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Studies on the Hexactinellida.

CONTRIBUTION III.

(*Placosoma*, a New Euplectellid; *Leucopsacidæ* and *Caulophacidæ*).

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With 8 plates.

In this contribution I propose first to describe a new stalked Euplectellid of an interesting structure, which I call *Placosoma paradictyum*. This form became known to me after I had provisionally considered my studies of the Euplectellidæ at end. It may however be best to describe it now and to follow it with some comments on the family generally, before I enter upon a treatment of other families.

The present contribution will further contain full descriptions of six other forms, partly likewise new and partly before described by me in brief, *viz.*, *Leucopsacus orthodocus* Ij., *L. scoliodocus* Ij., *Chaunoplectella cavernosa* Ij., *C. spinifera* n. sp., *Caulophacus lotifolium* n. sp. and *Sympagella anomala* n. sp. These will be referred to two families newly conceived and proposed for introduction into the system, *viz.*, the Leucopsacidæ and the Caulophacidæ. The former group is in part identical with that which I have formerly regarded as a Rossellid subfamily under the name of Leucopsacinæ (IJIMA '98, p. 41). The latter corresponds in a large measure to F. E. SCHULZE's Asconematidæ, which name will have to be dropped out. Grounds for the above rearrangement will be enunciated in the proper places.

PLACOSOMA PARADICTYUM. N. G., N. SP.

Pls. I. and II.

This new genus and species are founded on a single specimen obtained by KUMA in Outside Okinosé, Sagami Sea, from a depth of between 274 and 313 fathoms (501–572 m.).

The sponge is excellently preserved in a dried state, except for a rent across the body; this, however, in no wise prevents us from obtaining a correct conception of the shape. It has a long stalk, which is attached to a brecciated tufaceous substratum by a large, irregularly lobate, basal expansion. Total height of the sponge, 210 mm.

The sponge-body, though probably cup-like when young, can scarcely be called so as it is, but may best be described as an irregular, but transversely elongate and laterally compressed, cake-like mass. It is of a light, soft and very delicate texture. A light touch of the finger is liable to leave behind an impression on its surface. Length of transverse axis, 243 mm. Breadth in vertical direction, 126 mm. Thickness in the middle, 92 mm.

On account of the compression the body presents two sides, both with uneven, though on the whole convex, surfaces. The margin is by no means thin, being in places quite thick and rounded, while in other places it shows an angular edge-line.

Very remarkable and striking is the difference in appearance presented by the two sides of the sponge-body. Nevertheless, I consider the surfaces of both sides, in fact the entire external surface, as dermal, and therefore as adapted to the afferent passage of water. However, as judged from structural relations, the inflow evidently takes place with special activity, in fact principally, on the one side which may be called the *front* (Pl. I., fig. 1), while the other side, the *back* (fig. 2), seems to allow it only in a relatively insignificant degree and is further characterized by the presence of numerous oscula distributed over it.

The front of the entire sponge is quite destitute of oscula. So far as the smooth and undulating frontage of the body proper is concerned, it is nearly, if not wholly, occupied by a specialized area of the dermal layer, the *frontal lattice*, which consists of open-meshed dermal and hypodermal latticeworks of exquisite beauty. The dermal latticework (Pl. II., fig. 13), in which the laths are supplied by the fine paratangential rays of dermalia, is exceedingly delicate and shows small, regularly quadrate meshes. These measure 150–240 μ in length of sides. In nature they are easily discernible with the naked eye, but not in the reduced fig. 1, Pl. I., in which however the minutely tessellated pattern may in some parts be observed with the aid of a hand-lens.—The hypodermal latticework, plainly visible in the figure just referred to, is a much coarser structure and exhibits meshes of a rectangular, trapezoidal, triangular or irregular shape. Within a larger mesh bounded by the stronger beams are inclosed smaller meshes formed by the weaker beams, and all the hypodermal meshes, large and small, are alike overspread by the dermal (or autodermal) layer already described, similarly as in certain Rossellids, Caulophacids, etc. While weaker hypodermal beams appear as simple spicular bundles, stronger ones are in the form of laterally compressed bands. The latter, at the points of junction with the choanosome, expand into vertical plates, which go to form irregular pillars.

The frontal lattice evidently gives support to the ectosome only. It thus differs sharply from the sieve-plate of *Euplectella* or of *Hyalonema*, which structure, in my opinion, is a peculiarly modified part of the sponge-wall in its entire thickness and therefore contains not only the ectosome but also the choanosome (Contrib. I., pp. 38, 66). Moreover, while a sieve-plate always stands in connection with either the principal or the sole place of water exit, it is just the opposite with the frontal lattice, which is developed apparently for facilitating the inflow of water.

Nowhere else is the subdermal space so distinctly and spaciously developed as under the frontal lattice, which fact contributes not a little to the peculiarity of this side. It is especially deep (10 mm. or more) in the middle. In conformity with the wide subdermal space, many of the incurrent canals leading from it are large, some measuring 12 mm. across at the entrance.

The peripheral border of the frontal lattice may practically be considered to coincide with the marginal edge of the body, though at certain parts where this is rounded, it may not reach up to, but stops a greater or less distance short of, the ridge-line. In some parts of the margin, the lattice simply becomes gradually unrecognizable as such, without a distinct demarkation to delimit it; but the more usual condition is that there exists a rather sharply defined boundary. This consists either in a low and narrow wall-like ridge which is more or less distinctly inclined towards the front, or in that the angular body-edge is gently curved forwards, the concave surface being lined by the lattice up to the very edge and the convex, by the dense-looking covering of the back, presently to be described. The latter condition reminds one strongly of that of the oscular margin in many cup-like Hexactinellids with the outflaring rim.

On the back of the body the surface is much wrinkled or puckered up (Pl. I., fig. 2). Here, as on the entire stalk, a lattice-like arrangement of dermal spicules is not perceptible; the subdermal space is scarcely developed, or at any rate is quite insignificant. The entrances into incurrent canals are, if at all developed, small and indistinct. The dermalia are intimately associated with spicular elements of other categories and serve, together with these, to give to the surface a closely interwoven, opaque appearance. The superficial tissue thus formed is soft and extremely delicate, resembling a pith both in appearance and texture.—Further, this side of the body is, as before indicated, peculiar on account of the presence of oscula. These occur even on the stalk, but are confined to the same side. I distinguish a large primary or main osculum and numerous much smaller oscula of probably secondary origin.

That which I consider the *primary osculum*, is a roundish opening situated on the upper, broad and irregularly rounded edge of the body, well without the border of the frontal lattice.

The opening, with a part of the gastral cavity into which it leads, is seen in fig. 2, Pl. II., near the upper edge and to the left of the median line. It measures 36 mm. or more in maximum diameter. The oscular margin is partly rounded and indistinct, partly thin and wall-like. The gastral cavity may be described as a shallow cup-like depression, not more than 15 mm. deep. Its wall, formed of irregularly latticed strands, presents a somewhat powdery appearance, due to the presence of large numbers of a certain hexaster. On it open a number of large and small, oval or roundish, excurrent apertures, measuring up to 8 mm. in width. Right close to the apertures, the excurrent canals are seen to freely and widely intercommunicate with one another; then, they penetrate deeply into the sponge-mass.—The osculum and the gastral cavity here in question, I am inclined to assume, were formed in a very early period of postlarval development. For a time they must have given to the young sponge a cup-like shape. With subsequent general growth, the cup-wall must have increased so excessively in thickness as to have obliterated the original shape, at the same time breaking through new oscula on the one side, as the need arose. These secondarily formed, or we may say, accessory oscula then seem to be equivalent in a way to the parietal oscula of *Euplectella*, save in this unessential point that they open into the excurrent canal-system, instead of into a common gastral cavity.

The secondary oscula are oval or roundish, and sometimes rather irregularly shaped openings of various sizes. The larger may measure 5 mm. or more across, while some are small perforations about 1 mm. or less in diameter. They are irregularly distributed all over the rough-surfaced back, but somewhat more sparingly on the upper rounded edge of the body. In some places they lie tolerably close together. The thin and soft oscular rim is as often as not slightly raised in a lip-like manner. The oscula lead either directly into deep going excurrent canals or into such spaces of the excurrent canal-system as lie covered over by only a thin layer of the pith-like sponge-tissue. More than one secondary osculum may open into such a superficial space. This should not be mistaken for a subdermal space; the thin layer over it represents the entire thickness of the sponge-wall, consisting, as it does, of parenchymalia in addition to the dermal layer. If we suppose a number of oscula to have opened through it in close proximity to one another, we should have a structure strictly comparable to the Euplectellid sieve-plate. I believe it contains the chamber-layer in an undulating disposition, in much the same way as we usually see it in the thin marginal rim of cup-shaped Hexactinellids; all the chambers, I think, have apopyles directed away from the external surface and towards the canalar space mentioned above. But this point could not be definitely ascertained by direct observation, on account of the desiccated state of the specimen.

So far as the outward appearance goes, there is a certain resemblance between the back-surface of the present species and the gastral surface of certain other Hexactinellids, the oscula of the former simulating the apertures of excurrent canals opening on the latter. But, from the mode of origin of the gastral cavity, there should constantly exist an essential difference in the relation of the dermal and gastral surfaces to the outer or the inner aspect of the chamber-layer. In the case of a real gastral surface, the apopylar ends of chambers should invariably be turned towards it,—not away from it, as they should be if the surface were dermal.

