AN ACCOUNT

OF THE

INDIAN TRIAXONIA

COLLECTED BY THE

ROYAL INDIAN MARINE SURVEY SHIP

INVESTIGATOR

BY

FRANZ EILHARD SCHULZE, PH.D., M.D.,
PROFESSOR OF ZOOLOGY AT THE UNIVERSITY OF BERLIN.

The German Original translated into English

BY

ROBERT VON LENDENFELD, PH.D.,
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CALCUTTA:
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NOTE.

The Triaxon Sponges herein described by Professor F. E. Schulze were all collected during the years 1885–1900 by the Naturalists of the Royal Indian Marine Survey Ship "Investigator."

As to the ways and means by which they came to be collected and to be deposited in the Indian Museum, I may refer to the preface of certain other of the Trustees' publications, namely, to the *Catalogue of Indian Deep Sea Fishes*, to the *Account of the Investigator Deep Sea Brachyura*, and to the *Account of the Investigator Deep Sea Madreporaria*.

As to the scope of the Investigator's work and the nature of her equipment, etc., I may refer to the *Scientific Memoirs by Medical Officers of the Army of India* for the year 1899, Part XI.

A. ALCOCK, *Major, I.M.S.*,
Superintendent of the Indian Museum

INTRODUCTION.

In the "Abhandlungen der Kngl. Preussichen Akademie der Wissenschaften" for 1894, 1895, and 1900 I have published three memoirs on the Hexactinellida collected by the "Investigator" in 1885-1898 and placed at my disposal by Prof. J. Wood-Mason and Dr. A. Alcock.

At the latter's request I have now prepared a report embodying the results published in those memoirs for an English translation. Making use of the facts concerning these sponges since brought to light, through my investigation of the Hexactinellida collected for the most part under the supervision of A. Agassiz by the "Albatross" and through other investigations, I have now re-examined the "Investigator" material. This report is therefore not a mere translation of the German memoirs named above but a revised second edition of their re-arranged contents.

For the sake of completeness I shall first give a list of the Hexactinellida collected in the Indian Ocean by other expeditions than those of the "Investigator."

I limit the Indian Ocean as follows:—*West:* Africa from Suez to Cape Agulhas, and from thence to the South Polar circle, the meridian 20° E. *South:* South Polar circle from 20° E. to 146° 50′ 39″ E. *East:* from the South Polar circle to Tasmania, the meridian 146° 50′ 39″ E., then Tasmania, Australia, the Sunda Islands and the East Indies. *North:* Asia from the Malayan Peninsula to Suez.

Before the "Challenger" Expedition only four species of Hexactinellida were known from the Indian Ocean, namely:—

(1) *Euplectella cucumer* R. Owen 1857, in Trans. Linn. Soc., Vol. XXII, (2), pp. 117-124, pl. XXI. Seychelles.

(2) *Corbitella corbicula* Bowerbank 1867, in Proc. Zool. Soc., London, 1867, p. 858. Isle de Bourbon.

(3) *Farrea occa* Bowerbank 1862, in Phil. Trans., Vol. CLII, p. 747, pl. XXXIII, f. 7. Seychelles.

(4) *Farrea densa* Carter 1873, in Annals Mag. Nat. Hist., s. 4, Vol. XII, p. 463, pl. XVII, f. 6 and 7. Seychelles. Genus and species uncertain.

To those were added by the "Challenger" Expedition 15 species which I described in the "Report of the Scientific Results of the Voyage of H.M.S. "Challenger," Hexactinellida" in 1887, namely:—

(5) *Hyalonema clavigerum* F. E. Sch. *l.c.*, p. 220, pl. XLI, S. Penguin Island (Crozets), 46° 16′ S. 48° 27′ E., 2926 m.=1600 fths.

(6) *Hyalonema conus* F. E. Sch. *l.c.*, pp. 209 and 210, pl. XXXIII, f. 8-15. S. Australia 50° 1′ S., 123° 4′ E., 3291 m.=1800 fths.

(7) *Holascus fibulatus* F. E. Sch. *l.c.*, pp. 87-89, pl. XV, f. 1-5, XVI. S. Australia 42° 42′ S., 134° 10′ E., 4755 m.=2600 fths.; W. Crozet Islands 46° 46′ S., 45° 31′ E., 2515 m.=1375 fths.; S. Penguin Island (Crozets) 46° 16′ S., 48° 27′ E., 2926 m.=1600 fths.

(8) *Holascus polejævi* F. E. Sch. *l.c.*, pp. 89 and 90, pl. XVII, f. 1-5, S.W. Australia 53° 55′ S., 108° 35′ E., 3566 m.=1950 fths.

(9) *Malacosaccus vastus*, F. E. Sch. *l.c.*, pp. 90-93, pl. XVII. W. Crozet Islands 46° 46′ S., 45° 31′ E., 2515 m.=1375 fths.

(10) *Aulascus johnstoni* F. E. Sch. *l.c.*, pp. 118 and 119, pl. XXII, f. 1-3, S.E. Prince Edwards Island 46° 41′ S., 38° 11′ E., 567 m.=310 fths.

(11) *Pleorhabdus (Polyrhabdus) oviformis* F. E. Sch. gen. dubium, spec. dubia *l.c.*, pp. 121 and 122, pl. XXIII, f. 1-8, S.W. Australia 62° 26′ S., 95° 44′ E., 3612 m.=1975 fths.

(12) *Caulophacus latus* F. E. Sch. *l.c.*, pp. 124-126, pl. XXIV. S. Penguin Island (Crozets) 46° 16′ S., 48° 27′ E., 2926 m.=1600 fths.

(13) *Caulophacus (Balanella=Balanites) pipetta* F. E. Sch., *l.c.*, pp. 122 and 123, pl. XXIII, f. 9-14, S.W. Australia 59° 55′ S., 108° 35′ E., 3566 m.=1950 fths.

(14) *Bathydorus spinosus* F. E. Sch. *l.c.*, pp. 153-154, pl. LIX, f. 6-9, S. Penguin Island (Crozets) 46° 16′ S., 48° 27′ E., 2926 m.=1600 fths.

(15) *Rossella antarctica* Carter *l.c.*, pp. 139-142, pl. LV (including *Acanthascus grossularia* F. E. Sch. synonym *l.c.*, pp. 145-147, pl. LVI), S. Kerguelen 52° 4′ S., 71° 22′ E., 274 m.=150 fths. S.E. Prince Edwards Island 46° 43′ S., 38° 4′ 30″ E., 256 m.=140 fths. S. Possession Island (Crozets) 46° 47′ S., 51° 37′ E., 384 m.=210 fths.

(16) *Aulocalyx irregularis* F. E. Sch. *l.c.*, pp. 174-176, pl. LX, S.E. Prince Edwards Island 46° 41′ S., 38° 10′ E., 567 m.=310 fths.

(17) *Chonelasma lamella* F. E. Sch. *l.c.*, pp. 321-323, pl. LXXXVII, LXXXVIII, S. Possession Island (Crozets) 46° 53′ S., 51° 52′ E., 1006 m.=550 fths.

(18) *Farrea* spec. *l.c.*, p. 477, S. Penguin Island (Crozets) 46° 16′ S., 48° 27′ E., 2926 m.=1600 fths.

(19) *Hexactinella* spec. *l.c.*, p. 478, S. Possession Island (Crozets) 46° 53′ S., 51° 52′ E., 1006 m.=550 fths.

Lately two species were collected by the "Pola" Expedition. These I described in the "Bericht der Commission für Oceanographische Forschungen, Zoologische Ergebnisse XVI", in 1900. They are:—

(20) *Aulocystis grayi* (Bwbk.) *l.c.*, p. 1, pl. I-II, Red Sea 22° 51′ 5″ to 26° 75′ N., 490-868 m.=268-474 fths.

(21) *Tretocalyx polæ* F. E. Sch. *l.c.*, p. 9, pl. III, Red Sea 17° 42′ 2″ to 25° 57′ N., 841-820 m.=186-449 fths.

Some of the young "Investigator"-Hexactinellida described in my previous Memoirs as distinct species can now be identified with sufficient certainty as youthful forms of other species, so that the total number of the species collected by the "Investigator" appears slightly reduced.

A. AMPHIDISCOPHORA.

I. HYALONEMATIDÆ.

Of the 120 Hexactinellida collected by the "Investigator" a considerable number of specimens and of species belong to the *Amphidiscophora*, a group characterised and distinguished from the other *Hexactinellida (Hexasterophora)* by the presence of amphidiscs and the absence of hexasters. Having united *Poliopogon* Wyv. Thoms. with *Pheronema* Leidy, I distinguished in the only family of the *Amphidiscophora*, the *Hyalonematidæ*, the three genera *Pheronema* Leidy, *Hyalonema* J. E. Gray, and *Semperella* J. E. Gray. Further investigations have however shown me the advisability of re-establishing the genus *Poliopogon* as distinct from *Pheronema* (see below). To these four the new genus *Lophophysema*, based on a fine specimen of the "Investigator" collection, is to be added, so that the family now comprises five genera, *Pheronema* Leidy, *Poliopogon* Wyv. Thoms., *Hyalonema* J. E. Gray, *Lophophysema* F. E. Sch., and *Semperella* J. E. Gray. All these with the exception of *Poliopogon* are represented in the "Investigator" collection.

The two subfamilies *Hyalonematinæ* and *Semperellinæ* have nearly the same spiculation and are only distinguished by their external shape and the formation of their canals. This distinction appears so unimportant that I now refrain from distributing the genera among them.

Pheronema, Leidy.

Among the first "Investigator"-Hexactinellida received were two specimens of a new *Pheronema* species which I described as *P. raphanus* in the Abhandl. der Preuss. Akad. 1894, pp. 8–13. Both had completely lost their prostalia lateralia and I thought that their absence was a peculiarity of this species. Formerly, in the "Challenger" Report, I had distinguished the allied genera *Pheronema* and *Poliopogon* by the presence of prostalia lateralia in the former and their absence in the latter. Now finding a sponge undoubtedly belonging to *Pheronema* and, as I then believed, without prostalia lateralia, I thought it necessary to unite these two genera.* The material of *Pheronema*

* Abh. Preuss. Ak., 1894, p. 7.

raphanus subsequently received made it clear however that prostalia lateralia are normally present in good specimens of this species both young and adult.* The reason for uniting *Pheronema* and *Poliopogon* was thus invalidated and it became necessary, as stated above, to re-establish *Poliopogon* Wyv. Thoms. as a genus distinct from *Pheronema*.

One of the *Pheronema* specimens was a small and badly preserved specimen which appeared to be distinguished from *P. raphanus* by the large size of its prostalia marginalia and I established for it the species *Pheronema circumpalatum* F. E. Sch.† The examination of better preserved specimens of this sponge subsequently received showed however that *Pheronema circumpalatum* was merely a young *P. raphanus*.‡

Pheronema raphanus, F. E. Sch.

Plate I.

1895 *Pheronema raphanus* F. E. Sch., in Abh. Preuss. Ak. 1894, pp. 8-13, Taf. I.
„ *Pheronema circumpalatum* F. E. Sch., *ibidem*, pp. 13-17, Taf. II.
1900 *Pheronema raphanus* F. E. Sch. in Abh. Preuss. Ak., 1900 pp. 3-7, Taf. I.

The adult sponge is a hand in height and over. It has the shape of a radish and its maximum transverse diameter, which is situated two finger-breadths below the upper end, exceeds its height. The oscular margin is nearly circular. The upper surface is occupied by a plain or slightly concave sieve-plate. The sides bulge considerably in their upper part. Below, the sponge is attenuated, inversely conical, and terminates in a rounded protuberance two to three finger-breadths high. From this a root-tuft of spicules one finger long and two to three fingers broad protrudes. This tuft is composed of numerous spicule-bundles of the thickness of goose-quills. Above, the spicules composing the bundles are firmly united and the bundles themselves perfectly distinct. Below, the spicules diverge and the ends of the bundles unite to form a continuous spicule-mass.

The margin of the sieve-plate is alternately sharp and rounded; its edge appears as an undulating line slightly raised and sharpened at 5 (rarely 6 or more) equidistant points. Marginalia arranged in a single row protrude from it 2-3 cm. These marginalia are much larger and closer together on the sharp protruding parts of the margin than in the rounded and depressed interstices where they may be totally absent. The fringe they form accordingly appears fully developed only on the elevated parts of the margin. The ratio of the lengths of these well developed parts of the marginal fringe to the intervening spaces differs in different specimens, but is fairly constant in one and the same individual. The latter are usually longer than the former.

* Abh. Preuss. Ak., 1900, p. 5.
† Abh. Preuss. Ak. 1894, pp. 13–17.
‡ Abh. Preuss. Ak. 1900, pp. 4–7.

The prostalia lateralia which protrude radially from the sides of the sponge are most numerous just below the bulging equatorial zone. Scattered prostalia lateralia however occur right down to the lower end of the sponge. Most of them are stout, situated singly, and protrude several centimeters; some are smaller and arranged in protruding bundles. The lateralia are very liable to be broken off: one only finds them intact in the very best specimens.

The prostalia marginalia do not increase in thickness uniformly with the growth of the sponge. In young specimens of walnut-size they are much thicker than in specimens full grown. In the former we generally find 6–10 marginalia, 600–800 μ thick, situated in a row on each marginal prominence. In the latter there are about a hundred marginalia only 200 μ thick, or under, on each prominence. Specimens under walnut-size, again, have more slender marginalia than those of walnut-size. In such small specimens their thickness decreases with the size of the sponge, until in specimens 15 mm. high the marginalia are again, as in the fullgrown sponge, only 200 μ thick. This curious abnormity formerly induced me to establish a distinct species, *Pheronema circumpalatum*, for the walnut-sized specimens with stout marginalia. It seems that two generations of marginalia succeed each other, the spicules of the first, growing until the sponge has the size of a walnut, attain a thickness of 600–800 μ and are then thrown off; the more numerous slender spicules attaining a thickness of only 200 μ, composing the second generation, are then produced and replace those of the first. Possibly there may also be two generations of lateralia and basalia, for I sometimes found spicules in the small root-tufts of walnut-sized specimens considerably stouter than any in the much longer root-tufts of full-grown specimens.

The root-tuft increases in size as the sponge grows. In small specimens, 5 mm. in diameter, it consists of about 40 spicules protruding 2 cm., which are not arranged in bundles. Such root-tufts are surrounded by spicules transitional between the basalia and the lateralia, in such manner that there is no distinct limit between them: the former pass gradually into the latter. In specimens 10 mm. in diameter the root-tuft is composed of 5-6 bundles, each containing 4-6 closely-packed spicules. The bundles are about 1 mm. apart and form a tuft clearly distinguished from the lateralia surrounding it. As the sponge grows these bundles and the spicules composing them increase in number and in size; fullgrown hand-high specimens possess 20–30 bundles, each of a finger's length and composed of about 50 spicules. The centres of the large hypodermal pentactines which support the dermal membrane protrude slightly, forming, as in other Pheronema-species, low prominences. These spicules are not disposed so regularly as in the other species, their tangential rays not being disposed exactly parallel or vertical to each other. The superficial skeleton-net which they form consequently appears unusually irregular. These hypodermalia measure

10 mm. and more in length. In the dermal membrane which rests on their tangential rays a secondary more regular skeleton-net with quadratic meshes, composed of the tangential rays of similar but smaller spicules, is met with. In the meshes of this network lie the incurrent pore-sieves. In a belt, 2 cm. wide, surrounding the margin of the oscular sieve-plate the meshes of this network are smaller than elsewhere. The dermal membrane is densely covered with pinules. The stout quadratic skeleton-net of the gastral membrane which forms the flat or slightly concave sieve-plate on the upper end of the sponge, is conspicuous by its regularity. Also here the large meshes of the primary skeleton-net are occupied by a secondary network of smaller mesh, whilst the surface is densely covered with gastral pinules. This network is particularly clearly visible, the large subgastral cavities and the excurrent canal-stems forming a dark background to it. The subgastral cavity is not continuous, some of the membranes separating the excurrent canal-stems extend right down to the gastral membrane, *i.e.* the oscular sieve-plate, and attach themselves to it. All the specimens are more or less filled with fine clay-coloured silt and have the brownish-greenish-yellowish-greyish colour characteristic of most Hexactinellida preserved in spirit.

Longitudinal sections through the whole sponge show numerous irregular lacunar cavities below the dermal membrane, from which canals of the diameter of a little finger extend downward. Their width decreases towards the interior and they are much branched. Between these incurrents the excurrents, which join to form main canals of the thickness of a finger, extend. The latter open into the irregular lacunar spaces extending below the gastral membrane, which appears as an oscular sieve-plate.

The supporting spicules of the interior are exclusively stout **oxypentactines**. Their four basal rays lie in a plane and extend tangentially in the septa dividing the incurrent and excurrent canals; the apical ray pierces these septa more or less vertically like a nail. These spicules are very variable in size; the largest attain a length of 15 mm.; their rays are quite smooth and usually taper gradually towards the sharp-pointed end.

The prostalia marginalia protruding from the oscular margin, the long prostalia basalia forming the root-tuft, and the large uncinates with very oblique spines are also to be considered as macroscleres. The **marginalia** are **diactines**, straight or slightly curved, 4–6 cm. long and 20–60 μ thick. Their distal parts are more slender than their proximal parts and terminally pointed or slightly inflated. The proximal third, which is imbedded in the body of the sponge, has a smooth surface; the distal, protruding two-thirds are usually densely and uniformly covered with small, sharp, conuli-like tubercles so that the surface appears shagreen-like.

Between the proximal ends of these spicules and in other parts of the dermal and gastral membranes **uncinates**, 2 mm. and more in length and up to 16 μ thick,

occur in greater or smaller numbers. These macro-uncinates are covered with spines situated very obliquely, and extending nearly parallel, closely "anliegend," to the shaft of the spicule (pl. I, f. 13). They are arranged radially, the thicker distal end lies in the outer surface of the sponge.

The root-tuft is about as long as a hand. The **basalia** composing it are arranged in bundles 3–5 mm. thick. The smooth, upper, gradually-pointed ends of these spicules are imbedded in the sponge for a length of several centimeters. Their much longer free part extends more or less vertically downward into the silt on which the sponge grows. This part is not covered with conuli-like shagreened tubercles, like the distal parts of the marginalia : it is either quite smooth, or bears, as is the rule in basalia of *Hyalonematidæ*, flattened spines extending obliquely upwards. All the basalia not broken off which I examined terminated distally in the two-teethed anchors, characteristic of the genus *Pheronema*. 200–300 μ above the distal end the spines disappear and the shaft is slightly attenuated. Towards the distal end it thickens, first gradually, then abruptly, to form the central inflated part of the anchor which has a thickness of 60 μ. The two anchor-teeth are broad and flattened. Their distal contour has the shape of a rounded gothic arch. The chord between the points of the teeth is 600–800 μ long. The sharp lateral edges of the teeth have a slightly prominent bend in the middle. These edges are joined by two crests traversing the shaft (pl. I, f. 12).

I will now describe the **microscleres**. **Pinules** are met with in the dermal and gastral membranes, where they generally stand close together, their basal rays extending side by side for considerable lengths and forming a network with quadratic meshes. On narrower strips of dermal membrane, between pores, they form single rows and are further apart. The pinules are 70–140, usually 80 μ, high. The four basal rays are nearly always quite straight and form a regular cross with beams intersecting vertically. They are on an average about 50 μ long and 6 μ thick, proximally cylindrical and smooth, distally slightly inflated and covered with sparse, vertical, sharp tubercles. The distal inflation tapers towards the basal and the terminal part of the ray (pl. I, f. 7, 8). The centre of the spicule is slightly thickened, but there is no trace of a sixth, proximal ray. The distal ray is vertical to the plane of the four basal rays. It consists of a smooth, cylindrical proximal part 9 μ thick and 12 μ or more long, and a bushy distal, conical or carrot-shaped part covered with curved spines. This distal part is 60–130, usually 70 μ, long and 40 μ broad. Most of the pinules have a short terminal spine and very numerous and dense, long and stout lateral spines, terminally only slightly curved, extending obliquely upwards (pl. I, f. 8). Some of the pinules however are longer and more slender, have a longer and thinner terminal spine and less numerous but equally stout lateral spines which are curved more strongly. The pinules of the terminal sieve-plate are on the

whole similar to the dermal ones. Their basal rays are a little longer, measuring on an average 70 μ. Their distal ray measures about 100 μ in length. Such a diversity in shape and size as in the dermal pinules is not met with here. Canalar pinules are in this, as in other species of *Pheronema*, nearly entirely absent; only rarely one finds very slender pentactine or hexactine pinules, with sparsely-spined distal ray, in the canal-walls.

Amphidiscs of two kinds, macramphidiscs and micramphidiscs, are met with in the dermal membrane. Mesamphidiscs seem to be absent. The **Macramphidiscs** are 300–350 μ long, and have bell-shaped terminal discs which attain a diameter of 80 and a height of 70 μ. The shaft is 12 μ thick, smooth at the ends but roughened by a few rounded tubercles in the central part. Each disc has eight broad, spade-shaped, terminally-rounded marginal teeth (pl. I, f. 3).

The numerous **micramphidiscs** are 30, rarely as much as 40 μ long. Their terminal discs are bell-shaped, 8 μ long, 8 μ broad, and have eight or twelve marginal teeth. The shaft is rough. The amphidiscs of the gastral sieve-membrane and the canal-walls are similar.

Among the parenchymal microscleres micro-uncinates and micro-oxy-hexactines occur. The **micro-uncinates** are about 500 μ long and covered with short, oblique spines. They vary considerably in size and their shape is similar to that of the large uncinates described above. It might therefore be assumed that the large and the small uncinates are connected by transitional forms and not essentially different from each other. I do not think however that such is the case, and I believe that they really represent two different kinds of spicules because they differ in respect of the position and shape of their spines. In the large uncinates these spines are long, straight and very oblique, nearly parallel, closely "anliegend" to the shaft. In the small uncinates the spines diverge considerably. In the anterior part of the spicule their basal part is nearly perpendicular to the shaft and their distal part strongly bent, so that the spines appear hook-like (pl. I, f. 9, 10).

The **microhexactines** are found in the interior in varying quantities. Here and there they are pretty numerous. Their 6 rays are equal, smooth or slightly roughened, usually straight, rarely slightly and irregularly curved, 2-3 μ thick at the base and gradually attenuated towards the sharp end. The whole spicule is 150 μ long (pl. I, f. 11).

All the specimens of *Pheronema raphanus* F. E. Sch. brought home by the "Investigator" were found in the vicinity of the Andaman Islands. The two large specimens described by me in 1895 were captured 12° 37′ N., 92° 19′ E. in depths of 316 m.=184 fths. and 530 m.=280 fths. The small specimen of the size of a pigeon's egg formerly described by me as *Ph. circumpalatum* F. E. Sch., a quite young specimen of the size of a pea, and a fragment of a specimen

probably of the size of an apple, were procured west of the Andamans in depths of 436 m.=238 fths. to 531 m.=290 fths. Eight young specimens varying in size from a hazel-nut to a walnut and some fragments of larger, hand-high specimens were found 13° 27′ N., 93° 14′ 30″ E. in a depth of 741 m.=405 fths.

Hyalonema J. E. Gray.

The "Challenger" expedition collected two species of *Hyalonema*, *H. clavigerum* F. E. Sch. and *H. conus* F. E. Sch., in the southern part of the Indian Ocean. The "Investigator" captured quite a number of species of this large and widely distributed genus in the northern part of it. It is possible that the number of species here enumerated will in future be reduced, since, as I have indicated at the time, some of the young specimens described by me more or less provisionally as distinct species may turn out, on more material being available for study, as young stages of other known species. In 1895 I described 14 species of *Hyalonema* collected by the "Investigator." 6 of these, *H. aculeatum*, *heideri*, *pirum*, *heymonsi*, *weltneri* and *mæhrenthali*, I designated at the time as doubtful young forms. Later investigations, the results of which I published in 1899 * showed that *H. mæhrenthali* is a young form of *H. affine* Marsh. The other 5 of these young, more or less dubious species I will deal with at the end of this chapter, and now describe the 8 good species *H. indicum*, *masoni*, *lamella*, *rapa*, *martabanense*, *alcocki*, *investigatoris*, and *affine*, of which fullgrown specimens were examined by me.

Hyalonema indicum F. E. Sch.

Plate III, figs. 1–13 and Plate IV figs. 1–14.

1895 *Hyalonema indicum* F. E. Sch. 1894 in Abb. Preuss. Ak. 1894 p. 24, Taf. IV, f. 1–13, Taf. V, f. 1–14.

The two specimens for which I establish the species *Hyalonema indicum* are similar in shape and of nearly equal size. They were found in the vicinity of the Laccadives and the Andamans respectively, two localities a considerable distance apart. The slight differences between the Laccadive and the Andaman specimens induced me originally to propose the establishment of two distinct species, *Hyalonema laccadivense* and *Hyalonema andamanense* for them. They agree in their external form, their structure and their spiculation, to such an extent that I have decided to place both in one species. I now consider the slight differences between them only sufficient for the establishment of two subspecies, which may perhaps be considered equivalent to so-called varieties.

I will first give those specific characters which appertain to both specimens and then describe each of the two subspecies for itself.

* Sitzungsber. der Ges. naturf. Freunde in Berlin 1899 pp. 125-128.

Both specimens are tulip-shaped, abruptly truncated terminally, 7 cm. long, and 4 cm. broad above. The oscular sieve-plate is circular, flat, and raised towards the margin, which slightly protrudes upwards and outwards as a free sharp edge. The pores of the sieve-plate are numerous, more or less circular and 1–2 mm. wide. The principal skeleton-net is fairly well preserved, its meshes are small and quadratic. In one specimen the root-tuft (peduncle) projecting from the lower, attenuated end of the body is complete, cylindrical, over 18 cm. long and nearly 3 mm. thick. The upper, spirally-twisted part of it is covered with a continuous Palythoa-crust for a distance of at least 14 cm. (pl. III, f. 1). Below, the spicules composing it are isolated and diverge slightly. The sponge-body is, in spirit, light clay-coloured. The most numerous parenchymal **macroscleres** are **oxydiactines**. These are smooth, straight or slightly curved, and have a central inflation more or less clearly defined, which sometimes bears four tubercles arranged crosswise. The length of these oxydiactines is very variable, generally 1–2 mm., and they are usually 5–20 μ thick (pl. III, f. 2).

Less frequently **oxyhexactines** occur. Their rays are nearly equally long, smooth, 30–40 μ thick and gradually attenuated towards the sharp pointed end. Also monactines, with the blunt end occasionally inflated, sometimes even pinhead-like, are met with. In the subdermal **oxypentactines**, which form an important part of the supporting skeleton, the paratangential basal rays are considerably shorter than the radial ray which measures 50 μ and more in length (pl. III, f. 2, pl. IV, f. 2).

In well-preserved specimens one clearly sees that the acanthophores near the lower end of the body are chiefly composed of cross-shaped tetractines and straight diactines. Acanthophor-hexactines, -pentactines and -triactines are less frequent. All the superficial acanthophores are small, entirely covered with uniformly developed spines, and appear as if covered with crystallised sugar. Further in the interior they are longer, frequently curved, and bear spines on the inflated, terminal parts of the rays only.

The **diactine marginalia** forming the fringe of the oscular margin are not more than 100–120 μ long. The proximal ray of these spicules which is imbedded in the body of the sponge is perfectly smooth, the distal free ray spined, the spines decreasing in size towards the distal end of the spicule, the terminal part of which again appears smooth. The centre of the spicule bears four rounded protuberances arranged crosswise and containing rudiments of axial canals.

The long basalia-spicules of the root-tuft attain a thickness of 500 μ and are either quite smooth or covered in the greater part of their length with very oblique closely "anliegenden" spines. These are arranged in a somewhat irregular, often interrupted, spiral line. As the root-tuft is preserved only in one of the specimens and as its lower end is torn off also in that one, I could not observe the anchor-teeth at the ends of these spicules.

The dermal **pinules** are slender and very variable in length. In the specimen from the Laccadives they are on an average 300–400 μ, in the one from the Andamans 500-600 μ long. The upper, spined part of their distal radial ray is broader in the former than in the latter. The basal smooth part of the radial ray is 40-50 μ long and 7 μ thick (pl. III, f. 9, pl. IV, f. 14). The four basal rays are sharp-pointed, pretty stout, and 40-50 μ long; their terminal parts are covered with tubercles or small spines. The pinules of the oscular sieve-plate are a little shorter, but otherwise similar to the dermal ones. Those of the walls of the excurrent canals are very much shorter and considerably more slender.

The dermal **macramphidiscs** have hemispherical terminal discs with 6–8 broad and spade-like marginal teeth. The shaft bears rounded tubercles which form a ring round its centre and are sparsely and irregularly scattered over the other parts (pl. III, f. 3, pl. IV, f. 3, 4). The macramphidiscs of the Laccadive specimen are considerably larger than those of the Andaman specimen. In the former they are 300 μ long and have terminal discs 100 μ broad, in the latter they are mostly only half as long and have terminal discs only 60-70 μ broad (pl. III, f. 3, pl. IV, f. 3, 4).

Mesamphidiscs are very numerous in the walls of the excurrent canals of the Andaman specimen. They vary considerably in size, being 50–130 μ long, and are clearly distinguished from the stout macramphidiscs described above by the greater height and more slender form of their strongly curved terminal discs, which usually have 8 narrow marginal teeth (pl. III, f. 4, 5, pl. IV, f. 5). Not unfrequently the marginal teeth of the two opposite discs are so long as to come in contact with each other. Then the whole spicule attains an ellipsoidal shape. The shaft bears blunt, irregularly distributed spines, which are higher in its central part than towards its ends (pl. III, f. 4, 5, pl. IV, f. 5).

Micramphidiscs 30-50 μ long are abundant in the dermal membrane and in the oscular sieve-plate, chiefly in the former. Their terminal discs are hemispherical and have 10–12 narrow marginal teeth. The shaft is slender, thicker in the middle than towards the ends.

Micro-oxyhexactines are abundant in the parenchyme. Their rays are 50–60 μ long, at the base about 3 μ thick, straight and covered throughout with small tubercles so that their surface appears rough. Occasionally similar spicules with only 5 or 4 rays, pentactines or tetractines, are met with (pl. III, f. 11–13, pl. IV, f. 10–12).

On account of the differences in the shape and size of their dermal pinules and in the dimensions and abundance of the macramphidiscs, the two specimens should, I think, be considered as representing two distinct subspecies or local varieties. I accordingly distinguish them as *Hyalonema indicum laccadivense* and *Hyalonema indicum andamanense*.

The pinules of *H. i. laccadivense* are 300–400 μ long, those of *H. i. andamanense* measure 500–600 μ in length and their distal main-ray bears shorter spines. The dermal macramphidiscs of the subspecies *laccadivense* are on an average 300 μ long and 100 μ broad, those of *Hyalonema indicum andamanense* only 100–130 μ long and 60–70 μ broad. The ellipsoidal mesamphidiscs with terminal discs so extended as to touch each other more or less completely are large and abundant in the latter, smaller and much more scarce in the former.

The only specimen of *Hyalonema indicum laccadivense* was found near the Laccadives 11° 12′ 47″ N., 74° 25′ 5″ E. in a depth of 1830 m.=1000 fths. The specimen designated as *Hyalonema indicum andamanense* is somewhat defective, the lower end of the tulip-shaped body and the root-tuft having been torn off. This specimen was found in the Andamans at a depth of 1250 m.=683 fths. It is possible that the sponges provisionally named *Hyalonema pirum* and *H. heymonsi*, which will be described below, may be young forms of *H. indicum*.

Hyalonema masoni F. E. Sch.

Plate V.

1895 *Hyalonema masoni* F. E. Sch. in Abh. Preuss. Ak. 1894 pp. 31–34, Taf. VI.
1900 *Hyalonema masoni* F. E. Sch. in Abh. Preuss. Ak. 1900 p. 8.

Several of the "Investigator" Hexactinellida belong to that group of Hyalonema-species which is characterised by the presence of micro-oxyhexactines with smooth, strongly-curved rays. The most beautiful of these I have named *Hyalonema masoni* after the late Professor Wood-Mason, formerly Director of the Indian Museum in Calcutta, who had the great kindness to place all the "Investigator" sponges in my hands for examination.

The body of the sponge has the shape of a slender, slightly-inflated funnel. It is 12 cm. high and has above, at the upper free margin of the funnel, where it is broadest, a transverse diameter of 65 mm. From the centre of the floor of the funnel-cavity, that is, from the upper surface of the lower solid part of the body, a slender cone, 15 mm. high and 5 mm. thick at the base, rises vertically. The lateral wall of the funnel is at the base, where it rises from the lower solid part of the body, 5–10 mm. thick. Upwards it gradually becomes thinner, and it terminates with a circular, sharp margin (pl. V, f. 1).

The outer surface is composed of a fine and uniform dermal network, it appears even and smooth. The inner surface is perforated by numerous more or less circular apertures, 1–5 mm. wide, the openings of the excurrent canals into the funnel-cavity which is nothing else than the gastral cavity of the sponge. These canal-mouths are irregularly distributed and decrease in size towards the upper, free margin of the funnel-wall. There is no trace of an oscular sieve-plate.

A root-tuft or peduncle, 6 mm. in diameter, and composed of spirally intertwined spicules, each about 500 μ thick, protrudes from the basal, attenuated end of the sponge-body. The lower end of the peduncle has been torn off, the upper and central parts of it, still attached to the specimen, are together over 16 cm. long (pl. V, f. 1).

It is remarkable that the Palythoa-crust covering the upper dense part of the peduncle in many other Hyalonemas, is here replaced by Cirripedes. From 10 cm. below the insertion of the peduncle in the sponge-body downwards, a number of these sessile crustaceans of varying size, some as much as 44 mm. long, are attached to it. They stand pretty close together but do not form a continuous covering. Dr. Weltner of the Berlin Museum für Naturkunde, who was so good as to examine them at my request, found that most of them belong to a new species of the genus *Scalpellum* hitherto not recorded from the Indian Ocean. He described them as *Scalpellum squamuliferum* in the Sitzungsberichte der Gesellschaft naturforschender Freunde zu Berlin for 1894 on p. 81. One of these cirripedes, which is 8 mm. long, represents a different species. This he named (l.c.) *Megalasma carino-dentatum*.

Below, where the peduncle has been torn off, the spicules diverge.

The sponge is rather stiff and also the marginal part of the funnel-wall fairly resistant. The interior is clay-coloured, the surface has a rust-red tinge. It is difficult to say whether one is to consider this superficial tint, which is divided from the parenchymal clay-colour by a well defined limit, as proper to the sponge or as a precipitate produced in the spirit used for preserving the specimen.

The **macroscleres** resemble in shape and position those of other Hyalonema species. It must be remarked however that the diactines of the parenchyme are here in *H. masoni* unusually prevalent. In thin sections, particularly of the marginal part of the funnel-wall, one only rarely finds larger oxyhexactines between the numerous diactines which either terminate with sharp points or with slight, rough inflations. The dermal and gastral membranes and the walls of the larger excurrent canals are supported, as in other Hyalonemas, by stout, smooth oxypentactines.

In the lower basal part of the sponge-body siliceous spheres are not infrequently met with between the medium sized acanthophores which have the usual structure. These spheres are composed of regularly concentric layers of silica, so that they can appropriately be termed "silica pearls." I have found and described * such pearls also in *Pheronema giganteum* F. E. Sch.

The dermal **pinules** are very uniformly developed on all parts of the surface. They resemble in appearance Italian poplar-trees (*Populus pyramidalis*) and are on an average 160 μ high. Their basal rays are stout, about 20 μ long and

* Sitzber. der Berliner Akademie, 1893 p. 996.

slightly roughened. The smooth, proximal part of the radial main-ray is 16 μ long, the spined terminal part longer. The spines measure 10–20 μ in length and are directed obliquely upwards. The bud-shaped upper end contains a medium sized central cone. The gastral pinules of the inner side of the funnel-wall are similar to the dermal ones.

The margin of the funnel is composed of **diactine marginalia.** These resemble the main-rays of the pinules in that their proximal ray is smooth and sharp pointed, whilst the distal ray is covered with oblique spines, bushy and in appearance comparable to an Italian poplar. At the centre of the spicule there are four hemispherical protuberances arranged crossways (pl. V, f. 4).

The dermal **macramphidiscs** are 200–300, rarely 400 μ long, and have approximately-hemispherical terminal discs, 100–200 μ broad and about 80 μ high with 8 spade-like marginal teeth. The shaft is about 15 μ thick and bears tubercles, four larger ones arranged crosswise in the centre, and several smaller ones scattered irregularly over the whole length (pl. V, f. 10).

Mesamphidiscs are scarce. They are about 100 μ long, have relatively higher terminal discs with eight marginal spade-like teeth 40 μ long and a shaft which is, particularly in its central part, considerably tuberculous (pl. V, f. 7).

The **micramphidiscs** are numerous and of the shape and size usual in Hyalonema species (pl. V, f. 8, 9).

The **microhexactines** are abundant in the parenchyme. They have smooth, curved rays 60 μ long (pl. V, f. 5, 6). Larger and much stouter oxyhexactines with quite straight, strongly tuberculous rays (pl. V, f. 3, 11) are scattered throughout the parenchyme.

The only complete specimen of this fine species was captured in the Bay of Bengal, 11° 58′ N., 88° 5′ 17″ E. in a depth of 3200 m.=1748 fths. A fragment of another was procured in the Andaman sea 13° 50′ 30″ N., 93° 26′ 8″ E., from a depth of 911 m.=498 fths.

Hyalonema lamella F. E. Sch.

Plate XIX.

1900 *Hyalonema lamella* F. E. Sch. in Abh. Preuss. Ak. 1900 pp. 15–19, Taf. III.

Some lamellar fragments of a sponge were procured southwest of Cape Comorin, in two adjacent localities, from depths of 787 m.=430 fths. and 1530 m.=836 fths. respectively. For the reasons stated below I place this sponge in the genus *Hyalonema.* Since, however, the lower half of the body is missing, I must admit that its systematic position is not quite certain.

The better preserved one of the two specimens was captured 7° 17′ 30″ N., 76° 54′ 30″ E. in a depth of 787 m.=430 fths. It is a rather harsh and brittle

lamella, hand-high, 5-8 mm. thick and folded in the middle like the cover of a book. The two elongated halves, which nearly touch each other, are each about 6 cm. broad and 9 cm. high. The fold (back of the book-cover) is 5 cm. long and 2 cm. thick. The longer free lateral margins of the two lamellæ are on the whole parallel to the fold, but have an undulating outline. The lamellæ thin out towards the margin, the edge of which, with the marginal spicules, has been lost. The traces of the marginalia left are hardly visible to the naked eye. There is no sharp limit between this lateral and the upper margin, into which it gradually passes. The latter is convex, and also bears marginalia. The upper margins of the two lamellæ are divided at the fold by a pretty deep notch. The lower margin of each lamella is the rough line along which it has been torn off from the basal part of the sponge.

The lamellæ are covered on their external surface by a fairly even, velvet-like dermal layer, the reticular structure of which is very indistinct. The inner, gastral surface is more even and velvet-like than the outer. It is slightly reticulate and somewhat transparent, so that the excurrent canals lying below can be seen through it.

Some smaller fragments of identical spiculation, and therefore doubtless belonging to the same species, were found not far off, 7° 34′ 30″ N., 76° 8′ 23″ E. in a depth of 1530 m.=836 fths.

These consist of thin lamellæ firmly pressed together, with irregularly torn lateral margins. Their external surfaces are still covered in places by the finely-reticulate dermal membrane.

The supporting skeleton of the interior chiefly consists of parenchymal **oxydiactine macroscleres**. These are straight or slightly curved, smooth, and gradually attenuated towards the pointed ends. Most of them are aggregated in loose bundles which form a network traversing the sponge in every direction. Some are isolated. They are 6–20 μ thick and on an average 1–2 mm. long, occasionally they attain a length of 6 mm. and more. Some have a ring-shaped thickening or low protuberances, two opposite ones or four arranged crosswise, in the centre. As a rule however such thickenings are absent. Some of the radial rays of the stout subdermal and subgastral oxypentactines, which are up to 1 mm. long, also take part in the formation of the supporting skeleton.

Oxyhexactine microscleres with smooth rays of medium thickness, recurved in the distal third of their length (pl. XIX, f. 8), are numerous in the parenchyme. These spicules measure 80–120, usually 100 μ in diameter. It is to be noted that the oxyhexactines are not only scattered irregularly throughout the whole of the parenchyme, but congregate in great numbers in the walls of the subdermal cavities and the incurrent canals originating from them, where they often occupy a radial position like true canalaria (pl. XIX, f. 2). This circumstance has

strengthened my previously expressed opinion that the oxyhexactine parenchymalia of the Hyalonemas have been produced from true canalaria. It is remarkable that these spicules are confined to the walls of the incurrent canals and that they are absent in the walls of the excurrents, where their place is taken by certain forms of amphidiscs.

Both surfaces of the lamella are uniformly covered with slender **pentactine pinules**. The four basal rays, which form a rectangular cross, are on an average 50 μ long and pretty stout. Their terminal parts are covered with short, oblique spines directed outward. The free, radial ray varies in length. It bears rather short, slightly divergent spines, which are longest in the middle of its spiny part. From here they decrease in size towards its apex and also towards its smooth and spineless basal part. Sometimes a sixth ray of varying length, directed inwards, occurs, which generally resembles the basal rays. The dermal pinules of the external surface differ from the gastral pinules of the internal surface chiefly in the length of the radial distal ray, which measures in the former about 200, in the latter 400–600 μ and more in length (pl. XIX, f. 9, 10).

As the sharpened, free margin of the sponge has been lost, I cannot say anything about the marginalia which probably composed it in the living sponge.

Macramphidiscs are absent in the dermal membrane but occur scattered throughout the parenchyme. They are on an average 350 μ (300–400 μ) long. The shaft usually bears in the middle, where it is thinnest, a ring of sharp spines; apart from these it is smooth. The rather flat terminal discs are about 60 μ high, on an average 120 μ broad and have eight broad, spade-like marginal teeth (pl. XIX, f. 3).

Ellipsoidal **mesamphidiscs** of varying size, on an average 40–60 μ long, are very abundant and regularly arranged. The shaft is slender and covered with numerous small, sharp spines. In the centre there is a ring of longer, mostly curved spines. The high, bell-shaped terminal discs have 8–10, usually narrow marginal teeth 10 μ long (pl. XIX, f. 5–7). As in *Hyalonema rapa* and *H. martabanense* these amphidiscs are arranged in a single layer which coats the larger excurrent canals. It is true that they appear somewhat irregularly scattered in my sections, but still I believe that in the living sponge most of them were placed vertically in the canal-wall, in such a manner that one-half of each mesamphidisc was imbedded in the sponge-tissue whilst the other half projected freely into the cavity of the canal. The narrower incurrent canals are destitute of such a coating of mesamphidiscs (pl. XIX, f. 2).

The **micramphidiscs** are scarce and lie scattered irregularly in the dermal and gastral membrane; a few are also found in the choanosome. They are about 20 μ long and have hemispherical terminal discs with numerous marginal teeth (pl. XIX, f. 2, 4).

Although we know nothing of its missing basal part, we can now, taking into consideration the facts stated above, endeavour to ascertain the systematic position of this sponge. First, we will have to decide whether it is to be placed in one or other of the genera of *Hyalonematidæ* already known, or whether a new genus should be established for it. Neither the shape of the sponge nor its spiculation would warrant us in adopting the latter course, and so it only remains to find out which of the five known genera *Pheronema*, *Poliopogon*, *Hyalonema*, *Lophophysema*, and *Semperella* it belongs to. The lamellar form and the absence of uncinates show that it is not a *Pheronema*, *Poliopogon*, *Lophophysema* or *Semperella*, so that it must be a *Hyalonema*. And indeed we find that the entire spiculation, particularly the parenchymal oxyhexactines with their curved rays and the peculiar arrangement of the mesamphidiscs, are in complete accordance with what we meet with in the other species of *Hyalonema*.

The lamella must of course be considered as an upper portion of the wall of a calyculate sponge. Its being so sharply folded and its upper margin being so very oblique and so different from the usual circular shape, are the only points which might raise doubts as to the correctness of this assumption. But it seems to me that these peculiarities, even supposing them not to be mere individual abnormities, cannot be considered of sufficient importance to exclude this species from the genus *Hyalonema*, and the less so as one of these peculiarities, the obliqueness of the upper margin, is met with also in some other Hyalonemas, where it may, as in the Japanese *Hyalonema reflexum*, recently described by Ijima, be extremely marked.

The hand-high fragment was, as already stated, captured south-west of Cape Comorin 7° 17′ 30″ N., 76° 54′ 30″ E., in a depth of 787 m.=430 fths. The other, smaller, strongly compressed fragments with irregular torn margin were also found south-west of Cape Comorin 7° 34′ 30″ N., 76° 8′ 23″ E., in a depth of 1530 m.=836 fths.

Hyalonema rapa F. E. Sch.

Plate XVII.

1900 *Hyalonema rapa* F. E. Sch. in Abh. Preuss. Ak. 1900 pp. 15–19, Taf. I.

Of this species there was only a single fairly well preserved specimen among the "Investigator" sponges. Its body is slender, conical and pretty tough. It is 70 cm. long, and at the upper, truncated end, 3 cm. broad. From the lower attenuated end a somewhat spirally twisted root-tuft or peduncle, 17 cm. long and 5 mm. thick protrudes. This peduncle is composed of 20–30 spicules which slightly diverge below. The spicules are a little under 1 mm. thick. The upper, terminal face is not surrounded by a prominent edge; its margin is rounded off and

it gradually passes into the lateral surface of the conical sponge. This terminal face is covered by a tough skin and has irregular depressions which give it a somewhat folded appearance. A slight prominence, situated excentrically, corresponding to the upper end of the spicule-bundle of the peduncle arises from it. The greater part of the square-meshed skeleton-net of the dermal membrane has been lost; only in a few places it is still clearly distinguishable. The gastral membrane covering the terminal face of the sponge is well preserved but strongly compressed. It appears velvet-like. It is to be noted that large and conspicuous, curved or abruptly-bent oxydiactines, 6–15 mm. long, over 500 μ thick and extending longitudinally, are exposed to view in those parts of the external surface where the dermal layer has been lost (pl. XVII, f. 3). Closer investigation shows that these large and strong curved spicules are pretty abundant in the parenchyme generally, and particularly just below the dermal membrane.

The most important macrosclere parenchymalia are the **oxydiactines**. These are mostly aggregated in bundles, more rarely isolated, and very abundant throughout the interior. They are slender, straight or slightly curved, and 300–400 μ long, rarely longer. As in other Hyalonema species they are either quite smooth, that is destitute of a central inflation, or they have a thickening or two or four well defined protuberances in the middle.

Between these spicules sparsely scattered, smooth **oxyhexactines** of various size, 500–800 μ in diameter, are met with. Stout and smooth **oxypentactines** of similar size also occur. These appear as regularly arranged hypodermalia, lying below the outer surface and supporting the dermal membrane. Under the gastral membrane there are no such spicules.

In the central part of the body, particularly in the vicinity of the upper end of the spicule-bundle forming the peduncle, which is imbedded in the body of the sponge, not infrequently smooth amphityles or tylostyles occur. These resemble in length and in general character the ordinary oxydiactines, the inflated ends of which vary in shape but are never sharply defined.

