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Studies on the Hexactinellida.

CONTRIBUTION IV.

(*Rossellidæ*).

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With 23 plates.

The Rossellidæ I define as follows:

Lyssacine Hexasterophora of cup-like or sacciform body; sometimes stalked; generally firmly attached at base and exceptionally rooted by basal processes or by tufts of basal spicules. Besides the main terminal osculum, a few secondarily formed oscula may occur. Ectosomal skeleton composed of small rough dermalia with a variable number of rays and of large hypodermalia. The latter are generally pentactins which often show a tendency to protrude outwards in such a way that the paratangentials form a veil-like covering over the dermal surface. The dermalia, when hexactinic, have the distal ray not pinular but much like the rest in appearance. The gastralia are generally rough hexactins; without pentactins as hypogastralia. The hexasters are various but mainly oxyhexasters and discohexasters, these generally occuring together; but sometimes one kind occurs to the exclusion of the other. Oxyhexasters are often hemihexactinose and hexactinose. Discohexasters may be modified into discoctasters.

In the above, I have slightly modified the diagnosis of the same family as given in my Contrib. III., p. 114.

In '97 F. E. SCHULZE distinguished three subfamilies under the Rossellidæ, *viz.*, the Rossellinæ, the Lanuginellinæ and the Acanthascinæ. To these I added in '98 a fourth under the name Leucopsacinae; but since I have later (Contrib. III.) given to this group the status of a distinct family, there remain F. E. SCHULZE's three subfamilies above-mentioned to make up the Rossellidæ. As was pointed out by that writer, they may be distinguished from one another by the absence or presence of strobiloplumicomes or of discoctasters, thus:

a.—Without discoctaster.
  a[1].—With strobiloplumicome...A. *Lanuginellinæ.*
  b[1].—Without strobiloplumicome..B. *Rossellinæ.*
b.—With discoctaster; no strobiloplumicome.......................................C. *Acanthascinæ.*

A. LANUGINELLINÆ.

Pentactinic hypodermalia always present. Gastralia, hexactins. Parenchymalia consist of diactins and of large or medium-sized hexactins. Strobiloplumicome always present among the hexasters, which for the rest consist of either discohexasters or oxyhexasters, or of both; without the discoctaster.

Differential Key to the Known Genera and Species.

a.—Firmly attached at base to solid substratum.

a[1].—Without tufts of prostal diactins. Dermalia stauractinic. Only discohexasters present besides strobiloplumicomes....................1. *Lanuginella pupa* O. SCHM. (N. Atlantic; Polynesia; Sagami Sea).

b[1].—With tufts of prostal diactins. Dermalia pentactinic and hexactinic. Only oxyhexasters present besides strobiloplumicomes....................2. *Calycosoma validum* F. E. SCH.* (SE. of Mass.).

b.—Rooted in loose bottom by tufts of pentactinic anchor-needles.

c[1].—Both oxyhexasters and discohexasters present besides plumicomes. Shaft of anchor-needles barbed in the distal part. Body-surface veiled....................3. *Mellonympha velata* (W. THOMS.). (Strait of Gibraltar).

d[1].—Only oxyhexasters present besides plumicomes. Shaft of anchor-needles smooth. Body-surface not veiled, but with tufts of long prostal needles....................*Lophocalyx*.

a[2].—Body cup-like. Dermalia stauractinic. Oxyhexasters normal, with terminals shorter than principals....................4. *Lophocalyx philippinensis* (J. E. GRAY). (Philippines; Polynesia).

b[2].—Body irregularly shaped. Dermalia, convex stauractins and pentactins; the latter having the unpaired ray directed distad. Oxyhexasters normal, hemihexactinose and hexactinose; terminals about as long as principals....................5. *Lophocalyx spinosa* F. E. SCH. (W. of Andaman Is.).

Of the above-mentioned four genera and five species referable to the subfamily, *Lanuginella pupa* is the only form that has as yet been discovered in the Japanese seas. A description of it after my own studies follows.

LANUGINELLA PUPA O. SCHM.

Contrib. III., Pl. V., figs. 1—7; and this Contrib., Pl. I.

O. SCHMIDT, '70, p. 13; Pl. II., figs. 1,3.—S. KENT, '70, p. 247; Pl. LXV., figs. 1–6.—F. E. SCHULZE, '86,

* For the grounds of placing here this genus and species, originally described by F. E. SCH. ('99) as an Asconematid, see my Contrib. III., pp. 73-83.

p. 47.—F. E. SCHULZE, '87 (!)*, p. 130; Pl. LIII., figs. 3–5.—F. E. SCHULZE., '97 (!), p. 548.—E. TOPSENT, '95, p. 213.—I. IJIMA, '98, p. 44.

The species has long been known from St. Jago, one of the Cape Verde Islands (O. SCHM.), from the coasts of Spain and Portugal (S. KENT,) from the Strait of Gibraltar (924 m.; TOPS.) and from off Little Ki Island (236 m.; "Chall."). It occurs also in the Sagami Sea, so that it seems to be a very widely distributed species.

In the Sagami Sea, in all nearly a score or more specimens have thus far been obtained at Dōketsba, Mochiyama, Inside and Outside Okinosé and at a spot off the east coast of Vries Island. The depths from which they were obtained were 183–572 m. (100–313 fms.). The species is known to occur there along with *Euplectella marshalli*, *Leucopsacus orthodocus*, *L. scoliodocus*, *Staurocalyptus pleorhaphides*, *Crateromorpha meyeri*, *Hyalonema affine*, *Semperella stomata*, *Farrea* sp., *Hexactinella lorica*, etc.

The species is always firmly attached at base to the substratum. I have seen it growing on pebbles and shells as well as on dead remains of a coral, of a Bryozoa, of a Lithistid, of a *Farrea* and very frequently on *Hexactinella lorica*.

In the Challenger Report (p. 131), F. E. SCHULZE mentioned that the sponge might sometimes be rooted in a soft bottom by means of long anchors; this mention, so far as it goes, was probably founded upon observations, not on the present species, but on young *Lophocalyx philippinensis*, specimens of which, as we are told by him, were contained in the same bottle together

* In the list of literature given for each species treated of in this Contribution, the principal or the more important work or works are indicated by an exclamation mark in parenthesis.

with the *Lanuginella pupa* examined by him. In fact, a case of one and the same Hexactinellid species being firmly fixed when growing on hard substratum but producing a root-tuft when living on a soft bottom has never as yet been shown to exist.

The general shape of the sponge is ovoid or spherical, usually contracted below into a short stalk-like base. The body in larger specimens is often laterally compressed to a perceptible degree. Its small size led CARTER ('73 *a*, p. 283; '73 *b*, p. 359) to suspect that the species was based on young specimens of a larger sponge. It seems the species never attains a large size,—a size larger than, say, a large acorn or a hazelnut. One of the largest specimens I have measured was ovoid in shape, measuring 19 mm. in height and 11 mm. by 14 mm. in breadth at the broadest part. It had at the upper end a roundish osculum, 3 mm. in diameter. Wall as thick as 4½ mm. in the middle of the body. Another large specimen, likewise ovoid in shape, measured 22 mm. in length.

The specimen shown in natural size in fig. 1, Pl. I., measures 16 mm. in height and 13 mm. by 9 mm. in greatest breadth. The osculum, 3 mm. in diameter. Thickness of wall, as much as 4 mm.—The specimens of figs. 2 and 3 measure respectively 17 mm. and 10 mm. in height.

The osculum situated at or near the upper pole is always comparatively small; it is roundish or oval and has a thin smooth edge, never supplied with marginal prostals. It leads into a gastral cavity which is either pit-like or but slightly expanded internally, on account of the considerable thickness of the body-wall in the middle.—F. E. SCHULZE found small young specimens of 2–3 mm. diameter with the osculum still unopened. That negative condition may sometimes, but certainly does not always, persist even when the sponge has attained the size of a pea or of a bean. This is attested by two specimens of the size indicated, which I have found in my collection. In both the sponge-wall is simply thinned out, without being broken through, at the point where one would expect the formation of the oscular aperture. Though I have not examined them on sections, I believe that the wall there lacks the chamber-layer as represented by F. E. SCHULZE in his fig. 5, Pl. LIII. (*l. c.*), and further that, in the absence of a single large aperture, the discharge of water from the gastral cavity must have taken place through the intertrabecular gaps of that part of the wall. All the rest of my specimens, including the smallest of 6 or 7 mm. height, show an open osculum.

In some specimens I have seen the external surface covered partly or nearly all over with a veil, formed of small hypodermal pentactins which had protruded through the dermal layer. So, for instance, in two of the specimens figured on Pl. I. All the smaller specimens are without the veil. Not that all the larger specimens are provided with it; on the contrary, the two largest specimens, respectively 19 mm. and 22 mm. high, seem to show no trace of it. Presumably it is formed only under certain circumstances after the sponge has reached maturity. In forming it, the hypodermal pentactins stand out isolatedly but usually at such intervals that their paratangentials are nearly or quite in touch with one another. Their shafts are exposed over the dermal surface to a length of ½—1 mm.

The real dermal surface is smooth. When dried it is somewhat shiny, which is however by no means a peculiarity of the genus or of the species. The reflection of light takes place principally, if not solely, from the smooth hardened surface of the dermal membrane. Seen under the hand-lens, the delicate dermal latticework contains minute meshes which are more or less regularly rectangular in shape, though in certain individuals I have found them irregularly shaped throughout nearly the entire extent of the layer. With the larger-meshed hypodermal lattice, it is quite usual that the intersecting of the thin laths takes place in an irregular manner; only seldom are the meshes of a rectangular shape. Generally speaking, the ectosomal skeleton seems to lie in tolerably close apposition to the choanosomal mass, so that the subdermal space is but inconspicuously developed. The entrances into incurrent canals, indistinctly visible from the outside, are small; the larger of them are separated from one another by a comparatively wide interspace.

Towards the stalk-like base of the sponge the hypodermal lattice becomes unnoticeable. It is here replaced by parenchymal bundles running in the main longitudinally and with these the ectosomal layer is apparently in direct contact.

The gastral cavity, instead of being lined with a continuous gastral or endosomal layer, shows the apertures of excurrent canals freely open. Many of the apertures are much larger than those of the incurrent canals in the same specimen. They may measure 2 mm. across in fully grown specimens.

Spiculation.*

The *parenchymalia* consist of oxyhexactins and oxydiactins. In both these forms the rays run out to a sharp point and are either smooth all over or show a roughness near the end.

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* I am indebted to Professor F. E. Schulze for a slide-preparation of *Lanuginella pupa*, —presumably of one from the Challenger collection. It has been useful for the purpose of comparison.

The oxyhexactins are numerously represented in the parenchyma and play an important part in the formation of the supporting skeleton. Though somewhat variable in size, most of them are of moderately large dimensions. They may be so large as to present an axial length of nearly 2mm., the thickness of rays reaching up to 30μ near the central node. All the six rays are not always of the same length. As a general rule, the spicules lie with one of the axes directed radially and are met with in a layer,—at places in a few irregular layers,—in the thickness of the choanosome.

The oxydiactins likewise occur in considerable numbers. They are here decidedly more numerous than in *Leucopsacus*, but not so numerous as in the generality of Rossellid members in which diactins form the predominant, if not the only, megascleric elements of the parenchymalia. In the present species, the spicules in question are mostly thin and small, not exceeding 22μ in thickness near the center, which may or may not be externally marked by an annular swelling. Some are seen to run in company with the radial rays of parenchymal oxyhexactins or of hypodermal pentactins; but the majority seem to pursue a more or less paratangentially directed course, either isolatedly or arranged in bundles, which are strongest in the stalk-like basal region of the sponge. Here a diactin may reach a length of 3 or 4mm.

Close to the attachment-surface there occur a number of stout-rayed and prickly-surfaced hexactins of about 100μ axial length, forming a thin layer. The same spicules are occasionally pentactinic and even stauractinic. There can be no doubt that we have here to do with the *basidictyonalia*. Some of the spicules are loosely disposed; others, especially those in direct contact with the substratum, are joined together by synapticulæ in an irregular manner, forming a continuous basal plate in which the individual spicules can without difficulty be recognized in their proper forms.

The *hypodermalia* closely resemble the parenchymal oxyhexactins in character, except in being always devoid of a distal ray. The cruciate paratangentials, 1 mm. or over in axial length and up to 34 μ in thickness near the center, are usually in a slightly convex plane in conformity with the curvature of the body-surface. They may exhibit a sparing quantity of obsolete microtubercles near the pointed end (Pl. I., fig. 6) or may be quite smooth throughout. The unpaired proximal ray, more generally smooth all over, is straight and may be nearly three times as long as the paratangential.

As before mentioned, the hypodermalia in certain specimens are protruded through the dermal layer, their paratangentials thus forming a veil over the external surface. In one such veiled specimen,—namely, the one depicted in Pl. I., fig. 1,—I have found most of the prostalia to be rough-surfaced on the paratangentials (Pl. I., fig. 7) as well as on the shaft, but the latter only for a short distance from the spicular center. This shagreen-like roughness, which is known to exist also on the same spicules of several other Rossellids, is due to minute, fine, erect and closely set processes. On the paratangentials, the processes are most pronouncedly developed on the outer surface; laterally they become obsolete, leaving the inner surface along the middle line nearly smooth. Not that all the prostal pentactins are shagreened in the manner described, for some are quite devoid of this characteristic. On the other hand, among the hypodermalia, *i. e.*, the prostalia before protrusion, there occasionally occur such as show the same roughness of surface. It then seems that this shagreen-like character, beginning to arise, whenever it occurs, while the spicule is yet hypodermally situated, does not constitute a constant peculiarity of all old hypodermalia. This opinion is also supported by the fact that the specimen referred to is the only one in which I have seen the rough pentactins, while in all the rest I have failed to find the same spicules, whether as prostalia or as hypodermalia, characterized in the same way.

The *dermalia* (Pl. I., fig. 4) are rough stauractins, exceptionally and very rarely tauactins; they are nearly flat or perceptibly convex on the outer side. The rays taper but little towards the end which is rounded. The prickles on the surface are erect and generally tolerably conspicuous, but are subject to a considerable variation in this respect according to individuals, as are also the spicules in respect of their size. In most specimens the axial length averaged 220 μ (the maximum being 280 μ) in length and 7 μ in breadth near the central node. In one specimen, however, I found the average axial length to reach up to 330 μ (the maximum being 374 μ); the rays tapering gradually towards the conically or obtusely pointed end and being beset with rather inconspicuous prickles. F. E. SCHULZE ('97) had given 160–200 μ as the size of the dermalia.—It is by no means rare to meet, here and there among the dermalia, with perfectly smooth, small and unusually thin-rayed oxystauractins, such as are shown in Pl. I., fig. 5. They are evidently dermalia in an incomplete stage of development.

The *gastralia* (Pl. I., fig. 8) are regularly shaped oxyhexactins, measuring 220—330 μ in axial length and 7½ μ in average breadth of rays near the central node. The surface is uneven on account of obsolete microtubercles. The freely projecting ray is in no way differently characterized from all the rest. The gastralia occur abundantly but do not form a continuous lattice-work. Oxyhexactins of precisely the same appearance also occur in scattered distribution along the inner surface of excurrent canals—especially of the larger excurrent canals—as the *canalaria*. (See fig. 9).

The *hexasters* consist of the discohexaster and the strobiloplumicome.

The *discohexaster* (Pl. I., figs. 11 and 12; also Contrib. III., Pl. V., figs. 1–6) occurs commonly throughout the entire sponge-wall. It shows considerable variations in both size and appearance in the same as well as in different specimens. In general it may be said to be spherical or approximately spherical, in that the terminals so diverge peripherally that all the terminal discs are situated nearly equidistant from one another. In general appearance it most closely resembles certain discohexasters of *Chaunoplectella* and of *Leucopsacus scoliodocus*. The diameter ranges from 40 μ to 90 μ (according to F. E. Schulze, 32–100 μ). In some specimens of the species, however, the largest discohexaster does not exceed 70 μ in diameter. Aside from certain exceptional cases, each short or very short principal bears 2–4 or 5 (most commonly 3) terminals. The number may vary with different principals in one and the same rosette. The terminals appear to be rather strong—at any rate not quite thin except in the case of the smallest discohexaster; they are either of about the same thickness throughout the entire length or thicken slightly towards the outer end. Their surface, when seen under a high magnifying power, is rough on account of microtubercles (Pl. I., fig. 12). In some cases, the roughness of the surface is more pronounced than in others, the microtubercles being then visible as minute reverted prickles or barbs. The convex terminal disc, when well developed as is generally the case, exhibits comparatively strong recurvate marginal prongs, 5–6 in number. Occasionally the prongs are minute or quite obsolete; they may even be apparently wanting, in which case the terminals appear as if ending bluntly, in all probability representing a developmental stage previous to the formation of the terminal prongs. In rare instance I have seen small and delicate oxyhexaster-like forms, which I consider to be likewise an early stage in the genesis of the discohexaster.

One individual (Mus. No. 436) of the species from Outside Okinosé, which I have studied with special thoroughness as regards the spiculation, requires to be here particularly mentioned. In it I have discovered, though certainly as rare abnormalities, cases of the discohexaster in which some—not all—of the terminals are bent outwards and backwards, directly after their origin from the principal, in a semicircle or in a comma-like manner, apparently with no definite rule as to the relative orientation of the plane of curvature. They are not unlike the peculiarly twisted oxyhexasters figured by F. E. SCHULZE from *Bathydorus spinosus* (Chall. Rep., Pl. LIX., fig. 9) and from *Rhabdocalyptus mollis* (*l. c.*, Pl. LXIV., figs. 10, 11).—As representatives of normal discohexasters in the same specimen I have shown three in my Contribution III., Pl. V., figs. 1–3. Some of the smallest, such as is shown in *l. c.* fig. 3, are distinguished by the fact that the number of terminals is somewhat more numerous than usual, there being six or more of them to each principal.

Such forms are nearly as delicate as the so-called microdiscohexasters of certain other Rossellids, but grade over by transitional forms into the larger and commoner varieties, such as are depicted in figs. 1 and 2 (*l. c.*). They evidently correspond to the small and inconspicuous rosettes which were mentioned by F. E. SCHULZE (Chall. Rep., p. 131) as having been observed by him in some, but not in all, of his specimens. I am likewise of the opinion that the form in question is an inconstant one, only exceptionally presented by the smaller discohexaster of the species. —Further I have to note that in the same specimen I have met with a few hexactinose discohexasters which are in no way distinguishable from the same of *Leucopsacus scoliodocus.* I believe they are simply extrinsic, and am confirmed in this opinion by the fact that the specimen had been kept in a bottle together with the Leucopsacid just mentioned.

The *strobiloplumicome* (Pl. I., fig. 13; also Contrib. III., Pl. V., fig. 7) of the well-known form seems to be constantly present in all individuals though in varying numbers. So sparse is it in some that it requires a special search in preparations in order to find one. In others it occurs in greater or less abundance, not confined to the subgastral region but appearing in the subdermal as well, though frequently more numerously in the former than in the latter. I have met with the rosettes in especial abundance in a large specimen of 19 mm. height, in which they occurred subdermally and subgastrally as well as in all parts of the choanosome.

In one specimen of the species, the rosettes in question measured in diameter 34–42 μ; in another, 45–50 μ; and in still another 50–76 μ.

Structurally and in appearance the rosette is quite similar to the same of *Sympagella* (Contrib. III., p. 106). The hemispherical knob, bearing the feather-duster-like bunch of delicate terminals, usually shows at the center of the convex outer surface a small process, into which the axial filament is seen to extend itself. The process then is a direct continuation of the principal and represents the outer end of the primary ray of a hexactin; the terminal-bearing knob and the terminals with it are then to be considered as secondary structures that have developed along the course of a primary ray, not at its outer end. This may be held as an indication that the strobiloplumicome is a hexaster *sui generis*, having arisen independently of the ordinary discohexaster and oxyhexaster in which the terminals appear to be *ab origine* at the very ends of primary hexactin-rays.

The central process above referred to may be more or less atrophied and may even disappear altogether. Thus, several instances in the present species have come under my observation in which the process was reduced to a mere acuminous point, the entire knob in shape presenting a resemblance to an acorn. In some other exceptional cases I have convinced myself, as I did also with some of the same rosettes in *Sympagella anomala*, that the central process was totally wanting.

Soft Parts.

All that I have observed as regards the soft parts of this species may be referred to in brief.

In fig. 9, Pl. I., the soft parts are shown as seen in a section under a low power of the microscope. The shading given to the chambers is somewhat artificial. With respect to fig. 10, which is meant to illustrate the highly magnified appearance of the chamber-wall as well as that of archæocytes and of trabeculæ arising from the chamber-rim, I must state at once that it is to a great extent a failure, in part due to the unsuccessful lithographing and in part to the highly unsatisfactory state of the original preparation.*

The chambers are shallow and cup-like or long and thimble-like or tubular. Their diameter, 77–132 μ; on an average 100 μ. Length, up to 440 μ. The longest are found at the blind ends of excurrent canals, in the periphery of the choanosome: they may sometimes present a lobed or branched appearance. All the more deeply situated chambers are cup-like. In all my preparations, the chamber-wall appears at the best as a faintly stained reticulum with minute irregular meshes. The nuclei are not discernible under ordinary powers of the microscope; but by using an immersion system they can, under favorable circumstances, be recognized as ill-defined spots found at short intervals and measuring not more than 2 μ across. In staining capacity they differ scarcely at all from the substance of the reticulum. Flagella seem to be in no case preserved.

The trabeculæ are developed in moderate, and in some individuals in very great, abundance. On the external sponge-surface they are frequently spread out in a film-like manner to form the perforated dermal membrane. The nuclei are minute but distinct, being well stained as usual. Not seldom have I seen, hanging on the trabeculæ, homogeneous fat-like spherules which stained well with both carmine and hæmatoxylin: they were no doubt the product of the thesocytes.

* Many of the plates, now issued in this Contribution, were prepared and printed several years ago in the early period of my studies and therefore contain shortcomings of which I am more conscious than ever. For them I beg to ask a lenient judgment.

The archæocytes are as usual deeply stained and on the whole somewhat larger than trabecular nuclei. They do not exceed $3\frac{1}{2}$ μ in diameter. Though sometimes found isolated, they more commonly occur in loose or compact groups varying greatly in dimensions, always among, and on the outer side of, the chambers. Many of the groups are of a quite conspicuously large size (Pl. I., fig. 9).

B. ROSSELLINÆ.

Pentactinic hypodermalia generally present; exceptionally wanting. Gastralia, hexactins; exceptionally pentactins. Parenchymalia, chiefly diactins and including medium-sized or small hexactins, or exclusively diactins. Hexasters consist as a rule of oxyhexasters and discohexasters; the latter often in more than one variety, but may be totally absent; lacking both strobiloplumicome and discoctaster.

The following is a list of all the genera and species which I consider to make up the subfamily as it stands at present.

1. ***Rossella antarctica*** CARTER. (=*Acanthascus grossularia* F. E. Sch.). (S. of Kerguelen Is.; SE. of Prince Edwards Is.; Possesion Is.; 256–549 m.).
2. ***R. dubia*** (F. E. SCH.). (S. of Puerto Bueno, 732 m.).
3. ***R. racovitzæ*** TOPS. (Western Antarctic, 450–569 m.).
4. ***R. nuda*** TOPS. (Western Antarctic, 430 m.).
5. ***Scyphidium septentrionale*** F. E. SCH. (N. of Spitzbergen, 1000 m.).

6. ***S. longispina*** (Ij.). (=*Rossella longispina* Ij.). (Sagami Sea).
7. ***S. namiyei*** (Ij.). (=*Vitrollula namiyei Ij.*). (Sagami Sea).
8. ***S.*** sp. (=*Rossella* sp. F. E. Sch. '99). (Messier Channel in S. Chile, 821 m.).
9. ***Vitrollula fertilis*** Ij. (Sagami Sea).
10. ***Schaudinnia arctica*** F. E. Sch. (N. of Spitzbergen, 1000 m.).
11. ***Crateromorpha meyeri*** J. E. Gray. (Philippine Is., 174 m.; Sagami Sea).
11a. ***C. meyeri tuberosa*** Ij. (Sagami Sea).
11b. ***C. meyeri rugosa*** Ij. („ „).
12. ***C. pachyactina*** Ij. (Tosa Sea, Japan).
13. ***C. corrugata*** Ij. (Sagami Sea).
14. ***C. thierfelderi*** F. E. Sch. (=*C. murrayi* F. E. Sch.). (Little Ki Is., 236–256 m.).
15. ***C. tumida*** F. E. Sch. (Banda Is., 658 m.).
16. ***Hyalascus**** ***sagamiensis*** Ij. (Sagami Sea).
17. ***H. similis*** Ij. (Off coast of Prov. Tōtōmi, Japan).
18. ***H. giganteus*** Ij. (Sagami Sea).
19. ***Aulochone cylindrica*** F. E. Sch. (=*Crateromorpha cylindrica* (F. E. Sch.)). (Kermadec Is., 1097 m.).
20. ***Aulochone lilium*** F. E. Sch. (=*Crateromorpha lilium* (F. E. Sch.)). (Meangis Is., NE. of Celebes, 914 m.).
21. ***Aulochone lankesteri*** (R. Kirkp.). (=*Crateromorpha lankesteri* R. Kirkp.). (Off SE. coast of Cape Colony, 457–549 m.).

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* For including in the Rossellinæ the genera *Hyalascus* and *Asconema*, placed by F. E. Schulze ('97) under the Asconematidæ, see Contrib. III., pp. 81, 82.—For the omission, in the list here given, of the three genera *Placoplegma*, *Aulocalyx* and *Euryplegma*, all referred to the Rossellinæ by F. E. Schulze (*l. c.*), see Contrib. III., pp. 29–32.

22. ***Aulosaccus schulzei*** IJ. (Sagami Sea).
23. ***A. ijimai*** (F. E. SCH.). (= *Calycosaccus ijimai* F. E. SCH.). (S. of Alaska, 291 m.).
24. ***A. mitsukurii*** IJ. (Sagami Sea).
25. ***Asconema* setubalense*** S. KENT. (N. Atlantic, 185–1170 m.).
26. ***Trichasterina borealis*** F. E. SCH. (N. of Spitzbergen, 1000 m.).
27. ***Aphorme horrida*** F. E. SCH. (Off San Diego, Cal., 849 m.).
28. ***Bathydorus fimbriatus*** F. E. SCH. (N. Pacific, 4206 m.).
29. ***B. stellatus*** F. E. Sch. (Messier Channel, S. Chile, 256 m.).
30. ***B. lævis*** F. E. SCH. (B. of Bengal, 3652 m.).
31. ***B. uncifer*** F. E. SCH. (Galapagos Is., 717 m.).
32. ***B. spinosus*** F. E. SCH. (Pinguin Is., 2926 m.).
33. ***B. baculifer*** F. E. SCH. (S. Mid-Pacific, 4270 m.).

Differential Key to the Genera.

(The numbers in parenthesis refer to those of the above list).

a.—Without pentactinic hypodermalia.

- a^1.—Body trumpet-like or with gastral surface everted so as to form a large part of the outer surface; always with long stalk. Discohexaster in one small variety, or entirely wanting........*Aulochone* F. E. SCH. (Nos. 19–21).
- b^1.—Body saccular or vase-like, without stalk. Discohexaster in two (large and small) varieties........*Aulosaccus* IJ. (Nos. 22–24).

b.—With pentactinic hypodermalia.

- c^1.—Hexaster consists of oxyhexaster only (without discohexaster).
  - a^2.—Paratangentials of hypodermal pentactin, spiny. All oxyhexasters hexactinose. ....*Aphorme* F. E. SCH. (No. 27).
  - b^2.—Paratangentials of hypodermal pentactin, not spiny but smooth and rough at ends only. Oxyhexasters, some or all normal.

a[3].—Trichaster present besides ordinary oxyhexaster with barbed terminals. .... *Trichasterina* F. E. Sch. (No. 26).

b[3].—Without trichaster. Oxyhexaster terminals rough or nearly smooth......... .... *Bathydorus* F. E. Sch. (Nos. 28–33).

d[1].—Hexaster consists of oxyhexaster and discohexaster.

c[2].—Dermalia, pentactins with the unpaired ray distally directed...................... .... *Aseonema* S. Kent. (No. 25).

d[2].—Dermalia variable; generally without distally directed ray, which, if present, as it sometimes is, invariably belongs to a hexaster and not to a pentactin.

c[3].—Body smaller than acorn-size; parenchymalia include a considerable quantity of relatively large hexactins.................... *Vitrollula* Ij. (No. 9.)

d[3].—Body much larger; parenchymalia, diactins only or may include medium-sized or small hexactins.

a[4].—Gastralia not hexactins, but pentactins or other forms without free proximal ray. Sponge with distinct stalk.................................. .... *Crateromorpha* F. E. Sch. (Nos. 11–15),

b[4].—Gastralia, hexactins. Sponge generally without, but sometimes with stalk.

a[5].—Pentactinic hypodermalia partly with spiny and partly with smooth paratangentials. Rooted in loose bottom by basal processes.................................. *Schaudinnia* F. E. Sch. (No. 10).

b[5].—All pentactinic hypodermalia with smooth paratangentials rough at ends only. Firmly attached at base.

a[6].—Discohexaster in one small form of moderately uniform size .... *Hyalascus* Ij. (Nos. 16–18).

b[6].—Discohexaster in more than one form and differing in size; at any rate, the smallest being of about half the diameter of the largest, or even much smaller.

a[7].—Discohexaster distinguishable into three varieties, of which the largest has the terminals to each principal arranged in a narrow or a perianth-like tuft. Other varieties spherical............... *Rossella* Cart. (Nos. 1–4).

b[7].—Discohexasters all spherical, and without the largest form mentioned under *a*[7]...................................... .... *Scyphidium* F. E. Sch. (Nos. 5–8).

Further treatment is given, in this contribution, to only those genera and species known to me from Japanese waters.

SCYPHIDIUM F. E. Sch.

Saccular or vasiform, thick-walled, firmly attached by contracted base; showing a disposition to produce buds on the wall. Parenchymalia exclusively diactins. Pentactinic hypodermalia with paratropal or regularly cruciate, smooth or finely shagreen-like paratangentials, without spines. Dermalia, stauractins or pentactins, or both; rough-surfaced. Gastralia, regular hexactins with rough rays; forming a continuous layer over excurrent canalar apertures. Oxyhexaster normal, hemihexactinose or hexactinose. Discohexaster distinguishable into two forms differing in size, but both being spherical in shape. These two forms may grade over into each other; at all events, the smallest discohexaster is only about half as large as the largest or even much smaller.

The genus was first instituted by F. E. Schulze ('00) to receive the species *septentrionale* from the Arctic Ocean. Two forms occurring in the Sagami Sea and described by me before in brief under the names of *Rossella longispina* ('96) and *Vitrollula namiyei* ('98) I now consider to be generically unitable with *Scyphidium septentrionale* F. E. Sch. Further, the specimen from Messier Channel (Southern Chile), which had been described by F. E. Schulze ('99, p. 43) as *Rossella* sp. without receiving a specific name, likewise seems to be referable to the same genus and to represent a species especially closely related to my *Scyphidium namiyei.*

Under *Rossella* I put together the species (Nos. 1–4 of the list) in which the hexaster consists of oxyhexasters and of discohexasters in three varieties differing in size and appearance (macrodiscohexaster, mesodiscohexaster and microdiscohexaster). Now, *Scyphidium* in the scope given it by me differs from that genus chiefly in the fact that the hexaster occurs in only two varieties, the macrodiscohexaster of *Rossella* being wanting here. However there can be no doubt of the especially close relationship existing between the two genera. As another very close ally of *Scyphidium* is certainly to be considered *Vitrollula fertilis* IJ., which however lacks not only the macrodiscohexaster but also the mesodiscohexaster seen in *Rossella*, the only discohexaster-form present being apparently the microdiscohexaster.

The chief differential characters of the species of *Scyphidium* may be seen from the following key.

a.—Dermalia, stauractins.

*a*¹.—Pentactinic hypodermalia with smooth, regularly cruciate paratangentials. Larger discohexaster 80 μ, and microdiscohexaster 40 μ in dia. Oxyhexaster, about 100 μ in dia. Sponge with stalks; without prostalia.. *S. septentrionale* F. E. SCH. (N. of Spitzbergen).

*b*¹.—Pentactinic hypodermalia with either paratropal or regulary cruciate paratangentials, which are either smooth or shagreen-like. Larger discohexaster 90–130 μ, and microdiscohexaster 24 μ, in dia. Oxyhexaster, 100–122 μ dia. Sponge with contracted base; with long and conspicuous diactinic prostalia, in addition to which pentactinic prostalia may occasionally occur.. *S. longispina* (IJ.). (Sagami Sea).

b.—Dermalia, pentactins and stauractins. Pentactinic hypodermalia with smooth regularly cruciate paratangentials. Sponge with thick stalk-like base.

*c*¹.—Larger discohexaster of 100 μ dia. leading down to microdiscohexaster of 35 μ dia. Oxyhexaster, 53–76 μ in dia. Without prostalia.. *S. namiyei* (IJ.). (Sagami Sea).

*d*¹.—Larger discohexaster of 100 μ dia. leading down to microdiscohexaster of 25 μ dia. Oxyhexaster in two varieties; the smaller and thinner-rayed, 80–100 μ; and the larger, 120–150 μ in dia. Synapticular fusion among parenchymalia. Prostalia ?.................................. *S.* sp. (Messier Canal in Chile. *Vide* F. E. SCH. '99).

SCYPHIDIUM LONGISPINA (IJ.)

Plate II.

Rossella longispina, IJIMA, '96, p. 253.

Two specimens are now before me. The type-specimen, which is the larger and on which my original description was based, comes from Yodomi in the Sagami Sea (depth, about 429 m.). The second specimen, obtained last year, is from Inside Okinosé (about 572 m.). In general appearance both are not unlike certain *Staurocalyptus* or *Rhabdocalyptus* with spiny prostal needles.

The type-specimen (Pl. II., fig. 1) represents a pear-shaped, laterally compressed, thick-walled sac narrowed below into a stalk-like base, where it is torn off. Length, 51 mm.; greatest breadth, 37 mm. Thickness of wall, in places 6 mm. The osculum at the top is oval, 14 mm. by 7.5 mm.; its edge, thin and simple. The external surface is uneven on account of low conical elevations, from the apex of which strong diactinic prostalia project in an obliquely upward direction, some to a length of 30 mm. or more. These prostal needles stand out sometimes singly, but more commonly two or more (up to about half a dozen) together in tufts. They may moreover be associated with a few small and inconspicuous pentactinic prostalia, which are far two sparse to form a veil. Between the apices of the elevations the dermal surface is quite smooth. (Pl. II., fig. 10).

Attached to the diactinic prostalia and apparently pierced right through by these, there are two small young individuals of the same species. Possibly they arose as buds, which, after separation from the mother-body, were shifted outwards along the prostalia, similarly as in *Lophocalyx philippinensis.* One of the young individuals is 15 mm. long; it already shows a small oscular opening in its outer end. The other is much smaller, measuring only 6 mm. in length; the osculum is still unopen. Both possess thin and short prostal needles of their own.—Besides the young, a number of Foraminifera, some of which are about as large as a pin-head, are borne on the prostal needles of the old specimen.

The dermal skeleton is in close contact with the choanosome. The extremely delicate lacework formed by the dermalia exhibits meshes, more or less regularly quadrate, which are so small as to be scarcely discernible with the naked eye. The hypodermal latticework is formed of thin strands which intersect one another at various angles and thus produce irregularly shaped and rather small meshes. The larger incurrent canals visible through the dermal layer may be 2 mm. wide.

The simple gastral cavity is lined throughout with a smooth and continuous gastral layer. Under the lens this appears meshed like the dermal layer. Some apertures of excurrent canals situated right under it may be as wide as 3 mm.

The second smaller specimen (Mus. No. 507) from Inside Okinosé, is of an oblong ovoid shape. The lower end is likewise torn off. Length, 37 mm.; greatest breadth 18 mm.; osculum, 8 mm. by 9 mm. The lower half of the sponge presents a smooth undulating surface. The upper half bears a number of long and strong prostal needles; in this part the surface is much lacerated, to which fact may be due the fact that conical elevations are not observable in this specimen. On the prostals again are attached some Foraminifera, but no buds or young. The spiculation essentially agrees with that of the type-specimen.

Spiculation.

The following description refers to the large type-specimen shown in Pl. I., unless the other is specified.

The *parenchymalia* are exclusively diactins, of which some may be distinguished by larger dimensions as the principalia.

The *principalia* are oxydiactins with smooth or but faintly roughened ends; generally bow-like and sometimes boomerang-like in shape. The length may reach 12 mm. or more and the thickness at the middle, 350 μ. The oxydiactinic *prostalia* are evidently nothing else than principalia, which in a certain position have grown excessively in length. A large prostal oxydiactin measured was 50 mm. long and 275 μ thick. Smaller prostalia gradually grade over into the intraparietal principalia.

Similarly, the latter intergrade with the finest (7 μ thick) parenchymalia occurring as comitalia. These and in fact all the more slender parenchymalia are of a nearly uniform thickness thoughout their length and terminate with rough-surfaced, conically or obtusely pointed ends. Externally the spicular center is indicated not even by an annular swelling.

The thin strands constituting the irregularly meshed *hypodermal latticework* are made up for the greater part of diactins, exactly comparable in characters to those of similar dimensions in the parenchyma. One of them selected for the purpose of measuring was about 2 mm. long and 23 μ broad in the middle. Though occasionally found running singly, they are usually more or less combined into bundles of varying strength.

Pentactinic hypodermalia seem to be confined in their distribution to the upper part of the body. Here they are in places not uncommon, especially on the conical hillocks. I have been unable to detect any regularity in the mode of their relative arrangement. They are never very large; the largest I have picked out measured: length of paratangential ray, 1.5 mm.; that of the unpaired proximal ray, 5 mm; thickness of rays near the center, 55 μ. But the majority are considerably smaller. The paratangential rays, which taper outwards to a sharp point, are either regularly cruciately or more or less paratropally disposed. The latter form arises as the result of some strong diactinic prostalia in immediate proximity excercising a pressure in a lateral direction upon the paratangentials, pushing these away from them and thus widely opening one of the four angles which otherwise would all be right-angled. In some of the spicules, the rays are all perfectly smooth; in others, the paratangentials present a finely shagreen-like surface (Pl. II., fig. 3), caused by the same minute and thickly set processes which I have met with on certain hypodermalia of *Lanuginella pupa* (p. 9). The proximal ray, as also that part of the diactinic prostalia which dips into the sponge-wall, is accompanied with comitalia of the usual appearance.

As before mentioned, isolated pentactinic hypodermalia may project outwards, generally in association with the diactinic prostalia on or near the apex of the external hillocks (Pl. II., fig. 10). The pentactinic prostalia, unlike the other kind, are quite inconspicuous.

As rare abnormalities of the hypodermalia under consideration, I may mention a case in which a distal sixth ray was present as a short rudiment, and another case in which two of the paratangentials bore—one a single and the other three—prickles, suggestive of the same occuring in *Rossella antarctica.*

The *dermalia* (Pl. II., fig. 2) are stauractins, nearly flat or perceptibly concave on the inner side. The microtubercles, which beset the rays all over, are distinctly developed. The rays slightly taper outwards, to end in a rounded manner. Axial length, 250–360 μ (300 μ on an average); breadth of ray near the center, 7–12 μ (10 μ on an average). In forming the quadrate-meshed latticework, two rays of the directly adjoining dermalia run, as usual, alongside of each other for the greater part of their length. The meshes generally measure 140–180 μ in length of sides.—Exceptionally and quite rarely the dermalia are met with in the straight diactinic form. Of more frequent occurrence here and there are oxystauractinic forms with smooth and unusually thin rays. They are evidently dermalia that have not yet attained full development.

The dermalia of the second specimen from Inside Okinosé require special mention in that pentactinic forms were not seldom found amongst them.

The *gastralia* (Pl. II., fig. 4) are hexactins much larger than the dermalia, but with similarly characterized rays. Axial length, generally 0.55–1.00 mm. (0.75 on an average); breadth of ray close to base, 15–22 μ. The free proximal ray shows no point of special differentiation from the rest. Though the spicules are present in tolerable abundance, the paratangentials form but rarely meshes of approximately quadrate shape. The layer lies closely upon parenchymalia, of which none can however be distinguished as hypogastralia. There exist no pentactins under the layer.

In the two large specimens in hand, both being torn off at base, the *basidictyonalia* can not be observed. I have therefore examined one of the two young individuals for those characteristically ankylosed spicules, and actually found them in the basal region of the little sponge growing on a prostal needle. This was at the place directly invested by a thin and small-meshed siliceous reticulum, the basal-plate of F. E. SCHULZE, over which was a layer of irregularly distributed hexactins, the basidictyonalia. These are small but thick-rayed, with uneven surface. They are in fusion not only with the basal-plate but also here and there with themselves, in a manner similar to the condition seen in fig. 12, Pl. XXI. The mode of their occurrence on a spicule of another individual reminds me of the small basidictyonal masses I have found in *Staurocalyptus glaber* (*cfr.* Contrib. I., p. 186, foot-note).

The *hexasters* are of the following three types:

1. *Oxyhexaster.* This occurs in great abundance in the choanosome as well as in the subdermal space. Especially numerous is it near the gastral surface and in the gastral layer itself. It is not uncommon to see several attached to the proximal ray of the gastralia, as if they had been shifted on from below along it. Diameter, 100–122 μ. The principals are always exceedingly short, so that the bases of terminals are situated close to the somewhat swollen central node. The terminals are obsoletely rough-surfaced. As to their number and the degree of their development, there exists a certain difference between the oxy-

hexasters in the periphery and those in the deep part of the wall.

The former, as for instance those situated in the subdermal space, are as a rule normally developed, showing generally 3, but sometimes 2 or 4, terminals to each principal. The terminals are thin, measuring only about 2 μ in thickness at base.

The latter, as represented by those in the gastral layer, have perceptibly stronger terminals, about 3 μ thick at base. Moreover they are but seldom normally developed, exhibiting 2 terminals to each principal. The majority are hemihexactinose, there being also found not uncommonly quite hexactinose forms (Pl. II., figs. 5, 6). Of the hemihexactinose forms, the total number of terminals to the entire rosette may vary between 7 and 11 (most frequently 9 or 10) indicating in each case the number of the principals which remain biterminal and of those which had become uniterminal. In some cases one of the two terminals borne on a principal was found to be very much shorter than the other, these shorter terminals representing without doubt intermediate stages in the transition from a biterminal principal into a uniterminal. In both the hemihexactinose and hexactinose forms, the uniterminal principal may show the well-known bending at the point of its junction with the single terminal remaining to it, the two parts being not straightened out as they quite frequently are.

2. *Discohexaster.* Much less numerous than the oxyhexasters are the discohexasters (Pl. II., fig. 7), which occur subdermally and somewhat less sparingly in the choanosome. In a few cases they were found together with oxyhexasters on the free proximal ray of gastralia. Diameter, 90–130 μ. Each short principal, which is swollen knob-like at end, bears 4–6, long, slender, faintly rough-surfaced terminals diverging so as to give an approx-

imately spherical shape to the entire rosette. The convex terminal disc consists of 6, small, recurved teeth (fig. 8).

3. *Microdiscohexaster.* This (Pl. II., fig. 9) is clearly distinguished from the above by its small size and by the more numerous and exceedingly fine terminals. It is found in sparse distribution both subdermally and subgastrally. The shape is spherical with a diameter of only 23–25 μ. The terminal disc is so minute that it appears simply pinhead-like.

Soft Parts.

As the type-specimen was thrown into alcohol at the place of capture, I was able to make some observations on the soft parts, which may be worth recording in brief. All my sections are stained with borax-carmine. Figs. 10 and 11, Pl. II., show the general appearance of the soft parts in section.

The dermal membrane is represented for the most part by a sparse quantity of quite thin trabeculæ running between the rays of dermalia. It is membranously developed only here and there in limited areas between closely situated parts of certain dermalia.

The cup-like or thimble-like chambers measure 100 μ in average diameter. Examined under very strong magnification (Zeiss' homog. immers. system), its wall or the *membrana reticularis* exhibits *distinctly open* meshes. The delicate beams consist of granular protoplasm which is scarcely stained by the coloring reagent (Pl. II., fig. 14). Each nodal point, as seen surface on, is occupied by a faintly colored and clear looking nucleus, containing a few granules in its interior. Its boundary can not be said to be well defined but is often sufficiently indicated by the cytoplasmic granules lying against it as well as by the slight but perceptible difference in the staining capacity of the plasma within and without it. Diameter of the nucleus, not more than $2\frac{1}{2}$ μ. Flagella, not observed.

Archæocytes occur either isolatedly or in small flat groups on the outside of the chamber-wall. Size, $2\frac{1}{2}$–4 μ; exceptionally 5 or 6 μ. Here as in *Euplectella marshalli*, one is soon led to the conviction that he has before him small *cells*,—not nuclei,—unless an inadequate power of the microscope be used for the observation. At least the larger archæocytes are distinctly seen to be composed of deeply stained cytoplasm containing a still more deeply stained nucleus, which is indistinguishable from a trabecular nucleus both in size and appearance.

Sections of the large specimen are remarkably rich in peculiar bodies which I take to represent the thesocytes. We have here to do with clusters of fat-like globules found among the trabeculæ of both the subdermal and subgastral regions. They are shown, not quite successfully, in Pl. II., fig. 12. The globule, when of large size, may measure 20 μ across. Its substance is nearly homogeneous and weakly refractive, taking the stain tolerably well. It may at times be of a conglomerate-like or of an irregularly granular appearance. Not infrequently a small nucleus is seen in direct contact with the surface; the appearance then being that the bodies in question are some unusually bulky cell contents or product which has pressed the nucleus of the turgid cell against the external limit.

Together with the above there occasionally occur smaller and more weakly stained spheres with granular contents. They are shown in both figs. 12 and 13, Pl. II., and will be easily recognized. In the case of these again I have frequently ascertained that they contained a nucleus which was pressed against the wall. Cases also came under my observation, in which the spheres in question showed a close approach, in size as well as in the character of the contents, to the thesocytes which are filled up with the fat-like product. So that, I am inclined to think that they represent but an early stage in the development of thesocytes.

In sections of one (the larger) of the two young individuals found attached to the prostalia of the specimen, I find the thesocytes by no means so copiously present. On the other hand, I see in them an abundance of peculiar bodies. the like of which I have not met with in the large specimen and the nature of which remains perfectly dark to me. The bodies consist of numerous, thin, deeply stained filaments, which reach up to 55 μ in length and are arranged either radially so as to present an irregularly star-like appearance or in brush-like bunches diverging from a point (Pl. II., fig., 15). The filaments are sometimes nearly straight and needle-like; sometimes gently bent or wavy. The general appearance reminds me of the groups of stearin and margarin crystals, which A. LETELLIER* obtained from the alcoholic extract of the organ of Bojanus. But the stainability of the filaments at once excludes the idea of their being crystals. Possibly we have here to do with something which is certainly not identical with, but is allied to, the groups of rod-like bodies I have met with in *Acanthascus cactus* and *Euplectella marshalli* (Contrib. I., p. 180); at any rate, they all seem to be bodies foreign to the sponges.

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* A. LETELLIER. Fonction urinaire chez les Mollusques acéphales.—Arch. Zool. Expér. T. V. 2me Serie, p. 48; Pl. I., figs. 6, 7.

SCYPHIDIUM NAMIYEI (IJ.)

Plate VI., figs. 9–17.

Vitrollula namiyei, IJIMA, '98, p. 48.

Two complete specimens and some fragments of this species were obtained by KUMA in one haul of the long-line at Outside Okinosé by the Iwado-line, from a depth of about 457 m. (250 faths.).

Both complete specimens (Pl. VI., fig. 9) present a laterally compressed, irregularly shaped, moderately thick-walled, pouch-like body of a moderate size. Above, there exists in both a secondarily formed osculum besides the primary. Below, the somewhat contracted base had evidently been firmly fixed to the substratum by an irregular attachment surface or rather by a number of such.

The larger specimen (Pl. VI., fig. 9*a*) is 66 mm. high. A cross-section of the laterally compressed body at its widest part would present an oblong outline, 54 mm. long and about half as broad. The wall is about 5 mm. thick in the middle of the body. The upper end is occupied by a large, irregularly oval, sharp-edged osculum. To one side of this and well apart from it on the sagittal edge of the body, there is a papilla-like bud, the rounded apex of which shows a secondary osculum of 2 mm. diameter. This leads into a small gastral cavity about 5 mm. deep, which does not stand in open communication with the principal gastral cavity. The specimen also shows on one side an oval-shaped gap in the wall, leading into the main gastral cavity.

The smaller specimen (fig. 9 *b*) is 56 mm. high. It is widest at the upper end, measuring 41 mm. in the longest direction whereas, from side to side in the middle of the compressed body, it measures not more than 20 mm. across. Two separate oscula of different sizes, lying side by side, occupy the upper edge of the body. There is a clear indication of the two having been formed from an originally single and narrow osculum by the coming together and fusion of the oscular lips at one part, in a way similar to the process which takes place at the bifurcating point of a *Farrea*-tube. The smaller of the oscula thus formed occupies the end of a short tube which appears like a branch from the sponge-body.

In both specimens, there are present along the sharp oscular edge some prostal needles, which are fine, short and quite inconspicuous, besides being irregularly distributed and isolated. Similar prostals also occur in quite small numbers in the upper part of the lateral wall. They are in all cases diactins projecting to the extent of 3 or 4 mm. at most.—In places there are to be seen some isolated hypodermal pentactins apparently more or less protruded beyond the dermal level. Whether this represents a normal state or is the result of rough handling, I am at loss to decide.

On the whole the external surface may be said to be smooth. To the naked eye it appears as if loosely frosted. Not until observed under the hand-lens can the dermal latticework and the hypodermal supports be seen with distinctness. The dermal layer is in very close contact with the choanosome.—The subdermally situated entrances into the incurrent canals are small, probably never more than 1½ mm. in width.

The gastral surface is likewise smooth. It is continuously covered throughout by a most delicate gastral layer, supported on fine sinuous hypogastral strands.—The excurrent canalar apertures, indistinctly visible through the gastral layer, may be 2 mm. wide.

In the wet state the sponge-wall is rather firm but can be easily torn off. When dried it is of a light, delicate and friable texture.

Spiculation.

The *parenchymalia* consist of diactins only,—oxydiactins as a rule. These comprise all sizes from the large, elongate-spindle shaped or bow-like principalia down to the shorter and very much thinner comitalia. They are somewhat closely felted together in forming the parenchymal mass. (See Pl. VI., fig. 17).

The principalia, which occur rather numerously, may attain a length of 10 mm. and a thickness of 120 μ in the middle. They are smooth all over, even near the sharply pointed ends. The smaller parenchymalia, leading down to comitalia of only 10 μ thickness, often show an indication of an annular swelling at the center and are sparingly beset with obsolete microtubercles at the ends, which taper to a point instead of being slightly swollen as usual.—Certain small diactins on the outer and inner surfaces of the choanosome are formed into thin strands and go into the support of the dermal and gastral layers, more especially of the latter.

Hypodermal oxypentactins are abundantly present. The rays are all smooth throughout and always regularly cruciate in disposition. They are never very large, the paratangential axial length not exceeding 3 mm. The unpaired proximal ray is usually more than three times as long as the paratangential in the same spicule. Breadth of rays at base, as much as 55 μ.—No pentactins occur as hypogastralia.

Irregularly meshed *basidictyonalia* of the usual appearance are found in a thin connected layer over the places of basal attachment. The beams, which may be 20 μ thick, are uneven-surfaced with scattered spiny processes.

The *dermalia* (Pl. VI., fig. 10) are spinose stauractins and pentactins of considerable strength. As to the relative quantity of these, the former somewhat predominate over the latter in some places, and *vice versa* in certain other places. The rays are 90–165 μ long (as measured from the center), all those in one and the same spicule being nearly equally long. They are thick (up to 20 μ at base) and taper gradually outwards to the conically or bluntly pointed end. The microspines are well developed. The paratangentials are in a plane scarcely or but slightly concave on the inner side. In the case of pentactinic dermalia, the unpaired ray is always directed proximad.

The *gastralia* (Pl. VI., fig. 11) are hexactins and pentactins; exceptionally stauractins. The hexactins seem to be numerically the predominant form, though in some places the pentactins (with the unpaired ray directed distad) are found in about as great abundance. In the dimensions of rays and in the nature of their microspines, the gastralia are quite like the dermalia. The proximal free ray presents no features of special development.

The *oxyhexasters* (Pl. VI., fig. 12) occur in very great abundance throughout the choanosome. There is no appreciable difference in appearance between those situated in the subdermal and in the subgastral region. They are of a rather small size, measuring 53–76 μ in diameter. Nearly all are normally developed, each short principal bearing 2–4 terminals. Only occasionally do hemihexactinose forms occur, especially in the middle of the choanosome. The terminals are only moderately strong; their surface is rough. The minute processes causing this roughness, when examined under a strong power of the microscope, are seen to be distinctly inwardly directed (fig. 13).

The *discohexasters* (Pl. VI., figs. 15 and 16), present likewise everywhere in the choanosome, are less abundant than the above, though in several parts of the subdermal and subgastral regions they are found lying numerously together side by side. They are mostly of about the same size as the oxyhexasters or of a larger size, reaching up to 100 μ in diameter. Others are so small as to measure only 35 μ in diameter; discohexasters of such small size may be taken as representing the microdiscohexaster of the species. However, it is important to mention that the larger discohexaster (fig. 16) and the microdiscohexaster (fig. 15) in the present species are much the same in general appearance and are besides gradationally linked together by intermediate sizes. So that, it is also not improper to say that discohexasters are present in only one form, which is quite variable as to size (35–100 μ dia.), the smallest being less than half the size of the largest as measured by the diameter. Much the same relation seems to obtain among the corresponding rosettes (25–100 μ dia.) of *Scyphidium* sp. (=*Rossella* sp. F. E. SCH. '99, p. 43) described by F. E. SCHULZE from the coast of Chile; whereas, in *S. septentrionale* and *S. longispina* the microdiscohexaster is clearly distinguished from the larger discohexaster-form not only by its smaller size but also by having the terminals in far greater abundance.—In the present species it may be said in general that the discohexasters, irrespective of size, have 3–5 (or occasionally more), slender and faintly rough-surfaced terminals to each very short principal. All the terminals so radiate from the ends of principals that a spherical shape is given to the entire spicule. The arched terminal disc is composed of 5–8, distinctly developed, recurved prongs.

VITROLLULA Ij.

In '98 I included two species under this genus; but since I now consider that one of them had better be referred to *Scyphidium* and have described it above as *S. namiyei*, there remains only *V. fertilis* to represent the genus. A generic diagnosis may therefore be dispensed with.

The genus and species is a small-bodied sponge, which would be difficult to distinguish from a *Lanuginella* or a *Leucopsacus* without a microscopic examination of the spiculation. This closely resembles that of *Scyphidium*, of *Crateromorpha* and of *Hyalascus*. It differs from that of the first mentioned genus mainly in that the parenchymalia include hexactins and in that discohexasters occur in a single form which apparently corresponds to the microdiscohexaster. In these respects the agreement with certain *Crateromorpha* may be said to be almost complete, but the conspicuous difference with respect to the size and shape of the body may be regarded as sufficient to warrant the generic distinction. The difference from *Hyalascus* consists again in the much smaller size and further in the presence of hexactinic parenchymalia, in the oxyhexasters being pertinently normally developed, &c.

VITROLLULA FERTILIS Ij.

Plate III.

Vitrollula fertilis, Ijima, '98.

Four specimens in all of this genus and species have been at my disposal for study. I regard it worth while to mention the following particulars about each of them.

Two specimens, forming Sc. Coll. Mus. Sp. No. 228, were found attached in the dried state to a *Lophohelia*-like coral, obtained by Kuma April 2nd, 1894, at Okinosé from a depth estimated at about 429 m. (235 fms.). Both are of about the same shape, being spindle-like, slightly bent and broader at the oscular than at the somewhat contracted basal end. One of them is shown in Pl. III, fig. 1. It is 15 mm. long and 6 mm. broad in the middle, where the body is approximately circular in cross-section and the wall measures 1⅓–1¾ mm. in thickness. The small, thin-edged osculum at the superior end has a diameter of 1¾ mm. The other individual of the lot is slightly larger, being 16 mm. long and 7 mm. broad in the broadest part.

The third specimen (Sci. Coll. Mus. Sp. No. 231), shown in Pl. III, fig. 2, was obtained by myself July 23rd, 1894, at a spot about 4 kilometers off the village of Inatori on the eastern coast of the Province of Izu. The depth was somewhere between 330 m. and 414 m. (180–228 fms.) ; the bottom consisted of sand, pebbles and shells. There it occurred together with *Farrea*, *Aphrocallistes*, *Hyalonema affine* var. and *Semperella stomata*, specimens of all of these having been secured at the same time. The body of the specimen in question is laterally compressed ; it is 12 mm. high and 8½ mm. by 5 mm. broad. Wall, 2 mm.

thick in the middle of the body. The circular osculum at the upper end measures 3 mm. in diameter. The contracted and laterally compressed base is attached to a horny worm-tube.

The fourth specimen (Sci. Coll. Mus. Sp. No. 433) was obtained by KUMA in November, 1895, from an unknown depth at Inside Okinosé. In shape it is ovoid and slightly laterally compressed. It is torn off at the narrower end. Length, 14 mm.; breadth, 7½ mm. Wall, about 2 mm. thick. The oval osculum at the broader end measures 2½ mm. by 1½ mm. in diameter.

All the specimens agree in having a smooth external surface. Through the dermal layer, which is in close contact with the choanosome, are seen the variously sized, but generally small, apertures to incurrent canals; they rarely exceed ¾ mm. in width. The gastral surface presents a somewhat honeycombed appearance owing to the fact that excurrent canals open freely into the gastral cavity, the apertures being not covered over by a continuous gastral layer (Pl. III., figs. 7 and 8). Some of these apertures may be 1½ mm. wide. The gastral cavity is deep. The body-wall gradually thins out towards the thin simple oscular edge.

The texture of the sponge is delicate, soft and light. The basal end, for a greater or less extent, is firm, which is due to the basidictyonal mass being developed to a not inconsiderable thickness.

Spiculation.

The *parenchymalia* consist of slender diactins and more or less regular hexactins.

The former are present in tolerable abundance, running either isolatedly or in weak bundles. They are all thin and filamentous, probably never attaining a thickness of more than 12 μ. The majority, if not all, of them have the spicular center externally indicated by an annular swelling or by four cruciately disposed knobs. The rays are smooth except at the roughened ends, which sometimes terminate conically and at other times taper out to a point. Scarcely any of the diactins can be distinguished as principalia.

The latter are by no means uncommon, though they are more plentiful in some individuals than in others. They sometimes appear to be comparatively strong. Thus, a large parenchymal hexactin may measure 1.6 mm. in axial length, the rays being 30 μ thick at base. However, the majority of the hexactins are considerably smaller and weaker. The rays gradually taper outwards and are smooth all over except near the conically pointed end. As a general rule the hexactins are so disposed that one of the axes is radially directed, without however showing much regularity in the arrangement. Sometimes their rays are seen to pursue a solitary course; more frequently are they joined with the diactins in small numbers to constitute the parenchymal strands.

As in so many other lyssacine Hexactinellids, the basal end of the sponge exhibits a typical *basidictyonal* mass (Pl. III., fig. 22). This consists of a rigid, irregularly meshed reticulum of comparatively thick beams, the surface of which is beset throughout with small tubercles. These beams, for the most part, may without difficulty be recognized as the rays of unusually stout hexactins, which are ankylosed either directly ray to ray or by means of synapticular formations. The synapticulæ on the surface of the mass in contact with the substratum form a thin close-meshed limiting layer (see the lower part of fig. 22).

The *hypodermalia* (Pl. III., fig. 3) are moderately large pentactins; their rays closely resemble in character those of parenchymal hexactins. The regularly cruciate paratangentials may measure 1 mm. in axial length and 27 μ in breadth near the spicular center. The proximal fifth ray is always longer than the paratangential in the same spicule and at times is nearly twice as long. In the smaller hypodermalia the size of the paratangential cross approaches or may even nearly coincide with that of the larger stauractinic dermalia, so that in certain cases it is scarcely possible to decide whether a pentactin is to be considered as a dermalia or a hypodermalia. This may perhaps be regarded as an indication of the low degree of differentiation of the species from the Leucopsacidæ. Seen on surface-view preparations, the paratangential crosses are situated for the most part without any regularity of mutual arrangement, though at places they may show an attempt, so to speak, at the formation of a quadrate-meshed latticework. The hypodermalia are never observed protruded as prostalia; nor are they ever found with shagreen-like surface.

The *dermalia* are stauractins, the plane of which is usually slightly convex on the outer side. The rays are relatively long and slender and gradually taper towards the conically or obtusely pointed end; the surface is roughened, generally all over, on account of quite obsolete and insignificant microtubercles which are scattered over it at rather wide intervals (Pl. III., fig. 3). The axial length fluctuates generally between 360 μ and 680 μ; the breadth of rays at base between 7 μ and 12 μ. On the membranous oscular margin the size may decrease to 264 μ axial length. Exceptionally slender-rayed dermalia, found occasionally by the side of stouter ones, represent without doubt a developmental stage preceding the attainment of definitive dimensions.

The dermalia are found irregularly scattered in the dermal membrane. They can not be said to be numerous; in many places they occur in no greater, if not in somewhat smaller, numbers than the hypodermalia. Altogether, it may be said that the latter with their paratangentials are about as much concerned in the support of the dermal membrane as are the dermalia themselves. (See Pl. III., fig. 10. In this figure, the cruciate spicules drawn in blue represent partly the dermalia and partly the paratangential crosses of the hypodermalia. Through the deeply stained dermal membrane, perforated by roundish gaps or pores, is seen the most peripheral part of the choanosome).

The *gastralia* are represented by both hexactins and pentactins, the latter having the unpaired ray directed distad. I can not definitely state which of the two forms predominates, though in some places I have found several of the former form placed together side by side. In any case the gastralia are on the whole rather sparsely present, being situated in isolated positions. The rays are similar in appearance to those of the dermalia; their length as measured from the spicular center is 165–176 μ.

The hexasters are of the following two kinds:

Common but not abundant are the *oxyhexasters* (Pl. III., fig. 3) in the choanosome as well as in the subdermal space. They are characterized by the possession of rather numerous terminals, of which generally 4–7 are borne on each short principal. They are slender—at any rate not strong—and are distinctly rough-surfaced. Though bent at the base, they are straight for the rest of their length and so diverge from one another as to give a spherical shape to the entire spicule. This measures 114–140 μ; on an average 120 μ in diameter. Cases of a principal bearing less than three terminals probably never occur. Certain it is that hemihexactinose and hexactinose oxyhexasters are both entirely foreign to the species.

The only kind of *discohexasters* present is, as before indicated, comparable to the microdiscohexaster of certain other Rossellids. (Pl. III., fig. 6). They measure only 26–30 μ in diameter. The convex disc at the outer end of each tolerably strong principal bears a bunch of numerous and exceedingly fine divergent terminals, which end each in a minute terminal knob. The shape of the entire rosette is spherical. In a certain specimen the discohexasters in question were met with only occasionally; in another they were quite common, especially near the dermal and gastral surfaces, where they seemed to be somewhat more numerous than the oxyhexasters.

Soft Parts and Larvæ.

A glance at Pl. III., figs. 8–11, will show at once that the general arrangement of the soft parts is in essential agreement with what we know of other Hexactinellids.

The dermal membrane (fig. 10) is perforated by numerous pores of various sizes; its tissue separating these from one another is at times quite thin and filamentous, while at other times it is flat and film-like.

The trabeculæ are sparsely developed, without doubt on account of the narrowness of the space that they occupy.

Chambers of the usual cup-like or thimble-like shape are 80–150 μ wide. In a few instances it seemed to me that a chamber freely communicated with a neighboring one through the end which should normally be closed and rounded.

Their wall or the reticular membrane exhibits minute open meshes not more than 7½ μ wide (Pl. III., fig. 11). Under a moderately strong power of the microscope, the nodes of the reticulum appear as swollen points somewhat more deeply colored than the delicate beams. Seen under the immersion-system the choanocyte nucleus (about 2 μ dia.) is discernible not so much by itself as by the fact that the spot is relatively clear of the surrounding protoplasmic granules. It is scarcely stained by the borax-carmine or the hæmatoxylin. In some of my preparations the flagella is occasionally observable, though by no means in a complete state. The collar is unrecognizable.

Close to the thin oscular margin the chamber-layer is represented simply by the reticular membrane disposed in a continuous undulating manner instead of being formed into distinct chambers (upper part of fig. 8). Superiorly, it finally ceases to exist, its disappearance taking place insensibly in that its reticulum gradually passes over into the wider-meshed cobweb of the ordinary trabeculæ (fig. 11).

Well-stained archæocytes, either isolated or grouped together in varying numbers, occur in abundance on the outer side of the wall of the chambers, exactly as I have described in *Euplectella marshalli* (Contrib. I., p. 165) and in *Leucopsacus orthodocus* (Contrib. III., p. 41). Pl. III., fig. 11, shows two such groups of quite insignificant size. The larger of the archæocyte-congeries are very conspicuous on stained preparations on account of their compactly packed elements being very deeply colored (seen in Pl. III., figs. 8–10 as deep blackish spots). Though they may take a somewhat irregular shape in accordance with the circumstances of the space occupied by them, the normal shape of the congeries after attaining a certain size seems to be spherical (figs. 13–15). A rather small congeries of 40 μ diameter (fig. 13) is already evenly delimited on the external surface, though evidently it is still without a special enveloping membrane or epithelium. It may grow to double or more than double that diameter without showing a morphological change, except of course in the numerical increase of the closely crowded cells. The sharply defined surface presses against the incurrent side of the walls of the chambers, right in the midst of which the body is situated. The extent of the chamber-wall surface in contact with this is such that inceptively several little groups of archæocytes might have taken origin on it; hence it is exceedingly probable that the growth of an archæocyte-congeries takes place not only by multiplication of its elements but also by fusion of originally separate groups.

The archæocytes, taken singly, are only 2–4 μ large. Pl. III., Fig. 12, which shows a small group of them as seen in a borax-carmine preparation, is not a good representation in that it fails to indicate the nuclear outline in each cell-body. A renewed examination of the preparations, long after the plate had been printed, brought me to the conviction that here, as I believe in Hexactinellidan archæocytes generally, there exists a greater or less quantity of cytoplasm around the nucleus,—in other words, that we have here to do with small entire *cells* and not with free *nuclei* (*cfr*. Contrib. I., pp. 158, 171). The cytoplasm always takes up stains well, a fact which renders the limit of the inclosed nucleus indistinct. The use of the immersion-system for the examination will make the matter clear, unless the cells are overstained, as is generally the case when hæmatoxylin is used. The nucleus contains from one to several dark granules. It measures approximately 1½ μ, which is also about the size of the trabecular nuclei.

The Larva.—In the study of the present species I have been able to obtain a somewhat more definite knowledge of the larva, than was possible in the case of *Leucopsacus orthodocus* (*cfr.*, Contrib. III., pp. 42–46). And yet, many points certainly remain to be settled in the future with a further supply of the material.