In general shape the present species may be said to be not unlike a *Caulophacus* species, in which the gastral surface, correctly recognized as such, is so turned outwardly and exposed as to form a part of the external surface. Indeed, by a hurried inspection of the present species, one might possibly be misled into thinking of the area of the frontal lattice as the gastral surface similarly exposed on the outside. But the observer will soon see that structurally the frontal lattice is comparable with the dermal, and not to the gastral, layer of *Caulophacus*. Further, the system of canals communicating with the exterior by openings which I have unhesitatingly called the oscula is completely separate from the other canal-system that leads directly from the space right under the frontal lattice. Unless it be an error to regard the openings just referred to as oscula, the latter canal-system needs but to be considered as incurrent, and it then logically follows that the frontal lattice is a structure calculated to allow the afferent passage of water, which is invariably the character of the dermal latticework.

The stalk belongs to the back-side of the body; at any rate, it arises a good distance apart from, and behind, the lower border of the frontal lattice and is covered all over by a direct and uninterrupted continuation of the pith-like surface of the back. Moreover, as before mentioned, it bears a certain number of secondary oscular openings. I lay some importance on the above facts, as demonstrating at once the dermal nature of the back-side surface, since the stalk surface can not possibly be anything but dermal.

Excepting the soft covering layer, the stalk is firm and compact. It expands above to join the body. It is longitudinally ribbed, more prominently on the back than on the front. It may be described either as a hollow tube with the lumen running close under the back surface, or as being grooved on this side, which groove is covered only with a thin sheet of the pith-like tissue. The lumen or the groove is evidently a part of the excurrent canal-system. It opens externally by a limited number of secondary oscula, distributed irregularly on the thin covering sheet and therefore only on the posterior side of the stalk (Pl. I., fig. 2.).*

The large, irregularly lobed, basal disc is likewise soft on the surface but internally quite firm. The covered groove of the stalk extends for some distance on the disc-surface, showing on the cover a few more oscular openings. A certain number of other similar but branching canals are seen to ramify on the disc-surface in a vein-like manner.

The most remarkable features in the organization of the present species lie in the massive development of the body and in the differentiation of a part of the external surface into an area, the frontal lattice, more especially adapted to the reception and passing in of the water than other parts of the same.

As regards the former point, an analogous case seems to be presented by *Malacosaccus floricomatus*, recently described by TOPSENT ('01). In this interesting Euplectellid the body should be solid and provided with a number of orifices—evidently exhalant orifices or oscula—distributed over the external surface. The describer however leaves margin to allow assumption that perhaps the presence of a shallow hollow at the superior extremity, represent-

* The small hole seen on the front side of the stalk (Pl. I., fig. 1) is an artificial perforation.

ing a rudimentary gastral cavity, is to be ascribed to the species. If that be true, the species should be said to agree with *Placosoma paradictyum* not only in the excessively thick development of the originally cup-like sponge-wall but also in the possession of numerous secondary oscula in addition to the single primary one.

The development of the frontal lattice and the occurrence of oscula exclusively on the opposite side of the body in *Placosoma paradictyum* probably stand in relation to the physical circumstances of the habitat favoring the ingress of water on the one side or its egress on the other,—possibly in that the former is exposed to, and the latter sheltered from, a prevailing current. Here again we seem to have to do with a structural arrangement which does not stand quite isolated among the Hexactinellida. So, for instance, in *Semperella schultzei*, as is well known, the external (dermal) surface is differentiated into two sorts of tracts, the afferent and the efferent. The latter may indeed be said to occur here on all sides of the columnar body, but is relatively much more extensively developed on its one side than on the other,—a fact, which seems to have hitherto escaped the attention of observers, but which I have found to hold good for all the specimens examined by me. A closer analogy to the condition that obtains in *Placosoma paradictyum* is apparently exhibited by *Poliopogon amadou*, as known to me through F. E. SCHULZE's representations in the Challenger Report. In this form the entire external surface is, in my opinion, to be regarded as dermal, the gastral surface being nowhere outwardly exposed. The discharge of water is effected through orifices which are situated exclusively on the one—the concave—side of the half-rolled lamella-like body. This concave surface has been called by F. E. SCHULZE gastral, which appellation however seems inadmissible in view of the fact that the subjacent chamber-layer shows the blind chamber-ends all directed towards it, similarly as on the convex side (Chall. Rep., Pl. L., fig. 1). It is then plain that the inflow of water takes place all over the surface of both sides, except of course at the separate excurrent orifices on the concave side. The condition of this side then exactly corresponds to that on the back of *Placosoma paradictyum*, while the convex side may be said to correspond to the front, though it lacks a special structure like the frontal lattice.

Spiculation.

(Pl. II.).

First let me complete an account of the spiculation in the sponge-body proper.

Of the *parenchymalia* the predominating form is a fine diactin, generally 2–8 mm. in length. The breadth, not exceeding 15 μ, remains nearly the same throughout; not seldom however it slightly increases towards both extremities. These are usually bluntly pointed; the surface near them is nearly smooth or obsoletely rough on account of insignificant tubercles. The center of the diactins is generally quite smooth, and exceptionally marked by an annular swelling or by knobs in cruciate arrangement. The diactins are disposed partly irregularly or in loose indefinite groups and partly in long, compact and thread-like fascicles of variable strength (Pl. II., fig. 15). The hypodermal beams of the frontal lattice (see fig. 13) are nothing else than extensions of such parenchymal fascicles from the choanosome.—Among the parenchymalia making up the fascicles there are none which, on account of a specially emphasized size or strength, may be distinguished as the principalia. Nor does there exist synapticular fusion among any of the parenchymalia, so far as those of the main body are concerned.—Besides the diactins there also exist, among the parenchymalia, a number of medium-sized hexactins in sparse distribution (see fig. 15). Occasionally these are represented by forms more or less closely approaching a pentactin or even a stauractin in form. Axial length up to nearly 1 mm.; thickness of rays near base up to 20 μ; the rays gradually taper towards the free end, which is faintly rough-surfaced and either sharply or bluntly pointed. The rays in a spicule are often of unequal lengths. In some cases one of the axes was found to be prolonged more or less in comparison with the rest, and with that elongated axis the spicule took part in the composition of a parenchymal fascicle; but the rule is that the hexactins stand in no definite relation with other parenchymal spicules as regards the situation of their rays.

The parenchymal hexactins are, in point of size and shape, not always sharply distinguishable from those hexactins which may be called the *canalaria*. These are found sparingly and isolatedly in irregular distribution on the canalar surface as well as on the hypodermal beams of the frontal lattice. Two of them are seem in the lower part of fig. 13, Pl. II. They are recognizable as such only when one of the six rays is considerably shorter than the rest and projects freely, from base to tip, into the canalar lumen or the subdermal space. The free ray shows, though not always, a further specialization in that it has a rounded termination, instead of being pointed like the other rays.

The dermalia and the gastralia are likewise spicules whose shape and size present points of approach to the parenchymal hexactins.

The *dermalia* are hexactins, in part somewhat sword-like in shape as in the generality of the Euplectellid members, but in part much flattened owing to an extensive shortening of the proximally directed blade-ray. In details of characters they differ somewhat according as they are located on the front or on the back of the sponge-body.

First, the dermalia of the frontal lattice (Pl. II., figs. 1 and 2). The rays measure about 9 μ in breadth near the spicular center. The distal free ray is always very short, being only 45–55 μ and seldom 65 μ in length; it usually broadens slightly towards the distal end, which is rounded and has a surface supplied with quite insignificant microtubercles. The paratangential rays are 150–200 μ long, as measured from the center; they taper outwards in a barely perceptible degree, to terminate with rounded or bluntly conical tips; the surface is sprinkled with obsolete microtubercles which are distributed more densely near the end of the rays. The proximally directed ray resembles the paratangentials in general appearance but is subject to great variation as to its length, according to the position of the dermalia in the frontal lattice. Where there exists a hypodermal beam directly underlying the dermal layer, the spicules of the latter have a more or less elongated proximal ray dipping right into the substance of the former. That ray is then considerably—at times even thrice—longer than a paratangential of the same spicule (Pl. II., fig. 1). Whereas, within a mesh-area bounded by hypodermal beams, *i. e.*, in parts where the dermal layer has no skeletal support underneath, the dermalia have their proximal rays greatly reduced in length (Pl. II., fig. 2) In extreme cases, this ray may be only about as long as the distal ray and similarly club-like in appearance. So far as the dermal layer is made up of such—so to say, flat—hexactins, it stretches freely over the wide subdermal space without any spicular connection with the choanosome. Similarly flattened dermalia, occurring under the same circumstances, have been described by me from *Regadrella komeyamai* among the Euplectellidæ (Contrib. I., p. 261).

The dermalia on the back of the sponge-body are all supplied with a proximal ray which is always the longest of the six, the dermal layer on this side being everywhere in close connection with the choanosomal mass. Under a general agreement in appearance, they differ slightly from those of the frontal lattice in being on the whole larger and in the rays being somewhat more tapering and having a nearly smooth surface except for a short space at the end. Breadth of rays up to 10 μ near the spicular center. Distal ray 70–100 μ long; swollen towards the rounded end. Paratangentials 220–300 μ long. Proximal ray may be twice as long, or longer.

In the frontal lattice the paratangentials of separate dermalia are as a rule closely apposed to one another to form the exquisite checker-like latticework (fig. 13). On the back of the sponge this arrangement is carried out to a certain extent but not with the same degree of regularity (fig. 14). Here the separate dermalia generally lie wider apart and at places show no order as to the relative disposition of their paratangentials.

The *gastralia* (Pl. II., figs. 3 and 16), found in irregular distribution over the gastral surface inside the main osculum, are hexactins. They resemble in appearance the dermalia of the back. Length of the longest—the radially directed—axis, 600–800 μ. Paratangentials 200–260 μ long. The free gastral ray is of about the same length, or shorter; it is not always rounded at the end, but may be gradually tapering and conically pointed like the other rays. Thickness of rays near base 7½–8 μ.