Of the **microsclere parenchymalia** I shall first describe the **oxyhexactines**. These occur in different regions of the sponge in varying numbers. They measure 120–140 μ in diameter and their rays are fairly stout, nearly smooth, sharp-pointed and terminally slightly curved or angularly bent. In the walls of the subdermal cavities and some of the incurrent canals those spicules are very numerous, and form, like true canalaria, a continuous layer. They also appear to occur scattered, but less frequently, in the parenchyme. Here they may possibly occupy the walls of the smaller canals.

Oxypentactine dermal pinules cover the strands of the external network in great numbers. Their four basal rays, which form a rectangular cross, are of medium thickness, 40 μ long, terminally pointed and finely granular. The free

radial ray is on an average 150 μ long, in the proximal third smooth, uniformly attenuated towards the sharp-pointed end and covered with rather short, slightly divergent spines in the distal two-thirds. The spines attain the greatest length at the lower end of the distal spined part of the ray, upwards they gradually decrease in size (pl. XVII f. 6). The **canalar pinules** are very similar only a little shorter, not more than 120 μ long, and more slender. They occupy the walls of the larger excurrent canals but do not stand nearly so close together as the dermal pinules on the external surface (pl. XVII, f. 7.) The **gastral pinules** are considerably longer, 350 μ and more long, but otherwise similar. They are mostly oxypentactine, rarely oxyhexactine, and stand in great numbers close together on the strands of the gastral network on the terminal face of the sponge, causing the velvety appearance mentioned above (pl. XVII, f. 8).

The **oxydiactine marginalia** of the rounded oscular margin bear short spines on their distal free part. They are in the material at my disposal so much injured, however, that I cannot give an exact description of them.

Macramphidiscs are not met with in the dermal membrane itself but are fairly numerous just below it and in the internal parenchyme, where they appear to be irregularly scattered. They attain a considerable size, 600 μ and more, some of them however are much smaller, less than half as long. The shaft is either smooth or covered with irregularly distributed, sharp tubercles. It is not cylindrical, the central part being considerably thinner than the gradually thickened terminal parts. The terminal discs are 120 μ long, hemispherical, and have 8 marginal teeth of inconsiderable breadth, which terminate with lancet-shaped points (pl. XVII, f. 13).

Mesamphidiscs 50–60 μ long, chiefly occur between the basal crosses of the canalar pentactine pinules, where they are pretty numerous. Their shaft is cylindrical, of medium thickness, and covered with irregularly scattered sharp tubercles; sometimes there is a well defined central inflation. The terminal discs are more or less deeply bell-shaped and usually have 10 narrow and pointed marginal teeth which extend nearly parallel to the shaft (pl. XVII, f. 9, 10).

Micramphidiscs are found together with the mesamphidiscs, in the dermal and gastral membranes and sometimes also in the parenchyme. Their number is very variable. They have the usual shape, their terminal discs are hemispherical and have 10–12 marginal teeth. They are generally only 20 μ long but may attain a greater size and longer teeth, thus appearing connected with the mesamphidiscs by transitions (pl. XVII, f. 12).

In the lower, attenuated end of the body a few **acanthophores** are met with. They have 2–6 stout and usually slightly-curved rays; stauractines are most numerous. Usually only the free, slightly-thickened terminal parts of the rays are spined, the other parts remaining smooth.

The distal parts of the **basalia** of the root-tuft or peduncle are mostly badly preserved. No peculiarities distinguishing them in any way from the basalia of other Hyalonema species were noticed.

The only specimen of *Hyalonema rapa* was found in the Bay of Bengal 10° 12′ N., 92° 30′ 30″ E. in a depth of 1109 m.=603 fths.

Hyalonema martabanense F. E. Sch.

Plate XVIII.

1900 *Hyalonema martabanense* F E. Sch. in Abh. Preuss. Ak. 1900 pp. 12-15, Taf. II.

I have named this species after the Gulf of Martaban, the locality where it was found, *Hyalonema martabanense*. Three specimens of it were captured there. The one preserved best, the root-tuft or peduncle of which however has been entirely torn off, has the shape of a truncated cone and is 10 cm. long. The broader upper end has a diameter of 35 mm. The lateral surface of the cone is considerably crushed and injured and covered with irregular depressions. Below it passes into the slightly depressed basal face, above it is limited by a distinct marginal border. This divides it from the upper, laterally slightly overhanging terminal plate, which has a very different structure (pl. XVIII, f. 1). The terminal face is considerably depressed in the centre and raised towards the margin to form a low ring-wall with sharp projecting edge. The lateral surface is irregularly pitted and covered with a dermal reticulation. The terminal face is continuous, velvety, and perforated by more or less circular, irregularly scattered apertures, 2–3 mm. wide, the openings of the excurrent canal-stems. In one of the other, smaller specimens, which is badly preserved, much compressed and worn, the same features can be recognised. The third specimen, evidently a fragment, consists of a strongly-compressed, oval lamella, the size of a human ear.

The most conspicuous macrosclere parenchymalia are the slightly curved or angularly-bent, smooth and spindle-shaped **oxydiactines**. These can be detected by the naked eye. They are 6–12 mm. long and 150–250 μ thick. Only exceptionally their ends are sharply pointed, usually they are more or less blunt. I have found no trace of a thickening or of protuberances in the centre of the spicule. The oxydiactines are arranged longitudinally and occur in the interior, chiefly just below the dermal membrane. Very numerous similar, but smaller, amphioxes are also met with. These are 400–800 μ and more long, isolated, or aggregated in strands or bundles. The latter form a network with wide meshes, which traverses the sponge in all directions, the bundles parallel to the surface however predominating. As in other Hyalonemas these spicules are either quite smooth, or they have in the centre a slight inflation, or two opposite, or four crosswise-arranged, protuberances. Sometimes, particularly frequently in the

vicinity of the upper end of the spicule-bundles which form the peduncle, spicules of this kind, without central inflation or protuberances, are met with, one or both ends of which are thickened and clubshaped (pl. XVIII, f. 13, 14).

In all parts of the parenchyme **microsclere oxy-hexactines** about 100 μ in diameter are abundant. Their rays are either quite smooth or only very slightly roughened, of medium stoutness, gradually attenuated from the centre to the sharp-pointed end, and very distinctly and uniformly bent in their distal half (pl. XVIII. f. 11). In the vicinity of the folded chamber-layer, that is in the walls of both the incurrent and excurrent canals adjacent to it, only these oxy-hexactines occur.

In the membranes lining the larger canals further on, canalar **pentactine-pinules** are met with. Nearest to the chamber-layer, these are small, slender, and rather scarce, away from it they become stouter, longer, and more numerous. The dermal reticulation is also densely covered with pentactine-pinules, the straight and slightly-tuberculous basal rays of which are of medium thickness, gradually attenuated towards the sharp-pointed end and 40–50 μ long. Occasionally hexactine-pinules, with a shorter or longer inner ray, are found among them. The distal ray is on an average 200 μ long, not particularly stout, pointed, and covered in the usual way with rather short spines.

It is very remarkable that straight **diactine pinules**, pointed at both ends, occur in considerable numbers between the ordinary pinules. These are 500–600 μ long, their free distal ray is covered with very oblique pretty *anliegenden* spines, and 300–400 μ long ; their inner, proximal, ray is much shorter, and smooth or slightly tuberculous towards its pointed end. From the centre of the spicule four rounded protuberances, arranged crosswise, arise (pl. XVIII, f. 10). These spicules resemble in every respect the oxydiactine marginalia of other Hyalonema-species.

It is of great interest that the whole upper, terminal face is covered with such marginalia-like oxydiactine pinules. Here they are longer (1000–1500 μ) and stand much closer together than in the dermal reticulation of the lateral surface. Gastral pentactine pinules, similar to the dermal pentactine pinules, but a little longer (200–300 μ : pl. XVIII. f. 9) are found between them in small numbers. The dense masses of oxydiactine pinules covering the terminal face render its appearance velvet-like.

Amphidiscs of each of the three kinds are numerous, the macramphidiscs being represented by two essentially different varieties. In the parenchyme irregularly scattered **macramphidiscs of the first variety**, 500–1000 μ long are fairly abundant. The shaft is generally smooth, sometimes it bears scattered spines and in the centre a whorl of 4–8 small, sharp tubercles : it is attenuated in the middle and gradually thickened towards the ends. The terminal discs are hemisperical, broader than high, and 120–160 μ in transverse diameter : they have 8

marginal teeth, which are rather narrow and terminally lancet-shaped (pl. XVIII, f. 18).

The **second variety of macramphidiscs** is considerably smaller, only 80–100 μ long, has flatter terminal discs with 5, more rarely 6, broad and spade-like marginal teeth, and a cylindrical shaft, covered with more or less numerous, rounded tubercles (pl. XVIII, f. 15–17). This variety occurs scattered singly in the parenchyme and in the walls of the larger canals and is also met with in great numbers in the dermal and gastral membranes, where these spicules are placed vertically to the surface, one half being imbedded in the sponge, the other half projecting freely beyond it (pl. XVIII, f. 3).

The **mesamphidiscs** principally occur in the walls of the larger canals where they are vertically placed like the macramphidiscs in the dermal reticulation. They vary considerably in size, and measure 40–70 μ and more in length. The shaft is slender, cylindrical and spined; in the centre there is an annular thickening or a whorl of usually four crosswise-arranged spines; the other parts of the shaft are covered with irregularly-scattered, smaller, sharp tubercles. The deeply bell-shaped terminal discs usually have 10 narrow and long marginal teeth (pl. XVIII, f. 4–6).

The **micramphidiscs** have the usual shape and size. They are 20–40 μ long and very numerous in the dermal and gastral membranes; less frequently they occur in the parenchyme and in the canal-walls.

As the root-tuft or peduncle is missing in all the three specimens, I cannot say more about it than that the size of the cavity in the lower end of the sponge which was occupied by the upper end of the peduncle allows one to assume that it was 8 mm. thick.

Acanthophores are numerous in the elevated margin surrounding the entrance into the peduncle-cavity. They are mostly stauractines and diactines of various sizes, covered with stout spines. Scattered here and there, particularly below the gastral membrane, **spheres**, composed of concentric layers of silica (silica-pearls) are met with. These interesting structures (pl. XVIII, f. 12) measure 120 μ and more in diameter. They resemble the silica-pearls found and described by me in other species of Hexactinellida.

This species was found in the Bay of Martaban 13° 7′ N., 94° 44′ 15″ E., in a depth of 1171 m.=661 fths.

Hyalonema alcocki F. E. Sch.

Plate VI, figs. 1–8.

1895 *Hyalonema alcocki* F. E. Sch. in Abh. Preuss. Ak. 1894 pp. 34–37, Taf. VII figs. 1–8.

I name this species *Hyalonema alcocki* in honor of Dr. A. Alcock, who collected most of the Indoceanic deep-sea sponges here described. It resembles

H. masoni in that it has numerous parenchymal microhexactines with smooth, strongly-curved rays, but it differs, without mentioning other distinctions, from this and from most other species of *Hyalonema*, by the presence of a hitherto unknown, amphidisc-like spicule, peculiar to it, to such an extent, that I was at first inclined to establish a new genus for its reception. In consideration of the fact, however, that it accords with the well-known characters of the genus *Hyalonema* in all other respects I have refrained from doing this.

The body of the sponge is oval, 8 cm. long, 35 mm. broad, and laterally slightly compressed. It is difficult to say whether this compression was present in the living sponge or whether it has been produced *post mortem* by pressure. The oscular field has, in accordance with this compression, an oval shape. It is surrounded by a low but sharp protruding margin and has a diameter of 15 mm. The osculum is covered by a slightly concave sieve-plate which appears as a net with large meshes composed of very thin strands. From the middle of this there arises a conical protuberance, 3 mm. thick and equally high. This protuberance is the upper end of a slender central cone which traverses the space below the oscular sieve-plate and to which some of the membranes separating the excurrent canal-stems are laterally attached. These membranes are connected with the oscular sieve-plate by thin threads. Through the fine and somewhat transparent, quadratic dermal reticulation of the outer surface one can see the subdermal cavities and the entrances of the incurrent canals. These have regularly circular transverse sections and appear, thus looked at from outside, as dark round holes (pl. VI, f. 1).

The root-tuft or peduncle is above, where it arises from the lower end of the sponge-body, 4 mm. thick. The upper 12 cm. of its length are still attached to the sponge. The basalia-spicules composing it are, in the upper part of the peduncle, spirally twisted together pretty firmly; below, they slightly diverge. The lower end has been broken off in all of them. There is no Palythoa-crust or other covering on the peduncle.

The **macroscleres** of the supporting skeleton are similar to those of other Hyalonema-species. The subdermal **oxypentactines** are on an average 20 μ thick and their main ray attains on an average a length of 400–600 μ. Their basal rays, which form a cross, are not particularly stout, on an average 60–80 μ long and sparsely covered with small tubercles. The basal part of the main ray is smooth and up to 10 μ thick. The spines are short, up to 10 μ long, obliquely situated and partly curved upwards (pl. VIII, f. 7). The pinules of the oscular sieve resemble the dermal ones.

The **diactine marginalia** which surround the oscular sieve-plate are 1 mm. long. The distal ray, which protrudes freely, is similar to the main ray of the pinules but considerably longer. The proximal ray, which is imbedded in the sponge, is shorter and smooth throughout (pl. VIII, f. 8). There is a central

inflation, from which four rounded protuberances, arranged crosswise, arise. Sometimes these extend to form curved spines.

Macramphidiscs are met with in the dermal membrane. They attain a length of 300 μ, their terminal discs are relatively flat and 130 μ broad, and have 8 spade-like marginal teeth. The shaft has a considerable thickness (20 μ). It is covered with low, irregularly-scattered tubercles and bears in the centre four rounded protuberances, arranged crosswise (pl. VI, f. 3). Certain amphidiscs 40–50 μ long and 15 μ broad, which are met with pretty frequently in some places, I consider as **mesamphidiscs**. Their terminal discs are hemispherical, about 16 μ long and have 8–12 marginal teeth. The shaft is not particularly stout, distally smooth, thickened and often also spined in the middle (pl. VI, f. 5).

The **micramphidiscs** are numerous, 20–30 μ long and similar to the micramphidiscs of other species of *Hyalonema*. Besides these ordinary ones, micramphidiscs of about equal length (15–20 μ), but greater breadth (10–12 μ) and essentially different in shape, occur in *Hyalonema alcocki*. As these spicules have been observed for the first time in this sponge I think them worthy of a detailed description. They are on the whole similar to ordinary amphidiscs but differ from them fundamentally in that they are not radially symmetrical and have an excentric shaft. We can imagine that they have originated from ordinary amphidiscs by the atrophy of one half of the one and the opposite half of the other terminal disc. Such an atrophy must cause a change of the position of the shaft, relative to the terminal discs: it connects no longer their centres in a direction vertical to them, but lies obliquely, extending from the margin of one of the discs to the opposite margin of the other. The eight typical marginal teeth of the terminal discs have also lost their radial symmetry. On the side where the disc has attained its full development they are rather larger: towards the opposite, reduced side, they become smaller and smaller, the last two (in the middle of that side) having disappeared altogether. Thus the peculiar Z-shaped spicules illustrated on plate VI, figs. 4*a*, 4*b*, 12–16, which I shall henceforth designate as "**paradiscs**," are produced. Sometimes the teeth are uniformly rudimentary all round, then the terminal disc appears as a shield- or egg-shaped plate with continuous margin, but also in this case it is clearly to be seen that the disc is reduced on one side and elongated on the other (pl. VI, f. 11) and that the position of these deformations is reversed in the two opposite discs. The shaft of the paradisc has, in the centre, either a simple, spindle-shaped thickening (pl. VI, f. 4*a*, 4*b*), or four button-shaped protuberances, arranged crosswise (f. 15), or it is covered with scattered, rounded tubercles (f. 16) throughout, or finally it is a simple, smooth cylinder (f. 11, 12).

The **parenchymal microhexactines** are numerous, and have smooth, strongly curved rays, about 60 μ long.

The **acanthophores** of the basal part of the body are of varying size and

have 2–6 rays. Simple cross-shaped spicules with club-shaped basally smooth and terminally thickened and spined rays predominate.

Only a single specimen of *Hyalonema alcocki* was procured. This was captured near the Laccadives in a depth of 2288 m.=1250 fths.

Hyalonema investigatoris F. E. Sch.

Plate VI, figs. 9–17.

1895 *Hyalonema investigatoris* F. E. Sch. in Abh. Preuss. Ak. 1894 pp. 37–39, Taf. VII, figs. 9–17.

In this species, as in *Hyalonema alcocki*, paradiscs occur, but I have not been able to find in it true, ordinary amphidiscs, associated with them. The parenchymal microhexactines with curved rays, so common in *H. alcocki*, are in *H. investigatoris* also conspicuous by their absence. Unfortunately the only specimen of this species is rather indifferently preserved. I have named it after the ship which collected it *Hyalonema investigatoris*.

The specimen has evidently been considerably compressed and crushed after capture. It now appears as a triangular lamella, 85 mm. long, 30 mm. in maximum breadth and 3–4 mm. thick. From the corner, which corresponds to the lower end of the body of the sponge when alive, a tuft of stout spicules, up to 500 μ thick, which are all broken off, arises. This tuft is several centimeters long. The lateral margins of the triangular lamella are simply rounded, whilst the terminal margin is composed of two protruding edges which enclose a longitudinal fissure lying between them, like lips. Although the details of its structure are obliterated, I think one may safely assert that this fissure represents the now quite compressed, oscular, terminal face of the sponge.

The surface is covered with irregular protuberances. Here and there remains of the dermal membrane are attached to it. The marginal fringe of the oscular field has been lost. The whole body of the sponge is clay-coloured with a reddish-yellow tinge.

The macroscleres are fairly similar to those of *Hyalonema alcocki*, the microscleres however are considerably different. The dermal pinules measure on an average 800 μ in length, thus being about twice as long as those of *H. alcocki*. Also the rays which form their basal cross are longer and thicker. The lower, smooth part of the main ray is 10–16 μ thick and the spines of the distal part, although not longer than in *H. alcocki*, are much stouter at the base, and arise from an axis of far greater thickness.

I have not been able to find any macramphidiscs or mesamphidiscs. I do not wish to assert however, that such spicules are entirely absent. Micramphidiscs of the usual shape, with hemispherical terminal discs and 12 marginal teeth, I also sought for in vain. On the other hand paradiscs of the same shape,

size and variation as those of *H. alcocki*, described above and illustrated in figs. 11–16, plate VI, are abundant near the surface. The great variability of these paradiscs which I consider to be phylogenetically derived from ordinary amphidiscs by the atrophy of one-half of each terminal disc, is truly remarkable.

I was much surprised at the total absence of the micro-oxyhexactines with strongly-curved rays, so abundant in *Hyalonema alcocki*. The most careful search only brought to light a few oxyhexactines, the straight rays of which bear fine and short, obliquely-situated spines, which point upwards. *H. investigatoris* accordingly belongs to that group of Hyalonemas in which only very few microhexactines, or none at all, occur in the parenchyme.

The only specimen of *Hyalonema investigatoris* was found in the Bay of Bengal 12° 20′ N., 35° 8′ E. in a depth of 3300 m.=1803 fths.

Hyalonema affine W. Marshall.

Plate VII.

1860 M. Schultze *Die Hyalonemen* 4. p. 9.
1875 *Hyalonema affine* W. Marshall in Zeitschr. wiss. Zool. Bd. XXV Suppl p. 224.
1887 *Hyalonema stylocalyx apertus* F. E. Sch. in Abh. Preuss. Ak. 1886 p. 59.
1887 *Hyalonema apertum* F. E. Sch. in "Challenger" Report, Hexactinellida p. 214, pl. XXXVII, XXXVIII.
1895 *Hyalonema apertum* and *Hyalonema maehrenthali* F. E. Sch. in Abh. Preuss. Ak. 1894 pp. 39-44 Taf. VIII.
1899 *Hyalonema affine reticulatum* F. E. Sch. in Sitzber. Ges. naturf. Freunde in Berlin 1899 pp. 112-129.

Two species of the "Investigator" Hexactinellida belong to the group of Hyalonemas characterised by the presence of parenchymal microhexactines with curved and spined rays. One of them is represented by a fullgrown specimen which, although possessed of a few insignificant peculiarities, can be assigned to the species first described by Marshall in 1875 in the Zeitschrift für wissenschaftliche Zoologie (Bd. XXV, Suppl. p. 224) as *Hyalonema affine*, and later in 1887 by me in the "Challenger" Report as *Hyalonema apertum* F. E. Sch. from the Sagami Bay (Japan).

The body of the sponge is caliculate or trumpet-shaped, 9 cm. long. At the upper end, where the margin of the osculum bulges outward, the sponge is 5 cm. broad. The central part of the body is slightly compressed and measures 2–3 cm. in transverse diameter. The lower end is conical and truncate (pl. VII, f. 1). The whole of the outer surface is uniformly covered with a quadratic dermal reticulation. The inner surface of the wall surrounding the funnel-shaped gastral cavity is even, smooth, and perforated by circular apertures of various size, up to 4 mm. in diameter, which are distributed irregularly. There are typically four, equal main excurrent openings, arranged crosswise. In the "Investigator" specimen these have become very unequal: two of them lie side by side, are very much enlarged and separated from each other by a very narrow space only; the other two are quite rudimentary. The free terminal part of the conus

centralis is accordingly situated very excentrically and it is attached to the gastral wall in its whole length. A similar position of the central cone is occasionally also met with in the specimens from Sagami Bay (Japan). From the end of the conical, basal part of the sponge a long and slender root-tuft or peduncle protrudes. Unfortunately it is broken off and its lower end is missing. It measures from the point of insertion in the sponge-body to the broken lower end, where the spicules composing it slightly diverge and become isolated, 45 cm. in length. This peduncle is composed of about 30 stout basalia-spicules. Its upper half appears as a firmly, spirally twisted cord 2–5 mm. thick ; in its lower half the spicules are loose and not spirally twisted. The upper end of the peduncle, just below the sponge-body, is enclosed for a length of 2 cm. by the aboral plate of a single *Actinia*, 8–10 mm. high, 15 mm. broad and 6 mm. thick. Below this it is covered for 20 cm. with the well-known *Palythoa* (*fatua* ?) crust. The lower end is free.

I shall not enter into a description of the macroscleres, which show no peculiarities and resemble those of the specimens from Sagami Bay, but restrict myself to the microscleres, the structure of which is of such great importance in the classification of the Hyalonema species. The dermal and the gastral **pinules** are on an average 150 μ high. The four rays forming their basal cross are straight, stout, rough and 25 μ long. The smooth basal part of the radial main ray is 5 μ thick and pretty short. The distal part is terminally pointed and covered with spines, directed obliquely upwards. In the middle of it the spines are up to 10 μ long, towards the end and towards the base they decrease in size (pl. VII, f. 4, 5). The canalar pinules in the walls of the excurrent canals are shorter and more slender and have longer basal rays.

The dermal, gastral and canalar **macramphidiscs** are on an average 150–200 μ long; their terminal discs are about 40 μ long and broad, nearly hemispherical and have 8 teeth on the slightly-inverted margin (pl. VII, f. 6). The shaft is about 8 μ thick, from its centre four crosswise-arranged tubercles arise. The other parts of the shaft are covered with low, irregularly-scattered protuberances (pl. VII, f. 6).

Mesamphidiscs are rare. They are about 40–60 μ long, half as broad, and have somewhat elongated, bell-shaped terminal discs with 8 marginal teeth.

Micramphidiscs are numerous in the gastral and dermal membrane. They are 20–30 μ long, have short hemispherical terminal discs with 10–12 marginal teeth and a slender shaft which is generally thickened in the centre.

There occur two kinds of **parenchymal microhexactines.** The one kind with strongly-bent rays 35–40 μ long and covered with numerous, recurved spines (pl. VII, f. 2), is very abundant; the other kind has somewhat stouter, straight rays, only 25–30 μ long and covered with strong spines diverging vertically or slightly pointing outwards (pl. VII, f. 3).

The only full-grown and well-preserved specimen was found in the Andamans between the North and the South Sentinel Island in a depth of 403–439 m.=220–240 fths. A fragment was procured in the Andaman Sea 13° 27′ N., 93° 14′ 30″ E. in a depth of 741 m.=405 fths.

My extensive investigations of numerous Japanese specimens of *Hyalonema affine* W. Marshall, including the type specimen in the Leyden Museum studied by Marshall himself, have convinced me that this species is subject to great variations, not only in the external form of the body but also in the distribution, shape and size of some of the spicules, chiefly the dimensions and position of the pentactine hypodermalia and the occurrence of mesamphidiscs. I now feel certain that the Japanese sponges described by me in the "Challenger" Report as *Hyalonema apertum* belong to *Hyalonema affine* W. Marshall, taken in the wider sense I now give to it. The complete specimen, collected by the "Investigator" in the Andaman Sea and previously also placed by me in the species *H. apertum*, in no wise transgresses the limits of the variations met with in *H. affine*, so that it must also be assigned to this species. Some of its peculiarities, particularly the exceptionally strong development of its pentactine hypodermalia, render it desirable, however, to establish a distinct subspecies for its reception. The proof of its specific identity with *H. affine* was given by me in the paper "Ueber Hyalonema affine W. Marshall" (Sitzungsberichte der Gesellschaft naturforschender Freunde in Berlin, 1899 pp. 112–129) cited above.

In this paper I have also shown that the small specimens of *Hyalonema*, which I originally considered as representatives of a distinct species and named *Hyalonema mœhrenthali*, are young forms of the subspecies *reticulatum* F. E. Sch. of *Hyalonema affine*, with full grown individuals of which they have been found growing together.

Twelve such young stages of varying size, which are on the whole pear-shaped, have been found. Most of them have a circular transverse section, some are laterally slightly compressed. The smallest specimen (pl. VII, f. 7) is 12, most of them are 20–30 mm. long. The proportion of the maximum transverse diameter, which lies a little above the middle, to the length, is usually 2 : 3.

Everyone of these specimens has a more or less circular oscule, surrounded by a smooth marginal border, on the upper end. In the largest this border is particularly well-defined and slightly bent outward. On the whole, the size of the oscule increases with the size of the sponge, but it is not exactly proportional to it. The columella or central cone usually extends up to the aperture, but is by no means always situated exactly axially. The radial septa, which extend from it to the body-wall, typically four in number and vertical to each other, are in accordance with this frequent excentricity of the columella also often irregular, and there are often not exactly four main excurrent openings. Some-

times the central cone is so excentric that it coalesces in its entire length with the wall of the calyx, in which case only 1–3 septa are developed (pl. VII, f. 7*a*).

The root-tuft or peduncle is more or less intact. Its length and thickness is on the whole proportional to the size of the body. In the largest specimen the upper, firmly spirally twisted part of it is 2 mm. thick, and down to the broken end it is 7 cm. long (pl. VII, f. 11). In most specimens an annular Palythoa-crust with 1–7 polyps is met with on the upper end of the peduncle, just below the body of the sponge.

On the outer surface a dermal reticulation with quadratic meshes, the size of which increases with the size of the sponge, can always be traced. This network is exceptionally clearly visible in the specimen represented on pl. VII, f. 11. The gastral surface is perforated by round apertures, up to 1 mm. wide and surrounded by smooth margins; it is much more smooth than the outer surface.

The spicules of these young specimens of *Hyalonema affine reticulatum* resemble in most points of their arrangement, size and shape the spicules of fullgrown specimens. I will here dwell on those peculiarities of them only which I consider as expressions of differences of age.

In shape the macroscleres are similar to those of fullgrown specimens. Their length and thickness chiefly depends on the size of the sponge. All the macroscleres of the smallest specimen are much shorter and more slender than those of the largest (pl. VII, f. 11), the latter being about the same size as those of fullgrown individuals.

It is to be remarked that the dermal **pinules** have in all the twelve specimens the same shape and are slightly longer than in the fullgrown specimen described above. In this, as in the Japanese specimens, they are always over 200, on an average 300 μ long. The same applies to the **macramphidiscs**, which are in these young specimens always over 200 μ in length. The size and abundance of the **mesamphidiscs**, spicules of well known inconstancy, are subject to great variations. In some of the specimens they are abundantly present in many different forms, in others they are absent altogether. On the other hand **micramphidiscs**, of the typical form but very variable in size, 20–40 μ long, are always found in the dermal membrane.

Of these twelve specimens two, the large one figured in fig. 11 and *a* on plate VII, and a smaller one 20 mm. long, were found in the Andamans near North Sentinel Island in a depth of 458 m.=250 fths. The other ten small specimens were also captured in the Andamans near Ross Island, which is not very far from North Sentinel, in a depth of 485 m.=265 fths.

I shall now describe the five doubtful species of which only young specimens were at my disposal.

Hyalonema aculeatum F. E. Sch.

Plate II, Figs. 1–14.

1895 *Hyalonema aculeatum* F. E. Sch. in Abh. Preuss. Ak. 1894 p. 19, Taf. III, figs, 1–14.

Four of the numerous Hyalonemas found in the Andamans have remarkably long prostalia lateralia, so that I first supposed them to be young Pheronemas. This supposition appeared supported by the slender pear-shaped form of their body and the presence of a slender tuft of long basal spicules which protrude from its lower end, peculiarities which also appertain to the young *Pheronema carpenteri* described by Wyville Thomson and figured by him in the Philosophical Transactions for 1869 on plate LXXI. Closer investigation showed, however, that this sponge is not a *Pheronema* but a *Hyalonema*. The high central cone, the regularly-quadratic dermal reticulation, and the absence of bidentate anchor-spicules and simple uncinates exclude it from the genus *Pheronema*. The general structure, and particularly the shape of the spicules, are in accordance with *Hyalonema*. There is therefore nothing for it but to extend the genus *Hyalonema* as indicated above, so as to comprise not only smooth forms but also sponges rendered spiny by the presence of prostalia lateralia. The name *Hyalonema aculeatum* has been given to these sponges on account of their freely-projecting spicules, which render them spiny. It must be taken into account however that they are, in all probability, young forms which may possibly lose their prostalia lateralia on attaining maturity and then become just as smooth and spineless as the other species of *Hyalonema*. I do not consider this probable however, because the smallest of the very unequally sized specimens at my disposal does not possess more prostalia lateralia than the others. On the contrary, the number, size, and areas occupied by the lateralia increase with the growth of the sponge, as is shown in fig. 1–4 of plate II, in which these sponges are represented.

The smallest of the four specimens measures 7 mm. in length and 5 mm. in breadth, the largest is 14 mm. long and 10 mm. broad. Although not very constant in shape, they all resemble a turnip with considerably attenuated lower end. From this a root-tuft, 2–4 cm. long, up to 1 mm. thick, and lying in the prolongation of the axis of the sponge, protrudes. The broader upper end is covered by a dome-shaped continuation of the dermal membrane. In the two smaller specimens this is continuous, in the two larger ones it is perforated by a small circular oscule with sharp margin, which latter however is not raised to form a vertical oscular fringe or collar. The prostalia lateralia are confined to the broad upper part of the body; in the small specimens they are 5–10, in the larger ones 10–20 mm. and more long. With the age of the sponge they in-

crease in size and in number, and the area occupied by them extends the further downwards the larger the sponge is. In the youngest specimen only the upper third, in the intermediate ones the upper half, and in the oldest ones the upper two-thirds, are covered with protruding lateralia. These spicules are on the whole vertical to the surface, but nevertheless a great many of them, particularly in the younger specimens, are directed slightly upwards. Most of the prostalia lateralia arise from the apex of a small conical protuberance. They are 1–2 mm. apart. The lower ones are stouter and longer than the upper ones. The root-tuft is aproximately cylindrical, and naked. Its thickness increases with the size of the sponge and amounts in the older specimens, of the dimensions of a pea, to 2–3 mm. Their length cannot be definitely stated, since all the root-tufts are torn off. In one specimen the part of the root-tuft still attached to the body is 3 cm. long.

The delicate dermal reticulation has quadratic meshes. It is recognisable with the naked eye, better with a magnifying glass, and can be compared to the network formed by the lines of longitude and latitude on a terrestrial globe.

The sponge is yellowish-gray, clay-coloured. This colour is proper to it and not produced by silt in the sponge.

The parenchymal macroscleres are oxyhexactines and oxydiactines. The **oxyhexactines** are stout and have the usual form. Their rays are quite smooth and gradually attenuated towards the sharp pointed end.

The **oxydiactines** are straight or slightly curved, up to 1–2 mm. long and 10–20 μ thick. They are either quite smooth and spindle-shaped or have a well defined inflation or four crosswise-arranged tubercles, the remnants of the four atrophied rays, in the centre. Oxydiactines with rays about 500 μ long and numerous spines are also frequent. Four spines arranged crosswise occupy the centre, the others are scattered and point backwards towards the middle. The whole spicule consequently appears as a true **ambuncinate** (pl. II, f. 13).

The true parenchymal **oxyhexactines** form a regular quadratic or rather cubic network, to which the quite similar hypodermal oxypentactines are joined in a regular manner. The large prostalia lateralia are oxydiactines, 3–4 cm. long and over 70 μ thick. An axial cross defining the centre is, as a rule, not discernable. Most of the long **anchor-spicules** of the basal-tuft are quite smooth. It is very likely that they possess four terminal diverging and recurved transverse rays with central canal, forming a cross, as has been described above in *Pheronema raphanus* and also observed in some Hyalonema species. In others the shaft is covered throughout with stout spines, directed obliquely upwards. These spines are longest in the middle. Towards the upper pointed end, and also below, in the vicinity of the anchor-teeth at the distal termination of the shaft, the spines become smaller. The four anchor-teeth arise from the

club-shaped, thickened, lower termination of the spicule. They are curved upwards forming a sharp bow, spade-like, and destitute of axial canals. The axial canal of the shaft terminates a short distance above the rounded, hemispherical lower end; 6 μ above its termination the rudiments of the axial canals of the four atrophied transverse rays, which together form a rectangular cross with arms 6 μ long, arise from it (pl. II, f. 14).

The **dermal pinules** are pretty uniform in character. They are about 80 μ high; their basal rays, which form a rectangular cross, are about 35 μ long, gradually attenuated towards the pointed end, and slightly spined in their distal part. The spines of the main ray diverge from it with angles less than 45° and form a crown 30–40 μ broad, which is gradually attenuated towards its upper, pointed end. The basal part of the main ray is for a distance of 20–30 μ free from spines. Together with the comparatively great length of the slender basal rays this gives to these pinules a quite peculiar appearance (pl. II, f. 6 and 7.).

The **macramphidiscs** of the dermal membrane are 200–300 μ long and have a bell-shaped terminal disc about 70 μ long and equally broad, with eight marginal teeth. The shaft is 12 μ thick and covered with scattered, small protuberances; in the centre it has four or eight stout rounded tubercles. When there are four they are arranged crosswise (pl. II, f. 9).

The **micramphidiscs** are numerous. They vary in length from 10–30 μ and in the breadth of their terminal discs, which are hemispherical and have 10–12 marginal teeth, from 5–10 μ. The shaft is slender and usually covered with irregularly scattered, low spines (pl. II, f. 10–12).

The parenchymal **micro-oxyhexactines** are numerous. They have straight, smooth rays 70–80 μ long, and very gradually attenuated towards their pointed ends (pl. II, f. 8).

All the four specimens of this species are evidently young forms and their root-tufts are free from Palythoa. Of other Hyalonema species the most closely allied to this one appears to be *Hyalonema globus* F. E. Sch., of which a specimen was captured in the vicinity of the Banda Islands in a depth of 958 m.=523 fths. by the "Challenger" expedition. By its distinctly spherical or globe-like shape and by the absence of prostalia lateralia it certainly differs very considerably from the turnip-like, spined *Hyalonema aculeatum* in external appearance, but it is similar to it in the shape and size of the microscleres, particularly the dermal pinules. But also in these various differences are met with: the dermal pinules of *Hyalonema globus* have a short terminal cone, those of *Hyalonema aculeatum* a pointed end, etc. An identity of the two species is therefore out of the question.

All the four specimens were found in the Andamans, near North Sentinel Island, in a depth of 458 m.=250 fths.

Hyalonema heideri F. E. Sch.

Plate II, fig. 15–22.

1895 *Hyalonema heideri* F. E. Sch. in Abh. Preuss. Ak. 1894, p. 23, Taf. III, figs. 15–22.

Together with the *Hyalonema aculeatum*, characterised by the long, protruding prostalia lateralia, a pear- or turnip-shaped sponge, similar in shape and of equal size, 10 mm. high and 5 mm. broad, was found, which however is entirely destitute of the prostalia lateralia and quite smooth (pl. II, f. 15).

Having cut this specimen into a continuous series of longitudinal sections, 500 μ thick, I could easily see that it resembles *Hyalonema aculeatum* also in the shape, size and position of all the spicules, most of which are represented in fig. 16–22 on plate II. I only noticed that the dermal macramphidiscs are considerably larger, about 300 μ long (pl. II, f. 20).

I must confess I was long in doubt whether I should consider this sponge as a smooth variety of *Hyalonema aculeatum* or as a distinct species. I have followed the latter course provisionally, because it seems unlikely that such a great difference as is expressed by the presence of large prostalia lateralia in one, and their absence in the other, should have no specific value. But it must be acknowledged that we are hardly yet in a position to pronounce a final judgment on the systematic value of differences such as these in the *Hyalonematidæ*.

I have named this species after my friend and collaborator Prof. Carl Heider, with whom I have had occasion to discuss scientific questions like the one involved here, very frequently.

The only specimen of this species was found, together with the nearly allied *Hyalonema aculeatum*, near North Sentinel Island in the Andamans in a depth of 458 m.=250 fths.

Hyalonema pirum F. E. Sch.

Plate II, fig. 23–30.

1895 *Hyalonema pirum* F. E. Sch. in Abh. Preuss. Ak. 1894, p. 27, Taf. III, figs. 23–30.

Although it seems to me doubtful whether the small Hyalonema specimens from the Andamans (pl. II, f. 23–25) here described as *Hyalonema pirum*, really represent a distinct species, or whether they are merely young forms of *Hyalonema indicum* or some other *Hyalonema*, I consider it for the present better to give to these sponges, distinguished as they are by certain peculiarities from all other known Hyalonemas, a separate name, than to place them arbitrarily in some other known species of which they may possibly, but do by no means certainly,

represent the young stage. Should subsequent observations show that they do belong to another species, their present name, having served its purpose, can be dropped. The three specimens represented in fig. 23–25, plate II, show that the shape is, for a certain extent, subject to variations; they all however resemble a pear, or an egg pointed below. The smallest of the four specimens in the "Investigator" collection (pl. II, f. 25) is more truncate above than the others and destitute of an oscule. The others possess a more or less circular oscule, which increases in width with the size of the sponge to a diameter of 3 mm. It is not covered by a sieve, and has a sharp margin which, in the largest specimen (pl. II, f. 23) is already slightly elevated. On the outer surface the quadratic dermal reticulation is, particularly in the larger specimens, clearly discernable. Looking through the oscule into the gastral cavity, one notices a central cone extending upwards to the level of the oscule and connected with the body-wall by three or four unequally developed radial septa, which terminate above with concave margins. Greater or smaller parts of the root-tuft are still attached to the specimens. These root-tufts are slender and composed of not more than 10–50 spicules. Only in the largest specimen, represented in fig. 23 on plate II, an indication of a Palythoa crust, in the shape of a single contracted spherical polyp attached to one side of the root-tuft, just below the body of the sponge, is seen.

In shape, size and position the macroscleres do not differ essentially from those of *Hyalonema indicum*; the microscleres show however some peculiarities. The dermal **pinules** are in *Hyalonema indicum* 300–600 μ long, in *H. pirum* on an average only 300 μ long. Their thickness is about the same, their spines are less numerous in the latter.

The dermal **macramphidiscs** are rather variable. In shape, size and abundance they agree with those of *Hyalonema indicum*. The **mesamphidiscs** on the other hand, although resembling in shape and size those of *Hyalonema indicum*, are here not nearly so plentiful. In the **micramphidiscs**, which are not particularly frequent, no essential difference is discernable.

The same applies to the equally-abundant, rough parenchymal **micro-oxyhexactines** (pl. II, f. 27).

The plane oxytetractines of the sub-species of *Hyalonema indicum* are entirely absent.

The largest of the specimens, which is 20 mm. long and 12 mm. thick, was found in the Andamans, near Ross Island, in a depth of 485 m.=265 fths. The three other, considerably smaller specimens, two of which are figured in figs. 24 and 25 on plate II, were found in the Andamans, in the vicinity of North Sentinel Island, also in a depth of 485 m.=265 fths.

Hyalonema heymonsi F. E. Sch.

Plate III, fig. 14–18.

1895 *Hyalonema heymonsi* F. E. Sch. in Abh. Preuss. Ak. 1894 p. 29, Taf IV, fig. 14–18.

The sponge described as *Hyalonema heymonsi*, of which there is but one single small specimen in the "Investigator" collection, may possibly also be a young *Hyalonema indicum*. For the reason stated above, however, I prefer to distinguish it for the present by a special designation and have named it *heymonsi* after my friend and assistant, Professor Heymons, who greatly helped me in this work by preparing the sections, etc., required.

As is shown in the life-size figure of this sponge (fig. 14 on plate III) it is rounded, spindle-shaped, 10 mm. long and 4 mm. broad. There is no oscule on the upper end; to the lower end a slender root-tuft, composed of not more than 10–20 basalia-spicules, is attached. The quadratic reticulation of the dermal membrane is not yet clearly pronounced.

The macroscleres are in their shape, size and arrangement, similar to those of *Hyalonema indicum* and *H. pirum*. The microscleres show the following peculiarities. The dermal **pinules** are of equal length (300–350 μ) but considerably thinner, and the spines of the main ray are very short (pl. III, f. 18).

The dermal **macramphidiscs** are similar in shape but shorter, less than 300 μ long. Mesamphidiscs could not be found. **Micramphidiscs** are numerous and resemble in shape and size those of *Hyalonema indicum*.

The same applies to the **micro-oxyhexactines**. Plane, parenchymal micro-oxytetractines are absent.

The only specimen of this sponge procured was captured in the Bay of Bengal 9° 34′ N., 85° 43′ 15″ E. in a depth of 3655 m.= 1997 fths.

Hyalonema weltneri F. E. Sch.

Plate IV, fig. 15–24.

1895 *Hyalonema weltneri* F. E. Sch. in Abh. Preuss. Ak., 1894, p. 30, Taf. V, fig. 15–24.

Although the specimen on which this species is founded certainly represents a young form, there can be no doubt about its being a good species, because its dermal pinules are quite peculiar. I have named this sponge after my friend and worthy collaborator in the field of spongiology Dr. Weltner, Custos in the Berlin Museum.

The body is elongated, spindle-shaped, circular in transverse section, 16 mm. long and in the middle 4 mm. thick (pl. IV, f. 15). The upper end is rounded and destitute of an oscule; from the lower end a root-tuft, composed of 15–20

basalia-spicules protrudes. The lower end of this has been broken off but it is still 12 mm. long.

The macroscleres are essentially identical with those of *Hyalonema indicum*. Among the microscleres the dermal pinules, characterising as they do the species by their peculiarities, are of particular interest. They are about 150 μ long. The stout rays of their basal cross have an average length of 20 μ, terminate bluntly, and are uniformly covered with short spines. The main ray is basally 5 μ thick, and smooth for a length of 20 μ. Its upper part is covered with stout spines 20 μ long, which diverge considerably below but are nearly parallel, closely "anliegend" above. The upper end consists of a stout central cone 8–12 μ thick (pl. IV, f. 24).

Macramphidiscs are rather rare. They attain a length of 200 μ and a maximum breadth of 70 μ. Their terminal discs are bell-shaped, up to 80 μ long, and have 8 pretty broad, spade-like marginal teeth. The shaft is fairly stout. It has in the centre four crosswise arranged and, besides these, several irregularly scattered, vertically diverging, blunt spines (pl. IV, f. 17). Much more minute amphidiscs of similar shape, which are to be considered as **mesamphidiscs** (pl. IV, f. 18), occur in small numbers. **Micramphidiscs** showing the usual characters are plentiful (pl. IV, f. 19, 20).

Micro-oxyhexactines are very numerous in the parenchyme. Their rays are of medium thickness, about 60 μ long and mostly distinctly rough or even tuberculous; in some of them however the roughness is so slight that one might almost consider them as smooth (pl. IV, f. 22).

In the vicinity of the lower end of the body we find, just underneath the surface, together with the stout **acanthophores** of the usual form, hexactines, pentactines and cross-shaped tetractines with thin rays of different length (80–200 μ), covered with slender, vertically or obliquely diverging, straight or curved spines, variable in size (pl. IV, f. 23). Ambuncinates were not met with.

Of the Hyalonema species hitherto described, *Hyalonema poculum* F. E. Sch. ("Challenger" Report, p. 208, pl. XXXIII) appears to be the one most closely allied to *H. weltneri*. It differs from it, however, in the greater length and smaller breadth of the dermal pinules.

The only specimen of *Hyalonema weltneri* procured was captured in the Laccadives 11° 12′ 47″ N., 74° 25′ 5″ E. in a depth of 1830 m.=1000 fths.

I must finally mention that there are in the "Investigator" collection, besides the Hyalonemas described above, four isolated Hyalonema-root-tufts, 16–30 cm. long. These consist of loose bundles composed of 10–40 slightly spirally twisted spicules which are in some up to 1 mm. thick. No remains of the body of the sponges to which they belonged are attached to them. They are not

quite naked but, for a certain distance, surrounded by a sponge-tissue, which in external appearance resembles the loose structure of a Hyalonema-body and is in one case as large as a fist. In another one of these specimens this sponge tissue is more compact, and has, apart from a few short oscular tubes, a smooth surface. In one specimen the sponge-tissue covering the root-tuft has the appearance of a porous crust.

Closer investigation has shown that the loose specimen of the size of a fist and the porous incrusting specimens are Monaxonid Sponges, belonging to the genus *Gellius*, the large one representing a new species. The compact specimen consists of two spindle-shaped masses, one above the other, 3 cm. long and 1 cm. thick, and 9 cm. long and 3 cm. thick respectively. Also these are Monaxonid sponges and represent a new species of *Suberites*.

The last named specimen was found in the Laccadives 11° 12′ 17″ N., 74° 25′ 30″ E. in a depth of 1830 m.=1000 fths.; the large, massive *Gellius* south-west of North Sentinel Island in the Andamans, in a depth of 238–458 m.=130–250 fths.; and the two specimens with the incrusting *Gellius* also in the Andamans, one within this group of islands in a depth of 238–458 m.=130–250 fths., the other farther to the west in a depth of 435–530 m.=238–290 fths.

Lophophysema F. E. Schulze.

Lophophysema inflatum F. E. Sch.

Plate XX, XXI.

1900 *Lophophysema inflatum* F. E. Sch. in Abh. Preuss. Ak. 1900 pp. 19–23, Taf. IV, V.

The sponge now to be described, although nearly allied to *Hyalonema* in spiculation, differs in shape and structure to such an extent from all known *Hyalonematidæ* that I find it necessary to establish a new genus for its reception. This I name *Lophophysema* (λοφος tuft, φυσημα swelling).

There is only a single, somewhat injured specimen of this species in the "Investigator" collection. Of the root-tuft there is but little left. The body is so soft and tender that it collapsed on being removed from the strong spirit in which it was preserved, and then formed a shapeless mass, filling a soup-plate. To ascertain its natural shape I carefully placed it in a large vessel filled with very weak alcohol. Here the sponge, saturated with the lighter strong spirit, at first swam, extending horizontally on the surface. As the weak alcohol began to diffuse through the sponge, it became heavier and gradually commenced to sink, the lower end, weighted with the heavy basalia-spicules in front, thus being directed downward. The loose upper part was for some time supported near the surface by an accidentally enclosed air-bubble. In this position the sponge was drawn in natural size by Mr. Krohse, an artist well versed in this kind of work. This drawing is reproduced, reduced to two-thirds, on plate XX.

