, mammiform, vent-bearing projections. Surface smooth. Colour (in spirit) pale yellow; texture compact and firm, but brittle.

Main skeleton a compact, irregular, "Isodictyal" reticulation of spicules without any fibres. Dermal skeleton a dense but thin layer of tangentially placed oxea crossing one another in all directions parallel with the surface.

Spicules.—Oxea; slightly curved, usually gradually sharp-pointed at each end; occasionally strongylote; size about 0·164 millim. by 0·008 millim.

This species may possibly be identical with one of the numerous imperfectly known European species of *Reniera* (*Isodictya*).

R.N. 232 (deep water off Galle and onwards up West Coast of Ceylon).

Petrosia, Vosmaer.

Renierinæ usually of hard or even stony texture, owing to the density of the skeleton, which is composed of an irregular reticulation of oxeote or strongylote megascleres (usually short and thick), packed close together, sometimes in stout fibres.

Those species of this genus which have a more or less fibrous skeleton make a close approach to the genus *Pachychalina*.

Petrosia testudinaria (Lamarck).

[For literature and synonymy *vide* Dendy (3).]

This handsome sponge (see text-figure 1) has been recorded from Queensland (Ridley)

Fig. 1. *Petrosia testudinaria* (Lamk.), Gulf of Manaar; reduced one-half.

Fig. 2. Pearl-oyster shell honeycombed by *Cliona margaritifera* Dendy (see p. 128).

and from the Mergui Archipelago (Carter, Dendy), as well as from the Gulf of Manaar (Dendy).

R.N. 42 (Stat. LXI., Gulf of Manaar); 238 ? (deep water off Galle; fragments).

Petrosia similis, Ridley and Dendy.

1887, **Petrosia similis**, Ridley and Dendy (1).

There are in the collection a number of irregular, massive or more or less lobate specimens, with numerous rather large, scattered vents, which I refer to this species. The spicules measure about 0·22 millim. by 0·014 millim. The character of their ends varies greatly, from strongylote to apiculate and sharp-pointed.

The species was originally obtained by the "Challenger" from south of the Cape of Good Hope and between Kerguelen and Heard Islands.

R.N. 12, 61 (both from Gulf of Manaar); 289; 327 (Ceylon seas).

Petrosia similis, var. **delicatula**, nov.

This variety is distinguished from the typical form of the species by its more delicate texture and smaller vents, which are usually more or less blocked up by a strong development of gelatinous tissue. The spiculation differs little, if at all, from that of the types.

R.N. 84, 133, 276 (all from deep water off Galle and onwards up West Coast).

Petrosia similis, var. **halichondrioides**, nov.

In external appearance this variety closely resembles *P. similis*, var. *delicatula*. The single specimen is strongly compressed, with the rather small but conspicuous and widely open vents placed on prominent ridges. The texture (in spirit) is firm and compact, but brittle. The skeleton is very confused and dense, without distinct fibres, and the spicules are much more slender and *Halichondria*-like than in the typical form, being gently curved oxea, for the most part gradually sharp-pointed at each end, and measuring, say, about 0·2 millim. by 0·006 millim.

R.N. 79 (Gulf of Manaar).

Petrosia densissima, n. sp.—Plate IX., fig. 9.

Sponge massive, sub-conical, attached by the broad base; with rather irregular surface bearing feebly developed, meandering grooves. Surface minutely granular, without distinct dermal membrane, slightly sandy. Vents very small and scattered. Colour (in spirit) rather dark greyish-brown on the surface; pale yellowish-grey internally. Texture extremely compact and hard; stony; incompressible. The larger of the two specimens (R.N. 138A) measures about 40 millims. in height by 42 millims. in greatest breadth.

The skeleton is extraordinarily dense and compact, consisting of a sub-rectangular-meshed reticulation of very stout spicular fibres, in which both primary and secondary fibres are about as thick as the width of the meshes between them, say about

0·13 millim. The fibres are compact, but the arrangement of the spicules in them is very confused and there is no visible spongin. Many spicules occur scattered irregularly between the fibres, so that the whole skeleton forms an almost solid mass of spicules. There is no special dermal skeleton.

Spicules.—Stout, fusiform oxea (Plate IX., fig. 9); slightly curved and usually sharply and fairly gradually pointed; size when fully developed about 0·24 millim. by 0·02 millim., but with numerous smaller forms which are presumably young.

This species is evidently very closely related to THIELE's *Petrosia imperforata* from Celebes (39).

R.N. 138, 138A (both from deep water off Galle and onwards up West Coast of Ceylon).

Halichondria, FLEMING.

Renierinæ in which the skeleton consists of a confused reticulation of long and slender oxea (or strongyla) with little or no spongin; the spicules sometimes associated in ill-defined bands or fibres.

I have already indicated the doubt which exists as to the true relationship of this genus. Possibly it is, as at present understood, of polyphyletic origin, including species derived from several ancestral forms by loss of microscleres.

Halichondria panicea, JOHNSTON.

[For literature and synonymy *vide* RIDLEY and DENDY (1) and DENDY (2).]

This widely distributed species is represented in the collection by two well differentiated form-varieties, so that it seems desirable to distinguish them by varietal names. In both varieties many of the more superficial oxea are arranged more or less at right angles to the surface, with their apices projecting to a greater or less extent, thus making an approach to the genus *Trachyopsis*. In both the full-grown spicules measure up to about 1·0 millim. in length and are of the usual *Halichondria* type. Their arrangement in the interior of the sponge is quite irregular and confused.

Halichondria panicea, JOHNSTON, var. megalorhaphis, CARTER.

1881, Amorphina megalorhaphis, CARTER (5).

This variety is irregularly encrusting, growing out into lobose or digitiform processes, and with small scattered vents.

R.N. 87, 231, 248 (all from deep water off Galle and onwards up West Coast).

Halichondria panicea, JOHNSTON, var. hemispherica, nov.

This variety is massive and compact, more or less hemispherical or cushion-shaped, with vents usually arranged in conspicuous groups on the convex upper surface. It attains a considerable size, the largest specimen measuring about 100 millims. in greatest diameter and about 40 millims. in thickness in the middle.

R.N. 67 (Gulf of Manaar); 96 (Gulf of Manaar, dry); 141 ?, 142 (both from deep water off Galle and onwards up West Coast); 249 (Stat. XV., Periya Paar).

Trachyopsis, n. gen.

Renierinæ in which the main skeleton is composed of a dense, irregular network of oxea, while the surface is protected by similar (or perhaps more slender) spicules arranged in dense vertical brushes, which support the pore-bearing dermal membrane.

This genus is of somewhat doubtful systematic position; in certain features it recalls the genera *Trachya* and *Spongosorites*, and it differs from typical Renierinæ in the replacement of the reticulate dermal skeleton characteristic of that group by radially arranged brushes of oxea.

Trachyopsis halichondrioides, n. sp.—Plate X., fig. 10.

Sponge massive (or thickly encrusting ?); upper surface slightly convex, rising up at irregular intervals into a few short, thick-walled, cylindrical, tubular processes, each terminated by a single circular vent. General surface smooth and almost glabrous, but uneven; very minutely reticulate as seen under a lens. Inhalant pores minute and scattered. Colour in spirit, pale yellowish-grey. Texture of body hard and compact, penetrated by numerous narrow vertical canals. Greatest diameter of specimen, which is irregular in outline, 44 millims.; thickness about the middle 15 millims. (but the specimen has evidently been cut off from its base). Height of largest projection about 8 millims.; diameter in the middle about 5·5 millims.; diameter of the vent at its apex 2·5 millims.

The main skeleton is an extremely dense and very irregular reticulation of stout oxea, with a tendency to arrange themselves in ill-defined tracts running towards the surface. Immediately beneath the surface the oxea, here perhaps somewhat more slender than usual, are arranged in dense brushes perpendicularly to the dermal membrane, beyond which their apices may project very slightly.

Spicules.—Oxea (Plate X., fig. 10); short, usually stout, sub-fusiform, gently curved or (often) biangulate, fairly gradually and sharply pointed at each end; size, when fully developed, about 0·64 millim. by 0·0328 millim.; frequently more slender.

R.N. 147 (deep water off Galle and onwards up West Coast of Ceylon).

Sub-family: CHALININÆ.

Haplosclerida with microscleres and with diactinal megascleres. Skeleton a network of more or less strongly developed horny fibre cored by megascleres.

It is highly probable that this sub-family is of polyphyletic origin, being derived from several genera of Gelliinæ and Renierinæ by loss of microscleres and strong development of spongin. Some species have probably been derived from *Toxochalina*

and *Gelliodes* simply by loss of microscleres, the horny fibre being already strongly developed in those genera, while others have probably arisen from *Reniera* and *Petrosia* simply by strong development of the horny fibre, the microscleres having been already lost.

The excessive development of spongin appears to have taken place independently in many genera, and this fact, coupled with the loss of the characteristic microscleres and the uniform character of the megascleres, renders it extremely difficult to arrive at a natural classification of the Chalininæ.* The subject is, however, much too complex to be discussed here at length, especially as there are not a very large number of species in the collection. For our present purposes it will suffice to make use of the established genera, *Pachychalina*, *Chalina*, *Ceraochalina*, and *Siphonochalina*, without committing ourselves to an expression of opinion as to their genetic relationships. Owing to their degenerate character, it is impossible to define even these in such a way as to distinguish them quite sharply from one another.

Pachychalina, Schmidt.

Chalininæ of various external form, lobose or digitate, not tubular; with stout skeleton fibres, containing very numerous well developed spicules arranged multiserially.

Pachychalina subcylindrica, n. sp.—Plate X., figs. 1, 2.

Sponge elongated, rather slender, irregularly cylindrical or angular, probably branched and repent. Surface fairly smooth but uneven, with a very few coarse aculeations; minutely reticulate to the naked eye. Vents fairly large (about 2·25 millims. in diameter), irregularly scattered, with slightly prominent margins. Colour (in spirit) light brown. Texture compressible, resilient, rather coarsely fibrous, but somewhat fragile. The largest piece measures about 95 millims. in length, with a very variable thickness up to about 9 millims.

The main skeleton is a sub-rectangularly meshed network of very stout multispicular fibre, about 0·066 millim. in diameter; with meshes varying greatly in size, and with numerous spicules scattered irregularly between the fibres. The fibres themselves contain a very large number of spicules, but no visible spongin. The dermal skeleton (Plate X., fig. 1) is an irregular, polygonal-meshed network of similar coarse multispicular fibre.

Spicules.—Oxea (Plate X., fig. 2); more or less curved or angulated; when fully developed stout and very sharply pointed at each end; measuring about 0·14 millim. by 0·008 millim. Numerous slender forms also occur, probably immature.

In the feeble development of the spongin this species occupies an intermediate position between the genus *Petrosia* and the more typical Chalininæ.

R.N. 292; 360 (Stat. II., north of Negombo, 9 fathoms).

* Compare Lendenfeld (**51**) and Dendy (**63**). In the paper referred to I have explained the reasons why I cannot accept Lendenfeld's classification of the Chalininæ.

Pachychalina delicatula, Dendy.

1889, **Pachychalina delicatula,** Dendy (3).

With this species I identify three specimens, all characterized by their great softness and delicacy of texture, but all containing a good deal of sand.

R.N. 55, 264 (both from Gulf of Manaar); 364 (Stat. I., hauls 1–4, January 31, 1902, Colombo to Negombo, 12 to 20 fathoms).

Pachychalina brevispiculifera, n. sp.—Plate X., fig. 7.

The single specimen is compressed, digitate to flabellate (presumably erect), branching and anastomosing. The branches or fronds are sometimes narrow and sometimes broad, but always greatly flattened, and only about 6 millims. in thickness. The surface is beset with small conical aculeations, which form the principal nodes in a very strongly developed dermal skeletal reticulation. Vents rather large (about 4 millims. in diameter) but very shallow; numerous, but confined almost or quite entirely to one of the flattened sides of the frond or branch. Colour (in the dry state) light brown; texture coarsely fibrous, compressible, resilient, fragile. The single specimen measures about 120 millims. in height by 110 millims. in greatest width.

The main skeleton is a very coarse, sub-rectangularly or irregularly meshed network of very stout horny fibre almost filled with well developed and very abundant spicules arranged multiserially in all the fibres. The primary fibres, running lengthwise through the branches, measure up to about 0·164 millim. in thickness, and the secondaries are sometimes nearly as stout, though usually a good deal slenderer. Sometimes two or more primary fibres run close together side by side, connected with one another at frequent intervals by numerous very short secondaries. The dermal skeleton is a coarse, irregular reticulation of similar fibre, varying greatly in thickness and with meshes of varying diameter. The fibres, especially those of the dermal skeleton, are occasionally echinated by projecting oxea.

Spicules.—Oxea (Plate X., fig. 7); slightly curved; sub-fusiform; short, stout and sharp-pointed at each end; measuring about 0·1 millim. by 0·0055 millim.

R.N. 110 (Gulf of Manaar, dry).

Pachychalina spinilamella, Dendy—Plate VII., fig. 4.

1889, **Pachychalina spinilamella,** Dendy (3).

I identify with this species a number of specimens of somewhat variable external form, but all characterised by their strongly conulose surface and with closely similar skeleton arrangement. A fairly typical example is represented in Plate VII., fig. 4. R.N. 14, 296 and 326 are characterised by their more slender, irregularly branching form and smaller vents.

R.N. 14, 25, 94 (Periya Paar, &c., Gulf of Manaar); 172, 296, 326 (Ceylon seas).

Chalina, Grant.

Chalininæ of various external form; not tubular. Skeleton reticulation typically rectangular; fibres usually slender, with much spongin and few but usually well developed spicules.

Chalina subarmigera (Ridley)—Plate X., fig. 5.

1884, **Cladochalina subarmigera**, Ridley (**16**); 1887, **Chalinopora subarmigera**, Lendenfeld (**51**); 1898, **Chalina subarmigera**, Lindgren (**86**).

This species is represented in the collection by two specimens, which agree very well with Ridley's original description, except that the margins of the vents are slightly prominent and there are fewer spicules in the fibres of the main skeleton. The characteristic external form is shown in Plate X.. fig. 5.

The species was obtained by the "Alert" in Torres Straits and at Albany Island (north coast of Australia), and has also been recorded by Lendenfeld from Port Jackson, and by Lindgren from the Coast of Cochin China.

R.N. 116 (Gulf of Manaar, dry): 288 (Ceylon seas).

Chalina obtusispiculifera, n. sp.—Plate X., fig. 9.

Sponge elongated, slender, cylindrical; may be irregularly branched (? erect or repent). Surface even, very minutely hispid in its present condition. Texture (in spirit) soft and resilient, but fairly tough. Colour pale yellowish-brown. Vents and pores not seen. The largest specimen (R.N. 370) is about 130 millims. long by 3·5 millims. in diameter.

The skeleton is a well-developed reticulation of pale-coloured horny fibre cored by strongyla. The principal fibres run lengthwise through the sponge, branching as they go, and the branches curve outwards towards the surface; they are connected by short secondary fibres to form an irregular network. The principal fibres are about 0·04 millim. in diameter and contain many spicules arranged multiserially as well as much spongin extending well beyond the spicular core. The secondary fibres are only about half as thick and contain fewer spicules. There is no specially differentiated dermal skeleton, unless we consider the outermost secondary fibres of the main skeleton as such (Plate X., fig. 9).

Spicules.—Cylindrical strongyla (Plate X., fig. 9); broadly rounded off at each end, never pointed; nearly straight; measuring up to about 0·12 millim. by 0·007 millim., but frequently much more slender.

This species is easily recognised by its external form and blunt cylindrical spicules. Both specimens are more or less washed out and contain numerous foreign spicules and other débris. In R.N. 285 none of the spicules appear to attain as great a thickness as that given above for the type.

R.N. 285 (deep water off Galle and onwards up West Coast); 370 (deep water outside pearl banks, Gulf of Manaar).

Chalina clathrata, n. sp.—Plate X., fig. 3.

Sponge massively encrusting, the single specimen being attached to the valve of a *Pinna;* clathrous; with very uneven surface proliferating into numerous small, blunt outgrowths. Vents numerous and large (up to about 8 millims. in diameter), scattered singly, each at the end of a short tubular projection and forming the termination of a wide cylindrical oscular tube. Surface minutely reticulate. Texture very delicate, soft, compressible, resilient; colour (after drying) light yellowish-brown, with a tinge of purple. The single specimen measures about 220 millims. in maximum diameter.

The main skeleton is a sub-rectangularly or irregularly meshed network of very pale-coloured horny fibre. The fibre varies greatly in diameter (averaging, say, about 0·025 millim.) and contains very few spicules, arranged for the most part uniserially and absent altogether in places. The dermal skeleton is a close, polygonally or rectangularly meshed network of horny fibre cored by uniserially arranged spicules; the fibres being about 0·0165 millim. in diameter and the meshes about 0·1 millim. in diameter.

Spicules.—Very slender, usually slightly curved oxea or strongyla, measuring about 0·112 millim. by 0·002 millim., occurring in and between the fibres and often reduced to vestiges (Plate X., fig. 3).

With its large prominent vents and deep oscular tubes this species makes an approach to the genus *Siphonochalina*, while its massive (though clathrous) form recalls Ridley's *Acervochalina*.

R.N. 102 (Gulf of Manaar, dry).

Chalina cymæformis (Esper ?).

? 1798–1806, **Spongia cymæformis**, Esper (**6**); ? 1870, **Spongia cymæformis**, Ehlers (**58**).

Sponge shortly stipitate, bushily lamellar or frondose or sub-digitate. Lamellæ about 9 millims. thick, with broadly rounded margins. Surface rather uneven, minutely conulose, especially where the dermal membrane has been rubbed off. Vents small (about 2 millims. in diameter), more or less abundantly scattered, chiefly on the inner surfaces of the lamellæ. Inhalant pores scattered in the dermal membrane. Texture (in spirit) soft and compressible, but very tough and resilient; rather woolly. Colour brown. The most typical specimen (R.N. 16) is about 67 millims. high by 90 millims. in greatest breadth, with a stalk about 22 millims. high and 18 millims. thick. It bears a very close resemblance to the figure of *Chalina palmata*, given by Ridley and Dendy (**1**), as well as to Esper's figure of his *Spongia cymæformis* (Plate 69).

The main skeleton consists of what, at first sight, look like rather slender, ill-defined, plurispicular fibres running towards the surface at irregular intervals and branching as they go, connected by still less well-defined secondary fibres from one to about four spicules broad. No spongin is at first sight visible, but closer examination shows that a very large quantity is really present in the fibres, more or less completely imbedding

the spicules; owing to its very pale colour and great transparency, however, it readily escapes observation. Numerous spicules occur scattered irregularly between the fibres. There is no special dermal skeleton, the dermal membrane being practically destitute of spicules.

Spicules.—Slender, slightly or rather strongly curved oxea; more or less gradually sharp-pointed at the ends; size variable, say about 0·12 millim. by 0·003 millim.

It is probable that this species is identical with Esper's *Spongia cymaformis* (from Ceylon). It also appears to be nearly related to *Chalina palmata* from European, Indian and Australian waters; differing, however, in the absence of the dermal skeleton reticulation. In habit the species reminds one very much of some species of *Axinella*, a resemblance which appears from Ehlers' description to have been increased in the case of Esper's specimen by the presence of styli mingled with the oxea.

R.N. 16 (Gulf of Manaar); 349 (Stat. LV., west of Periya Paar, 20 fathoms).

Ceraochalina, Lendenfeld.

Chalininæ of various external form; not tubular. Texture hard, owing to the great thickness of the skeleton fibres, in which the spongin is very strongly developed and the spicules much reduced in size and sometimes also in number.

Ceraochalina retiarmata, n. sp.—Plate X., fig. 4.

The single specimen forms an erect, thin lamella, attached below by a constricted base; sub-dividing into flattened branches and giving off irregular digitiform processes almost exclusively in one plane; the branches to a slight extent anastomosing with one another. Surface glabrous, minutely granular under a lens; rather uneven. Vents minute, about 0·5 millim. in diameter, mostly arranged uniserially on the narrow margins. Inhalant pores scattered in the meshes of the dermal reticulation. Colour (in spirit) rather dark brown; texture compressible, resilient, tough and fibrous. Total height of specimen about 33 millims.; greatest breadth about 66 millims.; thickness of lamella about 3·5 millims.

The main skeleton is a network of stout horny fibre, sparingly cored by very slender vestigial oxea. The primary fibres are about 0·1 millim. in diameter and curve upwards and outwards towards the surface, branching as they go. They are connected together by short secondaries about 0·05 millim. in diameter and containing fewer spicules. There is also a system of tertiary fibres, much more slender (from about 0·008 millim. to about 0·024 millim. in diameter) and containing from one to about four rows of well-developed oxea imbedded in spongin. These tertiary fibres form an irregular network which seems to bear no relation to the rest of the main skeleton, except that its fibres are attached frequently to those of the latter.

The dermal skeleton is very strongly developed, forming a close polygonal-meshed reticulation of horny fibres cored by usually two or three rows of well developed oxea

and echinated abundantly by similar oxea projecting from the fibre singly or in small groups. The diameter of the dermal fibre is about 0·024 millim.; of the meshes between the fibres about 0·16 millim., but variable.

Spicules.—Rather short, slightly curved, gradually sharp-pointed oxea (Plate X., fig. 4), measuring about 0·084 millim. by 0·004 millim. in the dermal skeleton and in the tertiary fibres of the main skeleton, but becoming more or less vestigial in the other fibres.

R.N. 342 (Stat. V., off Chilaw, 10 fathoms).

Ceraochalina reticutis, n. sp.—Plate X., fig. 8.

The type specimen (R.N. 58) forms an agglomeration of short, irregular, sub-cylindrical or angular branches, slightly anastomosing with one another and branching with great irregularity. The branches vary greatly in diameter, from about 4 millims. to about 11 millims., and have a slightly nodose appearance. The entire mass measures about 80 millims. in greatest breadth. Vents small (about 1 millim. in diameter), but conspicuous and with slightly projecting margins; scattered abundantly and sometimes in ill-defined longitudinal series. The dermal membrane is parchment-like, and under a pocket lens appears very finely and regularly reticulate in triangular meshes, which are the coarser meshes of the dermal skeleton composed of dark brown spongin fibre. Texture (in spirit) compressible, very resilient, tough; colour dark brown.

The main skeleton is a fairly regular, sub-rectangularly meshed network of strong horny fibre. The principal fibres run longitudinally through the branches, sub-dividing as they go and curving outwards to the surface. They measure up to about 0·08 millim. in diameter, and contain a considerable number of slender vestigial spicules, irregularly and multiserially arranged. The secondary fibres are about as thick as the primaries, but contain fewer spicules (which are also vestigial). The meshes of the main skeleton reticulation vary a good deal in size; averaging, say, about 0·33 millim. in diameter.

The dermal skeleton (Plate X., fig. 8) is a very well developed, close, polygonal-meshed reticulation of horny fibre containing only a very few slender spicules scattered here and there. The fibres of which this reticulation is made up are of two principal sizes: (*a*) stout, about 0·03 millim. to 0·05 millim. in diameter, radiating from the ends of the primary fibres of the main skeleton and forming the coarser triangular-meshed reticulation visible under a pocket lens; (*b*) more slender, but very variable in diameter, forming a very close-meshed but irregular reticulation in the meshes of the coarser reticulation. A large number of well developed spicules may be irregularly scattered in the dermal membrane outside the horny fibres of the dermal skeleton.

Spicules.—Oxea; varying greatly in degree of development; in the horny fibres very slender and vestigial (Plate X., fig. 8, *v.s.*), but often well developed in the soft

tissues between the fibres, especially in the dermal membrane (Plate X., fig. 8, *o*). When fully developed they are slightly curved and somewhat hastately sharp-pointed, measuring about 0·072 millim. by 0·00265 millim.

R.N. 58 (Gulf of Manaar); 321; ? 346 (distinguished from the type chiefly by the numerous well developed oxea arranged uniserially in the slenderer fibres of the dermal skeleton and multiserially in the stouter fibres; while the spicules themselves are occasionally strongylote).

Ceraochalina multiformis, Lendenfeld, var. **manaarensis**, Dendy—Plate VII., fig. 2.

1889, **Pachychalina multiformis**, var. **manaarensis**, Dendy (**3**).

I identify with this variety a single specimen attached to a pearl oyster, which is represented in Plate VII., fig. 2. A feature which I omitted to mention in my original description of the variety is the echination of the fibres of the dermal skeleton by projecting oxea, singly or in groups.

The species was recorded by Lendenfeld (**51**) from Australia and New Zealand.

R.N. 98 (Gulf of Manaar, dry).

Ceraochalina ceylonica, n. sp.—Plate VII., fig. 3: Plate X., fig. 6.

Sponge (Plate VII., fig. 3) massive, irregular, sometimes clathrous, with a slight tendency to become lobose or digitate. Surface strongly and copiously aculeated by sharp-pointed conuli about 4 millims. in height; minutely fibro-reticulate between the conuli. Vents numerous, scattered, about 4 millims. or 5 millims. in diameter; the openings of deep, cylindrical oscular tubes. Colour (in spirit) pale brown; texture firm and tough, but compressible and resilient. The largest specimen (R.N. 5, figured) measures 200 millims. by 160 millims. in horizontal dimensions, by 90 millims. in height.

The main skeleton is a very strongly developed, irregular or rectangularly meshed network of stout, horny fibre, containing usually a large number of small oxea scattered irregularly throughout the spongin substance, but almost always more or less parallel with the long axis of the fibre. Occasionally (R.N. 5) the spicules are much less strongly developed and may be completely absent from some of the fibres. Numerous spicules also occur scattered between the fibres. The thickness of the fibres is variable, say about 0·08 millim. for the primaries and not much less for the secondaries

The dermal skeleton is a polygonally meshed network of fibre containing a very large proportion of spongin and a good many spicules. The latter are, for the most part, imbedded in the spongin substance more or less longitudinally; at frequent intervals, however, little groups of oxea, or single spicules, project more or less at right angles from the fibre in an echinating manner, and thus give a rather characteristic appearance to the dermal skeleton. The meshes of the dermal

reticulation are about 0·2 millim. in diameter, and the fibres from about 0·008 millim. upwards.

Spicules.—Slender oxea (Plate X., fig. 6), slightly curved and more or less gradually and sharply pointed; size about 0·088 millim. by 0·003 millim., but subject to a good deal of variation, and frequently, if not usually, more slender.

R.N. 4, 5, 50, 108, 113 (all from Gulf of Manaar).

Siphonochalina, Schmidt.

Chalininæ of tubular form. Tubes smooth, both inside and out, usually narrow; each with a large circular vent at the summit.

Siphonochalina communis (Carter), var. **tenuispiculata**, nov.—Plate VII., fig. 1.

This variety (Plate VII., fig. 1) agrees very closely in external form with the specimens of *Siphonochalina communis* described by Carter (5) and myself (3) from the Gulf of Manaar. Mr. Carter gave no measurements of the spicules in the case of the type of the species, but the specimens in Professor Herdman's collection differ rather strikingly from that collected by Mr. Thurston and described by myself, in that the spicules are very much more slender and very much more numerous in both primary and secondary fibres and in the fibres of the dermal skeleton. In fact, the spicules, though very abundant in all the fibres and occurring throughout the entire, or almost the entire, thickness of each fibre, are so slender as to be almost vestigial, measuring about 0·072 millim. by 0·001 millim.

In skeletal characters, although the spicules are more slender, this variety agrees much more closely with my *Siphonochalina crassifibra* from the same locality (3) than with Carter's *S. communis;* differing from *S. crassifibra* chiefly in the smaller size of the tubes. Thus it has the external form of *S. communis* combined with the skeletal characters of *S. crassifibra*, and I therefore propose to regard all three forms as mere varieties of one and the same species.

Professor Herdman informs me that the sponge in life had a violet-pink colour.

Ridley (16) records the species (under Carter's name *Tabulodigitus communis*) from Port Jackson, Australia, and also from Kurrachee.

R.N. 6, 7, 117 (dry, figured; all from Gulf of Manaar, Stat. II., 8 fathoms).

Sub-family: Desmacellinæ.

Haplosclerida with monactinal megascleres. Microscleres various.

Desmacella, Schmidt.

Desmacellinæ with reticulate skeleton composed of styli or tylostyli. Microscleres sigmata, toxa and trichodragmata variously combined.

Desmacella tubulata, n. sp.—Plate IX., fig. 4.

Sponge consisting of cylindrical, tubular processes, more or less widely open above

(? always) and (sometimes, at any rate) united together below. (Possibly they may have been attached to a common body, but only fragmentary tubes are present in the collection.) Diameter of individual tubes about 6 millims.; thickness of tube-wall about 1·25 millims. Outer surface slightly granular and very minutely hispid. Inner surface with numerous very minute openings of exhalant canals. Colour (in spirit) pale greyish-yellow. Texture very soft, compressible, fragile.

The main skeleton is a very irregular but close reticulation of slender styli, either isolated or in loose bundles; with no visible spongin cement. There is no special dermal skeleton.

Spicules.—(1.) Long slender styli (Plate IX., fig. 4, *a*, *b*); slightly curved or bent, broadly and evenly rounded off at the base, sharply and more or less gradually pointed at the apex; size about 0·28 millim. by 0·005 millim.

(2.) Trichodragmata (Plate IX., fig. 4, *d*); extraordinarily abundant, especially beneath the outer surface, and very variable in size, sometimes forming wisp-like fibres, sometimes breaking up into separate microxea (Plate IX., fig. 4, *e*); varying in length from about 0·02 millim. upwards, and always very slender.

(3.) Sigmata (Plate IX., fig. 4, *c*); also extraordinarily abundant; slender, commonly much contort, also C-shaped; occasionally in small bundles (sigmodragmata); length from bend to bend variable, say about 0·02 millim.

This appears to be a very well characterized species, and I know of no other which comes very near it. The immense number of microscleres is very remarkable.

R.N. 209 (Gulf of Manaar); 324.

Sub-family: HETEROXYINÆ.

Haplosclerida with a dense cortex composed of radially arranged megascleres. Megascleres smooth and spined oxea. Microscleres present or absent.

I propose this sub-family for the reception of the genera *Heteroxya*, Topsent, and *Acanthoxifer*, n. gen., the former of which is, apparently with very slight justification, placed by its founder amongst the Tethyidæ.

Acanthoxifer, n. gen.

Heteroxyinæ with a dense spicular cortex broken up into polygonal plates by pore-bearing grooves. Main skeleton a confused reticulation of oxea. Cortical skeleton composed chiefly of dense brushes of oxea arranged at right angles to the surface. Megascleres smooth and spined oxea. Microscleres trichodragmata.

This remarkable genus is evidently nearly related to Topsent's *Heteroxya* (45), but differs in several respects, notably in the presence of trichodragmata, which indicates that the true position both of *Acanthoxifer* and *Heteroxya* is amongst the Haplosclerida and not amongst the Tethyidæ, where Topsent has placed *Heteroxya*. The presence of the spined oxeote megascleres suggests a possible relationship to the Spongillinæ.

The breaking up of the cortex into polygonal plates or nodules by pore-bearing (and ? vent-bearing) grooves remind one forcibly of the genus *Placospongia* amongst Spirastrellidæ, but the resemblance is entirely superficial.

Acanthoxifer ceylonensis, n. sp.—Plate IX., fig. 5.

Sponge massively encrusting, irregular, with flattened or convex upper surface and broad base of attachment. Surface very minutely hispid or granular, uneven, nodular or tubercular, the nodules or tubercles being very low and roundedly polygonal in shape, separated by grooves of varying distinctness. Generally the grooves are broad and shallow: sometimes they are narrow, with prominent margins. Diameter of nodules, say, about 4 millims., but variable and irregular. Colour (in spirit) light brown. Texture compact, fleshy, but with much calcareous débris embedded. Pores and vents not recognisable externally. The largest specimen is cake-shaped, about 42 millims. in horizontal diameter, and up to 17 millims. in thickness.

The main skeleton is a quite confused, lax reticulation of very abundant, long, oxeote megascleres, occasionally collected together into loose, ill-defined bands, but without any distinct fibre, and with a little spongin becoming visible in stained sections. The cortical skeleton is very strongly developed and consists of dense brushes of oxea placed side by side and lying at right angles to the surface, beyond which their apices project (but are now nearly all broken off). These brushes are backed up internally by a very dense, irregular reticulation of oxea. The cortical skeleton is absent beneath the grooves which separate the surface nodules. Thus there is a separate section of the cortical skeleton for each nodule or tubercle, thinning out as it approaches the grooves in such a manner as to become strongly convex on the inner aspect.

Spicules.—(1.) Smooth oxea (Plate IX., fig. 5, *a*); long and rather slender, slightly curved or bent, variously and often irregularly ended, sometimes stylote (Plate IX., fig. 5, *b*). Size variable, say about 0·74 millim. by 0·012 millim. Abundant in the main skeleton and occasionally met with in the surface brushes.

(2.) Spined oxea (Plate IX., fig. 5, *c*); usually slightly and symmetrically curved (or angulated) in the middle; tapering fairly gradually to a sharp point at each end; provided with numerous very minute, sharp spines, most abundantly developed towards the two ends; size about 0·38 millim. by 0·008 millim. Characteristic of the cortical skeleton, but also common in the interior of the sponge.

(3.) Trichodragmata (Plate IX., fig. 5, *d*); oblong bundles of extremely slender rhaphides, which do not usually become dissociated even on boiling with nitric acid. Size usually about 0·016 millim. by 0·004 millim.; occasionally much longer.

Stained sections show that the ectosome (between the spicules) is chiefly collenchymatous, sometimes with a tendency to become fibrous near the surface. In both ectosome and choanosome are an immense number of minute granules of a pale

yellowish colour, aggregated in rounded masses of very varying size. These may be symbiotic algæ.

R.N. 213, 217 (both from deep water outside pearl banks, Gulf of Manaar); 247.

Family: DESMACIDONIDÆ.

Sigmatomonaxonellida in which some of the microscleres are chelæ (except when these have been lost by degeneration).

The presence of microscleres in the form of chelæ constitutes a natural character by which the Desmacidonidæ are, as a rule, easily distinguished from all other sponges. Unfortunately, however, the chelæ are very apt to disappear by degeneration, especially in the sub-families Ectyoninæ and Phlœodictyinæ, and we have then to depend upon other characters—such as the presence of spined echinating styli—for guidance in classification. That the chela, one of the most remarkable forms of microsclere known to us, has originated by modification of the sigma, there can, I think, be little doubt. In the Report on the "Challenger" Monaxonida* we showed that in ontogeny the chela arises from a sigmoid form (*Esperella mammiformis*) and that sigmata and chelæ must therefore be grouped in the same category. Nor are intermediate forms of adult spicules unknown to us, such as the curious "bipocilli" of the genus *Iophon*, especially those of *Iophon chelifer*, Ridley and Dendy (1), and, most notable of all, the bidentate sigmata of Topsent's *Gellius bidens* (64).

We are, therefore, justified in regarding the Desmacidonidæ as derived from the Haploscleridæ by modification of the sigmoid microscleres into chelæ, though why this modification should have taken place is very hard to understand. It is extremely difficult to see how the very peculiar and highly specialized chelate form of microsclere can be of any special advantage to its possessor, and we have here one of those numerous cases in which, so far as we can see at present, the theory of natural selection signally fails to account for the facts.

I have already pointed out that the sub-family Phlœodictyinæ must be transferred to the Desmacidonidæ on account of the presence of chelate microscleres in the genus *Histoderma*, certain species of which are obviously very closely related to *Phlœodictyon* and *Oceanapia*. For the purposes of this Report the three sub-families Esperellinæ, Phlœodictyinæ and Ectyoninæ will be sufficient. Topsent's sub-family Dendoricinæ appears to me to be an unnatural group which cannot be maintained, the differentiation of the ectosomal megascleres being far too general and widespread a character to be utilised as distinguishing the sub-family, whose members fall very naturally in one or other of the remaining sub-families. The sub-family Bubarinæ, proposed by the same author, has, I am glad to see, been again abandoned by him in his latest work (62).

* Page xx.

Sub-family: ESPERELLINÆ.

Desmacidonidæ without echinating spicules, and without fistular outgrowths of the sponge body.

Esperella, Vosmaer.

Esperellinæ of various external form, usually massive, lobose or ramose. Skeleton usually fibrous, often with much spongin. Megascleres monactinal, stylote or tylostylote. Characteristic microscleres palmate anisochelæ, to which may be added smooth sigmata, toxa, trichodragmata and small isochelæ* in various combinations.

Esperella parishii (Bowerbank ?), Ridley.

[For synonymy and literature *vide* Ridley and Dendy (**1**), p. 65.]

There is one small, thinly encrusting specimen of this sponge in the collection, growing on a calcareous nodule in association with *Paresperella serratohamata* and *Hymedesmia stellivarians*. The specimen agrees very closely in spiculation with the description given by Ridley (**16**), except that the megascleres are a little larger and the trichodragmata contain many more spicules.

The species has been hitherto recorded from the Straits of Malacca (Bowerbank); Port Darwin, Australia (Ridley), and the Philippine Islands ("Challenger"). Re-examination of the "Challenger" specimen, however, has convinced me that it does not belong to the same species as those described by Ridley from Australia and found by Professor Herdman in Ceylon waters, as it possesses toxa. It must be remembered that Bowerbank (**49**) originally described toxa as forming part of the spiculation, but Ridley regarded these as foreign elements. It is probable that we have here a confusion between two species.

It appears not improbable that the "thin fragment" recorded by Carter (**4**) from the Gulf of Manaar, under the name *Esperia tunicata*, Sdt., may be specifically identical with our specimen.

R.N. 220A (deep water off Galle and onwards up West Coast of Ceylon).

Esperella plumosa (Carter).

1882, **Esperia plumosa**, Carter (**33**); 1886, **Esperia plumosa**, Carter (**20**).

Sponge irregularly frondose or digitate; clathrous. Surface irregularly cactiform or conulose, covered by a very well-developed, stellately reticulate dermal membrane. Vents not seen; pores scattered in the meshes of the dermal reticulation. Texture (in spirit) coarsely fibrous, compressible, resilient, fragile. Colour grey. The largest fragment measures about 62 millims. in height by 41 millims. in greatest breadth.

The main skeleton is an irregular reticulation of coarse, stout, multispicular fibre without visible spongin; the main fibres running lengthwise and branching and

* Possibly young forms of the anisochelæ.

anastomosing with one another. The fibres are not very sharply defined and numerous megascleres occur scattered between them. The dermal skeleton is a very well-developed, triangular-meshed, stellate reticulation of stout, multispicular fibre (about 0·05 millim. in diameter).

Spicules.—(1.) Styli; fairly stout, often slightly crooked, with fairly well-developed oval heads and slightly constricted necks; sharply and rather abruptly pointed at the apex; size about 0·3 millim. by 0·009 millim.

(2.) Broad palmate anisochelæ, very similar to those of *Esperella simonis*:* about 0·048 millim. long; frequently in rosettes.

(3.) Minute palmate isochelæ; numerous, about 0·012 millim. long.

(4.) Large, stout sigmata, C-shaped and contort, with abruptly recurved and very sharply pointed ends; size about 0·08 millim. from bend to bend by 0·006 millim. thick in the middle.

(5.) Slender toxa with gently rounded curves; up to about 0·08 millim. long by 0·002 millim. thick in the middle; often in sheaves (toxodragmata) when young.

I have been able to satisfy myself by personal examination of Mr. Carter's type preparation of his *Esperia plumosa* (now in my possession) of the specific identity of the Ceylon form with the sponge recorded by Carter from Mauritius, and subsequently from the Mergui Archipelago also. As Mr. Carter's descriptions are very scanty, I have thought it desirable to give the above details concerning what is evidently a widely distributed and characteristic species in the Indian Ocean, distinguished by an exceptionally varied and beautiful spiculation.

R.N. 298, 328, 361 (three fragments amongst a large number; all from Ceylon seas).

Esperella crassissima, n. sp.—Plate XI., fig. 6.

The single specimen is rounded, cushion-shaped, attached by the base to a mass of calcareous débris. The upper surface is strongly convex and bears a single large prominent vent about 3 millims. in diameter. Surface with a more or less strongly marked reticulate appearance, due to the coarse sub-dermal network of very stout spicular fibre, the oval meshes of which are normally covered over by a thin pore-bearing membrane, now mostly rubbed off. Pores scattered in the meshes of the dermal skeleton. Texture (in spirit) rather hard but slightly compressible and resilient; coarsely fibrous. Colour pale grey. Maximum diameter of specimen about 24 millims.

The main skeleton is a very well-developed reticulation of very stout, compact spicular fibre up to about 0·33 millim. in diameter, composed of very numerous closely packed spicules and without visible spongin. The meshes of this reticulation vary greatly in size and shape; perhaps 1·3 millims. would be a fair average diameter. Immediately beneath the surface the main skeleton passes into the more compact

* *Vide* (1), Plate XV., fig. 16.

sub-dermal reticulation, with rounded meshes averaging about 0·5 millim. in diameter, separated by fibres of about the same diameter (more or less). Over this lies a true dermal reticulation composed mostly of loosely scattered spicules (sometimes aggregated in slender fibres) lying tangentially in the pore-bearing dermal membrane.

Spicules.—(1.) Tylostyli (Plate XI., fig. 6, *a*); slightly curved, rather stout; with well developed oval heads narrower than the middle of the shaft, from which they are separated by a well marked constriction; gradually or rather abruptly sharp pointed at the apex. Size about 0·49 millim. by 0·016 millim.

(2.) Large palmate anisochelæ of the ordinary form (Plate XI., fig. 6, *b*, *c*), measuring about 0·06 millim. by 0·024 millim. Very numerous, mostly in groups which look like disorganised rosettes; found chiefly just beneath the surface. In the dermal membrane numerous small palmate isochelæ occur scattered singly; these are about 0·012 millim. long and are probably young forms.

(3.) Sigmata (Plate XI., fig. 6, *d*); slender, C-shaped and contort, up to about 0·036 millim. long; numerous.

(4.) Trichodragmata (Plate XI., fig. 6, *e*); short, compact; about 0·02 millim. by 0·006 millim. Very abundant.

This species is very closely related to *Esperella fusca*, Ridley and Dendy (1), obtained by the "Challenger" off Bahia; it differs, however, in the more strongly developed main skeleton and consequently greater hardness of texture, and in the sharply pointed character of the tylostyles; possibly also in colour.

R.N. 240 (Ceylon seas).

Esperella tenuispiculata, n. sp.

Sponge irregularly massive, with a tendency to grow out into rounded lobes or short, thick branches. Surface very uneven, covered over by a soft dermal membrane. Vents few, small, scattered. Pores scattered (perhaps in irregular groups) in the dermal membrane. Texture (in spirit) soft and spongy, but intensely gritty from the presence of an immense quantity of coarse sand, chiefly in the interior of the sponge. Colour varying from grey to brown. The largest specimen is about 63 millims. long by 36 millims. in greatest breadth.

The skeleton is to a large extent replaced by the abundant sand-grains, which may be held together in very irregular bands by spongin cement. Between and in association with these we have loose, wispy bands of styli running towards the surface, or simply scattered styli. There is no dermal skeleton.

Spicules.—(1.) Tylostyli, very much reduced; straight, slender; with distinct oval heads, constricted necks and fairly gradually sharp-pointed apices; size about 0·21 millim. by 0·004 millim., but often more slender.

(2.) Small palmate anisochelæ, about 0·02 millim. long; rather scarce but constant.

(3.) Slender sigmata, C-shaped and contort, about 0·036 millim. from bend to bend; sometimes very abundant.

In its intensely arenaceous habit and the consequent reduction of the proper skeleton, this species resembles *Esperella arenicola*, Ridley and Dendy (1), and *E. crassa*, Dendy (10), both from Bass Straits. It differs from the former, however, in the absence of trichodragmata, and from the latter in the presence of sigmata.

R.N. 293; 305; 334; 344 (Ceylon seas).

Paresperella, n. gen.

Encrusting or massive Esperellinæ, with megascleres in the form of tylostyli or styli; with microscleres in the form of palmate anisochelæ and serrated sigmata, to which others (such as toxa) may be added.

