No. VI.—REPORT ON THE HOMOSCLEROPHORA AND ASTROTETRAXONIDA COLLECTED BY H.M.S. "SEALARK" IN THE INDIAN OCEAN.

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(Plates 44—48.)

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The present instalment of my Report on the Sponges collected in the Indian Ocean by the "Sealark" expedition deals with a portion only of the Tetraxonida, viz. the Homosclerophora and Astrotetraxonida, leaving the Sigmatotetraxonida—a very large group—to be dealt with subsequently. It will be noticed that the families Spirastrellidæ and Latrunculiidæ, hitherto included by general consent in the Astrotetraxonida, are omitted from the present communication. The reason for this is that I have convinced myself—largely through investigation of the "Sealark" material—that the so-called asters of these two families are really pseudasters, and that the groups in question are of desmacidonid origin and must therefore be included amongst the Sigmatotetraxonida. I hope to discuss the question at length in a future instalment of my Report.

The classification of the Astrotetraxonida is as yet by no means in a satisfactory condition, but a comprehensive revision of the group will be necessary before attempting any radical reform. Such a revision I have already commenced in conjunction with my colleague Mr R. W. H. Row, but it would not be desirable to delay the publication of this report until it is completed, as it must necessarily take a long time. I may be allowed to state, however, that, although I retain the family Pachastrellidæ as a matter of convenience, I cannot regard that family, as generally understood, as constituting a natural group—it probably contains forms on the up-grade from the Homosclerophora to the Stellettidæ and others which are nothing but degenerate Stellettids. The latter appear to be analogous to the so-called "Epipolasidæ," but differing from these in that it is only the rhabdome of the triæne that has undergone reduction. The "Epipolasidæ" I no longer accept as a family, those which are present in the "Sealark" collection will be found amongst the Stellettidæ.

Twenty-five species are dealt with in the present contribution, of which nine appear to be new. The list is as follows :—

Order TETRAXONIDA.

Sub-order HOMOSCLEROPHORA.

Family **Plakinidæ.**

1. *Dercitopsis minor* n.sp.

Sub-order ASTROTETRAXONIDA.

Family **Pachastrellidæ.**

2. *Pachastrella tenuilaminaris* (Sollas).
3. *Yodomia perfecta* n.sp.

Family **Stellettidæ.**

4. *Myriastra parva* (Row).
5. *Myriastra cavernosa* n. sp.
6. *Dragmastra lactea* (Carter) var. *mauritiana* nov.
7. *Rhabdodragma* (n. gen.) *conulosa* (Kieschnick).
8. *Ecionemia carteri* Dendy.
9. *Ecionemia laviniensis* Dendy.
10. *Aurora providentiæ* n. sp.
11. *Aurora cribriporosa* n. sp.
12. *Aurora rowi* n. sp.
13. *Asteropus simplex* (Carter).
14. *Jaspis johnstonii* (Schmidt).

Family **Geodiidæ**

15. *Geodia auroristella* n. sp.

Family **Erylidæ.**

16. *Erylus lendenfeldi* Sollas.
17. *Erylus proximus* n. sp.

Family **Donatiidæ.**

18. *Donatia lyncurium* auctorum.
19. *Donatia japonica* (Sollas).
20. *Donatia ingalli* (Bowerbank).
21. *Donatia seychellensis* (Wright).
22. *Donatia stella-grandis* n. sp.

Family **Chondrosiidæ.**

23. *Chondrilla australiensis* Carter.
24. *Chondrilla mixta* Schulze.
25. *Chondrilla sacciformis* Carter.

I am again indebted to the Trustees of the Percy Sladen Fund for financial assistance in the preparation of illustrations, &c., and to Miss Deakin for much valuable help rendered possible thereby, especially for her faithful and painstaking drawings of spicules.

I refrain from publishing a reference list of literature with the present instalment, as it will be quite sufficient to publish one list later on for the whole of the Tetraxonida. In the meantime the dates given after authors' names may afford sufficient clue to the memoirs referred to.

Order TETRAXONIDA Dendy [1905].

Sponges with siliceous spicules whose fundamental form is tetraxonid and tetractinellid. (This fundamental form is often obscured by secondary modifications, and the spicules may even disappear completely in some degenerate forms.)

In 1905 I proposed to arrange the order Tetraxonida as follows:—

Grade TETRACTINELLIDA.

Sub-order Homosclerophora.
" Astrophora.
" Sigmatophora

Grade LITHISTIDA.

Grade MONAXONELLIDA.

Sub-order Astromonaxonellida.
" Sigmatomonaxonellida.

The Sub-orders Astrophora and Sigmatophora were, of course, adopted from Sollas [1888] and the Homosclerophora replaced his Microsclerophora.

The Astromonaxonellida were regarded as being derived from the tetractinellid Astrophora and the Sigmatomonaxonellida from the tetractinellid Sigmatophora [Dendy, 1905, p. 133].

The views thus expressed as to the phylogeny of the Tetraxonida have been accepted by Hentschel [1909, 1911 A] in his work on the Tetraxonida of S.W. Australia. He has, however, proposed a modification of my arrangement which gives clearer expression to these views and which I gladly accept. He divides the order Tetraxonida directly into three sub-orders:—

Sub-order 1. Homosclerophora Dendy.
" 2. Astrotetraxonida Hentschel (= Astrophora + Astromonaxonellida Dendy).
" 3. Sigmatotetraxonida Hentschel (= Sigmatophora + Sigmatomonaxonellida Dendy).

We are thus, I hope, finally rid of the old artificial distinction between "Tetractinellida" and "Monaxonida," introduced by Zittel [1878 A], which the "Challenger" Reports unfortunately did so much to emphasise.

With regard to the Lithistida and Ceratosa Hentschel remains in some doubt, suggesting that they may have to be added as two separate sub-orders to the three above mentioned. This is possibly the best thing to do with the Lithistida in the present stage of our knowledge, though I should not like to commit myself to a definite

opinion as yet. With regard to the Ceratosa I adhere to the views I have already expressed [1905]. Only the "Pseudoceratosa" have any claim to be included in the Tetraxonida, and whether these can be constituted into a distinct sub-order is extremely doubtful. Some of them appear to me to be certainly Chalinine in origin, while others are very possibly Ectyonine.

Sub-order 1. Homosclerophora Dendy [1905].

Tetraxonida in which microscleres and megascleres have not yet become sharply differentiated from one another and no triænes are as yet developed.

I cannot agree with Hentschel in including [1909] the Oscarellidæ in this sub-order, which seems to me to be a distinctly retrograde step. I adhere to the opinion which I expressed in 1905, that Oscarella must be placed in a separate order, Myxospongida, which represents the common ancestors of all the siliceous sponges, both Triaxonida and Tetraxonida, and also of the Euceratosa.

Family **Plakinidæ**.

With the characters of the sub-order.

This family was proposed by Schulze in 1880 for the reception of the three genera Plakina, Plakortis and Plakinastrella. References to its history between 1880 and 1900 are given by Lendenfeld [1903, p. 118]. In addition to the three original genera Lendenfeld includes in the family Corticium and Thrombus. In 1905 I removed Plakinastrella from the Plakinidæ on account of the presence of short-shafted triænes, and placed it in the Pachastrellidæ, an arrangement to which I must adhere.

Genus Dercitopsis Dendy [1905].

Plakinidæ with calthrops, oxea and sometimes triods, but no candelabra. All spicules smooth.

When I proposed this genus in 1905 I unfortunately overlooked the existence of two species which must certainly be taken into account in discussing its affinities, viz. *Plakinastrella clathrata*, described by Kirkpatrick [1900 B] from Funafuti, and *P. oxeata*, described by Topsent [1904 A] from the Azores. More recently Lendenfeld [1906] has described a species under the name *Plakinastrella mammillaris*, from the west coast of Australia, which must also be considered in the same connection. That all these three species are closely related to my *Dercitopsis ceylonica* there can be no doubt, but I am not disposed to agree with Lendenfeld [1906] that *Dercitopsis ceylonica* should be associated with them in the genus Plakinastrella. On the contrary I think that all three should be removed from Plakinastrella and placed in Dercitopsis, and that for the following reasons.

The type species of Plakinastrella is *P. copiosa*, described and figured by Schulze [1880]. That species possesses well-differentiated, short-shafted triænes, definitely orientated beneath the surface of the sponge, and, as already stated, it was mainly for that reason that in 1905 I placed it in the Pachastrellidæ. Not one of the species placed

by Kirkpatrick, Topsent and Lendenfeld in the genus Plakinastrella possesses triænes, but, on the contrary, all of them belong to the Homosclerophora.

The genus to which *Dercitopsis* is most closely allied is not, in my opinion, Plakinastrella, but Plakortis [Schulze 1880]. Indeed it is perhaps not easy to separate the two satisfactorily, but Schulze, in his original diagnosis of the genus Plakortis, emphasised the fact that tetract spicules were wanting, only triacts and diacts being developed. We may take this as the basis of the generic distinction. Plakortis also seems to be more primitive than Dercitopsis as regards canal system, but in this respect the gap seems to be bridged over to some extent by *Dercitopsis clathrata* (Kirkpatrick).

The presence of radially arranged small oxea at the surface must be abandoned as part of the generic diagnosis of Dercitopsis, for, though such a layer is present in *D. ceylonica* Dendy, *D. clathrata* (Kirkpatrick) and *D. minor* n. sp., it is absent in *D. oxeata* (Topsent) and (apparently) in *D. mammillaris* (Lendenfeld). The last named species is remarkable in another respect, for the spiculation includes only oxea and calthrops, triods being completely absent.

1. *Dercitopsis minor* n. sp.

(Plate **44**, fig. 1; Plate **45**, fig. 1.)

The sponge (Plate **44**, fig. 1) forms irregular, rounded, cushion-like masses, encrusting pieces of rock, &c. The margins are broadly rounded and may project considerably beyond the base of attachment, and become tucked in, thus tending to envelope the support. The maximum dimensions of the largest specimen (R.N. XLII. 6) are as follows:—Length 78 mm., breadth 57 mm., thickness about 16 mm. The surface is smooth but rather uneven; subglabrous and minutely punctate. The colour of the surface (in spirit) varies from light brown to dark slate grey; internally it is pale yellowish. Vents of moderate size, up to about 3 mm. in diameter, each with a prominent, membranous collar; few in number and scattered singly on prominent portions of the upper surface. Inhalant pores closely scattered all over the surface. Texture firm and compact.

The skeleton is a dense feltwork of loose spicules, quite irregularly arranged except at the surface, where very small oxea are placed more or less at right angles to the surface to form a dermal layer.

Spicules:—(1) Calthrops (Plate **45**, fig. 1 *a*), with smooth, sharp-pointed rays measuring about 0·037 by 0·005 mm. in a well grown specimen, but varying a good deal.

(2) Triods (Plate **45**, fig. 1 *b*), differing from the calthrops in the absence of one ray. Perhaps, on an average, the rays of the triods are more slender than those of the calthrops, but slender-rayed forms of both occur.

(3) Oxea (Plate **45**, fig. 1 *c*), fusiform, slender, slightly curved, gradually sharp-pointed, almost always with a kink or enlargement in the middle. Size variable, averaging in the deeper parts of the sponge, say, about 0·1 by 0·004 mm., though often much more slender. The largest seen, and that only once, measured only about 0·19 mm. in length. The small dermal oxea measure up to about 0·04 mm. long and are of proportionate thickness. Intermediate sizes between these and the deeper oxea are abundant. The oxea are far more numerous than both triods and calthrops together.

The ectosome and the outer part of the choanosome contain numerous small, brown, granular pigment-cells. I have not examined the canal system in detail, but it appears to agree closely with that of *Dercitopsis ceylonica* [Dendy 1905].

Dercitopsis minor would appear to be a common species in the Indian Ocean. At first I thought it must be specifically identical with the Ceylon form, but the fact that the oxea never, in any of the specimens, seem to reach half the size that many of them attain in *D. ceylonica*, renders it, in my opinion, desirable to recognise a specific distinction.

The external appearance of the sponge strongly recalls that of a *Chondrilla*, with which genus it may readily be confounded until examined microscopically, especially when, as in the case of R.N. XXXIII. 1 A, the two are growing together.

Register Nos., Localities, &c. XXXIII. 1 A, XXXIII. 2, and XLIII. 3, Cargados Carajos, 30.8.05, B. 13, 30 fathoms; XLII. 6, Cargados Carajos, 30.8.05, B. 9, 30 fathoms; CII. 2 A (encrusting *Erylus lendenfeldi*), Amirante, 18.10.05, E. 25, 44—20 fathoms; CXI. 7 and CXIII. 12, Egmont Reef.

Sub-order 2. ASTROTETRAXONIDA Hentschel [1909].

Tetraxonida with astrose microscleres (except when these have been lost secondarily); without sigmata or their derivatives.

Family **Pachastrellidæ**.

Astrotetraxonida with calthrops and (or) short-shafted triænes, usually scattered irregularly in the interior of the sponge, though some of the short-shafted triænes may be definitely orientated, with the cladi supporting the ectosome. Without typical long-shafted triænes and without sterrasters.

As already stated, this family is only retained provisionally. It is probably of polyphyletic origin, containing both primitive forms and degenerate stellettids.

Genus PACHASTRELLA Schmidt [1868].

Pachastrellidæ with oxea and calthrops and (or) short-shafted triænes for megascleres; without mesotriænes; with microrhabds and various forms of streptaster for microscleres, but without spherasters.

I must agree with Lendenfeld [1903] in merging Sollas's genus Pœcillastra, which I was at first strongly disposed to retain, in Pachastrella. There appears to be really nothing but the plate-like form and the distribution of pores and oscula to distinguish the two, and these characters vary so much that they cannot, at any rate in this case, be regarded as of generic import.

2. *Pachastrella tenuilaminaris* (Sollas).

(Plate **45**, fig. 2.)

Normania tenuilaminaris Sollas [1886].
Pœcillastra tenuilaminaris Sollas [1888].
Pachastrella crassiuscula Lendenfeld [1903].
Pachastrella tenuilaminaris Lebwohl [1914].

I identify with this species a plate-like fragment of considerable size, about 58 mm. in length, 45 mm. in breadth and 8 mm. in thickness. The plate is slightly curved and one surface bears small, thickly scattered pore-sieves, while the other bears numerous small, scattered oscula, less than 1 mm. in diameter and with their margins level with the general surface. The margin of the plate, where intact, is broadly rounded, but the incurrent face ends sharply above in a well-marked edge. Part of this edge only is provided with a fringe of long projecting oxea and both surfaces are also hispid in places.

The broken edges show the narrow inhalant and exhalant canals running through the plate more or less at right angles to the two surfaces.

The colour in spirit is dull, pale yellow; texture firm and harsh, but rather friable.

The skeleton is an extremely confused feltwork of large oxea. There are also numerous very long and very slender oxea which are chiefly arranged in loose fibres or wisps, which run towards the surface and in places project therefrom in long loose bundles. The comparatively few tetract spicules appear to be quite irregularly scattered through the sponge.

Spicules. (1) Calthrops and short-shafted triænes (Plate **45**, fig. 2 *a*), not sharply distinguishable from one another. Rays sharp-pointed or rounded, about 0·5 mm. long by 0·05 mm. in diameter at the base. The rays are sometimes slenderer. These spicules are not numerous and they rarely show any reduction of rays, but irregularly branched forms are occasionally found.

(2) Stout, fusiform, slightly curved and sharply pointed* oxea (fig. 2 *b*), measuring about 3·0 by 0·05 mm. Sometimes reduced, by rounding off of one or both ends, to styli or strongyla (figs. 2 *c*, 2 *d*). Shorter oxea also occur.

(3) Long, hair-like oxea (fig. 2 *e*), of about the same length as the largest but only about 0·008 mm. thick. Very numerous and commonly arranged in loose wisps.

(4) Slender-rayed metasters (fig. 2 *f*), with about six or eight long rays or spines. Greatest length of entire spicule usually about 0·016 mm.

(5) Microxea (fig. 2 *g*); slender, slightly curved, sharply pointed; with very slight indications of roughening; size about 0·15 by 0·004 mm. Rather scarce.

I have in my possession several of Sollas's original preparations of *Pachastrella* (*Pœcillastra*) *tenuilaminaris* and a careful comparison of these with the "Sealark" specimen seems to me to justify a specific identification. The chief apparent differences are as follows.

(1) The "Challenger" specimen had no special hispidating fringe at the margin. This is of little importance.

(2) The long hair-like oxea are not mentioned in Sollas's description. They are certainly very rare in the "Challenger" material, but I have seen a few.

(3) The tetract spicules are less numerous in the "Sealark" specimen; they show no tendency (so far as observed) to regular arrangement at the margin, as in the "Challenger" specimen.

(4) Reduced tetracts with only one ray are common in the "Challenger" material. I have never seen them in the "Sealark" specimen.

* Sollas's statement that the oxea are not sharply pointed is not borne out by his preparations.

(5) The metasters are decidedly smaller in the "Sealark" specimen and do not show so strong a tendency to pass into plesiasters.

(6) The microxea are much fewer in the "Sealark" specimen and the tendency to roughening of the surface is less pronounced, but it is very slight even in the "Challenger" specimen.

(7) The plate of which the sponge is composed is more than twice as thick in the "Sealark" specimen as in the type of *P. tenuilaminaris*, but in spite of the specific name, somewhat unfortunately chosen, this character cannot be regarded as of great importance. Lendenfeld [1903] regards *P. tenuilaminaris* Sollas as a synonym of *P. crassiuscula* Sollas, but I doubt whether this is justifiable in the present state of our knowledge. The chief distinguishing feature of the species appears to be the absence of short-spined spirasters.

Previously known Distribution. South of Japan, 775 fathoms ("Challenger"); Japan (Lebwohl).

Register No., Locality, &c. LXXII. 2, Amirante.

Genus YODOMIA Lebwohl [1914].

Pachastrellidæ in which the principal megascleres are calthrops (or short-shafted triænes), mesotriænes and oxea, with various derivatives of these often exhibiting very abnormal characters. The microscleres consist of amphiasters (or possibly some other form of aster) and microrhabds.

This genus has recently been proposed by Lebwohl [1914] for the reception of a remarkable Japanese species, *Yodomia ijimai*, which agrees with Triptolemus in the presence of mesotriænes but differs in the possession of calthrops (or triænes) and oxea as well, thereby approximating to the more typical Pachastrellidæ. The presence of abnormal-looking derivatives of the megascleres, sometimes forming spheres, appears also to be very characteristic.

Lebwohl gives the following diagnosis of his new genus "Pachastrellidæ mit langschäftigen Triænen; mit radial orientirten Plagiotriænen und Mesotriænen an der Oberfläche." It appears to me that he has here laid undue emphasis on the long-shafted triænes, which are far from being typical long-shafted triænes and are said to be relatively scarce. In the new species discovered by the "Sealark" expedition they do not occur at all.