It soon became clear that the loose upper part had been so much injured as to render it impossible to ascertain how its contour was originally shaped. The other characters, particularly those of its rather stouter central and basal parts, could however be made out well enough. It was easy to discern that an annular prominent ridge, about 1 cm. high, surrounds the sponge and divides the low conical basal part, which is 23 cm. in diameter, from the larger upper cylindrical part of the body. The summit of the sponge is much lacerated but the greater part of it still present. The basal end, that is the apex of the cone forming the lower surface, is truncate, slightly concave, and surrounded by a tuberculous ring-wall a few millimeters high. It measures 3 cm. in diameter and is evidently the place where the root-tuft has been torn off from the sponge. Several stumps of basalia-spicules, as thick as knitting needles, protrude from it for a distance of a few centimeters. The surface of the lower cone, outside this place of insertion of the root-tuft, is strongly gyrated; the gyri extend chiefly in a radial direction and are frequently connected so as to form a sort of network, the meshes of which are occupied by very irregular round cavities about a finger or a thumb broad. The gyri extend nearly to the projecting annular ridge, only a zone 10–15 mm. broad, just within it, being free from the intervening cavities.

The much larger and softer part of the body lying above the annular ridge has a very different appearance. It most likely had in the living sponge the shape of a low, terminally-truncated or slightly-depressed beehive. Its transverse diameter measures 22 cm. and it is about 18 cm. high. It was originally, without doubt, entirely covered with a dermal reticulation, which however is now to be seen as a continuous net at the sides only; above it has been much torn and is quite defective. The meshes of this reticulation are numerous, rounded, and on an average 3–10 mm. wide, the strands between them are much narrower. In the vicinity of the annular ridge these meshes (holes) are smallest and least numerous, upwards they increase in number and in size. The whole of this reticulation is to be considered as a gastral or oscular sieve-plate. Below it, large cavities are seen, which pass into wide, slightly-ramified, vertical canals in the upper part of the sponge. These canals are closed above and emit terminally-closed diverticula. Trabeculæ connect the gastral reticulation with the tissue, excavated by these cavities and canals, lying below. These cavities, some of which are as large as a child's hand, communicate with the outer world freely by the large apertures between the gyri on the lower conical face of the sponge. Through these apertures the water enters the cavities which represent the incurrent canal-system of the sponge. Between these incurrent cavities the excurrent cavities are situated. The latter are everywhere in open communication with each other and with the subgastral cavity lying below the gastral reticulation of the convex upper side of the sponge. Through the holes in the latter the water leaves the sponge (pl. XXI, f. 1).

The entire canal-system is represented schematically in the sketch fig. 1 on plate XXI. It is on the whole similar to the canal-system of the Rossellid genus *Aulochone*, particularly *Aulochone cylindrica*, described and figured by me in the "Challenger" Report on the Hexactinellida on p. 168 and pl. 66, f. 2–4.

The walls of the wide and ramified canals and diverticula of the incurrent system chiefly consist of the richly-folded chamber-layer and the limiting membranes. The membrane on the side of the incurrent system is dermal, the one on the side of the excurrent system gastral. These membranes are covered with pentactine canalar pinules.

Straight or slightly-curved and slender **macrosclere oxydiactines** are numerous. Singly, or aggregated in strands, they occupy the parenchyme of the lamellæ between the incurrent and excurrent systems. They extend in various directions, chiefly in planes parallel to the canal surface, and on the whole resemble the corresponding spicules of most other species of *Hyalonema*; they are however only rarely over 1 mm. long and never attain such dimensions as the curved oxydiactines in the strands of *Hyalonema toxeres*, *rapa*, *martabanense* and others. Some of these spicules are quite smooth, others have a more or less clearly defined central inflation, or two opposite or four crosswise arranged tubercles with axial canals in the middle.

I do not remember having seen any macrosclere oxyhexactines. In the vicinity of the central cone, that is the upper end of the spicule-bundle forming the peduncle, straight or curved, smooth diactines with thickened, club-shaped ends are frequently met with. Sometimes both ends are club-shaped (pl. XXI, f. 9), sometimes only one, whilst the other is gradually attenuated to the sharp-pointed end. In this region also diactines are occasionally met with. These are simply rounded at one or at both ends and assume the shape of styles or amphistrongyles accordingly.

Stout **oxypentactine hypodermalia** are frequent everywhere below the dermal membrane. They take part in supporting the soft parts. Below the gastral membrane no such spicules are met with.

Microscleres, parenchymal **oxyhexactines**, are nowhere particularly abundant. Their rays are usually 60 μ, rarely as much as 80 μ long, and either covered with very minute spines or merely rough (pl. XXI, f. 4, 5).

On the dermal membrane of the lower face, on the limiting membranes of the internal cavities and canals, and on the inner and outer side of the gastral reticulation **pentactine pinules** are met with. These are regularly arranged and more or less numerous. They are slender and their basal rays are 40–50 μ long, smooth or slightly roughened and uniformly attenuated towards the pointed end. The free main ray is 100–280 μ and more long, and terminally covered with oblique spines not particularly long. On the whole the pinules of the dermal and

the gastral membranes are larger than those of the canal-walls (pl. XXI, f. 6, 7). The latter stand the further apart, and are the smaller, the narrower the canal or cavity is, in the wall of which they are situated.

The **oxydiactine marginalia**, which project from the annular ridge, form a single or double row. Their average total length is 600 μ. The proximal imbedded ray is smooth, gradually attenuated towards the pointed end and 100–200 μ long; the distal free ray is also gradually attenuated and pointed, and 400–500 μ long, it is covered with rather short, oblique spines. From the centre of the spicule four pretty high, pointed protuberances, arranged crosswise, arise (pl. XXI, f. 8).

Macramphidiscs 200 μ long are found in very small numbers, scattered singly throughout the parenchyme. Their terminal discs are of medium size, 100 μ broad and usually hemispherical; they have 8 broad and spade-like marginal teeth. Mesamphidiscs are absent. **Micramphidiscs** of the usual shape and size are abundant in the membranes lining the canals.

As in Hyalonema, **acanthophores** occur in the vicinity of the point of insertion of the root-tuft. They are usually spicules with stout rays, covered throughout or only terminally, with thick spines. Stauractines (pl. XXI, f. 11) are most frequent, but other hexactine-derivates, down to diactines, are also met with.

The **basalia** have the shape of knitting-needles. They form a slender central cone which extends upwards through the body of the sponge for a distance of 15 cm. Although only a few of them are preserved, and these broken off pretty short, one can see that they have the usual character of Hyalonema-basalia. Some of them are over 1 mm. thick.

The only specimen of *Lophophysema inflatum* was found in the Andaman Sea 13° 50′ 30″ N., 93° 26′ E. in a depth of 911 m.=498 fth.

Semperella J. E. Gray.

Semperella cucumis F. E. Sch.

Plate VIII.

1895 *Semperella cucumis* F. E. Sch. in Abh. Preuss. Ak. 1894 pp. 45–51, Taf. IX.

To my great delight I found among the "Investigator" sponges three specimens belonging to the Hyalonematid genus *Semperella*. One of these is fully developed, 40 cm. long, 8 cm. broad and very well preserved. Another one, only about 12 cm. long and 2 cm. thick, appears to be a young specimen, part of which has been lost. It is superficially injured and considerably macerated, only the macrosclere supporting-skeleton and here and there a small fragment of the soft parts being preserved. The third specimen is a root-tuft

with a small portion of the lower end of the sponge-body, of the size of a hen's egg attached. As is shown by its large dimensions this root-tuft, which is 5 cm. thick and 20 cm. long, formed part of a full-grown specimen.

I base my description on the intact, full-grown specimen. This evidently belongs to a new species of the genus *Semperella*, of which hitherto only a single species, viz., *Semperella schultzei* Semper, was known. On the whole this fine sponge has the shape of a cucumber; that is why I gave to it the specific name *cucumis*. *Semperella schultzei* Semper, which occurs in the Philippines and Moluccas, is club-shaped and has several projecting longitudinal ridges. *Semperella cucumis* is spindle-shaped, shows a slight S-shaped curvature, and has a circular transverse section. Its upper end is slightly truncate, of a somewhat loose and tufty appearance, and destitute of a simple oscule or a sieve-plate. Thus the two species, although attaining similar sizes, differ considerably in outward appearance. Below, the body is broadly truncate as in *Semperella schultzei*. The root-tuft, which protrudes from the lower terminal face, is about as thick as the inferior end of the sponge-body and appears as a direct continuation of the latter (pl. VIII, f. 1).

In both species the incurrent areas are coverd by fine quadratic reticulations. In *Semperella schultzei* the oscular areas appear as loose and irregular networks, situated on the projecting, longitudinal ridges; in *S. cucumis* the excurrent openings are rounded canal-mouths, partly arranged in irregular transverse rows or low spirals and partly scattered irregularly (pl. VIII, f. 1).

As in *Semperella schultzei*, the whole body consists of a complicated network of tubes, the walls of which completely separate the continuous excurrent from the equally-continuous incurrent cavities. These tubes have a more or less circular transverse section and are 5–10 mm. wide. Their walls are 500–2000 μ thick, and supported by numerous strands of stout macroscleres.

The root-tuft is 10 cm. long. The spicules composing it form bundles 2–5 mm. thick which arise 5–10 mm. apart from the lower face of the sponge. Further down, the bundles join to form a fairly continuous tuft, and at the lower end, which is imbedded in the silt of the sea-bottom, the basalia-spicules slightly diverge.

The supporting skeleton, composed of macroscleres, forms a rather loose system of rope- or band-shaped spicule-bundles up to 2 mm. thick. These traverse the tube-walls which divide the incurrent and excurrent cavities, in a more or less regular manner. In the whole of the axial part of the sponge, up to a distance of 1 cm. from the lateral surface, nearly all the bands of macroscleres are arranged longitudinally; only here and there oblique transverse bands, connecting the longitudinal ones, are met with. In the distal part of the sponge the spicule-bands anastomose here and there and mostly extend in a radial

direction. Towards the interior, these superficial radial bundles bend round and become longitudinal bundles. Towards the upper, narrow end of the sponge the axial longitudinal bundles approach the surface much more closely, the superficial region occupied by the radial bundles thins out, and finally, at the very summit, the longitudinal bundles reach the surface itself.

As in *Semperella schultzei* the spicule-bundles of the supporting-skeleton are chiefly composed of **oxypentactines**. Two of the rays of these spicules lying in one of the axes are very long, two lying in another are a little shorter, and the fifth ray is considerably shorter. To this latter there is either no antagonistic (sixth) ray at all, or this is represented by a small protuberance only.

True macrosclere **hexactines** with six fully-developed rays and true **diactines** are rare.

Pentactines also take part in the formation of the oscular sieves which rest on the distal margins of the tube-walls. One ray of these pentactines, which is situated radially, is of considerable length, slender at the base, but thickened in its distal part. The other four rays are very short and terminally rounded; they form a cross, and extend paratangentially just below the surface (pl. VIII, f. 3, 11). Together with these spicules numerous oxypentactine hypodermalia of the usual kind are met with. These have four pretty long paratangential rays, which form a cross, and a radial ray which is generally shorter than the basal rays. All the rays are pointed and often slightly inflated near the end. Such oxypentactine hypodermalia also form the support of the dermal reticulation and the oscular sieve-plate. In these the paratangential rays are elongated and the radial ray much shortened.

In the stout spicule-bundles of the tube-walls which reach the surface numerous radially-arranged **uncinates** of the usual form (pl. VIII, f. 7) occur. These are up to 4 mm. long and their distal end generally just reaches the outer surface.

Occasionally, straight and slender marginalia are met with in the distal ends of the tube-walls which lie just below the surface. These are similar to the marginalia which I found in great numbers in a young specimen of *Semperella schultzei* in the "Challenger" collection.* These marginal rhabds are minutely spined and gradually attenuated towards the proximal, pointed end. The distal end is abruptly thickened and bears four pointed spines, arranged crosswise (pl. VIII, f. 10).

The long bidentate anchor-spicules of the basal root-tuft are on the whole similar to those of *Semperella schultzei* described by previous authors and also by myself.† They differ from them, however, in the shape of the sharp lateral

* Challenger Reports, Hexactinellida p. 265, pl. LII, f. 3.

† Challenger Reports, Hexactinellida p. 265, pl. LII, f. 14.

margins of the two opposite spade-like anchor-teeth, which are continued proximally so as to join each other in the middle, at the sides of the shaft. In *Semperella schultzei* these margins are either quite smooth, or have only one or two slight indentations distally, and are strongly indented centrally, where they join. In *Semperella cucumis* they are serrated distally by numerous projecting lateral teeth and protrude, where they join centrally, outwards and upwards (pl. VIII, f. 9).

In the dermal membrane and the oscular sieve-plate stout **pinules** are everywhere numerous. Their length differs considerably in different parts of the dermal surface. It is here usually 200–300 μ. Their basal rays, which form a rectangular cross, are stout, straight, distally covered with tubercles or short spines, and also of varying length. They usually measure 60–80 μ. On the oscular sieve-plate pinules of considerably greater length, measuring 400–450 μ, are met with. The main ray is covered with stout, obliquely-diverging spines, and resembles an Italian poplar (pl. VIII, f. 12-13). The basal part of this ray is, for a length of usually less than 40 μ, free from spines, smooth, and on an average 6–10 μ thick. The terminal spine is not particularly long, and not much thickened. A curvature of the basal rays, giving to them the appearance of an 8, as in the pinules on the slender dermal strands of *Semperella schultzei*,* has never been met with in the pinules of *Semperella cucumis*.

The dermal and oscular **macramphidiscs** are large, stout and—particularly on the free ends of the tube-walls—numerous. Their terminal discs are approximately hemispherical, distally somewhat flattened, and have 8 broad spade-like, terminally-rounded marginal teeth. The shaft is pretty stout, knotty, but without any conspicuous protuberances in the centre (pl. VIII, f. 4).

True mesamphidiscs are entirely absent; **micramphidiscs**, however, are frequent. These differ considerably in size, but are all pretty much of the same shape. They are 20–40 μ and more long, and their terminal discs are hemispherical, have 10–12 marginal teeth, and are 6–12 μ broad. The shaft is slender and usually slightly tuberculous (pl. VIII, f. 5, 6).

It is a characteristic peculiarity that numerous spined oxypentactines, oxytetractines (stauractines) and spindle-shaped diactines are contained in the layer—of which the walls of the ciliated chambers form a part—dividing the incurrent from the excurrent system. The two limiting-membranes of this layer are nearly parallel to each other. Both are similarly chiefly supported by **oxypentactines.** Their basal (paratangential) rays are covered with small, vertical spines. They are at the base 8–12 μ thick and gradually attenuated towards the sharp-pointed end (pl. VIII, f. 8). Their length varies from 100–200 μ, the basal rays of one and the same spicule, however, are usually of equal length. The apical main ray is vertical to the basal rays and points inward; it is spined, and in

* Challenger Reports, Hexactinellida pl. LII, f. 6.

length still more variable than the basal rays. Frequently it is as long as the basal rays, usually however it is considerably shorter, and sometimes reduced to a simple, spined and distinctly pointed tubercle. Between these pentactines, and lying in the same level, numerous irregularly-scattered **stauractines** are met with, which are exactly similar to the basal crosses of the pentactines above described. They are, doubtless, derived from such pentactines by a complete atrophy of the fifth ray. Sometimes one of the four rays is considerably shorter and terminally inflated; sometimes two opposite rays are atrophied; and sometimes spicules of this kind are met with in which only the inflated centre and a single ray are left.

A peculiar spicule is a simple, straight, spindle-shaped **oxydiactine** 80–160 μ long, which is most frequent in the dermal reticulation and the walls of the incurrent and excurrent cavities, but also occurs in varying numbers in all other parts of the sponge. The cylindrical or slightly spindle-shaped central part of this spicule is quite smooth, the pointed terminal conical parts are covered with oblique protuberances and spines pointing outward (pl. VIII, f. 14–16). In *Semperella schultzei* such diactines also occur, but here they are spined throughout.

The second specimen, 12 cm. in length, which is, as stated, somewhat macerated, is in its external shape, general structure and the shape and arrangement of the spicules, on the whole so similar to the one described above that I consider it as a young specimen of the same species. There are however some slight differences. The macroscleres for instance are considerably smaller, but this is merely to be ascribed to the youth of the individual, since it is well known that in Hexactinellida generally these spicules increase in size with the age of the sponge. The small parenchymal amphioxes (diactines) are not always smooth in the centre as in the large specimen above described, but are very often spined throughout, as in *Semperella schultzei*. One also not unfrequently observes that one end of these spicules is more slender and less spiny than the other.

Of more importance than these insignificant differences is the fact that in this specimen, by no means rarely **mesamphidises** occur together with the macr- and micramphidiscs. These mesamphidiscs are 80–100 μ long and on the whole similar to the macramphidiscs. Like them they have 8 spade-like marginal teeth on the margins of their terminal discs, and a knotty or tuberculous shaft. The curvature of the terminal discs differs however, being more regularly hemispherical than in the macramphidiscs.

Although the third specimen is only a small fragment, there can be no doubt about its being specifically identical with the two specimens described above. For not only is that part of the sponge-body and root-tuft which is preserved, similar to the other two specimens, particularly the large one, in appearance and structure, but also the spicules agree perfectly in shape, size and arrangement with those of the latter. I even succeeded in finding in it a few of those

mesamphidiscs which are abundant in the young specimen but which I failed to observe in the fullgrown specimen.

The large complete, and the young, somewhat macerated, specimen were both procured at the same station to the west of the Andamans in a depth of 435–530 m.=238–290 fths. The fragment last described was also captured in the vicinity of the Andamans, 11° 25′ 5″ N. 92° 47′ 6″ E. in a depth of 740 m.=405 fths.

B. HEXASTEROPHORA.

The Hexasterophora comprise those Hexactinellida in which amphidises are invariably absent, but hexasters nearly always present. The first family of this group we shall deal with are the

II. EUPLECTELLIDÆ.

The sponges belonging to this family are usually thin-walled tubes, more rarely caliculate or honeycombed, and always possess sword-shaped hexactines in the dermal membrane.

Holascus F. E. Sch.

In 1887 I established the genus *Holascus* for the reception of certain tubular *Euplectellidæ* without parietal apertures. To the naked eye the outer surface of these sponges appears fairly smooth. On the inner surface we observe a network with quadratic meshes occupied by pit-like depressions. The upper end of the tube is closed by a terminal sieve-plate; the lower end appears drawn out to form the basal tuft which takes root in the sea-bottom. The spicules are never joined by apposed silica.

The supporting skeleton is chiefly composed of large principal pentactines, or stauractines, more rarely of hexactines. Triactine, diactine and pentactine comitalia are closely attached to the long and stout rays of these principal spicules which form a tubular network or scaffolding with quadratic meshes lying close to the inner, gastral surface of the tube-wall. As the sponge grows, parallel layers of stout oxyhexactines, the number of which increases with the thickness of the body-wall, make their appearance.

The external, dermal membrane is supported by a layer of hypodermal oxyhexactines with spined, protruding distal rays. To these spicules slender diactine comitalia are attached. The internal, gastral membrane is supported

by very similar hypogastral oxyhexactines, to which also slender comitalia are attached.

The intermediary parenchymalia are represented by very numerous microsclere oxyhexasters and their derivates (in *H. fibulatus* simple sigms). Besides these also micro-oxyhexactines with stout, conical rays which show a tendency to bifurcation (*H. robustus*) are sometimes met with. Graphiohexasters with long brush-like end-tufts of branch-rays and calicocomes with tassel-like bunches of branch-rays, arranged in a ring and forming a bush, are always met with, although sometimes their number is but small. The floricoms and discohexasters present in the nearly allied genus *Malacosaccus*, are entirely absent in *Holascus*.

The long anchor-spicules of the root-tuft are mostly covered with recurved spines. Below, at their distal ends, they are thickened and bear 3–5, rarely 2, 6 or 7 stout, obliquely-recurved spines, which form the anchor-teeth.

The species of this genus hitherto known accordingly are simple tubes with root-tuft and terminal sieve-plate but without parietal apertures and superficial floricoms. All of them have been found in great depths.

Holascus robustus F. E. Sch.

Plate IX, figs. 1–10.

1895 *Holascus robustus* F. E. Sch. in Abh. Preuss. Ak. 1895, pp. 4–7, Taf. 1, figs. 1–10.

The fragmentary specimen on which I have based this species is a simple tube, 8 cm. long and 15 mm. broad. The body- (tube-) wall is somewhat lacerated but on the whole fairly well preserved and has a thickness of 2–2·5 mm. This fragment appears to represent the upper part of a sponge, about 10 cm. long, the terminal sieve-plate of which has been lost.

The outer surface has an irregular appearance because the thin dermal membrane is in most places lost and most of the subdermal cavities, and the incurrent canals arising from them, are therefore exposed to view. The entrances into the latter appear as pores. The inner, gastral surface has a very different appearance. Here we find a regular rectangular network with quadratic meshes, each of which is occupied by a pit. These pits are arranged in regular longitudinal and transverse rows.

The structure of the soft parts can be well made out in stained sections, vertical to the surface. In such, one sees that the ciliated chambers are either thimble-shaped, or assume more complicated shapes in consequence of the formation of diverticula by the membrana reticularis. They are arranged radially round the short excurrent canals which lead into the central gastral cavity, into which they open directly with wide mouths,—the pits in the meshes of the gastral

reticulation described above. Their convex distal ends protrude into the subdermal cavities and the incurrent canals, which appear as narrow continuations of the latter.

The main supporting skeleton appears as a tubiform network, which lies close and parallel to the inner (gastral) surface of the tubular sponge. The strands or beams composing it are about 300 μ thick. Its meshes are rectangular, often quadratic and 2–3 mm. wide. The strands consist of the rays of the stout principal stauractines and the slender comitalia attached to them, which are parallel and close together and form dense bundles. These stauractines are the largest spicules of the sponge. Two opposite rays of each stauractine extend transversely, the other two longitudinally. The former are on an average 5, the latter 10–12 mm. long. The rays are, near the centre of the spicule, about 100–150 μ thick (pl. IX, f. 8) and gradually attenuated towards the sharp-pointed end. The rays of the comitalia are 6-12 μ thick and as long as those of the principalia to which they are attached. The free ends of the comitalia-rays are conically pointed, often a little thickened, and generally covered with small tubercles or spines. Most of the comitalia are sagittal triactines with longitudinally-extending paired rays; the unpaired ray is vertical to the other two and extends transversally. It may be straight and form part of a transverse bundle in its entire length (pl. IX, f. 9), or it may be abruptly bent under a right-angle near its origin and form part of the same longitudinal bundle in which the two other rays lie (pl. IX, f. 10). Also diactine comitalia are very numerous. Both these and the triactine comitalia possess rudiments of the missing rays of the ideal hexactine, which appear as small tubercles or rounded protuberances (pl. IX. f. 9, 10).

Among the principal parenchymalia numerous macrosclere **oxyhexactines** with gradually attenuated rays, 500–1000 μ long, are also met with. These lie in a single layer outside the main skeleton-net, two opposite rays being vertical to the axis of the sponge. The radial rays of the hypodermalia attach themselves closely to the distal, radial rays of the parenchymal oxyhexactines.

The hypodermalia and hypogastralia require a detailed description. Both are regularly arranged in equidistant transverse and longitudinal rows and form a very graceful mosaic. The freely projecting distal hypodermalia- and proximal hypogastralia-rays are usually accompanied by one or more slender diactine comitalia. The stout distal rays of the **hypodermalia** protrude freely from the outer surface, which is raised in the shape of small cones at the points of egress of these rays. They are about 230 μ long, slightly thickened in a spindle-shaped manner above the middle, and end with conic points. Basally they are smooth, further up covered with low, oblique spines pointing outwards. The proximal ray is not quite so thick as and is considerably longer than the distal ray. It measures 500 μ and more in length, is smooth, and gradually attenuated

towards the pointed end. The four tangential rays which lie just below the dermal membrane are also smooth, pointed, gradually attenuated and about 200 μ long.

The stout **hypogastralia** which lie opposite the hypodermalia are in many respects similar to the latter but differ from them considerably by their proximal rays being much longer (350 μ and more) and usually of a different shape. These rays are spined and protrude freely into the gastral cavity. At the points of egress they raise the gastral wall to form slender, conical protuberances. The whole of the proximal ray is covered with vertical spines and there is generally no spindle-shaped thickening in its central part. Like the other five smooth rays of the spicule it is gradually attenuated towards the sharp-pointed end.

In the lower part of the specimen basal anchor-spicules are met with here and there, between the longitudinal rays of the principalia which form the supporting skeleton-net. Although pretty slender these spicules are inflated at the distal end, club-shaped, and emit from the terminal thickening a verticil of a varying number, often three oblique and recurved anchor-teeth. These teeth contain no axial threads and are therefore not to be considered as rays but as mere spines. The axial cross does not lie in the terminal thickening near the place of insertion of these teeth, but higher up in the shaft (pl. IX, f. 6).

Four different kinds of intermediary parenchymalia are to be distinguished: slender oxyhexasters; stout-rayed micro-oxyhexactines, the rays of which show a tendency to bifurcation so that they pass into oxyhexasters; graphiohexasters or, as I now prefer to designate them, graphiocoms; and calicocoms.

The **slender oxyhexasters** are abundant in the walls of the incurrent system. They have short main-rays which are not thick, and terminally bear three or more thin, straight or slightly curved branch-rays (pl. IX, f. 5).

The **oxyhexactines** and the **stout oxyhexasters** they pass into, are restricted to the walls of the excurrent system. They have remarkably thick, conic rays and measure 100–150 μ in diameter (pl. IX, f. 2–4).

The **graphiocoms** are not very frequent and chiefly met with in the subdermal region. In my preparations the branch-rays forming the long terminal brushes are generally broken off, so that one usually sees only the six-rayed cross formed by the main-rays with their terminal discs which bear on the convex outer surface numerous stumps of the branch-rays which have been broken off (pl. IX, f. 7*a*). Usually one finds in the vicinity of these the long slender, straight, raphid-like branch-rays, either still joined in brushes, or isolated and scattered.

The calicocoms, which differ from the graphiocoms in several respects, are not numerous and rather irregularly scattered. They are chiefly met with in the subgastral, more rarely in the subdermal region, and measure about 200 μ in diameter. Their principal features are the conic, externally calyx-like, solid thickenings at the ends of the stout and short main rays and the flower-like verticils of slightly rough branch-rays curving gracefully outward which arise from the latter. These are of medium length and uniform thickness throughout; they arise in *Holascus robustus* exclusively from the circular margins of the terminal thickenings of the main-rays and accordingly form simple verticils (pl. IX, f. 7). In the calicocoms of other species of *Holascus* they arise from the whole of the distal surface of the terminal thickening and accordingly form solid brushes.

The only specimen of *Holascus robustus* was found in the Bay of Bengal 12° 20′ N. 85° 8′ E. in a depth of 3300 m. = 1803 fths.

Holascus tener F. E. Sch.

1895 *Holascus tener* F. E. Sch. in Abh. Preuss. Ak. 1895 pp. 7–9.

The lower part of a tube, 12 mm. wide, with a wall 2 mm. thick, is for a length of 55 mm. sufficiently well preserved to enable one to recognise the principal features of its structure. From the slightly attenuated lower end a basal root-tuft about 15 mm. long and in structure like wickerwork, arises. This tuft probably represents only a small part of the root-tuft of the living sponge the length of which, in the fresh state, I estimate at 8–10 cm. Macroscopically the sponge does not essentially differ from *H. robustus*. Also here one sees on the outer surface through the dermal membrane, of which only small parts are intact, the apertures and canals which lead from the subdermal cavities into the interior of the sponge, whilst the inner surface of the tube-wall shows a quadratic reticulation with meshes containing the openings of the excurrent canals into the central cavity, arranged in longitudinal and transverse rows.

The stout principal spicules of the tubular main skeleton are in *H. robustus* exclusively stauractines (pl. IX, f. 8), in *H. tener* nearly always pentactines, four rays of which are similar to the rays of the stauractines of *H. robustus* and arranged in the same manner. The fifth ray is vertical to the four others and directed outwards; it attains a length of 360 μ and nearly reaches the outer surface. Only very rarely I found, here and there, instead of such a pentactine, a stauractine. Attached to these stout principalia, similarly shaped and arranged, long triactine and diactine comitalia are met with, as in *H. robustus* (pl. IX, f. 9, 10). The macrosclere oxyhexactines, abundant in *H. robustus* and there forming a layer outside the main tubular reticulation, are absent in *H. tener* and are here probably functionally replaced by the distal rays of the pentactines in the main tubular skeleton-net.

The hypogastral **hexactines** are on the whole similar to those of *H. robustus*. The hypodermal hexactines differ from the corresponding spicules of that species however by the greater length of their inner, gastral, radial ray, which is 2 mm. long. Also this difference is correlated with the absence of parenchymal hexactine supporting spicules.

The root-tuft is in great part composed of the lower longitudinal rays of principal pentactines. Its anchor-spicules agree with those of *H. robustus*.

Of the intermediary parenchymalia of *H. robustus* the stout micro-oxyhexactines and the oxyhexasters they pass into, are absent. The **slender oxyhexasters** are, on the other hand, present in much greater numbers than in *H. robustus*. These differ from the corresponding spicules of the latter only in the curvature of the branch-rays which are nearly straight and not nearly so strongly bent as in *H. robustus*.

Graphiocoms are not numerous and are irregularly scattered through the dermal region. I have seen several intact ones with dermal brushes of branch-rays 200 μ long in situ, still attached to the main-rays.

In the subdermal and particularly in the subgastral region irregularly scattered **calicocoms** are found in small numbers. These are identical with those of *H. robustus*.

Only the lower part of a single specimen of this species is contained in the "Investigator" collection. This was found in the Bay of Bengal 6° 18′ N. 90° 40′ E. in a depth of 2506–2816 m. = 1370–1540 fths.

Euplectella, R. Owen.

The sponges belonging to this genus are tubular, have a root-tuft, a terminal sieve-plate, and numerous parietal apertures. Parenchymal oxyhexasters are usually present in the interior and floricoms always occur on the surface. Three species, *E. simplex*, *aspera* and *regalis* have been added to this genus by the "Investigator" expedition.

Euplectella simplex F. E. Sch.

Plate X.

1895 *Euplectella simplex* F. E. Sch. in Abh. Preuss. Ak. 1895 pp. 15–26, Taf. X.

In the "Investigator" material there are 10, unfortunately only indifferently preserved specimens of a hitherto undescribed species of *Euplectella*, which in external appearance and in structure closely resembles *Euplectella oweni* Marsh. and Herkl. but which essentially differs from this well known Japanese

form by the complete absence of the parenchymal oxyhexasters, which are so exceedingly abundant there.

Most of these 10 specimens fortunately represent different stages of developement, so that they afford an opportunity for ascertaining some facts concerning the developement, at least the post-embryonic developement in Hexactinellids, of which so very little is known. Before entering on this subject, however, I will give a diagnosis of this new species by describing its shape, its structure, and particularly its spiculation.

One of the specimens, the lower end probably of a fullgrown individual, is 8 cm. long. The upper part has the appearance of a funnel-shaped tube, 3 cm. wide. Below, it passes into a root-tuft, destitute of the soft parts (pl. X. f. 5).

The specimen next in age which is fairly complete—only the terminal sieve-plate and some parts of the lateral wall being lost—is, exclusive of the root-tuft, 11 cm. long. The body is, one-third of its length from the top, 25 mm. broad, and tapers slightly towards the upper, more considerably towards the lower end (pl. X, f. 6).

A third, still better preserved specimen, represented in fig. 4 on plate X, is, exclusive of the root-tuft, 9 cm. long and has a maximum breadth of nearly 2 cm. The terminal sieve-plate is well preserved and measures 10 mm. in diameter.

The fourth specimen is, exclusive of the root-tuft, 75 mm. long and up to 15 mm. broad.

Then there are five more or less injured specimens, 4–5 cm. long and about 1 cm. broad (pl. X, f. 2, 3).

The smallest specimen is, exclusive of the root-tuft, 3 cm. long and throughout its length pretty uniformly 5 mm. broad (pl. X, f. 1).

In the external appearance and in the macroscopic characters of its internal structure, *Euplectella simplex* is very similar to the doubtless closely-allied species *Euplectella oweni* Marsh. and Herkl., which was first described in detail and figured by W. Marshall in 1875 in his "Untersuchungen über Hexactinelliden" (Zeitschr. wiss. Zool. Bd. XXV, Suppl. Taf. XII D). The tubular body is in *Euplectella simplex*, as in *E. oweni*, extended a little in the middle and very slightly constricted above. The upper end is for some distance cylindrical. The wall of the sponge-tube is pretty thin, and perforated by numerous, circular parietal apertures, arranged fairly regularly in longitudinal and transverse rows. A collar surrounding the terminal sieve-plate as in *E. aspergillum*, is absent in *E. simplex* as in *E. oweni*. Its place is taken in *E. simplex* by the thickened margin of the terminal face, from which a verticil of short, oblique marginal spicules visible to the naked eye, protrudes obliquely.

The terminal sieve-plate is on the whole vertical to the axis of the sponge and strongly convex. It consists of a very irregular network of thin strands, thickened at the nodes, which enclose triangular to hexagonal meshes, 1–2 mm. wide.

The better the specimens are preserved the easier it is to make out the presence of a second, basal sieve-plate, similar to the one described by Marshall in *Euplectella oweni*. This basal sieve-plate has the appearance of a transverse, septum-like continuation of the lateral tube-walls and is also bent outwards, convex towards the base of attachment. Below the basal sieve-plate lies the free root-tuft, which is destitute of soft parts.

The main supporting skeleton consists of a tube-shaped network of spicular fibres, arranged strictly longitudinally and transversely and intersecting each other at right angles. In the central part of the body of larger specimens these are 3–6 mm. apart and up to 500 μ thick. The longitudinal fibres lie nearer to the outer, the transverse fibres nearer to the inner surface of the tube-wall and the latter protrude into the gastral cavity like internal hoops. The longitudinal fibres approach each other in the lower considerably attenuated part of the tubular sponge, and slightly also in the upper less attenuated part, which is at the top for some distance of uniform thickness and regularly cylindrical. The transverse fibres, which form the internal hoops, are throughout the sponge uniformly 3 mm. apart. Besides these longitudinal and transverse fibres there also exist thin fibres crossing the longitudinal and transverse ones under an angle of 45°. These are entwined with the latter and form two systems of spirals intersecting each other vertically. They are so arranged as to cut off the corners of the square meshes in the primary network composed of the longitudinal and transverse fibres and give to them an octagonal shape, as has first been clearly discerned in *Euplectella oweni* by W. Marshall.*

All the meshes of this parietal network are free from spicular fibres, and only covered by soft tissue, which can easily be perforated by indifferent parietal apertures. In *Euplectella aspergillum* and other species, the meshes of this primary network traversed or covered by spicular fibre, alternate with meshes not thus covered, both in the longitudinal and in the transverse direction. As the parietal apertures are restricted to the meshes not covered by spiral fibre, they are in these Euplectellids not situated side by side but are arranged like the black fields of a chessboard in oblique or diagonal, more correctly speaking, in spiral lines.

The spicules which compose this strong and elastic skeleton-net are in the older specimens to some extent glued together by silica. This concrescence is not carried so far however as in *Euplectella aspergillum*, where it leads to the

* "Untersuchungen über Hexactinelliden" in Zeitschr. wiss. Zool. Bd XXV, Suppl.

formation of a continuous and firm skeleton-net; nevertheless one often finds adjacent spicules connected by synapticula so as to form ladder-like structures. In respect to the developement of these secondary skeletal structures *Euplectella simplex* stands on a level with *Euplectella oweni*.

The most conspicuous spicules of the supporting skeleton are the stout and long **stauractines**. In older specimens these measure 8 cm. and more in length and 2 cm. and more in breadth. The thickness of their rays generally depends on the age of the sponge. The thickest measure basally 100 μ in diameter. The centres of the stauractines usually lie in the nodes of the skeleton-net. The longitudinal spicular fibres are nearly straight, the transverse fibres ring- or hoop-shaped. The longitudinal rays of the stauractines lie in the former and are also straight accordingly; their lateral rays lie in the latter and are accordingly also circularly curved and concave towards the axis of the sponge. Thus the rays of the stauractines do not lie in a plane but in a cylinder-surface; they are smooth, round, and gradually attenuated towards the sharp-pointed end.

To each of these principal spicules 10-30 much thinner and very long accompanying spicules—**comitalia**—are attached. The longest rays of the comitalia are situated longitudinally and transversely, mostly parallel to the rays of the stout principalia. Most of the comitalia are triactines, diactines are however also numerous; occasionally pentactines or even hexactines are met with. In the spiral spicular fibres the comitalia are not so numerous as in the longitudinal and transverse ones. Those rays of the triactine to hexactine comitalia, which are not parallel to the rays of the principalia are much shorter than the others and not unfrequently curved. Sometimes they reach another parallel fibre and then, bending round abruptly, follow it; sometimes they extend radially through the parenchyme, either towards the outer or towards the inner surface of the tube-wall and form a support for the soft parts overlying the inner and the outer side of the main skeleton-net. These radial comitalia-rays are generally conically pointed and slightly inflated and roughened just below their end.

In the irregular skeleton-net of the terminal **sieve-plate** no differentiation between stout principalia and slender comitalia is observed and the large stauractines are absent. The strands of the skeleton-net in the sieve-plate are composed nearly exclusively of triactines and diactines with long rays. The latter usually have a central thickening. Besides these spicules also numerous oxyhexactines of the same kind as those forming the support of the parenchyme overlying the skeleton-net, are met with.

The soft parts on the inner and outer side of the main skeleton-net are supported by the gastral and dermal comitalia-rays which do not take part in the formation of fibres; by the radial rays of the hypodermalia and hypogastralia; and by numerous **parenchymal oxyhexactines** four rays of which are parallel and two rays of which are vertical to the inner and outer surfaces of the tube-wall.

These oxyhexactines, which can, in consequence of their large size be considered as principalia, form a single layer on each side of the main skeleton-net. Their rays are vertical to each other, two opposite ones being situated longitudinally, parallel to the axis of the sponge. The oxyhexactines measure 400–500 μ in diameter and their rays are round, smooth, straight or slightly curved, near the centre 8–10 μ thick and gradually attenuated towards the sharp-pointed end (pl. X, f. 7).

The **hypodermalia** are stout, sword-shaped hexactines and resemble in their general character and in the thickness of their rays the parenchymal oxyhexactines described above. They differ from them however in that their rays are unequal in length and terminally roughened. This roughness is often very slight; it is most clearly marked on the outer, radial ray, which protrudes beyond the surface, where it occasionally extends right down to the vicinity of the centre of the spicule. This distal ray and the four paratangential rays which lie below the dermal membrane are about 250 μ long. The proximal radial ray, which points inward and penetrates the parenchyme, is 1000–1200 μ long and its pointed and roughened end nearly reaches the main skeleton-net.

The **hypogastralia** are similar to the hypodermalia but much shorter and destitute of a proximal, radial ray. They are accordingly, as in all other known species of Euplectella, **pentactines** (pl. X, f. 7). It is to be remarked that the four transverse (basal) rays which lie in, or just below, the gastral membrane, are in most regions, if not everywhere, slightly curved, concave towards the body of the sponge-tube-wall.

The main skeleton-net lies considerably nearer to the inner than to the outer surface of the tube-wall, the parenchyme overlying it on the outer dermal side being twice as thick as that overlying it on the inner, gastral side. In the superficial layer of the outer parenchyme **graphiocoms**, with branch-ray-brushes 200 μ long and 16 μ thick (pl. X, f. 11) are met with.

As a rule one **floricom** is attached to the protruding, distal ray of each sword-shaped hypodermal oxyhexactine. The floricoms bear on each of their 6 main-rays 7–9 (usually 8) branch-rays, arranged like the calyx of a flower. The thickened terminal discs of the branch-rays have about 8 fairly stout marginal teeth on the outer border (pl. X, f. 8–10). The whole floricom measures on an average 120 μ in diameter.

The **basalia-spicules** of the root-tuft arise from the longitudinal spicular fibres of the main skeleton-net and are several centimeters long. Two kinds of basalia, both anchor-shaped but essentially different, are to be distinguished. The basalia, of the first kind are smooth-rayed **pentactines** which have the shape of tetradentate anchors. One of their rays, the main ray, which forms the anchor-shaft is situated longitudinally, directed upwards, very long and pointed at the distal, upper end. The four other rays, which form the anchor-teeth, are

arranged crosswise, vertical to each other, much shorter than the main-ray but very stout and gradually attenuated to the pointed end. They are strongly curved, the two pairs of opposite ones forming semicircular bows, the concavity of which is directed shaftwards. It is to be remarked that both the main ray and the four lateral rays forming the anchor-teeth, which arise from the main-ray with trumpet-shaped extensions, are traversed by axial threads throughout their entire length (pl. X, f. 12).

The basalia of the second kind are **diactines**. They have the appearance of a long shaft, pointed at the upper end, which is however not so thick as the main-ray of the pentactine anchors. With the exception of the distal end, the shaft is covered in its entire length with slightly curved spines, directed backwards (upwards). The distal (lower) end is thickened and club-shaped. From the equator of this terminal inflation a verticil of 6–10 spade-like teeth which are bent upwards, arise (pl. X, f. 13). These teeth have nothing to do with rays; they are mere spines, comparable to the thorns projecting in great numbers from the upper part of the shaft. That it is so, is shown not only by their similarity with the latter but also, and still more clearly, by the variability of their number, by the absence of axial threads and particularly by the fact that the axial cross of the central canal of the shaft usually does not lie in the terminal inflation from which they arise but higher up in that portion of the shaft which is free from spines. Sometimes a slight swelling indicates the position of the axial cross: that is the centre of the spicule. In the terminal inflation the central canal dissolves itself into a bush of short terminal branches.

Having now described the adult sponge I will give the results of a comparison of those structures of the differently aged specimens at my disposal, which are of interest in studying its post-embryonic developement.

In the external shape of the entire sponge only very slight differences are to be discerned between differently aged individuals. The smallest specimens differ from the larger ones chiefly in their being on the whole more slender. The ratio of breadth and length (exclusive of the root-tuft) is in the smallest specimen 1: 6, in the largest one, preserved in its entire length, 1 : 5. It appears probable however that still larger specimens again revert to a breadth- and length-ratio similar to that of the smallest ones. As in *Euplectella oweni*, the larger specimens have an oval (ratio of axes 3 : 5) and not a circular transverse section. The small specimens at my disposal, on the other hand, have a circular and not an oval transverse section.

I took particular interest in the arrangement of the spicular fibres in the main skeleton-net of differently aged specimens because I hoped, by studying it, to gain an insight into the mode of growth of the sponge.

As was to be expected, the corresponding principalia are longer and thicker in older than in younger specimens. They grow with the age of the sponge

by the apposition of fresh layers of silica in length and in breadth. The silica-layers precipitated on the surface of the growing spicule have the shape of cylindrical tubes or rather long, hollow cones, closed at the narrow end and there attenuated to a point. Their lower tubular part is apposed to the sides of the ray and causes its growth in thickness, the solid pointed terminal part covers the old termination of the ray and causes its growth in length.

Here and there adjacent spicules are secondarily glued together. This process commences with a mere local concrescence of silica-layers apposed to different spicules and is then carried on by the deposition of fresh silica-layers on the place of junction, this being thus converted into a stout bridge or column, the synapticulum. If the parts of spicules (rays) thus joined lie parallel to each other and if, as is the rule in such cases, a number of synapticula are formed at nearly equal intervals, those well known ladder-like structures are produced, which are so well developed in the long and thin peduncles of *Caulophacus* and other Rossellids. In *Euplectella simplex* as in *E. oweni* such synapticular junctions of spicules are however rather scarce and, even in older specimens, generally met with only near the lower end of the body.

To obtain a clearer insight into the mode of growth I have tried to ascertain the number and arrangement of the transverse and longitudinal spicular fibres of the main skeleton-net in all the specimens preserved in their entire length. In these I find that the number of both the transverse and the longitudinal fibres distinctly increases, although not very greatly, with increasing age. In the smallest specimen at my disposal, which is 30 mm. long and 5 mm. broad, there are 25 transverse fibres and, in the middle of the body, 28 longitudinal fibres. In the largest one preserved in its entire length, which is 11 cm. long and 25 mm. broad, I counted 40 transverse, and, in the corresponding central part of the body, 30 longitudinal fibres. In the following fractions, arranged in order of the size of the specimens (increasing from left to right) the upper figures give the number of transverse and the lower figures the number of longitudinal fibres:—

$$\frac{25}{28} \quad \frac{25}{28} \quad \frac{26}{28} \quad \frac{32}{32} \quad \frac{36}{32} \quad \frac{40}{30} \quad \frac{}{31}$$

We see that the transverse fibres increase in number pretty considerably (from 25 to 40) and the longitudinal fibres only slightly, during the period of growth represented by the specimens at my disposal.

As regards the position of the fibres, particularly the distances between adjacent ones in different parts of the sponge-body, one finds that the parallel fibres retain their position and only move further apart and increase in thickness during the growth of the sponge. The increase of the distance between the longitudinal fibres is perfectly uniform throughout the length of the sponge,

the ratio of augmentation of the fibre-intervals being nearly the same in the upper, central, and lower part of the body. In a specimen 45 mm. long the longitudinal fibres are 500 μ apart above, 1 mm. apart in the inflated centre and 500 μ apart at the lower end, just above the root-tuft. In a specimen 11 cm. long their distances are 1 mm. above, 2·5 mm. in the centre and 1 mm. below. With the transverse fibres it is somewhat different, in as much as the distances between them increase, at least in young specimens, gradually from the upper to the lower end of the body. In a specimen 45 mm. long, for instance, the interval between the transverse fibres is in the upper cylindrical part of the body 200–400 μ, between the upper and middle third of the length 1, 5 mm. in the centre 2 mm. and at the lower end 2·5 mm. In the larger specimens the distance between the transverse fibres increases continuously from the upper end to the centre, whilst it remains pretty constant from there downwards. In the specimen 11 cm. long, the transverse fibres are in the upper, cylindrical part of the body, on an average 1 mm., between the upper and central third 2 mm., and in the centre and from there downwards 5 mm. apart. The cause of this remarkable difference in the arrangement of the longitudinal and transverse fibres must be sought in the mode of growth of the sponge and particularly in the difference of the regions, where the two kinds of fibres originate.

The fibres multiply by fission, the daughter-fibres subsequently moving away from each other. This can be gathered from the fact that one occasionally finds bifurcated fibres, the simple stem of which is broad, and pairs of fibres of the ordinary dimensions, quite close together, arrangements which differ very essentially from the ordinary skeletal structure described above. It is remarkable that the fissional structures of the longitudinal fibres are rare and quite irregularly distributed, whilst transverse fibres multiplying by fission are pretty frequently met with, three or four dividing transverse fibres being usually found in each specimen. These are generally restricted to the upper part of the body, in which these fibres are thinner and closer together than elsewhere. It follows from this that the growth of the sponge in thickness is accompanied by an increase of the distance between the longitudinal fibres and an occasional fission of one or another of them, and further that the multiplication of the longitudinal fibres by fission is not localised. The growth of the sponge-body in length is on the other hand accompanied by an increase of the distance between the transverse fibres particularly in the upper part of the body, and a multiplication of them by fission, which is pretty much restricted to that region. All the parenchymal principalia are much longer and stouter in the lower than in the upper part of the tubular body, the shortest and most slender principalia of every kind being met with at the upper end, just below the marginalia-verticil. From this it follows that the lower part of the body is older than the upper and that the summit is the youngest part of the whole sponge.