Of the larvæ which I consider to be fully developed (Pl. III., figs. 20, 21), a single case was discovered in one of the two mother-individuals constituting Sci. Coll. Mus. Sp. No. 228, collected in the month of April ; and no less than six cases, besides a number of those representing earlier developmental stages, were found in the third specimen obtained by myself during July. The fourth specimen obtained in November seemed to contain none, although it showed archæocyte-congeries developed in about the same degree as in all other specimens. The above gives a hint as to the season of the year in which the reproduction of the species seems to take place most actively.

In all probability the larvæ arise outside of the chamber-layer in the external trabecular spaces, which is the seat of all archæocyte-congeries. However, I can not definitely state that all the ripe larvæ I have found were invariably in that situation,—or that some of them were not situated in the inner system of the trabeculæ. A part of my material is contained in sections of the wall of the mother-sponge; the rest was removed from the wall by means of needles under the dissecting microscope and then prepared either in toto or laid out into sections (10–20 μ thick) with all the cares necessary for the microtomizing of such small objects. On examining the preserved sponge-wall with transmitted light, the larva present within could be recognized by its opaqueness and by its peculiar shape; it could thus be isolated without much difficulty.

The larva in the fully developed state is spindle-shaped, the broadest part of the ventricosity lying not in the middle but nearer to one of the pointed ends than to the other (figs. 20 and 21). The broader half of the body is presumably the anterior. Total length of body, 275 μ; greatest breadth, 88 μ. Cross-section of the body, circular.

The oldest larva I have seen in *Leucopsacas orthodocus* and which I have figured in my Contrib. III., Pl. III., fig. 25, is approximately spherical in shape (about 100 μ dia.). If I am right in considering that larva to be fully developed or at any rate not far removed from that stage, it follows that Hexactinellidan larvæ are subject to a certain variation as regards their external form.

In the larva of the present species, a distinct *epithelium*, 4 μ thick at the thickest part and consisting of approximately cubical cells arranged in a single layer, covers the external surface for at least the greater part of its extent. Towards both narrowed ends of the body, the layer gradually grows thinner, finally to become altogether unrecognizable. I hold it probable that the covering layer is in fact wanting at the poles, leaving the inner mass exposed at these parts. The cell-bodies take up stains well, on which account evidently the nuclei can not be perceived with any degree of distinctness. Notwithstanding this fact it seems assumable that the single bodies here taken for the cells are not merely nuclei by themselves. The cells, as seen in both cross (fig. 21) and tangential (fig. 19) sections, are separated from one another by narrow clear spaces.

Internally against the inner mass the covering layer is sharply delimited. On the external surface, so far as the presence of the layer can be demonstrated, there is a coating of quite clear appearance, showing a sparse granulation which here and there assumes the form of a vertical striation. I think there is no doubt whatever that this coating represents the flagella, which have deteriorated as the result of the application of reagents. The same was observed likewise in the larva of *Leucopsacus orthodocus* (Contrib. III., p. 43) ; therefore the Hexactinellida seem to offer no exception to the rule that the sponge-larva is provided with an external layer of flagellated cells.

The *inner mass*, as seen in toto preparations under a moderately high power of the microscope (Pl. III., fig. 20), appears, leaving aside the spicules, simply as a dense assemblage of well-stained corpuscles, much like a large congeries of the archæocytes before spoken of. Closer observations on serial sections (subjected to after-staining with hæmatoxylin or hæmatein-alum or with either of these in combination with eosin, &c.) reveal that to a certain degree histological differentiation already exists among the elements of the mass (Pl. III., fig. 21).

Peripherally and right under the external epithelium, the corpuscular elements, in respect to which it is difficult to determine whether we have to do simply with nuclei or with cells inclosing each a nucleus, are very small and compactly packed together. I am rather inclined to view them, as in the case of certain more internally situated elements (archæocytes) of similar appearance but of a somewhat larger size, in the light of complete cells. The spicules, to which I shall soon return, run for the most part in the peripheral layer just referred to. At the two poles of the larval body, which are apparently destitute of the external epithelium, cellular elements are not recognizable; whatever sparse quantity of the protoplasm exists over and between the bundled spicular rays simply appears finely granular.

The more internal and by far the principal part of the inner mass is composed of at least two kinds of cells, *viz.*, those which go to form a reticular kind of tissue and those which retain a more or less spherical shape (fig. 21). The former most likely correspond to the so-called "dermal cells", and the latter to the archæocytes, known in the inner cellular mass of non-hexactinellidan sponge-larvæ.

The reticular tissue is most plainly visible in the anterior part of the body, in front of the region where this is broadest (see fig. 21). There it presents a small and open meshed, cob-web-like appearance, consisting of irregularly branching and anastomosing filaments, which are well stained and tolerably sharply defined in contour. The small corpuscles occasionally contained therein, I take for the nuclei. What nature to ascribe to the fluid, which, though imperceptible, undoubtedly fills up the spaces of the meshes, is difficult to directly determine. On the other hand, I am stroughy inclined to assume that we have in the reticulum an inceptional trabecular system, which, in my opinion (Contrib. I., p. 164), represents at once both the connective-tissue cells and the pinacocytes of the Monaxonia and the Triaxonia. The two kinds of cells just mentioned are both the outcome of the larval "dermal cells", which in the Hexactinellida seem very early to take the form of trabeculæ.

If I am right in the above assumption concerning the morphological nature of the larval reticulum, the spaces in it or the meshes are simple interstitial lacunæ, which later (after the immigration of the external flagellated cells inwards to form the chambers) should come into free communication with the external world. From this standpoint it is exceedingly questionable if the fluid contained in them is to be regarded in the light of a connective-tissue mesoglœa, which, moreover, is something apparently totally undeveloped in the adults (Contrib. I., p. 161). It seems more likely that the fluid is simply imbibed water,—an assumption which suggests itself as being by no means improbable.

The reticulum can be traced, from the anterior region before referred to, backwards into that lying posterior to the broadest part of the larval body. In fact it may be said that the reticulum pervades almost the entire inner mass. Only, in the more extensive posterior region just indicated, forming about four-fifths of the entire mass, it is not quite plainly visible, this being probably due to the crowded co-existence here of small and approximately spherical cells. Moreover, the meshes here are on the whole considerably wider than in the small anterior region which lacks the said cells. It may not be improper to consider that in a measure their greater width stands in relation to the presence therein of the cells in question.

These cells, which probably deserve to be called simply the archæocytes, measure only 2–2½ μ. As in the case of the same cells in the mother sponge, the cytoplasm is deeply stained and thus makes indistinct the outline of the nucleus, which, excepting the few chromatic granules contained in it, does not surpass but rather falls behind the cytoplasm in staining capacity. Further like them, the larval cells in question either adhere to the reticulum (the trabeculae) or lie heaped together in the meshes (the trabecular spaces). They are by no means uniformly packed in, but are for the most part irregularly and apparently rather loosely arranged, so that there exist between them vacant gaps, evidently parts of the lacunar system traversed by the reticular filaments. The gaps may be of quite an insignificant extent, though at other times they may measure 14 μ across. While many of them are irregular in outline, others present a more or less roundish section and then may be bordered, either partly or nearly all around, by an epithelium-like row of the cells. Such an appearance gives one the impression that he has before him follicle-like structures; and at first I even thought of the possibility of their representing the *Anlagen* of the chambers. However, after more concentrated observations, I have had to throw off this illusion, because: firstly, several closely situated follicle-like spaces, though apparently distinct at first sight, could often be demonstrated to be parts of a continuous lacunar space; secondly, they are at places found to be partitioned from one another by a single row of the cells, which should not be the case if each were a follicle having a wall of its own; and thirdly, it not infrequently happens that the inner space is distinctly traversed by the filaments of the reticulum. After all, I believe the cellular mass is simply honeycombed, as it were, by a system of interstitial lacunae, which are the same as the meshes of the reticulum. In other words it may be said that the cells are, at least in part, arranged in reticular tracts in the same way as those in the oldest larva I have seen of *Leucopsacus orthodocus* (Contrib. III., p. 46; Pl. III., fig. 25), the cellular tracts occupying the same space as the trabecular reticulum with which they are joined together.

As to the probable origin of the chambers during the metamorphosis, I can here do no more than refer the reader to the considerations I have laid down on p. 163 of my Contribution I.

Now as to the spicules of the larva. As before stated, they lie mainly in the periphery of the inner mass,—close under, but not in direct contact with, the external epithelium. As in the larva of *Leucopsacus orthodocus*, they are all stauractins (*cfr.* pp. 44–46, Contrib. III.). They are always so oriented in relation to the form of the larva that we may speak of the transverse and the longitudinal axes (Pl. III., fig. 20). The former is always the shorter, and the two rays in it are usually of about equal length. Of those forming the longitudinal axis, one is as a rule much longer than the other. The four rays are in a plane more or less concave on the inner side, in conformity with the curvature of the body-surface. In the manner of distribution of the spicules, a strict regularity is not observable beyond the fact that the centers lie well separate from one another, the result being that the rays run singly without coming together into bundles. They are of such a length that intersection is of frequent occurrence: there is thus brought about a latticework, the meshes of which may be said on the whole to be rectangular but not regular in shape. Towards each pole of the larva, a number of longitudinally running rays converge and there come together into a bunch, thence to project their pointed ends for a short distance out of the soft tissue.

Finally, some remarks on the development.

In all appearance the larva originates from the archæocyte-congeries of the mother individual. In this respect I have nothing to add to what I have said in Contrib. I., pp. 187–190, and in Contrib. III., pp. 42, 43.* Pl. III., figs. 13–15, will give a fairly good idea of how archæocyte-congeries of various sizes appear in sections. In them the external epithelial layer of the larvæ is still undeveloped. This comes into formation when a congeries has attained a diameter of 90–100 μ, by which time it is invariably spherical in form. I must say that there can not be discovered in my series any stages which show the exact manner of the formation of the external epithelium. Nevertheless, I think it will not fall wide of the mark to assume that the peripheralmost cells in a congeries, which has grown to the proper size, take the epithelial arrangement and thus differentiate themselves as a layer from the inner cellular mass. Possibly this takes place synchronously with the development of flagella by the said cells. At any rate, the remnants of flagella in the form of a clear, granular or striated-like crust are observable as soon as the external epithelium has established itself as such. Whether the epithelium is at first formed alike all over the spherical embryo, must be left undecided. The appearance of

* In some of the sections of *Vitrollula fertilis* I have met with a few cases of veritable eggs which were undergoing the cleavage process. They measured about 100 μ and were of a dark appearance owing to the abundant presence of deutoplasmic granules which completely hid the nuclei. However, I have made myself sure of the fact that they did not belong to the sponge, but to a small Crustacea which lived in the sponge-wall,—a fact which could at once be foretold from the very appearance of the vitellus.

the inner cellular mass at this stage differs in no way from that of a simple archæocyte-congeries.

The spicules appear shortly after, in embryos of 110–130 μ diameter, in the same shape and position as I have described for the same embryonal stage of *Leucopsacus orthodocus* (Contrib. III., p. 44). (See Pl. III., figs. 16 & 17). They are all minute oxystauractins and are situated in the periphery of the inner mass and at a short distance from its limit against the external epithelium. They are distributed, widely apart from one another, in a single layer running parallel to the external contour of the spherical body. The plane of the four rays in each spicule coincides with that of the layer and is therefore slightly concave on the inner side. In the earliest developmental stage of the oxystauractins (fig. 17) that I have seen, the axial length mersured 15 μ. The central node was flat and disc-like and was relatively large in comparison with the small spine-like rays. I did not succeed in bringing the axial filaments into view, nor could any of the cells directly adjoining the spicules be distinguished from the rest as scleroblasts. It is most unsatisfactory that the spicules could not be observed at the very beginning of their development. For such minute observations the methods I have used seem to have been inadequate.

Some time after the appearance of the spicules, the embryonal body begins to elongate and assumes for a time an ovoid shape. Pl. III., fig. 18, shows an embryo in this stage of development. It is apparently in longitudinal section, but I am not in a position to state exactly the direction in which it had been cut, since it was found in the wall of the mother sponge which had been sectioned without any knowledge of its presence. As it appears on the section in question, the flagellated layer invests the body on the sides as well as at both ends,—in fact, all around. That this represents the true condition can be asserted only under the assumption that the section really passed through the two poles, which is however not certain. I regret that the point could be determined neither on other sections of the same embryo nor on any other of the material in hand.—The inner mass now shows an advance in that the reticulum, before described from fully developed larvæ, is distinctly observable in it. The open-meshed reticulum is for the most part situated at the periphery in one moiety of the body, which moiety is then probably to be regarded as the anterior. The cellular elements lie densely crowded in the central as well as in the posterior parts of the mass. There exists a distinct indication that the reticular and the cellular tracts penetrate to a certain extent into each other. In the latter tract there occur a few irregular slit-like gaps. The oxystauractinic spicules are still quite small.

Intermediate stages leading over the one just described to the fully developed larva were not discovered; but it will not be difficult to imagine the changes by which the form and organization of the latter is reached.

CRATEROMORPHA J. E. Gray.

Cup-like or bowl-like, firmly attached by distinct stalk; large or moderately large. Excurrent canalar apertures on gastral surface probably always freely open. Stalk generally not tubular but traversed by a system of anastomosing (excurrent) canals. Parenchymalia diactins, in addition to which medium-sized hexactins may sometimes occur. Pentactinic hypodermalia with regularly cruciate paratangentials, always present. Dermalia, rough pentactins or stauractins or both. Gastralia, generally similar pentactins and sometimes stauractins. Oxyhexaster as a rule normally developed. Discohexaster in one form, which is usually small (microdiscohexaster with diameter under 50 μ), but may be of a considerably larger size (80–120 μ dia.).

In the Challenger Report F. E. SCHULZE instituted a genus *Aulochone* as distinct from *Crateromorpha*. In '97 (p. 539) the same investigator included the former under the latter, thus joining the two genera into one, on account of the far reaching agreement in spiculation. However, I think the distinction between the two genera mentioned may be kept up in view of the fact that, while *Crateromorpha* possesses pentactinic hypodermalia, *Aulochone* is altogether devoid of these,—a sort of difference analogous to that which separates *Acanthascus* from either *Rhabdocalyptus* or *Staurocalyptus*.

Under *Aulochone* as a distinct genus may be placed not only F. E. SCHULZE's original *A. cylindrica* (from the Kermadec Is.) and *A. lilium* (from the Meangis Is.) but also the South African species recently described by R. KIRKPATRICK ('02) under the name of *Crateromorpha lankesteri*.

To the genus *Crateromorpha* I refer the species and varieties embodied in the following

Differential Key to the Species.

a.—Dermalia, exclusively or predominantly pentactins. Discohexaster, spherical, up to about 50 μ in diameter.

*a*¹.—Dermalia intermixed with some stauractinic forms. Hypodermal pentactins not conspicuously thick-rayed (not over 100 μ in breadth of rays at base).

*a*².—Sponge-body smooth on the outside, the entire sponge being exquisitely wine-glass-like............................*C. meyeri* J. E. GRAY. (Philippines; Sagami Sea).

*b*².—Sponge-body with rounded tubercle-like prominences on the outside.................. ....*C. meyeri tuberosa* IJ. (Sagami Sea, Suruga Bay).

*c*².—Sponge-body with numerous wrinkle-like ridges and irregular prominences on the outside..*C. meyeri rugosa* IJ. (Sagami Sea).

*b*¹.—Dermalia exclusively pentactins. Hypodermal pentactins have rays of striking thickness (300 μ or more at base)...............*C. pachyactina* IJ. (Off Shikoku, Japan).

b.—Dermalia, exclusively or predominantly stauractins.

*c*¹.—Discohexaster rather large (80–120 μ dia.) and strong-rayed; spherical. No hexactins among the parenchymalia ....*C. tumida* F. E. SCH. (Banda Is.).

*d*¹.—Discohexaster small (up to 50 μ dia) and delicate.

*d*².—Sponge-body with tortuous exterior, the depressions leading into intercommunicating intercanals. No hexactins among the parenchymalia. Discohexasters all spherical...*C. corrugata* IJ. (Sagami Sea).

*e*².—Sponge-body with smooth exterior; without intercanals. Medium-sized hexactins present among the parenchymalia. Most discohexasters with the terminals formed into six separate bunches (not spherical).. ....*C. thierfelderi* F. E. SCH. (Little Ki Is.).

CRATEROMORPHA MEYERI J. E. GRAY.

Plate IV., figs. 1–8 and 12.

Crateromorpha meyeri. H. J. CARTER, '72, p. 112.—J. E. GRAY, '72, p. 136.—H. J. CARTER, 73*a*.—H. J. CARTER, '73*b*, p. 361.—H. J. CARTER, '75, p. 199.—W. MARSHALL, '76, p. 125.—F. E. SCHULZE, '86, p. 52 (reprint).—F. E. SCHULZE, '87, p. 161, pl. LXI (!).—F. E. SCHULZE, '97, p. 540.—I. IJIMA, '98, p. 48.

Hyalonema anomalum. J. S. BOWERBANK, '77, p. 461 (*vide* F. E. SCHULZE '87, p. 188).

Besides the typical *Crateromorpha meyeri* I recognize two varieties or subspecies of it, *viz.*, *C. meyeri tuberosa* and *C. meyeri rugosa*. These will find special treatment later and here I restrict my account to the typical species. As such I consider those forms of the group which are exquisitely wineglass-like or tulip-like in shape and have the evenly rounded sponge-body,—forms, which have long been known from Cebu and are also found in the Sagami Sea.

According to the accounts of the Cebu specimens by CARTER, GRAY and SCHULZE the species occurs in that locality on a blue mud ground of 174 m. (=95 fms.) depth. It may reach 7 inches (say, 180 mm.) in total height; the stalk, which may be $\frac{7}{12}$ inch (say, 16 mm.) thick, being of nearly the same length as the body proper. The latter has a smooth external surface; its wall is thick but becomes very thin at the oscular margin.

In the Challenger Report (p. 164) it is mentioned that a dried *Crateromorpha meyeri* was found among the sponges that had been collected by DÖDERLEIN at Enoshima. Probably it was a representative of the typical species. To me, at any rate, two specimens have thus far become known from the Sagami Sea, both of which agree well in shape with the Philippine forms.

First may be mentioned the fine specimen preserved in formalin, which belonged to Mr. ALAN OWSTON and was kindly shown me by that gentleman. It came from a depth of 365 m. in the neighborhood of Okinosé. Total height, 114 mm. Stalk, 30 mm. long. Greatest diameter of body, 67 mm. Osculum, 63 mm. in diameter. Surface smooth all over. The one point specially worthy of note was the relative shortness of the stalk bearing the elongate sacciform body.

The second specimen (Sci. Coll. Mus. No. 364) is the one shown in Pl. IV., fig. 1. Locality, Outside Okinosé by the Iwado-line; 429 m. (235 fms.). Total height 115 mm., of which about 55 mm. belong to the stalk. This is of uneven contour, measuring 9–13 mm. across. In the lower two-thirds of its length it is quite hard and close-textured owing to spicular ankylosis, while the upper portion presents a longitudinally fibrous appearance. The lower end is thickened into an irregular basal enlargement, by means of which the sponge is fixed to the firm, finely grained, tufaceous substratum.

The bulging, cup-like body somewhat closes above but soon flares out at the simple-edged oscular rim. It is irregularly roundish in cross-section, with a diameter of about 50 mm. at its middle. The osculum is 35–40 mm. in diameter. The sponge-wall is thin and membranous at the rim but thickens below, attaining a thickness of 10–12 mm. near the insertion of the stalk.

The smooth external surface, when seen under the lens or even with the naked eye, shows the delicate and exceedingly fine-meshed dermal layer, which is supported by a much coarser hypodermal network composed of straight, but often interrupted, streaks of tolerably uniform fineness and showing small angular meshes, usually not exceeding half a millimeter in length of sides (Pl. IV., fig. 6). The hypodermal beams are finer than those in either *C. m. tuberosa* or *C. m. rugosa*, and do not form continuous strands of such length, which fact has its ground in a certain difference in the spicular elements composing them.

But of this later.—The apertures of incurrent canals, visible through the dermal layer, are small, not exceeding 2 mm. in diameter, even in the middle of the body where the largest occur.

On the gastral surface the apertures of excurrent canals open freely. Near the oscular margin they are all small; lower down, larger ones add themselves to the small, and in the lower half of the cavity the largest may measure 4–5 mm. across. Centrally at the very bottom there exists a space occupied by a few small apertures only; peripherally it runs out into five or six, septa-like, radial ridges, the interspaces between which are taken up by closely crowded excurrent apertures.

The compact stalk is traversed by a system of anastomosing excurrent canals as in most *Crateromorpha* (not simply tubular as in *C. thierfelderi*). Externally it lacks the dermal layer which must have fallen away.

The sponge as preserved in alcohol is colorless. So also the formalin specimen belonging to Mr. OWSTON. It is pure white after desiccation. KUMA states that the Sci. Coll. specimen, which was obtained by him, was in the fresh state "yellow like the yolk of a hen's egg."

Both specimens examined by me contained a large colony or colonies of *Syllis ramosa* M'INTOSH. This remarkable Annelid seems to be seated mainly in the excurrent canal-system, stretching out in part into the gastral cavity. When the sponge is dried it may still be recognized, as its colored body adheres to the white sponge-tissue. The specimens I have taken from the *C. meyeri* in possession of the Sci. Coll. were studied by Prof. A. OKA (Ueber die Knospungsweise der *Syllis ramosa*.—Zool. Mag., Tokyo, Vol. VII. [1895], p. 117).

Spiculation.

The spiculation was studied principally on the Sci. Coll. specimen (No. 364). I am also greatly indebted to Professor. F. E. SCHULZE for a gift of slide-preparations made from Cebu specimens, which have been invaluable for the purpose of comparison. As in external form, so also in spiculation I observe an essential and far-reaching agreement between the Japanese and the Philippine specimens.

The *parenchymalia* are mainly diactins, among which hexactinic forms are occasionally intermixed.

The diactinic parenchymalia are as usual of varied dimensions, ranging from filamentous comitalia up to principalia of 5 mm. or more in length and 80 μ in thickness in the middle. The larger diactins are met with more especially in the deeper parts of the body, close to the canalar and the gastral surfaces. They are bow-like or elongate spindle-shaped; smooth throughout (not roughened at ends), without central swelling or knobs and gradually running out to the pointed ends. This refers more especially to the larger diactins of the body proper; those of the stalk are generally roughened at the ends, which are often rounded instead of being pointed. The thinner diactins, which occur either isolated or as comitals, are smooth at the center or show there at most a weak annular swelling; their ends are always roughened and either swollen and rounded or attenuated to a point.

The isolated oxyhexactinic parenchymalia (some shown in Pl. IV., fig. 7) are of a medium or moderately large size. They may approach the dimensions of a hypodermal pentactin but are generally considerably smaller. The rays are smooth and straight or nearly straight. F. E. SCHULZE does not mention these hexactins in his descriptions but has not omitted them in his figure (Chall. Rep., Pl. LXI., fig. 3); indeed I observe their presence in the preparations from Cebu specimens. Such parenchymalia are known to exist not only in *C. meyeri*, but also in the subspecies *tuberosa* of the same as well as in *C. thierfelderi*. In the remaining members of the genus they seem to have disappeared altogether, leaving the parenchymalia composed exclusively of diactins, so far at least as those of the sponge-body are concerned.

In the upper one-third of the stalk the parenchymalia seem to consist only of longitudinally disposed diactins which are densely grouped together but free. Synapticular connections between them commence to occur at about the beginning of the lower two-thirds of the stalk. At the same time there begin to appear, among the diactinic parenchymalia of the region, small hexactinic—and occasionally pentactinic—elements (Pl. IV., fig. 8), the rays of which are comparatively short and thick, have rounded ends and show inconspicous microtubercles on the surface either all over or near the ends only. The spicules in question are at first free but soon become fused to one another as well as to the diactinic parenchymalia of the region in irregular orientation. Consequently, in about the middle of the stalk the skeleton is already entirely represented by a dense and stony siliceous framework, except for isolated oxyhexasters lying loose in the meshes. The small hexactins just mentioned I regard as homologous with those which I have called the *basidictyonalia* in other lyssacine Hexactinellids. They have been mentioned and well figured by F. E. SCHULZE (Chall. Rep., Pl. LXI., figs. 5, 6 & 8).

The *hypodermalia* are mainly oxypentactins of a comparatively large size and with rather strong rays. The paratangentials may be 1.5 mm. long and the unpaired proximal ray, 2.5 mm. The rays at base may attain a thickness of 100 μ. The pointed ends of rays usually show no roughness of surface. There occasionally occur exceptionally small and thin-rayed oxypentactins, situated somewhat deeper than those of more normal size; they probably represent early stages in the development of the hypodermalia. The meshwork formed by the paratangential crosses is irregular (Pl. IV., fig. 6).

In addition to the pentactinic hypodermalia there are observed at intervals slender diactins, which, running either solitarily or in small bundles, are in direct contact with the dermal layer and so serve as its support. They are thus to be regarded likewise as hypodermalia; however, it must be said that as such they play only a subordinate rôle in comparison with the pentactinic forms. In the Sci. Coll. specimen the diactinic hypodermalia are quite few and far between; in the larger specimen belonging to Mr. Owston, they are somewhat more numerous. It may be that as the sponge increases in size, their number is more or less augmented by transference from the ranks of the parenchymalia. It will later be seen that in large specimens of both the subspecies *tuberosa* and *rugosa*, the numerical ratio of pentactinic to diactinic hypodermalia is reversed, the latter greatly predominating over the former in numbers. But it is of course impossible to predict that the same will ultimately take place also in the typical species after a great advance in growth.

There exist in this species no spicules, which can be specified as the hypogastralia.

The *dermalia* are rough pentactins; occasionally stauractins (Pl. IV., figs, 2 & 3). The rays are on an average 130 μ long as measured from the center and 7.6 μ thick. They scarcely taper outwards at all or do so in but a slight degree. The ends are rounded. Not infrequently the pentactinic form, in which the unpaired ray is always directed proximad, shows an indication of the sixth distal ray in the form of a knob. The paratangential cross is usually—but not always—more or less convex on the outside, which is due more to the rays concerned being not quite at right angles to the radial axis, rather than to the curvature of the rays themselves. Seen surface on, the delicate dermal latticework (Pl. IV., fig. 6) presents irregular meshes, though in places these show a tendency to assume a regular quadrate arrangement. Here and there occur unusually small and slender-rayed dermalia—in all probability not fully developed—in which the rays are but obsoletely rough and run out to fine points.

On the thin oscular margin the dermalia present are all stauractins. These and some thin diactinic parenchymalia seem to be nearly all the spicules that enter into the support of that part.

The *gastralia* are pentactins, but sometimes stauractins and rarely even diactins. The rays are characterized similarly to those of the dermalia; only they are frequently of a much greater length, while the microtubercles of the surface occur somewhat more sparsely. Without forming a continuous layer the spicules in question are irregularly distributed over the choanosomal surface facing the gastral cavity.

The same kind of spicules as the gastralia just mentioned, are present on the surface of the excurrent canals. These may then be called the *canalaria*. They are most frequently met with in the widened proximal region of the canals, directly adjoining the apertures into the gastral cavity. It may safely be concluded that the same kind of lining spicules, whatever be their names, extends from the gastral cavity into the excurrent canals. Following the latter distad towards and into their narrower branches, the canalaria become more and more scarce until they cease altogether to exist.

To be explicit, the canalaria are, mostly at any rate, rough pentactins with the unpaired ray directed distad. So far as those in the body proper are concerned, I have not seen hexactinic forms amongst them, but I believe that some might possibly have been discovered, had a more extensive search been made. On the other hand, in preparations of tissues from the upper part of the stalk, I find a considerable quantity of regular hexactins occurring together with pentactins. All these spicules are quite like the gastralia in appearance and without doubt represent the canalaria lining the excurrent passages in the region mentioned. For Philippine specimens F. E. Schulze ('87, p. 163; '97) has given rough oxyhexactins as the canalaria generally. I find this fully borne out by the preparations of a Cebu specimen at my disposal. Nevertheless, the difference here indicated as regards canalaria I regard as probably inconstant and therefore as being not of systematic importance.

Of the hexasters, the *oxyhexaster* (Pl. IV., fig. 5) occurs abundantly in the choanosome. Diameter, 90–120 μ. Each very short principal bears usually 2–3, sometimes 4 and even 5, straight or slightly bent, obsoletely rough or nearly smooth, divergent terminals. There are in some oxyhexasters perceptibly more slender than in others.

The small *discohexaster* (Pl. VI., fig. 4) may be said to be spherical in shape; the terminals emanating from each principal do not form a distinctly separate tuft, as seems to have been the case in the specimens studied by F. E. SCHULZE. Diameter, 45–50 μ. As shown in the figure referred to, the minute terminal discs often appear as if they were situated in the periphery at unequal distances from the central point. I think this is due, not so much to actual differences in the length of the terminal rays as to the various directions in which these are viewed. The said discohexasters are scattered in moderate abundance in the subgastral region as well as along the surface of the excurrent canals. They are somewhat more common in the latter region than in the former. F. E. SCHULZE ('97) found the rosette in question generally shifted out to the free ray-tip of oxyhexactinic canalaria. Similar instances were observed also by me, in which a rosette hung on the free end of a stray parenchymalia-ray that projected into the canalar lumen.

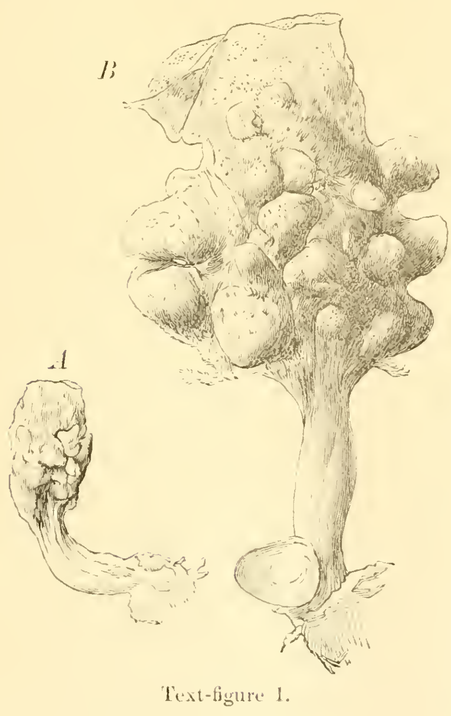
CRATEROMORPHA MEYERI TUBEROSA IJ.

Pl. IV., fig. 9; Pl. V., figs. 12 & 13.

C. meyeri var. *tuberosa*. IJIMA, '98, p. 49.

Of the specimens which I refer to a subspecies of *C. meyeri* under the above trinomial designation, several (no less than fourteen) have come under my observation. The localities in the Sagami Sea, so far as known to me, are: Outside Okinosé (about 429 m.), whence came most of the specimens; Homba (about 572 m.); and a spot a few miles E. of Habu, Vries Island. North of the latitude of Okinosé in the sea mentioned, no specimen as yet seems to have been obtained. Whereas in the Suruga Bay, on a rich *Metacrinus* ground near Enoura and of only about 80 fathoms depth, the "Albatross" (Stat. 3719; May 11, 1900) trawled up a badly macerated specimen which at the time seemed to me to belong to the present subspecies.

A specimen from Homba (Pl. V., fig. 12) was growing on a loose stone covered all over with remains of Bryozoa, worm-tubes, &c. Others from Outside Okinosé are attached to black lava, to masses of volcanic detritus or to some shells (in one case to a *Balanus* and in another to a Brachiopod). *Syllis ramosa* seems to be a very frequent, if not a constant, companion of the subspecies; at least I have been able to determine the presence of that commensal Annelid in all specimens (seven in number) from Outside Okinosé.



Text-figure 1.
Crateromorpha meyeri tuberosa IJ.
⅔ natural size.

This lot of Okinosé specimens is of further interest in that it comprises a graduated series of differently sized individuals of the subspecies, the extremes representing the smallest and the largest I have as yet seen.

To mention a few specimens in particular. The smallest just referred to is the one shown in the accompanying text figure 1, *A* (S. C. M. No. 478). It is only 42 mm. high, the stalk being nearly as long as the body proper. The latter is 18 mm. broad. The presence of tubercular prominences on this small specimen as also on such gradationally larger ones as measure 57 mm., 73 mm., 85 mm., &c. in height, shows that their their formation takes place very early in the life of the individual.

Text-fig. 1, *B*, represents a moderately large specimen with the typically characteristic shape of the subspecies. (From Outside Okinosé, S. C. M. No. 482). Total height, 115 mm. Greatest breadth of body, 63 mm.

Pl. V., fig. 12, shows in half natural size the single specimen I have from Homba (S. C. M. No. 444). Total height, 139 mm. Greatest breadth of body, 100 mm. The irregular protuberances of the body are 10–30 mm. or more in height. In places the surfaces of directly adjoining protuberances have come into contact and have fused together leaving an arch-like passage between them. The stalk is of about the thickness of one's thumb.

Fig. 13 of the same plate depicts the largest specimen (S. C. M. No. 445, from Outside Okinosé by the Iwado-line) that has come under my observation; it is cut open lengthwise, so as to show the gastral surface and the system of excurrent canals traversing the stalk. Total height, 210 mm. Thickness of wall, 7–10 mm. in the lower part, without taking the outbulging into consideration.

Summarily speaking, the general appearance of the sponge is essentially like that of the typical species, except in the fact already indicated that the external surface of the body proper is irregularly and conspicuously uneven on account of large and small rounded protuberances. These are usually only slightly or not at all developed along the rim of the cup-like body for some distance from the thin oscular edge. Lower down and on the remaining portion of the body, they exist in indefinite numbers and distribution (typically as in text-fig. 1, *B*). Noteworthy is the fact that in four cases I have found the bosses, scarcely developed on one side of the body, instead of being present all around as is usually the case, so that that side appears nearly smooth. Further, in several specimens the body is found to be laterally compressed to a greater or less degree, the osculum then presenting a correspondingly oblong shape. The firm-looking stalk, which is generally of an irregular outline in cross-section, makes up $\frac{1}{3}$–$\frac{1}{2}$ of the entire height of the sponge. It may be covered over by a crust-like coating of dermal and hypodermal pentactins, which however are easily detached.

Some of the freely open excurrent apertures on the gastral surface (Pl. V., fig. 13) are of a conspicuously large size. This is owing to the larger caliber of the excurrent canals which penetrate into the parietal bosses. When such a canal is excessively widened it may appear more like a niche in the wall of the gastral cavity than a tube, though it seems that the boss always arises as a thickening of the wall and not by an evagination of this. The bottom of the gastral cavity is occupied centrally by a space which peripherally runs out into radial septa-like ridges and on which open comparatively small apertures leading into the canal-system of the stalk.

Spiculation.

The various spicular elements are in essential agreement with those of typical *C. meyeri*. I may therefore confine my account of the spiculation to only those points which for one reason or another seem to me to be worthy of special note.

Among the parenchymalia, which are predominantly diactins, there are occasionally observed hexactins of moderately large size. This is exactly as in the typical species but is here specially mentioned, since in the subspecies *rugosa* I have failed to discover any parenchymalia of hexactinic shape.

In all the larger specimens, the hypodermal strands as seen with the naked eye or under the lens are on the whole somewhat coarser (up to 90 μ in thickness) and therefore more distinctly visible than in the individuals I have seen belonging to the typical species. Moreover, they extend continuously to considerable lengths without becoming broken at short intervals in course. By branching and by intersecting with one another they form a fine meshwork with small angular meshes. Microscopic examination shows that these hypodermal strands consist mainly of fine diactins in fascicular arrangement. Pentactinic hypodermalia in combination with the strands are comparatively sparse (cfr. p. 63), though they occur abundantly on the stalk. The wide difference in character between the hypodermal latticework as described above and that known to me from the typical species will be apparent by comparing figs. 11 and 6 in Pl. IV. However, the difference is apparently one which becomes pronounced only after the subspecies under consideration has grown to a certain large size. Thus, in the smaller specimens—say, in those not over 100 mm. or so in height—the diactins and the hexactins are either nearly equally represented or the latter predominate over the former in numerical proportion, in which cases the hypodermal structure as regards its composition is much the same as in the typical species. In the smallest specimen at my disposal (text-fig. 1, *A*), the hypodermal latticework is scarcely developed as such and can not be distinguished from the choanosomal feltwork.

The canalaria, which I have seen in both incurrent and excurrent canals, are rough pentactins with or without a rudiment of a sixth ray; occasionally they are stauractins or hexactins, though in some individuals the latter form may be said to be even abundant.

Of the hexasters, the microdiscohexaster (Pl. IV., fig. 9) is met with in moderate abundance in both the subdermal and subgastral regions. The terminals are perceptibly finer than in the typical species as exemplified by specimens from both Cebu and the Sagami Sea, but this may be a variable character. The diameter ranges from 38 μ to 50 μ.

CRATEROMORPHA MEYERI RUGOSA Ij.

Pl. IV., figs. 10, 11 : Pl. V., figs. 14, 15.

C. meyeri var. *rugosa*. Ijima, '98, p. 49.

This subspecies is established on the strength of five specimens. One of these belonged to Mr. Alan Owston (O. C. No. 6377); the rest are all in the Sci. Coll. Museum. The known localities are Outside Okinosé by the Iwado-line and Homba (about 572 m.), each of which localities has thus far yielded two specimens. The grounds may be said to be the same as those from which came both *C. meyeri* and *C. meyeri tuberosa*. Assumably the three forms thrive under different physical conditions of the bottom, and the possibility can certainly not be excluded that they represent what BIDDER has recently called "the metamps."

Subspecies *rugosa* is shaped much like *tuberosa* but is characterized by the fact that the external surface of the body proper, except close to the thin oscular margin, is extremely uneven on account of numerous wrinkle-like ridges and other irregular prominences. The sponge may grow to a respectable size, measuring 320 mm. in height, as attested by one specimen in the Sci. Coll. (Mus. No. 508, from Okinosé). In that specimen the stalk length is about equal to only one-fourth of the total height; it broadens above to an unusual extent, so as to assume an inverted conical shape. The body proper is unfortunately much shrunk and partly destroyed.

Very well preserved are the two specimens shown in Pl. V., figs. 14 and 15, and hence they may be taken as models for description. Though they are about the smallest I have had, the height measures nearly 240 mm. in both. The stalk is nearly as long as the body, near the small and irregular attachment disc is about as thick as one's finger and gradually thickens above towards the junction with the body. It is throughout compact-looking, being partly covered by a dense coating of dermal spicules which easily fall off, and partly firmly felt-like on account of the exposed parenchymal fibers that run in the main longitudinally. Lengthwise it is more or less prominently ribbed in the upper part, the ribs passing above into the superficial irregularities of the body proper.

This stalk expands somewhat abruptly at its upper end; it is more or less distinctly compressed laterally. In the specimen of fig. 15, the major transverse axis of the body measures 172 mm., the minor falling short of it by nearly 50 mm. The wall, which is thin along the oscular edge, shows a considerable thickness below. The osculum is large and wide, being of an oblong shape though quite irregular in outline. The irregularities of the external surface, which form the most conspicuous feature of the subspecies, are apparently due: firstly, to the thickening out of the wall into protuberances similar to those of *tuberosa*, these being generally most prominent in the lower part of the body; and secondly, to the fact that the general surface is thrown into low and sharp-edged wrinkles, such as arise on certain soft substances when they become parched. In the sponges before us there can be no doubt whatever that the rugosity is something natural to them and not a postmortem feature.

Except in the above character, the texture and general appearance of the sponge are in essential agreement with typical *C. meyeri* but especially with the subspecies *tuberosa*. I may specially mention that as regards the appearance of hypodermal strands and of the gastral surface (see fig. 15), what I have said under *tuberosa* is equally applicable here.

The agreement extends to the spiculation also. But there exists one, probably not unimportant point of difference in the fact that in no specimen of *rugosa* have I found hexactins among the parenchymalia, these consisting exclusively of diactins. This negative result was reached in spite of a special search made in a number of preparations.

Exactly as in *tuberosa*, the hypodermalia in the body proper are mainly diactins; pentactins occur only here and there amongst them (Pl. IV., fig. 11). They form relatively long and continuous strands of varying strength. Some of the strands, especially those running along or forming the edge of the more prominent wrinkle-like ridges, may be 300 μ or more in breadth. On the stalk, pentactinic hypodermalia are present in abundance; numbers of them adhere to the finger on being touched.

The canalaria are rough pentactins with or without the knob-like rudiment of a sixth ray. Regular hexactins as canalaria have not been met with.

On other points in the spiculation special remarks may be entirely dispensed with, as they would be but a repetition of what I have already said under typical *C. meyeri*.

CRATEROMORPHA PACHYACTINA IJ.

Pl. IV., fig. 13.

Crateromorpha pachyactina. IJIMA, '98, p. 49.

This species is based on a single and, unfortunately, much injured specimen (Sci. Coll. Mus. No. 395) which is stated to be from the Tosa Sea, off the island of Shikoku. The specimen was found included in the exhibits of the marine products of Kōchi-Ken (Prov. Tosa) in the Fourth Industrial Exhibition held at Kyōto 1895; it was purchased by the natural history dealer "Mimatsu" of Tokyō and subsequently acquired by the Science College. I at first referred it to *Crateromorpha meyeri*, but a closer examination of the structure revealed a number of points which seem to be sufficiently characteristic to found a distinct species on.

The specimen consists of a stalk and a large fragment of the body proper. The former is about 100 mm. long and 18 mm. by 26 mm. thick in the upper portion, but narrower below and just above the swelling at the extreme base. In its general appearance, in the mode of transition into the body proper, in the canal-system traversing the interior and in the ankylosis of principal spicules in the lower portion, the stalk corresponds exactly to that of *C. meyeri.* One thing which attracted my attention from the outset was the fact that on touching it with the fingers it readily gave off sharply pointed and disproportionately strong-rayed spicules (hypodermal pentactins), on which account it was necessary to use extreme caution in handling it.

The fragment left of the body-wall is in a mutilated condition but still sufficiently well preserved for determining the more important features of the sponge. It is easy to conceive that the specimen, when entire, had approximately the size and general appearance of the two specimens of *C. meyeri rugosa* figured in Pl. V., figs. 14 and 15. The external surface is extremely uneven on account of irregular elevations of varying height. The wall is thick, measuring not less than 15 mm. in thickness near its junction with the stalk.

While the gastral surface is perforated with numerous large apertures of excurrent canals and looks much like that of *C. meyeri,* the outer side of the wall presents a remarkably compact and densely felted appearance, apparently due to an excessive development of the parenchymalia as well as to the fact that the dermal layer is closely adherent to the parenchymal mass. The subdermal space is scarcely perceptible, while incurrent apertures and canals, so far as can be recognized with the naked eye, are narrow and widely separated from one another.

The largest incurrent apertures, seen here and there in scattered distribution, do not exceed 2 mm. in diameter.

Spiculation.

The *parenchymalia* seem to consist exclusively of diactins. Not a single parenchymal hexactin could be discovered although a special search was made for them. A number of the diactins may be called *principalia*. These are straight or bow-shaped spicules of varying strength; smooth all over and sharply pointed at ends. In the body proper they may measure 6 mm. in length and 275 μ in thickness in the middle; in the stalk they are generally longer but more slender, reaching up to 15 mm. in length and 100 μ in thickness. The larger diactins are found in especial abundance near the external surface in both the body and the stalk. In the latter they mostly run in longitudinal directions.

But by far the greater part of the parenchymalia is made up of very much finer diactins (accessoria) generally not over 3 mm. in length with a breadth of only 4–15 μ. The ends of these are somewhat swollen, rounded and rough-surfaced. These filamentous diactins occur in part as comitalia to the stronger spicules; for the rest they stand alone by themselves and may be developed in such exceedingly great numbers as to form a tissue of very fine soft texture. Such a tissue exists even in the stalk but is confined to the inner portion of its upper part. When freed of any such coarser spicules as may be contained in it, which can be done without much difficulty by feeling for them, the tissue can be balled like wool or cotton by rolling it between the fingers.

The *ankylosis* of certain spicules in the lower part of the stalk occurs in much the same manner as in *C. meyeri*. Perhaps it may be regarded as a point of slight difference that the obsolete microtubercles on the beams of the basal framework are comparatively sparsely present in an irregular distribution.

Strongly developed as are the parenchymal principalia, a far more striking feature is offered by the unusually thick-rayed *hypodermal oxypentactins* (Pl. IV., fig. 13). These occur in abundance on both the body and the stalk. Handling the sponge without due care is liable to lead to the irritating result of finding them impertinently sticking to the skin by their sharp points.

While some of the pentactins—evidently those not yet fully developed—have indeed comparatively slender rays, most of them have rays so thick that they may be said to be nearly of an elongate conical shape. With a length of 2¼ mm. (as measured from the spicular center), the rays may be 330 μ thick close to their base. They taper gradually towards the sharply pointed ends and are smooth throughout. All the rays in one and the same pentactin are of nearly equal length. The plane of the paratangentials is usually convex on the outside. The pentactins in situ can be discerned with the naked eye and picked up one by one by means of a pincette. In Pl. IV., fig. 13, a few dermalia and some fine parenchymalia (comitalia) are drawn by the side of a hypodermal pentactin in order to show at once the striking difference in bulk.

No other spicular forms than the above pentactins can be distinguished as hypodermalia. The dermal layer lies in most places in direct apposition to the parenchymal mass, and therefore it is scarcely possible to discriminate any one of the underlying diactins as being hypodermal and not parenchymal.

The *dermalia*, so far as I have seen, are all small rough pentactins, exactly comparable to the same of *C. meyeri*. They do not form a distinct dermal lacework, being closely adherent to the tissues below. The *gastralia*, which are likewise rough pentactins, also show no noteworthy point of difference from the same of *C. meyeri*.

The same may further be said of the *hexasters* of this species, so that I need not enter into a description of them beyond making the following cursory remarks.

The *oxyhexaster* is abundantly present in all parts of the parenchyma. Diameter, 80–100 μ. Number of terminals to each principal, 2–4.

The *microdiscohexaster* is common in the parenchyma generally. Diameter, 38–50 μ. The figure of this rosette given in Pl. IV., fig. 9, from *C. meyeri tuberosa*, may pass equally well as that of one from the present species.

CRATEROMORPHA CORRUGATA IJ.

Pl. VI., figs. 1–8.

Crateromorpha corrugata. IJIMA, '98, p. 49.

I consider this as a very well characterized species, which, unless the specimen to be identified is too imperfectly preserved, can be easily recognized.

About fifteen specimens in all have passed through my hands. No doubt they all came from the Sagami Sea; a more exact statement of locality can be made only in the cases of five specimens from Outside Okinosé by the Iwado-line (200–300 fms.) and of one from a spot in Dōketsba (100 fms.). The latter specimen, together with *Euplectella marshalli*, *Metacrinus rotundus*, &c., was obtained by Professor Mitsukuri in one of his excursions on the "Golden Hind."

At first sight the species may appear not unlike *C. meyeri tuberosa* or *rugosa* (Pl. VI., fig. 6). The general shape of the body is that of a bowl of irregular contour, broadest at the base, the central portion of which passes below into the stalk. The periphery of the body-base may somewhat overhang the insertion of the stalk.

The external surface of the body proper is very peculiarly characterized. Though it looks much the same as in *C. meyeri* along the thin smooth oscular border, the greater part of it presents a much folded or corrugated appearance. The rounded and quite irregular folds causing this appearance may at once be distinguished from the simple protuberances of *C. meyeri tuberosa* or from the wrinkled irregularities of *C. meyeri rugosa*. Between the folds are furrow-like or pit-like depressions; many of these are shallow and plainly show the cul-de-sac bottom, while others, especially the pit-like ones, are frequently deep and may even be so deep and canal-like that their course can be followed only by introducing probes or by cutting open the wall. And among such deeply penetrating pits or canals there invariably exist some that internally freely intercommunicate with others of the kind. The canals may divide in their course and the branches may by anastomosis from a tunnel-system that opens externally by more than two openings. Thus the canals in question are strictly comparable in character to the intercanals of the Ascons, and indeed the species bears some external resemblance to certain of those Calcarea. Needless to say the above perforating passages, for which the name intercanal may be borrowed, are throughout lined with the dermal layer as is of course the entire surface externally exposed (*vide* Pl. VI., fig. 7, in which the dermal surface is colored yellow).

The external depressions are on the whole deepest, and the intercanals most frequently developed, in the lower part of the body. In that region the thickness of the body-wall—considering this to be represented by the space between the general surfaces of the exterior and of the central gastral cavity—must be said to be considerable, being 90 mm. or more in very large specimens. But, if we restrict the application of the term "body-wall" to that layer of the sponge-tissue which is bounded externally by the dermal layer and internally by the excurrent surface, irrespective of whether the latter belongs to the gastral cavity or to the canals opeining into it, the wall-thickness is nowhere very great, being usually 2–3 mm. and probably never more than 5 mm.

Apart from the external irregularities above described, the dermal surface is smooth. The dermal layer is of an extremely delicate kind. The hypodermal lattice-work is made up of beams which are so fine as to be barely discernible with the naked eye. The closely set incurrent apertures, visible through the dermal layer, are small, measuring not more than 2 mm. in diameter.

The gastral surface (Pl. VI., fig. 7) presents an appearance essentially similar to that of *C. meyeri.* Above and near the oscular margin, there occur only small roundish excurrent apertures, mostly under 2 mm. in diameter. Lower down, larger apertures likewise of roundish or oval shape are added to them until the largest occurring in the deepest part of the cavity may measure 15 mm. or more across. Centrally at the bottom there is an irregular space with comparatively small apertures, as we have seen also in *C. meyeri*. The larger apertures usually do not lie very close together but are separated from one another by a rather wide interspace occupied by small apertures only. While the smaller apertures show a sharp angular edge, the larger ones are without any edge at all, the transition of the central gastral cavity into the excurrent passages being gradual and imperceptible. The latter are sometimes shallow and niche-like, at other times much deeper and pit-like or canal-like. The appearance of their wall is essentially that of an extension of the gastral surface. The larger deeply penetrating excurrent canals, as can be determined by cutting them open, often but not always intercommunicate with one another. The anastomosis reminds one strongly of the gastrocanals or the tubar system of the Ascons. It is plainly associated, both genetically and in topographical relation, with the intercanal system of the exterior.

The stalk is nearly as long as, and sometimes perceptibly longer than, the body proper. In general appearance it is scarcely distinguishable from that of *C. meyeri*. It is firm throughout, the lower part being quite hard and compact. The lower end may expand into an attachment disc. Superiorly it gradually broadens, acquiring a densely and longitudinally fibrous appearance and an obtusely polygonal shape in cross-section. On severing the sponge-body, the upper end of the stalk is found to be divided into a few branches; so, at any rate, after the sponge has attained a large size. It is solely by this peculiarity that I identify the completely macerated stalk shown in Pl. VI., fig. 5, as that of the present species. The branched state is to be accounted for by the intercanal or intercanals that go right through the sponge at the junction of the body with the stalk. The figure just cited will give a good idea of the manner in which the excurrent canals traverse the stalk.

I may now add some remarks concerning certain individual specimens.

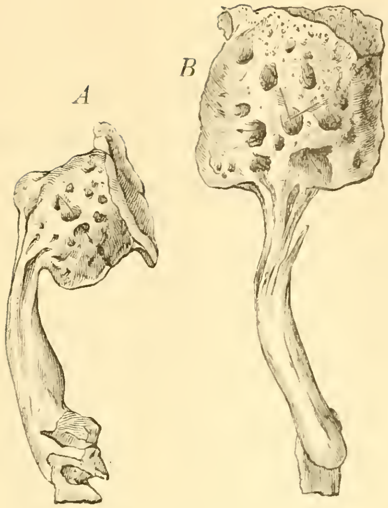
The largest specimen I have seen (O. C. No. 4064) was 320 mm. high, the body measuring fully 250 mm. in greatest breadth.

The typically shaped specimen (O. C. No. 108), shown in Pl. VI., fig. 6, measures 247 mm. in height and 196 mm. in greatest breadth. Stalk, about 90 mm. long. Osculum, 120–140 mm. in diameter. Gastral cavity not deeper than 100 mm. Greatest thickness of body-wall (as measured between two points in the gastral and the general external surface), 90 mm. or more.

Another exquisitely preserved specimen—that depicted in Pl. VI., fig. 7, in a longitudinal section (S. C. M. No. 365, from Outside Okinosé)—is smaller. Total height 116 mm. Breadth at the osculum, 30 mm. Greatest breadth, 74 mm. Stalk, about 60 mm. long and 6–14 mm. broad. Gastral cavity, 40 mm. deep.

An individual with an unusually widely expanded calyx had a breadth of 300 mm. and a height of 250 mm.

Of special interest are the two smallest specimens I have had at my disposal (S. C. M. Nos. 484 & 485, shown in the appended text-figure 2). The smaller of the two (*A*) is about



Text-figure 2.

Two small specimens of *Crateromorpha corrugata* IJ., from Outside Okinosé. The arrows indicate the intercommunicating external depressions. $\frac{3}{4}$ nat. size.

50 mm. high; size of the osculum with out-flaring rim, 26 mm. by 19 mm.; and breadth of the body at base, 23 mm. by 18 mm. The other specimen (*B*) is 80 mm. high; body, 34 mm. long, and 27–37 mm. broad; size of the oblong osculum, 34 mm. by 16 mm. In both the lateral compression of the body is distinct, a fact which I have not specially noticed in all the larger specimens. Both the small specimens show on the dermal surface of the body a number of dimple-like depressions. Some—not all—of the deeper and pit-like depressions intercommunicate with one another, representing an early stage in the formation of intercanals. From their general appearance it is to be concluded that the intercanals result from the breaking through of adjacent external depressions, which become deeper as the sponge advances in growth, and apparently not by the fusion of tubular outbulgings from the sponge-wall, although the two processes, as both actually occur among the Ascons, are to be considered as modifications of one and the same process leading to the same result. In the two little specimens under consideration, the junction of the body with the stalk is simple exactly as in *C. meyeri*; the piercing through of that part seems to take place at a later stage of the growth of the sponge.

Spiculation.

The *parenchymalia* do not contain hexactins but consist exclusively of diactins, as in *C. meyeri rugosa.* The diactins are for the most part thin and small, terminating with rough swollen ends; generally under 1.5 mm. in length and 10 μ in thickness. Occasionally there occur larger diactins which may be called the principalia. These may attain a length of 3 mm. and a breadth of 55 μ at the middle. They are bow-like or almost straight and differ from the smaller parenchymalia in tapering towards both ends. On account of the general smallness and fineness of the parenchymalia (Pl. VI., fig. 8) the consistency of the sponge-body is soft and delicate, as ascertained on spirit specimens.

The firm stalk, on the other hand, contains parenchymal diactins which may be 10 mm. or more long with a thickness of nearly 80 μ. In its lower portion is observed the usual synapticular coalescence between the principal supporting spicules. The beams of the rigid framework are nearly smooth all over, the microtubercles being present at places only in a sparse number, much as I have seen them in *C. pachyactina.*

The *hypodermalia* are mainly pentactins, which are supplemented by occasional diactins. The pentactins are small to medium sized, the rays measuring up to 500 μ in length and 33 μ in breadth at base. The unpaired proximal ray is somewhat longer than any of the paratangentials in the same spicule. Each ray gradually tapers towards the roughened, usually conically pointed end. The above pentactins exist rather copiously, the spicular centers being separated from one another by an interval which is approximately equal to the length of the paratangential rays. With these rays they form a fine hypodermal network, the small meshes of which are irregularly angular or are often incompletely enclosed.—The hypodermal diactins are fine and differ in no way from the smaller parenchymalia. In one specimen of the sponge they were found in tolerable frequence; in others they were rather rare.

The *dermalia* (Pl. VI., figs. 1 & 2) are rough stauractins and pentactins, the former predominating. Length of ray as measured from the spicular center, 85–138 μ. In certain specimens I have frequently seen the stauractinic forms in possession of the rudiment of the fifth (proximal) ray in the form of a boss (fig. 2). The four paratangentials of a spicule are in a plane which is but slightly convex on the outside and is often nearly perfectly flat. The roughness of the ray surface is, as a general matter, less pronounced than in *C. meyeri*. It often diminishes towards the base of the rays where it is altogethor lost (fig. 1).

Along the thin oscular margin the dermalia are found to be represented now and then by tauactins and even by diactins. The latter seem to intergrade with the parenchymalia of the region by forms of intermediate size and character.

The *gastralia* are quite like the dermalia. There occur both stauractins and pentactins amongst them, but their number must be said to be sparse, being found in scattered distribution. A considerable area of the gastral surface may sometimes be searched in vain for gastralia.

No special canalaria have been observed.

The *hexasters* of the species closely agree with those of most other *Crateromorpha*. They are :

Firstly, the oxyhexasters (Pl. VI., fig. 3) which are of quite common occurrence. Diameter, 80–114 μ. Very rarely I have met with oxyhexasters in which one or two of the principals—never all the six (hexactinose)—bore each a single terminal which was bent at base in the well-known manner. The rule is that the six principals bear each 2 or 3, sometimes 4, diverging terminals. Except at base, these are nearly straight; otherwise they are slightly wavy. Their surface is obsoletely rough or nearly smooth. I have noticed that the principals are, generally at least, perceptibly longer than those in the corresponding rosette of *C. meyeri*. But such finer points in the character of the rosette are probably subject to considerable individual variations.

And secondly, the minute discohexasters (Pl. VI., fig. 4) which have been met with in some numbers—by no means abundantly—in the subdermal space. In no other region of the body have they been discovered. Diameter, 40–50 μ. The entire shape is quite spherical, all the terminal discs being uniformly distributed on the surface. Under a high power of the microscope the minute terminal disc is seen to be supplied with six, and sometimes more, marginal teeth. The numerous fine terminals arise from all over the convex surface of the disc at the end of each principal, as is usually the case with the so-called microdiscohexaster of the Rossellidæ.

HYALASCUS Ijima.

Vase-like, firmly attached by contracted base; large. Gastral surface lined with distinct endosomal layer covering over the excurrent canalar apertures. Parenchymalia, diactins only. Hypodermalia, pentactins supplemented with some diactins. Dermalia, generally rough pentactins; occasionally hexactins. Gastralia, similar hexactins. Oxyhexaster represented by hemihexactinose and hexactinose forms. Discohexaster in one small form with very fine terminals.

The genus was originally instituted by me for the reception of a single species which I briefly described in '96 under the name of *H. sagamiensis*. F. E. Schulze ('97, p. 525), in his revision of the Asconematidæ, placed this genus and species under that family. For the grounds that have led me to take up the genus under the Rossellidæ, the reader is referred to my Contribution III. ('03, pp. 78–82).

In '98 I referred to the same genus a second species, *H. giganteus*. And now I feel the necessity of establishing a third and new species, *H. similis*.

The genus seems most nearly related to *Scyphidium*, *Vitrollula* and *Crateromorpha*. Its distinction from these as well as from certain other allied genera may be gleaned from the differential key given on p. 18.

The three species, which are all of the genus at present known, will in the sequel be described in detail. They may be distinguished by the following characters:

a.—Canals narrow, under 2 mm. diameter. Discohexaster, spherical, 80–90 μ. in diameter; usually with only 3, widely divergent terminals to each principal..*H. sagamiensis* Ij.

b.—Canals as in the above. Discohexaster, not spherical, 46–50 μ. in diameter; with 12 or more terminals in a separate, outwardly expanding tuft to each principal...*H. similis* Ij.

c.—Canals may be very wide, reaching several mm. in diameter. Discohexaster, spherical, 30–38 μ. in diameter; with about 10 or less terminals to each principal..*H. giganteus* Ij.

HYALASCUS SAGAMIENSIS Ij.

Pl. VII. and Pl. VIII., figs. 1, 2.

Hyalascus sagamiensis. IJIMA, '96, p. 251.—F. E. SCHULZE, '97, p. 525.

The species is based on a single specimen (Pl. VII., fig. 1) which belonged to Mr. ALAN OWSTON. After I had studied it, as I understand, the specimen passed into the possession of Prof. B. K. EMERSON of Amherst College, Mass., in which institution it is now probably preserved.

It was stated to have been obtained by some fisherman in the Sagami Sea. Nothing further about the circumstances of the capture is known.

The specimen had been torn off at the inferior end. The wall had also been torn lengthwise right through, but this had been repaired by sewing together the severed edges. Notwithstanding the above defects I believe, especially in view of the shape presented by *H. similis* (text-fig. 3) which so closely resembles the present species that the specific distinctness may almost be doubted, that the specimen had suffered but little change from the original natural shape and that it had been firmly attached to the substratum by the contracted lower end. In short, the shape of the species seems to be essentially the same as that which I shall later describe for *H. similis* (text-fig. 3, p. 96).

As it was, the specimen (Pl. VII., fig. 1) was vase-like, bulging out on one side at the middle of the upper half, in which part the greatest breadth measured 230 mm. Entire length 500 mm. Shape of cross-section somewhat angular on one side but otherwise rounded. From the broadest part the body narrowed gradually towards the torn off base; superiorly it also showed a slight and gentle contraction before the irregular out-flaring of the oscular region. The osculum, surrounded by a thin, undulating and apparently simple-edged rim, measured 160 mm. across in one direction and 140 mm. in another. Compared with the size of the specimen, the wall must be said to be rather thin. In the broadest part of the body the thickness measured only about 10 mm. and in the lowest part, where the gastral cavity had been opened by the tearing off of the base, about 12 mm.

Both external and internal surfaces are tolerably smooth. The apertures of the canals, incurrent as well as excurrent, are small, all being under 2 mm. in diameter. This doubtless stands in a measure in relation to the fact that the sponge-wall is dense and moderately firm.

The dermal layer of the ectosome is so fine as to be scarcely perceptible with the naked eye. Under the lens its minute meshes appear to be generally quadrate in shape. The hypo-dermal latticework, just discernible by the unaided eye, comprises irregularly angular meshes not more than 1 mm. in length of sides. Aside from the genuine hypodermal beams there are distinctly observable on the outside a number of much coarser, long, obliquely running and intersecting strands, which run directly beneath the ectosome. Since this lies close over the choanosomal surface, the said strands may as well be regarded as forming a part of the hypodermal framework as to be considered the most superficially situated parenchymal bundles.

Where the thin ectosome has fallen away, the choanosomal surface appears somewhat roughened on account of numerous shredded ends of very small parenchymal bundles (the pillars), which, coming up from below, terminate just at the ectosomal surface. The little shreds are apparently, at least in part, formed of those parenchymalia which accompany the unpaired proximal ray of hypodermal pentactins.

In the upper part of the gastral cavity the surface, perforated by small excurrent canalar apertures, at places presents simply a coarse felt-like appearance. This is doubtless due to the loss by abrasion of the gastral layer or the endosome which must have once covered the entire gastral surface. At any rate, the deeper and by far the greater part of the cavity is actually lined by a delicate and continuous endosomal layer, through which are seen the excurrent canalar apertures as well as the subgastrally running, long and intersecting strands of the parenchymal mass. At places the surface shows dead-white patches, as if affected by a mould; these are due to excessive local accumulations of gastralia.

Spiculation.

Pl. VIII., figs. 1 and 2, will serve to give a general idea of the spiculation of the species.

The *parenchymalia* are all slender diactins of variable thickness. Only exceptionally among the thinner ones do there exist such as show an annular swelling in the middle. Their ends are usually sparsely beset with microtubercles and are sometimes pointed and sometimes rounded. The diactins run either isolatedly or combined into long thread-like bundles. In the latter case some of them may, on account of their larger size, be distinguished as the principalia. These are long, slender and gently curved or nearly straight oxydiactins, very gradually tapering out towards both fine smooth ends. They may attain a length of 20 mm. or more and a breadth of 120 μ in the middle. The comitalia are only 10 μ thick or even thinner, showing as usual the same breadth for the greater part of their length. The presence of gradationally intermediate sizes between the principalia and the comitalia clearly indicates the origin of the former simply by continued growth from amongst the rank of the latter. Synapticular formation exists nowhere, but we should expect to find it in the very base of the sponge which is not preserved.

Along the oscular edge there are seen at some places a palissade-like row of needles, projecting free for about half a millimeter or so; however, it is clear that we have here to do not with special marginalia but simply with the ends of ordinary parenchymalia unnaturally exposed as the result of abrasion.

The *hypodermalia* (Pl. VII., fig. 6) are, mainly at least, moderately large oxypentactins with smooth tapering rays. The unpaired proximal ray, which is straight, may be 2–3 mm. long. The paratangential rays are shorter, generally measuring 0.9–1.2 mm. in length; they are always curved to a greater or less degree or somewhat wavy. The pentactins as seen on surface-view preparations are commonly arranged in groups of two or three, the centers lying more or less closely together. The paratangentials in each group, together with those emanating from adjacent groups, are brought together into loose bundles, which constitute the beams of the irregularly meshed hypodermal latticework. Now and then some diactins take part in the formation of the said latticework; they may therefore be regarded as occasional elements of the hypodermalia. Hypogastrally no pentactins occur in the endosome.

The *dermalia* (Pl. VII., figs. 2 & 3; Pl. VIII., fig. 1) are mostly pentactins, not infrequently hexactins and very rarely stauractins. The pentactins are commonly supplied with a boss-like rudiment of the distal sixth ray. The rays are rather strong, measuring 80–110 μ in length (as measured from the center) and 8–11 μ in thickness at base. They taper perceptibly from the base towards the conically pointed end (a point, which Pl. VII., fig. 3, fails to show). Their surface is throughout beset with conical and erect or nearly erect microspines that give a coarsely shagreen-like appearance to the entire surface of the spicule. The more prominent microspines may be turned obliquely outwards. Sometimes, but not always, the microspines grow considerably weaker and more sparse towards the base of the rays and the central node. In the hexactinic form the ray that is distally directed is in no way differentiated from the rest. Seen under the microscope the dermal latticework is not in all parts regularly meshed, and where the meshes show an approximately quadrate shape, the paratangentials of separate but directly adjoining dermalia are, as usual, apposed side by side throughout their entire length.

The *gastralia* (Pl. VII., fig. 4; Pl. VIII., fig. 2) are all hexactins in which the free proximal ray is much longer than any of the other rays. Length of paratangentials, 90–110 μ. Distal ray as long as paratangentials or somewhat shorter. Length of proximal ray, 185–275 μ. Breadth at base of rays, 10–14 μ. All the rays taper very gradually towards the conically pointed ends. (Pl. VII., fig. 4, does not faithfully represent this point. The general shape of the gastralia is better shown in Pl. VIII., fig. 2). Except at the base of rays and on the central node, both of which parts are generally smooth, the surface is beset with numerous microspines similar to those on the dermalia. The microspines on the free proximal ray may be slightly more strongly developed and more distinctly outwardly directed than those on the other rays. In my preliminary description ('96) of the species I have said that the gastralia, on account of their specially developed proximal ray, might be called hexactin-pinules. That statement I beg now to withdraw for fear that it may lead to an over-estimation of the degree of differentiation shown by the proximal ray. The gastral hexactins, it may be said, are no more specially characterized than are those with prolonged proximal rays in certain other Rossellids (f. i., *Staurocalyptus glaber*, *Rhabdocalyptus unguiculatus*, etc.)

Oxyhexasters (Pl. VII., figs. 7–10), represented by hemihexactinose and somewhat less frequently by strictly hexactinose forms, are abundantly present in the choanosome as well as in the gastral layer. Normally developed oxyhexasters, in which all the principals bear two or more terminals each, were not met with; if at all present, they must be exceedingly rare. In diameter or axial length, the oxyhexasters measure 100–145 μ. Hexactinose forms (axial length 120–145 μ) are for the most part appreciably larger than those which are hemihexactinose; indeed this seems to be the general rule with all the Rossellids in which oxyhexasters show a tendency to take the hexactinose form. The terminals appear to be moderately strong, on an average are about 2½ thick at base, and are generally nearly straight. Their surface is obsoletely rough. The principals are exceedingly short, being almost reduced to nothing. In all cases of the rosettes, if recourse be taken to proper methods of treatment, the axial filament is seen to extend from the spicular center into each principal but never beyond into the terminal, whether this be single or double.