The existence of several esperelline species with serrated sigmata justifies the erection of a new genus, of which the type will be Carter's *Esperia serratohamata*, I am not aware that this very extraordinary form of spicule has hitherto been met with in any other genus.

There are probably at least three species of the genus *Paresperella* in the neighbourhood of Ceylon, for in an indeterminable sponge encrusting a calcareous nodule from "Deep water off Galle and onwards" I have found (as a foreign body) a huge serrated sigma (Plate XI., fig. 3) like those of *Paresperella serratohamata*, but far too large to be referred to that species. It measures 0·3936 millim. from bend to bend and 0·0146 millim. thick in the middle of the shaft, while, according to Mr. Carter's measurements, the corresponding spicule in *P. serratohamata*, though large, measures only 0·1 millim. by 0·0052 millim. Curiously enough, *P. serratohamata* was also first known from a single spicule.

Lindgren (86) has described, under the name *Esperella macrosigma*, a species of *Paresperella* in which the serrated sigmata attain still more enormous dimensions, measuring 0·48 millim. in length by 0·024 millim. in diameter. This species comes from the straits of Korea, and it is quite likely that it occurs also in Ceylon waters and may be represented by the single spicule above described.

The genus is, of course, very closely related to *Esperella*, from which it has evidently been derived.

Paresperella serratohamata (Carter)—Plate XI., fig. 2.

1880, **Esperia serratohamata**, Carter (4).

A minute specimen of this remarkable sponge occurs on a calcareous nodule in association with *Hymedesmia stellivarians* and *Esperella parishii*. The spiculation agrees very well with Mr. Carter's description, but the apices of the tylostyles are uniformly mucronate (Plate XI., fig. 2, *a*). This character is not mentioned in Mr. Carter's description, and the figure which he gives of the tylostyle is on too small a scale to afford satisfactory evidence.

Lambe (85) records this species from Vancouver, but I am doubtful, from the

measurements which he gives of the spicules, whether his identification is correct; we have probably here yet another species of the genus.

R.N. 220c (deep water off Galle and onwards up the West Coast of Ceylon).

Paresperella bidentata, n. sp.—Plate XI., fig. 1.

Sponge intensely arenaceous, the single specimen consisting of a friable mass of coarse yellow sand, held together and permeated by the soft sponge-tissues. Somewhat cavernous internally. Surface uneven, with a soft dermal membrane visible in places. The single specimen is an irregular massive fragment about 25 millims. in maximum diameter.

The main skeleton of the sponge, between the closely aggregated sand-grains, consists of slender megascleres, mostly loosely scattered, but occasionally collected in fairly stout multispicular fibres. In the dermal membrane there is a distinct but very loose and wide-meshed reticulation of slender spicular fibre, three or four spicules wide, supported here and there on very loose sub-dermal brushes belonging to the main skeleton.

Spicules.—(1.) Tylostyli (Plate XI., fig. 1, *a*); long, slender, straight or nearly so, with oval heads, about equal in diameter to the middle of the shaft, and slightly constricted necks; typically with the apex slightly enlarged, truncated, and provided with two (sometimes three ?) minute conical teeth placed side by side on the truncated end (with their long axes parallel with the long axis of the spicule). The enlargement from which these teeth project contains a diverticulum of the central canal of the spicule. These spicules are best developed in the dermal membrane (and in the lining membrane of the large canals ?). In the dermal membrane they form the reticulation of spicular fibre mentioned above, and measure about 0·27 millim. by 0·0053 millim. In the deeper parts of the sponge, between the sand-grains, they are more slender and their apices sometimes appear to end in simple, long-drawn-out points.

(2.) Palmate anisochelæ (Plate XI., fig. 1, *c*, *d*), about 0·028 millim. long; mostly in rosettes near the surface, very abundant and similar to those of *P. serratohamata*.

(3.) Sigmata (Plate XI., fig. 1, *b*, *b*); long and slender, usually contort, with sharply incurved apices and (? always) with more or less distinct teeth on the outer side of each bend, similar to those on the sigmata of *P. serratohamata*, but much less strongly developed. Size about 0·052 millim. from bend to bend by 0·002 millim. thick in the middle.

This species differs from *P. serratohamata* in the presence of two teeth, instead of one, at the apex of the tylostyle; in the much more slender and less distinctly toothed or serrate character of the sigmata, and in the absence of toxa; as well as in the arenaceous habit, which has doubtless caused considerable reduction in the proper skeleton. I know of no other case where one can trace such a close and evident relationship between an arenaceous sponge with reduced skeleton and a non-arenaceous

congener. The bidentate character of the apex of the tylostyle is very remarkable, especially in comparison with the mucronate character of the corresponding spicule in *P. serratohamata*.

R.N. 263A (Gulf of Manaar).

Iotrochota, Ridley.

Esperellinæ of massive, ramose, or flabellate form, and usually of dark purple or brown colour. Skeleton reticulate. Megascleres styli, to which diactinal forms may be added, especially in the more superficial parts of the sponge. Typical microscleres birotulate (apparently modified isochelæ).

In previous papers I have used the term "Amphiaster" for the birotulate spicules of this and certain other genera of Esperellinæ. There can, however, be little doubt that these microscleres are modified isochelæ, and do not belong to the astrose series at all. They are connected with the more typical isochelæ by the peculiar isochelæ of the genera *Chondrocladia* and *Axoniderma*, and may conveniently be termed "birotulate isochelæ."

Iotrochota purpurea (Bowerbank), Ridley.

1875, **Halichondria purpurea**, Bowerbank (**49**); 1884, **Iotrochota purpurea**, Ridley (**16**).

The Ceylon variety of this species is characterized by its dark brown instead of purple colour in spirit.* It is also easily distinguished from *Iotrochota baculifera* by this character as well as by the replacement of the tylote megascleres by slender styli, commonly arranged in radiating tufts at the surface.

The specimens are for the most part irregularly cylindrical in shape, may be much branched; and the surface is covered irregularly with small, sharp conuli. The styli of the main skeleton are usually sharp-pointed and very variable in size. The birotulate isochelæ are numerous and about 0·02 millim. long. Not infrequently, the straight, slender styli in the radiating tufts at the surface of the sponge exhibit an inflation not far from the middle of the shaft, causing them to resemble a pipette. The fibres of the main skeleton reticulation are stout and contain much spongin as well as very many spicules.

The original type of the species was described by Bowerbank from the Straits of Malacca. Ridley recorded it from Torres Straits, Albany Island, Port Molle, and the Amirante Group. The West Indian *Iotrochota birotulata* (Higgin) (**53**) and the Southern Australian *Iotrochota coccinea* (Carter)† are very possibly identical with this species, or only varietally distinct.

R.N. 258; 297; 309; 343; 354; 366 (Stat. V., off Chilaw, 10 fathoms, and elsewhere in Ceylon seas. Some are mere fragments).

* It should, however, be noted, that a portion of the collection was preserved in formalin and transferred to spirit afterwards. I do not know which specimens were treated in this way, nor do I know what effect such treatment may have had upon the colour.

† *Vide* Dendy (**10**).

Iotrochota baculifera, Ridley.

1884, **Iotrochota baculifera**, Ridley (**16**); 1887, **Iotrochota baculifera**, Ridley, var. **flabellata**, Dendy (**2**).

There are in the collection a number of dark purple-coloured specimens, mostly small or mere fragments, which I identify with this species. The flabellate habit, characterizing my variety *flabellata*, is not recognisable in most of them, and it seems hardly worth while to retain a special varietal name for the Ceylon form. In a boiled-out preparation of R.N. 164 I find the styli frequently much stouter than the measurements which I gave from Mr. Thurston's specimens, often measuring about 0·2 millim. by 0·012 millim., but very variable in diameter, while the tylota measure about 0·246 millim. by 0·007 millim., and the birotulate isochelæ about 0·02 millim. long. It will be seen that these measurements agree very closely with those given by Ridley for the type specimen from Port Darwin.

Thiele (**39**) has recorded the species also from Celebes.

R.N. 47 (Gulf of Manaar); 164; 317; 322; 331 (all from Ceylon seas).

Sub-family: PHLŒODICTYINÆ.

Desmacidonidæ in which the sponge body is provided with fistular outgrowths, and, usually at any rate, with a spicular rind or cortex.

In this sub-family I include the genera *Phlœodictyon*, *Oceanapia*, *Histoderma*, *Sideroderma* and *Amphiastrella*, which appear to me to form a very natural group.

The microscleres are usually more or less completely suppressed.

Phlœodictyon, Carter.

Phlœodictyinæ with oxeote or strongylote megascleres and no microscleres at all.

Lundbeck (**88**) has shown pretty conclusively that Carter's name "*Phlœodictyon*" must be revived for this genus, the type species of "*Rhizochalina*," described by Schmidt, being true Chalininæ.

Phlœodictyon fistulosum (Bowerbank).

1873, **Desmacidon fistulosa**, Bowerbank (**22**); 1880, **Desmacidon Jeffreysii**, Carter (**4**); 1884, **Rhizochalina fistulosa**, Ridley (**16**); 1888, **Rhizochalina fistulosa**, Ridley and Dendy (**1**); 1897, **Oceanapia fistulosa**, Topsent (**83**); 1904, **Phlœodictyon fistulosum**, Topsent (**62**).

Mr. Carter recorded this species from the Gulf of Manaar under the name *Desmacidon Jeffreysii*. It differs, however, from the British *Oceanapia jeffreysi*, as Mr. Carter himself pointed out, in the absence of sigmata. In this respect it agrees with the Australian *Phlœodictyon fistulosum*, with which I have no hesitation in identifying it.

In a footnote to the account of this species in the Report on the "Challenger"

Monaxonida. Mr. Ridley and I suggested that *Rhizochalina* and *Oceanapia* should be united in one genus, and in a subsequent paper (**10**) I have carried out this suggestion. Our reason for this proposal was that at one of the "Challenger" stations (188, off New Guinea) specimens with and without sigmata appear to occur together, and are so closely similar in external appearance that they cannot be distinguished otherwise than microscopically. It seems equally reasonable, however, to suppose that the two genera actually occur together in this locality, or that there has been some confusion in the sorting out of the specimens. We can hardly suppose that the same species sometimes occurs with, and sometimes without, sigmata. I therefore propose to return to the arrangement originally adopted in the "Challenger" Report, substituting, for the reason above given, the name "*Phlœodictyon*" for "*Rhizochalina*."

Neither Mr. Carter nor I have been able to find sigmata in the Ceylon specimens, though I have myself examined about half-a-dozen microscopically.

One of Professor Herdman's specimens has the body, which varies much in shape and is often very irregular, up to 48 millims. in maximum diameter. As pointed out by Mr. Carter, the fistular processes are long and may be ramified. They sometimes appear to be naturally closed at the extremity (except, perhaps, for small pores), and sometimes open. In nearly all cases they have been broken off short.

R.N. 81, 90, 237 (all from deep water off Galle and onwards up West Coast of Ceylon); 260; 363 (fistulæ only, Stat. I., hauls 1–4, January 31, 1902, Colombo to Negombo, 12 to 20 fathoms). Also other unnumbered specimens and loose fistulæ.

Histoderma, Carter.

Phlœodictyinæ with usually diactinal megascleres and microscleres in the form of isochelæ, to which others may be added.

An examination of Mr. Carter's own preparations of his *Phlœodictyon singaporense* (**54**) has revealed the presence of small palmate isochelæ. I therefore propose to place this species, together with a closely related Ceylonese form, in the genus *Histoderma*.

The presence of isochelæ in this genus is of great interest and necessitates the inclusion of the Phlœodictyinæ amongst the Desmacidonidæ, the two species referred to forming an important connecting link between *Phlœodictyon* and *Oceanapia* on the one hand and *Desmacidon* on the other.

Histoderma vesiculatum, n. sp.—Plate XI., figs. 8, 9.

This remarkable sponge is represented in the collection by two fragments of about equal size and closely similar appearance. Each consists of an elongated cylindrical body inflated at irregular intervals to form oval vesicles. In one specimen there are two distinct vesicles connected by a short cylindrical piece, and from the larger of the two, which is broken across at the end, another short cylindrical piece is given off as

a branch. The slender cylindrical portions, and the vesicles too, are now more or less hollow, but they contain the remains of the coarse skeleton network and a certain amount of decomposed soft tissue. Thus, in the present condition of the specimens, the outer wall of the sponge forms a thin but firm shell enclosing a wide cavity in which lie the remains of the choanosome. How far the sponge was hollow in life cannot now be ascertained. The colour (in spirit) is dark brown throughout, with a slight purplish tinge on the surface. The surface is smooth, but has a very characteristic tessellated appearance, caused by the very stout sub-dermal reticulation of spicular fibre showing through the thin dermal layer. Each specimen has a total length of about 27 millims. The largest vesicle measures about 11 millims. by 9 millims., and the slender cylindrical portions are about 4 millims. in diameter (sometimes rather less).

The main skeleton forms a very wide-meshed reticulation of very stout spicular fibre, occupying the interior of the sponge; the meshes being very irregular in shape and size. The diameter of the fibre, which appears to be composed entirely of very closely packed megascleres, is about 0·165 millim. There is a sub-dermal reticulation of similar fibre with roundedly polygonal meshes, the meshes being about 1 millim. in diameter. This supports the dermal skeleton (Plate XI., fig. 8), which is very well developed and extremely beautiful, consisting of a single layer of strongyla of various lengths lying tangentially side by side as closely packed together as possible, with a few much larger oxea, or sometimes styli, intermingled with them.

Spicules.—(1.) Oxea (Plate XI., fig. 8, *o*, *o*, *o*); rather long and only moderately stout; slightly curved, usually sharply but sometimes rather abruptly pointed at each end; size about 0·3 millim. by 0·009 millim., but variable. Abundant in the fibres of the skeleton and scattered in the soft tissues between, where numerous very slender, hair-like forms, possibly young, also occur.

(2.) Strongyla (Plate XI., fig. 8, *s*, *s*); cylindrical, more or less curved, and evenly rounded off at each end; size extremely variable, from 0·04 millim. by 0·005 millim. to 0·1 millim. by 0·007 millim., or perhaps more. Characteristic of the dermal skeleton, but also found in the spicular fibres and soft tissues of the choanosome.

(3.) Palmate isochelæ (Plate XI., fig. 9), about 0·016 millim. long; very similar to those of *Desmacidon conulosa*, as figured in the Report on the "Challenger" Monaxonida; numerous.

(4.) I have also seen one "birotulate" of about the same length as the ordinary isochelæ; with very slender and apparently straight shaft and short umbrella-like ends with minutely dentate margins. Whether or not this forms a constant element in the spiculation I am not prepared to say, but its presence is very interesting in view of the normal occurrence of such spicules in the genus *Amphiastrella*.

This species differs from *Histoderma singaporense* (Carter) chiefly in external form, but also in the more slender character of the oxea.

Lindgren, however, has described (86), under the name *Rhizochalina singaporensis*

(Carter), a sponge from the China Sea, in which he also discovered isochelæ. This specimen seems to resemble the Ceylon form very closely, and it is possible that future investigations may show them all to be specifically identical.

R.N. 212 (deep water outside pearl banks, Gulf of Manaar).

Sub-family: ECTYONINÆ.

Desmacidonidæ in which some of the megascleres take the form of spined styli, originally developed as echinating spicules of the skeleton fibre or projecting at right angles from the substratum.

The members of this sub-family are usually easily recognised by their spined styli, but, as in the case of perhaps every type of spicule, the spined styli may be lost again by degeneration. Such degeneration has obviously taken place in the genus *Raspailia*, which, until recently, has been confounded with the Axinellidæ. As a rule, microscleres are present in the form of isochelæ (to which toxa are frequently added), but these also may be lost.

Myxilla, Schmidt.

Ectyoninæ, usually of massive, irregular form, in which the megascleres are spined styli, which may or may not be echinating, and variously ended diactinal forms which typically belong to the dermal skeleton. The typical microscleres are tridentate isochelæ, to which other forms may be added.

This genus in a certain sense occupies, as pointed out by Mr. Ridley and myself in the Report on the "Challenger" Monaxonida, a position intermediate between the sub-families Esperellinæ and Ectyoninæ, including both species with definite echinating spicules and species in which such spicules cannot be distinguished from those of the ordinary skeleton reticulation. It appears probable, from their form, that the spined styli originated in the first instance as echinating spicules, *i.e.*, spicules in which the growth of one end (the base) became arrested by pressure against a firm substratum, while the apex projected freely into the surrounding soft tissues and thus formed an internal defence against the attacks of parasites. In some species these echinating spicules appear to have passed into the main skeleton and form a reticulation with one another.* It appears desirable, therefore, to regard the presence of spined styli (or tylostyli) as constituting the leading feature of the Ectyoninæ, without insisting too strongly upon their actual arrangement.

In the genus *Myxilla* itself it is sometimes impossible, owing to the irregular character of the skeleton reticulation, to distinguish sharply between echinating and non-echinating styli, and, as I have pointed out before (10), I cannot, therefore, agree with Topsent (62, &c.) and Hanitsch (46) in retaining Gray's genus *Dendoryx* for species in which no special echinating spicules are recognisable.

* Compare *Rhabderemia indica* and its relationship to the thin encrusting forms of the same genus. See also below, under *Myxilla tenuissima*.

This important genus is represented in the present collection by only two species, but both of these are of exceptional interest owing to their unusual habit, the one being a typical sand-sponge and the other a very thinly encrusting form.

Myxilla arenaria, n. sp.

Sponge massive, irregular; intensely and coarsely sandy, with a distinct translucent dermal membrane visible in places. Pores and vents (?). Greatest diameter of type (R.N. 263) 30 millims. Colour (in spirit) light brown (the colour of the sand) or grey; texture very friable.

Main skeleton composed almost entirely of sand, with slender strongyla scattered between the sand-grains and also collected in loose, wispy fibres; and with small spined tylostyli or styli very sparsely echinating the sand-grains. Dermal skeleton composed of slender strongyla scattered irregularly in the dermal membrane.

Spicules.—(1.) Strongyla, perhaps sometimes faintly tylote; straight, slender, smooth; measuring about 0·146 millim. by 0·002 millim.

(2.) Spined tylostyli or styli; straight; gradually and very sharply pointed at the apex; rather sparsely and irregularly spined, chiefly at and near the base, which is generally distinctly tylote. Size variable, say about 0·056 millim. by 0·004 millim. (near the head, including spines).

(3.) Tridentate isochelæ, with small teeth and fairly stout, strongly curved shaft; length about 0·014 millim.; not very abundant.

(4.) Slender sigmata; C-shaped and contort; measuring about 0·032 millim. from bend to bend, but rather variable in size.

As usual in sand-sponges, the proper skeleton is reduced in accordance with the arenaceous habit. In external appearance the sponge closely resembles *Paresperella bidentata*, and might easily be mistaken for that species.

R.N. 263 (Gulf of Manaar); 266 (pearl banks off Aripu).

Myxilla tenuissima, n. sp.—Plate XI., fig. 5.

Sponge extremely thin, encrusting. The single specimen forms a small crust of a pale yellowish colour growing on a mass of calcareous worm-tubes in association with *Discodermia emarginata*. Vents and pores not seen.

The skeleton consists partly of slender tylota, scattered irregularly and in loose wisps, and partly of spined tylostyles projecting vertically from the substratum, upon which their bases rest while their apices point outwards.

Spicules:—(1.) Tylota (Plate XI., fig. 5, *a*); smooth, slender, straight or nearly so, with rather feebly developed oval heads and commonly with the shaft slightly inflated (tylote) in many places at irregular intervals. Size about 0·148 millim. by 0·002 millim.

(2.) Spined tylostyli (Plate XI., fig. 5, *b*); quite straight and abundantly spined all over; with spherical head not much wider than the shaft, which tapers gradually

from the head to a fine, sharp apex. Spines rather small, conical and sharp pointed; on the head rather longer than elsewhere and arranged in a radiating manner, so that the head, when viewed end on, resembles a spheraster. Size variable, up to about 0·08 millim. in length by 0·008 millim. in thickness where the shaft joins the head (exclusive of spines). These spicules are very numerous and, though quite separate from one another, are placed pretty close together.

(3.) Stout tridentate isochelæ (Plate XI., fig. 5, *c*, *d*) of the usual *Myxilla* type, with rather strongly curved shaft; length about 0·032 millim.; very numerous.

This is a *Myxilla* with the encrusting habit of a *Hymedesmia*, and with correspondingly arranged skeleton. In spiculation it closely resembles TOPSENT'S *Dendoryx certa* (48), but differs in skeleton arrangement, the spined styli forming a network in the latter species. In fact, *Myxilla tenuissima* bears much the same relationship to *Myxilla* (*Dendoryx*) *certa* that *Rhabderemia pusilla* does to *Rhabderemia indica*.

R.N. 234A (on same mass as R.N. 234, "deep water off Galle and onwards").

Clathria, SCHMIDT.

Ectyoninæ of various habit, frequently clathrous; skeleton a reticulation of fibre, usually with much spongin, containing smooth styli and echinated by spined styli. Typical microscleres small palmate isochelæ, to which toxa are frequently added.

I have already (10) indicated the necessity for abandoning the genus *Rhaphidophlus* of EHLERS, which differs from *Clathria* only in the possession of a dermal crust of radially disposed styli. The degree of development of this crust varies to such an extent, however, that it is quite impossible to base a generic distinction on this character alone.

Clathria frondifera (BOWERBANK).

1875, **Halichondria frondifera**, BOWERBANK (49); 1884, **Clathria frondifera**, RIDLEY (16); 1889, **Clathria corallitincta**, DENDY (3).

I do not think it is possible to keep the Ceylonese form, described by me under the name *Clathria corallitincta*, separate from the common Australian and Indian Ocean species, originally described by BOWERBANK from the Straits of Malacca and Gaspar Straits under the name *Halichondria frondifera* and subsequently re-investigated by RIDLEY.

The external form of the sponge is very characteristic, and one of Professor HERDMAN'S specimens (R.N. 44) bears a remarkably close resemblance to a specimen from the Mascarene group figured by RIDLEY (*loc. cit.*, Plate liii., fig. j). The spiculation, however, seems to be somewhat variable, and I must add to the description which I gave of Mr. THURSTON'S specimens the following particulars concerning those in the present collection.

The palmate isochelæ may be abundant. Smooth, slender toxa of very various length are also met with. These are best developed in R.N. 85 and 281, where they attain a length of about 0·184 millim., being almost straight from end to end except for a small bow in the middle. The stout styli of the main skeleton vary greatly in thickness. The slender styli or tylostyli may form a fairly distinct dermal skeleton, in which they are either irregularly scattered or arranged in more or less definite radiating brushes. The bases of these spicules are sometimes minutely spined (R.N. 169).

One of the specimens (R.N. 97) is attached to a pearl oyster (*Margaritifera vulgaris*).

R.N. 44, 97, 268 (all Gulf of Manaar); 85, 169, 281 (all deep water off Galle and onwards up West Coast of Ceylon).

Clathria indica, Dendy.

This common species (Dendy, **3**) is represented in the collection by four specimens.

R.N. 27, 106 (both from Gulf of Manaar, Stat. IX., &c.); 166; 291 (Ceylon seas).

Clathria spiculosa (Dendy).

1889, **Rhaphidophlus spiculosus**, Dendy (**3**).

There is one small specimen of this sponge which makes a close approach to the original types both in external form and spiculation.

R.N. 335 (Ceylon seas).

Clathria spiculosa, var. **ramosa**, nov.

This variety agrees closely with the types of the species in skeleton arrangement and spiculation, but differs conspicuously in its elongated, slender, sub-cylindrical, irregularly branching external form. It thus makes a very close approach to Ridley's *Echinonema gracilis* from the Mascarene Islands (**16**), but the megascleres in the Mascarene species are much stouter.

R.N. 168; 308; 310; 333; 368 (deep water outside pearl banks, Gulf of Manaar).

Clathria spiculosa, var. **tessellata**, nov.—Plate VIII., fig. 2.

This variety again differs from the types of the species only in external features, which are, however, very characteristic. The sponge consists of more or less erect, thick, irregular lamellæ, with the margin rising up here and there into short, digitiform processes. The vents are minute and few, marginal or on the ends of the processes. The most striking character of the variety, however, is the tessellated appearance of the surface, due to the presence of a close, polygonal-meshed reticulation of (presumably) pore-bearing grooves; the meshes of the reticulation are about 1 millim. to 1·5 millims. in diameter. The general appearance of the sponge is well shown in the figure. One specimen (R.N. 92A) measures about 70 millims. in greatest

breadth and the same in height. The colour (in spirit) is dark grey, and the texture characteristically firm and fleshy, and very tough.

R.N. 92; 92A (Gulf of Manaar).

Raspailia, Nardo.

Ectyoninæ of elongated, slender, branching habit. Skeleton composed of a dense central axis of spicular fibre containing much spongin, from which bundles or tufts of spicules radiate to the surface. Smooth monactinal (sometimes diactinal) megascleres are present, and also (normally) spined echinating styli. No microscleres.

As already indicated, the members of this genus bear a strong superficial resemblance to Axinellidæ, but it is evident from the presence of the spined echinating styli (though these may be vestigial) that they are really highly modified Ectyoninæ.

Raspailia thurstoni, Dendy.

There is one specimen of this sponge (Dendy, 2, 1887) in the collection.

R.N. 39 (Stat. LX., outside Muttuvaratu Paar, 30 fathoms)

Raspailia fruticosa, Dendy, var. tenuiramosa, nov.—Plate VIII., fig. 5.

1887, Raspailia fruticosa, Dendy (2).

There are in the collection two specimens, one dry and one in spirit, which differ from the type of the species only in the much more slender and much shorter branches, and in the greater density of the skeleton, which is less distinctly reticulate. The branches are usually only from 2 millims. to 3 millims. in diameter, and very numerous, so that the whole sponge is even more fruticose than the type. The largest specimen (dry) is about 55 millims. in total height and 78 millims. in greatest breadth; it is represented in Plate VIII., fig. 5.

R.N. 100 (dry, Gulf of Manaar); 173.

Raspailia hornelli, n. sp.—Plate XI., fig. 7.

The single specimen is erect, arborescent, branching in one plane. The branching at first sight appears to be dichotomous, but in reality the two branches present are both given off from the same side of a main axis which in no way differs from them in appearance, except that the part below the first branch, which we may consider as representing the stalk, is more rounded in transverse section and slightly expanded below at the attachment, while the branches themselves are slightly flattened. Each branch is very much narrowed at the end to form a slender, elongated apex. The surface is rather coarsely granular, with numerous minute apertures between the granules; slightly hispid in places. Colour (in spirit) dark brown. Texture tough, compressible, resilient. Total height about 99 millims. Length of stem below the

first branch 33 millims., diameter about 5 millims. Length of longest (lowest) branch about 64 millims.; greater transverse diameter of branches when fully developed about 6 millims.

The skeleton consists of a network of stout horny fibre, irregularly cored by smooth megascleres and fairly abundantly echinated by spined styli. There is a well marked axial condensation of the reticulation, in which most of the larger spicules are to be found densely packed together lengthwise in the stout horny fibre. From this axial portion more slender fibres run obliquely outwards to the surface, where each one ends (typically) in a projecting brush composed of a very few long, stout styli, surrounded at the base by numerous much shorter and very slender styli (these often appear to be absent). The outwardly-directed horny fibres are irregularly cored by usually slender megascleres and abundantly echinated towards their outer ends by spined styli. They are connected together to form a network by short secondary fibres of similar structure, but more slender. There are also many of the smooth megascleres scattered through the soft tissues apparently without any relation to the fibres at all

Spicules.—(1.) Smooth styli (Plate XI., fig. 7, *a*); long and comparatively stout, evenly rounded off at the base, gradually and sharply pointed at the apex; usually slightly curved towards the base; size about 0·65 millim. by 0·018 millim.; found chiefly in the axial condensation (but also scattered in the soft tissues outside it) and in the surface brushes.

(2.) Smooth styli (Plate XI., fig. 7, *b*, *c*); very slender, straight or nearly so, evenly rounded off at the base and very finely and gradually pointed at the apex; size, say about 0·24 millim. by 0·0027 millim., but sometimes longer; characteristic of the surface brushes, but also occurring frequently between the axis and the surface; perhaps sometimes oxeote.

(3.) Smooth oxea (Plate XI., fig. 7, *d*, *e*, *f*, *g*); rather short and fairly stout, fusiform, more or less curved or angulated in the middle, gradually sharp pointed at each end; size very variable, commonly about 0·2 millim. by 0·012 millim., but may be as much as 0·46 millim. by 0·014 millim.; abundant, scattered irregularly outside the horny fibres, and within them.

(4.) Strongyla (Plate XI., fig. 7, *h*, *h*); very short and comparatively stout, straight, equal-ended and broadly rounded off at each end; size very variable, say about 0·2 millim. by 0·024 millim.; sometimes pretty numerous in the axial condensation and occasionally met with outside it, but very erratic in occurrence.

(5.) Spined styli or sub-tylostyli (Plate XI., fig. 7, *k*, *l*, *m*); rather short, straight, tapering gradually from base to apex, which, though narrow, is bluntly pointed; covered all over with very minute, sharp spines, which are most abundant at the base and apex; size about 0·08 millim. by 0·008 millim. (at the base, including spines).

Numerous small, spherical, granular, brown pigment cells, about 0·01 millim. in diameter, are scattered through the outer part of the soft tissues.

This species, though evidently closely related to the European *Raspailia* (*Dictyo-*

cylindrus) *hispida*, is readily distinguished by the details of its spiculation. I have much pleasure in naming it after Mr. HORNELL, to whose energy this collection owes, I am told, so much of its value.

R.N. 59 (Stat. IV., off Karkopani, Gulf of Manaar).

Agelas, DUCHASSAING and MICHELOTTI.

Ectyoninæ in which the skeleton is composed of horny fibre echinated by verticillately spined styli; with no other spicules.

For synonymy and references I must refer to the Report on the "Challenger" Monaxonida (p. 163).

Agelas mauritiana (CARTER).

1883, **Ectyon mauritianus**, CARTER (**54**); 1887, **Agelas mauritianus**, RIDLEY and DENDY (**1**); 1903, **Agelas cavernosa**, THIELE (**87**).

This species is represented by a tubular fragment 31 millims. long and up to about 16 millims. in diameter; widely open at both ends and with the wall of the tube only about 3·5 millims. thick. It is of rather dark brown colour and firm, resilient consistence.

The skeleton is a close, irregular network of stout, amber-coloured horny fibre echinated very abundantly by the characteristic verticillately spined styli, which measure about 0·176 millim. by 0·016 millim. (including spines).

This beautiful species has hitherto been recorded from Mauritius (CARTER), off Tristan da Cunha (?) ("Challenger"), and from Ternate (THIELE).

R.N. 358 (Ceylon seas).

Agelas ceylonica, n. sp.—Plate XII., fig. 9.

The type specimen* consists of a few slender, anastomosing, sub-cylindrical branches, arising from an irregular, proliferous basal crust attached to a calcareous nodule. The branches are only about 2 millims. in diameter, and their surface is irregular and sometimes minutely hispid. Texture (in spirit) compressible, resilient, fibrous and fairly tough. Colour brown. Vents minute and scattered on the branches.

The skeleton is an irregular network of pale-coloured horny fibre about 0·03 millim. in diameter, abundantly echinated by the spined styli, which are occasionally also found embedded lengthwise in the fibre, two or three side by side.

Spicules.—Verticillately spined styli (Plate XII., fig. 9), straight or slightly curved; the spines mostly small and conical, especially about the middle of the spicule; those at the base irregularly arranged, larger, and often hook-shaped, with the sharp points curved towards the apex of the spicule; apex sharp-pointed and free from spines for a short distance. Size variable, but characteristically long, say about 0·24 millim. by

* A second specimen closely resembles the type.

0·02 millim. at the base (including spines). Although they are verticillately spined, the annulation of these spicules is not nearly so distinct as in *Agelas mauritiana*.

R.N. 304; 312 (type). (Both from Ceylon seas.)

Echinodictyum, Ridley.

Ectyoninæ with reticulate main skeleton composed of spicular fibre containing smooth oxea and echinated by spined styli. Smooth styli may also be present. Microscleres usually absent.

Echinodictyum clathratum, n. sp.—Plate XI., fig. 4.

The single specimen forms a sub-spherical, clathrous mass of rather thin, short, flattened trabeculæ, echinated on the outer surface by slender conuli. Vents and pores not seen. Colour (in spirit) pale greyish-yellow; texture soft and resilient, fairly tough. Total diameter about 20 millims.

The main skeleton is a very irregular network of fairly stout spicular fibre; the size and shape of the meshes and the thickness of the fibres varying greatly. The fibres contain a very large number of oxeote megascleres closely packed together side by side, while the spongin cement which unites them is inconspicuous on account of its very pale colour. The fibres are echinated more or less abundantly by spined styli which project from them almost or quite at right angles. Numerous loose megascleres (oxea and styli) are scattered between the fibres. There is a dermal skeleton of well developed brushes of very slender styli; the brushes are well separated from one another, and each exhibits a beautiful radiate arrangement of its component spicules. These brushes appear to be confined to the outer surface of the sponge as a whole, and are absent from the surfaces of the inner trabeculæ.

Spicules.—(1.) Oxea (Plate XI., fig. 4, *c*, *d*); smooth, slender, usually more or less sharply bent at or near the middle, gradually and sharply pointed at each end; size very variable, commonly about 0·25 millim. by 0·006 millim. In the fibres and scattered between them, forming the greater part of the skeleton.

(2.) Smooth styli (Plate XI., fig. 4, *a*, *a*); very long and fairly stout, tapering gradually from the evenly rounded base (which may be very faintly tylote) to the sharply pointed apex; nearly straight but generally slightly curved towards the base; size variable, say about 1·26 millims. by 0·012 millim. These spicules lie parallel to the surface in the thickness of the sponge-lamella, without any definite arrangement.

(3.) Smooth styli (Plate XI., fig. 4, *b*); very slender, almost hair-like; straight or gently curved; evenly rounded at the base, very gradually and finely pointed at the apex; size about 0·34 millim. by 0·002 millim. In the dermal brushes.

(4.) Spined tylostyli (Plate XI., fig. 4, *e*, *f*); rather long and slender, straight, tapering gradually from the slightly developed head to the narrow, fairly sharp-pointed apex. Spines small but abundant all over, especially on the head. Size about 0·1 millim. by 0·006 millim. where the shaft joins the head.

I have also seen three small isochelæ about 0·018 millim. long, and two or three sigmata, one of which measured about 0·05 millim. from bend to bend; but these spicules are so scarce that I am doubtful whether they are proper to the sponge.

This is an interesting species, having (if we leave out of account the doubtful microscleres) the spiculation of an *Echinodictyum* combined with the habit of an *Echinoclathria*. It is evidently nearly related to THIELE's *Echinodictyum cavernosum* from Celebes (**39**), but differs in its pale colour and in the presence of the large styli.

R.N. 325 (Ceylon seas).

Aulospongus, NORMAN.

Massive Ectyoninæ with plumose columnar skeleton, comprising both smooth and spined styli in the spiculation. Without microscleres.

In my 'Report on a Second Collection of Sponges from the Gulf of Manaar' (**3**) I expressed the opinion that NORMAN's genus *Aulospongus* (**55**) was unnecessary, and that the species for which it was established might be included in the genus *Axinella*. Further consideration has, however, induced me to alter my views on this question, and to consider the presence of the spined styli as constituting a sufficient generic distinction from *Axinella*, and, indeed, necessitating the removal of the genus to the Ectyoninæ.

This genus is evidently closely related to *Raspailia*, and constitutes one of the apparent connecting links between the Ectyoninæ and Axinellidæ. THIELE (**39**) has referred to the genus *Raspailia* two or three Japanese species, one, at least, of which (*Raspailia* (?) *villosa*) should perhaps be included in *Aulospongus*. The Australian *Raspailia cacticutis* (*vide* DENDY, **10**) may also possibly belong here, and likewise Mr. CARTER's *Dictyocylindrus sessilis* from the Gulf of Manaar (**4**).

Aulospongus tubulatus (BOWERBANK).

1873, **Haliphysema tubulatum**, BOWERBANK (**8**); 1878, **Aulospongus tubulatus**, NORMAN (**55**); 1889, **Axinella tubulata**, DENDY (**3**).

Fig. 3. *Aulospongus tubulatus* (BOWERB.); from Gulf of Manaar; nat. size.

There are a number of specimens of this sponge in Professor HERDMAN's collection. The species (fig. 3) forms one of the most characteristic elements in the Sponge-Fauna of Ceylon, and is of especial biological interest as affording an example of symbiosis, or perhaps commensalism, between a Sponge and an Annelid. I have nothing to add to the account which I gave in my 'Report on a Second Collection of Sponges from the Gulf of Manaar' (**3**).

R.N. 1, 2, 3 (and others not numbered; all from Gulf of Manaar (Stats. V., IX., XV., LV., LXI., LXVIII.).

Acarnus, Gray.

Ectyoninæ in which the megascleres may be stylote, oxeote, tylote and cladotylote, the latter forming the characteristic "grapnel-spicules" which typically echinate the skeleton fibre. Microscleres may be present in the form of palmate isochelæ and toxa.

Acarnus ternatus, Ridley.—Plate VIII., fig. 4.

There is in the collection a remarkably fine dry specimen of this species (R.N. 105, Plate VIII., fig. 4), of proliferous and thickly flabellate habit, with rather large vents (about 8 millims. in diameter) on the summits of the lobes. The specimen measures 270 millims. in greatest breadth by 150 millims. in height, and its colour is brown. There are also a couple of small specimens in spirit, the best of which is sub-cylindrical in form and irregularly branched.

The spongin of the skeleton fibres is very strongly developed but very pale-coloured.

Spicules.—(1.) Styli, measuring about 0·3 millim. by 0·0164 millim.

(2.) Cladotylota (grapnels), with usually three large, strongly recurved, sharp teeth; shaft about 0·21 millim. by 0·012 millim.

(3.) Slender tylota with slightly spined heads; about 0·22 millim. by 0·0035 millim. in the middle.

(4.) Oxea; long and very slender, gradually sharp-pointed at each end, may be angulated at or near the middle; say about 0·74 millim. by 0·004 millim.

(5.) Toxa; say about 0·152 millim. by 0·008 millim., but often more slender.

(6.) Palmate isochelæ, about 0·02 millim. long.

The slender oxea occur irregularly distributed outside the horny fibres. Ridley (**16**) makes no mention of them in his description, but they might be overlooked or regarded as accidental. Keller, on the other hand, describes and figures similar spicules in his *Acarnus wolffgangi* from the Red Sea (**61**). The latter species may possibly prove to be a mere synonym of *A. ternatus*.

The species has hitherto been recorded from Torres Straits (Ridley), Bombay (?) (Ridley), Amirante Islands (Ridley), and Tahiti ("Challenger").

R.N. 105 (dry, Gulf of Manaar); 313; 329 (Ceylon seas).

Cyamon, Gray (*emend.*).

Ectyoninæ in which the principal megascleres are smooth styli and tylostyli; the echinating spicules have a radiate form, and there are no microscleres.

In 1867, Gray (**31**) proposed this genus for Bowerbank's *Dictyocylindrus vickersii*, of which a single spicule was figured and described in the 'Monograph of British Spongiadæ.'* It was not until 1879 that this species was first really described by

* Vol. i., p. 267, fig. 234.

CARTER (56), who, however, did not adopt GRAY'S genus, but adhered to BOWERBANK'S original name.

In 1880, CARTER (4) also described two species from the Gulf of Manaar, which he named *Microciona quadriradiata* and *M. quinqueradiata* respectively, and called attention to the resemblance of the echinating spicules in these species to those of "*Dictyocylindrus vickersii*." It appears to me that all these three species must be included in one genus, distinguished as in the diagnosis given above, for which we may retain GRAY'S name *Cyamon*.

This genus appears to be nearly related to *Trikentrion*, but is distinguished from it by the absence of oxeote megascleres (compare CARTER, 56).

The peculiar radiate echinating spicule is probably derived from a spined echinating stylus by great enlargement of three or four of the basal spines. In this way it may come to resemble a tetractinellid spicule or an aster. It is extremely interesting to compare with these forms the equally peculiar echinating "grapnel" spicule of *Acarnus*, in which a tetractinellid form may also be arrived at secondarily, but by enlargement of spines at the apex instead of at the base of the spicule.

Cyamon quinqueradiatum (CARTER).

1880, **Microciona quinqueradiata**, CARTER (4).

The single specimen in the collection forms a sub-circular crust, about 11 millims. in diameter and 3 millims. thick in the middle, attached to a mass of nullipore.* The surface is uneven and irregularly conulose, and there is in parts a distinct, thin dermal membrane. In parts also the surface is sparsely hispid from the projection of some of the large spicules. The texture is soft and compressible, internally somewhat cavernous, and the colour (in spirit) is pale yellowish-brown.

The skeleton consists chiefly of tylostyles and styles of various sizes, the latter (at any rate usually) longer than the former. These spicules sometimes have their bases resting on the substratum and sometimes they are arranged in short plumose columns; some have their apices projecting for a considerable distance beyond the surface. The echinating spicules are rather scarce and local in their distribution, mostly to be found amongst the bases of the other spicules; though plentiful here and there, they might easily be overlooked except in fortunate preparations.

The spiculation agrees fairly closely with CARTER'S description, but I think he has laid too much stress upon the distinction of the various forms of styli and tylostyli. In our specimen these pass gradually into one another; the slender "acuate" is not recognisable as a distinct type (it may be simply a young form), while the tylostyli have larger heads than appears from CARTER'S description and figure. There may be either three or four smooth rays in the echinating spicule (in addition to the spined ray), but it agrees very closely with CARTER'S description and figure.

R.N. 270 (deep water off Galle and onwards up West Coast).

* In association with a small specimen of *Petromica massalis*, R.N. 269.

Plocamia, Schmidt.*

Ectyoninæ of varying form; may be encrusting or erect and branched. The characteristic spicules are dumb-bell-shaped or sausage-shaped megascleres, in addition to which styli or tylostyli of various forms (some of which are typically echinating) may be present. The microscleres are isochelæ and (at any rate usually) toxa.

Plocamia manaarensis (Carter)—Plate VIII., fig. 1.

1880, **Dictyocylindrus manaarensis**, Carter (4); 1881, **Dirrhopalum manaarense**, Ridley (60).

There are several specimens of this curious sponge in the collection. Mr. Carter figured and described both external form and spiculation, and Mr. Ridley added valuable information on the latter point and on the question of systematic position. It is therefore unnecessary for me to do much more than refer to Plate VIII., fig. 1, which represents a much finer specimen than any hitherto obtained. The colour of the sponge (in spirit) varies from pale yellowish-grey to almost black,† and the branching is extremely irregular. One specimen (R.N. 367) shows very clearly how the main stem may be attached to the substratum by an expanded base.

Lambe (85) has recorded this species from California, but I think that his identification is probably erroneous.

R.N. 41 (Gulf of Manaar); 76 (Stat. XXXIII., 18 fathoms); 107 (off Galle, February 13, 1902); 278 (deep water off Galle and onwards up West Coast of Ceylon); 367 (deep water outside pearl banks); 374 (Stat. LX., 20–30 fathoms, Gulf of Manaar).

Bubaris, Gray.

Ectyoninæ of usually encrusting habit. Skeleton consisting of an inner mass of diactinal (vermicular) spicules, from which large styli or tylostyli project vertically outwards. Without microscleres.

This genus was founded by Gray (31) for Bowerbank's *Hymeraphia vermiculata*, the type of the genus *Hymeraphia* (*H. stellifera*) being a totally different sponge. Topsent (59, 62) has already adopted the genus.

It is probable that there are a large number of encrusting sponges, with skeleton arrangement very similar to that of *Bubaris*, which are in reality not closely related to one another, but derived from several groups by adaptation to an encrusting habit (compare *Hymedesmia* amongst Astromonaxonellida). In such cases we must judge of their systematic position rather by the form of the spicules than by the mere arrangement of the skeleton.