The comparison of sieve-plates of specimens of different ages shows that their growth is accompanied by a growth of the parenchymal principalia in length and thickness and an increase of the width and number of the meshes. The strands forming the sieve-plate-net become broader and then multiply by fission, and new strands are formed, which cut off corners of the old meshes.

I consider it to be of great importance that the spicules of the gastral and dermal membranes, and the microscleres generally, particularly the graphiocoms and floricoms, have in all the specimens at my disposal the same shape and size, and that they are in the smallest (youngest) specimens only somewhat tender and more slender than in the larger (older) individuals. Everywhere, also in the older specimens, fresh spicules are constantly being formed. These have very slender main- and branch- rays and are remarkable for the slight development of their stouter parts, as for instance the hand-like terminal discs of the floricoms (pl. X, f. 9. 10). Such slender young spicules are more abundant in young specimens than in older, particularly in perfectly fullgrown ones.

All the 10 specimens of *Euplectella simplex* were found near the Andamans, 8 (5 small and 3 larger ones) 33km. to the west of middle Andaman Island in a depth of 457 m.=250 fths., and the other 2 (1 small one and 1 half of a large one) between North- and South-Sentinel Island in a depth of 402–439 m.=220–240 fths.

Euplectella aspera F. E. Sch.

Plate XI.

1895 *Euplectella aspera* F. E. Sch. in Abh. Preuss. Ak. 1895 pp. 26-29 Taf. III.

Under the name *Euplectella aspera* I have described a species of Euplectella from the Indian Ocean, of which only two incomplete specimens were contained in the collection. The smaller specimen, the soft parts of which are fairly well preserved, is 5 cm. long and has a maximum breadth of 2 cm. It represents the lower half of a straight, slightly inflated, tubular body to the under end of which a short, torn remnant of a root-tuft is attached.

The parietal apertures measure about 3 mm. in diameter, are rather distant, circular or oval, and arranged, as in *Euplectella suberea* Wyv. Thomson, not in transverse and longitudinal, but in spiral rows. The similarity to the Atlantic *E. suberea* is increased by the presence of numerous radial spines, 5 mm. long, projecting freely from the outer surface. These are arranged regularly, and arise from the crossing-points of the numerous longitudinal and transverse spicule-fibres of the main skeleton-net. Another point of similarity between the two species is the rough tuberculous, "cork-like" structure of the wall of the tubular sponge, which is 2-3 mm. thick (pl. XI, f. 1, 3).

The other specimen, the soft parts of which are not so well preserved, is 11 cm. long, has a maximum breadth of 3 cm. and is on the whole similar to the one described above. In consequence of its greater age the parietal apertures are farther apart and also a little larger. The root-tuft is over 2 cm. long and comparatively well preserved. Its lower end is anchored to a mass of thin and long worm-tubes (pl. XI, f. 1).

Most of the principalia-spicules of the skeleton-net supporting the tube-wall are stout **oxystauractines** and **oxyhexactines**. The longitudinal rays of these spicules lie nearer to the outer, the transverse rays nearer to the inner surface of the tube-wall. The former are 1–3 mm. long, the latter shorter. In the longitudinal and transverse fibres composing the skeleton-net, hexactines and stauractines alternate regularly, so that every second crossing-point of the fibres is formed by the centre of one of the former and every other by the centre of one of the latter. The radial, distal rays of the stout principal hexactines form the spines above described, which protrude from the outer surface. They are 5 mm. long, smooth at the base, and spined in the distal, freely projecting part. Below, the spines are quite short, further on they become higher, but towards the distal end they are again reduced in length. The proximal radial ray, lying opposite to the distal one, is comparatively small and appears rudimentary. It is 500 μ long, smooth, and rapidly attenuated to a blunt, sometimes slightly inflated end (pl. XI, f. 5,7).

Thin comitalia accompany the principalia of the tube-wall in not very great numbers. They are mostly triactines, with two long rays extending in a straight line and a third, much shorter one, vertical to the other two. Also diactine, stauractine, pentactine and hexactine comitalia are met with. The rays of the comitalia end nearly always with a slight tuberculous, club-shaped terminal inflation. The numerous oxydiactines attached to the distal protruding rays of the hexactine principalia are also to be considered as comitalia. They are about 500 μ long, slightly rough and have in the middle an elongated, spindle-shaped, not sharply defined thickening. These spicules are slightly spirally twisted and firmly cling to the spined, distal parts of the projecting radial rays of the hexactine principalia, which they entwine (pl. XI, f. 4, 5).

The root-tufts of the older specimen is 2–3 cm. long. They are composed of the same well-known two kinds of anchor-spicules which are met with in *Euplectella aspergillum* and *Euplectella simplex* and which have been described above in the latter. It is probable that the root-tuft is in all Euplectella-species composed of such spicules.

The stout, sword-shaped, hexactine supporting-spicules of the dermal membrane, the **hypodermalia**, and the more slender pentactine supporting-spicules of the gastral membrane, the **hypogastralia**, do not essentially differ in shape,

size and arrangement from the corresponding spicules of other species of Euplectella, particularly *Euplectella simplex*, described above (pl. XI, f. 4).

The same can be said of the parenchymal **graphiocoms**, which also here occur irregularly scattered, but always vertical to the surface, not very frequently in the external region of the body, in the vicinity of the dermal membrane (pl. XI, f. 4).

On the other hand the parenchymal **oxyhexasters**, absent in *Euplectella simplex*, are present in *E. aspera* and are here pretty uniformly distributed throughout the parenchyme. They measure 120 μ in diameter, are characterised by the remarkable tenderness of their main- and branch-rays, and generally bear three or four quite smooth and slightly curved branch-rays on each main-ray (pl. XI, f. 8).

The **floricoms**, one of which is attached to the distal ray of each sword-shaped hypodermal, measure 120 μ in diameter. Each one of their short main-rays bears 8–12 branch-rays so arranged as together to represent a flower-calyx. The terminal discs of the branch-rays are convex and bear on their outer, free, semicircular, sharp margin a considerable number (about twelve) of small pointed teeth (pl. XI, f. 9). Among these normally developed floricoms with thick terminal discs, sometimes also floricoms are met with the branch-rays of which are much thinner and do not bear a nearly hemispherical end-plate, but terminate with slightly club-shaped thickenings, without discs or marginal teeth (pl. XI, f. 10). I am not inclined to consider these spicules as a special kind of floricom, but suppose them to be young stages of the ordinary floricoms above described. This view is supported by the fact that there exist transitional forms connecting these disc-less floricoms, the branch-rays of which are simply pointed, with the disc-bearing floricoms of the usual form represented in fig. 9; and that the few disc-less floricoms do not differ in size, distribution or position from ordinary floricoms.

Only two specimens of this species are known. The smaller one, represented in figs. 1 and 2 on plate XI in natural size, was found in the most southerly part of the Bay of Bengal 60° 18′ N. 90° 40′ E. in a depth of 2506–2816 m.= 1370–1540 fths. The larger specimen, represented in fig. 3 on plate XI, was found in the Laccadives 11° 12′ 47″ N. 74° 25′ 30″ E. in a depth of 1830 m.= 1000 fths.

Euplectella regalis F. E. Sch.

Plate XXII, figs. 1–9.

1900 *Euplectella regalis* F. E. Sch. in Abh. Preuss. Ak. 1900 pp. 24–30, Taf. VI, figs. 1–9.

There is in the "Investigator" collection a single specimen, fairly well preserved in spirit, of a new species of Euplectella, allied to Ijima's *Euplectella*

imperialis. It has the appearance of a rather soft, straight and slightly-inflated tube with circular transverse section. The terminal sieve-plate is only slightly convex and is surrounded by a collar 5 mm. high, which thins out to a sharp margin and is nearly vertical to the axis of the sponge. The slightly attenuated lower end of the body is continued into a root-tuft, composed of a felted mass of spicules. The total length, inclusive of the root-tuft, is about 40 cm. the maximum transverse diameter of the central part of the body is 7 cm. The upper end is 7 cm., the lower end 6 cm. and the root-tuft 4·5 cm. broad.

The wall of the sponge-tube is 2–3 mm. thick and perforated by numerous, circular parietal apertures with smooth margins. These are situated at the bases of crater-like depressions of the outer surface. The latter has a reticular structure, whilst the inner surface of the tube-wall appears smooth. The parietal apertures are surrounded by iris-like, annular membranes of varying breadth. Although the position of these apertures is not quite regular, yet one can see, that they are on the whole arranged in longitudinal and transverse rows, crossing each other at right angles, at least in the upper and central parts of the body (pl. XXII, f. 1, 2).

The size of these parietal apertures, and their distance from each other, increases pretty uniformly from the upper to the lower end of the sponge. Just below the collar surrounding the terminal sieve-plate they are hardly 1 mm. wide and only 2 mm. apart. In the lower part of the body they are often over 2·5 mm. wide and 6–8 mm. apart. Between them sharp ridges and crests of variable height (3–6 mm. and more) protrude from the outer surface. These extend transversely or obliquely in diagonal, low spirals, more rarely longitudinally, and anastomose frequently; here and there they dissolve themselves into rows of conic protuberances; generally speaking they are very irregularly developed. On the whole these protuberances are higher on the upper and the lower than on the central parts of the sponge. On the outer surface small roundish pores, less than 500 μ broad and the same distance apart, the entrances to the incurrent canals, are everywhere visible through the tender dermal membrane. On the inner, gastral surface of the tubes one finds, between the parietal apertures, numerous, small, circular pores of varying diameter, the openings of the excurrent canals. These do not lie so close together as the incurrent pores of the outer surface. Often one sees a single or double longitudinal or transverse row of such pores up to 1 mm. wide and numerous more irregularly arranged, smaller pores, between the parietal apertures (pl. XXII, f. 2).

The terminal sieve-plate is convex, watch-glass-shaped and consists, as in all other species of Euplectella of an irregular network of flattened strands, lamellarly extended at some of the nodes. The meshes of this network are irregularly polygonal, more rarely rounded, and 2 to 5 mm. wide (pl. XXII, f. 8).

The tough basal root-tuft, which arises from the longitudinal spicular fibres of the lower, attenuated, funnel-shaped end of the sponge-tube and forms further down a compact bundle of fibres in no way differs from the root-tufts of other Euplectella-species, *Euplectella aspergillum* for instance.

The whole of the tubular sponge is soft and, particularly in its upper and middle portion, so lax that it collapses on being removed from the liquid in which it is preserved. The lower, funnel-shaped, terminal part is harder.

The spicular fibres of the main supporting skeleton are 333–500 μ thick, arranged longitudinally and transversely and cross each other at right angles. These fibres are chiefly composed of stout **stauractines** with rays up to 200 μ thick. The longitudinal rays of these spicules are nearly straight and attain a length of several centimeters; in the lower part of the body they are as much as 5 cm. long. The transverse rays are curved in accordance with the curvature of the tube-wall in which they lie, and are rarely more than 3 cm. long. The transverse rays lie close to the inner surface of the tube-wall, the longitudinal rays are nearer to the outer surface: they lie on the transverse ones like rails on sleepers. To attain such a position outside the ideal cylinder-surface in which they would otherwise lie, the rays, particularly the transverse ones, are abruptly curved. A short distance from the centre of the spicule these rays are bent inwards towards the axis of the sponge, and then again outward, whilst the longitudinal rays often nearly retain their ordinary position in a straight line. I never found in these spicules a fifth distal ray; they are always strictly tetractine and never pentactine as the principalia of some other Euplectella species.

These principal stauractines are accompanied by varying numbers of much thinner, smooth and long triactine and diactine, closely attached **comitalia**. The rays of the latter terminate with slight club-shaped thickenings pointed at the end, and rough or covered with short spines. The triactine comitalia consist of two long opposite rays lying in a straight line and a third, much shorter ray, vertical to the other two and usually slightly curved.

The transverse and longitudinal spicular fibres are similar in composition, both consisting of the rays of the stout stauractine principalia and the slender comitalia described above. The intervals between the circular, hoop-like, transverse fibres are narrowest near the upper end of the sponge; downwards, towards the lower end of the body, they uniformly increase in breadth. The longitudinal fibres are furthest apart in the central, inflated part; upwards and downwards, towards the ends of the body, they approach each other. The rectangular meshes formed by these fibres are accordingly nearly quadratic in the upper and central part of the body, whilst they become considerably elongated towards the lower end. Where the longitudinal fibres have recently multiplied by fission and consequently lie nearer together, such elongated meshes are also seen in the central part of the body.

The diagonal spicular fibres form two systems of spirals in the tube-wall crossing each other at right angles. They partly extend outside of the longitudinal fibres and partly between the longitudinal and transverse ones and consist exclusively of long and thin triactines and diactines with terminally-thickened, club-shaped rays. They are usually arranged in such a manner, that they cut off the corners of the rectangular meshes of the primary network formed by the longitudinal and transverse fibres, leaving the central part of the mesh free, so that a parietal aperture can be formed in it. These systems of spiral fibres form a network with quadratic meshes, which lie obliquely side by side and are in the longitudinal and transverse directions in contact with each other by their corners. In each of these meshes of the spiral fibre-net alternately a mesh-centre and a node of the primary network of longitudinal and transverse fibres are situated. Sometimes branched spiral fibres take a considerable part in the formation of the supporting skeleton of the freely projecting crests and ridges on the outer surface.

Where the tube-wall passes into the terminal sieve-plate, which is nearly vertical to it, the stout stauractines are replaced by nearly equally thick, smooth triactines, pentactines or even unilaterally developed hexactines. One ray of these triactines extends longitudinally in the tube-wall, whilst the others, which diverge at right angles from it, lie in the margin. Three of the rays of the pentactines are arranged similarly to the rays of the triactines, the fourth ray extends radially and distally into the collar and the fifth ray radially and proximally into the terminal sieve-plate. The hexactines are similar in shape and position to the pentactines and differ from them only by the possession of a short, terminally thickened and club-shaped sixth ray, which lies opposite to the longitudinal ray extending downwards in the tube-wall. These principal supporting spicules of the margin are also accompanied by numerous thin, triactine and diactine comitalia.

All these supporting spicules can be firmly united by secondarily apposed masses of silica. This joining takes place in all the older parts of the body where the rays of adjacent spicules approach each other closely, parallel rays lying very near each other being usually joined by a series of synapticula so as to form ladder-like structures. This joining or glueing process advances in accordance with the age of the parts from the base of the sponge upwards. The funnel-shaped lower end of the body, which lies hidden in the midst of the upper part of the root-tuft, is consequently already supported by joined fibres and is hard and resistant at a time when the central and upper parts are still supported by isolated spicules only and consequently soft and resilient.

The spicules supporting the terminal sieve-plate are not joined by silica and differ considerably from the supporting spicules of the tube-wall. They are oxydiactines, angularly bent in the middle, and generally possess a more or less

clearly defined swelling at the point where the axial cross is situated. They are several (6 and more) mm. long and about 80 μ thick. The angle at which their two rays meet is exceedingly variable. Some of them are nearly straight (angle nearly 180°) others form, according to their position in the reticulating fibres supporting the sieve-plate, a blunt, right, or even an acute angle with curved apex. The spicules lying at the margin of the sieve-plate are usually rectangularly bent; one of their rays lies in the sieve-plate, the other in the tube-wall. The bulk of the fibres forming the supporting skeleton-net of the sieve-plate does however not consist of these stout principalia, but of the numerous, long and thin comitalia which form bundles, accompanying and enclosing the principalia. These comitalia closely resemble the comitalia of the tube-wall and are, like them, slender triactines and diactines, the latter however greatly predominating. Rarely similar, long stauractines, pentactines or hexactines are found in these fibres. Shorter and stout, scattered oxyhexactines and oxypentactines on the other hand are pretty frequent.

Here and there the elongated proximal rays of the rather stout, sword-shaped hexactine hypodermalia also take part in supporting the parenchyme; this is particularly conspicuous in the crests and ridges of the outer surface and in the marginal collar surrounding the sieve-plate.

Among the parenchymal, microsclere intermedia very tender and thin **oxyhexasters**, about 100 μ in total diameter, are to be mentioned, which occur sparsely scattered here and there. Each of the short and slender main-rays of these spicules bears 3 or 4 slender, slightly diverging branch-rays (pl. XXII, f. 6).

In the vicinity of the outer surface very few, singly scattered, slender **sigmatocoms**, which may perhaps lie in the dermal membrane itself, are met with. These measure 80 μ in diameter and their rather stout, cylindrical main-rays are about 8 μ long. Each main-ray terminally slightly extends and then divides into 6–8 thin branch-rays. The latter are arranged in a verticil, are curved in an S-shaped manner and together form a calyx of medium breadth. The outwardly bent basal half is very thin, thread-like, the inwardly-bent distal half is thickened in the middle and terminally pointed (pl. XXII, f. 5).

I particularly remark that I have not found in this species any of those larger parenchymal graphiocoms, formerly called graphiohexasters, which are met with in or below the dermal membrane in *Euplectella imperialis* Ijima and *Euplectella oweni* Marshall.

The sword-shaped, **hexactine hypodermalia** which typically form the main part of the dermal skeleton in all *Euplectellidæ* are met with everywhere below the outer surface. They differ from each other, however, considerably in size and in thickness. Their paratangential and proximal rays are for the most part smooth and only terminally rough or covered with stout spines, their free

distal rays are covered with short spines for the greater part of their length, frequently right down to the vicinity of the centre of the spicule. To this distal, radial, free ray rough, oxydiactine comitalia with a well defined, central, knot-shaped thickening are sometimes closely attached longitudinally. Generally however a typical floricom adheres to the pointed and roughened end of this distal ray. The **floricoms** measure 80–100 μ in diameter and bear 7–8 branch-rays on each main-ray. The branch-rays terminate in not sharply defined terminal discs, curved in a hand-like manner, with about 7 small, marginal teeth (pl. XXII, f. 3, 4).

The **hypogastralia** are always simple, smooth oxypentactines with a more or less elongated, radial and four equal basal rays, lying tangentially in the gastral membrane. Their length and thickness is subject to considerable variations.

The **oxypentactine canalaria** are similar in shape and position but not so large. These spicules not infrequently have a sixth ray which protrudes into the cavity of the canal, in which case they must, although this sixth ray is quite short, be considered as hexactines.

The hypogastralia of the iris-like membranes surrounding the parietal apertures are very peculiarly developed. They are here converted into stout pentactines or hexactines with short, thick and equal, conical rays only about 100 μ long (pl. XXII, f. 7). Also on the margins of the meshes of the terminal sieve-plate such pentactines and hexactines with short, strongly thickened, conic rays are met with. On the whole however the sieve-plate resembles the other parts of the body, both in the structure of its soft parts and its spiculation.

The **basalia-spicules**, of the root-tuft do not essentially differ from those of most of the Euplectella species. The well-known club-shaped anchors with several (5–12) smooth, recurved teeth are mumerous (pl. XXII, f. 9), but I have not been able to find the simple pentactine-anchors with axial canals in the four transverse rays, which occur in *Euplectella aspergillum* and *E. simplex*.

The Indian *Euplectella regalis* F. E. Sch. accordingly appears to be most closely related to the Japanese *Euplectella imperialis* Ijima, of which Ijima recently has published a detailed description in the Journal of the College of Science, Imperial University, Tokyo, Japan, Vol. XV, p. 59. The chief differences between the two are the following. All the large specimens of *Euplectella imperialis* are slightly bent in the central part of the body, the only known, doubtless full-grown specimen of *Euplectella regalis* is on the other hand quite straight. The stout and strong spicules of the iris-like annular membranes which surround the parietal apertures are hexactine in *Euplectella imperialis*, and mostly pentactine in *Euplectella regalis*. In the parenchyme of *Euplectella imperialis* numerous graphiocoms (graphiohexasters) are met with, in *Euplectella regalis* these spicules are absent.

The single specimen of *Euplectella regalis* was found near the Andamans 13° 27′ N. 93° 14′ 30″ E. in a depth of 741 m.=405 fths.

Regadrella O. Schmidt.

Firmly attached tubes with terminal sieve-plate and numerous circular parietal apertures; with oxyhexasters or oxystaurasters in the parenchyme and a floricom attached to the distal ray of each one of the sword-shaped oxyhexactine hypodermalia.

Regadrella decora F. E. Sch.

Plate XXII, figs. 10–18.

1900 *Regadrella decora* F. E. Sch. in Abh. Preuss. Ak. 1900 pp. 30–34 Taf. VI figs. 10–18.

The fragments on which this species is based would hardly have sufficed for a proper specific diagnosis if they had not contained those peculiar spicules, previously only known from *Regadrella okinoseana*, where they have been described by Ijima as oxystaurasters (formerly oxytetrasters), in the Journal of the College of Science, Imperial University, Tokyo, Japan, Vol. XV. p. 237. I will here give the abridged diagnosis of *Regadrella okinoseana* published by him preliminarily in the Zoologischer Anzeiger for 1896, Nr. 504.

"Similar to *Regadrella phœnix* in form and in general arrangement of the "spicules, but with the following characteristic features:

"The spaces between parietal openings (up to 3 mm. in diameter and 3–15 "mm. distant from one another) are elevated into irregular ledges and protuber- "ances that may attain a height of 20 mm. A broad cuff surrounds the arched, "terminal sieve-plate.

"Distal ray of sword-shaped hypodermals short and mostly rounded at end "This and paratangentials sparsely beset with prickles near ends.

"Among the parenchymal diacts, there occur in abundance oxyhexacts with "finely spinous rays of 0·055–0·14 mm. length.

"Rosettes are present in three forms: (1) oxytetrasters * or occasional "oxyhexasters, (2) graphihexasters, and (3) floricoms. In what I have called "oxytetrasters * the principals form a regular cross and the terminals, usually 4 "in number to each principal, end in a point after a diverging, somewhat wavy "course. Floricoms similarly shaped as in *R. phœnix*.

"Of several specimens collected, but one is in a perfectly uninjured condi- "tion. The latter is 185 mm. long and 77 mm. broad at the cuff."

* Subsequently in Journ. Coll. Sci. Tokyo, Vol. XV. p. 237 termed oxystaurasters.

My material consists of the caliculate, basal part represented in fig. 10 on plate XXII, which is attached to a piece of coral by a tough basal plate; and of some loosely joined fragments of the tubular, lateral wall of the sponge-body.

In the wall of the slightly laterally compressed basal calyx some irregularly distributed, circular or oval apertures with smooth margins, about 1 mm. wide, are met with. The uniformly convex outer side of the calyx is covered with a dermal membrane through which an irregular network of stout skeletal strands is visible. On the inner surface one sees a slightly raised reticulation corresponding to this network, with pit-like depressions of varying breadth in the meshes. Some of these pits lead down to the parietal apertures mentioned above.

The basal plate is as hard as stone and also laterally slightly compressed. In it the same well-known, dense skeletal reticulation as in the basal part of all other sessile *Euplectellidæ* is met with. The stout spicules composing it, which are wholly glued together by silica or joined by synapticula only, can be distinctly made out in this network.

The supporting skeleton-net of the body-wall, which grows up from this dense basal reticulation, is loose and has pretty large meshes. It is chiefly composed of stout and smooth, usually curved or angularly bent **oxydiactines** 1·5–2 cm. long and 100–200 μ thick. These thick principalia are accompanied and closely surrounded by numerous slender diactines of the same length. The spicular fibres thus composed are joined, either by simply overlying one another or by the formation of numerous synapticula, to form a network with strongly elongated meshes. The firmness of the junction of the fibres increases towards the base of the sponge. It is greatest in the rigid basal plate.

Between the slender, fibrous diactines, **hexactines** with short, smooth rays of similar thickness are found pretty frequently. More rarely **triactines** and **pentactines** are met with. All these spicules are, in the lower part of the sponge, glued together by secondarily apposed masses of silica.

Oxyhexactines, two opposite rays of which are usually vertical to the surface, are met with everywhere in the parenchyme. Their rays are slender, about 150 μ long, basally smooth and usually rough or covered with small tubercles in their distal thirds. More rarely the rays are rough, tuberculous or even covered with spines in their entire length.

Scattered throughout the choanosome great numbers of those remarkable **oxystauraster** microsclere parenchymalia are met with, which have been described by Ijima in *Regadrella okinoseana*. These spicules consist of four main-rays each of which bears four (more rarely 5 or 6) terminal branch-rays. The four main-rays are equal, lie in a plane, and together form a rectangular cross; they are 3 μ thick and about 10 μ long, smooth, basally cylindrical and terminally

thickened and abruptly truncate. The branch-rays are about 35 μ long, smooth, straight or slightly bent outward at the base, and gradually attenuated towards the sharp-pointed end. They arise from the margin of the terminal faces of the truncate main-rays. Unlike the branch-rays of most hexasters the branch-rays of these oxystaurasters do not diverge from the main-ray under equal angles. The branch-rays, which lie in or near the plane of the main-rays, do not diverge nearly so much as the others. The angle between the former and the continuation of the main-ray is about 45°, whilst the other branch-rays often stand nearly vertical to the main-ray. By thus so strongly diverging these rays evidently endeavour, as it were, to replace the two missing main-rays of the ideal hexaster.

The sword-shaped **oxyhexactine hypodermalia** are generally stouter than the parenchymal oxyhexactines. Their distal, radial ray attains a length of 120 μ and is terminally closely covered with very small tubercles. Each of the four similar paratangential rays is about 200 and the proximal, radial ray about 400 μ long.

In the subdermal region bundles of slender, straight rhaphids over 100 μ in length occur. The presence of these and of regularly hexaradiates consisting of six slender rays with terminal discs, to the outer surfaces of which stumps of broken branch-rays are attached, prove that **graphiocoms** occur in this sponge. Occasionally I also found an intact graphiocom.

The **floricoms** present in the different genera of *Euplectellidæ* and also in *Regadrella*, are in this species rather small; they measure only 72-80 μ in diameter. Their main-rays are cylindrical, about 10 μ long and bear a calyx-like, terminal verticil of 7–9 S-shaped branch-rays, the discs at the end of which have only 3, more rarely 5 or 2, marginal teeth (claws).

The gastral membrane is supported by **pentactine hypogastralia** the size of which differs in the different regions of the body. The four tangential rays measure 200 μ and more in length and are terminally thickened, club-shaped. They are smooth at the base and in the middle but tuberculous in their terminal, thickened part. The radial, distal ray is similar, but considerably longer. In place of the missing sixth, proximal ray a simple tubercle, or button-shaped protuberance, is generally met with.

In the annular membranes surrounding the parietal apertures stout, rough, tuberculous or even spined **hexactines** and **pentactines** with rays only 100–150 μ long occur. The spined rays measure at the base 8–20 μ and more in thickness.

Although only a few small fragments of this sponge are at my disposal it is, on account of the similarity of the spicules, chiefly the peculiar oxystaurasters, hardly to be doubted that it is closely allied to, if not identical with Ijima's Japanese *Regadrella okinoseana*. The most important differences between the two are the following: Ijima states that, in his species hexasters occur together

with the staurasters in the parenchyme; in *R. decora* I failed to find any hexasters in the parenchyme. On the other hand the large and stout, curved or angularly bent oxydiactines which I found among the parenchymal principalia of *R. decora* are not mentioned by Ijima in *R. okinoseana*. The unusual shortness of the radial rays of the hypodermalia mentioned by Ijima in the latter, has not been noticed by me in the former.

In spite of their great similarity I therefore find it necessary to establish a species for the specimens examined by me, distinct from Ijima's *Regadrella okinoseana*. It is another question whether these two species should be placed in the genus *Regadrella*, for it must be taken into consideration, that the peculiar oxystaurasters so characteristic of them, do not occur in *Regadrella phœnix* O. Schm. the only species of this genus formerly known. Neither in the West-Indian specimens of this species nor in the specimens from the Gulf of Gascogne studied by Topsent, have such spicules been met with. They are here replaced by the remarkable onychasters. As however these sponges agree in the shape and structure of the whole body and all the spicules with the single exception of the staurasters and as—at least in Ijima's species—oxyhexasters occur together with the oxystaurasters, it will I think be best to unite the three species in one genus.

Regradrella decora was found southwest of Cape Comorin 7° 17′ N. 76° 54′ 30″ E. in a depth of 787 m.=430 fths.

Dictyaulus, F. E. Sch.

Dictyaulus elegans F. E. Sch.

Plate XII.

1895 *Dictyaulus elegans* F. E. Sch. in Abh. Preuss. Ak. 1895 pp. 36-42, Taf. IV.

1900——F. E. Sch. in Abh. Preuss. Ak. 1900 pp. 34, 35.

This species is characterised by a very elegant external shape and an extraordinary abundance of various exceedingly beautiful parenchymal hexasters. Two specimens of this species, both representing the upper third of a long tubular sponge, are contained in the "Investigator" collection. One is 5 cm. broad and 10 cm. long, the other 11 cm. broad and 18 cm. long. The larger fragment formed the upper part of an individual probably half a meter in length. The sponge-tube has a circular transverse section, and is slightly thickened above, where it is closed by a very delicate terminal sieve-plate. This is convex, watch-glass-shaped in the smaller, more flat in the larger specimen. It is composed of a wide-meshed network with one central stellar node in the smaller specimen (pl. XII, f. 1) and with several such nodes in the larger specimen.

The tube-wall is, in the smaller specimen, on an average about 1 mm. thick and perforated by numerous circular parietal apertures, 1–2 mm. wide. These are situated at the bottom of slight, rounded depressions, surrounded by thin annular membranes and regularly arranged in longitudinal and transverse rows, 3-4 mm. apart. The parietal apertures are arranged so regularly because, as is also the case in *Euplectella oweni* and *Euplectella simplex*, one such aperture is contained in nearly every mesh of the main tubular supporting skeleton-net, composed of the longitudinal and transverse fibres.

The distance between the longitudinal fibres is in all parts of the portion of the tube-wall preserved, about equally great. The distance between the transverse fibres on the other hand is, as in *Euplectella princeps* and E. *oweni*, smallest above and increases downwards, towards the lower, torn end of the tube. Here and there, where a fibre has recently divided, this rule is set aside in the manner described in *Euplectella princeps*. The main skeleton-net of the tube-wall has quadratic meshes. It is, in consequence of the greater developement of secondarily apposed silica glueiug the comitalia and principalia together, much harder and more resistant in the large than in the small specimen.

The principalia composing this skeleton-net are exclusively **oxystauractines** with smooth rays, 60-100 μ thick. The long rays of adjacent stauractines are parallel and lie for some distance quite close together. Generally two to three of these rays extend side by side in the fibres. These principalia are accompanied and enclosed by numerous triactine and tetractine, more rarely diactine or pentactiue, comitalia with very long smooth rays, 10–20 μ thick, the pointed ends of which are usually rough or covered with tubercles. It is to be remarked that the spicular fibres forming the main skeleton-net are not, as in *Euplectella simplex* and other species of *Euplectella*, so arranged that the longitudinal ones overlie the transverse ones. They are on the contrary interwoven like the strands in a web and thus form a texture, which however is not quite regular, since sometimes the transverse fibres divide into two strands at the crossing points and the longitudinal fibres pass through the slits thus formed.

The diagonal spicular fibres are more slender but otherwise similar to the longitudinal and transverse ones. The two spiral systems formed by them cross each other at right angles and consist nearly exclusively of triactine and tetractine spicules with long and slender rays. As in *Euplectella* these fibres extend mostly outside of the main longitudinal and transverse fibres, some of them however are interwoven with the longitudinal fibres so as to form a texture, similar to that in our cane-chairs.

As in *Euplectella* the dermal layer is supported by pretty stout, sword-shaped oxyhexactines, and the gastral membrane by oxypentactines of similar stoutness.

The tubular main skeleton-net lies nearer to the inner, than to the outer surface of the tube-wall, the greater part of the parenchyme and of the folded chamber-layer being situated outside of it. This parenchyme is supported by the radial rays of the hypodermalia and hypogastralia and by one or two layers of pretty numerous parenchymal **oxyhexactines**, two opposite rays of which are vertical to the surface. The rays of these spicules are 100–150 μ long, about 4 μ thick, always quite straight and either smooth or covered with sparse, pretty long and slightly curved, vertical spines (pl. XII. f. 2).

The parenchymal hexasters are exceedingly numerous throughout the soft parts; there is a very unusually large number of different hexaster-forms in this species. The most numerous hexasters are in both specimens **discohexasters** of varying size. Each of their main-rays bears a considerable number, mostly five, seven, or nine, long branch-rays which are distally thickened, club-shaped and which end in transverse, circular, convex terminal discs, the sharp margins of which have six to eight slightly recurved teeth (pl. XII, f. 8–12). All the branch-rays of these discohexasters are nearly equidistant and so arranged that their terminal discs lie in the surface of a sphere, the centre of which coincides with the centre of the spicule. Most of these discohexasters measure 200 μ in diameter; middlesized ones, 160 μ in diameter; and numerous smaller ones only 100 μ, or even 80 μ in diameter, are also met with.

In another kind of hexaster with similar, circular, transverse, sharp-margined, terminal, toothed discs the disc-teeth are 6–8 in number, exceedingly long and slender and so strongly recurved as to extend backwards, parallel to the branch-ray to which they belong. Together with the terminal disc itself, the marginal teeth form in these hexasters a deep bell (pl. XII, f. 13–15). In consequence of this remarkable shape of the branch-ray-terminations I have designated these spicules as **codonhexasters.** They are in both specimens pretty numerous. Two varieties of codonhexasters can be distinguished, differing by their size, their shape and the number of their branch-rays. The **codonhexasters of the large variety** measure 60–80 μ in total diameter and have a small central thickening from which the six slender main-rays arise. These are 6 μ long and each one bears five to seven, straight and very slender branch-rays, 24–30 μ long. The latter are distally extended to form terminal, bell-shaped structures which consist of a small, central, convex, transverse terminal disc with six to eight recurved, slender rod-like marginal teeth, extending backwards, parallel to the branch-ray to which they belong. These rod-bells are about 8 μ long and 4 μ broad (pl. XII, f. 14–15). All the terminal bells lie in the surface of a sphere so that the whole spicule is spherical in shape (pl. XII, f. 13).

The **smaller variety of codonhexasters** is only 40 μ in diameter, has a somewhat different shape and is, in consequence of the extreme minuteness of its parts, rather difficult to see. The main-rays are 8 μ long and bear a much greater

number of branch-rays than the main-rays of the other variety of codonhexasters. I estimate the number of branch-rays on each main-ray at 30, so that the whole spicule has 180 branch-rays. The rod-bells on the ends of the branch-rays are only about 3 μ long and half as broad. It is to be remarked that the terminal bells of these small codonhexasters do not lie in *one* spherical surface but in six, the centres of which are situated at the ends of the main-rays: the branch-rays of each main-ray form part of a sphere. The external surface of the spicule is consequently not a simple spherical one, but composed of six segments of spheres the radii of which are represented by the branch-rays (pl. XII, f. 21).

Other kinds of hexasters met with have simple, terminally-pointed branch-rays of considerable length, which in their S-shaped curvature and calyx-like arrangement resemble the branch-rays of floricoms. Of these hexasters two different kinds, designated by me as drepanocoms and sigmatocoms, can be distinguished. Both are not nearly so frequent as the hexaster-form described above and, particularly in the large specimen, are so scarce that one often seeks them in vain in the microscopic preparations. Their non-occurrence in such preparations can therefore not be considered as a proof of their non existence in the sponge.

The **drepanocoms** (from δρεπανη scythe or sickle and κομη hair) measure 60–70 μ in diameter. Their main-rays are slender, 8 μ long and slightly thickened at the ends. Each main-ray bears a terminal verticil of seven or eight branch-rays. These are slightly curved, S-shaped and angularly bent below the distal end, so that the terminal portion is directed backwards and the relative position of the distal and central parts are similar to those of the shaft and blade of a scythe. These branch-rays are very slender at the base, gradually thickened towards the distal bend and up to this point 27 μ long. The terminal blade-like part is straight or only very slightly curved and gradually attenuated to a sharp point (pl. XII, f. 16, 17). One might consider these drepanocoms as belonging to the same category of spicules as those floricoms, the branch–rays of which have no terminal discs and bear at their ends, instead of a more or less circular, marginally serrated plate, only a few, sometimes only two, elongated teeth, the position of which is similar to the position of the distal recurved part of the drepanocom-branch-ray (pl. XII, f. 7). The drepanocoms of *Dictyaulus elegans* are similar to the hexasters of *Hertwigia falcifera*, described by O. Schmidt as "Sichelrosetten," and found by me also in *Trachycaulus gurlitti*.

The **sigmatocoms** are on the whole similar to the drepanocoms, differing from them however by their considerably greater size and by the absence of an abrupt bend in the branch-rays. Also in these spicules the distal parts of the branch-rays are, although considerably longer, somewhat similar to scythe-blades, but these are not attached to the proximal part of the branch-rays, as in a peaceful scythe, but lie in the same direction and appear as a direct continuation of it, as in a scythe converted into an implement of war. Thus the branch-rays are not

scythe-shaped but elongated S-shaped. The sigmatocoms are exceedingly fragile. They measure about 150 μ in diameter, their branch-rays have a total length of 60–80 μ, their scythe-blade-shaped terminal parts measuring about 15 μ in length (pl. XII, f. 18, 19).

To the ends of the free projecting distal rays of the sword-shaped hypodermalia **floricoms** are attached, which do not essentially differ from the floricoms of most other Euplectella-species. They measure 100 μ in diameter and each of their main-rays generally bears 8 branch-rays, curved in the shape of an S. The convex terminal discs on the distal ends of the branch-rays have sharp margins with five or seven small, pointed teeth (pl. XII, f. 3, 4). Sometimes I found floricoms, the terminal discs of which were only slightly developed and had a smaller number of marginal teeth. In a few, only two teeth or spines were to be seen at the ends of the branch-rays in place of the missing terminal disc (pl. XII, f. 6, 7). I cannot say whether these floricoms with only two terminal teeth, which resemble the drepanocoms very closely, were, like the ordinary floricoms, attached to the distal hypodermalia-rays, or whether they originally lay, like the doubtless nearly allied drepanocoms, in the parenchyme, because I only saw a few of them and these were not *in situ*.

It is to be remarked that in young specimens of Hexactinellids generally the hexasters with terminally thickened or disc-bearing branch-rays are, although of equal diameter as those of full-grown specimens, much more slender, their main- and branch-rays, and particularly the terminal thickenings of the latter, being much thinner. It seems that all the radial rays of the hexasters are at once formed in their full length and that their later growth only leads to an increase of thickness and to the local developement of lateral appendages.

As only the upper part of the sponge is known I cannot say anything definite about its mode of attachment to the sea-bottom. That both specimens were torn off between the upper and central part of their length indicates, that this sponge is, like *Taegeria*, *Walteria* and others, firmly attached ; and not loosely planted in the silt by a root-tuft, like *Euplectella*, *Holascus* and others. I found, however, in the lower part of the small specimen, one pentactine anchor with four transverse, slightly recurved teeth, which formed a cross and contained axial canals. The presence of this spicule might be supposed to indicate the presence of a root-tuft.

The upper, thickened margin of the sponge-tube is supported by stout **oxyhexactine principalia**, the six rays of which are smooth, 60–100 μ thick and of varying length. Their basal parts are regularly vertical to each other. Distally they are either straight or curved in a peculiar and characteristic manner. The lower paratangential ray, which extends longitudinally in the tube-wall and attains a considerable length, and the two radial rays which remain short, are quite straight. The two lateral paratangential rays are long and slightly curved in conformity with

the curvature of the tube-wall in which they lie. The upper, longitudinal, paratangential ray, which is also pretty long (1–2 cm.) is, a short distance from the centre of the spicule, strongly curved towards the axis of the sponge. These upper, inwardly bent rays of the marginal principal hexactines form the lateral support of the terminal sieve-plate and extend in it centripetally, following its curvature.

The terminal sieve-plate is surrounded by a collar only about 1 mm. high, extending obliquely upward and outward. This is composed of the distal, radial rays of the sword-shaped hypodermalia occupying the upper margin of the tube-wall. These spicules are here larger and stouter than elsewhere, and the distal ray, taking part in the formation of the collar, is considerably elongated and covered with spines. In the larger specimen these marginal hypodermal hexactines are arranged in one or in several rows and their distal, collar-forming rays are particularly well developed, gradually pointed, and covered with more or less numerous spines, pointing outward.

The strands of the skeletal reticulation of the terminal sieve-plate chiefly consist of centrotyl oxydiactines of various sizes, which, lying parallel and close together, form dense spicular fibres. In the larger specimen some of these oxydiactines are slightly curved and 200 μ and more thick. Together with these spicules triactines with two long rays lying nearly in line, and one short, terminally often rounded ray vertical to the other two, also occur in the sieve-plate. Stauractines and—here and there in the nodes of the network—hexactines, with rays of varying length, are likewise found in it. To the thicker strands, particularly of the central part of the terminal sieve-plate, dermal and gastral membranes of the usual character, and a little of the parenchyme, are still attached. The latter does not differ essentially in structure and spiculation from the parenchyme of the tube-wall.

The smaller specimen of this graceful species was found near the Laccadives 10° 47′ 45″ N. 72° 40′ 20″ E. in a depth of 1290 m.=705 fths.; the larger specimen S.S.W of Cape Comorin 7° 5′ 45″ N. 75° 4′ E. in a depth of 1316 m.=719 fths.

Saccocalyx, F. E. Sch.

Saccocalyx pedunculata F. E. Sch.

Plate XIII.

1895 *Saccocalyx pedunculata* F. E. Sch. in Abh. Preuss. Ak. 1895 pp. 53-56, Taf. V.

When I first described this sponge in 1895 I placed it, on account of the strong pinule-like developement of the hexactine dermalia in the family *Asconematidæ*. Since then I have however been convinced * that its spiculation is more closely allied to that of Euplectellids, for instance *Hertwigia*. I accordingly now place *Saccocalyx* in the Family *Euplectellidæ*.

* Amerikanische Hexactinelliden 1899 pp. 96 and 98.

The body of the sponge is attached to the upper end of a hollow, tubular peduncle at least 25 cm. long and 5 mm. in diameter, with walls 1 mm. thick. This peduncle is considerably thickened above and passes into the body of the sponge with a trumpet-shaped extension. The body has on the whole the shape of a cup with nearly vertical sides, gracefully bent outward above. From the base of the cup large cylindrical, terminally rounded, digitate processes extend vertically downwards. The cup is, exclusive of the basal processes, 4–5 cm. high, and above, at the sharp outwardly bent margin, about 5 cm. wide. The vertical lamella, forming the sides of the cup, is 2–3 mm. thick. It bears a few hemispherical outgrowths 3–5 mm. broad, but is otherwise, both on the inner and the outer side, pretty smooth. The entrances to the in- and ex-current canals which traverse the lamella vertically appear as small, dark spots. The digitate processes, attached to the whole of the basal part of the cup, are up to 40 mm. long and up to 15 mm. broad. They stand close together and even coalesce here and there with each other laterally. At their apex one generally sees a small irregular aperture. Some of these apertures may perhaps have been formed *post mortem*. The large basal processes, the 6 or 7 largest of which form a cluster round the upper end of the peduncle, are morphologically identical with the smaller hemispherical protuberances of the lateral cup-walls. The axis of the latter however is horizontal, whilst that of the former is vertical.

The peduncular cavity does not, by gradually widening out, simply pass into the central cavity of the cup, but is connected with the latter by a narrow passage only, the cup-base being very thick and having grown in bulk to such an extent, as only to leave this small canal open. There is accordingly no large, funnel-shaped depression in the cup-bottom leading into the peduncle-cavity as might, *a priori*, be expected, but only a small, central aperture. Round this, other, larger apertures, the entrances into the diverticula of the cup-cavity occupying the hemispherical and digitate processes described above, are observed.

All the diverticula are in structure similar to the cup-wall. Both the cup-wall and the processes arising from it, are pretty soft. The main supporting skeleton consists of longitudinal and transverse spicular fibres composed of diactines and oxyhexactines and crossing each other at right angles. The **diactines** are smooth, several millimeters long, terminally rounded and slightly thickened in a club-shaped manner at the ends. At the centre of the spicule four rounded protuberances with axial canals, arranged crosswise, are situated.

The **oxyhexactines**, which form two or three layers parallel to the surface, are of medium stoutness and size, about 400 μ long and sparsely covered with thin, short spines.

The **hexactine hypodermalia** have an elongated distal ray, measuring 200–400 μ in length, which is considerably thickened near the rounded, conic end and

here has a maximum transverse diameter of 18 μ. The distal ray is smooth only basally and covered with scale-like processes directed outwards for the rest of its length. The five other rays are quite smooth or only sparsely covered with small, pointed protuberances. They are much thinner than the distal ray and gradually attenuated towards the sharp-pointed end. The proximal ray is about half as long as the distal ray, the paratangential rays are longer than this, but hardly attain the same length as the distal ray.

The **hypodermalia** have on the whole a similar shape. The radial, distal ray, which penetrates the parenchyme in a direction vertical to the surface, is usually as long as the freely projecting proximal ray, sometimes it is even considerably longer.

The excurrent canals, which open out into the gastral cavity, are surrounded by pretty large, radially arranged **oxyhexactines** with slightly rough rays, 200 μ long.

The intermediary parenchymalia are represented by two different kinds of hexasters, larger discohexasters about 150 μ and smaller plumicoms, about 80 μ in diameter. The former are more numerous than the latter. The **discohexasters** have short and stout main-rays with thick, circular terminal discs, which bear about 12 branch-rays on their flat or slightly convex outer surface. About eight of the branch rays are usually attached to the marginal part of the terminal disc, whilst the others are scattered over its central part (pl. XIII, f. 4,9,10). The branch-rays are smooth, filiform, proximally rather stout but very slender half way up, towards the end they are thickened in a club-shaped manner and terminally extended to form a transverse, watchglass-like, convex circular disc, 10–12 μ in diameter, from the margin of which 16–18 slender, pointed teeth 3–4 μ long, following the curvature of the disc and recurved accordingly, arise (pl. XIII, f. 5, 6). The bundles of branch-rays are spirally twisted in a most unusual and remarkable manner through about half a turn (pl. XIII, f. 4, 10.)

The **plumicoms** are met with chiefly in the vicinity of the gastral membrane. They have a considerable central thickening from which six stout and short main-rays arise; these extend terminally in a mushroom-like manner to form a circular, convex, transverse disc, 12 μ broad. The margin of the disc is continued in a fine membrane, which is bent upwards and then inwards; completely closing over the disc and forming a continuous, convex roof over it. From this roof numerous slender branch-rays, arranged in concentric circles, rise vertically. These branch-rays are all gracefully curved outwards, like the petals of a *Thalictrum* blossom. Those forming the inner circle are the longest and basally nearly straight. Those forming the outmost circle are the shortest and curved right down to their base. Thus the branch-ray-groups attain the shape of low and broad fountains (pl. XIII, f. 7, 8).