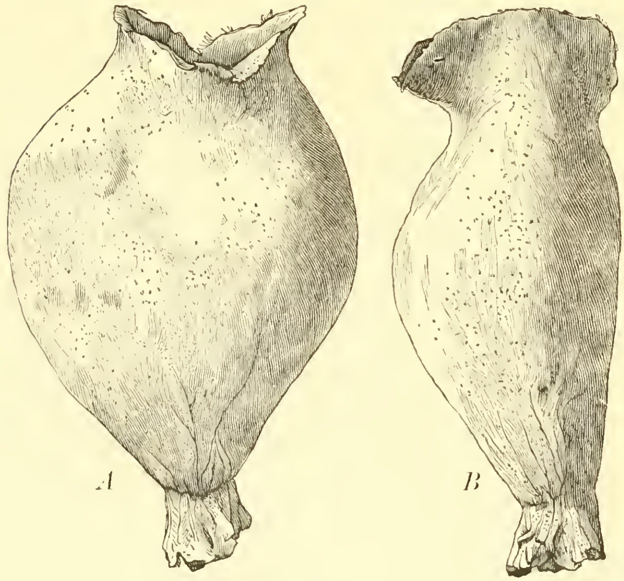
In the hemihexactinose forms, it seems most usual that only one or two, but sometimes three, of the six principals bear two widely divergent terminals on each, the rest of the principals being uniterminal. Thus, oxyhexasters with seven or eight terminal points in all are of the most frequent occurrence. Some with as many as nine terminal points in all have occasionally been met with. A case of a principal bearing more than two terminals has not been observed. This is in unison with the apparently strong tendency of the oxyhexasters towards becoming hemihexactinose or hexactinose, for a biterminal principal may be said to be in a stage which by but one last step in the process of reduction would lead to a uniterminal state. The simple ray composed of a principal and a single ray, whether belonging to a hemihexactinose or to a hexactinose oxyhexaster, is usually nearly straight throughout but may not infrequently show a gentle and sometimes a more pronounced and somewhat angular bending at base. The latter condition is one which would arise directly from the biterminal state by total atrophy of one of the terminals, while the former condition represents transitional phases of a uniterminal ray towards becoming perfectly straight at base.

Noteworthy seem the degenerate oxyhexasters with less than six terminal points, such cases being certainly quite rare. In Pl. VII., fig. 8, I have shown a case which in view of the shape might be called an oxystauraster. There can be no doubt whatever that this spicule was derived from a hexactinose oxyhexaster by complete suppression of two opposite rays occupying the position of an axis.

The *discohexaster* (Pl. VII., fig. 5) is moderately common near the gastral surface. It is probably not totally wanting in the parenchyma generally. It is rather small in size, spherical in shape and of an exceedingly delicate nature. Diameter, 80–90 μ. A spherical central node is sometimes distinctly perceptible and sometimes not. The six principals are short, being only about 3 μ long; their outer ends seem to be simply truncate, instead of forming a disc-like expansion. The terminals, of which there are usually only three and exceptionally four to each principal, are very fine filaments which thicken somewhat towards the outer end. The small number of the terminals radiating in all directions seems to be characteristic, forming the most important diagnostic feature by which the present species can be distinguished from *Hyalascus similis.* The terminal discs are quite small; in lateral view they appear arched like a watch-glass. Their marginal dentation could not be brought into view. The terminals break off easily at a certain distance from the base, so that the discohexaster is found but rarely in a perfectly intact state.

HYALASCUS SIMILIS NOV. SP.

Just in time to admit of the insertion of this description, Mr. ALAN OWSTON has shown me, with his usual courtesy, a beautiful and excellently preserved specimen (O. C. No. 7803) acquired by him not long ago from the coast of the Province of Tōtōmi. It at first appeared to me to be a second specimen of *Hyalascus sagamiensis*, but a close study of the spiculation has led me to think otherwise and I propose to call it *H. similis* n. sp. The exact circumstances of the capture of the specimen are not known.



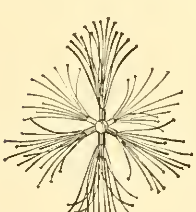
Text-figure 3.

Hyalascus similis n. sp. in $\frac{1}{5}$ natural size. Two views of the same specimen seen from different directions.

The shape of the specimen is shown in the accompanying text-figure 3 in one-fifth natural size. The saccular and rather thin-walled body measures 380 mm. in total height. The main part of it is distinctly laterally compressed. At the ventricose middle the breadth measures sagittally 230 mm. and transversely 150 mm. The body contracts towards both ends, but less so above than below. The oscular region, which terminates in a thin simple edge, is outflaring to a greater or less degree in different places. The osculum measures 135 mm. by 150 mm. in diameter, the lesser and the greater diameter in relation to those of the laterally compressed main part of the body being exactly reversed in orientation. The basal end with irregular longitudinal ribs and furrows measures about 70 mm. across. The surface of attachment to the firm substratum is in several irregularly shaped patches. The wall is only about 5 mm. thick in the middle of the sponge. The gastral cavity extends at the bottom into the stalk-like basal region.

As regards the general appearance of both the external and internal surfaces, the texture and the canals, what I have said under *H. sagamiensis* (pp. 89 & 90) is equally applicable here. The similarity further extends into the spiculation so that this again need not be described in detail except in regard to one point which constitutes the chief, if not the only, distinctive character of the present species.

The point in question concerns the discohexaster (text-figure 4). This occurs not uncommonly in scattered distribution throughout the parenchyma, though by no means so abundantly as the oxyhexasters. Being of very inconspicuous appearance, a careful examination of the preparations is necessary in order to find one. Moreover, the exceedingly fine terminals easily break off, as that it is usual to find the discohexaster in a more or less damaged condition and not infrequently repre-



Text-figure 4.
The discohexaster of *H. similis*. 500 ×.

sented by only the central parts. The size is small, measuring only 46–50 μ in diameter. The general form can not be said to be spherical, since the terminals to each principal form a distinctly separate tuft shaped like the perianth of a lily. The six principals arising from the small and spherical central node are short; the measurement from end to end of two principals in one axis is scarcely 10 μ. Their outer ends do not appear to be expanded. The thin terminals (20 μ long), of which there are 10, 12 or more in a tuft at the end of each principal, are of the most delicate description. They thicken just perceptibly towards the outer end which terminates in a minute pinhead-like disc. The entire ray, with the outwardly expanding tuft of terminals, is in appearance not unlike that of the octaster of certain Acanthascinæ.

The above discohexaster as compared with that of *H. sagamiensis* presents marked differences. (Compare text-figure 4 [magn. 500 times] with Pl. VII., fig. 5 [magn. 300 times]). It is considerably smaller (46–50 μ dia. against 80–90 μ dia.), and the fact that the much more numerous terminals are arranged in distinct tufts gives to the spicule a very characteristic appearance. I think the differences indicated are of sufficient import to justify the specific separation of *H. similis* from the foregoing species.*

* Too late to admit of introducing changes in the text I find that the discohexaster here described is not the only kind but that there is to be ascribed to the species another which I had entirely overlooked. Having occasion to re-examine the preparations, I have come across a discohexaster lying near the gastral surface, which closely resembles that of *H. sagamiensis* (Pl. VII., fig. 5). Spherical in shape, with diameter of 76 μ. Terminals, 3 or 4 to each short and minute principal; exceedingly fine and very slightly thickened towards the outer end which terminates in a minute disc. Having once seen it, I have succeeded after a prolonged search on several preparations in discovering a few more of the same kind. It must be said that this discohexaster is of very rare occurrence; possibly it is on the verge of disappearance. But then it seems undeniable that we have in it a discohexaster form which is common to both *H. sagamiensis* and *H. similis*. Was not the smaller form (text-fig. 4), considered in the text to be peculiar to the latter species, over-

Of other points in the spiculation I may put down the following notes, though these are in the main nothing but repetitions of what I have already stated under *H. sagamiensis.*

Parenchymalia, slender diactins of varying length (up to 25 mm. or more) and thickness (up tp about 175 μ) ; no hexactins. Medium-sized diactins under the gastral layer often with cruciately disposed knobs at the spicular center.

Hypodermalia, slender-rayed oxypentactins with bent paratangentials which may be 1 mm. long.

Dermalia, pentactins, sometimes hexactins ; prickly all over. Length of ray, 80–114 μ.

Gastralia, hexactins in which the free proximal ray may attain a length of 285 μ; other rays 120–165 μ long. Rays prickly but smooth at base.

Oxyhexaster, hemihexactinose and often hexactinose. Diameter, 90–125 μ.

All the spicules here remarked upon, let it be repeated, essentially agree with those of *H. sagamiensis* in the manner of their arrangement as well as in details of character.

Finally, I regard it worth while to mention certain oxyhexasters which seemed to be in a state intermediate, so to say, between the hemihexactinose and the hexactinose forms. Such

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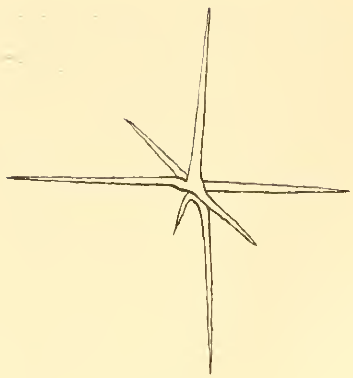
looked by me in the specimen of the former? If it was, *H. similis* at once loses its specific status and should be combined with *H. sagamiensis.* However, careful re-examinations of the preparations of the latter, partly newly made from a piece in my possession, have entirely failed to reveal a second discohexaster form in addition to the one attributed to the species in the text. So the matter stands thus: *H. sagamiensis* has a single discohexaster form ; *H. similis* possesses the same in quite a limited number and, in addition to it, a sec nd smaller form which occurs in moderate abundance. Whether with more specimens in hand th difference indicated can be maintained as a specific distinction, can not be foretold. Since anyway it seems impossible to base generic separation on that difference, it becomes necessary to make a slight emendation in the generic diagnosis given on p. 87, the last sentence on which should read "Discohexasters in one or two small forms with very fine terminals," instead of "Discohexasters in one small form", &c.



Text-figure 5.

An oxyhexaster in the last stage of becoming hexactinose. 440 ×.

cases were incidentally met with more than once in the present species. The accompanying text-figure 5 shows one of them. Five of the rays are simple, being either straight or bent at base, exactly like those in hexastinose forms of the oxyhexaster; in them the principals are strictly uniterminal. The sixth of the principals, which are all of quite an obsolete length, bears, besides a normally developed terminal, another of spurious size. Were this as much developed as its fellow on the same principal, we should have a normally hemihexactinose form in which a single principal is biterminal and all the other five are uniterminal. On the other hand, if it should altogether disappear, as it apparently is on the verge of doing, the result would be a hexactinose form, the exact like of which may not be difficult to find among the oxyhexasters of the species. In my experience certain other Rossellids have also yielded similar cases of oxyhexasters being in the last stage of transition into the hexactinose state.

HYALASCUS GIGANTEUS IJ.

Pl. VIII., figs. 3–16.

Hyalascus giganteus, IJIMA, '98, p. 50,

This species is described on the basis of a large fragment which originally belonged to Mr. ALAN OWSTON (O. C. No.

4063) and is now to be seen in the British Museum. It came from the Sagami Sea, the more exact locality being unknown.

The thick plate-like fragment is nearly as large as the blade of a tennis racket. Greatest length, 480 mm. Greatest breadth, 255 mm. Thickness, 45 mm. It is torn all around, had evidently been flattened out during desiccation and does not warrant inference as to the shape and size of the original sponge except that it must have formed part of the wall of a very large and presumably vase-like individual. The piece, being preserved in the dry state, is light and of a cavernous appearance on account of broad incurrent and excurrent canals. The spongy septa between the two canal systems are rather thick. The incurrent canals, which in places may be 15 mm. wide, seem to freely anastomose with their branches, thus forming a continuous system extending throughout the whole specimen, while the excurrent canals only occasionally intercommunicate with the branches and more usually remain separate from one another.

The dermal surface (Pl. VIII., fig. 3) is much macerated, so that its exact nature is difficult to determine. Here and there the apertures of incurrent canals appear as oval or roundish openings of not over 10 mm. diameter. Not that they are all freely open, but a large number of them are seen to be covered over with an uneven and irregularly cobweb-like layer formed of spicular bundles which intersect, unite and branch in quite an indefinite manner. The thicker bundles may show in places a thickness of over 1 mm. Between the canalar apertures the said layer is indistinguishable from the tissue of the parenchymal septa. It is not to be doubted that the layer constitutes the hypodermal framework. The dermal layer proper remains in small patches only in a few places. Even if it were extensively preserved, I should think it would be rather inconspicuous because it closely overlies the choanosomal surface in parts and the cobweb-like hypodermal framework in other parts.

Some deep and chasm-like slits occur on the external surface, their wall presenting a granular appearance. This is due to broken ends of the parenchymalia which there appear to be evenly nipped off. The slits were evidently made by Ophiurons which took their abode in the sponge, as is apparent from such as still contain that animal.

The gastral surface (Pl. VIII., fig. 4) is in a much better state of preservation. The excurrent canalar apertures, of very various sizes under 18 mm. diameter, are covered over with an endosomal latticework composed mainly of moderately strong and compact strands which may be called hypogastralia. The meshes are angular but irregular in shape, mostly measuring 1–3 mm. in length of sides. They are all open, which I believe is the natural state. At any rate, the gastralia proper are only found either distributed singly on the beams, or several together on the nodes, of the hypogastral latticework.

Remarkable is the fact that under certain circumstances the above endosomal latticework, instead of extending merely in a plane layer, may be developed more or less in the third dimension also so as to form a trabecular system of some thickness. Thus, I have seen some cases of the excurrent canalar apertures being incompletely closed, so to say, by a spongy partition.

The larger the excurrent aperture, the deeper is the pit-like canal it leads into. Usually about half-way through the sponge-wall, the larger canals begin to divide up into branches. And these branches, unless they happen to be small, are seen to begin with apertures which are spanned by essentially the same latticework as that guarding the entrance into the main canal on the gastral surface. In other words, the lining layer of the gastral cavity is duplicated on the wall of the main passage of excurrent canals. But this duplication does not occur in all the smaller canals.

It must be said that in respect of the wall-structure macroscopically considered, the sponge shows a rather wide deviation from both *H. sagamiensis* and *H. similis*. Nevertheless, there exist several points of close resemblance in spiculation, a fact which mainly weighed with me in referring the species to the same genus. The species is probably very nearly related to *Crateromorpha*; but I was deterred from placing it under that genus solely by the presence of hexactins among the dermalia and of a covering latticework to excurrent canalar apertures and by the fact that the gastralia are all hexactins.

Spiculation.

The *parenchymalia* are exclusively slender diactins of widely varying sizes. The largest, the principalia, may reach 23 mm. in length and 175 μ in breadth at the middle, while the finest are of the ordinary dimensions of a comitalia only about 7 μ thick. They are in general irregularly bent or wavy, either gradually tapering out to a point at both ends or terminating with conical or rounded tips. Subterminally the surface seems to be always rough on account of microtubercles that are sometimes wart-like and sometimes spine-like. As a rule there exists not the slightest trace of an external swelling marking the spicular center.

Both the *hypodermal* and *hypogastral* beams (Pl. VIII., figs. 5, 6), giving support to the ectosome and the endosome respectively, consist in the main of bundles of diactins, either loose or compact, which are comparable to the smaller parenchymalia. Among themselves the hypodermal and hypogastral diactins are of various sizes, with thickness reaching up to 30 μ. The shorter ones amongst them usually show a gentle annular swelling around the spicular center. Hypogastrally there not infrequently occur diactins as short as, or at any rate not much longer than, the axial length of the gastral hexactins, like which spicules such short diactins may have microtubercles sprinkled nearly all over the surface. Their appearance is such that they might have arisen directly from the gastralia by loss of the four rays in two axes.

Hypodermal pentactins were discovered only in a limited number. There can scarcely be a doubt as to their being clearly distinguishable from the dermalia, though under certain circumstances they seem to closely approach these both in size and appearance. In them the unpaired proximal ray is the longest of all the five rays ; it may be more than twice as long as the paratangential. The latter, in one case measured, was 700 μ long and in another case, considerably over that ; but it may sometimes be as short as 300 μ. In short the size is subject to considerable variation. The paratangentials are rough nearly throughout their entire length, the roughness being quite similar to that of the dermalia, while the proximal ray is generally smooth except towards the end.

The *dermalia* are predominantly pentactins (Pl. VIII., fig. 3) with a sixth ray represented by a small hillock-like prominence on the distal side. In these the unpaired proximal ray is usually somewhat shorter than the paratangentials. Not infrequently the proximal ray is also reduced to a knob-like rudiment, so that the spicule takes the form of a stauractin (Pl. VIII., fig. 9). On the other hand, the distal knob of the pentactins is sometimes prolonged in varying degrees, leading to the regular hexactinic form which is in fact occasionally met with. In all cases the rays are rather slender, tapering but slightly outwards and terminating with rounded or subconical tips; the roughness of surface, caused by rather unprominent microtubercles, is most pronounced in the outer half of the rays and becomes gradually weaker and inconspicuous towards the base. In size the dermalia show a somewhat wide range of variation. As measured on the paratangentials, the ray-length (half-axis) measures 120–200 μ with a breadth of about $7\frac{1}{2}$ μ at base. The plane of the four paratangentials in a pentactinic dermalia is flat or just perceptibly arched. In some parts of the sponge surface, I have seen the dermalia form a regularly quadrate-meshed lacework in which the meshes measured on an average 110 μ in length of sides. In other places they are evidently quite irregular in the mutual relation of their paratangential rays.

The *gastralia* (Pl. VIII., fig. 7) are similar but on the whole much larger hexactins. The length of rays, as measured from the spicular center, is mostly 165–385 μ. In the largest of the spicules, the breadth of rays at base may reach 20 μ. The six rays are often unequally long, but I could not deduce the rule that the free proximal ray is the longest. It is only occasionally that a number of the gastralia are found so grouped as to form approximately quadrate meshes with their paratangentials. The distribution is for the most part quite irregular. As before mentioned, a continuous autogastral layer covering up the meshes of the hypogastral framework seems not to exist. Perhaps worth noting is the fact that the paratangentials are frequently observed running among or under, instead of over, the diactinic elements of the hypogastral beams.

Hexactins similar to the gastralia occur in some number as *canalaria* on the beams of the lattice-like layer lining the lumen of the larger excurrent canals.

Of the hexasters, *oxyhexasters* (Pl. VIII., figs. 12–16) occur in abundance in the choanosome. Diameter or axial length, 80–125 μ. They are mostly hexactinose and less frequently hemi-hexactinose. In the latter case, one to three of the six, extremely short or nearly entirely atrophied principals bear each two widely diverging terminals. In fact, three seems to be the utmost number of principals that may be biterminal in an oxyhexaster. At any rate, normally developed oxyhexasters, i. e., those in which all the six principals bear more than one terminal each, were on no occasion met with. The uniterminal rays, i. e., those consisting of a principal continued into a single terminal, whether belonging to a hexactinose or to a hemihexactinose oxyhexaster, are either bent at base or are straight or nearly straight from the origin at the central node. Pl. VIII., fig. 16, represents a rare case of a hemihexactinose oxyhexaster with peculiarly bent rays. Now and then there are observed cases of a principal bearing a terminal of normal length and in addition the short rudiment of a second. Pl. VIII., fig. 14, is an example of such cases; and text-figure 5, on p. 100, may well pass for one taken from the present species. Occasionally a principal together with its terminal seems to be totally suppressed in development; only in this way can be explained such oxyhexaster forms as are shown in Pl. VIII., figs. 12 and 13, or those I have seen in which less than six (e. g., only four) rays in all emanated from the central node.

In all the oxyhexasters the terminals are rough-surfaced. The roughness is frequently seen to be caused by minute retroverted tubercles.

The precise extent of the short axial filaments forming the central cross can be clearly observed if one goes through the necessary steps of preparation. It needs simply to be stated that Pl. XIV., figs. 24 and 25, may be said to represent exactly the state of things in the central part of oxyhexasters of the present species.

The *discohexasters* (Pl. VIII., figs. 10 & 11) are common in both the choanosome and the gastral layer. At places they are much more numerous than the oxyhexasters. They occur in one small and delicate form of spherical shape, measuring only 30–38 μ in diameter. Each short principal bears sometimes about 10, and sometimes only about 6, very slender terminals ending in a comparatively large disc with about half a dozen, slender, marginal teeth.

AULOSACCUS Ijima.

Aulosaccus, Ijima, '96.

Calycosaccus, F. E. Schulze, '99.

Vase-like, thick-walled, firmly attached at base; moderately large. Gastral surface lined with a continuous endosomal layer. Parenchymalia, of diactins only. Without pentactinic hypodermalia. Dermalia, various according to species. Gastralia, rough hexactins. Oxyhexasters show a greater or less tendency to occur in hemihexactinose and hexactinose forms. Discohexasters in two spherical or approximately spherical forms: macrodiscohexaster and microdiscohexaster. The former with numerous terminals and usually strikingly large in size.

The above diagnosis is drawn up regarding the genus, as it now stands, as made up of the three following species:

1. *A. schulzei* IJ.
2. *A. ijimai* (F. E. SCH.) = *Calycosaccus ijimai* F. E. SCH.
3. *A. mitsukurii* IJ.

The first and the last mentioned species, which were years ago described by me in brief, will be treated of in full in this Contribution.

The second mentioned species is one which was described by F. E. SCHULZE ('99), who made of it a special genus, *Calycosaccus*. He was certainly fully cognizant of the close similarity of his genus and species to my *Aulosaccus schulzei*, so much so that, as he clearly implies (*l. c.*, p. 100), he would not have hesitated to associate the two forms in the same genus, had it not been for a difference in the character of their dermalia. That difference was the one on which he based the distinction between the families Asconematidæ and Rossellidæ. His species had to be placed under the Asconematidæ, while *Aulosaccus* was to be considered a Rossellid. From such a position, it of course followed that the species must receive a generic designation of its own. Now, in my Contribution III., pp. 78–83, I have endeavored to show that the Asconematidæ had better be dissolved and that a number of its genera, *Calycosaccus* for one, should be taken over by the Rossellidæ. If I am right in so doing, *Calycosaccus* as a name for a Rossellid genus seems to lose its claim for existence, as was indeed anticipated by F. E. SCHULZE himself. Nothing more than a specific value can be attached to the difference between *C. ijimai* and *A. schulzei*.

It is with a much less degree of certainty that I refer *A. mitsukurii* to the genus. It differs decidedly from both *A. schulzei* and *A. ijimai* in the possession of strong prostal needles and in the comparatively small size of its macrodiscohexaster. That these differences sufficiently warrant generic distinction seems to me to be doubtful, so that the species may best be left for the present in the genus to which it was originally assigned.

Aulosaccus shows greatest affinity to *Scyphidium* and *Rossella* in that it possesses like these the two kinds of discohexasters, but differs from both in having no pentactinic hypodermalia. This negative character is also shared by *Aulochone* under the Rossellinæ, but that genus lacks the macrodiscohexaster. If *A. mitsukurii* were only provided with pentactinic hypodermalia, I should have no hesitation in referring it to *Scyphidium* and placing it by the side of *S. longispina*, which species it most closely resembles in the rest of its characters.

The three species of the genus may be distinguished as follows:

a.—Without conuli and needle-like prostalia.

a[1].—Dermalia, hexactins or predominantly hexactins. Macrodiscohexaster may measure 400 μ in diameter; its principals separate or represented by six hemispherical bosses........ *Aulosaccus ijimai* (F. E. SCH.).

b^1.—Dermalia, pentactins or predominantly pentactins. Macrodiscohexaster may measure nearly 1 mm. in diameter; its principals fused into a spherical mass...*Aulosaccus schulzei* IJ.

b.—With conuli, from the apex of which project needle-like prostalia.

c^1.—Dermalia, predominantly stauractins. Macrodiscohexaster not over 120 μ in diameter; its principals separate .... *Aulosaccus mitsukurii* IJ.

AULOSACCUS SCHULZEI IJ.

Pl. VIII., figs. 26–28, and Pl. IX.

Aulosaccus Schulzei, Ijima, '96, p. 252.

In Mr. OWSTON's collection there existed a single specimen from which I have described this genus and species. It subsequently passed, together with the type specimen of *Hyalascus sagamiensis*, into the possession of Prof. B. K. EMERSON of Amherst College, Mass. A second specimen of the species has never been obtained.

The type specimen (Pl. IX., fig. 1) was procured by Mr. OWSTON by purchase from a fisherman of the village Koshigoe, near Enoshima, and there could be no doubt of its having been taken from the Sagami Sea.

It is exquisitely vase-like, being broadest in the upper third of its length and gradually narrowed below. The basal end is cut off and not preserved. Total length of the specimen, 450 mm. Greatest breadth, about 225 mm. Superiorly from the broadest part the wall more or less curves in to terminate with a thin oscular margin, which is much injured and may have been in part somewhat out-flaring. The osculum is irregularly circular with a diameter of approximately 150 mm. Thickness of wall in the middle of the upper half, 25 mm.; same in the middle of the lower half, 39 mm. The lower or severed end is somewhat oval in section, measuring about 110 mm. across. Here the wall is 35–50 mm. thick, the gastral cavity opening by an elongate aperture of 35 mm. by 20 mm.

The greater part of the dermal skeleton has fallen off. Where it is preserved it shows an exceedingly delicate dermal layer supported below by fine hypodermal strands that intersect one another at various angles (Pl. VIII., fig. 26). The latticework of the former is scarcely perceptible with the naked eye; the latter form irregular meshes of various sizes, generally under 2 mm. in length of a side. The dermal skeleton must have given a tolerably smooth surface to the sponge. It easily breaks off in flakes in the dried state. The subdermal space seems to be of an inconsiderable width.

The parenchymal mass, exposed on the outside by abrasion, presents a curly appearance, not unlike that of a wiry fur. The apertures to incurrent canals are medium-sized or smaller.

The gastral surface is very well preserved. It is lined all over with a continuous layer of the delicate endosomal skeleton. This consists of a small (generally 1–1½ mm.) and irregularly meshed latticework of thin hypogastral strands bearing the gastralia which, without forming a continuous layer by themselves, leave the hypogastral meshes more or less freely open. Seen under the lens, the gastralia are arranged for the most part in a row on the hypogastral strands with their paratangentials standing out free at right angles on both sides of the latter, though here and there several of them may lie side by side so as to form with their paratangentials small irregular patches of a quadrate-meshed latticework. Taken altogether the arrangement of the gastral skeleton resembles that in *Acanthascus cactus* as shown in Pl. XI., fig. 16, though it is more delicate. It forms a sieve-like layer covering over the entrances into the excurrent canals.

Spiculation.

The *parenchymalia* are all slender diactins in loose felt-like arrangement or grouped together into thin ill-defined bundles. The principalia may attain a length of 17 mm. or more and a breadth of 100 μ at the middle; they taper gradually towards both the smooth and sharply pointed ends. There exist all sizes down to comitalia only 8 μ in thickness. All the smaller diactins have rough ends, which may be tapering but are more usually slightly swollen and terminating in a conical or rounded tip. In all the parenchymalia the spicular center is externally evenly contoured.

The *hypodermalia* and *hypogastralia* are both likewise diactins, generally 15–20 μ in breadth and under 3½ mm. in length. They quite agree in appearance with similarly sized parenchymalia, except in the fact that the spicular center is often, but not always, externally marked by an inconspicuous annular swelling. They are generally arranged into thin strands of varying strength. The manner in which these strands make up the hypodermal and hypogastral latticework has already been dwelt upon. No pentactins enter into their composition.

The *dermalia* (Pl. VIII., fig. 26; Pl. IX., fig. 12) are predominantly pentactins in which the place of the atrophied sixth ray is generally indicated by a gentle swelling on the distal side of the paratangential cross. Exceptionally they are represented by stauractinic forms, in which the two aborted rays in the radial axis are either quite obliterated or represented by vestiges in the form of an external and an internal knob. The rays, as measured from the spicular center, are 100–250 μ (on an average 130 μ) long and 7½–9½ μ broad at base. For the greater part of their length they maintain a nearly uniform thickness. Their surface is entirely rough, the roughness being most pronounced near the outer conically pointed end.

The meshes of the dermal latticework are tolerably regularly quadrate, measuring on an average 140 μ in length of sides.

The *gastralia* (Pl. VIII., fig. 27 ; Pl. IX., fig. 11) are rough hexactins, rarely pentactins and still more rarely stauractins, of much greater dimensions than the dermalia. The paratangentials mostly measure 200–275 μ in length and 10–15 μ in thickness at base. The distal ray is nearly as long as, or somewhat shorter than, the paratangential in the same spicule, while the proximal ray is generally longer than the same and may be 385 μ in length. The rays taper perceptibly towards the conically pointed end ; their entire surface is nearly uniformly rough. The manner of arrangement of the gastralia over the hypogastral beams in completing the endosomal skeleton has already been referred to.

Of the hexasters, the *oxyhexaster* (Pl. IX., fig. 2–7) is of frequent occurrence among the parenchymalia. As in *Hyalascus* it is present in either hemihexactinose or hexactinose forms but probably never in the completely hexasterous. Axial length or diameter, 100–150 μ. The terminals which look moderately strong are about 3 μ thick at base, and are obsoletely rough on the surface.

In the hemihaxactinose form (fig. 6) it is only one or at most two of the exceedingly short principals that bear two widely divergent terminals. A case of more than two terminals to a principal has not been met with.

The hexactinose form (fig. 2) is as common as, if not more common than, the hemihexactinose. Uniterminal rays, whether occurring in this or in the other form, are usually straight but may sometimes be bent at base. One case that I observed of a straight rayed hexactinose hexaster, in which two of the rays bore each a small spine-like rudiment of an obsolescent terminal, seems to be worthy of special note.

In this species again it is a readily noticeable fact that the largest of the oxyhexasters are found among those of the hexactinose variety.

Exceptionally certain principals totally disappear together with the terminals belonging to them. Thus arise peculiar degenerate forms which under certain circumstances may have less than six terminal points in all (figs. 4, 5 and 7). Fig. 4 is evidently a case in which one entire axis is quite suppressed, there remaining three uniterminal principals and a single biterminal one, all lying in one plane. In fig. 5 there are seen six rays, but all these again lie in one plane; they represent either three biterminal principals or four principals of which two are biterminal and the rest uniterminal. Fig. 7 is an extreme case of the reduction ; there are left only three rays, assumably representing as many half-axes each composed of a principal continued into a single terminal.

The most characteristic spicule of the species is the *macrodiscohexaster* (Pl. VIII., fig. 27 ; Pl. IX., fig. 8). This is strikingly large and of a shape which may be called sun-like. From a central spherical mass there arise like rays from all over its surface numerous very long and slender terminals. This most remarkable rosette is of moderately common occurrence in the choanosome and can easily be recognized under the hand-lens as it lies on or among the extracted parenchymalia, appearing like a whitish fleck. The terminals always appear to have been more or less disturbed in their positions; they often stick together and form indefinite bundles (Pl. VIII., fig. 27), apparently as the result of mechanical strains upon their flexibility. If left perfectly undisturbed, we may assume that they would radiate uniformly in all directions, thus giving an approximately spherical shape to the entire spicule. The diameter should then measure nearly or quite 1 mm., a size which may be said to be gigantic for a hexaster. As first sight one may be inclined to take the spicule for some object other than a hexaster. Nevertheless, there can be no doubt whatever as to its hexaster-nature.

The central sphere (Pl. VIII., fig. 28) measures 46–49 μ in diameter. The surface is not even but shows some irregularity in contour; however, this does not in the slightest degree indicate the convexity of the terminal surface of the six principals. These, together with the original central node, seem to be completely imbedded in the sphere. In other words, apparently a secondary deposition of siliceous matter has taken place between and over the principals so as to fill up the interspaces between them, also covering them up on the external surface between the bases of the terminals. To become convinced of this point it is necessary to examine the spicule in glycerine after it has been thoroughly cleansed by boiling in acid. Under a high power of the microscope, the six-armed cross of axial threads is then detectable with unmistakable distinctness in the central sphere, as depicted in Pl. VIII., fig. 28. The periphery of the sphere appears compact, while more centrally in the neighborhood of the axial threads are visible a number of small and irregularly shaped vacuoles which appear like dark granules. These vacuoles I consider to be the same as those which are so commonly seen, often arranged in rows, in the eight principal arms of Acanthascine discoctasters (*cfr.*, f. i., Pl. XII., fig. 27; Pl. XV., fig. 9). They are in all probability spaces which remain unfilled by the siliceous substance during the amalgamation process of spicular parts originally separate, and are in that sense comparable to the mesh-like spaces inclosed between synapticulæ that solder together parenchymalia. I am therefore strongly inclined to believe that the state of things in the macrodiscohexaster of the present species is brought about by the formation of synapticular connections between the principals, and not by simple fusion of their surfaces after coming into direct contact nor by their total disappearance in which case the central sphere would be identical with the central node of ordinary hexasters, which does not appear to be really the case.

The appearance of the surface of the central sphere as seen by focussing up and down the microscope, strongly reminds one of that of a Foraminifera shell. The points of origin of the numerous terminals are thickly and uniformly distributed all over the surface (Pl. VIII., fig. 28).

The terminals are filament-like and quite obsoletely rough-surfaced. The minute prominences causing the roughness have their points directed backwards (Pl. IX., fig. 9). The terminals thicken just perceptibly towards the outer end, where the breadth measures only about 2 μ. The length is quite various, fluctuating between 95 μ and 475 μ in the same rosette. I thought it possible that the terminals formed six bunches corresponding to the six original principals and that in each bunch the longer terminals occupied a more central position than the shorter; but this could not be verified. On the contrary, those of different lengths seemed to be situated together promiscuously.

The terminal disc (Pl. IX., fig. 9) is somewhat conically convex on the outer side. It measures about 10 μ in diameter. The margin shows a row of numerous small teeth.

The *microdiscohexaster* (Pl. IX., fig. 10) of a very delicate nature is common in the choanosome as well as in the endosome. In some places in the former it occurs almost as numerously as the oxyhexaster. Diameter, 26–38 μ.

The shape is spherical, the minute granule-like terminal discs however do not lie on an even level at the surface. The terminals are so exceedingly fine that they can scarcely be perceived unless a very high power of the microscope be used for the observation. The principals are slender and form a cross measuring about 7½ μ in axial length. Their outer ends do not show a disc-like expansion, nor is the central node spherically swollen.

AULOSACCUS MITSUKURII IJ.

Pl. X., figs. 1–15.

Aulosaccus mitsukurii, IJIMA, '98, p. 52.

A single specimen belonging to the Sci. Coll. Museum formed the type of this species at the time it was first described by me in '98. Subsequently I have had the good fortune to discover a second specimen in Mr. OWSTON's collection.

The original type-specimen (S. C. M. No. 427) was obtained by KUMA at a spot, about 572 m. (=313 fms.) deep, on Inside Okinosé by the Sengenzuka-line (W. of Dōketsba). It is shown in half natural size in Pl. X., fig. 1. In shape and other general characters it so closely simulates *Acanthascus cactus* that the specimen long remained among the duplicate specimens of that Hexactinellid until I chanced to examine it microscopically and thus became aware of its remarkable differences in spiculation. Since then I have subjected all my *Acanthascus* material to a microscopical test in order to see if the determination was correct.

The specimen is an elongate, moderately thick-walled sac with several broad and irregular processes in the lower part. One of these processes, which stands out most prominently to one side, is to be considered in the light of a bud; for, it opens at the rounded end an independent osculum leading into a gastral cavity which is widely separate from that of the mother person. The other processes clasp the branched skeleton of an *Isis* on which the specimen grows. The coral branches also pass through a thickened part on one side of the lateral wall. Height of body, 147 mm. Breadth at the middle, about 56 mm. Thickness of wall in that part, 9 mm.; thicker lower down the body. The main osculum at the upper end is irregularly roundish, measuring 33–40 mm. in diameter; its margin is simple and sharp-edged. It leads into a deep gastral cavity which widens somewhat at the bottom and is continued obliquely below into a tubular passage that finally opens outside by a small secondary osculum situated on a gentle swelling near the lower end.

A conspicuous feature of the species is presented by a number of broad-based conical prominences, the conuli, that rise from the external surface. These are most prominent in the middle part of the body, reaching 10 mm. or more in height as measured from the depressed surface between them. Their apices are generally 10–30 mm. apart from one another. Their appearance reminds one at once of the conuli of *Acanthascus cactus*. The resemblance is all the greater since they bear on the apices thin prostal needles directed either straight outwards or obliquely upwards. Usually a single prostal occurs on each conulus, but there are sometimes more than one. It may project to a length of 15 mm. In the immediate neighborhood of the oscular margin there exist some upwardly directed prostals that arise without a conical elevation of the wall at their base.

Strikingly similar as is the general external appearance between this species and *Acanthascus cactus*, a close comparison reveals certain points of difference in the structure of the ectosomal skeleton,—differences, which, under certain circumstances, might suffice to distinguish the two species upon superficial observation alone. In the first place, the delicate dermal lacework of the present species allows the meshes, minute though they are, to be perceived without difficulty with the naked eye, while for *A. cactus* the same can hardly be said. This is owing to the difference in the thickness of the rays of their dermalia. In the next place, the supporting hypodermal strands are considerably fewer. They intersect one another at various angles and form triangular, trapezoidal or irregular meshes, the sides of which not infrequently measure 4 mm. or more in length. Whereas, the same meshes in *A. cactus* (Pl. XI., fig. 17) rarely, if ever, exceed 1½ mm. In short, the hypodermal framework of the present species incloses much wider meshes, which fact imparts a more delicate appearance to the entire ectosome.

The hypodermal strands on the conuli are seen to converge towards the apex. The extreme apex is generally compact-looking, owing to the crowded presence there of the dermalia. The same may be said of the dermal surface at, or close to, the oscular margin.

The subdermal space in the greater part of the sponge is moderately wide. Strands of spicules pass up across it, at frequent intervals, from the exceedingly uneven choanosomal surface to join the hypodermal framework.

Through the thin ectosome are plainly visible the numerous incurrent canalar apertures, 3 mm. and under in diameter.

A thin and delicate endosomal layer lines the entire gastral surface. The gastralia form a continuous lacework with quadrate meshes which are considerably larger than those of the dermal layer. The layer appears as if sprinkled with white powder, owing to accumulations of microscleræ. To the naked eye, the presence of hypogastral strands is in most places not apparent ; but where the gastralia are sparse and scattered or when seen under the microscope on preparations of the endosome, the hypogastralia appear to form a thin-beamed and comparatively wide-meshed latticework similar to the hypodermal. In *Acanthascus cactus* the hypogastral beams (see Pl. XI., fig. 16) are somewhat coarser and inclose smaller meshes which moreover open free instead of being covered over by a continuous gastral lacework. Here then is another point which might serve in distinguishing between that and the present species.

The excurrent canalar apertures are all small in the upper part of the gastral cavity. Lower down, larger ones add themselves and in the deep part of the cavity there are some that reach 6 mm. in diameter.

The second specimen (O. C. No. 4399) I have seen of the species was from an unknown locality in the Sagami Sea. It was collapsed and incomplete, lacking the basal part. Length, 225 mm. Greatest breadth, 130 mm. Average thickness of wall, 16 mm. The piece must have originally formed a great part of a large individual. The one end still preserved a section of the oscular margin; the state of the parenchymalia at the other end indicated proximity to the basal attachment. The external surface was badly lacerated but still showed traces of the conuli. The prostalia had all been lost. Some of the canalar apertures on that side were as much as 5 mm. in width. The endosomal skeleton remained in good preservation, covering over the excurrent canalar apertures.

Spiculation.

Pl. X., fig. 11, represents in a general way the spiculation as observed on a section of the sponge-wall.

The *parenchymalia* are all diactins which are generally smooth throughout except subterminally for a short space where the surface is roughened in the well-known manner. Of rather common occurrence are the strong principalia which may attain a length of 20 mm. and a thickness of nearly $\frac{3}{4}$ mm. at the middle. These have gradually tapering and acuminate rays and are therefore to be called oxydiactins. They are bent in a bow-like manner but are otherwise nearly straight. The rest and by far the greater number of the parenchymalia are more slender spicules, there existing all sizes transitional between the strongest principalia and the shortest and finest comitalia. Those of the smaller dimension usually have the tips of the rays rounded or somewhat conically shaped. As usual the diactins run either solitarily or in loose bundles of indefinite strength. The parenchymal fibers may be said to be somewhat coarse; decidedly so are they in the larger specimen belonging to Mr. OWSTON, especially in its lower part.

The *prostalia* are diactins of moderately large size. It would not be improper to regard them simply as certain parenchymalia that had protruded themselves to a greater or less extent from the apices of conuli (Pl. X., fig. 11). Their outer ends are generally broken off.

The *hypodermalia* are likewise diactins, exactly similar in character to the smaller parenchymalia. One large hypodermal diactin measured was 2 mm. long and 27 μ thick at the middle. In forming the hypodermal beams, the diactins run sometimes singly and at other times combined into bundles in variable number.

The *hypogastralia* again are diactins which for the most part are exactly comparable in all respects to the hypodermalia or to the smaller parenchymalia. However, one feature peculiar to many of them, but not to all, consists in the fact that the spicular center is externally marked by an annular swelling or by four cruciately disposed bosses,—a feature which is but rarely, if at all, noticeable on either hypodermal or parenchymal diactins. Precisely the same fact has been noticed by me in certain other Rosselline species. Further, among the hypogastralia with the above markings, not a few are comparatively short in proportion to their breadth and present an elongate spindle-like shape. These, like all other diactins of the species, are subterminally always rough-surfaced, and in some cases the roughness is seen to extend nearly all over the rays in that some obsolete micro-tubercles are found scattered even on the basal part. Such short rough hypogastralia appear to lead over gradationally into the gastralia which may exceptionally be diactinic. The fact here set forth indicates a close genetic relation between hexactinic gastralia and underlying diactinic megascleræ in general, and seems to be noteworthy in view of certain Hexactinellids, as e. g. *Staurocalyptus pleorhaphides*, in which the gastralia are represented, not by hexactins as in closely allied forms, but by diactins alone.

The *dermalia* (Pl. X., fig. 9, 12) are rather thick-rayed stauractins, the rays of which are in a plane slightly arched on the outside. Occasionally pentactins with the unpaired ray directed proximad and rarely tauactins are met with, but these are certainly exceptional. Length of ray as measured from the central point, 110–176 μ. Thickness at base, 13 μ on an average. The rays slightly narrow outwards; the tip is rounded or somewhat conically pointed. Their surface is thickly beset all over with unusually strongly developed, erect and conical prickles, which constitute one of the most striking characteristics of the species. The quadrate meshes formed by apposed rays of the dermalia measure generally 100–130 μ in length of sides.

The *gastralia* (Pl. X., figs. 10, 13) are strong and prickly hexactins, for the most part fully twice as large as the dermalia or even much larger. The rays are somewhat more tapering towards their ends; the prickles on the surface are in like manner strongly developed. Length of ray, 250–400 μ. Thickness at base, 21 μ on an average. The quadrate meshes formed by the paratangentials of the gastralia measure generally 275–330 μ in length of sides.

Special mention should be made of the fact that in the Sci. Coll. specimen I have not infrequently met with paratangentially disposed, diactinic gastralia, in which the aborted rays are at most represented by vestigial bosses. The manner of their situation in company with the hexactinic form, together with the nature of the prickles on the surface, leaves no doubt as to the legitimacy of considering them to be gastralia. As already mentioned, they seem to be linked to the hypogastralia by means of intermediate forms. But their presence in the species seems to be inconstant, for in Mr. OWSTON's specimen I have not succeeded in discovering a single diactinic gastralia.

In the specimen belonging to the Sci. Coll., a thin *basidictyonal plate* is found to cover the surface of that part of the coral on which it grows. The plate consists of amalgamated hexactins and pentactins, arranged for the most part in a single layer. The spicules have comparatively short rays which may be as thick as 23 μ and whose surface shows a sparse quantity of microtubercles. Several basidictyonalia were found still lying loose and separate in the proximity of those that had fused together to form the reticular plate.

The *oxyhexaster* (Pl. X., figs. 4–7) occurs very abundantly in all parts except the ectosome. Especially plentiful is it in and near the endosome. Diameter, 100–130 μ. There exists no appreciable difference in appearance between those in the periphery and others situated more deeply in the wall. Forms like those depicted in Pl. X., figs. 4–6, predominate. From each exceedingly short principal there diverge 2 or 3, seldom 4, rather thin, obsoletely rough-surfaced and nearly straight terminals. The microtubercles on the basal parts of these frequently have the distinct appearance of being retroverted. Occasionally the oxyhexaster is hemihexactinose (fig. 7); i. e., while one or more of the six principals bear each two terminals, the rest are uniterminal, in which latter case the entire ray is either straight or else is bent at the base. The quite hexactinose oxyhexaster occurs but very rarely; only one or two instances of it being all that I have encountered.

The *macrodiscohexaster* (Pl. X., figs. 2 & 3) is much smaller than that of either *A. schulzei* or *A. ijimai*, a fact which at first made me hesitate somewhat to refer the present species to the same genus; but on further consideration I can but think that its generic separation on account of that difference alone can scarcely be justified.

The macrodiscohexaster may be said to be spherical in shape. It measures 80–120 μ in diameter, being therefore of about the same size as average oxyhexasters of the species or somewhat smaller. It is tolerably rich in the number of terminals, which are not quite thin and are generally straight and nearly uniformly thick throughout their length. Not less than 5 terminals arise, not in a circle but promiscuously, from the swollen knob-like end of each very short principal. The terminal discs are small; they are furnished with minute marginal teeth, six or more to each.

The *microdiscohexaster* (Pl. X., fig. 8) is relatively very small, measuring only 20–23 μ in diameter. It is an exceedingly delicate object and might easily escape attention. Spherical in shape, it is of the usual appearance and structure, so that a special description appears superfluous. I have found them on the whole sparsely distributed in the gastral membrane, though in some parts of it they are rather common. They occur also in the dermal membrane but exceedingly rarely.

Soft Parts.

The collector of the Sci. Coll. specimen had put a small piece cut from it into alcohol at the spot of capture; so that, I was enabled to make some observation on the soft tissues stained and sectioned in the ordinary way.

The dermal membrane is film-like, perforated by large and mesh-like pores.

The trabeculæ are thin, though in places membranously expanded. They form a dense cobweb at the pillars joining the ectosome to the choanosome (Pl. X., fig. 12) and also in the subgastral space. The cobweb is borne on the free proximal rays of the gastralia in a tent-like manner (Pl. X., fig. 13). The well-stained trabecular nuclei measure about 2½ μ.

Archæocytes are met with in small groups on the outside of flagellated chambers (Pl. X., fig. 15). Thesocytes with well-stained spherical contents, are present in some numbers.

The chambers show the usual shape and arrangement (Pl. X., fig. 12). They are cup-like or glove-finger-like with a diameter of about 140 μ. Their wall (Pl. X., fig. 15) is open-meshed, the beams being thin, finely granular and but little stained. The choanocyte nuclei appear pale, being not more strongly stained than the reticulum-forming protoplasm. They contain one or more chromatic bodies resembling nucleoli. They can be observed with an unusual degree of distinctness (Pl. X., fig. 12); this may be due in a measure to their relatively large size, measuring $3\frac{3}{5}$—$4\frac{1}{5}$ μ in diameter (as against $1\frac{1}{2}$—$1\frac{7}{10}$ μ in *Euplectella marshalli*). They are thus much larger than either trabecular or archæocyte nuclei. In optic sections of the chamber-wall (Pl. X., fig. 14), the choanocyte nuclei appear oval in shape, as the result of their being flattened. I believe that I have seen the flagellum in some cases but the collar could never be brought into view with any degree of distinctness.

C. ACANTHASCINÆ.

Saccular, moderately thick-walled, often distinctly laterally compressed. Pentactinic hypodermalia generally present; exceptionally wanting. Gastralia, hexactins; sometimes pentactins, stauractins or diactins. Parenchymalia, exclusively diactins; never hexactinic. Hexasters consist of oxyhexasters and discohexasters; the latter being generally in two varieties, the discoctaster and the microdiscohexaster. The former is invariably present, but the latter may be wanting; no strobiloplumicome.

Three genera make up the subfamily. They can be distinguished from one another by the characters indicated in the following key.

a.—Without pentactinic hypodermalia .... *Acanthascus* F. E. SCH.
b.—With pentactinic hypodermalia.
  a[1]. The paratangentials of hypodermal pentactins never pronged .... *Staurocalyptus* IJ.
  b[1].—The same, when fully developed, armed with spine-like or hook-like prongs.. *Rhabdocalyptus* F. E. SCH.

A fourth genus, *Acanthosaccus* (with the single species *A tenuis*), was instituted by F. E. SCHULZE ('99) on the ground that it is totally lacking in oxyhexasters, instead of which there should occur numerous minute oxyhexactins. The oxyhexactins here referred to are in my opinion identical with the spicules called by me the hexactinose oxyhexaster. So that, in my system of terminology, *Acanthosaccus* F. E. SCH. is as really in possession of oxyhexasters as any other genus of the subfamily. Whatever be the name given to these spicules I am wholly skeptical as to the expediency of regarding this sponge as generically distinct from *Rhabdocalyptus*.

As regards the organization of the subfamily a great deal can be said in general.

The Acanthascinæ are all moderately thick-walled, pouch-like, barrel-like, cup-like, vase-like, or tubular forms with a deep gastral cavity. The osculum, surrounded by a thin marginal edge, occupies the superior end, while the inferior blind end, which may be contracted into a short stalk-like base, is as a rule firmly attached to the substratum. The only exception is offered by *R. plumodigitatus* R. KIRKP. ('01), which is rooted in the loose bottom by means of basal tufts of anchoring spicules, on this account deserving perhaps to be erected into a new and distinct genus. It frequently happens in firmly fixed forms that the basal region is bent to a greater or less degree; this probably results from the sponge growing on an inclined or vertical substratum while the main part of the body stands erect, directing the osculum upwards (Pl. XIV., fig. 14; Pl. XVII.; etc.).

The body is often laterally compressed, so that we may speak of the median sagittal plane that divides the body into symmetrical lateral halves. The bending of the sponge-base, whenever it occurs with a laterally compressed body, is invariably in this plane (see Pl. XVII.; etc.); so that the bent base is subjected to the same lateral compression as that of the main body,—a rule, the applicability of which is not restricted to the Acanthascinæ alone but extends to the Rossellidæ in general.

Many species have the power of opening secondary oscula on the general body-wall or of budding out daughter persons, although neither of them are ever formed in any great number. Some species seem to be more prone to forming them than others. A daughter person first arises as a cœcum-like outbulging of the wall, eventually to open an osculum at the summit. In the case of the laterally compressed mother body, it may be given as the rule that the bud formation takes place on or along the median edge, generally in the lower part (Pl. XVII.; Pl. XX., fig. 2., etc.).

As to the spiculation, the *parenchymalia* are always and exclusively diactins. Hexactins never occur amongst them. When a number of the diactins are combined into bundles, some of them may be distinguished from the rest as the *pripncialia* on account of their greater strength. The principalia are elongate spindle-like, bow-like or boomerang-like ; in the last case they have an elbow-like bend in the middle. They gradually taper towards both pointed ends ; the surface is in most cases smooth throughout ; the spicular center is never marked by a swelling in the external contour.

The *comitalia*, i.e., the finest parenchymal diactins directly surrounding the principalia, are filamentous spicules which are nearly uniformly thin throughout and are subterminally always rough-surfaced, ending with rounded or conically pointed tips. They may sometimes show either an annular swelling or four boss-like prominences around the spicular center. The principalia and the comitalia are in all cases intergradationally connected by such diactins as are intermediate in form and dimensions.

Certain parenchymalia under special circumstances seem to become protruded on the external side of the body-wall and thus form the diactinic needle-like *prostalia* found in a number of species. In certain *Staurocalyptus* and *Rhabdocalyptus* the prostalia of the kind in question are present on all parts of the body as long as the sponge is young and small (Pl. XV., fig. 3 ; Pl. XXII., figs. 3–5 ; etc.) ; but with growth of body, they are either lost or become restricted to the oscular margin where they may form an ill-defined palissade-like fringe (*marginalia*).

A hypodermal system of spicules is always differentiated. For *Acanthascus* it is characteristic that the hypodermalia consist exclusively of diactins. In both *Staurocalyptus* and *Rhabdocalyptus* they consist of moderately large pentactins, of which the cruciate paratangentials, representing two complete axes, support the dermal layer either alone by themselves or in union with a greater or less quantity of diactinic hypodermalia. The paratangential rays of individual pentactins, which are smooth or shagreened or else are armed with prongs, are often, though not always, paratropal, *i.e.*, they are, as it were, pushed to one side in their plane so that they form with one another three acute angles and one obtuse angle greater than 90° or even 180°. Similar hypodermal pentactins have long been known in *Rossella antarctica*. As in this species they are generally found in groups of several together. In every such group, the proximally directed shafts, accompanied by comitalia, form a more or less compact column or tuft that dips deep into the choanosome, while the four-rayed heads produce on the sponge surface a star-like figure in which a number of streaks, *i.e.*, the paratangentials, radiate in all directions from a central space (Pl. XIII., fig. 12; Pl. XVIII., fig. 16; Pl. XIX., fig. 23; Pl. XXII., fig. 16; etc.). It is easy to discover that the separate pentactin-heads in a hypodermal group lie one above another in close order, the upper one of any two being older and more fully developed than that next below (see Pl. XVIII., fig. 16; etc.). The lowest is therefore the youngest, which develops while clasping in one of its angles the column of shafts belonging to older pentactins. It is this preëxisting shaft-column that disturbs the regularly cruciate development of the paratangentials, forcing these to deviate sideways from their normal directions; hence, their paratropal arrangement. In *Rhabdocalyptus* it is in the older pentactin-heads only that the rays are armed with prongs; in the younger and therefore the more deeply situated heads the rays are smooth.

The hypodermal pentactins remain in the *locus nascendi* only in certain species. More often they are destined to be protruded outwards through the dermal layer and thus to form a second kind of pleural prostalia, the other being the diactinic prostalia before mentioned. The *pentactinic prostalia* stand out isolated or in tufts and the paratangential rays of their heads form a gossamer-like veil at a certain distance from the dermal surface, exactly as is known also in some Rossellids outside of the Acanthascinæ. It is the oldest pentactinic hypodermalia that are thus shifted out; therefore, in *Rhabdocalyptus* the paratangentials of pentactinic prostalia are always found to be pronged.

It may here be remarked that the basal anchoring spicules of *R. plumodigitatus* KIRKP. ('01) represent in all probability a special adaptation of the pentactinic prostalia of the species.

On the inside of the sponge-wall, *hypogastral* strands are usually more or less distinctly observable. They are to all appearance nothing else than certain parenchymal bundles that have dissociated themselves to a certain degree from the parenchymal mass and have entered into the support of the endosomal layer. They are seen to pursue a sinuous course and to intersect one another at irregular intervals.

Turning back to the external surface, the *dermalia* are small rough-surfaced spicules which may be pentactins, stauractins or straight diactins. All the three forms or any two of them, the number of whose rays are consecutive, may occur together in a species, but it is usual that one or the other of the said forms predominates to a greater or less degree. Hexactins, tauactins, orthodiactins and monactins are quite rare and exceptional, if any of them occur at all among the dermalia as they do in some species. Pentactinic dermalia have the unpaired ray always directed proximad. When stauractins or pentactins constitute the main elements of the dermal layer, their cruciate paratangentials are so arranged as to bring about a delicate latticework with more or less regularly quadrate meshes; whereas, in species with diactinic dermalia the meshes formed are triangular, trapezoidal or irregular in shape, a fact which can easily be observed under the hand-lens and may be depended upon in concluding that the dermalia are diactins and not forms with cruciate paratangentials.

The *gastralia* are, with some exceptions, rough hexactins. In the exceptional cases, they are represented by pentactins intermixed with some stauractins (*A. cactus*), or by pentactins and stauractins with occasional tauactins and diactins (*S. heteractinus*), or by diactins alone (*S. pleorhaphides, R. plumodigitatus*). The diactinic gastralia may insensibly intergrade with hypogastral diactins. In the pentactinic forms the unpaired ray is always directed away from the gastral cavity. In the hexactinic forms the free proximal ray is often developed to a greater length than any of the other rays. The cruciate paratangentials may form, as they constantly do in several species, a continuous quadrate-meshed gastral layer covering the excurrent canalar apertures, but in several other species they are normally so sparsely present as to leave in the endosome gaps by which the excurrent water passes out freely into the gastral cavity (*A. cactus, S. dowlingi, S. solidus, S. tubulosus, S. japonicus*). Also in cases in which the gastralia are diactins (*S. pleorhaphides, R. plumodigitatus*), a continuous gastral layer is not developed, and hence the excurrent canalar apertures are left freely open.

A *basidictyonal plate* (Pl. XII., fig. 37; Pl. XV., fig. 12; Pl. XVIII., fig. 14; Pl. XXI., fig. 12; etc.) seems to be possessed by all the species that are firmly attached at base to the hard substratum. The dictyonal framework discovered by F. E. Schulze ('99) in the buds of *R. mirabilis*, the like of which will be described by me under *S. glaber*, I hold to be identical with the plate in question. For the significance I attach to the structure, the reader is referred to my Contrib. III., p. 24, foot-note.

In the Acanthascinæ the basidictyonal plate is never of any considerable thickness, but always thin and insignificant. The elements (*basidictyonalia*) composing it are, as usual, small but comparatively thick-rayed hexactins—sometimes spicules with a less number of rays—in which the rays are roughend by the presence of microtubercles either all over the surface or near the ends only. The spicules are both directly and synapticularly fused with one another, forming a rigid framework with irregular meshes, though there may occasionally occur such as are yet unfused or are in the process of fusing together. The uneven limiting surface presented by the plate against the substratum is covered by a special, thin and sieve-like siliceous layer perforated by very small meshes (*vide* especially Pl. XXI., fig. 12). This limiting reticular layer, which may be regarded as a part of the basidictyonal plate or mass, was long ago noticed and figured by F. E. Schulze (Chall. Rep., Pl. LXIV., fig. 3). It is a structure that reminds one of the "Deckschicht" that is known to cover the exterior of many fossil Dictyonina. Occasionally fine axial canals in the form of a plane cross are found inclosed in its beams (Pl. XXII., fig. 17), indicating that a stauractin, which may be classed under the basidictyonalia, is structurally involved in it; but by far the greater part of the layer consists of synapticula-like deposits formed in connection with the basidictyonalia present and invariably in direct relation with the foreign body with which the sponge-base is in contact. It sometimes happens on fragments of the limiting layer taken from certain species or individuals, that no basidictyonal spicules in union with the beams can be seen. This may be due to their being somehow concealed from view, perhaps in that they are too sparse and widely scattered to be easily discovered. At the same time I hold it not impossible that their development may under circumstances be quite suppressed, in which case the limiting layer alone would stand for the basidictyonal plate.

Finally with respect to the *hexasters*, it may be said that there are three forms occurring together in a species; *viz.* oxyhexasters, discoctasters and microdiscohexasters.

The *oxyhexasters* are the most abundant of all. Strong and wide-spread is the tendency shown by them to assume hemihexactinose and quite hexactinose forms. In some species the hemihexactinose form predominates; in some others, the hexactinose. In *R. tenuis* (F. E. Sch.), as before alluded to, all the oxyhexasters present appear to be hexactinose. Basing our description on normally developed oxyhexasters, the principals are always very short,—often so exceedingly short as to be called vestigial. The number of terminals most frequently borne by a principal is two;* but it may sometimes be three and rarely four. The terminals are nearly smooth or more frequently rough. The roughness may be developed on their basal parts into retroverted prickles or barbs. In several species the oxyhexasters situated in the periphery of the sponge-wall, but particularly in the subdermal

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* For those oxyhexasters generally in which the principals appear bifurcated in that they are provided each with two terminals, it has been given by F. E. Schulze ('97 *a*) as an approximate rule that the plane of bifurcation of a principal stands at right angles with that of another belonging to the same axis, and that the six separate bifurcation planes in one oxyhexaster of the kind correspond to the so-called secondary planes of symmetry in the isometric crystal system, the primary or principal planes of symmetry being given by the principals forming the three axes. So that the principals and the terminal forks should represent all the nine possible planes of symmetry distinguishable in a regular crystal (three principal planes determined by the axes and six secondary planes determined by diagonally opposite edges of a cube). I have not specially gone into the testing of the truth of the above statement; but so far as concerns the two bifurcation planes at the ends of any one axis, my experience makes me hesitate to lay it down as a general rule that they are relatively vertically oriented to each other, for the angle referred to seemed to me to be much too variable and indefinite, as observed in a large number of cases in various Hexactinellid species.

region, differ from those more deeply situated in having somewhat longer principals and slightly more slender terminals. Moreover, the former generally show a greater total number of terminals, being usually normally developed, although hemihexactinose and hexatinose forms may be common among the latter. (Compare in Pl. XXI., figs. 4 and 5 with figs. 6–8; in Pl. XXII., figs. 7 and 8 with figs. 14 and 15). It must however be borne in mind that between the peripheral and the more deeply located oxyhexasters there is always a gradual transition within one and the same sponge.

Of the three oxyhexaster-forms occurring together in a species, it is usually the hexactinose amongst which are found individual oxyhexasters with greatest diameter or axial length,—a fact which I have noticed also in some Rossellinæ. It appears as if the reduction in the number of terminals to the minimum, *i.e.*, to one to each principal, in a measure favors the growth of the spicule in general size.

In a number of the species I have specially gone into the observation of the axial cross in hexactinose oxyhexasters. With a little trouble I have found it in all cases an easy matter to demonstrate what I have repeatedly emphasized as to the extent of the axial filaments in the central parts of that oxyhexaster variety. For the rest I may let fig. 25, Pl. XIV., speak for itself. By the side of that figure is another (fig. 24) showing, for the sake of comparison, the extent of the axial cross in the central part of a normal oxyhexaster in which each principal is supplied with two terminals.

It scarcely needs to be reiterated that uniterminal principals, irrespective of their occurrence in a hemihexactinose or in a hexactinose oxyhexaster, are joined to their single terminal mostly in a straight line in such a manner that the point of junction of the two parts is externally not in the least indicated; but the terminal may sometimes be bent at base exactly as in a hexaster ray with two divergent terminals, save that one of these terminals is entirely wanting, in which case it may be said to be well marked off from the principal bearing it.

The *discoctasters* are spicules peculiar to the Acanthascinæ; in fact their presence constitutes the only reliable criterion by which a Rossellid can be determined as a member of that subfamily. Hence a misgiving might be entertained that should they chance to be simply overlooked or not properly identified, or if there existed a species which had lost them only secondarily, the sponge in question would likely be taken up under the Rossellinæ, which are apparently *ab origine* without these characteristic spicules.

The discoctasters were first recognized by F. E. Schulze ('93) to be strongly modified discohexasters in which the six principals have entirely or almost entirely atrophied while the terminals have undergone a new arrangement into eight secondary principals and terminal tufts at points of the central node corresponding to the eight corners of a cube. It was pointed out by the above-mentioned writer that there may exist on the central node and in the center of the space surrounded by every four secondary principals a hump-like prominence representing the outer end of a primary principal, and further that this protuberance may run out at base into four radial ridges (see Pl. XI., fig. 20), marking the course along which the original terminals were laid down in order to combine into the eight secondary principals. These are frequently not quite cylindrical being longitudinally ribbed or at any rate somewhat angulate in cross-section, indicating their formation by a coalescence of parts running lengthwise. If more support is needed to establish the correctness of F. E. SCHULZE's enunciation as to the nature of the discoctaster, a noteworthy fact may be adduced with respect to the typical triaxial cross of filaments inclosed in the central node, which I believe I was the first to demonstrate in the spicule under consideration ('97). As I have repeatedly had occasion to remark, the cross becomes plainly visible if the spicule be examined in glycerine or in any other medium of a refractive power similar to that of the siliceous substance, and its six points are seen to be always directed towards the middle of the space surrounded by every set of four secondary principals. That space is either simple-surfaced and somewhat concave or shows in the middle the hump-like protuberance before alluded to. In the latter case, each arm of the axial cross extends directly into the protuberance towards which it is directed (see Pl. XI., fig. 20). Of some interest is the not infrequent occurrence of malformed discoctasters in which there exist such a primary terminal or terminals as stand out from the central node, having apparently been left free without fusing with any of the secondary principals (Pl. XIII., fig. 5; Pl. XVI., fig. 10; Pl. XVIII., fig. 6; etc.). The cases may be said to be in a measure suggestive of the condition of the spicule before the primary terminals were brought together and joined into the eight secondary tufts. Noteworthy also seems the presence of minute vacuole-like spaces in the secondary principals and sometimes also in the central node (Pl. XII., figs. 25, 27; Pl XV., fig. 9; etc.). In the former as well as in the ridges running out from the six protuberances on the central node, the little spaces are usually found arranged in a row or rows that run longitudinally. There can scarcely be a doubt as to their being vacancies between the primary terminals, left unfilled by the siliceous deposit which solders these together (*cfr.* p. 116).

The free terminals at the end of secondary principals are always rough, though often obsoletely so. The minute terminal discs are either simple like pinheads or else toothed at the margin. The general size of discoctasters and the proportion and shape of their parts are of great systematic value and may be utilized in distinguishing the different species. It frequently happens that in one and the same species the deeply situated discoctasters are considerably larger than those in the periphery of the wall.

The *microdiscohexasters* are minute and extremely delicate rosettes of the usual structure. In general shape they seem to be uniformly spherical, measuring under 40 μ in diameter. In some species the diameter is only about 15 μ. Not that they have been observed in all Acanthascine species, for several species have been found to be without them, though it is difficult to decide in all cases if that negative result was not due simply to oversight or to the individuality of the sponge.

ACANTHASCUS F. E. Sch.

Hypodermalia, diactins only; at any rate, no pentactins amongst them; hence, never veiled.

This genus, as originally established by F. E. SCHULZE in the Challenger Report, included, besides *A. cactus*, two other species that were called *A. grossularia* and *A. dubius;* neither of these however possesses discoctasters and hence can not be placed under the Acanthascinæ. The former has since been declared by the same writer ('97, p. 537) to represent merely a young specimen of *Rossella antarctica* CARTER, while the latter was recognized to be a species which should properly be called *Rossella dubia* (F. E. SCH.). Subsequently in '98 (p. 55) I described *A. alani* from the Sagami Sea and in '99 (p. 45) F. E. SCHULZE put forth his *A. platei* from the Californian coast (E. of St. Diego, 572 m.). Accordingly, the genus as it now stands, comprises three species, the differential characters of which may be gleaned from the following key:

a.—Dermalia, predominantly stauractins, occasionally pentactins; gastralia, mostly pentactins, sometimes stauractins. Oxyhexaster, 90–152 μ dia. Discoctaster, 106–300 μ dia. Microdiscohexaster, 15–23 μ dia.. *A. cactus* F. E. SCH.

b.—Dermalia, predominantly pentactins, usually with a knob-like rudiment of the distal sixth ray; gastralia, hexactins.

*a*¹.—Oxyhexaster, 100–130 μ dia. Discoctaster, 120–250 μ dia. Microdiscohexaster, at most 20 μ dia.. *A. platei* F. E. SCH.