The possible relationship of the genus *Bubaris* to the Axinellidæ is indicated in the Report of the "Challenger" Monaxonida (p. 182).

* For literature, &c., *vide* Ridley and Dendy (1).

† See footnote under *Iotrochota purpurea*.

Bubaris eruca (CARTER).

1880, **Hymerhaphia eruca**, CARTER (**4**); 1894, **Rhabderemia eruca**, TOPSENT (**59**).

There are three specimens of this very curious encrusting sponge in the collection; it has been well described and figured by CARTER (*loc. cit.*), who himself pointed out its close resemblance to BOWERBANK'S *Hymeraphia vermiculata*, which is the type species of the genus *Bubaris*.

TOPSENT (**62**) has recently proposed to include this species in his genus *Monocrepidium*, distinguished from *Bubaris* by the tuberculation of the diactinal megascleres. In *Bubaris eruca* the spicules in question are annulated rather than tuberculated.

R.N. 183 (Stat. XLIII., off Kaltura, February 19, 1902, depth 22 fathoms); 239A, 240A (both from deep water off Galle and onwards up West Coast).

Rhabderemia, TOPSENT.

Encrusting or massive Ectyoninæ in which the principal megascleres are styli with strongly curved base, shaped like a hockey stick, and the principal microscleres are contorted sigmata. There are no chelæ and the echinating spicules appear to be greatly reduced or absent.

TOPSENT (**48**) established this genus in 1892, originally for the reception of CARTER'S *Microciona pusilla* and *M. intexta* (**57**), and a new species described by himself under the name *Rhabderemia guernei*. *R. pusilla*, being mentioned first, may be taken as the type of the genus. *R. guernei* and the new species which I am about to describe under the name *Rhabderemia indica*, agree so closely with *R. pusilla* that there can be no reasonable doubt of their generic identity. *R. intexta* differs more from the typical species, but may still, I think, be included in the genus. It is distinguished from the others by the possession of spined megascleres and the absence of small slender styli. There is in Mr. CARTER'S cabinet, however, a preparation labelled by him "*Microciona minutula*," which is intermediate in spiculation, having large bent styli minutely spined at the apex and also very slender styli slightly roughened at the base. It is further characterized by having toxa amongst the microscleres, and is evidently quite distinct from *Rhabderemia* (*Microciona*) *pusilla*, with which Mr. CARTER has apparently confounded it.*

It is probable that some other species hitherto referred to the genus *Microciona* will also have to be included under *Rhabderemia*; on the other hand, as I have shown in dealing with *Bubaris eruca*, this species has been erroneously included in the genus *Rhabderemia* by TOPSENT.

Rhabderemia indica, n. sp.—Plate XII., fig. 10.

The specimen encrusts and almost completely envelopes some large fragments of shell, and attains on one side of the shell a thickness of 7 or 8 millims. The shape of the entire specimen with its enclosed shell-fragments is massive and irregular.

* The name *pusilla* was intended by CARTER to be *minutula*, *vide* CARTER (**57** and **4**).

The surface is uneven but fairly smooth; granular; with a distinct, translucent dermal membrane in places. Vents probably small and scattered. Texture rather soft, spongy and friable. Colour (in spirit) dull grey. Greatest diameter of the entire mass about 48 millims.

The skeleton is a close-meshed, very irregular reticulation of megascleres, many of which are collected together into loose multi-spicular bands running perpendicularly to the surface. These primary fibres, if we may so call them, are connected together by still looser and more irregular secondary bands, and the whole is confused by immense numbers of irregularly scattered megascleres. There is no special dermal skeleton and I have detected no spongin.

Spicules.—(1.) Styli, "rhabdostyles" of Topsent (Plate XII., fig. 10, *a*, *b*, *c*); base evenly rounded off, not tylote; basal part of shaft sharply bent at an angle to the remainder, like the end of a hockey stick, occasionally somewhat spirally curved; remainder of shaft straight or nearly so; gradually or somewhat hastately pointed at the apex; size fairly uniform, about 0·24 millim. by 0·006 millim., the bent basal portion being about 0·018 millim. long. These make up the main skeleton.

(2.) Very small, slender styli (Plate XII., fig. 10, *d*); straight or nearly so; tapering gradually from rounded base to finely pointed apex; with very slightly roughened surface; size about 0·044 millim. by 0·002 millim. at the base. Scattered very abundantly through the soft tissues as microscleres, and very uniform in size. I am inclined to think that these spicules are vestigial echinating styli.

(3.) Sigmata (Plate XII., fig. 10, *e*); very much contort, slender, often twisted into a kind of half-knot in the middle, sharply pointed at each end (when one end appears bluntly rounded, or even knobbed, it is probably due either to its having been broken short or to fore-shortening in perspective). The greatest length, measured in a straight line from bend to bend, is only about 0·012 millim., but if the spicule were straightened out it would measure at least twice as much. Very abundant.

This species is distinguished from *Rhabderemia pusilla* by the greater length of the bent styli and the much smaller size and roughened surface of the minute styli; from *R. guernei* by the absence of the peculiar microscleres which Topsent terms "thraustoxes," and by the smaller size of the megascleres and the roughening of the minute styli; from *R. intexta* by the presence of the minute styli, the smoothness of the large megascleres and the form of the sigmata. It differs from all in its much more robust growth, which constitutes perhaps its most noteworthy feature.

R.N. 341 (Ceylon seas).

Family: AXINELLIDÆ.

Sigmatomonaxonellida in which the microscleres have usually been entirely lost by degeneration; the megascleres are usually, in part or entirely, stylote; the skeleton arrangement is usually, but not always, plumose; and there are no spined echinating styli.

Owing to their loss of microscleres and want of other well-marked characters, this family is one of the most unsatisfactory with which we have to deal. The plumose arrangement of the megascleres in the main skeleton cannot be regarded as exclusively diagnostic, for it is met with also in Ectyoninæ and even in Chalininæ, and too great reliance upon this character has led to the inclusion of forms amongst the Axinellidæ which certainly should not be included in that family. I have already indicated that those so-called Axinellids in which true asters have been observed (*e.g.*, *Vibulinus*) should be placed amongst the Astromonaxonellida. The genus *Raspailia*, similarly, has been removed from the Axinellidæ to the Ectyoninæ, but we are still left with a somewhat heterogeneous collection of sponges which it is extremely difficult to define, and which will probably be subjected to considerable re-arrangement in the future. A curiously constant feature in this group is the irregularity exhibited by the ends of the megascleres and the manner in which the stylote and oxeote forms tend to pass into one another.

It is highly probable that the group, even as here restricted, is of polyphyletic origin.

Spongosorites, Topsent (*emend.*).

Axinellidæ with the main skeleton composed of an irregular but dense reticulation of large oxea or styli, and dermal skeleton composed of a thin layer of very much smaller oxea lying tangentially, and in close contact with the main skeleton; oxea typically biangulate.

Topsent (**14**, &c.) places the genus *Spongosorites* in his family Coppatiidæ, assuming that it has lost the characteristic microscleres, and calling attention to the apparent tetractinellid affinity indicated by the biangulate oxea. It appears to me, on the other hand, to come more naturally amongst the Axinellids, being not distantly removed from *Leucophlœus* and *Ciocalypta*, as indicated by the new species described below, in one of which we perhaps find a clue to the evolution of the curious finger-shaped "processes" of the latter genus. In *Ciocalypta tyleri*, var. *aberrans*, we also sometimes find biangulate oxea.

The genus *Spongosorites* may also be nearly related to Thiele's *Dactylella* (**39**).

Spongosorites topsenti, n. sp.—Plate XII., fig. 1.

There are six specimens of this curious sponge in the collection, differing so much amongst themselves in external form that it seems desirable to give a short account of each.

R.N. 152 is a depressed cake-shaped sponge of nearly circular outline, with convex upper and almost flat lower surface, the latter having been evidently attached to the substratum all over. Greatest diameter 36 millims., thickness in the middle 13 millims. The upper surface is somewhat corrugated, with shallow grooves (indicating underlying canals) radiating in a stellate manner from low, mound-like

projections, one at least of which bears at its summit a small group of vents through which the radiating canals open, while another bears no visible apertures at all. The upper surface also bears one very small digitiform process, about 5 millims. long and 2 millims. in diameter, with no visible opening, and there may have been more of these processes, now broken off. The texture is hard and compact, almost stony, and the colour (in spirit) is dull brownish-grey.

R.N. 68 is similar in general features, but the upper surface is much more strongly convex; the broad, mound-like projections are rather better developed, but still few in number (about three, grouped in the middle of the upper surface), and one bears a conspicuous vent. The slender digitiform processes without visible openings are more numerous than in R.N. 152. Greatest diameter of specimen 34 millims.

R.N. 182 is a small hemispherical specimen only about 15 millims. in diameter, with the convex upper surface produced in the middle into a single stout digitiform process, about 11 millims. long by 6 millims. thick, but of irregular shape. This process contains wide canals which enter it from the body of the sponge. There are apparently none of the slender digitiform processes. I have seen no vents, but the specimen is somewhat damaged.

R.N. 202 is closely similar to the last, but rather larger, with a single stout digitiform process in the middle, containing longitudinal canals, but now broken short.

R.N. 134 is a small specimen about 26 millims. in diameter, with slightly conulose surface and two very short but stout finger-like processes.

R.N. 77 is much larger than any of the preceding, and the base, instead of being flat below, has grown partially round several loose calcareous nodules. It is strongly convex and more or less conulose and corrugated above, and the upper surface also bears two or three well-developed, stout, erect digitiform processes, very irregularly distributed. These processes contain more or less well-developed longitudinal canals, but there are no visible vents. On the general surface of the sponge the usually low conuli are in places elongated to form slender projections about 4 millims. long, and with strongly hispid surface. The base of this specimen is about 78 millims. long by 35 millims. in greatest breadth. One of the larger processes is about 26 millims. high by 15 millims. broad at the base, tapering upwards almost to a point.

From the above descriptions it would appear that the sponge is normally cushion- or cake-shaped, with the upper surface conulose or rugose, and sometimes bearing processes of two kinds, viz., (1) large processes which appear to contain the exhalant canals and to be produced by elongation of low, mammiform, vent-bearing projections, with the conspicuous vents probably replaced by a cribriform dermal membrane; and (2) small slender processes produced by elongation of the surface conuli, and apparently bearing no special relation to the canal system.

The main skeleton in the body of the sponge consists of a very dense and confused reticulation of scattered spicules lying in all directions and varying greatly in form

and size, stout and slender mixed up together. At the surface, lying immediately on the main skeleton, there is a thin dermal layer of short and rather slender oxea, through which the apices of the large underlying spicules frequently project. In the processes of both kinds, large and small, the spicules of the main skeleton for the most part run lengthwise, and there is the same irregular dermal reticulation of small oxea. There are none of those characteristic radiating pillars of spicules, supporting the dermal membrane over large sub-dermal cavities, which we find in a typical *Ciocalypta*.

Spicules.—(1.) Large and very stout (Plate XII., fig. 1, *a–k*), typically fusiform oxea, but variously ended, sometimes stylote or strongylote, always more or less curved, sometimes biangulate, sometimes very crooked and irregular; size about 1·1 millims. by 0·065 millim., but variable.

(2.) Short, slender oxea (Plate XII., fig. 1, *l*); usually biangulate, gradually and sharply pointed at each end, symmetrical; measuring about 0·18 millim. by 0·008 millim., but variable. These forms occur chiefly, but not entirely, in the dermal skeleton; while between these and the largest spicules numerous intermediate forms (Plate XII., fig. 1, *m*) may be observed.

The above account of the spiculation is taken from R.N. 152, but the spiculation of the other specimens does not differ in any important respect.

The species may be distinguished from its European congener, *S. placenta* (the type of the genus), by the development of the finger-like outgrowths (which, however, may be not always present) and by details of spiculation, such as the absence of the central inflation of the oxea.

R.N. 68 (Gulf of Manaar); 77 (Stat. XLV., off Pantura, 25 fathoms); 134, 202 (deep water off Galle and onwards up West Coast); 152; 182 (Stat. XLIII., off Kaltura, February 19, 1902).

Spongosorites (?) lamellata, n. sp.—Plate XII., fig. 2.

Sponge irregular, compressed, lamello-digitate; only 3 millims. or 4 millims. in average thickness, with a maximum length of about 45 millims. ? Erect. Surface granular in appearance and minutely hispid, fairly smooth but uneven; margins rounded. Colour (in spirit) pale greyish-yellow.

The main skeleton consists of a dense and very irregular reticulation of styli, mostly scattered singly, but occasionally collected in loose strands. The dermal skeleton is formed of a thin layer of small slender oxea, lying tangentially to the surface and very irregularly scattered.

Spicules.—(1.) Styli (Plate XII., fig. 2, *a*, *b*, *c*); usually fairly stout and slightly curved or crooked (especially towards the base), narrowing slightly to the base, which is evenly rounded, and tapering gradually to the apex, which is sharply pointed; size, when fully grown, about 0·95 millim. by 0·02 millim., but numerous smaller and more slender forms occur which are apparently young.

(2.) Oxea (Plate XII., fig. 2, *d*, *e*); slender, sub-fusiform, slightly curved or angulated once or twice, sharply pointed at each end; size very variable, averaging, say, about 0·2 millim. by 0·0055 millim. These spicules occur chiefly at the surface of the sponge, but are also found in the interior.

This species differs widely from *Spongosorites topsenti*, not only in external form but also in the (? invariably) stylote character of the larger spicules.

R.N. 236 (deep water off Galle and onwards up West Coast of Ceylon).

Spongosorites (?) lapidiformis, n. sp.—Plate XII., fig. 3.

The three specimens by which this species is represented in the collection are quite irregular in shape; massive, and everywhere evenly rounded off, like water-worn pebbles, with no recognisable points of attachment or differentiation of surfaces. The surface is granular and very shortly hispid; harsh to the touch; occasionally veined by underlying ramifying canals. Vents few, small, sometimes hardly recognisable. Texture hard and compact, without separable dermal membrane. Colour (in spirit) pale wax-yellow. The largest specimen measures about 29 millims. in maximum diameter.

The skeleton is a very dense, irregular reticulation of megascleres, partly collected together in ill-defined bands. This reticulation extends right up to the surface of the sponge, and there is no special dermal skeleton, and apparently no spongin.

Spicules.—(1.) Very stout, fusiform oxea (Plate XII., fig. 3, *a*, *b*); slightly curved and gradually and sharply pointed at each end; measuring, say, about 0·87 millim. by 0·0495 millim.; pretty frequently becoming stylote (Plate XII., fig. 3, *c*) by rounding off of one end, and rarely even strongylote. These oxea are connected by intermediate forms (Plate XII., fig. 3, *d*) with

(2.) Slender oxea (Plate XII., fig. 3, *e*); slightly curved, gradually sharp-pointed at each end; measuring, say, about 0·54 millim. by 0·012 millim.; irregularly intermingled with the large oxea, and perhaps only young forms thereof.

This species is of very doubtful systematic position. Had it not been for the presence of so many stylote spicules, I should probably have referred it to *Halichondria*. It differs from typical species of *Spongosorites* in the absence of a special dermal layer of small oxea.

R.N. 143, 144, 145 (all from deep water off Galle and onwards up West Coast).

Hymeniacidon, Bowerbank (*emend.*).

Axinellidæ of massive habit. Skeleton reticulate, composed of spicular fibre usually containing a good deal of spongin; with no special dermal skeleton. Megascleres styli or sub-tylostyli; no microscleres.

I have pointed out on a previous occasion (**10**) that Lendenfeld's genus *Stylotella* (with which Topsent's *Stylinos* is admittedly synonymous) is not distinguishable

from *Hymeniacidon*. The position of the genus amongst the Axinellidæ is, of course, open to question, but it seems to come at least as naturally here as anywhere else.

Hymeniacidon petrosioides, n. sp.—Plate XII., fig. 4.

The type specimen (R.N. 151) is massive, cushion-shaped, strongly convex above and irregularly concave below, having evidently been attached to the substratum at a few points only. Upper surface fairly even but coarsely granular. Vents (probably) few, small and scattered. Texture very hard and compact; surface harsh to the touch. Colour (in spirit) dull grey, with a purplish tinge here and there. Greatest breadth about 47 millims.; maximum thickness about 19 millims. There is another much smaller specimen of irregularly massive form.

The skeleton is a dense, close-meshed reticulation of short, stout styli, in which one can readily distinguish stout, multispiculous main fibres running at right angles to the surface at distances of about one spicule's length from one another, and connected crosswise by isolated spicules and bundles of spicules, with other similar spicules irregularly scattered in the soft tissues.

Spicules.—Short, stout, more or less curved or bent styli (Plate XII., fig. 4), broadly rounded off at the base (occasionally slightly tylote) and gradually sharp pointed at the apex; fairly uniform in size, measuring about 0·39 millim. by 0·022 millim. (There are apparently no oxea.)

This species appears to be nearly related to Topsent's *Stylinos jullieni* from the Atlantic (48), but the spicules are much larger. In external appearance it bears a very close resemblance to *Thrinacophora durissima*, with which it may easily be confounded until microscopically examined, and, indeed, I am inclined to think that these species of *Hymeniacidon* are really closely related to the massive species of *Thrinacophora*. We may also have here, so to speak, a point of contact between the Axinellidæ and Desmacidonidæ, indicated both by the form and arrangement of the megascleres and the presence of trichodragmata in the last-named genus. The spicular fibre in *Hymeniacidon* is not plumose, or, at most, very feebly so, but it is impossible to draw a hard and fast line between the plumose type of fibre characteristic of the Axinellidæ and the non-plumose type characteristic of the Desmacidonidæ, &c.

R.N. 151; 316 (Ceylon seas).

Thrinacophora, Ridley and Dendy.

Axinellidæ with typically plumose skeleton and with microscleres in the form of trichodragmata.

Thrinacophora agariciformis, n. sp.—Plate XII., fig. 6.

Sponge consisting (usually, at any rate) of a short, thick stalk (which has evidently been attached below), supporting a thick, rounded, cushion-shaped body which is irregularly depressed above so as to form a more or less shallow, very thick-walled

cup; or the top of the sponge-body may be flattened, with several irregular, shallow depressions. Surface minutely and uniformly conulose; the conuli barely 0·5 millim. in diameter and separated from one another by deep but narrow, meandering grooves. In the depression at the top the conuli may be covered over by a thin translucent membrane containing small circular vents. Consistence compressible, resilient. Colour (in spirit) pale yellowish-grey. A typical specimen (R.N. 163, not quite the largest) gave the following measurements: total height 25 millims.; length of stalk 8 millims.; diameter of stalk 13 millims.; longer diameter of body 31 millims.; shorter diameter 21 millims.

The skeleton is arranged in a typical axinellid manner, consisting chiefly of plumose columns of spicules running at right angles to the surface and ending in the conuli. These columns lie pretty close together and are connected with one another crosswise by occasional groups of spicules, or by single spicules, running across at right angles from one to the other; there are also numerous irregularly scattered spicules in the interspaces. The spicules are cemented together in the columns, and sometimes also in the cross connections, by a large amount of very pale-coloured spongin. There is no special dermal skeleton, but the surface may be rendered slightly hispid by the projection of the terminal spicules of the columns.

Spicules.—(1.) Short styli (Plate XII., fig. 6, *b*, *c*); fairly stout and more or less curved, especially towards the base, which is broadly rounded off; with gradually and finely pointed apex; size about 0·268 millim. by 0·01 millim., but variable.

(2.) Oxea (Plate XII., fig. 6, *d*, *e*); usually gently and evenly curved and sharply pointed, but often irregularly ended; of about the same size as the short styli, and very numerous.

(3.) Very long and slender, setaceous styli (Plate XII., fig. 6, *a*) (sometimes oxea), measuring, say, about 0·75 millim. by 0·008 millim., but variable. These spicules are found lying lengthwise in the interspaces between the plumose columns.

(4.) Trichodragmata (Plate XII., fig. 6, *f*); bundles of short and very slender, hair-like microscleres, slightly curved, the whole bundle measuring, say, about 0·032 millim. by 0·005 millim., but variable. These occur scattered quite irregularly between the spicular columns.

This beautiful and well-characterised little sponge is represented in the collection by seven specimens. It differs widely from any of its known congeners in external form, and spirit specimens are easily mistaken, at first sight, for young examples of *Phakellia donnani*, though readily distinguished on closer inspection by their paler colour, more finely conulose surface, &c. It is apparently common and may be looked upon as one of the most characteristic species of the Ceylon Sponge-Fauna.

R.N. 160A; 160B; 163; 163A; 314; 332; 356 (all from Ceylon seas).

Thrinacophora durissima, n. sp.—Plate XII., fig. 5.

Sponge sessile, cushion-shaped, very strongly convex above and somewhat con-

tracted below, but attached by a broad base. Surface even, but granular or minutely conulose, the conuli being in part covered over by a translucent dermal membrane; very minutely hispid. Vents small, few, scattered; surrounded by feebly developed grooves arranged in a somewhat stellate fashion. Colour (in spirit) pale yellowish-grey. Texture compact, very hard; surface harsh to the touch; internal structure radially columnar. Greatest diameter about 23 millims.

The skeleton is composed chiefly of close-set, rather irregular, plumose columns of megascleres, running at right angles to the surface and ending in the small conuli or granules. These columns are connected by numerous spicules, isolated or in loose bands, which run across at right angles from one to another, while numerous megascleres are also scattered irregularly in the soft tissues.

Spicules.—(1.) Oxea (Plate XII., fig. 5, *b*); short, fairly stout, fusiform, gently and symmetrically curved, gradually sharp-pointed at each end; size up to about 0·39 millim. by 0·024 millim., but usually somewhat less, especially in diameter.

(2.) Styli (Plate XII., fig. 5, *a*); with broadly rounded base and gradually sharp-pointed apex; usually more or less curved towards the base; dimensions about the same as those of the oxea. Perhaps not quite so abundant as the oxea.

(3.) Trichodragmata (Plate XII., fig. 5, *c*, *d*); short, stout bundles of very slender, hair-like spicules, the whole bundle having, as usual, a faint brownish colour; dimensions of the entire bundle about 0·02 millim. by 0·008 millim.; abundant towards the surface of the sponge.

This curious little sponge is evidently closely related to Topsent's *Thrinacophora spissa* (**48**) from the North Atlantic, and forms an interesting connecting link between that species (which has only oxeote megascleres, apparently arranged in a halichondrioid rather than an axinellid fashion) and the more typical species of the genus.

R.N. 355 (Ceylon seas).

Axinella, Schmidt.

Axinellidæ of varying habit, but not flabellate. With plumose skeleton composed of smooth styli or oxea and no microscleres.

Axinella labyrinthica, Dendy.

There are three specimens of this sponge in the collection. The species is easily recognisable by its external appearance, and I have nothing to add to my former description, Dendy (**3**), 1889.

R.N. 33, 103 (both from Gulf of Manaar); 357 (Ceylon seas).

Axinella manus, n. sp.—Plate XII., fig. 8.

Sponge erect, stipitate, branched in a somewhat palmate manner, but with the branches coming off at different levels and curving slightly towards one another (so as to suggest a hand holding a ball). Stem cylindrical, slightly expanded below,

about 25 millims. long and 9 millims. in diameter. Branches about as thick as the stem, slightly flattened, short (usually about 30 millims. long), rather few in number, terminating in abrupt, conical apices. The vents are small openings in the floors of stellately arranged or longitudinal grooves, which give a characteristic appearance to the sponge, and are chiefly placed on the inner surface of the branches, but also occasionally on the outer surface and on the stem. Surface between the vent-bearing grooves granular or minutely conulose. Texture compressible, resilient but tough, with the stem a good deal harder than the branches. Colour (in spirit) rather light grey. Total height of specimen 84 millims.

The skeleton is rather loose and irregular, consisting (in the branches) of plumose columns radiating outwards to the surface and with many spicules irregularly scattered between; the whole becoming quite confused towards the middle of the branch, but without any special axial condensation.

Spicules.—(1.) Rather short and fairly stout styli (Plate XII., fig. 8); more or less curved towards the base, which is broadly rounded off; gradually and sharply pointed at the apex; size about 0·295 millim. by 0·016 millim., but often more slender.

(2.) Oxea: almost symmetrically curved and gradually sharp pointed at each end; of about the same dimensions as the styli; abundant.

This species, in the arrangement of the vents and in the skeletal characters, makes a close approach to *Phakellia donnani* and *P. symmetrica*, and demonstrates very clearly the impossibility of distinguishing sharply between the genera *Phakellia* and *Axinella*.

R.N. 53 (Gulf of Manaar).

Axinella tenuidigitata, n. sp.—Plate XIII., fig. 4.

The single specimen is a small massive sponge of short, thick, irregularly cylindrical form, attached by a broad base below and strongly convex on the upper surface, from which a number of slender, elongated, finger-like processes are given off. Surface uneven and irregularly hispid, especially on the digitiform processes; in part minutely and irregularly conulose and in part covered by a distinct, sub-glabrous, translucent dermal membrane. The digitiform processes are solid and they may unite with one another. Vents apparently small and scattered between the processes. Colour (in spirit) pale wax-yellow; texture hard and compact. Height of body about 20 millims., diameter about 15 millims.; length of processes, of which there are about half a dozen, about 11 millims., with a diameter of not much more than 1 millim.

The skeleton in the body of the sponge consists of an irregular reticulation of long styli, which, as they approach the surface, arrange themselves in loose, irregular, plumose columns. The digitiform processes are composed each almost entirely of a dense axis of similar spicules closely crowded together and placed longitudinally, with a few spicules projecting outwards beyond the surface, so as to give rise to its hispid character.

Spicules.—Apparently all stylote and all long (Plate XIII., fig. 4), but varying much in thickness; usually only very slightly curved (towards the base), but sometimes crooked; broadly rounded off at the base, which may be somewhat narrower than the middle part of the spicule, and gradually and sharply pointed at the apex. The stouter forms measure about 1·18 millim. by 0·0328 millim. In the digitiform processes they are a good deal more slender, and slender forms also occur intermingled with the stout ones in the body of the sponge.

R.N. 202A (deep water off Galle and onwards up West Coast of Ceylon).

Axinella halichondrioides, n. sp.—Plate XII., fig. 7.

Sponge encrusting, extended horizontally. Upper surface somewhat convex and rather uneven, with small monticular elevations, each bearing a single vent, scattered at fairly regular intervals; granular (minutely conulose) between the elevations, the conuli being normally covered over by a thin, transparent dermal membrane. Colour (in spirit) light brown; texture firm and compact, columnar in vertical section. Greatest breadth of specimen about 64 millims.; thickness in the middle about 16 millims. Height of vent-bearing projections up to about 2 millims. Diameter of vents about 1 millim. Distance between vents about 9 millims.

The skeleton consists chiefly of very stout but rather loose and irregular and only slightly plumose columns of spicules running vertically to the surface and ending in loose brushes in the small surface conuli. These columns contain a very large number of spicules and are connected together by short, loose bands of spicules running across the interspaces at right angles. There are also a large number of spicules irregularly and loosely scattered through the soft tissues.

Spicules.—Mostly oxeote (Plate XII., fig. 7, *a*); gently and uniformly curved, gradually and sharply pointed at each end; size about 0·31 millim. by 0·01 millim. A few styli of about the same size also occur (Plate XII., fig. 7, *b*, *c*).

This species resembles pretty closely THIELE'S *Axinella incrustans* (39) from Japan, but its spiculation shows it to be distinct.

R.N. 75 (outside pearl banks, Gulf of Manaar).

Phakellia, BOWERBANK.

Axinellidæ of compressed, flabellate (or cup-like) form, usually with vents on one of the flat surfaces and inhalant pores on the other. Without microscleres.

Phakellia donnani (BOWERBANK).

1873, **Isodictya donnani**, BOWERBANK (8); 1887, **Axinella donnani**, DENDY (2).

There are a dozen specimens of this characteristic species in the collection, in various stages of growth. The spiculation, as usual in the Axinellidæ, is somewhat variable, and oxeote as well as stylote spicules occur. In view of the cup-shaped (or sometimes flabellate) form (see fig. 4) it seems desirable to remove the species from the genus

Axinella and put it in *Phakellia*, if indeed the distinction between these two genera is to be maintained.

Fig. 4. *Phakellia donnani* (Bowerb.), from Gulf of Manaar, nat. size. A, flabellate; B, cup-shaped form.

R.N. 10, 15, 20, 21, 22, 23 (all from Gulf of Manaar); 160; 160A; 160B; 160C; 181, 181A (the last two from Stat. XLIII., off Kaltura, depth 22 fathoms, February 19, 1902).

Phakellia symmetrica, n. sp.—Plate XIII., fig. 3.

The single specimen is a short-stalked, flabellate sponge, the somewhat compressed stalk widening out not very suddenly into a single vertical expansion with evenly rounded margin and without any proliferation. The two surfaces are exactly alike; minutely conulose with small circular openings (? inhalant pores) everywhere between the conuli, and with numerous stellate vents scattered at moderately wide intervals. Towards the margin the surface becomes longitudinally grooved rather than conulose, and there are also a few marginal vents. Colour (in spirit) dull yellowish-grey; texture compressible, resilient, tough. Total height of specimen about 55 millims.; length of stalk about 16 millims.; greatest breadth of frond about 41 millims.; thickness of frond in the middle about 8 millims.

The skeleton is composed of moderately stout, slightly plumose fibres curving upwards and outwards to the surface (where they terminate in the small conuli) and connected together by short, irregular cross fibres, so as to form an ill-defined reticulation with many spicules scattered irregularly in the interspaces. The skeleton fibres contain much spongin, not very conspicuous, however, on account of its pale colour.

Spicules.—Styli (occasionally oxeote) of two principal varieties: (*a.*) Comparatively short and stout (Plate XIII., fig. 3, *a*, *b*); more or less curved towards the base, which is evenly rounded off, and gradually and sharply pointed at the apex; size about 0·23 millim. by 0·009 millim. (*b.*) Comparatively long and slender (Plate XIII., fig. 3, *d*), slightly curved towards the base, which is evenly rounded off, and gradually and finely pointed at the apex; size about 0·5 millim. by 0·008 millim.

This pretty little sponge may prove to be merely a variety of *Phakellia donnani*, connected with the typical form by the flabellate variety figured in my paper on the Sponge-Fauna of Madras (2). For the present, however, it is perhaps better to keep the two distinct.

R.N. 159 (Muttuvaratu Paar, 8 fathoms).

Phakellia ceylonensis, n. sp.—Plate VIII., fig. 3 ; Plate XIII., fig. 5.

The single specimen (Plate VIII., fig. 3) is shortly stipitate, erect, thinly flabellate and very proliferous. The branching and anastomosing vertical lamellæ of which it is composed all terminate at about the same level in thin, sinuous margins. The lamellæ are scarcely 3 millims. in thickness and have a tendency to become perforated by larger and smaller apertures. The two surfaces of the lamella are not distinguishable; each is finely conulose (granular) and minutely and slightly hispid. Vents not recognisable. Texture tough and resilient ; colour (in spirit) greyish-brown. Total height only about 41 millims., but with a maximum breadth of about 90 millims.

The skeleton is dense, composed of plumose columns radiating upwards and outwards into the small surface conuli, and merging internally into an irregular but fairly dense reticulation of spicules. There is a large development of very pale-coloured spongin.

Spicules.—(1.) Styli ; slightly curved or bent, evenly rounded off at the base, usually very gradually and finely pointed at the apex ; of two principal sizes, but very variable : (*a.*) Comparatively short and stout (Plate XIII., fig. 5, *a*), say about 0·2 millim. by 0·008 millim. (*b.*) Long and slender (Plate XIII., fig. 5, *b*), say about 0·44 millim. by 0·005 millim.

(2.) Oxea (Plate XIII., fig. 5, *c*, *d*, *e*) ; subject to much the same variations in size as the styli, and variously ended.

This species is nearly related to Carter's *Phakellia flabellata* from Australia (*vide* Dendy, **10**), but for the present at any rate it may be regarded as specifically distinct.

R.N. 34 (Gulf of Manaar).

Phakellia crassistylifera, n. sp.—Plate XIII., fig. 6.

The single specimen is a small, irregular, proliferously lamellar and slightly clathrous sponge, without recognisable point of attachment. The surface is granular and minutely hispid, and there are no visible vents. Texture hard, tough, resilient. Colour (in spirit) pale wax-yellow. Height (?) 31 millims. ; greatest breadth about 19 millims. ; thickness of lamellæ variable, say about 2 millims.

The skeleton is a very dense, close and irregular reticulation of very stout fibre, composed of a large quantity of almost colourless spongin, in which numerous usually stout styli are more or less completely embedded. The primary fibres are stouter than the secondaries, and may have a somewhat plumose character ; but the whole reticulation is so confused, and the spongin, though very abundant, so pale in colour, that at first sight the entire skeleton looks like a dense, irregular network of thickly scattered styli.

Spicules.—Styli (Plate XIII., fig. 6) ; usually stout and comparatively short and more or less curved ; broadly rounded off at the base, which is not narrowed, and usually sharply and gradually pointed at the apex ; but the apex is occasionally bluntly rounded off, so that the spicule becomes strongylote with unequal ends. Size

commonly about 0·46 millim. by 0·0285 millim., but very variable in diameter; often much more slender than the measurement given, and occasionally a good deal stouter; sometimes rather longer.

R.N. 256 (Ceylon seas).

Acanthella, Schmidt.

Axinellidæ of usually flabellate form and more or less cartilaginous consistence. With more or less strongly aculeate or conulose surface. With no microscleres.

Acanthella carteri, Dendy.—Plate VIII., fig. 6.

There are several specimens of this sponge in the collection, and as the external form has not yet been figured, Professor Herdman has kindly had one of them photographed for this report (Plate VIII., fig. 6). There is a strong development of very pale-coloured spongin fibre associated with the spicules, which I omitted to mention in my original description, Dendy, 3 (1889).

Keller's *Acanthella aurantiaca* (61), from the Red Sea, comes very near to this species, if it be not identical with it.

R.N. 11, 36, 49 (all from Gulf of Manaar, Stats. II., IV., V.); ? 301 (perhaps young); ? 336 (perhaps young).

Acanthella flabelliformis, Keller.

The single specimen is thinly flabellate; ? stipitate (the stalk may have been broken off, the specimen being somewhat damaged and worn); both surfaces beset with rather sharp longitudinal ridges, showing a tendency to break up into conuli; with deep, semi-cylindrical, longitudinal grooves between the ridges. The floor of the grooves is formed by a rather thick, translucent dermal membrane, containing no spicules and easily stripping off; in this membrane are scattered numerous small vents. Colour (in spirit) dark greyish-brown. Texture tough, compressible, resilient. Height of the single lamella of which the specimen consists 37 millims.; breadth 51 millims.; thickness (including ridges) about 5 millims.

The skeleton is a reticulation of stout spicular fibre, containing much spongin and comparatively few, though still very numerous, spicules. The main fibres curve upwards and outwards to the surface, and are united by irregular cross-fibres. The arrangement of the spicules, both in the fibres and between them, is very irregular and confused. The main fibres are often somewhat plumose.

Spicules.—Oxea; straight or curved, slender, gradually and sharply pointed at each end; size fairly uniform, up to about 0·3 millim. by 0·0065 millim.; occasionally stylote.

The soft tissues are densely charged with small, round, granular brown cells, probably pigment cells.

This species is chiefly characterised by its oxeote spicules and by the distinctly reticu-

late skeleton with its strong development of spongin. It appears to form a connecting link between the genera *Acanthella* and *Phakellia*.

I have little doubt of the specific identity of the Ceylon form with that from the Red Sea, where it is, according to KELLER, one of the most abundant and characteristic forms on the reefs. Such slight differences as I have observed will be sufficiently evident by comparison of the description given above with that given by KELLER (61), in 1889. KELLER tells us that the colour in life is blue.

R.N. 31 (Gulf of Manaar).

Auletta, SCHMIDT.

Axinellidæ of tubular form; without microscleres.

Auletta lyrata (ESPER).

1798–1806, **Spongia lyrata**, ESPER (6); 1870, **Raspaigella lyrata**, EHLERS (58); 1889, **Auletta aurantiaca**, DENDY (3).

There are a number of specimens of this species in the collection, which show it to be an extremely variable one, both as regards external form and spiculation. The re-discovery of the typical flabellate form, agreeing closely with ESPER's figs. 1 and 2 (Plate 67), enables me to identify my *Auletta aurantiaca* with ESPER's *Spongia lyrata*, which was also obtained from Ceylon.

Typical examples may be described as follows:—

Sponge erect, flabellate, shortly stalked. Lamella thick, slightly proliferous, with broadly rounded margin bearing a row of small, sometimes sphinctrate vents, which are the outlets of vertical oscular tubes. Surfaces of lamella rather minutely conulose or rugose, and slightly hispid. Texture (in spirit) compressible and resilient, but tough; colour yellowish-grey. One specimen (R.N. 345) has a total height of about 31 millims., the lamella is about 42 millims. in breadth, and 7 millims. in thickness. The vents are rather less than 1 millim. in diameter.

The main skeleton consists of wispy bands of long, slender spicules united together by abundant very pale-coloured spongin, running upwards and outwards to the surface conuli (from which their terminal spicules project more or less) and connected with one another by occasional short cross-fibres of one spicule's length, forming an ill-defined, rectangular-meshed network of spicular fibre. In these fibres the spicules lie approximately parallel to one another, there being none of the typical axinellid arrangement except in the surface brushes. Between the fibres, which have a very loose, irregular appearance, numerous isolated spicules are scattered.

Spicules.—(1.) Styli; long and very slender, nearly straight; evenly rounded off at the base and fairly sharply pointed at the apex; size about 0·41 millim. by 0·005 millim., but variable.

(2.) Slender oxea; variously ended; mostly a good deal shorter than the styli.

A second specimen (R.N. 174) differs in having the margin of the sponge thinner,

the vents fewer and somewhat larger (with a tendency to occupy separate prominences of the margin), and the spicules somewhat stouter.

In the arrangement of the vents, this typical form of the species resembles *Phakellia tumida*, from Australia (**10**), but the genus *Phakellia*, if retained, should probably be restricted to species with the vents arranged on one or both of the flat surfaces of the lamella. It differs from my "*Auletta aurantiaca*" in the more slender form of the spicules, as well as in the distinctly flabellate character of the sponge, which may be regarded as formed from a number of *Auletta* tubes fused together side by side.

R.N. 174; 345 (Stat. LXVIII., Gulf of Manaar, 10 fathoms).

Auletta lyrata, var. **glomerata**, nov.

In this variety the sponge consists of an irregular agglomeration of short, finger-like processes, more or less united together laterally, and each containing a longitudinal oscular tube terminating at the apex of the process in a sphinctrate vent. In other respects, including spiculation, this variety resembles the preceding, and the whole mass is attached to the substratum by a short stalk.

This variety makes a near approach to THIELE'S *Auletta halichondrioides*, from Japan (**39**), while in external form it closely resembles fig. 3 of ESPER'S Plate 67.

R.N. 170 (pearl banks off Aripu); 194 (south of Dutch Modragam Paar); 303.

Auletta lyrata, var. **crassispiculata**, nov.

I propose this name for three irregularly branched, loosely bushy specimens, characterised mainly by the large size of the spicules, which, however, vary so much that it is almost impossible to express the difference by measurements. The tubular branches of which the sponge is composed are short and rather slender.

R.N. 43, 60 (both from Gulf of Manaar); 161 (deep water off Galle and onwards up West Coast).

Auletta lyrata, var. **brevispiculata**, nov.

This variety is represented in the collection by one very fine specimen of much larger size than usual and consisting of a great mass of branching and anastomosing tubes, each ending in a sphinctrate vent now more or less completely closed by the membranous sphincter. The whole mass is attached to a very short, stout stem, and the shape and size of the individual branches do not differ from those of the specimens of "*Auletta aurantiaca*" originally described by me. The total height of the specimen, however, is 122 millims., and the greatest breadth about 73 millims. The branching is very irregular.

The spicules commonly measure about 0·35 millim. by 0·0164 millim.

R.N. 45 (Gulf of Manaar).

Auletta elongata, n. sp.—Plate XIII., fig. 7.

The type specimen (R.N. 73) consists of a bunch of seven elongated, sub-cylindrical tubes, branching out from each other and from the short, thick stem by which they

are attached to the substratum. All the tubes grow vertically upwards, close together and parallel with one another, and they do not vary greatly in length. Each terminates in a wide vent, which may be more or less closed by a membranous sphincter. Colour in spirit, dull yellowish-grey. Texture of tubes compressible, resilient, stiff; stem hard and tough. Total height of specimen 90 millims.; length of stem about 18 millims.; diameter of stem about 10 millims.; length of longest unbranched tube about 52 millims.; diameter of tube about 8 millims. The thickness of the wall of the tube is about 2 millims., and the inner surface of the wall bears the numerous small apertures of the exhalant canals, while the outer surface is granular and porous in appearance and minutely hispid.

The skeleton consists chiefly of very stout bands of spicular fibre, which run longitudinally through the inner half of the tube-wall, branching and anastomosing with one another in a quite irregular manner. From these stout fibres very short, irregular, loose, somewhat plumose columns of long, slender spicules run almost vertically outwards to the surface of the sponge, beyond which the apices of some of them project; the distance between the longitudinal fibres and the outer surface being only about one spicule's length. No spongin is recognisable in ordinary unstained sections.

Spicules.—Very variable in form and thickness, the stoutest being found for the most part in the coarse longitudinal fibres, while more slender ones radiate thence to the surface. The following may be regarded as the chief varieties:—

(1.) Styli (Plate XIII., fig. 7, *a*, *b*); fairly stout or slender, slightly curved, evenly rounded off at the base, bluntly or sharply pointed at the apex; size about 0·83 millim. by 0·022 millim.; passing into

(2.) Oxea (Plate XIII., fig. 7, *c*), of about the same dimensions, but more or less sharply pointed at each end.

(3.) Strongyla (Plate XIII., fig. 7, *d*, *e*); more or less crooked, often very much so; size, say, about 1·2 millims. by 0·022 millim.

More slender forms of all occur, and the slenderer styli may be nearly as long as the strongyla or much shorter than the stout styli whose measurement is above given.

This species is evidently nearly related to *Auletta lyrata*, differing chiefly in the arrangement of the skeleton and the length of the tubes.

R.N. 73 (outside pearl banks, Gulf of Manaar); 148, 283 (fragment, both from deep water off Galle and onwards up West Coast of Ceylon).

Leucophlœus, Carter.*

Axinellidæ of massive habit, often clathrous. Skeleton reticulate, composed of stout multispicular fibres with little if any spongin; with a well-developed dermal skeleton composed of a reticulation of spicule-bundles or a crust of tangentially placed spicules. Megascleres typically stylote, sometimes oxeote. No microscleres.

* *Vide* Carter (**54**), p. 323.

This genus, which was never diagnosed by its author, is an extremely difficult one to deal with. In our Report on the "Challenger" Monaxonida, Mr. RIDLEY and I decided to suppress it as a synonym of *Hymeniacidon*, but it has lately been revived by THIELE (39) as a distinct genus, and I am prepared to follow him in this respect. I cannot quite see, however, why THIELE should, in the same work, have established another genus (*Amorphilla*) for the reception of closely similar forms (especially as he gives no definite generic diagnoses), unless it be on account of the comparatively small size of the spicules.

If we decide to separate *Leucophlœus* from *Hymeniacidon*, as I think we must, it must be mainly on the ground of the presence in the former of a strongly developed dermal skeleton (composed, mostly at any rate, of tangentially placed spicules) which often forms a white crust in dry specimens.

Our knowledge of these sponges, however, is still very deficient, and their systematic position very doubtful. I retain the genus amongst the Axinellidæ on account of the presence of stylote megascleres and the apparent relationship to *Ciocalypta* as pointed out by Mr. CARTER. *Leucophlœus fœtidus*, with its long oxeote megascleres, perhaps comes nearer to *Halichondria* than any other species, and may indicate a close relationship with the Renierinæ.

Leucophlœus fœtidus (DENDY).