The genus Triptolemus, proposed by Sollas in 1888, includes small encrusting forms, and may possibly be regarded as having been derived from Yodomia by reduction of the spiculation.

Schmidt's *Stelletta pathologica* [1868] from the coast of Algiers, redescribed by Sollas in 1888, also includes mesotriænes in its spiculation and is perhaps a nearly related form.

3. *Yodomia perfecta* n. sp.

(Plate **44**, figs. 2, 2*a*; Plate **45**, fig. 3.)

The external form of the sponge is irregular and variable. Thus R.N. x. 1 (Plate **44**, fig. 2) forms a flat, spreading crust about 8 mm. in thickness, with an uneven, nubbly

surface and strongly hispid in places, especially along part of the margin, where dense tufts of oxea project for as much as 3 mm.; the entire crust is about 55 mm. in length and 27 mm. in greatest breadth; irregularly oval in shape. R.N. x. 2 and x. 3 are essentially similar to R.N. x. 1. R.N. vi. (Plate **44**, fig. 2 *a*), on the other hand, has the form of a thick, vertical, wall-like plate, attached without any spreading base to a stone. The two sides of the plate are flattened but rather uneven, the margin broadly rounded, the surfaces alike, coarsely granular in appearance but at the same time slightly hispid in places. The entire specimen measures about 50 mm. in length, 30 mm. in height and 18 mm. in maximum thickness. R.N. ix. 1 closely resembles R.N. vi.

None of the specimens show any oscula. The texture is compact, firm and very harsh to the touch. Colour in spirit pale, dull yellow.

The skeleton is a dense, confused mass of large and small calthrops and small mesotriænes, penetrated here and there by loose wisps or bundles of oxea, running towards the surface. The relative numbers of the large and small calthrops vary greatly in different specimens. The microrhabds are abundantly scattered all through the sponge but are accumulated in an especially dense layer at the surface.

Spicules. (1) Large calthrops or short-shafted triænes (Plate **45**, figs. 3 *a*—3 *a*″). Rays generally about equal in length, sometimes straight and sometimes curved or crooked; sometimes sharp-pointed and sometimes rounded off, sometimes (in R.N. ix. 1) reduced to rounded knobs, so that the whole spicule may become almost spherical (fig. 3 *a*″); occasionally divided into two short branches at the extremity (figs. 3 *a*, 3 *a*′); size very variable; rays measured up to about 1·5 by 0·15 mm.

(2) Small calthrops or short-shafted triænes (figs. 3 *b*, 3 *b*′). Rays usually straight, gradually sharp-pointed; sometimes differing a good deal in length, while more frequently the three which are alone fully visible at the same time appear to be about equal; length very variable, say about 0·2 mm., with a diameter of about 0·03 mm. Numerous intermediate sizes between these and the large calthrops also occur.

(3) Mesotriænes (figs. 3 *c*—3 *c*″). The three cladi spring from about the middle of a short shaft. The cladi are always branched, usually bifurcating once only but occasionally twice. All the cladi and both ends of the shaft are gradually sharp-pointed. Size very variable, say about 0·2 mm. across the cladome, from tip to tip of cladi, in R.N. x. 1, but may be at least twice this size in R.N. vi. Each half (ray) of the straight, unbranched shaft (rhabdome) is about as long as the cladi. An abnormal form with four cladi has been met with and one with only one ray of the rhabdome developed.

(4) Oxea (fig. 3 *d*). Very long, straight and slender; tapering very gradually to each extremity; measured up to 7·7 by 0·04 mm.

(5) Amphiasters (fig. 3 *e*). The shaft between the two whorls of rays is so short that the spicule looks like an oxyaster, especially when seen obliquely or end on, but I think it is really an amphiaster. The rays are long, slender and sharply pointed, altogether about 10 in number. Total diameter of spicule about 0·016 mm. These spicules are abundantly scattered through the sponge.

(6) Smooth microrhabds (fig. 3 *f*). Oval, measuring about 0·012 by 0·006 mm. Extremely abundant throughout the sponge, but especially so at the surface. Sometimes

varying to more slender forms as shown in the figures, and even passing into the next form.

(7) Spined microrhabds (fig. 3 *g*). Slender; covered with minute short spines; measuring about 0·022 by 0·002 mm. (exclusive of spines), but variable. This spicule is extremely scarce in some specimens, though plentiful in others, so that it may very easily be overlooked. It seems to be a characteristic feature of the genus Triptolemus and is probably proper to Yodomia also. It may be a reduced streptaster.

The condition of the material and the character of the skeleton make it impossible to prepare satisfactory paraffin sections, but investigation by this method reveals the presence of an enormously thick, gelatinous ectosome. This tissue appears to be of the nature of that termed "chondrenchyme" by Sollas [1888]. Imbedded in the clear, gelatinous, faintly staining matrix are numerous oval, granular cells, about 0·02 mm. in diameter, each with a small nucleus and each surrounded by a well-defined shrinkage cavity or lacuna in the matrix, usually much larger than itself. The relative proportion of cells and matrix varies in different parts, but generally the cells lie pretty close together. The outermost portion of the ectosome is occupied by the thick layer of oval microrhabds.

This species in many respects resembles Lebwohl's *Yodomia ijimai* from Japan, but it differs in important details of spiculation. Thus the mesotriænes of *Y. ijimai* have simple cladi while in *Y. perfectus* they are branched; *Y. perfectus* has no long-shafted triænes and *Y. ijimai* appears to have none of the smooth oval microrhabds which are so abundant in our species.

Register Nos., Locality, &c. VI., IX. 1, X. 1, 2, 3, 4, all from Saya de Malha, 4.9.05, C. 1, 150 fathoms.

Family **Stellettidæ.**

Astrotetraxonida with long-shafted triænes; without calthrops, sterrasters and aspidasters. (In a number of genera and species with reduced spiculation, constituting the so-called family Epipolasidæ, the tetract megascleres have completely disappeared, while in certain forms the astrose microscleres seem to have vanished.)

The original Stellettids appear to have arisen by the development of long-shafted triænes and the radial arrangement of the megascleres in some primitive pachastrellid ancestor. It is a very remarkable and interesting fact that along a number of more or less distinct lines of descent within the stellettid family the power to produce tetract megascleres seems to have become exhausted and these lines have passed over into the monaxonellid condition. It was for such lines that Sollas [1888] proposed the family Epipolasidæ, which he placed as an "Appendix" to his Astrophora Euastrosa (= Stellettidæ). In the Epipolasidæ he recognised three genera, Amphius, Asteropus and Coppatias. His diagnosis of the family fully recognises the principle of the loss of tetract megascleres, it runs as follows:—"Euastrosa (?) without triænes, possessing oxeas and one or more forms of aster. The oxeas arranged partly in radiating fibres, partly scattered loosely

in the choanosome; in the ectosome they lie tangentially. The chamber system (so far as investigated) diplodal* " (p. 177).

Since 1888 a considerable number of species have been assigned to the " Epipolasidæ " and it has become increasingly evident that the group is of polyphyletic origin. It is perhaps not even certain that all Epipolasids are reduced Stellettids, for it is quite conceivable that similar reduction may have taken place in primitive Pachastrellids and given rise to Epipolasids which never passed through a stellettid stage in their ancestry. Apart from this question, however, it is by no means difficult to find, amongst the known Stellettidæ, genera, or even species, which seem to represent very closely the ancestors of certain Epipolasids. Sollas himself pointed out that " If *Asteropus* is a reduced *Stellettid* it is to *Stryphnus* that we must look for its nearest alliance " (*l.c.* p. 206). In another part of the same work, however, he expresses the strong opinion that "*Asteropus* has resulted from an *Algol* by the loss of triænes " (p. cxlii).

In 1905 I pointed out that the epipolasid genera Coppatias (now sunk in Jaspis) and Cryptotethya are evidently very closely related to Stelletta, and said that "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 " (p. 110).

Most remarkable, however, is the existence of three epipolasid species, viz. *Rhabdastrella distincta* Thiele, *Diastra sterrastræa* Row and *Aurora cribriporosa*, n. sp., each of which is represented by a closely related, triæne-bearing species in the stellettid genus Aurora. The relationships of these species will be discussed later on.

In view of these facts it seems to me that the time has now arrived when we may conveniently abandon the family Epipolasidæ altogether and distribute its members as best we can amongst the Stellettidæ, and, if subsequent research should render it necessary, amongst the Pachastrellidæ also.

Genus Myriastra Sollas [1886].

Stellettidæ with or without a distinct fibrous cortex and with only one form of microsclere, a chiaster.

This genus has been sunk by Lendenfeld [1903] in Stelletta, but it appears to me convenient to retain it, at any rate pending a much needed revision of the Stellettidæ. It seems impossible, however, to draw a real distinction between *Myriastra* and *Pilochrota*, for all degrees of development of the fibrous cortex occur in different species of these genera. I therefore propose to merge Pilochrota in Myriastra.

4. *Myriastra parva* (Row).

Pilochrota parva Row [1911].

This species is represented in the collection by a small fragment about 6 mm. in greatest diameter and of a pale, dull yellow colour.

* On p. 141 he says "aphodal."

The skeleton is dense, radially arranged, and the spiculation very typical, as follows :—

(1) Orthotriænes; with simple unbranched cladi; shaft straight, tapering gradually to a sharp point, measuring about 0·76 by 0·026 mm.; cladi gradually sharp-pointed, measuring about 0·15 by 0·026 mm.

(2) Anatriænes; numerous and frequently projecting beyond the surface. Cladi strongly recurved. Shaft very long and slender, measuring about 0·9 by 0·0086 mm. Cladi gradually sharp-pointed, about 0·034 mm. long.

(3) Oxea; straight or nearly so, fairly gradually and sharply pointed, measuring up to about 0·9 by 0·02 mm. Considerably shorter and more slender forms also occur.

(4) Chiasters (tylasters); very minute, with very slender rays and very small heads; total diameter about 0·008 mm. Scarce.

The cortex is very feebly developed and not sharply differentiated from the choanosome; say about 0·12 mm. thick. It contains very little fibrous tissue and the large subcortical crypts push their way through it to within a short distance of the surface, lying between the distal portions of the bundles of large orthotriænes, whose cladi are extended actually at the surface. The inhalant pores seem to open singly by short, narrow canals into the subcortical crypts. An inner zone of smaller orthotriænes extend their cladi beneath the subcortical crypts.

The "Sealark" fragment agrees closely with the type of the species from the Red Sea, as described by Row. I have examined one of Mr Row's preparations of the type and can find no important difference. I cannot find the slender, hair-like oxea which he describes and figures, but which I cannot regard as of any taxonomic importance.

The species is evidently closely related to Sollas's *Myriastra simplicifurca* [1888] from Torres Strait; differing, however, in the much smaller size of the spicules. It also comes near to Hentschel's *Stelletta tuberosa* [1909] from S.W. Australia, from which it differs in the form of the cladome of the anatriæne, the cladi being, usually at any rate, much more strongly recurved. Hentschel also mentions the occurrence of small, slender oxea here and there in the choanosome in his species. They are probably merely young individuals of the large oxea. Probably all three forms will have to be united as varieties of one and the same species, but it would be premature to do this at present.

Previously known Distribution. Red Sea (Row).

Register No., Locality, &c. LV. 1, Coetivy.

5. *Myriastra cavernosa* n. sp.

(Plate **44**, figs. 3, 3 *a*; Plate **46**, fig. 1.)

Sponge (Plate **44**, figs. 3, 3 *a*) massive, irregularly subspherical; without definite points of attachment but more or less thickly encrusted with nullipores and Orbitolites. Surface uneven, granular, occasionally hispid where well protected. A few rounded openings, say about 3 mm. in diameter, irregularly scattered between the débris on the surface, and without prominent margins, probably represent the vents. They communicate with the extensive system of wide canals which ramify all through the interior

of the sponge and give it its characteristic cavernous appearance when cut open. In the outer part of the sponge these canals often approach very close to the surface, being covered in only by a thin membrane. Texture compressible, resilient, fairly compact between the wide canals. Colour in spirit light yellowish grey. There are four specimens in the collection; three of these have each a diameter of about 40 mm., while the fourth is much smaller.

The skeleton, at any rate towards the surface, is radially arranged, consisting of large, stout oxea and orthotriænes grouped to some extent in loose, very ill-defined bundles. Most of the triænes are in the outermost portion and have their cladi extended at or very near the surface.

Spicules:—(1) Orthotriænes (Plate **46**, fig. 1 *a*); with stout, straight or nearly straight shaft, usually tapering very gradually to a fine point. Cladi simple, stout, nearly straight; extended nearly at right angles to the shaft but inclined slightly forward and then slightly recurved (may be slightly inclined forward again towards the apex). Shaft measuring up to about 2·0 by 0·066 mm., with cladi about 0·27 by 0·066 mm.

(2) Oxea (fig. 1 *b*); long, stout, fusiform, slightly and gently curved, usually gradually and sharply pointed at each end; measuring up to about 2·6 by 0·07 mm.

(3) Oxea (fig. 1 *c*); short, slightly curved, fairly sharply pointed at each end; measuring about 0·155 by 0·0086 mm. A few of these occur scattered through the choanosome; they are possibly foreign.

(4) Chiasters (fig. 1 *d*); small, with slender, slightly tylote rays; total diameter about 0·013 mm.

There is a good deal of fibrous tissue in the thin ectosome (only about 0·085 mm. thick), but the ectosome is not very sharply differentiated from the underlying choanosome and it is impossible to speak of a distinct cortex.

This species seems to differ from most species of Myriastra in the absence of the anatriæne, of which I have found no trace. Its curious cavernous character and general habit are also probably very distinctive.

Register No., Locality, &c. VII. 5, Saya de Malha, 6.9.05, C. 15, 55 fathoms. Four specimens.

Genus DRAGMASTRA Sollas [1888] *emend.*

Stellettidæ in which the microscleres consist of euasters and trichodragmata.

Sollas restricts this genus to corticate species in which the middle or collenchymatous layer of the cortex is crowded with trichodragmata. I have already pointed out that the degree of development of the cortex in the Stellettidæ is so variable, and so many transitions occur, that it does not form a satisfactory generic character. I therefore omit all reference to the cortex from the diagnosis of this genus.

Sollas [1888] expressly excluded Carter's *Stelletta lactea* from the genus Dragmastra, on the ground that "the orthodragmas [= trichodragmata], as stated by Carter, are confined to the choanosome, and there is no necessity therefore to assign it to *Dragmastra*, with which it is evidently not nearly related."

I cannot, myself, see why it is not nearly related to Dragmastra, and I find, in the

variety about to be described, that the trichodragmata occur in the cortex as well as in the choanosome. - I therefore think that Dragmastra is the genus to which *Stelletta lactea* must be assigned.

6. *Dragmastra lactea* (Carter) var. *mauritiana* nov.

(Plate **46**, fig. 7.)

Stelletta lactea Carter [1871 A].
Stelletta lactea Norman [Bowerbank 1882].
Pilochrota (?) *lactea* Sollas [1888].
Pilochrota lactea Topsent [1894 G].
Stelletta lactea Lendenfeld [1903].

Mr Carter originally described this species from the coast of Devonshire, and stated that it is "massive, spreading, fixed, following and filling the cavities of deciduous small boring shells (*Saxicavæ*) and Annelids, which confine themselves to the surface of the sandstone rock in which they live, almost entirely concealed by overgrowths of small Cirripedes and Fuci, and communicating with the exterior only through the openings of the cavities mentioned."

It is very interesting to find a closely related form, obviously a variety of the same species, adopting a similar "cryptozoic" mode of life at Mauritius.

The single specimen forms a thin crust, growing upon a horny sponge (R.N. CXXVI. 4) beneath a specimen of *Latrunculia* (R.N. CXXVI. 4 C). The main skeleton consists of dichotriænes and oxea; the dichotriænes being mostly arranged in loose brushes with their cladomes just beneath the surface, while others are irregularly scattered in the deeper parts of the sponge. A few of the oxea are radially arranged, but most of them seem to be irregularly scattered, singly or in bundles.

Spicules:—(1) Dichotriænes (Plate **46**, fig. 7 *a*); shaft short and stout, gradually sharp-pointed, characteristically bent somewhat to one side at about one quarter of its length below the cladome, measuring about 0·4 by 0·0258 mm; cladi very short, each bifurcating into two short, sharply conical branches about equal in length to the main branch; total diameter of cladome about 0·1 mm. A few much more slender triænes, with unbranched cladi, also occur; these I take to be young forms of the dichotriænes.

(2) Oxea (fig. 7 *b*); nearly straight, fusiform; gradually and fairly sharply pointed; measuring about 0·75 by 0·02 mm., but frequently more slender.

(3) Oxyspherasters (fig. 7 *c*); very minute, sometimes with well-developed centrum and numerous very slender rays about as long as the diameter of the centrum, but the proportions are variable; total diameter about 0·008 mm. Especially abundant in a superficial layer. A few (fig. 7 *d*) occur as much as 0·016 mm. in diameter, usually with long, slender rays and relatively small centrum.

(4) Trichodragmata (fig. 7 *e*); very numerous in some parts of the sponge, rare in others; measuring about 0·02 by 0·004 mm.

The small size and general condition of the sponge do not allow of my saying much about its minute anatomy or histology. There is no distinct fibrous cortex, but there appears to be a thick gelatinous ectosome (about 0·86 mm. thick), distinguished by its lighter colour and clearer appearance from the underlying choanosome.

This variety differs from the type of the species chiefly in the much smaller size of the megascleres and in the fact that all the triænes when full-grown seem to be dichotriænes.

Previously known Distribution. Devonshire coast (Carter); French coast (Topsent).

Register No., Locality, &c. CXXVI. 4 E, Mauritius, 23.8.05.

Genus RHABDODRAGMA n. gen.

Stellettidæ with (?always) a very strongly developed, partly fibrous cortex. The microscleres include asters, microrhabds and trichodragmata.

This genus stands in the same relation to Sollas's Psammastra as that in which the same author's Dragmastra stands to Stelletta. Stelletta includes forms without microrhabds and without trichodragmata, while Dragmastra includes forms with trichodragmata but no microrhabds. Psammastra includes forms with microrhabds but without trichodragmata, and is perhaps indistinguishable from Ecionemia, while Rhabdodragma includes forms with both microrhabds and trichodragmata, in addition, of course, to the asters.

Topsent's genus Sanidastrella [1892 D] cannot, in my opinion, be distinguished from Psammastra, for the so-called sanidaster merges into the microrhabd type of spicule, as the figures given by Topsent [1894 G] clearly show.

We have here a group of usually corticate Stellettidæ which are evidently all closely related to one another but in which the microscleres show great variation from genus to genus. The presence or absence of such distinct types of microsclere as microrhabds and trichodragmata appears to me to afford good ground for generic distinction, and the same may be said of the characteristic spherasters of the genus Aurora and the sterrasters of the Geodiidæ and Erylidæ, but we cannot attribute a like value to the extremely variable oxyasters (and chiasters and other related forms), as Lendenfeld [1903] has done in attempting to differentiate subgenera of Stellettidæ.