*b*¹.—Oxyhexaster, 144–190 μ dia. Discoctaster, 136–220 μ dia. Microdiscohexaster, 30–35 μ dia.. *A. alani* IJ.

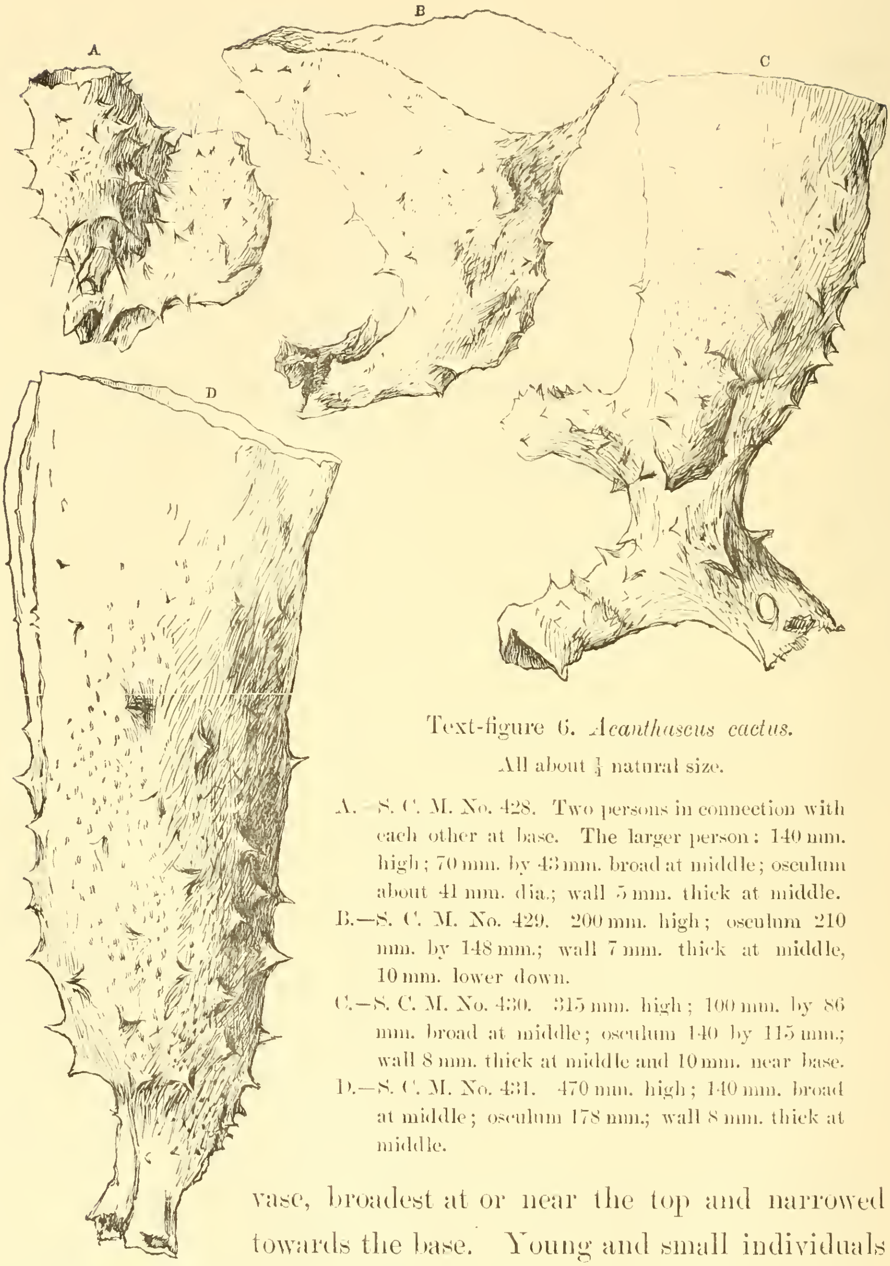
ACANTHASCUS CACTUS F. E. SCH.

Pl. XI., figs. 16–22 and Pl. XII.

Acanthascus cactus. F. E. SCHULZE, '86, p. 49. '87 (!), p. 148; Pl. LVII., figs. 1–7. '97, p. 551.—IJIMA, '97, p. 48.

The species was first described by F. E. SCHULZE from a single small specimen which was obtained by DÖDERLEIN probably from a shop in Enoshima. Some years later, as the fishermen became aware of the demand by naturalists, specimens began to be brought to us in such numbers that soon we had to decline to purchase them unless unusually large in size or beautiful in appearance. Evidently the species is one of the most abundant and most widely distributed Hexactinellids of the Sagami Sea. It is known to the fishermen along the coast under the name of "Wata" (cotton) or "Wataboshi" (cotton-hood). Nearly half a hundred specimens now lie before me, all obtained from depths between 220 and 572 m. and from a bottom of volcanic origin in the Sagami Sea. The more exact localities known to me are: Yodomi, Mochiyama, Inside Okinosé, Outside Okinosé and Homba. I myself have collected several fragments at a spot about 2 kilometers off the village of Senzu on the northern coast of Vries Island, from a depth of 220 fathoms and a bottom of a black basalt-like rock. Mr. T. TSUCHIDA, Assistant in the Misaki Marine Laboratory, obtained some fragments on the north of Okinosé from a depth of 235 fathoms. In 1900, the U. S. Fish Commission S. S. "Albatross" trawled up several fragments, together with *Rhabdocalyptus mollis*, at her Station 3697 (about 4 kilometers off the mouth of the Sakawa river in Sagami Province; 265–120 faths.; black volcanic mud). While most specimens grow on a tufaceous substratum, I have seen some attached to the dead skeletons of other Hexactinellids (*Hexactinella ventilabrum*, *Farrea occa*).

On the following page are given sketches of a few selected specimens in order to give an idea of the general appearance of the sponge. The shape is in general like that of a wide-mouthed



Text-figure 6. *Acanthascus cactus*.

All about $\frac{1}{4}$ natural size.

A.—S. C. M. No. 428. Two persons in connection with each other at base. The larger person: 140 mm. high; 70 mm. by 43 mm. broad at middle; osculum about 41 mm. dia.; wall 5 mm. thick at middle.

B.—S. C. M. No. 429. 200 mm. high; osculum 210 mm. by 148 mm.; wall 7 mm. thick at middle, 10 mm. lower down.

C.—S. C. M. No. 430. 315 mm. high; 100 mm. by 86 mm. broad at middle; osculum 140 by 115 mm.; wall 8 mm. thick at middle and 10 mm. near base.

D.—S. C. M. No. 431. 470 mm. high; 140 mm. broad at middle; osculum 178 mm.; wall 8 mm. thick at middle.

vase, broadest at or near the top and narrowed towards the base. Young and small individuals generally show the wall somewhat closed in at the oscular margin. This, in the larger specimens, is usually directed straight upwards or otherwise somewhat outwards. Sometimes the body expands superiorly in such a manner that it presents a funnel-like shape. The sponge stands either erect from the basal attachment or is bent more or less in the basal part. Laterally it is frequently more or less distinctly compressed, especially in the basal region; but the upper part is about as often simply roundish or irregularly roundish in cross-section.

The wide and deep gastral cavity extends close to the inferior end, so that the blind wall presenting the irregularly shaped surface of basal attachment is not thicker than the adjoining part of the lateral wall. This is on the whole only moderately thick, gradually thinning above towards the thin and simple-edged oscular margin.

While many specimens represent pure and simple individuals, each being in possession of a single large osculum at the superior end, others show complication in that they consist of a main person bearing one, two or sometimes more, generally much smaller daughter persons secondarily produced by budding. The bud is at first a blind-sac-like outbulging of the wall, which eventually opens an osculum at the top. The oscular rim is for some time closed inwards but may flare out later. The bud-formation seems to be confined to the basal region, or at any rate to the lower half of the mother body. Text-figure 6, *A*, represents a case in which two persons, one somewhat smaller than the other, arise side by side from a common basal part. The specimen shown in *C*, same figure, bears three buds: two on the convex sagittal edge of the bent basal region, and one on the lateral side. Several cases have been encountered of specimens similarly bent at base and bearing on the convex side a single bud directed in the opposite direction from the main part of the mother sponge, the general shape being then not unlike that of the *Rhabdocalyptus* shown in Pl. XVII. The buds are sometimes represented merely by secondary oscula which are unaccompanied by any outbulging of the surrounding parts and thus appear like simple gaps in the wall. Thus, the specimen marked *B* in text-figure 6 is in possession of more than one small such osculum in addition to the large primary one at the superior end.

The species grows to very considerable dimensions. The largest complete specimen before me (S. C. M. No. 432) is 432 mm. high, and consists of two large persons and of a boss-like cœcum of the size of one's fist, all these parts arising from a common basal portion. There is also in the Science College a larger fragment with an osculum measuring 240 mm. in diameter. On the other hand, the smallest individual I have seen was only about the size of a walnut.

A striking feature of the sponge consists in the sharply apexed conical elevations of the external surface. These occur at various but rather wide intervals. They are usually most numerous, largest and tallest near the middle or in the lower half of the body. In large specimens they may be as high as 25 mm., but are much shorter in the smaller specimens. They grow more and more sparse superiorly towards the osculum, becoming at the same time smaller and more inconspicuous, until they no longer exist close to the oscular margin.

The cones bear on the apex moderately strong, needle-like prostalia lateralia, which project either singly or in tufts of a few together to various lengths, up to about 20 mm. They are directed on the whole radially, though frequently inclined obliquely one way or the other. When the prostalia are well preserved, as is especially the case in the smaller specimens, the resemblance of the sponge to a cactus is so remarkable that one is at once impressed with the appropriateness of F. E. SCHULZE's selection of the specific name. No doubt all the cones arise in connection with the prostalia, but it is by no means uncommon that we meet with such as show no trace of the latter, which evidently have been lost. Cones without prostalia are especially frequent in the larger and therefore older individuals; in fact in these it is rare that we find any of the prostal needles at all. The loss is undoubtedly partly due to a mechanical breaking off at the apex of the cones due to some external cause, as is proven by the proximal part of the needles still remaining in the cones, the outer end being broken off. At the same time I am inclined to assume that a large part of the loss is to be accounted for by the fact that the spicules in their entirety are cast off by some natural physiological process of the sponge. Only in this way can be explained the entire absence of even the proximal remnant within the cones in so many cases. Probably the longer and therefore older prostals are the first to be thrown out, and in support of this theory stands the fact that those still remaining on the larger specimens are not so long nor so strong as some to be seen on the smaller individuals. If I am right in the above assumptions, it follows that the period of the greatest development of the prostalia is when the sponge is comparatively small and young, or at any rate before its full size is attained—a fact which is not without parallel in other Acanthascinæ (*S. glaber*, *R. victor*, *R. capillatus*).

Near the oscular margin there may occur some fine prostalia which project either singly or in small tufts without having cones at bases. They are however never so numerous as to form anything like a fringe to the osculum.

Figs. 16 and 17, Pl. XI., show in natural size the appearance of the endosomal and the ectosomal layer respectively. A close familiarity with the characters of either will be sufficient to enable one to recognize the species even if the specimen to be determined be a small fragment, provided of course one or the other of the layers is well preserved.

In the ectosome (Pl. XII., fig. 34) the extremely delicate dermal layer exhibits minute quadrate meshes, just discernible as such with the naked eye. Much more distinct is the hypodermal latticework (see Pl. XI., fig. 17), the meshes of which are triangular, trapezoidal or polygonal in shape and measure rarely over 2 mm., but far more frequently less than 1 mm., in the length of their sides. Towards the apex of the cones the hypodermal beams converge more or less from all sides, making the meshes between them narrower but more elongate than in other parts. The beams may measure up to 130 μ in breadth. They are therefore not very thick, but still are thick enough to be distinctly perceived with the unaided eye. The points of intersection often appear somewhat thickened in a node-like manner, owing to dense concentration there of the soft parts. The subdermal space in the intervals between the incurrent canalar apertures may be as wide as 1 mm. It is traversed by numerous strands, the pillars, connecting the ectosome to the choanosome. The apertures of the incurrent canals are of various sizes. In the larger specimens, the largest canals may reach 4 mm. in diameter but are in general much smaller.

The gastral surface is on the whole tolerably smooth, though it may sometimes exhibit a wrinkled appearance. The canalar apertures on this side of the wall are on the whole larger, but necessarily less in number, than those on the external side of the same specimen (*cfr.* Pl. XI., figs. 16 and 17), as is the rule with all Hexactinellids of similar shape and structure. All the excurrent canalar apertures, in fact the entire gastral surface, is covered over by a well differentiated endosome (Pl. XI., fig. 16; Pl. XII., fig. 35). In this the gastralia are however never so abundantly present as to form a continuous layer of latticework by themselves; so that, the endosomal meshes, which present themselves as such to the naked eye, may be said to be freely open, except for some fine and insignificant trabeculæ of the gastral membrane that may occasionally extend across them. The said meshes are of about the same size and shape as those of the hypodermal framework; only they are generally more rounded at the corners, while the beams inclosing them are perceptibly thicker. These beams, so far as the skeletal parts are concerned, consist in the main of the strands of hypogastralia, along which there occur the gastralia proper in scattered distribution together with numerous hexasters. Certain hypogastral strands are somewhat conspicuously thicker than the rest and can be traced continuously for a considerable distance, pursuing an irregular course and frequently intersecting others of similar strength.

The sponge in the living state is colorless or whitish. The texture may be said to be rather firm.

Spiculation.

As to the spiculation I have but little of importance to add to what is already known through the investigations of F. E. Schulze. To that gentleman I am indebted for the gift of a slide-preparation made from the type-specimen described in the

Challenger Report, which preparation was of great service to me in insuring a correct identification of specimens in the early stage of my studies.

Principal *parenchymalia*, elongate spindle-like, sometimes bow-like. Length, up to 15 mm.; thickness at middle, up to 300 μ. Thier pointed ends smooth, but sometimes rough as in all the smaller parenchymalia. There exists a gradational series of variously sized parenchymalia, from the principalia down to comitalia of only 6 μ thickness. (Fig. 36, Pl. XII., is intended to illustrate the different modes of termination of the parenchymal diactins. Unfortunately the representation of the subterminal roughness in the thinner spicules has turned out to be a failure).

The *prostalia* are diactins of great length, which may measure up to 25 mm. or more. They are probably to be looked at simply in the light of excessively elongated parenchymal principalia. Like these, the part imbedded within the sponge-wall is accompanied by filamentous comitalia as well as by other loosely and radially arranged parenchymalia whose outer ends are directed towards the apex of the cones.

The *hypodermal* and *hypogastral* strands consist of diactins, and of diactins only, which are arranged in loose or compact bundles of variable strength (Pl. XII., figs. 34 and 35). The elements look much like parenchymalia of similar dimensions. They are generally not longer than 3 mm. nor broader than 38 μ in the middle. Towards both ends they gradually taper, the very tip being either simply acuminate or conically pointed. Subterminally, the surface is roughened by microtubercles which are however never numerously present. Usually the spicular center is externally provided with a gentle annular swelling; more rarely, with two opposite protuberances.

When the sponge is torn from the rock to which it was attached, the basidictyonal plate is left adhering to the latter. The plate can easily be separated out by boiling in acid. It is found to be in places quite thin, being represented by an uneven and small-meshed siliceous reticulum (the limiting layer of the basidictyonal plate, see p. 134), the beams of which may at intervals show spicular axial filaments in the form of a plane cross (as in Pl. XXII., fig. 17). At other places there exists, besides the same limiting or attachment layer and in direct union with it, a somewhat wider-meshed sponge-work (Pl. XII., fig. 37) which increases the thickness of the basidictyonal plate to half a millimeter or more. The relalively thick beams of the sponge-work are rough-surfaced all over on account of the presence of numerous conical microtubercles. The manner of their arrangement is apparently irregular, but by exact observations it is not difficult to make out that the foundation to the structure is given by certain hexactins, the basidictyonalia, which are directly as well as synapticularly fused together. Isolated instances also occur of diactins or of parts of diactins—apparently belonging to the parenchymalia—being incorporated in the beams. Observed in glycerine, such a diactin is seen to be of smooth-contour and distinctly traversed by the axial canal but entirely enveloped by an irregular and synapticula-forming secondary deposit of siliceous matter. But by far the greater part of the parenchymalia in the region have their lower end simply loosely inserted into the interspaces of the basidictyonal framework.

Dermalia predominantly stauractins, rough all over, nearly plane or slightly arched so as to be convex on the outer side (Pl. XII., fig. 23). Axial length, 200–350 μ. Rays perceptibly tapering towards the rounded tip or nearly uniformly thick; sometimes slightly swollen at the ends. Thickness at their middle, $8\frac{1}{2}\ \mu$ on an average. The quadrate meshes formed by mutual apposition of the rays of separate dermalia measure on an average 165 μ in length of sides.

Occasionally among the dermalia there occur pentactinic forms in which the proximally directed, unpaired ray is somewhat shorter than, or nearly equally as long as, the paratangentials. They scarcely ever occur on the cones. Under exceptional circumstances a stauractin may have one of the rays so shortened that it approaches a tauactin in shape. A few cases of unusually small, smooth and slender-rayed oxystauractins and oxypentactins that I have seen I hold to be dermalia in an incomplete state of development.

Gastralia rough pentactins, in which the unpaired ray is directed distad (Pl. XII., fig. 24); occasionally stauractins. They are quite like the dermalia, though perhaps on the whole slightly smaller. As before mentioned they are never so numerous as to form a continuous gastral lacework, occurring, as they do, in widely scattered distribution on the hypogastral strands (see Pl. XII., fig. 35).

Oxyhexasters, 90–152 μ in diameter (120 μ on an average). Those occurring in abundance in the choanosome as well as in the endosome (Pl. XII., figs. 29–32) have mostly exceedingly short principals which in many cases may be said to be almost reduced to nothing. In them the terminals are comparatively strong, reaching up to nearly 5 μ in thickness at base; they are obsoletely rough all over. The roughness is especially pronounced at their base and here it may often be distinctly observed, under a very high power of the microscope, that it is caused by reverted microtubercles or minute barbs. Each principal may bear two, seldom three or four, divergent terminals, thus giving in all 12 or more than 12 terminal points to the entire oxyhexaster. More usually the oxyhexasters seem to be hemihexactinose and not seldom quite hexactinose (figs. 30 and 31). In the former case, the principals are biterminal if not uniterminal. Thus, forms with 11, 10, 9, 8, 7, or only 6 terminal points are not uncommon.

Of the oxyhexasters situated in the subdermal space, many (not all) are considerably different in appearance from those described above and which are more deeply situated in the wall. In them the principals are appreciably longer and more slender, while the terminals are simply more slender; moreover, there occur as a rule two or three terminals to each of the six principals. One specimen of such peripheral oxyhexasters is to be seen in Pl. XI., fig. 18, on the right hand side. A comparison of that oxyhexaster with the others shown in Pl. XII. will at once make apparent the differences above indicated.

In all the oxyhexaster varieties the central cross can easily be brought into view and the extent of its arms exactly determined, if proper steps be taken in preparing.

Pl. XII., fig. 33 represents a case of what seems to be an abnormally developed oxyhexaster. It was met with but once in the dermal membrane of a certain specimen and may possibly have been only an extrinsic object. Central node irregularly shaped, but still with indications of the six principals. Total number of terminals, 20 at least; some of them bifurcated at the end as shown in the figure.

Discoctasters (Pl. XII., figs. 25 and 27) various in size, measuring 106–260 μ in diameter. Secondary principals $\frac{1}{3}$—$\frac{1}{2}$ as long as the free part of the terminals. Number of terminals in a tuft, 3–7; most usually 4 or 5. The discoctasters in the periphery of the wall are the smallest (106–137 μ dia.), while those in the deepest parts may be twice as large (generally 200–260 μ in diameter). In other respects than in size there also exist some noteworthy differences between the two.

The smaller peripheral discoctasters (fig. 25) usually show distinct hump-like prominences on the central node, in the middle of the spaces surrounded by every set of four secondary principals. The four ridges radiating from the prominence towards and into each principal are also generally but not always distinct. The principals as seen in a lateral view are frequently uneven in contour; a more exact observation may show that they are longitudinally ribbed throughout the length, indicating their formation by a coalescence of parts running lengthwise. Pl. XI., fig. 20, representing the central part of a discoctaster taken from the subdermal region, demonstrates the points mentioned above, besides showing the disposition of the axial cross in the central node and the series of small vacuole-like spaces contained in the ridges that go to form the secondary principals. The terminals are obsoletely rough-surfaced; their disc at the end is minute, appearing simply like a pinhead.

In the larger, deeply situated discoctasters (fig. 27), the central node may be so large as to measure 20 μ across. On it the hump-like prominences are seldom seen, these being usually either merely indicated or not at all present. The space where they should occur may even be concave. It seems that the prominences, as also the ridges arising from them, disappear as the central node becomes larger with the growth of the entire spicule; possibly they become, so to say, covered up by the siliceous deposit added to the node. The secondary principals, which may measure $7\frac{1}{2}\,\mu$ across in the middle, are obsoletely rough-surfaced. The terminals are similarly rough. Near their outer end the roughness grows somewhat coarser and is here seen to be caused by retroverted microtubercles (Pl. XII., fig. 28). In direct proximity to the terminal disc, which marginally runs out into 7 or 8 small teeth, there exists a very short tract devoid of the microtubercles.

Not rarely malformed discoctasters are met with, in which some primary terminals have apparently failed to unite in the proper way with any of the secondary principals but remain more or less free, appearing like supernumerary appendages to an ordinary discoctaster. As a case of such malformation is to be considered the spicule figured by F. E. Schulze in the Challenger Report, Pl. LVII., fig. 4.

Of special interest are the isolated cases of true discohexasters I have come across in certain specimens and which I consider to represent the primitive form whence the discoctaster was derived. In general size and in the appearance of the terminals they are exactly comparable to the smaller discoctaster of the periphery, but the essential difference consists in the fact that the principals are six in number, these being short, thick and knob-like and arranged in the usual disposition. Four or five terminals arise divergingly from each principal. The discohexaster, which is much too rare and inconstant to be counted among the regular hexasters of the species, may be said to be in appearance not unlike the macrodiscohexaster of *Aulosaccus ijimai* F. E. SCH.; it is apparantly in the state of nearest approach to the discoctaster, into which it may become converted by comparatively short steps of change.

Microdiscohexasters (Pl. XII., fig. 26) of only 15–25μ diameter and of the usual appearance are common in both the dermal and gastral membranes as well as in the subdermal and subgastral trabeculæ. In some individuals they are much more abundant than in others. In the choanosome they do not seem to occur. In stained preparations a nucleus—in all probability representing a silicoblast—is almost always seen in each of the angles formed by the principals, as shown in Pl. XI., fig. 18. The interspaces between the exceedingly delicate terminals are filled up by a protoplasmic matrix, so that the entire rosette first attracts one's attention as a small, faintly colored mass of spherical shape.

Soft Parts.

Some fragments fixed and preserved by myself at different times at the place of capture have been utilized for making the following observations on the soft parts.

The *chambers* are so numerous and densely crowded together that it is difficult to exactly determine the shape and extent of each (see Pl. XI., fig. 22). However there can be no doubt of their being as usual cup-like or thimble-like in shape. The diameter varies from $90\,\mu$ to $190\,\mu$. The chamber wall I have seen as a reticular membrane with *open* meshes (Pl. XI., fig. 19). The choanocyte nuclei, though scarcely differentially stained as they lie in the nodes of the reticulum-forming granular protoplasm, can at places be distinctly recognized as such. They are of about the same size as the trabecular nuclei. None of the preparations are such as to allow anything to be said about the flagellum or the collar.

On the outside of, and in close apposition to, the chamber wall are variously sized groups of well-stained *archæocytes* reaching up to $3\frac{1}{2}\,\mu$ in diameter. A small group of the same is seen in Pl. XI., fig. 19, on the left. The archæocytes lie close together, generally arranged in a single layer flat upon the chamber wall or between the walls of directly adjacent chambers.

The *trabeculæ*, both external and internal, are as usual cobweb-like. Their nuclei, measuring about $2\,\mu$ in diameter, are well-stained and contain generally more than one chromatic granule.

Along the lumen of the larger canals, both incurrent and excurrent, the trabeculæ are at places extensively expanded into a thin lining film, so that they might be spoken of as constituting here a canalar membrane.

The dermal membrane (see Pl. XI., fig. 18, left) is film-like perforated by large and small "pores" of roundish or oval shape. The parts between closely adjoining "pores" may be reduced to mere threads indistinguishable from the trabeculæ. Not only does the essential agreement in histological nature but also the fact that the same thesocytes and microdiscohexasters occur in both the dermal membrane and the trabeculæ, strengthen me in the belief that the two parts just mentioned are genetically and fundamentally one and the same structure, whatever differences apparently exist between them being due to the circumstances of their respective situations (see Contrib. I., pp. 122, 147).

The gastral membrane is of much the same appearance as the dermal.

The *thesocytes* of the species are of a characteristic appearance. They may occur in the dermal and gastral membranes as well as on trabeculæ in all parts of the sponge-wall, but seem to be most abundant in the subdermal region. They are shown in numbers in Pl. XI., fig. 18, in which they appear as morula-like masses consisting of numerous small spherules. The quantities in which they occur are subject to variation according to individuals; but they seem to be present all the year round, since I have observed them in specimens preserved in the months of April, July, August and December.

The thesocytes are spherical, ovoid or somewhat irregular in shape and may be more or less flattened when situated on or against a membranously expanded trabecula. They measure 8–20 μ across. A fine cell-limit and the nucleus are only exceptionally distinguishable; the former can be perceived only when the spherules contained in it are not developed in too excessive numbers, while the latter is generally concealed among the spherules.

The spherules, which measure 1.7–2.5 μ are refractive and homogeneous, appearing yellowish in the unstained state. Their reactions towards different stains have already been noticed on p. 178 (foot-note) of my Contribution I. and therefore need not be mentioned here. They are generally tolerably uniform in size within a thesocyte. In certain cases, however, I have found them quite unequal in size, the larger ones appearing to have arisen from the combination of several smaller ones. Further in certain individuals I have not infrequently met with thesocytes in which the spherules were apparently in the process of disintegrating into irregular granules; or in other cases, of dissolving into a diffuse state. The differences in appearance may be partially due to the drastic influence of the preserving reagents; nevertheless I believe that they may in general be taken as representing the changes which the spherules, as a nutritive substance held in reserve, undergo by a natural physiological process before they are consumed. And it would be but natural if we should find that some thesocytes are quite or nearly quite devoid of the fat-like contents as the result of consumption. As such thesocyte relics I consider certain pale-looking cells which are now and then found wherever thesocytes might be expected to occur. A few cells of the kind in question are to be seen in the left upper part of fig. 18, Pl. XI. They are of about the size of ordinary thesocytes filled up with spherules. Probably they are of a more or less collapsed shape. The faintly colored and finely granular cytoplasm incloses a distinct nucleus, while its external limit is well-defined and is sometimes distinctly provided with an enveloping membrane. The cells can scarcely be viewed in the light of early thesocyte stages *before* the formation of the spherules; for, there exist other cells which alone can be viewed as inceptional thesocytes, *viz.*, those very much smaller than full-sized thesocytes and which already contain the spherules though yet in quite a limited number.

I may here add that in some instances the fat-like spherules presented the appearance of dispersing after having been set free from the thesocyte which originally contained them all. Quite isolated spherules, evidently the same as those of thesocytes, are occasionally found sticking to the trabeculæ.

The peculiar rosette-like bodies depicted in Pl. XI., fig. 21, were met with in profusion in a preparation of a specimen taken in April. Reference to them has already been made on p. 31 of this Contribution, under *Scyphidium longispina.* The body consists of a varying number of well-stained spindle-like or rod-like pieces in radial arrangement. These measure up to 4 μ in length. The figure was included in the plate under a suspicion that the bodies might represent stages in the spermatogenesis, but now I think they are something, extrinsic or otherwise, at any rate quite foreign to the sponge.

ACANTHASCUS ALANI Ij.

Pl. X., figs. 16–23.

Acanthascus alani. Ijima, '98, p. 55.

The species is based on a single specimen (Pl. X., fig. 16) which originally belonged to Mr. Alan Owston (O. C. 4097) but is now in the collection of the British Museum.

It is a dried specimen greatly macerated on the exterior. In shape it is ovoid, goblet-like and slightly laterally compressed. The lower end contracts into a short, stalk-like and irregular base. Total height, 190 mm. Greatest breadth of body, 133 mm.; lesser breadth in the same region, 104 mm. Stalk-like base, about 60 mm. in greatest breadth. Superiorly the body-wall closes in towards the thin oscular margin which is apparently simple-edged. The irregularly roundish osculum is about 60 mm. in diameter. The deep gastral cavity extends into the stalk-like base. The body-wall in the lower part is as thick as 35 mm.

Notwithstanding the lacerated condition of the external surface, it can be ascertained that this was by no means smooth but must have shown a number of irregular hillock-like or ridge-like elevations, judging from what appear to be their rests. The more prominent of the elevations may have been 10 mm. high, as measured from the bottoms of adjacent depressions. Possibly their summits were originally provided with diactinic prostalia as in other species of the genus, but no such spicules have been found preserved in the specimen.

Fortunately there has remained the ectosome in some places, though in small patches (Pl. X., fig. 23). It is uneven, being much creased. The minutely and more or less regularly quadrate meshed dermal lacework is exceedingly delicate; it is supported below by fine intersecting hypodermal strands, mostly under 0.1 mm. in thickness, which pursue a sinuous course. Over the interapertural spaces, as also over the external prominence, the ectosome is generally in close contact with the choanosome, so that it can not be very clearly distinguished. Where it has fallen off, the sponge-surface appears somewhat crisp-hairy on account of the dishevelled fibers of the parenchymal strands. The stalk-like base presents the usual fibrous texture.

The incurrent canalar apertures measure mostly under 5 mm.

in diameter, though a few may be as large as 9 mm. Those of an approximately similar size lie separated from one another by a space nearly equally as wide as, or sometimes much wider than, their diameter.

On the gastral side, the endosome is not developed in a continuous layer, so that the excurrent canalar apertures all open freely into the gastral cavity. The apertures are of various sizes, some being as wide as 15 mm.; their edge is either sharp and distinct or but slightly indicated. The interapertural space shows an irregular interlacing of fine fibers.

All the principal spicules are very fine, which fact accounts for the soft and delicate texture of the sponge. The septa between the two systems of canals are thin; consequently, the sponge is light, and cavernous in appearance. Its general aspect is not unlike *Chaunoplectella cavernosa* or *Aulosaccus schulzei*.

The species is apparently more closely allied to *A. platei* than to *A. cactus*. From the former it is distinguishable by a number of points, of which I may mention the relatively wider canals, the freely open excurrent apertures, the smaller discoctaster and the larger oxyhexaster and microdiscohexaster.

Spiculation.

Parenchymal diactins small, slender; generally less than 1 mm. in length and at most 12 μ thick. In the stalk-like base, they may be over 1 mm. long and 30 μ thick but can scarcely be said to be coarse. Center, usually without external swelling or bosses. Nearly uniformly thick throughout except at the ends which are more or less swollen and rough; extreme tip rounded. Oxyhexactins met with here and there in preparations of the septa are either canalaria or gastralia.

Hypodermalia quite like the above.

Dermalia (Pl. X., fig. 16), almost always pentactins; usually with a gentle prominence representing the distal sixth ray. Rays, slightly attenuated outwards but with rounded tip; microtubercles, not numerous, nor strongly developed, so that the roughness of surface is not pronounced. Axial length, generally 250–350 μ. Breadth of rays at base, 9–11 μ.

Gastralia (Pl. X., fig. 18), hexactins; irregularly scattered. Rays, like those of dermalia but with less roughness of surface. Axial length, 280–460 μ. Hexactins similar to the gastralia occur along the excurrent canals as *canalaria*. In the incurrent canals pentactins resembling dermalia were occasionally found; they are probably to be considered likewise as canalaria.

Oxyhexaster, present in abundance. Diameter, 144–190 μ; on an average 160 μ. From the characters of its rays, two varieties can be distinguished; both seem to occur together promiscuously.

In the one variety (Pl. X., fig. 20) the center is swollen to a globular node, while the short principals are rounded in a knob-like manner. Slender rough terminals, generally 3 or 4, arise from each principal. They seem to be very liable to be broken off near the base, the fragments being found in abundance in the soft parts. It seems that this is the more abundant of the two oxyhexaster varieties.

In the other variety (Pl. X., fig. 21) the terminals are considerably stronger while the principals are much less distinctly indicated, being in fact quite abortive. Number of terminals to each principal, generally 2 ; seldom 3 and sometimes only 1 to some of the principals. Insignificant microtubercles are sometimes seen on the surface of terminals, at the base of which they are reverted barb-like.

Discoctaster (Pl. X., fig. 19), common in all parts ; varying in size. Diameter, 136–220 μ. Central node, always with the six boss-like prominences. Secondary principal, about as long as, or longer than, the terminal tuft. The latter consists of 6–8, fine terminals (drawn too thick in the figure) ; narrow at base and expanding more or less distally. Terminal disc, small and pinhead-like.

Microdiscohexaster (Pl. X., fig. 22), very sparsely present, having been found in canalar septa only in a few instances after a careful search ; spherical, with 30–35 μ diameter. Central node, swollen to spherical shape. Principals moderately long, with numerous fine terminals.

STAUROCALYPTUS Ij.

IJIMA, '97, p. 53.

Hypodermalia include pentactins in which the paratangentials are smooth or rough, but never armed with spines. Generally veiled, sometimes not.

The genus, as I consider it at present constituted, comprises the eleven species embodied in the following

Differential Key to Species.

a.—Dermalia nearly exclusively, or at any rate predominantly, pentactins.

a^1.—Discoctasters (both subdermal and subgastral) of less than 200 μ dia.; rarely up to 213 μ dia.

a^2.—Thin-walled. Gastral surface with a continuous endosomal layer covering over the excurrent canalar apertures. (Without prostalia. Discoctasters 80–100 μ dia.; with characteristically short and cylindrical tufts of terminals)..*S. fasciculatus* F. E. Sch. (Coast of California, 690 mm.).

b^2.—Tolerably thick-walled. Gastral surface without a continuous endosomal layer, the excurrent canalar apertures opening freely.

a^3.—Without prostalia (?). With peculiar pit-like subdermal cavities whence arise narrow incurrent canals. Excurrent canalar apertures wide (up to 8 mm. dia.). (Discoctasters 128–180 μ dia.)...*S. rœperi* (F. E. Sch). (Coast of Patagonia, 731 m.).

b^3.—With both pentactinic and diactinic prostalia. Subdermal cavity inconspicuous. All canals narrow, even extremely narrow; not more than 2 mm. wide.

a^4.—Gastral surface smooth. Among the gastralia pentactins more numerous than hexactins. Rays of dermalia and gastralia smooth basally. (Discoctasters 150–200 μ dia.)...*S. solidus* F. E. Sch. (Coast of California, 486–1254 m.).

b^4.—Gastral surface hairy on account of short projecting ends of fine diactins. Gastralia hexactins. Rays of dermalia and gastralia entirely rough. A considerable number of stauractins among the dermalia. (Discoctasters 130–213 μ dia.)...............*S. tubulosus* n. sp. (Sagami Sea).

b^1.—Subgastral discoctasters larger than 220 μ, reaching up to nearly 300 μ or over in diameter; subdermal discoctasters considerably smaller. (Tolerably thick-walled; with pentactinic and generally also diactinic prostalia; canals comparatively narrow).

c^2.—Smallest discohexasters not smaller than 200 μ dia. (in fact 228–320 μ dia.). Gastral surface smooth. Prostal pentactins small; their paratangentials up to 2.2 mm. in length. Principal parenchymal oxydiactins under 8 mm. in length and 41 μ in thickness. Gastral hexactins 80–100 μ in length of rays.....................................*S. dowlingi* (Lambe). (Pacific coast of N. America, 63–512 m.).

d^2.—Smallest discohexasters (subdermally situated) much smaller than 200 μ dia. Gastral surface with numerous projecting diactins. Prostal pentactins moderately large; their paratangentials reaching up to 4 mm. or considerably more in length. Principal parenchymal oxydiactins much coarser than in c^2 (may be 80–600 μ thick). Gastral hexactins on the whole as large or decidedly larger than in c^2.

c^3.—Gastral surface hairy on account of short projecting ends of fine diactins. Excurrent canalar apertures mostly freely open; in some places covered over by an irregularly coarse-meshed endosomal layer. Oxyhexasters largely hexactinose...*S. affinis* n. sp. (Sagami Sea).

d^3.—Gastral surface conspicuously hispid on account of projecting and rather coarse diactins. All excurrent canalar apertures covered over by an irregularly coarse-meshed endosomal layer. Oxyhexasters, rarely hexactinose. ....*S. entacanthus* n. sp. (Sagami Sea)

b.—Dermalia nearly exclusively, or at any rate predominantly, stauractins.

c^1.—With small and inconspicuous prostal pentactins. (Dermalia uniformly microtubercled on all sides). Gatralia hexactins, forming a continuous lacework in the endosome. Discoctasters 114–128 μ dia....................*S. microchetus* Ij. (Sagami Sea).

d^1.—Without prostal pentactins, the dermal surface being smooth, (though in e^2 isolated and slender prostal diactins may sometimes occur).

e^2.—Dermalia decidedly spiny on the external side but obsoletely microtubercled on the inside of rays. Gastralia hexactins in which the free proximal rays are over 450 μ in length; forming a continuous gastral lacework over excurrent canalar apertures. Discoctasters very large, 500–660 μ in diameter............... ....*S. glaber* Ij. (Sagami Sea).

f^2.—Dermalia slightly rough. Gastralia pentactins and stauractins, with rays up to 100 μ length; not forming a continuous layer over excurrent canalar apertures. Discoctasters 110–210 μ diameter.................... *S. heteractinus* Ij. (Sagami Sea).

c.—Dermalia straight diactins. (Gastralia represented likewise by diactins. Discoctasters 140–200 μ dia. Sponge veiled and with long diactinic prostalia................................ ....*S. pleorhaphides* Ij. (Sagami Sea).

In the present Contribution I propose to treat in full nine species which I have studied.

S. fasciculatus and *S. solidus* are two American species of which my knowledge has been solely derived from the describer's work (F. E. Sch., '99). I beg here to offer a few remarks with regard to both.

S. fasciculatus is undoubtedly a well differentiated species. Its peculiarly characterized discoctaster (only 80–100 μ large and with 4–6 terminals, about 12 μ long, forming a cylindrical tuft not broader than the principal of over 20 μ length) should alone be sufficient to distinguish the species from all the rest in the genus.

With respect to *S. solidus* it seems that F. E. Schulze (*l. c.*, p. 52) regards it to be distinct from the closely similar *S. dowlingi* mainly on the strength of two peculiarities, *viz.*, that the general shape is invariably barrel-like, straight and broad-based instead of being cup-like, outbulged on one side and narrowed towards the base; and that the discoctasters are much smaller and more slender-rayed. It occurs to me that perhaps some other points might well be added to the specific difference, to which view I am led from certain facts contained in F. E. Schulze's own description and figures. On p. 105 (*l. c.*), in a short diagnosis of *S. solidus*, is a statement to the effect that as gastralia there occur a greater number of pentactins than hexactins; whereas, in *S. dowlingi* the same spicules are known to be hexactins and only occasionally pentactins. Again, on his Plate X. (*l. c.*), F. E. Schulze gives figures of the dermalia and gastralia from *S. solidus;* both the spicules mentioned are shown to have rays which are basally quite smooth, instead of being rough all over as in *S. dowlingi.* The differential characters above indicated, if shown to be constant, would certainly be of no small importance in distinguishing the two species.

Concerning the three new species described for the first time in this Contribution (*viz.*, *S. tubulosus*, *S. affinis* and *S. entacanthus*), it may here be mentioned that they are all very nearly related to *S. dowlingi* and that some of the specimens on which they are based were at first referred by me to that species, though with some hesitation. The characters of the specimens referred to were therefore taken into account in drawing up the diagnosis of *S. dowlingi* in my "Revision of Hexactinellids with discoctasters" (Ijima, '97, p. 53). However, a renewed examination of the Japanese materials and a comparison with typical *S. dowlingi*, the characters of which have since become more precisely known to me, have led me to think that I was mistaken in the identification. *S. dowlingi* is, for the present at least, to be eliminated from the list of Japanese Rossellids; on the other hand, I think it fairly justifiable, under the circumstances, to add to the list the three new species mentioned above. But I can not

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* Table showing some points in the characters of those *Staurocalyptus* species (or speci-

Name of species.	Size of specimens described.	Dermal side.			Gastral side.	
		Diactinic prostalia.	Pentactinic prostalia.	Incurrent canalar apertures.	Projecting needles.	Excurrent canalar apertures.
S. fasciculatus F. E. S.	"Albatross" specimen. 150 mm. high.	Not found.	Not found.	Small.	Not found.	Entirely covered by "gastral membrane."
S. rœperi (F. E. S.)	"Challenger" specimen. 160 mm. high.	Not found (abraded ?).	Not found (abraded ?).	Small.	Not found.	Large; up to 8 mm. dia.; freely open.
S. solidus F. E. S.	"Albatross" specimens. Up to 290 mm. high.	Numerous; strong.	Numerous; strong.	Moderately large.	(Gastral surface smooth).	1–2 mm. dia. All freely open.
S. dowlingi (L. M. L.)	Canadian and Californian specimens. 100–120 mm. high.	Numerous; strong.	Numerous; small.	Small; up to 1½ mm. dia.	Occasionally present.	All freely open.
S. tubulosus IJ.	S. C. M. No. 241. 50 mm. high.	Present in some numbers; strong.	Present; on the whole small.	Very small; up to ½ mm. dia.	Numerous; fine and short; hairy.	Very small; all freely open.
S. affinis IJ.	S. C. M. No. 194. Moderately large	Not found; probably owing to abrasion.	Not found; probably owing to abrasion.	Up to 3½ mm. dia.	A few present.	Partly open and partly covered by an open-meshed endosomal lattice.
" " "	S. C. M. No. 400. 103 mm. high.	Present in some numbers; strong.	Present; large.	Small; up to 1½ mm. dia.	Present; fine and short; hairy.	ditto.
S. entacanthus IJ.	S. C. M. No. 242. Very large.	Not present.	Present in some places; small to moderately large.	Up to 3 mm. dia.	Numerous; strong; spinose.	Entirely covered by an open-meshed endosomal lattice.
" " "	S. C. M. No. 403. Much smaller.	A few present; weak.	Not found; evidently on account of abrasion.	Up to 2 mm. dia.	Numerous; strong; spinose.	ditto.

altogether suppress the apprehension that further studies on more material than is at present available may necessitate changes of greater or less importance in the systematic arrangement of the specimens now referred to those species.

(For use in comparing the characters of closely similar *Staurocalyptus* species, in which the dermalia are nearly exclusively or at any rate predominantly pentactins, I append, as a foot-note,*

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mens), in which the dermalia are predominantly or nearly exclusively pentactins.

Spicules.												
Parenchymal principalia.		Prostal diactin.		Prostal or hypodermal pentactin.	Pentactinic dermalia.	Hexactinic gastralia.	Oxyhexaster.		Discoctaster.		Microdiscohexaster.
Maximum		Maximum									
									Diameter.		
Length.	Breadth	Length.	Breadth.	Length of paratangentials.	Length of rays.	Length of rays.	Diameter of normal and hemihexactinose forms.	Hemihexactinose forms.	Peripheral discoct.	Subgastral discoct.	Diameter.
					80–150 μ.	100–150 μ.	80–100 μ.	Apparently numerous.	80–100 μ.		
Long.	35 μ.			Under 2 mm.	100–165 μ.	100–220 μ.	88–130 μ.	Apparently rare.	128–180 μ.		22–24 μ or more.
						(Pentactins more numerous than hexactins).			150–200 μ. (160 μ in average).		
8 mm.	41 μ.	60 mm.	300 μ.	About 2.2 mm.	160–180 μ.	80–100 μ.	100–120 μ.	Many.	228–320 μ.		20 μ.
12 mm.	130 μ.	20 mm. +	95 μ.	Generally under 2 mm.; rarely 4 mm.	84–190 μ.	130–200 μ.	75–115 μ.	Rare.	130–170 μ.	175–213 μ.	19 μ.
35 mm. +	600 μ.			7–12 mm.	130–200 μ.	140–240 μ.	130–152 μ.	Very numerous.	120–200 μ.	280–400 μ.	20 μ.
25 mm.	520 μ.	40 mm.	180 μ.	5–6 mm.	100–170 μ.	140–175 μ.	115–160 μ.	Very numerous.	160–183 μ.	350–380 μ.	19 μ.
9 mm.	250 μ.			2–4 mm.	130–200 μ.	95–130 μ.	100–132 μ.	Not present.	155–220 μ.	220–286 μ.	Not found.
15 mm.	80 μ.			4–6 mm.	130–200 μ.	140–250 μ.	120–186 μ.	Numerous.	143–176 μ.	262–352, rarely 428 μ.	19 μ.

a table showing for each species or specimen certain noteworthy points from its characters).

STAUROCALYPTUS RŒPERI (F. E. Sch.).

Pl. XIV., figs. 26–32.

Rhabdocalyptus Rœperi. F. E. Schulze, '86, p. 51. '87 (!), p. 158 ; Pl. LXV. '97, p. 553.

Staurocalyptus rœperi. I. Ijima, '97, p. 55. '98, p. 53,

The following account of this species is here introduced mainly to record certain points which go in a measure to supplement the excellent description we have already received from F. E. Schulze, the original describer, and which seem to be of importance for a sharp distinction between this and certain other species closely resembling it.

To the liberality of the investigator just mentioned I am indebted for a gift of two slide-preparations made from the type-specimen, and on which my own observations have been solely made·

The species was obtained by the "Challenger" to the south of Puerta Buono in Patagonia (depth, 731 m.). It should exhibit a medium-sized and moderately thick-walled, vase-like or cup-like body, firmly attached to the substratum by a short stalk-like base. No prostalia of any kind were found, possibly as the result of abrasion. Through the even ectosome were seen elongated, angular or spindle-shaped and pit-like subdermal spaces, whence arose rather narrow incurrent canals. On the gastral side the large (up to 8 mm. dia.), sharply contoured, excurrent apertures were freely open, *i.e.*, not covered by endosome. The above seem to constitute the more important macroscopic features of the species.

As to the *spiculation*, all the skeletal elements are remarkable for their slenderness.

The strongest *parenchymal* diactins seem not to exceed 35 μ in breadth. The parenchymalia in general have sparsely micro-tuberculated ends, the very tips being pointed. The smaller or the more slender of them show knobs cruciately disposed around the spicular center.

The oxypentactinic *hypodermalia* have slender paratangentials under 2 mm. in length and 13 μ in thickness at base; these are smooth except at the rough outer ends and are not quite straight, but rather wavy.—Besides the oxypentactins, strands of diactins also serve to support the ectosome. These hypodermal diactins are of various lengths; they are all cruciately tubercled in the middle. While those of greater length are indistinguishable in appearance from a parenchymal diactin, the shorter ones may equal the dermalia in axial length and may have rays exactly similarly characterized as in the latter; so that, such short diact-ins, especially when in isolated positions, might as well be classed under the dermalia as under the hypodermalia. The statement therefore seems justifiable that the dermalia pass over by gradation to the parenchymalia through the intermediation of hypodermal diactins.

The *dermalia* (Pl. XIV., figs. 30 and 31) are predominantly pentactins, not infrequently stauractins and rarely monactins, not to mention the occasional diactins above referred to. In all the different forms it is quite usual that the suppressed ray or rays are indicated by vestigial knobs. Such rays as are well developed are 100–165 μ long and 6 μ or less broad at base; the microtubercles on their surface are sparse and weakly developed; their tips are conically pointed. Not only are the rays considerably more slender than in the corresponding spicules of all other closely related species of the genus, but also the roughness of surface is far less pronounced, as has already been pointed out by F. E. Schulze.

The *gastralia* (Pl. XIV., fig. 32) are oxyhexactins with similarly characterized rays, which measure 100–220 μ in length and not over 5 μ in breadth at base. Over the interspace between the freely open excurrent canalar apertures, the gastralia are present in abundance, forming a nearly regularly quadrate-meshed latticework. In this, the laths are formed frequently by two or more gastral paratangentials combined in a loose strand.

The *oxyhexasters* (Pl. XIV., figs. 27, 28) are small and very slender-rayed. Diameter, 88–130 μ. Those situated in the periphery of the wall are on the whole somewhat smaller than others in deeper situations. The short, often exceedingly short, principals bear each 2–3, nearly straight or slightly wavy and obsoletely rough terminals. Less frequently there is only a single terminal to one or more principals in an otherwise normal oxyhexaster (hemihexactinose). In the preparations at my disposal I have not discovered any regularly hexactinose oxyhexasters, but I presume that the spicules spoken of by F. E. Schulze as "small, weakly developed oxyhexacts" (Chall. Rep., Pl. LXV., fig. 6) and which should occur isolated are nothing else than such. Their rays are said to be wavy and to have a rough surface (F. E. Sch., '97).

It frequently happens that in biterminal rays of the oxyhexasters a third terminal is represented by a minute spine which seems not to have attracted F. E. Schulze's attention. In Pl. XIV., fig. 28, I have figured a case in which every principal bears a spurious terminal besides two well developed ones. Special examinations were made to convince myself of the fact that the minute spine was not an axial elongation of the principal to which it belonged. In one instance I observed a principal bearing two terminals which were quite normally disposed except that one of them was very much shorter and more rudimentary-looking than the other. There can be no doubt whatever that the cases in question represent stages preliminary to the reduction of the number of the terminals.

The *discoctasters* (Pl. XIV., fig. 26) measure 128–180 μ in diameter. Those situated subdermally seem to show no appreciable difference in any respect from others lying near the gastral surface. The slender secondary principal, not over 4 μ broad, is nearly as long, in some cases only about ½ as long, as the free terminals belonging to it. The terminals number 2–5, usually 3 or 4, in a tuft which broadens but slightly in the distal direction. They are nearly straight; the surface is obsoletely rough when seen under a very high power of the microscope. The minute terminal disc is always shaped like a pinhead, and not marginally toothed.

The delicate *microdiscohexasters* (Pl. XIV., fig. 29) are found in tolerable abundance in the gastral region. Diameter, 22–24 μ

(32 μ, according to F. E. SCH.). In shape they are spherical, the six tufts of terminals in the same spicule being not widely separated from one another. The terminals are not very numerous; they are exceedingly fine and about twice as long as the principal.

The slimness of the rays in all the spicules, the sparsely microtuberculate character of the dermalia and gastralia as well as the small size of the discoctaster seem to make up the more conspicuously distinctive features in the spiculation of this species.

STAUROCALYPTUS DOWLINGI (L. M. LAMBE).

Rhabdocalyptus dowlingi. LAMBE, '93 (!), p. 37; Pl. III., figs. 2, 2*a*–2*h*.—F. E. SCHULZE, '97, p. 554.

Staurocalyptus dowlingi. F. E. SCHULZE, '99 (!), p. 47; Pl. IX., figs. 1–6.—(*Not* IJIMA '97, p. 53; *nor* IJIMA '98, p. 53).

The following account of this species is given more for the purpose of furnishing basis with which to compare certain Japanese forms, than to give the results of my own observations on the sample taken from the Canadian type-specimen and which was kindly sent to me at my request by Mr. L. M. LAMBE of Ottawa.

As mentioned before (pp. 165–167) I now consider, contrary to my earlier assumption (IJ. '97), that this species is not represented in the Japanese waters so far as is known at present. The localities then to be assigned to the species are: Strait of Georgia (Canada; about 63 m.), near St. Rosa Island (California; 221 m.). and near Lenard Rock (Aleutian Islands; 512 m.).

According to the descriptions of L. M. LAMBE and F. E. SCHULZE, the species should show a tolerably thick-walled broadly sacciform body, somewhat outbulged on one side and narrowed at base. It may attain a large size, as attested by a fragment of the wall 300 mm. long and 15 mm. thick, obtained by the "Albatross" on the Californian coast. From all over the dermal surface there stand out both diactinic and pentactinic prostalia. The gastral surface is smooth but may show in places the ends of some parenchymal oxydiactins projecting beyond it. The subdermal space is evidently of a quite insignificant width. The apertures of both the incurrent and excurrent canals seem to be small as a rule. LAMBE gives $1\frac{1}{2}$ mm. as an average diameter of the larger and $\frac{3}{4}$ mm. as that of the smaller incurrent apertures of a specimen 100 mm. high. The same specimen showed on the internal surface evenly distributed excurrent apertures of about $\frac{3}{4}$ mm. diameter. A continuous endosomal layer is apparently not present over the excurrent apertures, which thus seem to open free into the gastral cavity.

The single imperfect specimen,—220 mm. high and 120 mm. broad,—obtained by the "Albatross" near the Aleutian Islands and referred to the present species by F. E. SCHULZE, requires special mention in so far as it has, in contrast to the specimens from Canada and California, very wide canals and subdermal spaces, on which account the upper part of the wall is said to have presented an appearance almost of a lamellar structure. It seems to me that this structural deviation apparently extends somewhat beyond the ordinary range of variability to be expected in different individuals of a Rossellid species.

With respect to *spiculation* the more important points, known to me from the descriptions of LAMBE and SCHULZE as well as from my own observations, may be summed up as follows :

Parenchymalia, oxydiactins under 8 mm. length and 41 μ breadth.

The small diactins with 2 or 4 knobs at the middle and of 0.28–1.37 mm. length, mentioned by LAMBE as occurring in the dermal and gastral layers and seen also by SCHULZE, are apparently either those that enter into the composition of hypodermal beams together with the paratangentials of oxypentactinic hypodermalia or what might be called the hypogastralia.

Prostal oxydiactins, as long as 60 mm. with a thickness of 300 μ.

Hypodermal oxypentactins, mostly with orthotropal (*i.e.*, regularly cruciate) paratangentials, which are smooth and measure about 2.2 mm. in length. In those oxypentactins which stand out as prostalia, the paratangentials and the base of the shaft-ray have a densely granular surface.

Dermalia, rough pentactins ; with rays rounded at end, 160–180 μ long and 10–13 μ thick. Exceptionally the dermalia are diactinic.

Gastralia, similar but somewhat smaller hexactins, with rays of 80–100 μ in length.

Oxyhexasters, numerous ; each very short principal with two, straight, moderately strong and slightly rough terminals ; 100–120 μ in diameter. Many are hexactinose (then up to 138 μ dia. or axial length) ; some others are hemihexactinose.

Discoctasters, abundant especially in the deeper parts, 228–320 μ (as a rule 260 μ) in diameter. Principals, short being $\frac{1}{5}$–$\frac{2}{5}$ of the entire arm-length. Terminals, nearly straight, slightly rough, 3–10 (most usually 4) in number to each slightly expanding tuft. Terminal disc, pinhead-like or marginally toothed. Central node, generally without hillock-like prominences on its six sides.

Microdiscohexasters, common especially in or near the dermal and gastral layers; spherical; about 20 μ in diameter.

The points to be especially noted in the spiculation of this species, in relation to that of others that very closely resemble it, seem to be the slenderness of principal parenchymal diactins, the small-size of prostal pentactins and the fact that the discoctasters do not fall below 200 μ in diameter.

STAUROCALYPTUS TUBULOSUS NOV. SP.

Contrib. III (IJIMA, '03), Pl. VI., figs. 11–17.

This is a species which, like certain others of the genus, is but little differentiated from *S. dowlingi* of the N. American Pacific coast and yet seems to deserve being erected into a distinct species. The only type-specimen of the species is shown in my Contrib. III., Pl. VI., fig. 11. The original (S. C. M. No. 241) was obtained in Homba from a depth of 572 m.

The specimen is a nearly complete individual of a slightly bent, tubular and spindle-like shape, 50 mm. long and 12–14 mm. broad at the middle, where the wall is about 2½ mm. thick. The body is somewhat laterally compressed. The oval osculum at the superior truncated end measures 4 mm. by 8 mm. in diameter. The inferior portion of the sponge gradually narrows towards the pointed torn-off base. The texture of the wall-tissue is rather firm.

A number of thin and isolated diactinic prostalia project at low angles from the lateral surface, and are directed obliquely upwards. They are generally 16 mm. or more in length. Close to the thin oscular edge they are more numerous than elsewhere but shorter, projecting straight upwards to a length generally under 3 mm. Here and there, especially near the oscular margin, some pentactinic prostalia are also found. These are not large nor numerous; they project to the extent of at most 1 mm. beyond the dermal surface. The latter is rather uneven, though no conical or papilla-like elevations exist.

The endosomal layer appears closely adherent to the choanosomal mass, which fact is undoubtedly greatly due to the smallness of the incurrent canals. The dermal lacework is but indistinctly visible even when observed under the lens. Beneath it are seen thin hypodermal fibers,—mostly the paratangentials of hypodermal pentactins,—intersecting one another in an indefinite way, while in places they converge towards several central points.

The incurrent canalar apertures are not larger than about 1 mm. across. On the gastral surface, the very small apertures of excurrent canals are of a roundish or irregular shape, measuring about ½ mm. in average diameter. They open close together, without being covered over by a special endosomal latticework. The entire gastral surface, when looked at horizontally, presents a finely and somewhat uniformly hairy appearance. This is caused by the trichodal ends of numerous parenchymal diactins freely protruding beyond the surface to the length of about half a millimeter or more.

Macroscopically the sponge may be said to be but slightly different in appearance from *S. dowlingi*, except perhaps in its generally tubular shape and the peculiarly hairy character of the gastral surface. Certainly these features have yet to be shown to be constant before they can be finally accepted as specific differential characters. However they seem to me to be not unimportant when taken into consideration conjointly with certain points in the spiculation in which the present species stands in disagreement with *S. dowlingi*.

Spiculation.

The *principal parenchymalia* are oxydiactins which not infrequently attain a length of 12 mm. and a breadth of 130 μ in the middle. Generally, however, they are much smaller, being under 10 mm. in length. The ends are finely attenuated and smooth-surfaced. Compared with *S. dowlingi*, the parenchymalia of the present species are on the whole considerably coarser. (In *S. dowlingi* the maximum dimensions of parenchymalia, in specimens very much larger than the type of *S. tubulosus*, are known to be length 8 mm. and breadth 41 μ).

The *oxydiactinic prostalia* may attain 20 mm. or more in total length and 95 μ in greatest breadth. (In *S. dowlingi* 60 mm. by 300 μ).

The *oxypentactinic prostalia* are generally small, inconspicuous and usually isolated, but sometimes stand out in small loose groups. The paratangentials are either paratropal or nearly regularly cruciate. Their length rarely reaches 4 mm.; more generally they are much shorter (under 2 mm.). In the prostalia situated close to the oscular margin, they measure scarcely 1 mm. in length. The proximal ray (shaft) may be twice as long as the paratangentials in one and the same spicule. In size and shape the spicules in question seem to agree approximately with those of *S. dowlingi*, but the paratangentials in the present species show a noteworthy feature, perhaps peculiar to the species, in the close-set microtubercles that give roughness to their surface. The microtubercles are not rounded as usual but take the form of fine, short and sharply pointed microspines (Contrib., III., Pl. VI., fig. 13), somewhat as in *Lanuginella pupa* and *Scyphidium longispina* (this Contrib., Pl. I., fig. 7 and Pl. II., fig. 3). They stand nearly vertically or slightly inclined outwards, giving a fine and densely hirsute, rather than "granular," appearance to the surface beset by them. This appearance is acquired by the paratangentials before the pentactins are protruded as prostalia, apparently as the last step in the development of hypodermal (*i. e.*, prospectively prostal) pentactins. This is clearly indicated by those groups of hypodermal pentactins (Contrib. III., Pl. VI., fig. 12) in which the most superficially situated pentactin-head consists of rough paratangentials while another or others following in deeper levels are smooth and successively more slender rayed.

A small number of diactins associate with the paratangentials of hypodermal pentactins in forming the support to the dermal lacework.

The *dermalia* (Contrib. III., Pl. VI., figs. 14 and 15) are predominantly rough pentactins but intermixed with a goodly number of stauractins. The former frequently, but not always, show a knob-like relic of the atrophied sixth and distal ray. Rarely and exceptionally I have encountered hexactins among the dermalia. In all these the rays taper slightly towards the rounded or obtusely pointed ends. Their length as measured from the spicular center, 84–190 μ; on the average about 140 μ. Breadth of rays near base, 7–12 μ. I have noticed that the stauractins attain on the average a considerably larger size than the pentactins (see Contrib. III., Pl. VI., fig. 12). (For the sake of comparison I may mention that in *S. dowlingi* the dermalia are known to be generally pentactins and occasionally diactins. Length of rays, 160–180 μ; according to LAMBE, 160 μ on the average).

The *gastralia* are all hexactins with rays similar in appearance to those of the dermalia. Length of rays, 130–200 μ (in *S. dowlingi*, 80–100 μ).

Oxyhexasters (Contrib. III., Pl. VI., fig. 17) occur in abundance. They are mostly normally developed; less frequently are they hemihexactinose. Quite hexactinose forms are very rare. The central node is often swollen to a spherical shape. The principals are as usual short—often exceedingly short. The diameter is in general 75–115 μ (in *S. dowlingi* 100–120 μ).

The oxyhexasters in the subdermal region mostly measure less than 100 μ in diameter. In them the terminals are slender, slightly rough and 2 or 3 in number to each principal.

Those situated more deeply in the wall are on the whole somewhat larger, many also having perceptibly stronger terminals, which are then nearly smooth-surfaced.

From this species again I am in a position to record a case of an oxyhexaster in which five of the principals bore each a set of two, nearly equally developed terminals, but the sixth principal ran out into a single normal terminal besides showing near its base the short and spurious rudiment of a second terminal. By one short step of reduction, the oxyhexaster might change itself into a hemihexastinose form with one uniterminal principal.

The *discoctasters* may in general be said to have a diameter of 130–213 μ; the principal takes up nearly one half or somewhat less of the entire ray-length. Terminals straight, nearly smooth, 2–5 in a tuft which broadens gradually and slightly outwards. The smaller discoctasters show six tubercles on the central node, but the larger ones do not. Those in the subdermal region are smaller than others in the subgastral; the former measuring 130–170 μ, and the latter 175–213 μ, in diameter. The specimen spicule shown in Contrib. III., Pl. VI., fig. 16, is from the subdermal space. (In *S. dowlingi* the discoctaster diameter is known to be 228–320 μ, manifestly never falling below 200 μ).

Spherical *microdiscohexasters* of 19 μ diameter and of the usual appearance are found very sparsely distributed in the endosomal layer. I consider that they require no special description.

STAUROCALYPTUS AFFINIS NOV. SP.

Pl. XIII. and Pl. XIV., figs. 14, 16, 17, 22–25.

Staurocalyptus Dowlingi in part. IJIMA, '97, p. 53; '98, p. 53.

This new species is based on two specimens in the Science College Museum, which were at first—erroneously, I now think

—taken by me for *S. dowlingi.* This would suggest its close resemblance to that species and also to *S. tubulosus,* a fact which can not be gainsaid. The two specimens differ in certain points of outward appearance but show an essential or almost complete agreement in spiculation. Such differences as exist between them are manifestly referable to difference in individual age and partly also to the different state of their preservation ; so that, I have scarcely a doubt as to their specific identity. I propose to call them *S. affinis.*

Each of the two specimens serves greatly to supplement the knowledge to be derived from the other. They will be separately described as regards their macroscopic characters.

The one I take up first (S. C. M. No. 194, from which all the figures in Pl. XIII. are taken), was purchased of a Misaki fisherman in 1891. The locality as put down on the label is Okinosé ; depth not stated. The specimen consists of large and small dried fragments which must originally have formed the wall of a tubular or vase-like form, assumably about 300 mm. in height and not less than 100 mm. in diameter. The maximum thickness of the wall is about 9 mm. Owing to imperfect desiccation the texture is soft and loose, the tissues easily falling off in crumbs and shreds.

The external surface is much abraded. No lateral prostalia, which I presume were once present, are preserved. However, the delicate ectosome still remains here and there in small patches. It adheres closely to the choanosomal surface and consists of the usual dermal lacework supported by thin and irregularly intersecting hypodermal strands (see Pl. XIII., fig. 10). The dermal meshes, of approximately quadrate shape, are on an average about 165 μ wide.

The external choanosomal surface (Pl. XIII., fig. 1) is tolerably even and presents a coarsely fibrous appearance. It exhibits variously sized, roundish, incurrent canalar apertures, the largest of which may measure 3½ mm. in diameter. The larger apertures are separated from one another by an interspace nearly as wide as themselves or even considerably wider. They lead into deep pit-like canals.

The gastral surface (Pl. XIII., fig. 2) is on the whole excellently preserved. On it there open numerous, closely set, roundish and sharp-edged excurrent apertures measuring not more than 2 mm. in diameter. Most of them open freely and directly into the gastral cavity without a covering endosome, similarly as in several species of the genus (*S. ræperi*, *dowlingi*, *tubulosus*, *solidus*). In many cases the apertures are provided with an iris-like rim. It is, however, a remarkable fact that a covering endosomal latticework is not entirely undeveloped. Such a structure is in fact to be found here and there in small irregular areas, some of which are to be seen in Pl. XIII., fig. 2. It consists of irregularly reticulate beams, mainly composed of diactinic hypogastralia and inclosing small angulate meshes. These meshes are open, not filled in by a continuous gastral lacework ; they can easily be distinguished from the underlying canalar apertures proper by their position, small size and irregular shape. The above endosomal layer, so far as it is distinctly differentiated, greatly resembles in appearance that of *Acanthascus cactus* (Pl. XI., fig. 16).

No diactins are found that project their ends through and beyond the gastral surface except such occasional cases as may be regarded as due to unnatural displacement.

The loose feltwork of the parenchyma contains a quantity of coarse strands, running more or less parallel to the surfaces but otherwise in all directions (Pl. XIII., fig. 1). Especially coarse is its appearance on the external side of the wall. Picked up by means of a pincette the strands easily come off in strips often as long as 40 or 50 mm. At the torn edge of the wall the fibers bristle out in a conspicuous manner.

The second specimen (S. C. M. No. 400, shown in Pl. XIV., fig. 14) was obtained by Kuma in the Uraga Channel (Nago Hill-⊖-Daibusa Spit and about 4 kilom. off the latter). It resembles a tube which laterally is slightly and irregularly compressed. It is 103 mm. long, 24–27 mm. broad in the middle and considerably broadened at the lower end. At one corner of the latter there is a small stalk-like base for attachment. At the opposite corner the wall is outbulged and thinned out at the top, apparently in the first stage of the breaking through of a secondary osculum. It is to be noticed that both this outbulging and the attachment base lie in the sagittal plane of the body, as is the rule with so many other Acanthascinæ with similar parts. The upper truncated end of the body is taken up by an oval-shaped osculum. The wall is about 6 mm. thick in the inferior part, gradually becoming thinner towards the oscular edge.

From all over the external surface, except near the basal stalk, there arise both oxydiactinic and oxypentactinic prostalia lateralia. The prostal diactins are not very numerous; they are long needles that spring out isolatedly to a length of 30 mm. or less, directed obliquely outwards and upwards. In the upper part of the body they are finer and much shorter than those situated lower down. Along the oscular edge they project straight upwards, the exposed portion not exceeding 4 mm. in length.—The large prostal pentactins, either isolated or in loose tufts, arise from the top of small papilla-like prominences of the dermal surface, situated at intervals of 1–2½ mm. The pentactins, wherever they have escaped the influence of abrasion, are so numerous and crowded together that they form a gauzy layer of 3 or 4 mm. thickness over the dermal surface.