1889, **Hymeniacidon (?) fœtida**, DENDY (3); 1897, **Amorphinopsis fœtida**, TOPSENT (83); 1898, **Ciocalypta fœtida**, LINDGREN (86).

There is one good specimen of this sponge in the collection, differing from the type as originally described in its partially trabecular and clathrous external form, and in the pale yellowish (not blackish) grey colour of the surface (in spirit).

I have already pointed out the resemblance which this species bears to RIDLEY and DENDY'S *Hymeniacidon* (?) *subacerata*, and it is not impossible that the presence of the small projecting styli in the dermal membrane of both these species may ultimately prove to be of generic import.

R.N. 63 (Gulf of Manaar).

Ciocalypta, BOWERBANK.

Axinellidæ provided with elongated, digitiform processes springing from a massive body. In the processes the skeleton is arranged in a plumose manner with a dense central axis. There is a thin dermal membrane supported on spicular columns and usually strengthened by a reticulation of tangentially placed spicules, overlying extensive sub-dermal cavities. There are no microscleres.

Ciocalypta tyleri, BOWERBANK.

There is in the collection one specimen which I must refer to the typical form of this species (22). This specimen (R.N. 29), which I examined hastily in Liverpool, has unfortunately not been sent out to me, as it appeared to be identical with another which was sent instead (R.N. 29A), and the only preparation which I have of it (made

in Liverpool) shows none of the very large spicules characteristic of the variety *manaarensis* previously described by me (3), though it is not impossible that such may occur in other parts of the sponge.

R.N. 29 (Gulf of Manaar).

Ciocalypta tyleri, var. **aberrans,** nov.

The single specimen consists of a flattened, cushion-shaped body of oval outline, with a number (now four, but apparently one at least has been broken off) of slender, upright, digitiform processes springing from the upper surface. These processes are long and conical, tapering gradually almost to a point, and with no visible vents; their walls, however, are pierced by numerous small dermal pores. The surface of the sponge between the roots of the processes is rather uneven and somewhat rugose, with branching canals radiating from the roots of the processes beneath the surface, through which they are plainly visible; these canals are continuous with the large canals which run lengthwise through the digitiform processes, about four in each. The general surface of the sponge is very minutely hispid; the walls of the processes have a minutely reticulate appearance and may also be very slightly hispid. The texture of the basal part of the sponge (which has been cut off below) is fairly compact, except for the numerous cylindrical canals, some of which run almost vertically downwards from the bases of the digitiform processes. The colour of the sponge (in spirit) is dull brownish-grey. The longer diameter of the base measures about 45 millims., the shorter diameter about 24 millims.; the thickness in the middle of the base (now) is about 13 millims. The digitiform processes are about 29 millims. long and 6 millims. in diameter at the base, from which they taper gradually to the narrow, blunt apex.

The skeleton in the body of the sponge is a dense, irregular reticulation of loosely scattered spicules, chiefly oxeote, of various sizes. There is no special dermal skeleton and no extensive sub-dermal cavities, and the spicules at the surface do not differ in size, form, or arrangement, from those below. In the digitiform processes there is a central axis surrounded by about four longitudinal canals, separated from one another by rather thin longitudinal septa radiating from the central axis. Both axis and septa are crowded with spicules similar to those in the body of the sponge, but mostly arranged lengthwise. From the more peripheral portions of the septa radiate loose brushes of, for the most part, more slender and shorter oxea, which spread out beneath the dermal membrane and support it on their apices, which may project slightly beyond the surface. Although the more peripherally placed spicules of each brush are inclined very obliquely to the surface, there is no true dermal reticulation, but the dermal membrane may contain irregularly scattered spicules of various sizes.

Spicules.—Oxea of various dimensions; usually gently curved, symmetrical, gradually and fairly sharply pointed at each end; sometimes biangulate instead of simply curved; occasionally stylote with broadly rounded base. Size varying up to

about 0·69 millim. by 0·025 millim.; sizes indiscriminately mixed in the body of the sponge, partially sorted out as described above in the digitiform processes, measuring in the surface brushes usually only about 0·377 millim. by 0·0082 millim.

This variety differs from the typical form of the species in the absence of the special dermal skeleton of slender oxea placed tangentially.

R.N. 29A (Stat. XLIII., off Kaltura, 22 fathoms).

Collocalypta, n. gen.

Axinellidæ consisting of a basal crust, from which isolated digitiform processes spring vertically upwards. With a thick, collenchymatous ectosome which, in the digitiform processes, is penetrated by wide longitudinal canals communicating with the exterior by groups of small canals ending in dermal pores. Skeleton consisting in the basal portion of erect plumose columns of megascleres; in the digitiform processes of an axial core of spicular fibre from which loose bands of spicules radiate outwards between the longitudinal canals to surface conuli. Spicules more or less cemented together by spongin. Without microscleres.

This remarkable genus bears a very striking superficial resemblance to *Ciocalypta*, from which, however, it differs widely in the presence of the thick, collenchymatous ectosome and the typically axinellid (plumose) character of the main skeleton, as well as in the total absence of dermal skeleton (compare, however, *Ciocalypta tyleri*, var. *aberrans*), and the presence of abundant spongin cement.

Collocalypta digitata, n. sp.—Plate VII., fig. 6; Plate XIII., figs. 1, 2.

Sponge (Plate VII., fig. 6) consisting of a flat, wide-spreading, encrusting base, about 8 millims. thick, from which arise erect digitiform processes widely separated from one another by irregular intervals. These processes vary much in size, the largest in my possession is about 53 millims. high by 8 millims. in diameter in the middle. They usually taper to a sharp apex and are, as a rule at any rate, unbranched. The surface of the basal crust, between the processes, is smooth or nearly so, but it may be slightly hispid, and it is covered by a good deal of foreign matter in places. The digitiform processes have a distinctly conulose and, at the same time, longitudinally corrugated surface. They bear no visible vents, but numerous minute pores (now all closed). The colour of the sponge (in spirit) is pale grey; the consistence tough and fleshy.

The skeleton in the basal crust consists of stout, erect, plumose columns of spicular fibre, closely crowded together. The spicules are arranged in the typical axinellid manner, with their outer ends projecting obliquely upwards and outwards, while their inner portions are cemented together by a considerable amount of spongin. Each column is continued through the ectosome as a loose tuft of more slender and longer spicules than those which compose its deeper portion, and the apices of these spicules commonly project beyond the surface. There is no dermal skeleton. In the digitiform

processes we find a very dense, stout axial core of spicules more or less cemented together by spongin, from which numerous loose bundles of spicules radiate obliquely outwards and upwards into the surface conuli, beyond which their apices may project. Here, again, there is no dermal skeleton.

Spicules.—Oxea (Plate XIII., fig. 1), of various shapes and sizes according to situation; (*a.*) in the columns of the basal skeleton, stout, sub-fusiform, slightly curved, irregularly ended, variable in size, say about 0·56 millim. by 0·03 millim.; (*b.*) in the ectosome of the base, comparatively long and slender, slightly curved, irregularly ended, measuring, say, about 0·88 millim. by 0·02 millim.; (*c.*) in the digitiform processes the spicules are mostly of the long and slender type just described, but occasionally stout and comparatively short forms occur.

One of the most characteristic features of this sponge is the thick gelatinous ectosome (Plate XIII., fig. 2, *ect.*), composed of collenchyma, with a hyaline, or sometimes finely granular, matrix containing an immense number of large, stellate, connective-tissue cells. In the basal crust this ectosome is about 0·65 millim. thick. In the digitiform processes it forms an even thicker layer around the dense central axis of spicular fibre (Plate XIII., fig. 2), but it is penetrated by large longitudinal canals (*l.c.*), about half a dozen in number, and varying in diameter up to about 2·25 millims. These canals are separated from one another by radially arranged longitudinal septa (*sept.*), in which the bundles of spicules run out from the central axis to the surface conuli. The ectosome on the outer sides of the longitudinal canals is reduced to a membrane of varying thickness, containing no spicules and penetrated by short, narrow canals which place the great longitudinal canals in communication with the exterior. These short canals are arranged in groups at wide intervals, and those of each group unite together into a single larger canal before opening into the longitudinal canal. The dermal pores are doubtless arranged in corresponding groups, probably with one pore at the end of each of the smaller canals, but they are now all closed (their position is shown in Plate XIII., fig. 2, *d.p.*). The fact that the smaller canals unite together as they pass inwards to the great longitudinal canals seems to indicate that this is an inhalant system. The arrangement of the exhalant system I have not succeeded in making out, and the choanosome is not sufficiently well preserved to enable me to give any details with regard to the flagellate chambers.

The digitiform processes may contain a good deal of sand outside the spicular axis.

R.N. 74, 74A (outside pearl banks, Gulf of Manaar).

Order 4: EUCERATOSA.

Non-calcareous sponges without siliceous spicules, but with a skeleton consisting of horny fibres developed independently, *i.e.*, not in relation to any pre-existing spicular skeleton. (The skeleton is sometimes replaced or supplemented to a greater or less extent by foreign bodies.)

The study of the very interesting series of twenty-two species, by which the horny sponges are represented in the present collection, has caused me greatly to modify my views as to the phylogeny of this group. Hitherto I have, in common with certain other writers on the subject, been in the habit of regarding it as a group of polyphyletic origin, derived probably from several distinct groups of monaxonellid sponges by substitution of spongin for spicules. This view I now believe to be true only for a very limited number of horny sponges, which might be distinguished from the true Ceratosa (or "Euceratosa," as I propose to term them) under the name "Pseudoceratosa," until such time as our increased knowledge shall enable us to assign them to their proper systematic positions. This is already possible in some cases, as, for example, in certain species of the Chalinine genus *Siphonochalina* (*Spinosella*), concerning which I observed as far back as 1887, in my memoir on the West Indian Chalinine Sponges (75):—

"Here we can trace in different species of the same genus the gradual degeneration and disappearance of the spicules until we come down to forms like *Spinosella maxima*, mihi (Plate LXI.), and *Spinosella plicifera*, D. and M. (Plate LVIII., fig. 5; Plate LX., fig. 1), which sometimes still contain traces of the spicules imbedded in the horny fibre, and apparently on the verge of disappearance, while at other times they contain no spicules whatever; and yet the specimens with spicules and those without are specifically indistinguishable."

As regards the great majority of the horny sponges, however, I feel convinced that they form a natural and compact group, in which it is almost impossible to separate even the genera from one another by hard and fast lines. Thus I am in close agreement with Poléjaeff, who summarizes (74) his own observations on the classification of the group as follows:—"*With the exception of the genera Darwinella, Ianthella, and Psammopemma, all genera are devoid of any properties separating them absolutely from one another.*"

Lendenfeld (66) has endeavoured to show that the Ceratosa are divisible into two great groups of very different phylogenetic origin, viz., "Monoceratina" and "Hexaceratina." It would not be difficult to expend a very large amount of criticism upon his system, but, without going into detail, I must remark that this main sub-division appears to me to be wholly erroneous, and that the connection between these two groups is so close that it is quite impossible to separate them from one another; while, instead of the "Hexaceratina" being derived from the Hexactinellida and the "Monoceratina" from the Monaxonellida, as Lendenfeld would have us believe, it appears to me tolerably certain that the majority of the "Monoceratina"* are descended from ancestral "Hexaceratina," and the latter in turn from Myxospongida.

Some justification of my views concerning the phylogeny of the Euceratosa will,

* It must be remembered that Lendenfeld's "Monoceratina" include both Pseudoceratosa and Euceratosa; the latter alone are here referred to.

I hope, appear in the course of the subsequent pages; in the meantime I may give the following summary of the conclusions at which I have arrived:—

In the first place it is pretty obvious that the Aplysillidæ (constituting a large part of the so-called "Hexaceratina") form the starting point of the evolutionary series within the order. The primitive character of such genera as *Aplysilla* and *Darwinella* is clearly indicated by the simple canal-system, the large sac-shaped flagellate chambers, and the very simple skeleton of branched spongin-fibres, supplemented in *Darwinella* by detached spicules of spongin. The presence of these so-called spicules at first sight seems to lend colour to LENDENFELD's views as to the relationship between the Aplysillidæ and Hexactinellida. It is very difficult to see, however, how the horny spicules in question can have anything to do with the siliceous spicules of the Hexactinellida; their shape is extremely variable and they are probably best regarded simply as isolated portions of the general spongin skeleton, secreted by groups of spongoblasts which, for some unknown reason, have become isolated from their fellows.

Altogether the Aplysillidæ agree very closely in structure with the Myxospongida, especially with the genera *Halisarca* and *Hexadella*, and it is not impossible that the curious fibres of *Halisarca* may represent a rudiment of a horny skeleton. That the spongin skeleton in the Aplysillidæ has been developed quite independently of that of the Monaxonellida, and with no relation to a pre-existing siliceous skeleton, admits, I think, of little doubt. The character of the skeleton, consisting in the simplest cases of a thin basal lamina of spongin, from which slightly branched fibres spring vertically upwards and end in surface conuli, without anastomosing with one another to form a network, is quite different from what we find in typical horny Monaxonellida, in which the spongin is originally deposited as a cement which binds together the spicules of a reticulate skeleton, and in which, consequently, when the spicules disappear, the spongin is left in the form of a network of horny fibres. A very similar network of horny fibres appears, however, to have been independently evolved in the higher Euceratosa.

This difference in the arrangement of the horny skeleton—in the one case in the form of a network and in the other case in the form of separate tree-like fibres—has given occasion to MINCHIN (12) to divide his "Grade" Keratosa into two orders, viz., "Dictyoceratina (= Monoceratina, LDF.)" and "Dendroceratina (= Hexaceratina, LDF., *pars*)," the latter group including only the family Aplysillidæ. MINCHIN's distinction cannot, however, be maintained as a basis of classification, for, as LENDENFELD himself recognised, there are undoubted Aplysillids (*e.g.*, *Dendrilla elegans*, LENDENFELD) which possess a reticulate skeleton, and in the present report I propose the new genus *Megalopastas* for such forms, of which two species occur in Ceylon waters.

The importance of the genus *Megalopastas* lies in the fact that it forms a connecting link between the Aplysillidæ and Spongeliidæ, and thus completely breaks

down the distinction between "Monoceratina" and "Hexaceratina," or "Dictyoceratina" and "Dendroceratina." The Spongeliidæ, like the Aplysillidæ, have large sac-shaped flagellate chambers, simple canal-system, and clear transparent ground-substance. In fact, they differ from the Aplysillidæ only in their reticulate skeleton and in their habit of taking foreign bodies into the fibre. The so-called "pith" in the fibre is also less obvious, but this is an extremely variable character, and one upon which we cannot place very much reliance for purposes of classification. In *Megalopastas pulvillus*, for example, one and the same section may show great differences in this respect, some fibres showing a strongly marked pith, differentiated by its darker colour, and others apparently having no pith at all (Plate XV., fig. 3), the difference apparently depending upon differences in local conditions at the time when the fibre is growing, which give rise to a more or less distinct lamination analogous to the annual rings in a tree trunk.

Moreover, when we remember that SCHULZE has described (71), under the name *Spongelia spinifera*, a species in which the arenaceous fibres do not form a network at all, but are arranged in a tree-like manner, as in the genus *Aplysilla*, we see at once that the distinction between the Spongeliidæ and Aplysillidæ is purely arbitrary, though, as a matter of convenience, it may, perhaps, still be maintained. From the Spongeliidæ the transition to the Spongiidæ, by complication of the canal-system, reduction in the size of the flagellate chambers and granulation of the ground substance between them, is very simple.

I therefore conclude that the Euceratosa are a natural group descended from the Myxospongidæ, that their evolution starts with the Aplysillidæ and ends with the Spongiidæ, between which the Spongeliidæ occupy an intermediate position, and that the reticulate skeleton of the higher types has been independently evolved from a more primitive dendritic skeleton.

FAMILY: APLYSILLIDÆ.

Euceratosa with a dendritic or reticulate skeleton composed of spongin-fibres containing a more or less distinct pith, but usually without foreign inclusions; sometimes also with isolated spicules of spongin; with a lacunar canal-system and large sac-shaped flagellate chambers opening by wide mouths direct into wide exhalant lacunæ.

Darwinella, MÜLLER.

Aplysillidæ with a dendritic skeleton and with isolated spicules of spongin.

Four species of this remarkable genus have been described, viz., *D. aurea*, MÜLLER (67); *D. australiensis*, CARTER (18); *D. joyeuxi*, TOPSENT (89); and *D. simplex*, TOPSENT (84); but it appears to me somewhat doubtful whether they should all be regarded as specifically distinct from one another.

Darwinella simplex, TOPSENT, 1892 (84, *vide* also 62)--Plate XV., figs. 1, 2.

The single specimen forms a thin crust extending over a considerable area on the surface of a branching tube which has apparently belonged to some annelid worm. The surface of the sponge is glabrous and covered with sharp-pointed conuli, about 1 to 1·5 millims. in height and some 2 to 3 millims. distant from one another. The maximum thickness of the crust is only about 2 millims. The dermal membrane is minutely reticulate and lifted up in a tent-like manner on the ends of the vertical skeleton fibres to form the surface conuli. The colour (in spirit) is dark purple,* and the texture very soft and tender. The vents are inconspicuous, only one small one having been detected. The inhalant pores are abundantly grouped in pore-sieves, which occupy the oval or rounded meshes of the dermal reticulation.

The skeleton consists, in the first place, of sparingly and irregularly branched, pithed horny fibres (Plate XV., figs. 1, 2) of the usual *Darwinella* type, which rise more or less vertically from the base of the sponge and terminate in rounded apices in the surface conuli. These fibres have a diameter of about 0·165 millim. near the base, diminishing to about half as much in the conuli. The base of the fibre is expanded into a thin plate of spongin, doubtless attached to the substratum; the fibres themselves do not appear to form any anastomoses. The wall of the fibre is only about 0·01 millim. thick, and the interior is generally occupied by a much-branched filamentous fungus (?), composed of rows of short cells, which more or less completely replaces the pith in the older parts of the fibre (Plate XV., fig 2). In the younger parts of the fibre (Plate XV., fig. 1) the pith exhibits the characteristic thimble-shaped layers described and figured by LENDENFELD in *D. aurea*.

In the second place we have horny spicules of the usual *Darwinella* type, but rather sparingly developed and, so far as I have been able to ascertain, all of the triradiate form. They are irregularly scattered through the soft tissues, and I have seen no union between them. The rays are long, slender and tapering; say about 0·5 millim. long by about 0·025 millim. thick near the base.

The canal-system and general anatomy agree very closely with the description and figures given by LENDENFELD (66) for *D. aurea*.

The Ceylon specimen agrees very well with TOPSENT's descriptions of the species, but the horny spicules (in the single specimen available) do not appear to attain so large a size. The species has hitherto been recorded only from the Mediterranean and the Azores.

R.N. 302 (Ceylon seas).

Megalopastas, n. gen.

Aplysillidæ with an entirely reticulate skeleton and without spongin spicules.

As I have already pointed out, LENDENFELD (66) includes in his genus *Dendrilla* both species (*e.g.*, *D. rosea*) without and species (*e.g.*, *D. elegans*) with a reticulate

* *Vide* footnote under *Iotrochota purpurea*.

skeleton. It is very doubtful, however, whether the genus, as constituted by LENDENFELD, is separable from the older *Aplysilla*. The type species of *Dendrilla* appears to be a form with a dendritic skeleton, viz., *D. rosea*, and if we are to separate the species with reticulate skeleton, we can, for etymological reasons, hardly employ the name *Dendrilla* for them.

In my report on Mr. THURSTON's Second Collection of Sponges from the Gulf of Manaar (3) I attempted to avoid the necessity for erecting a new genus by employing BOWERBANK's old name *Spongionella* for what must now be regarded as the type of the genus *Megalopastas*, viz., *Megalopastas nigra*. I must admit, however, that BOWERBANK's type of the genus *Spongionella*, viz., *S. pulchella*, is probably not an Aplysillid at all (according to LENDENFELD it is a "*Leiosella*"), while, on the other hand, BOWERBANK (8) also applied the name *Spongionella* to another totally different sponge, viz., *Phyllospongia* (*Spongionella*) *holdsworthi*, and *Spongionella* is retained by LENDENFELD (66) as a sub-genus of *Phyllospongia*. I therefore now revert to what was my original intention in 1889, and propose the new genus *Megalopastas*, the name being chosen in allusion to the large size of the flagellate chambers.

The anatomical characters of the genus are shown in Plate XV., fig. 4, which represents, somewhat diagrammatically, a vertical section of an Australian species, *M. elegans* (LENDENFELD's *Dendrilla elegans*), of which I happen to have much better preserved material than of the Ceylon species. Excepting that in *M. elegans* the ectosome is thicker and the outermost secondary fibres of the skeleton do not lie so near the surface, so that there is no "dermal skeleton," the figure would serve almost equally well for either of the Ceylon species. My preparations of *M. elegans* contain numerous embryos, enclosed in spherical endothelial capsules, and mostly in the stage represented in the figure, consisting of a solid inner mass of cells surrounded by an outer layer modified near one end to form a pigment ring. This embryo agrees pretty closely with those described by SCHULZE in *Spongelia* (71) and *Euspongia* (72), and its occurrence perhaps tends to show the correctness of my views as to the close relationship of the so-called "Hexaceratina" to the other Euceratosa.

Megalopastas nigra (DENDY).—Plate XIV., fig. 7 ; Plate XV., figs. 5–8.

1889, **Spongionella nigra**, DENDY (3).

This very remarkable species was originally discovered by Mr. THURSTON and is represented in Professor HERDMAN's collection by two specimens. The sponge (Plate XIV., fig. 7) is sessile, and consists of a number of vertical lamellæ, branching and anastomosing with one another, often in a very complex manner. The largest specimen I have seen was about 250 millims. high and the same in breadth, with lamellæ about 5 millims. thick. The colour of the living sponge is black (THURSTON), when dry, dull black, and in spirit rather lighter, blackish-grey. Texture (in spirit) very compressible and resilient ; moderately tough. Surface granulated, the granules being really minute, close-set conuli. Vents abundantly scattered, but almost or

quite confined to one surface of each lamella. The vents are compound, each consisting of an aggregation of several smaller ones, the entire group only from 1 millim. to 2 millims. in diameter.

The main skeleton (Plate XV., fig. 5) is a rectangularly meshed network of very distinct primary and secondary fibres, the primaries running vertically to the surface and the secondaries crossing them more or less at right angles. The primary fibres average about 0·049 millim. in diameter, and the secondaries about half as much. The outermost secondary fibres form a well-developed dermal or sub-dermal skeleton (Plate XV., fig. 5, *d.s.*; fig. 6), in the form of an irregular network with fairly wide polygonal meshes, the fibres averaging about 0·02 millim. in diameter.

There are many more minute conuli on the surface than there are of the stout primary fibres, and those which do not contain the apices of such fibres are supported by short fibres which spring vertically from the tangential fibres of the dermal skeleton (Plate XV., figs. 5, 8).

All the fibres of the skeleton are composed of pale-coloured spongin without any foreign enclosures. They are not distinctly "pithed" except at the growing apices (Plate XV., fig. 7), where the usual thimble-shaped layers of spongin are added one on top of the other, as in other Aplysillidæ, but even here the "pith" is not distinctly differentiated.

The ectosome forms a thin dermal membrane containing the inhalant pores, and the choanosome is very delicate and gelatinous. The canal-system agrees closely with that of *Aplysilla*, as described and figured by Schulze (70). It is lacunar, and the flagellate chambers are sac-shaped and large, averaging when full-grown about 0·07 millim. in diameter. They are not placed very close together and they open directly into the excurrent lacunæ, without special exhalant canaliculi.

R.N. 71, 161A (Pearl banks, Gulf of Manaar—not uncommon).

Megalopastas pulvillus, n. sp.—Plate XV., fig. 3.

The single specimen has the form of a small flattened cushion, slightly convex above and (has been) attached by a broad flat base below. The outline of the specimen is irregularly rounded. The upper surface bears several small, compound vents, each about 2 millims. in total diameter; it also appears granular from the presence of numerous minute, slender, sharp-pointed conuli containing the ends of the primary fibres. The inhalant pores are conspicuous under the microscope in small groups in the thin, translucent dermal membrane. Texture (in spirit) firm, but compressible and resilient; colour, pale yellowish-grey. Diameter of specimen about 18 millims.; thickness in the middle about 5 millims.

The skeleton (Plate XV., fig. 3) is a partly rectangular- and partly polygonal-meshed network of pale amber-coloured horny fibre, in which the primary fibres are very clearly differentiated, radiating towards the surface and terminating in long, slender apices in the surface conuli. The primary fibres not infrequently branch,

while at the base of the sponge they are seen to originate in a thin horizontal spongin-lamella, which evidently forms the means of attachment to the substratum. The primary fibres are about 0·096 millim. in diameter, the secondaries are usually a good deal more slender, say about 0·04 millim. in diameter, but variable. Both primary and secondary fibres frequently exhibit a very distinct pith of variable thickness, which evidently simply represents the older part of the fibre surrounded by fresh accretions of spongin. Even in old parts of the primary fibres the old slender apices may frequently be observed thus imbedded in the new growth (Plate XV., fig. 3, *ap.*). The principal secondary fibres run across at right angles between the primaries, but numerous others run in various directions. The outermost secondary fibres form a pretty definite dermal skeleton with polygonal meshes of very variable size. Here and there short, vertical, gradually tapering branches arise from this network and enter some of the surface conuli. These branches evidently form the commencements of new primary fibres, as in *M. nigra*.

The ectosome is feebly developed, forming a thin dermal membrane containing the inhalant pores and overlying the sub-dermal cavities. The canal-system is lacunar. The flagellate chambers are large and sac-shaped, about 0·088 millim. in longer diameter; they open by wide mouths direct into wide exhalant lacunæ. The ground substance between them is very feebly developed, gelatinous-looking and broken up into trabeculæ by the smaller inhalant lacunæ in the characteristic aplysillid fashion. The larger exhalant canals converge towards the compound vents, where they open to the exterior.

It will be seen from the above description that this species agrees closely in skeletal characters and canal-system with *M. nigra*, but it differs widely in external form and colour (in spirit). The fact that the specimen contains large ova and embryos in endothelial capsules likewise seems to indicate that it is not merely a young form of *M. nigra*. Owing to the much greater distinctness of the pith in the horny fibres the species is a more typical aplysillid than its congener.

R.N. 191 (Muttuvaratu Paar, Gulf of Manaar).

Family: SPONGELIIDÆ.

Euceratosa with a (usually) reticulate skeleton of horny fibres without distinct pith, but containing foreign bodies; or with a skeleton composed of foreign bodies united together by little if any spongin. With lacunar canal-system and large, sac-shaped flagellate chambers opening directly by wide mouths into wide exhalant lacunæ.

This family may be retained as a matter of convenience, but it is, as I have already indicated, logically impossible to separate it sharply from the Aplysillidæ, for the genus *Megalopastas*, on the one hand, and Schulze's *Spongelia spinifera*, on the other, are strictly intermediate between the two groups.

Spongelia, Nardo.

Spongeliidæ with a skeleton composed of distinct, but more or less areniferous, horny fibres.

Spongelia fragilis, Montagu, var. ramosa, Schulze.

1879, **Spongelia pallescens**, sub-species **fragilis**, var. **ramosa**, Schulze (**71**); 1889, **Spongelia fragilis**, var. **irregularis**, Lendenfeld (**66**), *pars*.

There is a single, partly macerated specimen of this variety in the collection. The external form appears to have been loboso-digitate. The skeleton network is very coarse, with rectangular meshes, and densely charged throughout with sand. The soft tissues are very densely charged with chains of algæ, probably *Oscillaria spongeliæ*. The large sac-shaped flagellate chambers measure up to about 0·1 millim. in longer diameter.

Under the name *Spongelia fragilis*, var. *irregularis*, Lendenfeld has already (**66**) recorded a sponge from Ceylon which probably belongs to this variety, as he himself admits that his var. *irregularis* partly corresponds with Schulze's var. *ramosa*. The species, at any rate, appears to be cosmopolitan, if not the variety also.

R.N. 307 (Ceylon seas).

Spongelia elastica, var. lobosa, Schulze.

1879, **Spongelia pallescens**, sub-species **elastica**, var. **lobosa**, Schulze (**71**); 1889, **Spongelia elastica**, var. **lobosa**, Lendenfeld (**66**).

There is one specimen of this variety in the collection, consisting of a massive, columnar and slightly clathrous basal portion, giving off numerous short, irregular, digitiform processes above. The surface is covered with acute conuli, larger and further apart on the lower than on the upper portions of the sponge, varying from about 0·5 millim. to 2·5 millims. in height. Between the conuli is stretched the usual reticulate dermal membrane, and the lines of the dermal reticulation are areniferous. The texture (in spirit) is soft and elastic and the colour pale greyish-yellow. The specimen measures about 58 millims. in height by 40 millims. in maximum diameter. The apices of the branches are commonly occupied by parasitic barnacles, each enclosed in a cavity which opens to the exterior by a small terminal aperture resembling a vent.

The primary fibres of the skeleton, ending in the conuli, are abundantly charged with foreign matter, chiefly sponge-spicules, while the connecting fibres are almost free from foreign matter, and form a moderately close network. The canal-system and histology agree closely with Schulze's classical description. The large, sac-shaped flagellate chambers, about 0·08 millim. in maximum diameter, are imbedded in a sparsely developed gelatinous ground substance. They have numerous prosopyles and open directly by wide mouths into the exhalant canals.

This variety is well known in the Mediterranean and, according to LENDENFELD, occurs also in the North Atlantic and in Australian seas.

R.N. 165 (deep water off Galle and onwards up West Coast of Ceylon).

Spongelia elastica, var. **crassa,** nov.—Plate XIV., fig. 4.

This variety differs from var. *lobosa* in the much coarser main fibres, filled with much larger foreign particles (sand grains), and in the more areniferous character of the connecting fibres, which, however, are still occasionally quite free from sand. In external appearance (Plate XIV., fig. 4) the single specimen closely resembles the specimen of var. *lobosa* described above, but it may readily be distinguished by its much more rigid and coarsely arenaceous character. The very stout main fibres contain sand grains of extremely various size. The network of connecting fibres is very irregularly developed and sometimes is absent over wide areas. The sponge is infested by numerous small chætopod worms imbedded in the soft tissues.

R.N. 35 (Gulf of Manaar).

Spongelia incrustata, n. sp.

Sponge compressed, irregularly lobose, proliferous. Surface with small acute conuli irregularly scattered over it at varying intervals, and only about 1 millim. in height; minutely reticulate over large areas, while over areas quite as large the dermal reticulation is completely obliterated by the sand cortex. Vents rather small and mostly on the margins of the lobes. Texture (in spirit) rather soft, compressible, flaccid, cavernous internally. Colour yellowish-grey throughout. The largest specimen is about 100 millims. in maximum diameter, and the lobes are generally not more than 5 millims. or 6 millims. thick, though variable.

The skeleton consists in the first place of the dense arenaceous cortex, which is well developed everywhere, except in the thin dermal membrane of the pore-areas which lie between the meshes of the dermal reticulation (where present). This cortex is about 0·5 millim. thick. Internally the skeleton also consists chiefly of sand-grains, arranged in irregular tracts rather than in well-defined fibres, but often held together by spongin cement. Between these tracts are wide areas free from sand.

The canal system is that of a typical *Spongelia*. The sub-dermal cavities, underlying the pore-sieves, are large, and the whole canal-system is lacunar in a high degree. The flagellate chambers are sac-shaped and up to about 0·08 millim. in longer diameter, opening by wide mouths into the exhalant canals and provided with numerous prosopyles. The mesoglœa between them is very scantily developed, clear and gelatinous, but with numerous stellate connective-tissue cells. The walls of the larger exhalant canals contain numerous elongated muscle-cells.

This species appears to be nearly related to LENDENFELD'S *Spongelia laxa* from the South Coast of Australia (**66**), but the surface conuli are more or less acute instead of rounded, the skeleton fibres are apparently much less well-defined, and the sand cortex is apparently much thicker.

R.N. 72 (outside pearl banks, Gulf of Manaar); 279 (deep water off Galle and onwards up West Coast of Ceylon).

Psammopemma, Marshall.

Spongeliidæ in which the skeleton is composed of densely aggregated sand-grains which are more or less connected together by spongin.

Psammopemma crassum (Carter), var. clathrata, nov.

1885, **Holopsamma crassa**, Carter (18); 1889, **Psammopemma crassum**, Lendenfeld (66).

The specimens differ from the types as described by Mr. Carter in their clathrous form and in the absence of large conspicuous vents. They are extremely irregular and friable, and densely charged with coarse sand, over which a distinct pellucid dermal membrane, free from sand, is frequently stretched. The surface is very uneven, sometimes ribbed and sometimes conulose; the texture incompressible but fragile, and the colour (in spirit) pale brown.

The sand grains are not arranged in distinct fibres, but in ill-defined bands forming an irregular reticulation. They are connected at the points of contact by a very small quantity of spongin cement.

The flagellate chambers are large (about 0·08 millim. in longer diameter) and sac-shaped, and open direct into the exhalant canals by wide mouths. The ground substance between them is clear and transparent and very sparsely developed, except in the neighbourhood of the larger canals, which are surrounded by an abundant gelatinous collenchyma, with numerous stellate or fibrous connective-tissue cells.

The types of the species came from Australia, and Lendenfeld also records it from New Zealand.

R.N. 64 (type of variety, Gulf of Manaar); 330 (Ceylon seas).

Family: Spongiidæ.

Euceratosa with a reticulate horny skeleton and with small, more or less spherical flagellate chambers, commonly provided with special narrow exhalant canaliculi. The ground-substance between the chambers is compact and densely charged with fine granules.

Cacospongia, Schmidt.

Spongiidæ with a very wide-meshed skeleton network, and with distinctly lamellated horny fibres which are usually of a brown colour and of very variable diameter.

Cacospongia scalaris, Schmidt.

1862, **Cacospongia scalaris**, Schmidt (47); 1879, **Cacospongia scalaris**, Schulze (72); 1889, **Stelospongia scalaris**, Lendenfeld (66).

There are several rather small specimens in the collection which agree closely with

the Mediterranean form as described and figured by SCHULZE. The connecting fibres are often very irregular in arrangement and very variable in diameter. The histological features are not very well preserved, but the flagellate chambers probably have elongated exhalant canaliculi, as described by SCHULZE.

The main fibres may contain many foreign bodies. What can LENDENFELD mean by saying that the fibres are all of uniform diameter and never contain foreign bodies, in direct opposition to the observations of SCHMIDT and SCHULZE?

R.N. 18 (Gulf of Manaar); 162 (three specimens); 347 (all Ceylon seas).

Euspongia, BRONN.

Spongiidæ of compact structure and with a very fine-meshed skeletal network of slender and fairly uniform horny fibre. Primary fibres, usually containing foreign bodies, radiate towards the surface and are connected together by a close but very irregular-meshed network of more slender connecting fibres free from foreign bodies.

LENDENFELD (66) has already recorded several species of *Euspongia* from Ceylon, viz.:—

E. trincomaliensis, which he identifies with one of HYATT'S American varieties of "*Spongia officinalis*";

E. irregularis, var. *pertusa*, which is also recorded from North America, Australia, and the tropical Pacific; and

E. irregularis, var. *dura*, also recorded from Madagascar and Australia.

There are two forms in Professor HERDMAN'S collection which appear to be quite distinct from all these.

Euspongia officinalis, AUCTORUM, var. **ceylonensis**, nov.—Plate XIV., fig. 3; Plate XVI., fig. 5.

There are in the collection several nice specimens of a bath sponge which obviously belong to a variety of *Euspongia officinalis*, closely resembling *E. officinalis*, var. *rotunda*, of HYATT (69) and LENDENFELD (66). The latter is one of the American varieties, and there is probably sufficient difference in the Ceylon sponge to merit recognition under a new varietal name.

The sponge is massive and compact, without vestibules Of the two specimens which I now have before me, the one (in spirit) is slightly elongated vertically and at the same time slightly compressed laterally and slightly flattened on the top, while the base is somewhat constricted and charged with pebbles and other foreign matter. The vents are rather large and conspicuous, scattered on the top and sides of the sponge, from 2·5 millims. to 5 millims. in diameter, sometimes more or less prominent. Each vent forms the termination of a long vertical oscular tube, of the same diameter as itself. The surface is thickly and uniformly covered with minute, low conuli

(about 0·8 millim. apart, from apex to apex), from the summits of which fine ridges radiate into the intervening valleys, where they branch and anastomose with one another, so as to give rise to a delicate reticulation which is scarcely visible to the naked eye, and in the meshes of which the dermal pores are situate in small groups.

The colour of the surface in spirit is black, paling to grey below and internally, and the texture compact, but compressible and very elastic. The specimen thus described measures about 90 millims. in height by 73 millims. in greatest breadth. Another somewhat similar spirit specimen has been photographed for me by Professor Herdman, and is represented, about two-thirds natural size, in Plate XIV., fig. 3.

Professor Herdman has also sent me part of the macerated skeleton of a much larger specimen. The piece sent is a segment of what appears to have been a massive, hemispherical sponge, with very strongly convex upper surface and broad flattened base. Numerous large vents, up to 8 millims. in diameter, are scattered singly over the upper surface, each at the end of a long, vertical oscular tube. Between these vents the surface is rather uneven (but not channelled or grooved) and honeycombed by close-set narrow vertical canals (inhalant) about 0·5 millim. in diameter, which reduce the skeleton reticulation to a mesh-work of thin trabeculæ which terminate at the surface in small, slightly projecting villi. The texture, after soaking in water, is very soft and elastic and not very tough, and the colour is pale greyish-yellow. The specimen from which this piece was taken must have been about 200 millims. in diameter by 100 millims. in height.

The primary fibres of the skeleton (Plate XVI., fig. 5) run parallel with one another (at distances of about 0·8 millim.) towards the surface, where they end singly in the conuli. They rarely branch, and apparently never anastomose. They are about 0·04 millim. in diameter and composed chiefly of broken sponge spicules, with comparatively little spongin cementing them together. They are connected with one another by a polygonal-meshed network of secondary fibres, in which the meshes vary greatly in size and shape, while the fibres are of fairly uniform diameter and only rarely contain foreign matter. Average diameter of meshes, say, about 0·17 millim.; diameter of the secondary fibres themselves, when fully developed, about 0·02 millim., but often less.

Owing to the quantity of broken spicules which they contain, the primary fibres are distinctly visible to the naked eye in the macerated sponge, appearing as very fine threads of a paler colour than the rest of the skeleton, and thus constituting what is perhaps the most obvious distinctive feature of the variety.

The dermal membrane contains numerous broken sponge-spicules scattered through it.

In internal anatomy this variety agrees minutely with Schulze's classical account of the bath sponge (72), so that it is unnecessary to describe the canal-system and histology in this place. One point perhaps deserves mention, and that is the very strong development of long bands or cords of granular fibrous cells, running through

the sponge in various directions (but mostly more or less at right angles to the surface), and not by any means confined to the neighbourhood of the larger canals. These bands are, as already suggested by SCHULZE for closely similar structures in the Adriatic bath sponge, probably muscular, and their function appears to me to be to effect the contraction of the sponge as a whole and thus squeeze the water out very thoroughly when necessary.

This Ceylon bath sponge appears to differ from most of the varieties of *Euspongia officinalis* in the greater slenderness of the very pale-coloured secondary or connecting fibres of the skeleton. SCHULZE gives the average thickness of these fibres in *Euspongia officinalis* as 0·03 millim. to 0·035 millim., while in our variety they attain only a thickness of about 0·02 millim., and are often less.

Owing to this character the sponge acquires a remarkable softness, but at the same time loses somewhat in durability. This want of durability may impair its value as an article of commerce, but in view of its softness and elasticity and its great absorbent power, combined with its good shape and size, I am inclined to think that it would be worth while to experiment in the way of placing it upon the market if it can be obtained in sufficient quantity.

R.N. 37 (several specimens in spirit); 101 (dry). All from Trincomalee.

Euspongia tenuiramosa, n. sp.

Sponge consisting of irregular, slender branches, usually only about 5 millims. or 6 millims. in diameter and apparently repent. The branches are more or less angular or nodose, and usually very crooked. The surface is more or less concealed by coarse, calcareous débris, such as the shells of large Foraminifera, &c. Where free from foreign matter, it is covered with small, sharp conuli, scattered at very various intervals. Vents small and few; pores not observed. Colour (in spirit) purplish-brown or nearly black. Texture, where free from foreign matter, which occurs internally as well as at the surface of the sponge, compressible and resilient. The longest branch is about 60 millims. in length by 5 millims. in diameter, but the diameter varies much.

The skeleton is an irregular but fairly close, polygonal- or sometimes quadrangular-meshed network of rather dark-coloured fibre varying much in diameter. Here and there primary fibres can be recognised running into the surface conuli, and these may contain a rather slender core of broken sponge-spicules. The primary fibres have a diameter of about 0·05 millim. The connecting fibres vary from about the same diameter downwards to about 0·008 millim. The diameter of the meshes varies so much that it is useless to give measurements.

The material is not very well preserved for histological investigation, but, so far as I have been able to make out, the internal anatomy offers no features of special interest and agrees closely with that of other species of the genus. The flagellate chambers are small, about 0·024 millim. in diameter, and nearly spherical, and the

ground-substance between them is finely granular. I have not been able to make out the nature of their openings. The usual cylindrical cords of elongated fibre-cells are present, and there is a collenchymatous ectosome. There appears also to be a thin cuticle similar to that of various species of *Hippospongia*.

As regards skeletal characters this species agrees closely with LENDENFELD'S very comprehensive *Euspongia irregularis*, but the external appearance is so characteristic that it seems to deserve a distinct specific name.

R.N. 311; 339 (Yard Cove, Trincomalee, shallow water).

Hippospongia, SCHULZE.

Spongiidæ of clathrous structure, but otherwise resembling *Euspongia*, except that the skeleton fibre may be much coarser and the whole sponge harder.

Except in its harder and more incompressible character, I cannot see that LENDENFELD'S genus *Hyatella* differs from SCHULZE'S *Hippospongia*, yet LENDENFELD himself describes a *Hippospongia dura* which is, perhaps, as hard as any *Hyatella*.

Hippospongia intestinalis (LAMARCK).

1813, **Spongia intestinalis,** LAMARCK (**73**); 1877, **Spongelia velata,** HYATT (**69**); 1884, **Hippospongia intestinalis,** RIDLEY (**16**); 1889, **Hyatella intestinalis,** LENDENFELD (**66**).

This species is represented in the collection by several specimens of elongated tubular form, very intestinal in appearance and of a light brown colour, with their walls perforated here and there at irregular intervals, and the surface slightly conulose. The tubes may branch and anastomose, but are for the most part well separated from one another and usually about 10 millims. in diameter, but variable. The characteristic surface reticulation of slender horny fibre is very well developed, and the surface appears to be covered by a remarkable continuous but separable cuticle, which possibly has some connection with the dermal skeleton, but I have not been able to elucidate its true nature. The main skeleton is very irregular and composed of mostly stout amber-coloured horny fibre. Primary fibres cored with foreign bodies are visible here and there.

The flagellate chambers are small (about 0·03 millim. in diameter) and approximately spherical, and the ground-substance between them is finely granular. The special exhalant canaliculi, if present, are short. Stout bands of elongated fibres, presumably muscular and mostly longitudinal in direction, are developed as in other Spongidæ, and there may be a good deal of collenchyma around some of the larger canals.

The species has been recorded from the Mediterranean, Zanzibar, the Mascarene Islands, and the Amirante Group (**66**), and from Porto Rico (**29**).

R.N. 65 (Gulf of Manaar); 83 (deep water off Galle and onwards up West Coast); 337 (Ceylon seas).

Hippospongia clathrata (CARTER)—Plate XIV., fig. 2.

1881, **Hircinia clathrata**, CARTER (5); 1887, **Hircinia clathrata**, DENDY (2); 1889, **Hircinia clathrata**, DENDY (3); 1889, **Hyatella clathrata**, LENDENFELD (66).