The *hexasters* of the species belong all to one type, the discohexaster; but this occurs in no less than three varieties of markedly different characterization, *viz.*, the hexactinose discohexaster, the spherical discohexaster and the hexactinose codonhexaster. Floricomes and graphiocomes are not present.

By far the most abundant and the most generally distributed are the small *hexactinose discohexasters* (Pl. II., figs. 4 and 7). They are very numerous about the hypodermal beams of the frontal lattice and everywhere in the parenchyma (see figs. 13–16). The manner of their distribution in large numbers reminds one of that of micramphidiscs in certain Amphidiscophora. The size is subject to considerable variation. In most cases the diameter measures 30–60 μ, on an average about 46 μ; but occasionally, and especially near the back surface of the sponge, the hexaster attains a much larger size, reaching 100 μ in diameter. The axial filaments in the central node extend, as determined by direct observation, only to the base of the six moderately strong rays. The watchglass-like or nearly hemispherical terminal disc measures 8–15 μ across; its well developed marginal teeth vary from 8 to 15 in number, according to the smaller or larger size of the spicule. In some rare instances I have found the terminal disc unusually small and toothless, a condition which is probably to be considered as representing a stage in its developmental history. Also a few cases of hemihexasterous forms, such as are shown in figs. 5 and 6, came under my observation. It seems that through these forms the small hexactinose variety of hexasters now in question passes over gradationally into the spherical discohexaster next to be described. On the other hand, there not infrequently occur, especially near the surface of the back and of the gastral cavity, such forms as bridge over the gap between the present variety and the hexactinose codonhexaster (fig. 8). The intermediate forms just referred to are generally somewhat larger than usual and possess terminal discs, which, by elongation of the marginal teeth, have acquired a more or less bell-like shape.

The *spherical discohexasters* (Pl. II., figs. 9–12) are large and of great beauty, most closely resembling those that are known from *Dictyaulus elegans* F. E. SCH. I have found them only close to the dermal layer on the back of the sponge, where they occurred abundantly in some places (see fig. 14), but only occasionally in others. They mostly measure 160–240 μ in diameter. From the expanded end of each short and stout principal there arise in the smaller rosette 4 or 5 terminals and in the larger ones 12 or thereabout. They are not always arranged in a whorl, but often one or more are seen to spring from a position inside the points of origin of the peripheral ones. The slender terminals thicken considerably at the outer end and are capped with a strongly convex disc, which may measure up to 23 μ in diameter. Of the well developed marginal teeth there are 10–13, sometimes more (up to 17), to a disc. All the terminal discs in a rosette of the kind are approximately equidistant from one other, so that a spherical form is given to the entire spicule.—Special mention must be made of unusually small, normally developed, but only occasionally occurring discohexasters which seem to lead the large spherical discohexaster gradationally over to the small hexactinose discohexaster before described, especially to the hemihexasterous form of this rosette. We have here to do with spherical discohexasters of under 150 μ diameter, leading down to 100 μ or less (even to 55 μ). Fig. 9, Pl. II., represents one such case, measuring about 100 μ in diameter. Two or three, sometimes four, terminals belong to a principal; the terminal disc is just the same as in a small hexactinose discohexaster.—Noteworthy also seem the cases—quite rare though these are—of certain moderately large (132 μ diameter) discohexasters in which 4 or 5 terminals, each ending in a bell-shaped terminal disc, belong to each principal (see fig. 10). Here is apparently an approach of the normal discohexasters to the hexactinose codonhexaster next to be described; but an intermediate hemihexasterous codonhexaster has not been met with.

The *hexactinose codonhexasters* (Pl. II., figs. 11, 16) occur in great abundance just under the gastral layer. The powdery appearance, before noticed, of that layer is due to their crowded presence. They are also found in the parenchyma generally, but only quite seldom and at wide intervals. Diameter in most cases 110–176 μ. The slender hexradiate rays, arising from a small central node, are usually more or less bent. Here again the axial filament of the central cross extends, as a matter of fact, only a very short distance into the base of the rays. The deeply bell-like terminal umbel may be 30 μ broad and 42 μ long; the long teeth of the sides 12–16 in number. I have already indicated that this category of the hexasters is connected with the small hexactinose discohexasters by forms that are intermediate both in point of size and of the shape of the terminal disc.

Finally, as to the spiculation of the stalk and of the basal disc.

In both these parts the main mass of the parenchyme is rigid and consists of long, synapticularly connected diactins, measuring 10–40 μ in thickness. These run in longitudinal bundles in the stalk, while in the disc they are disposed more or less parallel to the surface but otherwise in all directions. Hexasters among the fused parenchymalia seem to be rarely present.

Towards the external surface, in both the stalk and the disc, the synapticulæ cease to exist. The peripheral diactinic parenchymalia thus left loose and unconnected, together with the dermalia and the hexasters present, form a soft tissue which in a thin layer covers the entire external surface of the parts in question, besides constituting the substance of the thin oscula-bearing sheet which partially shuts off the large excurrent canals from the exterior (see p. 9).

The dermalia of the stalk compare well with those of the body, except in often having the distal ray considerably reduced in length, sometimes even to a mere knob or a gentle swelling. And, lower down the sponge, *i.e.*, on the disc-surface, this ray is completely lost in all, so that here the dermalia are pentactinic, —a condition which may possibly represent the state as assumably obtains in the entire dermal layer of the species in the earliest period of postlarval development, as I have found to be the case in young *Regadrella okinoseana* (see Contrib. I., pp. 246, 247). In all the dermalia the proximal ray, penetrating into the underlying tissue, is always the longest. Seen on the surface, the paratangential crosses lie rather densely crowded, without any regularity as to their relative position.

The hexasters in the said soft tissue of the periphery are the small hexactinose and the larger spherical discohexasters, both of exactly the same characters as those of the body. The former are common everywhere, while the latter have been found scattered here and there in the stalk only.

The large excurrent canal in the stalk is likewise lined with a thin layer of fine diactinic parenchymalia, free of synapticular formations. No special canalaria exist here, but the hexasters are represented by the usual, small, hexactinose discohexaster and the hexactinose codonhexaster of a larger size—the former in excessive abundance but the latter only sparsely. It may be pointed out that the presence of the codonhexasters along the canalar wall manifests a point of agreement, and indicates a direct continuity, between the surfaces of that canal and of the gastral cavity, in a manner as it is perfectly natural to find, as we did, the same spherical discohexaster under the continuous dermal surfaces of the stalk and of the back of the sponge-body.

Observations on the Euplectellidæ generally.

As to the systematic position of *Placosoma paradictyum*, it is safe to say that it should be placed under the Euplectellidæ. In an attempt to determine, as nearly as possible, its position within that family, I have been led to undertake a renewed study of all the members of the family as regards their known systematic characters, and this induces me to make here some observations concerning the family diagnosis and the division into subfamilies, and in this connection I take the opportunity to modify certain statements that I made prematurely in Contribution II. with respect to the Euplectellid subfamily Corbitellinæ.

It may be well to preface my remarks by an enumeration of all the genera that I consider as making up the family as it now stands. These are as follows:

1. *Holascus* F. E. Sch.	(With 8 species).
2. *Malacosaccus* F. E. Sch.	(„ 3 „).
3. *Euplectella* Owen.	(„ 13 „).
4. *Regadrella* O. Schm.	(„ 3 „).
5. *Corbitella* Gray.	(„ 3 „).
6. *Heterotella* Gray.	(„ 1 „).
7. *Walteria* F. E. Sch.	(„ 2 „).
8. *Dictyaulus* F. E. Sch.	(„ 1 „).
9. *Dictyocalyx* F. E. Sch.	(„ 1 „).
10. *Hertwigia* O. Schm.	(„ 1 „).
11. *Trachycaulus* F. E. Sch.	(„ 1 „).
12. *Saccocalyx* F. E. Sch.	(„ 1 „).
13. *Rhabdopectella* O. Schm.	(„ 1 „).
14. *Rhabdodictyum* O. Schm.	(„ 1 „).
15. *Hyalostylus* F. E. Sch.	(„ 1 „).
16. *Placosoma* Ij.	(„ 1 „).

The family diagnosis, as given by F. E. Schulze ('99, p. 97) in the latest period, runs as follows:

"Röhren-, sack- oder kelchförmige Hexasterophora, welche entweder mit einem basalen Nadelschopfe im Boden wurzeln oder, sei es direkt, sei es mittelst eines langen röhrenförmigen Stieles, aufgewachsen sind. Die Dermalmembran wird gestützt durch hexactine Hypodermalia, deren Proximalstrahl in der Regel verlängert ist."

Excellent as this diagnosis is on the whole, I think it may perhaps with advantage be somewhat remodelled in order the more sharply to characterize the family. In fact, this seems necessitated to a degree by the discovery of new forms since the above diagnosis was drawn up. In attempting the revision, it is to be borne in mind that of all the lyssacine families it is especially the Caulophacidæ (for which, *vide* a later paragraph in this Contribution), with which the Euplectellidæ, as bearing closest resemblance in certain important systematic characters, require to be placed in contrast. Now, the more important points not indicated or explicitly mentioned in the above diagnosis F. E. SCHULZE's but which appear to call for our attention here, seem to be the following.

1. The massive development of the body in *Malacosaccus floricomatus* TOPS. and *Placosoma paradictyum* IJ., neither of which can be said to be tubular, saccular or cup-like.

2. The presence of a distinctly stalk-like part in the body of *Malacosaccus floricomatus*, running out into a tuft of anchoring spicules at the inferior end. The stalk is then a thing, the occurrence of which is not confined to those Euplectellids which at base are firmly fixed to the hard substratum.