Kieschnick's *Psammastra conulosa* from Ternate, first adequately described by Thiele [1900], is the type and so far only known species of the genus, and it is extremely interesting to meet with this little-known sponge again at Cargados Carajos.

7. *Rhabdodragma conulosa* (Kieschnick).

(Plate **44**, fig. 7; Plate **47**, fig. 1.)

Psammastra conulosa Kieschnick [1896].
Psammastra conulosa Thiele [1900].

There are in the collection three specimens of this remarkable sponge, two large and one small, all from Cargados Carajos. The type specimens, from Ternate, were only about 1 cm. in diameter, but the smallest of the "Sealark" specimens has a diameter of about 2 cm., while the largest has a diameter of about 6 cm., being nearly as large as a cricket ball. The external appearance (Plate **44**, fig. 7)

is very characteristic, the surface being beset with irregularly arranged, more or less elongated conuli. These conuli are stiff and supported by spicule bundles. In addition to the conuli there are short, root-like attaching processes on the lower surface. Between the conuli the surface is in many places minutely reticulate, with pore-sieves in the meshes of the reticulation. There are no conspicuous vents, and it appears probable that the exhalant openings are covered over by sieve-nets. The smallest specimen is almost spherical, but the two larger ones are both slightly flattened dorsoventrally, and the largest (fig. 7) has a rather prominent equatorial ridge, dividing the more flattened upper from the more convex lower surface; on this ridge the conuli are especially numerous. The colour in spirit is dark purplish-brown. All the specimens show clearly the small white specks due to the accumulation of trichodragmata just beneath the surface, as described by Thiele. The texture is firm and compact.

The cortex, in the largest specimen, is about 3 mm. thick. It is divided into two very distinct layers, an outer, soft, pigmented one, to which the colour of the sponge is due, and an inner, very dense, fibrous one with only occasional pigment cells. The inner, fibrous layer is very much more strongly developed than represented in Thiele's figure, the difference being no doubt correlated with the much larger size and presumably greater age of the specimen. It makes up considerably more than half the thickness of the cortex and is composed of an extremely dense interlacement of fibre-tracts running in all directions. From its outer surface fibre-tracts run into the outer layer of the cortex, where they form a loose network, concentrated, however, towards the surface and around the radially arranged bundles of megascleres. In the meshes of this network lie the large vesicular pigment cells described by Thiele, the pigment being most strongly developed in the deeper part of the layer. The outer layer of the cortex also contains great rounded masses of trichodragmata.

The inner layer of the cortex is pierced by narrow canals, which may branch and anastomose with one another and frequently unite to form wide chones, and whose course is clearly marked out by the microrhabds lying in their walls. In the outer layer of the cortex the canals are not easy to follow, but they appear to be still narrow and no doubt lead inwards from the dermal pores.

Beneath the fibrous layer of the cortex there is a much thinner collenchymatous layer containing numerous subcortical crypts. This layer also contains a good many pigment cells.

I am unable to say anything definite about the exhalant canal system, but there is good reason to believe that it is similar to that described by Topsent [1894 G] for his *Sanidastrella coronata*, a sponge which is obviously nearly related to our species. In that sponge the exhalant canals open at the sides of the much elongated dermal appendages (corresponding to the conuli of Rhabdodragma), not by large openings but through sieves. At the same time it seems probable that in our species the exhalant openings are not confined to the conuli.

The skeleton of the choanosome is very dense, consisting of pretty closely packed, radially arranged, large oxea and plagiotriænes. Most of these terminate below the cortex, but here and there, at wide intervals, dense bundles of oxea and plagiotriænes penetrate

the cortex and either reach the surface of the sponge between the conuli or are continued into the conuli.

Spicules:—(1) Plagiotriænes (Plate **47**, fig. 1 *a*); with stout shaft and short, stout, often somewhat incurved cladi; shaft sharply and very gradually pointed, cladi sharp or blunt; shaft about 2·5 by 0·068 mm.; cladi about 0·14 by 0·04 mm.

(2) Oxea (fig. 1 *b*); stout, fusiform, straight or nearly so, gradually and finely pointed at both ends or with ends somewhat blunted; measuring sometimes as much as 4 by 0·07 mm.

(3) Chiasters (fig. 1 *c*); with about eight rather slender, usually slightly roughened rays each ending in a small oval knob (I have seen one specimen with spiny instead of knobbed ends, as described and figured by Thiele); usually about 0·02 mm. in total diameter but sometimes nearly twice as much.

(4) Slender oxea (fig. 1 *d*); straight, gradually sharp pointed at each end, with very faintly roughened surface; measuring about 0·266 by 0·005 mm.

(5) Microrhabds (fig. 1 *e*); short, thickly covered with small, short spines; varying in diameter; say about 0·012 by 0·004 mm., including spines. Especially abundant in the dermal membrane.

(6) Trichodragmata (fig. 1 *f*); each dragma about 0·03 by 0·012 mm.; readily breaking up into hair-like raphides. Enormously abundant and sometimes collected in large oval or spherical masses, especially in the outer part of the cortex.

A careful comparison with Thiele's excellent description and figures leaves no doubt as to the specific identity of the "Sealark" with the Ternate specimens. Yet Lendenfeld [1903] speaks of the asters as "oxyasters" (Thiele simply calls them asters), while in our specimens they are chiasters with knobbed ends, the difference between the two being extremely minute; and Thiele regards the spiny microrhabds as sanidasters! These facts show the utter hopelessness of basing generic distinctions upon oxyasters and sanidasters as distinct from chiasters and microrhabds. I think a comparison of my figures of the spicules with those given by Thiele will fully justify the identification.

Previously known Distribution. Ternate (Thiele).

Register Nos., Locality, &c. LXXVIII. 1 A, B, 3, Cargados Carajos, 28.3.05, B. 2, 30 fathoms.

Genus ECIONEMIA Bowerbank [1862 c].

Stellettidæ in which the microscleres include microrhabds in addition to euasters; the former are commonly minutely spined or roughened and usually form a dermal layer. There are no trichodragmata.

I accept this genus in the same sense as that in which I employed it in my Ceylon Pearl Oyster Report [1905]. I cannot at present enter into the very difficult and complex question of its relationship to Ancorina and other stellettid genera and sub-genera, but I may say that neither the arrangement of Sollas [1888] nor that of Lendenfeld [1903] appears to me satisfactory. There can be no doubt that the species which I include in Ecionemia are closely related to *E. acervus*, Bowerbank's type of the genus.

8. *Ecionemia carteri* Dendy.

Ecionema carteri Dendy [1905].

This species is represented in the collection by a number of specimens, varying in shape from almost spherical to irregularly massive, and in colour from light to dark brown. They agree very closely with the Ceylon form and I need add nothing to my original description except the statement that granular brown pigment cells occur in very varying numbers in the outer parts of the sponge, both in the Ceylon and in the "Sealark" specimens.

Previously known Distribution. Ceylon (Dendy).

Register Nos., Localities, &c. LII. 3, 6, Coetivy; LXXI. 2, Amirante, 17.10.05, E. 21, 30 fathoms; LXXVIII. 18, Cargados Carajos, 28.3.05, B. 2, 30 fathoms.

9. *Ecionemia laviniensis* Dendy.

(Plate **44**, fig. 6; Plate **46**, fig. 5.)

Ecionema laviniensis Dendy [1905].

There is a single specimen (Plate **44**, fig. 6) of this species in the collection, considerably larger than the type; irregularly massive, potato-like, in form, and measuring 46 mm. in longer diameter. The surface is marked here and there by very irregular, strongly hispid grooves, some of which contain openings which may be vents. Elsewhere the surface is rather uneven, granular and minutely porous. Only a small quantity of calcareous débris is attached to the surface. The texture is hard, incompressible. The colour in spirit is light purplish brown.

In spiculation this specimen agrees closely with the type, but the cladi of the dichotriænes (Plate **46**, figs. 5 *a*, 5 *a'*) are stouter, while the microstrongyla (fig. 5 *g*) appear on an average to be somewhat smaller. Minute chiasters with stout cylindrical rays (fig. 5 *d*) and small, slender-rayed oxyasters (fig. 5 *e*) are both present, together with intermediate forms (figs. 5 *e*, 5 *f*).

Previously known Distribution. Ceylon (Dendy).

Register No., Locality, &c. XI. 2, Saya de Malha, 7.9.05, C. 19, 29 fathoms.

Genus AURORA Sollas [1888].

Stellettidæ in which the principal microscleres are large spherasters (or sterrospherasters), accumulated especially in a cortical layer.

This genus was proposed by Sollas [1888] for the reception of Carter's *Stelletta globostellata* and *S. reticulata*. Lendenfeld [1903] has again merged it in Stelletta, and in this respect he has been followed by Hentschel [1909], but the large spheraster (or sterrospheraster) forms such a characteristic and well-defined feature, and so many species are now known, that it seems to me desirable to retain Sollas's genus. To Carter's species must be added, as typical members of the genus, Hentschel's *Stelletta aurora* [1909] and *Isops membranacea* [1909], and two new ones to be described presently under the names

Aurora providentiæ and *A. rowi*. In addition I propose to include in this genus three reduced or 'epipolasid' species, viz. *Coppatias* (*Rhabdastrella*) *distinctus* Thiele [1900], *Diastra sterrastræa* Row [1911] and *Aurora cribriporosa* n. sp.

Aurora globostellata remains the type of the genus, and I therefore call special attention to the fact mentioned later on (p. 247), that it probably does not possess trichodragmata*, as described by Sollas.

The genus is of great phylogenetic interest as representing almost certainly the starting point for the evolution of the Geodiidæ, as well as for other reasons. To work out this problem as fully as it deserves would require more time and material than I at present have at my disposal, but the following considerations appear to me to leave little doubt as to the results which such an investigation would yield.

The Geodiidæ are, as is well known, distinguished by the possession of a very peculiarly modified spheraster, known as the sterraster, and these spicules form a dense cortical crust. In the more typical forms of Aurora, such as *A. globostellata* and *A. providentiæ*, the characteristic microsclere is a large spheraster with conical rays, very like that of Donatia or Chondrilla, and these also are arranged in a cortical layer. Now in certain species of Aurora, such as *A. membranacea* (Hentschel), *A. sterrastræa* (Row) and *A. rowi*, n. sp., the typical spheraster is either associated with or replaced by a peculiarly modified spheraster resembling a sterraster, which I propose to call a *sterrospheraster* (Plate **46**, fig. 4 *c*). What appears to be this type of spicule was indeed actually described as a sterraster by Hentschel [1909] in his *Isops* (*Aurora*) *membranacea*. The same type of spicule was described by Row [1911] in his *Diastra sterrastræa*, which may be looked upon as an Aurora with reduced spiculation. Row pointed out the resemblance which it bears to a sterraster. He also noted the absence of a "hilum," and it is possible that this may prove to be a distinctive feature of the sterrospheraster, though I think it hardly likely.

Row gave some account of the development of the sterrospheraster in Diastra, and I have been able to work it out somewhat more fully in the case of *Aurora rowi* (*vide infrâ* and Plate **46**, fig. 4). It certainly resembles pretty closely the development of a typical geodiid sterraster, but at the same time it passes through a stage in which it is a fairly typical spheraster, identical, in fact, with the spheraster of *Aurora aurora*, which has no sterrospherasters. There can be no doubt that the typical spheraster of Aurora, the sterrospheraster, and the sterraster of Geodia, are all closely related spicule-forms, the sterrospheraster being in some respects intermediate between the other two. At the same time we must not forget that a "sterrospira," practically indistinguishable in the adult condition from the sterraster of the *Geodiidæ*, has arisen independently in the spirastrellid genus *Placospongia*, as shown by Vosmaer and Vernhout [1902].

The sterrospheraster, however, actually occurs in certain undoubted Geodiidæ, as, for example, *Geodia carteri* Sollas [1888, p. 247], associated with true sterrasters. Carter, who originally described that species from the south coast of Australia under the name *Geodia canaliculata*, Sdt., and figured the spicules [1883 B], regarded the sterrospheraster

* Sollas [1888] uses the term "orthodragma," but the spicules in question are identical with the spicules described by Ridley and Dendy [1887] as "trichodragmata."

as an abnormal form of spicule*. That this is not the case I have convinced myself by examination of Mr Carter's preparations now in my possession. Schmidt [1868] certainly figured a very similar spicule in his *Geodia canaliculata*, but it is not clear, from the descriptions given by him and by Sollas [1888], whether or not it is associated in this case with a typical sterraster, *i.e.* whether the species is a Geodia or an Aurora.

It is obvious from what has been said that the genus Aurora bridges over to a very large extent the gap between the Stellettidæ and Geodiidæ, and the fact that Hentschel described as a geodiid (*Isops*) a species which I feel constrained to place in the genus Aurora, affords eloquent testimony to the close relationship of the two families†. If asked exactly where we ought to draw the line between the two, I should say that further minute anatomical investigation is needed before the question can be answered. Provisionally we may take the typical, hilum-bearing sterraster as a distinctive feature of the Geodiidæ. The sterrospheraster occurs in both families and cannot be regarded as distinctive of either; indeed we cannot even regard it as affording the basis of a generic separation from Aurora, because of its close relationship to the typical spheraster, the gap between the two being completely bridged over by the adult spheraster of *Aurora aurora* and *A. reticulata* and the developmental stages of the sterrospheraster. There is just the possibility that the spheraster of *Aurora aurora* is not a true spheraster but represents a case of convergence, and that true spherasters do not develop in the same manner as sterrospherasters, but this does not seem very likely, and in any case more information is wanted before we can settle the point.

The close relationship between the Geodiidæ and Stellettidæ was recognised many years ago by Czerniavsky [1879], who proposed the sub-genus Stello-geodia for a species (*Geodia stellosa*) which he regarded as intermediate between the two, with the following diagnosis:—"Membrana sarcodea superficialis, corticem tegens, *stellulas minimas* numerosas breviradiatas continens. Parenchyma præter *globulos* siliceos *stellas* majores numerosas pauciradiatas continet." The author evidently regarded the presence of euasters in addition to the "siliceous globules" as the distinguishing feature of his sub-genus, but such euasters as he figures of course occur abundantly in the genus Geodia itself and are by no means distinctive. On the other hand, it seems probable from his figures and description that the "siliceous globules" are not true sterrasters, and that the sub-genus may be identical with Aurora. The description and figures, however, are not sufficiently accurate to enable me to decide this point, and it hardly seems necessary to abandon the generic name Aurora in favour of Stello-geodia, especially as the type species of the latter appears to contain tylostyles, which are not met with in Aurora, though possibly these spicules are only abnormal forms of the oxea.

As already indicated above, the transition from the tetractinellid to the epipolasid condition by loss of the triæne megascleres appears to have taken place at least three times in the genus Aurora. At any rate there are three epipolasid species each of which

* This is also the view taken by Lendenfeld [1910 A] of the spicules termed by him "sterroids" (*e.g.* in *Geodia variospiculosa*), which seem to be identical with the sterrospherasters.

† It is not impossible that several other species at present included in the Geodiidæ, such, for example, as Hentschel's *Geodia punctata* [1909], may be shown by future research to be Auroras.

is evidently closely related to a corresponding species of Aurora which still retains its triænes. *Aurora* (*Rhabdastrella*) *distincta* (Thiele), with large smooth spherasters but without triænes, is closely related to *Aurora globostellata* (Carter) with large smooth spherasters and triænes. *Aurora cribriporosa*, n. sp., with large rough spherasters but without triænes, is closely related to *Aurora providentiæ*, n. sp., with large rough spherasters and triænes; and *Aurora* (*Diastra*) *sterrastræa* (Row), with sterrospherasters but without triænes, is closely related to *Aurora rowi*, n. sp., with sterrospherasters and triænes.

Aurora (*Rhabdastrella*) *distincta* was first described by Thiele [1900] as a Coppatias, but he subsequently [1903] separated it from Coppatias under the new generic name *Rhabdastrella*.

Aurora sterrastræa was described by Row in 1911 and also recognised as an epipolasid, for which the new genus Diastra was instituted. If these genera were to be retained it would, I think, be necessary also to propose a new genus for *Aurora cribriporosa*, but all three genera would have to be based upon very inadequate characters. We cannot include all three species in a single genus distinct from Aurora unless we are willing to retain that single genus merely as an artificial one of polyphyletic origin, and any argument in favour of doing this would apply equally to the case of the so-called family Epipolasidæ. There seems nothing for it, then, but to abandon the genera Rhabdastrella and Diastra and place all three species in Aurora. It may be said that we ought also to abandon the genera Amphius, Asteropus and Jaspis (Coppatias), and this I shall be quite prepared to do when I feel as certain about their origin from particular tetractinellid genera as I do in the case of Diastra and Rhabdastrella.

In this connection it is also necessary to say something about Sollas's genus Magog [1888], which was proposed for the reception of Carter's *Chondrilla sacciformis* [1879 B]. This species was described by Carter as having "acerates" (oxea) and "globostellates" (spherasters). Sollas accepted this as correct after examination of one of Carter's slides, and diagnosed the genus Magog thus:—"Tethyidæ in which the rhabdus spicule is an oxea, which is confined to the choanosome."

Were the spiculation of *Chondrilla sacciformis* really as described I think we should be obliged to accept that species also as an epipolasid Aurora. I have in my possession, however, in Mr Carter's cabinet, two microscopical preparations of his *Chondrilla sacciformis*, one consisting of teased fragments mounted in balsam and the other of a number of fair-sized fragments put up dry in a cell. I have examined sections and boiled-out spicules from one of these fragments, but neither in these preparations nor in Carter's own balsam slide can I find any oxea at all. The species is a genuine Chondrilla, identical with Thiele's *Chondrilla grandistellata* [1900]. As to how the mistake arose I can only surmise that the preparation from which Carter's original description was taken, and which is now presumably lost, must have contained, as accidental inclusions, oxeote megascleres of *Rhaphidhistia spectabilis*, which Carter described as a thinly encrusting sponge growing on the same mass as *Chondrilla sacciformis*. That the preparations now in Mr Carter's cabinet, and labelled by himself "*Chondrilla sacciformis*," were made at a later date than the original description seems certain, as they bear the date 1881. That they were taken

from one or more of the original types (there were several specimens on the same mass) seems also certain, for one of the slides is labelled "Bk. Coll. 701. Mauritius," and this number and locality are quoted in the original description. Moreover the size and form of the large spherasters are extremely characteristic (*vide infrâ*, p. 269 and Pl. **48**, fig. 8).

The genus Magog therefore must fall to the ground, (1) as being based upon a serious misconception as to the characters of the type species, which is a genuine Chondrilla, and (2) because even were the type species as represented it would have to be regarded merely as a reduced Aurora.