The tubular **peduncle** is very hard, only slightly flexible. Its skeleton chiefly consists of round and smooth, parallel, longitudinal beams, 20–40 μ thick, which are numerous and connected with each other by a great number of synapticula,

mostly extending in paratangential and radial directions. Hexactines, increasing in number towards the inner surface of the tube-wall, are associated with the longitudinal beams. These hexactines vary in size, are mostly arranged radially and joined to each other and to the beams by synapticula. The skeleton of the inner part of the tube-wall, where the hexactines are more numerous, forms a much less regular network with wider meshes than the skeleton of the outer parts of the tube-wall, composed chiefly of joined beams. The skeleton of the lower part of the peduncle is much stronger than that of its central and upper parts, where the supporting spicules are not so stout and not so firmly joined by synapticula. Here, in the upper part of the peduncle, a number of the hexactines remain free and here also a few of the same discohexasters which occur in the body parenchyme are met with. Finally, at the upper end, where the peduncle widens out in a trumpet-shaped manner, the synapticula joining the longitudinal beams become scarcer and less firm, the hexactines quite slender and mostly quite free and the discohexasters numerous. Further up we find, on the inner and outer surfaces of the tube-wall, the same layer of hypogastralia and hypodermalia as on the surfaces of the sponge-body itself and so the peduncle gradually passes into the body.

Saccocalyx pedunculata was found in the central part of the Bay of Bengal 12° 20′ N., 85° 8′ E. in a depth of 3300 m.=1803 fths.

As there are no *Asconematidae* in the " Investigator " collection we now come to the Family

III. ROSSELLIDÆ

Sponges which generally have a caliculate or sack-shaped body and autodermalia without pinule-like distal ray.

Bathydorus F. E. Sch.

The body has the shape of a thin-walled sack or tube. The microsclere parenchymalia are oxyhexasters and the autodermalia tetractines and diactines, rarely pentactines.

Bathydorus levis, F. E. Sch.

Plate XIV, figs. 1–10.

1895 *Bathydorus laevis* F. E. Sch. (corr. levis) in Abb. Preuss. Ak. 1895 pp. 57-59, Taf. VI, figs. 1-10.

In the south-western part of the Bay of Bengal three sponges were brought up at one haul, which so closely agree in their macroscopic and microscopic

structure that they doubtless belong to the same species. One of them has the shape of a graceful, thin-walled calyx, the lower end of which has been torn off, but which otherwise is pretty well preserved. The sack-shaped body is about 1 cm. high and has an oval transverse section. The upper part is bent outward and forms a horizontally-extending rim 15–20 mm. broad and only 1 mm. thick. This thins out towards the free margin which is destitute of a spicular fringe. Thus the whole sponge has the shape of a hat lying on its crown (pl. XIV, f. 1).

Both the inner and the outer surface are covered by thin, fairly smooth and continuous limiting layers, which represent the dermal and the gastral membrane. Through them one sees the incurrent and excurrent cavities lying below.

The second specimen consists of a flat plate, irregularly square, 1–2 mm. thick and as large as a hand. On one side this plate thins out to form a pretty straight, sharp margin which however is destitute of a spicular fringe ; one side of this plate is covered in its whole extent by a flat dermal membrane, the other side is only in its thinner part thus covered by a limiting layer, here the gastral membrane: in the thicker parts the mouths of the largest excurrent canals are not covered, the gastral membrane extending inwards in those places and clothing the walls of these excurrent canals.

The third specimen is similar to the second. It appears as a plate of the size of a rupee and has an irregular, torn margin.

The parenchymal principal spicules are chiefly **oxydiactines.** These are straight, 2 cm. and more long and of varying (4–40 μ) thickness. In the centre, where the axial cross is situated, a slight swelling, or two or four rounded protuberances, are met with. The rays are pointed and towards the ends thickened, club-shaped, and covered with short and thin spines. Occasionally also monactine tylostyles, with a more or less clearly defined spherical terminal swelling (pl. XIV, f. 5, 6), spherical silica-pearls (pl. XIV, f. 7) and stout hexactines occur.

The long diactines are nearly all quite or nearly parallel to the outer and inner surface but lie at different levels and extend in all directions, crossing each other at various angles. The stoutest and longest diactines are met with in the vicinity of the gastral surface and there sometimes form distinct strands (pl. XIV. f. 2).

The **pentactine hypodermalia** are very stout and greatly contribute to the strengthening of the body-wall. Their proximal, radial ray extends right down to the vicinity of the gastral surface and is 1–2 mm. long accordingly. The paratangential rays are only about 40–50 μ long and slightly bent inwards, pretty blunt and smooth.

Hypogastralia are entirely absent (pl. XIV, f. 2).

The **autodermalia** are represented by numerous **stauractines** about 150 μ long, which are almost entirely covered with small, short spines (pl. XIV, f. 3, 4).

Their rays are about 4′ thick, straight and terminally rounded or bluntly pointed. Sometimes rudiments of one or both of the missing rays of the ideal hexactine are met with in the shape of rounded tubercles or stumps. Also here one occasionally sees a pentactine with proximal, radial ray between the ordinary stauractines.

The gastral membrane contains numerous **hexactine autogastralia**, 120-140 μ in diameter, with pretty gradually pointed rays, covered with small spines or thorns (pl. XIV, f. 8). The spines are in these spicules longer than in the autodermalia and often, particularly on the distal, radial ray, not quite vertical but slightly oblique and directed outward.

The very numerous **microsclere parenchymalia** are strong, rough oxyhexasters, hemioxyhexasters and oxyhexactines measuring about 150 μ in diameter. In the oxyhexasters each one of the six short and smooth or slightly rough main-rays is usually divided into two pretty strongly diverging, straight and gradually pointed, long, rough or finely spined branch-rays (pl. XIV, f. 10). Sometimes one of the main-rays remains undivided, such main-rays being, in their terminal part, similar to the branch-rays (pl. XIV, f. 9). Sometimes more than one main-ray or even all main-rays remain thus undivided. In the former case these spicules are hemioxyhexasters, in the latter case oxyhexactines. True oxyhexactines are not numerous but they can be found everywhere between the oxyhexasters and hemioxyhexasters and have the same characters as these.

Bathydorus levis has been found in the South-western part of the Bay of Bengal 9° 34′ N. 85° 43′15″ E. on globigerina-ooze in a depth of 3652 m.=1997 fths.

Placopegma F. E. Sch.

Placopegma solutum F. E. Sch.

Plate XIV figs. 11–17.

1895 *Placopegma solutum* F. E. Sch. in Abh. Preuss. Ak. 1895 pp. 63–65, Taf. VI, figs. 11–17.

Only the upper part, of a single specimen, the size of a hen's egg, is contained in the "Investigator" collection. This has a loose texture and possesses a large oscule, covered by a sieve-plate which gives to the sponge a peculiar and characteristic appearance (pl. XIV, f. 11).

The body consists of an irregular network of thin lamellae, inclosing lacunous cavities of various size, local extensions of the in- and excurrent canalsystem. A large gastral cavity, irregular in shape, into which the excurrent canals open, lies underneath the sieve-plate. Below the dermal membrane, which is unfortunately badly preserved, an irregular labyrinth of incurrent, subdermal cavities extends.

From the lacerated, lateral marginal parts cylindrical rhabds, 200-500 μ, thick and several centimeters long protrude singly in various directions. Similar rhabds form the main support of the irregular skeleton-net of the interior. These rhabds are smooth **diactines**. Besides them numerous other, much thinner, parenchymal diactine principalia (4-10 μ and more thick) are met with. The two rays of these are gradually attenuated till near the pointed end, but terminally often slightly thickened. In the centre, at the axial cross, a slight spindle-shaped thickening is occasionally met with.

The dermal membrane is supported by large **oxypentactine dermalia** with tangential rays 400–500 μ long, which are straight or bent inward, gradually attenuated towards the sharp-pointed end, smooth on the inner proximal side and covered on their outer, distal side more or less densely with small, sharp spines. The proximal radial ray measures 600 μ and more in length, is gradually attenuated to the slightly roughened, pointed end and usually bears varying numbers of sparse, small, irregularly distributed, pointed tubercles (pl. XIV, f. 13).

In the oscular margin surrounding the sieve-plate **hexactines** are met with instead of pentactines. They are arranged in an annular manner and covered like the pentactines with small, pointed spines. Their stout, freely protruding distal rays form a low but hard marginal ridge or collar.

In many places **gastralia** are met with. These are smooth or only slightly rough pentactines, more slender and smaller than the dermal ones. Their rays, particularly their tangential rays, are often terminally slightly thickened and club-shaped (pl. XIV, f. 17). I could not with certainty ascertain whether or not any of the gastralia are hexactines, similar to these pentactines, because the only specimen at my disposal is in so unsatisfactory a state of preservation. I think it however very probable.

In the parenchyme one finds, beside the long diactines described above, numerous **oxyhexactines** of varying size, 300–800 μ in diameter, with smooth or more or less roughened rays, 2–10 μ thick (pl. XIV, f. 12).

Discohexasters are also met with in the parenchyme. Their abundance differs in the different regions of the body. They measure 80–100 μ in diameter and are on the whole spherical (pl. XIV, f. 14). The main rays are short, stout and terminally thickened, inversely conical. From the end of each one 4–6 long, slightly diverging branch-rays arise, which are gradually thickened towards the distal end and terminally bear a convex, watchglass-like, transverse, circular disc, 8–10 μ in diameter, with 20–30, short marginal teeth (pl. XIV, f. 14, 15).

Not infrequently I found in the parenchyme, particularly of the lower part, anchor-spicules (pl. XIV. f. 16.) Their shaft is long and slender, pointed at one end and thickened in a club-shaped manner at the other. It is covered with stout, mostly recurved spines and from its terminal thickening four slightly

recurved, crosswise-arranged anchor-teeth, 20 μ long, arise. The axial cross lies in the terminal thickening, close to the bases of the four teeth which are therefore probably to be considered as true rays and not as mere enlarged spines. Whether these anchor-spicules serve to attach the sponge to the sea-bottom cannot be decided on account of the fragmentary condition of the specimen. It is certainly probable that spicules of this kind, but of much larger size, protrude from the basal part of the sponge and form an anchoring root-tuft.

Placopegma solutum was found in the central part of the Bay of Bengal 12° 50′ N., 90° 52′ E. in a depth of 3008 m.=1644 fths.

Lophocalyx F. E. Sch.

Lophocalyx spinosa F. E. Sch.

Plate XXIII.

1900 *Lophocalyx spinosa* F. E. Sch. in Abh. Preuss. Ak. 1900 pp. 35-39 Taf. VII.

The only specimen of this sponge consists of an irregular, round mass, 3–4 cm. in diameter, with a large, strongly curved, cylindrical, handle-like, digitate process so bent round, that the distal part extends nearly parallel to the central body of the sponge. Part of the surface is simply convex and smooth, the other part, from which the large process arises, is tuberculous. An equatorial groove partly bounded on one side by a projecting ridge, divides these differently formed parts of the surface from each other. From this limiting, marginal ridge and from the protuberances of the tuberculous region numerous straight or slightly curved spicules, about 100 μ thick, protrude singly or in small bundles for a distance of 2–3 cm. beyond the surface (pl. XXIII, f. 1, 2). Most of these prostalia-spicules are broken off; the few intact ones are either gradually attenuated and simply pointed or terminate with tetradentate anchors. There is no distinct oscule, but there are a few roundish apertures, 2–3 mm. wide, with smooth margins in the equatorial groove, and some small, scattered openings covered by the superficial membrane, which can be considered as excurrent apertures. In the interior, a system of cavities, 3–4 mm. wide, is observed, which doubtless form part of the excurrent system.

Since the shape of the body and the arrangement of the protruding spicules resemble those of some species of *Thenea* I think it justifiable to suppose that the natural position of this sponge is similar to that of those Theneas, that is to say that the smooth, convex part of the surface is its upper and the tuberculous part its lower side. The prostalia protruding from the tubercles of the latter would accordingly have to be considered as root-tuft-spicules, anchoring the sponge to the sea bottom.

The macrosclere, parenchymal principalia are oxydiactines. They traverse the body, singly or in bundles, in different directions, chiefly however parallel

and vertical to the surface. They are slender, smooth, rarely straight, usually slightly curved and of varying length, often 3 mm. and more long, either simply pointed and smooth or slightly inflated and rough or tuberculous at the ends (pl. XXIII, f. 15–16). A more or less distinct annular thickening is often observed in the centre of the spicule.

I have not seen any hexactine macrosclere parenchymalia.

The hypodermalia are stout **oxypentactines** with mostly straight or slightly curved rays, pointed not very acutely, and rough near the ends, but otherwise smooth. In some of these spicules the four paratangential rays are strongly and uniformly recurved (pl. XXIII, f. 3), giving to them a form passing into that of an anchor. It is to be noted that the large, freely projecting prostal anchors (pl. XXIII, f. 14) mentioned above, are, apart from the difference in size, similar to these pentactine hypodermalia. This leads me to suppose that the anchors are to be considered as protruded and enlarged hypodermalia.

The **microsclere parenchymalia** are slightly rough oxyhexactines with straight rays, hemioxyhexasters and true oxyhexasters, all about 100 μ in diameter. They lie in the well-known typical manner near the folded chamber-layer. The most numerous of these spicules are the hemioxyhexasters. Their main-rays are divided half way up into two branch-rays which accordingly are as long as the main-ray and diverge pretty considerably. The branch-rays are uniformly attenuated to the pointed ends, straight and rough. Sometimes only one of the six main-rays is thus bifurcated, sometimes two or more. Not so numerous are the forms in which all the six main-rays, and those in which none of the main-rays are forked. The former appear as true oxyhexasters, the latter as true oxyhexactines.

Below the superficial membranes, in the subdermal as well as in the subgastral trabecular regions, those exceedingly graceful hexasters, designated by me as **strobilocoms** * are met with. These spicules, which I have also found in *Lophocalyx philippensis*, *Sympagella nux* and *Calycosoma validum*, measure 80 μ in diameter (pl. XXIII, f. 12, 13).

The spined **stauractine autodermalia** exhibit the peculiar curvature in a spherical surface, otherwise only met with in the stauractines of *Lophocalyx philippensis*. They measure 150–200 μ in length and their rays are distally rounded and densely covered on all sides with short spines (pl. XXIII, f. 4–7). In some of these spicules a fifth ray rises from the convex side of the crossing-point of the other four. This ray is directed outward, cylindrical, quite straight, terminally rounded and spined (pl. XXIII, f. 3, 4). In some of these pentactine forms, as well as in some of the ordinary tetractine ones, an indication of a radial ray directed inwards is present in the shape of a spined tubercle

* Amerikanische Hexactinelliden 1899 p. 29, Taf. IV figs. 3, 4.

arising from the convex side of the crossing-point of the four long, lateral rays (pl. XXIII, f. 7). Young autodermalia are quite smooth and more slender than adult ones.

The **autogastralia** are represented by stout, sword-shaped oxyhexactines regularly arranged in a quadratic reticulation and uniformly distributed over the walls of the excurrent cavities. Their four tangential rays are gradually attenuated to the pointed end, slightly rough and about 100 μ long. The distal, radial ray imbedded in the parenchyme is similar to the tangential rays, the proximal ray, which protrudes freely into the gastral cavity, is also pointed, but rougher (pl. XXIII, f. 8).

In consequence of the great similarity of nearly all the different kinds of spicules with those of *Lophocalyx philippensis* F. E. Sch. there can, I think, be no doubt that the sponge here described, must in spite of the difference of its shape, and the fact that the radial rays of some of the autodermalia freely protrude from the outer surface, be placed in the Rossellid genus *Lophocalyx*. That this sponge seems to approach the family *Asconematidæ* by the presence above mentioned, of protruding autodermalia, cannot induce us to remove it from the *Rossellidæ* because many observations have shown that the boundary between the *Asconematidæ* and *Rossellidæ* is by no means a very distinct one.

The only specimen of *Lophocalyx spinosa* was found to the west of the Andamans in a depth of 436–531 m.=238–290 fths.

I will finally mention two specimens of Lyssacine Hexactinellids, collected by the "Investigator" in the central part of the Bay of Bengal, which are so fragmentary that they cannot be determined with any degree of certainty. It therefore does not appear advisable to give them specific names and assign to them definite positions in the classificatory system.

One of the specimens is a strongly compressed fragment of the size of a thumb, the original shape of which cannot be made out.

At one point a bundle of 20–30 stout, cylindrical spicules, 300–800 μ thick protrudes. These spicules are all broken off a few centimeters from the surface. They on the whole make the impression of basal root-tuft-spicules, are either quite smooth or have a peculiarly granular or tuberculous surface, but nowhere an indication of the presence of recurved spines or thorns (pl. IX, f. 11).

The whole specimen seems to consist of a compressed mass of irregular spicular fibres. It contains numerous slender oxyhexactines of various size, which are doutless proper to the sponge. Other kinds of spicules, however, which are present in some parts, but totally absent in others, cannot, with any degree of certainty, be considered as belonging to it. For this reason it is impossible reliably to determine the species to which the specimen belongs; and it would be

of little use to describe these spicules, some or all of which may have been introduced into the specimen from outside, in a more detailed manner. Only one of these various kinds of spicules, which occurs pretty frequently in the midst of the densest part of the fibre-mass, and which may therefore probably be considered as proper to the sponge, is worthy of closer study. These spicules are peculiar, concentrically stratified spheres. I have represented them, magnified 100 diameters, in figs. 12–14 on plate IX. They closely resemble the "silica-pearls" which I first found in *Pheronema giganteum* F. E. Sch. in 1893 and which I have described in the Sitzungsberichte der Berliner Akademie for 1893, p. 996. Some of them are quite smooth, the surface of others is tuberculous or spined. In some of the larger ones we find on the surface irregularly distributed, smooth convexities, divided from each other by striated grooves which extend in various directions.

This fragment was found in the western part of the Bay of Bengal, 12° 10′ N. 85° 8′ E. in a depth of 3300 m.=1803 fths.

The second of these fragments consists of an entirely macerated skeleton-net and has the size of a walnut. The strands of the network are joined in a quite irregular manner and enclose several cavities, communicating with each other and appearing as passages, 5 mm. wide and circular in transverse section. The irregular network forming the walls of these passages is perforated by several nearly round apertures, 2–3 mm. in diameter, so that the whole, to a certain extent, becomes similar to the skeleton of *Rhabdodictyum delicatum* O. Schmidt. It is probable that this sponge belongs to the species mentioned, of which only the supporting skeleton-net is known.

This skeleton-fragment was found in the middle of the southern part of the Bay of Bengal 6° 18′ N. 90° 40′ E. in a depth of 2506–2816 m.=1370–1540 fths.

IV. FARREIDAE.

Uncinataria composed of systems of tubes tending to anastomose. The dictyonal skeleton is in the younger portion of the sponge a simple network with quadratic meshes. With clavules.

Farrea Bowerbank.

Systems of tubes, branching dichotomously and tending to anastomose, which are distally sometimes extended in a caliculate manner. On the dermal, as well on the gastral surface clavules occur together with the uncinates. Scopules are always absent.

Farrea occa (Bwbk.) Carter.

1862 *Farrea occa* Bowerbank in Phil. Trans. R. Soc. London Vol. CLII, p. 747.

1885———Carter in Ann. Mag. Nat. Hist. Ser. 5, Vol. XV, p. 387.

1887———F. E Schulze in Rep. Voy. Challenger, Hexactinellida p. 277.

1895———F. E. Schulze in Abh. Preuss. Ak. 1895, p. 67.

1899———F. E. Schulze Amerikanische Hexactinelliden, pp. 68, 69.

The genus *Farrea* is represented in the " Investigator " collection by some small fragments, attached to other sponges, and two larger specimens, one dried and one preserved in spirit.

The dry specimen has the size of an apple. Its soft parts are in places sufficently preserved to enable one to recognise the microscleres and to determine the species. It is pretty typically developed and in outer appearance to some extent resembles the specimen illustrated by me in the " Challenger"-Hexactinellida on plate LXXII, fig. 1. The microscopic structure of its dictyonal skeleton-net and the shape of its isolated spicules so closely correspond to the description there given (*l.c.* p. 277 ff.) that it suffices here to refer to that account. The only peculiarities noticed by me, which are probably only individual, are the following : —

The four tangential rays of the dermal pentactines are not distinctly tuberculous as is the rule in the specimens described by Carter * and myself † but are either quite smooth or covered with very small tubercles only. The dermal clavules are not, as in other specimens, spined on the whole surface but only bear on the terminal, club-shaped thickening several (often four) laterally projecting thorns.

The second larger specimen, preserved in spirit, is attached to root-tuft-spicules of *Hyalonema* as long as a hand and 500–1000 μ thick. It has the size of a child's fist and is dichotomously branched and composed of anastomosing tubes. Although the greater part of it is so completely macerated that only the dictyonal net is left, the soft parts are sufficiently preserved in other parts to study the isolated spicules. These show that this specimen doubtlessly also belongs to this widely distributed species.

The dry specimen was found in the Bay of Bengal to the west of the Andamans in a depth of 402–439 m.=220–240 fths.; the specimens attached to the Hyalonema-basalia, near the Andamans in a depth of 238–458 m.=130–250 fths. The smaller fragments of dictyonal nets of *Farrea* spec. have been found in the following localities: 1. west of the Andamans between North and South-Sentinel Island, attached to *Gellius*, in a depth of 402–439 m.=220–240 fths.;

* Ann. Mag. Nat. Hist. ser 5, v. XV, p. 388, pl. XIII.

† " Challenger "-Hexactinellida p. 282 pl. LXXI, f. 6.

2. near the Andamans, on the root-tuft of *Pheronema raphanus* F. E. Sch., in a depth of 315 m.=172 fths; 3. near the Andamans 12° 37′ N. 92° 19′ E. on the root-tuft of *Pheronema raphanus* F. E. Sch.; 4. Southwest of Cape Comorin 7° 17′ 30″ N. 76° 54′ 30″ E. in a depth of 787 m.=430 fths. The latter probably belongs to *Farrea occa*.

MELITTIONIDAE.

Tubular or caliculate sponges with lateral diverticula. The dictyonal net has hexagonal meshes and is regular, honeycomb-like. Scopules are present.

Aphrocallistes, J. E. Gray.

The dermalia are hexactines with a pinule-like distal ray. The microsclere parenchymalia are oxyhexasters.

Whilst *Aphrocallistes*, the only recent genus of the family *Melittionidae*, is very clearly distinguished from all other Hexactinellid genera now living by the hexagonal structure of its dictyonal network, we find that the species belonging to it are not at all well defined. They vary considerably and their distinction and definition is very difficult.

Aphrocallistes beatrix J. E. Gray.

Plate XV, figs. 1–13

1858 *Aphrocallistes beatrix* J. E. Gray in Proc. Zool. Soc. London. 1858 p. 114.

1887———F. E. Schulze Challenger Hexactinellida pp. 311-313 pl. LXXXIV, f. 9, 10

1895———F. E. Schulze in Abh. Preuss. Ak. 1895 pp. 68-76 Taf. VI f. 1-13.

1900———F. E. Schulze in Abh. Preuss. Ak. 1900 pp. 38-39.

Among the Approcallistes-specimens brought home by the "Investigator" there are six, all from the same locality, Station 9, to the west of the Andamans which so closely agree in shape, structure and size with the specimen from Malacca, described by Gray* in 1858 as *Aphrocallistes beatrix*, the type of the genus, that there can be little doubt about their belonging to this species, although no exact description of the spicules is contained in Gray's diagnosis.

These "Investigator" specimens are, like Gray's type specimen, slender, erect, inversely conical and 4–6 cm. high. At the upper end there is a rather irregular, round oscular aperture, 1 cm. in diameter, covered with a sieve-plate. From the sides of the body numerous beehive-shaped or hemispherical diverti-

* Proc. Zool. Soc. London, 1858, p. 114.

cula, arranged in irregular, longitudinal rows protrude. Some of these processes, particularly those of the lower end of the body, are extended to form tubes, terminally irregularly truncate, 1–2 cm. long and 3–4 mm. broad. Most of them however, particularly those of the upper part of the body, are much shorter, and terminate with a hemispherical, dome-shaped apex. It is particularly to be remarked that, both in the "Investigator" specimens and in Gray's figure of the type specimen, these diverticula gradually decrease in size towards the upper end of the body. The lowest diverticula are always the longest, and the uppermost ones, situated just below the oscular margin, always the shortest. The latter usually appear as slight, rounded elevations of the outer surface (pl. XV, f. 1). In the upper and central part of the body these diverticula are usually so close together as to be nearly in contact with each other. Further down the diverticula are not so numerous, and at the narrow lower end itself are generally entirely absent. Most of the diverticula have a perforation, more or less round and 1–2 mm. wide, at, or a little below the apex. Exceptionally, here and there one is met with without such a perforation.

The dictyonal net, which forms a regular and uniform hexagonal honeycomb; the hexactine dictyonalia, which are joined in a peculiar manner to form a rather irregular net- or lattice-work with triangular meshes and irregularly polyradiate nodes; and the slender, tuberculous, cylindrical processes which protrude from the dermal and gastral surface; all accord with the typical characters of the genus *Aphrocallistes*.

I find the dictyonal net of the younger, central and upper regions of the body thin, the beams composing it nearly quite smooth and the nodes but very slightly or not at all thickened, and only sparsely covered with small, pointed tubercles. Only at the dermal and gastral margins, on the surfaces bounding the honeycomb-cavities, the pointed tubercles of the beams and of most of the nodes are stouter and more numerous. In the lower, older regions of all the specimens the dictyonal network forms a thicker layer, is stronger and covered nearly entirely with numerous, stout, pointed tubercles. The nodes are here, particularly on the dermal and gastral surface, considerably thickened and appear as round, generally clearly defined inflations.

The differences in the developement of the small, pointed tubercles on the beams and nodes of the dictyonal net and of the thickness of the nodes themselves, can therefore not be considered as distinctive specific features. It is not to be denied however, that the constancy and degree of developement of these peculiarities, although dependent on the age of the specimen, may occasionally attain the importance of specific characters.

The **dermalia** are slender hexactines, with free distal rays 100–200 μ long, terminally sometimes thickened in a club-shaped manner and covered with slender spines or thorns of medium length which diverge obliquely and are curved to-

wards the end of the ray like the branches of an Italian poplar towards the top of the stem (pl. XV, f. 4). The tangential rays are simple, straight, slightly tuberculous at the blunt ends and about as long as the distal ray. The proximal ray is similar in shape but generally longer.

The **gastralia** are stout, straight diactines with or without a more or less clearly defined swelling, or two or four rounded protuberances, or even rudiments of a third and a fourth ray, in the middle. Their ends are rounded and always covered more or less densely with small, pointed tubercles. Usually, but not always, the spicule is covered with such protuberances in its entire length. The length of these spicules varies considerably from about 1 to 2 mm. and more. Not infrequently spicules of this kind slightly bent or terminally thickened in a club-shaped manner, are met with (pl. XV, f. 8, 9).

The **scopules** are numerous, arranged vertically to the surface and variable in shape. They have 4–6 branches which lie between the proximal, radial rays of the dermal hexactines and nearly reach the surface. The shaft is generally simple, straight, 400–500 μ long and gradually attenuated towards the pointed end. It is always rough terminally, but for the remainder of its length either rough or smooth. The number, shape and direction of the dermal branches are subject to considerable variation. Most frequently four stout diverging dermal branches are observed, which arise from a comparatively short thickening at the distal end of the shaft. The basal part of each branch is thin, about 10 μ long, and extends at first upwards in a pretty straight line, it is then bent outward more or less sharply. The free distal part, lying beyond the bend, is about three times as long as the basal part and, below, of about the same thickness as the latter. Towards the end it is thickened in a club-shaped manner and it terminates with a convex, cupola-like transverse disc, bearing a verticil of marginal teeth. These vary in length, are pointed and directed outwards and backwards (pl. XV, f.2). The branches themselves are either quite smooth or covered with small and slender, oblique spines, directed backwards. Of the other kinds of scopules the one most different from this kind is pretty rare. This scopule also has four branches, but differs from the one described above by the following peculiarities. The distal thickening of the shaft is stout and caliculate and the branch-rays arise from its margin and extend upwards towards the surface, nearly parallel to each other. They are nearly cylindrical, slightly thickened in a knot-shaped manner at the distal end and uniformly and closely covered in their entire length with very slender spines, directed obliquely backwards. The terminal thickening is covered with similar, but slightly stouter spines. Besides these rare scopules with nearly parallel cylindrical dermal branches, other, similar ones, in which the dermal branches diverge more strongly or are more or less abruptly bent outward below the middle, occur a little more frequently. One of the former is represented in fig. 10, one of the latter in fig. 11 on plate XV.

Sometimes I found scopules with more than four, with six or even eight branches. The branches of these scopules are, like those of the tetrabrachial ones above described, either of nearly uniform thickness throughout, or basally very thin and terminally thickened in a club-shaped manner; and they are also, like those, densely covered with spines, small at the base, larger towards the distal end and directed backwards (pl. XV, f. 3). It is to be remarked that transitional scopuleforms, connecting the extreme ones here described in different ways, are pretty frequent. Scopules with fewer than four branches are exceedingly rare.

Uncinates, varying in length and thickness, are met with close to the dictyonal honeycomb pretty frequently. They are arranged vertically to the surface and usually penetrate the whole thickness of the body-wall. The outer half of the spicule, nearer the dermal surface, is always thicker than the inner half, nearer the gastral surface, which latter is quite gradually attenuated to a pointed end. The spines which are generally very oblique, closely "anliegend" to the shaft, point inwards. If the uncinates protruded beyond the surface they could be compared to harpoons.

Of the spicules irregularly scattered throughout the parenchyme I will first describe those simple **hexactines** which measure 100–150 μ in diameter and play so important a part in the growth of the dictyonal network. In all the places where this skeleton-net is growing in thickness or otherwise, great numbers of such hexactines are met with. Their centres are usually considerably thickened and their rays are stout, straight, gradually attenuated, bluntly pointed and irregularly covered with more or less numerous, small tubercles or vertical spines. Besides these robust hexactines, most of which are to be considered as building material for the dictyonal net, other, similar oxyhexactines are met with here and there (pl. XV, f. 13). The rays of these are longer and more slender and covered more or less densely with vertical, straight or outwardly curved spines. These hexactines are at first loosely scattered through the parenchyme, later they are apparently also incorporated by the dictyonal net, at least I have seen, in the massive, basal part of the skeleton, such slender, spined hexactine sfirmly attached to it.

Another kind of parenchymalia are the **hexasters**. Some of them are very peculiar, one axis being differentiated and usually elongated. These spicules are never connected with the dictyonal network. Curiously enough the distribution of these hexasters is so irregular that one finds great numbers of them in some places, whilst in others they are very scarce. They are scattered irregularly through the chamber-layer, the subgastral and subdermal regions, but always absent in the gastral and dermal membranes.

The most frequent hexaster-form is that described by Wyville Thomson in 1868 in his essay * "On the Vitreous Sponges" and there illustrated on p. 123. It has a considerably elongated main axis. W. Thomson says of it: "One set

* Ann. Mag. Nat. Hist. ser. 4, Vol. 1, p. 114.

of the sarcode-spicules of *Aphrocallistes* is almost identical with the 'furcate spiculated biternate' spicule from *Farrea occa* (Brit. Spong. Vol. I, fig. 190), but more spiny. I am afraid to name this form; but I am sure it would be highly suggestive to Dr. Bowerbank."

The following year, 1869, he described it in his paper "On Holtenia" * as "a regular six-rayed star with the principal axis longer than the transverse rays and one half of it feathered."

In 1870 † Percival Wright described a new species of *Aphrocallistes* as *A. bocagei* and in diagnosing it he laid considerable stress on the absence of the "porrectomultiradiate spicules" of *A. beatrix*. Saville Kent ‡ on the other hand, who studied *Aphrocallistes bocagei* in the same year, said concerning it: "the spicula of the sarcode are very different, the porrecto-multiradiate spicules are not wanting, as Prof. Wright imagined, and in fact appear to constitute the type-form of the genus; but there are none of the verticillately spined ones so abundant in *A. beatrix*."

I myself examined and described § a specimen, labelled *Aphrocallistes beatrix* Gray, in the collection of the British Museum of Natural History (London) and particularly laid stress on the presence of parenchymal hexasters with a considerably elongated main axis, as distinguishing this species from the doubtless closely allied *Aphrocallistes bocagei* Perc. Wright. I have found that in this latter species the parenchymal hexasters are mostly without a considerably elongated main axis and that it posesses small disco-hexasters.

Also in the Indoceanic specimens of *Aphrocallistes beatrix* Gray, brought home by the "Investigator," the hexasters with a differentiated, strongly elongated main axis are apparently more numerous than the other hexaster-forms, which latter are subject to considerable variations. The elongated hexasters are the most conspicuous microscleres. They differ considerably in shape and are connected in various ways by transitional forms with the normal, regular oxyhexasters which have 4-6 equally long obliquely diverging branch-rays on each one of the short main-rays (pl. XV, f. 5). It is to be remarked that all these hexasters have pointed branch-rays and are true oxyhexasters or hemioxyhexasters. There are no such claw-bearing onychasters among them as in *Aphrocallistes ramosus*, described on p. 93.

I think it most probable that the "syngramme" oxyhexaster-forms with a differentiated, mostly elongated main-axis have been phylogenetically developed from ordinary, regular "synstigme" oxyhexasters with equal axes. Thus considering the former as derived from the latter, I will describe the regular

* Phil. Trans, Roy. Soc., Vol. 159, p. 713.

† Quart. Journ. Micr. Sci. 1870, p. 78.

‡ Monthly Microsc. Journ. 1870, p. 248.

§ "Challenger Hexactinellida p. 221 pl. 84, f. 9, 10, and Abh. Preuss. Ak. 1886, p. 75.

oxyhexasters first. The main-rays of these spicules are about 8 μ long and 2 μ thick and bear on the margin of the thickened end 4, more rarely 5, 6 or 3 branch-rays. The latter are somewhat bent outwards at the base, but further up they are quite straight and considerably divergent. The branch-rays are 26–30 μ long and gradually attenuated to a sharp-pointed end (pl. XV, f. 5). If five branch-rays are attached to each main-ray, one branch-ray of each of the six groups usually lies in the continuation of the main-ray, whilst the four others diverge, forming, if viewed from above, a cross around the central one. The simplest derivative of this regular form is a hexaster in which two opposite main-rays are longer than the four others. The branch-rays of the latter are reduced to three or two, or they are absent altogether, these main-rays remaining simple (Hemioxyhexaster). Many different forms of such irregular hexasters are met with, and it would lead too far to describe them all. Some, however, are so frequent as to deserve a more accurate description. Such are the hexasters with two differentiated, equal, opposite, elongated main-rays each of which bears four or five branch-rays. If five branch-rays are present, these are arranged as described above. The four other main-rays remain simple, are about 80 μ long, pointed and straight (pl. XV, f. 12). In other frequent forms the two opposite, differentiated main-rays are unequal in length, one of them being so reduced that its branch-rays become nearly sessile and concentric with the other main-rays. A considerable difference in the dimensions of the two opposite, differentiated main-rays is also observed in those hexasters which are termed "porrecto-multiradiate" by the English authors and which have always been considered as typical of the species *Aphrocallistes beatrix* J. E. Gray. These spicules are hemioxyhexasters, attain a length of 150 μ and are generally pretty stout. The four lateral main-rays, which are vertical to the axis formed by the two differentiated ones, are usually unbranched, whilst each of the two axial main-rays generally bear five branch-rays, one of which lies in the continuation of the main-ray to which it belongs, that is in the axis of the spicule (pl. XV, f. 6, 7). Sometimes the axial branch-ray is absent. More rarely spicules are met with in which one of the lateral main-rays is divided at the base into two straight diverging branches as long as the other, simple, lateral main-rays.

The terminal **sieve-plate** extends transversely and covers the entrance to the cavity of the caliculate sponge. Sometimes a second transverse sieve-plate, situated further down, is met with. The skeleton-net supporting the sieve-plates has polygonal meshes, rounded at the corners and 1–2 mm. wide. J. E. Gray has figured it in natural size and magnified 3 diameters (*l.c.* pl. XI, f. 1,2). These drawings illustrate its macroscopic appearance very correctly. Microscopically the skeleton-net and the isolated spicules of the sieve-plate do not essentially differ from those of the body-wall, where however meshes of the skeleton-net are a little smaller and more regularly hexagonal.

These specimens of *Aphrocallistes beatrix*, which are all very similar to each other, were found in the Andamans, to the west of North Sentinel Island, in a depth of 238–458 m=130–250 fths.

There are, besides these specimens, two completely macerated skeletons of *Aphrocallistes beatrix* in the "Investigator" collection, in both of which the doubtless funnel-shaped base is missing. One of these is caliculate, 3 cm. long, 10 mm. broad below and 24 mm. above. It has an upper and a lower sieve-plate and is broken off just below the latter, which therefore appears partly to close the calyx-cavity below. The upper sieve-plate is in this specimen depressed in the centre, funnel-shaped and not flat. Above, the sponge is not torn, but terminates with the natural sharpened margin. The lateral diverticula of the calyx-wall are arranged in 8–10, pretty irregular longitudinal rows; they are mostly quite low, measuring only 3–5 mm. in height, and hemispherical. Near the apex there is, on the lower side, generally a circular perforation. Only at the lower and at the upper end, just below the margin of the calyx, a few longer diverticula are met with, some of which are terminally still closed, while others are perforated near the end or broken off.

The other specimen is more tubular, 4 cm. long, 8 mm. broad below and 15 mm. above and has only one sieve-plate which is situated some distance above the lower, torn end. The upper end has been broken off. The diverticula of the wall of the calyx are arranged in indistinct, longitudinal and transverse rows and also quite low, only 3–5 mm. high. Nearly all are perforated by a circular aperture on the lower side. Some of the diverticula, which are now however broken off, seem to have been longer.

The first of these specimens was found near the Andamans, 13° 15′ N., 93° 10′ E. in a depth of 362 m=198 fths; the second also in the vicinity of the Andamans, but in a depth of 436–531m=238–290 fths.

Aphrocallistes bocagei Perc. Wright.

Plate XVI.

1870 *Aphrocallistes bocagei* Perc. Wright in Quart. Journ. Micr. Sci. Vol. X, p. 77, pl. I.

1887 ——— F. E. Schulze "Challenger"-Hexactinellida p. 305, pl. 83-86.

1895 ——— F. E. Schulze in Abh. Preuss. Ak. 1895, p. 78—82, Taf. VIII.

1900 ——— F. E. Schulze in Abh. Preuss. Ak. 1900, p. 39-41.

Some of the *Aphrocallistes* collected by the "Investigator" so closely agreed in size and shape with the typical *Aphrocallistes bocagei* described by Perc. Wright in 1870 in the Quarterly Journal of Microscopical Science, Vol. 10, p. 73 that there can be no doubt about their belonging to the same species; others however are not quite so similar to it and at first it appeared by no means

impossible that these represented another species. They are remarkable for their small size, being rarely 10 cm. usually only a few centimeters high. The caliculate or funnel-shaped body is, in accordance with its small height, very narrow and its diverticula are very thin. The latter measure only 3–5 mm. in thickness and are on an average 10–15 mm. long. It is also to be remarked that in these specimens the cavities of adjacent calices or funnels are united much more extensively than in other species. Their radial, tubular diverticula very frequently reach the next funnel, whereupon an open communication is established between the cavity of the diverticulum and of the adjacent funnel by the resorption of the intervening septum. As the radial, tubular diverticula attain a width nearly equal to that of the funnels themselves, the whole sponge appears as a network of tubes, in which the limits between the diverticula (radial tubes) belonging to different funnels can hardly be made out. And this limitation is rendered still more indistinct and difficult to determine by the habit of the radial tubes terminally to divide dichotomously. This habit of these specimens makes it quite possible to confound them, particularly when they are merely isolated fragments, with *Aphrocallistes ramosus*.

From *Aphrocallistes beatrix* Gray they can be distinguished by the radial tubular diverticula which do not, as in that species, increase in size towards the base of the sponge, but which on the contrary become longer towards the upper end of the sponge. This is a constant character, met with in all specimens of *Aphrocallistes bocagei* hitherto described.

The dictyonal net corresponds, as far as the most essential points of its structure are concerned, with the descriptions given of the skeleton of *Aphrocallistes bocagei* Perc. Wright.

The formation of the typical hexagonal cells of the honeycomb, open at both ends, the irregular polyradiate nodes and the tuberculous, conical beams, which protrude from it towards the dermal and gastral surface are quite the same. In some points however, as the thickness of the septa and the triangularly prismatic pillars dividing the cells of the honeycomb, the thickness of the beams, the sculpture and degree of distinctness of the nodes and particularly the number and density of the small tubercles or spines covering the beams and nodes, such great differences are met with, that I cannot consider these peculiarities as having any systematic importance and I therefore do not believe that they can be used as classificatory characters for the purpose of distinguishing the species. I think it much more likely that they are merely individual characters, partly perhaps dependent on the age of the specimen. It seems to me that at first, that is to say in young specimens, the beams are slender and quite smooth, and that they become thicker and more rough as the sponge grows older. Together with the beams, the septa, and particularly the triangularly prismatic columns dividing the cells of the honeycomb, increase in thickness and the nodular

thickenings become stouter, more clearly defined and, in the vicinity of the free surfaces, more densely covered with small spines.

The dermal **hexasters** are slender throughout; their radial, distal rays are pinule-like, smooth in the basal third and covered with thin not very numerous spines bent obliquely outwards, which decrease in size towards the end of the ray, in the distal two-thirds.

The dermal **scopules** vary considerably in different individuals and also in different parts of one and the same individual, but are on the whole similar to those of *Aphrocallistes beatrix*, described and figured above. In some specimens the forms with abruptly outwardly bent and terminally considerably thickened branch-rays, represented in fig. 4 on plate XVI, are numerous and those with rough straight, nearly cylindrical branch-rays, only slightly thickened terminally, represented in fig. 5 on plate XVI, rare. In other individuals the scopules with thin, slightly outwardly curved branch-rays with terminal thickenings are the most numerous. I have not seen any scopules with pointed branch-rays similar to those found by me in the "Challenger" material (Challenger Hexactinellida pl. LXXXIV, f. 5).

As in all the other species of the genus, the gastral membrane is supported by thick, tuberculous, usually straight and terminally blunt **diactines** or **stauractines.**

The **uncinates** also resemble those of other species. They are long, lie vertical to the outer surface, and their distal ends nearly reach the latter.

The same is to be said of the slender, parenchymal **oxyhexactines,** all the rays of which are covered with fine, vertical spines.

Much more peculiar and worthy of interest are the **hexasters** scattered in varying numbers irregularly through the parenchyme. These microscleres are, as in *Aphrocallistes beatrix* and *ramosus*, subject to considerable variation. Their shape and size differ in different individuals, and in different regions of one and the same individual, so that it will be necessary to characterise the range of forms assumed by these spicules in its whole extent. I wish to state at once, however, that I found oxyhexasters and onychasters in varying relative quantities in all specimens of *Aphrocallistes bocagei*. Sometimes it was difficult to find even a single onychaster between the numerous oxyhexasters, sometimes onychasters and oxyhexasters were present in nearly equal numbers and sometimes the former were more abundant than the latter. The onychasters themselves greatly vary in the length and curvature of their fine terminal claws. The "regular" hexasters with six equal main-rays, forming with each other right angles and terminally crowned with groups of branch-rays of the same thickness, shape, number and degree of divergence, are fairly numerous. The thickness of their main- and branch-rays and the number of the latter are, in different spicules, however, subject to considerable variation (p. XVI, f. 6, 9).

The main-rays are generally short and bear 4 or 5, considerably divergent branch-rays. Such spicules usually have a diameter of not more than 50 μ. The terminations of the branch-rays of all these hexasters, the stoutest as well as the most slender, are either all simply pointed or all bear a verticil of fine claws usually four in number. These are vertical to the branch-ray or extend obliquely upwards and are either straight or slightly recurved. The size of these claws is subject to great variation, some are so short as to be barely visible under the highest powers of the microscope, whilst the largest attain a length of 3 or even 4 μ. In one and the same spicule all the claws are similar in shape and of nearly equal size (pl. XVI, f. 9,10). It is not at all probable that these terminal claws are senile structures, produced in all hexasters when they attain a certain age, because they are met with similarly developed and just as frequently, if not more frequently, on the most slender and therefore probably youngest, as on the most robust and therefore probably oldest, hexasters. The elongated hemihexasters, in which only two opposite main-rays are differentiated and terminally divided into four, five, or more, diverging branch-rays, and the four other lateral main-rays remain undivided, are just as numerous as the "regular" hexasters described above. The length of their axial main-rays is exceedingly variable and one of them is usually much shorter than the other which latter is not infrequently shortened to such an extent, that its branch-rays appear nearly sessile and radiate from the same centre as the other main-rays (pl. XVI, f. 8). The branch-rays of the axial, differentiated main-rays are 20–25 μ, the simple, lateral main-rays 20 μ long. Also among these spicules slender and robust, oxyhexactrose and onychastrose forms are met with. More rarely spicules of this kind occur, in which one or all of the lateral main-rays are terminally divided into branch-rays (pl. XVI, f. 7,10, 11). I wish to add that I have observed these variations of the parenchymal hexasters not only in the Indoceanic "Investigator" specimens but also in the numerous other specimens examined by me which were partly collected by the "Challenger" expedition and which I partly obtained from other sources.

Most of these "Investigator" specimens of *Aphrocallistes bocagei* Perc. Wright were found in the Bay of Bengal near the Andamans, some also to the south of Bombay near the Angrias bank. All were obtained in depths of 200–500 m.=105–263 fths.

As mentioned above, these specimens represent two rather different forms. One form is more robust and has radial diverticula of the thickness of the little finger. This corresponds to the type specimen originally described by Perc. Wright. The other form, represented in figs. 1 and 2 on plate XVI, is more graceful and has radial diverticula only 3–5 mm. thick. I have not found that the specimens belonging to these two forms are locally distinct. Both were captured in most localities in nearly equal numbers, and they are, as stated above, connected with each other by occasional transitions.

Another specimen of the size of a fist, similar to the one represented in fig. 1 on plate XVI, consists of 6 pretty normally developed calices a finger long, the walls of which bear a considerable number of hollow, digitate diverticula, 3-5 mm. broad and 10–20 mm. long. Although these diverticula, which increase in size towards the upper end of the sponge, are situated somewhat irregularly, one can easily discern an indication of an arrangement in transverse and longitudinal rows. In each verticillary, transverse row there are about five diverticula. The intervals between the diverticula of each verticil increase in width towards the upper end of the sponge, where they are 10 mm. wide. It is also to be noticed that the calyx-wall tends to form five longitudinal, projecting folds, which correspond to the five indistinct longitudinal rows of diverticula.

Some of the diverticula are dichotomously divided, most of them are however simple and straight or slightly curved. In some a terminal, circular aperture is observed which has obviously been produced by a secondary local resorption of the apex. Nearly all the diverticula reach other diverticula belonging to different calices and impinge on them either terminally or laterally, whereupon they grow together. Thus all the calices are firmly united to form a solid continuous structure. Each calyx has one or two transverse sieve-plates which however are not regularly placed in the interstices of the verticils of diverticula. Sometimes such a sieve-plate does extend between two consecutive verticils, sometimes however it is attached to the wall of the calyx at the level of the entrance to a diverticulum, in which case the communication between the cavity of the latter and the central cavity of the calyx is made possible by the formation of a marginal hole in the sieve-plate.

Concerning the microscopic structure of the skeleton and the soft parts I have observed nothing new in this specimen. The state of its preservation precluded any closer investigation.

This specimen was found in the Andamans, 13° 17′ N. 93° 7′ E. in a depth of 165 m.=90 fths. Some macerated, smaller fragments of similar calices were found South-West of Cape Comorin, 7° 17′ 30″ N. 76° 54′ 30″ E. in a depth of 787 m.=430 fths. and some other fragments near the Andamans in depths of 238–458 m.=180–250 fths. and 436–531 m.=238–290 fths.

Aphrocallistes ramosus F. E. Sch.

Plate XV, fig. 14.

1886 *Aphrocallistes ramosus* F. E. Schulze in Abh. Preuss. Ak. 1886 pp. 75, 76.