3. The Euplectellidæ, excepting a few insufficiently known forms (*Malacosaccus vastus, M. unguiculatus, Hertwigia, Hyalostylus*), as a rule exhibit on the parietes a large number of separate orifices (oscula) for the discharge of water. It is common to find them all (*Holascus*) or in part (*Euplectella, Corbitella*, etc.) in close congregation (forming the sieve-plate meshes) at the superior end of the body, whereby is brought about a condition which simulates such other cases as show a single large terminal osculum with (e.g., *Placosoma paradictyum*) or without (e.g., *Malacosaccus*

unguiculatus) a greater or less number of additional oscula on the lateral wall. The multiplicity af oscules is certainly not a peculiarity of the Euplectellidæ; and moreover, cases are not wanting in this family which indicate that we have here to do with a very variable character, sometimes apparently of no more than specific, or at most generic, value. Nevertheless, it seems undeniable as a general fact that the tendency toward that character is, in the Euplectellidæ, brought into expression with such a degree of constancy and accentuation as is foreign to any other lyssacine hexasterophorous family (Leucopsacidæ, Caulophacidæ, Rossellidæ). And further, it is a noteworthy feature that on this account the appearance of individuality is not generally in the least impaired. Whereas, in the Caulophacidæ, the formation of additional oscula in an individual is always in connection with a process of budding, thus imparting to it a more or less cormus-like or "polyzoic" appearance.

4. The dermalia (=F. E. SCHULZE's Hypodermalia) in the Euplectellidæ may be said, as a general matter of course, to still remain in a comparatively incipient stage of morphological differentiation.* Thus, they stand in direct and intimate relation with the parenchymalia in that the proximal ray dips right into the choanosome; they are known in some cases even to intergrade in the characters of rays with certain hexactinic parenchymalia. On the other hand, in the Caulophacidæ—and, I may add, in the Rossellidæ—the corresponding spicules (*i.e.*, the autodermalia) apparently represent a more highly specialized category of spicules which are joined to the parenchymalia only through the inter-

* This condition of the dermalia is shared in a way also by the Leucopsacidæ, in which however the dermalia are pentactins or are at any rate always wanting in distally directed rays.

mediation of the hypodermalia, especially the large pentactinic hypodermalia. Amongst the Euplectellids, the hypodermalia are thus far known only in the frontal lattice of *Placosoma paradictyum* but in no case have hypodermal pentactins been found. Here is, I think, an important negative character which distinguishes the family from such others as are most liable to be confounded with it.

After what I have said above, the diagnosis may be made so as to read somewhat as follows:

Lyssacine Hexasterophora* of tubular, cup-like or massive body; sometimes stalked; either rooted by a tuft of basal spicules or firmly attached by compact base; generally possessing numerous separate oscula. Dermal skeleton composed of hexactinic dermalia, the proximal ray of which is as a rule much longer than any other in the same spicule; no hypodermal pentactins. Hexasters various.

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* I adopt F. E. Schulze's ('99, p. 93) system of dividing the Hexactinellida—the living Hexactinellida, at least—into two great primary groups or suborders, the Amphidiscophora and the Hexasterophora. Here, as elsewhere in this paper, the term "lyssacine" is used without implying the Lyssacina as a systematic group, but merely to denote the condition of those Hexactinellids, in which the parenchymalia are all or mostly free and unfused, or in which these may sometimes be extensively ankylosed and then consist not exclusively of hexactins, but of hexactins and their derivative forms or of the latter only. The term "dictyonine," as employed by me, refers to the state of those Hexactinellids in which the parenchymalia, consisting of hexactins, and as a rule of hexactins only, undergo fusion among themselves from a very early period of their existence. A brief exposition of my views on the Hexactinellid phylogeny and system, incomplete and somewhat provisional as these necessarily are in the present stage of my studies, may help to clear up the points in question, and may at the same time serve to indicate the position of the different families described in this Contribution.

For the ancestral Protohexactinellida is to be assumed a *lyssacine* form, in which the spicules consisted, mainly at least, of more or less regularly developed hexactins. Now, the Amphidiscophora should represent a very early differentiated branch of the Hexactinellida, which has remained thoroughly lyssacine in character and has been, on that account, in a position to give rise to such manifold variations of triaxonic spicules as we see in that group.

Now as to the division of the Euplectellidæ into subfamilies. Of these, three have been recognized by F. E. SCHULZE ('99, p. 97), *viz.*, the Holascinæ, the Euplectellinæ and theTægerinæ.

The Hexasterophora, it seems safe to say, should have had for its prototype a form which was firmly attached by its base to the hard substratum. Whenever a Hexactinellid is thus fixedly seated, even though it be a so-called Lyssacina, it is quite generally true that certain small hexactinic spicules occurring at the base very early undergo fusion, beginning with those in direct contact with the substratum, thus bringing about a typically dictyonine framework at the part. This might have taken origin in consequence of the sponge requiring a certain degree of firmness at the part of attachment. That rigid framework, so far as it occurs in lyssacine Hexactinellids, I have called the *basidictyonalia* (Contrib. I., pp. 186 [foot-note], 232 and 264). The same framework it is, I hold, which has reached the most extensive development in the so-called Dictyonina and has been called by F. E. SCHULZE the *dictyonalia*. The basidictyonalia and the dictyonalia I consider as genetically and morphologically identical. Both retain a primitive character in that they alike consist, as a general rule, of hexactins only, although derivative forms of spicules with a smaller number of rays may secondarily come into fusion with the beams. The true dictyonine skeleton as here specified, should be kept distinct from another kind of ankylosed framework in which the elements involved are not solely hexactins, but principally derivatives of the same, such as stauractins, tauactins, diactins, etc. (as, e. g. in the rigid skeletal frame of the lateral wall or the stalk in the *Euplectellinæ*). The rigidity in the latter case is clearly a much later acquisition than that in the basidictyonalia or the dictyonalia. For, before the ankylosing process, starting at the base, has encroached upon the parts occupied by the derivative spicules indicated, these must have had a long period of loose existence during which they should have derived their shape from the original hexactinic form,—which would be impossible had they been soldered together beforehand. From this standpoint, the well-known skeletal framework of f. i. *Euplectella aspergillum*, notwithstanding the completely ankylosed state of its component spicules, ought not to be confounded with the basidictyonalia or the dictyonalia of certain other Hexactinellids but should fall under the lyssacine category, in which the ankylosis has but secondarily set in.

But to return to the Hexasterophora prototype. I consider this to have already possessed at its base a basidictyonal mass in addition to the loose spicules of the body proper, which were directly inherited from the Hexactinellid ancestor. In other words, it may be said that the skeleton was partly dictyonine and partly lyssacine in character,—a dual condition, which, in general, may be said to obtain in all the recent Hexasterophora, if we except those forms which have apparently lost the basidictyonalia in secondarily adapting themselves to the special mode of attachment by means of anchoring spicules (Euplectellinæ, *Lophocalyx*, *Melonympha*). During the phylogeny, the elements of the dictyonine portion have remained essentially unchanged in character, as they should owing to their rigidly fixed state. On the other hand, those of the lyssacine portion have been capable of adapting themselves in manifold ways to varied conditions of existence, analogously to the similarly circumstanced spicules of the Amphidiscophora, the result being the multifarious hexactin-modifications—amongst them the hexasters—which we meet with in the Hexasterophora.

Whether or not the Holascinæ, made up of the two genera *Holascus* and *Malacosaccus*, and the Euplectellinæ, consisting of the single genus *Euplectella*, are to be kept separate, is, I should think, largely a matter of opinion. To me it appears that the two subfamilies had better be united into one, chiefly because the main distinctive character that has been assumed as existing between them,—*viz.*, the absence or presence of orifices on the lateral wall,—has been discredited by the recent discovery of *Malacosaccus floricomatus* Tops., in which a number of orifices,

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Whether or not the palæozoic lyssacine forms, put together by Schrammen ('02) under a distinct suborder, the Stauractinophora, are to be looked upon as really representing a phylum systematically nearly equivalent to the Amphidiscophora or the Hexasterophora, I prefer to leave undecided, owing to uncertainties that always attach to the fossil Hexactinellids in respect of the finer spiculation.

The Hexasterophora I assume to have early split into at least three branches or tribes, to be here provisionally called A, B and C.

Tribe A, which may be allowed to retain Zittel's name Lyssacina but in an altered sense, comprises all the hexasterophorous lyssacine families, of which I distinguish four, *viz.*, Euplectellidæ, Leucopsacidæ, Caulophacidæ and Rossellidæ.

The other two tribes are both dictyonine and together correspond to Zittel's Dictyonina, but are probably not to be put together under one such systematic group.

Under Tribe B, which in scope nearly agrees with F. E. Schulze's Inermia, I place the family Dactylocalycidæ (made up of the genera *Dactylocalyx*, *Margaritella*, *Myliusia*, *Aulocalyx* and *Euryplegma*) as well as all the lychniscophorous forms, both recent and fossil. Schrammen (*l. c.*) though essentially in agreement with F. E. Schulze and with me as regards the principles of classification, stands in practice at variance with the view here advanced in that the Lychniscophora Schr. is made by him into a suborder distinct from another, the Hexactinophora Schr., which latter is made up of the Tribes Amphidiscophora, Hexasterophora and Uncinataria. That writer evidently lays undue weight on the lychnisc. This in my opinion is formed simply by the addition of peculiarly arranged synapticulæ around the central node of hexactins composing an ordinary dictyonal skeleton. The Lychniscophora then seems to me to be just as much a Hexactinophora as any form referred by Schrammen to this group. And furthermore, it is certainly a Hexasterophora, as is proved by what we know of the living lychniscophorous genus *Aulocystis*.