It seems quite probable that the genus Chondrilla itself has been derived from Aurora by complete loss of *all* the megascleres, and not only of the triænes.

10. *Aurora providentiæ* n. sp.

(Pl. **46**, fig. 2.)

This species is represented by a thin crust, about 25 mm. in greatest breadth, which has apparently been pared off some other object, or possibly sliced off from the surface of a larger specimen of the same species, but if the latter hypothesis be correct it is remarkable that the specimen in question is missing from the collection*. The shape of the fragment is quite irregular. The upper surface is fairly smooth and shows two sieve-like groups of openings, of very varying size, which are evidently oscula. There are a large number of small calcareous foreign bodies scattered over the surface. Colour in spirit pale, dull yellow. Texture cavernous.

There is a thin, fibrous cortex, about 0·1 mm. thick, containing numerous large and small spherasters in its outer portion, and pierced at wide intervals by inhalant chones. Each chone is divided into ectochone and endochone by a thin diaphragm perforated by a pore. The ectochone terminates externally in a single (?) dermal pore, the endochone merges indistinguishably into a subcortical crypt.

In the deeper part of the sponge the skeleton consists of loose bundles of oxea running towards the surface, with many loose oxea scattered between. As these bundles approach the surface they spread out into brushes composed mainly of slender oxea and orthotriænes, the cladi of the latter being extended in or beneath the fibrous cortex, below the layer of large spherasters.

Spicules:—(1) Orthotriænes (Plate **46**, fig. 2 *a*). Shaft varying from gradually and finely pointed to rounded or even knobbed at the extremity. Cladi usually simple, gradually and sharply pointed; rarely bifid for a short distance at the extremity. Shaft measuring about 0·5 by 0·017 mm., but variable; cladi about 0·14 by 0·013 mm., but also variable.

(2) Anatriænes (figs. 2 *b*, 2 *b'*, 2 *b''*). Minute, with long, hair-like shaft and widely extended cladi curving backwards almost on arcs of a sphere. Shaft about 0·37 by 0·001 mm. Cladome about 0·0164 mm. across from tip to tip of cladi; cladi about

* The fact that *Aurora* (*Isops*) *membranacea* [Hentschel 1909] forms a thin crust suggests that *A. providentiæ* not improbably has a similar form.

0·001 mm. in diameter at base, but may be reduced to a mere knob (fig. 2 *b''*). These spicules are very rare in the boiled out preparations, but paraffin sections show them in considerable numbers piercing the cortex and usually projecting freely from the surface, where their cladomes are generally broken off.

(3) Oxea (fig. 2 *c*, 2 *c'*). Very slightly curved, usually gradually and finely pointed at each end; measuring up to about 0·84 by 0·02 mm., but varying a good deal, both in length and diameter, and often very slender.

(4) Large spherasters (fig. 2 *d*); with large centrum and generally sharp-pointed, conical rays, usually more or less roughened on their sides, especially towards the apex; total diameter about 0·04 mm., with rays about 0·008 mm. long. Very numerous, especially in the cortex. Occasionally the rays are all blunted and roughened at the ends, very much as in Hentschel's *Aurora* (*Stelletta*) *aurora* [1909].

(5) Small spherasters and oxyasters (fig. 2 *e*); total diameter about 0·008 to 0·02 mm., variable. Some of these are probably early stages of the large spheraster, but I doubt if this is the case with all.

(6) Oxyasters (fig. 2 *f*); rather large, with straight, moderately stout rays, about 6 or 8 in number and usually more or less roughened. Sometimes there is a small but distinct centrum. Total diameter of spicule about 0·07 mm.

This species is evidently related not distantly to Carter's *Aurora* (*Stelletta*) *globostellata* from Ceylon [1883 B], which has never been satisfactorily described. I have two preparations in Mr Carter's cabinet, evidently made from the type, though labelled "*Stelletta globostellifera.*" From an examination of these I find that the principal points in which Carter's species differs from *Aurora providentiæ* are as follows:—(1) The large spheraster has a somewhat smaller centrum and the rays are rather longer, smooth, and often blunted at the ends; (2) The large oxyaster is represented by a smaller spicule with long and very slender rays (apparently the "chiaster" of Sollas's description [1888] but reaching a total diameter of 0·045 mm., whereas Sollas gives 0·015 mm.). I have found no anatriænes, but these are so minute and the cladomes are so easily broken off in the "Sealark" species that I cannot attribute any great importance to their apparent absence in *A. globostellata*. Sollas gives an "orthodragma" as a constituent of the spiculation in *A. globostellata*, but I can find none in Carter's slides nor does Carter himself mention it, so we must suppose that Sollas has made a mistake in this respect. He does not say how he obtained his information.

It is also evident that our species is related to Hentschel's *Aurora* (*Stelletta*) *aurora*, from S.W. Australia, but the details of spiculation afford quite sufficient differences to separate the two.

Register No., Locality, &c. LXXXVI. 2, Providence, 4.10.05, D. 4, 50—78 fathoms.

11. *Aurora cribriporosa* n. sp.

(Plate **44**, fig. 4; Plate **46**, fig. 3.)

The single specimen (Plate **44**, fig. 4) has a broad, oval base of attachment, from which it rises up on all sides like a hillock, culminating in a somewhat excentrically

placed, rounded apex bearing a group of between twenty and thirty minute, sphinctrate vents of varying sizes. The surface is smooth and only slightly uneven; minutely punctate under a pocket lens owing to the thickly and for the most part uniformly scattered pore-sieves. The texture is rather leathery owing to the well-developed cortex, internally somewhat cavernous owing to the more or less radially arranged canals. Colour, throughout, brown, not very dark (in spirit). A small amount of calcareous débris is attached to the surface but there seems to be little or none internally. The longer diameter of the base measures 34 mm., the shorter diameter 17 mm., and the maximum height from base to apex about 17 mm.

The cortex is fibrous and about 0·35 mm. thick. It is much excavated, however, by the large inhalant chones, each divided into ectochone and endochone. The ectochone is conical in shape, with the broad base turned outwards and formed by the thin sieve-membrane pierced by numerous inhalant pores. The ectochone is separated from the endochone by a moderately thick diaphragm of fibrous tissue pierced by a single pore which occupies the apex of the cone. The endochones merge insensibly into the large, irregular, subcortical crypts, which unite together in groups and give rise to the wide inhalant canals which penetrate to the interior of the sponge.

The mesoglœa of the choanosome is finely granular, penetrated by numerous narrow, branching canaliculi. The chamber system cannot be satisfactorily made out in my preparations.

The main skeleton is an irregular feltwork of moderate-sized oxea. These are present abundantly in the fibrous cortex, as well as in the choanosome. Indeed, they almost seem to form a special cortical layer, being arranged paratangentially, while beneath the cortex there is a tendency towards radial arrangement. The radial ones also frequently penetrate the cortex with their outer ends. There are also in the cortex numerous very much smaller, slender oxea, arranged radially and with their outer ends, now mostly broken off, projecting slightly beyond the surface.

The outermost part of the cortex and the thin, pore-bearing membrane which covers over the inhalant chones are densely charged with minute spherasters; beneath this layer lie numerous large spherasters, practically confined to the outer half of the cortex, where the fibrous tissue is less strongly developed. Slender-rayed oxyasters, together with a few of the other kinds, occur scattered through the choanosome.

Spicules:—(1) Oxea (Plate **46**, fig. 3 *a*); very slightly curved, fusiform, usually gradually and finely pointed at each end, occasionally blunted or even becoming stylote, and occasionally with short abnormal branches. Measuring up to about 0·7 mm. in length. Thickness very variable, up to about 0·025 mm. but usually more slender.

(2) Slender cortical oxea; slightly curved; ends varying from sharply and gradually pointed to rounded off. Size about 0·2 by 0·004 mm.

(3) Large spherasters (fig. 3 *b*); with large centrum and conical rays beset with short spines. Total diameter about 0·0287 mm.

(4) Spherasters (fig. 3 *c*); with small centrum and numerous long, slender rays; diameter about 0·016 mm. Fairly common in the cortex; possibly young forms of the large spheraster.

(5) Minute spherasters (fig. 3 *d*); with moderately large centrum and numerous short, strongylote rays; total diameter about 0·008 mm.

(6) Oxyasters (fig. 3 *e*); with no centrum and about 6 or 7 long, slender, slightly roughened rays, usually strongylote. Total diameter about 0·04 mm. Very abundant in the choanosome.

This species must, as already stated, be regarded as derived from some form closely related to *Aurora providentiæ* by loss of the triænes. It is also nearly related to *Aurora* (*Rhabdastrella*) *distincta* Thiele [1900] from Ternate, differing mainly in its rough spherasters.

Register No., Locality, &c. CXIX. 12, Salomon.

12. *Aurora rowi* n. sp.

(Plate **44**, fig. 5; Plate **46**, fig. 4.)

The single specimen (Plate **44**, fig. 5) is an irregularly rounded, massively lobose sponge, attached to a calcareous nodule very much smaller than itself. (There are indications that at least one other large foreign body has been removed from the surface.) The specimen measures about 36 mm. in height, 41 mm. in breadth, and has a very varying thickness up to about 25 mm. The surface is subglabrous; minutely punctate under a pocket lens, and has a curious crumpled appearance, with irregular meandering grooves of varying depth. The oscula are of moderate but variable size, measured up to 2 mm. in diameter; few in number, scattered singly; without prominent margins. The inhalant pores are scattered singly on the surface of the sponge, each in the middle of a small polygonal area.

The colour in spirit is a uniform chocolate brown throughout. The texture is compressible but resilient; fairly compact, but with a tendency towards the inclusion of rather large foreign bodies.

The skeleton is not very dense and somewhat confused, but on the whole shows a marked radial arrangement, consisting principally of very loose wisps of large oxea running towards the surface. In the more superficial part of the sponge occur numerous radially arranged orthotriænes with cladi extended beneath a dermal crust of sterrospherasters and small spherasters.

Spicules:—(1) Orthotriænes (Plate **46**, fig. 4 *a*); shaft well developed, straight, gradually sharp-pointed, measuring about 0·74 by 0·023 mm. Cladi unbranched, slightly recurved, sharply pointed, about 0·16 mm. long.

(2) Oxea (fig. 4 *b*); rather slender, straight or very slightly curved; gradually and sharply pointed at each end, measuring about 1·1 by 0·023 mm.

(3) Sterrospherasters (figs. 4 *c*—4 *h*). The full-grown spicule (fig. 4 *c*) is spherical, with a very large, solid centrum whose surface is covered with close-set, irregular, flattened protuberances, incompletely separated from one another by narrow grooves which form a reticulate pattern. The diameter of the spicule is about 0·04 mm. The development of this spicule is very interesting. The first stage (fig. 4 *d*) is a slender-rayed oxyaster, but apparently the rays may sometimes be truncated (fig. 4 *d'*). A distinct

centrum is then developed between the basal portions of the rays, and the whole spicule at the same time increases in size (figs. 4 *c*, 4 *c'*). As the centrum grows larger the rays grow longer and increase in number. They may still be either sharp-pointed (fig. 4 *f*) or truncated (fig. 4 *f'*), but remain slender, so that their bases stand far apart from one another on the surface of the spherical centrum. As growth proceeds the rays begin to thicken and become bluntly conical. The radius of the centrum is now growing more rapidly than the length of the rays, so that the intervals between the latter become to a large extent filled up, the ends of the rays forming blunt conical projections on the surface of a sphere (fig. 4 *g*). Short spines are now developed at the ends of the rays (fig. 4 *h*). The spheraster has now reached what appears to be the adult condition in *Aurora* (*Stelletta*) *aurora* Hentschel [1909]*. The adult condition in our species (fig. 4 *c*) appears to be arrived at by further development of the terminal spines and by their fusion with one another to form the enlarged extremities of the rays, and with those of adjacent rays to form bridge-like connections between these extremities. There seems to be little doubt that we have here a very interesting case of the recapitulation of phylogenetic history, the penultimate stage in the development of the sterrospheraster, with terminally spined rays, representing an ancestral condition which is still retained as the adult form in *A. aurora*. The oxyaster with which the development commences, and the various intermediate stages, no doubt also represents ancestral adult forms.

The sterrospheraster and its developmental stages are abundantly scattered through the choanosome. The adult form is especially abundant in the cortex.

(4) Small, irregular spherasters without any distinct rays but merely a nubbly surface (fig. 4 *j*). Varying in diameter up to about 0·0082 mm., but usually a good deal smaller. These spicules look as if they might owe their origin to the separation of the enlarged extremities of the rays of the sterrospherasters. They resemble these extremities closely in shape, and usually also in size, though some of them are larger. I have, however, found no evidence of such an origin, and they are probably independent spicules, homologous with the strongylasters of *Aurora aurora*. They are scattered abundantly throughout the sponge, but are especially numerous in the cortex.

(5) Oxyasters (fig. 4 *k*); minute, slender-rayed, with no distinct centrum and about 5 or 6 rays; total diameter about 0·0165 mm. It is very doubtful whether these can be sharply distinguished from the early stages of the sterrospheraster.

The condition of the specimen does not permit of my giving a detailed account of the canal-system and histology, but the following particulars may be noted. There is a thin, fibrous cortex, about 0·2 mm. thick, densely packed, especially in its outer part, with sterrospherasters and spherasters. This cortex is pierced at intervals by chones. Each chone is divided into ectochone and endochone and the two are connected by a very narrow and fairly long canal. The ectochone terminates at the surface of the sponge in a single inhalant pore. The endochone opens into a subcortical crypt, from which, indeed, it is not sharply distinguishable, and the subcortical crypts unite together to form large irregular spaces from which the incurrent canals take their origin. The entire arrangement is very similar to that figured by Keller for *Stelletta siemensi* [1891, fig. 56].

* Compare especially Hentschel's figure of *A. aurora* var. *arenosa* (*loc. cit.*, p. 363, fig. 7).

The choanosome contains numerous large, oval, thin-walled, vesicular pigment-cells, about 0·04 mm. in longer diameter and containing a granular reticulum of brown or yellow pigment to which the colour of the sponge seems to be chiefly due.

This is an extraordinarily interesting species, evidently closely related to *Aurora* (*Stelletta*) *aurora*, Hentschel, *Aurora* (*Isops*) *membranacea* (Hentschel) and *Aurora* (*Diastra*) *sterrastræa* Row. The sterrospherasters are identical with those of Row's species, only somewhat larger*. In *A. sterrastræa*, however, there are no triænes, and Row therefore very naturally included that species amongst the so-called Epipolasidæ. *Aurora rowi* undoubtedly represents very closely the actual stellettid species from which *Aurora* (*Diastra*) *sterrastræa* was derived by loss of triænes. The resemblance between the two is remarkably close, even to the characteristic chocolate-brown colour. Unfortunately Row's description of his species is faulty in certain respects. His account of the cortex is very misleading. He has evidently included as part of the cortex a considerable portion of the choanosome. The special layer of oxea which he describes in the supposed deeper parts of the cortex, 0·5 mm. from the surface of the sponge, does not belong to the cortex at all; moreover it is not a properly defined layer but part of a confused general skeleton. The mistake seems to have arisen through the lack of stained paraffin sections.

Register No., Locality, &c. CXXXI., Seychelles, F. 9, 37 fathoms.

Genus ASTEROPUS Sollas [1888].

Reduced Stellettidæ which have completely lost their tetractinellid megascleres. The main skeleton is a confused feltwork of large oxea. The microscleres are oxyasters and sanidasters.

I have already pointed out that Sollas regarded this genus as probably being derived from either Stryphnus or Algol by loss of triænes.

13. *Asteropus simplex* (Carter).

(Plate **46**, fig. 6.)

Stellettinopsis simplex Carter [1879 B].
Asteropus simplex Sollas [1888].
Asteropus haeckeli Dendy [1905].
Asteropus simplex Hentschel [1909].
Asteropus simplex Dendy [1915].

The single specimen in the collection is a cake-shaped mass about 90 mm. in maximum diameter, flattened below and convex above. A few mammiform projections scattered here and there on the upper surface are penetrated each by several narrow oscular tubes and bear at their summits the rather small vents, most of which appear to be closed. The surface is uneven and encrusted by a good deal of calcareous débris, together with a species of Gelliodes. Texture firm, compact, coarse. Colour in spirit rather dark, purplish brown.

* Row gives the diameter of the full-grown sterrospheraster in *D. sterrastræa* as 0·36 mm. This is obviously a mistake. I find it to be 0·028 mm. by actual measurement from the type.

The main skeleton is a confused, dense feltwork of large oxea, with numerous oxyasters and sanidasters scattered between.

Spicules:—(1) Oxea (Plate **46**, fig. 6 *a*); fusiform, more or less curved; for the most part gradually and sharply pointed, but may be rounded off at one or both ends, *i.e.* stylote (fig. 6 *a'*) or strongylote. Size up to about 2·1 by 0·065 mm.

(2) Oxyasters (fig. 6 *b*); rays slender, sharply pointed, slightly roughened, usually about 10 in number, often springing from a small but distinct centrum; total diameter of spicule about 0·05 mm.

(3) Sanidasters (fig. 6 *c*); with approximately straight axis, usually bifurcate or trifurcate at the ends, and with a number of rather short, strongylote spines coming off irregularly along its length or in two principal whorls; total length about 0·02 mm.

In describing my *Asteropus haeckeli* from Ceylon in 1905 I pointed out its close relationship to Carter's *Stellettinopsis simplex* from Western Australia, and suggested that the future discovery of intermediate forms might justify us in uniting the two. This union has since been effected by Hentschel [1909] on the basis of Australian material collected by the Hamburg South-West Australian Expedition. I have no doubt that he is right, nor have I any doubt that the "Sealark" specimen falls within the same species.

Mr Carter, when he first described the species in 1879 referred to a specimen from Hayti which he believed to belong to the same species, but which differs in small details of spiculation. In 1905 I expressed doubt as to this identification, but a careful examination of Carter's original preparation, now in my possession, convinces me that he was right, and that the differences in spiculation, such as the very slightly inflated ends of the rays of the aster, are not of specific value.

Previously known Distribution. Fremantle, Western Australia (Carter); Port Phillip Heads, Victoria (Carter 1886); South-West Australia (Hentschel); Ceylon (Dendy); Okhamandal (Dendy); Hayti (Carter).

Register No., Locality, &c. LXXVIII. 2, Cargados Carajos, 28.3.05, B. 2, 30 fathoms.

Genus JASPIS Gray [1867 F].

Stellettidæ (?) with oxeote megascleres irregularly interlaced to form a confused skeleton, and with microscleres in the form of euasters (and perhaps microxea which cannot be sharply distinguished from the megascleres).

This genus was proposed by Gray [1867 F] for the reception of Schmidt's *Vioa johnstonii*, with the diagnosis "Spicules of two kinds:—1. Fusiform. 2. Stellate."