The latter is tolerably smooth except for the above-mentioned papillæ. Close beneath the thin ectosomal layer are seen the roundish apertures of the incurrent canals, which, in the lower part of the sponge, may measure up to 1½ mm. in diameter. The smallness of the canals in comparison with those of the first specimen seems to be sufficiently accounted for by the much smaller size of the individual.

The characters of the gastral surface are essentially the same as in the first specimen. Namely, while most excurrent canalar apertures are freely open, certain others are covered over by an irregularly meshed endosomal latticework. A number of small oxydiactinic parenchymalia are seen to project their fine ends beyond the gastral surface to the extent of about 1 mm. or more.

Taken all in all, the general appearance of the species is closely similar to that of both *S. dowlingi* and *S. tubulosus*, but especially of the latter. With our present knowledge it would be unsafe to pick out this or that macroscopic character in the above description of the specimens as in any degree distinguishing the species from either of the two just mentioned. It may further be stated that the spiculation, so far as the kinds of spicules entering into it are concerned, is to a great extent, if not essentially, the same in all the three species (to which I may add *S. entacanthus* n. sp. as a fourth). Nevertheless, there exist certain points of difference shown by several of their spicules, that seem to warrant the separation of *S. affinis* as a distinct species.

Spiculation.

The following description applies to the first specimen (S. C. M. No. 194; Pl. XIII.), unless the other specimen (S. C. M. No. 400; Pl. XIV., fig. 14) is explicitly referred to.

The *principal parenchymalia* are oxydiactins of unusually large dimensions, often 35 mm. or more in length and 600 μ in thickness in the middle. (A portion of one is seen in Pl. XIII., fig. 12). They occur in great abundance, especially in the periphery of the choanosome. They are entirely smooth, tapering gradually towards both finely attenuated and sharply pointed ends. They are slightly wavy or else are bent either in a bow-like or in a boomerang-like manner. Diactins of gradationally intermediate shape and dimensions lead over the principalia to filamentous comitalia of only 12 μ or less in thickness.

In the second and smaller specimen the principalia attain a length of 25 mm. and a breadth of 520 μ.—It may be remarked that in no other *Staurocalyptus* species are the parenchymal elements known to develop such length and coarseness.—The needle-like prostal oxydiactins which were found only in the second specimen may be 40 mm. long and 180 μ thick.

The diactins which join in the formation of *hypodermal strands* are mostly short, having a length of 1–2 mm. and a breadth of 14–33 μ at the middle, where they may show a slight annular swelling. The ends are rough, somewhat tapering and obtusely or conically pointed,—not swollen as in the much longer parenchymal comitalia. The diactins run sometimes singly but more usually a few are combined into thin bundles.

The *hypogastral diactins*, likewise running singly or in loose strands (see Pl. XIII, fig. 11), are similar to the hypodermal.

The *oxypentactinic hypodermalia* (to be seen in Pl. XIII., fig. 12) are large spicules with smooth, nearly straight or slightly bent rays. The paratangentials are in most cases more or less distinctly paratropal, but sometimes regularly cruciate. Their length measures 7–12 mm. and their thickness at base, about 100 μ. The unpaired proximal ray is longer; it is accompanied by numerous thin comitalia (about 9 μ thick) of the usual character.

In the second specimen I find the hypodermal (and also the prostal) oxypentactins somewhat smaller, the paratangentials measuring mostly between 5 and 6 mm. in length. Nevertheless it may be said that the spicule in question is on the whole considerably larger in the present species than in either *S. dowlingi* or *S. tubulosus*. Decidedly larger does it seem to be than in the former species, in which the paratangentials are said not to exceed 2.2 mm. in length.—The paratangentials of those pentactins already protruded as prostalia remain smooth in most cases. Only occasionally have I met with such prostal pentactins as have slightly rough or granular paratangentials. The roughness is here due to the presence of rounded and inconspicuous microtubercles somewhat like those in *S. dowlingi* but unlike the same in *S. tubulosus*.

The *dermalia* (Pl. XIII., fig. 3) are nearly exclusively pentactins; rarely and exceptionally, stauractins. The paratangentials are nearly straight or very slightly arched. All the rays are rough throughout; they generally taper perceptibly outwards to terminate with rounded tips. Their length as measured from the spicular center is 130–200 μ; on an average, 160 μ; breadth close to base, 11–15 μ. In the second specimen the length was 100–170 μ or on an average 130 μ; the breadth, 7½–10 μ.—The dermal paratangentials form a tolerably regularly quadrate-meshed dermal lacework (Pl. XIII., fig. 10).

The *gastralia* (Pl. XIII., fig. 4) are hexactins with similar but often longer rays than those of the dermalia. Length of rays, 140–240 μ; in the smaller specimen, 140–175 μ. The free proximal ray is not distinguished from the others by a greater length. The gastralia are present in far too sparse a number to form a continuous lacework by themselves (Pl. XIII., fig. 11). They are found in irregular distribution in the spaces between the excurrent canalar apertures as well as on the endosomal reticular beams, where these are developed.

The *oxyhexasters* (Pl. XIII., figs. 7 and 9; Pl. XIV., figs. 16 and 17) measure 130–152 μ in diameter (in the second specimen, 115–160 μ). They are exceedingly numerous both in the choanosome and the endosomal layer. While in the former the hexactinose and the hemihexactinose forms predominate, in the latter region the normally developed form is by far the most abundant.

The normal oxyhexasters, occurring in the endosome or in its proximity (Pl. XIII., fig. 9; Pl. XIV., fig. 16), show two or sometimes three, generally smooth, nearly straight and widely divergent terminals to an excessively short principal. The central node is often spherically swollen, but not sharply dermarcated from the principals.

In the subdermal space, oxyhexasters are altogether sparse and those that do occur there are as a rule again normally shaped. They are on the whole slightly smaller and more slender-rayed than in those in or near the endosome; besides, the terminals are always more or less distinctly rough (Pl. XIV., fig. 17). The roughness is in many cases plainly attributable to minute and inwardly directed barbs, especially distinct in the basal parts of terminals.

Hemihexactinose forms of the oxyhexaster most commonly show one or two uniterminal principals, the rest of the principals being each in possession of two terminals as is usually the case. The terminals are nearly straight and more or less rough-surfaced.

Hexactinose oxyhexasters (Pl. XIII., fig. 7) have likewise rough rays which are however frequently not quite straight but somewhat wavy. They are quite numerous in the choanosome, a fact which may perhaps be regarded as constituting one of the peculiarities of the species.

Occasionally I have met with interesting exceptional forms of the oxyhexaster, in which the hexactinose character is still further modified into the pentactinose and even the stauractinose by a complete suppression of the terminals on one or more of the principals. The principals, thus deprived of their terminals, remain in their position as smoothly rounded off prominences which leave no room to doubt that the terminals have not been lost by mechanical breakage but were undeveloped from the first. The above, evidently abnormal, forms were not noticed in the second specimen. In this, on the other hand, I have not infrequently met with the small rudimentary-looking spicules shown in Pl. XIV., fig. 22. These contain a small axial cross of filaments and there can be no doubt about their being oxyhexasters with terminals but little developed, though it is difficult to decide whether we have to do with early developmental stages or with abnormal appearances.

The *discoctasters* occur in the subdermal space as well as near the gastral surface. They are not very abundant, though in places several are found together. Right in the choanosome they must be very rare, if indeed they are ever present. Two sizes are distinguishable according to their position. The smaller discoctaster form (Pl. XIII., fig. 5), measuring 120–200 μ (in the second specimen, 160–183 μ) in diameter, occurs only in the subdermal space; while the larger (Pl. XIII., fig. 6) of 280–400 μ (in the second specimen, 350–380 μ) is confined to the proximity of the gastral surface. The range of variability in the size of discoctasters is here decidedly wider than in either *S. dowlingi* or *S. tubulosus*.

As to general shape the discoctasters in general closely agree with those of several other nearly allied *Staurocalyptus* species and also with those of *Acanthascus cactus*. The principals take up $\frac{1}{3}$–$\frac{2}{5}$ of the entire ray-length, are unevenly contoured, thicken somewhat in the outward direction and carry a slightly expanding tuft of 3–7, straight or nearly straight terminals. The central node, especially that of the smaller discoctasters, frequently shows the six well-known tubercles. In the larger form, the distal portion of the terminals is beset with minute but distinct barbs (fig. 6) and the terminal disc exhibits a number of marginal teeth exactly as I have figured them from *Acanthascus* cactus (Pl. XII., fig. 28). In the smaller form, the terminals are simply rough and the terminal discs pinhead-like.

The discoctaster as well as the oxyhexaster,—of the latter, both the normal and the hexactinose forms,—I have subjected to special examinations in order to determine the position and extent of the central cross of axial filaments in the central node. The results are embodied in Pl. XIV., figs. 23–25, which will speak sufficiently for themselves, so that comments upon them may here be dispensed with.

Microdiscohexasters (Pl. XIII., fig. 8) of spherical shape and 19–20 μ diameter are not uncommon in or near the endosomal layer. They were occasionally observed in the ectosome also. From a spherical node arise comparatively thick principals, which in length are about $\frac{1}{3}$ the radius of the rosette and each of which carries at the outer end a small disc, usually provided with a central tubercular prominence on the external side. The terminals are exceeding fine and difficult to count, but probably not more than 10 to each principal.

Finally, the *basidictyonal plate*, found preserved in the second specimen, is rather thick and consists of an irregular reticulum of beams of variable thickness (up to 30 μ), inclosing mesh-like spaces up to 100 μ in width. The beams are beset with small prickles as well as with larger conical protuberances. Here and there can be observed hexradiate axial crosses in the nodal points. Also some rough and thick-rayed hexactins are seen in the first process of being amalgamated with the basidictyonal beams. Pl. XV., fig. 12, taken from *S. glaber*, equally well illustrates the condition of the basidictyonalia in the present species.

The chief points in the spiculation of the present species, requiring special attention in relation to such other species as are most likely to be confounded with it, seem to be: the great length and coarseness of the principal parenchymalia; the large size of prostal pentactins, in which the paratangentials are in most cases smooth but occasionally slightly granular; the comparatively large size attained by gastral hexactins; the great abundance of hexactinose oxyhexasters; and the wide range (120 μ–400 μ) of variation in the size of discoctasters as well as their large maximum size. (For a comparative table of the main distinctive features of this species and of certain others, see the foot-note on pp. 166–167).

STAUROCALYPTUS ENTACANTHUS NOV. SP.

Pl. XIV., figs. 15, 18.

Staurocalyptus Dowlingi in part. IJIMA, '97, p. 53; '98, p. 53.

The specimen which I now make the type of this new species is another that was at first placed by me under *S. dowlingi*. Its characters were therefore taken into account in drawing up the diagnosis of that species given by me in '97.

The said specimen (Pl. XIV., fig. 15. S. C. M. No. 242) comes from the north of Onigasé and from a depth of between 429 and 572 meters. It is a large piece of wall torn from the superior end of an individual, which when entire must have had a sac-like or vase-like shape with a diameter of nearly a foot. It exhibits a part of the natural oscular edge, which is sharply angular but not thin. The marginal zone, is divided into a number of broad triangular flaps, folded outwards and backwards and even partially rolled up, so that in places the oscular edge is in touch with the dermal surface of the lateral wall. Between each two of the flaps there remains in the oscular edge an unreflected point; consequently there arises at each such position an ear-like projection, which is all the more prominent since the edge of reflection of the flaps on its either side is depressed so as to present a concavity directed upwards. There are three such ears in the fragment on hand, measuring 105–145 mm. from tip to tip of two adjacent ears. In the entire state of the individual there must have existed at least seven ears and as many reflected flaps around the superior opening of the gastral cavity.

The wall is 13 mm. thick at a point about 100 mm. below the tip of the ears and must have been thicker towards the sponge-base.

The state of preservation of the specimen which has been dried, is as good as could be desired. The dermal surface is tolerably smooth, distinctly showing the delicate, regularly quadrate-meshed dermal lacework and the irregularly meshed hypodermal network. On close observation, the thin fibers composing the latter are seen to be so arranged as to present numerous radial figures, the centers of which are 2½–6 mm. apart from one another. Pentactinic prostalia of medium size are found only on parts of the external surface that are protected from abrading influences by the folding of the marginal flaps. They are irregularly distributed, usually solitary and project to the length of at most 3 mm. Except a few isolated and quite insignificant needle-like spicules springing out on the sharp oscular edge, no diactinic prostalia are present. Presumably, however, the species in a young stage of growth is provided with a greater quantity of both pentactinic and diactinic prostalia.

The larger apertures of incurrent canals, vaguely visible through the dermal layer, may be 3 mm. wide, and that in a position not more than 100 mm. distant from the uppermost end of the specimen. In the interspaces between the apertures the ectosomal layer is in tolerably close contact with the choanosomal surface.

The gastral surface, so far as this extends in the specimen, is entirely lined with a well-developed endosomal latticework, which is for the most part very distinctly set apart from the underlying choanosome and covers up all the excurrent canalar apertures (up to 3 mm. dia.), in a measure concealing these from view. Its appearance is not unlike that of the same structure in *S. affinis,* in which species, however, it is developed in but small irregular patches and not all over the gastral surface. The endosomal beams, the main support of which is afforded by strands of hypogastral diactins, are of a moderate strength and inclose small, irregularly shaped meshes (mostly ½–¾ mm. wide), which are open and not filled in by a continuous lacework of gastralia, unlike those in *S. fasciculatus* but quite like the same of *Acanthascus cactus* (see Pl. XI., fig. 16). This endosomal latticework, probably developed over the entire gastral surface and leaving none of the excurrent canalar apertures quite freely open, may be regarded as one of the distinctive features of the present species as contrasted with many closely related forms in the same genus.

Another noteworthy, and I think characteristic, point in the features of the gastral surface is the fact that numerous, moderately strong oxydiactins project freely beyond the surface, mostly to a length of 4 or 5 mm. There is no rule as to the direction of the projecting needles, which occur over the entire gastral surface so far as this is represented in the fragment, but somewhat more abundantly in the region of the reflected marginal flaps than lower down. They give to the gastral surface a peculiarly hispid or spiny appearance, an idea of which may be obtained from the appearance presented by the upper border of fig. 15, Pl. XIV. Similarly disposed needles are known to me to occur on the gastral surface of *S. tubulosus* and *S. affinis;* but in both these species their trichodal ends project to so short an extent that their effect upon the surface is to render it at most delicately hairy. *S. dowlingi* also seems to be not altogether devoid of needles protruding from the gastral surface; but here, F. E. SCHULZE ('99, p. 49) was led to regard them as something of occasional and rather accidental occurrence; while L. M. LAMBE ('93), in his description of that species, says that the gastral surface is smooth, and makes no mention of projecting needles. Now, in the present species, the needles in question are spicules, coarse rather than fine and of a considerable length, and moreover so abundant that they can not fail at once to attract one's attention; and in view of the well-preserved state of the tissues, I see no reason for not assuming that we have here to do with a normal character, probably constant to the species.

Here I may interpolate an account of a specimen which I provisionally refer to *S. entacanthus* but with a query. While agreeing as regards many characters with the above-described type-specimen, it shows several points of difference, especially in regard to the spiculation,—differences, which, on further study with more material, may possibly turn out to be of more than individual value.

The specimen in question (S. C. M. No. 403) was obtained at Inside Okinosé by the Iwado-line from a depth of 618 m.

Two views of it have already been published in my Contribution III., Pl. VI., figs. 9 and 10. Appended to them will be found the name of *S. japonicus*, an appellation which I beg herewith to withdraw.

The specimen is the upper portion of a thick-walled and probably tubular or cylindrical individual. It is about 62 mm. long by 42 mm. diameter; the wall is 9 mm. thick in the thickest part. While the gastral cavity is nearly cylindrical throughout, the external surface curves in at the top forming a rather thick oscular edge. The osculum is irregularly roundish with a diameter of 22–24 mm. I presume that pentactinic prostalia in tufts, were originally present but have been lost by breakage, for there exist stumps of what appear to be their shafts arising in association with small papilla-like prominences of the dermal surface, which is on the whole tolerably smooth. The said prominences occur on the average at intervals of about 3 mm. Of diactinic prostalia some remnants seem to be represented by a few, fine and isolatedly projecting needles. The apertures of the larger incurrent canals reach up to nearly 2 mm. in diameter; those of an approximately similar size are separated from one another by an interspace usually wider than their own diameter. Over this interspace the thin and delicate ectosomal layer is closely adherent to the choanosome.

The endosomal layer, closely similar to that of the type-specimen (*i.e.*, consisting of a small and irregularly meshed lattice-work, in which the meshes are not filled in by a dermal lacework but remain open), is well differentiated over the entire gastral surface. Accordingly, no excurrent canals can be said to open freely and directly into the gastral cavity. Not only in this respect does there exist an agreement with the type-specimen but also in the strikingly and densely hispid character of the gastral surface (see Contrib., III., Pl. VI., fig. 9). This is caused by numerous projecting needles of a moderate strength, occuring from the oscular edge downwards over the entire gastral surface of the specimen. They are firmly implanted in the sponge-wall, their inner ends protruding 5 mm. or more, sometimes vertically but more usually inclined in indefinite directions. It is entirely beyond question that the spiny character of the internal surface is not accidental but natural.

The spicules of this specimen will be specially dealt with after I shall have described those of the type-specimen in the following paragraph.

Spiculation.

First, that of the type specimen (Pl. XIV., fig. 15).

The *principal parenchymalia* are oxydiactins which may attain a length of 9 mm. and a breadth of 250 μ in the middle. They are relatively thick, nearly straight but sometimes bow-like or boomerang-like spicules; entirely smooth and not very much attenuated towards both sharply pointed ends. Small and finer parenchymalia are of the usual characters.

The needles projecting from the gastral side are oxydiactins similar in appearance to the principal parenchymalia. They may be 9 mm. long and 90 μ thick. A varying number of fine comital diactins are found accompanying them.

Hypodermal oxypentactins are mostly found several together in loose groups, in which the smaller and therefore younger ones are always more deeply situated than those of older formation.

When fully grown, the paratangentials, which are either paratropal or regularly cruciate, measure 4 mm. in length and 65 μ in thickness at base. They may acquire a rough surface, due to rounded microtubercles, while still remaining in the hypodermal situation. But this apparently does not take place in all cases, for among the oxypentactins already protruded as prostalia I have found some with rough and others with perfectly smooth paratangentials.

Diactins also enter into the composition of the hypodermal strands though not in large numbers. These hypodermal diactins are somewhat variable in size and characters. While the larger of them are indistinguishable from ordinary parenchymalia, others are small, tubercled around the center and rough all over instead of being so at the ends only. The latter kind might easily be taken for dermalia, were it not for their association with unmistakeable hypodermal elements.

The *hypogastralia* are diactins similar to those of the hypodermal strands.

The *dermalia* and *gastralia* may be said to be essentially like those of *S. dowlingi*, *tubulosus* and *affinis*.

On the pentactinic dermalia, which are by far the predominant form, I have frequently observed a low prominence in the place of the aborted distal ray. Length of rays, 130–200 μ. Rarely stauractins and still more rarely diactins are met with among the dermalia.

With respect to the hexactinic gastralia, it may be mentioned that these are on the whole somewhat smaller than the same spicules in either *S. tubulosus* or *affinis*, agreeing closely in this respect with *S. dowlingi*. Length of rays, 95–130 μ.

The *oxyhexasters* measure 100–132 μ in diameter, thus coming next in size to the same rosette in *S. dowlingi* and *tubulosus.* A goodly number of them are hemihexactinose, but I have found none in quite hexactinose form. This negative character may perhaps be regarded as one of the peculiarities of the species, or at any rate of the particular specimen now being described. The terminals are rather strong (often 4 μ thick at base),—stronger than I have found them to be in other closely similar species of the genus. Moreover, they are always rough, the roughness being frequently developed into short barbs on the basal parts.

Of the *discoctasters,* those in the subdermal space measure 155–220 μ in diameter ; those in or near the endosome, 220–286 μ. It may be pointed out that the lower limit (155 μ) in this range of variation falls considerably below that in *S. dowlingi* (228 μ) but coincides in an approximate way with the same in *S. tubulosus* and *affinis.* In all of the discoctasters the principal is somewhat shorter than, or sometimes nearly as long as the terminal tuft belonging to it. The general appearance of the spicule agrees well with that of the same in *S. affinis.* In no case, however, have I noticed the six prominences on the sides of the central node.

Microdiscohexasters I have failed to discover anywhere in the specimen ; but, in view of the ease with which they might be overlooked, I am not fully prepared to assert their total obsence.

Now let me describe some points in the spiculation of the smaller specimen (No. 403 ; Contrib., III., Pl. VI., figs. 9 and

10), provisionally referred by me with some degree of hesitation to *S. entacanthus.*

Here the principal parenchymal oxydiactins attain a maximum size of 15 mm. length by 80 μ breadth. Thus they may be longer and decidedly more slender than in the type-specimen. Another appreciable point of difference consists in the more gradual manner of tapering towards both ends which are slender and more or less rough-surfaced.

The oxydiactins protruding from the gastral surface may be 20 mm. long and 250 μ broad in the middle. They are much longer and thicker than the corresponding spicules in the type-specimen. This fact seems noteworthy especially when the smaller size of the specimen under question is considered.

Among the dermalia I have found, though exceedingly rarely, regularly developed hexactinic forms. In many of the dermal pentactins the distal ray is represented by a mere knob.

The different kinds of hexasters are quite similar to those of *S. affinis.*

Oxyhexasters are normal, hemihexactinose or hexactinose. The last mentioned form is numerously represented, and constitutes another notable point of difference from the type-specimen. Diameter, generally 120–186 μ; the hexactinose form may be larger, sometimes attaining 242 μ in axial length.

Peripheral discoctasters, 143–176 μ; those deeply situated, 262–352 μ, rarely up to 428 μ in diameter. The upper limit in the size of discoctasters seems to extend very considerably over and beyond that determined for the type specimen.

Microdiscohexasters of spherical shape and 19 μ diameter are occasionally found in the endosome.

Soft Parts.

Care was taken by Kuma, the collector, to preserve in strong spirit small pieces from both the specimens described above; so that I have been able to make some studies on their soft parts. This however has yielded no special additions to the knowledge we already possessed. I therefore restrict myself to recording only a few points.

The thimble-like and sometimes cup-like chambers were observable with especial distinctness in the specimen (No. 403) referred tentatively to *S. entacanthus*. Here they have a diameter of 110–187 μ (on an average, 155 μ). The usual reticular structure of the chamber-wall is in places very beautifully shown (Pl. XIV., figs. 20 and 21). The meshes, the open nature of which can not be doubted, measure about 5 μ in length of sides. Observed under the immersion system, every nodal point is seen to be occupied by a vesicular, not specially well-stained nucleus, 1.7–3.4 μ in diameter and containing some chromatic granules. The smaller nuclei present a more compact appearance than those of a larger size. In optic sections of the wall, the nuclei have a distinctly oval outline.

In both specimens the trabeculæ are frequently spread out in the form of a membrane especially on the surfaces which come in contact with the external world,—not only on the dermal and gastral sides but also along the lumen of the larger canals. The finely granular substance of trabeculæ may exhibit in the film-like parts somewhat deeper-stained and often irregularly branched streaks, which in some places may run more or less parallel to the edge of the film-like plate (Pl. XIV., figs. 18 and 19). The first thought on observing them would likely be that we have here to do with a fibrillar structure. But by close observations I have come to the belief that the streaks do not represent fibrils actually developed as such but are merely wrinkles or irregularities in the thickness of the film. One strong reason in support of this view is the fact that the streaks are frequently quite ill-defined as to their contour and may, at one place or another, pass over gradually and insensibly into the general substance of the film. They are in part probably the effect of shrinkage or contraction, such as might be caused by the action of reagents or by protoplasmic activity in the living state; the rest are to all appearance simply the terminations of those filamentous trabeculæ which have just reached the film-like portion in order to join it.

In certain places it seemed to me that the spaces between the trabecular nuclei (2–$2\frac{1}{2}\ \mu$ large) were unusually wide.

The thesocytes are of a somewhat different appearance in the two specimens.

In the type specimen of *S. entacanthus*, they are conglomerate-like in that the contents consist of a group of variously sized spherules (Pl. XIV., fig. 18). These are usually deeply stained but not always to the same intensity. Their substance is nearly homogeneous or shows a faint granulation. In many cases the contents appear to be in the process of breaking up and becoming resorbed. The nucleus evidently lies concealed among the spherules.

In the other specimen (*S. entacanthus ?*) the thesocytes have moderately well-stained protoplasma-like contents which are rather coarsely granular (Pl. XIV., fig. 19), instead of being composed of spherules in conglomeration. The nucleus is distinctly visible as a dark spot. The cells are roundish or oval in shape with a diameter of $20\ \mu$ or under. A delicate enveloping membrane can often be distinctly made out. I have found the cells in abundance on the dermal and subdermal trabeculæ as well as on those around the lumen of the larger incurrent canals, but none in any part of the trabecular system of the excurrent side.

STAUROCALYPTUS MICROCHETUS* IJ.

Pl. VIII., figs. 17–25.

Staurocalyptus microchetus. IJIMA, '98, p. 53.

The single type-specimen of this species (S. C. M. No. 450) is from Outside Okinosé by the Iwado-line (about 572 m. depth). It is attached to a piece of rust-colored, easily breakable tuff.

The body represents a rather thin-walled, laterally compressed tube, gently and slightly outbulged between the two ends (see Pl. VIII., fig. 17). It is attached at the lower end by a tubercular base and also by an accessory base a short distance above the first. Total height of the specimen, 95 mm. Breadth at the middle, 37 mm. by 23 mm. Thickness of wall in that region, 3 mm. The simple-edged, wavy oscular rim is directed straight upwards.

A veil covers the entire external surface. It is by no means conspicuous, because the pentactinic spicules composing it are very small and project only about 1 mm. or less beyond the smooth dermal surface. Here and there a few, short and very fine needles are seen standing out from the external surface in the manner of diactinic prostalia, which probably they really are.

* μικρὸς, and ὀχετὸς canal.

The wall is tolerably firm on account of the closely interwoven state of the parenchymal spicules as well as of the small size of the canals. These, both incurrent and excurrent, are never so large as to measure 1 mm. across. Their apertures lie close together and are indistinctly visible through the tissues (ectosomal or endosomal as the case may be) immediately above them.

The gastral surface, like the dermal, appears smooth and uniformly compact. Some parenchymal needles are seen to project into the gastral cavity but not in considerable numbers.

I may say that the essential microscopic characters of the sponge are quite unlike those of any other *Staurocalyptus* known to me, so that they alone should in my opinion suffice to prevent the species being confounded with any other in the genus.

Spiculation.

Some *parenchymal diactins*, evidently the principalia, are comparatively very large. They may be as long as 24 mm. with a thickness of 143 μ in the middle. Such large diactins are invariably without a central swelling; they gradually taper towards both ends which are nearly smooth or only slightly rough. The smaller parenchymalia and the comitalia are of the usual characters.

The *hypodermal pentactins* (seen in Pl. VIII., fig. 24) are isolated, not in groups. In relation to this fact the four paratangentials always are regularly cruciately, and not paratropally, disposed. They are nearly straight or only slightly bent, measuring up to 1¼ mm. in length and 32 μ in breadth at base. The unpaired proximal ray may be twice as long as the paratangentials in the same spicule. In most cases all the rays are smooth except for a sparse number of obsolete microtubercles near their conically pointed or rounded tips. However, some of the spicules —without doubt those that are old and ready to be protruded as prostalia—show paratangentials which are entirely rough, this being due to a thick covering of minute processes similar to those I have observed on the corresponding spicules of *Scyphidium longispina* (Pl. II., fig. 3). On the other hand, among those pentactins already protruded from the dermal surface as prostalia, I find some with paratangentials roughened in the manner just mentioned but others exhibit no trace whatever of such roughness. Thus, it seems that this roughness may possibly never appear on some of the pentactins, though under certain circumstances it develops while the spicules are still hypodermally situated.

The *dermalia* (Pl. VIII., fig. 18) are generally stauractins; exceptionally pentactins. The former are nearly flat or just perceptibly arched. The latter have the unpaired ray directed proximad. The rays are strongly prickly all over, gradually tapering from the base towards the pointed end. Length of rays, 75–100 μ (on an average 85 μ). Their average thickness at base, 9 μ. The arrangement of the spicules in their relation to one another is rather irregular (see Pl. VIII., fig. 24), though here and there an approach towards forming quadrate meshes is observable.

The *gastralia* (Pl. VIII., fig. 19) are hexactins with rays characterized similarly as in the dermalia. All the rays in the spicule are generally about equally long, though sometimes the free proximal ray is found to be somewhat longer than any other of the six. Length of rays, 120–143 μ; average thickness at base, 10 μ. The spicules form a continuous lacework which is for the most part regularly quadrate-meshed (Pl. VIII., fig. 25). It lies close over the parenchymalia, from which scarcely any diactins can be distinguished as hypogastralia.

The *oxyhexasters* may be distinguished as of two kinds, though these seem to intergrade into each other by transitional forms. They may be said to differ in respect both of size and general appearance.

One kind (Pl. VIII., fig. 21) is met with, not abundantly but in moderate frequency, only in the proximity of the ectosome. It is comparatively small and of a delicate appearance. Diameter, 68–100 μ. From each short and slender principal there arise 3–5, thin and widely divergent terminals.

The other kind (Pl. VIII., fig. 20) occurs in the choanosome as well as in the endosome and is far commoner. Besides being larger, the terminals are somewhat stronger and the principals usually so exceedingly short that they may be called abortive. Diameter, 106–136 μ. The central node is frequently swollen to a globular shape. The number of terminals to a principal is usually 2, but may rarely be 3 or sometimes only 1. Hemihexactinose forms are of occasional occurrence. Hexactinose forms were not found; if they occur at all, they must be very rare. The terminals are nearly smooth or obsoletely rough.

The *discoctasters* (Pl. VIII., fig. 23) are very abundant subgastrally and apparently also in the endosome itself. I have not found them in any other position. Diameter, 114–128 μ.

The central node is provided with the six tubercles which are moderately prominent. The secondary principal measures in length between ⅓ and ½ that of the entire ray. The number of terminals to each principal may be put down at 5–10, but is more usually 8–10. The terminals appear to be rather strong; at any rate they cannot exactly be called fine. The tuft they form is about 10 μ broad at base and may expand to thrice that breadth at the outer end. Each terminal gently bends slightly outwards in its course towards the thinly attenuated end, which is furnished with a pinhead-like terminal disc.

The *microdiscohexasters* (Pl. VIII., fig. 22) seem to be very sparse; in fact they were met with only in a few isolated cases, in what part of the wall I can not definitely state. Diameter 23–26 μ. The terminals are exceedingly fine and not very numerous. They give a spherical shape to the entire spicule. The principals may be simply knob-like as shown in the figure; but this is not always the case; for, in some specimens of the spicule I have seen each short principal furnished with the usual terminals-bearing discs at their outer ends.

Finally, the *basidictyonal* plate. This I have isolated in small fragments from the attachment surface. In these I have made out that the single spicules, which by amalgamation go to constitute the plate, are mainly stout stauractins and occasionally pentactins. The rays in these spicules may be as thick as 15 μ, their surface showing microtubercles in moderate numbers. The fact that these spicules are not hexactins as is the rule with dictyobasalia in general, probably has some connexion with the thinness of the plate in the present case.

STAUROCALYPTUS GLABER Ij.

Pl. XV.

Staurocalyptus glaber. Ijima, '97, p. 57.

This species seems to be not altogether uncommon in the Sagami Sea. More than a dozen specimens, representing various stages of growth, have been examined by me. The exact localities they came from are: Maye-no-Yodomi, in depth between 501 and 572 m. (=274 and 317 fms.); Inside Okinosé by the Sengenzuka-line, about 500 m. (=274 fms.); Outside Okinosé by the Iwado-line, about 480 m. (=262 fms.); Homba, between 501 and 572 m. (=274 and 317 fms.); etc.

In some specimens the sample of the bottom attached to the base is of a tufaceous nature, but the majority are attached to dead remains of other Hexactinellids, such as *Periphragella elisæ*, *Chonelasma calyx*, *Hexactinella lorica*, *Farrea* sp. and *Hyalonema* sp. On that most remarkable *Chonelasma calyx* which I have mentioned on p. 25 and figured on p. 31 of my Contrib. I., a small specimen of the present species was found in association with *Chaunoplectella cavernosa* and *Rhabdocalyptus capillatus*.

To mention some of the representative specimens in particular. The largest specimen I have seen was of a laterally compressed, vase-like shape, measuring 250 mm. in height, 66 mm. by 95 mm. broad at about the middle and 17 mm. in thickness of wall in the same part. The specimen was in a bad state of preservation.

In Pl. XV., figs. 1 and 2, are shown in half natural size two exquisite specimens in the possession of the Sci. Coll. Museum.

The individual of fig. 1 (Mus. No. 244) represents a thick-walled vase, slightly laterally compressed, rounded above and narrowed towards the base by which it is attached to the side of a dead *Periphragella elisæ*. Entire height, 109 mm.; breadth in the broadest part, 47 mm. by 64 mm.; thickness of wall in the same part, 14 mm. Somewhat on one side of the upper end is situated the roundish osculum, 27 mm. in diameter. A sparse number of inconspicuous prostal diactins, protruding to a length of 14 mm. or less, is present, especially in the region adjoining the oscular margin.

That of fig. 2 is pouch-like and distinctly laterally compressed. Height, 130 mm. Breadth near the middle, 80 mm. in one direction and 54 mm. in another. Thickness of wall at about the middle, 14 mm. The osculum is of an oblong shape, being elongate in the sagittal line. The basal attachment is on one side of the inferior end. The sponge is therefore bent in the basal region, the bending being as usual in the sagittal plane of the laterally compressed body. Nearly opposite to the basal attachment there exist two small secondary oscula, situated close to each other. No prostalia of whatever sort are to be seen on the specimen.

Small, and therefore evidently young, specimens of the species are characterized by the possession of fine, but conspicuous, prostal needles.

The smallest specimen I have had was of a nearly globular shape, measuring only 6 mm. in height and with a roundish osculum of 2 mm. in dia. It showed a small number of fine prostal needles, apparently in the first stage of protruding outwards.

Much larger are the two young individuals shown in Pl. XV., fig. 3. They are both of an ovoid shape, growing side by side on a dead *Chonelasma calyx.* One is 38 mm. and the other 32 mm. high. The latter shows an osculum of 6 mm. dia. Fine and long prostal needles, springing out isolatedly and directed outwards and upwards, are present in moderate numbers. They occur more especially in the upper half of the body. Some of them may be 14 mm. long. From the constant absence of pentactinic prostalia and from the peculiarly cavernous appearance of the wall, I find it easy to distinguish the young of this species from those of certain other discoctasterophorous species, such as *Rhabdocalyptus victor* (Pl. XIX., fig. 17) and *R. capillatus* (Pl. XXII., fig. 3–5).

One more specimen (text-fig. 7) requires special mention as being highly remarkable in more than one respect. The sponge-body (64 mm. long and 27 mm. by 37 mm. broad in the middle) presents the appearance of running out basally into a root-tuft consisting of a number of strong needle-like spicules, instead of being firmly fixed to a hard substratum as in all other specimens of the species. F. E. Schulze (Chall. Rep., p. 41) conceived the idea that with differing conditions of the sea-bottom, it was possible for one and the same species to produce a root-tuft in one case and not in another. This assumption of F. E. Schulze's I at first thought had been actually realized in the case under consideration; but this proved to be simply an illusion, for by microscopic observations it could clearly be demonstrated that the tufted spicules at the basal end of the specimen do not belong to that sponge and are nothing

Text-fig. 7.
S. glaber growing on basal spicules of *Hyalonema* sp. (S. M. No. 361, obtained may May 1895 at Outside Okinosé).

else than old and much lacerated, anchoring needles of a *Hyalonema* species,—presumably, of *H. affine.* The ends of the needles are invariably broken; some of them show the characteristic spines on the surface; and their surface, so far as it lies imbedded in the sponge, is covered with a thin siliceous reticulum, the same as the so-called basal-plate which is known to develop on the attachment surface of so many Hexactinellids firmly fixed to the substratum. It is then beyond dispute that the *S. glaber* in question had attached itself to, and was growing on, a tuft of *Hyalonema* needles.

Another very interesting fact in relation to the specimen under consideration is the presence in large numbers of certain, peculiar, small bodies lodged among the tissues of the choanosome. To these bodies I have already had occasion to refer in Contrib. I. (p. 186, foot-note) of this series of Studies. To the naked eye they appear as whitish spots of various sizes under 0.6 mm. diameter. Except in the ectosome and the endosome, they occur throughout the sponge in tolerably uniform distribution. Under the microscope the body is found to be a reticular mass of no definite shape; it consists of an irregular rigid framework of microtuberculate siliceous beams (Pl. XV., fig. 13). The mass is always traversed quite through by a few parenchymal diactins of the sponge containing it. It is further easy to make out that the aforesaid beams are formed by the soldering together of small but comparatively thick-rayed hexactins that exhibit no regularity as to their relative disposition. The hexactins (under 100 μ in length, and 10 μ in thickness, of rays) are in characters quite similar to those that go to compose the basidictyonal framework of the species (see Pl. XV., fig. 12). In fact, I have no hesitation in regarding the above described reticular bodies to be the basidictyonalia belonging to quite young individuals of the species: it appears that a brood of the young had temporarily or otherwise settled themselves on, and had each formed its own basidictyonal framework around, the parenchymalia of the old specimen in question. It is impossible to do more than speculate as to the mode of origin of that brood of the young. But one point appears to me to be almost certain, *viz.*, that the reticular bodies treated of are the same as those described by F. E. SCHULZE ('99, p. 64; Pl. XIV, figs. 2–6) from the buds borne on the prostalia lateralia of *Rhabdocalyptus mirabilis*. Seen in this light and from my point of view concerning the phylogenetic relation between the "Lyssacina" and the "Dictyonalia" (Contrib. III., pp. 23–25, foot-note), it seems to me readily explicable, if, in the development of a firmly seated lyssacine Hexactinellid, certain supporting spicules early underment ankylosis and thus acquired a dictyonine character.

But to return to the general characters of the species. Summarily speaking, we have here to do with thick-walled, saccular or vase-like, firmly seated forms, which, after attaining a certain size, are laterally compressed to a greater or less degree. Superiorly the wall somewhat closes in towards the sharp, but not thin, oscular edge. The young are ovoid in shape and are furnished with conspicuous, but slender and isolated prostal needles, which, after the full growth of individuals, seem to become entirely or almost entirely lost. Pentactinic prostalia do not occur in any stage of the life.

The dermal surface is moderately smooth. The delicate ectosomal skeleton consists of a minutely quadrate-meshed dermal lacework and of supporting hypodermal strands. The latter are of various thicknesses but on the whole are thin. They run in somewhat curved courses and intersect with their fellows at various angles, thus forming meshes of very irregular shapes. Frequently a number of the strands are seen to radiate, though in an irregular manner, from the point where a pillar or pillars from the choanosme join the ectosome.

The endosome appears much like the ectosome. It lies closely applied to the internal choanosomal surface. The gastralia form a continuous lacework over the meshes bounded by the hypogastral strands which are on the whole somewhat thicker than the hypodermal.

Characteristic of all the specimens are the rather cavernous appearance, and the somewhat loose and light-looking texture, of the wall. The former character is due to the spacious development of the subdermal cavity and to the comparatively large caliber of the canals proceeding from it. The subdermal cavity is of a width known to me in no other Acanthascine species. In large specimens it may in some places be nearly 10 mm. wide. Conical or irregularly ridge-like projections—the pillars—join the choanosome to the ectosome. The spaces between such adjacent pillars vary in extent and may each contain sometimes a single and sometimes several large incurrent canalar apertures. These are round or oval, measuring up to about 7 mm. dia. in large individuals, and may be separated from one another by an interspace of 4 mm. or more.

The incurrent canals are not deep and pit-like, but rather shallow and funnel-shaped. This is probably in some way related to the wide development of the subdermal space, which not infrequently passes over into the canals without any perceptible demarcation. The apertures of branch canals opening into the primary canals are generally plainly visible from the outside.

Excurrent canalar apertures on the gastral side are on the whole much smaller and situated more closely together than the incurrent. The canals they lead into are deep and pit-like, unlike those of the incurrent system.

The *soft parts* (see Pl. XV., fig. 11) were studied by me but without results of any special interest. The limiting trabeculæ of both the dermal and the gastral surfaces are to a great extent membranously developed. The free proximal rays of the gastralia heave up the gastral membrane in a tent-like manner. External trabeculæ are most numerously present where the choanosome most closely approaches the ectosome. A large part of the wide subdermal spaces is quite free of them. Chambers, of the usual shape and appearance; 100–165 μ in diameter. Archaeocytes and thesocytes much as I shall later describe from *Rhabdocalyptus capillatus* (Pl. XXIII.).

Spiculation.

Pl. XV., fig. 11, will serve to give a general idea of the spiculation.

The *parenchymal principalia* are elongate spindle-shaped oxydiactions with rough-surfaced ends and are more or less bent in a bow-like manner. They may attain a length of 13 mm. and a thickness of 190 μ in the middle. The smaller parenchymalia and the comitalia are of the usual characters.

The diactinic *prostalia*, present on the younger specimens, may be 25 mm. long or longer. In thickness they may measure

90 μ, but are usually thinner. The major part of the length is protruded free, while the part rooted in the wall is accompanied by fine comitalia.

The *hypodermalia*, which go to form the hypodermal strands, are pentactins and diactins, in both of which the rays are always smooth except at the roughened ends. The extreme tip of the rays is either rounded or conically pointed.

The hypodermal pentactins are of a large size. The curved or nearly straight paratangentials may be 8 mm. long with a breadth of 80 μ at base. The unpaired proximal ray, which is always straight, is much longer and is invested with fine comital diactins in the usual manner. This ray, together with the roots of the diactinic prostalia that may be present, forms a part of the so-called pillars. Seen on the sponge surface, the centers of hypodermal pentactins are situated either isolatedly or a few together in loose groups. Their loose arrangement sufficiently accounts for the fact that the four paratangentials in a spicule generally have a regularly cruciate disposition, each being free to take its natural direction during development (cfr. p. 131). Only occasionally have I met with such hypodermal pentactins as have paratropal paratangentials.

In certain very small specimens I ascertained that the hypodermalia consisted of pentactins alone. Some of these showed paratangentials with microtubercles sparsely distributed throughout the length, and seemed to intergrade with the larger dermalia.

Whereas, in all the larger specimens the paratangentials of hypodermal pentactins are usually accompanied by a greater or less number of slender diactins, which are scarcely distinguishable from parenchymalia of similar dimensions. In some places the strands consist of the diactins only, and in still other places these are seen to run singly, not being combined into bundles.

The *hypogastral* strands are made up of similar diactins, and of diactins only.

The *dermalia* (Pl. XV., figs. 4–6) are almost exclusively stauractins; rarely pentactins and still more rarely tauactins or diactins. The stauractins are very slightly convex on the outside. On some of them the atrophied proximal ray, and occasionally also the distal, may be represented by a boss-like protuberance. Length of rays, 100–165 μ; breadth at base, 6–9½ μ. The rays may be said to be entirely rough; and it is a remarkable fact that the microtubercles on their outer surface are developed into more or less prominent, conical and vertically erect spines. Those on the lateral sides of the rays are much less strongly developed, while those on the inner side may be said to be obsolete. The length attained by the spines on the outer surface differs somewhat in different individuals, but at all events their unusually strong development constitutes one of the characteristics of the species. Even in a small specimen of only 6 mm. height, the spines in the position indicated are quite prominent, though much thinner than in the larger specimens.

The *gastralia* (Pl. XV., fig. 7) are oxyhexactins of a moderately large size. All the six rays in one spicule may sometimes be of nearly equal length, but more frequently the free proximal ray is the longest and the distal the shortest. Length of proximal rays, 450–560 μ; of paratangential rays, 330–352 μ; and of distal rays, 190–262 μ. Thickness at base, about 10 μ on an average. The tapering rays belonging to one and the same spicule may all be nearly equally rough on account of the presence of microtubercles, but the usual condition is that the prolonged proximal ray is, in comparison with the others, much more pronouncedly rough, the microtubercles on it being developed into distinct, conical and vertically projecting prickles.

The gastral hexactins are generally so arranged as to form with their paratangentials a continuous quadrate-meshed lacework, in which the sides of the meshes, exactly like those in the dermal lacework, are formed of the two apposed rays belonging to each of every two adjacent gastralia. Occasionally two gastralia lie very close together, making the four laths proceeding from their position three rays strong instead of two.

In the smallest specimen I have had (6 mm. high), the gastralia were quite sparsely present in scattered arrangement.

No special *canalaria* were found in the species.

The *oxyhexasters* (Pl. XV., fig. 10) measure 98–114 μ in diameter. They all seem to be normally developed, neither hemihexactinose nor hexactinose forms having been noticed. Further a distinction between those in the periphery of the wall and others more deeply situated can scarcely be drawn. The principals are usually short but distinct ; sometimes they are quite obsolete. Two to four—commonly three—terminals are borne by a principal. They are generally thin and nearly straight, showing a slight roughness at base when seen under a high power of the microscope. In some of the rosettes the terminals may be nearly twice as thick as in others with which they promiscuously intermingle.

The above oxyhexasters are not found in the ectosome, but occur abundantly in the choanosome, especially in the deeper parts. Very frequently they are seen shifted out to a point midway towards, or right on the tip of, the free proximal rays of gastral hexactins (fig. 11).

The *discoctasters* (Pl. XV., fig. 9) are common in the deeper parts of the wall, probably never occurring in the subdermal space. They may attain a size larger than is known to me from any other Acanthascinæ. Diameter, generally 500–660 μ, but sometimes reaching down to 300 μ or even less. In the very young specimen of only 6 mm. height, the discotasters, of which only two or three in all were found, measured 240–352 μ.

The central node is of a plain appearance. The secondary principal gently thickens outwards, forms about one-third of the entire ray-length and splits at the outer end into five or six slightly rough, but sometimes nearly smooth, straight and slightly divergent terminals, which together give rise to a tuft of an elongate conical shape. The terminal disc is without marginal teeth, being simply like a pinhead in shape.

Microdiscohexasters (Pl. XV., fig. 8) of spherical shape and 15–22 μ diameter occur extremely rarely in the older specimens, but are not uncommon in the younger. They are found on or near to both the dermal and gastral surfaces. About ten terminals of extreme fineness, each having a minute terminal swelling, occur to the flat or externally convex disc at the outer end of each moderately long principal.

Finally—the basidictyonal plate (Pl. XV., fig. 12) is of quite a similar appearance as in other species of the subfamily. In the larger specimens it is of a considerable thickness and consists of both directly and synapticularly connected, thick-rayed and mierotuberculate hexactins, amongst which there occasionally occur pentactinic and even stauractinic forms. Its surface in direct contact with the substratum is lined with a thin and particularly close-meshed reticular layer, the limiting basal-plate.—Of the small basidictyonal mass shown in fig. 13, I have already spoken on p. 210.

STAUROCALYPTUS HETERACTINUS IJ.

Pl. XI., figs. 1–10.

Staurocalyptus heteractinus. IJIMA, '97, p. 56.

This species was described by me in '97 from a single specimen. A second specimen has not been obtained.

The type-specimen (Pl. XI., fig. 1; S. C. M. No. 409) comes from a depth between 501 and 572 m. It is of the size of a bean and represents a strongly laterally compressed pouch, measuring 21 mm. long and 10½ mm. broad in one direction and 6 mm. broad in another. On one side of the upper rounded end is the small oval-shaped osculum with its thin simple edge. The opposite end shows two processes with torn off terminations. Both these processes probably served to fix the sponge to the substratum. Thickness of wall at the middle of the body, about 2½ mm. Possibly the specimen is a young individual.

The external surface is tolerably smooth, being without prostals of any kind. Examined under the hand-lens, there are seen to proceed upwards from the basal processes obliquely running and intersecting strands of rather coarse fibers which build up the parenchyma. Close over this is an ill-defined hypodermal network with irregular meshes of various sizes. The dermal layer is only partially preserved, and is very indistinct. The incurrent canalar apertures are represented by small gaps between the parenchymal strands and quite occasionally by pit-like but shallow depressions.

The gastral surface exhibits a number of freely open excurrent apertures, which may reach up to $\frac{3}{4}$ mm. in diameter. Some of the excurrent canals are pit-like but never deep in relation to the thinness of the sponge-wall.

Altogether, the appearance of the wall is much like that of the oscular region of a larger Acanthascine species.

Spiculation.

The *parenchymalia* include an abundance of comparatively strong principalia of elongate spindle-shaped or bow-shaped oxydiactins, which may attain a length of 12 mm. and a breadth of 220 μ at the middle. In them the ends are smooth. The smaller parenchymalia present no features worthy of special mention.

The *hypodermalia* (Pl. XI., fig. 2) are moderately large and strong pentactins, occurring commonly but in irregular distribution. The paratangentials, which are regularly cruciate and never paratropal, usually measure under $\frac{1}{2}$ mm. in length but are sometimes longer. The unpaired proximal ray is always much longer than the paratangentials. The rays may be 30 μ thick at base. The surface near the conically pointed tip is either quite smooth or sparsely beset with microtubercles. Occasionally the hypodermalia are represented by paratangentially situated stauractins; more rarely by tauactins. Certain diactins seem also to lend themselves to the formation of hypodermal strands.

The *dermalia* (Bl. XI., figs. 3 and 4) are predominantly stauractins, occasionally pentactins and tauactins and rarely diactins. The rays are slightly rough all over and have rounded tips, which are occasionally somewhat swollen. The size varies considerably, some of the spicules being in axial length twice or even three times as long as the smallest. Thus, a small dermalia measured had rays of only 90 μ length and 9 μ thickness at base, while a large one may have rays 270 μ long and 13 μ thick. The largest nearly approaches the size of the smallest hypodermalia, but the latter seem to be always distinguished from the former by the fact that the rays are rough at the ends only. Exceptionally thin-rayed and smooth oxystauractins, found here and there in the dermal layer, I take to be dermalia that are still in an incomplete state of development. The separate dermalia are irregularly disposed as regards the mutual orientation of their paratangentials.

The *gastralia* (Pl. XI., fig. 5) are pentactins and stauractins, the former being present in somewhat greater relative abundance. Rarely are they tauactins or diactins. The rays are quite like those of the dermalia but are generally smaller. Length of rays, 55–100 μ. Average thickness at base, 6½ μ. In the pentactins the unpaired ray is directed distad; sometimes the proximal ray is represented by a boss. The gastralia are nowhere numerously present.

The *oxyhexasters* (Pl. XI., figs. 7 and 8) have a diameter of 106–114 μ. They seem to be never hemihexactinose or hexactinose. As regards appearance they may be divided into two categories, which seem however to intergradate. The one category (fig. 7) is composed of those mostly lying in the periphery of the sponge-wall, and in them each principal of a perceptible length bears 2–4 (usually 3), slender and obsoletely rough or nearly smooth terminals. To the other category (fig. 8) belong the great majority of the oxyhexasters abundantly present near the gastral surface and occasionally a few of those found in the periphery. In these the principals are extremely short and bear each 2 (sometimes 3), strong and distinctly rough terminals. The roughness may be developed into retroverted microspines or barbs on the basal parts of the terminals.

The *discoctasters* (Pl. XI., fig. 6) vary in diameter from 110 μ to 200 μ. They are tolerably common, especially near the gastral surface. Those in the periphery of the wall are on the whole smaller than others more deeply situated. In the former (of which Pl. XI., fig. 15, in reality taken from an undetermined *Staurocalyptus*, might well pass for a representative) the secondary principals are as slender as 4 μ or less. In the latter (fig. 6) the same may be fully 6 μ thick. Generally speaking, the central node is either plain or is supplied with the six boss-like prominences. The secondary principals make up about two-fifths of the entire ray-length. The terminals, 2–7 in number to a principal, are straight and form a tuft which expands generally but little outwards. The terminal discs appear simply like pinheads.

The microdiscohexasters (Pl. XI., fig. 9) are of the usual appearance. Diameter, 16–19 μ. They occur in scattered distribution both near the gastral surface and in the peripheral parts. In some places in the dermal membrane I find them to be quite common.

STAUROCALYPTUS PLEORHAPHIDES Ij.

PI. XVI.

Staurocalyptus pleorhaphides. Ijima, '97, p. 58.

Three specimens of this species have come under my observation. Roughly speaking, they all represent thick-walled, elongate, pear-shaped sacs, firmly attached by the narrowed lower end and provided with prominent prostal needles and pentactins. In external appearance the species bears a close similarity to *Scyphidium longispina.*

The first specimen (Pl. XVI., fig. 2 ; S. C. M. No. 226) is from a depth of between 429 and 572 m. in Homba. Height of body, 43 mm. Greatest breadth, 23 mm. Greatest thickness of wall, 6 mm. The roundish osculum at the upper end, 7 mm. in diameter ; leading into a deep cylindrical gastral cavity. Base, stalk-like ; 6 mm. thick.

The second specimen (Pl. XVI. fig. 2 ; S. C. M. No. 415) comes from a depth of about 300 fms. (say, 550 m.) in Inside Okinosé by the Sengenzuka-line. It is attached on the external side of a *Hexactinella lorica.* Body, 55 mm. long ; somewhat laterally compressed, measuring 35 mm. by 26 mm. in breadth at the middle. Basal end, 10–12 mm. broad. The irregularly elliptical osculum on one side of the upper end, 13 mm. by 7 mm. across. Thickness of wall in the middle, 8 mm.

The third specimen again is attached to a large *Hexactinella lorica* (S. C. M. No. 448), together with *Lanuginella pupa*, *Leucopsacus scoliodocus*, etc. Locality, Outside Okinosé by the Iwado-line. Total height, 40 mm. Greatest breadth, 30 mm., the body being nearly circular in cross-section. Thickness of wall in the lower part, about 10 mm. The roundish osculum, 13 mm. in diameter.

The following are the details of the macroscopic characters of all the three specimens taken together.

The oscular margin is thin and simple-edged. By far the greater part of the external surface is uneven on account of the presence of numerous small conuli, lying at distances of 3–10 mm. from one another. From each such conulus there spring a number of prostal spicules arranged in a loose divergent bunch. The prostal bunch generally comprises both diactins and pentactins, but sometimes consists of the latter alone.

The diactinic prostals are generally strong needles of various lengths. They may project to a length of 25 mm. or more, being directed on the whole obliquely outwards and upwards, though there may exist some that proceed straight outwards or even somewhat downwards. Those in the broadest part of the body are the longest. The needles give an altogether spiny appearance to the sponge. Seen under the hand-lens, some of them may present a dirty brownish color due to a thin incrustation of some foreign substance. Adhering to them are seen here and there some animal remains, among which Foraminifera shells are the more common.

The pentactinic prostals are of a moderately large size. They form over the dermal surface a gossamer-like covering, which in places is about 5 mm. thick. They generally protrude in groups of two or more but may sometimes stand out singly.

The dermalia, together with the hypodermal spicular rays, form quite an irregularly meshed latticework. The meshes are never quadrate but triangular, trapezoidal or indefinite in shape. This irregularity has its explanation in the fact that the dermalia are predominantly straight diactins, which may lie in all possible directions in the plane of the dermal layer (Pl. XVI., fig. 15).

The subdermal space is inconspicuously developed. The variously sized apertures of incurrent canals are largest in the broadest region of the body. Here they occasionally measure 3 or 4 mm. across. Apertures of a similar size are separated from one another by a space as wide as, or wider than, their own width.

The gastral surface presents a loosely felt-like appearance, not being covered with a well differentiated endosomal layer (Pl. XVI., fig. 1). On it the excurrent canals, up to 5 mm. in width, open with free apertures. These canals are mostly not deep but are seen soon to divide up into branches.

Spiculation.

The larger *parenchymalia*, which may be called the principalia, are elongate spindle-shaped oxydiactins, either nearly straight or gently bent in a bow-like manner. They may attain dimensions of 7 mm. length and 80 μ breadth at the middle. The ends are usually rough in varying degrees; in other cases they are smooth. Under certain circumstances, one end of the diactins may be rounded while the other is as usual acutely pointed, as e.g. in some of those diactins that just reach the dermal surface with one of their tips, in which case it is the distal end which may be rounded off (Pl. XVI., fig. 14).

The smaller parenchymalia, including the fine comitalia, are of the usual appearance. They seem to grade down in dimensions uninterruptedly to the small diactins which I shall describe further on as the gastralia.

The *prostal diactins*, which are in fact to be regarded as enormously developed parenchymal principalia, are of various sizes. A small one may measure only 10 mm. in length, while the largest measured was 40 mm. long and 253μ thick. The needle-like spicules are straight or nearly straight, tapering perceptibly towards both ends. The outer end is usually found to have been broken off; the inner is either acutely or bluntly pointed, the subterminal surface being smooth or sparsely beset with micro-tubercles. The entire exposed surface of the prostal needles,—at least, of the larger of these,—is minutely and densely rough, in exactly the same way as the paratangentials of certain prostal pentactins soon to be described. The roughness extends a short distance into the parts rooted in the sponge-wall, gradually fading into a perfectly smooth surface. The parts in the wall, as also the same parts of the shafts of hypodermal and prostal pentact-ins, are generally accompanied by some comital parenchymalia.

The *hypodermal pentactins* are somewhat variable in size. The paratangentials, which are generally not quite straight but rather wavy, may be 5 mm. long or longer. The straight shaft or the unpaired proximal ray is always much longer than the paratangential in the same spicule. The pentactins situated near the oscular margin and already externally protruded as prostalia, I have found to be unusually small, measuring not more than half a millimeter in the length of paratangentials, which in these small pentactins are generally arranged in the form of a regular cross to each.

This cruciate arrangement of the paratangentials also occurs, but only occasionally, in the larger pentactins lower down on the sponge. In by far the greater number of these the rays referred to are paratropal. The paratropism is carried out to varying degrees in different spicules. In some cases, one of the four angles formed by the rays is simply obtuse while the rest are all acute though greater than 30° each ; in other cases the four rays form only three angles, each of about 30° or less. It is to be noted that whenever two or more paratropal pentactins form a close group, whether by themselves alone or in company with diactinic prostalia, the paratangentials of each pentactin are, as it were, pushed away from the center of that group (Pl. XVI., fig. 14). I shall have to return to this point under *Rhabdocalyptus victor*.

All the rays of the pentactins are at first smooth except at the ends which are rough. So are they in most of the spicules in the hypodermal situation ; however, here and there among these are to be seen such as show the paratangential cross finely rough all over. The roughness is caused by minute, erect and sharply pointed processes, which, when seen from above, appear to be somewhat laterally compressed so as to present a shape elongated in the direction of the axis of the ray they beset (Pl. XVI., fig. 13). The microspines reminds me of those I have seen on the prostal pentactins of *Scyphidium longispina*. To judge from what appear to represent developmental stages, the roughness first sets in as an extension of that at the ends of the paratangentials; thence it proceeds to develop towards the spicular center and from this point proximad for a short distance on the shaft. Not that the roughness develops on all the old pentactins before these are protruded as prostalia. Of those which already stand out and form the gossamer-like covering on the exterior, many indeed have the rays roughened in the manner described; but in certain others these are perfectly smooth except subterminally. It is difficult to say if all the latter will eventually acquire the character of the former.

Running along with hypodermally situated paratangentials are occasionally seen some fine diactins, which thus help to support the dermal layer.

The *dermalia* (Pl. XVI., figs. 3–5) are rough diactins. Exceptionally they may be stauractins or tauactins; extremely rarely, orthodiactins and monactins.

The diactins measure 264–520 μ (on an average, 400 μ) in total length and about $9\frac{1}{2}$ μ in thickness at the middle. They are generally gently bent in a bow-like manner, the concavity facing downwards. They taper slightly towards both ends which are either rounded or conically but bluntly pointed. The center is usually without an external swelling; only occasionally it is marked by a pair of opposite bosses and much less frequently by a single unilateral boss.

A noteworthy feature of the present species consists in the fact that the *gastralia* are represented by straight diactins. I at first felt inclined to pass over the matter by simply assuming a total absence of gastralia for the species. Upon further studies, however, and having found the same diactins in like abundance over the entire gastral surface of the three specimens examined, I have come to see no inappropriateness in calling them the gastralia. Moreover, a second Acanthascine species with diactinic gastralia is now known, *viz.*, *Rhabdocalyptus plumodigitatus* R. KIRKP. It should, however, be said that the gastralia in the present species seem to intergrade with the parenchymalia by an uninterrupted series of transitional forms. Like the dermalia, the gastralia lie in quite irregular disposition on the gastral surface (Pl. XVI., fig. 16).

Many of the gastralia are much like the dermalia both in dimensions and general appearance. What may perhaps be mentioned as slight deviations shown by the former are the facts that the microtubercles on the surface are on the whole more sparse and more thinly scattered and that the middle of the spicules is frequently, but not always, marked by a gentle annular swelling. Many others of the gastral diactins are considerably larger (Pl. XVI., fig. 6), acquiring characters approaching those of parenchymal diactins. With the increase in size, the microtuberculation becomes more and more sparse except at the ends, finally rendering the middle parts of the spicules perfectly smooth.

In one specimen (No. 226), in which I have studied the spiculation most closely, I find the gastral skeleton in the proximity of the osculum scarcely at all distinguishable as to its elements from the dermal. That is to say, the gastralia in that region contain, besides an abundance of the rough diactins, occasional stauractinic and tauactinic forms, underlying which spicules are some hypogastral pentactins with cruciate paratangentials. Deeper down and in by far the greater part of the gastral surface, the hypogastral pentactins are not found, while as gastralia there occur only diactins though in somewhat diminished numbers.

The *oxyhexasters* (Pl. XVI., fig. 7), occurring in moderate abundance in all parts, are partly normally developed and partly hemihexactinose. Hexactinose forms, with the terminals either straight throughout or bent at base, were met with in only a few cases. Diameter, 114 μ on an average. The terminals are rather strong, measuring about 2 μ across at base; they are nearly straight or slightly bent and show a rough surface, due to microtubercles which are sometimes distinctly retroverted but never much prolonged. The principals are extremely short and often almost obsolete.

In most normal oxyhexasters all the principals bear two terminals each, so that the total number of terminal points is twelve. Sometimes some—not all—of the six principals may show three terminals, in which cases the points in one spicule number more than twelve in all. Thus, not rarely have I come across normal oxyhexasters with sixteen or seventeen terminal points. In the hemihexactinose forms, the uniterminal rays are either straight or bent at base, the rest of the rays being always biterminal.

The peculiarly twisted and evidently malformed oxyhexaster, shown in Pl. XVI., fig. 8, was observed but once. It possesses six terminals in all, but these evidently belonged not to as many principals, but to the four or five remaining of the original six principals. The curvature of the rays is in different planes, the relative orientation of which could not be determined.

The *discoctasters* (Pl. XVI., figs. 9–11) are present in abundance in the entire wall. They are slender-rayed and on the whole small though of various sizes. The diameter is usually 140–200 μ; occasionally, only 100 μ. The central node is either plain or tubercled. The principals are about half as long as the terminals. Number of terminals to a principal, 2–4; usually 3; probably never more than 4. They form a slightly diverging tuft and are nearly straight or perceptibly bent outwards. Under a high power of the microscope they appear to be rough-surfaced. On the minute terminal discs the marginal serration is unrecognizable.

Malformed discoctasters, in which one or more primary terminals stand free without fusing with any of the secondary principals, are of no infrequent occurrence.

The *microdiscohexaster* (Pl. XVI., fig. 12) are of the usual appearance and 20 μ in diameter, and are found, mostly near the gastral surface, in small numbers and in scattered distribution.

Finally, as to the basal plate. I have seen this in the specimen shown in Pl. XVI., fig. 2, which is attached to a *Hexactinella lorica.* The dictyonal skeletal parts of this sponge, at the place where the said specimen is fixed, are enveloped in a thin, small-meshed, siliceous reticulum, evidently the limiting basal-plate of the latter. The beams of this plate are sparsely microtuberculate and look quite like those I have figured in Pl. XXII., fig. 17, from *Rhabdocalyptus capillatus.* Outside that plate and in the sponge under consideration there may possibly occur at places some basidictyonal hexactins, but these were not actually encountered.

UNDETERMINED STAUROCALYPTUS.

Here I wish to mention three specimens (α-γ) which I have studied but prefer to leave unnamed, though placing them provisionally under *Staurocalyptus*. They are all very small and therefore very probably young specimens in which the characters may not have been fully developed.

Staurocalyptus sp. α.

(Figures already published in Contrib., III., Pl. III., figs. 1–6).

This little specimen (S. C. M. No. 437) was found on a dead *Hexactinella lorica* from Outside Okinosé, together with *Leucopsacus scoliodocus*, *Lanuginella pupa*, etc. The body of a barrel-like shape is somewhat larger than a grain of rice. It shows at the lower end a rigid basidictyonal mass measuring about 2 mm. across. From that mass, as also from the body proper, there spring out some fine prostal needles of a considerable length, mostly directed obliquely upwards and outwards. The dermal surface is smooth.

The parenchymalia are chiefly diactins under 14μ in thickness. In most of them the spicular center is marked externally by an annular swelling or by two or four knobs arranged in the usual manner. It seemed to me that the subterminal roughness extended over a relatively greater area than usual, some of the shorter diactins showing sparsely distributed obsolete microtubercles nearly all over them. Highly remarkable is the fact that some of the parenchymalia are apparently hexactinic. The parenchymal oxyhexactins may have rays 95 μ long and 8 μ thick at base, the entire surface being thinly microtubercled. Their position and manner of occurrence scarcely warranted interpreting them as gastralia.

The dermalia are both stauractins and pentactins in about equal numbers (Contrib. III., Pl. III., fig. 1). Size various, 43–152 μ in length of rays and 4–9 μ in breadth at their base. The relatively strong and slightly tapering rays are entirely rough on account of sparse but distinct microtubercles. The atrophied rays are sometimes represented by an external and an internal knob in the stauractins, and by an external knob in the pentactins. The larger dermal pentactins approach in size the pentactinic hypodermalia in which the paratangential rays may reach 380 μ in length and are smooth except near the ends.

The gastralia are hexactins found in scattered distribution (*l. c.*, Pl. III., fig. 2). Rays as in dermalia; length, 34–72 μ.

Oxyhexasters (*l. c.*, Pl. III., figs. 3 and 4) are of common occurrence. They are normally developed, there being two or three, slender and rough-surfaced terminals to each principal, which is short. Diameter, 88–106 μ.

Discoctasters (*l. c.*, Pl. III., fig. 6), a small number found; small and slender-rayed; measuring 130–144 μ in diameter.

Microdiscohexasters (*l. c.*, Pl. III., fig. 5), very small and delicate; 15 μ in diameter. They occur in abundance in the wall, but especially in the periphery.

The basidictyonal mass is of the usual structure, being composed of fused hexactins with thick, short and sparsely microtubercled rays. The skeletal beams of the *Hexactinella*, at the spot giving attachment to the specimen, are entirely enveloped by a thin and small-meshed limiting plate.

The spiculation as described above seems to come nearest to, and indeed closely resembles, that of *Staurocalyptus rœperi* (F. E. Sch.). But, under the circumstances, I hesitate to make a definite specific determination.

Staurocalyptus sp. β.

(Figures in Contrib. III., Pl. III., figs. 7–13).