There is a single specimen of this well-characterised sponge in the collection. LENDENFELD (66) has added particulars as to the canal-system to our previous knowledge. The sponge contains no filaments, but the bands or cords of fibrous tissue in the choanosome, so characteristic of many other Spongidæ, are very well developed. The species was recorded by CARTER from the Gulf of Manaar and the Red Sea, and it also occurs in Australia (DENDY, LENDENFELD) and on the American coast of the North Atlantic (LENDENFELD).

The figure represents the characteristic appearance of a spirit specimen, no good illustration of the external form having yet been published.

R.N. 24 (Gulf of Manaar).

Hippospongia anomala, POLÉJAEFF.

1884, **Hippospongia anomala**, POLÉJAEFF (74); 1889, **Hippospongia anomala**, LENDENFELD (66).

There is one specimen in the collection which, although of smaller size, agrees very well in nearly all respects with POLÉJAEFF'S description and figure of the type specimen from Torres Straits. Our specimen consists of an erect, sub-cylindrical cavernous body, expanding gradually below and giving off two short digitiform processes on one side. The interior, especially in the lower portion, is sub-divided by trabeculæ, and the surface is covered over by a thin, parchment-like dermal membrane pierced by numerous larger and smaller circular apertures, especially abundant towards the extremity. These apertures lead into the large vestibular spaces in the interior of the sponge. The end of the main body and those of the two processes taper suddenly to rather sharp apices, and are covered with fairly numerous small conuli, elsewhere the surface is nearly smooth and glabrous and provided with a delicate cuticle, like that of *Hippospongia intestinalis*. POLÉJAEFF'S expression "shagreen-like" may refer to the same character. The colour (in spirit) is pale grey, the texture compressible and very resilient. The height of the specimen is about 120 millims. and the maximum diameter at the base about 50 millims.

The skeleton is a pretty close but irregular polygonal-meshed network of fibres of very uniform diameter, about 0·02 millim. to 0·03 millim. thick, and free from foreign bodies. Occasionally only one observes much stouter primary fibres, composed principally of broken sponge spicules, running towards the surface and sometimes branching. Occasionally also one sees very slender connecting fibres amongst the ordinary ones; these are probably young. There is no specially differentiated dermal skeleton, but the main skeleton reticulation comes close to the surface. A good many broken spicules are scattered in the dermal membrane.

The canal system is remarkable for the unusual length of the exhalant canaliculi of the flagellate chambers, reminding one of the similar condition described by

Schulze (72) in *Cacospongia scalaris*. Polejaeff (74) has already called attention to variability in the development of the cameral canaliculi in this species, so that we can hardly consider the presence of long exhalant canaliculi as a character of specific value.

R.N. 56 (Gulf of Manaar).

Hippospongia dura, Lendenfeld (66).

The single specimen consists of an irregular massive body tapering gradually upwards (?) or on one side (?) into a sub-cylindrical fistular process, the conical extremity of which is perforated by numerous small, round apertures leading into the internal vestibular space. Similar apertures are scattered more sparsely on other parts of the sponge. Internally the sponge is cavernous, with wide, sub-cylindrical, vestibular spaces, more or less sub-divided by trabeculæ of smaller diameter than the vestibules. The vestibular spaces are covered in at the surface partly by a somewhat parchment-like dermal membrane and partly by superficial extensions of the trabeculæ themselves. The surface is rather uneven, but not distinctly conulose; a considerable amount of calcareous and other foreign matter is attached to it. The texture, in spirit, is hard and only slightly compressible, and the colour rather dark brown throughout. The specimen measures about 110 millims. in greatest length (height ?) and 60 millims. in greatest breadth at right angles to the length.

The skeleton is an unusually close and fairly uniform network of rather stout, amber-coloured horny fibre. There is no distinction between primary and secondary fibres, except at wide intervals, where the network becomes somewhat closer and forms stout columns radiating towards the surface. In these columns many primary fibres run side by side and nearly parallel with one another, connected at frequent intervals by short, transverse secondaries to form a very stout, but ill-defined, compound, trellis-like fibre. Elsewhere the stouter fibres frequently run parallel with the surface of the sponge and are connected together by more slender fibres which run transverse to the stouter ones. In other places again the network is quite irregular. The stouter fibres, forming the bulk of the skeleton, are about 0·04 millim. or 0·05 millim. in diameter; the more slender ones are very variable. Usually the fibres are quite free from foreign bodies, but broken spicules may be found occasionally in fibres of the trellis-like groups. There is no special dermal skeleton, but the ordinary reticulation of fibres comes close to the surface, which is covered by a thin cuticle like that of *Hippospongia intestinalis* and *H. anomala*. A remarkable feature of the skeleton fibre is the brilliant yellow colour which it assumes in sections stained with picro-carmine. The superficial cuticle stains in the same way, and sometimes appears to be continuous with the more superficial skeleton fibres, but this is a point which requires further investigation.

The flagellate chambers are nearly spherical, only about 0·024 millim. in diameter, and the ground-substance between them is finely granular. There is a rather thin,

collenchymatous ectosome, containing a good many brown pigment cells. Cylindrical bands or cords of elongated fibrous cells are developed as usual.

Lendenfeld describes the species, apparently from a dry specimen, from the American coast of the North Atlantic. Under these circumstances the identification may seem somewhat hazardous, but the species is so well characterised by its general form, its colour and texture, and its peculiar skeleton arrangement, that I do not think there can be much doubt about it. Of course, it is possible that there has been a mistake about the locality of the type specimen, which is in the British Museum Collection.

R.N. 57 (Gulf of Manaar).

Phyllospongia, Ehlers.

Spongiidæ of thin, lamellar form, often cup-shaped. With a close-meshed skeleton network of slender horny fibre.

Phyllospongia papyracea (Esper), var.—Plate XIV., fig. 6.

1798–1806, **Spongia papyracea**, Esper (6); 1870, **Phyllospongia papyracea**, Ehlers (58); 1877, **Phyllospongia papyracea**, Hyatt (69); 1884, **Phyllospongia papyracea**, Ridley (16); 1889, **Phyllospongia papyracea**, *pars*, Lendenfeld (66).

This variety is represented in the collection by a fine dry specimen, of which a photograph is reproduced in Plate XIV., fig. 6. The specimen is frondose, proliferous and decumbent, and has apparently been attached to the substratum at many points. The thickness of the fronds is about 1·25 millims. The consistence (when perfectly dry) is stiff and rather fragile, the colour light brownish-yellow. The upper surfaces of the fronds are marked with feebly developed concentric and radiating ridges, and also by numerous narrow grooves, frequently arranged in a branching or stellate manner and probably containing minute exhalant apertures. The lower surface is entirely free from such grooves. Both surfaces appear minutely reticulate under a lens, and neither possesses a continuous sand-cortex, though there is a good deal of sand scattered on the upper surface.

The skeleton is a close network of very pale-coloured horny fibres usually about 0·02 millim. in diameter. The fibres are mostly free from foreign matter, but the primary lines, radiating to the surface, contain many comparatively large sand-grains.

Except for the presence of the stellate or branching grooves on the upper surface and the sand-grains in the primary fibres, this species agrees very closely with the figures and description of the type given by Esper and Ehlers. As the type came from Southern India (Tranquebar), it is not likely that the Ceylon form is more than varietally distinct.

The species has been previously recorded from Tranquebar (Esper); Cape of Good Hope (Hyatt); and Mozambique (Ridley). Lendenfeld also records it from

Australia and New Zealand, but his identifications are not always trustworthy, and he appears to me to have got a wrong conception of the species. Thus he states that " in every case the sponge is attached by a short peduncle." He also includes (perhaps rightly) the cup-shaped *Phyllospongia holdsworthi* in the species.

R.N. 104A (Gulf of Manaar).

Phyllospongia holdsworthi (BOWERBANK).

1873, **Spongionella holdsworthii**, BOWERBANK (8); 1889, **Phyllospongia papyracea**, *pars*, LENDENFELD (66).

There are several exquisitely cup-shaped specimens of this sponge in the collection. BOWERBANK's figures and descriptions do not appear to me to be very typical, and it seems not impossible that he had also before him, when writing, specimens of *Phyllospongia papyracea*. The specimens which I have examined are regularly cup-

Fig. 5. *Phyllospongia holdsworthi*, half nat. size.

shaped (see text-fig. 5), with an entire margin and a very well developed peduncle branching out into root-like processes below. The wall of the cup is only about 1·5 millims. thick, stiff and tough and slightly flexible in the perfectly dry state. Both surfaces are smooth or nearly so, but show feebly developed concentric and sometimes radiating ridges. The vents are minute, usually circular in outline, and abundantly scattered over the inner surface only of the cup, which is covered by a thin sand-cortex not sufficiently developed to conceal the minutely reticulate character of the dermal skeleton. There is no sand-cortex on the outer surface, which is also minutely reticulate. Professor HERDMAN informs me that the colour of the sponge in life is purplish-brown, and my dry specimens still retain a distinctly purple tinge in places.

The skeleton is a close-meshed but very irregular network of horny fibre, mostly about 0·02 millim. in diameter and free from sand, but with stouter primary lines radiating to the surface and containing numerous comparatively large sand-grains, especially towards the inner surface of the sponge.

Bowerbank's figures certainly represent a form which is intermediate in external appearance between what I regard as the typical cup-shaped *P. holdsworthi* and the foliaceous *P. papyracea*, and it is quite possible that the two are not more than varietally distinct.

Bowerbank quotes from a letter of Mr. Holdsworth the following interesting particulars:—"Spongionella is only found on the 9-fathom line of the large pearl-bank. It is attached to pieces of dead coral or stones. When alive it is of a dark brown; and when taken out of the water it looks exactly like dirty wet leather. If you soak a bit of one of the dark specimens* you will see it with as nearly as possible the original appearance. This sponge is so strictly confined to the locality above mentioned, that its discovery by the divers is considered the strongest evidence that the outer part of the bank has been reached."

Professor Herdman adds, as the result of his much more extended examination of the Gulf of Manaar, that "although very characteristic of the Periya Paar and other deeper grounds west of the Cheval Paar, still it is not absolutely confined to these, but may be found elsewhere, as on the Muttuvaratu Paar."

R.N. 30; and other specimens (dry). (Periya Paar, Muttuvaratu Paar, &c., Gulf of Manaar.)

Hircinia, Nardo.

Spongiidæ with a coarse-meshed skeleton network usually containing much foreign matter. Denser aggregations of the network along the primary lines frequently form trellis-like compound fibres. Filaments are usually present in the ground-substance.

Hircinia fusca, Carter—Plate XIV., fig. 1.

1880, **Hircinia fusca**, Carter (4), not **Hircinia fusca**, Ridley (16) and Lendenfeld (66).

This is a very remarkable and well-characterised species. It was originally described by Carter in less than four lines, and the species was styled "provisional." It is, therefore, little wonder that Ridley and Lendenfeld have erred in identifying certain slender branching sponges from other localities with the Ceylon species. Carter's description of the external form should, however, have been sufficient to prevent any such misconception, for a slender, branched, cylindrical sponge, narrower at the base, and with conuli only 1 millim. high, can hardly be identical with one which is described as "massive, digitate, branched lobate, cactiform on the surface." In addition to these characters, the dark brown colour and the resemblance to *Aplysina fusca*, noted by Mr. Carter, leave no doubt in my mind that Professor Herdman's specimens really belong to the species in question, an opinion which is rendered almost

* Professor Herdman's dry specimens are very pale in colour.

certainly correct by the fact of their coming from the same locality. Under the circumstances it seems desirable to give some details with regard to the species.

There are two good specimens in the collection, one in spirit (R.N. 48) and one dry (R.N. 99). The former (figured) is massive, irregular, attached by a broad spreading base, from which compressed digitate or flabellate processes rise vertically upwards, bearing small vents at their apices (vents about 1·5 millims. in diameter). The surface is cactiform, with usually sharp-pointed but broad conuli, up to about 3 millims. in height, but usually less. The distance between the conuli varies greatly, but they are usually widely separated from one another by intervals of about 8 millims. The surface between the conuli is smooth or wrinkled, finely granular, under a lens very minutely reticulate and porous. The colour on the surface (in spirit) is warm brown, internally it is much paler, yellowish. The texture is compressible and resilient, but extraordinarily tough and leathery, so that it is very difficult to cut sections. This leathery character is obviously due to the enormous quantity of "filaments" which the sponge contains. Internally it is somewhat cavernous, owing to the presence of numerous cylindrical canals running vertically upwards towards the vents. This specimen measures about 190 millims. in greatest breadth of base and 56 millims. in greatest height.

The dry specimen is strongly compressed, flabellate, and only very slightly proliferous, with a narrow margin bearing a row of vents. It contains much more sand than the spirit specimen, but in other respects agrees closely. It measures about 135 millims. in height by 120 millims. in greatest breadth.

The skeleton is composed principally of large sand-grains, with a comparatively small quantity of spongin; arranged as follows:—(1) Very stout columns or tracts of sand-grains run vertically through the sponge and end in the surface conuli. These columns are compound structures, in which the sand-grains are held together by numerous short, slender spongin threads running from one to the other, in much the same way as Lendenfeld (66) has figured for *Psammopemma marshalli*. They apparently represent an exaggerated condition of the trellis-like main fibres of certain other Hircinidæ. (2) A very irregular network of more slender secondary fibres, composed of sand-grains held together by spongin threads as in the main columns, but the large sand-grains often only in single series. (3) In the dermal membrane there is a thin layer of broken sponge-spicules and large sand-grains, the former lying somewhat more superficially than the latter. Numerous broken spicules also occur along with the sand in the deeper parts of the sponge.

The canal-system appears to be that of a typical *Hircinia*, but, owing to the large quantity of sand and "filaments," it is impossible to get satisfactory sections. The flagellate chambers are not well preserved, but they appear to be about 0·04 millim. in diameter and approximately spherical, and the ground-substance between them is finely granular. The soft tissues are very densely charged with filaments. These have a maximum thickness of about 0·004 millim. between the heads. The heads,

which stain deeply with picro-carmine, are about 0·008 millim. in diameter and somewhat variable in shape, sometimes nearly spherical and sometimes more or less pointed at the end.

Ridley's *Dysidea fusca*, which that author (16) supposed might be identical with Carter's *Hircinia fusca*, appears to be quite a different sponge.

R.N. 48, 99 (pearl banks, Gulf of Manaar); 271 (small specimen with fewer filaments. "Deep water off Galle and onwards up West Coast of Ceylon").

Hircinia tuberosa, n. sp.—Plate XVI., fig. 2.

The sponge consists of a very irregular, somewhat tuber-like body, from which irregular, finger-like processes are given off in various directions, the whole much mixed up and partially coated with calcareous débris. In the largest specimen the central portion of the sponge measures about 60 millims. in diameter, and the two larger processes each about 44 millims. in length by 18 millims. in diameter. The surface is very uneven, but sub-glabrous (not reticulate) between the foreign adhesions, and only slightly conulose, the conuli being low, irregular, and widely separated from one another. Internally the sponge is cavernous, being permeated by wide, cylindrical, meandering vestibules, which are covered in at the surface of the sponge by a thin, parchment-like dermal membrane, pierced here and there by rounded apertures. These apertures are evidently vents. They vary from about 0·5 millim. to 4 millims. in diameter, and are frequently arranged in groups. They are found sometimes on the central portion of the sponge, but more frequently on the more or less fistular, finger-like processes. Texture extremely coarse and gritty throughout, but tough. Colour (in spirit) pale yellowish-grey throughout. There is a distinct but thin sand-cortex in the parchment-like dermal membrane.

The skeleton (Plate XVI., fig. 2) is an extremely irregular network of more or less trellis-like horny fibre, partly enclosing and partly connecting together the very numerous sand-grains and other foreign bodies with which the sponge is filled. Main fibres are recognisable, but not very well defined, and the whole is so irregular that it is useless to give measurements.

The flagellate chambers are about 0·03 millim. in diameter and approximately spherical, and the ground-substance between them is finely granular.

Filaments are present in enormous numbers and usually collected together in more or less dense bundles. They measure about 0·006 millim. in maximum diameter between the heads, and their heads are approximately spherical and about 0·008 millim. in diameter.

R.N. 86, 88, 88A (all from deep water off Galle and onwards up West Coast).

Hircinia schulzei, n. sp.—Plate XVI., fig. 3.

Sponge slender, cylindrical, irregularly branched, and attached at many points to fragments of calcareous débris, amongst which it appears to creep. A few rather

short and somewhat club-shaped branches, about 25 millims. in length and 3 millims. in maximum diameter, probably rose vertically upwards from repent stems of about the same diameter. The surface is pretty uniformly covered with low conuli, between which narrow longitudinal canals may be seen running beneath a thin membrane, which is occasionally broken through by a single small vent or by a sieve-like group of very small vents. The colour (in spirit) is very pale yellow and the texture pretty stiff, but compressible and resilient.

The skeleton (Plate XVI., fig. 3) consists of widely distant, longitudinal main fibres curving outwards towards the surface and connected at irregular intervals by a round-meshed lattice work of secondaries. The main fibres are pretty regularly cylindrical and about 0·12 millim. in diameter, not fascicled, and containing a good many fragments of sponge-spicules. The connecting fibres are entirely free from foreign matter ; they vary much in diameter, but are usually pretty stout.

The canal-system is of the type usually met with amongst the Spongiidæ. The small flagellate chambers are approximately spherical and up to about 0·04 millim. in diameter, with short, wide, exhalant canaliculi. The ground-substance between them is finely granular. A very conspicuous histological feature is the presence of numerous long, cylindrical cords of fibrous tissue running longitudinally through the sponge. These cords are composed each of a compact mass of elongated, finely granular cells, each with a very distinct, darkly staining nucleus. They closely resemble the similar fibrous bands found in *Euspongia*, &c., and are probably contractile. The characteristic *Hircinia* filaments are abundantly scattered through the soft tissues. They are, however, very slender, and I have not succeeded in making out the nature of their terminations.

This appears to be a very distinct and well-characterised species, differing from *Hircinia dendroides*, Schmidt, which is, perhaps, its nearest ally, in its much more slender branches and much more regular main fibres. I have much pleasure in dedicating it to the zoologist to whom we chiefly owe our accurate knowledge of the Spongiidæ.

R.N. 277 (deep water off Galle and onwards up West Coast of Ceylon).

Hircinia anomala, n. sp.—Plate XIV., fig. 5 ; Plate XVI., fig. 1.

Sponge massive, irregular, with a tendency to become lobose or digitate. Surface uniformly covered with small, sharp conuli, about 1 millim. in height and 2 millims. apart ; with a minute reticulation of fine ridges chiefly radiating from the apices of the conuli. Sometimes the surface reticulation is suppressed, and it may be present or absent in different parts of the same specimen. The surface is not sandy, except sometimes at the apices of the conuli. Vents inconspicuous, the sponge being, perhaps, sometimes lipostomous. Pores scattered abundantly in the meshes of the dermal reticulation. Colour (in spirit) varying from pale brown to black on the surface ; pale brown internally. Consistence firm, but compressible and elastic. The

largest specimen is about 75 millims. in length by 42 millims. in greatest breadth; another is about 140 millims. long, with a maximum diameter of 25 millims.

The skeleton (Plate XVI., fig. 1) is an extremely irregular network of highly arenaceous fibres. There is no distinct differentiation into main and secondary fibres, but the reticulation is much closer along tracts which run vertically to the surface and end in the surface conuli. These denser parts of the reticulation are evidently homologous with the trellis-like main fibres of other Hircinidæ. Between them large tracts may remain entirely devoid of skeleton. The fibres themselves vary a good deal in thickness and in the amount of foreign matter which they contain. Usually there is a very large proportion of sand or sponge spicules, and comparatively little spongin; occasionally, however, I have seen fibres without foreign inclusions. The spongin of the fibres is very distinctly lamellated.

The flagellate chambers are approximately spherical, up to about 0·04 millim. in diameter (but often smaller), and either eurypylous or with short exhalant canals. The ground-substance between them is finely granular, though perhaps somewhat less markedly so than in typical Spongiidæ. The larger canals are surrounded by a very large quantity of gelatinous, vesicular-looking collenchyma, and commonly more or less sub-divided by septa. Bands of fibrous tissue penetrate the soft tissues as in other Spongiidæ, but I have not found any of the "filaments" so common in the genus *Hircinia*. R.N. 13 contains an immense number of unicellular bodies of a pale yellow colour (staining brown with picro-carmine); these are oval or nearly spherical, and about 0·02 millim. in diameter; each with a small nucleus. Occasionally they appear to be broken up into fragments. Probably they are unicellular Algæ, comparable to those which I have described in *Hexadella*. R.N. 82 and 171 contain numerous groups of smaller cells which are, perhaps, the same Alga in process of division.

This species exhibits characters intermediate between those of the Spongeliidæ and those of the Spongiidæ. The skeleton, in its highly arenaceous character, agrees with that of *Spongelia*, but the small size of the flagellate chambers and the granular character of the ground-substance prevent us from including it in that genus. The absence of filaments, on the other hand, militates against our regarding the species as a typical *Hircinia*, but the nature of these filaments and their taxonomic value are still so obscure that I am not inclined to exclude the sponge from the genus solely on account of their absence.

In external appearance the species somewhat resembles *Cacospongia scalaris*.

R.N. 13 and 91 (Gulf of Manaar); 82 and 171 (deep water off Galle and onwards).

Aplysina, Nardo.

Spongiidæ with distinctly pithed horny fibres forming a coarse-meshed skeleton network. Of very compact texture, with narrow canals and very small flagellate chambers.

Aplysina purpurea, CARTER.

1880, **Aplysina purpurea,** CARTER (**4**); 1881, **Aplysina purpurea,** CARTER (**65**); 1889, **Aplysina purpurea,** DENDY (**3**); 1889, **Psammopemma fuliginosum,** LENDENFELD, *pars* (**66**).

There is only a single dry specimen of this sponge in the collection, so that I am not in a position to add anything to the descriptions of the species given by CARTER and myself, except by referring back to some preparations of spirit material collected by Mr. THURSTON, which show the sponge to be a true *Aplysina* and not, as LENDENFELD has supposed, a *Psammopemma*.

The skeleton is composed of dense local aggregations of very irregular, branching and anastomosing horny fibres, accumulated along certain tracts to form the so-called "compound fibres," while large intervening areas remain free from fibre altogether. The fibres themselves have a very curious structure, consisting of a very thin outer layer (if any) and a very thick "pith," the latter exhibiting a granular or often minutely reticulate appearance. They are free from foreign bodies. The inhalant pores are abundantly scattered over certain parts of the surface. The structure of the soft tissues is very compact and the flagellate chambers are small and probably aphodal or diplodal. In short, the canal-system probably agrees closely with that described and figured by SCHULZE in *Aplysina aërophoba*, although the condition of my material is not good enough to render a detailed comparison possible.

LENDENFELD has, as already indicated, made the curious mistake of confounding this species with "*Psammopemma fuliginosum*," a totally different sponge. CARTER'S specimens of *Aplysina purpurea* were from the Gulf of Manaar and Trincomalee, but he subsequently (**65**) identified an Australian sponge with the same species. Still later, however, when describing his *Pseudoceratina durissima* (**18**), he showed that the *Australian* specimen previously identified by him as *Aplysina purpurea* should really be considered as a specimen of *Pseudoceratina durissima*. LENDENFELD, accordingly (**66**), in a manner very characteristic of that writer, observes that "CARTER himself has shown that his *Aplysina purpurea* and his *Pseudoceratina durissima* are identical," which, of course, is by no means the case. At the same time he omits the locality from which the types of *Aplysina purpurea* were obtained from the geographical distribution of *Psammopemma fuliginosum*, under which name (while admitting that it is not the oldest) he also includes (rightly or wrongly) CARTER'S *Pseudoceratina durissima*.

Mr. CARTER has given a characteristic sketch of the external form of the sponge, together with figures of the skeletal structure (**65**, Plate IX., fig. 1), which are sufficient for the identification of the species.

There can be no doubt that KELLER'S *Psammaplysilla arabica* from the Red Sea (**61**) is very closely related to, if not identical with, this species. The compound skeleton fibres, consisting entirely (according to KELLER) of reticulate "Marksubstanz," the cactiform surface, and black-violet colour in alcohol, all point to generic if not

specific identity. In the Ceylon specimens, however, there appears to be (usually at any rate) no sand in the skeleton fibres. KELLER makes his species the type not only of a new genus, but even of a new family. He considers it to be closely related to *Aplysilla*, but, unfortunately, his material did not enable him to investigate the form and arrangement of the flagellate chambers, or he would probably have seen that the affinity was rather with *Aplysina*, as the firm, almost leathery texture of the living sponge and its stony hardness when dry might alone have indicated. I follow Mr. CARTER in retaining the Ceylon species, at any rate (with which KELLER does not appear to have been acquainted), in the latter genus, from which it differs in no important respect. In any case the name *Psammaplysilla* appears to have been very unfortunately chosen, as the sandy character of the fibre is hardly of generic value, and the relationship with *Aplysilla* is not nearly so close as that with *Aplysina*, a very distinct genus.

R.N. 95 (Stat. IV., off Karkopani, 6–9 fathoms, Gulf of Manaar).

Aplysina herdmani, n. sp.—Plate XVI., fig. 4.

The single specimen consists of a rather thin, irregular, flattened crust, from which short, slender, cylindrical, digitiform processes rise vertically upwards at wide and irregular intervals. The ends of these processes are truncated, and each has a single small vent in the middle.* The surface, both of the basal crust and of the digitiform processes, is glabrous, but beset with numerous minute conuli, from the apices of which the ends of the primary fibres sometimes project. The colour, in spirit, is dull purple throughout; the texture compact and rather fleshy, but compressible and resilient. The maximum diameter of the basal crust is about 55 millims. and its thickness about 4 millims. The digitiform processes are about 11 millims. high by only 2 millims. or 3 millims. in diameter.

The skeleton, in the basal crust, consists of a reticulation of thin-walled, pithed fibres of a rather dark brown colour, amongst which distinct primary fibres, running vertically into the surface conuli, are clearly differentiated (Plate XVI., fig. 4). These primary fibres are about 0·08 millim. in diameter, and the very thick, granular "pith" contains abundant broken sponge spicules as foreign inclusions. The primary fibres sometimes branch, and they are connected together by a network of secondaries which vary greatly in diameter, being sometimes as stout as the primaries and sometimes very slender, only about 0·016 millim. in diameter. The secondary fibres are free from foreign matter and the stouter ones commonly run across between the primaries and thus form rectangular meshes, but the meshes are usually irregularly polygonal and very variable in diameter.

In the digitiform processes the main fibres—containing broken spicules—run longi-

* One of the processes forks into two close to its extremity, and each of the very short branches thus produced bears a small vent on its truncated end.

tudinally and give off short branches—also containing broken spicules—into the surface conuli. The secondaries are arranged as in the basal crust.

The flagellate chambers are very small, only about 0·024 millim. in diameter, and approximately spherical, but the arrangement of the collared cells, on the inhalant side of the chamber only, gives them a curious crescentic appearance ; moreover, they frequently appear in sections to be arranged in single curved rows ; surrounding the narrow exhalant canals at about equal distances, and doubtless communicating with them by very long and narrow canaliculi, but the condition of the specimen is not good enough to enable me to make out minute histological details. The ectosome is chondrenchymatous rather than collenchymatous, but a large quantity of gelatinous tissue is developed around the larger canals in the choanosome. In the neighbourhood of the flagellate chambers the choanosome is abundantly granular, and both ectosome and choanosome contain numerous pigment cells.

It affords me much pleasure to name this well-characterised species after Professor W. A. Herdman.

R.N. 340 (Ceylon seas).

Class : CALCAREA.

Porifera with a skeleton composed of calcareous spicules.

The number of calcareous sponges in the collection is remarkably small, only four species being represented, two of which, however, are new. I have discussed the classification of the group in considerable detail in my earlier writings (**76, 78, 80**) and adhere to the opinions therein expressed.

Order 1 : HOMOCŒLA.

Calcareous sponges in which the endoderm consists throughout of collared cells.

Leucosolenia, Bowerbank.

With the characters of the order.

Leucosolenia (Clathrina) coriacea (Montagu), var. **ceylonensis,** nov.—Plate XIII., fig. 8.

[For literature and synonyms *vide* Haeckel (7)].

This well-known European species is represented in the collection by a slight variety belonging to the reticulate section of the genus *Leucosolenia* as defined by the present writer (**76**). The sponge forms massive, closely reticulate colonies of slender ascon-tubes, each colony with a constricted base of attachment ; with fairly numerous, small but prominent true oscula formed each by the coalescence of several tubes in a projection from the general surface. The ascon-tubes are only about 0·16 millim. in diameter and there is no pseudoderm. The entire colony attains a diameter of some 10 millims. or 20 millims. The colour in alcohol is pale grey.

The spicules are nearly all regular triradiates (Plate XIII., fig. 8, *a.*, *b.*, *c.*); with slender, not very sharply pointed rays of pretty uniform diameter and measuring about 0·088 millim. in length by 0·008 millim. in diameter at the base. The apex is rather abruptly and rather irregularly pointed. There are apparently no quadriradiates at all, but two (R.N. 377, 378) of the three specimens in the collection show a few very slender oxea (Plate XIII., fig. 8, *d*) projecting from the surface of some of the tubes. I have not been able to obtain these spicules in an unbroken condition, but they apparently closely resemble those found in the next species; whether or not they should be regarded as constant features of this variety, I am unable to say with certainty.

R.N. 377, 378, 379 (all from Cheval Paar).

Leucosolenia (Clathrina) tenuipilosa, n. sp.- -Plate XIII., fig. 9.

Sponge forming massive, reticulate colonies of ascon-tubes, closely resembling the preceding variety but somewhat coarser. Here and there on the surface of the colony the tubes converge to unite in small, prominent, true vents. The tubes themselves are about 0·5 millim. in diameter, and they form a close reticulation without any pseudoderm. The colour in alcohol is pale grey. The largest specimen (R.N. 158, which may be regarded as the type of the species) is cake-shaped and flattened, measuring about 47 millims. in length, 37 millims. in breadth, and 16 millims. in thickness.

The skeleton is arranged as usual in the genus, and the spicules are of three kinds :—

(1.) Regular triradiates (Plate XIII., fig. 9, *a*), with rather stout, slightly fusiform rays, bluntly and rather abruptly pointed at the apex, which is often somewhat irregular. Rays measuring about 0·1 millim. in length by 0·012 millim. in diameter at the thickest part.

(2.) Quadriradiates (Plate XIII., fig. 9, *b*, *c*) abundant; resembling the triradiates, but with an apical ray projecting at right angles into the gastral cavity. This ray is somewhat variable in form and size; typically it is long and slender, gradually and sharply pointed, and slightly undulated towards the extremity; in the type specimen it attains a length of about 0·14 millim.

(3.) Very slender, hair-like oxea (Plate XIII., fig. 9, *d*), sparsely hispidating the surface of the tubes. These may attain a length of more than 0·4 millim., with an average diameter of only about 0·002 millim. They taper very gradually from the proximal extremity, which is somewhat hastately sharp-pointed and may be as much as 0·004 millim. thick, to the distal, which is hair-like and apparently nearly always broken off.

This species is evidently closely related to *Leucosolenia coriacea*, var. *ceylonensis*, but differs in the presence of the quadriradiates, and also in the greater stoutness and the frequently fusiform shape of the rays of the triradiates.

R.N. 158 (Stat. LXIV., 5 fathoms, south-east of Modragam, March 17, 1902); 158A (south of Cheval); 380 and 381 (both from Cheval Paar, March 4, 1902).

Order 2 : HETEROCŒLA.

Calcareous sponges in which the collared cells are confined to more or less well-defined flagellate chambers.

Family: GRANTIIDÆ.

Heterocœla with a distinct and continuous dermal cortex, completely covering over the chamber-layer and pierced by inhalant pores. There are no sub-dermal sagittal triradiates, nor conspicuous sub-dermal quadriradiates. The flagellate chambers vary from elongated and radially arranged to spherical and irregularly scattered; while the skeleton of the chamber layer varies from regularly articulate to irregularly scattered

Leucandra (Haeckel).

Grantiidæ in which the flagellate chambers are spherical or sac-shaped, never arranged radially around the central gastral cavity, with which (or with the main exhalant canals derived therefrom) they communicate by a more or less complicated exhalant canal-system. The skeleton of the chamber layer is composed of irregularly scattered radiate spicules, but it may still present traces of its derivation from a radially symmetrical type in the presence of a few sub-gastral sagittal triradiates.

Leucandra donnani, n. sp.—Plate XIII., fig. 10.

The only specimen in the collection consists of a single Leucon person of sac-like form; elongated, sub-cylindrical, but slightly compressed; rather strongly curved; tapering gradually from broadly rounded base to narrower apex, where the terminal osculum is situated. The outer surface is nearly smooth, but slightly granulated in appearance. The osculum has no spicular fringe, but a slightly developed membranous margin. The total length of the specimen is 23 millims.; the maximum diameter at the base is about 9·5 millims., and the diameter of the vent is 2 millims. The thickness of the sponge-wall in the middle is about 2 millims. The colour (in spirit) is light brown and the texture firm but brittle.

The dermal cortex, of sagittal triradiates, is only about 0·05 millim. thick; beneath it lie large, irregular sub-dermal cavities, without, however, any special supporting skeleton of their own. The gastral cortex, of sagittal quadriradiates, is about as thick as the dermal cortex and pierced by the numerous apertures of the exhalant canals. The skeleton of the chamber layer consists for the most part of very large sagittal triradiates, generally arranged with the basal ray pointing outwards.

The canal-system is typically leuconoid; the flagellate chambers, abundantly scattered in the ground-substance between the gastral and dermal cortex, being spherical or sac-shaped, and having a maximum diameter of about 0·08 millim. The epithelial cells lining the larger canals contain numerous brown pigment granules.

Spicules.—(1.) Dermal triradiates (Plate XIII., fig. 10, *c*, *d*); sagittal, with slender rays of not very unequal length, measuring, say, about 0·276 millim. in length by 0·016 millim. in thickness at the base, and tapering pretty gradually from base to apex, which is sharp-pointed. The rays are all straight, and the angle between the two paired rays is only slightly greater than the other two angles.

(2.) Triradiates of the chamber-layer (Plate XIII., fig. 10, *a*, *b*); stout, sagittal, with the basal ray somewhat shorter than the paired rays. Rays usually straight; somewhat fusiform and gradually and very sharply pointed. Angle between paired rays only slightly greater than the other two angles. The paired rays in a typical example measured about 0·7 millim. in length by 0·066 millim. in maximum diameter, with a basal ray about 0·57 millim. long and of about the same thickness as the others.

(3.) Gastral quadriradiates (Plate XIII., fig. 10, *e*, *f*); strongly sagittal, with the paired rays extended nearly, or quite, at right angles to the conspicuously shorter basal ray, and with the still shorter apical ray directed forwards almost in a line with the basal. The rays are all straight, or nearly so, and only moderately stout, and taper gradually from the base to the sharp-pointed apex. Length of paired rays about 0·188 millim., with a diameter at the base of 0·012 millim.; with basal ray about 0·072 millim. long and apical ray about 0·048 millim. long; the basal ray of about the same diameter as the paired rays; the apical ray rather more slender.

(4.) Fusiform oxea (Plate XIII., fig. 10, *g*); very slightly curved; gradually and finely pointed at the inner end, but with the outer end nearly always broken off; moderately stout, measuring, say, about 0·74 millim. in length by 0·02 millim. in maximum diameter. Arranged in sparse bundles at right angles to the surface, with the outer ends projecting but slightly.

This species is perhaps most nearly related to Lendenfeld's *Leucandra typica* (79) [= *Leuconia typica*, var. *tuba*, of Poléjaeff (77)], from the East Coast of Australia (and Bermudas ?), but differs considerably in details of spiculation. I have much pleasure in naming it after Captain Donnan, the veteran Inspector and explorer of the Ceylon pearl banks.

R.N. 186 (Donnan's Muttuvaratu Paar, Gulf of Manaar).

Family: AMPHORISCIDÆ.

Heterocœla with a distinct and continuous dermal cortex. With conspicuous subdermal quadriradiate spicules with inwardly directed apical rays. Flagellate chambers varying from elongated and radially arranged to spherical and irregularly scattered.

Heteropegma, Poléjaeff.

Amphoriscidæ with elongated flagellate chambers arranged radially around the central gastral cavity. With a vestigial tubar skeleton of minute radiates. With a very thick dermal cortex, composed principally of triradiate spicules.

Heteropegma nodus-gordii, Poléjaeff (77).

This remarkable and well-characterised species is represented in the collection by a single good-sized specimen, which agrees very closely with the types described by Poléjaeff in 1883 from Australia (Cape York) and the Bermudas. The only other species known is the very closely related *H. latitubulata* from near Port Phillip Heads (80), so that the genus is apparently a characteristic Australian one, and the discovery of *H. nodus-gordii* (the Northern Australian form) at Ceylon affords another good example of the close relationship between the Ceylonese and Australian Sponge-Fauna. The anatomy of this species has been figured both by Poléjaeff (77) and by myself (78).

R.N. 155 (Ceylon seas).

LIST OF THE CEYLON SPONGE-FAUNA

so far as at present known; showing the classification adopted and the geographical distribution of those species which have been recorded from localities beyond the Ceylon area. The species marked H occur in Professor Herdman's collection; those marked D are doubtful* :—

Class: NON-CALCAREA.

Order: Myxospongida.

H 1. *Hexadella indica*, n. sp.
D 2. *Halisarca* (?) *rubilingens*, Carter (5).

Order: Tetraxonida.

Grade: Tetractinellida.

Sub-order: Homosclerophora.

Family: Plakinidæ.

H 3. *Dercitopsis ceylonica*, n. gen. et sp.

Sub-order: Astrophora.

Family: Pachastrellidæ.

H 4. *Plakinastrella intermedia*, n. sp.
H 5. „ *schulzei*, n. sp.
6. *Stæba* (*Samus*) *simplex* (Carter, 4)†, Ternate (87).
H 7. *Stæba extensa*, n. sp.
8. *Triptolemus* (*Samus*) *parasiticus* (Carter, 4).†
9. *Nethea* (*Tisiphonia*) *nana* (Carter, 4).†
10. *Sphinctrella* ? (*Tisiphonia*) *annulata* (Carter, 4).†

Family: Stellettidæ.

11. *Myriastra* (*Stelletta*) *crassicula* (Carter, 5).†
H 12. „ *clavosa* (Ridley). Off north coast of Australia; Philippine Islands; Amboyna (83); Ternate (87); Coast of Cochin China (86).
H 13. *Myriastra tethyopsis* (Carter).
14. *Pilochrota ceylonica*, Sollas (15).
H 15. „ *haeckeli*, Sollas. Philippine Islands.

* In compiling this list no notice has been taken of varietal distinctions. It may be noted that the sponges described by me in my paper on "The Sponge-Fauna of Madras" (2) all came from the Gulf of Manaar (*vide* Thurston, 99).

† *Vide* Sollas (15).

H 16. *Pilochrota hornelli*, n. sp.
H 17. *Stelletta herdmani*, n. sp.
H 18. „ *vestigium*, n. sp.
19. *Aurora* (*Stelletta*) *globostellata* (Carter, 21).†
H 20. *Ecionema carteri*, n. sp.
H 21. „ *laviniensis*, n. sp.

Family: Geodiidæ.

H 22. *Geodia perarmata*, Bowerbank.
H 23. „ *peruncinata*, n. sp.
H 24. „ *areolata*, Carter.
H 25. „ *ramodigitata*, Carter.
26. „ *globostellifera*, Carter. Port Darwin, Australia (Ridley, 16).*
27. *Erylus carteri*, Sollas (15) = *Stelletta euastrum* Carter (4).

Sub-order: Sigmatophora.

Family: Tetillidæ.

H 28. *Tetilla hirsuta*, Dendy.
H 29. „ *poculifera*, n. sp.
H 30. „ *anomala*, n. sp.
H 31. „ *limicola*, n. sp.
H 32. *Craniella elegans*, n. sp.
H 33. *Paratetilla cineriformis*, n. gen. et sp.

Family: Samidæ.

34. *Samus anonymus*, Gray; *fide* Carter (4). Bahia, West Indies, Australia, South Seas, Seychelles (15).

Grade: Lithistida.

35. *Discodermia papillata*, Carter (4).
36. „ *aspera*, Carter (4).
37. „ *lævidiscus*, Carter (4).
38. „ *sinuosa*, Carter (5).
H 39. „ *emarginata*, n. sp.
40. *Racodiscula* (*Discodermia*) *spinispirulifera* (Carter, 4).†
41. *Racodiscula* (*Discodermia*) *sceptrellifera* (Carter, 5).†
42. *Corallistes aculeata*, Carter (4).
43. „ *verrucosa*, Carter (4).
D 44. *Corallistes elegantissima*, Carter (4).
H 45. *Aciculites orientalis*, n. sp.
H 46. *Taprobane herdmani*, n. gen. et sp.
H 47. *Petromica massalis*, n. sp.

Grade: Monaxonellida.

Sub-order: Astromonaxonellida.

Family: Epipolasidæ.

48. *Coppatias* (*Tisiphonia*) *penetrans* (Carter, 4).
H 49. „ *reptans*, n. sp.
H 50. *Asteropus haeckeli*, n. sp.
H 51. *Cryptotethya agglutinans*, n. gen. et sp.

Family: Tethyidæ.

H 52. *Tethya lyncurium*, Lin. Semi-cosmopolitan (especially in the North Atlantic).
H 53. *Xenospongia patelliformis*, Gray. Torres Straits.

Family: Spirastrellidæ.

H 54. *Hymedesmia stellivarians*, Carter. Azores (48).
55. „ *moorei*, Carter (4).
56. „ *spinatostellifera*, Carter (4).
57. „ *capitatostellifera*, Carter (4).
58. „ *trigonostellata*, Carter (4).
H 59. „ *curvistellifera*, n. sp.
H 60. *Spirastrella vagabunda*, Ridley. Torres Straits; Ternate (87); Aden (92).
H 61. *Spirastrella tentorioides*, n. sp.
H 62. *Placospongia carinata* (Bowerbank). Widely distributed in tropical seas (35).
63. *Placospongia melobesioides*, Gray, *fide* Carter (4). Widely distributed in tropical seas (35).
H 64. *Negombo tenuistellata*, n. gen. et sp.

Family: Clionidæ.

65. *Cliona warreni*, Carter (5).
66. „ *indica*, Topsent (37).
H 67. „ *margaritiferæ*, n. sp.
68. *Thoosa socialis*, Carter (4).
69. *Dotona pulchella*, Carter (4). Azores (62).
70. *Alectona higgini*, Carter (4).

Family: Suberitidæ.

71. *Suberites vestigium*, Carter (4).
D 72. „ *inconstans*, Dendy (2).
H 73. „ *cruciatus*, n. sp.

* Ridley's identification seems a little doubtful (*vide* Sollas, 15).
† *Vide* Sollas (15).

FAMILY: Chondrosiidæ.

74. *Chondrilla nucula*, SCHMIDT; *fide* CARTER (5). Adriatic, Florida, Antilles, Azores (48); Red Sea (61).

H 75. *Chondrilla australiensis*, CARTER. Australia; Coast of Cochin China (86).

H 76. *Chondrosia reniformis*, NARDO. Adriatic; Aden (92); Amboyna (83).

SUB-ORDER: SIGMATOMONAXONELLIDA.

FAMILY: Haplosclerida.

SUB-FAMILY: Gelliinæ.

H 77. *Gellius fibulatus* (SCHMIDT). Adriatic; European coast of North Atlantic; Azores (62); Australia (16); Ternate (87).

H 78. *Gellius angulatus* (BOWERBANK). British seas (52); Azores (1, 48, 62); Iceland (88).

H 79. *Gelliodes carnosa*, DENDY.

H 80. „ *incrustans*, n. sp.

H 81. „ *petrosioides*, n. sp.

H 82. *Toxochalina robusta*, RIDLEY. Port Jackson (Australia).

H 83. *Strongylophora durissima*, n. gen. et sp.

SUB-FAMILY: Renierinæ.

84. *Reniera madrepora*, DENDY (2). Java (86).