Sollas [1888] proposed the genus Astropeplus for the reception of his *Astropeplus pulcher*. Lendenfeld [1896] showed that *Astropeplus pulcher* Sollas is synonymous with *Vioa johnstonii* Schmidt, but unfortunately placed that species in the genus Xenospongia, which had been proposed by Gray [1858] for a totally different sponge. Topsent [1898 B] pointed out that *Vioa johnstonii* cannot be a Xenospongia and relegated it to Sollas's genus Coppatias, which had been defined by Sollas [1888] as comprising "Epipolasidæ in which but one form of aster, and that a euaster, is present." Sollas's Astropeplus thus became for Topsent a synonym of the same author's Coppatias. In his Monograph on the

Sponges of France [1900] Topsent fully discussed the synonymy of *Vioa johnstonii* (up to date) and decided upon the name *Coppatias Johnstoni*, rejecting Gray's generic name Jaspis on the ground that the diagnosis of that genus had no scientific value and could not be accepted. A few years later, however, he had changed his opinion, and in his work on the Sponges of the Azores [1904 A] he accepted Gray's name.

If we are to accept others of Gray's generic names, proposed in the same paper as Jaspis [1867 F], as has lately been done in the case, for example, of Mycale, I certainly do not see how we can refuse to accept Jaspis; indeed, according to the laws of nomenclature, I believe we are bound to accept it, for not only did Gray give a diagnosis but he mentioned a type, and there can be no possible doubt as to what he meant.

The character of the oxea, and especially of the centrotylote microxea of *Jaspis johnstonii*, suggests that this genus may have originated directly from some pachastrellid ancestor without having passed through a stellettid stage, but until we have more evidence that this is the case it seems better to include it with the other "epipolasid" genera in the Stellettidæ.

14. *Jaspis johnstonii* (Schmidt).

(Plate **47**, fig. 2.)

Vioa Johnstonii Schmidt [1862].
Jaspis Johnstonii Gray [1867 F].
Vioa Johnstonii var. Schmidt [1868].
Vioa Schmidtii Carter [1882 A].
Astropeplus pulcher Sollas [1888].
Dorypleres incrustans Topsent [1892 C].
Coppatias inconditus Topsent [1892 D].
Xenospongia johnstonii Lendenfeld [1896].
Asteropus incrustans Lendenfeld [1896].
Coppatias Johnstoni Topsent [1898 B].
? *Dorypleres biangulata* Lindgren [1898].
Coppatias Johnstoni Topsent [1900].
? *Jaspis biangulata* Thiele [1903 B].
Jaspis Johnstoni Topsent [1904 A].
Jaspis johnstoni var. *incrustans* Topsent [1904 A].
? *Coppatias albescens* Row [1911].

The specimen forms a thin crust of a light pinkish-brown colour, spreading over and cementing together a mass of Siliquaria shells and other calcareous débris. The vents are minute and scattered. The soft tissues contain numerous granular brown pigment-cells.

The skeleton is a more or less dense feltwork of small oxea and microxea.

Spicules:—(1) Short, stout, fusiform oxea (Plate **47**, fig. 2 *a*); slightly curved; usually very gradually and finely pointed, but may be a little blunted and may also occasionally become stylote, but styli are rare. Size when full-grown about 0·46 by 0·024 mm.

(2) Microxea (fig. 2 *b*); sharply pointed, curved, usually centrotylote, closely resembling the microxea of Erylus; size very variable, say about 0·08 by 0·004 mm.,

but numerous smaller ones occur and also numerous forms connecting with the larger oxea (1).

(3) Oxyasters (fig. 2 *c*); with no distinct centrum, or quite a small one, and slender rays, usually about eight in number; total diameter of spicule about 0·016 mm.

Topsent has pointed out the variability in the size of the spicules in this species, and also mentions that the smaller oxea are frequently centrotylote. I have therefore no hesitation in identifying the "Sealark" specimen with the European form. I have thought it desirable, however, to give measurements and figures of the spicules of the "Sealark" specimen as a contribution to our knowledge of the range of variation. Topsent [1898 B] has also expressed the opinion that Lendenfeld's *Asteropus incrustans* is identical with *Jaspis johnstonii*, an opinion with which I agree. It appears to me very probable that Row's *Coppatias albescens* from the Red Sea [1911] may belong to the same species, and possibly also Lindgren's *Dorypleres biangulata* from Java [1898], also recorded by Thiele [1903 B], under the name *Jaspis biangulata*, from Ternate.

Previously known Distribution. Adriatic (Schmidt, Lendenfeld); Mediterranean coast of France (Topsent); St Iago, Porto Praya, Cape Verde Is. (Sollas); Azores (Topsent); ? Red Sea (Row); ? Java (Lindgren); ? Ternate (Thiele).

Register No., Locality, &c. LXXVIII. 11, Cargados Carajos, 28.3.05. B. 2, 30 fathoms.

Family **Geodiidæ.**

Astrotetraxonida with triæne megascleres, a cortical layer of sterrasters, and various forms of euasters, to which microrhabds may be added.

The question of the probable origin of this family from the genus Aurora has already been discussed. The classification of the Geodiidæ is an extremely difficult problem and one which cannot be properly tackled without a comprehensive re-investigation of the group. I may state, however, that I have the gravest doubts as to the value of the character and arrangement of the inhalant and exhalant openings for the discrimination of genera, upon which so much stress has been laid by Sollas and subsequent writers. I therefore use the old genus Geodia in a far less restricted sense than is customary, but, laying the greatest stress as usual upon skeletal characters, I have framed the diagnosis thereof so as to exclude Pachymatisma, Caminus and Geodinella, which may conveniently be kept distinct.

I have followed Lendenfeld [1910 B] in referring the genus Erylus to a separate family.

Genus GEODIA Lamarck [1815 A].

Geodiidæ with well-developed triænes arranged radially at or near the surface; without microrhabds and without spherules.

15. *Geodia auroristella* n. sp.

(Plate **47**, fig. 3.)

The single specimen, in its present condition, has the form of a thin crust, which has evidently been sliced off either from a larger specimen of the sponge or from some foreign object which it was encrusting. As there is no larger specimen of the sponge in the

collection the latter explanation is probably correct. The specimen measured about 25 mm. in length by 8 mm. in breadth and 3 mm. in thickness. The colour on the surface is almost white, internally more yellowish. The surface is almost smooth, very minutely hispid. A group of some 20 or 30 minute, inconspicuous openings, situate close to the margin, but not in any special depression, represent the vents.

Paraffin sections show that each of the small vents is really covered in by a thin pore-sieve, which roofs over a funnel-shaped chone that penetrates the cortex. The inhalant pores are very difficult to make out, but I conclude from the study of sections that they are scattered over the surface, probably in groups, and lead into narrow canals which penetrate the cortex, anastomosing as they go. The cortex is about 0·7 mm. thick, densely charged with sterrasters and with a superficial layer of minute spherasters. It contains a good deal of fibrous tissue connecting the sterrasters with one another and especially strongly developed round the inner ends of the exhalant chones, where it apparently forms sphincters.

The skeleton in the deeper part of the sponge is confused, but loose bundles of diactinal megascleres radiate towards the surface, terminating distally in tufts of triænes which penetrate the cortex. The stout orthotriænes for the most part extend their cladi in the outermost part of the cortex, just beneath the surface; beyond them again loose tufts of slender spicules project freely and are almost invariably broken off short; some of the latter are very slender oxea (? styli), others are reduced anatriænes with vestigial cladome.

Spicules:—(1) Orthotriænes (Plate **47**, fig. 3 *a*); with long, straight or slightly curved shaft, gradually and finely pointed at the end or somewhat blunted, measuring about 1·7 by 0·034 mm.; with short, stout, sharp-pointed cladi extended almost at right angles to the shaft, measuring about 0·086 by 0·034 mm.

(2) Anatriænes (fig. 3 *b*); with long, slender, almost hair-like shaft, tapering away to a very fine point, and sharply recurved cladi, rather long, slender and gradually and finely pointed. Shaft about 1·7 by 0·008 mm.; cladi about 0·07 by 0·006 mm. The cladome may be reduced to a mere knob.

(3) Oxea (fig. 3 *c*); long, slender, sometimes slightly curved; may be sharply pointed at each end, but more often one or both ends is more or less rounded off, giving rise to stylote (fig. 3 *c'*) and strongylote (fig. 3 *c''*) forms; measuring about 1·4 by 0·023 mm. The long, very slender oxea (? styli) projecting from the dermal surface may be regarded as modifications of these.

(4) Sterrasters (figs. 3 *d*—3 *d''''*); of typical oval form, with distinct hilum and surface reticulation formed by the stellate ends of the fused rays; size about 0·123 by 0·1 mm., but many smaller ones occur which appear to be fully developed. Developmental stages are shown in figs. 3*d'*—3*d''''*.

(5) Spherasters (fig. 3 *e*); with stout, smooth, conical but somewhat irregular rays, resembling an Aurora or Donatia spicule; total diameter about 0·05 mm. Choanosomal (subcortical).

(6) Spherasters (fig. 3 *f*); with relatively longer, more slender and minutely spined, conical rays; total diameter about 0·037 mm. Choanosomal.

(7) Minute spherasters (fig. 3 *g*); with small centrum and short, strongylote (perhaps sometimes tylote) rays; total diameter about 0·008 mm. Choanosomal and dermal.

(8) Oxyasters (fig. 3 *h*); with usually about 8 or 9 slender, minutely roughened rays and inconspicuous centrum; total diameter about 0·02 mm.

In spiculation this species approaches Lendenfeld's *Sidonops oxyastra* [1910 A] pretty closely, but differs in the possession of the large spherasters and perhaps in other details. It also comes near to Carter's *Geodia globostellifera* [1880 B], from the Gulf of Manaar, which has a similar spheraster ("globostellate"), but is only 0·021 to 0·028 mm. in diameter, instead of 0·05 mm. as in our species. Carter's species, however, appears to have protriænes and no anatriænes, and the oxyasters seem to be absent.

Register No., Locality, &c. LXXXVI. 1, Providence, 4.10.05, D. 4, 50—78 fathoms.

Family **Erylidæ**.

Astrotetraxonida with a cortex containing aspidasters. The typical megascleres are triænes and oxea (or strongyla). The microscleres include microrhabds and choanosomal euasters.

The remarkable genus Erylus was included by Sollas [1888] in the family Geodiidæ, as it had been by Gray [1867 F], and this procedure has since been generally followed. In 1910, however, Lendenfeld proposed to remove Erylus to a separate family by itself, to which he gave the name "Erylidæ." He pointed out that Erylus differs very considerably from Geodia and proposed the name "aspidaster" for the characteristic cortical spicule, which had previously been regarded as a sterraster. This spicule is undoubtedly the most characteristic feature of the Erylidæ, and it is quite conceivable that, like the sterrospira of Placospongia, its resemblance to the Geodia sterraster may be due simply to convergence. This view is supported by the fact that Erylus differs from Geodia also in other respects, such as the presence of the very characteristic microrhabd and the absence of anatriænes. The triænes that are present seem to be less differentiated than those of the Geodiidæ and may resemble the short-shafted triænes of the Pachastrellidæ, from primitive members of which family it seems quite possible that the Erylidæ have been independently and directly evolved, while the Geodiidæ have almost certainly arisen through the Stellettidæ.

It is customary at the present time to recognise only a single genus in this family, but it seems possible that we may before long be able to sub-divide it according to the form of the aspidaster. Even if we are able to do this, however, I fear that Ferrer's recently proposed genus Scutastra [1912] will have to be regarded as a synonym of Erylus.

Although a good many species have been described these are for the most part evidently very closely related to one another.

Genus Erylus Gray [1867 F].

With the characters of the family.

16. *Erylus lendenfeldi* Sollas.

(Plate **47**, fig. 4.)

Stelletta euastrum Carter [1880 B, p. 136], not Schmidt.
Erylus lendenfeldi Sollas [1888].

I am not aware that this species has been met with since it was first described by Carter in 1880 from Fremantle, Western Australia, and Carter's description was taken from a single dry specimen. It seems therefore worth while to describe it again.

The single specimen in the "Sealark" collection is cushion-shaped, subspherical, about 16 mm. in maximum diameter. It has been torn off from some attachment below. It bears a single circular vent, about 2 mm. in diameter, not far from the centre of the upper surface, without any oscular collar or fringe of any kind. The inhalant pores are distinctly visible under a pocket lens, scattered irregularly and singly over the general surface, each with a narrow whitish margin; sometimes widely open and sometimes closed to varying extents. The surface is smooth and of a dark, greyish-brown colour; the interior is yellow. Texture firm and fairly compact, but with a wide oscular tube running up to the vent and appearing (broken across) on the lower surface, which suggests that there may have been a good deal more of the sponge below.

Skeleton confused internally, radially arranged towards the surface, consisting principally of large oxea but with a fair number of orthotriænes typically orientated beneath the cortex of aspidasters.

Spicules:—(1) Orthotriænes (Plate **47**, fig. 4 *a*); with well-developed cladi, typically unbranched but sometimes irregularly bent and even forked; shaft and cladi tapering to more or less sharp points (often blunted). Size variable, a typical specimen gave the following measurements:—shaft 0·5 by 0·034 mm.; cladi 0·24 by 0·034 mm.

(2) Oxea (fig. 4 *b*); slightly curved, tapering at each end to a sharp or blunt point, measuring about 1·0 by 0·026 mm.

(3) Aspidasters (figs. 4 *c*—4 *c''''*); much flattened, oval or irregular in outline, surfaces beset with numerous small, scattered, simple or slightly stellate tubercles; dimensions about 0·17 by 0·082 mm. Young forms radially striate, formed by fusion of slender rays proceeding from a central mass; intermediates smooth, without tubercles.

(4) Large oxyasters (fig. 4 *d*); with no distinct centrum and long slender rays, minutely spined and not quite sharply pointed; rays usually 4 in number, measuring each up to about 0·07 by 0·004 mm.

(5) Small oxyasters (fig. 4 *e*); similar to the last but with rays only about 0·01 mm. long; perhaps young forms; abundant.

(6) Polyactinose oxyasters (fig. 4 *f*); with minutely spined, slender rays and no distinct centrum. Total diameter up to about 0·028 mm.

Intermediate forms between (4), (5) and (6) occur; and some of the small asters may have slightly tylote rays.

(7) Microrhabds (fig. 4 *g*); smooth, curved, often centrotylote and usually bluntly pointed at each end; measuring, say, about 0·07 by 0·006 mm., but variable.

The cortex is about 0·2 mm. thick and is sharply differentiated into two layers—an outer layer forming about four-fifths of the whole and so densely charged with tangentially placed aspidasters, arranged in several layers, that it is impossible to make out its histological characters; and an inner layer, forming the remaining fifth, composed of fibrous tissue. Both layers contain numerous pigment cells, which, in the fibrous layer, are elongated in the same direction as the fibres, *i.e.* parallel to the surface. A few pigment cells also occur in the outer part of the choanosome.

The scattered inhalant pores lead each into a very well-defined chone, subcylindrical in shape but widening out somewhat as it penetrates the cortex, the bottom of the chone being at about the junction of the outer and inner layers of the cortex. A rather thick sphincter diaphragm, formed from the inner, fibrous layer of the cortex, separates the chone from the subcortical crypt into which it opens. The subcortical crypts are irregular spaces which unite together to form wide inhalant canals running almost vertically inwards.

The choanosomal ground-substance is compact and finely granular; the flagellate chambers are subspherical, close-packed, about 0·024 mm. in diameter.

It will be seen that our sponge agrees very closely with Sollas's re-description of the type [1888]. The chief distinguishing feature of the species is evidently the large oxyaster.

Previously known Distribution. Fremantle, Western Australia (Carter).

Register No., Locality, &c. CII. 2, Amirante, 18.10.05, E. 25, 44—20 fathoms.

17. *Erylus proximus* n. sp.

(Plate **47**, fig. 5.)

The single specimen consists of an irregular mass of Siliquaria shells and sponge inextricably mixed together; the whole measuring about 65 by 36 by 25 mm. The entire mass is somewhat flattened dorsoventrally, but the surfaces are very uneven and irregular, with portions of the Siliquaria projecting freely at frequent intervals. What was presumably the lower surface is penetrated by numerous minute, singly scattered, dermal pores, widely open, commonly with distinct whitish margins; numerous minute whitish specks scattered singly over the upper surface represent similar pores in a closed condition. A few open vents, about 1·5 mm. in diameter, occur singly on prominent parts of the upper surface. The colour of the upper surface (in spirit) is purplish or brownish grey; of the lower surface greyish yellow.

The main skeleton is a confused interlacement of large oxea, with a few short-shafted triænes beneath the dermal crust. Some at any rate of the triænes have their cladi extended paratangentially beneath the surface. There is a thin dermal crust formed of the thin, plate-like aspidasters, which also occur scattered abundantly in the choanosome.

Spicules:—(1) Short-shafted triænes (Plate **47**, fig. 5 *a*); much resembling calthrops, but with the cladi extended almost at right angles to the shaft; cladi may be a little longer or a little shorter than the shaft. Shaft and cladi sharp-pointed, stout or slender;

cladi occasionally bifurcate at the apex. In a typical example the shaft measured about 0·2 by 0·03 mm., cladi about the same. The forms with slender rays are perhaps young.

(2) Oxea (fig. 5 *b*); fairly stout, fusiform, slightly curved and gradually and sharply pointed; varying occasionally to stylote (fig. 5 *b'*) or even strongylote (fig. 5 *b''*) forms; often slightly centrotylote; typical size about 0·7 by 0·025 mm.

(3) Aspidasters (fig. 5 *c*—5 *c''''*); thin, plate-like, oval; usually with fairly even outline; surface beset with numerous, scattered, slightly stellate, short spines or tubercles; size about 0·15 by 0·07 mm. The young forms are very thin, smooth, oval plates, with a marginal fringe of slender spines; radially striate when very young.

(4) Chiasters (fig. 5 *d*); polyactinal strongylasters and tylotasters; about 0·012 mm. in total diameter; sometimes with a distinct centrum.

(5) Microrhabds (fig. 5 *e*); smooth, fusiform, usually slightly curved, usually sharply pointed, often centrotylote; size about 0·053 by 0·004 mm. Abundantly scattered in the choanosome and in the pore-sphincters.

With regard to the microscopical anatomy of the soft parts in this form I have only to note two points. The inhalant pores are situated each in a distinct gap in the dermal armour of aspidasters, and each is provided with a thin sphincter membrane strengthened by numerous microrhabds. The interior of the sponge is charged with numerous small, brown, granular pigment-cells, especially abundant near the surface.

This species comes very near to *Erylus carteri* Sollas [1888], originally described by Carter from the Gulf of Manaar under the name *Stelletta euastrum* [1880 B, p. 135], which was also associated with Siliquaria. The most important difference lies in the fact that the microrhabds (microxea) are smooth, as usual in the genus, instead of minutely spined as described and figured by Carter for the type of the species.