1887———F. E. Schulze, Challenger Hexactinellida p. 319.

1895———F. E. Schulze in Abh. Preuss. Ak. 1895, p. 76, Taf. VII, fig. 14.

The species *Aphrocallistes ramosus* described by me in the Abhandlungen der Berliner Akademie for 1886 and in the Report on the "Challenger" Hexact-

inellida is distinguished very clearly from all other species of *Aphrocallistes* by its peculiar shape. In the structure of its dictyonal net and in the shape of its isolated spicules on the other hand, no distinctive character is noticeable. The three specimens collected by the "Investigator" to the West of the Andamans agree in size and shape perfectly with those found in the Philippines and near Japan, which I have described previously. They are tubular, dichotomously branched, circular in transverse section and widen out to a diameter of 8 mm. above. By the repeated bifurcation and the breaking off of every second branch, a zig-zag-shaped tube, 8–15 mm. wide is produced, from the angular bends of which the stumps of the branches broken off, extend obliquely upwards. In the upper parts the branches are generally not broken off and are preserved with their dichotomous ramifications (pl. XV, f. 14). The largest specimen is 10 cm. high.

The dictyonal net is similar to that of *Aphrocallistes beatrix*, described on p. 88. Also the slender, hexactine dermalia and most of the robust, rough gastral diactine beams, agree perfectly with the corresponding spicules of that species. The same can be said of the parenchymal oxyhexactines. The scopules also here extend right up to the dermal membrane and are, on the whole, similar to those described above of *Aphrocallistes beatrix*. Their terminally thickened branches are however never strongly bent outwards as is so frequently the case in that species.

The parenchymal **hexasters**, the number of which differs considerably in different specimens and in different parts of one and the same specimen, are somewhat remarkable. They agree on the whole in shape with the parenchymal hexasters described above of *Aphrocallistes beatrix*, but are rarely elongated to such an extent as in that species. In some specimens of *Aphrocallistes ramosus* the branch-rays of the hexasters all terminate with simple points as in *Aphrocallistes beatrix*. In another specimen, from a different locality, the branch-rays of some of these hexasters, but by no means of all of them, bear on their ends four, more rarely three, fine, terminal claws, which are either vertical to the ray from which they arise or extend obliquely upwards. These claws are basally straight and terminally slightly recurved, they terminate in fine points. As these terminal appendages of the branch-rays have the shape of claws (ὄνυξ), I have named the hexasters supplied with them, onychasters, a term also used in the description of *Regadrella* on p. 70. A revision of my older slides of the specimens of *Aphrocallistes ramosus* brought home by the "Challenger" has revealed the fact that there also not unfrequently onychasters, similar in shape and in size, occur together with the parenchymal oxyhexasters, although they are in these specimens not so abundant as in the "Investigator" material. I must suppose that the spicule represented in fig. 10 plate LXXXVI of my "Challenger" Report on the Hexactinellida as a discohexaster, should in reality have been drawn as an onychaster, that is to say that there were present on the

ends of its branch-rays four vertical claws arranged crosswise, as I now see them on all these spicules, instead of the terminal disc.

Two specimens of *Aphrocallistes ramosus* F. E. Sch. were found 30 nautical miles to the West of Cape Bluff in the Middle Andaman Island in a depth of 878–1006 m.=480–550 fths.; and one further to the west in the Bay of Bengal in a depth of 403–439 m.=220–240 fths.

TABLES

OF THE

INDOCEANIC TRIAXONIA.

Table I. Indoceanic Triaxonia known independently of the "Investigator" Collection, with their localities.

Table II. Indoceanic Triaxonia of the "Investigator" Collection, with their localities.

Table III. The Triaxonia of the Indian Ocean.

TABLE I.

INDOCEANIC TRIAXONIA KNOWN INDEPENDENTLY OF THE "INVESTIGATOR" COLLECTION, WITH THEIR LOCALITIES.

Station.	Locality.	Position.		Depth.		Species.
		Latitude.	Longitude.	Meters.	Fathoms	
.....	Isle of Bourbon ...	.....	.....	.....	.....	Corbitella corbicula Bwbk.
.....	Seychelles ...	.....	.....	.....	.....	Euplectella cucumer R. Owen. Farrea occa (Bwbk.) Carter. Farrea densa Bwbk. (sp. dub.)
Challenger 145 ...	S.E. Prince Edward Island	46° 43′ S.	38° 4′ 30″ E.	256	140	Rossella antarctica Carter.
Challenger 145a ...	S.E. Prince Edward Island	46° 41′ S.	38° 10′ E.	567	310	Aulascus johnstoni F. E. Sch. Aulocalyx irregularis F. E. Sch.
Challenger 146 ...	West Crozet Island ...	46° 46′ S.	45° 31′ E.	2515	1375	Holascus fibulatus F. E. Sch. Malacosaccus vastus F. E. Sch.
Challenger 147 ...	South Penguin Island (Crozets) ...	46° 16′ S.	48° 27′ E.	2926	1600	Hyalonema clavigerum F. E. Sch. Holascus fibulatus F. E. Sch. Caulophacus latus F. E. Sch. Bathydorus spinosus F. E. Sch. Farrea sp.
Challenger 148 ...	South Possessiou Island (Crozets) ...	46° 47′ S.	51° 37′ E.	384	210	Rossella antarctica Carter.
Challenger 148a ...	South Possession Island (Crozets) ...	46° 53′ S.	51° 52′ E.	1006	550	Chonelasma lamella F. E. Sch. Hexactinella sp.
Challenger 150 ...	South Kerguelen Island...	52° 4′ S.	71° 22′ E.	274	150	Rossella antarctica Carter.
Challenger 156 ...	S.W. Australia ...	62° 26′ S.	95° 44′ E.	3612	1975	Pleorhabdus oviformis F. E. Sch. (sp. dub.)
Challenger 157 ...	S.W. Australia ...	53° 55′ S.	108° 35′ E.	3566	1950	Holascus polejaevi F. E. Sch. Caulophacus pipetta F. E. Sch.

Station.	Locality.	Position.		Depth.		Species.
		Latitude.	Longitude.	Meters.	Fathoms.	
Challenger 158 ...	S. Australia ...	50° 1′ S.	123° 4′ E.	3291	1800	Hyalonema conus F. E. Sch.
Challenger 160 ...	S. Australia ...	42° 42′ S.	134° 10′ E.	4755	2600	Holascus fibulatus F. E. Sch.
Pola 20 ...	Red Sea ...	23° 20′ N.	36° 20′ E.	780	427	Aulocystis grayi Bwbk. Tretocalyx polae F. E. Sch.
Pola 26 ...	Red Sea ...	24° 4′ N.	37° 3′ E.	725	397	Aulocystis grayi Bwbk. Tretocalyx polae F. E. Sch.
Pola 27 ...	Red Sea ...	23° 41′ N.	37° 23′ E.	747	409	Aulocystis grayi Bwbk.
Pola 31 ...	Red Sea ...	22° 50′ N.	36° 25·5′ E.	820	449	Aulocystis grayi Bwbk. Tretocalyx polae F. E. Sch.
Pola 48 ...	Red Sea ...	24° 5′ N.	37° 45′ E.	700	383	Aulocystis grayi Bwbk.
Pola 53 ...	Red Sea ...	23° 12′ N.	38° 19′ E.	600	328	Aulocystis grayi Bwbk.
Pola 56 ...	Red Sea ...	25° 22′ N.	34° 55′ E.	582	318	Aulocystis grayi Bwbk. Tretocalyx polae F. E. Sch.
Pola 107 ...	Red Sea ...	20° 27·2′ N.	38° 51′ E.	748	409	Tretocalyx polae F. E. Sch.
Pola 125 ...	Red Sea ...	26° 4′ N.	34° 30′ E.	690	377	Aulocystis grayi Bwbk.
Pola 127 ...	Red Sea ...	17° 42·2′ N.	39° 42·3′ E.	341	186	Tretocalyx polae F. E. Sch.
Pola 156 ...	Red Sea ...	22° 51·5′ N.	38° 24·4′ E.	712	389	Aulocystis grayi Bwbk.
Pola 173 ...	Red Sea ...	26° 75′ N.	35° 47·9′ E.	868	474	Aulocystis grayi Bwbk.
Pola 176 ...	Red Sea ...	25° 57′ N.	34° 36′ E.	612	334	Tretocalyx polae F. E. Sch.
Pola 179 ...	Red Sea ...	26° 34·5′ N.	34° 14·7′ E.	490	268	Aulocystis grayi Bwbk.
Pola ...	Red Sea ...	22° 18′ N.	36° 27′ E.	.....	.....	Tretocalyx polae F. E. Sch.

TABLE II.

INDOCEANIC TRIAXONIA OF THE "INVESTIGATOR" COLLECTION, WITH THEIR LOCALITIES.

"Investigator" Station.	Locality.	Position.		Depth.		Species.
		Latitude North.	Longitude East.	Meters.	Fathoms.	
.....	Angrias Bank, S.W. by S. Bombay.	.....	.....	.....	.....	Aphrocallistes bocagei Perc. Wright.
124 ...	Laccadives ...	10° 47′ 45″	72° 42′ 20″	1290	705	Dictyaulus elegans F. E. Sch.
104 ...	Laccadives ...	11° 12′ 47″	74° 25′ 5″	1830	1000	Hyalonema indicum laccadivense F. E. Sch. Hyalonema weltneri F. E. Sch. Euplectella aspera F. E. Sch. Hyalonematid (spec. dub.)
125 ...	Laccadives ...	10° 7′ 50″	74° 42′ 30″	2286	1250	Hyalonema alcocki F. E. Sch.
150 ...	S.W. Cape Comorin ...	7° 5′ 43″	75° 4′	1316	719	Dictyaulus elegans F. E. Sch.
231 ...	S.W. Cape Comorin ...	7° 34′ 30″	76° 8′ 23″	1530	836	Hyalonema lamella F. E. Sch.
232 ...	S.W. Cape Comorin ...	7° 17′ 30″	76° 54′ 30″	787	430	Hyalonema lamella F. E. Sch. Regadrella decora F. E. Sch. Farrea occa (Bwbk.) Carter. Aphrocallistes bocagei Perc. Wright.
118 ...	Bay of Bengal ...	12° 20′	85° 8′	3300	1803	Hyalonema investigatoris F. E. Sch. Holascus robustus F. E. Sch. Saccocalyx pedunculata F. E. Sch.
110 ...	Bay of Bengal ...	9° 34′	85° 43′ 15″	3655	1997	Bathydorus levis F. E. Sch. Hyalonema heymonsi F. E. Sch.

"Investigator" Station.	Locality.	Position.		Depth.		Species.
		Latitude North.	Longitude East.	Meters.	Fathoms.	
117 ...	Bay of Bengal ...	11° 58′	88° 52′ 17″	3200	1748	Hyalonema masoni F. E. Sch.
12 ...	Bay of Bengal ...	6° 18′	90° 40′	2506–2876	1370–1540	Holascus tener F. E. Sch. Euplectella aspera F. E. Sch.
111 ...	Bay of Bengal ...	12° 50′	90° 52′	3008	1644	Placopegma solutum F. E. Sch.
.....	Bay of Bengal ...	12° 37′	92° 19′	316–530	184–280	Pheronema raphanus F. E. Sch. Farrea sp.
241 ...	Bay of Bengal ...	10° 12′	92° 30′ 30″	1109	606	Hyalonema rapa F. E. Sch.
9 ...	Bay of Bengal, S. by W. of North Sentinel Island (Andamans).	.....	.....	238–458	130–250	Farrea occa (Bwbk.) Carter. Aphrocallistes beatrix J. E. Gray. Aphrocallistes bocagei Perc. Wright.
.....	Bay of Bengal, North Sentinel Island bearing N. 15° W. 18 miles.	.....	.....	457	250	Hyalonema aculeatum F. E. Sch. Hyalonema heideri F. E. Sch. Hyalonema affine reticulatum F. E. Sch. Hyalonema pirum F. E. Sch. Euplectella simplex F. E. Sch.
55 ...	Bay of Bengal, 30 miles W. of Cape Bluff Andaman Isl.	.....	.....	878–1006	480–550	Aphrocallistes ramosus F. E. Sch.
56 ...	Bay of Bengal, midway between North and South Sentinel Island.	.....	.....	402–439	220–240	Hyalonema affine reticulatum F. E. Sch. Euplectella simplex F. E. Sch. Farrea occa (Bwbk.) Carter. Aphrocallistes ramosus F. E. Sch.
.....	Bay of Bengal, W. of the Andamans.	.....	.....	436–531	238–290	Pheronema raphanus F. E. Sch. Lophocalyx spinosa F. E. Sch. Aphrocallistes beatrix J. E. Gray. Aprocallistes bocagei Perc. Wright. Semperella cucumis F. E. Sch.

"Investigator" Station.	Locality.	Position.		Depth.		Species.
		Latitude North.	Longitude East.	Meters.	Fathoms.	
.....	Bay of Bengal, W. of the Andamans.	.....	.....	315	173	Pheronema raphanus F. E. Sch. Farrea sp. Aphrocallistes bocagei Perc. Wright.
115 ...	Andaman Sea ...	11° 31′ 40″	92° 46′ 40″	343–402	188–220	Semperella cucumis F. E. Sch.
116 ...	Andaman Sea ...	11° 25′ 5″	92° 47′ 6″	740	405	Semperella cucumis F. E. Sch. Pheronema raphanus F. E. Sch.
13 ...	Andaman Sea, S.E. by S. Ross Island.	11° 38′	92° 52′	485	265	Hyalonema pirum F. E. Sch. Hyalonema affine reticulatum F. E. Sch. Aphrocallistes bocagei Perc. Wright.
237 ...	Andaman Sea ...	13° 17′	93° 7′	165	90	Aphrocallistes bocagei Perc. Wright.
220 ...	Andaman Sea ...	13° 16′ 30″	93° 8′	144	79	Aphrocallistes beatrix J. E. Gray.
221 ...	Andaman Sea ...	13° 15′	93′ 10′	362	198	Aphrocallistes beatrix J. E. Gray.
222 ...	Andaman Sea ...	13° 27′	93° 4′ 30″	741	405	Pheronema raphanus F. E. Sch. Hyalonema affine reticulatum F. E. Sch. Euplectella regalis F. E. Sch.
113 ...	Andaman Sea ...	12° 59′	93° 23′ 10″	1250	683	Hyalonema indicum andamanense F. E. Sch.
234 ...	Andaman Sea ...	13° 50′	93° 26′	911	498	Hyalonema masoni F. E. Sch. Lophophysema inflatum F. E. Sch.
228 ...	Andaman Sea, Gulf of Martaban.	13° 7′	94° 44′ 15″	1171	660	Hyalonema martabanense F. E. Sch.

TABLE III.

The Triaxonia of the Indian Ocean.

	Locality.	Position.		Depth.		Ship and Station.
		Latitude.	Longitude.	Meters.	Fathoms.	
A. AMPHIDISCOPHORA.						
I. HYALONEMATIDAE.						
Gen. Pheronema Leidy.						
Ph. raphanus F. E. Sch. ...	1. Bay of Bengal	12° 37′ N.	92° 19′ E.	316–530	173–280	Investigator.
	2. W. Andamans	.....	.....	435–530	232–280	Investigator.
	3. Andaman Sea	13° 27′ N.	93° 14′ 30″ E.	741	405	Investigator 222.
Gen. Hyalonema J. E. Gray.						
H. clavigerum F. E. Sch. ...	S. Penguin Island (Crozets.) ...	46° 16′ S.	48° 27′ E.	2926	1600	Challenger 147.
H. conus F. E. Sch. ...	South Australia	50° 1′ S.	123° 4′ E.	3291	1800	Challenger 158.
H. indicum andamanense, F. E. Sch. ...	Andaman Sea	12° 59′ N.	93° 23′ 10″ E.	1250	683	Investigator 113.
H. indicum laccadivense, F. E. Sch. ...	Laccadive Sea	11° 12′ 47″ N.	74° 25′ 5″ E.	1830	1000	Investigator 104.
H. masoni F. E. Sch. ...	1. Bay of Bengal	11° 58′ N.	88° 52′ 17″ E.	3200	1748	Investigator 117.
	2. Andaman Sea	13° 50′ N.	93° 26′ E.	911	498	Investigator 234.

	Locality.	Position.		Depth.		Ship and Station.
		Latitude.	Longitude.	Meters.	Fathoms.	
H. lamella F. E. Sch. ...	1. Cape Comorin	7° 17′ 30″ N.	76° 54′ 30″ E.	787	430	Investigator 232.
	2. Cape Comorin	7° 34′ 30″ N.	76° 8′ 23″ E.	1530	836	Investigator 231.
H. rapa F. E. Sch. ...	Bay of Bengal, W. Andamans ...	10° 12′ N.	92° 30′ 30″ E.	1109	606	Investigator 241.
H. martabanense F. E. Sch. ...	Gulf of Martaban	13° 7′ N.	94° 44′ 15″ E	1171	640	Investigator 228.
H. alcocki F. E. Sch. ...	Laccadive Sea	10° 7′ 50″ N.	74° 42′ 30″ E.	2288	1250	Investigator 125.
H. investigatoris F. E. Sch. ...	Bay of Bengal	12° 20′ N.	85° 8′ E.	3300	1803	Investigator 118.
H. affine reticulatum F. E. Sch.	1. Bay of Bengal, between N. and S. Sentinel Island.	.....	.....	403-439	220-240	Investigator 56.
	2. Bay of Bengal, S. by W. North Sentinel Island	.....	.....	238-458	130-250	Investigator 9.
	3. Andaman Sea, Ross Island ...	11° 38′ N.	92° 52′ E.	485	265	Investigator 13.
	4. Andaman Sea	13° 27′ N.	93° 14′ 30″ E.	745	405	Investigator 222.
H. aculeatum F. E. Sch. ...	Bay of Bengal, S. by W. North Sentinel Island	.....	.....	458	250	Near Investigator 9.
H. heideri F. E. Sch. ...	Bay of Bengal, S. by W. North Sentinel Island	.....	.....	458	250	Near Investigator 9.
H. pirum F. E. Sch. ...	1. Bay of Bengal, S. by W. North Sentinel Island	.....	.....	458	250	Near Investigator 9.
	2. Andaman Sea...	11° 38′ N.	92° 52′ E.	485	265	Investigator 13
H. heymonsi F. E. Sch. ...	Bay of Bengal	9° 34′ N.	85° 43′ 15″ E.	3655	1997	Investigator 110.
H. weltneri F. E. Sch. ...	Laccadive Sea	11° 12′ 47″ N.	74° 25′ 5″ E.	1830	1000	Investigator 104.
Hyalonema sp.	1. Bay of Bengal, S. by W. North Sentinel Island	.....	.....	238-458	130-250	Investigator 9.
	2. Laccadive Sea	11° 12′ 47″ N.	74° 25′ 5″ E.	1830	1000	Investigator 104.
	3. West of Andamans	.....	.....	.....	.....	Investigator.
	4. West of Andamans	.....	.....	435-530	238-290	Investigator.

	Locality.	Position.		Depth.		Ship and Station.
		Latitude.	Longitude.	Meters.	Fathoms.	
Gen. Lophophysema F. E. Sch.						
L. inflatum F. E. Sch. ...	Andaman Sea	13°30′50″N.	93° 26′ E.	911	498	Investigator 234.
Gen. Semperella J. E. Gray.						
S. cucumis F. E. Sch. ...	1. Andaman Sea	11°31′40″N.	92°46′40″E.	343–402	188–220	Investigator 115.
	2. Andaman Sea	11° 25′ 5″ N.	92° 47′ 6″ E.	740	405	Investigator 116.
	3. W. Andamans	.....	.....	435–530	238–290	Investigator.
B. HEXASTEROPHORA.						
II. EUPLECTELLIDAE.						
Gen. Holascus F. E. Sch.						
H. fibulatus F. E. Sch. ...	1. S. Australia	42° 42′ S.	134° 10′ E.	4755	2600	Challenger 160.
	2. Between Prince Edward and Crozet Islands	46° 46′ S.	45° 31′ E.	2515	1375	Challenger 146.
	3. W. Crozet Islands	46° 16′ S.	48° 27′ E.	2926	1600	Challenger 147.
H. polejaevi F. E. Sch. ...	S. Australia	53° 55′ S.	108° 35′ E.	3566	1950	Challenger 157.
H. robustus F. E. Sch. ...	Bay of Bengal	12° 20′ N.	85° 8′ E.	3300	1803	Investigator 118.
H. tener F. E. Sch. ...	Bay of Bengal	6° 18′ N.	90° 40′ E.	2506–2816	1370–1540	Investigator 12.
Gen. Malacosaccus F. E. Sch.	.....	.....	.....	.....	.....	.....
M. vastus F. E. Sch. ...	Between Prince Edward and Crozet Islands.	46° 46′ S.	45° 31′ E.	2515	1375	Challenger 146.
Gen. Euplectella Owen						
E. cucumer Owen ...	Seychelles	.....	.....	.....	.....	.....

	Locality.	Position.		Depth.		Ship and Station.
		Latitude.	Longitude.	Meters.	Fathoms.	
E. simplex F. E. Sch. ...	1. Bay of Bengal, North Sentinel Island...	... ..	.....	457	250	Investigator.
	2. Bay of Bengal between N. and S. Sentinel Island.	.....	.....	402–439	220–240	Investigator 56.
E. aspera F. E. Sch. ...	1. Bay of Bengal	6° 18′ N.	90° 40′ E.	2506–2816	1370–1540	Investigator 12.
	2. Laccadive Sea	11° 12′ 47″N.	74° 25′ 5″ E.	1830	1000	Investigator 104.
E. regalis F. E. Sch. ...	Andaman Sea	13° 27′ N.	93° 14′ 30″ E.	741	405	Investigator 222.
Gen. Regadrella O. Schm.						
R. decora F. E. Sch. ...	S. W. Cape Comorin	7° 17′ 30″ N.	76° 54′ 30″ E.	787	430	Investigator 232.
Gen. Dictyaulus F. E. Sch.						
D. elegans F. E. Sch. ...	1. Laccadive Sea	10° 47′45″N.	72° 40′ 20″ E.	1290	705	Investigator 124.
	2. S. W. Cape Comorin	7° 5′ 45″ N.	75° 4′ E.	1316	719	Investigator 150.
Gen. Corbitella Bowerbank.						
C. corbicula Bwbk. ...	Isle de Bourbon	.....	.....	.....	.....	.....
Gen. Saccocalyx F. E. Sch.						
S. pedunculata F. E. Sch. ...	Bay of Bengal	12° 20′ N.	85° 8′ E.	3300	1803	Investigator 118.
III. ASCONEMATIDAE.						
Gen. Aulascus F. E. Sch.						
A. johnstoni F. E. Sch.	Prince Edward Island	46° 41′ S.	38° 10 E.′	567	310	Challenger 145*a*.
Gen. Pleorhabdus F. E. Sch.						

	Locality.	Position.		Depth.		Ship and Station.
		Latitude.	Longitude.	Meters.	Fathoms.	
Pl. oviformis F. E. Sch. (sp. dub.)	.....	62° 26′ S.	95° 44′ E.	3612	1975	Challenger 156.
Gen. Caulophacus F. E. Sch.						
C. latus F. E. Sch. ...	W. Crozet Island	46° 16′ S.	48° 27′ E.	2926	1600	Challenger 147.
C. pipetta F. E. Sch. ...	S. Australia	53° 55′ S.	108° 35′ E.	3566	1950	Challenger 157.
IV. ROSSELLIDAE.						
Gen. Bathydorus F.E. Schulze.						
B. spinosus F. E. Sch. ...	S. Penguin Island (Crozets)... ...	46° 16′ S.	48° 27′ E.	2926	1600	Challenger 147.
B. levis F. E. Sch. ...	Bay of Bengal	9° 34′ N.	85° 43′ 15″ E.	3652	1997	Investigator 110.
Gen. Rossella Carter.						
R. antarctica Cart. ...	1. S. E. Prince Edward Island ...	46° 43′ S.	38° 4′ 30″ E.	256	140	Challenger 145.
	2. S. Kerguelen Island	52° 4′ S.	71° 22′ E.	274	150	Challenger 150.
	3. S. Possession Island (Crozets) ...	46° 47′ S.	51° 37′ E.	384	210	Challenger 148.
Gen. Aulocalyx F. E. Schulze.						
A. irregularis F. E. Sch. ...	Prince Edward Island	46° 41′ S.	38° 10′ E.	567	310	Challenger 145a.
Gen. Placopegma F. E. Schulze.						
P. solutum F. E. Sch. ...	Bay of Bengal	12° 50′ N.	90° 52′ E.	3008	1644	Investigator 111.
Gen. Lophocalyx F. E. Schulze						
L. spinosa F. E. Sch. ...	W. Andamans	.....	.....	436–531	83–290	Investigator.

	Locality.	Position.		Depth.		Ship and Station.
		Latitnde.	Longitude.	Meters.	Fathoms.	
V. FARREIDAE.						
Gen. Farrea Bowerbank.						
F. occa (Bwbk.) Cart. ...	1. Seychelles	.....	.....	.....	.....	.....
	2. Bay of Bengal	.....	.....	403–439	220–240	Investigator 56.
	3. Andamans	.....	.....	238–458	130–250	Investigator.
F. densa Bwbk. (sp. dub.) ...	Seychelles	.....	.....	.....	.....	.....
Farrea sp.	1. S. Penguin Island (W. Crozets) ...	46° 16′ S.	48° 27′ E....	2926	1600	Challenger 147.
	2. Bay of Bengal...	.....	.....	403–439	220–240	Investigator 56.
	3. Andamans	.....	.....	315	172	Investigator.
	4. Cape Comorin	7° 17′ 30″ N.	76° 54′ 30″E.	787	438	Investigator 232.
	5. Bay of Bengal, Andamans ...	12″ 37′ N....	92° 19′ E.	316–530	184-280	Investigator
VI. EURETIDAE.						
Gen. Tretocalyx F. E. Schulze.						
T. polae F. E. Sch. ...	1. Red Sea	25° 57′ N.	34° 36′ E.	612	334	Pola 176.
	2. Red Sea	25° 23′ N.	34° 55′ E.	582	318	Pola 56.
	3. Red Sea	24° 4′ N.	37° 3′ E.	725	397	Pola 26.
	4. Red Sea	23° 20′ N.	36° 20′ E.	780	427	Pola 20.
	5. Red Sea	22° 59′ N.	36° 25′ E.	820	449	Pola 31.
	6. Red Sea	22° 18′ N.	36° 27′ E.	.....	.....	Pola
	7. Red Sea	20° 17′ 2′ N.	38° 31′ E.	748	409	Pola 107.
	8. Red Sea	17° 42′ 2′ N.	39° 42′ 3′ E.	341	186	Pola 127.
VII. MELITTIONIDAE.						
Gen. Aphrocallistes J. E. Gray.						
A. beatrix J. E. Gray ...	1. Andaman Sea	13° 16′ 30″N.	93° 8′ E.	144	79	Investigator 220.
	2. Bay of Bengal, S. by W. North Sentinel Island.	.....	.....	233–4 58	130–250	Investigator 9.

	Locality.	Position.		Depth.		Ship and Station.
		Latitude.	Longitude.	Meters.	Fathoms.	
	3. Andaman Sea	13° 15′ N.	93° 10′ E.	362	198	Investigator 221.
	4. W. Andamans	.....	.....	436-531	238-290	Investigator.
A. bocagei Perc. Wright ...	1. Andamans	.....	.....	351	172	Investigator.
	2. Bay of Bengal, S. by W. North Sentinel Island.	.....	.....	238-458	130-250	Investigator 9.
	3. W. Andamans	.....	.....	436-531	238-290	Investigator.
	4. Angrias Bank	.....	.....	.....	.....	Investigator.
	5. Andaman Sea	13° 17′ N.	93° 7′ E.	165	90	Investigator 237.
	6. Bay of Bengal	.....	.....	403-439	220-240	Investigator 56.
	7. S. W. Cape Comorin	7° 17′ 30″N.	76° 54′ 30″E.	787	430	Investigator 232.
A. ramosus F. E. Sch. ...	1. W. Middle Andaman, W. of Cape Bluff.	.....	.....	878-1006	480-550	Investigator 55.
	2. Bay of Bengal, between N. and S. Sentinel Island.	.....	.....	403-439	220-240	Investigator 56.
VIII. COSCINOPORIDAE.						
Gen. Chonelasma F. E. Schulze						
Ch. lamella F. E. Sch. ...	S. Possession Island (Crozets) ...	46° 53′ S.	51° 52′ E.	1006	550	Challenger 148*a*.
Gen. Hexactinella Carter ...						
Hexactinella sp.	S. Possession Island (Crozets) ...	46° 53′ S.	51° 52′ E.	1006	550	Challenger 148*a*.
IX. MACANDROSPONGIDAE.						
Gen. Aulocystis F. E. Schulze.						

	Locality.	Position.		Depth.		Ship and Station.
		Latitude.	Longitude.	Meters.	Fathoms.	
A. grayi Bwbk.	1. Red Sea	26° 75′ N.	35° 47·9′ E.	868	474	Pola 173.
	2. Red Sea	26° 34·5′ N.	34° 14·7′ E.	490	268	Pola 179.
	3. Red Sea	26° 4′ N.	34° 30′ E.	690	377	Pola 125.
	4. Red Sea	25° 22′ N.	34° 55′ E.	582	318	Pola 56.
	5. Red Sea	24° 5′ N.	37° 45′ E.	700	383	Pola 48
	6 Red Sea	24° 4′ N.	37° 3′ E.	725	397	Pola 26
	7. Red Sea	23° 41′ N.	37° 23′ E.	747	409	Pola 27
	8. Red Sea	23° 20′ N.	36° 20′ E.	780	427	Pola 20.
	9. Red Sea	23° 12′ N.	38° 19′ E.	600	328	Pola 53.
	10. Red Sea	22° 59′ N.	36° 25·5′ E.	820	449	Pola 31.
	11. Red Sea	22° 51 5′ N.	38° 24·4′ E.	712	389	Pola 156
Hexactinellidae dubiae ...	1. Bay of Bengal	12° 20′ N.	85° 8′ E	3300	1803	Investigator 118.
	2. Bay of Bengal	6° 18′ N.	90° 40′ E.	2506–2816	1370-1540	Investigator 12.

EXPLANATION OF PLATE I.

Pheronema raphanus. F. E. Sch.

Fig. 1. Lateral view of a specimen from the Andamans. Nat. size. After a photograph taken by Dr. von Mährenthal.

Fig. 2. The same specimen seen from above. Nat. size. After a photograph taken by Dr. von Mährenthal.

Fig. 3. Macramphidiscs of the skin. × 300.

Figs. 4, 5 and 6. Micramphidiscs of the skin. × 300.

Fig. 7. Large pinule of the outer skin. × 300.

Fig. 8. Low pinule of the outer skin. × 300.

Fig. 9. Micro-uncinate of the parenchyme. × 200.

Fig. 10. Fragment of the central part of an uncinate. × 400.

Fig. 11. Micro-oxyhexactine of the parenchyme. × 300.

Fig. 12. Lower end of an anchor. × 300.

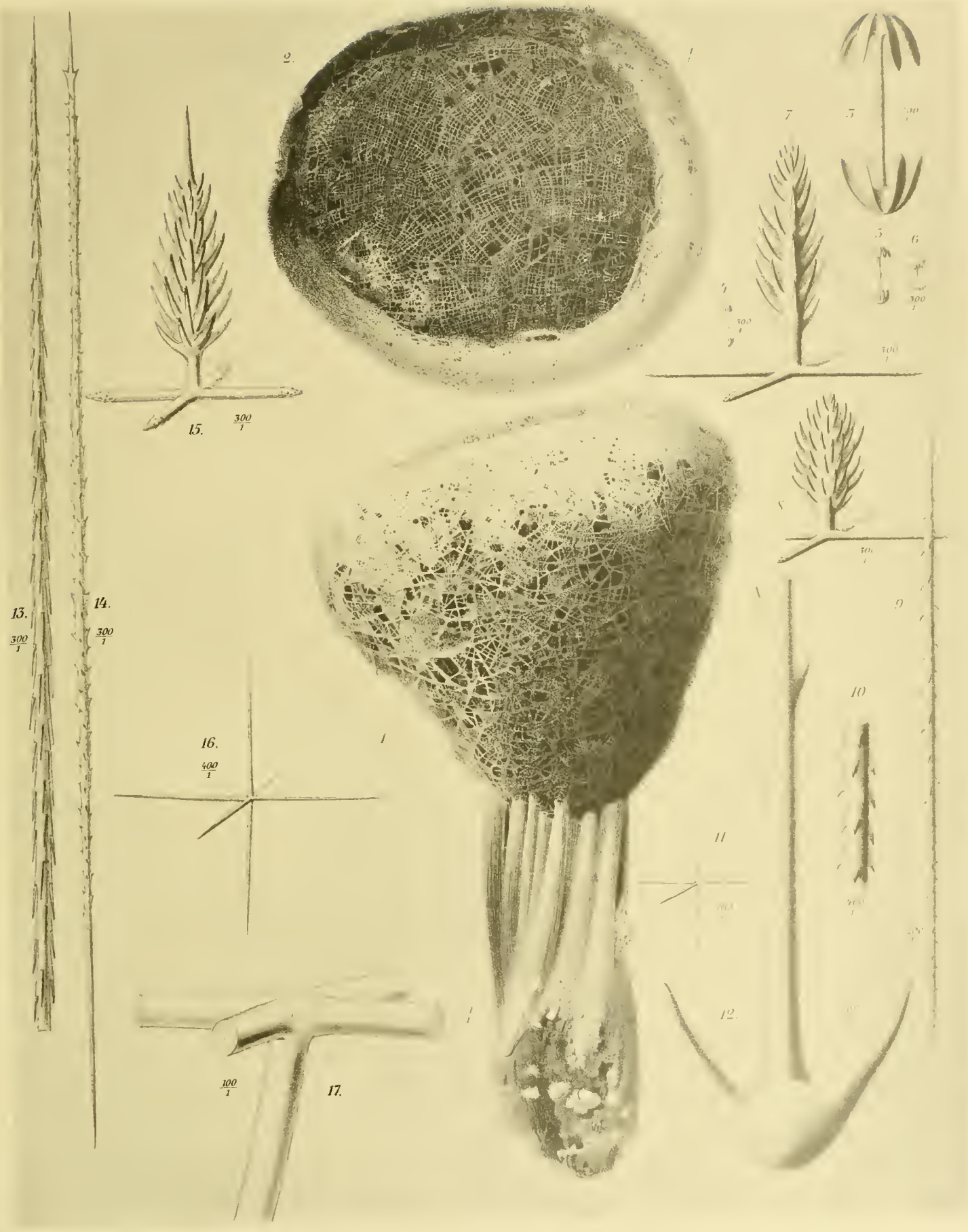
Fig. 13. Upper end of a large uncinate. × 300.

Fig. 14. Small marginal spicule. × 300.

Fig. 15. Large pinule of the outer skin. × 300.

Fig. 16. Larger parenchymal oxyhexactine. × 400.

Fig. 17. Central part of a pentactine hypodermal. × 100.



Pheronema raphanus F. E. Sch.

EXPLANATION OF PLATE II.

Figs. 1–14. *Hyalonema aculeatum*. F. E. Sch.

Figs. 1–4. Four differently sized specimens in lateral view. Nat. size.

Fig. 5. Arrangement of the spicules in a section vertical to the surface. × 50 (combined figure).

Figs. 6 and 7. Dermal pinules. × 300.

Fig. 8. Micro-oxyhexactine. × 300.

Fig. 9. Macramphidises. × 300.

Figs. 10, 11 and 12. Micramphidises. × 300.

Fig. 13. Ambuncinate. × 200.

Fig. 14. Lower end of an anchor-spicule. × 300.

Figs. 15–22. *Hyalonema heideri*. F. E. Sch.

Fig. 15. The only known specimen. Nat. size.

Fig. 16. Arrangement of the spicules in a section vertical to the surface. × 50 (combined figure).

Fig. 17. Micro-oxyhexactine. × 300.

Figs. 18 and 19. Dermal pinules. × 300.

Fig. 20. Macramphidisc. × 300.

Fig. 21. Mesamphidisc. × 300.

Fig. 22. Ambuncinate. × 300.

Figs. 23–30. *Hyalonema pirum*. F. E. Sch.

Figs. 23–25. Three differently sized specimens in lateral view. Nat. size.

Fig. 26. Arrangement of the spicules in a section vertical to the surface. × 50 (combined figure).

Fig. 27. Micro-oxyhexactine. × 300.

Fig. 28. Dermal pinule. × 800.

Fig. 29. Macramphidisc. × 300.

Fig. 30. Micramphidisc. × 800.

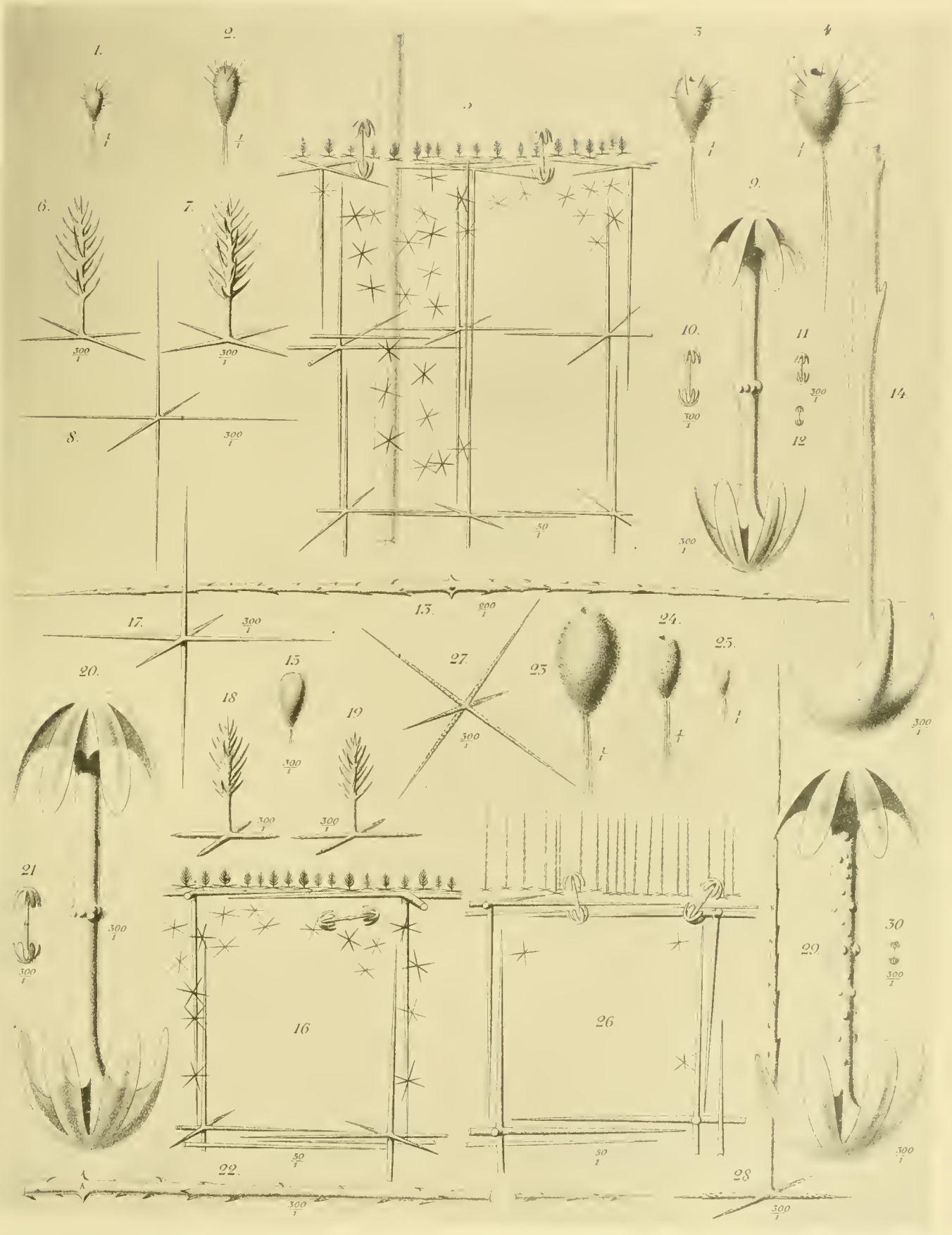


Fig. 1-14 Hyalonema aculeatum F. E. Sch. Fig. 15-22 Hyalonema heideri F. E. Sch. 23-30. Hyalonema pirum F. E. Sch.

EXPLANATION OF PLATE III.

Figs. 1–13. *Hyalonema indicum laccadivense*. F. E. Sch.

Fig. 1. The only known specimen. Nat. size.

Fig. 2. Arrangement of the spicules in a section vertical to the surface. × 60 (combined figure).

Fig. 3. Dermal macramphidisc. × 300.

Figs. 4 and 5. Canalar mesamphidiscs. × 300.

Figs. 6 and 7. Dermal micramphidiscs. × 300.

Fig. 8. Terminal disc of a macramphidisc seen from within. × 300.

Fig. 9. Dermal pinule. × 300.

Fig. 10. Pinule of the oscular sieve-plate. × 300.

Fig. 11. Micro-oxystauractine of the canal-wall. × 300.

Fig. 12. Parenchymal micro-oxyhexactine. × 300.

Fig. 13. Micro-oxypentactine of the canal-wall. × 300.

Figs. 14–18. *Hyalonema heymonsi*. F. E. Sch.

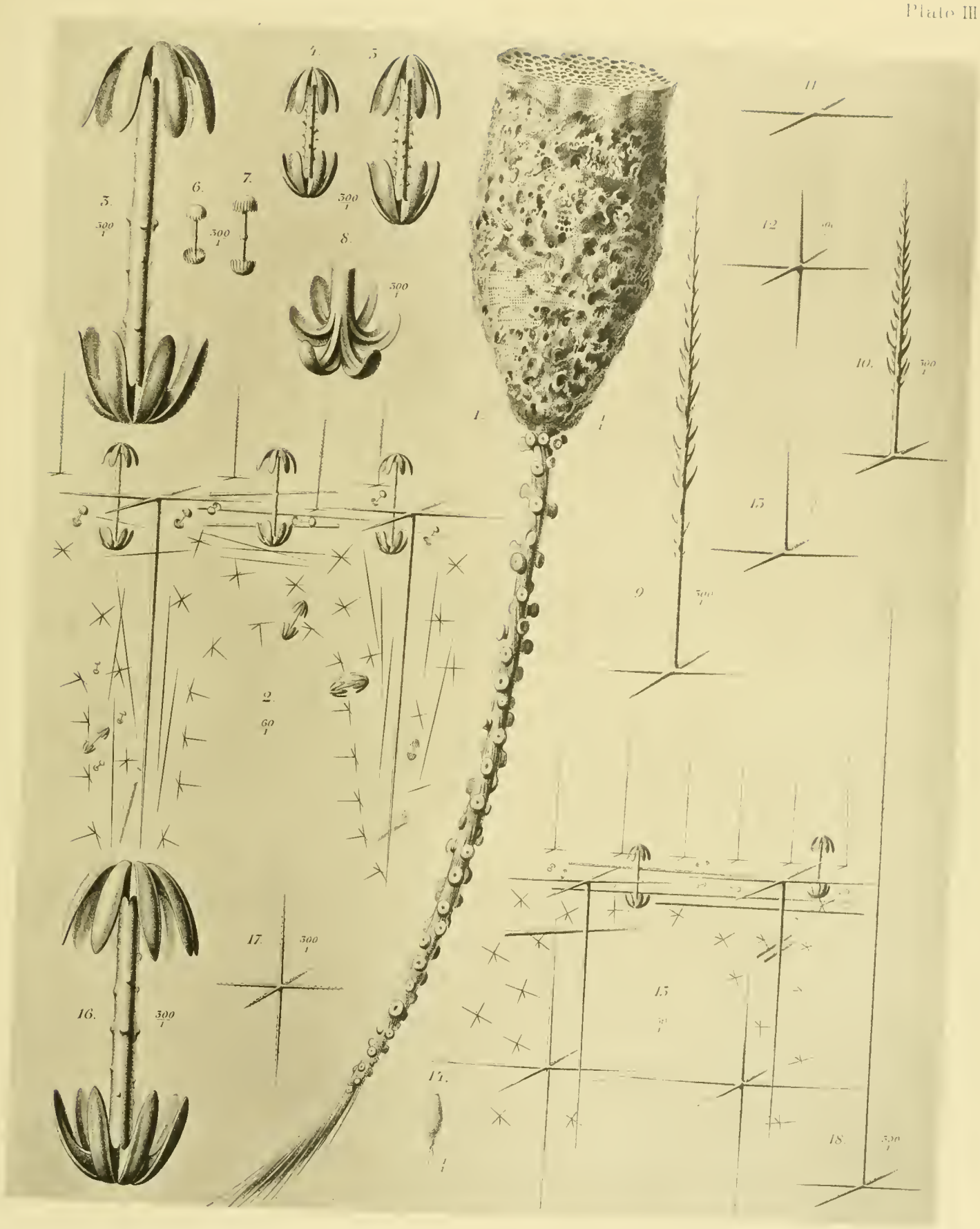
Fig. 14. The only known specimen. Nat. size.

Fig. 15. Arrangement of the spicules in a section vertical to the surface. × 50 (combined figure).

Fig. 16. Dermal macramphidisc. × 300.

Fig. 17. Micro-oxyhexactine. × 300.

Fig. 18. Dermal pinule. × 300.



1-13. Hyalonema indicum laccadivense F.E.Sch. 14-18. Hyalonema heymonsi F.E.Sch.

EXPLANATION OF PLATE IV.

Figs. 1–14. *Hyalonema indicum andamanense.* F. E. Sch.

Fig. 1. The only known, considerably compressed specimen. Nat. size.

Fig. 2. Arrangement of the spicules in a section vertical to the surface. × 60 (combined figure).

Figs. 3 and 4. Dermal macramphidisc. × 400.

Fig. 5. Mesamphidisc. × 400.

Figs. 6–9. Micramphidiscs of different sizes. × 400.

Figs. 10 and 11. Micro-oxystauractines. × 600.

Fig. 12. Micro-oxyhexactine. × 600.

Fig. 13. Pinule of the ocular sieve-plate. × 300.

Fig. 14. Pinule of the outer skin. × 300.

Figs. 15–24. *Hyalonema weltneri.* F. E. Sch.

Fig. 15. The only known specimen. Nat. size.

Fig. 16. Arrangement of the spicules in a section vertical to the surface. × 60 (combined figure).

Fig. 17. Dermal macramphidisc. × 230.

Fig. 18. Mesamphidisc. × 300.

Figs. 19 and 20. Micramphidiscs. × 300.

Fig. 21. Lower end of an anchor-spicule of the canal root-tuft. × 200.

Fig. 22. Parenchymal micro-oxyhexactine. × 300.

Fig. 23. Spined, parenchymal micro-oxyhexactine. × 300.

Fig. 24. Dermal pinule. × 300.