D 85. *Reniera albescens* (= *Halichondria albescens*, JOHNSTON), *fide* CARTER (4). British seas (81).

H 86. *Reniera implexa*, SCHMIDT. Adriatic (50); Azores (1, 62).

H 87. *Reniera pigmentifera*, n. sp.

H 88. „ *zoologica*, n. sp.

H 89. *Petrosia testudinaria* (LAMARCK). Queensland (16); Mergui Archipelago (3)

H 90. *Petrosia similis*, RIDLEY and DENDY. South of Cape of Good Hope and between Kerguelen and Heard Islands (1).

H 91. *Petrosia densissima*, n. sp.

H 92. *Halichondria panicea*, JOHNSTON. Cosmopolitan (1).

H 93. *Trachypsis halichondrioides*, n. gen. et sp.

SUB-FAMILY: Chalininæ.

H 94. *Pachychalina subcylindrica*, n. sp.

H 95. „ *delicatula*, DENDY.

H 96. „ *brevispiculifera*, n. sp.

H 97. *Pachychalina spinilamella*, DENDY.

H 98. *Chalina subarmigera*, RIDLEY. Torres Straits (16); Port Jackson (51); Coast of Cochin China (86).

H 99. *Chalina obtusispiculifera*, n. sp.

H 100. „ *clathrata*, n. sp.

H 101. „ *cymæformis* (ESPER ?).

H 102. *Ceraochalina retiarmata*, n. sp.

H 103. „ *reticulis*, n. sp.

H 104. „ *multiformis*, LENDENFELD. Australia and New Zealand (51).

H 105. *Ceraochalina ceylonica*, n. sp.

H 106. *Siphonochalina communis* (CARTER). Port Jackson (16); Kurrachee (16).

SUB-FAMILY: Desmacellinæ.

H 107. *Desmacella tubulata*, n. sp.

SUB-FAMILY: Tedaniinæ.

108. *Tedania digitata*, SCHMIDT, *fide* DENDY (2). Cosmopolitan (1).

SUB-FAMILY: Heteroxyinæ.

H 109. *Acanthoxifer ceylonensis*, n. gen. et sp.

FAMILY: Desmacidonidæ.

SUB-FAMILY: Esperellinæ.

H 110. *Esperella parishii*, RIDLEY. Port Darwin, Australia (16).

H 111. *Esperella plumosa* (CARTER). Mauritius (33); Mergui Archipelago (20).

H 112. *Esperella crassissima*, n. sp.

H 113. „ *tenuispiculata*, n. sp.

D 114. *Esperella tunicata* (SCHMIDT), *fide* CARTER (4). Adriatic (47); Azores (62).

H 115. *Paresperella serratohamata* (CARTER). Vancouver, *fide* LAMBE (85).*

H 116. *Paresperella bidentata*, n. sp.

H 117. *Iotrochota purpurea* (BOWERBANK). Straits of Malacca (49); North Australia (16); Amboyna (83); Amirante group (16); ? South Coast of Australia (10); ? West Indies (53).

H 118. *Iotrochota baculifera*, RIDLEY. Western Indian Ocean (16); North Australia (16); Amboyna (83); Celebes (39); Ternate (87); Coast of Cochin China (86).

* LAMBE'S identification is probably erroneous.

119. *Vvesia* (?) (*Halichondria*) *aceratospiculum* (Carter, 4).
120. *Paramyxilla** (*Halichondria*) *infrequens* (Carter, 5).

Sub-family: Phlœodictyinæ.

H 121. *Phlœodictyon fistulosum* (Bowerbank). Northern and Western Australia (1, &c.); Amboyna (83); Azores (1; 62); ? off Bahia (1); Ternate (?) (87).
122. *Histoderma* (*Suberites*) *fistulatum* (Carter, 4). West Australia, *fide* Carter (4).
H 123. *Histoderma vesiculatum*, n. sp.

Sub-family: Eetyoninæ.

H 124. *Myxilla arenaria*, n. sp.
H 125. „ *tenuissima*, n. sp.
H 126. *Clathria frondifera* (Bowerbank). Straits of Malacca and Gaspar Strait (49); Queensland and Torres Strait (16); Western Indian Ocean (Providence, Amirante, Seychelles) (16); Red Sea (91); Java Sea (86).
H 127. *Clathria indica*, Dendy.
H 128. „ *spiculosa* (Dendy).
H 129. *Raspailia thurstoni*, Dendy.
H 130. „ *fruticosa*, Dendy.
H 131. „ *hornelli*, n. sp.
132. *Plumohalichondria* (*Halichondria*) *plumosa* (Montagu); *fide* Carter (5). British seas (52, &c.); off Bahia (1); Kerguelen (82).
133. *Microciona armata*, Bowerbank, *fide* Carter (4). British seas (52).
134. *Microciona atrasanguinea*, Bowerbank, *fide* Carter (4). British seas (52).
135. *Microciona affinis*, Carter (4).
136. *Hymeraphia clavata*, Bowerbank, *fide* Carter (4). British Isles (52); Azores (62); Amboyna (83); &c. (*vide* 62).
137. *Hymeraphia* (*Microciona*) *bulbovetorta* (Carter, 4).
138. *Hymeraphia* (?) (*Microciona*) *fascispiculifera* (Carter, 4).
139. *Hymeraphia* (?) *unispiculum* (Carter, 4).
H 140. *Agelas mauritiana* (Carter). Mauritius (54); off Tristan da Cunha (?) (1); Ternate (87).
H 141. *Agelas ceylonica*, n. sp.
H 142. *Echinodictyum clathratum*, n. sp.
H 143. *Aulospongus tubulatus* (Bowerbank).
144. „ (?) (*Dictyocylindrus*) *sessilis*, Carter (4).
H 145. *Acarnus ternatus*, Ridley. Bombay (?) (16); Amirante (16); Torres Straits (16); Tahiti (1); Ternate (87).
H 146. *Cyamon quinqueradiatum* (Carter).
147. „ (*Microciona*) *quadriradiatum* (Carter) (4). West Indies (4).
H 148. *Plocamia manaarensis* (Carter). California, *fide* Lambe (85).†
H 149. *Bubaris eruca* (Carter).
150. *Rhabdoploca* (*Microciona*) *curvispiculifera* (Carter, 4). Azores (62).
H 151. *Rhabderemia indica*, n. sp.

Family: Axinellidæ.

H 152. *Spongosorites topsenti*, n. sp.
H 153. „ (?) *lamellata*, n. sp.
H 154. „ (?) *lapidiformis*, n. sp.
H 155. *Hymeniacidon petrosioides*, n. sp.
H 156. *Thrinacophora agariciformis*, n. sp.
H 157. „ *durissima*, n. sp.
H 158. *Axinella labyrinthica*, Dendy.
H 159. „ *manus*, n. sp.
H 160. „ *tenuidigitata*, n. sp.
H 161. „ *halichondrioides*, n. sp.
162. „ (?) (*Hymeraphia*) *erecta*, Carter (4). North and South Atlantic and Southern Ocean (1); Azores (62).
H 163. *Phakellia donnani* (Bowerbank).
164. „ *ridleyi*, Dendy (2).
H 165. „ *symmetrica*, n. sp.
H 166. „ *ceylonensis*, n. sp.
H 167. „ *crassistylifera*, n. sp.
H 168. *Acanthella carteri*, Dendy.
H 169. „ *flabelliformis*, Keller. Red Sea (61).
H 170. *Auletta lyrata* (Esper).

* This genus I now propose for the reception of Carter's *Halichondria infrequens*. It is evidently nearly related to *Myxilla*, and may be diagnosed as follows:—"Esperellinæ whose principal megascleres are spined oxea, with which are associated smooth tylota. Microscleres tridentate isochelæ and sigmata."

† Lambe's identification is doubtful.

H 171. *Auletta elongata*, n. sp.

H 172. *Leucophlœus fœtidus* (Dendy). Amboyna (83); Ternate (87); (?) China Sea (86).

H 173. *Ciocalypta tyleri*, Bowerbank. Port Elizabeth (22); Southern and Eastern Coasts of Australia (3, 10).

H 174. *Collocalypta digitata*, n. gen. et sp.

Order: Euceratosa.

Family: Aplysillidæ.

H 175. *Darwinella simplex*, Topsent. Mediterranean, Azores.

H 176. *Megalopastas nigra* (Dendy).

H 177. „ *pulvillus*, n. sp.

Family: Spongeliidæ.

H 178. *Spongelia fragilis*, Montagu. Cosmopolitan.

H 179. „ *elastica*, Schulze. Cosmopolitan.

H 180. „ *incrustata*, n. sp.

D 181. „ (?) *conica* (Bowerbank, 8). Western Indian Ocean (Glorioso Island) (16).

H 182. *Psammopemma crassum* (Carter). Australia and New Zealand (66).

Family: Spongiidæ.

183. *Cacospongia cavernosa*, Schmidt (*fide* Lendenfeld, 66). Almost cosmopolitan (66).

H 184. *Cacospongia scalaris*, Schmidt. Mediterranean.

H 185. *Euspongia officinalis*, Auctorum. Almost cosmopolitan (66).

186. *Euspongia irregularis*, Lendenfeld (*fide* Lendenfeld, 66). Madagascar; East Coast of Australia; Torres Straits; Oceania; Bahamas (66).

H 187. *Euspongia tenuiramosa*, n. sp.

188. „ *trincomalensis*, Lendenfeld (*fide* Lendenfeld, 66). Nassau; Havannah; Pernambuco (66).

H 189. *Hippospongia intestinalis* (Lamarck). Mediterranean; Zanzibar; Masearene and Amirante Islands; Porto Rico.

H 190. *Hippospongia clathrata* (Carter). Red Sea; Australia; American Coast of North Atlantic.

H 191. *Hippospongia anomala*, Polejaeff. Torres Straits.

H 192. *Hippospongia dura*, Lendenfeld. American Coast of North Atlantic.

193. *Stelospongia onduatjeana*, Lendenfeld (66).

H 194. *Phyllospongia papyracea* (Esper). Tranquebar; Cape of Good Hope; Mozambique; (?) West Coast of Australia; (?) New Zealand; (?) Chatham Islands (66).

H 195. *Phyllospongia holdsworthi* (Bowerbank).

H 196. *Hircinia fusca*, Carter.

197. „ *vallata*, Dendy (2). Port Phillip Heads, Australia (66).

H 198. *Hircinia tuberosa*, n. sp.

H 199. „ *schulzei*, n. sp.

H 200. „ *anomala*, n. sp.

D 201. „ *arundinacea*, Carter (4).

H 202. *Aplysina purpurea*, Carter.

203. „ *fusca*,* Carter (4). Seychelles (16); South-west Coast of Australia (65).

204. *Aplysina spengelii*, Lendenfeld. Jamaica (66).

H 205. *Aplysina herdmani*, n. sp.

Class: CALCAREA.

Order: Homocœla.

H 206. *Leucosolenia coriacea* (Montagu). North-east Atlantic (7).

H 207. *Leucosolenia tenuipilosa*, n. sp.

208. *Leucosolenia* (*Ascaltis*) *darwinii* (Haeckel, 7). Red Sea, Java (7).

Order: Heterocœla.

Family: Sycettidæ.

209. *Sycetta sagittifera*, Haeckel (7).

210. *Sycon raphanus*, Schmidt, *fide* Haeckel (7). Mediterranean, Red Sea (7); South Coast of Australia (7, 80).

Family: Grantiidæ.

211. *Leucandra* (*Leucetta*) *primigenia* (Haeckel, 7). Cosmopolitan.

212. *Leucandra* (*Leucortis*) *pulvinar* (Haeckel, 7).† West Coast of Australia, Red Sea (7).

H 213. *Leucandra donnani*, n. sp.

Family: Amphoriscidæ.

H 214. *Heteropegma nodus-gordii*, Polejaeff. North Australia, Bermudas (77).

215. *Leucilla* (*Leucandra*) *cucumis* (Haeckel, 7). South Coast of Australia (7).

* According to Lendenfeld (66), this species is identical with Hyatt's *Dendrospongia crassa*. If so, the geographical range must be extended to Nassau.

† Carter (5) adopts Haeckel's varietal name *indica* for the Ceylon form.

It appears from the above list that no less than 215 species of sponges (including about seven doubtful ones) have now been recorded from Ceylon waters, which evidently form an extremely rich centre of sponge distribution. Of these 215 species, 146 occur in Professor HERDMAN's collection, of which 77 (or 52·7 *per cent.*) are here described as new. I consider it very satisfactory to have been able to identify as many as 69 previously known species in the collection, especially as I always prefer giving a new specific name to making a doubtful identification; mistakes of the latter kind being often far more difficult to correct than those of the former. Seventy-five out of the total number of species have been recorded from localities beyond the Ceylon area.

As regards the general character of the Ceylon Sponge-Fauna, the most striking feature, next to its richness, is its close relationship with the Sponge-Fauna of Australia and the adjacent islands. In the Report on the "Challenger" Monaxonida we defined an area of distribution (No. IV. on the chart) including Australia and the islands north of Australia as far as the Philippines (inclusive). This we called the Indo-Australian area. No less than 47 out of the 75 species whose range is known to extend beyond the Ceylon region are common to the latter and our Indo-Australian region—the majority of them occurring actually along the Australian Coast.

Of these 47 species, the following are not known to occur except in the Indo-Australian area (in the "Challenger" sense) and westwards as far as Southern India:—*Stœba simplex*, *Myriastra clavosa*, *Pilochrota haeckeli*, *Geodia globostellifera*, *Xenospongia patelliformis*, *Chondrilla australiensis*, *Toxochalina robusta*, *Reniera madrepora*, *Petrosia testudinaria*, *Chalina sub-armigera*, *Siphonochalina communis*, *Esperella parishii*, (?) *Iotrochota purpurea*, *Histoderma fistulatum*, *Leucophlœus fatidus*, *Hippospongia anomala*, *Hircinia vallata*, *Leucilla cucumis*. The following extend (so far as known) westwards not further than the East Coast of Africa or eastwards not further than New Zealand:—*Spirastrella vagabunda* (Aden), *Ceraochalina multiformis* (New Zealand), *Iotrochota baculifera* (Western Indian Ocean), *Clathria frondifera* (Western Indian Ocean, Red Sea), *Acarnus ternatus* (Western Indian Ocean, Tahiti), *Ciocalypta tyleri* (Port Elizabeth), *Psammopemma crassum* (New Zealand), *Phyllospongia papyracea* (Mozambique, Australia ?, New Zealand ?), *Aplysina fusca* (Seychelles), *Leucosolenia darwini* (Red Sea), *Leucandra pulvinar* (Red Sea). Another characteristic Indo-Australian species is *Agelas mauritiana*, hitherto recorded only from Mauritius, Ceylon, Ternate (under the synonym *A. cavernosa*, THIELE), and doubtfully from Tristan da Cunha.

If, on the other hand, we compare the Ceylon Sponge-Fauna with that of the Red Sea, as elaborated chiefly by KELLER (**61**), we notice a considerable difference. KELLER records a total of 88 species from the Red Sea, to which TOPSENT (**91**, **92**) has added 13. Of these, only 14 are known to occur in Ceylon, viz.:—*Spongelia fragilis*, *Euspongia officinalis*, *Cacospongia cavernosa*, *Hippospongia clathrata*, *Clathria frondifera*, *Acanthella flabelliformis*, *Spirastrella vagabunda*, *Placospongia*

melobesioides, *Chondrilla nucula*, *Chondrosia reniformis*, *Leucosolenia darwini*, *Sycon raphanus*, *Leucandra primigenia*, *Leucandra pulvinar*, of which all but five (*Clathria frondifera*, *Acanthella flabelliformis*, *Spirastrella vagabunda*, *Leucosolenia darwini*, and *Leucandra pulvinar*) are so widely distributed that their occurrence is of little significance. A few other Red Sea species, however, are very closely related to Ceylon forms, and it is not improbable that two or three which have been described by KELLER under new names may be identical with Ceylon species, as will appear from the descriptive part of this report. Amongst the Australian Sponge-Fauna also a number of species occur which are very nearly related to Ceylon species, and which have not been taken account of in the above comparison.

A considerable number of sponges have also been described from South and East African waters outside the Red Sea. The "Challenger" made collections in the neighbourhood of the Cape of Good Hope, and KIRKPATRICK (17) has lately described 45 species collected by Dr. GILCHRIST. KELLER (61) also gives a considerable list of species from the East African area, in which, however, while excluding South Africa, he includes the islands of the Western Indian Ocean visited by the "Alert." In spite of these researches only four Ceylon species appear to have been met with along the African Coast itself (outside of the Red Sea), viz. :—*Phyllospongia papyracea* (Mozambique), *Ciocalypta tyleri* (Port Elizabeth), *Tedania digitata* (Mozambique), and *Spongelia fragilis* (Zanzibar), the last two being cosmopolitan. On the other hand, a number of Ceylon species extend, as we have seen, to the islands of the Western Indian Ocean, viz. :—*Hippospongia intestinalis*, *Euspongia irregularis*, *Cacospongia cavernosa*, *Spongelia* (?) *conica*, *Aplysina fusca*, *Tedania digitata*, *Iotrochota baculifera*, *Iotrochota purpurea*, *Clathria frondifera*, *Acarnus ternatus*, *Agelas mauritiana*, *Chondrilla nucula*, *Samus anonymus*, *Leucandra primigenia*. These species have very possibly spread south-westwards from Ceylon along the chain of small islands formed by the Maldives, Seychelles, Chagos, Amirantes, &c.

Even if we make allowance for errors and omissions in identification and doubtful species, and also for the important fact that many more species are known from Australasian waters than from the Red Sea and East African Coast, it appears probable from the above data that the Sponge-Fauna of Ceylon is more closely related to that of the eastern side of the Indian Ocean than it is to that of the western side, and the Ceylon region may be safely included zoo-geographically in our Indo-Australian area. The similarity of the Sponge-Fauna of Ceylon to that of Australia is doubtless to be accounted for by the facilities of distribution and suitable habitats afforded by the broken coast line which extends between the two, for it is probable that, owing to the brief duration of their free-swimming larval condition, shallow-water sponges are rarely able to traverse wide areas of deep ocean.

A few other points concerning the geographical relationship of the Ceylon Sponge-Fauna are, perhaps, worth noticing in this place. The Sponge-Fauna of the Azores

has lately been worked out in great detail by Topsent (48, 62), who records eight species from that area which are also met with in Ceylon, while two of these, *Dotona pulchella* and *Rhabdoploca unispiculifera*, have not yet been met with elsewhere. The genus *Petromica*, also, is only known as yet from the Azores and from Ceylon, the two species being almost identical. Hence, in spite of the great difference in point of distance, the Sponge-Fauna of the Azores appears to resemble that of Ceylon nearly as much as does that of the Red Sea!

There also appears to be a certain amount of affinity between the Sponge-Fauna of Ceylon and that of the American coast of the North Atlantic, especially amongst the horny sponges (*e.g.*, *Hippospongia dura*), though, perhaps, some of the identifications in this group are a little doubtful. The Lithistid genus *Acicultes*, however, has, so far as I am aware, only been recorded from Ceylon and Havannah, and the two species in these two remote localities are closely similar.

Very nearly two-thirds of the total number of species are, however, so far as is known at present, peculiar to the Ceylon area, and, although the number of such species (at present 140) will certainly be largely decreased by future identifications and discoveries in other localities, it will, on the other hand, also be augmented by fresh additions to the list of the Ceylon Sponge-Fauna. My investigations of the Sponge-Fauna of other parts of the world also lead me to believe that while a considerable number of species enjoy a very wide geographical range, the majority have comparatively small areas of distribution. I strongly suspect, however, that a large number of our so-called "species" will ultimately be found to be so closely connected by intermediate forms that it will no longer be possible to separate them sharply from one another. In the meantime they must be distinguished by separate names, and, if the different forms are fully and properly described, it should be easy for future workers to trace out their true relationships.

REFERENCE LIST OF LITERATURE.

(1.) Ridley and Dendy.—'Report on the Monaxonida collected by H.M.S. "Challenger,"' 1887.

(2.) Dendy.—"The Sponge-Fauna of Madras. A Report on a Collection of Sponges obtained in the Neighbourhood of Madras by Edgar Thurston, Esq." 'Ann. and Mag. Nat. Hist.' (5), xx., p. 153. 1887.

(3.) Dendy.—"Report on a Second Collection of Sponges from the Gulf of Manaar." 'Ann. and Mag. Nat. Hist.' (6), iii., p. 73. 1889.

(4.) Carter.—"Report on Specimens dredged up from the Gulf of Manaar and Presented to the Liverpool Free Museum by Captain W. H. Cawne Warren." 'Ann. and Mag. Nat. Hist.' (5), v., p. 437; (5), vi., pp. 35 and 129. 1880.

(5.) Carter.—"Supplementary Report on Specimens dredged up from the Gulf of Manaar," &c. 'Ann. and Mag. Nat. Hist.' (5), vii., p. 361. 1881.

(6.) Esper.—'Fortsetzung der Pflanzenthiere,' Part 2. 1798–1806.

(7.) Haeckel.—'Die Kalkschwämme.' 1872.

(8.) Bowerbank.—"Report on a Collection of Sponges found at Ceylon by E. W. H. Holdsworth, Esq." 'Proc. Zool. Soc. Lond.,' p. 25. 1873.

(9.) Holdsworth.—"Note on the Occurrence of *Xenospongia patelliformis*, Gray, on the Coast of Ceylon." 'Proc. Zool. Soc. Lond.,' p. 32. 1873.

(10.) Dendy.—"Catalogue of Non-calcareous Sponges collected by J. Bracebridge Wilson, Esq., M.A., in the Neighbourhood of Port Phillip Heads." 'Proc. Roy. Soc. Victoria,' vol. vii. (N. S.), p. 232; vol. viii. (N. S.), p. 14; vol. ix. (N. S.), p. 230. 1895–1897.

(11.) Topsent.—"Matériaux pour servir à l'étude de la Faune des Spongiaires de France." 'Mém. Soc. Zool. de France,' tome ix., p. 113. 1896.

(12.) Minchin.—"Sponges." 'Lankester's Treatise on Zoology,' Part ii. 1900.

(13.) Lendenfeld.—"Die Tetractinelliden der Adria." 'Denk. Math.-Nat. Classe K. Akad. Wiss.,' Band lxi. 1894.

(14.) Topsent.—"Étude Monographique des Spongiaires de France." 'Arch. Zool. Expér. et Gén.,' sér. 3, tome ii., p. 259; sér. 3, tome iii., p. 493; sér. 3, tome viii., p. 1. 1894–1900.

(15.) Sollas.—'Report on the Tetractinellida collected by H.M.S. "Challenger."' 1888.

(16.) Ridley.—"Spongiida. Report on the Zoological Collections made in the Indo-Pacific Ocean during the Voyage of H.M.S. 'Alert.'" 'Brit. Mus.' 1884.

(17.) Kirkpatrick.—"Descriptions of South African Sponges." 'Marine Investigations in South Africa, Cape of Good Hope Department of Agriculture.' 1902–1903.

(18.) Carter.—"Descriptions of Sponges from the Neighbourhood of Port Phillip Heads, South Australia." 'Ann. and Mag. Nat. Hist.' (5), xvi., pp. 277, 347; (5), xvii., pp. 40, 112, 431, 502; (5), xviii., pp. 34, 126. 1885–1886.

(19.) Carter.—"Supplement to the Descriptions of Mr. J. Bracebridge Wilson's Australian Sponges." 'Ann. and Mag. Nat. Hist.' (5), xviii., pp. 271, 369, 445. 1886.

(20.) Carter.—"Report on the Marine Sponges, chiefly from King Island, in the Mergui Archipelago, collected for the Trustees of the Indian Museum, Calcutta, by Dr. John Anderson." 'Journ. Linn. Soc.' (Zool.), vol. 21, p. 61, 1887.

(21.) Carter.—"Contributions to our Knowledge of the Spongida.—Pachytragida." 'Ann. and Mag. Nat. Hist.' (5), xi., p. 344. 1883.

(22.) Bowerbank.—"Contributions to a General History of the Spongiadæ," Part IV. 'Proc. Zool. Soc., Lond.,' p. 3. 1873.

(23.) Schmidt.—'Grundzüge einer Spongien-Fauna des atlantischen Gebietes.' 1870.

(24.) Fristedt.—"Bidrag till Kännedomen om de vid sveriges vestra Kust lefvande Spongiæ." 'Kongl. Svenska Vetenskaps-Akademiens Handlingar,' Band 21, No. 6. 1885.

(25.) Topsent.—"Application de la Taxonomie actuelle à une Collection de Spongiaires," &c. 'Mém. Soc. Zool. de France,' tome vii., p. 27. 1894.

(26.) Topsent.—"Introduction a l'étude monographique des Monaxonides de France. Classification des Hadromerina." 'Arch. Zool. Expér. et Gén.,' sér. 3, tome vi., p. 91. 1898.

(27.) Carter.—"Contributions to our Knowledge of the Spongida." 'Ann. and Mag. Nat. Hist.' (5), iii., p. 343. 1879.

(28.) Topsent.—"Sur les Hadromerina de l'Adriatique." 'Bull. Soc. Sci. et Méd. de l'Ouest.' 1er trimestre, p. 117. 1898.

(29.) Wilson.—"The Sponges collected in Porto Rico in 1899," &c. 'U.S. Fish Commission Bulletin,' vol. 2, p. 375. 1900.

(30.) Gray.—"Description of a New Genus of Sponge (*Xenospongia*) from Torres Strait." 'Proc. Zool. Soc., Lond.,' p. 229. 1858.

(31.) Gray.—"Notes on the Arrangement of Sponges, with the Descriptions of some new Genera." 'Proc. Zool. Soc., Lond.,' p. 492. 1867.

(32.) Carter.—"Notes introductory to the Study and Classification of the Spongida." 'Ann. and Mag. Nat. Hist.' (4), xvi., pp. 1, 126, 177. 1875.

(33.) Carter.—"Some Sponges from the West Indies and Acapulco in the Liverpool Free Museum," &c. 'Ann. and Mag. Nat. Hist.' (5), ix., pp. 266, 346. 1882.

(34.) Carter.—"Description of a Siliceous Sand-Sponge found on the South-East Coast of Arabia (*Tethya dactyloidea*)." 'Ann. and Mag. Nat. Hist.' (4), iii., p. 15. 1869.

(35.) Vosmaer and Vernhout.—'The Porifera of the Siboga Expedition. I. The genus *Placospongia*.' 1902.

(36.) Topsent.—"Contribution à l'étude des Clionides." 'Arch. Zool. Expér. et Gén.,' sér. 2, tome v., *bis*. Supt. 1887.

(37.) Topsent.—"Deuxième Contribution à l'étude des Clionides." 'Arch. Zool. Expér. et Gén.,' sér. 2, tome ix., p. 555. 1891.

(38.) Hancock.—"On the Excavating Powers of certain Sponges belonging to the genus *Cliona*; with Descriptions of several new Species, and an Allied Generic Form." 'Ann. and Mag. Nat. Hist.' (2), iii., p. 321. 1849.

(39.) Thiele.—"Studien über pazifische Spongien." 'Zoologica,' Heft 24 und 24[II]. 1898 and 1899.

(40.) Schulze.—"Die Familie der Chondrosidæ." 'Zeit. f. Wiss. Zool.,' Band xxix 1877.

(41.) Carter.—"On two new Species of *Gummineæ*, with Special and General Observations." 'Ann. and Mag. Nat. Hist.' (4), xii., p. 17. 1873.

(42.) Lendenfeld.—"A Monograph of the Australian Sponges." 'Proc. Linn. Soc. N.S.W.,' vol. ix., pp. 121, 310, 1083; vol. x., pp. 3, 282, 475, 481, 845. 1884–1885.

(43.) Carter.—"Additional Information on the Structure of *Tethya dactyloidea*, Cart." 'Ann. and Mag. Nat. Hist.' (4), ix., p. 82. 1872.

(44.) Schmidt.—"Die Spongien des Meerbusen von Mexico." 1879–1880.

(45.) Topsent.—"Éponges nouvelles des Açores." 'Mém. Soc. Zool. de France,' tome xi., p. 225. 1898.

(46.) Hanitsch.—"Revision of the Generic Nomenclature and Classification in Bowerbank's 'British Spongiadæ.'" 'Trans. Liverpool Biol. Soc.,' vol. viii. 1894.

(47.) Schmidt.—"Die Spongien des Adriatischen Meeres." 1862.

(48.) Topsent.—"Contribution à l'étude des Spongiaires de l'Atlantique Nord." 'Résultats des Campagnes Scientifiques du Prince de Monaco,' fascicule ii. 1892.

(49.) Bowerbank.—"Contributions to a General History of the Spongiadæ." 'Proc. Zool. Soc. Lond.,' p. 281. 1875.

(50.) Schmidt.—"Die Spongien der Küste von Algier." 1868.

(51.) Lendenfeld.—"Die Chalineen des Australischen Gebietes." 'Zoolog. Jahrbüch.,' Band 2, p. 723. 1887.

(52.) Bowerbank.—"Monograph of British Spongiadæ." 'Ray Society.' 1864–1882.

(53.) Higgin.—"Description of some Sponges obtained during a Cruise of the Steam-yacht 'Argo' in the Carribean and neighbouring Seas." 'Ann. and Mag. Nat. Hist.' (4), xix., p. 291. 1877.

(54.) Carter.—"Contributions to our Knowledge of the Spongida." 'Ann. and Mag. Nat. Hist.' (5), xii., p. 308. 1883.

(55.) Norman.—"On the Genus *Haliphysema*, with Descriptions of several Forms apparently allied to it." 'Ann. and Mag. Nat. Hist.' (5), i., p. 264. 1878.

(56.) Carter.—"Contributions to our Knowledge of the Spongida." 'Ann. and Mag. Nat. Hist.' (5), iii., p. 284. 1879.

(57.) Carter.—"Descriptions and Figures of Deep-sea Sponges and their Spicules, from the Atlantic Ocean," &c. 'Ann. and Mag. Nat. Hist.' (4), xviii., pp. 226, 307, 388, 458. 1876.

(58.) Ehlers.—'Die Esper'schen Spongien,' &c. Erlangen. 1870.

(59.) Topsent.—"Une Réforme dans la Classification des *Halichondrina*." 'Mém. Soc. Zool. de France,' tome vii., p. 5. 1894.

(60.) Ridley.—"On the Genus *Plocamia*, Schmidt," &c. 'Journ. Linn. Soc. (Zool.),' vol. 15, p. 476. 1881.

(61.) Keller.—"Die Spongienfauna des Rothen Meeres." 'Zeit. f. Wiss. Zool.,' Band 48, p. 311. 1889; Band 52, p. 294. 1891.

(62.) Topsent.—"Spongiaires des Açores." 'Résultats des Campagnes Scientifiques du Prince de Monaco,' fascicule xxv. 1904.

(63.) Dendy.—"The New System of Chalininæ, with some brief Observations upon Zoological Nomenclature." 'Ann. and Mag. Nat. Hist.' (5), xx., p. 326. 1887.

(64.) Topsent.—"Spongiaires." 'Résultats du Voyage du S.Y. "Belgica" en 1897–1898–1899.' Anvers, 1901.

(65.) Carter.—"Contributions to our Knowledge of the Spongida. Order II.: Ceratina." 'Ann. and Mag. Nat. Hist.' (5), viii 1881.

(66.) Lendenfeld.—"A Monograph of the Horny Sponges." 'Roy. Soc.' 1889.

(67.) Müller.—"Ueber *Darwinella aurea*, einen Schwamm mit sternförmigen Hornnadeln." 'Archiv. f. mikr. Anat.' Band i. 1865.

(68.) Carter.—"Description, with Illustrations, of a New Species of *Aplysina* from the North-West Coast of Spain." 'Ann. and Mag. Nat. Hist.' (4), x., 1872.

(69.) Hyatt.—"Revision of the North American Poriferæ." 'Mem. Boston Soc. Nat. Hist.,' vol. ii., 1875 and 1877.

(70.) Schulze.—"Die Familie der Aplysinidæ." 'Zeit. f. Wiss. Zool.,' Band xxx. 1878.

(71.) Schulze.—"Die Gattung Spongelia." 'Zeit. f. Wiss. Zool.,' Band xxxii. 1879.

(72.) Schulze.—"Die Familie der Spongidæ." 'Zeit. f. Wiss. Zool.,' Band xxxii. 1879.

(73.) Lamarck.—"Sur les Polypiers empâtés." 'Ann. Mus. Nat. Hist.,' Paris, vol. 20. 1813.

(74.) Poléjaeff.—'Report on the Keratosa collected by H.M.S. "Challenger."' 1884.

(75.) Dendy.—"Observations on the West Indian Chalinine Sponges, with Descriptions of New Species." 'Trans. Zool. Soc. Lond.,' vol. xii., part 10. 1890.

(76.) Dendy.—"The Organization and Classification of the Calcarea Homocœla, with Descriptions of the Victorian Species." 'Trans. Royal Soc. Victoria,' vol. iii., Part 1. 1891.

(77.) Poléjaeff.—'Report on the Calcarea collected by H.M.S. "Challenger."' 1883.

(78.) Dendy.—"Observations on the Structure and Classification of the Calcarea Heterocœla." 'Quart. Journ. Micro. Sci.,' vol. 35 (N. S.). 1893.

(79.) Lendenfeld.—'Descriptive Catalogue of the Sponges in the Australian Museum, Sydney.' London, 1888.

(80.) Dendy.—"Synopsis of the Australian Calcarea Heterocœla," &c. 'Proc. Roy. Soc. Victoria,' vol. 5. 1893.

(81.) Johnston.—'British Sponges and Lithophytes.' 1842.

(82.) Carter.—"Zoology of Kerguelen Island—Spongiidæ." 'Phil. Trans. Roy. Soc.,' vol. 168. 1879.

(83.) Topsent.—"Spongiaires de la Baie d'Amboine." 'Revue Suisse de Zoologie et Annales du Musée d'Histoire Naturelle de Genève,' tome iv., fascicule 3. 1897.

(84.) Topsent.—"Diagnoses d'Eponges nouvelles de la Méditerranée et plus particulièrement de Banyuls." 'Arch. de Zool. Exp. et Gén.,' tome x. 1892.

(85.) Lambe.—"Sponges from the Western Coast of North America." 'Transactions of the Royal Society of Canada,' Section iv. 1894.

(86.) Lindgren.—"Beitrag zur Kenntniss der Spongien-Fauna des Malayischen Archipels und der Chinesischen Meere." 'Zoologische Jahrbücher,' Band xi. 1898.

(87.) Thiele.—"Kieselschwämme von Ternate, I., II." 'Abhandlungen der Senckenbergischen naturforschenden Gesellschaft,' Band xxv. 1900–1903.

(88.) Lundbeck.—"Porifera.—Part 1." 'Danish Ingolf-Expedition,' vol. vi. 1902.

(89.) Topsent.—"Quelques Spongiaires du Banc de Campèche et de la Pointe-à-Pitre." 'Mém. Soc. Zool. de France,' tome 2. 1889.

(90.) Thurston.—"Rámésvaram Island and Fauna of the Gulf of Manaar." 'Madras Government Museum,' Bulletin No. 3. 1895.

(91.) Topsent.—"Éponges de la Mer Rouge." 'Mém. Soc. Zool. de France,' tome v. 1892.

(92.) Topsent.—"Note sur quelques Éponges du Golfe de Tadjoura." 'Bull. Soc. Zool. de France,' tome xviii. 1893.

DESCRIPTION OF PLATES.

PLATE I.

Fig. 1. *Hexadella indica;* vertical section of R.N. 46, combined drawing.
Ch., inhalant chones; *Ch.L.*, choanosomal lamella; *Cr.*, sub-cortical crypts; *Ect.*, ectosome; *F.C.*, flagellate chambers; *L.E.C.*, larger exhalant canal; *Mem.*, roofing membrane of inhalant chones; *P.E.C.*, primary exhalant canals; *P.I.C.*, primary inhalant canals; *Sy.A.*, symbiotic algæ.

„ 2. *Hexadella indica;* small portion of vertical section through choanosomal lamella, more highly magnified (Zeiss F., Oc. 2).
C.T.C., connective-tissue cells; *Ep.*, epithelium lining primary inhalant and exhalant canals; *I.Ca.*, inhalant canalicuti. (Other lettering as before.)

„ 3. *Hexadella indica;* tangential section of the ectosome, seen from below, showing the inhalant chones, &c. × 52. (Lettering as before.)

„ 4. *Plakinastrella intermedia;* R.N. 224. × 2.—*o.*, vent.

„ 5. *Ecionema carteri;* R.N. 175. × 2.—*o.*, vents; *p.s.*, pore-sieves.

„ 6. *Tetilla poculifera;* R.N. 230. × 3. Upper part in section.
Cl., cloaca; *L.E.C.*, larger exhalant canals.

„ 7. *Tetilla limicola;* R.N. 70. Nat. size.
o., vents; *r.t.*, root tuft of spicules matted together with mud.

„ 8. *Taprobane herdmani;* R.N. 40. Slightly reduced; from a photograph.

PLATE II.

Fig. 1. *Dercitopsis ceylonica;* R.N. 139. Spicules. All × 230.
a.–b., calthrops and triods; *i.–o.*, oxea.

„ 2. *Plakinastrella intermedia;* R.N. 224. Spicules.
a.–d., dichotriænes, × 52; *e.–n.*, oxea, × 52; *o.–p.*, microxea, × 230; *q.–r.*, oxyasters, × 230.

„ 3. *Plakinastrella schulzei;* R.N. 149. Spicules.
a.–d., triænes, × 52; *e.–q.*, oxea, × 52; *r.–t.*, microxea, × 230; *u.–x.*, oxyasters, × 230.

„ 4. *Pilochrota haeckeli?* R.N. 127. Spicules. All × 52.
a., orthotriæne; *b.*, monstrous form of orthotriæne; *c.*, anatriæne; *d.*, *e.*, monstrous forms of anatriæne.

„ 5. *Pilochrota hornelli;* R.N. 176. Spicules.
a., *b.*, orthotriænes, × 52; *c.*, *d.*, cladomes of orthotriænes seen from above, × 52; *e.*, anatriæne, × 52; *f.*, oxeote, × 52; *g.–i.*, chiasters, × 230.

„ 6. *Stelletta herdmani;* R.N. 137. Spicules.
a.–c., triænes, × 52; *d.*, oxeote, × 52; *e.–h.*, chiasters, × 230; *i.–k.*, oxyasters, × 230.

„ 7. *Stelletta vestigium;* R.N. 200A. Spicules. All × 230.
a.–d., reduced triænes; *e.*, oxeote; *f.*, *g.*, spherasters; *h.*, *i.*, oxyasters.

PLATE III.

Fig. 1. *Ecionema carteri;* R.N. 175. Spicules.
a., *b.*, plagiotriænes, × 52; *c.*, plagiotriæne (protriæne ?), × 52; *c'.*, cladome of *c.*, × 230; *d.*, anatriæne, × 52; *d'.*, cladome of *d.*, × 230; *e.*, oxeote, × 52; *f.*, microstrongyla, × 230; *g.*, chiasters, × 230.

„ 2. *Ecionema laviniensis;* R.N. 265. Spicules.
a., dichotriæne, × 52; *b.*, cladome of dichotriæne, seen from above., × 52; *c.*, anatriæne, × 52; *c'.*, cladome of *c.*, × 230; *d.*, oxeote, × 52; *e.*, chiasters, × 230; *f.*, oxyasters (?), × 230; *g.*, microstrongyla, × 230; *h.*, microxeote (?), × 230.

„ 3. *Geodia peruncinata;* R.N. 223. Arrangement of the skeleton as seen in vertical section, × 52.
a., *a'.*, dichotriænes; *b.*, somal anatriæne; *c.*, reduced cortical anatriænes; *d.*, oxea; *e.*, sterrasters in cortical layer; *e'.*, young sterrasters in choanosome; *f.*, large spherasters.

„ 3A. *Geodia peruncinata:* R.N. 223. Reduced anatriæne, × 230.

„ 3B. *Geodia peruncinata;* R.N. 223. Microscleres. All × 230.
a., small spheraster (chiaster ?); *b.*, large spheraster; *c.*, outline of sterraster, to show relative size.

„ 4. *Tetilla poculifera;* R.N. 230. Spicules.
a., *b.*, plagiotriænes, × 52; *c.*, anatriæne, × 52; *c'.*, cladome of *c.*, × 230; *d.*, protriæne, × 52; *d'.*, cladome of *d.*, × 230; *e.*, oxeote, × 52; *f.*, *g.*, microxea, × 230; *h.*, sigmata, × 230.

„ 5. *Tetilla anomala;* R.N. 153. Spicules.
a., part of protriæne, × 230; *b.*, anatriæne, × 52; *b'.*, cladome of *b.*, × 230; *c.*, oxeote, × 52; *d.*, sigmata, × 230.

„ 6. *Tetilla limicola;* R.N. 70. Spicules from body. All × 230.
a., anatriæne, cladome and part of shaft; *b.*, protriæne, cladome and part of shaft; *c.*, oxeote; *d.*, sigmata.

„ 7. *Paratetilla cineriformis;* R.N. 214. Spicules.
a.–d., modified triænes, × 230. (The central canal of these spicules is indicated by the dark shading.) *e.*, protriæne, × 52; *e'.*, cladome of *e.*, × 230; *f.*, anatriæne, × 52; *f'.*, cladome of *f.*, × 230; *g.*, oxeote, × 52; *g'*, *g''*, ends of *g.*, × 230, showing their irregularity in shape and the central canal; *h.*, sigmata, × 230.

PLATE IV.

Fig. 1. *Craniella elegans;* R.N. 193. Vertical section, × 28.
a., anatriænes; *b.*, protriænes; *c.o.*, cortical oxea; *d.m.*, dermal membrane; *emb.*, embryo; *f.c.*, fibrous layer of cortex; *i.c.c.*, intracortical (sub-dermal) cavities; *r.b.*, radiating spicule-bundles of main skeleton.

„ 2. *Taprobane herdmani;* R.N. 40. Desmas. All × 230.
a., *b.*, young monocrepid desmas; *c.*, adult desma.

„ 3. *Aciculites orientalis;* R.N, 150. Spicules. All × 230.
a., *b.*, *c.*, young monocrepid desmas; *d.*, adult desma; *e.*, *f.*, strongyla.

„ 4. *Discodermia emarginata;* R.N. 234. Spicules. All × 230.
a.–d., stages in the development of the tetracrepid desma; *e.*, end of branch of an adult desma; *f.*, very young discotriæne, side view, *s*, shaft; *g.*, adult discotriæne, surface view *s*, shaft; *h.*, microrhabds.

„ 5. *Petromica massalis;* R.N. 257. Spicules. All × 52.
a., monocrepid desma; *b.–d.*, monaxonid megascleres, showing variation in form.

PLATE V.

Fig. 1. *Stelba extensa*; R.N. 167. Spicules.
a.–d., dichotriænes (*sh.* = shaft), × 230; *e.*, *e.*, microxea, × 530.

„ 2. *Coppatias reptans*; R.N. 242. Spicules.
a.–c., oxea, × 52; *d.*, chiasters, × 530.

„ 3. *Asteropus haeckeli*; R.N. 219. Spicules.
a., oxeote, × 52; *b.*, oxyaster, × 530; *c.*, *d.*, sanidasters, × 530.

„ 4. *Cryptotethya agglutinans*; R.N. 62. Half the specimen, after division in the median plane. Natural size.
ch., choanosome; *ect.*, ectosome; *f.b.*, foreign bodies adhering to the surface; *f.l.*, inner fibrous layer of ectosome; *f.p.*, finger-shaped process of ectosome; *x.*, process of ectosome flattened at the end and containing longitudinal canals.

„ 5. *Cryptotethya agglutinans*; R.N. 62. Spicules.
a., *b.*, oxea, × 52; *c.*, chiasters from ectosome, × 230.

„ 6. *Hymedesmia curvistellifera*; R.N. 320. Spicules.
a., tylostyle, × 230; *b.*, *c.*, *d.*, asters, × 530.