On another *Hexactinella lorica* from an unknown spot in the Sagami Sea was found the small specimen here to be described, together with some other Hexactinellid species (*Leucopsacus scoliodocus, Lanuginella pupa, Staurocalyptus pleorhaphides*).

The specimen is shown in *l. c.*, Pl. III., fig. 9. Barrel-shaped; only about 4½ mm. high; with numerous fine prostal needles and a deep gastral cavity. A comparatively wide subdermal cavity exists.

The parenchymalia are all slender diactins, rough only near the sharply pointed ends and generally without a swelling around the spicular center. Prostal needles, 4 mm. or over in length and up to 57 μ in thickness.

The dermalia are mainly oxystauractins and rarely oxypentactins, in both of which the cruciate paratangentials are slightly convex on the distal side. Rays, slightly rough; 100–154 μ long and 6–7½ μ thick at base. (For the dermalia and hypodermalia, see *l. c.*, Pl. III., fig. 7).

The hypodermalia are oxypentactins with paratangentials up to 450 μ long and 27 μ thick at base. The rays are usually smooth except at the roughened ends, but in some of the spicules I have found the paratangentials thickly beset all over with pointed microtubercles in much the same manner as in *Staurocalyptus pleorhaphides*.

Special gastralia have not been found.

Oxyhexasters (*l. c.*, Pl. III., figs. 12 and 13), very abundant, generally normal and rarely hemihexactinose. Diameter, 68–114 μ. Terminals, two (at most three) to a principal; nearly straight; obsoletely rough; much thinner in the smaller than in the larger oxyhexaster.

Discoctasters or rather their representatives were found in quite a limited number,—only two cases in all which were discovered after a careful search throughout the entire specimen. They are both shown in *l. c.*, Pl. III., figs. 10 and 11. The case of fig. 10 is without doubt that of a malformed discoctaster,—at any rate, one in which some of the primary terminals remain free without uniting into secondary principals, though certain others are united into such for a short distance and situated in proper positions on the central node. This central node is nearly cubical and shows the rounded bosses corresponding to the primary principals. Diameter, 122 μ. The other case, shown in *l. c.*, fig. 11, may almost be called a discohexaster, in which the primary principals are in part still distinct and partly fused together. The terminals are all free and radiate in all directions from the irregularly shaped central mass, showing as yet no trace of rearrangement into the eight bunches of a discoctaster. I regard the spicule, though possibly a case of deformity in itself, as representing an early stage in the transformation of a discohexaster into a discoctaster. Speaking on *a priori* grounds, discoctasters should have passed through a phylogenetic stage appearing much like the spicule now in question. Diameter, 85 μ.

Microdiscohexasters, quite like those of *S.* sp. *a* (*l. c.*, fig. 5).

They are common on or near the gastral surface. The terminals are so fine that it is difficult to observe them in Canada-balsam preparations.

Basidictyonal beams as in *S.* sp. α; nearly smooth, the scanty microtubercles present being quite obsolete.

Staurocalyptus sp. γ.

(This Contrib., Pl. XI., figs. 11–15).

On the same *Hexactinella lorica* as that which bore the foregoing specimen (β), was found another (Pl. XI., fig. 11) of about the same size and appearance but differing somewhat in some points of the spiculation.

Parenchymalia, as in *S.* sp. β. Prostal oxydiactins, under 34 μ in thickness.

Dermalia (fig. 13), exclusively stauractins; more or less convex on the outside and with slightly roughened rays 90–230 μ long and not thicker than $7\frac{1}{2}$ μ at base.

Hypodermal oxypentactins, moderately large; with comparatively slender rays, which are smooth except at the roughened end. Length of paratangentials, up to 700 μ; thickness at base, under $11\frac{1}{2}$ μ. The unpaired proximal ray is longer than,—frequently fully twice as long as—the paratangential in the same spicule.

No gastralia, nor microdiscohaxasters, were discovered.

Oxyhexasters in moderate abundance (fig. 14); normal and all of a uniform appearance. Two or three, sometimes four, slender, rough terminals to a principal which is very short. Diameter, 128–138 μ.

Discoctasters (fig. 15), common. The six bosses present on the central node. Principals slender, at most 4 μ thick; about $\frac{1}{3}$ the length of the entire ray. Terminals fine, 3–6 in a gently expanding tuft, with the minute terminal disc shaped like a pinhead. Diameter of the spicule, 128–160 μ.

Basidictyonalia, as in *S.* sp. β.

In spiculation the specimen seems to resemble most closely a young *S. glaber*, but differs not inconsiderably in the qualification of the roughness of dermalia and in the size of oxyhexasters as well as of discoctasters,—differences which at least render doubtful the propriety of considering the specimen as of that species. I have come to this view after carefully comparing it with the smallest specimen (6 mm. high) of *S. glaber* in my possession.

RHABDOCALYPTUS F. E. Sch.

Hypodermalia include pentactins in which the paratangentials, when fully developed, bear series of strong hook-like or prong-like spines. Veiled, but in some cases the veil may be lost.

Key to the known species.

a.—Dermalia predominantly pentactins, or pentactins and stauractins in nearly equal numbers.
  a^1.—Discoctaster not more than 100 μ in diameter.
    a^2.—Discoctaster with nearly straight terminals, which diverge but slightly outwards in each tuft. Dermalia pentactins, occasionally stauractins............................
    ....*R. dawsoni* (Lambe). (Pacific coast of N. America).

b^2.—Discoctaster with terminals bent outwards in each tuft. Dermalia pentactins, occasionally hexactins. (Oxyhexaster with spherical central node)..*R. tener* F. E. Sch. (C. of California).

b^1.—Discoctaster more than 150 μ in diameter.

c^2.—Oxyhexasters normal, hemihexactinose and hexactinose.

a^3.—Discoctaster, 150–200 μ in dia. Dermalia pentactins, less frequently stauractins. Gastralia, hexactins and pentactins..*R. asper* F. E. Sch. (C. of California).

b^3.—Discoctaster, 240–300 μ in dia. Dermalia, stauractins and pentactins. Gastralia oxyhexactins. (Oxyhexaster with spherical central node)..*R. nodulosus* F. E. Sch. (C. of California).

d^2.—Oxyhexasters, all hexactinose. Dicoctaster about 200 μ in diameter. Dermalia pentactins, stauractins and diactins. Gastralia hexactins with the proximal ray 600–800 μ or more in length.............*R. tenuis* (F. E. Sch). (C. of California).

b.—Dermalia nearly all stauractins. (Discoctaster, 180–240 μ in dia. Oxyhexaster, 180–280 μ in dia.)..*R. victor* Ij. (Sagami Sea).

c.—Dermalia nearly all or at least predominantly compass-needle-like diactins.

c^1.—Sponge firmly attached at base to solid substratum. Gastralia hexactins.

e^2.—Discoctaster more than 130 μ in dia.; reaching up to about 180 μ.

c^3.—The radial axis of gastralia about as long as, or shorter than, the length of the longest dermalia. The free proximal ray of gastralia about as long as any other ray in the same spicule.

a^4.—Among the diactinic dermalia, stauractins and pentactins occur but rarely. Oxyhexaster terminals more or less distinctly barbed at base. ....*R. mollis* F. E. Sch. (Sagami Sea).

b^4.—Among the dermalia, diactins are most numerous, but stauractins and pentactins are also abundant. Oxyhexaster terminals slightly roughened, not barbed. (Paratangentials of hypodermalia chagreened besides being spined)..*R. australis* Tops. (Antarctic).

d^3.—The radial axis of gastralia nearly twice as long as the longest dermalia, or even longer. The free proximal ray is considerably prolonged over any other in the same spicule. (Among the dermalia, other forms than diactins occur, but quite exceptionally. Oxyhexaster terminals smooth or obsoletely rough).

c^4.—Oxyhexaster only occasionally hexactinose. Discoctaster with principals 20–25 μ in length; terminal discs toothed on the external side only or with the teeth much more strongly developed on that side than on the inner. Microdiscohexaster, 22–30 μ dia..*R. unguiculatus* n. sp. (Sagami Sea).

d^4.—Oxyhexaster, mostly hexactinose. Discoctaster with principals only about 8 μ in length; terminal disc equally toothed all around. Microdiscohexaster, 32–40 μ in dia.......*R. mirabilis* F. E. Sch. (S. of Alaska).

f^2.—Discoctaster small; 82–106 μ in dia.; terminal tuft distinctly flaring at the outer end..*R. capillatus* Ij. (Sagami Sea).

d^1.—Sponge with finger-like basal processes and rooted in loose bottom by means of anchor-needles. (Gastralia, compass-needle-like diactins like the dermalia. Discoctaster of two kinds, large (130–160 μ dia.) and small (60 μ dia.)..*R. plumodigitatus* Kirkp. (S. Africa).

The four species occurring in the Sagami Sea, *viz.*, *R. victor*, *R. mollis*, *R. unguiculatus* and *R. capillatus*, will now be dealt with in detail.

RHABDOCALYPTUS VICTOR Ij.

Pls. XVII., XVIII., and XIX.

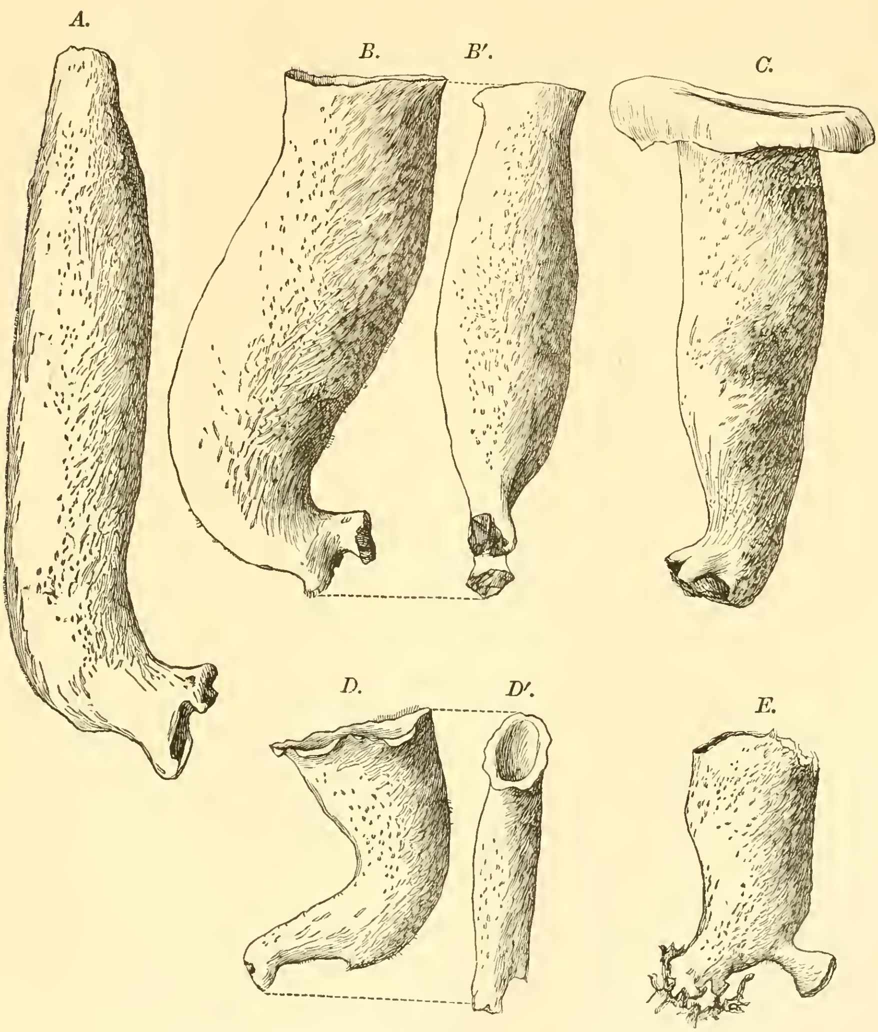
Rhabdocalyptus victor. Ijima, '97, p. 52.—Ch. Gravier, '99, p. 421.

Specimens of this species have passed through my hands in no small numbers. The localities in the Sagami Sea where they have been obtained, so far as is known to me, are: Homba (572–859 m.) and Outside Okinosé (by both the Iwado and Sengenzuka lines, 501–572 m.). In these localities the species seems to be moderately common. Most of the specimens bore at the base samples of a tufaceous bottom; others grew on corals, on dead *Chonclasma* or on *Hexactinella lorica*.

On the following page (text-fig. 8) and in Plate XVII., I have depicted several of the better preserved specimens that I have seen, which are illustrative of the shapes assumed by the species.

In text-figure 8, in which all the figures are drawn to the scale of ⅛ natural size, *A* represents a specimen which belonged to Mr. Owston. It was 23 inches high. Oscular margin directed upwards. Lateral compression of body especially distinct at the base, which is bent in the sagittal plane.

B and B′, two views of a similarly shaped but relatively broader specimen (S. C. No. 425); B′, as viewed from the side of the lesser curvature of the body. Height, 550 mm. Diameters



Text-figure 8.—*Rhabdocalyptus victor.* All in $\frac{1}{5}$ natural size.

of the oval-shaped osculum, 176 mm. and 118 mm. At the middle of the body, the likewise oval cross-section presents diameters of 212 mm. and 148 mm. The strongly compressed base measures only 37 mm. in thickness from side to side. Thickness of wall at the middle of the body, 9.5 mm ; farther below, up to 12 mm. Basal end attached to the substratum at two places, between which is a free dermal surface still preserving a number of pentactinic prostalia.

C, a specimen (S. C. No. 460) slightly bent at the base and with the oscular margin expanded outwards all around and bent backwards. Height, 570 mm. Body laterally compressed but only to a slight degree. Pentactinic prostalia preserved in many part of the dermal surface.

D and *D'*, two views of a specimen with bent body (S. C. No. 267). Height, 348 mm. The oval osculum, 170 mm. by 73 mm.; elongate in the sagittal direction ; with flaring oscular rim. In the middle of the body the breadths are 100 mm. sagittally and 77 mm. transversely. The base is nearly round in cross-section, measuring about 46 mm. across. A low conical outbulging is seen at about the boundary between the lower and the middle third of the body on the side of the greater curvature but to one side of the median line. This is undoubtedly the beginning of the formation of a daughter person ; but a secondary osculum has not yet opened itself at the summit. Thickness of wall at about the middle of the body, 10 mm.

E, a slightly bent specimen (S. C. No. 416) attached by tubercle-like basal processes to a branched coral. Below and on one side is a funnel-like daughter person. Height, 285 mm. Near the upper end the walls of the two sides have come into contact and have fused together. Above this place of fusion, the gastral space and the original main osculum are narrow and slit-like ; below it is the main part of the gastral cavity which communicates with the exterior only by means of the (secondary) osculum of the daughter person.

Essentially similar in shape is the magnificient specimen shown in Pl. XVII., reduced to one-fourth of the natural size (S. C. M. No. 423; from Homba, about 859 m.). The circumstances of its capture I have already had occasion to relate in my Contribution I., pp. 24–25. Its total height is 880 mm. As in many other cases, the body is laterally compressed, the compression being especially distinct in the stalk-like basal region which is bent towards one side. The major and minor diameters of the osculum are 400 mm. and 300 mm. respectively; those of the body at about its middle, 270 mm. and 220 mm. The basal region measures only 50 mm. trasversely from side to side. The lower end of the body is continued, in the direction opposite to the main osculum at the upper end, into a laterally compressed outbulging, which soon divides into two thin-walled tubes, situated one behind the other in the median sagittal plane and each terminating in a secondary osculum directed downwards. The irregular attachment surface of the bent base is (supero-inferiorly) 180 mm. long and (transversely) 85 mm. broad. Judging from its disposition in relation to the directions of the oscula present, it is highly probable that the sponge was growing on a perpendicular surface. The wall is 14 mm. thick in the middle of the body; lower down, it is as thick as 19 mm. The gastral cavity extends into the laterally compressed base in the form of a vertical slit-like space, giving to the wall at the *cul-de-sac* end a thickness of only about 11 mm. On one side of the lateral wall (not seen in the figure) and at a short distance from the main osculum, there exists in the wall an irregularly shaped gap, apparently the result of a mechanical injury. The torn edge of the gap had, so to say, healed and regenerated a natural looking edge which appears much like that of the osculum.

Speaking of the larger specimens in general, the shape is exquisitely vase-like and in a measure laterally compressed. The sponge stands either erect or is bent at the base. In the latter case the bending takes place invariably in the median plane containing the major diameter of the laterally compressed body. The daughter person or persons, occasionally found on the specimens, seem to be restricted in their location to the convex side of the bent basal region. The moderately thick wall is gradually thinned out at the oscular margin, which is sometimes outflaring and sometimes not. The base can not be said to be solid, since the gastral cavity extends almost to the attachment surface. The edge of the extreme base, as seen from the exterior, is often tubercled and indented reminding one of a cat's paw.

The thin oscular edge is of a finely granular or densely felt-like appearance. It may be perfectly simple but more usually is provided with a thin row of fine needle-like marginalia, not over 10 mm. in length. The intervals at which these stand out are usually irregular.

The dermal surface, when in a good state of preservation, is on the whole tolerably smooth except for the small papilla-like prominences and the slightly raised hypodermal strands, both soon to be referred to again. The dermalia form an exceedingly delicate lacework in which the minute meshes are quadrate in shape and measure on an average 170 μ in length of sides. The hypodermal strands appear as thin streaks which, running in all directions, frequently intersect one another (Pl. XVIII., fig. 2). Upon closer attention it will be seen that they form a number of radial patterns,—that they converge towards numerous central points, lying 3–7 mm. apart from one another. At each of these is situated the papilla-like prominence mentioned above. The radial pattern is caused by the paratangentials of a number of hypodermal pentactins which are arranged in a group (Pl. XVIII., fig. 16), their shafts and the accompanying comitalia combining together to form a loose, vertically dipping bundle. The axis of this bundle is occupied by the erstwhile comitalia to the shafts of prostal pentactins which were once present at the spot but are now lost. The outer ends of the comital spicules in question form a compact bundle and, projecting more or less beyond the dermal surface, give rise to the small papilla-like prominence at the center of each radial figure brought about by the hypodermal strands. In the inferior region of the body, the prominences are generally disintegrated and take the form of little parallel tuft of fine spicules, projecting to a length of 2 mm. or less (Pl. XIX., fig. 23) ; whereas, in the superior parts they are usually to be seen as whitish, slightly elevated spots. The prostal pentactins, when present, invariably stand out on the papilla-like prominences, either singly or a few together in a tuft.

However, prostal pentactins are in general but sparsely present in the mature specimens : they seem to become readily lost as they are somehow shed off. Many individuals are quite or nearly destitute of the prostalia in question, showing at most only a few isolated representatives of them. But under certain circumstances they may be somewhat extensively preserved not only in such parts as seem to be protected in a way from abrading influences but also on the exposed lateral surfaces. The spiny armature of the prostal paratangentials can be easily recognized when seen under the hand-lense. Diactinic prostalia, apart from those which sometimes fringe the oscular margin, were not observed on the lateral wall of the larger specimens.

The subdermal space is narrow. The variously sized apertures of incurrent canals, visible through the ectosome, may be as large as 5 mm. in diameter (Pl. XVIII., fig. 2). The interapertural choanosomal surface, usually not wider than the width of the directly adjacent canalar apertures, shows an interweaving of fibers or strands which run irregularly but in the main in oblique directions. In the proximity of the basal attachment the parenchymal texture is dense and coarsely fibrous.

On the inner side of the wall, the endosome shows a continuous gastral lacework (Pl. XVIII., fig. 3) the quadrate meshes of which are distinctly visible to the naked eye. The gastral layer is supported below by a well differentiated system of hypogastral strands which are long and of various strengths under 300 μ and which by intersecting one another enclose wide meshes of an irregularly angulate shape. Frequently the strands are seen to run over and across the apertures of the excurrent canals. Interaperturally the endosome is closely adherent to the choanosome.

The excurrent canalar apertures are of about the same size as the incurrent on the external side, but are somewhat more closely set together. Both the incurrent and excurrent canals are pit-like; when seen in sections of the body-wall, they are alternately arranged, their wall showing variously sized, oval or roundish entrances into the branches.

Finally, a few words with regard to the small and young specimens of the species. The smallest I have seen was only 23 mm. high, thin-walled and with an osculum of 3 mm. diameter at the upper end. The next larger is the one depicted in Pl. XIX., fig. 17 ; height of body, 37 mm.; wall, 5 mm. thick in the middle ; osculum, 7–9 mm. in diameter. All the young of a similar or somewhat larger size are ovoid or barrel-shaped, and, besides being covered with a gossamer-like layer of prostal pentactins, show numerous, fine, needle-like (diactinic) prostalia which spring singly from all parts of the external surface. Thus the young are, in general appearance, scarcely distinguishable from those of *R. capillatus* (Pl. XXII., figs. 3–5). It seems the diactinic prostalia lateralia are all lost during later stages of the growth, though in some individuals similar prostals may arise in later life but in such cases they are restricted in their distribution to the oscular rim (marginalia).

Spiculation.

The *parenchymalia principalia* are bow-like oxydiactins with tapering rays which subterminally are either smooth or sparsely microtubercled. In large specimens they may attain 28 mm. in length and 400 μ in thickness at the middle ; such coarse spicules occurring especially abundantly near the external surface in the lower part of the body. The strength of the principalia of course varies with the size of specimens.

Close to the basal attachment I have found, abundantly in one large specimen but not in the same proportion in others, straight or bent parenchymal diactins, 8–15 mm. long and 20 μ thick on an average, in which the center is externally marked by an annular swelling while one or both of the ends are swollen, round-tipped and thickly beset with well-developed, conical microtubercles. When one end only is thus swollen (Pl. XVIII., fig. 4), as is most frequently the case, the spicular center is situated very much nearer to that end than to the other; the spicule is quite unequally rayed, the ray which is directed towards, and almost or quite touches, the basidictyonal plate, being always the shorter and having the rounded tip. Even in this extreme basal region synapticular fusion never takes place between the parenchymal spicules, nor between these and the basidictyonalia.

The smaller parenchymalia, including the comitalia, are of the usual appearance and require no special description.

The *marginalia*, present on some specimens, are needle-like oxydiactins which may be 10 mm. or more in length and 40 μ thick in the middle. The similarly shaped *prostalia lateralia*, seen only on small and young specimens, may be 20 mm. long and 90 μ thick. Diactins further go to compose the long *hypogastral* strands. These are combinations of long comitalia-like diactins, 7–35 μ (generally about 10 μ) thick and mostly without an annular swelling in the middle.

The *hypodermalia* are moderatey large oxypentactins with paratropal paratangentials. They occur in close groups, generally of 4–8 each (Pl. XVIII., fig. 16), the manner of arrangement being typically that which I have described on p. 131. There are usually in each group one or two pentactins which have entirely smooth paratangentials; they are always the smallest and the most slender-rayed—*i. e.*, the youngest—of all in the group. The older pentactins being always situated at a higher level than the younger, the shafts of the former obstruct the paratangentials of the latter and prevent them from developing in a regularly cruciate disposition ; hence, the paratropism. It may be said that in each group the oldest pentactins are the most centrally situated ; thus, after their protrusion as prostalia lateralia ; they stand out from the center of a hypodermal group ; and when cast off, they leave behind in that position a compact little bunch of the outer ends of fine needles that accompanied their lost shafts as comitalia.

After full development, the hypodermalia have the paratangentials armed from base to tip with strong and sharply pointed prongs, arranged in two series along the lateral sides of the rays. The prongs are situated at tolerably regular intervals, those of the two sides alternating with one another. In the basal parts of the rays, the strongest prongs may be 100 μ long ; there they all spring out nearly vertically but soon become bent in a claw-like manner, the bending taking place generally either backwards or forwards, and occasionally downwards away from the dermal surface. I do not remember ever to have seen the prongs bent upwards. Towards the tip of the rays and along with the gradual attenuation of these, the prongs grow continually smaller, and in the terminal parts they are simply thorn-like, being directed obliquely forwards. Apart from the above prongs, the surface of the paratangentials is perfectly smooth. The unpaired shaft-ray is never pronged ; it is entirely smooth except for a few microtubercles which may be present near its inner pointed end.

The *prostal pentactins, i.e.,* the hypodermalia after protrusion through the dermal layer, always show pronged paratangentials. The protrusion evidently takes place only after complete development of the armature, a fact which seems to hold true for all members of the genus. The paratangentials are, as measured on the prostalia, generally 5.5–6.5 mm. long and the shafts, 4.5–8 mm. Thickness of rays, not more than 65 μ at base. The shaft may in length exceed the paratangential in the same spicule by about half the length of the latter; in other cases it is only about as long or even somewhat shorter. Compared with the same spicules of certain other species (*e.g.*, *R. capillatus*) in which they form a persistent veil, the shaft rays in the present species fall behind considerably in length, a fact which may have bearing on their tendency to be readily cast off.

The *dermalia* (Pl. XVIII., figs. 8–11) are predominantly rough stauractins. The center of these is generally plain but occasionally shows a gentle swelling on either the external or the internal side or on both sides. Rarely the dermalia are pentactins in which the unpaired ray is directed proximad while the distal ray is represented by a vestige in the form of a mere swelling. I have found the pentactinic forms especially along the hypodermal beams. Still more rarely are the dermalia diactins and tauactins, lying with all their rays in the dermal plane. In the former the suppressed rays are indicated by four knobs around the center; in the latter the atrophied paratangential usually leaves a knob-like relic, while the radial rays may or may not be similarly represented. Length of dermalia rays, 114–194 μ (on an average 156 μ). Their thickness at base, 9½–12⅓ μ (on an average 10 μ). Sides of the quadrate dermal meshes, on an average 180 μ.

The *gastralia* (Pl. XVIII., fig. 13) are rough hexactins in which the free proximal ray is not specially characterized. Length of rays, 150–230 μ (on an average 180 μ); breadth at base, 11–15 μ (on an average 12½ μ). Sides of the quadrate gastral meshes average 200 μ in length. Sometimes two gastralia may lie close together, in which case the directly adjoining gastral laths are three rays strong instead of two as usual. Unusually small and slender-rayed oxyhexactins occasionally present in the layer are without doubt gastralia which have not yet attained complete development.

Taking part in the formation of gastral laths, diactins are not infrequently found, the rays of which are generally somewhat thinner but longer than those of the hexactins. The center is marked either by an annular swelling or by four cruciately disposed knobs; the surface may be nearly smooth but is more generally roughened by the presence of microtubercles in varying numbers. There can scarcely be any impropriety in classing some at least of the diactins under the gastralia; at the same time they may be looked upon as spicules linking the gastralia proper to the hypogastralia.

Oxyhexasters (Pl. XVIII., figs. 5, 7 and 15) of a large size, measuring 180–280 μ in diameter, are abundant in the choanosome. Normal forms are rather scarce; more frequently are the oxyhexasters hexactinose and most commonly, hemihexactinose. The principals are extremely short or nearly obsolete, making the terminals almost appear to radiate directly from the common central node. The terminals are strong, measuring up to 4 μ in thickness at base; their surface is always rough, the roughness developing into small barbs in the basal parts. The uniterminal principal is either straight or bent at its junction with the terminal. In the former case the atrophied terminal may sometimes be represented by a unilateral boss (fig. 7).

In the normal oxyhexasters the number of terminals to each and every principal seems to be generally two, giving twelve terminal points in all to the entire rosette. Quite rarely I have counted as many as fourteen terminal points, in which cases I presume one or two of the principals have had more than two terminals each. The hemihexactinose forms show 7–11 terminal points.

In one specimen I have noticed the presence in the subdermal space of a number of oxyhexasters, which, besides being normal, had appreciably thinner rays than others in deeper situations. Probably this differentiation of the peripheral oxyhexaster obtains in all individuals of the species, but is not always manifest owing to the sparseness of this kind of oxyhexasters in the periphery.

The *discoctasters* (Pl. XVIII., figs. 6, 12) are of about the same size, and occur in nearly equal abundance, as the oxyhexasters. Diameter, 180–240 μ. Large and small discoctasters occur together promiscuously. The central node is either plain or is supplied with the six hump-like prominences, the latter form being especially common in the case of the smaller of the rosettes. Principals smooth; about half as long as the terminal tuft; 5–$7\frac{1}{2}$ μ thick in the middle and somewhat thicker towards the outer end. Terminals slightly rough; gradually attenuating; nearly straight or just perceptibly bent after the manner of the latter S. Their number is 6–8, sometimes as few as 4, to a tuft, which expands gently towards the outer end. Terminal discs, minute and pinhead-like; not dentate.

Microdiscohexasters of the usual size and shape, most nearly resembling those of *R. mollis* (Pl. XX., fig. 4) or of *R. unguiculatus* (Pl. XXI., fig. 9), were found exceedingly sparsely in one specimen. In other specimens I have sought after them in vain, though certainly I can not be quite sure that they were really totally absent in all these cases.

As to the *basidictyonal plate* of the species (Pl. XVIII., fig. 14), I have always found the structure to be thin and extremely uneven. The irregularly contoured beams are sparsely micro-tubercled. The meshes are small and roundish, oval or irregular in shape.

Soft Parts.

A specimen of the size of an apple, killed and preserved in alcohol, was utilized for the study of the soft parts. However, this led to no important results. Not a little information as to the arrangement of the soft parts may be gathered from figs. 18–23 in Pl. XIX. and from the explanations appended thereto; and I here limit myself to recording some of the points determined, which are as follows:

Chambers, 120 μ in average diameter. Meshes in their walls open, generally 3–6 μ wide. Nuclei, about 2 μ large in diameter; rather distinct though stained in about the same degree as the reticulum-forming protoplasm; containing one or more darkly stained granules. At the chamber-rim (fig. 19), as also along the termination of the chamber-layer close to the oscular edge (fig. 18), the finely reticular wall passes into film-like or filamentous trabeculæ without any sharp demarcation. In the thin oscular margin the chamber-layer assumes the character of a continuous, irregularly undulating, reticular membrane, instead of being differentiated into separate chambers (fig. 18).

On several occasions I have distinctly observed the presence of a film-like *membrana reuniens* (Contrib. I., p. 130) filling up the gap between the circular apopyles of three or four, directly adjoining chambers (fig. 20, *f.*), thus shutting off at the spot the intercameral incurrent space from the excurrent lacunæ of the internal trabecular layer. At other times, however, the gaps were clearly seen to be open (fig. 20, *g.*), so that I believe the membrana reuniens is not a thing of constant occurrence.

Dermal and gastral membranes, rather extensively film-like (Pl. XVIII., fig. 16). Trabeculæ, thread-like; rather sparse in the subdermal space as well as along the lumen of both incurrent and excurrent canals. Their nuclei, at most 2 μ in diameter; scattered at irregular intervals.

Archæocytes, found in small flat groups on the wall of chambers; not forming large congeries, which fact is probably due to the immature state of the specimen.

Scattered in irregular distribution and suspended on the trabeculæ, both external and internal, are found numerous fat-like spheres of various sizes (shown in figs. 20–22 as black dots). Diameter, 7½–20 μ. Sometimes they seem to be inclosed in a thin envelope; more often they are apparently quite naked. Their substance is either homogeneous or granular; it is intensely stained by carmine or hæmatoxylin, and is browned by osmic-acid but is not coloured blue by iodine. Neither alcohol nor ether dissolves it. I have therefore no doubt as to the bodies being thesocytal products. Frequently two spheres are seen closely apposed to each other, as if they had taken origin and were actually lying together within one and the same cell,—which is probably the real fact, though the nucleus can not be distinguished.

Together with the above bodies or in places where one might expect to find them, there not uncommonly occur roundish, oval or irregularly contracted cells of pale appearance and each containing a darkly stained nucleus (fig. 20, *c*.). They measure $7\frac{1}{2}$–$12\,\mu$ or more across. An enveloping membrane is distinguishable; the contents are thinly granular. I take these cells for old thesocytes, which have lost the fat-like products by consumption.

RHABDOCALYPTUS MOLLIS F. E. SCH.

Pl. XX.

Rhabdocalyptus mollis. F. E. SCHULZE, '86, p. 51; '87 (!), p. 155, Pl. LXIV; '97, p. 552.—I. IJIMA, '97, p. 50.—CH. GRAVIER, '99, p. 421.

The specimens I have seen of this species number not less than a dozen. Most of them belonged to Mr. ALAN OWSTON. That all came from the Sagami Sea there can be no doubt, but only in the following three cases can the localities be more exactly stated: Homba (about 572 m. depth), where KUMA obtained two very small specimens together with *R. capillatus;* off Odawara in the Province of Sagami (about 500 m.), at which locality I myself obtained a fragment attached, together with a number of other animals, to the carapace of a *Macrocheirus kæmpferi;* and the "Albatross" Station 3697 (about 4 kilom. off the mouth of Sakawa River in Sagami, 265–120 fms., black volcanic mud), where a tubular fragment of the species was trawled up by the "Albatross" (1900) together with *Acanthascus cactus.*

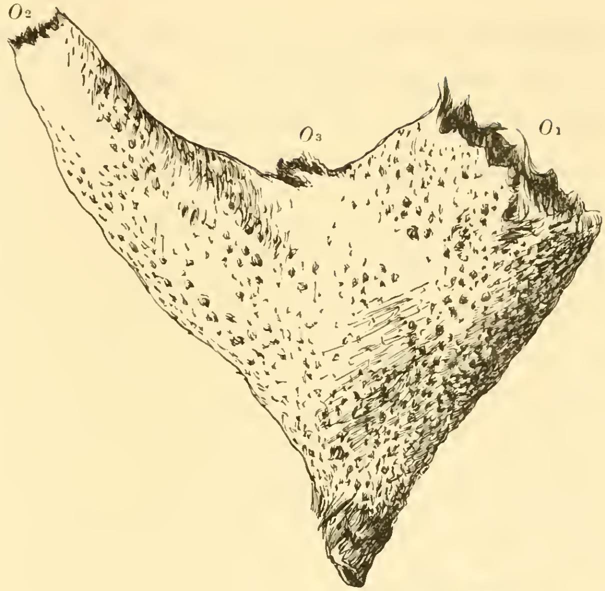
Nearly all of the specimens I have seen bore on the basal attachment samples of the bottom which consisted of a fine-grained, tufaceous clay.

I may begin the description of the general characters with the two little individuals (S. C. M. No. 421) mentioned above as having been obtained at Homba. Both are of about the size of a pea and are torn off at the base. They are both ovoid in shape and show a small round osculum. They possess some fine prostal needles together with a few prostal pentactins and are thus indistinguishable in outward appearance from the young of *R. capillatus* (Pl. XXII., figs. 3, 4).

The species attains rather large dimensions. The individual shown in Pl. XX., fig. 1, which is one of the largest I have seen, measures 337 mm. in height and 6–8 mm. in thickness of the wall at most parts; that of fig. 2, same plate, 366 mm. in total height and 10 mm. in thickness of the wall in the inferior half of the body.

In general all the larger specimens are of a saccular, funnel-like or vase-like shape, gradually contracted towards the knobby base and more or less distinctly compressed in a lateral direction. In the specimen of Pl. XX., fig. 1, which, so much of it as is preserved, retains the natural shape in a perfect state, the osculum at the upper end is roundish measuring approximately 82 mm. in diameter; but a third of the height lower down, the body is sagittally 153 mm. and transversely 94 mm. broad; and still lower, the greater breadth is 82 mm. and the lesser, only 30 mm.

The species seems to be in a high degree prone to form secondary oscula; in fact all the large specimens I know of are in possession of one or more such in addition to the primary or main osculum. They may be represented by simple perforations



Text-fig. 9.—*Rhabdocalyptus mollis* F. E. Sch. (O. C. No. 104). Drawn in $\frac{1}{4}$ natural size.

O_1., main osculum or osculum of the mother person. O_2., osculum of the first-formed daughter person. O_3., osculum of the second-formed daughter person (injured).

Text-fig. 10.—*Rhabdocalyptus mollis* F. E. Sch. (O. C. No. 105). Drawn in $\frac{1}{4}$ natural size.

O_{1-4}., oscula numbered in the order of their formation, as in the preceding figure.

but are more generally situated at the end of tubular outbulgings or buds of the sponge-wall. These are at first cæcum-like but after a time an osculum opens at the blind end of each; they, as also the simple secondary oscula, should be considered to represent daughter-persons formed by the mother-person, ill-defined and persistently continuous with the latter though they are. The bud may grow to conspicuous dimensions and thus may give to the sponge a very peculiar and characteristic shape. It seems to be invariably the rule that the simple secondary osculum or the tubular daughter-person, whichever be the case, arises at some point on one of the median edges—not on the broad lateral sides—of the laterally compressed mother-sponge, and that, when two or more secondary oscula or daughter-persons coexist, these are all situated in a row on the same body-edge.

My material comprises a series of specimens varying in the number of daughter-persons from one up to five.

The two specimens of Pl. XX., figs. 1 and 2, show each a single daughter-person. In the one (fig. 1) the wall is somewhat bulged out sagitally in the upper half of one of its obtuse edges. At the lower end of this out-bulging is an artificial gap in the wall, produced without doubt by the severing off of a daughter-person which had grown there. Assumably the upper part of the same out-bulging is in an inceptional stage of giving rise to a second daughter-person. The other specimen (fig. 2), a strongly laterally compressed individual, shows a conspicuous tubular daughter-person, 183 mm. long and springing from the upper part of the mother-wall in an obliquely upward direction. In this case we may presume, from the circumstances of space, that a second daughter-person, were it ever to arise, would be formed below the one already present. In the third specimen I have seen with a single tubular daughter-person, this constituted a very conspicuous feature in that it was somewhat longer, though certainly less broad, than the mother-body. It arose from near the base, so that the formation of a future bud was to be anticipated most likely in a position above the daughter-person just referred to. That the second bud may be situated either above or below the first formed, is established by actual cases to be mentioned directly.

In text-figure 9 I have represented a specimen with two secondary oscula in addition to a large primary osculum (O_1). Of the former, the larger one (O_2) is situated at the end of a broad branch from the mother-body; it is evidently the older. The other (O_3)—the smaller and younger—is situated in the axil between the branch-like daughter-person and the mother-body; or, it would be proper to say simply that in that position is situated the second formed daughter-person which seems to have suffered much mechanical injury. The general shape of the sponge has been suggestively described by Mr. Alan Owston as like "a hand with thumb extended." Another specimen of essentially the same shape existed in the collection of the gentleman just mentioned. In it the second daughter-person was well-preserved in the form of a tube, smaller than the first daughter-person and situated between the origin of this and the oscular margin of the mother-person.

Here a reference may be made to the two specimens which are mentioned by F. E. Schulze in the Challenger Report. The smaller of them is said to have exhibited near the lower end two small roundish apertures. I consider it probable that these apertures were secondarily formed oscula or at any rate some sort of gaps indicative of daughter-persons. The other specimen, which is figured, should have possessed on one side of the lower part a tube-like branch opening in a wide orifice at its extremity; directly below it a small cæcal protrusion or boss ; and just above the solid base a small round perforation in the body-wall. Whatever may be the nature of the last mentioned perforation, there can be no doubt about that of the tubular branch open at the end and of the cæcal boss. The latter would after a time have developed an osculum at the blind end, like the older bud just above it.

The specimen of text-figure 10 bears three daughter-persons. The lowest, of a long tubular and chimney-like appearance, is without doubt the first formed (O_2). As the second formed I consider the uppermost, a great part of which had evidently been torn off and lost, leaving an irregular gap in the wall (O_3). Between the above two is the third tubular bud (O_4) which is open at the end and is of a comparatively small size ; this I regard as the one last formed.

Another specimen was essentially similar to the last mentioned except in the fact that it showed a distinct trace of the fourth bud which had been torn off. If it be justifiable, as in a great measure I think it is, to infer the order of successive formation from the relative caliber of the buds, then the lowest situated and by far the largest of them all is the oldest ; the one directly above it, the third ; next above comes the second ; while the uppermost is the fourth and last formed.

A specimen with five well-preserved buds is distinctly bent in the sagittal plane. On the body-edge which formed the greater curvature the tubular buds are arranged in a row, after the manner of glove-fingers. Counting from below upwards, the first (the lowest) bud is very long, chimney-like and open at the end ; this is probably the oldest daughter-person. The second resembles a tube only about half as long as the first and still closed at the tip. The third is a long tube, broader but slightly shorter than the first and open at the end ; this I regard in point of age as next to the oldest daughter-person. The fourth is a relatively short blind tube like the second. Finally the fifth, *i. e.*, the uppermost situated near to the margin of the main osculum, is a tube of about the same size as the last but open at the end ; it probably represents a daughter-person younger than the third but older than either the second or the fourth, both of which terminate in a cul-de-sac indicative of their incomplete development and may have originated nearly simultaneously.

Thus far concerning the peculiar external shape which the species may acquire as the result of budding out tubular daughter-persons.

Now, the gastral cavity of the mother-person—it is scarcely necessary to say—is directly continuous with the like cavities of the daughter-persons. It is very deep and extends close to the basal attachment, so that a solid stalk can certainly not be attributed to the species. Externally, the circumference of the basal attachment may show irregular pad-like thickenings.

The oscular margin, which is always thin, is generally simple-edged in the daughter-persons. That of the mother-person may, on the other hand, show a varying number of fine, short prostal needles, projecting upwards to a length not exceeding 5 mm. These partly springing from the very edge and partly from the dermal surface adjoining it, may form an inconspicuous and interrupted fringe to the osculum. That diactinic prostalia occur with comparatively greater prominence in the young stage of the sponge, may be concluded from the condition presented by the two very small individuals before mentioned.

As in *R. victor* the prostal pentactins seem to fall off readily. Thus, in the specimen of Pl. XX., fig. 1., in which the external surface is in an almost perfect state of preservation, the pentactins, protruded to an extent of 3 or 4 mm., occur isolatedly and sparsely in certain parts only, while over the greater part of the sponge they are totally missing.

The delicate dermal lacework is thrown into little creases, possibly as the result of desiccation. Observed under the lens the meshes appear to be irregular and indefinite in shape, which is due to the fact that the dermalia are diactins that cross, or are joined to, one another at various angles (Pl. XX., fig. 12). The thin and wavy hypodermal strands, in places so thin as even to closely resemble the dermalia in strength, form also irregularly angulate, but of course much larger, meshes. They are seen, sometimes with a fair degree of distinctness, to converge towards separate central points which are 3–6 mm. apart. This is on account of the pentactinic hypodermalia being arranged in groups, much as we have seen them in *R. victor*. In the lower parts of the sponge, especially near the base, the centers of the hypodermalia groups are usually well indicated by short small projecting tufts of fine needles which either cohere or are loose and brush-like. The same tufts we have likewise seen in *R. victor*. The prostal pentactins that may occur spring out in connexion with the tufts.

In one specimen I have seen on the dermal surface several cicatrice-like spots which appeared white and densely textured. The same have sometimes been noticed in several other Acanthascinæ. It is more than probable that they arise by hyper-regeneration of tissues, both soft and scleric, at places where the sponge had suffered an injury.

The internal surface of the sponge-wall is covered throughout with a continuous gastral lacework, in which the meshes, for the most part regularly quadrate in shape, can be discerned with the naked eye (Pl. XX., fig. 13). Beneath the layer are seen hypogastral strands varying in thickness, running in indefinite directions and intersecting one another at various angles.

The canals, both incurrent and excurrent, are deep and pit-like. In the larger specimens, the roundish canalar apertures of the incurrent system may be as large as 4 or 5 mm. in diameter, while those on the gastral surface measure at most 2 mm. The latter are thus on the whole smaller than the former but are situated more closely together (Pl. XX., fig. 2). On cross-sections of the sponge-wall, the canals of the two systems do not alternate so regularly as in certain other species in which they are of approximately the same caliber.

Spiculation.

With F. E. Schulze's excellent descriptions of the spiculation of this species and with two slide preparations from the type specimen which he gave me, it was an easy matter for me to recognize the species.

The *principal parenchymalia* are bow-like oxydiactins which may be 20 mm. long and 90 μ thick in the middle but are more generally smaller. The middle is not externally marked by swellings. The rays are gradually attenuated toward the end.

The smaller parenchymalia, down to comitalia of only 4 μ thickness, are of the usual description. A central nodal thickening is by no means of such frequent occurrence as one might be led to suppose from F. E. SCHULZE's statement in the Challenger Report. The tips are acuminate, rounded, conical or mucronate; occasionally swollen to a club-like or even a bulbous shape. Subterminally rough in varying degrees; the microtubercles, when strongly developed, are retroverted.

The parenchymalia undergo synapticular fusion close to the basal attachment and in conjunction with the basidictyonalia. In certain specimens the fusion was limited to the central parts of the base; in others it extended to the external surface.

The *basidictyonal* plate is at places represented by a very thin reticular layer quite agreeing in appearance with F. E. SCHULZE's Pl. LXIV., fig. 3, in the Challenger Report. At other places it is of a considerable thickness, being composed of basidictyonal hexactins ankylosed together in the usual manner.

The *hypodermal* pentactins show essentially the same characters and arrangement as in *R. victor*. Paratangentials, not exceeding 5 mm. in length; the shaft, longer, up to 10 mm. The former are more or less paratropal, but cases of their being quite or nearly regularly cruciate are not infrequent. This may be explained by the fact that the hypodermalia do not lie close together in their groups (Pl. XX., fig. 12) and consequently their shafts run a certain distance apart from one another, thus departing in a measure from the condition that causes the paratropism in a developing hypodermal pentactin. Not uncommonly four or five pentactin-heads are seen in a group, of which the most superficially situated (*i. e.*, the oldest) one or two have the four paratangential rays provided with the spiny armature. The spines are somewhat less developed, with respect both to their size and number, than in *R. victor*. They are directed obliquely outwards, the stronger ones in the basal parts of the rays being curved generally likewise outwards but occasionally in some other direction, in a claw-like manner. Though arranged as a rule in two irregular series on the lateral sides, there may occasionally exist a spine or spines on the external side of the ray, especially in the basal parts. The spines on the two sides may alternate with tolerable regularity, but this is subject to frequent interruptions. Those on the same side are situated at intervals which frequently may measure 160 μ or thereabout.

In some cases—not all—of the spined hypodermal pentactins, I have found the general surface of the paratangentials to be finely shagreen-like on account of the presence of dense microtubercles, similar to those in certain *Staurocalyptus* species. In this, as also in several other features of the spiculation, the present species stands in very close agreement with *R. australis* Tors.

A number of slender diactins, indistinguishable from parenchymalia of a similar strength, associate with the paratangentials in forming the hypodermal strands. A number of comitalia accompany the shafts.

The *dermalia* (Pl. XX., fig. 12) are generally rough and rod-like diactins, much like those given in Pl. XXI., fig. 2 (from *R. unguiculatus*). Rarely and exceptionally are they orthodiactins, tauactins, stauractins or pentactins. According to F. E. Schulze monactins should occasionally occur also.

The diactins, which are either straight or very slightly arched, are 265–485 μ long as measured from tip to tip. Breadth in or near the middle, 9–15 μ. The spicular center is generally plain; otherwise it is externally marked, sometimes by an annular swelling and sometimes by knobs which may occur either in a single pair or in two pairs. The rough-surfaced rays generally taper slightly towards the tip which is rounded off or conically pointed.

The *gastralia* (Pl. XX., fig. 13) are hexactins with rays appearing exactly like those of the dermalia. Length of rays, 165–245 μ (about 200 μ on the average). Breadth at base, 11–15 μ. All the six rays in the same spicule may in general be said to be nearly equally long, though in some cases the distal ray has been found to be somewhat shorter, and the free proximal ray to be somewhat longer, than the paratangential rays. The microtubercles may be slightly more pronounced on the proximal ray than on any other, but in any case the differentiation of that ray is never carried out to any considerable degree. The unusually small and slender-rayed gastralia, which are occasionally met with, are apparently those that have not yet attained full development.

The *oxyhexasters* occur much more abundantly in the deeper parts of the wall than in the periphery, as has been pointed out by F. E. Schulze. Diameter, 102–160 μ; usually about 120 μ. The microtubercles on the basal parts of terminals show the tendency to develop into barbs in an unusual degree.

One point concerning the spicules, which has not been mentioned by F. E. Schulze, is the fact that they occur in two slightly differing forms, the one chiefly in the subdermal space and the other in more deeply situated parts. It must however be said at once that the two varietal forms intergrade.

The subdermal oxyhexasters (Pl. XX., fig. 3) are distinguished by being nearly always of the normal shape and by having very slender terminals. Each exceedingly short principal in a spicule carries 2–4 (usually 3), nearly straight, rough terminals. These seem to be very fragile; the broken off terminals are usually found in numbers sticking to the dermal membrane. The roughness of surface becomes more pronounced towards the base of the terminals, where it may distinctly appear to be due to reverted microtubercles. Under certain circumstances these may be developed even into long and conspicuous barbs, but such is by no means the case with the generality of the peripheral oxyhexasters. Rarely is the variety in question hemihexactinose or hexactinose. Deep in the choanosome it is only occasionally met with promiscuously with the following.

The second variety (Pl. XX., figs. 6–11) is by far the more numerously represented, occurring in greatest abundance in the subgastral region as well as in the endosomal layer. In it the principals are reduced almost to nothing, so that the terminals appear to radiate directly from the central node. The terminals are—in some individuals of the sponge slightly and in others decidedly—stronger than in the other variety. In some exceptional cases of the spicule I have found all the rays nearly or quite smooth from tip to base; but the general rule is that their basal parts show a varying number of barbs or unusually strongly developed retroverted microtubercles, while the distal parts are either obsoletely rough or quite smooth. Sometimes the basal barbs occur in quite a limited number; it may even happen that in the same spicule some rays are provided with only a few of them while the rest are entirely smooth. As a general rule, however, the barbs are numerous, gradually increasing in length towards the very base of the ray to which they belong. As has been known from F. E. SCHULZE, the more basally situated barbs may sometimes be so long that those of adjacent rays almost unite. In a few instances I have seen some of the barbs of the different rays actually in fusion, thus producing around the central node a structure which bears a certain resemblance to a lychnisc.

The total number of rays in an oxyhexaster of the second variety may be twelve or even thirteen or fourteen. These evidently represent cases of normal oxyhexasters, in which the six, nearly suppressed principals are either all biterminal or are partly biterminal and partly triterminal. On the other hand a large, if not the greater, number of the oxyhexasters in question are apparently hemihexactinose, leading down to the quite hexactinose forms which are also numerously represented. Both the reduced oxyhexasters just named are of the usual general shape and need not be specially described. But I should mention that again in this species I have encountered several instances of a principal bearing divergently a well developed terminal and the spurious rudiment of a second (Pl. XX., fig. 10). The rudiment may occur as a small unilateral spine even in the cases in which the principal and the persistent terminal have straightened out as a simple ray, not bent at the base (Pl. XX., fig. 7).

F. E. SCHULZE has found in some numbers peculiar oxyhexasters—reduced forms with six or less rays in all—in which all or some of the rays present are spirally twisted (Chall. Rep., Pl. LXIV., figs. 10 and 11). A similar oxyhexaster was noticed by me in *Staurocalyptus pleorhaphides* also (p. 229, Pl. XVI., fig. 8). As regards the present species, certain specimens indeed were found to possess the twisted oxyhexasters though sparingly, but in several others I have searched for them in vain. I am therefore disposed to consider them as of inconstant occurrence in the species. Possibly they are produced only under certain abnormal conditions.

The *discoctasters* (Pl. XX.,. fig. 5) are found scattered in the wall, but in especial abundance in the subdermal space as was noted by F. E. Schulze. I may here note that contrariwise in *R. capillatus* the same spicule is most numerous in the subgastral region. What causes such a dissimilar distribution can certainly not be told. In diameter the spicules in question vary from 130 μ to 175 μ (on an average 140 μ). They are nearly as large as, or but slightly larger than, the average oxyhexasters of the species. The central node exhibits the six hillock-like prominences more or less distinctly. The principals (secondary) take up about one-third or less of the entire ray-length; they are 5 μ or more thick in the middle. Number of terminals in a tuft, 5–9; rarely as few as 3 or even 2. The tuft is gently expanded distally, the terminals composing it being each slightly bent outwards or, as is sometimes the case, nearly straight. The surface of terminals is slightly rough; under the immersion system the roughness may be seen to be caused by reverted microtubercles. The terminal discs are either simply pinhead-like or show seven or eight marginal teeth, the latter being the case in the larger discoctasters.

Not infrequently are the discoctasters malformed in that some terminals remain free without being incorporated into any of the secondary principals. Noteworthy seem the few instances that came under my observation, in which the terminals stood out in eight tufts directly from the tubercled central node, without coming into fusion in the basal parts.

The *microdiscohexasters* (Pl. XX., fig. 4) are of the familiar appearance. Diameter, 22–27 μ. F. E. Schulze found these spicules in especial abundance in the proximity of the dermal membrane. In the preparations that he sent to me I find them quite common in the endosome as well as in the subgastral region, once counting as many as a dozen in the same visual field of the microscope. Far less commonly and even quite sparsely were they represented in several specimens in which I have specially looked for them. In these they were to be met with only now and then, both subdermally and subgastrally.

RHABDOCALYPTUS UNGUICULATUS NOV. SP.

Pl. XXI.

The species here described as new under the above name is unquestionably a very near relative of *R. mollis* F. E. Sch. and of *R. mirabilis.* From both these species it can scarcely be said to differ so far as the categorical forms of the spicular elements are concerned; but in the details of characters I find, common to all the individuals referred to it, certain constant peculiarities which, I think, may be considered to be of specific value.

I have had at my disposal for examination no less than eight specimens, all of which I place under the present species. The known locality is Okinosé, both Inside and Outside; depth, about 500 m.

Three of the said specimens are small, young individuals, quite similar in external appearance to the young of *R. victor*

(Pl. XIX., fig. 17) or of *R. capillatus* (Pl. XXII., figs. 3–5). Two of them grow together on a mass of coal-cinder in company with the large and beautiful specimen shown in Pl. XXI., which will soon be described in detail as the type of the species. A fifth specimen (S. C. M. No. 473) shows a tubular shape, 58 mm. high. A sixth (S. C. M. No. 402), 100 mm. high, is much macerated; it is attached to a branch of *Ceratoisis* sp. together with a small *R. victor*. Finally two more specimens, which belonged to a collector, came under my inspection; they were both tubular and somewhat fusiform, measuring respectively 115 mm. and 150 mm. in height. These two also grew on a piece of coal-cinder, erect and side by side. In the gossamer-like covering and in other points of the macroscopic characterization, they agreed well with the type-specimen. In no specimen have I seen any indication of the formation of secondary oscula or daughter persons.

The type-specimen referred to above (Pl. XXI., fig. 1; S. C. M. No. 501, from Outside Okinosé) is an exquisitely preserved individual of the shape of a thick-walled, somewhat laterally compressed, tubular sac, gently swollen out on the sides. It is attached to the substratum by an irregular basal mass, situated on one side of the lower end and as usual in the sagittal plane of the body. Total length, 365 mm. Breadth in the middle (exclusive of the layer of prostals), 140 mm. sagittally and 120 mm. transversely. Thickness of wall in the same position, 21 mm.; it is much greater than in specimens of *R. mollis* of approximately the same size. The oval osculum at the upper truncated end, 72 mm. by 107 mm. in diameter.

In the peristomal region there exist numerous, fine, needle-like oxydiactinic prostalia of variable length. They may project to the length of 14 mm. or more. They spring out partly isolated and in irregular distribution but more usually in tufts from the top of little tubercle-like prominences of the dermal surface. Within a centimeter's distance from the oscular edge the oxy-diactinic prostalia become entirely replaced by large oxypentact-inic ones, which cover the rest of the external surface down to the basal mass. All the pentactins arise in tufts from the summit of small tubercle-like or papilla-like prominences, which are always of small diameter but may sometimes be 2–3 mm. high. They are usually separated from one another by a space of 5–10 mm. In many cases there are only two or three pent-actins in a tuft; in other cases there may be more than ten. The paratangential heads in a tuft do not all lie in the same level but usually rise to various heights from the dermal surface, representing different stages of the protrusion of the shafts from the latter. Thus, there arises the gossamer-like layer, in places 15 mm. thick, over the sponge exterior. The conditions of the prostalia are exactly the same as in *R. capillatus* (*cfr.* Pl. XXII., fig. 12, etc).

On the basal mass there bristle out numerous hair-like prostals. These, on close observation, were found to be simply the shafts of such prostal pentactins whose distal parts had been broken off.

The dermal surface is rather uneven. Under the lens it shows the dermal layer to be irregularly meshed, which is due to the diactinic dermalia. The comparatively fine hypodermal fibers exhibit a certain regularity of arrangement in so far as they appear to radiate from the base of each prostal tufts. In short, the structure of the ectosomal skeleton is essentially the same as is known to me from *R. mollis* and *R. capillatus*.

The subdermal space presents itself as a rather conspicuous layer in sections of the wall. In places it is as much as 3 mm. across. It is traversed by the pillars which join the ectosome to the choanosome and consist mainly of the shafts of prostal and hypodermal pentactins and of their comitalia. The appearance of the wall in section partakes much of that which I have figured from *R. capillatus* in Pl. XXII., fig. 12.

As to the roundish apertures of the incurrent canals a certain difference is noticeable with respect to their size and manner of distribution on the two lateral sides. On the side shown in Pl. XXI., fig. 1, some of them measure up to 7 mm. in diameter, and lie promiscuously with others which are at most about half, and often much less than half, as wide. On the other side the apertures are of a more uniform size, mostly measuring 3–5 mm. in width and situated somewhat more closely together.

The gastral surface is covered over by a continuous gastral lacework, the regularly quadrate meshes of which are plainly visible to the naked eye. They are much larger than in *R. mollis* or *R. capillatus*, measuring $\frac{1}{3}$–$\frac{1}{2}$ mm. in length of sides. In the interspace between the excurrent canalar apertures, the layer is in tolerably close contact with the choanosome; over the apertures it frequently heaves up in a vault-like manner. Remarkable is the fact that even over the largest apertures there are seen no hypogastral strands in support of the gastral layer.

The excurrent canalar apertures in most parts of the gastral cavity are rather closely set, reaching up to 5 or 6 mm. in diameter. In the bottom of the cavity some of them are as wide as 8 mm.

Spiculation.

The following account is based on my observations on the type specimen, except when other specimens are specially referred to.

The *principal parenchymalia* are large oxydiactins which may measure 30 mm. in length and 175 μ in breadth in the middle. They are generally more or less bent and gradually attenuated towards both ends, which are rough for a short distance even in the largest of the spicules. The accessory parenchymalia present no point that seems to require special mention.

The *prostal oxydiactins* of the marginal zone may attain a length of 25 mm. and a breadth of 85 μ in the middle. They are smooth throughout, without any indication of the spiny character of the distal parts, such as has been observed in *R. mirabilis*.

The *prostal oxypentactins* have paratangentials which are nearly always paratropal and are 8–11 mm. long and about 85 μ broad near the base. The spines on the paratangentials may be as high as 150 μ. Basally on the rays they are rather irregularly disposed but more distally are arranged in two lateral rows. The smooth shaft-ray generally measures 15 mm. or over in length. On the basal mass of the sponge it may be as long as 40 mm.

With respect to the arrangement of the same oxypentactins as *hypodermalia* and of the younger spineless hypodermal oxypentactins, what I have said under *R. victor* may be considered to apply equally well to the present species.

No diactins seem to occur as hypodermalia, unless those that occasionally extend from the choanosome into the ectosome or unless those which will presently be mentioned as unusually elongate dermalia be regarded as such.

The *dermalia* (Pl. XXI., fig. 2) are nearly exclusively diactins and only occasionally stauractins or tauactins. The rays are rough all over and slightly tapering towards the rounded or obtusely conical end. The diactins are nearly straight or only perceptibly arched. In them the center is usually not marked by any swelling; only occasionally it is indicated by two opposite lateral tubercles, never by four such in cruciate disposition,—a fact which suggests the direct derivation of the diactins from stauractins and not immediately from either pentactins or hexactins. The diactinic dermalia generally measure 330–420 μ (about 400 μ on an average) in total length and 8–15 μ (about 10 μ on an average) in thickness near the middle. Rarely there occur, among the dermalia, diactins, 800 μ or nearly 1 mm. long. With such an increase in length of the dermalia, the roughness of the surface shows a tendency to become confined to the terminal parts, leaving the middle parts smooth.

The *gastralia* (Pl. XXI., fig. 3) are rough oxyhexactins of much greater axial length than the dermalia. They are considerably larger than the same spicules of *R. mollis*. The radial axis is 640–850 μ (on an average about 780 μ) long. Length of the free proximal ray, 440–550 μ; that of the distal ray, 230–300 μ; that of paratangentials, 275–330 μ. Thickness of rays near base, about 15 μ on the average. The proximal ray, which is not only the longest but generally also the thickest of all in the same spicule, shows no swelling in its course but gradually tapers like the rest of the rays, whereas in *R. mirabilis* the same ray should be thickened in the middle. The microtubercles on that ray are more numerous and somewhat more strongly developed than on all the other rays on which they appear rather sparsely.

The *oxyhexasters*, which occur abundantly in all parts, measure 130–160 μ in diameter. Those situated in the periphery of the wall are mostly normal, having usually two and occasionally three, slender (about 2 μ thick at base) and obsoletely rough terminals to a principal, the latter being very short (Pl. XXI., figs. 4 and 5). It seems that the terminals are very easily broken off at base, for it is seldom that one meets with an oxyhexaster of this variety in a perfectly intact state.

In the deeper parts of the wall the oxyhexasters change in their character, though in general size there exists no appreciable difference (Pl. XXI., figs. 6–8). Thus, in the subgastral region as well as in the endosome they are scarcely ever normal but are nearly always hemihexactinose and occasionally regularly hexactinose. Moreover, the terminals are quite smooth throughout and are considerably stronger than in the peripheral oxyhexasters. —sometimes fully twice as thick at base as in the latter. The exceedingly short principals bear at the most two terminals.

The *discoctasters* (Pl. XXI., figs. 10 and 11) resemble in shape and size those of *R. mollis* or *R. mirabilis*. They are found more abundantly in, as well as directly under, the ectosome, than in the deeper parts. Diameter, 175–190 μ. The six bosses on the central node are sometimes distinct and sometimes not.

The principals are 20–25 μ long as measured from the spicular center,—in any case they are much longer than in *R. mirabilis;* they are of uneven contour and slightly swollen towards the outer end (about 10 μ thick). The terminals number 7–12 to each principal and form a rather broad, lily-like tuft, expanded at the outer end to a breadth of about 60 μ. Each single terminal is nearly smooth, rather strong, thickens slightly near the distal end and terminates with a small disc of a characteristic shape. This disc distinctly shows some recurved marginal teeth, which are however not uniformly developed, but are longest and strongest on that side of the disc which is turned away from the axis of the perianth-like tuft of terminals. On the opposite side of the disc, *i.e.*, the part of the disc circumference nearest the axis, the teeth are smaller and often obsolete or even totally suppressed (fig. 11). Thus, the disc approaches or factually assumes *en miniature* the shape of the unguiculate terminal plate in an Euplectellid floricome. The teeth, when present all around, number six, but there may be only the three or four on the external side of the disc. In width the disc may measure about 7 μ, of which nearly 4 μ constitute the length of the longest tooth.

Microdiscohexasters (Pl. XXI., fig. 9) of 22–30 μ diameter are sparsely distributed in the dermal membrane. They are of the usual description.

And now a few words about the *basidictyonal plate* (Pl. XXI., fig. 12). This consists as usual of a thin limiting plate, inside of which are found some small but thick-rayed hexactins in fusion with it. The uneven and irregularly cribrate limiting plate shows roundish meshes, generally under 35 μ in width; its beams, 25 μ or less in thickness, are sparsely microtubercled and contain, here and there in the nodes, axial canals in the form of a plane cross. The basidictyonal hexactins are likewise sparsely microtubercled. There can be scarcely any doubt that these are the same as those which F. E. SCHULZE ('99, p. 63) discovered forming a rigid framework in the buds of *R. mirabilis.*

Finally it should be stated that the spicules, as might be expected, are subject to certain variations according to the age or the individuality of the sponge. Thus, in a young specimen not larger than a nut and attached to the same piece of coal-cinder as the type specimen, I find several of the spicules considerably smaller than those mentioned above. They measure as follows: Paratangentials of prostal pentactins not over 5 mm. in length; dermalia 275–330 μ (on an average 320 μ) long and generally about 7½ μ thick in the middle; proximal ray of gastralia 330–385 μ long; paratangentials of same 187–240 μ long; diameter of discoctasters 143–155 μ; principals of same about 19 μ long; etc. In a certain specimen I have found the terminals of oxyhexasters sparsely microtubercled at the base, instead of being entirely smooth.

RHABDOCALYPTUS CAPILLATUS IJ.

Pls. XXII. and XXIII.

Rhabdocalyptus capillatus. I. IJIMA, '97, p. 51.

Of this species some sixteen specimens of various sizes have thus far been examined by me. The known localities are:

Maye-no-Yodomi; Mochiyama; Inside Okinosé by the Ena-line; Outside Okinosé by the Iwado-line; and Homba;—all in the Sagami Sea. Depth, between 500 and 572 m. (274 and 313 fms.). The samples of the bottom found attached to some of the specimens are tufaceous. In one case six small specimens were found seated on a dead *Chonelasma calyx* from Maye-no-Yodomi. Another dead *Chonelasma calyx* from Mochiyama bore three young individuals of the species together with two of *Staurocalyptus glaber*.

The smallest specimen I have had was globular in shape, measuring only about 3 mm. in diameter. It already possessed a small osculum, while from its surface there emanated, almost radially, a number of fine prostal diactins that stood out isolated. These were the only prostalia to be seen on it.

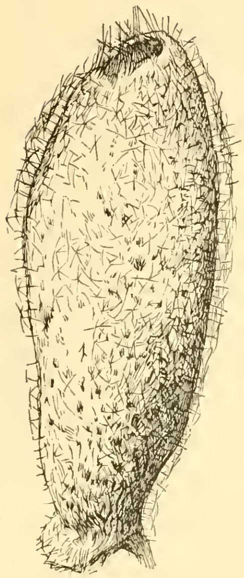
The next larger specimen, shown in natural size in Pl. XXII., fig. 3, is barrel-like; it shows in addition to prostal diactins some small pentactinic prostalia. But these are as yet quite few in number.

Young specimens (figs. 4 and 5), still larger but under 30 mm. or thereabout in height, may be said to retain the barrel-like shape, the cross-section of the body being of an approximately circular outline. Both the diactinic and the pentactinic prostalia have greatly increased in number. The former are more abundant in the upper parts of the body than in the lower, being most numerous in the marginal zone around the circular osculum. The latter are present all over the body, mostly arising in tufts from slight elevations of the dermal surface. The general appearance of young individuals closely resembles that of *R. victor* of about the same size, so that in their cases the microscopic examination of the spicules is quite indispensable to insure correct identification.

After attaining a moderately large size, the body is pouch-like, tubular or vase-like, and laterally compressed to a greater or less degree. The wall is moderately thick. The deep gastral cavity extends close to the basal attachment. Pl. XXII., figs. 1 and 2, and text-figure 11 will serve to give a fair idea of the external appearance of what I consider to be quite or nearly mature specimens.

Fig. 1 shows a specimen—from Inside Okinosé by the Enaline—of a strongly laterally compressed pouch-like shape. Height, 97 mm. Breadth sagitally, 40 mm. at the attachment base and 77 mm. in the broadest part. The osculum is slit-like and comparatively small, occupying a position at one end of the upper body-edge, the other end of which forms a part of a rounded outbulging of the wall. This outbulging shows a small perforation at the top besides a thinning-out of the wall at two places. It contained in the internal cavity a cluster of Cephalopod eggs in which the embryonal development was still in an early stage and which therefore could not have been there long enough to justify the assumption that their presence had acted as the cause of the outbulging.