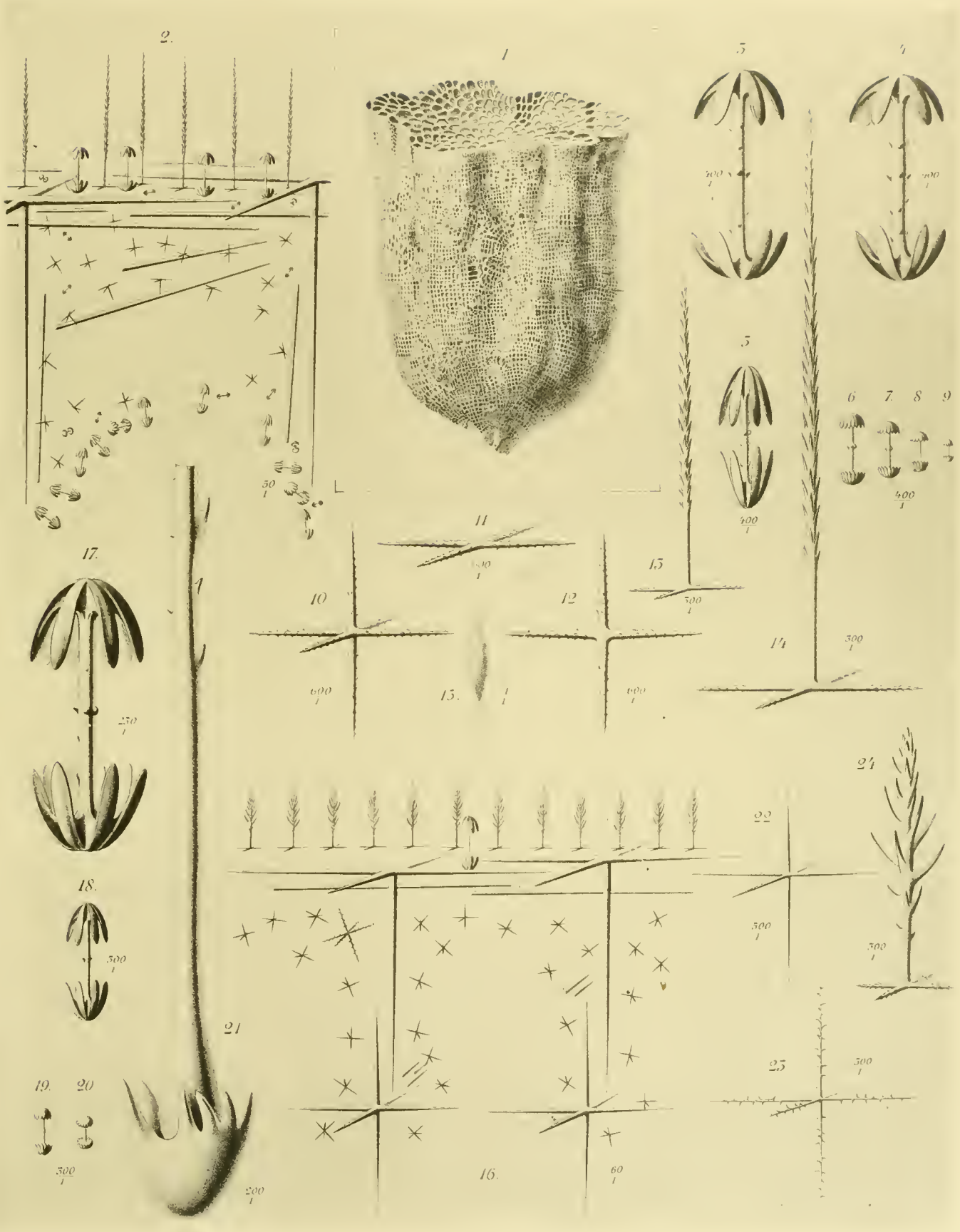


Fig. 1-14. Hyalonema indicum andamanense F. E. Sch. Fig. 15-24. Hyalonema weltneri F. E. Sch.

EXPLANATION OF PLATE V.

Hyalonema masoni. F. E. Sch.

Fig. 1. A specimen. Nat. size.

Fig. 2. Arrangement of the spicules in a section through the margin of the calyx, vertical to the surface. × 60 (combined figure).

Fig. 3. Arrangement of the spicules in a section vertical to the surface. × 200 (combined figure).

Fig. 4. Pinule-like marginal spicule. × 200.

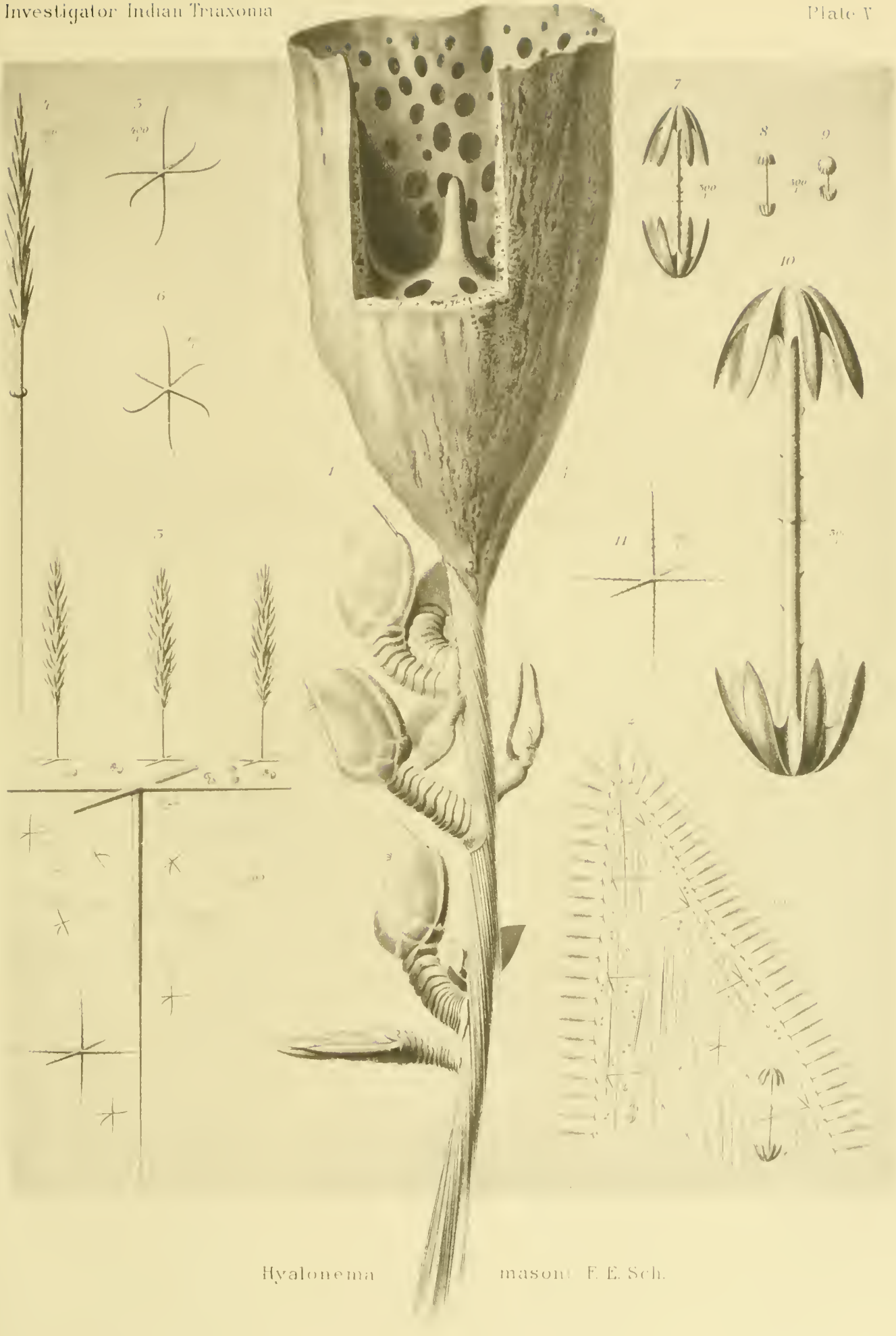
Figs. 5 and 6. Parenchymal micro-oxyhexactines. × 400.

Fig. 7. Mesamphidisc. × 300.

Figs. 8 and 9. Micramphidiscs. × 300.

Fig. 10. Dermal macramphidisc. × 300.

Fig. 11. Parenchymal micro-oxyhexactine. × 300.



Hyalonema masoni F. E. Sch.

EXPLANATION OF PLATE VI.

Figs. 1–8. *Hyalonema alcocki*. F. E. Sch.

Fig. 1. The only known specimen. Nat. size.

Fig. 2. Arrangement of the spicules in a section vertical to the surface. × 60 (combined figure).

Fig. 3. Dermal macramphidisc. × 300.

Fig. 4. Mieramphidisc. × 400.

Figs. 4*a* and 4*b*. Paradises. × 600.

Fig. 5. Mesamphidisc. × 400.

Fig. 6. Parenchymal micro-oxyhexactine. × 500.

Fig. 7. Dermal pinule. × 300.

Fig. 8. Marginal spicule. × 300.

Figs. 9–17. *Hyalonema investigatoris*. F. E. Sch.

Fig. 9. The only known specimen, which is strongly compressed. Nat. size.

Fig. 10. Arrangement of the spicules in a section vertical to the surface. × 40 (combined figure).

Fig. 11. Paradise with non-serrated terminal discs. × 1000.

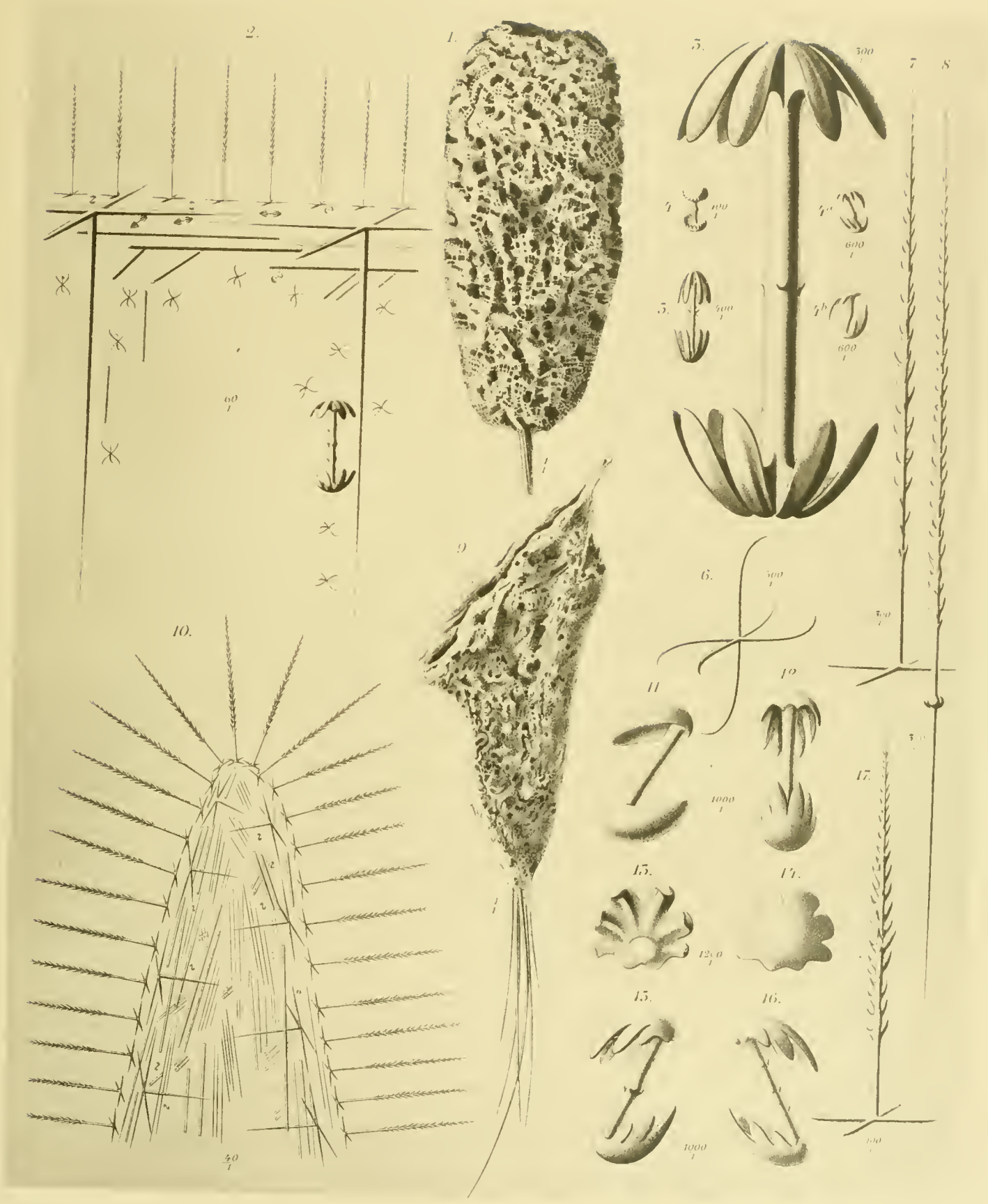
Fig. 12. Paradise with serrated terminal discs. × 1000.

Fig. 13. Terminal disc of a paradise seen from within. × 1200.

Fig. 14. Terminal disc of a paradise seen from without. × 1200.

Figs. 15–16. Paradises. × 100.

Fig. 17. Dermal pinule. × 100.



1-8. Hyalonema alcocki F.E.Sch. 9-17. Hyalonema investigatoris F.E.Sch

EXPLANATION OF PLATE VII.

Hyalonema affine reticulatum. F. E. Sch.

Fig. 1. A specimen. Nat. size. After a photograph taken by Dr. von Mährenthal.

Fig. 1*a*. The root-tuft belonging to this sponge, which had been broken off. Nat. size.

Fig. 2. Parenchymal micro-oxyhexactine. × 300.

Fig. 3. Parenchymal micro-oxyhexactine. × 300.

Figs. 4 and 5. Dermal pinules. × 300.

Fig. 6. Dermal macramphidisc. × 300.

Fig. 7. Small specimen in lateral view. Nat. size.

Fig. 7*a*. The same specimen seen from above. Nat. size.

Figs. 8, 9 and 10. Three different specimens. Nat. size.

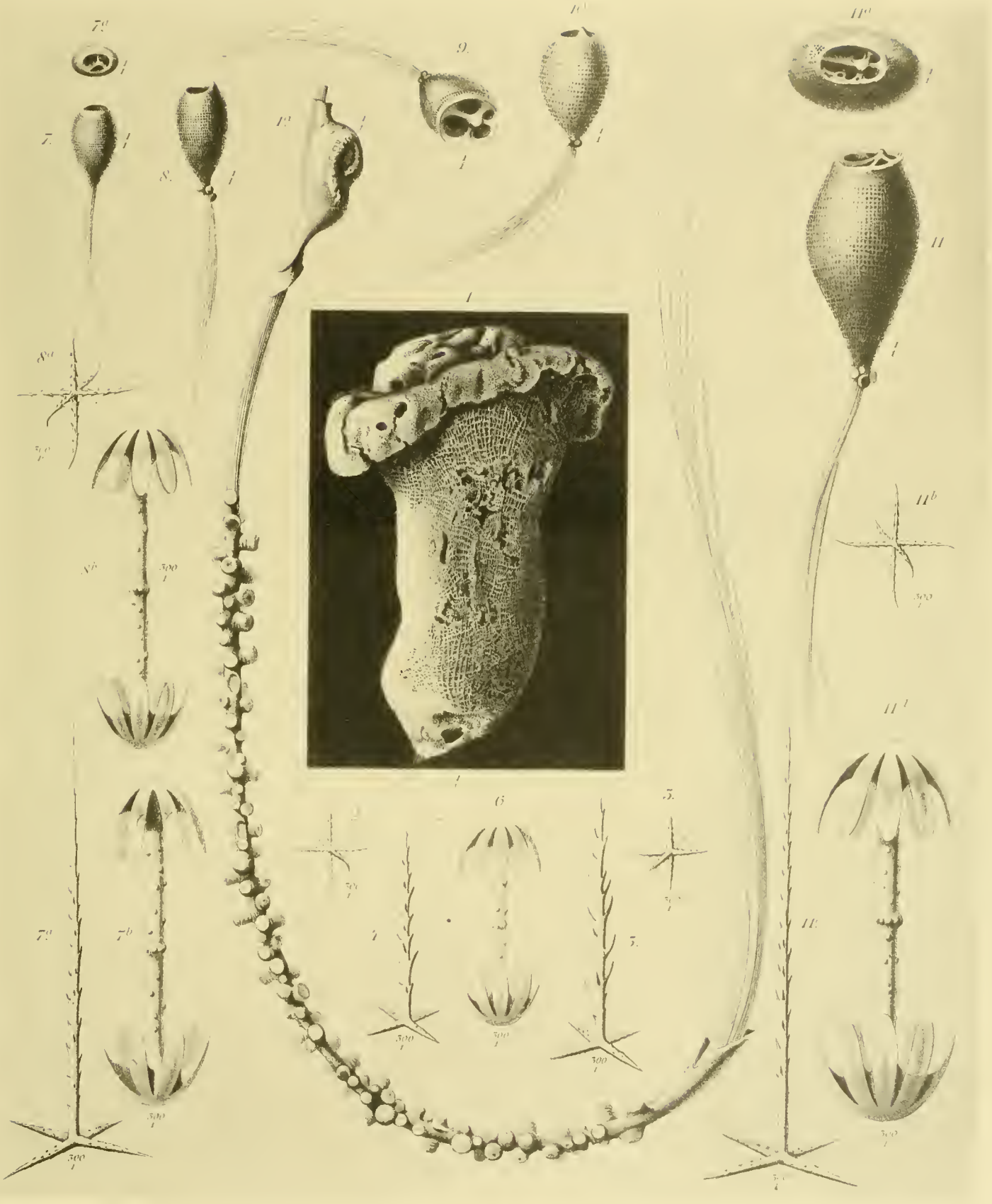
Fig. 11. A larger specimen in lateral view. Nat. size.

Fig. 11*a*. The same specimen seen from above. Nat. size.

Fig. 11*b*. Micro-oxyhexactine. × 300.

Fig. 11*c*. Dermal pinule. × 300.

Fig. 11*d*. Dermal macramphidisc. × 300.



Hyalonema affine reticulatum F E Sch

EXPLANATION OF PLATE VIII.

Semperella cucumis, F. E. Sch.

Fig. 1. Large specimen. One-half nat. size. After a photograph taken by Dr. von Mährenthal.

Fig. 2. Part of the external surface in the vicinity of the lower end. Nat. size. After a photograph taken by Dr. von Mährenthal.

Fig. 3. Arrangement of the spicules in a section of a part of the skin and the septal wall, vertical to the surface. × 50.

Fig. 4. Dermal macramphidisc. × 300.

Figs. 5 and 6. Micramphidiscs. × 300.

Fig. 7. Central part of an uncinate. × 300.

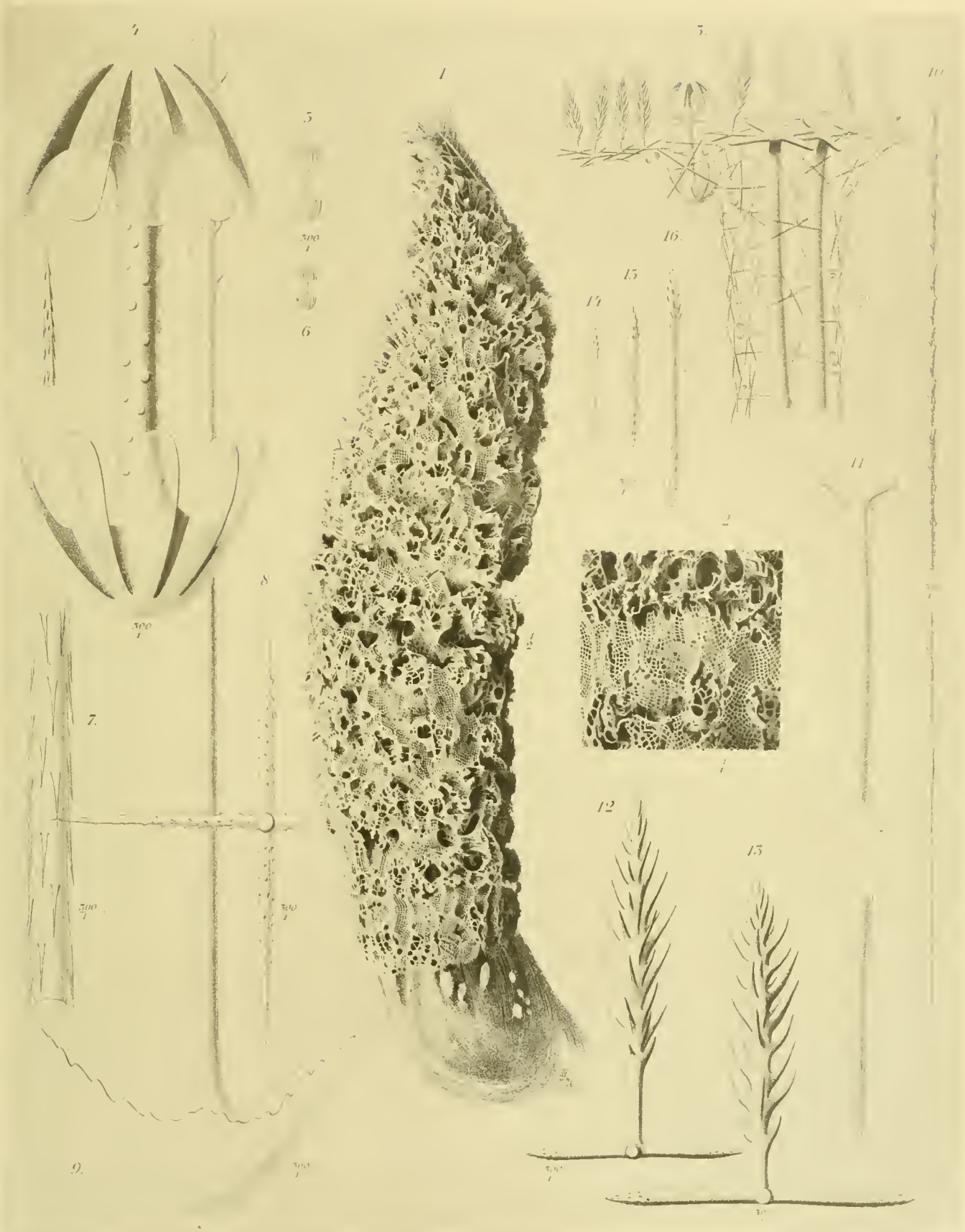
Fig. 8. Part of a micro-oxypentactine lying in the canal-wall. × 300.

Fig. 9. Lower end of an anchor-spicule of the root-tuft. × 300.

Fig. 10. Marginal spicule. × 300.

Fig. 11. Subdermal pentactine. × 50.

Figs. 12 and 13. Dermal pinules. × 300.



Semperella cucumis F. E. Sch.

EXPLANATION OF PLATE IX.

Figs. 1-10. *Holascus robustus.* F. E. Sch.

Fig. 1. Arrangement of the spicules in a transverse section of the body-wall. The upper margin corresponds to the dermal surface. × 80 (combined figure).

Fig. 2. Simple parenchymal micro-oxyhexactine. × 400.

Fig. 3. Hemioxyhexaster with only one branched main-ray. × 400.

Fig. 4. Hemioxyhexaster, most of the main-rays of which are branched. × 400.

Fig. 5. Oxyhexaster with slender main- and branch-rays. × 400.

Fig. 6. Lower part of a basal anchor-spicule. × 250.

Fig. 7. Calicocom. × 400.

Fig. 7*a*. Central part of a graphiocom, the branch-rays of which have been broken off. × 400.

Fig. 8. Central part of a macrosclere stauractine. × 100.

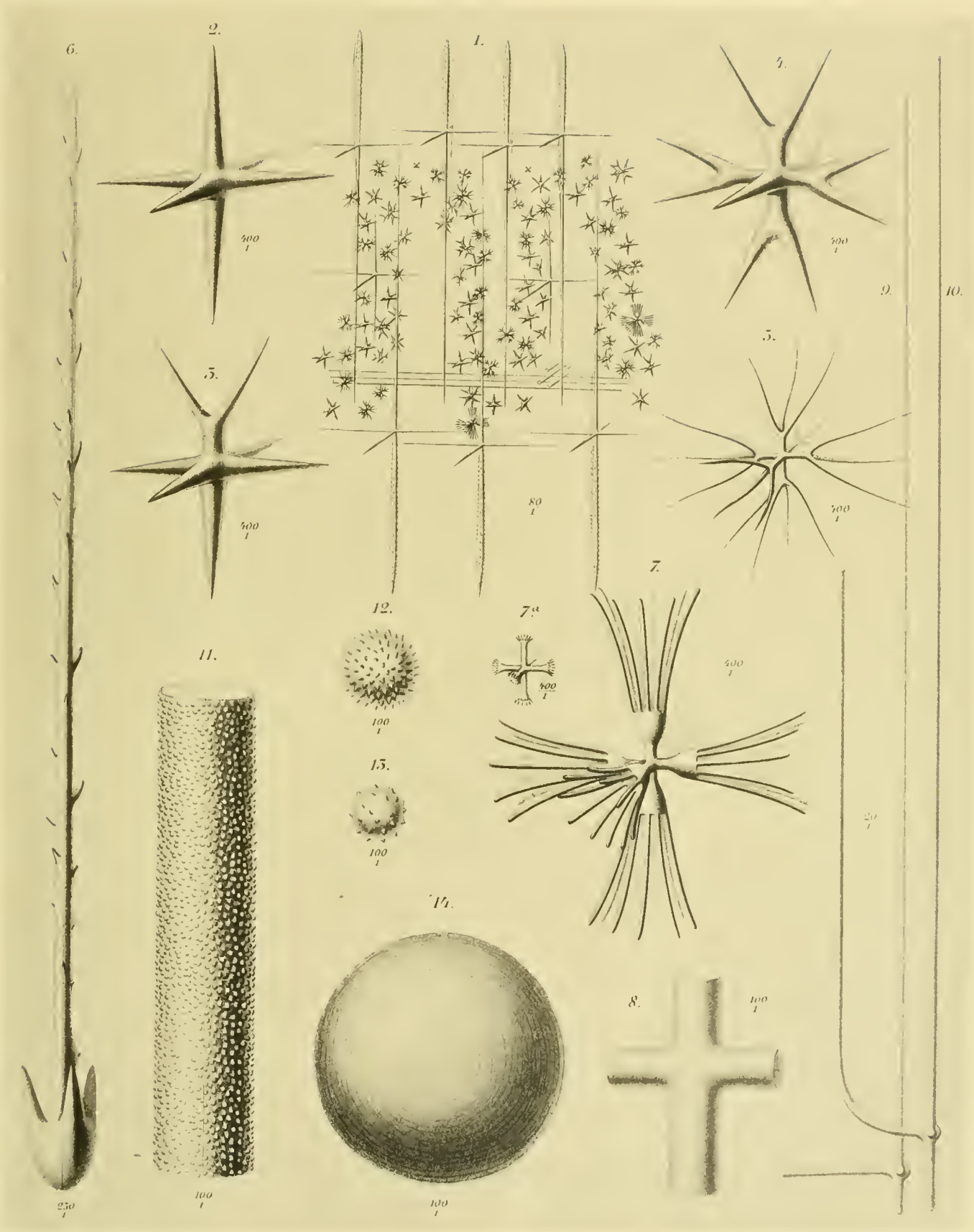
Figs. 9 and 10. Parts of long triactine comitalia. × 20.

Figs. 11–14. *Lyssacines.*

Fig. 11. Part of basal prostal. × 100.

Figs. 12–13. Tuberculous silica-pearls. × 100.

Fig. 14. Larger, smooth silica-pearl. × 100.



1-10 Holascus robustus F.E.Sch. 11-14 Lyssacine

EXPLANATION OF PLATE X.

Euplectella simplex. F. E. Sch.

Fig. 1. Youngest specimen. Nat size.

Fig. 2. Young specimen. Nat. size.

Fig. 3. Young specimen, cut open. Nat. size.

Fig. 4. Larger specimen with a well preserved sieve-plate. Nat. size.

Fig. 4*a*. Ocular sieve-plate of this specimen seen from above. Nat. size.

Fig. 5. Lower, somewhat injured end of a larger specimen. Nat. size.

Fig. 6. A larger specimen, a part of the lateral wall of the body of which has been cut out; without sieve-plate. Nat. size.

Fig. 7. Arrangement of the spicules in a transverse section of the body-wall. The upper side of the figure corresponds to the dermal side of the sponge. × 50.

Fig. 8. Dermal floricom. × 800.

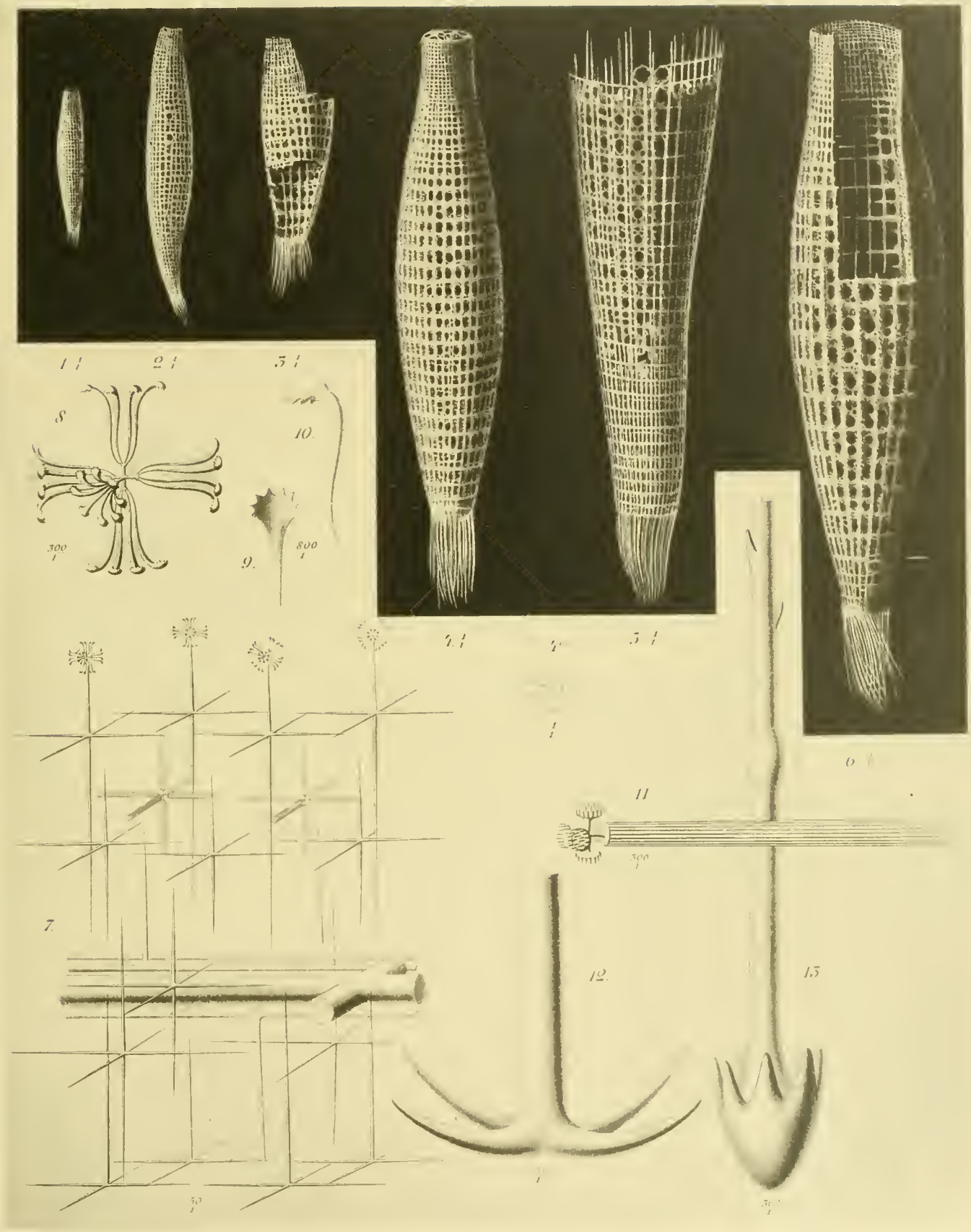
Fig. 9. Terminal extension of a branch-ray of a dermal floricom, seen from below. × 800.

Fig. 10. Branch-ray of a floricom, lateral view. × 800.

Fig. 11. Graphiocom; the branch-rays of five of the main-rays are broken off. × 300.

Fig. 12. Lower end of a tetradentate, basal anchor-spicule. × 50.

Fig. 13. Lower end of an octodentate, basal anchor-spicule. × 300.



Euplectella simplex F.E. Sch.

EXPLANATION OF PLATE XI.

Euplectella aspera. F. E. Sch.

Fig. 1. Lower end of a larger specimen. Nat. size.

Fig. 2. Younger specimen the upper part of which is missing. Nat. size.

Fig. 3. The same specimen seen from within. Nat size.

Fig. 4. Arrangement of the spicules in a transverse section of the body-wall, vertical to the surface. × 50 (combined figure).

Fig. 5. Central part of a principal hexactine with some comitalia on the distal ray. × 130.

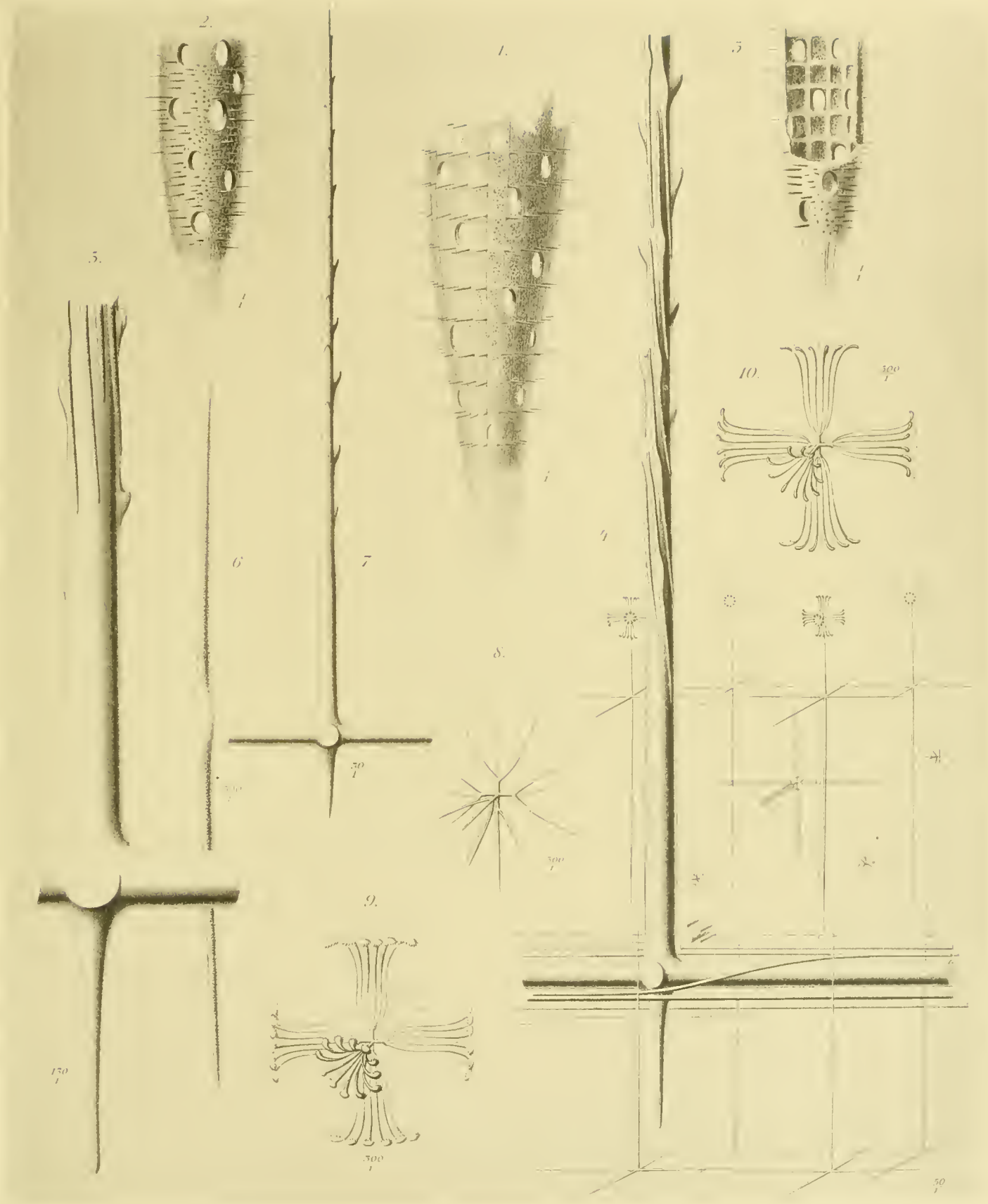
Fig. 6. Comital diactine. × 300.

Fig. 7. Principal hexactine with quite intact radial rays. × 30.

Fig. 8. Parenchymal oxyhexaster. × 300.

Fig. 9. Fully developed floricom. × 300.

Fig. 10. Young, not fully developed floricom. × 300.



Euplectella aspera F. E. Sch.

EXPLANATION OF PLATE XII.

Dictyaulus elegans. F. E. Sch.

Fig. 1. Upper part of a specimen. Nat. size.

Fig. 2. Arrangement of the spicules in a transverse section of the body-wall, vertical to the surface. × 50 (combined figure).

Fig. 3. Dermal floricom. × 300.

Fig. 4. A single branch-ray of a dermal floricom. × 300.

Fig. 5. Central part of a dermal floricom. × 1200.

Fig. 6. Parenchymal floricom. × 300.

Fig. 7. A single branch-ray of a parenchymal floricom, in lateral view. × 1200.

Fig. 8. Small, parenchymal discohexaster. × 300.

Fig. 9. Surface view of a terminal disc of a parenchymal discohexaster. × 1200.

Fig. 10. Large, parenchymal discohexaster. × 300.

Figs. 11 and 12. Distal part of a branch-ray of a large discohexaster. × 300.

Fig. 13. Parenchymal codonhexaster. × 300.

Fig. 14. Branch-ray of a parenchymal codonhexaster. × 1200.

Fig. 15. Central part of a codonhexaster, with one branch-ray. × 1200.

Fig. 16. Parenchymal drepanocom with recurved branch-ray terminations. × 300.

Fig. 17. Lateral view of a single branch-ray of the drepanocom represented in fig. 16. × 1200.

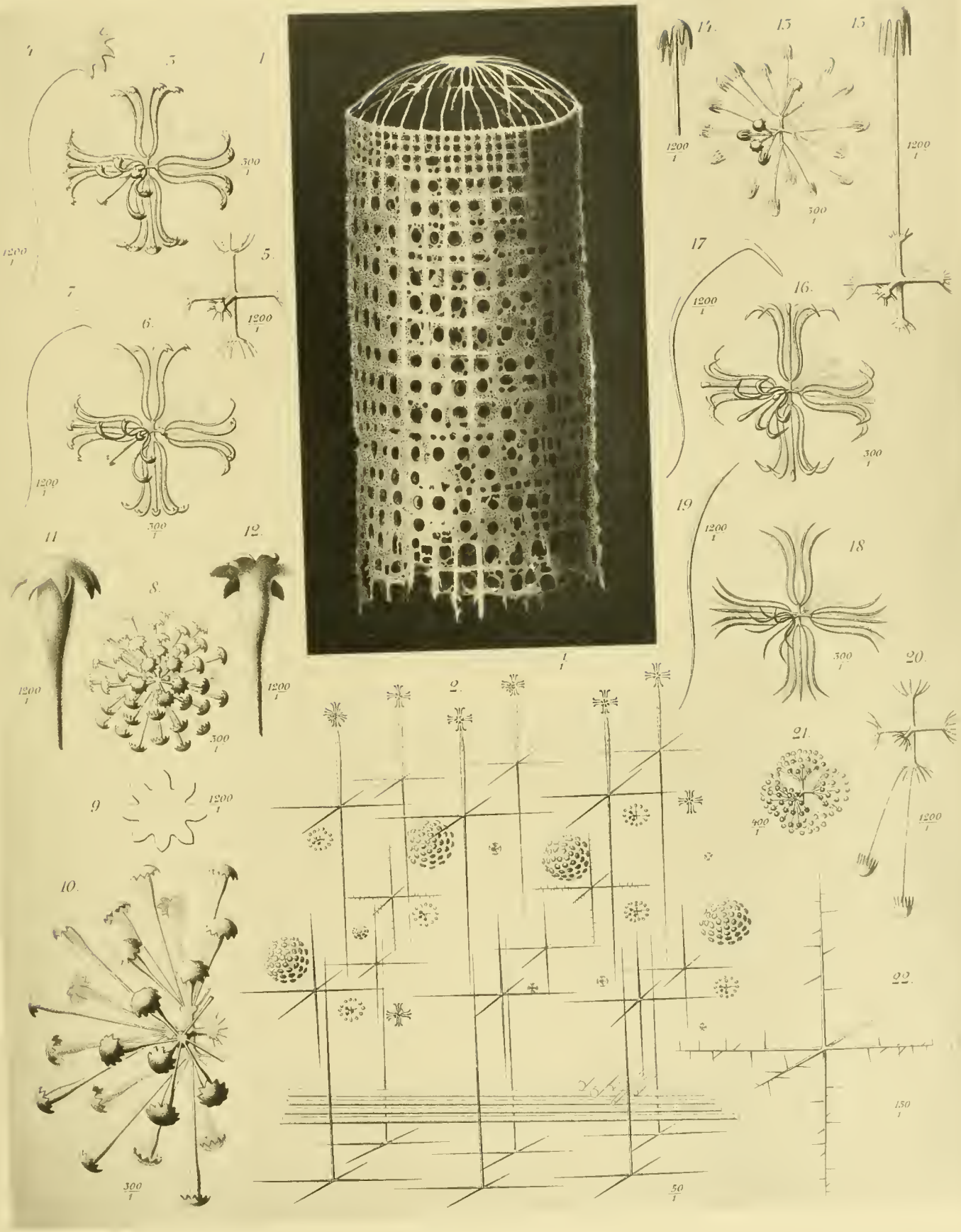
Fig. 18. Drepanocom with erect branch-ray terminations. × 300.

Fig. 19. Lateral view of a single branch-ray of the drepanocom represented in fig. 18. × 1200.

Fig. 20. Fragment of a small codonhexaster. × 1200.

Fig. 21. Small codonhexaster. × 400.

Fig. 22. Parenchymal spined oxyhexactine. × 150.



Dictyaulus elegans F E Sch.

EXPLANATION OF PLATE XIII.

Saccocalyx pedunculata. F. E. Sch.

Fig. 1. A specimen with the upper end of the peduncle; above, a part of the body-wall is cut away. Nat. size.

Fig. 2. Lower end of the peduncle. Nat. size.

Fig. 3. Arrangement of the spicules in a transverse section of the upper part of the lateral body-wall, vertical to the surface. × 30 (combined figure).

Fig. 4. Parenchymal discohexaster with spirally twisted branch-rays. × 300.

Fig. 5. Terminal disc of a parenchymal discohexaster, viewed obliquely from within. × 1000.

Fig. 6. Marginal view of a terminal disc of a parenchymal discohexaster. × 1000.

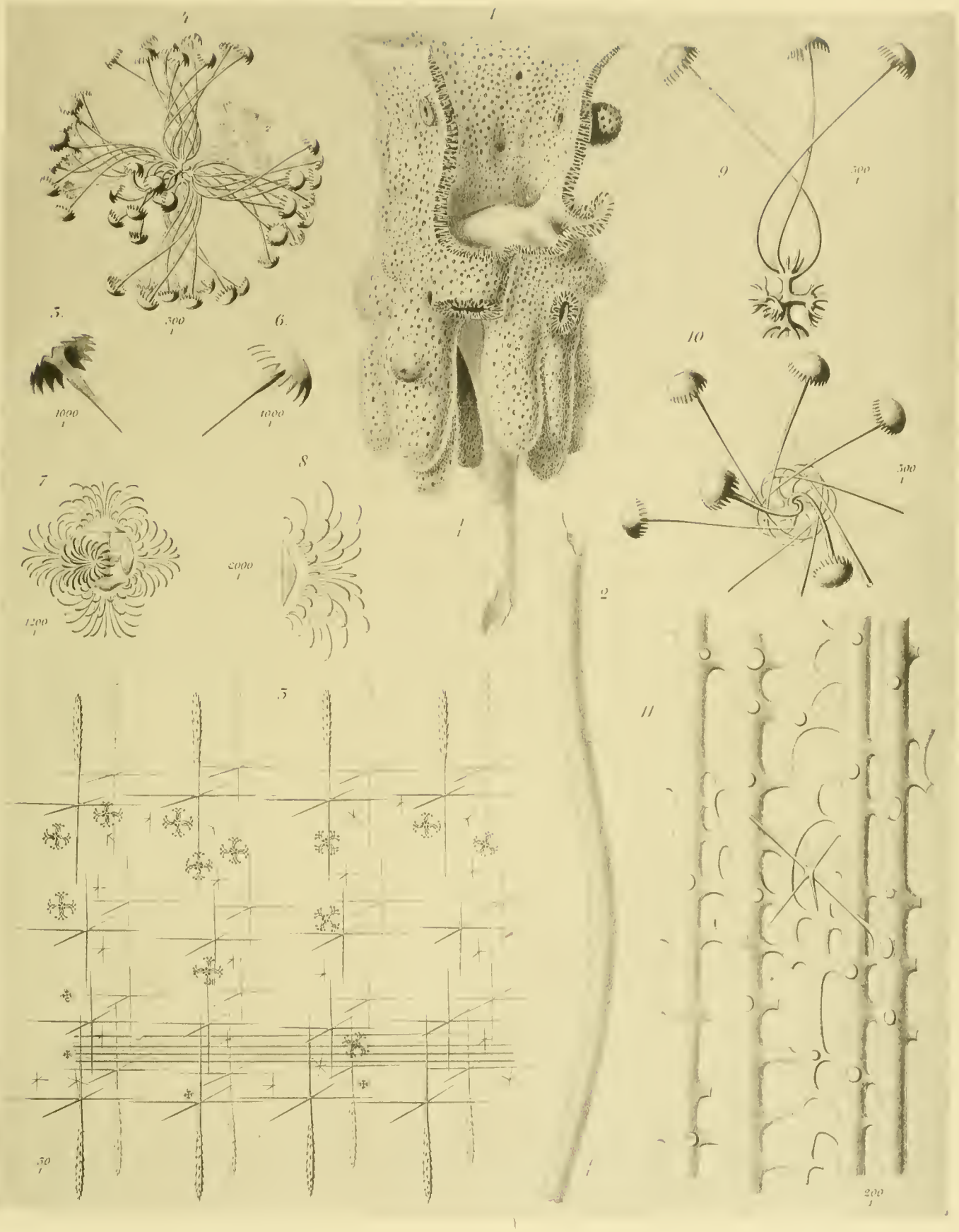
Fig. 7. Parenchymal plumicorn. × 1200.

Fig. 8. Lateral view of a ray of a parenchymal plumicorn. × 2000.

Fig. 9. Parenchymal discohexaster, most of the branch-rays of which have been broken off near the base. × 500.

Fig. 10. A group of spirally twisted branch-rays of a parenchymal discohexaster belonging to one main-ray, seen from without. × 500.

Fig. 11. Fragment of the supporting skeleton of the peduncle containing parts of four diactine rhabds, connected by numerous synapticula. × 200.



Saccocalyx pedunculata F.E. Sch

EXPLANATION OF PLATE XIV.

Figs. 1–10. *Bathydorus levis.* F. E. Sch.

Fig. 1. Upper end of a small specimen in lateral view. Nat. size.