„ 7. *Spirastrella tentorioides*; R.N. 239. Spicules.
a., *b.*, tylostyli, × 230; *c.–g.*, spirasters, × 530.

„ 8. *Negombo tenuistellata*; R.N. 362. Spicules.
a.–c., styli, × 230; *d.*, sanidasters, × 530.

„ 9. *Cliona margaritiferæ*; R.N. 261. Spicules.
a., tylostyle, × 230; *b.–d.*, spirasters, × 530; *e.*, *g.*, intermediate microscleres, × 530; *h.*, *k.*, spined microxea, × 530.

„ 10. *Suberites cruciatus*; R.N. 315. Spicules.
a., *b.*, tylostyles, × 230; *c.–g.*, heads of tylostyles, showing variations, × 530.

PLATE VI.

Xenospongia patelliformis, R.N. 375.

Fig. 1. Entire specimen (young), upper surface, slightly diagrammatic, × 2.
a., projection caused by foreign body; *m.f.*, marginal fringe of spicules; *m.p.g.*, marginal pore-grooves; *o.*, vents; *r.p.g.*, radiating pore-grooves, feebly developed.

„ 2. Radial vertical section, showing the ectosome (cortex), the sand-free portion of the choanosome, and part only of the sandy layer of the choanosome; slightly diagrammatic.
cort., cortex; *d.b.*, dermal brushes of styli; *ex.c.*, exhalant canal; *f.b.*, bands of fibrous tissue running inwards from the cortex to the sandy layer; *m.f.*, marginal fringe of styli; *m.p.g.*, marginal pore-grooves, showing inhalant pores and canals; *o.*, vent.; *s.g.*, sand grains.

„ 3. Small portion of similar section, including the entire thickness of the cortex and a small portion of the choanosome, × 230.
cort., cortex; *f.b.*, band of fibrous tissue running inwards from the cortex; *fl.c.*, flagellate chambers; *scl.*, scleroblasts, containing small asters.

„ 4. Megascleres.
a., *b.*, styli, × 52; *b'.*, *b''.*, basal and apical portions of *b*, × 230.

„ 5. Larger microscleres, × 230.
a.–c., various forms of aster; *d.*, a much-branched aster from the interior of the sponge.

„ 6. Smaller microscleres, × 530.
a.–m., various forms of aster.

PLATE VII. (All the figures from photographs.)

Fig. 1. *Siphonochalina communis*, var. *tenuispiculata*; R.N. 117, reduced to nearly $\frac{1}{2}$.
„ 2. *Ceraochalina multiformis*, var. *manaarensis*; R.N. 98, × about $\frac{4}{7}$.
„ 3. „ *ceylonica*; R.N. 5, × about $\frac{1}{2}$.
„ 4. *Pachychalina spinilamella*; R.N. 94, × about $\frac{4}{7}$.
„ 5. *Gelliodes carnosa*; R.N. 69, × about $\frac{1}{2}$.
„ 6. *Collocalypta digitata*; R.N. 74A, nearly natural size.

PLATE VIII. (All the figures from photographs.)

Fig. 1. *Plocamia manaarensis*; R.N. 107, × about $\frac{2}{3}$.
„ 2. *Clathria spiculosa*, var. *tessellata*; R.N. 92, × about $\frac{2}{3}$.
„ 3. *Phakellia ceylonensis*; R.N. 34, × $\frac{13}{18}$.
„ 4. *Acarnus ternatus*; R.N. 105, × about $\frac{1}{2}$.
„ 5. *Raspailia fruticosa*, var. *tenuiramosa*; R.N. 100, × about $\frac{5}{7}$.
„ 6. *Acanthella carteri*; R.N. 36, × about $\frac{2}{3}$.

PLATE IX.

Fig. 1. *Strongylophora durissima*; R.N. 244. Part of dermal skeleton, × 230.
m., microxea; *s.*, strongyla.
„ 2. *Toxochalina robusta*, var. *ridleyi*; R.N. 109. Part of main skeleton in vertical section, × 230.
o., oxea; *t.*, toxa.
„ 3. *Gelliodes petrosioides*; R.N. 146. Spicules, × 230.—*a.*, *b.*, *c.*, megascleres; *d.*, sigmata.
„ 4. *Desmacella tubulata*; R.N. 324. Spicules, × 230.
a., *b.*, styli; *c.*, sigmata; *d.*, trichodragmata; *e.*, isolated microxeote.
„ 5. *Acanthorifer ceylonensis*; R.N. 247. Spicules, × 230.
a., smooth oxeote; *b.*, stylus; *c.*, spined oxeote; *d.*, trichodragmata.
„ 6. *Gelliodes inerustans*; R.N. 112. Part of dermal skeleton, × 230.—*o.*, oxea; *s.*, sigmata.
„ 7. *Gellius angulatus*, var. *canaliculata*; R.N. 140. Spicules, × 230.
a., oxeote; *b.*, sigmata; *c.*, toxiform.
„ 8. *Reniera zoologica*; R.N. 262. Oxea, × 360.
„ 9. *Petrosia densissima*; R.N. 138A. Oxea, × 360.
„ 10. *Reniera pigmentifera*; R.N. 290. Spicules, × 360.—*a.*, oxeote; *b.*, strongylote; *c.*, *d.*, stylote.

PLATE X.

Fig. 1. *Pachychalina subcylindrica*; R.N. 292. Part of dermal skeleton, × 52.
„ 2. „ R.N. 292. Oxea, × 360.
„ 3. *Chalina clathrata*; R.N. 102. Part of skeleton in tangential section near the surface, × 360.
„ 4. *Ceraochalina retiarmata*; R.N. 342. Oxea, × 360.
„ 5. *Chalina subarmigera*; R.N. 116, about half natural size (dry specimen, from photograph).
„ 6. *Ceraochalina ceylonica*; R.N. 50. Oxea, × 360.
„ 7. *Pachychalina brevispiculifera*; R.N. 110. Oxea, × 360.
„ 8. *Ceraochalina reticutis*; R.N. 58. Part of dermal skeleton, × 360.
o., well developed oxea, lying for the most part outside the horny fibre; *v.s.*, vestigial oxea, lying in the horny fibre.
9. *Chalina obtusispiculifera*; R.N. 370. Part of surface skeleton, × 360.
10. *Trachyopsis halichondrioides*; R.N. 147. Oxea, × 230.

PLATE XI.

Fig. 1. *Paresperella bidentata*; R.N. 263A. Spicules, ×530.
a., tylostyle with bidentate apex; *b.*, *b.*, serrated sigmata; *c.*, anisochela, side view; *d.*, anisochela, front view.

„ 2. *Paresperella serratohamata*; R.N. 220C. Spicules, ×530.
a., tylostyle with mucronate apex; *b.*, *b.*, serrated sigmata.

„ 3. *Paresperella*, sp. Gigantic serrated sigma, ×230.

„ 4. *Echinodictyum clathratum*; R.N. 325. Spicules, ×230.
a., large stylus; *b.*, slender stylus; *c.*, *d.*, oxea; *e.*, *f.*, spined tylostyli.

„ 5. *Myrilla tenuissima*; R.N. 234A. Spicules, ×530.
a., polytylote; *b.*, spined tylostyle; *c.*, isochela, front view; *d.*, isochela, side view.

„ 6. *Esperella crassissima*; R.N. 240. Spicules, ×230.
a., tylostyle; *b.*, anisochela, side view; *c.*, anisochela, front view; *d.*, sigmata; *e.*, trichodragmata.

„ 7. *Raspailia hornelli*; R.N. 59. Spicules, ×230.—*a.*, large stylus; *b.*, *c.*, small surface styli; *d.*, *e.*, *f.*, *g.*, oxea; *h.*, *h.*, strongyla; *k.*, *l.*, *m.*, spined subtylostyli.

„ 8. *Histoderma vesiculatum*; R.N. 212A. Part of dermal skeleton, ×230.
o., *o.*, *o.*, oxea; *s.*, *s.*, strongyla.

„ 9. *Histoderma vesiculatum*; R.N., 212A. Isochelæ, ×460.—*a.*, side view; *b.*, front view.

PLATE XII.

Fig. 1. *Spongosorites topsenti*; R.N. 152. Spicules, ×52.
a.–k., various forms of large megascleres; *l.*, two small oxea; *m.*, intermediate form.

„ 2. *Spongosorites* (?) *lamellata*; R.N. 236.
a. b. c., styli, ×52; *d.*, two small oxea, ×52; *e.*, small oxeote, ×230.

„ 3. *Spongosorites* (?) *lapidiformis*; R.N. 145. Spicules, ×79.

„ 4. *Hymeniacidon petrosioides*; R.N. 151. Spicules, ×230.

„ 5. *Thrinacophora durissima*; R.N. 355. Spicules, ×230.
a., stylote; *b.*, oxeote; *c.*, *d.*, trichodragmata.

„ 6. *Thrinacophora agariciformis*; R.N. 160A. Spicules, ×230.
a., *b.*, *c.*, styli; *d.*, *e.*, oxea; *f.*, trichodragmata.

„ 7. *Axinella halichondrioides*; R.N. 75. Spicules, ×230.—*a.*, oxeote; *b.*, *c.*, stylote.

„ 8. *Axinella manus*; R.N. 53. Spicules, ×230.

„ 9. *Agelas ceylonica*; R.N. 312. Spicules, ×230.

„ 10. *Rhabderemia indica*; R.N. 341.
a., *b.*, *c.*, rhabdostyli, ×230; *d.*, minute spined styli, ×530; *e.*, contort sigmata, ×530.

PLATE XIII.

Fig. 1. *Collocalypta digitata*; R.N. 74. Oxeote spicule from body, ×230.

„ 2. „ R.N. 74. Part of transverse section of a digitiform process, ×52.
ax., axial skeleton of spicules and spongin; *d.p.*, position of dermal pores; *ect.*, collenchymatous ectosomal tissue; *l.c.*, longitudinal canals; *sept.*, septum between two longitudinal canals.

„ 3. *Phakellia symmetrica*; R.N. 159. Spicules, ×230.—*a*, *b*, short styli; *c*, oxeote; *d*, long stylus.

„ 4. *Axinella tenuidigitata*; R.N. 202A. Styli, ×79.

„ 5. *Phakellia ceylonensis*; R.N. 34. Spicules, ×230.—*a*, *b*, styli; *c*, *d*, *e*, oxea.

„ 6. *Phakellia crassistylifera*; R.N. 256. Three spicules, ×230.

Fig. 7. *Auletta elongata*: R.N. 73. Spicules, × 79.—*a*, *b*, styli; *c*, oxeote; *d*, *e*, *f*, strongyla.

„ 8. *Leucosolenia coriacea*, var. *ceylonensis*: R.N. 377. Spicules, × 360.
a, *b*, *c*, triradiates; *d*, portion of oxeote.

„ 9. *Leucosolenia tenuipilosa*: R.N. 158. Spicules, × 360.—*a*, triradiate; *b*, quadriradiate, facial view; *c*, quadriradiate, side view, showing apical ray; *d*, part of oxeote.

„ 10. *Leucandra donnani*: R.N. 186. Spicules, × 79.
a, *b*, parenchymal triradiates; *c*, *d*, dermal triradiates; *e*, *f*, gastral quadriradiates; *g*, oxeote.

PLATE XIV. (All the figures from photographs.)

Fig. 1. *Hircinia fusca*: part of R.N. 48, × $\frac{2}{3}$.

„ 2. *Hippospongia clathrata*: R.N. 24, × $\frac{11}{16}$.

„ 3. *Euspongia officinalis*, var. *ceylonensis*: R.N. 37A, × about $\frac{2}{3}$.

„ 4. *Spongelia elastica*, var. *crassa*: R.N. 35, × about $\frac{3}{4}$.

„ 5. *Hircinia anomala*: R.N. 13, × about $\frac{2}{3}$.

„ 6. *Phyllospongia papyracea*, var.; R.N. 104A, × $\frac{14}{25}$.

„ 7. *Megalopastas nigra*: R.N. 71, × $\frac{5}{8}$.

PLATE XV.

Fig. 1. *Darwinella simplex*: R.N. 302.—End of primary fibre, enclosed in conulus, × 230.

„ 2. *Darwinella simplex*: R.N. 302.—Portion of primary fibre, in which the pith (*p.*) is partially replaced by fungal (?) filaments (*f.*), × 230.

„ 3. *Megalopastas pulvillus*: R.N. 191.—Portion of skeleton as seen in vertical section, showing the old apices of primary fibres (*ap.*) enclosed in younger portions of the fibres, × 79.

„ 4. Diagrammatic sketch of the general anatomy of the genus *Megalopastas*, based upon vertical sections of a specimen of *M. elegans* (= *Dendrilla elegans*, LENDENFELD) from Port Phillip Heads, Australia, × 52.—*c.*, surface conuli; *e.c.*, embryo capsules; *em.*, embryo; *ex.c.*, exhalant canals; *f.c.*, flagellate chambers; *i.c.*, inhalant canal; *p.f.*, primary skeleton fibres; *p.s.*, pore-sieves; *s.c.*, subdermal cavities; *s.f.*, secondary skeleton fibres.

„ 5. *Megalopastas nigra*: R.N. 161A.—Part of skeleton, as seen in vertical section, including the dermal skeleton (*d.s.*) as well as the main skeleton, × 52.

„ 6. *Megalopastas nigra*: R.N. 161A.—Dermal skeleton, × 52.

„ 7. *Megalopastas nigra*: R.N. 161A.
End of primary fibre, showing mode of growth and origin of secondary fibres, × 230.

„ 8. *Megalopastas nigra*: R.N. 161A.
Origin of new primary fibre from a secondary fibre of the dermal skeleton, vertical section, × 230.—*c.*, surface conulus; *d.s.*, dermal skeleton; *p.f.*, new primary fibre.

PLATE XVI.

Fig. 1. *Hircinia anomala*: R.N. 82.—Part of skeleton, as seen in transverse section, × 52.

„ 2. *Hircinia tuberosa*: R.N. 88A.—Part of skeleton, as seen in vertical section through the surface, including the sand-cortex (*s.c.*), × 52.

„ 3. *Hircinia schulzei*: R.N. 277.—Part of skeleton, as seen in vertical longitudinal section, × 52.

„ 4. *Aplysina herdmani*: R.N. 340.—Part of skeleton, as seen in vertical section of body, × 79.

„ 5. *Euspongia officinalis*, var. *ceylonensis*: R.N. 101.—Part of skeleton, as seen in vertical section, × 79.

FIG. 1

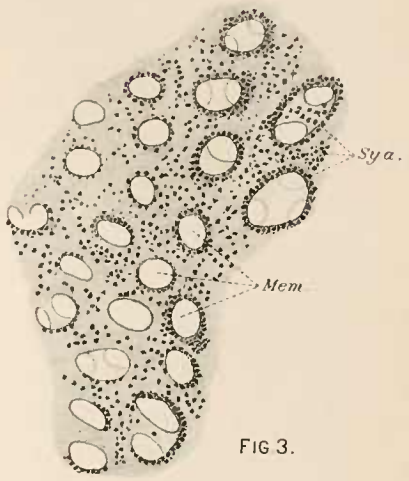


FIG. 3.

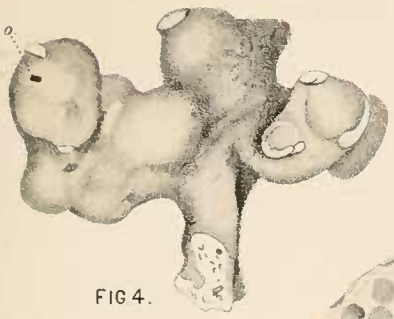


FIG. 4.

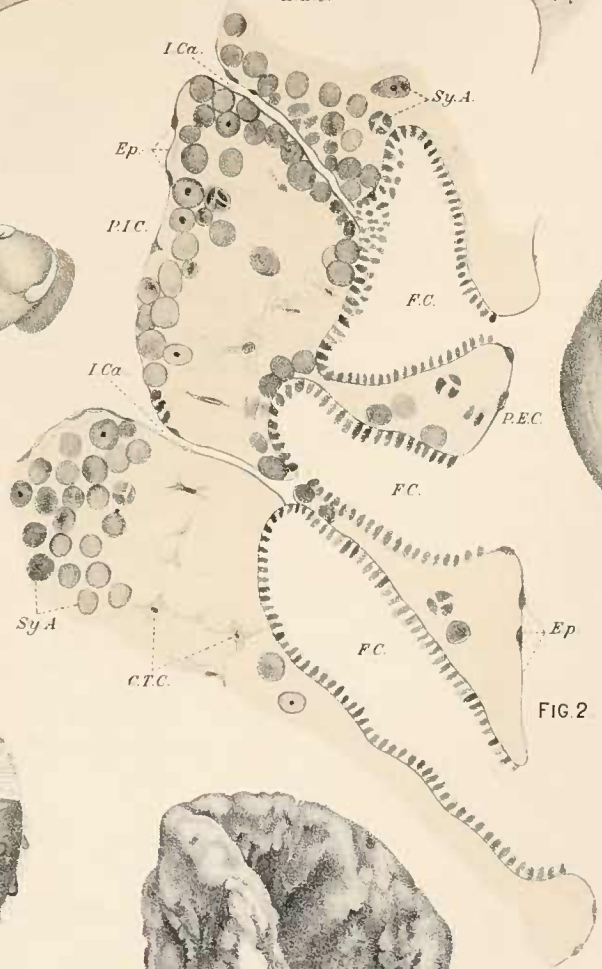


FIG. 2.

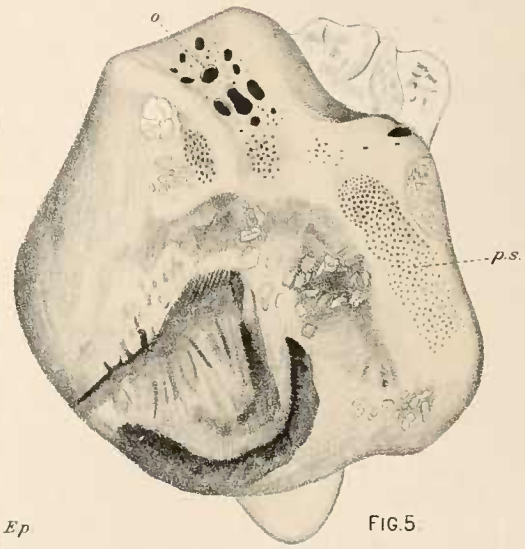


FIG. 5.

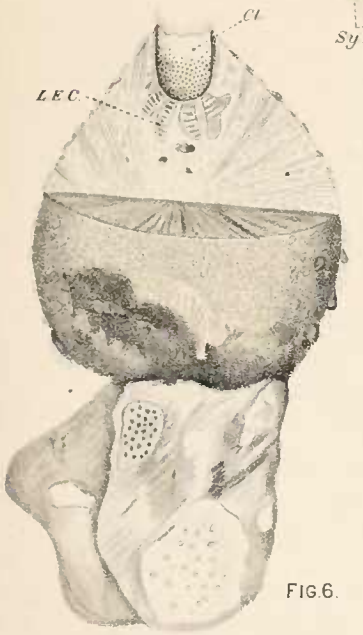


FIG. 6.

FIG. 8.

FIG. 7.

A. Dendy del. Figs 1-7

E. Wilson, Lith. Cambridge

FIGS. 1—3, HEXADELLA INDICA, n.sp.; FIG. 4, PLAKINASTRELLA INTERMEDIA, n.sp.;
FIG. 5, ECIONEMA CARTERI, n.sp.; FIG. 6, TETILLA POCULIFERA, n.sp.; FIG. 7, TETILLA LIMICOLA, n.sp.;
FIG. 8, TAPROBANE HERDMANI, n.sp.

FIG. 2.

FIG 6.

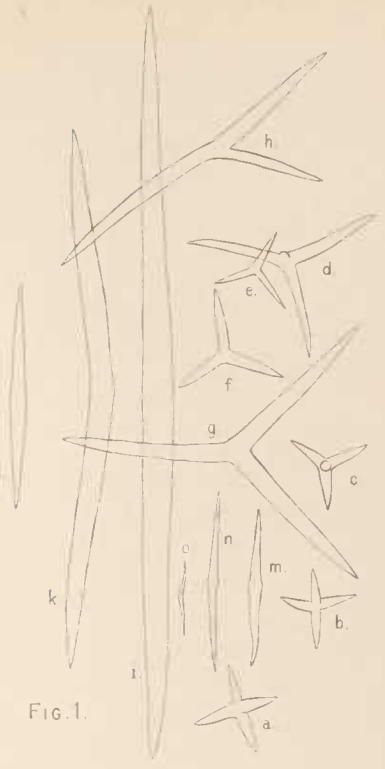


FIG. 1.

FIG. 3.

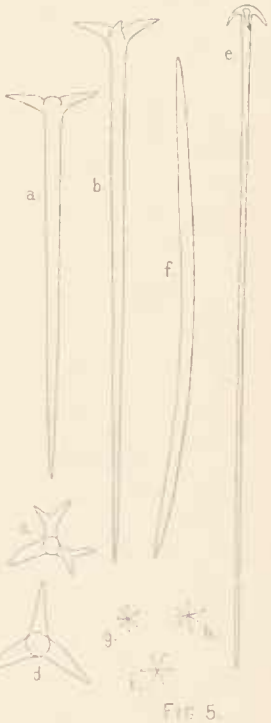


FIG. 5.

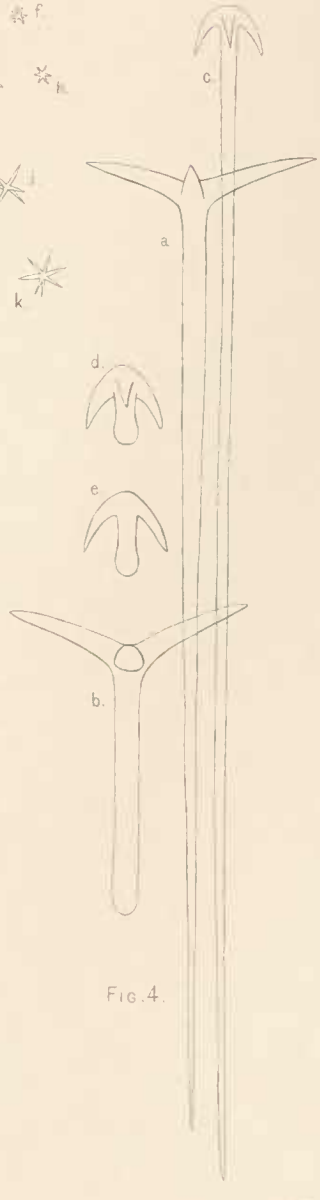


FIG. 4.

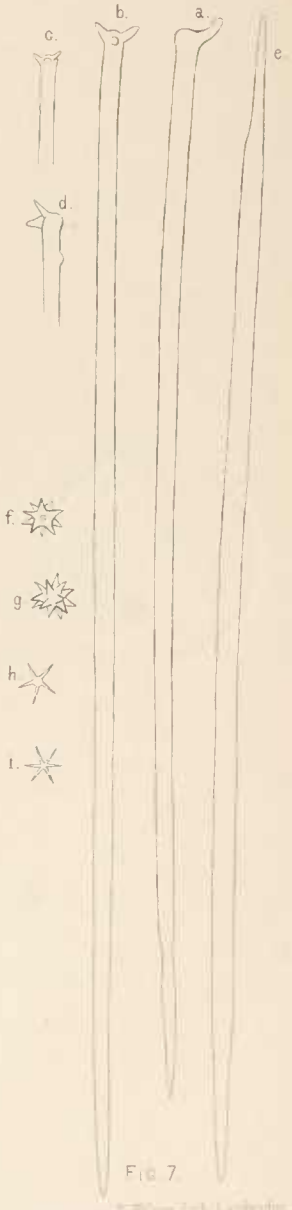


FIG. 7.

FIG. 1, DERCITOPSIS CEYLONICA, n.sp.; FIG. 2, PLAKINASTRELLA INTERMEDIA, n.sp.; FIG. 3, PLAKINASTRELLA SCHULZEI, n.sp.; FIG. 4, PILOCHROTA HAECKELI, Sollas; FIG. 5, PILOCHROTA HORNELLI, n.sp.; FIG. 6, STELLETTA HERDMANI, n.sp.; FIG. 7, STELLETTA VESTIGIUM, n.sp.

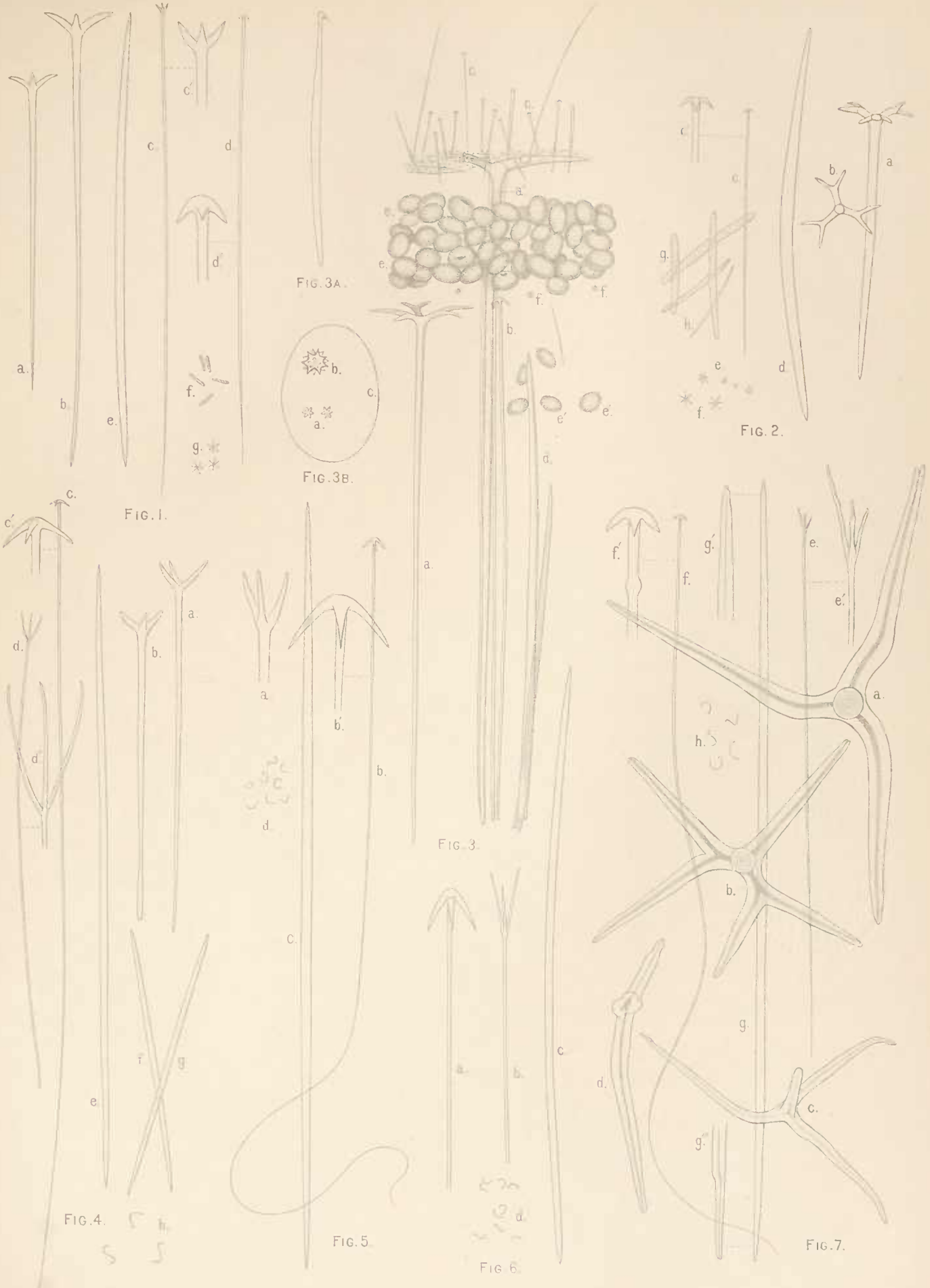
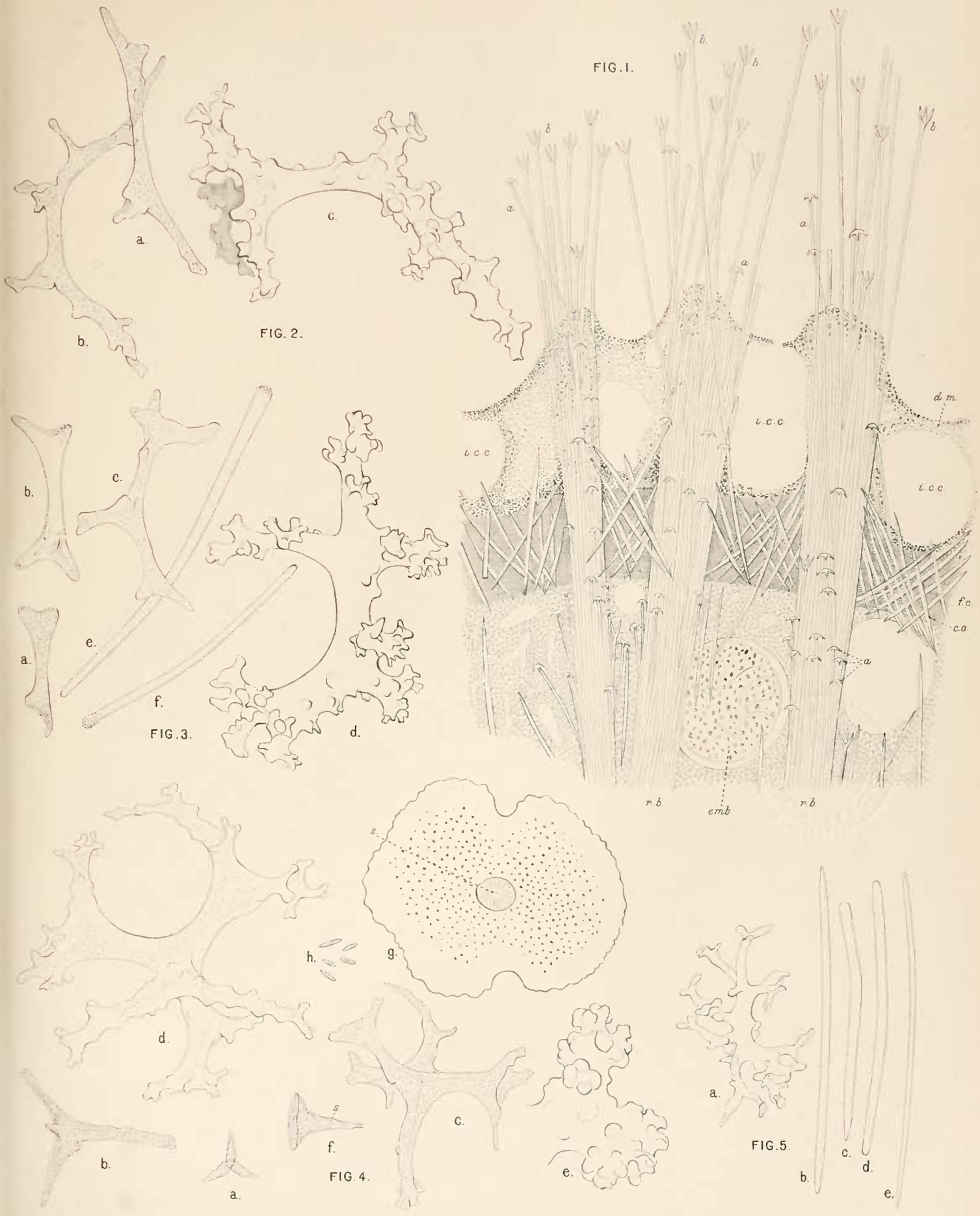


FIG. 1, ECIONEMA CARTERI, n.sp.; FIG. 2, ECIONEMA LAVINIENSIS, n.sp.; FIG. 3, 3A, 3B, GEODIA PERUNCINATA, n.sp.; FIG. 4, TETILLA POCULIFERA, n.sp.; FIG. 5, TETILLA ANOMALA, n.sp.; FIG. 6, TETILLA LIMICOLA, n.sp.; FIG. 7, PARATETILLA CINERIFORMIS, n.sp



A. Dendy del E. Wilson, Lith. Cambridge

FIG. 1, CRANIELLA ELEGANS, n.sp.; - FIG. 2, TAPROBANE HERDMANI, n.sp.; FIG. 3, ACICULITES ORIENTALIS, n.sp.; FIG. 4, DISCODERMIA EMARGINATA, n.sp.; FIG. 5, PETROMICA MASSALIS, n.sp.

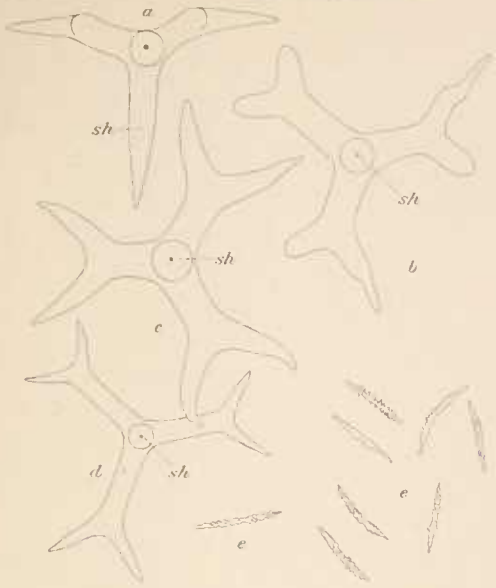


FIG 1.

FIG.2

FIG 8

FIG.3.

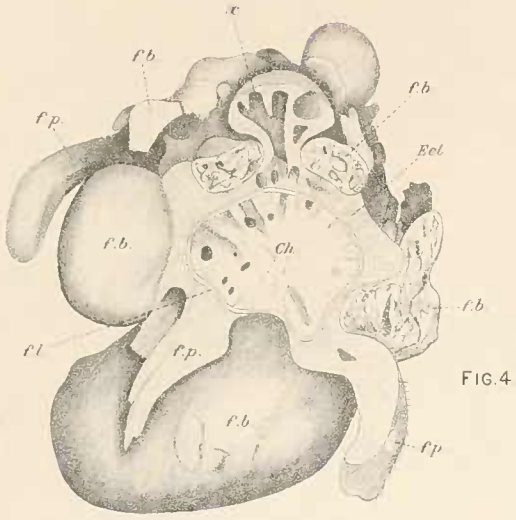


FIG.4

FIG.5.

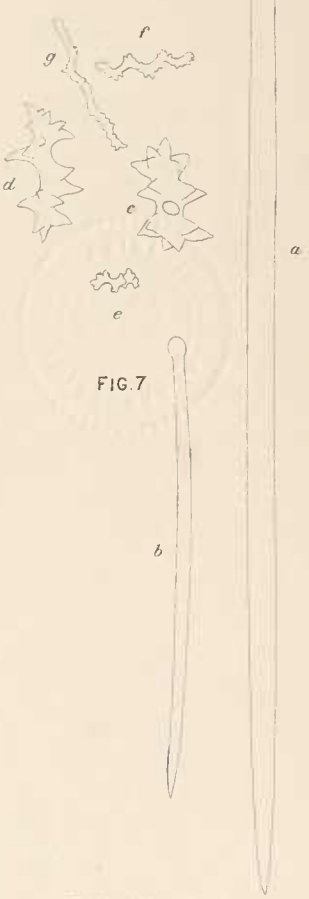


FIG.7

FIG.9

FIG.10

FIG 6

FIG. 1, STŒBA EXTENSA, n.sp.; FIG. 2, COPPATIAS REPTANS, n.sp.; FIG. 3, ASTEROPUS HAECKELI, n.sp.; FIGS. 4, 5, CRYPTOTETHYA AGGLUTINANS, n.sp.; FIG. 6, HYMEDESMIA CURVISTELLIFERA, n.sp.; FIG. 7, SPIRASTRELLA TENTORIOIDES, n.sp.; FIG. 8, NEGOMBO TENUISTELLATA, n.sp.; FIG. 9, CLIONA MARGARITIFERÆ, n.sp.; FIG. 10, SUBERITES CRUCIATUS, n.sp.

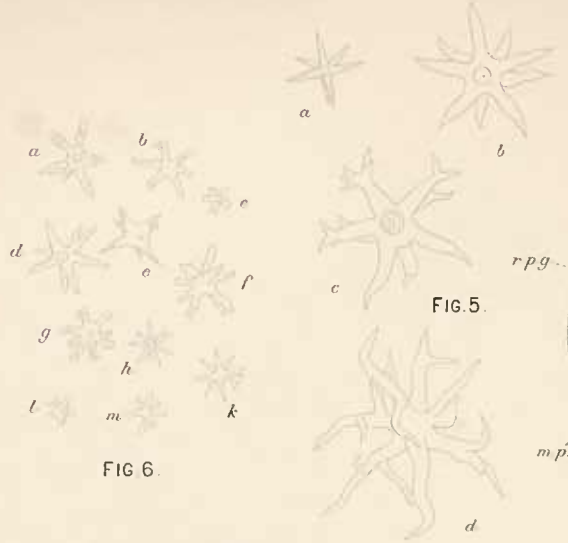


FIG. 6.

FIG. 5.

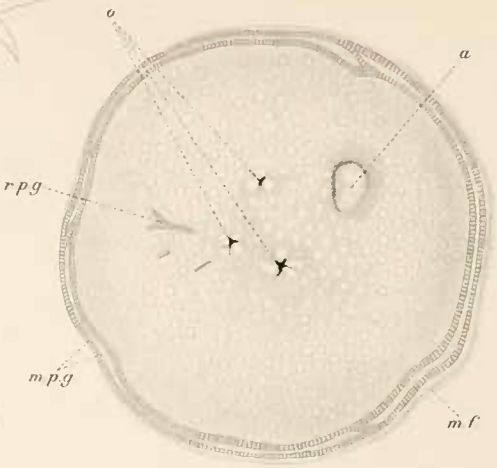


FIG. 1.

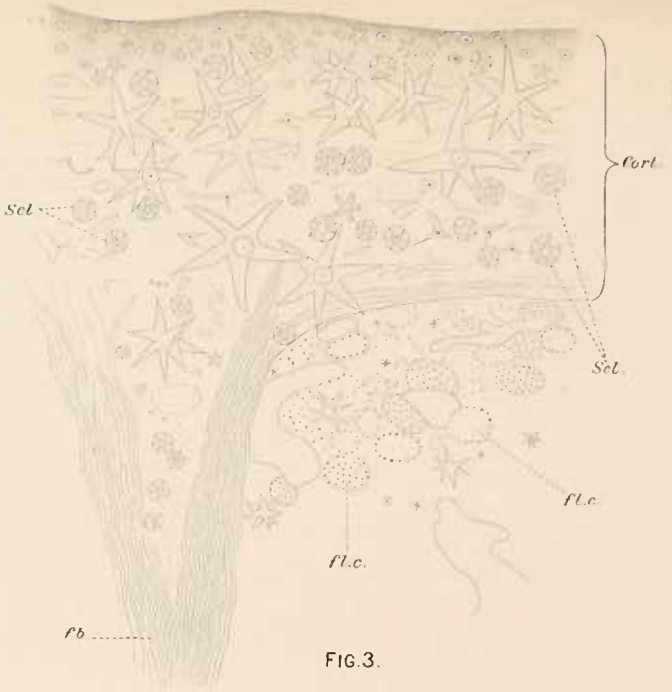


FIG. 3.

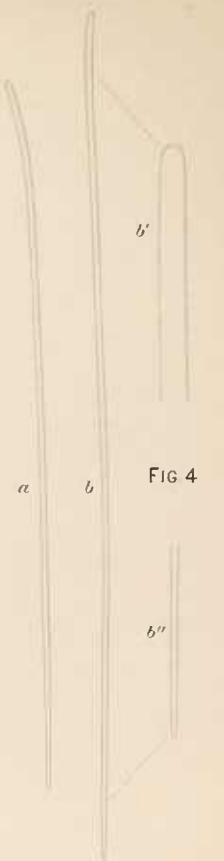


FIG 4

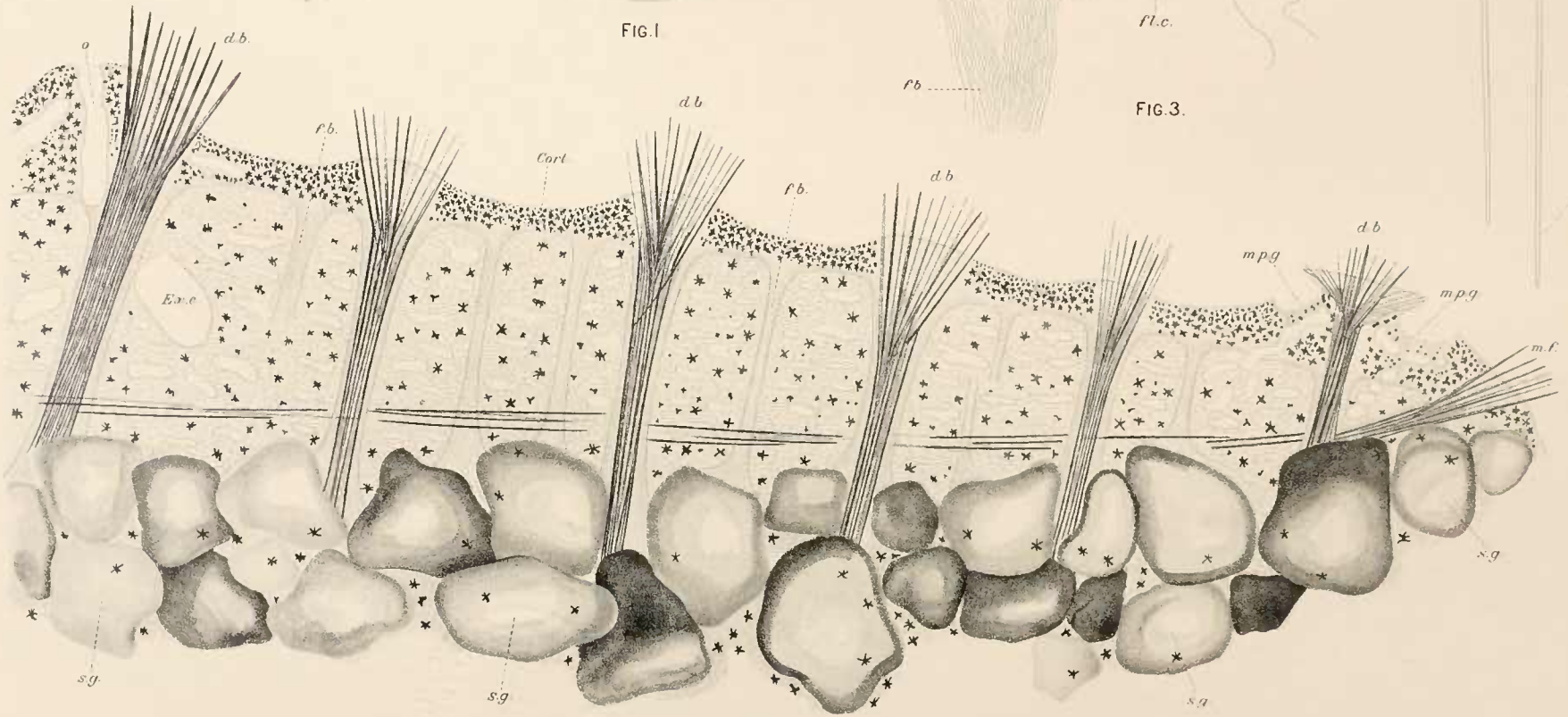


FIG. 2.