Tribe C is exactly identical with F. E. Schulze's Uncinataria. The spicules called uncinates, from which the tribe received the name just mentioned, are peculiar in that they can not be proved to be secondarily derived from a triaxon owing to the absence of the axial cross, though the axial canal is present. A noteworthy fact it is that the same spicules occur also in certain Amphidiscophora, though not in all. This seems indicative of a near phylogenetic relation between the Uncinataria and the Amphidiscophora, but just how it is scarcely possible to determine.

apparently fundamentally the same as those seen in *Euplectella*, are found distributed all over the body. At any rate, the system suffers no disadvantage if the Euplectellinæ, consisting, as it does, of only a single genus, be deprived of its doubtful status as a distinct subfamily ; and moreover, the group resulting from the above amalgamation seems to be a perfectly natural and well defined one, representing a Euplectellid phylum which has adapted itself to a special mode of attachment to the soft or loose sea-bottom. For this new group or subfamily, the name Euplectellinæ may however be retained but in a new sense, as follows: Euplectellidæ rooted in the substratum by a tuft of basal spicules.

Setting aside the three genera that make up the Euplectellinæ as defined above, the remaining genera (13 in number, *vide* the list on p. 20) are, assumably all and without exception, those forms which are directly and firmly fixed at base to the hard substratum,—probably the primitive mode of attachment of the Euplectellidæ.

This assemblage of genera includes all those that were referred to the Tægerinæ by F. E. SCHULZE, besides others which have been left by him unassigned to any of the subfamilies as being too insufficiently known (F. E. SCH., '87, p. 99). In my last Contribution (IJ., '02, p. 30) I had, for what I considered a necessity by usage, substituted the name Corbitellinæ for that of Tægerinæ, to which change I still adhere ; but the scope I had given to the subfamily, though on the whole much more extended than before, was in one respect narrowed, *viz.*, in that the genera *Hertwigia*, *Trachycaulus* and *Saccocalyx*, all placed by F. E. SCHULZE ('99, pp. 96–98) among his Tægerinæ, were not included in my list of the Corbitellinæ then given (IJ., *l. c.*). It may supplementarily be explained that the omission was made under the impression that a distinct subfamily should be instituted to receive the genera mentioned, together with certain others. I have since come to see that this is not practicable; in fact, all the firmly seated Euplectellids known at present now seem to me to form a group, which admits of no subdivision so as to represent more than one phylum. This is especially on account of the intricate manner in which certain highly characterized hexasters are distributed among, and combined in, the different genera. So that, after all, they can not but be left to stand as one subfamily, the Corbitellinæ, in contrast with the only other subfamily, the Euplectellinæ, of the family under consideration. The Corbitellinæ may then be characterized simply as: Euplectellidæ firmly attached to the substratum by compact base.

It goes without saying that the definition of the Corbitellinæ as it stands in my Contribution II. and the list of the species appended thereto are rejectable, the former as going too much into particulars and the latter as being incomplete.

Inseparably linked together as the Corbitelline genera apparently are, the series may nevertheless be said to show a general tendency of development in two directions. At the one end of the series may be placed those forms, which, like *Regadrella*, *Corbitella* and the like, are of a tubular shape having the sieve-plate and possessing both the floricome and the graphiocome among the hexasters. *Euplectella*, and with it the Euplectellinæ, represents in all probability an off-shoot by special adaptation somewhere from this end of the Corbitelline series. At the other end may be placed those forms, e. g., *Dictyaulus*, *Hertwigia* and *Saccocalyx*, which, under variable external shapes, have given rise to such special hexaster-modifications as the discospiraster, the codonhexaster, the aspidoplumicome, or the drepanocome, while the graphiocome, alone by itself or together with the floricome, has either been lost or has never come into development. *Placosoma paradictyum*, as being in possession of codonhexasters and wanting in both floricomes and graphiocomes, seems to have its position somewhere in the latter end of the Corbitelline series, though it is difficult to indicate to which of the genera it is most nearly related.

The division of the Corbitellinæ somewhat in the manner hinted at above may become possible and even necessary in the future; for a far wider knowledge than we at present possess is to be taken in prospect, when we remember that most of the genera are now known only in solitary species and that too, in so many cases, in a single specimen.

LEUCOPSACIDÆ.

In '98 (p. 41) I introduced into the system a group by the name of Leucopsacinæ, to which the status of a subfamily under the Rossellidæ was given. It is herewith made a distinct family with some change in its scope and definition.

To the Leucopsacinæ, as a Rossellid subfamily, I originally referred the following six genera:

1. *Leucopsacus* IJ. (With 2 species, *L. orthodocus* IJ. and *L. scoliodocus* IJ.).
2. *Chaunoplectella* IJ. (With 2 species, *C. cavernosa* IJ. and *C. spinifera* n. sp.).
3. *Caulocalyx* F. E. SCH. (With 1 species, *C.* tener F. E. SCH.).
4. *Placopegma* F. E. SCH. (With 2 species, *P. solutum* F. E. SCH. and *P.* sp.).
5. *Aulocalyx* F. E. SCH. (With 1 species, *A. irregularis* F. E. SCH.).
6. *Euryplegma* F. E. SCH. (With 1 species, *E. auriculare* F. E. SCH.).

I now think that the two last named genera, *viz.*, *Aulocalyx* and *Euryplegma*, had better be separated from the group in question as well as from the Rossellidæ altogether and placed under a dictyonine family, Dactylocalycidæ, together with *Dactylocalyx, Margaritella,* and *Myliusia.** I am led to this conclusion chiefly by reason of an essential agreement in the characters of

* With *Myliusia* GRAY is probably identical *Scleroplegma* O. SCHM.

the dermalia and of the parenchymalia made up of hexactins, and of *hexactins only*, which are quite extensively ankylosed except in growing parts of the body. It may be remarked that, through the two genera herewith united to the Dactylocalycidæ, this family is brought into close relationship with the lyssacine family which I shall call the Leucopsacidæ.

The four remaining genera, *viz.*, *Leucopsacus*, *Chaunoplectella*, *Caulocalyx* and *Placopegma*, are all lyssacine forms, but should likewise, I think, be removed from the Rossellidæ on account of a somewhat marked difference in the nature of the dermal skeleton, a point to which we give, rightly I believe, much weight in distinguishing the families. The removal would be an advantage to the system in this respect, that the Rossellidæ is thereby left a group much more uniformly characterized than before, in that its dermal skeleton may then be said to be uniformly composed of well differentiated, small, rough-surfaced dermalia and of much larger, supporting spicules, the hypodermalia, which are generally pentactins much less specialized in characters from certain parenchymalia. On the other hand, the four genera in question have all relatively large *pentactinic* dermalia with which are associated *no* spicules that may be called the hypodermalia. Owing to this character they can not, in my opinion, very well be received into any known lyssacine family. However it may be said that in general features of the dermal skeleton, as in fact in general spiculation, they most closely resemble, and therefore show nearest relationship to, the Euplectellidæ, but of course with this difference that the dermalia lack the distally directed, sixth rays which are always present in those of the family just mentioned. If they should perforce be united to any of the accepted families, the union must be with the Euplectellidæ and not with any other family. The absence of distal rays to the dermalia, it may be said on theoretical grounds, is simply due to a secondary loss, which might be easily conceived if we remember the great variability of the corresponding spicules within the family Rossellidæ. It may be that the pentactinic dermalia, as represented in quite young *Regadrella okinoseana* (IJ., '01, p. 240) probably as the result of adaptation to certain secondary circumstances and which in this Euplectellid are soon overcrowded by later formed hexactinic forms, have in the present cases become permanent under the continuance of the same adaptive conditions. It is certainly not to be excluded that hexactinic dermalia develope in certain limited parts of the body-surface; thus, in *Placopegma solutum,* according to F. E. SCHULZE ('95, p. 64), the dermalia on the oscular margin are hexactins, instead of pentactins as on the general surface. At all events it appears justifiable to assume that the four genera under consideration, whether separately or as a group, were derived either secondarily from the Euplectellidæ or from an early prototype of the same. With the progress of our knowledge in the future, it may become necessary to incorporate them all or in part in the family just referred to; but meanwhile, I consider it expedient to keep them separate in a distinct family, to be designated the Leucopsacidæ, even if only to avoid disturbing the integrity of the Euplectellidæ as already defined.

As regards the genera *Leucopsacus* and *Chaunoplectella,* it seems nothing stands in the way of regarding them as forming a systematically coherent group which may have very early diverged from the Euplectellid Corbitelline phylum. But now, in associating with them the genera *Caulocalyx* and *Placopegma* in one taxonomic group, I am not without misgivings as to whether a polyphyletic character is not thereby given to it. As to *Caulocalyx*, the presence of aspidoplumicomes (F. E. SCH., '97, p. 549)—the same peculiar hexasters as those found in *Hertwigia* and *Saccocalyx*—indicates its affinity with these highly organized Corbitellinæ and so suggests that it had an origin later than, and independent of *Leucopsacus* and *Chaunoplectella*. With respect to *Placopegma*, should F. E. SCHULZE's ('95, p. 65) assumption of the presence of a basal anchoring tuft prove correct, the genus must probably be regarded as derived from the Euplectellinæ, and not from the Corbitellinæ as is the case with the other genera. The barbed anchor-needles that were discovered in *P. solutum* have been assumed by F. E. SCHULZE (*l. c.*) to be pentactinic, each of the four anchor-teeth being taken for a real spicular ray; but this seems to me highly improbable. The short transversely disposed axial filaments forming a part of the central cross in the said needle (*l. c.*, Taf. VI, Fig. 16) are far from extending into the anchor-teeth and appear much too abortive to allow of these being interpreted as real rays, but they are only of such a degree of development as we see in a diactin or a monactin of a similar strength; so that, I think, the anchor-needle is essentially comparable to that of the Euplectellinæ, save in this relatively unimportant respect that the central axial cross is brought down into the inferior swollen end, instead of being situated some distance above it.