The specimen shown in fig. 2 is from Outside Okinosé. It is one of the largest I have seen, measuring 210 mm. in height. The lower half of the body is distinctly compressed laterally, the breadth measuring 90 mm. sagittally and 50 mm. transversely. The upper parts are swollen, the osculum being roundish with a diameter of about 45 mm. Thickness of the wall in the middle of the body, about 14 mm. (exclusive of the gossamer-like layer of prostals). The basal attachment is at one corner of the lower end. In the angular corner opposite to this opens a small secondary osculum of an irregularly oblong shape. On one side of the specimen there is a large cicatrice-like patch where the wall is very thin, probably the result of the healing of an injury received there.



Text-fig. 11.—*Rhabdocalyptus capillatus.* $\frac{1}{3}$ natural size.

The annexed text-figure 11 represents another large specimen which belonged to Mr. Alan Owston (O. C. No. 102). The shape is that of a spindle-like vase, standing erect and but little compressed laterally. Height, 210 mm. Breadth, 72–79 mm. in the middle. Thickness of wall in the broadest part, 7–16 mm. The irregularly shaped osculum at the narrowed upper end is 35 mm. long and about 20 mm. broad. The body likewise narrows below but somewhat expands again at the very base.

In all the larger specimens, the distribution of diactinic prostalia is confined to the oscular edge and to a narrow zone along it. I presume that in this species, as in *R. victor* and *Staurocalyptus glaber*, the early formed diactinic prostalia of the young are cast off and thus become lost during growth, though new spicules of the same kind continue to be produced in the growing parts, *i. e.*, in the oscular margin. Here the spicules spring out either singly or in small tufts. In the latter case they generally arise from the apex of small dermal elevations, the same as those which, lower down in the body, bear the tufts of pentactinic prostalia. The marginalia project generally straight upwards to a length of 7–12 mm. and taken together may form a bristly wall around the oscular opening. The secondarily formed osculum is provided with none or at most with only a few of such marginalia.

All the rest of the external surface is thickly covered with large or moderately large pentactinic prostalia, forming a persistent gossamer-like layer much as we have seen in *R. unguiculatus*. The layer, which may be 9 mm. thick, is sufficiently resistent to allow handling the specimens without touching the dermal surface. The pentactins arise invariably in tufts, often ten or even more in number to each, situated at intervals of 4–10 mm. from one another. The ectosome projects at the tuft-basis in the form of a narrow papilla-like prominence which may be 2 mm. high (Pl. XXII., fig. 12); and this prominence always occupies a position central to each irregularly radiating group of hypodermal fibers (=paratangentials of hypodermal pentactins; same plate, fig. 16). In the prostal tufts the different paratangential heads usually lie at various distances from the dermal surface, according to the order in which their successive protrusions took place.

In certain specimens I find in some places a film-like substance stretching in streaks and patches between the prostalia. The presence of nuclei in it can not be demonstrated and there can be little doubt that it represents something—probably mucous—foreign to the sponge.

The dermal surface is rather uneven. As in all species with diactinic dermalia, the dermal meshes are observed under the lens to be irregularly shaped,—not quadrate. The layer is supported by the intersecting hypodermal fibers already referred to (fig. 16).

There is a comparatively wide subdermal space, traversed by the shafts of hypodermalia and prostalia and also by the distal ends of certain parenchymalia. On sections of the dried body-wall it plainly presents itself to the unaided eye as a layer which may be 1–2 mm. wide.

The roundish entrances into the incurrent canals are on the whole rather wide. In large specimens they may attain 4 or 5 mm. in diameter, those of nearly similar sizes being separated from one another by an interspace measuring in width nearly as much as their own diameter.

The entire inner surface of the wall is covered by a gastral lacework with regularly quadrate meshes of 130–240 μ (on the average 175 μ) on a side. When viewed in an oblique direction under the hand-lens, the gastral layer presents a velvety appearance on account of the projecting proximal rays of the hexactinic gastralia. Directly beneath it are distinctly observable hypogastral strands of varying strength. They run in various directions and by intersecting form wide and irregularly shaped meshes. As usual they are frequently seen to stretch right across the excurrent canalar apertures. The stronger strands may push out the gastral surface in a ridge-like line.

A somewhat different state of the gastral surface obtains in very small young specimens. Until these have grown to a certain size, the gastralia are not present in numbers sufficient to form a continuous layer. Hence, there occur between them gaps by which the excurrent canals open directly and freely into the gastral cavity. The little specimen of Pl. XXII., fig. 3, still exhibits this condition of the gastral surface; whereas, that of fig. 4 is already in possession of a continuous gastral layer covering the apertures of all the excurrent canals.

These, in large specimens, are smaller than the average incurrent apertures on the external side, generally measuring 2–3 mm. in diameter. They are closely packed together.

The main canals, both incurrent and excurrent, are pit-like and deep. On sections of the wall it is easy to make out that those of the two systems alternate (fig. 12).

Spiculation.

The *principal parenchymalia* are slender bow-like oxydiactins, reaching up to 24 mm. length and 132 μ in thickness at the middle. The gradually tapering rays are subterminally more or less rough. Of the more slender parenchymalia I see no points worth special mention.

The *hypodermalia* consist of large or moderately large oxypentactins with paratropal paratangentials which may reach 12 mm. in length and about 55 μ in thickness at base. The shaft, up to 15 mm. in length, is always the longest of all the rays; it is smooth except at the end which is somewhat rough. The paratangentials are likewise smooth in the incompletely developed state of the spicule, but finally acquire the spiny armature characteristic of all *Rhabdocalyptus* species. The stout conical spines occur here in a rather irregular distribution—at any rate, not strictly in two lateral rows—at intervals varying from 70 μ to 200 μ. Those situated on the basal parts of the rays may be 80 μ long, springing at first vertically and then becoming more or less bent in an indefinite direction. Towards the end of the rays they become shorter and more slender, being pointed obliquely away from the spicular center. Exactly as I have enunciated under *R. victor* (p. 243), the hypodermalia occur in close groups of two or more —frequently as many as eight or nine,—the paratangential heads in each group forming hypodermally an irregularly radiate system of fibers (Pl. XXII., fig. 16). In each such system, the most superficially situated head or heads, generally 1–3 in number and belonging to the oldest hypodermalia in the group, consist of rays which exhibit the spines; all the more deeply lying and successively younger heads are made up of smooth rays. From the center of the radiate hypodermal system arise the prostalia in a tuft, the base of which is enveloped in the papilla-like prominence of the dermal surface. A number of comitalia accompanying the shafts and those of certain more or less radially disposed parenchymalia extend their distal ends into this papilla-like base of the prostalia. The prostal pentactins, being nothing else than old hypodermal pentactins protruded through the dermal layer, need not be specially described.

Diactins do not seem to associate with the hypodermal paratangentials in forming the support to the dermal layer.

It may be worth mentioning here that in the smallest specimen I have had—measuring only 3 mm. across the body—the small hypodermal pentactins were all found to have regularly cruciate paratangentials. This may be explained by the fact that they were situated isolatedly and hence there were wanting in their close proximity shafts of older pentactins, the presence of which shafts should cause the paratropism of the younger pentactin-heads. None of the hypodermalia in this little specimen were protruded as prostalia, nor were any of them as yet in possession of the spines.

The *hypogastral* strands consist of diactins, essentially the same as those which make up the parenchymal bundles.

The *dermalia* (Pl. XXII., fig. 6) are quite predominantly diactins; rough throughout, straight or slightly arched and some with the central annular swelling or knobs. Total length, 286–462 μ (on an average 380 μ); thickness near the middle, 7½–11½ μ. Rarely the dermalia are stauractins or tauactins; even pentactins and hexactins were met with amongst them during my studies, though in quite a limited number of instances.

I regard it important to mention that up to certain early stages in the post-larval growth of the sponge, the dermalia may be predominantly stauractins, not diactins as in all the larger individuals. Thus, in the little specimen of Pl. XXII., fig. 3, as also in the still smaller one of only 3 mm. diameter, I find stauractins more numerously represented among the dermalia than diactins; whereas, in the specimen of fig. 4, same plate, the two forms of dermalia occur already in the inverse proportion. This change in the predominant form of dermalia during the ontogeny might well be regarded as the repetition of that which had taken place during the phylogeny of the species.

The *gastralia* (Pl. XXII., fig. 13) are almost all hexactins with rough, tapering and pointed rays. Exceptionally forms with a less number of rays and even diactins may occur as the gastralia. The hexactins have distal and paratangential rays 120–220 μ in length and 12–13½ μ in thickness at base; the free proximal ray may be twice as long as any other ray in the same spicule and the microtubercles on it may be slightly more strongly developed than those on the others. However, there not infrequently occur such hexactins as have the proximal ray in no way specially distinguished from the others. With their paratangentials the hexactins form a continuous and regularly quadrate-meshed lacework. The sides of the meshes, 132–242 μ long, are composed usually of two rays, but occasionally of three, belonging to as many different spicules and running side by side.

No special *canalaria* are found.

The *oxyhexasters* occur in abundance in all parts of the sponge-wall. In a few instances I have seen them even outside of the dermal layer, and frequently they are borne, together with some discoctasters, on the free proximal rays of gastralia. They are mostly normally developed, the terminals being in general slender, minutely rough and nearly straight or slightly wavy. Diameter, 106–136 μ. The oxyhexasters in the periphery of the wall are somewhat differently characterized from those in the deep parts. The former (Pl. XXII., figs. 7 and 8; also Pl. XXIII., fig. 19) are on the whole slightly larger; their principals are of a perceptible length; and there occur usually 3, sometimes 4, terminals to a principal. In the latter (figs. 14 and 15) the principals have almost disappeared; the terminals are somewhat stronger but less in number, there being generally 2 or rarely 3 of them to a principal. Occasionally the deeply situated oxyhexasters are hemihexactinose and only rarely hexactinose; moreover, their terminals may sometimes be provided at base with some distinctly barb-like microtubercles,—all of which seems never to be the case with the peripheral oxyhexasters. In a certain specimen I have found the terminals in some of the subgastral oxyhexasters supplied with basal barbs about as prominently developed as in *R. mollis*, but in any case this seems to be a character varying much according to individuals as well as within the same individual.

In the smallest specimen I have had (3 mm. in size), oxyhexasters were already numerously present, but all these agreed in appearance with those occurring in the peripheral parts of the larger specimens, though the terminals numbered usually two to each principal.

The *discoctasters* (Pl. XXII., figs. 9 and 10) are met with in fair abundance in all parts of the wall, though much less numerously than the oxyhexasters. They occur most abundantly in the endosome, in which they may nearly equal the number of the meshes in the gastral lacework; on the other hand, they are found but rarely, if at all, in the ectosome. Of all the Acanthascinæ known to me from the Sagami Sea, this species has the smallest discoctasters. Diameter, 76–110 μ (on an average 94 μ). Thus, they are in general smaller than the oxyhexasters. The central node exhibits the six hump-like tubercles more or less prominently developed. The principal is about one-fourth, or more commonly somewhat less than one-fourth, of the length of the entire ray; it is longitudinally ribbed and uneven in contour, being thicker in some parts than in others. The slender terminals number 6–12 to each tuft; they are arranged not in a circle but in a solid bundle. The tuft widely expands distally since the terminals are bent outwards. A tuft measuring $7\frac{1}{2}$ μ across at base may be 30 μ wide at the outer end. The terminal discs are minute and pinhead-like. Sometimes they may show 7 or 8 recurved marginal teeth when examined under a very high power of the microscope.

Now and then there occur discoctasters in which some primary terminals stand out free from the central node, without combining with any of the eight secondary principals.

Both in size and shape the discoctasters of the species seem to most closely resemble the same of *R. tener* F. E. Sch. Their appearance is so very characteristic that they constitute a highly important differential point in the identification of the present species.

The *microdiscohexasters* (Pl. XXII., fig. 11) are sparsely present. I have met with them mostly in preparations of the ectosome, but they are not altogether wanting in those of the endosome. Diameter 20–25 μ. The figure I have given will suffice to give a good idea of their appearance.

In the smallest specimen frequently referred to, I have failed to discover a single microdiscohexaster, although the entire body was made into preparations and subjected to examination.

The *basidictyonal* plate was found to be represented for the most part by the usual thin and small meshed limiting layer (Pl. XXII., fig. 17). Here and there in the sparsely microtubercled beams are seen spicular axial canals in the form of plane crosses. At certain places in the layer the beams are developed, though irregularly, in all the three dimensions; thus, bringing about in the parts a dictyonal framework of some massiveness. Probably hexactins, and possibly pentactins also, participate in the formation of such parts. I have omitted to determine the disposition of the axial canals contained in those parts.

Soft Parts.

Unsatisfactory as is my knowledge concerning the histology of the species, I may put down some points from notes taken long ago. I beg to mention here that Plate XXIII., illustrative of the soft parts, had been prepared and printed before I found better material for the study in *Euplectella marshalli* (Contrib. I).

An idea of the arrangement of the soft parts may be obtained from Pl. XXIII., figs. 22–24, comments upon which I consider unnecessary beyond the explanations attached to them.

The chambers measure 88 μ in average diameter. In favorably situated parts of their small-meshed reticular wall, I have seen, though faintly, choanocyte-nuclei, generally one to each of the nodes, as shown in fig. 20.

The three round or oval bodies in the lower part of the figure just referred to are without doubt archæocytes, though at the time of drawing them I was under the impression that they were merely nuclei of a special sort. Small groups of the same cells are also seen on the chamber-wall in fig. 19. Occasionally they were observed forming compact masses of a quite large but varying size.

The trabecular cobweb is very extensively developed. Nuclei, 2–2½ μ in diameter; usually with several nucleoli-like granules within. The trabeculæ, generally very thin and filament-like, are frequently expanded into films (fig. 19), especially on the dermal and gastral limiting surfaces (fig. 18). The film-like parts may appear as if containing irregularly branched and often ill-defined fibers or streaks of condensed protoplasm; this is evidently due simply to irregularities in the thickness, or on the surface, of the film as enunciated on pp. 220–201.

The trabeculæ of the gastral surface are pushed out, so to say, by each and every proximal ray of gastralia, so as to form a little cone around the latter (fig. 24). The cone may well be compared to a tent, but it must not be accepted that it invariably exhibits externally a membranous limiting surface. More frequently it is made up of a cobweb of filamentous trabeculæ internally as well as in the most superficial situation, similar to the trabecular cones on the dermal surface of *Euplectella marshalli* (Contrib. I., p. 123). Sometimes the trabecular substance may extend as a thin film vertically between adjacent proximal rays of gastralia in a sail-like manner; at other times I have seen it in the form of thin isolated threads running straight from one cone to another or directly between the terminal parts of the rays, each of which basally supported a cone. Such being the real circumstances, the term gastral membrane, unless used with certain explicit reservations, would be apt to lead one into misconceptions.

Thesocytes occur in abundance. I have seen them mostly in the dermal layer and on trabeculæ of the subdermal space. Numbers of them may be recognized in figs. 18 and 19 as spherical or ovoid and often conglomerate-like bodies which are stained as well as trabecular nuclei but are much larger. Several are shown much more highly magnified in fig. 21. The cells are of various sizes, from 4 μ up to 15 μ in diameter. The small nucleus is generally seen pressed against the cell-surface, where there probably always exists a delicate enveloping membrane. In the smaller of the cells the contents may sometimes appear to be simply finely granular or homogeneous; otherwise they are seen to contain, or rather to consist of, one or more fat-like spheres of the same microchemical character as the thesocytal contents of other Hexactinellids. Of the larger thesocytes the majority are represented by compact conglomerate-like groups of the same spheres, showing the appressed nucleus at some part of the periphery. The not very numerous spheres in one such cell are comparatively large and may give it a rosette-like appearance. Thesocytes of the above description I consider to be such as have attained full development. Certain other thesocytes of the larger size show irregularly and rather coarsely granular contents, the granulation often being considerably rarified or even entirely obliterated in the peripheral parts. At times the cell-outline is irregular, apparently as the result of shrinkage. Such thesocytes may be regarded as those in which the contents are undergoing, or have undergone, disintegration preparatory to becoming consumed.

In the present species I have observed a number of oxyhexasters which apparently were not yet fully developed, or had but recently attained full size; at all events they seemed to preserve undisturbed their original relation with the surrounding soft tissues. Reference has already been made in Contribution I., p. 199, to the developing oxyhexaster and the scleroblasts. In this connection I can add nothing of much importance to what I then said; but attention may be called to the three oxyhexasters included in fig. 19. The smallest depicted is about the smallest and youngest I have met with; the fact that the terminals appear to be stained throughout their length indicates the presence of a protoplasmic envelope. The two others may be considered to be of nearly or quite mature development. In all the three oxyhexasters the central parts are enveloped in a nucleated protoplasmic mass running out in the periphery into filamentous trabeculæ. The mass itself may indistinctly show a cobweb-like structure and I am inclined to regard it as for the most part nothing else than the trabecular substance. Accordingly, some of the nuclei contained in the mass are probably simply trabecular nuclei, and the rest, scleroblast-nuclei which should be present. It is difficult to discriminate between the two sorts of nuclei; however, I believe that at least those lying immediately around the central node of the spicules may safely be taken for the scleroblast-nuclei. The nuclei in question occur in this position constantly in all such spicules as are apparently still growing and also for some time after these have attained full dimensions. As viewed in an equatorial optical section of the spicule the said nuclei are seen to be four in number, one situated in each of the four angles formed by the short principals. In certain cases these particular nuclei were found to be somewhat larger than others lying close beside them. For the present I can definitely say nothing more about the matter.

DIAGNOSES OF THE SPECIES TREATED OF IN THIS CONTRIBUTION.

Genus LANUGINELLA O. Schm.

L. pupa O. Schm.—Small, spherical or ovoid, firmly attached at base; with a small, smooth-edged osculum leading into a nearly tubular gastral cavity. External surface smooth or covered with a veil formed of small prostal pentactins. Apertures of excurrent canals not covered by gastral layer. Dermalia, rough stauractins. Gastralia, regular oxyhexactins. Hexasters consist of discohexaster and strobiloplumicome. Discohexaster, varying in size but under 100 μ dia.; spherical; each short principal generally with 2–4, rough, moderately strong terminals; marginal prongs of terminal disc, distinctly developed. Strobiloplumicome, 34–76 μ in dia.

Genus SCYPHIDIUM F. E. SCH.

(Diagnosis on p. 20).

S. longispina (IJ.).—Saccular, moderately thick-walled, somewhat like a pear in shape but smaller, with an osculum at the upper rounded end; firmly attached by the contracted base. External surface with low conuli, from which there arise long and rather strong, diactinic prostalia. In association with these may occur a few small and inconspicuous pentactinic prostalia, with paratangentials which are smooth or shagreen-like and either regularly cruciate or paratropal. Dermalia, predominantly stauractins with spinose rays. Gastralia, similarly rayed hexactins of a larger size. Oxyhexaster, 88–104 μ dia., frequently hemihexactinose and hexactinose in the deeper part of the choanosome. Discohexaster, 90–130 μ dia., with slender terminals. Microdiscohexaster of the typical shape, 23–25 μ dia.

S. namiyei (IJ.)—Saccular, laterally compressed, moderately thick-walled, with one or more secondarily formed oscula (or buds) besides the main osculum, firmly attached by rather broad base. Short, fine prostal needles present in insignificant numbers near the oscular margin; for the rest, the surface is tolerably smooth. Dermalia, stauractins and pentactins with spinose and rather strong rays. Gastralia, similar hexactins and pentactins. Oxyhexaster, 53–76 μ dia.; only occasionally hemihexactinose.

Discohexaster, up to 100 μ in dia.; leading down gradationally to microdiscohexasters of 35 μ dia., which are of much the same appearance as the larger discohexaster; terminals slender, with disc composed of distinct prongs.

Genus VITROLLULA Ij.

(See p. 37).

V. fertilis Ij.—Small, spindle-like or pouch-like; may be laterally compressed; firmly attached at base; with small, simple-edged osculum at the upper end, leading into deep gastral cavity. External surface smooth; internal surface without a gastral layer over the apertures of excurrent canals. Parenchymalia consist of slender diactins and of moderately large hexactins, the latter being not uncommon. Dermalia, rough stauractins; supported by pentactinic hypodermalia. Gastralia, hexactins and pentactins; sparsely present. Hexasters of two kinds: Oxyhexaster, 114–140 μ in diameter; each short principal with rather numerous, slender, rough terminals; never hexactinose or hemihexactinose. Microdiscohexaster, 26–30 μ in diameter, spherical; each principal having numerous fine terminals.

Genus CRATEROMORPHA J. E. Gray.

(Diagnosis on p. 55).

C. meyeri J. E. Gray.—Sponge-body smooth on the outside, the entire sponge being exquisitely wine-glass- or tulip-like. Parenchymalia mainly diactins, with isolated oxyhexactins. Among the pentactinic hypodermalia, diactins may occasionally occur.

Dermalia, rough pentactins; sometimes stauractins. Microdisco-hexaster, spherical; under 50 μ dia.

C. meyeri tuberosa IJ.—Sponge-body with a number of variously sized, irregularly rounded, tubercle-like prominences on the outside. Spiculation as in the typical *C. meyeri*. Diactins may have a large part in the formation of hypodermal beams.

C. meyeri rugosa IJ.—Sponge-body with quite uneven surface, due to numerous wrinkle-like ridges and irregular prominences on the outside. Spiculation as in *C. meyeri tuberosa*, but the parenchymalia lacking in hexactinic elements.

C. pachyactina IJ.—Sponge-body shaped somewhat as in *C. meyeri rugosa*; of rather compact texture; with small and scanty incurrent canals. Parenchymalia exclusively diactins, of which the principalia are comparatively large and strong. Hypodermal oxypentactins with strikingly strong rays, which may be $\frac{1}{3}$ mm. thick at base with a length of $2\frac{3}{4}$ mm. Dermalia, rough pentactins. Hexasters as in *C. meyeri*.

C. corrugata IJ.—Sponge-body of corrugated appearance, due to pit-like or irregular groove-like depressions of the external surface. Many of the pit-like depressions lead into a system of anastomosing intercanals: some of these, extending quite through the sponge at the junction of body with stalk, may give to the latter the appearance of being branched at its upper end. Parenchymalia of diactins only, most of which are thin and small. Hypodermalia, pentactins with occasional diactins. Dermalia, rough stauractins and pentactins, the former predominating. Hexasters, essentially as in *C. meyeri*.

Genus HYALASCUS IJ.

(Diagnosis on p. 87).

H. sagamiensis IJ.—Body comparatively thin-walled, outbulged in the middle, with flaring oscular rim. Incurrent and excurrent canalar apertures under 2 mm. diameter. Gastral cavity lined with continuous gastral layer. Discohexaster in one spherical form of 80–90 μ diameter; each principal bearing usually 3 slender terminals.

H. similis IJ.—Quite like the foregoing species; but the discohexaster proper to that species is here exceedingly rare, while the commonest discohexaster is a smaller and not spherical form of 46–50 μ diameter in which 12 or more delicate terminals to each principal form a separate, expanding and perianth-like tuft.

H. giganteus IJ.—Thick-walled; with wide canals and canalar apertures, giving a cavernous appearance to the wall. The incurrent canals form an extensively intercommunicating system. Gastral surface, as also the wall of the larger excurrent canals, is lined by an irregularly meshed endosomal lattice, with no continuous covering layer of gastralia over the meshes. Discohexaster in one spherical form of 30–38 μ diameter, with 10 or less terminals to each principal.

Genus AULOSACCUS IJ.

(Diagnosis on p. 107).

A. schulzei IJ.—Thick-walled, vase-like; without conuli or prostal needles on the outside. Gastral surface covered with a sieve-like endosomal lattice, in which the gastralia do not form a continuous layer over the meshes. Dermalia, rough pentactins or predominantly pentactins. Macrodiscohexaster, very large measuring nearly 1 mm. in diameter; sun-like, the six principals being fused into a spherical mass 46–49 μ in diameter. Microdiscohexaster, 26–38 μ in diameter.

A. mitsukurii IJ.—Moderately thick-walled, tubular; external surface with cones, from the apex of which project needle-like prostalia either singly or in a small tuft. Gastral surface lined by a continuous gastral layer. Dermalia, predominantly stauractins, the entire surface of which is covered with rather strong prickles. Macrodiscohexaster, 80–120 μ in diameter; the short knob-like principals being separate. Microdiscohexaster, 20–23 μ in diameter.

Genus ACANTHASCUS F. E. SCH.

(Diagnasis on p. 139).

A. cactus F. E. SCH.—Cup-like, vase-like or funnel-shaped; sometimes bearing a secondary person or persons. Dermalia, predominantly stauractins, occasionally pentactins. Gastralia, mostly pentactins and sometimes stauractins; not forming a continuous lattice-work. Oxyhexaster, 90–152 μ dia.; often hemihexactinose and not seldom hexactinose. Peripheral discoctaster, 106–137 μ dia.; more deeply situated discoctaster, generally 200–260 μ dia.; secondary principal in length shorter than, or about equal to, the terminals. Microdiscohexaster, 15–23 μ dia.

A. alani Ij.—Ovoid in shape; thick-walled. (Prostal diactins present ?). Dermalia, almost exclusively pentactins. Gastralia, hexactins; not forming a continuous lacework over excurrent canalar apertures. Oxyhexaster, 144–190 μ dia.; generally normal, with 2–4 terminals to each principal; seldom hemihexactinose. Discoctaster, 136–220 μ dia.; secondary principal about equal to, or longer than, the terminals. Microdiscohexaster, 30–35 μ dia.

Genus STAUROCALYPTUS Ij.

(Diagnosis on p. 162).

S. ræperi (F. E. Sch.).—Cup-like, with short stalk-like base. With peculiar pit-like subdermal cavities whence arise narrow incurrent canals. Excurrent canalar apertures, relatively very wide (up to 8 mm. dia.); all freely open. All spicules with remarkably slender rays. Pentactinic hypodermalia, small; with paratangentials under 2 mm. in length. Principal parenchymalia under 35 μ in thickness. Dermalia, slightly rough pentactins; not infrequently stauractins. Gastralia, similar hexactins. Oxyhexaster, 88–130 μ dia.; some hexactinose. Discoctaster, 128–180 μ dia. Microdiscohexaster, 22–24 μ or more in dia.

S. dowlingi (L. M. Lambe).—Broadly sacciform, somewhat outbulged on one side and narrowed at base. Canalar apertures small; those on the gastral surface freely open. Both diactinic and pentactinic prostalia present over the entire body; the latter are small with granular-surfaced paratangentials about 2.2 mm. long. Principal parenchymalia, fine (less than 41 μ in breadth). Dermalia, rough pentactins; exceptionally diactins. Gastralia, similar but smaller hexactins, with rays of 80–100 μ length. Oxyhexaster, 100–120 μ dia.; both hemihexactinose and hexactinose forms numerous. Discoctaster, 228–320 μ dia. Microdiscohexaster, 20 μ dia.

S. tubulosus Ij.—Similar to *S. dowlingi* in general characters and in spiculation. Body, tubular. Gastral surface with freely open canalar apertures; hairy on account of the projecting ends of fine parenchymalia. Paratangentials of pentactinic prostalia, generally under 2 mm. in length; rarely 4 mm.; acquiring a rough surface due to nearly vertical, fine and sharply pointed microspines. Principal parenchymalia may be 12 mm. long and 130 μ broad. Dermalia, rough pentactins but frequently stauractins and rarely hexactins. Gastralia, similar hexactins, with rays 130–200 μ in length. Oxyhexaster, 75–115 μ dia.; very rarely hexactinose. Discoctaster, 130–213 μ dia. Microdiscohexaster, 19 μ dia.

S. affinis Ij.—Similar to *S. dowlingi* in general characters and in spiculation. Body, tubular or vase-like. Canalar apertures on the gastral surface, some freely open while others are covered with a small-meshed endosomal lattice, developed in irregular patches and in which the gastralia do not form a continuous lacework. Pentactinic prostalia, large; with smooth or granular paratangentials 5–12 mm. in length. Principal parenchymalia, long and thick (some over 25 mm. long and over 500 μ thick). Dermalia, rough pentactins; rarely stauractins. Gastralia, similar hexactins with rays 140–175 mm. long or even longer. Oxyhexaster, 115–160 μ dia.; hexactinose forms quite numerous. Discoctaster, 120–400 μ dia. Microdiscohexaster, 19–20 μ dia.

S. entacanthus IJ.—Similar to *S. dowlingi* in general characters and in spiculation. Body, vase-like (?). Gastral surface, entirely covered with a small-meshed endosomal lattice in which the gastralia do not form a continuous lacework, but which extends over all the excurrent canalar apertures. This surface is beset with rather coarse projecting needles which render it conspicuously spiny. Diactinic prostalia not found on the lateral surface. Pentactinic prostalia with smooth or granular paratangentials reaching up to 4 mm. or more in length. Principal parenchymalia may be 250 μ thick. Dermalia, rough pentactins; rarely stauractins and diactins. Gastralia, similar hexactins with rays 95–130 μ or more in length. Oxyhexaster, 100–132 μ or more in dia.; hexactinose forms not found (entirely wanting ?). Discoctaster, about 150 μ up to nearly 300 μ in dia. Microdiscohexaster, not found (wanting ? ; if present, 19 μ dia.).

S. microchetus IJ.—Tubular, laterally compressed. Canals very narrow. With inconspicuous veil, formed of pentactins in which the paratangentials are regularly cruciate and measure not more than 1¼ m.m. in length. Dermalia generally stauractins, exceptionally pentactins; rays beset with rather strongly developed microtubercles. Gastralia, similar hexactins. Oxyhexasters in the subdermal region, 68–100 μ dia.; those in deeper parts, 106–136 μ dia., with stronger rays; occasionally hemihexactinose;

hexactinose forms not found. Discoctaster, 114–128 μ; found in subgastral region only. Microdiscohexaster, 23–26 μ dia.; rare.

S. glaber IJ.—Saccular or vase-like; thick-walled; somewhat laterally compressed after attaining a certain size. Small young specimens with fine long prostal needles which seem however to become lost with growth. Pentactinic prostalia, never present; so that old specimens have a quite smooth external surface. The extensive subdermal space and large canals give a cavernous appearance to the delicately textured wall. Dermalia, nearly all stauractins with microtubercles most strongly developed on the outer side of the rays. Gastralia, moderately large oxyhexactins, generally with the free proximal ray longer and more rough than the others. Oxyhexasters, 98–114 μ in diameter; all normally developed, having 2–4 terminals to a principal. Discoctasters may be of an unusually large size; 240–660 μ in diameter. Microdiscohexasters, 15–22 μ diameter; not uncommon, but sometimes extremely rare.

S. heteractinus IJ.—Laterally compressed, pouch-like, with narrow canals. No prostalia of any kind. Dermalia, predominantly stauractins, occasionally pentactins and tauactins, rarely diactins; with slightly rough rays. Gastralia, similarly rayed but smaller pentactins and stauractins; not forming a continuous lacework. Oxyhexasters, always normally developed; 106–114 μ in diameter. Discoctasters, 110–200 μ in diameter. Microdiscohexasters, 16–19μ in diameter; common in certain parts.

S. pleorhapides IJ.—Thick-walled, pear-shaped, attached by the narrower end. With strong prostal needles and a gossamer-like layer of prostal pentactins, springing out from the small conuli of the surface. Dermalia, nearly all rough diactins. Gastralia, similar diactins. Oxyhexasters mostly normal or hemihexactinose; rarely hexactinose; with rather strong, rough terminals; 114 μ in average diameter. Discoctasters, small; 100–200 μ in diameter. Microdiscohexasters, 20 μ in average diameter; sparsely present.

Genus RHABDOCALYPTUS F. E. Sch.

(Diagnosis on p. 236).

R. victor Ij.—Vase-like; somewhat laterally compressed, especially at base. Veil and fine prostal needles present in the young stage but later are generally cast off. Dermalia, nearly all rough stauractins. Gastralia, similarly rayed hexactins of a nearly regular shape. Oxyhexasters, with rough terminals: 180–280 μ in dia.; hemihexactinose form, numerous; hexactinose form, not uncommon. Discoctasters, 180–240 μ in dia.; terminals nearly straight. Microdiscohexaster of the usual size and shape in sparse distribution.

R. mollis F. E. Sch.—Vase-like or sac-like, laterally compressed; with a strong tendency to form tubular daughter persons along one of the sagittal body-edges. Veil generally cast off. Dermalia, nearly all rough diactins. Gastralia, similarly rayed hexactins of nearly regular shape. Oxyhexasters with terminals more or less distinctly barbed at base; hemihexactinose and hexactinose forms, common; 102–160 μ in dia. Discoctasters, 130–176 μ in dia.; terminals nearly straight or slightly bent outwards. Microdiscohexasters, present in variable numbers ; 22–27 μ in dia.

R. unguiculatus IJ.—Vase-like ; entirely covered with a thick gossamer-like veil. Dermalia, nearly all rough diactins. Gastralia, hexactins ; similarly rough but with much longer rays, the free proximal ray being especially well developed ; the radial axis, 640–850 μ long. Oxyhexasters, 130–160 μ in diameter ; not infrequently hemihexactinose and only occassionally hexactinose. Discoctasters, 143–190 μ in diameter ; principals, 20–25 μ long ; terminal tufts expanded at the outer end ; terminal discs with strongest marginal teeth on the side turned away from the axis of the tuft, or toothed only on that side. Microdiscohexasters, sparse ; 22–30 μ in diameter.

R. capillatus IJ.—Vase-like or sac-like, more or less laterally compressed ; entirely covered with a thick gossamer-like veil. Dermalia, nearly all rough diactins. Gastralia, rough hexactins in which the free proximal ray may be twice as long as any other ray in the same spicule. Oxyhexasters, 106–136 μ in diameter ; occasionally hemihexactinose and rarely hexactinose. Discoctaster small, measuring 82–106 μ in diameter ; terminal tuft distinctly outflaring at the outer end. Microdiscohexasters, sparse ; 20–25 μ in diameter.

List of Literature referred to in this Contribution.

KENT, W. S. **'70.** On the "Hexactinellidæ," or hexradiate spiculed siliceous sponges taken in the 'Norna' Expedition, etc.—Monthly Microsc. Jour., IV., pp. 241–252; pl. LXIII–LXV.

SCHMIDT, O. **'70.** Grundzüge einer Spongien-Fauna des Atlantischen Gebietes.

CARTER, H. J. **'72.** Descriptions of two new sponges from the Philippine Islands.—Ann. and Mag. Nat. Hist., ser. 4, vol. X., pp. 110–113.

GRAY, J. E. **'72.** On a new genus of hexradiate and other sponges discovered in the Philippine Islands by Dr. *A. B. Meyer*.—Ann. and Mag. Nat. Hist., ser. 4, vol. X., pp. 134–139.

CARTER, H. J. **'73*a*.** Description of *Labaria hemispherica*, etc.—Ann and Mag. Nat. Hist., ser. 4, vol. XI., pp. 275–286.

,, **'73*b*.** On the Hexactinellidæ and Lithistidæ generally, etc.—Ann. and Mag. Nat. Hist., ser. 4, vol. XII.

,, **'75.** Notes introductory to the study and classification of the Spongida. Pt. II.—Ann. and Mag. Nat. Hist., ser. 4, vol. XVI., p. 199.

MARSHALL, W. **'76.** Ideen über die Verwandtschaftverhältnisse der Hexactinelliden.—Zeitschr. f. wiss. Zool., vol. XXVII.

BOWERBANK, J. S. **'77.** Descriptions of five new species of sponges discovered by *A. B. Meyer* on the Philippine Islands and New Guinea.—Proc. Zool. Soc. Lond., 1877, pp. 461–464.

SCHULZE, F. E. **'86.** Ueber den Bau und das System der Hexactinelliden.

,, **'87.** The Challenger Report. Hexactinellida.

LAMBE L. M. **'93.** Sponges from the Pacific Coast of Canada.—Trans. Roy. Soc. Canada. Sect. IV., pp. 37–38.

SCHULZE, F. E. **'93.** Ueber die Ableitung der Hexactinelliden Nadeln vom regulärem Hexactine.—Sitz.-ber. Akad. wiss. Berlin. 1893, pp. 991–997.

TOPSENT, E. **'95.** Campagnes du Yacht Princess Alice, etc.—Bull. Soc. Zool. de France, t. XX., pp. 213–215.

Ijima, I. **'96.** Notice of new Hexactinellida from Sagami Bay.—Zool. Anz. 1896, No. 504.

„ **'97.** Revision of Hexactinellids with discoctasters, etc.—Annot. Zool. Jap. Vol. I., pp. 43–59.

Schulze, F. E. **'97.** Revision des Systemes der Asconematiden und Rosselliden.—Sitz.-ber. Akad. wiss. Berlin, XXVI., pp. 520–558.

„ **'97*a*.** Ueber einige Symmetrieverhältnisse bei Hexactinelliden Nadeln.—Verhandl. Deutsche Zool. Gesellsch. 1897, pp. 35–37.

Ijima, I. **'98.** The genera and species of Rossellidae.—Annot. Zool. Jap. Vol. II., pp. 41–55.

Gravier, Ch. **'99.** Sur une collection d'Éponges (Hexactinellides) du Japon.—Bull. Mus. d'hist. nat. Paris, t. V., No. 8, pp. 419–423.

Schulze, F. E. **'99.** Amerikanische Hexactinelliden. Jena, 1899.

„ **'00.** Die Hexactinelliden. Fauna Arctica, vol. I., pp. 87–108.

Ijima, I. **'01.** Studies on the Hexactinellida. Contribution. I.—Jour. Sci. Coll., Tokyo. Vol. XV.

Kirkpatrick, R. **'01.** Description of a new Hexactinellid sponge from S. Africa.—Ann. and Mag. Nat. Hist., ser. 7, vol. VII., p. 457.

„ **'02.** Descriptions of S. African Sponges. C. of Good Hope, Dept. of Agriculture, No. 4.

Ijima, I. **'03.** Studies on the Hexactinellida. Contribution III. Jour. Sci. Coll., Tokyo. Vol. XVIII.

N. B.

A Correction with Regard to the Generic Name Placosoma applied by me to an Euplectellid.

In Contribution III., I described a new Euplectellid genus and species under the name of *Placosoma paradictyum*. Now, Professor F. E. Schulze, in a letter, has very kindly pointed out to me the fact, which I had entirely overlooked, that the generic name "*Placosoma*" had been pre-occupied, having been employed by Tschudi for a reptilian genus in 1847 (Arch. f. Naturgesch., Bd. 13, I., p. 50). I therefore beg to withdraw that generic name as applied by me to the Euplectellid and to substitute for it "*Bolosoma*" (ἡ βῶλος=clump),—a designation, for the suggestion of which I am likewise indebted to Professor Schulze. Henceforth, the Euplectellid in question should go by the name of

Bolosoma paradictyum.

Contents.

PAGE.
ROSSELLIDÆ ... 1
Key to the subfamilies ... 2

A. Lanuginellinæ ... 2
Key to the known genera and species... 3
Lanuginella pupa O. SCHM. ... 3
Spiculation ... 7
Soft parts ... 14

B. Rossellinæ ... 16
A list of the genera and species making up the subfamily ... 16
Key to the genera ... 18
Scyphidium F. E. SCH. ... 20
Key to the species ... 21
S. longispina (IJ.) ... 22
Spiculation ... 24
Soft parts ... 29
S. namiyei (IJ.) ... 32
Spiculation ... 34
Vitrollula IJ. ... 37
V. fertilis IJ. ... 38
Spiculation ... 39
Soft parts and larvæ... 43
Crateromorpha J. E. GRAY. ... 55
Key to the species ... 57
C. meyeri J. E. GRAY. ... 57
Spiculation ... 61
C. meyeri tuberosa IJ.... 66
C. meyeri rugosa IJ. ... 71
C. pachyactina IJ. ... 74
Spiculation ... 76
C. corrugata IJ. ... 78
Spiculation ... 84
Hyalascus IJ. ... 87
Key to the species ... 88
H. sagamiensis IJ. ... 88
Spiculation ... 90
H. similis n. sp. ... 96
H. giganteus IJ. ... 100
Spiculation ... 103
Aulosaccus IJ. ... 107
Key to the species ... 109
A. schulzei IJ. ... 110
Spiculation ... 112
A. mitsukurii ... 117
Spiculation ... 121
Soft parts ... 126

	Page.
C. Acanthascinæ	127
Key to the genera	128
General organization	128
Acanthascus F. E. Sch.	139
Key to the species	140
A. cactus F. E. Sch.	140
Spiculation	147
Soft parts	154
A. alani Ij.	158
Spiculation	160
Staurocalyptus Ij.	162
Key to the species	163
S. rœperi F. E. Sch.	168
S. dowlingi (L. M. Lambe).	172
S. tubulosus nov. sp.	175
Spiculation	177
S. affinis nov. sp.	180
Spiculation	185
S. entacanthus nov. sp.	191
Spiculation	196
Soft parts	200
S. microchetus Ij.	202
Spiculation	203
S. glaber Ij.	207
Spiculation	213
S. heteractinus Ij.	218
Spiculation	219
S. pleorhaphides Ij.	222
Spiculation	224
Undeterminable *Staurocalyptus.*	
S. sp. α.	231
S. sp. β.	233
S. sp. γ.	235
Rhabdocalyptus F. E. Sch.	236
Key to the species	236
R. victor Ij.	238
Spiculation	245
Soft parts	251
R. mollis F. E. Sch.	253
Spiculation	261
R. unguiculatus nov. sp.	268
Spiculation	272
R. capillatus Ij.	276
Spiculation	282
Soft parts	287
Diagnoses of the species treated of in this Contribution	291
List of literature referred to in this Contribution	303
N.B. A correction with regard to the generic name "Placosoma" applied by me to an Euplectellid	305

PLATE I.

Lanuginella pupa O. Schm.

Plate I.

Lanuginella pupa O. Schm. P. 3.

Figs. 1–3. Three specimens in natural size. Fig. 1, attached to a dead coral. Figs. 1 and 2, with veil over the surface.

Fig. 4. Dermalia in lateral view. 300 ×.

Fig. 5. Same in an early stage of development. 300 ×.

Fig. 6. Part of a large hypodermal pentactin as seen from distal side. 150 ×.

Fig. 7. Part of a prostal pentactin forming the veil; seen from distal side. 150 ×.

Fig. 8. Gastralia in lateral view. 300 ×.

Fig. 9. Section of sponge-wall, showing a wide and branched excurrent canal, the chamber-layer with archaeocyte-congeries, etc. Above, the dermal side; below, the gastral side. 50 ×.

Fig. 10. Parts of the walls of three chambers lying close together. Archaeocytes and membrana reticularis very badly represented. Above, trabeculae arising from chamber-rim. 450 ×.

Fig. 11. Discohexaster. 300 ×.

Fig. 12. Outer end of discohexaster terminal. Highly magnified.

Fig. 13. Plumicome. 300 ×.

(Figs. 4–13 were all taken from the specimen shown in fig. 1 [Sci. Coll. Mus. No. 229]. For more figures relating to the species, see Contribution III., Pl. V.).

Lanuginella pupa O. SCHM.

PLATE II.

Scyphidium longispina (IJ.).

Plate II.

Scyphidium longispina (Lr.). P. 22.

Fig. 1. The type specimen (Sci. Coll. Mus. No. 222); with two small young individuals attached to the prostalia of the large one. Natural size. All the other figures in this plate, except fig. 15, are taken from the largest individual.

Fig. 2. Dermalia in lateral view. 300 ×.

Fig. 3. Part of a pentactinic hypodermalia. 150 ×.

Fig. 4. Gastralia. 300 ×.

Fig. 5. Hexactinose oxyhexaster. From a deep part of the wall. 300 ×.

Fig. 6. Hemihexactinose oxyhexaster. From a deep part of the wall. 300 ×.

Fig. 7. Discohexaster. 300 ×.

Fig. 8. Outer end of a discohexaster terminal. About 1000 ×.

Fig. 9. Microdiscohexaster. 300 ×.

Fig. 10. Section of wall; part adjoining the outer surface. Above, dermal layer; with a pentactinic prostal and two strong diactinic prostals cut off. About 25 ×.

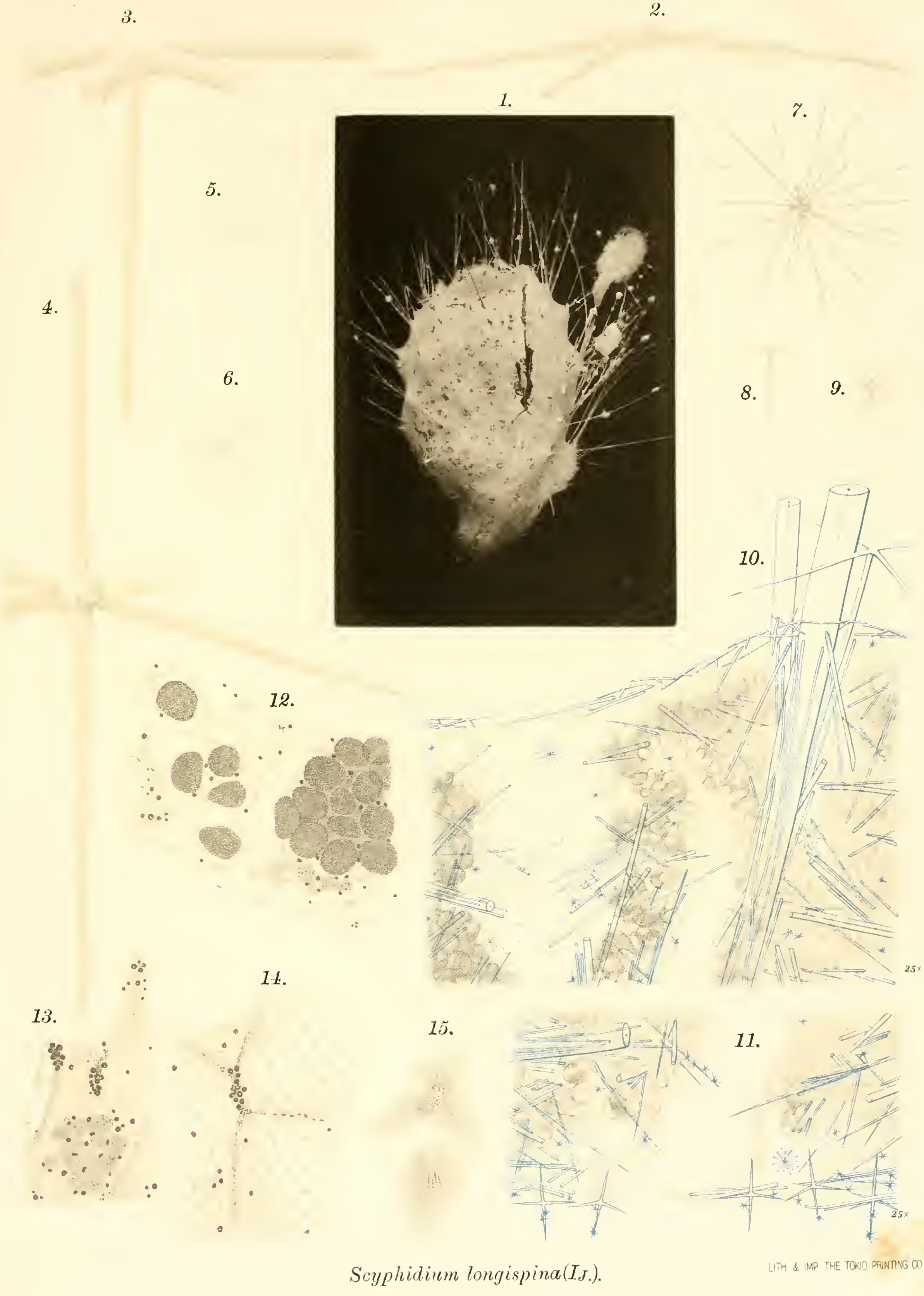
Fig. 11. Section of wall; part adjoining the inner surface. Below, gastral layer. About 25 ×.

Fig. 12. Trabeculae and thesocytes; from a borax-carmine preparation. The nuclei appear as deeply stained dots. The thesocyte product is represented by the large, more or less globular, strongly stained bodies. Smaller, more weakly stained and granular spheres represent probably a stage in the development of the thesocyte product. 450 ×.

Fig. 13. Chamber-rim; not well preserved. The larger deeply stained dots in groups are probably archaeocytes; the weakly stained spheres of granular appearance are likely thesocytes not yet fully grown. Stained with borax-carmine. 450 ×.

Fig. 14. Chamber-wall. The deeply stained dots are probably partly archaeocytes and partly trabecular nuclei. Choanocyte nuclei are scarcely indicated in the figure. Strongly magnified.

Fig. 15. Peculiar bodies of uncertain nature, consisting of well-stained threads arranged in diverging bunches or in a radial manner. Seen in one of the two young individuals attached to the prostal needles. 300 ×.



Scyphidium longispina (*Ij.*).

PLATE III.

Vitrollula fertilis IJ.

Plate III.

Vitrollula fertilis IJ. P. 38.

Fig. 1. One of S. C. M. Sp. No. 228, found attached to a dead coral. From Okinosé. Nat. size.

Fig. 2. S. C. M. Sp. No. 231, attached to a worm-tube. From off Inatori. Nat. size.

Fig. 3. Part of a moderate-sized stauractinic dermalia. 300 ×.

Fig. 4. Part of the paratangential cross of a hypodermal pentactin. 300 ×.

Fig. 5. Oxyhexaster. 300 ×.

Fig. 6. Microdiscohexaster, the only form of discohexaster present in the species. 300 ×.

Fig. 7. Part of a stained transverse section through the body of Sp. No. 231. Excurrent canal opening freely into the gastral cavity. 3 ×.

Fig. 8. Part of a longitudinal section of the same specimen. Above, the oscular margin. About 25 ×.

Fig. 9. Surface view of the stained wall of S. C. M. Sp. No. 433; above, oscular margin. Seen from the gastral side. About 50 ×.

Fig. 10. Same, seen from the dermal side. About 50 ×.

Fig. 11. Showing the gradual transition of *membrana reticularis* (above) into trabeculæ (below) near the oscular margin. From a hæmatoxylin preparation. 300 ×.

Fig. 12. A small group of archaeocytes lying on the chamber-wall. From a borax-carmine preparation. 1000 ×.

Figs. 13–16. Stages in the development of a larva, from sections of Sp. No. 231. Stained with borax-carmine. 150 ×.

Fig. 17. Stauractinic spicules from the larval stage of fig. 16. The lower figure, in side view. 440 ×.

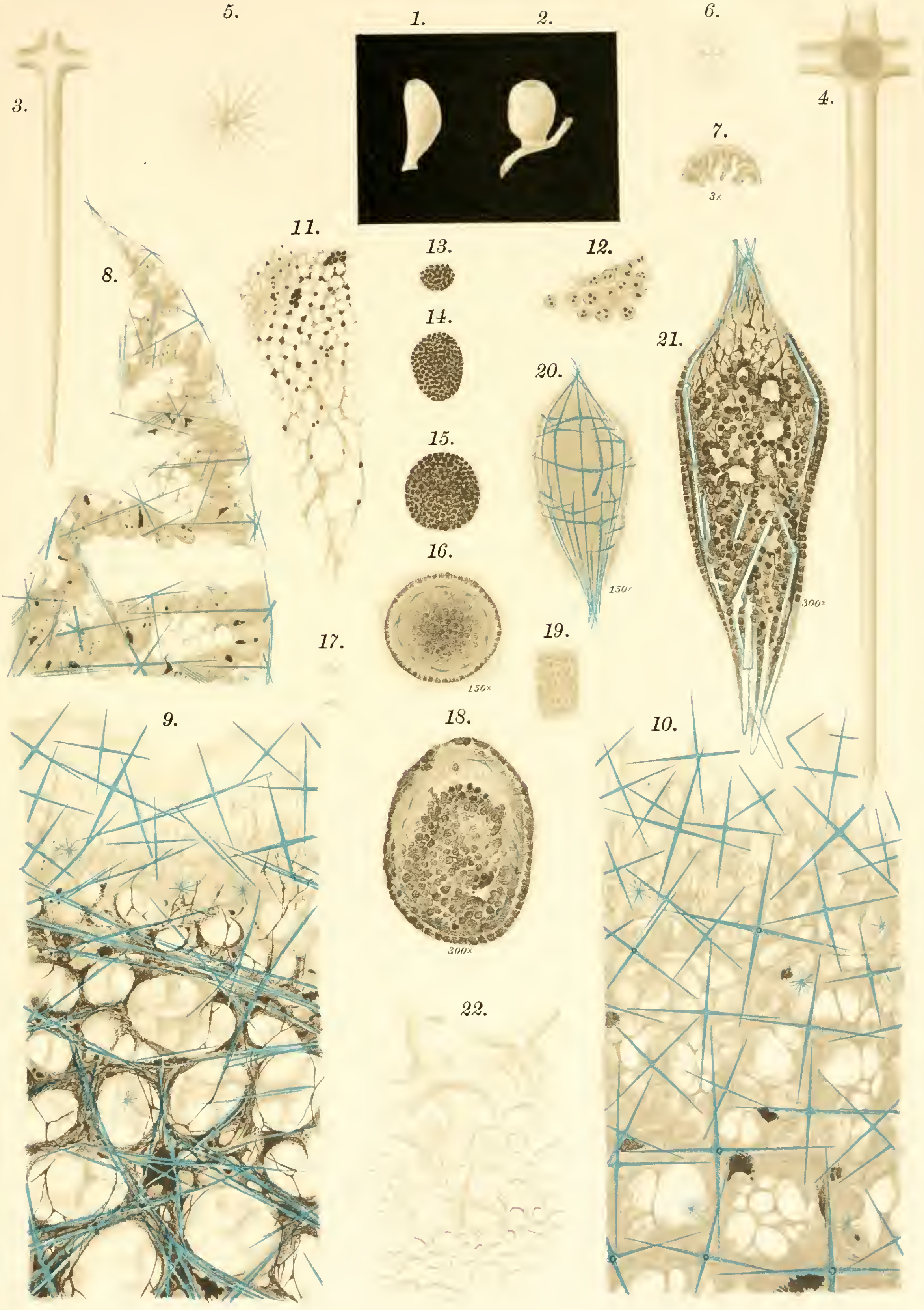
Fig. 18. Section of a developing larva, somewhat more advanced than that of fig. 16. Stained with hæmatein-alum. 300 ×.

Fig. 19. The outer layer of flagellated cells, seen surface on. From the same larva. 300 ×.

Fig. 20. A fully developed larva in optical section, but with the peripherally situated spicules of one side drawn in. 150 ×.

Fig. 21. Longitudinal section of a fully developed larva, stained with hæmatein-alum. 300 ×.

Fig. 22. Basidictyonalia, joined below to the small-meshed attachment plate. 100 ×.



Vitrollula fertilis Ij.

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PLATE IV.

Crateromorpha meyeri J. E. Gray.
C. meyeri tuberosa Ij.
C. meyeri rugosa Ij.
C. pachyactina Ij.

Plate IV.

Figs. 1–8. Typical *Crateromorpha meyeri* J. E. Gray. P. 57.

Fig. 1. A specimen of typical *C. meyeri*. (S. C. M. No. 364). Nat. size. Figs. 2–8 were all taken from this specimen.

Figs. 2, 3. Dermalia. 300 ×.

Fig. 4. Microdiscohexaster. 300 ×.

Fig. 5. Oxyhexaster. 300 ×.

Fig. 6. Dermalia and hypodermalia in situ; seen from outside. About 20 ×.

Fig. 7. Section of wall. About 20 ×.

Fig. 8. Basidictyonalia, from middle of stalk. 100 ×.

Fig. 9. *C. meyeri tuberosa* Ij. P. 66.

Fig. 9. Microdiscohexaster. 300 ×. (This figure might pass for that of the corresponding spicule of *C. meyeri rugosa*).

Figs. 10, 11. *C. meyeri rugosa* Ij. P. 71.

Fig. 10. Canalar surface of stalk, with canalaria and fused parenchymalia. 50 ×.

Fig. 11. Dermalia and hypodermalia in situ; seen from outside. About 20 ×. (This figure might pass for that of the corresponding skeletal parts of *C. meyeri tuberosa*).

Fig. 12. *C. meyeri*.

Fig. 12. Cross-section of stalk, showing the canals running through it. $\frac{1}{2}$ nat. size.

Fig. 13. *C. pachyactina* Ij. P. 74.

Fig. 13. Thick-rayed hypodermal pentactin, together with a few dermalia and comitalia. (From S. C. M. No. 395). 20 ×.

1—8, 12. *Crateromorpha meyeri* (J. E. GRAY) CARTER. 9. *C. meyeri tuberosa* IJ.
10, 11. *C. meyeri rugosa* IJ. 13. *C. pachyactina* IJ.

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PLATE V.

Crateromorpha meyeri tuberosa Ij.
Crateromorpha meyeri rugosa Ij.

Plate V.

(All figures in half natural size).

Fig. 12. A specimen of *Crateromorpha meyeri tuberosa* IJ. from Homba. S. C. M. No. 444.

Fig. 13. Another specimen of same, from Outside Okinose. S. C. M. No. 445. A part of the wall and of the stalk removed.

Fig. 14. A specimen of *Crateromorpha meyeri rugosa* IJ. from Outside Okinosé. S. C. M. No. 366.

Fig. 15. Another specimen of same, from Homba. S. C. M. No. 360. A part of the wall and of the stalk removed.

12, 13. *Crateromorpha meyeri tuberosa* IJ. 14, 15. *C. meyeri rugosa* IJ.

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PLATE VI.

Crateromorpha corrugata Ij.
Scyphidium namiyei (Ij.).

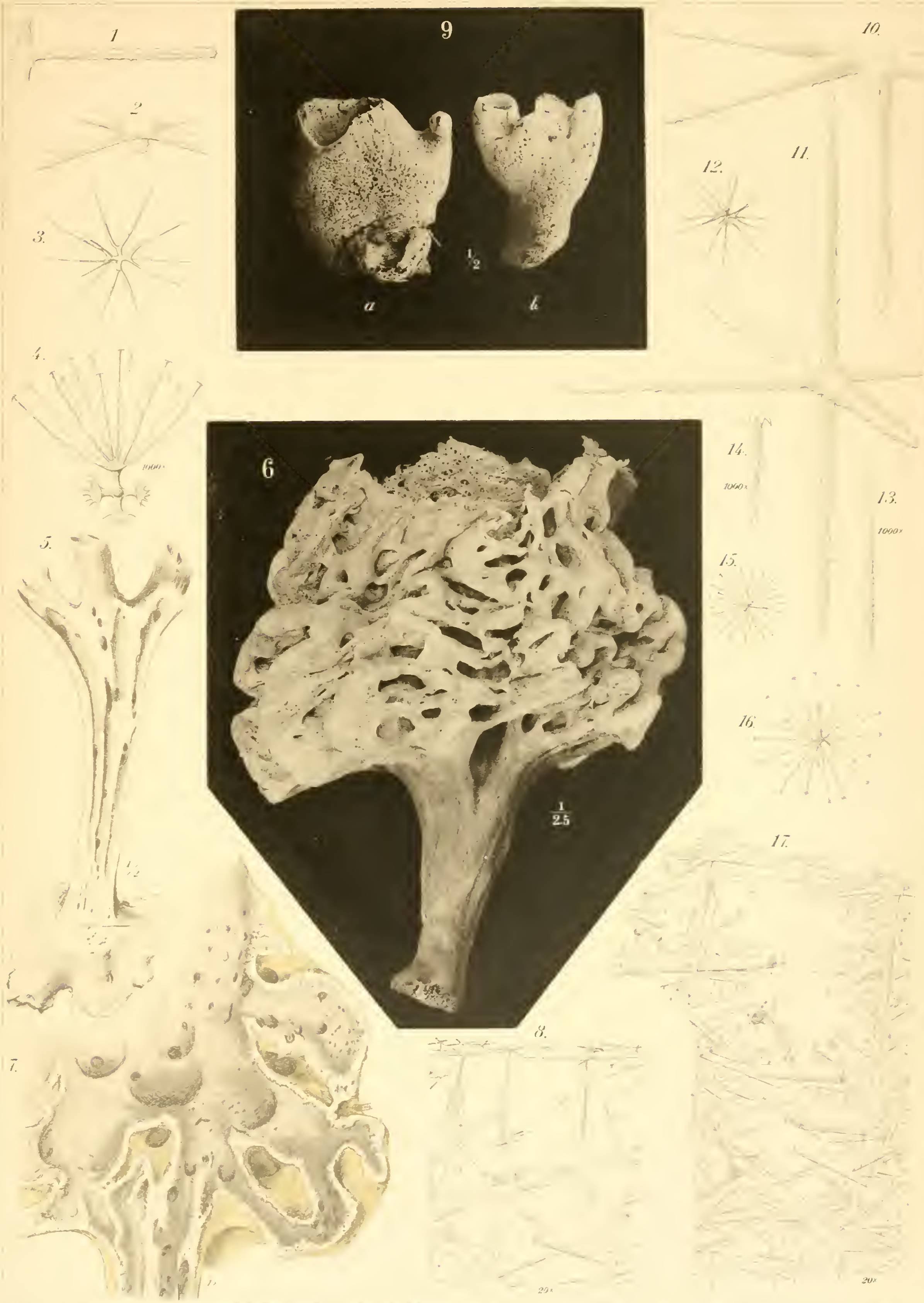
Plate VI.

Crateromorpha corrugata IJ. P. 78.

Figs. 1. & 2. Dermalia drawn in part. 300 ×.
Fig. 3. Oxyhexaster. 300 ×.
Fig. 4. Part of a discohexaster. 1000 ×.
Fig. 5. Stalk and basal disc; the former cut open longitudinally to show the internal canals. Above, the stalk is branched at the junction with the body proper, which is lost. $\frac{1}{2}$ nat. size.
Fig. 6. An entire specimen (O. C. No. 108). $\frac{1}{2.5}$ nat. size.
Fig. 7. The body of another complele specimen (S. C. M. No. 365) longitudinally bisected. The dermal surface, including that of intercanals, is colored yellow. Nat. size.
Fig. 8. Spiculation of the body-wall. Above, dermal surface; below, gastral surface. About 20 ×.

Figs. 9–17. *Scyphidium namiyei* (IJ.). P. 32.

Figs. 9, *a* & *b*. The two type-specimens (S. C. M. No. 362). About $\frac{1}{2}$ nat. size.
Fig. 10. Pentactinic dermalia. 300 ×.
Fig. 11. Gastralia. 300 ×.
Fig. 12. Oxyhexaster. 300 ×.
Fig. 13. A terminal from the same. 1000 ×.
Fig. 14. Outer end of discohexaster terminal. 1000 ×.
Fig. 15. Microdiscohexaster. 300 ×.
Fig. 16. Discohexaster. 300 ×.
Fig. 17. Spiculation of the wall. Above, dermal layer; below, gastral layer. About 20 ×.



1—8. *Crateromorpha corrugata* IJ.
9—17. *Scyphidium namiyei* IJ.

PLATE VII.

Hyalascus sagamiensis Ij.

Plate VII.

Hyalascus sagamiensis IJ. P. 88.

Fig. 1. The type-specimen, which is probably to be found preserved at Amherst College (Prof. B. K. Emerson), Mass., U. S. A. About $\frac{1}{3}$ nat. tize.

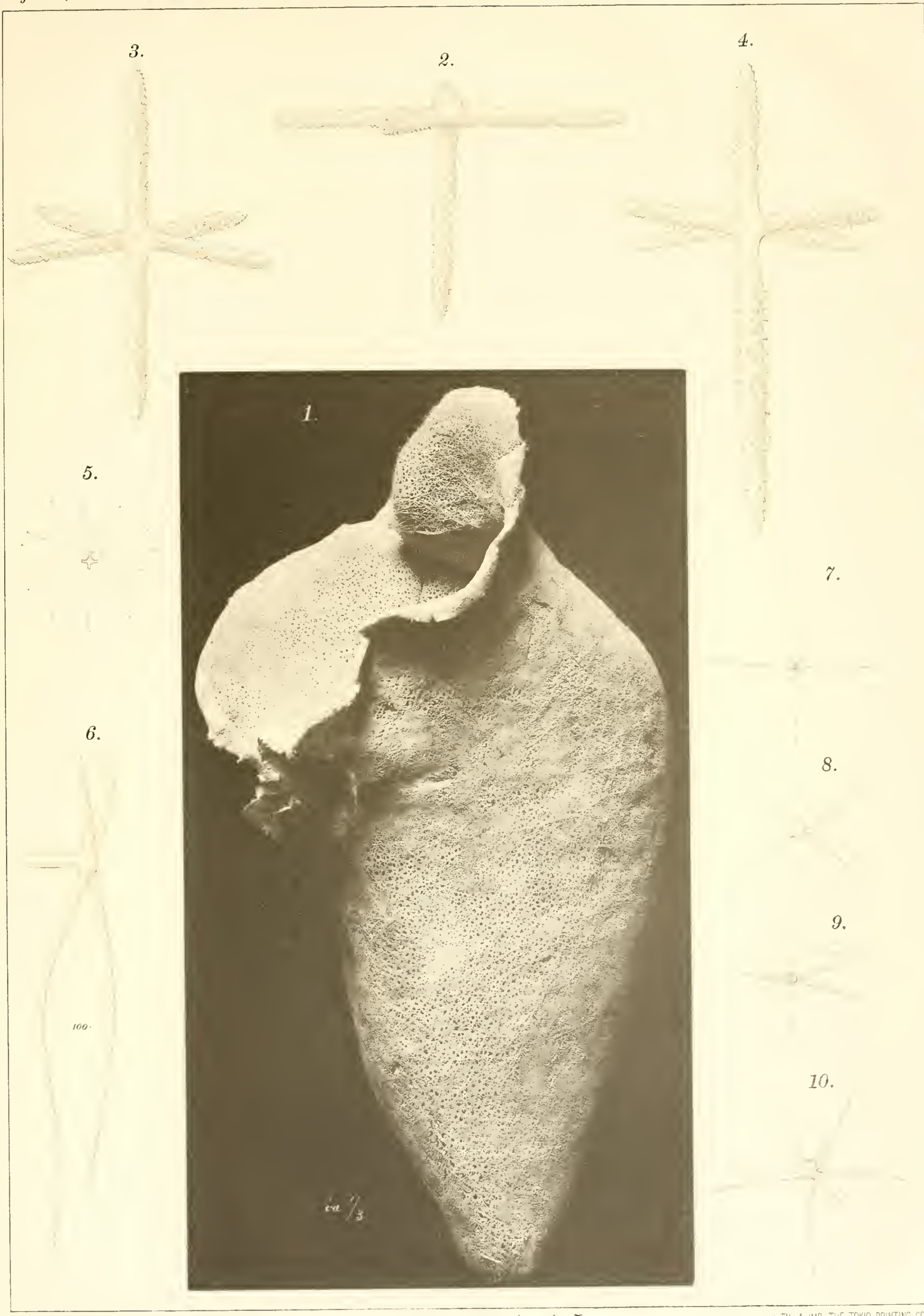
Figs. 2, 3. Dermalia. 300 ×. (Fig. 3 is not good, the rays being drawn relatively too short or too thick).

Fig. 4. Gastralia. 300 ×. (This figure is again not good, the rays being drawn relatively too short or too thick).

Fig. 5. Discohexaster. 300 ×.

Fig. 6. Hypodermal oxypentactin. 100 ×.