To judge from the emended description given by Sollas [1888], Ridley's [1884 C] *Erylus cylindrigerus* from the Mascarene Islands is perhaps even more closely related to the present species, differing, however, in the lozenge-shaped form of the aspidaster, the form and size of the small asters, and the (constant?) strongylote form of the main skeleton spicule. It appears to me highly probable that all three species will have to be united in the future.

Register No., Locality, &c. LVII. 7, Cargados, 30 fathoms.

Family **Donatiidæ**

= *Tethyadæ* or *Tethyidæ* auctorum.

Astrotetraxonida without tetractinellid megascleres. With a strongly developed fibrous cortex. Main skeleton composed of radially arranged styli (or oxea?). Microscleres euasters of various forms, including large spherasters, to which microrhabds may be added.

This family appears to have originated from some corticate stellettid ancestor of the Aurora type. Indeed, if we admit such "epipolasid" forms as *Aurora distinctus*, *A. cribriporosa* and *A. sterrastræa* amongst the Stellettidæ, it is not easy to frame a diagnosis by which the Donatiidæ can be logically excluded from the same family.

It appears, however, that there is a small group of genera, including Donatia (Tethya), Tethyorhaphis and Xenospongia, of monophyletic origin and closely related to one another, in which the loss of the tetractinellid megascleres is absolutely constant and forms the principal distinguishing feature, instead of occurring sporadically as amongst the Auroras. This character, taken in connection with the characteristic spherasters* and the very strongly developed cortex, seems to form a sufficient justification for retaining the family.

Hitherto I have employed the name "Tethyidæ" for this family, on the supposition that the proper name of the typical genus was Tethya and not Donatia. It will be remembered that Sollas expressed himself very emphatically on this point. He says "*Tethya lyncurium* is a combination that by the accepted laws of nomenclature cannot possibly be disturbed, since the species is the type of the genus so named by Lamarck, and accepted and redefined by O. Schmidt in 1862" [1888, p. CXXI]. Until recently the name Tethya has been accepted in this sense by nearly every writer, including Vosmaer, Lendenfeld, Thiele, Topsent and Lindgren.

In 1903, however, Thiele, after consistently using the name Tethya for the genus in question throughout the body of his paper on the "Kieselschwämme von Ternate," remarked in a footnote that by strict application of the laws of nomenclature Tethya must be substituted for Craniella and Donatia for Tethya. In 1905 Baer followed this up by proposing the family name Donatiidæ, and Lendenfeld [1903], Topsent [1906 B] and Hentschel [1909] have all fallen into line.

It must be admitted that there is nothing in Lamarck's original paper [1815] to justify Sollas's confident assertion. The genus Tethya is there quite unrecognisably defined and *Tethya lyncurium* is the fifth species to be described. The first is *Tethya asbestella*, which, whatever it may be, is certainly not congeneric with *T. lyncurium*. It is true that *T. lyncurium* comes before *T. cranium*, which Lamarck places sixth, but that hardly justifies us in accepting it as the type species of the genus. According to Vosmaer [1887], followed by Lendenfeld [1903], the fourth of Lamarck's Tethyas, *T. lacunata*, is a Geodia! As the generic name Geodia was only proposed by Lamarck himself on a later page of the same volume as Tethya, it certainly looks as if neither *T. lyncurium* nor *T. cranium* had a right to the name Tethya on the ground of priority of mention. But then there are three other species before *T. lacunata*. What these may be I do not know, and I doubt if anyone else does, but if the types are still in existence further researches might upset any decision as to priority which might now be made.

On the whole the wisest course would seem to be to abandon the generic name Tethya altogether and to use Nardo's name Donatia, proposed in 1833, for *D. lyncurium* and its congeners, and Baer's name Donatiidæ for the family.

Genus DONATIA Nardo [1833]

= *Tethya* auctorum.

Donatiidæ of usually more or less spherical form; megascleres styli; microscleres large spherasters, with smaller chiasters or oxyasters or both; without microrhabds.

Many species of Donatia have been described by various authors, but the question

* In the aberrant genus Tuberella, however, the microscleres have also completely disappeared.

of their mutual relationships is no less difficult than that of the name of the genus. There is no doubt that members of the genus exhibit very great variability in all those characters that might be used for the purpose of specific distinction; in the character of the surface, the form and size of the microscleres, the arrangement of the microscleres, the thickness of the cortex, &c.

Lindgren [1898] proposed to arrange the described forms in three groups, each of which might be regarded as a species. The names of the three species would then be *lyncurium*, *ingalli* and *japonica* respectively. This arrangement is based on the characters of the smaller asters. In *Donatia lyncurium* the smaller asters are supposed to be oxyasters (0·012—0·02 mm. in diameter) only, variable in form and size but never with tylote rays. In *D. ingalli* the smaller asters are tylote chiasters (0·006—0·016 mm.) and oxyasters (0·02—0·052 mm.). In *D. japonica* the smaller asters are all tylote chiasters (0·008—0·016 mm.). *D. lyncurium* would appear to be characteristic of the North Atlantic and Mediterranean; *D. ingalli* of the Red Sea, Indian Ocean, Malay Archipelago, Australia and the Pacific; *D. japonica* of the Philippines, Java and Australia. I do not think that this arrangement can be accepted, the "lumping" of species appears to be too comprehensive.

In my report on the sponges of Ceylon [1905] I proposed to regard all the specimens of Donatia in Professor Herdman's collection as belonging to three varieties of *Donatia* (*Tethya*) *lyncurium*, which I distinguished as *a*, *b* and *c* respectively. The undoubted existence of transitional forms of the small asters at first sight seems to make it impossible to recognise such forms as *D. lyncurium*, *D. ingalli*, *D. seychellensis* and *D. japonica* as distinct species. There is no reason, however, why either specific or varietal distinctions should be based exclusively upon the characters of the chiasters and oxyasters. The form, size and arrangement of the large spherasters, and the arrangement of the megascleres may also prove useful in this respect, and by taking these into account I now believe it possible to arrive at fairly satisfactory specific distinctions.

It is impossible to discuss in this place all the species and varieties that have been proposed. Nothing but a thorough and tedious revision of the whole genus, based, if possible, upon the examination of type specimens, can lead to any really satisfactory general conclusions.

There are thirty-one specimens of Donatia in the "Sealark" collection, and after careful examination, including measurement of the microscleres of all of them, I have decided to arrange them in five species. None of the specimens are much more than an inch in diameter and many of them are much less; they attain nothing like the size often seen in Australian Donatias.

It will be seen from the locality lists that the different species occur very much mixed together. I have found three species (*lyncurium*, *japonica* and *seychellensis*) in the same jar from Salomon, presumably all obtained in the same haul of the dredge, and a different three (*japonica*, *seychellensis* and *ingalli*) in the same jar from Praslin Reef. These facts show how necessary it is to examine every specimen microscopically before determining to which species it belongs.

18. *Donatia lyncurium* auctorum.

(Plate **48**, fig. 1.)

Tethya lyncurium auctorum.

(For synonymy and literature of the species *vide* Lendenfeld [1896].)

There is in the collection a single very small specimen, only about 8 mm. in diameter, which appears to me to be indistinguishable from the European form. It has a strongly tessellated surface and a few small, root-like attachment processes, and the colour in spirit is nearly white.

The cortex is about 0·86 mm. thick and there appear to be no large intracortical crypts. The radiating bundles of the main skeleton pierce the cortex and spread out into wide brushes, the projecting ends of the component spicules of which render the surface slightly hispid. Beneath the cortex the intervals between the well-defined skeletal bundles are occupied by numerous loose styli or subtylostyli radially arranged.

The large spherasters (Plate **48**, figs. 1 *a*, 1 *b*) are scattered irregularly and rather sparsely in the cortex. They are abundant in the outer part of the choanosome mixed with smaller forms, possibly developmental stages. When fully grown they measure about 0·07 mm. in diameter. Their sharp conical rays are about half as long as the diameter of the centrum.

The cortical chiasters (fig. 1 *c*) are strongylasters or oxyasters, rarely faintly tylote, with usually more than six very slender rays and no conspicuous centrum ; total diameter about 0·012 mm. Curiously enough these spicules appear to be absent from the surface, where, it will be remembered, the cortical chiasters are usually most abundant. The choanosomal chiasters (fig. 1 *d*) are rare and closely similar in form and size to those of the cortex.

Previously known Distribution. European Seas, &c. (For further particulars *vide* Lendenfeld [1896].)

Register No., Locality, &c. CXX. 2 C, Salomon, 10—14 fathoms.

19. *Donatia japonica* (Sollas).

(Plate **48**, fig. 2.)

? *Tethya lyncurium* Deszö [1878].
Tethya japonica Sollas [1888].
Tethya japonica Lindgren [1898].
Tethya lyncurium var. *a.* Dendy [1905].
Donatia japonica Topsent [1906 B].
Donatia parvistella Baer [1905].
Tethya lyncurium Row [1911].

(For other possible synonymy *vide* Lindgren [1898] and Hentschel [1909].)

There are in the collection nine specimens which I think must be referred to this species. They are all more or less spherical in form, and the surface exhibits the usual

range of variation from strongly tessellated in polygonal areas to conulose and proliferous. Although the varying character of the surface causes the specimens to differ very strikingly in external appearance I do not think that it implies any specific or even varietal distinction, but merely phases of growth, possibly associated with a periodic activity in throwing off buds *. None of the specimens exceed a diameter of about 20 mm. The colour in spirit is light grey or yellowish.

The cortex is only about 1·0 mm. thick, with more or less well developed intracortical crypts from which narrow inhalant canals run into the choanosome.

The spicule-bundles of the main skeleton penetrate the cortex and either spread out in brushes at the surface (in the tesseræ) or are continued into well-marked conuli. In the outer part of the choanosome, between the spicule-bundles, numerous loose megascleres (styli or subtylostyli) are radially arranged. These cease abruptly just beneath the cortex.

The large spherasters are rather sparsely scattered in the cortex. In the choanosome their numbers vary greatly and they are apt to be mixed with small forms that probably represent, in part at any rate, developmental stages.

The small tylasters form a distinct dermal layer, as well as occurring scattered in cortex and choanosome.

The spherasters (Plate **48**, figs. 2 *a*, 2 *b*), when fully grown, range from about 0·04 to about 0·07 mm. in total diameter. They have sharp conical rays whose length is about half the diameter of the large centrum.

The cortical and choanosomal tylasters (fig. 2 *c*, 2 *d*) closely resemble one another both in form and size and range from about 0·0082 to 0·0164 mm. in total diameter. They usually have more than six rays, but in R.N. XLVII. 2 E they are usually six-rayed.

The chief distinguishing features of this species are the tylote character of the cortical and choanosomal chiasters, the absence of oxyasters and the comparative scarcity of spherasters in the cortex. The choanosomal chiasters may, however, occasionally lose the heads of the rays and exhibit a transition to those of *D. ingalli* (fig. 2 *e*).

I pointed out in my Report on the Ceylon sponges that the tylote character of the chiaster may occasionally occur even in a British Donatia, and I must now add that Deszö, as far back as 1878, figured typical tylasters for a specimen of Donatia from Naples, identified by him as *Tethya lyncurium*. Perhaps he really had *D. japonica* before him.

Previously known Distribution. Manila (Sollas); Java Seas (Lindgren); Ceylon (Dendy); Zanzibar (Baer); Red Sea (Topsent, Row); ? Naples (Deszö). (For other possible localities *vide* Lindgren [1898] and Hentschel [1909].)

Register Nos., Localities, &c. XLVII. 2 E, XLVII. 3, XLIX., all from Praslin Reef; LIV. 2 B, Coetivy; LVII. 10 A, B, Coin, Peros; LXII., Lagoon, Diego Garcia, 8.7.05; CVII. 2, Amirante, 14.10.05, E. 17, 12—18 fathoms; CXX. 2 B, Salomon, 10—14 fathoms.

* Compare Sollas's remarks on this subject in the case of *Donatia seychellensis* [1888].

20. *Donatia ingalli* (Bowerbank).

(Plate **48**, fig. 3.)

Tethea ingalli Bowerbank [1872 A].
Tethya ingalli (pars) Sollas [1888].
Tethya ingalli (pars) Lindgren [1898].
Tethya lyncurium var. *b*. Dendy [1905].
Donatia Ingalli (pars) Hentschel [1909, 1912].

This is much the commonest form of Donatia in the collection, being represented by seventeen specimens. These range in form from a flattened crust, with wide-spreading base and strongly convex upper surface (R.N. CX. 7), to the usual subspherical form with root-like processes of attachment spreading broadly over the substratum. The surface is usually more or less strongly tessellated in polygonal areas. The colour in spirit is yellowish grey. The subspherical specimens attain a diameter of about 25 mm.

The cortex is some three or four millimetres in thickness and densely charged throughout with large spherasters forming an almost solid mass.

The spicule-bundles of the main skeleton penetrate the cortex and spread out into brushes beneath the surface as usual, but there are, usually at any rate, no loose, radially arranged megascleres beneath the cortex and between the bundles.

The large spherasters (Plate **48**, figs. 3 *a*, 3 *b*), when fully grown, range from about 0·08 to 0·14 mm. in diameter, with rays about half as long as the diameter of the large centrum. Though most abundant in the cortex they are often common also in the choanosome, where they may be associated with numerous much smaller forms*. Sometimes comparatively small forms, with very short rays, occur in the cortex just beneath the surface (R.N. CXIII. 1 B, fig. 3 *a*). In the larger forms the rays may occasionally branch (R.N. CXIX. 10 B).

The cortical chiaster is a typical tylaster (fig. 3 *c*) with usually more than six rays, from about 0·012 to 0·016 mm. in total diameter.

The choanosomal chiaster ranges from a typical tylaster (fig. 3 *d*) to an oxyaster or strongylaster (fig. 3 *d'*) with many short rays, which may be slightly roughened, and a total diameter of about 0·012 to 0·02 mm.

The chief distinguishing features of these specimens are the great thickness of the cortex, the close-packed arrangement of the spherasters in the cortex, and the strong tendency of the choanosomal chiasters to lose the heads of the rays and assume the form of many-rayed oxyasters.

I base my conception of this species upon Bowerbank's original description, the emended description by Sollas, and my own study of one of Bowerbank's specimens. I conclude that the "Sealark" and Ceylon specimens differ from the Australian types in the shorter rays and less strongly developed spination of the choanosomal oxyasters. As regards these spicules the typical form seems to approach *D. seychellensis*, while differing

* I have in all the species assumed that these small choanosomal forms are immature and have not included them in the range of size.

from that species in the structure of the cortex. I refrain at present from expressing any opinion as to the supposed identity of *D. robusta* and *D. cliftoni* [Bowerbank 1873 A] with this species.

Previously known Distribution.· S.W. Australia (Bowerbank, Hentschel); Bass Str., Port Jackson (Sollas); Queensland (Berlin Museum; a section in my possession labelled *Tethya fissurata* Ldf. and numbered 1120); ? Java Sea and Gaspar Strait (Lindgren); Ceylon (Dendy).

Register Nos., Localities, &c. XLVII. 2 B, C, D, F, Praslin Reef; LII. 8 A, B, LIV. 1, 2 A, C, D, all from Coëtivy; CX. 7, CXI. 4, 5, CXIII. 1 A, B, all from Egmont Reef; CXIX. 10 A, B, Salomon.

21. *Donatia seychellensis* (Wright).

(Plate **48**, fig. 4.)

Alemo seychellensis Wright [1881].
Tethya seychellensis Sollas [1888].
Tethya seychellensis Keller [1891].
Tethya seychellensis Topsent [1893 E].
Tethya ingalli (pars) Lindgren [1898].
Tethya seychellensis Kirkpatrick [1900 A].
Tethya lyncurium var. *c.* Dendy [1905].
Donatia Ingalli Topsent [1906 B].
? *Donatia Ingalli* (pars) Hentschel [1909].
Tethya seychellensis Row [1911.]
Donatia seychellensis Dendy [1915].

This species is characterised above all by the large choanosomal oxyasters (Plate **48**, fig. 4 *d*), usually with six, often branched rays. The hexradiate character of these spicules has already been pointed out by more than one writer and seems to be fairly constant. In the "Sealark" specimens the cortical and choanosomal tylasters (fig. 4 *c*, *d'*) are also typically hexradiate. The measurements of the three kinds of aster in the "Sealark" specimens are as follows:—Large spheraster (fig. 4 *a*), when fully grown, 0·07 mm.; cortical tylaster 0·012 mm.; choanosomal oxyaster (total diameter) 0·04 mm.

The three specimens in the collection have the usual subspherical form and more or less strongly tessellated surface, and all of them, in parts, show remarkably wide gaps (pore-grooves) between the tesseræ. The largest is about 25 mm. in diameter. The colour in spirit is grey or yellowish. One specimen only shows a few elongated, slender conuli (? budding).

In all three the cortex is very lacunar and does not contain nearly so many spherasters as in the specimens of *D. ingalli*, while beneath the cortex and between the radiating spicule bundles (which pierce the cortex and spread out as usual) are found numerous loose, radially arranged styli, as in *D. japonica*.

The large red Donatia so common in the neighbourhood of Port Phillip, Victoria, possesses large oxyasters very similar to those of *D. seychellensis*, but I am inclined to think, on account of other characters, that it is specifically distinct both from *D. seychellensis* and *D. ingalli*.

Previously known Distribution. Seychelles (Wright); Samboangan (Sollas); Flinders Passage, Torres Straits (Sollas); Red Sea (Keller, Row, Topsent); Okhamandal and Gulf of Manaar (Dendy); ?South West Australia (Hentschel).

Register Nos., Localities, &c. XLVII. 2 A, Praslin Reef; CXIII. 1 C, Egmont Reef; CXX. 2 A, Salomon, 10—14 fathoms.

22. *Donatia stella-grandis* n. sp.

(Plate **44**, fig. 8; Plate **48**, fig. 5.)

The single specimen (Plate **44**, fig. 8) is irregularly spherical, about 25 mm. in diameter, attached at one (evidently the lower) side to a small mass of nullipore. Part of the surface is very distinctly tessellated, the flat polygonal tesseræ being separated by wide pore-grooves; elsewhere the tesseræ are obsolete and the pore-grooves hardly discernible. There are two slight mammiform elevations on the upper surface, each of which probably bears a small vent, now closed. The colour in spirit is dull greyish yellow and the texture incompressible and of almost stony hardness.

There is nothing peculiar to notice about the arrangement of the megascleres. They radiate in stout, widely separated bundles from the interior of the sponge and penetrate the cortex. On approaching the surface these bundles spread out into brushes of spicules whose ends may project slightly beyond the surface.

The cortex is only about 0·7 mm. thick, and cortex and choanosome alike are densely packed with an almost solid mass of spherasters of various sizes.