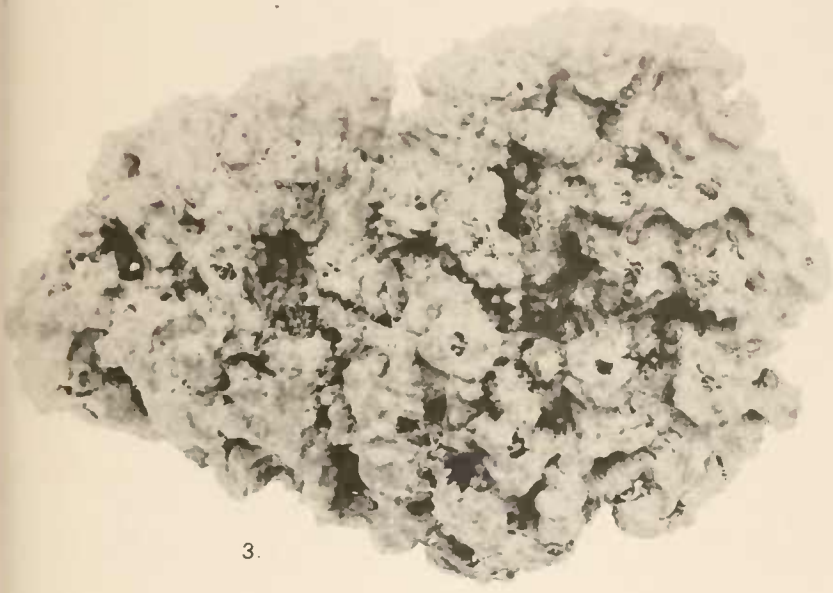
E. Wilson, Lith. Cambridge

A. Dendy del

XENOSPONGIA PATELLIFORMIS, Gray.

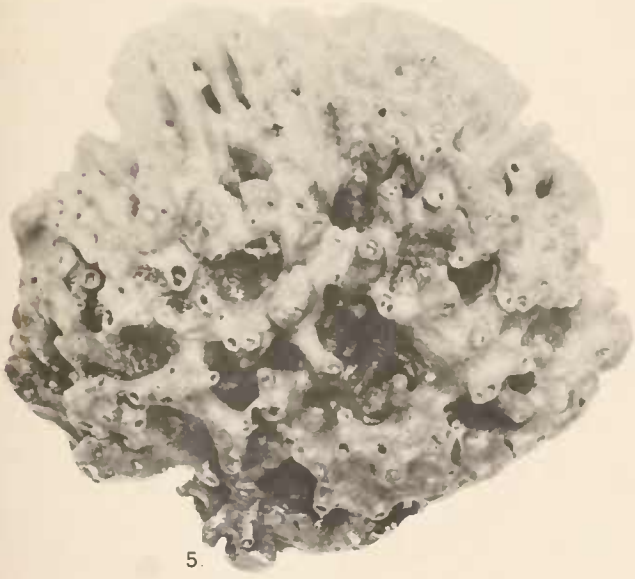
1.

2.



3.

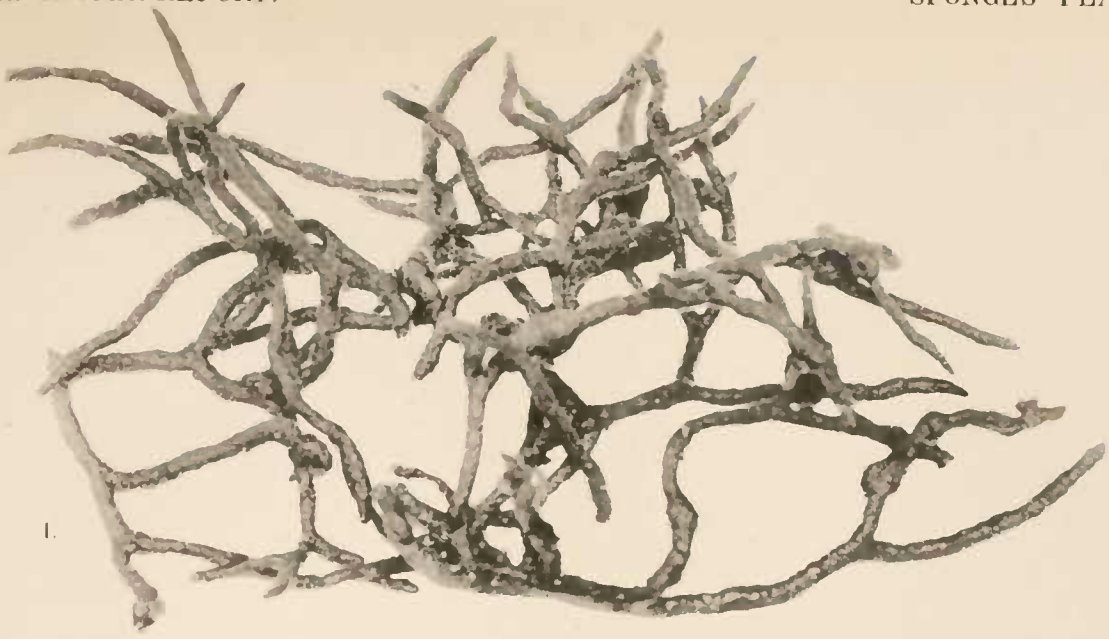
4.

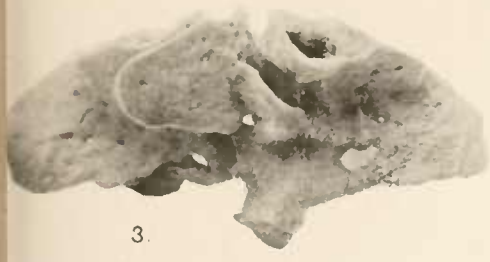


5.

6.

FIG. 1, SIPHONOCHALINA COMMUNIS, var. tenuispiculata, n.; FIG. 2, CERAOCHALINA MULTIFORMIS, var. manaarensis, Dendy; FIG. 3, CERAOCHALINA CEYLONICA, n.sp.; FIG. 4, PACHYCHALINA SPINILAMELLA, Dendy; FIG. 5, GELLIODES CARNOSA, Dendy; FIG. 6, COLLOCALYPTA DIGITATA, n.sp.





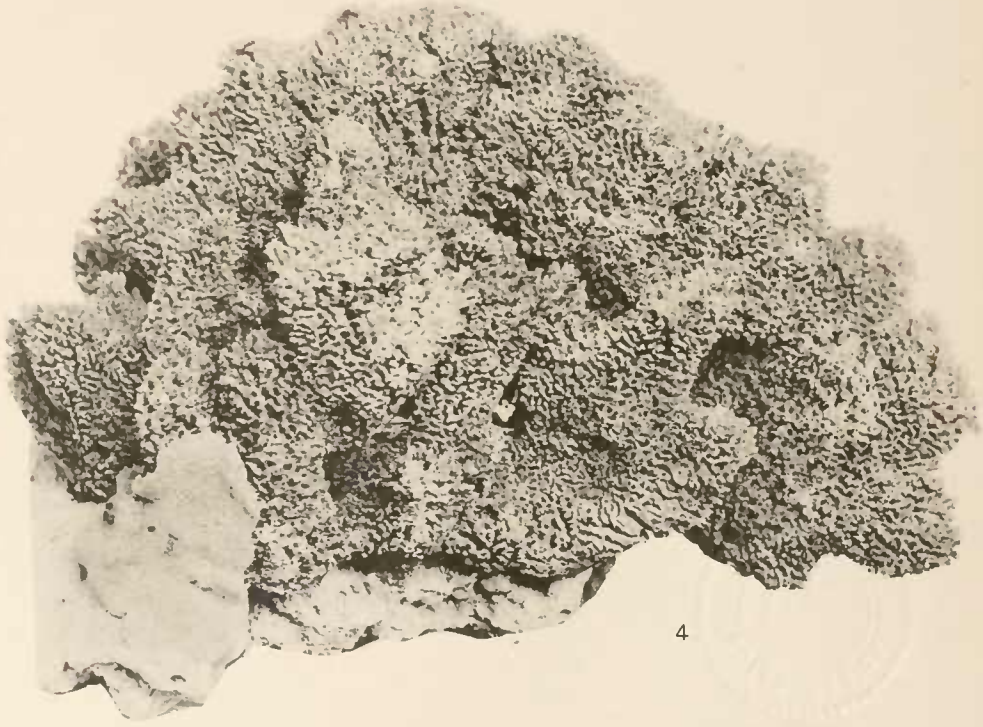
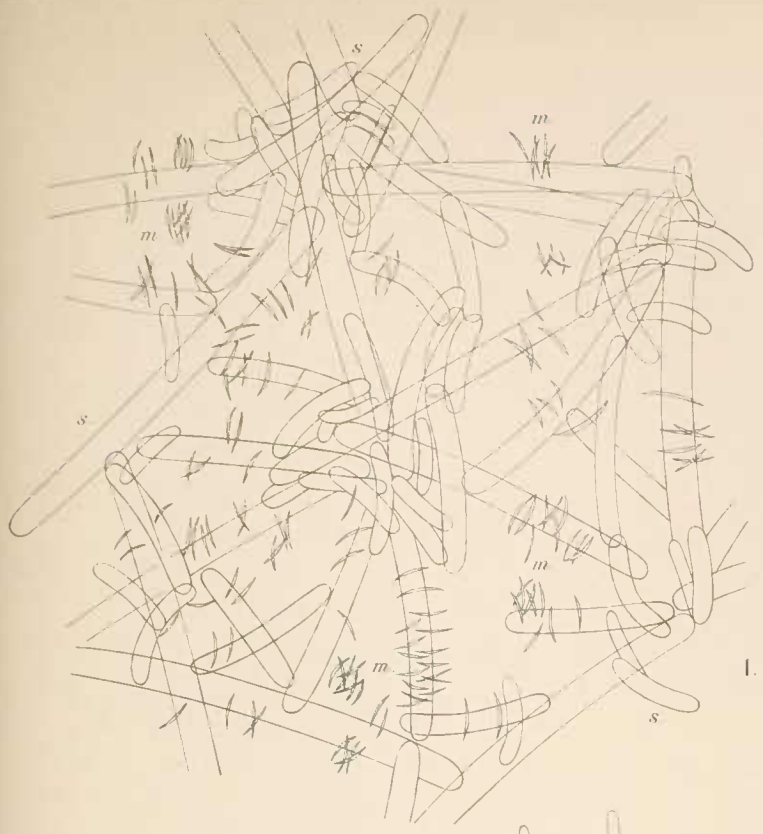
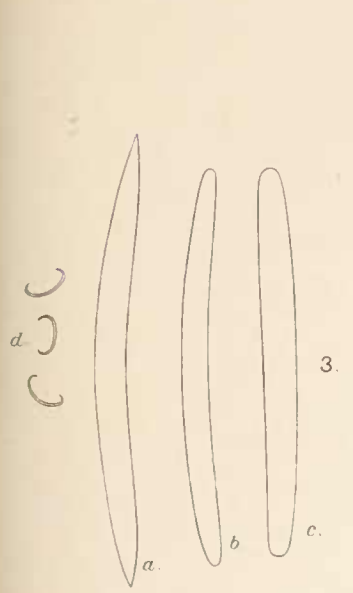
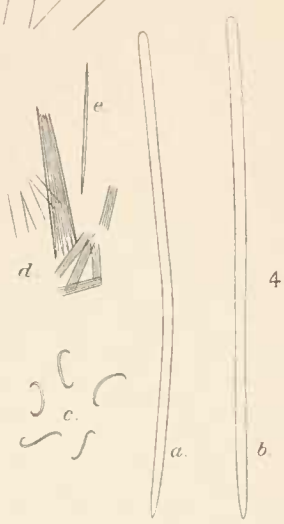
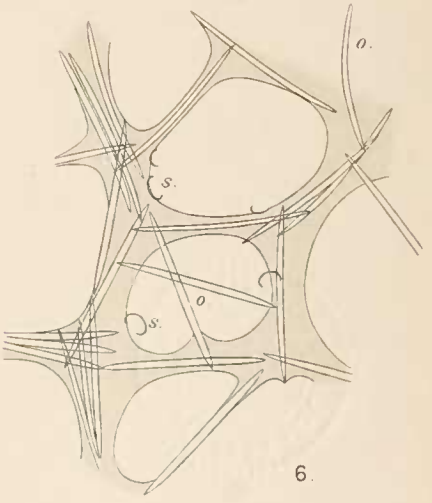


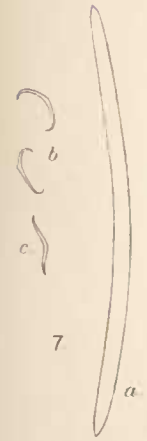
FIG. 1, PLOCAMIA MANAARENSIS (Carter); FIG. 2, CLATHRIA SPICULOSA, var. tessellata, n.; FIG. 3, PHAKELLIA CEYLONENSIS, n.sp.; FIG. 4, ACARNUS TERNATUS, Ridley; FIG. 5, RASPAILIA FRUTICOSA, var. tenuiramosa, n.; FIG. 6, ACANTHELLA CARTERI, Dendy.

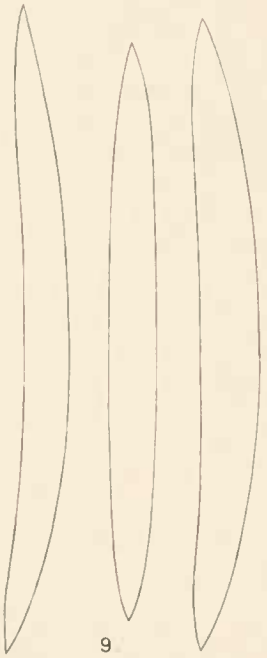


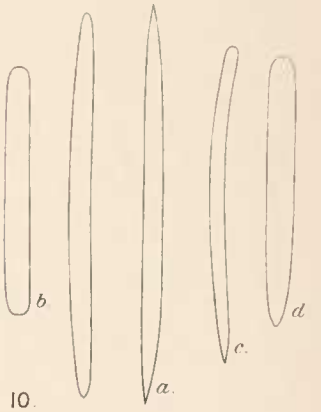












A. Bendy del. E. Wilson, Lith. Cambridge

FIG. 1, STRONGYLOPHORA DURISSIMA, n.sp.; FIG. 2, TOXOCHALINA ROBUSTA, var. ridleyi, n.; FIG. 3, GELLIODES PETROSIOIDES, n.sp.; FIG. 4, DESMACELLA TUBULATA, n.sp.; FIG. 5, ACANTHOXIFER CEYLONENSIS, n.sp.; FIG. 6, GELLIODES INCRUSTANS, n.sp.; FIG. 7, GELLIUS ANGULATUS, var. canaliculata, n.; FIG. 8, RENIERA ZOOLOGICA, n.sp.; FIG. 9. PETROSIA DENSISSIMA, n.sp.: FIG. 10, RENIERA PIGMENTIFERA, n.sp.

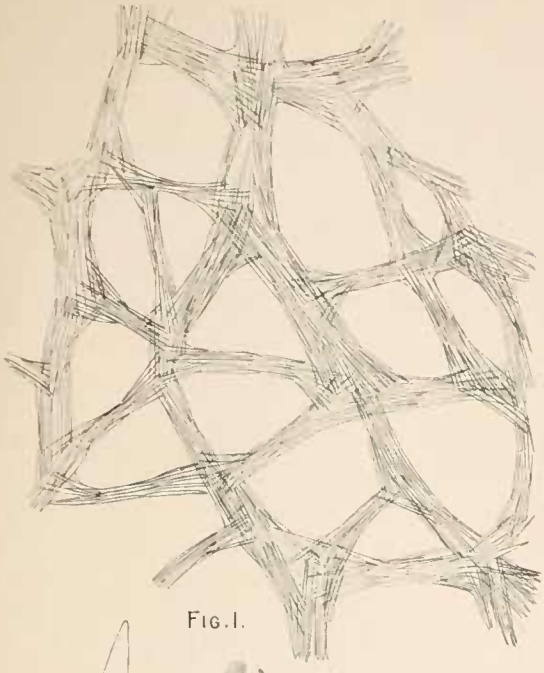


FIG. 1.

FIG. 2.

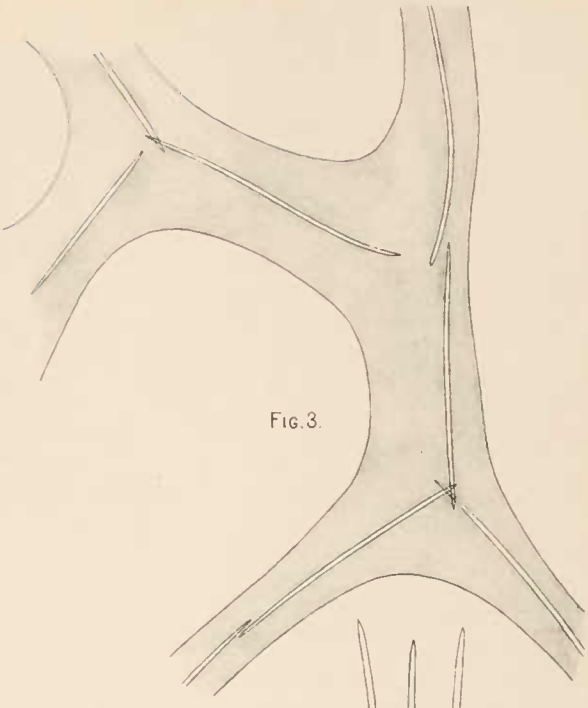


FIG. 3.

FIG. 4.

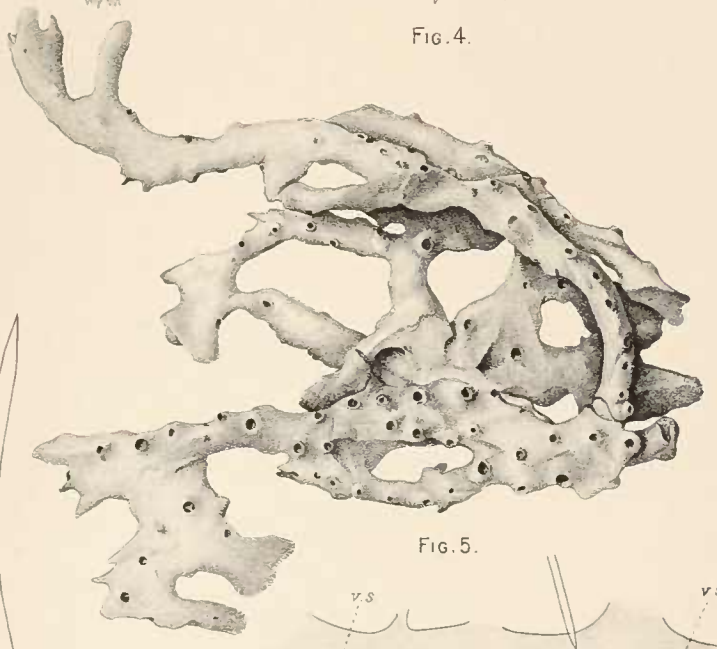


FIG. 5.

FIG. 6.

FIG. 7.

FIG. 10.

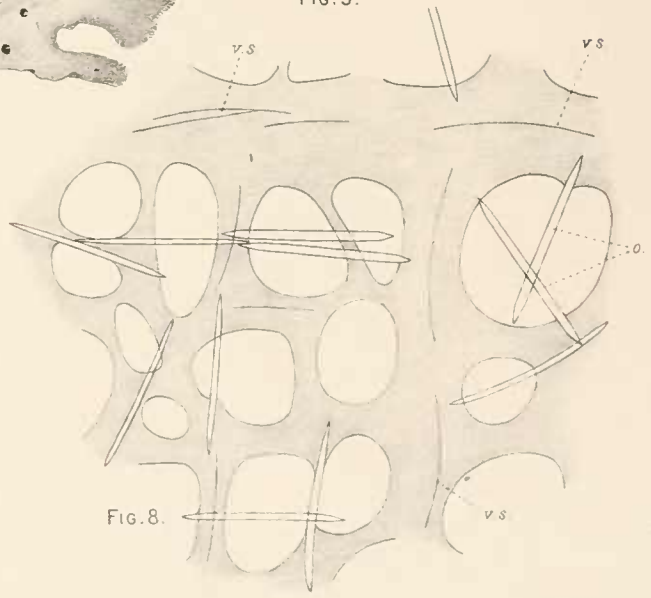


FIG. 8.

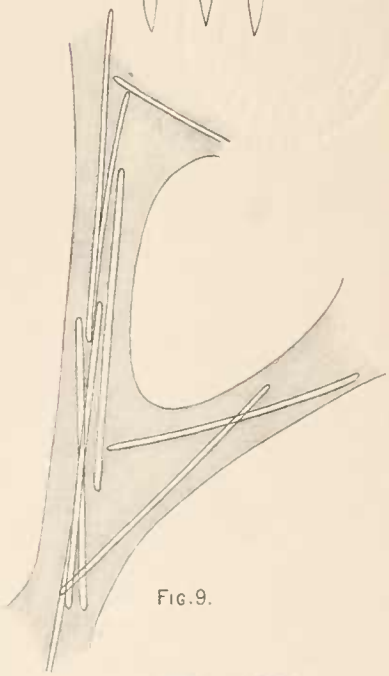


FIG. 9.

Bemrose del. et lith. Pl. 5 E. Wilson, Lith. Cambridge

FIGS. 1, 2, PACHYCHALINA SUBCYLINDRICA, n.sp.; FIG. 3, CHALINA CLATHRATA, n.sp.; FIG. 4, CERAOCHALINA RETIARMATA, n.sp.; FIG. 5, CHALINA SUBARMIGERA (Ridley); FIG. 6, CERAOCHALINA CEYLONICA, n.sp.; FIG. 7, PACHYCHALINA BREVISPICULIFERA, n.sp.; FIG. 8, CERAOCHALINA RETICUTIS, n.sp.; FIG. 9, CHALINA OBTUSISPICULIFERA, n.sp.; FIG. 10, TRACHYOPSIS HALICHONDRIOIDES, n.sp.

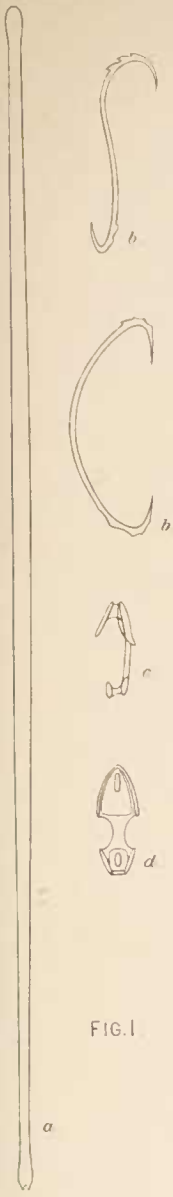


FIG. 1

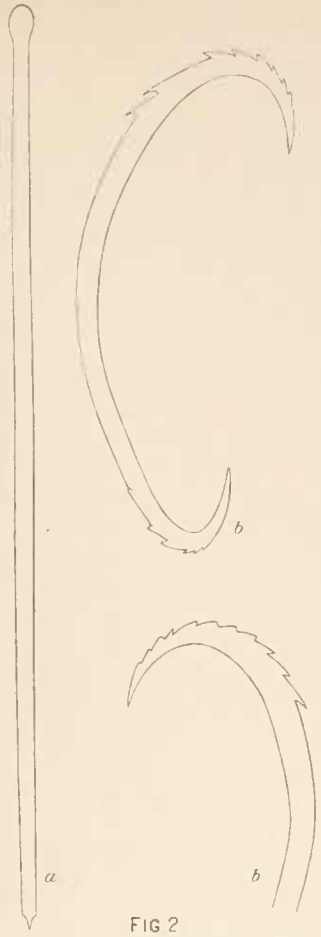


FIG 2

FIG. 3

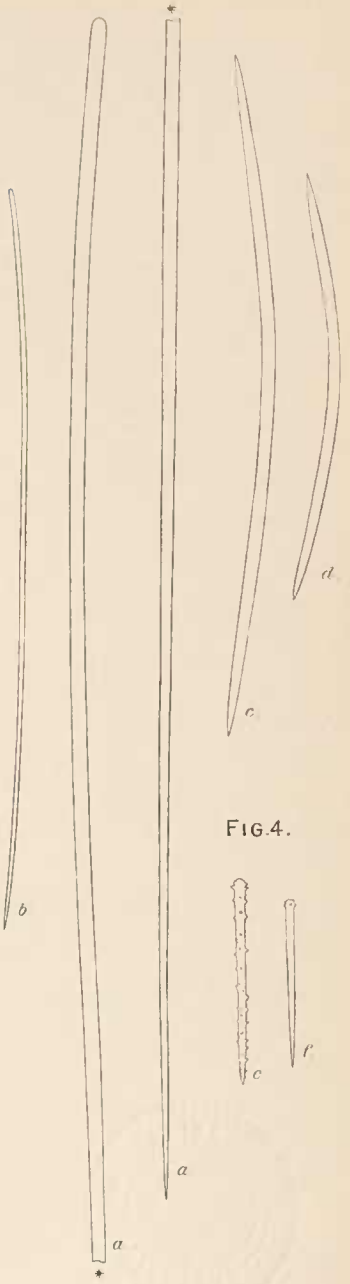


FIG. 4.

FIG. 7.

FIG. 9.

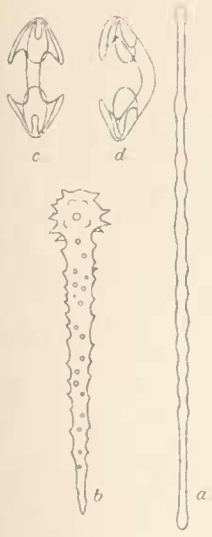


FIG. 5

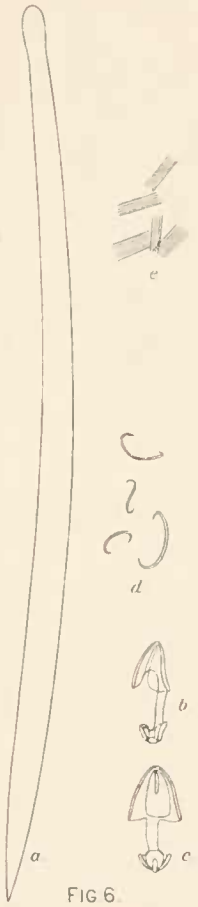


FIG. 6.

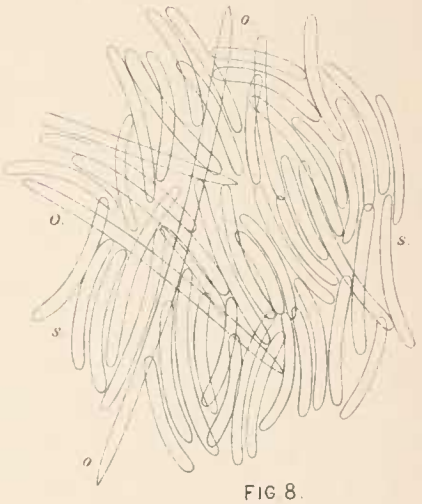


FIG 8.

Fig. 1, Paresperella bidentata, n.sp.; Fig. 2, Paresperella serratohamata (Cart.); Fig. 3, Paresperella, sp.; Fig. 4, Echinodictyum clathratum, n.sp.; Fig. 5, Myxilla tenuissima, n.sp.; Fig. 6, Esperella crassissima, n.sp.; Fig. 7, Raspailia hornelli, n.sp.; Figs. 8, 9, Histoderma vesiculatum, n.sp.

Fig. 1

Fig. 2

Fig. 3.

Fig. 4

Fig. 6.

Fig. 7.

Fig. 8.

Fig. 5

Fig. 9

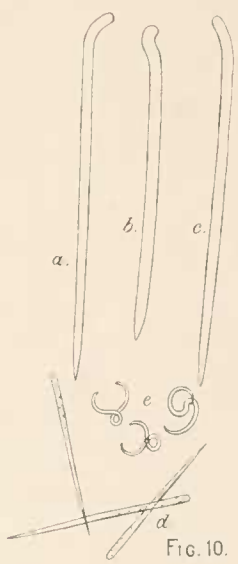
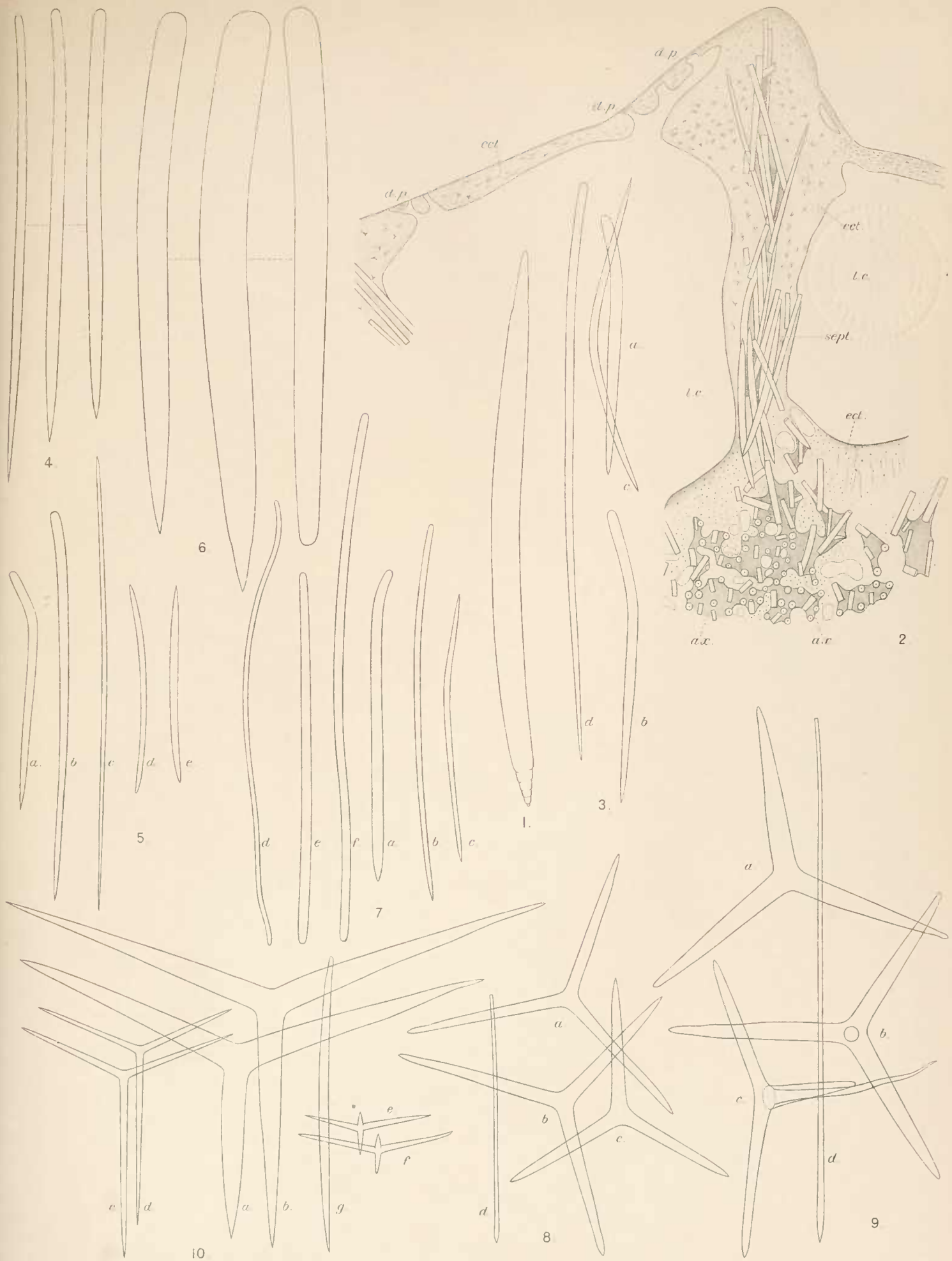


Fig. 10.

A. Denny del. E. Wilson, Lith. Cambridge

Fig. 1, Spongosorites topsenti, n.sp.; Fig. 2, Spongosorites (?) lamellata, n.sp.; Fig. 3, Spongosorites (?) lapidiformis, n.sp.; Fig. 4, Hymeniacidon petrosioides, n.sp.; Fig. 5, Thrinacophora durissima, n.sp.; Fig. 6, Thrinacophora agariciformis, n.sp.; Fig. 7, Axinella halichondrioides, n.sp.; Fig. 8, Axinella manus, n.sp.; Fig. 9, Agelas ceylonica, n.sp.; Fig. 10, Rhabderema indica, n.sp.



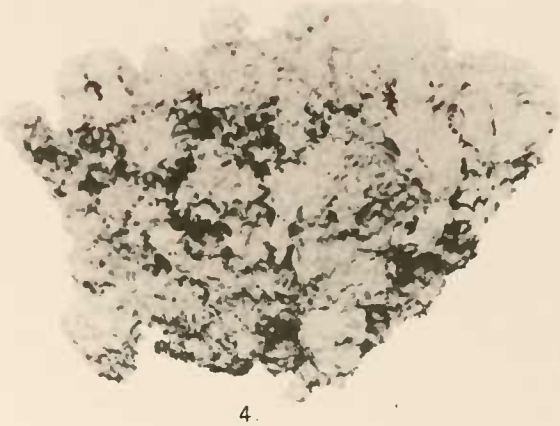
A. Denny, del. E. Wilson, Litho. Cambridge.

FIGS. 1, 2, COLLOCALYPTA DIGITATA, n.sp.; FIG. 3, PHAKELLIA SYMMETRICA, n.sp.; FIG. 4, AXINELLA TENUIDIGITATA, n.sp.; FIG. 5, PHAKELLIA CEYLONENSIS, n.sp.; FIG. 6, PHAKELLIA CRASSISTYLIFERA, n.sp.; FIG. 7, AULETTA ELONGATA, n.sp.; FIG. 8, LEUCOSOLENIA CORIACEA, var. CEYLONENSIS, n.; FIG. 9, LEUCOSOLENIA TENUIPILOSA, n.sp.; FIG. 10, LEUCANDRA DONNANI, n.sp.

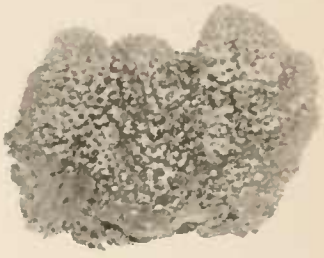
1.

2.

3.



4.

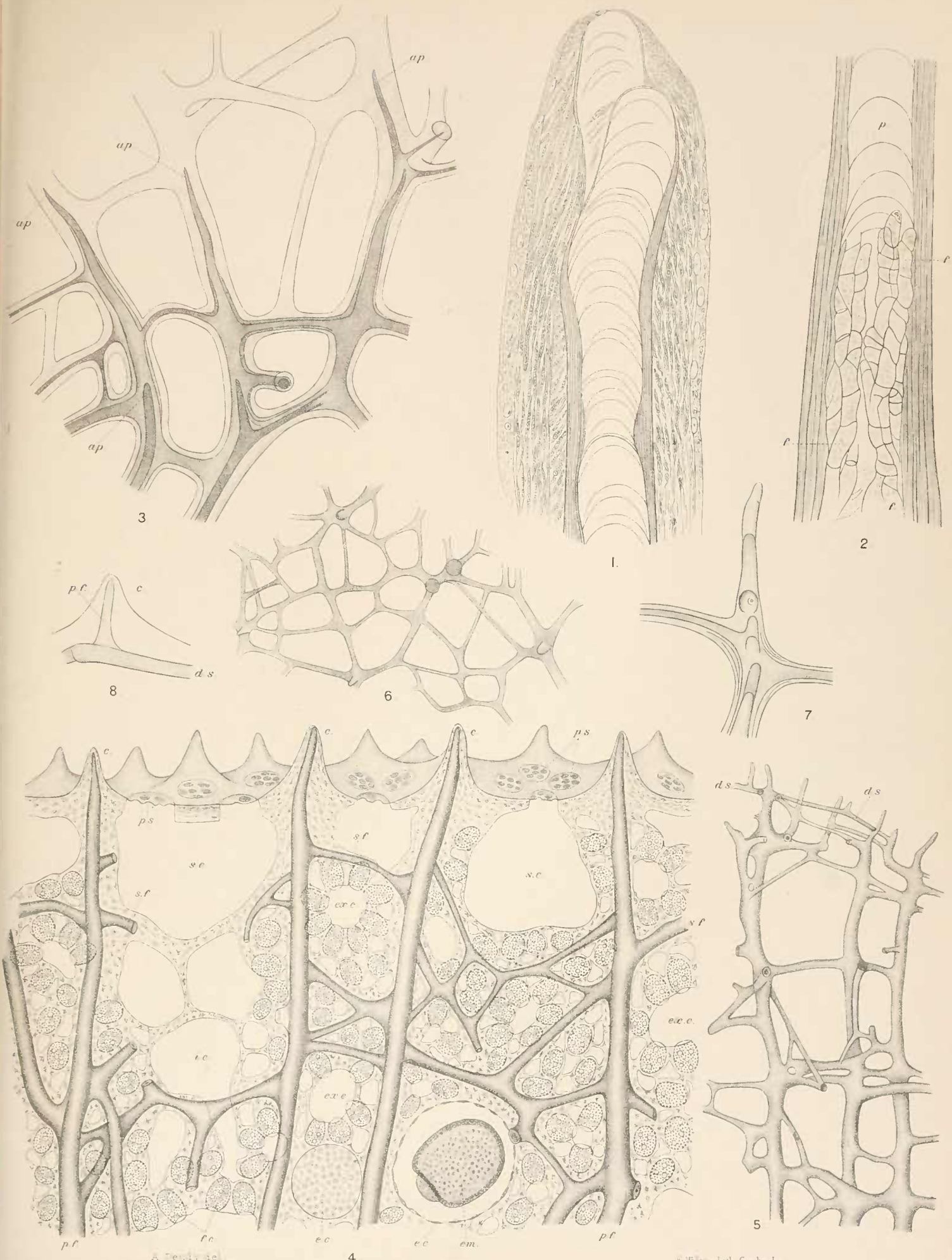


5.

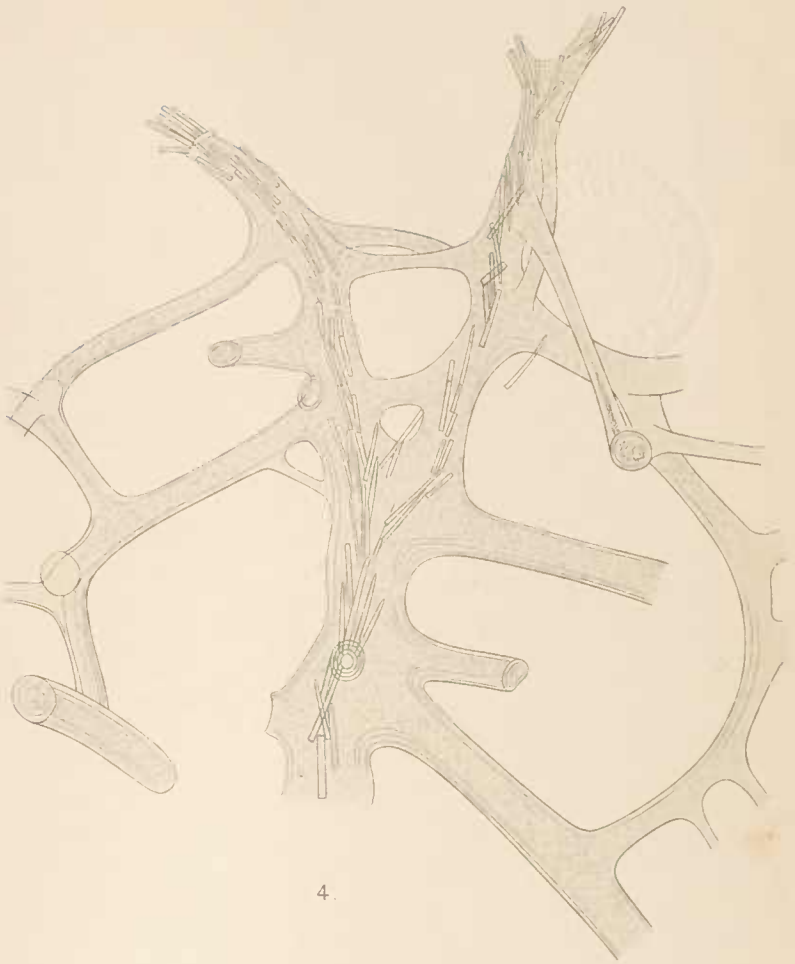
6.

7.

Fig. 1, Hircinia fusca, Carter; Fig. 2, Hippospongia clathrata (Carter); Fig. 3, Euspongia officinalis, var. ceylonensis, n.; Fig. 4, Spongelia elastica, var. crassa, n.; Fig. 5, Hircinia anomala, n.sp.; Fig. 6, Phyllospongia papyracea, var.; Fig. 7, Megalopastas nigra (Dendy).



FIGS. 1, 2, DARWINELLA SIMPLEX, Tops.; FIG. 3, MEGALOPASTAS PULVILLUS, n.sp.;
FIG. 4, MEGALOPASTAS ELEGANS (Lend.); FIGS. 5—8, MEGALOPASTAS NIGRA (Dendy).



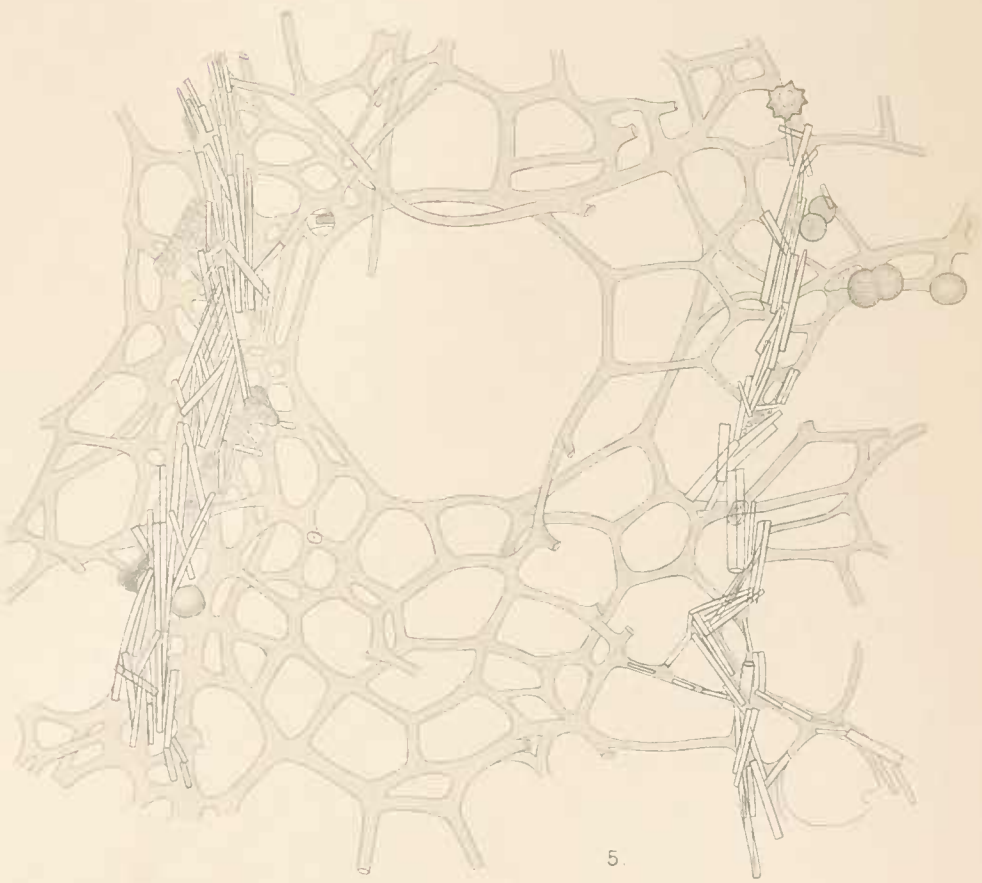


Fig. 1, Hircinia anomala, n.sp.; Fig. 2, Hircinia tuberosa, n.sp.; Fig. 3, Hircinia schulzei, n.sp.;
Fig. 4, Aplysina herdmani, n.sp.; Fig. 5, Euspongia officinalis, var. ceylonensis, n.