Figs. 7–10. Oxyhexasters. 300 ×. Fig. 7, a hexactinose form. Fig. 8, an exceptional degenerate form in which the rays are reduced to only four in number. Figs. 9 and 10, hemihexactinose forms.



Hyalascus sagamiensis Ij.

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PLATE VIII.

Hyalascus sagamiensis IJ.
H. giganteus IJ.
Staurocalyptus microchetus IJ.
Aulosaccus schulzei IJ.

Plate VIII.

Figs. 1–12. *Hyalascus sagamiensis* IJ. P. 88.

Fig. 1. Spicules on and near the dermal surface in oblique view; Some dermalia, hypodermalia and parenchymalia. 50 ×.

Fig. 2. Gastral layer (below) and some spicules (parenchymalia and oxyhexasters) directly beneath it: from a section. 50 ×.

Figs. 3—16. *Hyalascus giganteus* IJ. P. 100.

Fig. 3. A small portion of the dermal surface, much abraded, of the type specimen preserved in the British Museum. Nat. size.

Fig. 4. A small portion of the gastral surface of same. Nat. size.

Fig. 5. Spicules on and near the dermal surface in oblique view: some dermalia, a hypodermal pentactin and some parenchymalia. 50 ×.

Fig. 6. Gastralia and hypogastral beams in surface view. 50 ×.

Fig. 7. Gastral hexactin. 300 ×.

Fig. 8, 9. Dermalia. 300 ×.

Fig. 10. Discohexaster. 300 ×.

Fig. 11. Portion of the same, more highly magnified.

Figs. 12–16. Various forms of oxyhexaster. 300 ×.

Figs. 17–25. *Staurocalyptus microchetus* IJ. P. 202.

Fig. 17. The type specimen (S. C. M. No. 450). Nat. size.

Fig. 18. Dermalia. 300 ×.

Fig. 19. Gastralia. 300 ×.

Fig. 20. Oxyhexaster from a deep part of the wall. 300 ×.

Fig. 21. Oxyhexaster from periphery of the wall. 300 ×.

Fig. 22. Microdiscohexaster. 300 ×.

Fig. 23. Discoctaster. 300 ×.

Fig. 24. Dermal layer in oblique view and underlying spicules, some hypodermal pentactins protruded as prostalia. 50 ×.

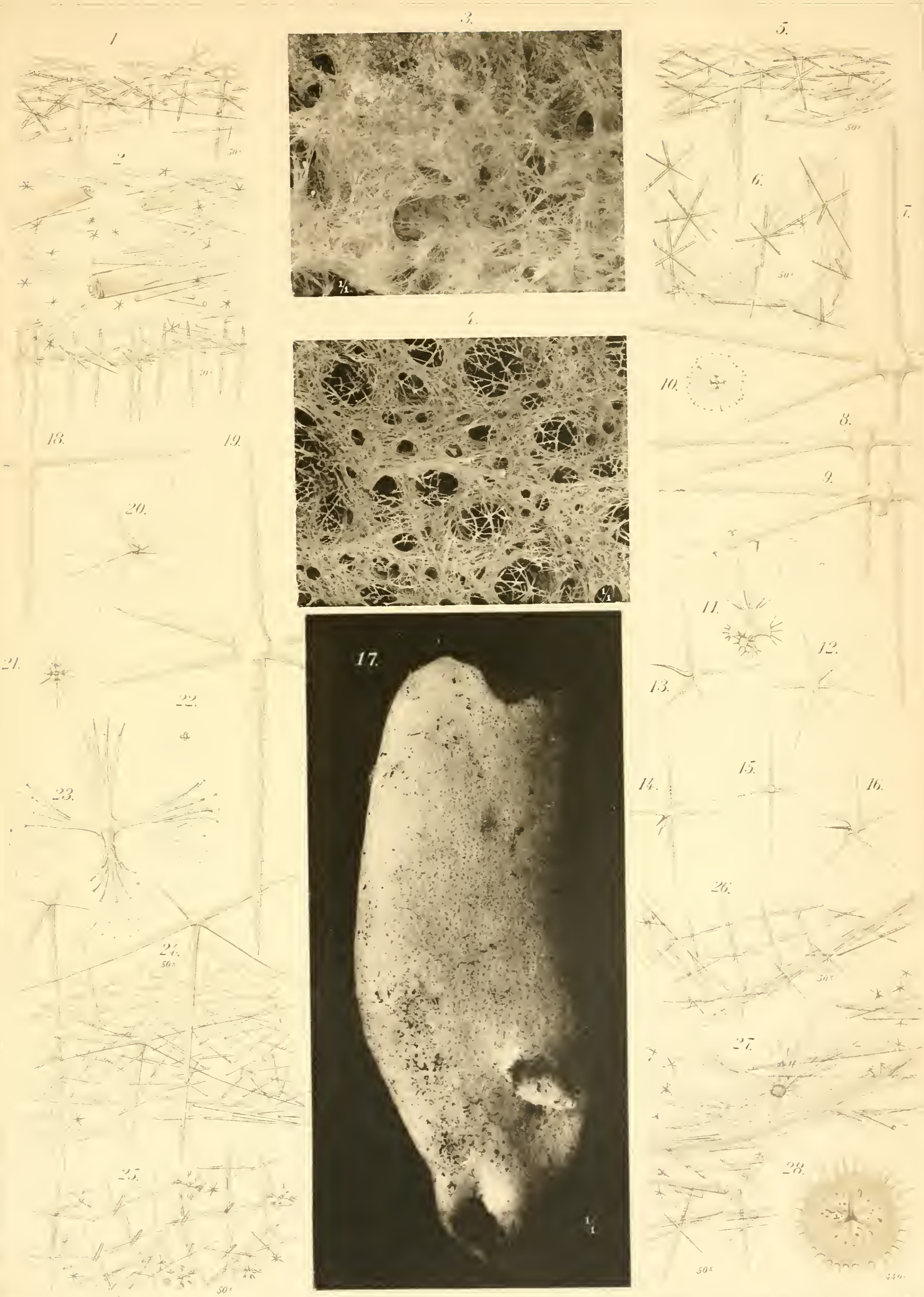
Fig. 25. Gastral layer in surface view; some discoctasters and oxyhexasters in situ. 50 ×.

Figs. 26–28. *Aulosaccus schulzei* IJ. P. 110.

Fig. 26. Dermal layer and hypodermal beams (ectosomal skeleton) in surface view. 50 ×.

Fig. 27. Two gastralia (below) and adjoining spicules in situ. Amongst the latter, a macrodiscohexaster. 50 ×.

Fig. 28. Central sphere of macrodiscohexaster, examined in glycerine, showing the axial cross. 440 ×.



1—2. *Hyalascus sagamiensis* IJ. 3—16. *H. giganteus* IJ.
17—25. *Staurocalyptus microchetus* IJ. 26—28. *Aulosaccus schulzei* IJ.

I. IJIMA.

STUDIES ON THE HEXACTINELLIDA. CONTRIBUTION IV.

PLATE IX.

Aulosaccus schulzei IJ.

Plate IX.

Aulosaccus schulzei IJ. P. 110.

Fig. 1. The type specimen, now preserved probably at Amherst College (Prof. B. K. Emerson), Mass., U. S. A. About $\frac{1}{3}$ natural size.

Figs. 2–7. Oxyhexasters. 300 ×. Fig. 2 is hexactinose, the commonest form. Fig. 6 is hemihexactinose. All the rest are degenerate forms, in which one or more principals, together with their terminals, have disappeared.

Fig. 8. Macrodiscohexaster. 150 ×.

Fig. 9. Outer end of a terminal belonging to a macrodiscohexaster. 450 ×.

Fig. 10. Microdiscohexaster. 300 ×.

Fig. 11. Gastralia. 300 ×.

Fig. 12. Dermalia. Not quite 300 ×.

Figs. 13, 14. Scopulae of extrinsic origin, found in the type specimen. 300 ×. The figures were inadvertently introduced into the plate.

Aulosaccus schulzei Ij.

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PLATE X.

Aulosaccus mitsukurii Ij.
Acanthascus alani Ij.

Plate X.

Figs. 1–15. *Aulosaccus mitsukurii* Ij. P. 117.

Fig. 1. The type-specimen in the Sci. Coll. Museum (No. 427), attached to *Isis*. $\frac{1}{2}$ nat. size. (Figs. 2–15 were all taken from this specimen).

Figs. 2, 3. Macrodiscohexasters. 300 ×.

Figs. 4–7. Oxyhexasters. 300 ×.

Fig. 8. Microdiscohexaster. 300 ×.

Fig. 9. Dermalia. 300 ×.

Fig. 10. Gastralia. 300 ×.

Fig. 11. Showing the spiculation of the wall. Above, a conulus with a tuft of prostalia. 20 ×.

Fig. 12. A small part of a section through the body-wall, stained with hæmatoxylin. Above, two dermalia and the dermal membrane. The latter connected with the choanosome by a pillar consisting of spicules and a dense cobweb of trabeculæ. Below, parts of two flagellated chambers. 100 ×.

Fig. 13. A gastralia with the free ray directed downwards, and the trabecular cobweb in connection with it. 100 ×.

Fig. 14. Chamber wall (membrana reticularis) in optical section. 1000 ×.

Fig. 15. Same in surface-view. Below, a group of strongly stained archaeocytes. 1000 ×.

Figs. 16–23. *Acanthascus alani* Ij. P. 158.

Fig. 16. The type-specimen now belonging to the British Museum. $\frac{1}{2}$ nat. size.

Fig. 17. Dermalia. 300 ×.

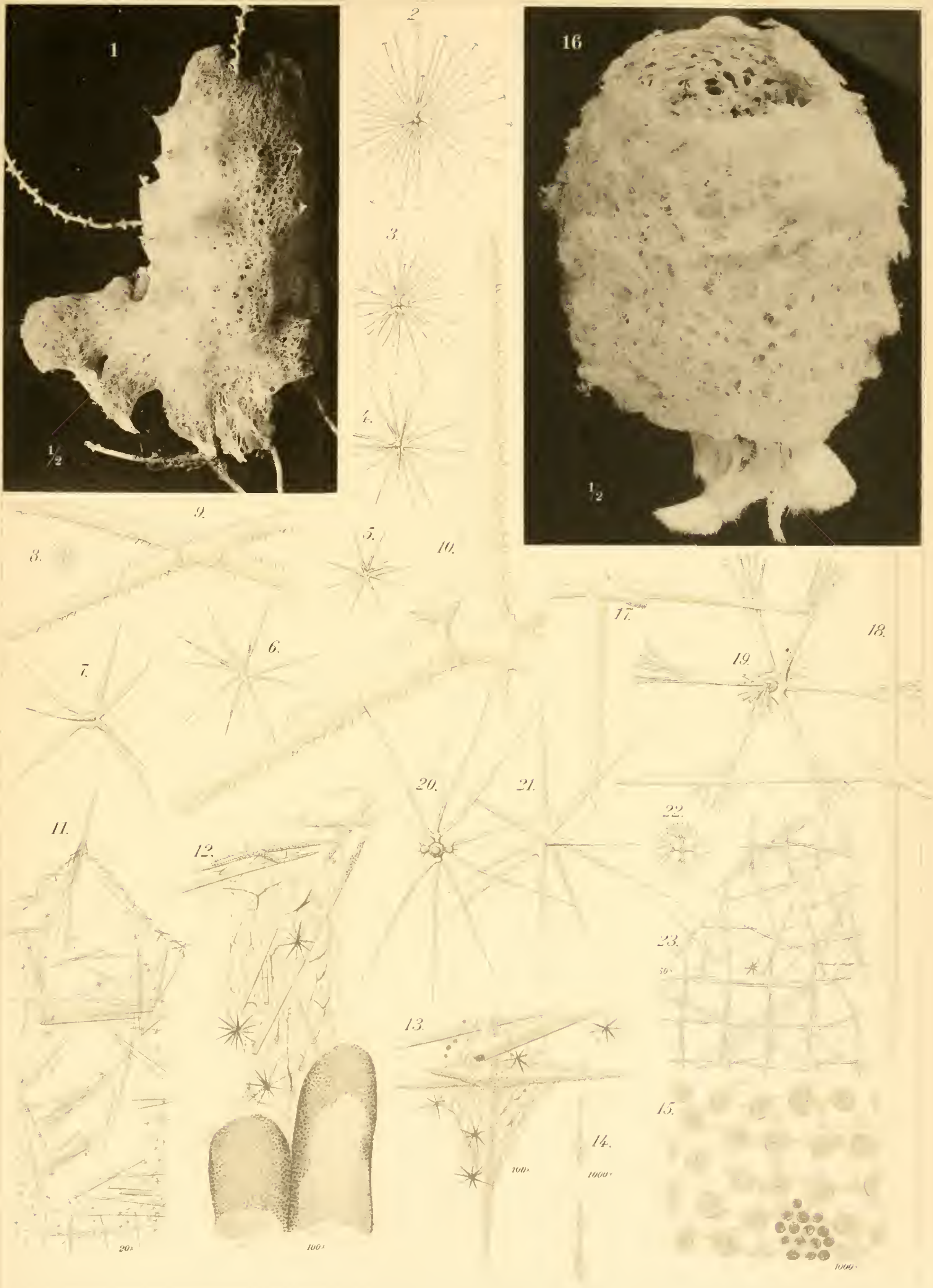
Fig. 18. Gastralia. 300 ×.

Fig. 19. Discoctaster. 300 ×. (The terminals are drawn a little too thick.)

Figs. 20, 21. The two varieties of oxyhexaster. 300 ×.

Fig. 22. Microdiscohexaster. 300 ×.

Fig. 23. Skeletal parts of the ectosome: dermal lacework and hypodermal strands. 50 ×.



1—15. *Aulosaccus mitsukurii* IJ.
16—23. *Acanthascus alani* IJ.

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PLATE XI.

Staurocalyptus heteractinus IJ.

Staurocalyptus sp.

Acanthascus cactus F. E. SCH.

Plate XI.

Figs. 1–10. *Staurocalyptus heteractinus* Ij. P. 218.

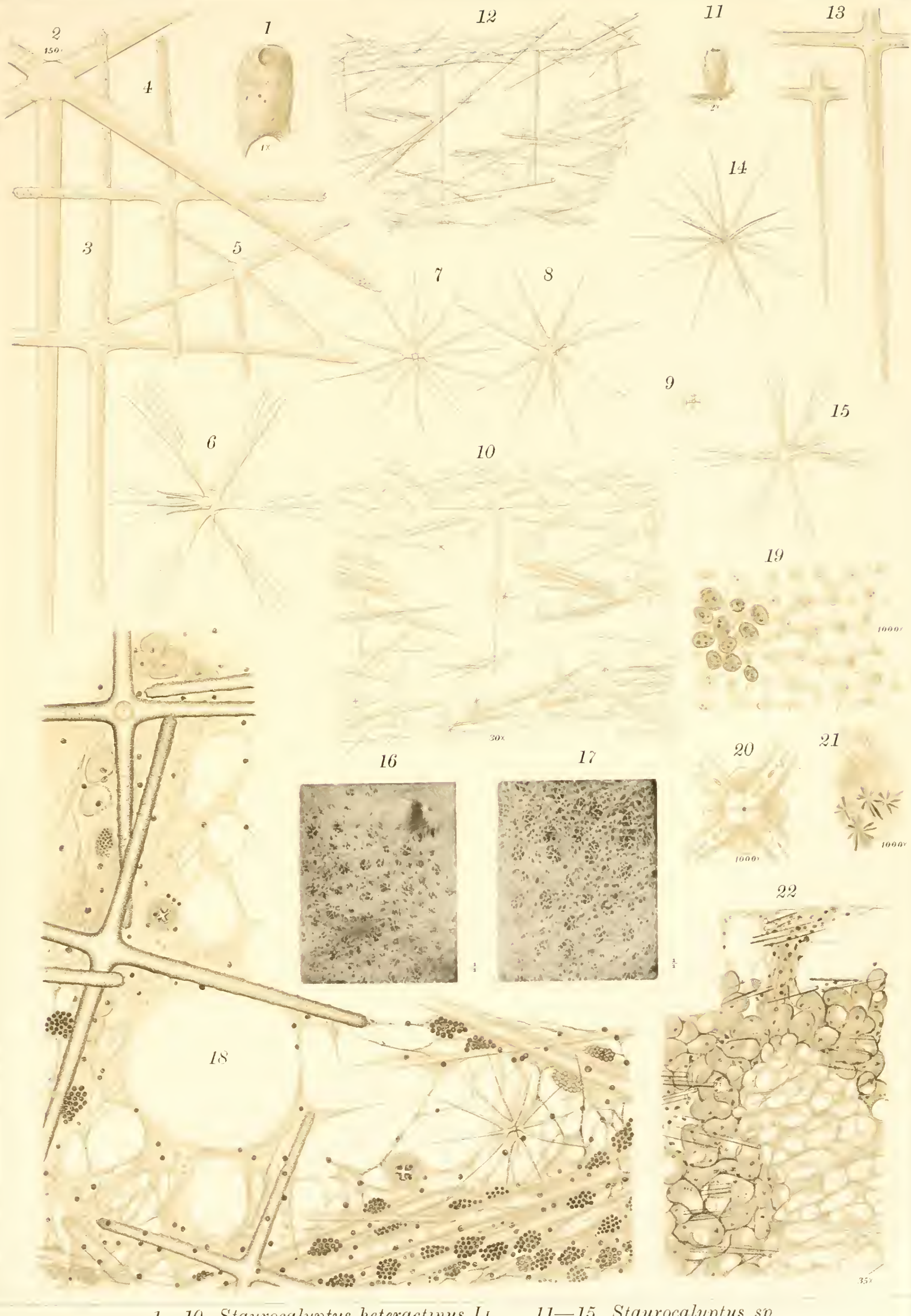
Fig. 1. The type-specimen (S. C. M. No. 409). Nat. size.
Fig. 2. Hypodermal pentactin. 150 ×.
Figs. 3, 4. A large and a small stauractinic dermalia. 300 ×.
Fig. 5. Gastral pentactin. 300 ×.
Fig. 6. Discoctaster from the deeper part of the wall. 300 ×.
Fig. 7. Oxyhexaster from the periphery. 300 ×.
Fig. 8. Same from a deep part. 300 ×.
Fig. 9. Microdiscohexaster. 300 ×.
Fig. 10. Spiculation of the wall. Combination figure. About 30 ×.

Figs. 11–15. *Staurocalyptus* sp. P. 235.

Fig. 11. The entire specimen, attached to a dead *Hexactinella*. 2 ×.
Fig. 12. Spiculation of the wall. Combination figure.
Fig. 13. Portions of large and small dermal stauractins. 300 ×.
Fig. 14. Oxyhexaster. 300 ×.
Fig. 15. Discoctaster. 300 ×.

Figs. 16–22. *Acanthascus cactus* F. E. Sch. P. 140.

Fig. 16. Gastral surface of a dried specimen, showing the endosomal latticework covering the excurrent canalar apertures. Nat. size.
Fig. 17. Dermal surface of the same, showing the ectosomal latticework, beneath which are visible the incurrent canalar apertures. Nat. size.
Fig. 18. Portion of a tangential section of the wall, with soft parts stained with hæmatoxylin. 300 ×. To the left, dermal membrane with dermalia, etc. To the right, subdermal trabeculæ and spicules. Thesocytes visible as masses of fat-like spherules.
Fig. 19. Reticular chamber-wall in surface-view; with a small group of deeply stained archaeocytes. 1000 ×.
Fig. 20. Central node of a small discoctaster from subdermal region. The central axial cross drawn in as seen in glycerine-mounted preparations. 1000 ×.
Fig. 21. Peculiar rosette-like groups of deeply stained rod-like or spindle-like bodies, found on soft tissues of a specimen hardened in absolute alcohol and stained with borax-carmine. 1000 ×.
Fig. 22. Portion of a section through the wall, with soft parts stained with hæmatoxylin. Above, the dermal layer or ectosome and the subdermal space traversed by a pillar. Below and to the right, an excurrent canal with apopyles of chambers seen *en face*. About 35 ×.



1—10. *Staurocalyptus heteractinus* IJ. 11—15. *Staurocalyptus sp.*

16—22. *Acanthascus cactus* F. E. Sch.

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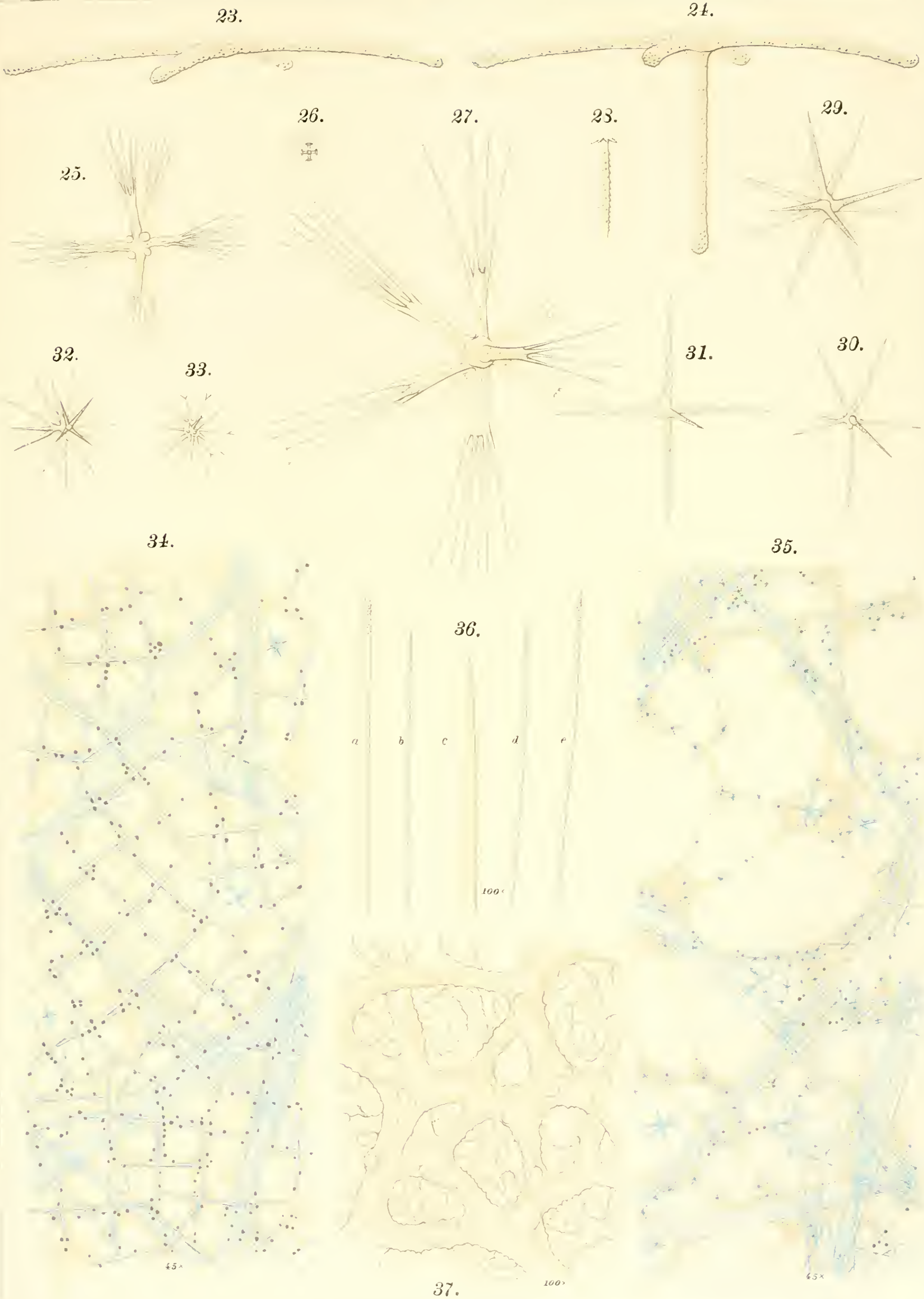
PLATE XII.

Acanthascus cactus F. E. Sch.

Plate XII.

Acanthascus cactus F. E. Sch. P. 140.

Fig. 23. Stauractinic dermalia in lateral view. 300 ×.
Fig. 24. Pentactinic gastralia in lateral view. 300 ×.
Fig. 25. Peripheral discoctaster. 300 ×.
Fig. 26. Microdiscohexaster. 300 ×.
Fig. 27. Discoctaster from subgastral region. 300 ×.
Fig. 28. End of a terminal of a subgastral discoctaster. Very highly magnified.
Fig. 29. Oxyhexaster, in which each nearly atrophied principal seems to bear two terminals. 300 ×.
Fig. 30. Hemihexactinose oxyhexaster. 300 ×.
Fig. 31. Hexactinose oxyhexaster. 300 ×.
Fig. 32. Oxyhexaster with four terminals to each principal. A rare form. 300 ×.
Fig. 33. Abnormal oxyhexaster, only once met with. 300 ×.
Fig. 34. Ectosome in surface-view, showing the dermal lacework, the hypodermal strands and the perforated dermal membrane. The larger black dots in the last represent deeply stained thesocytes. About 45 ×.
Fig. 35. Endosome in surface-view, showing the perforated gastral membrane and the various spicules found in and below it. Black dots as in last figure. About 45 ×.
Fig. 36. Ends of parenchymalia of various sizes. 100 ×.
Fig. 37. Small portion of basidictyonal framework. 100 ×.



Acanthascus cactus F. E. Sch.

PLATE XIII.

Staurocalyptus affinis n. sp.

Plate XIII.

Staurocalyptus affinis n. sp. P. 180.

All figures from Sci. Coll. Mus. Sp. No. 194.

Fig. 1. External surface of the wall. Dermal spicules wanting in the greater part. Nat. size.

Fig. 2. Gastral surface of the same. Canalar apertures mostly freely open but some covered with small-meshed endosomal lattice which is differentiated in irregular patches. Nat. size.

Fig. 3. Dermalia. 300 ×.

Fig. 4. Gastralia. 300 ×.

Fig. 5. Small discoctaster from subdermal space; imperfectly developed in so far as some terminals remain isolated from the secondary principals. 300 ×.

Fig. 6. Part of a larger discoctaster from the subgastral space. 300 ×.

Fig. 7. Hexactinose oxyhexaster from choanosome. 300 ×.

Fig. 8. Microdiscohexaster.

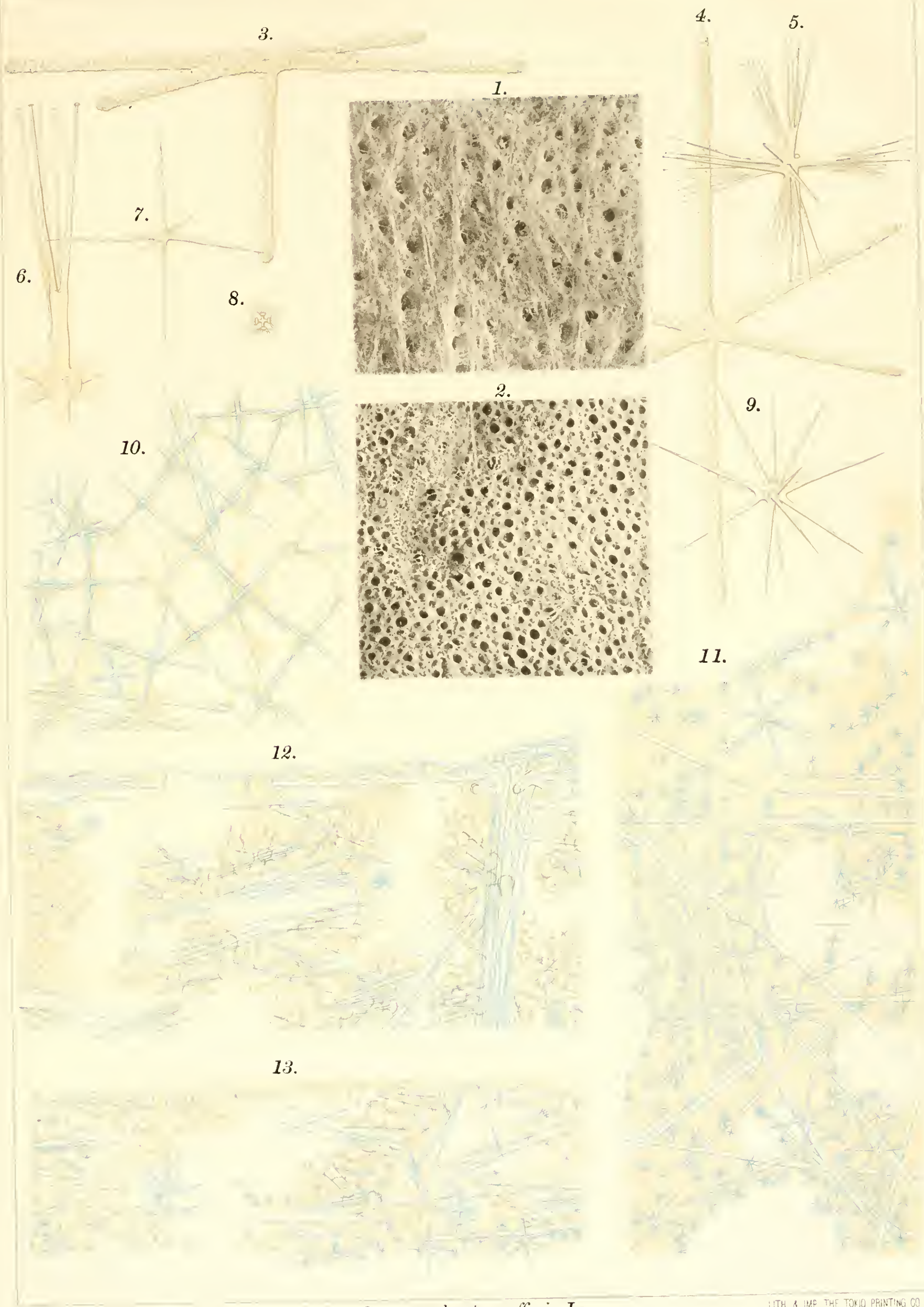
Fig. 9. Smooth-rayed oxyhexaster from endosome. 300 ×.

Fig. 10. Small portion of ectosome in surface view. Dermalia and hypodermalia held together by desiccated soft tissue. 60 ×.

Fig. 11. Small portion of endosome in surface view. 60 ×.

Fig. 12. Peripheral portion of a section through the wall. Above, dermal surface. To the right, a group of paratropal hypodermal pentactins. In the center, the central portion of a large parenchymal principalia, surrounded by comitalia. 30 ×.

Fig. 13. Portion adjoining the gastral surface of a section through the wall. Below, the gastral surface. 30 ×.



Staurocalyptus affinis IJ.

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PLATE XIV.

Staurocalyptus affinis n. sp.
S. entacanthus n. sp.
S. rœperi (F. E. Sch.).

Plate XIV.

Staurocalyptus affinis n. sp. P. 180.

Fig. 14. The smaller of the two type specimens of *S. affinis* (Sc. Coll. Mus. No. 400). About $\frac{2}{3}$ nat. size.
Fig. 16. Smooth-rayed oxyhexaster from gastral side. 300 ×. (From Sp. No. 400).
Fig. 17. Rough-rayed oxyhexaster from subdermal space. 300 ×. (From Sp. No. 400).
Fig. 22. Two rudimentary oxyhexasters (early developmental stage?). 300 ×. (From Sp. No. No. 400).
Fig. 23. Central node of a discoctaster, showing the disposition of axial filaments. Seen in glycerine. 1200 ×. (From Sp. No. 194).
Fig. 24. Central node of an oxyhexaster, showing the axial cross of filaments. Seen in glycerine. 1200 ×. (From Sp. No. 194).
Fig. 25. Central node of a hexactinose oxyhexaster, showing the axial cross of filaments. Seen in glycerine. 1200 ×. (From Sp. No. 194).

Staurocalyptus entacanthus n. sp. P. 191.

Fig. 15. The type specimen (Sc. Coll. Mus. No. 242), a fragment from the oscular margin of a large individual. Seen from the dermal side. Marginal lappets reflected outwards and backwards, thus showing the spiny gastral surface. About $\frac{1}{2}$ nat. size.
Fig. 18. Subdermal trabeculæ, showing four thesocytes. Fixed with alcohol and stained with hæmatoxylin. 440 ×.

Staurocalyptus entacanthus? Pp. 194 & 198.

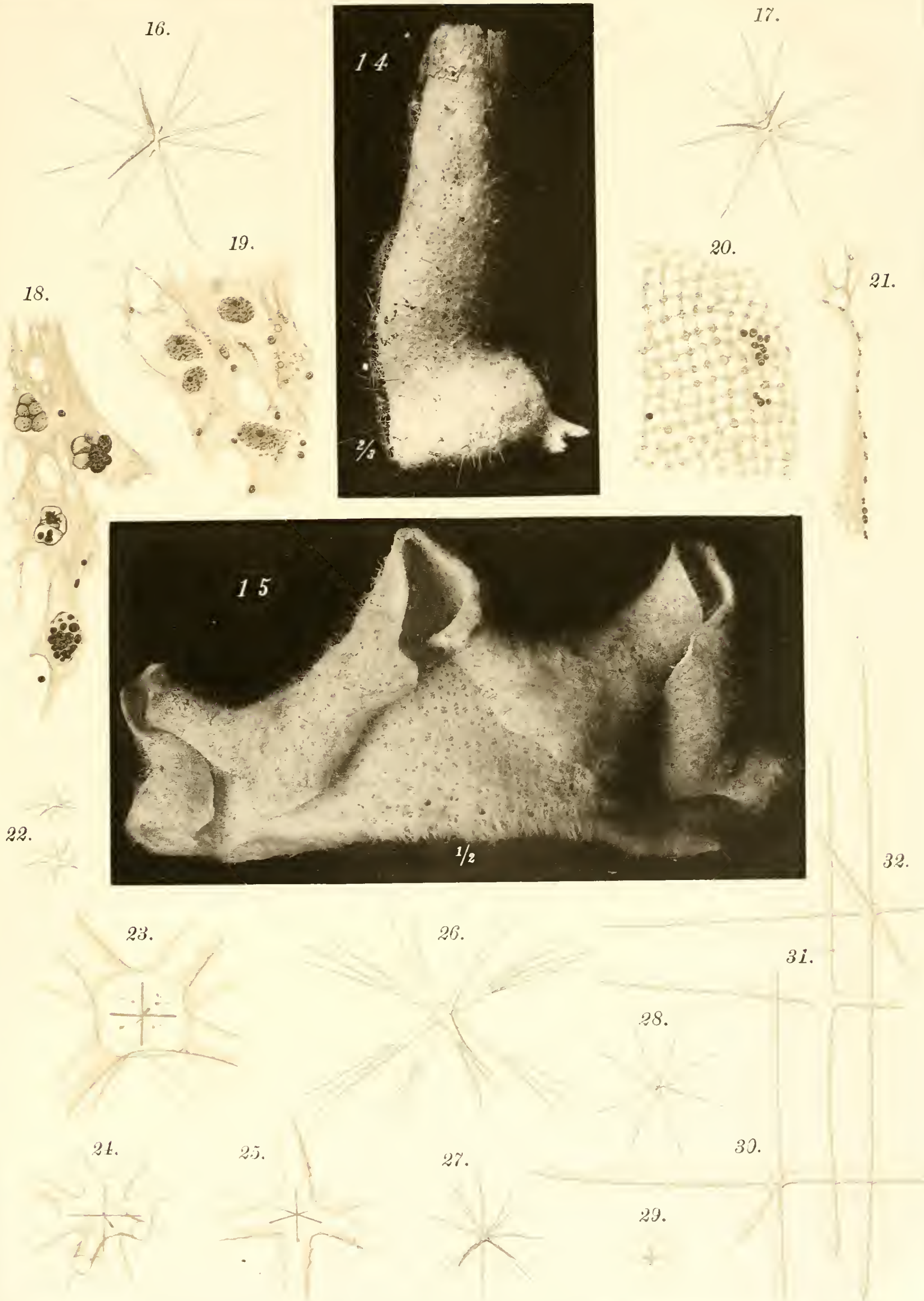
Sc. Coll. Mus. No. 403, which specimen is shown in these Studies, Contrib. III., Pl. VI., figs. 9 and 10, under the name of *S. japonicus*.

Fig. 19. Trabecular tissue, with four thesocytes, from along the lumen of an incurrent canal. Alcohol and hæmatoxylin. 440 ×.
Fig. 20. Chamber-wall, seen surface on. Well-stained archæocytes in small groups. Alcohol and hæmatoxylin. 440 ×.
Fig. 21. Same in optical section. 440 ×.

Staurocalyptus rœperi (F. E. Sch.). P. 168.

All figures from F. E. Schulze's type-specimen, obtained by the "Challenger."

Fig. 26. Discoctaster. 300 ×.
Fig. 27. Oxyhexaster, from gastral side. 300 ×.
Fig. 28. Another oxyhexaster, in which each principal bears, besides two well-developed terminals, a minute rudiment of a third terminal. 300 ×.
Fig. 29. Microdiscohexaster from gastral surface. 300 ×.
Fig. 30. Pentactinic dermalia. 300 ×.
Fig. 31. Stauractinic dermalia. 300 ×.
Fig. 32. Gastralia. 300 ×.



14, 16, 17, 22—25. *Staurocalyptus affinis* IJ. 15, 18. *St. entacanthus* IJ.
19—21. *St. entacanthus ?* 26—32. *St. roeperi* (F. E. SCH.)

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PLATE XV.

Staurocalyptus glaber Ij.

Plate XV.

Staurocalyptus glaber IJ. P. 207.

Fig. 1. A large specimen attached to a dead *Periphragella elisæ* (Sci. Coll. Mus. No. 244). $\frac{1}{2}$ nat. size.

Fig. 2. Another attached to a specimen of a tufaceous bottom (Sci. Coll. Mus. No. 398). $\frac{1}{2}$ nat. size.

Fig. 3. Two young specimens attached to a dead *Chonelasma calyx*. Nat. size.

Figs. 4–6. Dermalia in different views. 300 ×.

Fig. 7. Gastralia. Below, the free proximal ray. 300 ×.

Fig. 8. Microdiscohexaster. 300 ×.

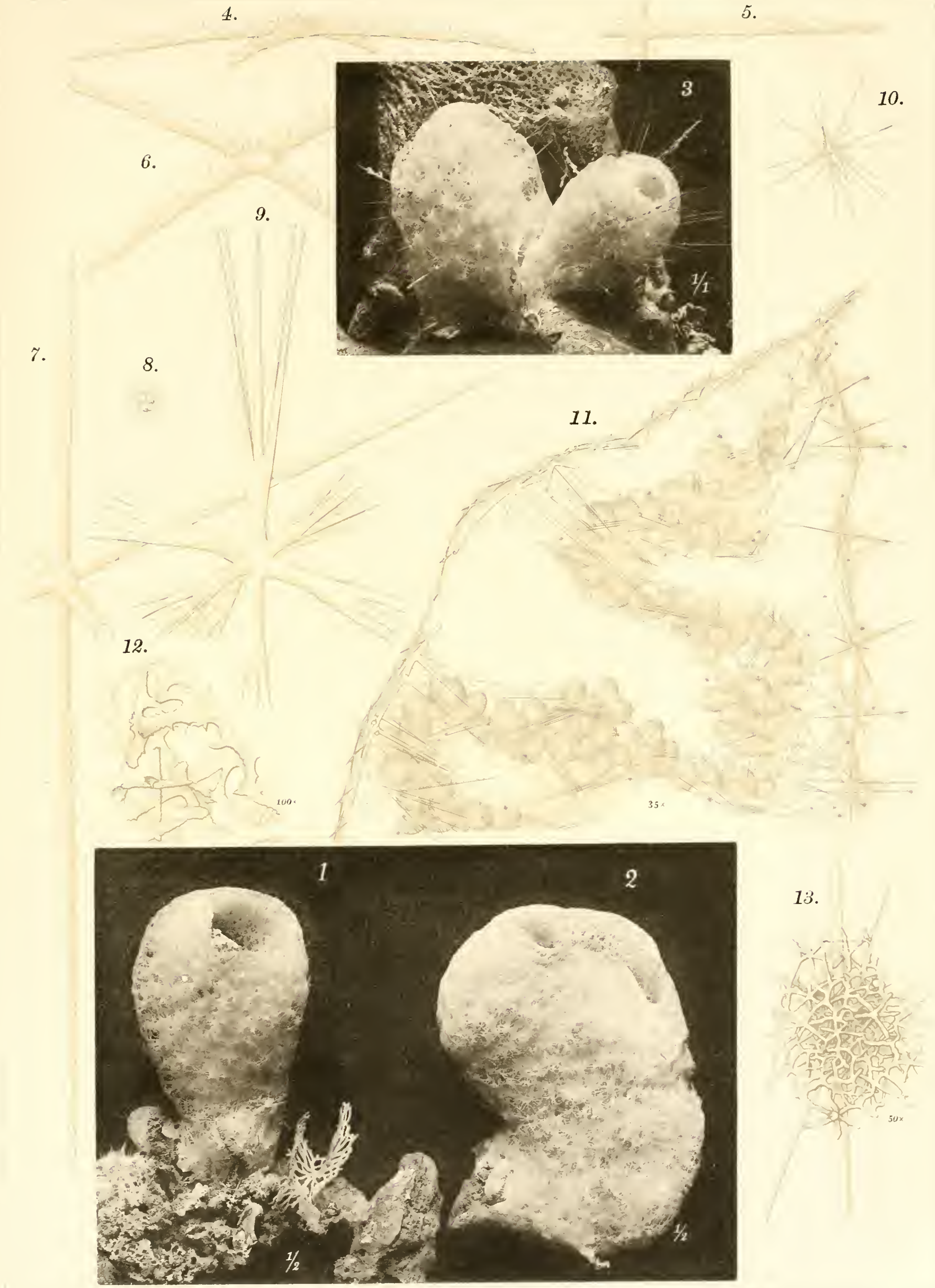
Fig. 9. Discoctaster. 300 ×.

Fig. 10. Oxyhexaster. 300 ×.

Fig. 11. Portion of a longitudinal section through the wall of a young specimen. Above, the oscular edge. 30 ×.

Fig. 12. Small portion of the basidictyonal plate. 100 ×.

Fig. 13. One of the small basidictyonal masses, found in abundance in the parenchyma of Sci. Coll. Mus. No. 361,—probably basidictyonalia belonging to a young brood which had fixed themselves, temporarily or otherwise, to the parenchymalia of the mother-sponge. 50 ×.



Staurocalyptus glaber IJ.

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PLATE XVI.

Staurocalyptus pleorhaphides IJ.

Plate XVI.

Staurocalyptus pleorhaphides. Ij. P. 222.

Fig. 1. S. C. M. No. 226. A part of the wall cut off and the gastral surface exposed. Nat. size.

Fig. 2. Another entire specimen. S. C. M. No. 415. Nat. size.

Figs. 3–5. Dermalia. 300 ×.

Fig. 6. Gastral diactin of a moderately large size. 300 ×.

Fig. 7. Normally developed oxyhexaster. 300 ×.

Fig. 8. Malformed oxyhexaster, observed but once. 300 ×.

Fig. 9, 10. Discoctasters of the larger size. 300 ×.

Fig. 11. Part of a very small discoctaster. 300 ×.

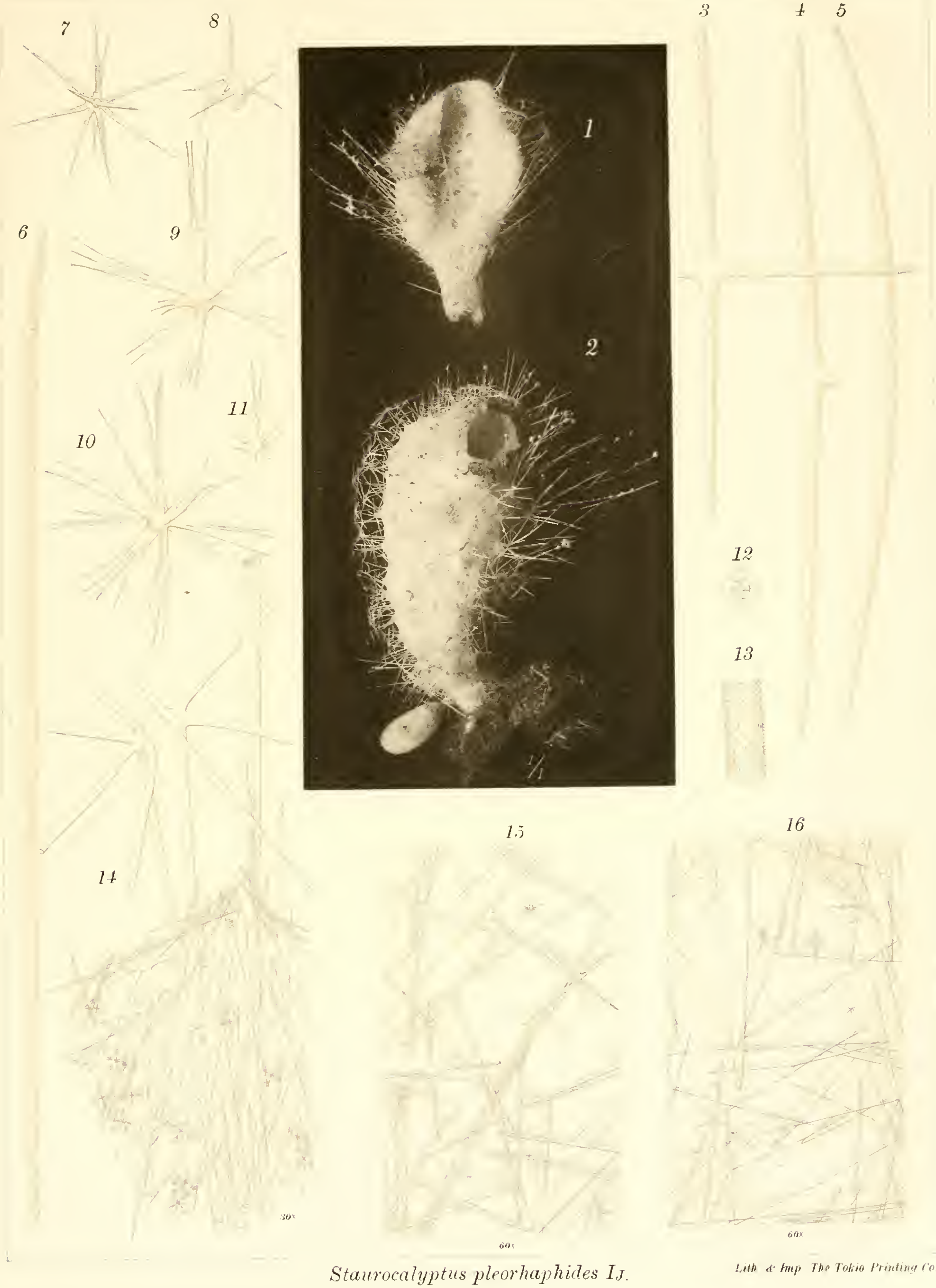
Fig. 12. Microdiscohexaster. 300 ×.

Fig. 13. Part of the paratangential ray of a prostal pentactin, to show the roughness of surface caused by minute and pointed microtubercles. 300 ×.

Fig. 14. Spicules in and on a conulus of the sponge-surface. Two prostal, paratropal oxypentactins and a part of a prostal oxydiactin. About 30 ×.

Fig. 15. Surface view of the ectosome, with dermalia which are mostly diactins. 60 ×.

Fig. 16. Surface view of the endosome, with diactinic gastralia. 60 ×.



Staurocalyptus pleorhaphides IJ.

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PLATE XVII.

Rhabdocalyptus victor Ij.

Plate XVII.

Rhabdocalyptus victor I.J. P. 238.

Fig. 1. Sci. Coll. Mus. No. 423. Slightly less than $\frac{1}{4}$ nat. size. Total length 880 mm.; diameter at middle 220–270 mm.

Rhabdocalyptus victor IJ.

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PLATE XVIII.

Rhabdocalyptus victor Ij.

Plate XVIII.

Rhabdocalyptus victor IJ. P. 238.

Fig. 2. A portion of the dermal surface, magnified about two diameters. Dermal lacework, blurred. Hypodermal strands radiating from several central points.

Fig. 3. A portion of the gastral surface, magnified about two diameters. Gastral lacework supported on hypogastral strands, covering the excurrent canalar apertures.

Fig. 4. A large, unequally rayed, parenchymal diactin from the basal region. 150 ×.

Fig. 5. A hemihexactinose oxyhexaster with nine terminal points. 300 ×.

Fig. 6. Portion of a discoctaster, with a primary terminal which has remained free, unfused with the secondary principal running by its side. 300 ×.

Fig. 7. A hexactinose oxyhexaster. 300 ×.

Figs. 8–11. Different forms of dermalia, the stauractinic form of fig. 10 being by far the most common. 300 ×.

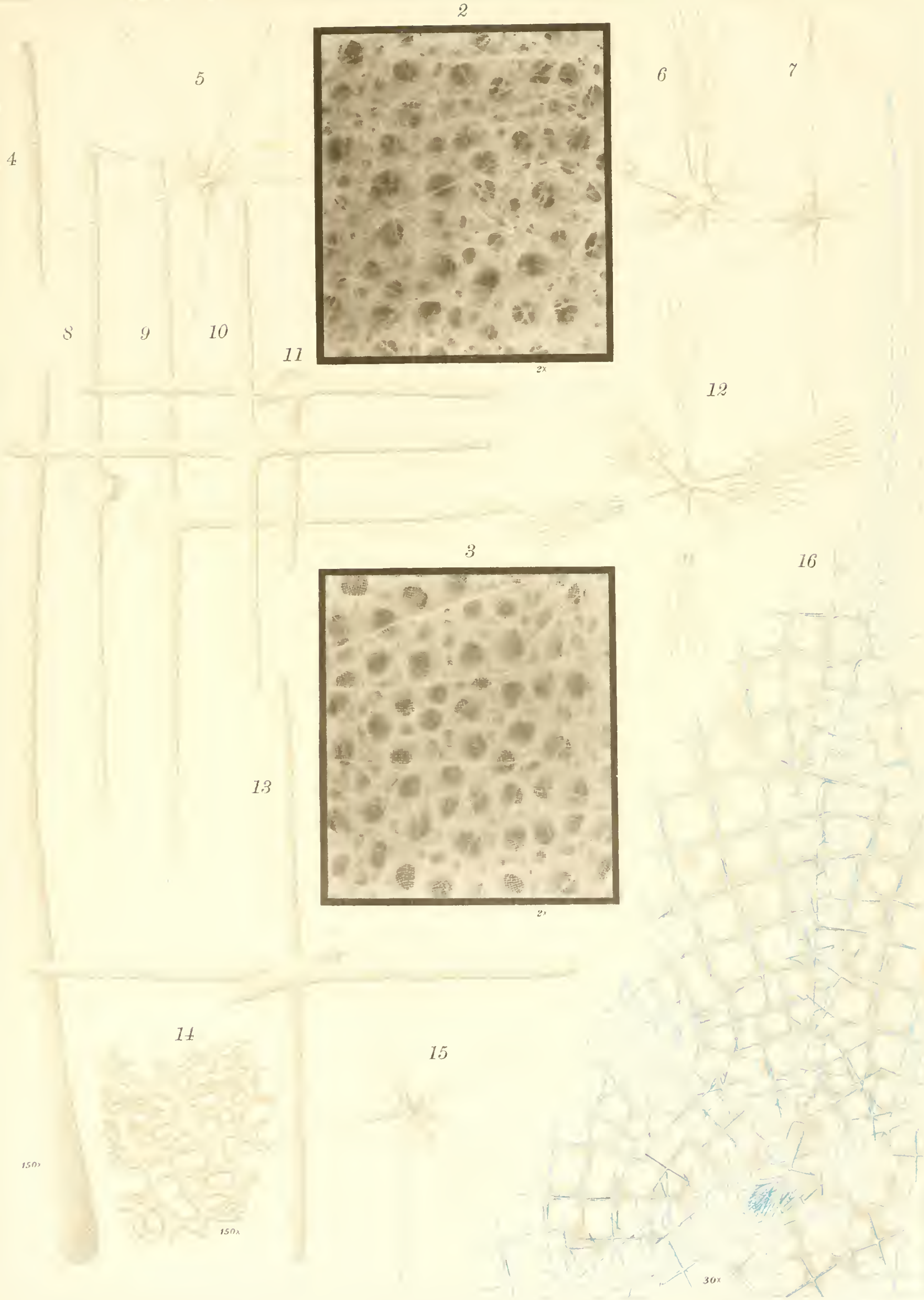
Fig. 12. A discoctaster, with plain central node. 300 ×.

Fig. 13. A gastral hexactin. 300 ×.

Fig. 14. A small portion of the basidictyonal plate. 150 ×.

Fig. 15. A hemihexactinose oxyhexaster with seven terminal points. 300 ×.

Fig. 16. A small portion of the ectosome, seen from outside; including a group of hypodermal pentactins with the paratangentials in a radial disposition. In the center of the group, a dense projecting tuft of fine diactins. 30 ×.



Rhabdocalyptus victor Ij.

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PLATE XIX.

Rhabdocalyptus victor Ij.

Plate XIX.

Rhabdocalyptus victor Ij. P. 238.

Fig. 17. A young specimen (S. C. M. No. 227) attached to a *Hexactinella lorica.* Nat. size.

Fig. 18. Portion of the longitudinal section of a young specimen. Above, the oscular edge; at the middle, the irregularly wavy chamber-layer which loses itself close to the oscular edge. About 30 ×.

Fig. 19. Free edge of chamber-wall, gradually passing into trabeculæ. 440 ×. This figure, as also all the following figures, was taken from a young specimen of the size of a small apple, hardened in alcohol and stained with hæmatoxylin.

Fig. 20. Small portion of a section, drawn with the microscope focussed at apopyles of chambers. 300 ×. *c.*, old and empty thesocytes. The darkly stained bodies are thesocyte spheres. *e.*, free edge of apopyle. *f.*, film-like connecting membrane covering the gap between four adjoining apopyles. *g.*, freely communicating gap (without a connecting membrane) between apopyles.

Fig. 21. Portion of a paratangential section passing near the gastral surface. About 40 ×. *ex.*, excurrent canals in cross-section. *in.*, intercommunicating lacunæ, the ultimate end of the incurrent canal system.

Fig. 22. Portion of a similar section, passing through the periphery of the choanosome. About 40 ×. Lettering as in above. Here the ultimate branches of excurrent canals are seen to form anastomosing lacunæ around the stem of incurrent canals.

Fig. 23. Constructed figure to show in section the branching of canals and the folding of the chamber-layer. Above, the dermal surface is supposed to be seen in a slanting away position. *in.*, *ex.*, wall of incurrent and excurrent canals seen *en face.* Below, the continuous gastral layer.

Rhabdocalyptus victor IJ.

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PLATE XX.

Rhabdocalyptus mollis F. E. Sch.

Plate XX.

Rhabdocalyptus mollis F. E. Sch. P. 253.

Fig. 1. A specimen (O. C. No. 103) well preserved, except in that a bud has been torn off. $\frac{1}{4}$ natural size.

Fig. 2. A specimen (S. C. M. No. 420) from which a triangular piece of the wall had been cut away. $\frac{1}{4}$ natural size. (Figs. 3–9 were all taken from this specimen).

Fig. 3. A normal oxyhexaster from the subdermal space. 300 ×.

Fig. 4. Microdiscohexaster. 300 ×.

Fig. 5. Discoctaster. 300 ×.

Fig. 6. A hemihexactinose oxyhexaster with 10 terminals in all, from deep parts. 300 ×.

Fig. 7. A hexactinose oxyhexaster; two of the straight rays each showing at base the remnant of an atrophied terminal in the form of a unilateral spine. 300 ×.

Fig. 8. A quite hexactinose oxyhexaster. 300 ×.

Fig. 9. Another hexactinose oxyhexaster with all the rays crooked at base. 300 ×.

Fig. 10. A nearly hexactinose oxyhexaster; one of the rays is simply bent at base, while another similarly bent ray shows the rudiment of a fellow terminal belonging to the same principal. From O. C. No. 104. 300 ×.

Fig. 11. A hemihexactinose oxyhexaster with very strongly developed basal barbs to the rays. From O. C. No. 104. 300 ×.

Fig. 12. Spicules of ectosome seen in surface view. From S. C. M. No. 420. 30 ×.

Fig. 13. Spicules of endosome seen in surface view. From S. C. M. No. 420. 30 ×.

Rhabdocalyptus mollis F. E. Sch

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PLATE XXI.

Rhabdocalyptus unguiculatus IJ.

Plate XXI.

Rhabdocalyptus unguiculatus Ij. P. 268.

Fig. 1. The type-specimen (Sci. Coll. Mus. No. 501). ½ natural size. All the following figures of spicules were taken from this specimen.

Fig. 2. Two dermal diactins. 300 ×.

Fig. 3. A gastral hexactin. 300 ×.

Figs. 4, 5. Thin-rayed oxyhexasters from the periphery of the sponge wall. 300 ×.

Figs. 6, 7. Stronger-rayed, smooth, hemihexactinose oxyhexasters from the gastral side of the sponge wall. 300 ×.

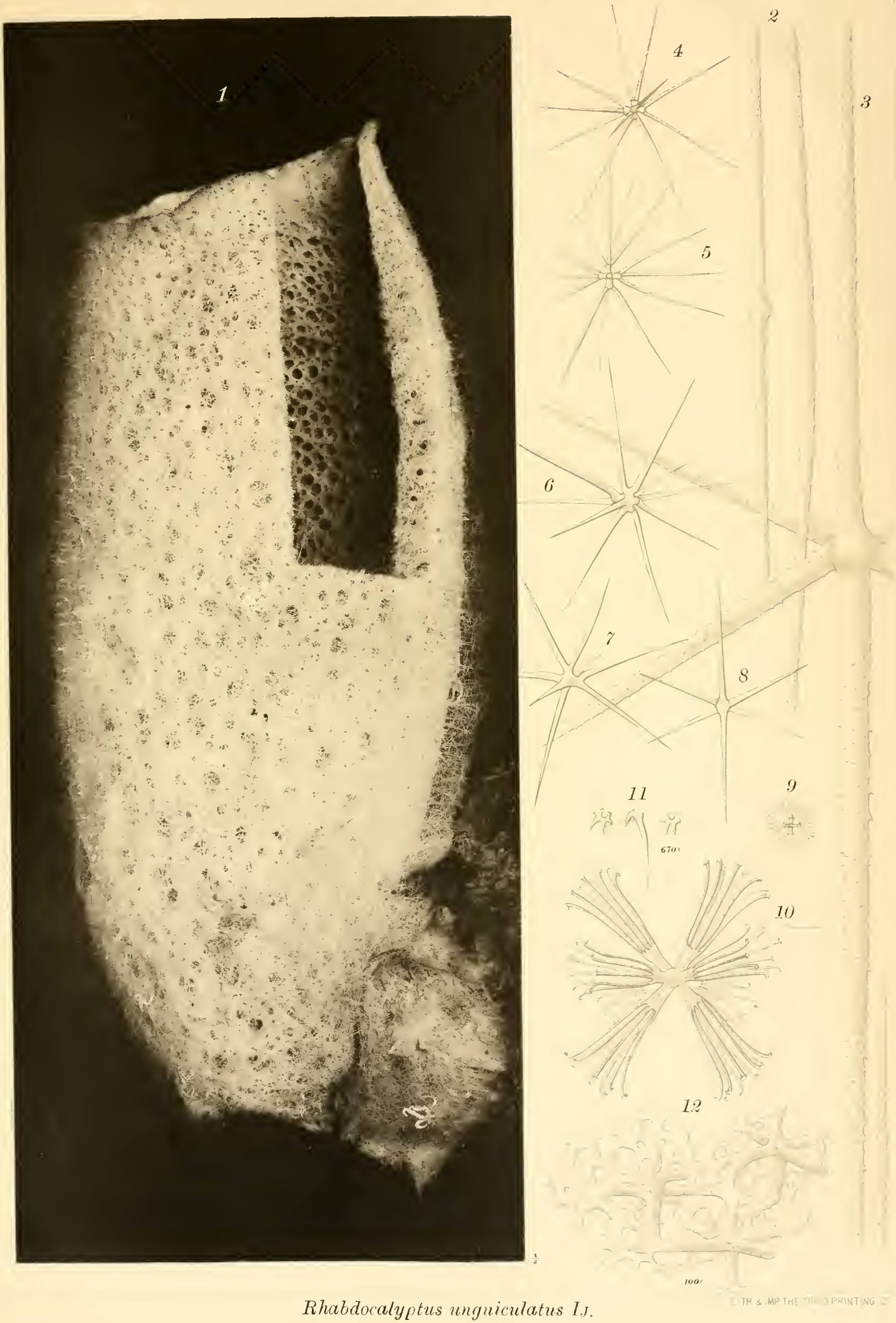
Fig. 8. Hexactinose oxyhexaster from the same region. 300 ×.

Fig. 9. Microdiscohexaster from the dermal membrane. 300 ×.

Fig. 10. A discoctaster. 300 ×.

Fig. 11. Unguiculate terminal discs of discoctaster. One in lateral view; two as seen from above. 670 ×.

Fig. 12. A small fragment from the basidictyonal plate. The small-meshed limiting layer and some basidictyonal hexactins in fusion with it as well as with one another. 100 ×.



Rhabdocalyptus unguiculatus IJ.

PLATE XXII.

Rhabdocalyptus capillatus Ij.

Plate XXII.

Rhabdocalyptus capillatus IJ. P. 276.

Fig. 1. A specimen from Inside Okinosé by the Ena-line (S. C. M. No. 287). $\frac{1}{2}$ nat. size.

Fig. 2. Another from Outside Okinosé by the Iwado-line (S. C. M. No. 397). $\frac{1}{2}$ nat. size.

Figs. 3, 4. Two very small specimens from a lot of six, all of which were found attached to a dead *Chonelasma calyx* from Maye-no-Yodomi (S. C. M. No. 406). Nat. size.

Fig. 5. A young specimen from a lot of three, found attached to a dead *Chonelasma calyx* from Mochiyama (S. C. M. No. 413). Nat. size.

Fig. 6. Dermalia. 300 ×.

Figs. 7, 8. Oxyhexasters from subdermal space. 300 ×.

Figs. 9, 10. Discoctasters. 300 ×.

Fig. 11. Microdiscohexaster. 300 ×.

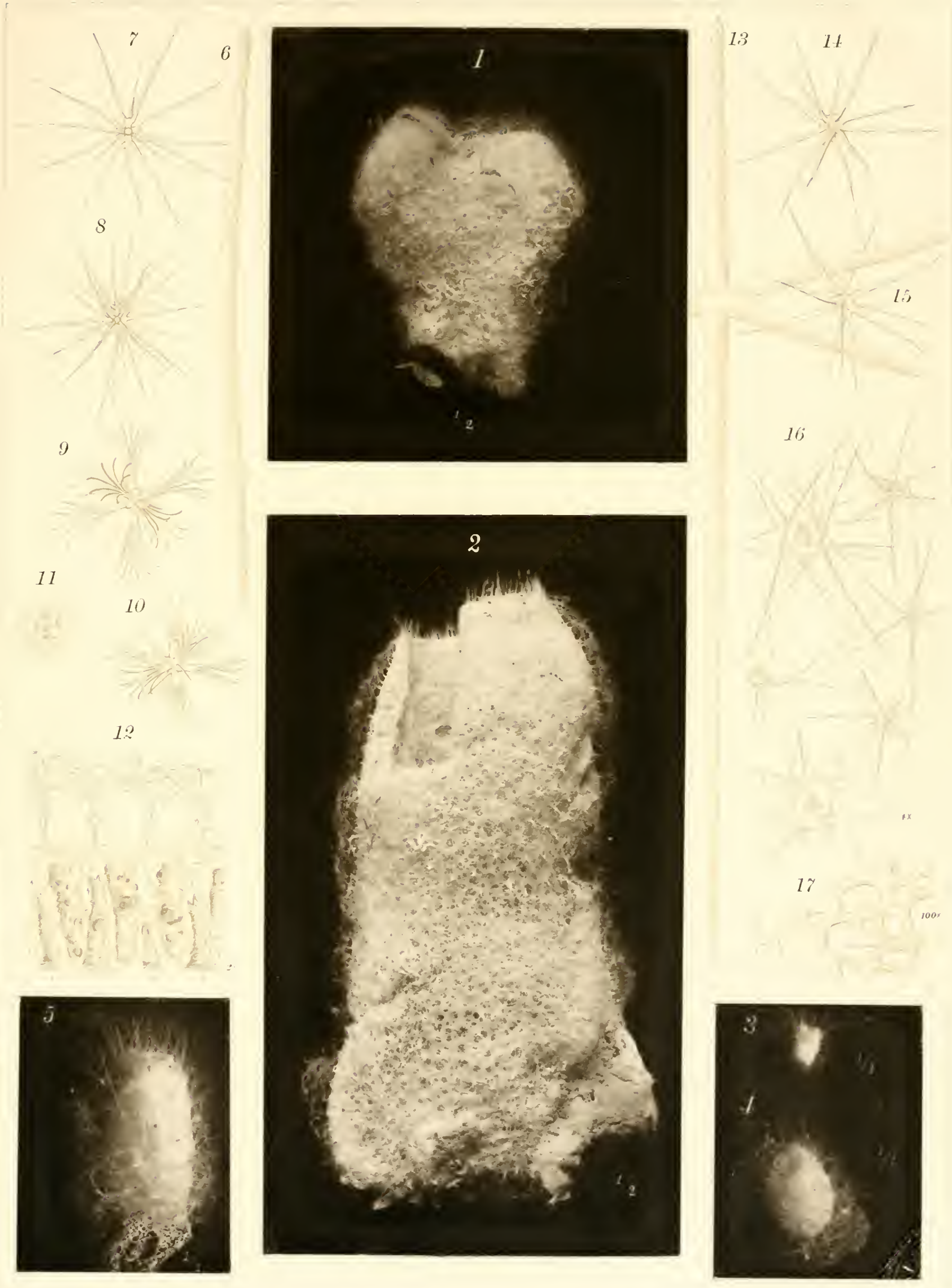
Fig. 12. Wall of dried specimen in section. The arrows indicate incurrent and excurrent canals. 2 ×.

Fig. 13. Gastralia. 300 ×.

Figs. 14, 15. Oxyhexasters from subgastral space. 300 ×.

Fig. 16. Arrangement of the paratangential heads of hypodermal pentactins in groups. About 4 ×.

Fig. 17. Part of basidictyonal plate. 100 ×.



Rhabdocalyptus capillatus IJ.

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PLATE XXIII.

Rhabdocalyptus capillatus Ij.

Plate XXIII.

Rhabdocalyptus capillatus IJ. P. 276.

(All figures from sections stained with borax-carmine).

Fig. 18. Surface view of ectosome. 300 ×.

Fig. 19. A small part of the subdermal region. Below, blind end of a chamber and a small (young) oxyhexaster. 300 ×.

Fig. 20. A small part of chamber wall. Below, three archæocytes. 1000 ×.

Fig. 21. Thesocytes of varied appearance. 1000 ×.

Fig. 22. Peripheral part of a section vertical to the surfaces. 30 ×. Above, dermal surface; *s. s.*, subdermal space; *in.*, incurrent canal; *ex.*, excurrent canal.

Fig. 23. Part of a paratangential section. 30 ×. *in.*, intercommunicating incurrent spaces; *ex.*, excurrent canal.

Fig. 24. Gastral part of a section vertical to the surfaces. 30 ×. Below, the gastral surface. Lettering as in the above figure.

Rhabdocalyptus capillatus Ij.

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