Spicules:—(1) Styli (Plate **48**, fig. 5 *a*), tylostyli (fig. 5 *a'*) or strongyla (fig. 5 *a''*); measuring up to about 1·9 by 0·038 mm. These spicules are typically fusiform, but with the centre of the spindle much nearer to the broad end. The broad end is never much narrowed as compared with the middle of the shaft and is often distinctly tylote; the narrow end (centrifugal) may be sharply pointed or truncated.

(2) Spherasters (fig. 5 *b*); rays elongated, conical, sharp, often slightly bent, sometimes slightly and irregularly branched, about as long as the diameter of the centrum; total diameter very variable, up to about 0·25 mm. The branching of the rays seems to be confined to the larger forms, which are very numerous.

(3) Small chiasters (figs. 5 *c*, 5 *d*); with about 10 fairly stout, cylindrical rays, usually slightly roughened towards the ends, which may appear slightly tylote or simply strongylote; total diameter up to about 0·016 mm. Abundant in cortex (especially at the surface) and in choanosome.

(4) Chiasters (fig. 5 *c'*) of about the same size but with slender oxeote rays (?roughened); these seem to occur in both choanosome and cortex but are not nearly so common as the other chiasters, from which, however, they cannot be sharply separated.

This species is distinguished from all the other species of Donatia known to me, with the exception of Hentschel's *Donatia tylota* [1912], by the enormous size frequently attained by the spherasters. The largest ones are about twice the diameter of those of any other specimen in the collection, and six times the diameter of those of a specimen of *D. japonica* from Praslin (R.N. XLIX.). Bowerbank speaks of the corresponding spicules

in his *Tethea robusta* [1873 A] as being very large, but they are only one-fifth the diameter of those of the present species, according to his measurements and figure. In *Donatia tylota*, however, they seem to be nearly as large as in *D. stella-grandis*.

Register No., Locality, &c. CVI. 5, Amirante, 13.10.05, E. 16, 39 fathoms.

Family **Chondrosiidæ**.

Corticate Astrotetraxonida with complex canal system and small flagellate chambers. Without megascleres. Microscleres, when present, euasters.

This family, as at present understood, comprises only the two genera, Chondrilla and Chondrosia. These may both be regarded as reduction forms derived from some stellettid ancestor such as Aurora. The spherasters of Chondrilla closely resemble those of Aurora, but the megascleres have entirely disappeared. In some specimens of *Chondrilla mixta* the asters have already become very rare, and these seem to lead the way to the genus Chondrosia, in which all spicules have entirely disappeared.

Genus CHONDRILLA Schmidt [1862].

Chondrosiidæ with microscleres (euasters of one or more kinds).

23. *Chondrilla australiensis* Carter.

(Plate **48**, fig. 6.)

Chondrilla australiensis Carter [1873 c].
Chondrilla australiensis Lendenfeld [1886 A].
Chondrilla australiensis Lindgren [1897, 1898].
Chondrilla australiensis Dendy [1905, 1915].
Chondrilla australiensis Hentschel [1909, 1912].

This species is characterised by the presence of two kinds of aster, spherasters (Plate **48**, fig. 6 *a*) about 0·03 mm. in diameter, and oxyasters (fig. 6 *b*) of somewhat smaller size with roughened and sometimes slightly branched rays. The spherasters are characteristically cortical in distribution and the oxyasters characteristically choanosomal, but spherasters occur also in the choanosome and oxyasters in the cortex.

It seems possible also that the light colour as compared with some other species may be a more or less constant character. Carter originally described the species as "of a dirty yellow or buff colour." Lendenfeld copies this. Hentschel speaks of the colour of specimens from S.W. Australia as mostly clear greyish-yellow, almost white in some small specimens, but in places brown to black-brown. The Ceylon specimens collected by Prof. Herdman were of a greyish colour (in spirit). The "Sealark" specimens range from almost quite white all over (R.N. XLIII. 2) to light brown (in spirit); they form flattened or lobular crusts of the usual appearance. R.N. XXXI. 1 is growing upon a specimen of *Dercitopsis minor*.

In some specimens (R.N. XLIII. 2, 4) the oxyasters are so nearly smooth as to resemble very closely those of *C. mixta*.

Previously known Distribution. Port Jackson, E. Coast of Australia (Carter, Lendenfeld); Shark's Bay, S.W. Australia (Hentschel); Okhamandal and Ceylon (Dendy); coast of Cochin China (Lindgren); Aru Islands (Hentschel).

Register Nos., Localities, &c. XXXIII. 1, 3, XLIII. 2, 4, all from Cargados Carajos, 30.8.05, B. 13, 30 fathoms; LXXXVII., Amirante, 9.10.05, E. 6, 28 fathoms; CXXXV. 2, Seychelles, 13.10.05, F. 9, 37 fathoms.

24. *Chondrilla mixta* Schulze.

(Plate **48**, fig. 7.)

Chondrilla mixta Schulze [1877 c].
? Chondrilla mixta Ridley [1884 c].
Chondrilla mixta Lindgren [1897, 1898].
Chondrilla mixta Kirkpatrick [1900 B].

This species was described by Schulze from the Red Sea. Schulze had only a single specimen, of which he observes "Dasselbe stellte eine blassgraue, braungefleckte Kruste von 2—4 Mm. Dicke mit unregelmässig welliger aber glatter Oberfläche dar."

The "Sealark" specimens are for the most part dark brown or nearly black on the surface, owing to the strong development of pigment-granules in and beneath the cortex.

The spicules are by no means numerous and in some specimens almost disappear from the cortex, so that it is hard to find anything but the choanosomal oxyasters.

The characteristically cortical spherasters (Plate **48**, fig. 7 *a*) resemble those of *C. australiensis* and measure about 0·03 mm. in diameter. The choanosomal oxyasters (fig. 7 *b*) are of about the same size or a little smaller. They differ from those of *C. australiensis* in having smooth, unbranched rays. Apart from the possible difference in colour this seems to be the only feature that distinguishes the two species, and it may well be doubted whether the two are more than varietally distinct.

The specimen described by Ridley from the Amirante group was of a pale brown or buff colour and had oxyasters frequently with branched rays; it was probably *C. australiensis.*

Two specimens described by Lindgren from Java and Gaspar Straits were blue-black on the outside with a finely granulated surface due to the presence of very minute papillæ.

Previously known Distribution. Red Sea (Schulze); Java and Gaspar Straits (Lindgren); Funafuti Atoll (Kirkpatrick).

Register Nos., Localities, &c. LIII. 8, Coetivy; LVII. 1, Coin, Peros; CX. 4, CXIII. 3, 9, Egmont Reef; CXII. 2, 4, Egmont Lagoon; CXX. 6, Salomon, 10—14 fathoms.

25. *Chondrilla sacciformis* Carter.

(Plate **48**, fig. 8.)

Chondrilla sacciformis Carter [1879 B].
Magog sacciformis Sollas [1888].
Chondrilla grandistellata Thiele [1900].

The single specimen in the collection forms an elongated, slug-shaped crust, about 30 mm. in length, 10 mm. in greatest breadth and 6 mm. in greatest thickness. The margins are strongly incurved towards the base of attachment, probably owing to contraction after removal from the substratum. There are five or six minute, contracted vents, scattered singly, each on a small mammiform projection on the upper surface. The

texture is hard and tough. The colour of the upper surface is rather dark brown, internally much paler, with, to the naked eye, a sharp boundary line between cortex and choanosome. Under a pocket-lens the huge spherasters can be distinctly seen both on the surface and in the interior (when cut); they give the surface a characteristically harsh feel.

The cortex is about 0·3 mm. thick and contains a great many of the large spherasters, for the most part arranged in a single layer at the surface. It is fibrous, and around the spherasters the fibres are concentrically arranged. The dark brown pigment granules are most abundant in the outermost part of the choanosome, just beneath the cortex, but occur also both in the choanosome below and in the cortex above this layer. Numerous narrow inhalant canals (pore-canals) penetrate the cortex vertically, each starting above from a single dermal pore. These canals are rendered conspicuous by the numerous pigment granules that accompany them. Probably they unite in groups on their way through the cortex as in other species of Chondrilla.

The skeleton consists of spherasters (Plate **48**, figs. 8 *a*, 8 *b*, 8 *c*) only, varying much in size and in the shape of the rays. They are abundantly scattered in the choanosome as well as in the cortex. The fully grown ones, measuring about 0·14 mm. in diameter, are by far the most abundant. There appears to be no difference between the cortical and choanosomal spicules, much the same range of variations occurring in both situations. The small ones are probably young forms; I have measured one with a diameter of no more than about 0·04 mm.; they have very numerous, simple, smooth, conical rays, springing from an enormous centrum, the rays only about 0·004 mm. long. The large ones are of two principal kinds, with intermediates:—(1) with sharp-pointed conical rays, somewhat inflated towards the base; often slightly roughened except for the tips of the rays (fig. 8 *a*); (2) with the rays truncated and roughened at the ends (fig. 8 *b*), or even reduced to short, subcylindrical projections with roughened ends (fig. 8 *c*) The intermediate forms show all degrees of truncation and roughening of the rays*.

I have already, in discussing the genus Aurora†, given my reasons for believing that Carter's *Chondrilla sacciformis* is a true Chondrilla, and I need not repeat them here. The examination of a type specimen in his cabinet has convinced me that the "Sealark" specimen is specifically identical, and there appears little doubt that this is also the case with Thiele's *Chondrilla grandistellata*. I hardly know what Thiele means by the statement that a distinctly differentiated cortex is not present in his specimens. At the same time it is true that the line of demarcation between cortex and choanosome is by no means everywhere clearly defined in mine, possibly owing to the indifferent histological condition of the material.

The enormous size of the spherasters is very remarkable in comparison with such species as *C. australiensis*, *C. mixta*, &c.

Previously known Distribution. Mauritius (Carter); Ternate (Thiele).

Register No., Locality, &c. XI. 4, Saya de Malha, 7.9.05, C. 19, 29 fathoms.

* The form represented in Fig. 8 *c* is probably alone fully grown, all the others being developmental stages.

† *Vide* p. 245.

DESCRIPTION OF PLATES

PLATE 44.

(On specially toned paper.)

Fig. 1. *Dercitopsis minor* n. sp. R.N. XLII. 6. Nat. size.
Fig. 2. *Yodomia perfecta* n. sp. R.N. X. 1. Nat. size.
Fig. 2 *a*. *Yodomia perfecta* n. sp. R.N. VI. Nat. size.
Fig. 3. *Myriastra cavernosa* n. sp. R.N. VII. 5 A. Nat. size.
Fig. 3 *a*. *Myriastra cavernosa* n. sp. R.N. VII. 5 B. Cut surface of divided specimen. Nat. size.
Fig. 4. *Aurora cribriporosa* n. sp. R.N. CXIX. 12. Seen from above. Nat. size.
Fig. 5. *Aurora rowi* n. sp. R.N. CXXXI. Nat. size.
Fig. 6. *Ecionemia laviniensis* Dendy. R.N. XI. 2. Nat. size.
Fig. 7. *Rhabdodragma conulosa* (Kieschnick). R.N. LXXVIII. 1 A. Nat. size.
Fig. 8. *Donatia stella-grandis* n. sp. R.N. CVI. 5. Nat. size.

PLATE 45.

Fig. 1. *Dercitopsis minor* n. sp. R.N. CXI. 7.
1 *a*. Calthrops; 1 *b*. triods; 1 *c*. oxea; all × 330.
Fig. 2. *Pachastrella tenuilaminaris* (Sollas). R.N. LXXII. 2.
2 *a*. Calthrops and short-shafted triænes, × 60; 2 *b*. oxea, × 60; 2 *c*. style, × 60; 2 *d*. strongyle, × 60; 2 *e*. hair-like oxea, × 60; 2 *f*. metasters, × 550; 2 *g*. microxeote, × 550.
Fig. 3. *Yodomia perfecta* n. sp.
3 *a*. R.N. X. 1, calthrops, × 60; 3 *a'*. R.N. IX. 1, calthrops, × 60; 3 *a''*. R.N. IX. 1, reduced calthrops, × 60; 3 *b*. R.N. X. 1, small calthrops, × 60; 3 *b'*. R.N. IX. 1, small calthrops, × 60; 3 *c*. R.N. X. 1, mesotriænes, × 60; 3 *c'*. R.N. IX. 1, mesotriænes, × 60; 3 *c''*. R.N. VI., mesotriænes, × 60; 3 *d*. R.N. X. 1, oxeote, × 60; 3 *e*. R.N. VI., amphiasters, × 550; 3 *f*. R.N. VI., smooth microrhabds, × 550; 3 *g*. R.N. VI., spined microrhabds, × 550.

PLATE 46.

Fig. 1. *Myriastra cavernosa* n. sp. R.N. VII. 5.
1 *a*. Orthotriænes, × 60; 1 *b*. oxea, × 60; 1 *c*. small oxeote, × 550; 1 *d*. chiasters, × 550.
Fig. 2. *Aurora providentiæ* n. sp. R.N. LXXXVI. 2.
2 *a*. Orthotriænes, × 60; 2 *b*. anatriæne, × 60; 2 *b'*. cladome of anatriæne, × 770; 2 *b''*. cladome end of reduced anatriæne, × 770; 2 *c*. oxea, × 60; 2 *c'*. small oxeote, × 770; 2 *d*. large spheraster, × 770; 2 *e*. small spherasters, × 770; 2 *f*. oxyasters, × 770.
Fig. 3. *Aurora cribriporosa* n. sp. R.N. CXIX. 12.
3 *a*. Oxea, × 60; 3 *b*. large spheraster, × 770; 3 *c*. young spheraster(?), × 770; 3 *d*. minute spheraster, × 770; 3 *e*. oxyaster, × 770.
Fig. 4. *Aurora rowi* n. sp. R.N. CXXXI.
4 *a*. Orthotriænes, × 60; 4 *b*. oxeote, × 60; 4 *c*. sterrospheraster, × 770; 4 *d*—4 *h*. stages in the development of the sterrospheraster, × 770; 4 *j*. small, irregular spherasters, × 770; 4 *k*. oxyasters, × 770.
Fig. 5. *Ecionemia laviniensis* Dendy. R.N. XI. 2.
5 *a*. Dichotriænes, × 60; 5 *a'*. cladome of dichotriæne, × 60; 5 *b*. anatriæne, × 770; 5 *c*. oxea, × 60; 5 *d*. chiasters, × 770; 5 *e*. oxyasters, × 770; 5 *f*. intermediate forms between oxyasters and chiasters, × 770; 5 *g*. microstrongylote, × 770.
Fig. 6. *Asteropus simplex* (Carter) R.N. LXXVIII. 2.
6 *a*. Oxea, × 60; 6 *a'*. style, × 60; 6 *b*. oxyasters, × 770; 6 *c*. sanidasters, × 770.
Fig. 7. *Dragmastra lactea* (Carter) var. *mauritiana* nov. R.N. CXXVI. 4 E.
7 *a*. Dichotriænes, × 60; 7 *b*. oxea, × 60; 7 *c*. small oxyspherasters, × 770; 7 *d*. larger oxyspheraster, × 770; 7 *e*. trichodragmata, × 770.

Plate 47.

Fig. 1. *Rhabdodragma conulosa* (Kieschnick). R.N. LXXVIII. 1.
1 *a*. Plagiotriænes, × 60; 1 *b*. oxea, × 60; 1 *c*. chiasters, × 770; 1 *d*. small oxeote, × 770; 1 *e*. microrhabds, × 770; 1 *f*. trichodragmata, × 770.

Fig. 2. *Jaspis johnstonii* (Schmidt). R.N. LXXVIII. 11.
2 *a*. Oxea, × 60; 2 *a'*. stylote form, × 60; 2 *b*. microxea, × 770; 2 *c*. oxyasters, × 770.

Fig. 3. *Geodia auroristella* n. sp. R.N. LXXXVI. 1.
3 *a*. Orthotriænes, × 60; 3 *b*. anatriæne, × 60; 3 *c*. oxeote, × 60; 3 *c'*. style, × 60; 3 *c''*. strongylote, × 60; 3 *d*. sterraster, × 310; 3 *d'*—3 *d'''*. developmental stages of sterraster, × 310; 3 *d''''*. portion of surface of late developmental stage of sterraster, × 310; 3 *e*. smooth spheraster, × 770; 3 *f*. spined spheraster, × 770; 3 *g*. minute spheraster or chiaster, × 770; 3 *h*. oxyaster, × 770.

Fig. 4. *Erylus lendenfeldi* Sollas. R.N. CII. 2.
4 *a*. Orthotriæne, × 60; 4 *b*. oxea, × 60; 4 *c*. aspidasters, × 310; 4 *c'*—4 *c'''*. developmental stages of aspidaster, × 310; 4 *c''''*. marginal portion of surface of aspidaster, × 770; 4 *d*. large oxyaster, × 770; 4 *e*. small oxyasters, × 770; 4 *f*. polyactinose oxyaster, × 770; 4 *g*. microrhabds, × 770.

Fig. 5. *Erylus proximus* n. sp. R.N. LXXVII. 7.
5 *a*. Short-shafted triænes, × 60; 5 *b*. oxea, × 60; 5 *b'*. style, × 60; 5 *b''*. strongylote, × 60; 5 *c*. aspidasters, × 310; 5 *c'*—5 *c''''*. developmental stages of aspidaster, × 310; 5 *c'''''*. marginal portion of surface of aspidaster, × 770; 5 *d*. chiasters, × 770; 5 *e*. microrhabds, × 770.

Plate 48.

Fig. 1. *Donatia lyncurium* auctorum. R.N. CXX. 2 C.
1 *a*. Spheraster from cortex, × 310; 1 *b*. spheraster from choanosome, × 310; 1 *c*. chiasters from cortex, × 770; 1 *d*. chiasters (oxyasters) from choanosome, × 770.

Fig. 2. *Donatia japonica* (Sollas). R.N. LVII. 10 B.
2 *a*. Spheraster from cortex, × 310; 2 *b*. spheraster from choanosome, × 310; 2 *c*. tylasters from cortex, × 770; 2 *d*. tylasters from choanosome, × 770; 2 *e*. strongylaster from choanosome, × 770.

Fig. 3. *Donatia ingalli* (Bowerbank). R.N. CXIII. 1 B.
3 *a*. Spheraster from cortex, × 310; 3 *b*. spheraster from choanosome, × 310; 3 *c*. tylasters from cortex, × 770; 3 *d*. tylaster from choanosome, × 770; 3 *d'*. strongylasters from choanosome, × 770.

Fig. 4. *Donatia seychellensis* (Wright). R.N. CXX. 2 A.
4 *a*. Spheraster from cortex, × 310; 4 *b*. spheraster from choanosome, × 310; 4 *c*. tylasters from cortex, × 770; 4 *d*. oxyasters from choanosome, × 770; 4 *d'*. tylasters from choanosome, × 770.