Fig. 2. Arrangement of the spicules in a transverse section of the body-wall. × 40 (combined figure).

Fig. 3. Lateral view of an autodermal stauractine. × 300.

Fig. 4. Surface-view of a similar autodermal stauractine. × 300.

Figs. 5 and 6. Ends of long parenchymal diactines. × 300.

Fig. 7. Silica-pearl of the parenchyme. × 300.

Fig. 8. Antogastral hexactine. × 300.

Fig. 9. Parenchymal hemioxyhexaster with two unbranched main-rays. × 300.

Fig. 10. Parenchymal oxyhexaster, each of the main-rays of which bears two branch-rays. × 300.

Figs. 11–17. *Placopegma solutum.* F. E. Sch.

Fig. 11. View of the free surface. Nat. size.

Fig. 12. Arrangement of the spicules in a transverse section of the body-wall. × 60 (combined figure).

Fig. 13. Dermal oxypentactine. × 200.

Fig. 14. Parenchymal discohexaster. × 400.

Fig. 15. Lateral view of a terminal disc of a parenchymal discohexaster. × 1000.

Fig. 16. Anchor-spicule. × 500.

Fig. 17. Gastral pentactine. × 200.

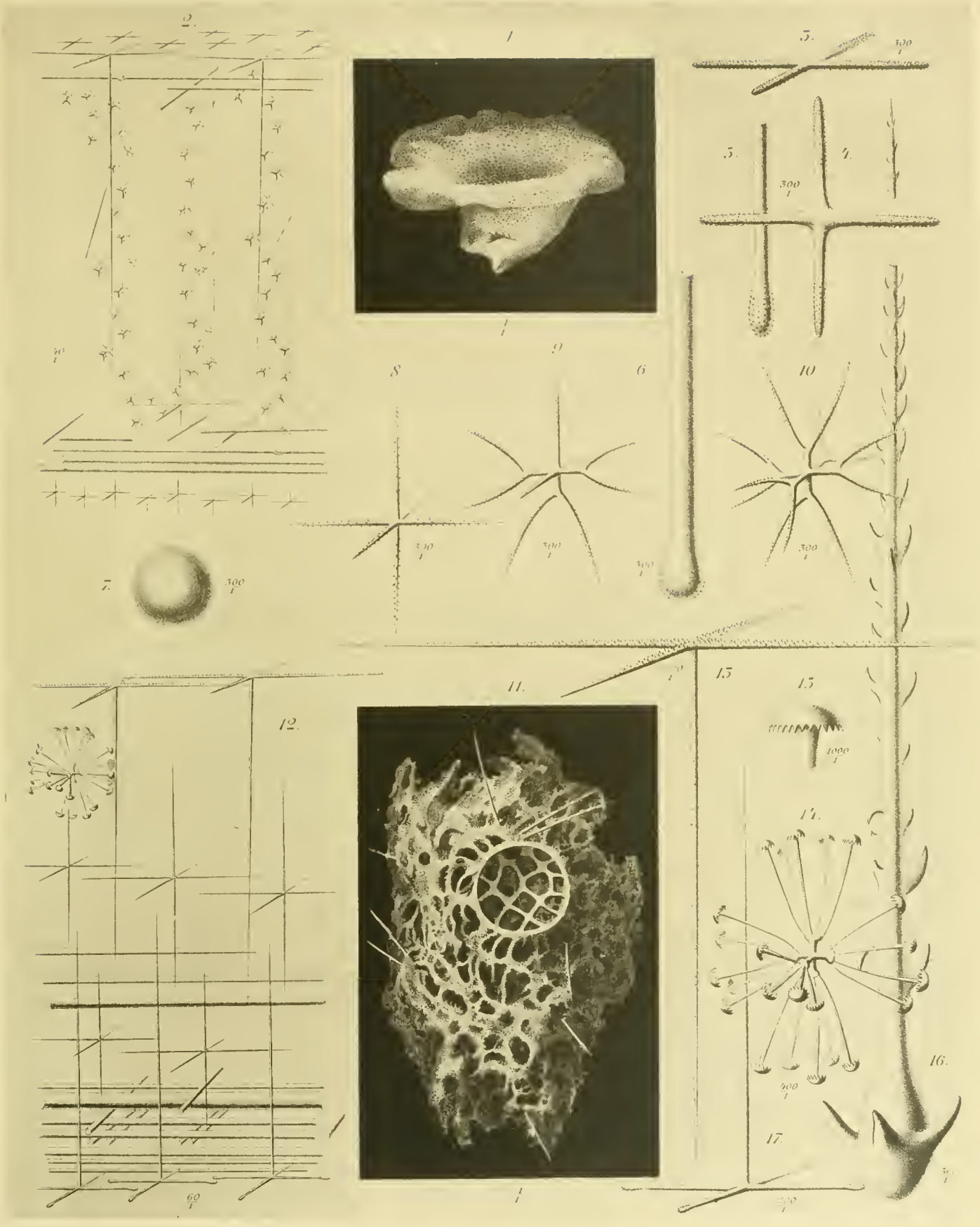


Fig 1-10. Bathydoras levis F.E. Sch Fig. 11-17 Placopegma solutum F.E. Sch

EXPLANATION OF PLATE XV.

Figs. 1–13. *Aphrocallistes beatrix*. J. E. Gray.

Fig. 1. A specimen seen from the side and a little from above. Nat. size. After a photograph taken by Dr. von Mährenthal.

Fig. 2. Scopule with four abruptly bent and strongly diverging dermal branches. × 450.

Fig. 3. Scopule with six club-shaped dermal branches, uniformly bent outwards. × 450.

Fig. 4. Dermal oxyhexactine with fir-tree-like distal, radial ray. × 450.

Fig. 5. Regular parenchymal oxyhexaster. × 450.

Figs. 6 and 7. Parenchymal hemioxyhexasters with elongated axis. × 450.

Figs. 8 and 9. Rhabdose diactines with club-shaped, thickened ends. × 150.

Fig. 10. Scopule with four slightly diverging, straight dermal branches. × 450.

Fig. 11. Scopule with four slightly-abruptly bent, diverging dermal branches. × 450.

Fig. 12. Hemioxyhexaster with short main axis. × 450.

Fig. 13. Spined, parenchymal oxyhexactine. × 450.

Fig. 14. *Aphrocallistes ramosus*. F. E. Sch.

Fig. 14. Lateral view of a specimen. Nat. size. After a photograph taken by Dr. von Mährenthal.

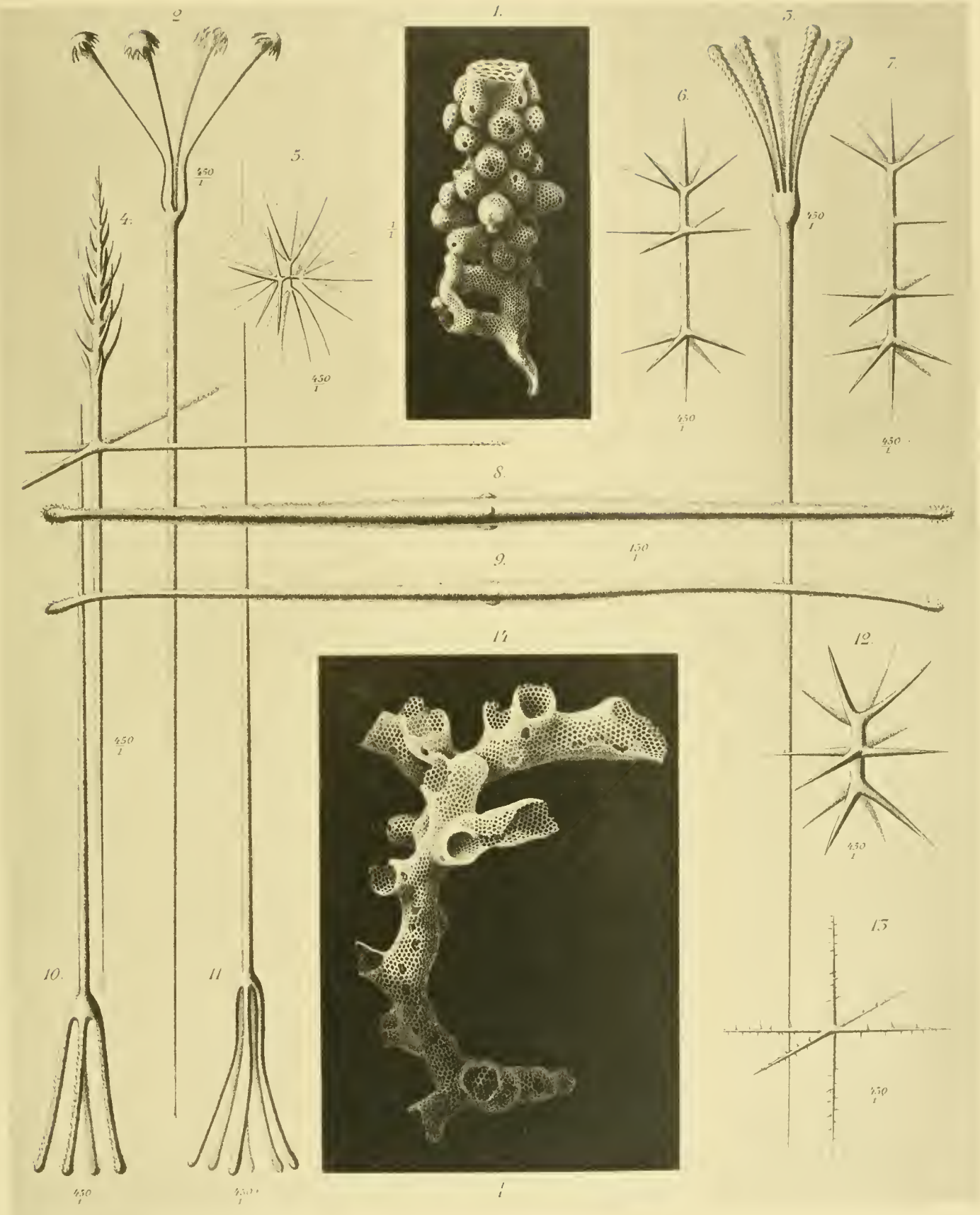


Fig 1-13. Aphrocallistes beatrix J E Gray Fig. 14. Aphrocallistes ramosus F.E. Sch.

EXPLANATION OF PLATE XVI.

Aphrocallistes bocagei. Percival Wright.

Fig. 1. A colony of several calyces joined by narrow radial tubes. Nat. size.

Fig. 2. A macerated, slightly injured dictyonal skeleton of a calyx with narrow radial tubes. Nat. size. After a photograph taken by Dr. von Mährenthal.

Fig. 3. A macerated, slightly injured dictyonal skeleton of a calyx with wide radial tubes, seen from above. Nat. size. After a photograph taken by Dr. von Mährenthal.

Fig. 4. Scopule with four abruptly bent, strongly diverging dermal branches which bear terminal discs. × 450.

Fig. 5. Scopule with four straight and parallel, rhabdose dermal branches. × 450.

Fig. 6. Regular parenchymal oxyhexaster. × 450.

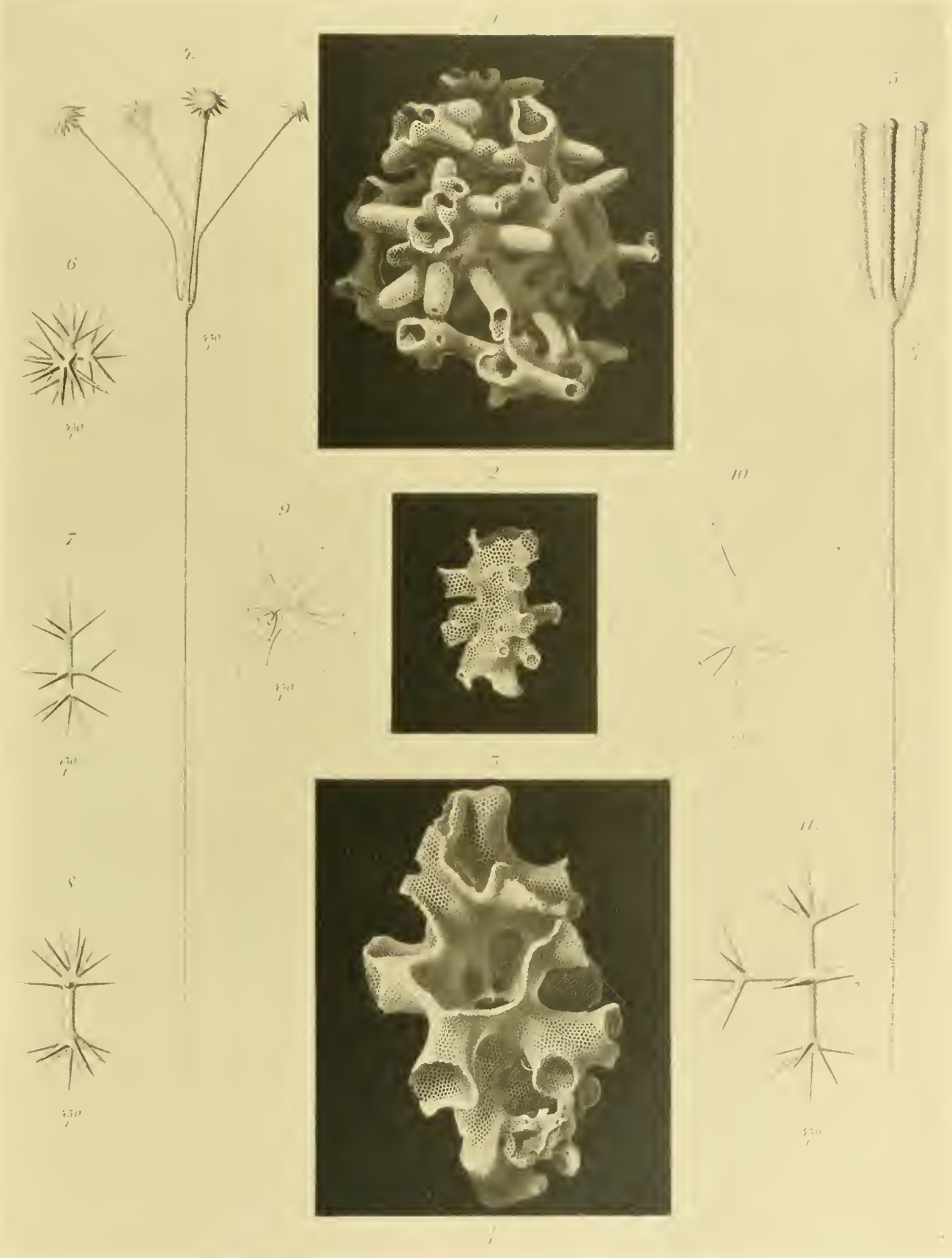
Fig. 7. Parenchymal hemioxyhexaster with somewhat elongated main axis. × 450.

Fig. 8. Parenchymal hemioxyhexaster, one of the differentiated main-rays of which is considerably elongated. × 450.

Fig. 9. Regular parenchymal onychaster. × 450.

Fig. 10. Parenchymal onychaster with one elongated main-ray. × 450.

Fig. 11. Hemioxyhexaster with three long and branched and three short and unbranched main-rays. × 450.



Aphrocallistes bocagei Pere Wright

EXPLANATION OF PLATE XVII.

Hyalonema rapa. F. E. Sch.

Fig. 1. Lateral view of a specimen. Nat. size.

Fig. 2. Arrangement of the spicules in a transverse section of the upper marginal region, vertical to the surface × 50 (combined figure).

Fig. 3. Large, curved oxydiactine. × 20.

Figs. 4 and 5. Intermediary parenchymal oxyhexactines. × 300.

Fig. 6. Dermal pinule. × 300.

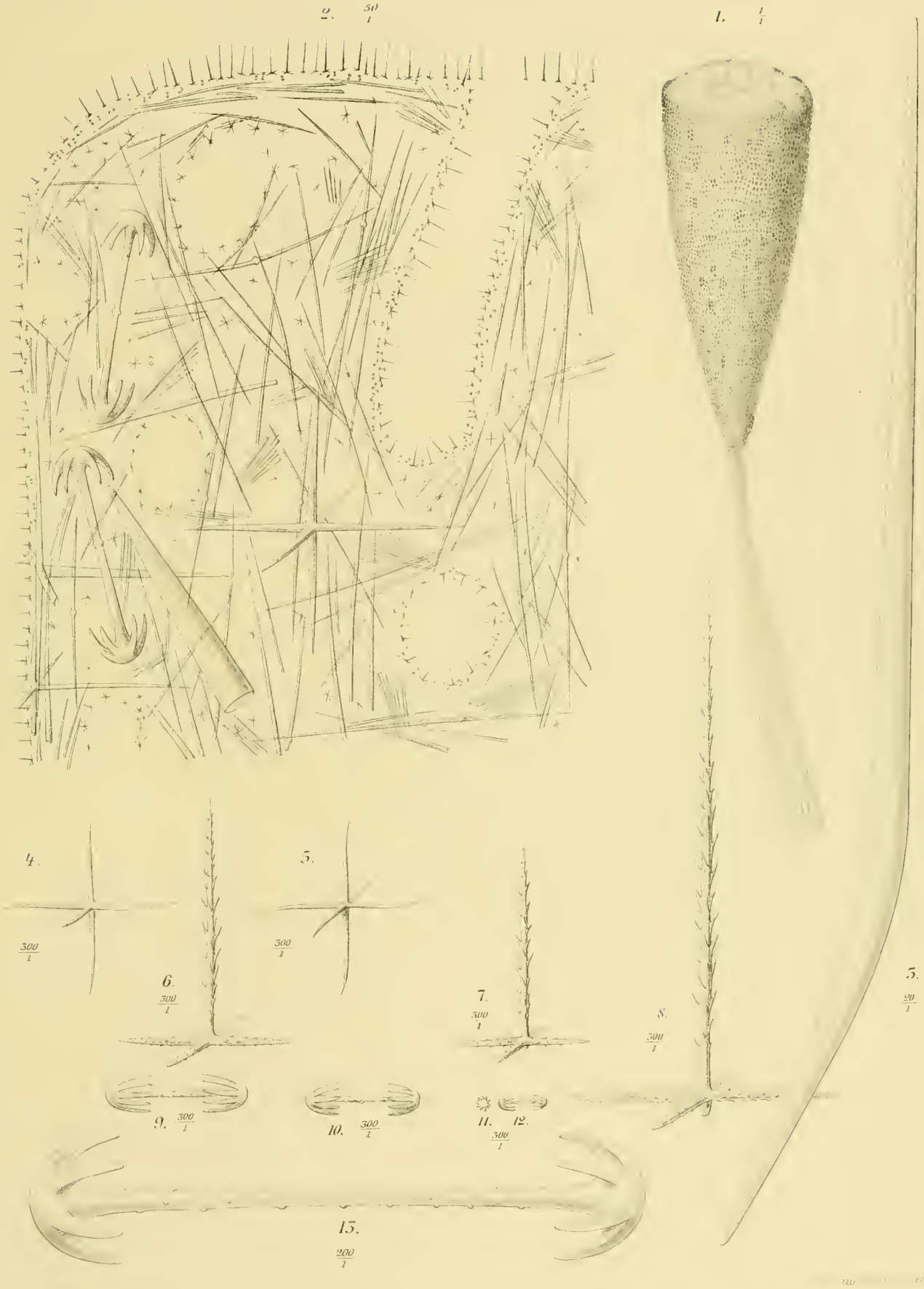
Fig. 7. Canalar pinule. × 300.

Fig. 8. Gastral pinule. × 300.

Figs. 9 and 10. Mesamphidiscs. × 300.

Figs. 11 and 12. Micramphidiscs seen from the side and from above. × 300.

Fig. 13. Macramphidisc. × 200.



Hyalonema rapa F. E. Sch.

EXPLANATION OF PLATE XVIII.

Hyalonema martabanense. F. E. Sch.

Fig. 1. Oblique lateral view of a specimen. Nat size.

Fig. 2. Oblique view of the lower end of a specimen. Nat. size.

Fig. 3. Arrangement of the spicules in a transverse section of the upper, lateral margin, vertical to the surface. × 50 (combined figure).

Figs. 4–7. Mesamphidiscs. × 300.

Fig. 8. A terminal disc of a micramphidisc, seen from above. × 300.

Fig. 9. Dermal pinule. × 300.

Fig. 10. Marginal spicule. × 300.

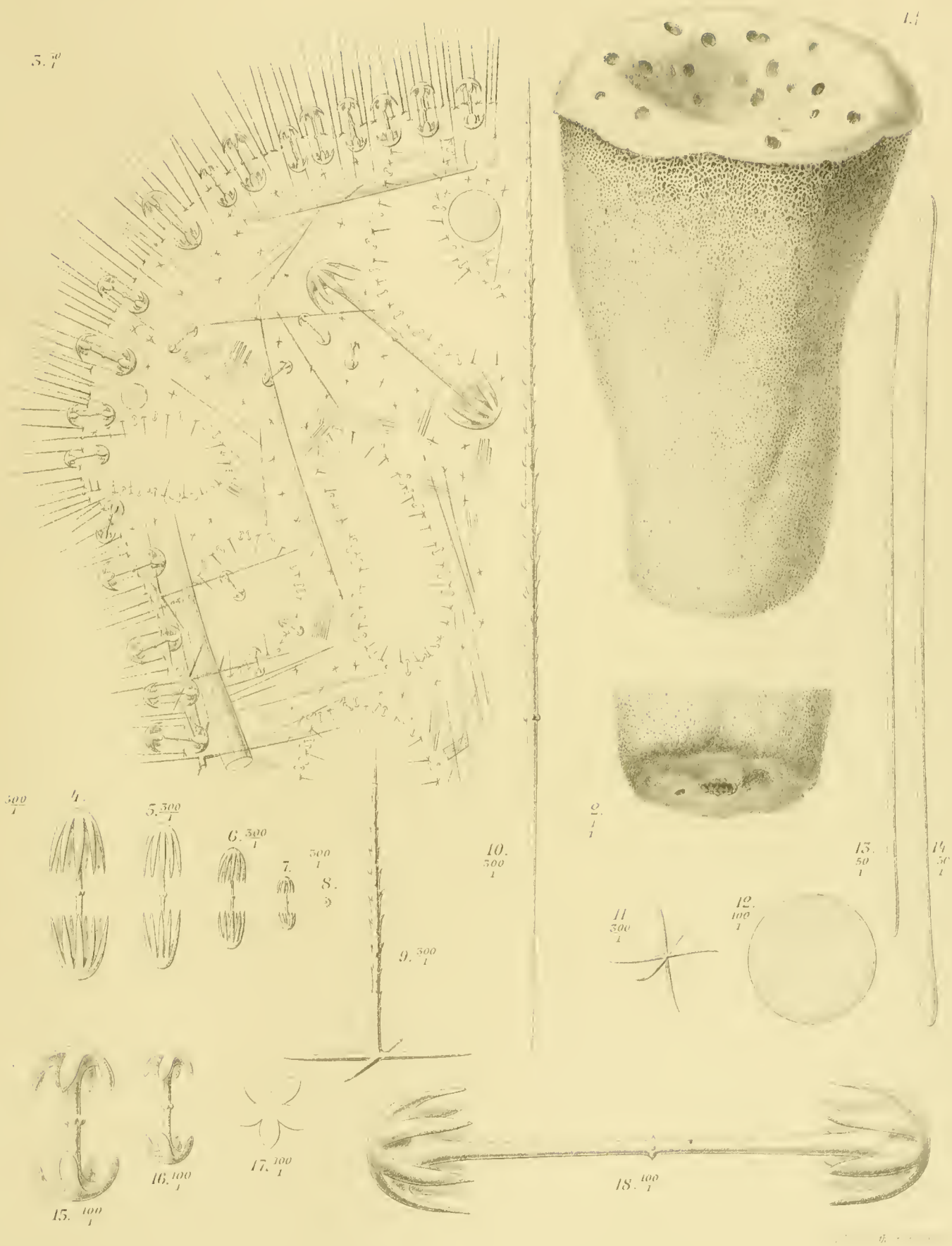
Fig. 11. Parenchymal oxyhexactine. × 300.

Fig. 12. Silica-pearl. × 100.

Figs. 13 and 14. Parenchymal diactines from the neighbourhood of the axial spicular fibre. × 50.

Figs. 15–17. Shorter macramphidiscs. × 100.

Fig. 18. Longer macramphidisc. 100.



Hyalonema martabanense F. E. Sch.

EXPLANATION OF PLATE XIX.

Hyalonema lamella. F. E. Sch.

Fig. 1. Fragment of a specimen, probably a part of the upper margin of the calyx. Nat. size.

Fig. 2. Arrangement of the spicules in a transverse section of the upper margin, vertical to the surface. × 50 (combined figure).

Fig. 3. Macramphidisc. × 300.

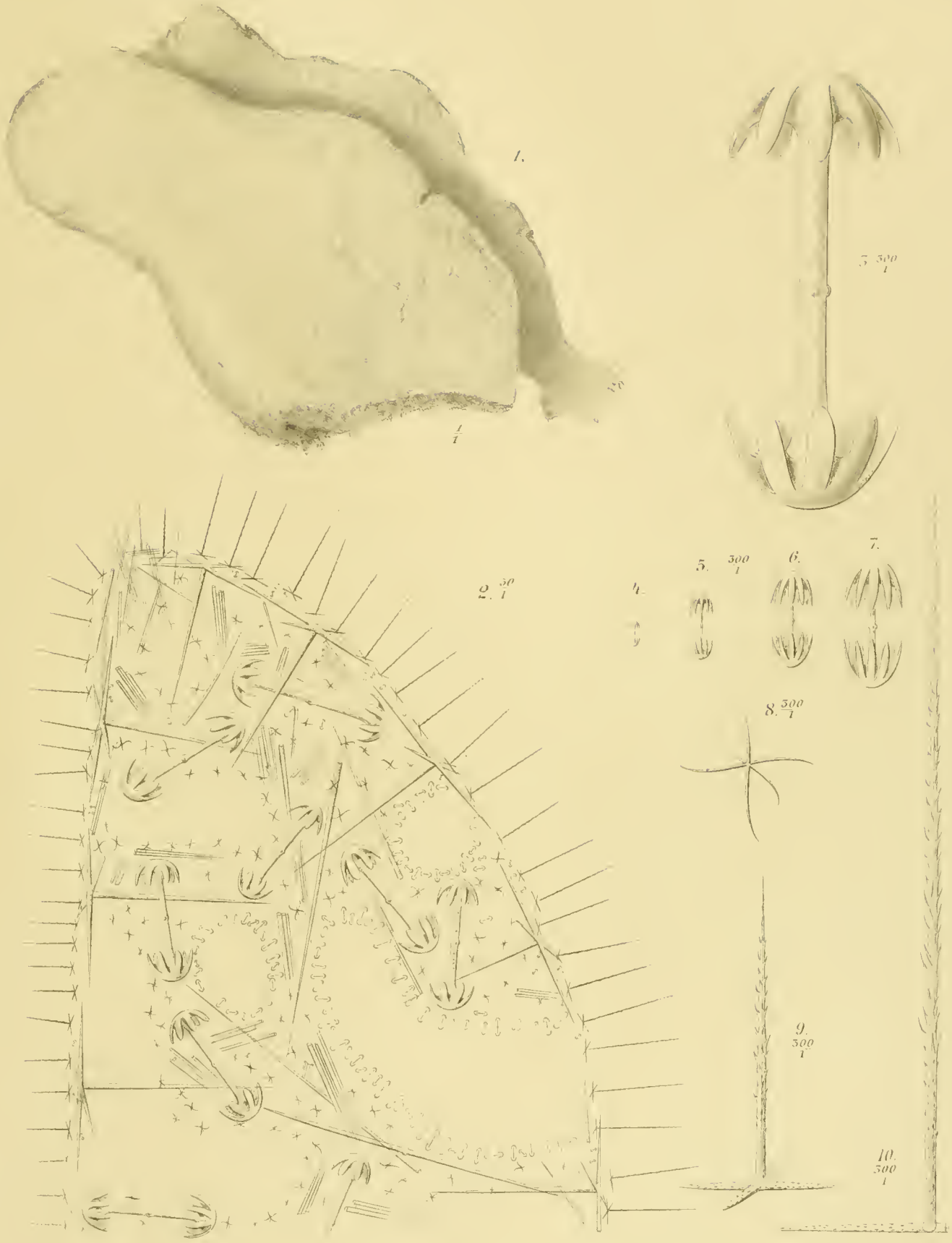
Fig. 4. Micramphidisc. × 300.

Figs. 5–7. Mesamphidisc. × 300.

Fig. 8. Parenchymal oxyhexactine. × 300.

Fig. 9. Dermal pinule. × 300.

Fig. 10. Gastral pinule. × 300.

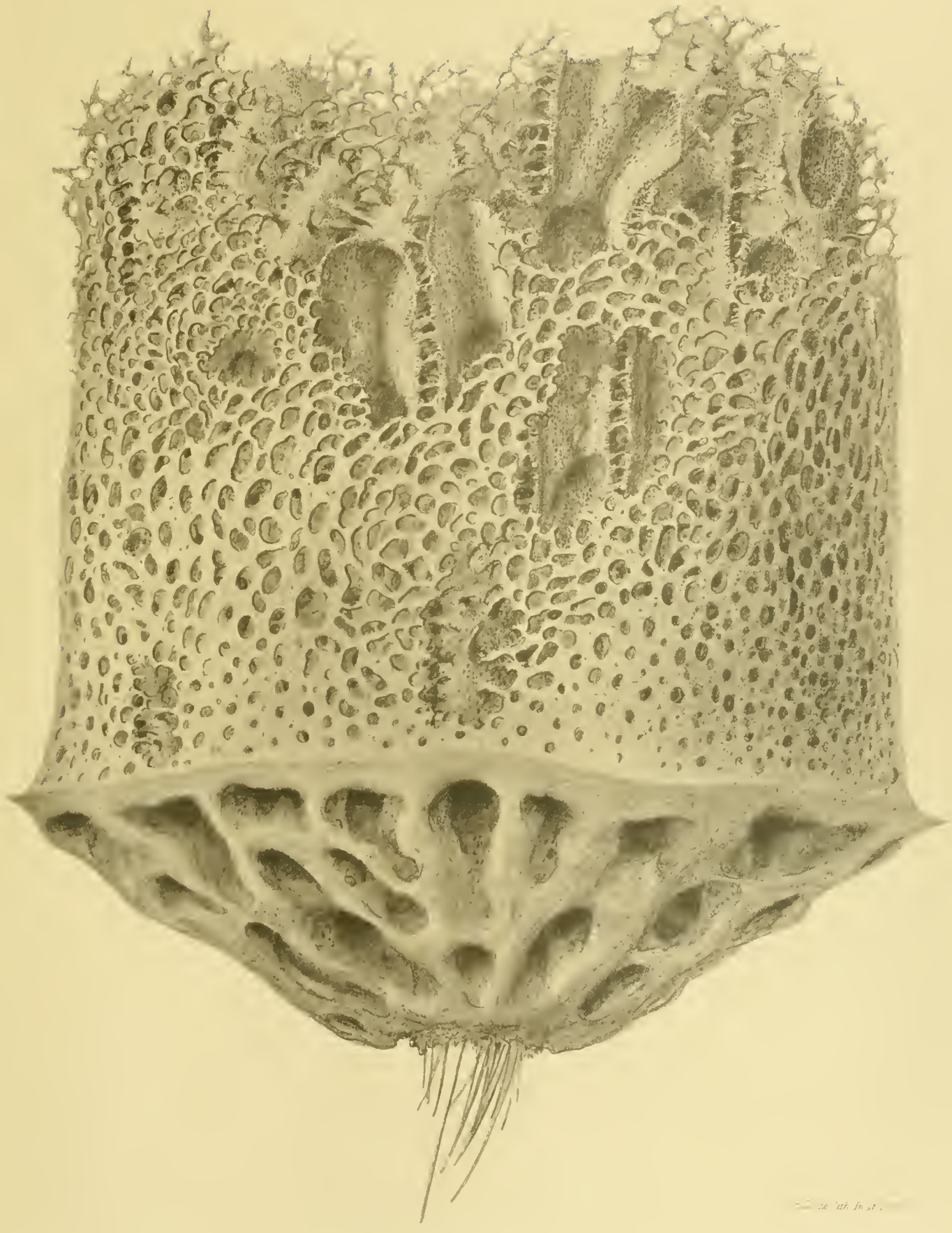


Hyalonema lamella F. E. Sch

EXPLANATION OF PLATE XX.

Lophophysema inflatum. F. E. Sch.

Lateral view of a specimen. Two-thirds of the natural size.



Lophophysema inflatum F. E. Sch.

EXPLANATION OF PLATE XXI.

Lophophysema inflatum. F. E. Sch.

Fig. 1. Schematic representation of a longitudinal section to show the relation between the in- and ex-current canals. One-third of the nat. size.

Fig. 2. Arrangement of the spicules in a transverse section of a plate dividing an in- from an ex-current cavity. The dermal surface is to the left, the gastral to the right. × 50 (combined figure).

Fig. 3. Arrangement of the spicules in a transverse section of the marginal crest. The dermal surface is below, the gastral above. × 50 (combined figure).

Figs. 4 and 5. Parenchymal, intermediary oxyhexactines. × 300.

Fig. 6. Canalar pentactine pinule. × 300.

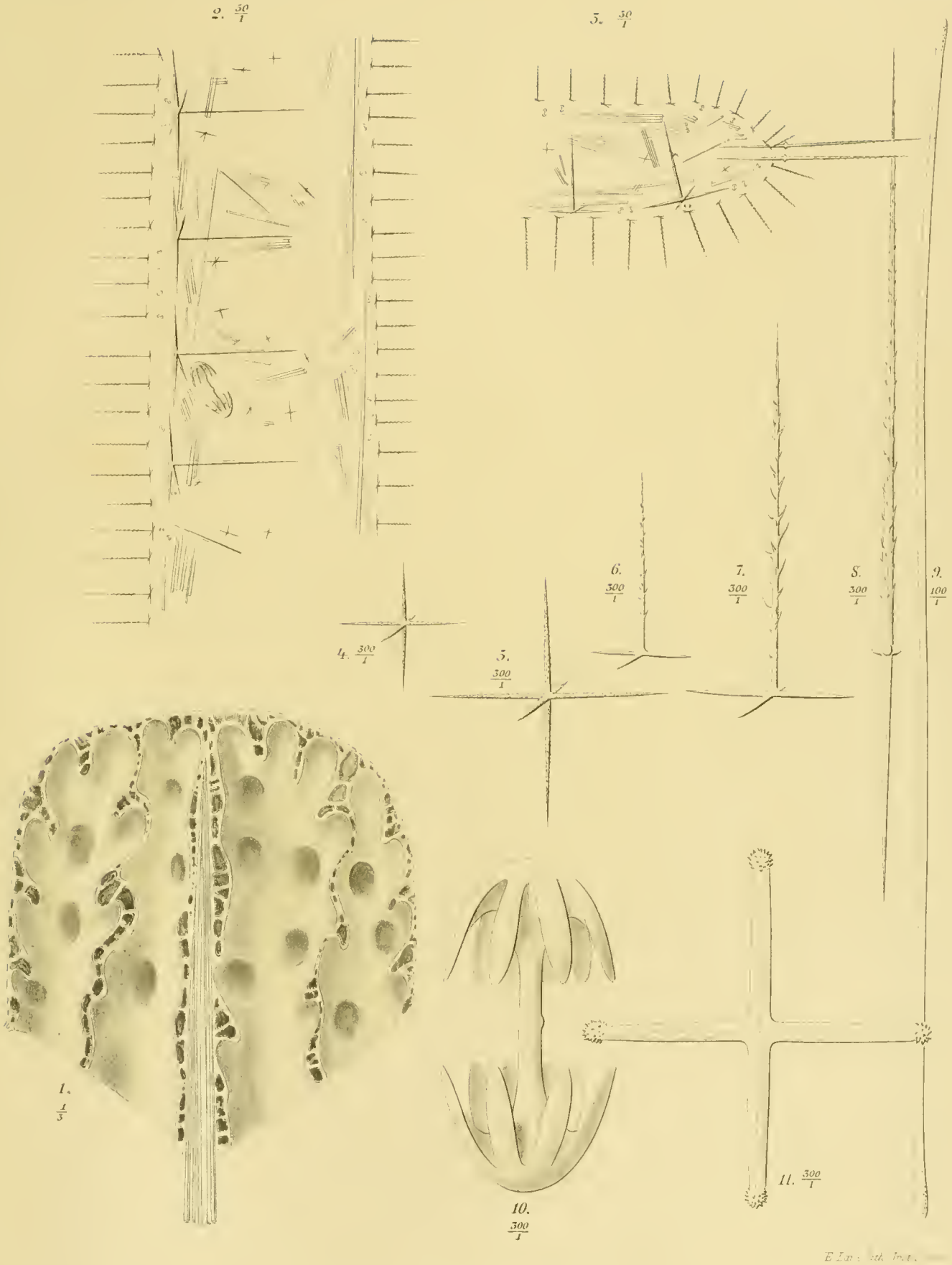
Fig. 7. Dermal pentactine pinule. × 300.

Fig. 8. Oxydiactine marginal. × 300.

Fig. 9. Parenchymal diactine from the neighbourhood of the central cone. × 100.

Fig. 10. Macramphidisc. × 300.

Fig. 11. Stauractine acanthophor. × 300.



Lophophysema inflatum F. E. Sch.

EXPLANATION OF PLATE XXII.

Figs. 1–9. *Euplectella regalis*. F. E. Sch.

Fig. 1. One-half of the upper end with sieve-plate and marginal collar. Nat. size.

Fig. 2. Portion of the central part of the body, both the external and internal surface are visible. Nat. size.

Fig. 3. A verticil of floricom branch-rays, seen from above. × 500.

Fig. 4. Lateral view of a verticil of floricom branch-rays. × 500.

Fig. 5. Sigmatocom. × 500.

Fig. 6. Oxyhexaster. × 300.

Fig. 7. Robust oxypentactine from the annular membrane of a parietal oscule. × 100.

Fig. 8. Part of the terminal sieve-plate and marginal collar, seen from above. Nat. size.

Fig. 9. Lower end of a basal club-anchor-spicule. × 100.

Figs. 10–18. *Regadrella decora*. F. E. Sch.

Fig. 10. Basal part of the tubular body. Nat. size.

Fig. 11. Arrangement of the spicules in a transverse section of the body-wall, vertical to the surface. × 100 (combined figure).

Fig. 12. A verticil of floricom branch-rays seen from above. × 300.

Fig. 13. Lateral view of a single branch-ray of a floricom. × 500.

Fig. 14. Lateral view of a floricom with two branch-ray verticils. × 300.

Fig. 15. Surface view of an oxystauraster. × 300.

Figs. 16 and 17. Lateral view of oxystauraster. × 300.

Fig. 18. Curved, macrosclere diactine. × 10.

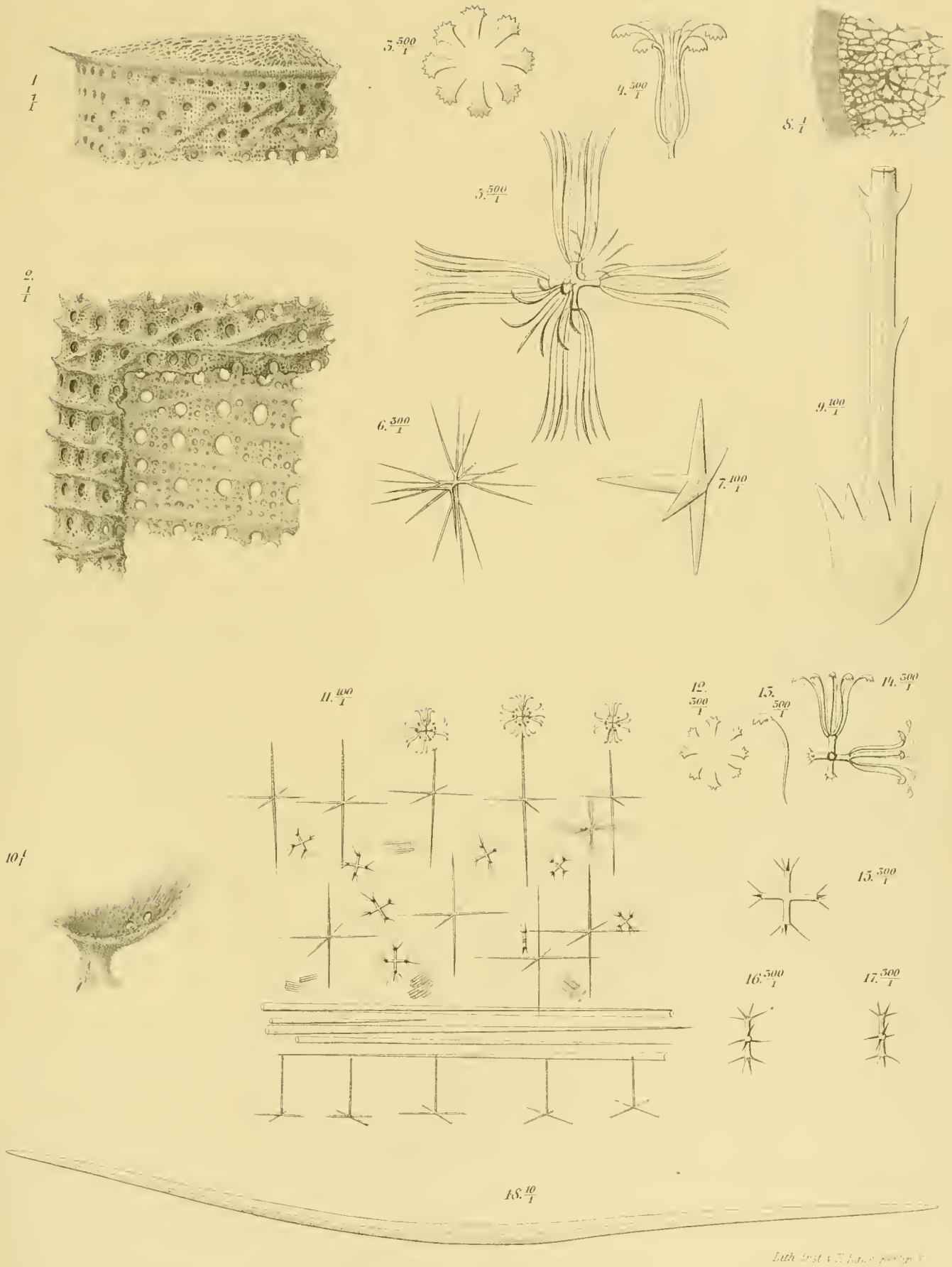


Fig 1-9 Euplectella regalis F. E. Sch. Fig 10-18. Regadrella decora F. E. Sch.

EXPLANATION OF PLATE XXIII.

Lophocalyx spinosa. F. E. Sch.

Fig. 1. Oblique, lateral view of a specimen. Nat. size.

Fig. 2. A specimen seen from above. Nat. size.

Fig. 3. Arrangement of the spicules in a transverse section of the body-wall, vertical to the surface. × 50 (combined figure).

Fig. 4. Autodermal pentactine. × 300.

Fig. 5. Surface-view of an autodermal stauractine. × 300.

Fig. 6. Oblique view of an autodermal stauractine. × 300.

Fig. 7. Lateral view of an autodermal stauractine. × 300.

Fig. 8. Autogastral hexactine. × 300.

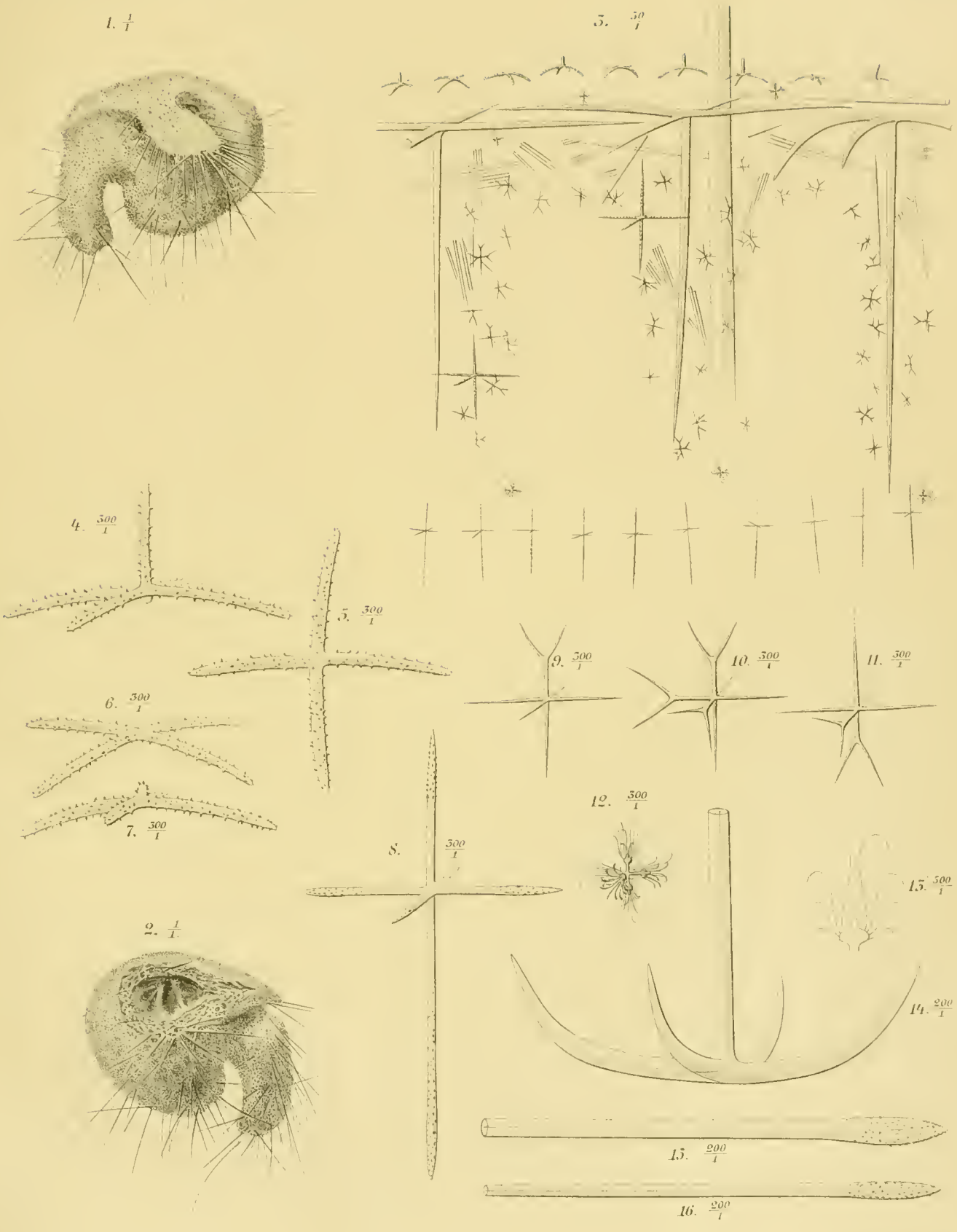
Figs. 9–11. Hemioxyhexasters. × 300.

Fig. 12. Strobilo-plumicom. × 300.

Fig. 13. Schematic longitudinal section of a branch-ray-group of a strobilo-plumicom. × 500.

Fig. 14. Lower end of a tetradentate basal anchor-spicule. × 200.

Figs. 15 and 16. Ends of two macrosclere, parenchymal diactines. × 200.



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