Under the above circumstances it is with a certain degree of reserve that I place *Placopegma*, and *Caulocalyx* also, although with somewhat less care, under the Leucopsacidæ together with *Leucopsacus* and *Chaunoplectella*. I think the family may be made to stand on the strength of the two last mentioned genera alone, if it should become necessary to remove the other two from it. For the present I consider it preferable to include all the four genera in the Leucopsacidæ, which may then be diagnosed as follows:

Lyssacine Hexasterophora of thick-walled, cup-like or ovoid body; sometimes stalked; firmly attached by base (? or rooted by basal spicules). Dermal skeleton composed as a rule of moderately large pentactins with the unpaired ray directed proximad; hypodermalia not distinguishable. Hexasters represented mainly by discohexasters (no oxyhexaster).

A key to the genera and species, which should also show in a way the structural peculiarities of each, may properly be appended here.

a.—With hexactinose forms among the discohexasters. Gastralia hexactinic, similar to parenchymal hexactins. Sponge-body small..Leucopsacus.

- *a*[1].—Other discohexasters with terminals in a distinct group to each principal. Parenchymal hexactin with straight rays. Body stalked...*Leucopsacus orthodocus.* (Sagami Sea).
- *b*[1].—Other discohexasters generally spherical in shape. Parenchymal hexactin with more or less bent rays. Not stalked...............*Leucopsacus scoliodocus.* (Sagami Sea).

b.—Without hexactinose discohexasters. Sponge-body of a considerable size.

- *c*[1].—The larger discohexaster with terminal prongs arranged in a whorl like anchor-teeth. Gastralia hexactins ....Chaunoplectella.
  - *a*[2].—Dermalia of not only pentactins but also other forms without distally projecting rays. Discohexaster may be as large as to measure 250–400 μ in diameter. Small and delicate sigmatocomes present on the tip of the outstanding ray of canalaria ....*Chaunoplectella cavernosa.* (Sagami Sea).
  - *b*[2].—Dermalia always pentactins, some of which have paratangentials sparingly supplied with bent spines on the outer surface. Discohexaster not larger than 114 μ diameter. Sigmatocome not found ....*Chaunoplectella spinifera.* (Sagami Sea).
- *d*[1].—The only or the larger kind of discohexaster with convex terminal disc, the margin of which is serrated.
  - *c*[2].—With aspidoplumicome. Gastralia hexactinic. Paratangentials of dermalia with curved spines laterally. Body stalked.. Caulocalyx.—*C. tener.* (W. of Tristan d'Acunha).

d^2.—Without aspidoplumicome. Gastralia pentactinic. Discohexaster in one kind .... Placopegma.

a^3.—Paratangentials of dermalia beset with small erect spines on the outer surface. With sieve-plate and anchoring needles. Discohexaster up to 100 μ in diameter.............................. *Placopegma solutum*. (B. of Bengal).

b^3.—Paratangentials of dermalia without spines. Discohexaster spherical, 140 μ in diameter.. .... *Placopegma* sp., F. E. SCH. '99, p. 44. (SW. of Vancouver Is.).

I now proceed to give full descriptions of the genera and species that occur in the Sagami Sea.

LEUCOPSACUS* IJ.

IJIMA, '98, p. 42.

Leucopsacids with small, ovoid or spindle-like body, which may be stalked. Parenchymalia chiefly hexactins; diactinic parenchymalia present, but play a subordinate part. Gastralia represented by hexactins similar to those of the parenchyma. Discohexasters in part hexactinose and in part hexasterous.

LEUCOPSACUS ORTHODOCUS† IJ.

Pl. III., figs. 14–26.

Leucopsacus orthodocus, IJIMA, '98, p. 42.

The species is based on two specimens, obtained by myself at different times at and near Dōketsba from a depth of, say, 214–429 meters (117–235 faths.).

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* λευκὸς, white; ψακὰς, drop.

† ὀρθὸς, straight; δοκὸς, beam.

The first specimen (Sci. Coll. Mus., Sp. No. 230) was discovered among the trophies of a long-lining expedition to Dōketsba, which I had undertaken on Aug. 6 th, 1894, together with Professor MITSUKURI. I consider the exact date as not unimportant owing to the fact that the specimen contained larvæ in different stages of development. It was found attached to a dead *Caryophyllia*-like coral in company with a specimen of *Lanuginella pupa,* and is shown in Pl. III, fig. 14, in natural size. The body is of an ovoid shape, with the inferior narrower end continued into a stalk of moderate length. Total height, 11 mm.; greatest breadth, 6.5 mm. The upper rounded end bears, somewhat to one side of the center, a roundish osculum of 1.5 mm. diameter. The stalk is laterally compressed, measuring in breadth 2 mm. in one direction and only 1 mm. in another; it expands at the lower end into a small basal disc. The sponge-wall is about 1.5 mm. thick at the part where the body is broadest; the oscular margin is thin and simple (fig. 15). So far as can be made out by cutting open the wall, the gastral cavity seems to extend downwards for a considerable distance into the stalk.

The second specimen (Sp. No. 438) was obtained also by me, Aug. 12 th, 1895, at a spot in or near Dōketsba but which could not be precisely located on account of the foggy weather. It is a fragment representing the upper part of an individual probably similarly shaped, but somewhat larger than the first specimen. It bears a roundish osculum of 2 mm. diameter. The wall is nearly 2 mm. thick in the thickest part.

In general appearance both specimens remind one of *Lanuginella pupa,* long known from the Atlantic and which also occurs in the Sagami sea. The external surface is perfectly smooth. Examined under a hand-lens the apertures of incurrent canals appear as indistinct minute spots beneath a thin and clear dermal layer. On the gastral side the excurrent canals open apparently directly into the cavity; many of the openings are considerably larger than the incurrent canalar apertures seen on the outside. The sponge is soft and delicate in texture. In all essential points of the spiculation the two specimens agree closely with each other.

In view of their small size, I at first considered it possible that these were young specimens, but the presence of large archæocyte-congeries in both and the discovery, in one specimen, of larvæ which apparently belonged to it, decidedly support the view that they are mature and full-grown individuals.

Spiculation.

The *parenchymalia*, forming the main framework of the sponge-wall, are for the most part regular oxyhexactins of moderately large size; diactins occur in a relatively small number. The oxyhexactins have straight tapering rays which may reach nearly half a millimeter in length and 10 μ in thickness close to the central node. There are all sizes leading down to the dimensions, given later, of those oxyhexactins which I consider as gastralia. The rays appear smooth under a low magnification but are in fact insignificantly rough-surfaced on account of minute tubercles occurring at rather wide intervals all over them. The general manner of arrangement of the hexactins in relation to one another is such that, while being disposed in several layers with one axis directed radially, they have each of the rays placed, for nearly its entire length, side by side with or in more or less close apposition to, a ray of adjacent hexactins (Pl. III, fig. 26). The result is a parenchymal framework which, whether seen in a transverse or a longitudinal section, presents approximately rectangular or quadrate meshes bounded by straight beams; hence the name I have given to the species. The beams consist usually of two, but sometimes of three, spicular rays running alongside but not always placed compactly together. It is however by no means infrequent to find some hexactins, situated in an indefinite relation to their neighbors, thus disturbing the regularity of the framework. This is no doubt due in a measure to the free state of each separate spicule.

The comparatively few diactins that occur as parenchymalia are small forms, probably never more than 1.5 mm. in length and 8 μ in breadth near the center, which is always marked externally by an annular swelling. The surface is smooth, but towards the gradually attenuated ends, is roughened by micro-tubercles sparsely present. More especially are the oxydiactins to be found in the deeper parts of the wall, running either isolatedly or combined in weak bundles.

In the basal disc and directly against the foreign surface to which the sponge is attached, the parenchymal hexactins form a thin, irregularly meshed, *basidictyonal plate.* This is of essentially the same structure and appearance as that I have described from *Regadrella okinoseana* and *komeyamai* (Contrib. I., pp. 231–232, 264). The medium-sized, rough hexactins, which go to compose it by being soldered together either directly ray to ray or by means of irregular synapticulæ, may have rays as thick as 16 μ.

The *gastralia* differ in no way from the ordinary parenchymal oxyhexactins in their characters, except in being on the whole smaller and in having proportionally thinner rays. Axial length 280 μ and over. It would not be improper to say that they are here represented simply by those parenchymal oxyhexactins which, being situated in the deepest part of the wall, project one of their rays into the gastral space. They are found rather irregularly scattered and are far from forming a continuous gastral layer.

Like the gastralia the *dermalia* are only slightly differentiated from the parenchymal hexactins, except in lacking a distally directed, sixth ray. To be more explicit, the dermalia are exclusively moderately large oxypentactins with the rays supplied with sparsely distributed, quite insignificant microtubercles similarly as in parenchymal oxyhexactins. The cruciate paratangentials up to 270 μ in length and 15 μ in breadth near the central node, are in either a perfectly flat or a slightly outwardly curved plane. The straight, unpaired, proximal ray is longer than,—often fully twice as long as,—the paratangential in the same spicule; it generally runs in association with a radially directed beam of the parenchymal framework. Observed from the surface, the centers of the paratangential crosses lie separated from one another by a space nearly equal to, or considerably less than, the length of the paratangentials,—by a distance of about 200 μ on an average. Occasionally there are seen two centers, placed close together. At the same time the paratangentials form the usual, quadrate-meshed, dermal latticework, the beams of which are composed usually of two, but sometimes of one or three, rays running together. As is usual, the dermal meshwork is by no means everywhere uniformly and regularly developed but shows at places a greater or less deviation from the regular pattern.