Fig. 5. *Donatia stella-grandis* n. sp. R.N. CVI. 5.
5 *a*. Styli, × 60; 5 *a'*. tylostyli, × 60; 5 *a''*. strongyle, × 60; 5 *b*. spheraster, × 310; 5 *c*. cortical chiasters, × 770; 5 *c'*. slender-rayed chiaster, × 770; 5 *d*. choanosomal chiasters, × 770.

Fig. 6. *Chondrilla australiensis* Carter. R.N. XXXIII. 3.
6 *a*. Spheraster from cortex, × 550; 6 *b*. oxyasters from choanosome, × 550.

Fig. 7. *Chondrilla mixta* Schulze. R.N. CX. 4.
7 *a*. Spheraster from cortex, × 550; 7 *b*. oxyasters from choanosome, × 550.

Fig. 8. *Chondrilla sacciformis* Carter. R.N. XI. 4.
8 *a*—8 *c*. Spheraster, showing variation in shape of rays, × 550. (8 *a* and 8 *b* are probably developmental stages of 8 *c*.)

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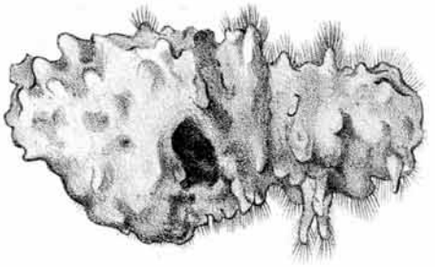

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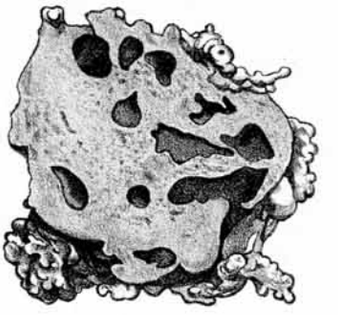

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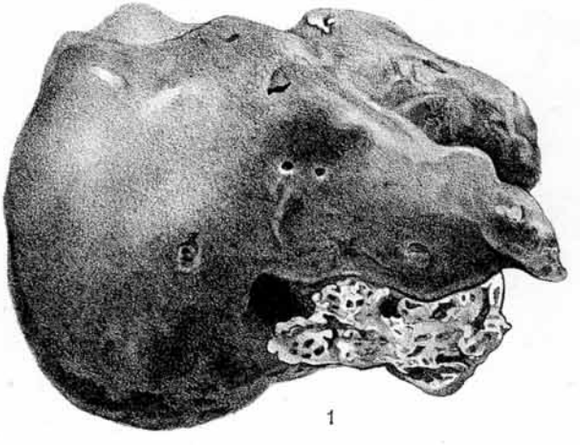

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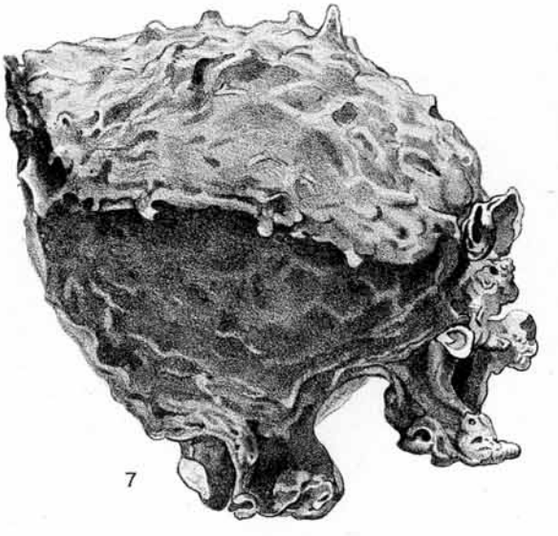

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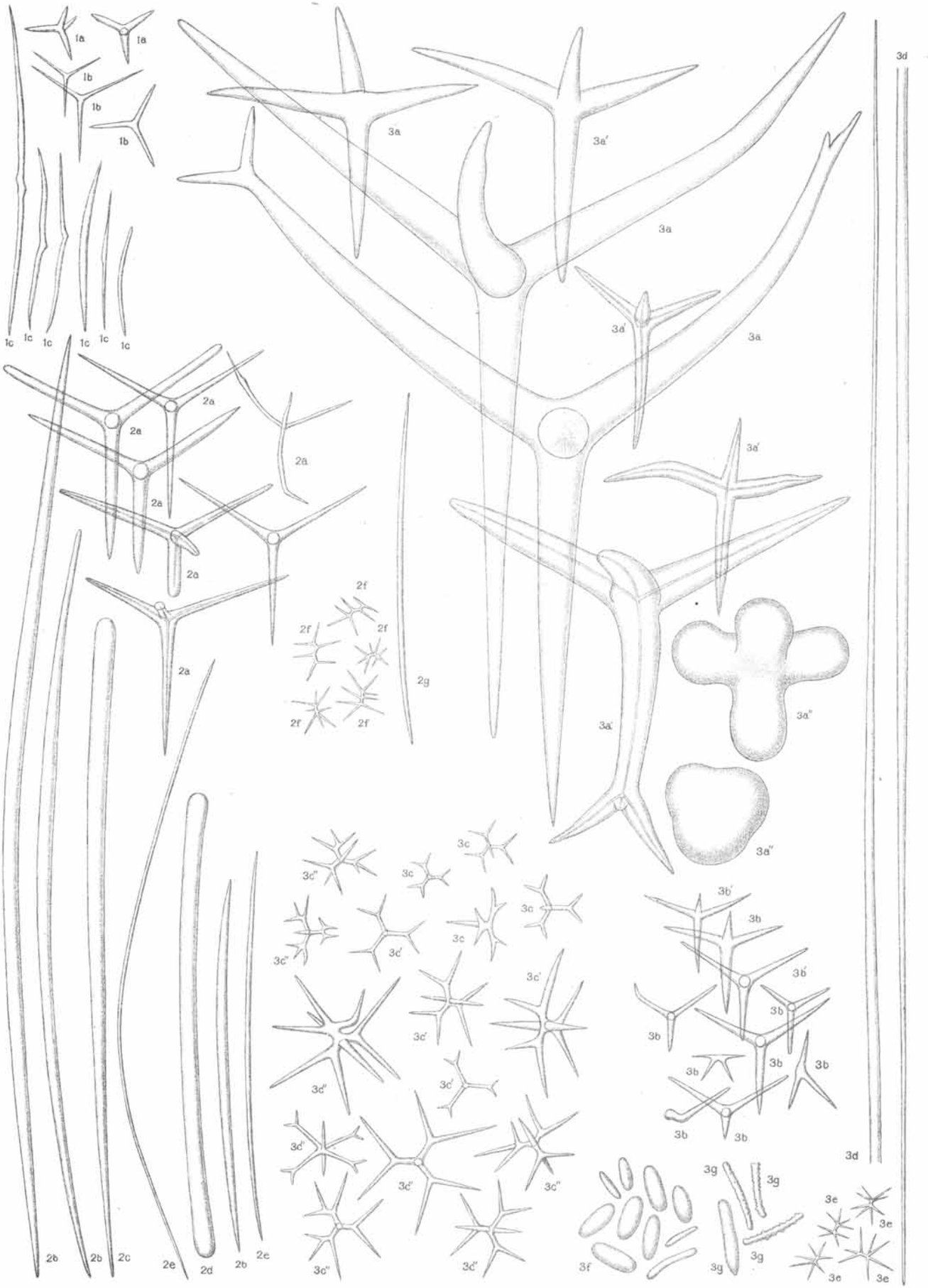

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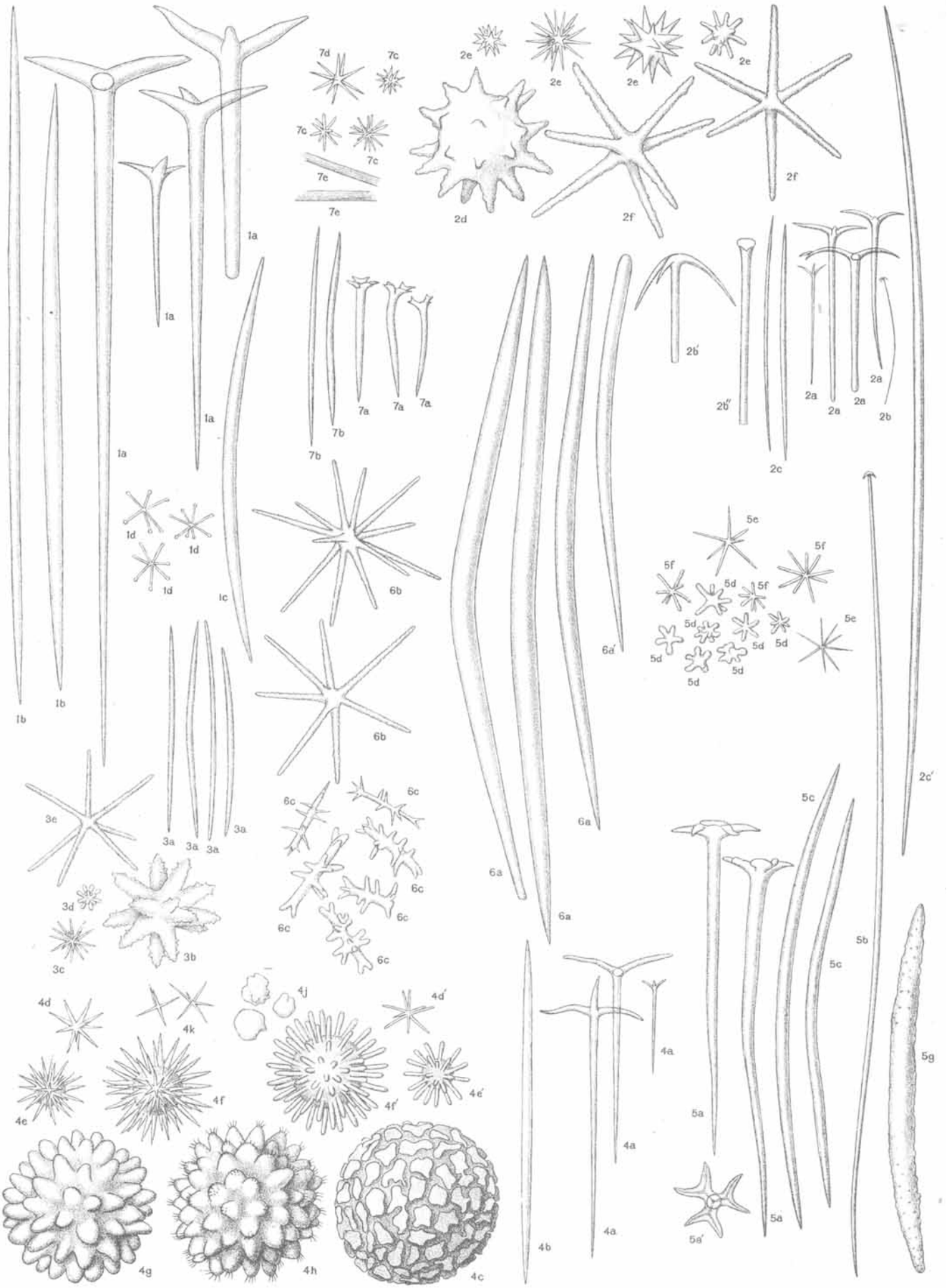
SEALARK TETRAXONIDA.



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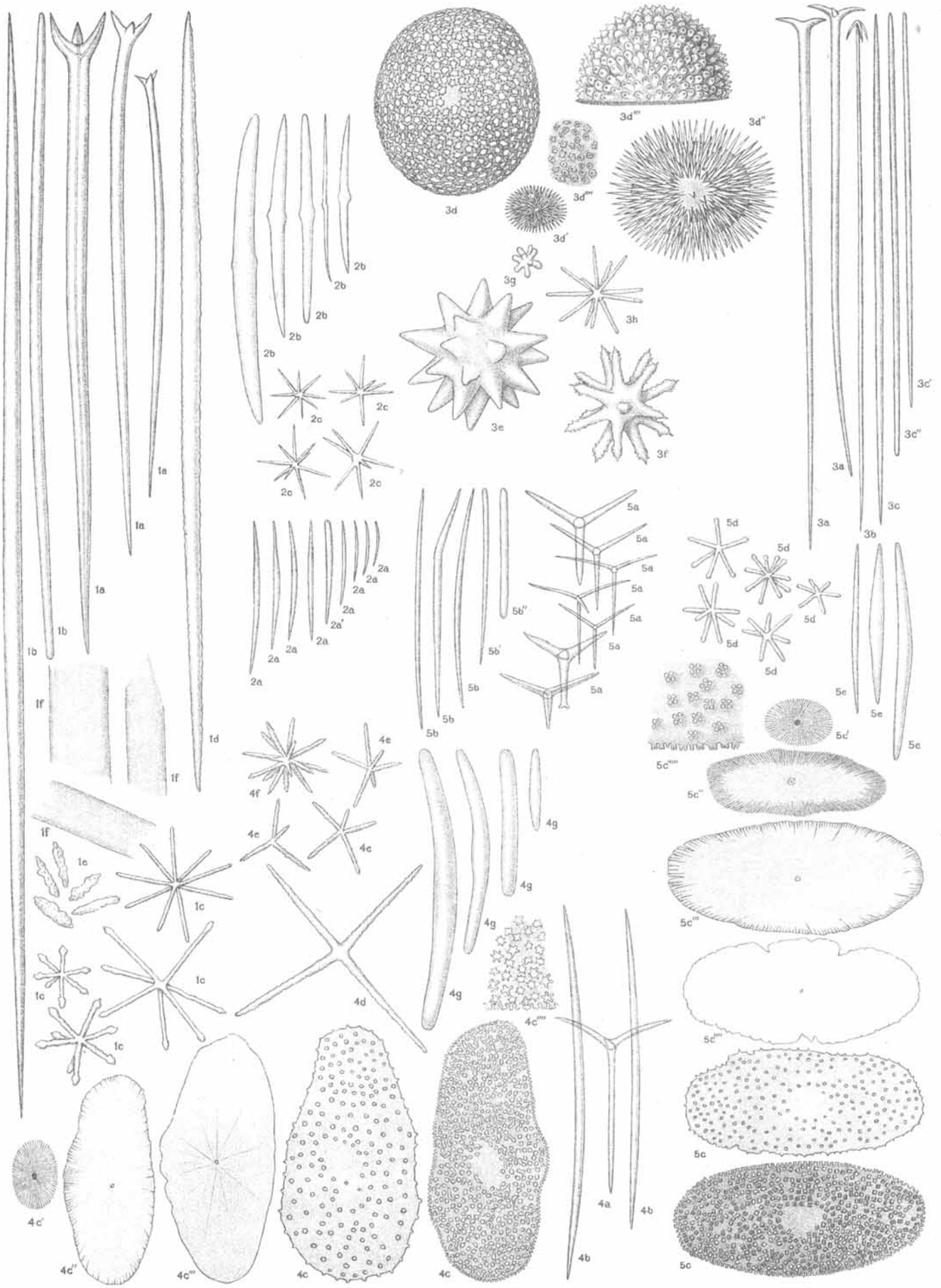

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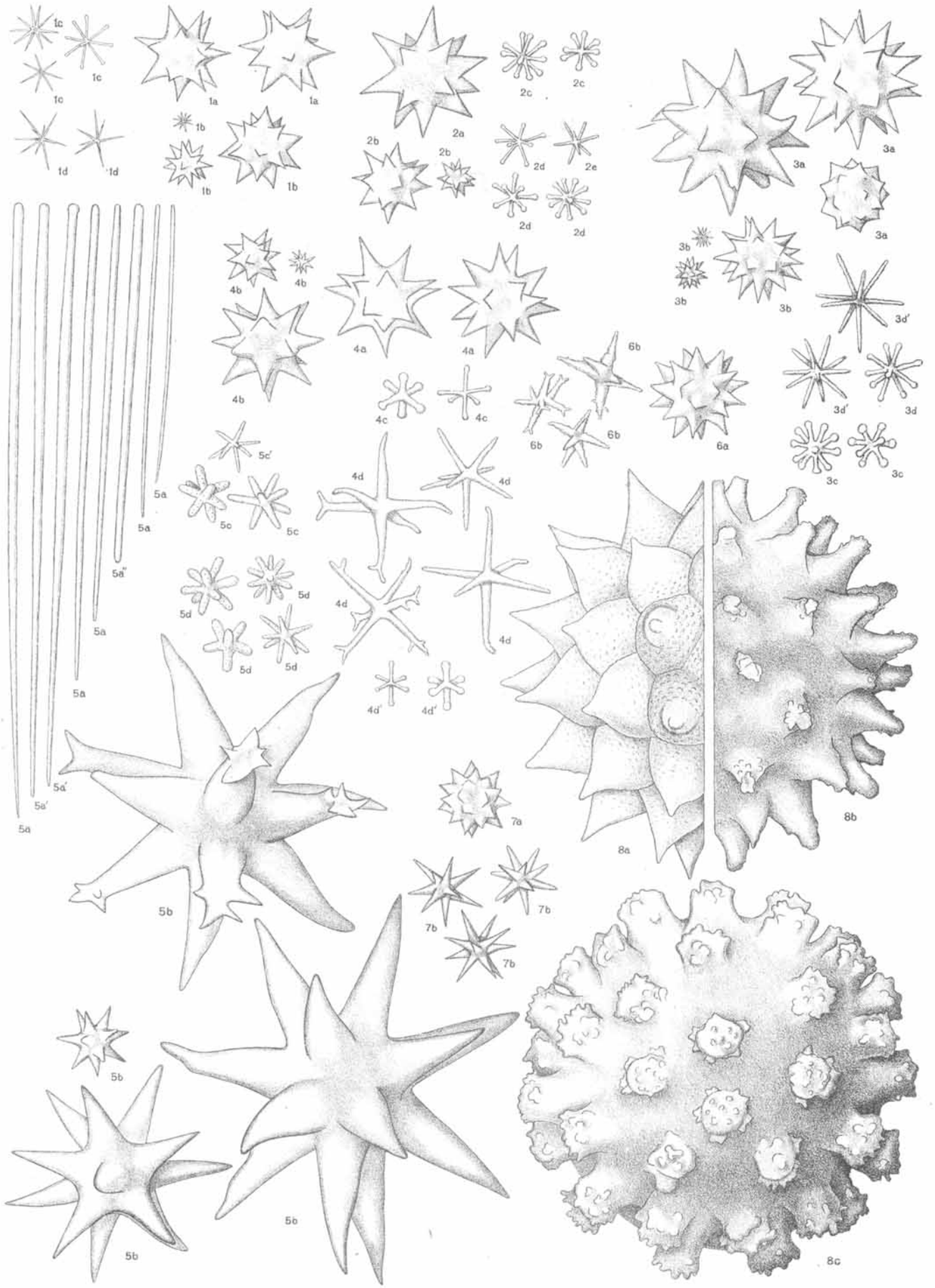

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