The *hexasters* of the species may be said to be of two kinds, *viz.*, the larger hexactinose and the smaller hexasterous discohexasters, both found commonly in the tissues of the choanosome.

The *hexactinose discohexaster* (Pl. III., fig. 16) is essentially similar to that known to occur in the Euplectellid genus *Corbitella* (IJ., Contrib. II.) or to the spicule figured by F. E. SCHULZE from *Rossella antarctica* (Chall. Rep. Pl. LV., fig. 8) but regarded by him as perhaps extrinsic and intruded. In the present species it measures 110–168 μ in axial length. The six, slender, smooth and straight arms, arising from the central node in exactly the same way as the rays in a regular hexactin, thicken slightly towards the outer end, which bears a convexly arched, anchor-like umbel of 3–5, usually 4, strong, recurved and sharply pointed teeth. These are, as measured from tip to umbel center, 14 μ long on an average. Special examination of the spicule mounted in glycerine, showed the central cross of axial filaments in the central node, the filaments not extending themselves beyond the base of each arm, precisely in the manner indicated in fig. 30, Pl. III.

The *hexasterous discohexaster* (Pl. III, figs. 17–20), *i.e.*, the form in which each principal bears more than one terminal in distinction from the hexactinose form, is somewhat variable as regards size and certain other points, not only in different individuals but also in one and the same individual. It may be said in general that the most usual size is 60–75 μ in diameter. Each short principal is supplied with a bell-shaped, outwardly expanding tuft of 4–8 (most commonly 7 or 8) terminals, which arise not always in a single circle but sometimes so that one is surrounded by others in a whorl. The terminals are of moderate strength and terminate each with a small star-like disc having 5 or 6, minute, marginal teeth; their surface is obsoletely rough. The general shape of the discohexaster is quite often not unlike that of a floricome.

In one (Sp. No. 438) of the two specimens, on which the species is based, I find the range of variability of the discohexaster in question somewhat wider than in the other. (Pl. III., figs. 18–20). In that specimen there are occasionally some discohexasters that are so small as to measure only 50 μ in diameter, while others not infrequently reach up to 88 μ. The terminals are slightly thinner but often, though not always, more numerous (up to 11 in a tuft) than in the other specimen (Sp. No. 230). By the side of such discohexasters rather copiously supplied with terminals, there exceptionally occur others of a comparatively large size such as is represented in fig. 20, in which each principal is seen to bear only 2 or 3 terminals. No such rosette was found in Sp. No. 230.

Notes on the Soft Parts and the Larva.

As the specimens were killed and hardened by means of corrosive sublimate, the soft parts are preserved, not so satisfactorily as might be desired, but in a sufficiently good condition to enable me to make the following observations.

As in *Euplectella marshalli* (Contrib. I., p. 123), the dermal membrane is usually not membranously developed but is represented by fine, irregularly branching and anastomosing, cobweb-like threads spread over the meshwork formed by the paratangentials of the dermalia. The "pores" or the gaps inclosed by the threads are accordingly not rounded and pore-like, but quite irregular in shape and size. The dermal membrane is therefore in no way distinguishable from the more deeply situated trabeculæ, with which it is in fact directly continuous.

In the subdermal space, which is nowhere of any great extent, trabeculæ are present in moderate abundance. The nuclei, found here and there in the little stained granular substance of the trabeculæ, measure not more than 2 μ in diameter. They are moderately strongly colored without showing chromatic contents with any distinctness.

Archæocytes occur in abundance as usual, especially on and close to the outside of the flagellated chambers, either solitarily or grouped together in exceedingly variable number. They are 2–3½ μ large. A strongly stained and externally well defined cytoplasm is to be ascribed to the cells, though always sparsely present. The nucleus is of about the same size as the trabecular nucleus, but generally incloses a somewhat refractive chromatic mass; it is about as well stained as the cytoplasm, though appearing clearer at a certain focus of the microscope.

In Sp. No. 230, but not in the other specimen, I have found a number of large, ovum-like cells (dia. 20–40 μ), apparently freely occuring in the trabecular spaces. A description of these peculiar cells has already been given by me in my Contribution I. ('01), p. 182, and need not be repeated. A figure of one is now given in Pl. III., fig. 21. As to their real nature and import, I am still in the dark.

The flagellated chambers are cup-like or thimble-like. The more elongated chambers occur in the periphery of the choanosome. The flagella are not preserved in my preparations. The chamber-wall consists of the usual *membrana reticularis*, the open meshes of which may measure $7\frac{1}{2}\,\mu$ or less across. At places, a pale ill-defined nucleus may be defined tolerably constantly at every nodal point of the reticulum.

The larva (Pl. III., figs. 23–25).—As announced in my Contribution I. (pp. 182, 187), *Leucopsacus orthodocus* is one of the two Hexactinellid species in which I have discovered developmental stages of larvæ, or at any rate of certain reproductive bodies which may reasonably be interpreted as such,—the other species being *Vitrollula fertile*, a Rossellid to be described in full in a future Contribution. It was in only Sp. No. 230 of the above mentionod Leucopsacid that I have found the said reproductive bodies. These had to be searched for in sections of the sponge and were by no means so numerous, nor so favorably conditioned for observation, as was desirable; hence, the fragmentary nature of the account given below.

As before indicated, there exist, in both the specimens examined, variously sized archæocyte-congeries (Pl. III., fig. 22) between the chambers or in the narrow spaces between the evaginations of the chamber-layer. To judge from appearances, they grow in size by multiplication of the compactly crowded cells. A large congeries is spherical or approximately so and may be nearly or quite as large as the body, shown in Pl. III., fig. 23 and which I consider as the larva in an early stage of development.

The larva in this stage is spherical, measuring about $57\,\mu$ in diameter. It shows a moderately thick epithelial covering, in which the nuclei are indistinctly visible but the cell-outlines scarcely visible at all, owing in a great measure to the diffuse and strong staining of the cells as well as to the thickness of the preparations. However, to judge from the arrangement of the nuclei, we here evidently have to do with a single-layered cylindrical epithelium. The epithelium appears on the whole somewhat clearer than the internal cell-mass from which it seems to be distinctly delimited. Whether it extends over all the surface in equal thickness or distinctness could not be determined with certainty. Often in one and the same larva it can not in fact be perceived with as much distinctness in one part as in another; this may be due as well as not to certain defects in the manner of preparation. Frequently, but not always, a clear, irregularly granular layer is seen to cover the external surface. I consider that layer to have been brought about by the deterioration of the flagella belonging to the epithelial cells, as the result of the hardening process.—The internal mass is diffusely and very strongly colored; it shows closely crowded nuclei, around which cell-outlines can not be defined with any degree of distinctness. A further insight into the histology could not be obtained, all my sections being much too thick for that. Under a moderately high power of magnification, the internal cell-mass appears densely and uniformly granular, exactly agreeing in all points with a larger archæocyte-congeries. From the latter, it may be said, the larva in the early stage now being described differs only in the presence of the peripheral epithelial layer. And there exists nothing besides such archæocyte-congeries to which the origin of the developing larva can be traced back with any degree of probability. For the enigma which follows this way of interpreting the source of the larva, the reader is referred to my enunciations in my Contribution I., pp. 185–190.

By the time the larve has grown to a size of 60–70 μ diameter, the first spicules make their appearance (Pl. III., fig. 24). These are minute and delicate-rayed oxystauractins,—not hexactins, contrary to what might be expected on *a priori* grounds. It does not necessarily follow from this that stauractins represent the most primitive form of Hexactinellid spicules. I simply consider that the stauractinic form of the spicules developing first in the ontogeny is due to the suppression of one of the three primitively present axes, in adaptation to a certain secondary condition of the larva—assumably to circumstances of the space in which the spicules develop themselves, as seems to hold true in a general way of all triaxonic spicules with a reduced number of rays. A close investigation of the central cross of the axial filaments—which however can not be undertaken with the objects in hand—will presumably reveal an abortive third filament representing the suppressed axis.

The said embryonal oxystauractins are situated in the periphery of the central cell-mass, with the plane of the four rays disposed paratangentially to the surface of the larva; they lie not in direct contact with the external epithelium but well separated from its internal limit by a few cells of the internal mass. To give a connected account of what I have seen in several larvæ, the oxystauractins are at first scattered singly; they are by no means numerous in number and show no definite rule as to the manner of relative distribution, except in that they always occur in a single layer. They grow in size, apparently without increasing in number; all seem to have taken origin nearly simultaneously and are therefore of approximately the same size. They soon come to intersect one another with their elongated rays. After reaching a certain size, each single oxystauractin is distinctly outwardly convex, in conformity with the rounded external surface of the larva. The convexity becomes more and more pronounced as the spicule grows larger, which takes place with comparatively greater rapidity than the growth of the larva in general size. The entire skeleton, considered apart from the soft parts, represent a hollow spherical basketwork composed of the loose oxystauractins. (In figs. 24 and 25, Pl. III., the soft parts are drawn as seen in optical sections, while the spicules put in are all those that could be seen in one-half of the larva by focussing the microscope up and down).

In the stage shown in fig. 24, Pl. III., in which the approximately spherical body measures about 70 μ in diameter and the spicules reach up to 30 μ or thereabout in axial length, the soft parts still appear to retain the same histological character as before the formation of spicules. At places favorably situated for the observation, there is to be seen on the surface a granular coating, indicating the presence of flagella to the external epithelial layer.

Further advanced stages than those just referred to were not discovered except in a single case, which is shown in fig. 25. In this larva, the body, still approximately spherical in shape, may measure nearly 100 μ in diameter. An exact measurement can not be made since the larva lies so mixed up in the soft tissues of the choanosome that it is difficult to precisely determine its external limit. The epithelial covering, which should not be wanting until after the larva should have fixed itself on a foreign object after liberation from the mother body, is entirely concealed from view. Most plainly visible is the hollow skeletal basketwork.

The oxystauractins composing this have now greatly grown in dimensions; their smooth, gradually tapering rays may be 57 μ long. All that I can say concerning the soft parts is that the cells (or nuclei) within the hollow of the skeletal system are now arranged, not compactly crowded as before, but in irregularly reticular tracts, evidently on account of the formation of vacant sinus-like spaces.

The above account of the larval development, incomplete as it is, will be corroborated and in a measure also supplemented by the description, to be given in another place, of the same process in *Vitrollula fertile.*

LEUCOPSACUS SCOLIODOCUS* IJ.

Pl. III., fig. 27–37.

Leucopsacus scoliodocus, IJIMA, '98, p. 43.

This species is now known to me in more than a dozen specimens, all from the Sagami Sea and a depth of 400 hiro (313 fms. =572 m.) or thereabout. They represent fusiform, ovoid or globular, moderately thick-walled sacs, up to the size of a small acorn or a hazel-nut. The particulars about the specimens are as follows:

Specimen No. 233 of the Sci. Coll. Mus. (the largest of the three shown in Pl. III., fig. 27) is globular but somewhat laterally compressed. Height 17 mm.; breadth in the middle 10–13 mm.; wall 4 mm. thick in the thickest part. The constricted

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* σκολιός, curved; δοκός, beam.

base is 6½ mm. broad. This expands below into a firm, thick, basal disc, 11 mm. in diameter. The osculum at the upper end is roundish, measuring 5 mm. in diameter and with a thin and simple oscular margin. The specimen was found attached on an undescribed *Hexactinella*, which shall be described in a later Contribution under the name of *H. lorica*. Locality: Outside Okinosé by Iwado-line.

A bottle, numbered 235 in the Sci. Coll. Mus., contains no less than nine specimens of the present species from the same locality, all found attached likewise to a piece of *Hexactinella lorica*. Two of them are shown in natural size right and left of fig. 27, Pl. III. All the specimens are small, being fusiform or ovoid in shape and round in cross-section. The smallest is not larger than a grain of rice, while the largest is 13 mm. long and 6 mm. broad in the middle. The upper end is occupied by a round and simple osculum; the opposite end terminates in a firm basidictyonal mass or plate, which may be very thin or of a considerable thickness. Fig. 28, Pl. III., represents the appearance of one of the specimens as seen in a stained longitudinal section.

On still another *Hexactinella lorica* (Sp. No. 448) from the same spot and a depth of 572 m., I have found several *L. scoliodocus* of varying sizes (2–13 mm. in height), in company with *Lanuginella pupa*, *Staurocalyptus pleorhaphides*, etc.

Finally I have to mention a specimen from the northern side of Onigasé (Sp. No. 434). It has the shape of a somewhat laterally compressed spindle, 20 mm. long and 11 m. broad in the midde, in which region the wall is about 2 mm. thick. The truncated oscular end as well as the base measures about 4 mm. in breadth.

The dermal surface in all the specimens is smooth. In the profile edge of the body, there is seen a clear space right under the dermal layer and separating this from the opaque choanosome; it is the relatively widely developed subdermal space. The surface of the choanosome presents a spongy appearance on account of the ill-defined, variously sized but on the whole small, apertures to incurrent canals. The gastral surface is not covered with a continuous gastral layer, but there directly open excurrent canals which may measure 1 mm. or more across in the larger specimens. Such a small specimen as is represented on the right of fig. 27 may, in the wet state, be said to be nearly translucent all over excepting only the basidictyonal mass which appears whitish.

None of my specimens is in a sufficiently good state of preservation for a histological study. Nevertheless, thus much could be determined, *viz.*, that the trabeculæ are scantily and thinly developed both in and below the bounding surfaces, and that the shape and arrangement of the chambers are much the same as in *L. orthodocus.*

Spiculation.

The *parenchymalia* consist of oxyhexactins and diactins, the latter occurring only very sparsely (Pl. III., fig. 37).

The parenchymal oxyhexactins may be said to be of a moderately large size, though subject to much variation in this respect. A large one may measure 4 mm. or more in axial length and about 13 μ in breadth of ray near the central node; but such large dimensions are attained by the spicule in question only in the larger specimens of the species. The larger parenchymal oxyhexactins lead over by forms of intermediate sizes to the small and slender-rayed gastral oxyhexactins, which measure generally only 260–340 μ in axial length. The rays gradually attenuate outwards and are usually smooth except near the finely pointed ends which are more or less rough-surfaced. Only the smaller oxyhexactins, notably those which I consider to be gastralia, have rays rough all over on account of very minute and sparsely scattered tubercles. Both the parenchymal and the gastral oxyhexactins in the present species are characterized by the fact that the rays are seldom straight but far more usually curved to a greater or less degree—sometimes gently and at other times in an arch-like or a wavy manner—apparently in no definite plane or direction. Accordingly, when they combine to form a bundle, as they sometimes do, this takes an irregular sinuous course; hence the name I have given to the species. In this respect the species is at once distinguishable from *L. orthodocus* in which the parenchymal hexactins have straight rays and give rise to a skeletal framework with rectangular meshes.

The parenchymal diactins are present in such a small number that in many slide-preparations of the wall they have to be specially searched for. However, they are to be constantly found in tolerable abundance, either isolatedly or in bundles, in the basal region of the body, where they pass out from among the basidictyonal mass and upwards into the body-wall. In size and characters the diactins agree with those of *L. orthodocus*.

The *dermal skeleton* again is very similar to that of the species just referred to. It consists exclusively of moderately large oxypentactins, amongst which none can be distinguished as hypodermalia; they are themselves but little specialized from the parenchymal oxyhexactins. It may be said in general that in length of rays they are about equal to the larger oxyhexactins of the parenchyma in the same individual. In most of the different individuals examined, I have found the length of the cruciately disposed paratangential axis to fluctuate between 500 μ and 800 μ; in the large specimen (No. 434) from Onigasé, the same axis reaches up to 1½ mm. in length and 20 μ in breadth of ray near the central node. The unpaired proximal ray is always longer than, and often fully twice as long as, the paratangential of the same spicule; it is always straight and dips inwards, generally in association with the radially directed axis of a parenchymal oxyhexactin. The paratangentials, as seen in surface view, are straight; the latticework formed by them is on the whole irregular, though in places an approach is shown to the formation of rectangular meshes. In lateral views the paratangentials are either likewise straight or so curved as to accommodate themselves to the curvature of the external body-surface. As in parenchymal oxyhexactins, the rays taper towards their ends, near which the otherwise smooth surface is more or less roughened by the presence of obsolete microtubercles.

The *gastral oxyhexactins*, already described in passing, occur in abundance on the internal surface, without however showing any definite order in their relations with one another or forming a distinct layer by themselves. Exactly similar oxyhexactins often occur also as *canalaria* along the lumen of excurrent canals.

The *basidictyonal plate* or *mass* is composed, as usual, of synapticularly fused, thick-rayed hexactins, the rays of which are beset with prickles on the surface. The hexactins may be so large as to measure 120 μ in axial length and 10 μ in thickness of rays. At places the prickles on the basidictyonal beams are elongated into stout, sharply pointed spines, as much as 30 μ in length.

As constant *hexasters* of the species are to be mentioned discohexasters of both the hexactinose and the hexasterous varieties.

The *hexactinose discohexasters* (Pl. III., figs. 29 and 30) are shaped exactly like those of *L. orthodocus.* They are of common occurrence everywhere in the body-wall; only in the specimen (No. 434) from Onigasé were they found scantily represented. Axial length, 100–180 μ. Number of terminal anchor-teeth, usually 3 or 4, sometimes 5, in a whorl. The limited extent of axial threads in the spicule, as ascertained by special examination, is depicted in fig. 30.

Of the *hexasterous discohexasters,* the most constant are the forms shown in Pl. III., figs. 32–34. These are especially abundantly met with in the periphery of the wall. In diameter they commonly measure 70 μ, though sometimes only as much as 46 μ. In the larger discohexaster each very short principal usually bears 8 or more, rough-surfaced, moderately strong-looking terminals, while in the smaller one there may be only 4 terminals to a principal. The small, convex, terminal disc is provided with 5 or more, minute, marginal teeth. The terminals from all the six principals radiate in such a way that the terminal discs are all situated nearly equidistant from one another, the result being the spherical shape of the entire spicule. Here I see another point of difference from *L. orthodocus,* in which the corresponding discohexaster has the terminals arising from each principal arranged in a separate perianth-like tuft.—As variations of the discohexaster under consideration are found occasionally such forms as resemble the two shown in figs. 35 and 36, Pl. III. They grade over to the more usual spherical discohexasters through intermediate forms. Those, of which the one figured in fig. 35 may be taken as a representative, are unusually large (up to 114 μ diameter) and have long, slender terminals, 7 or 8 in number to each principal. Spicules like fig. 36 are more rarely seen; in these, each principal possesses usually three somewhat bent terminals, the discs of which have marginal teeth appreciably larger than usual.

Of inconstant occurrence in the species is the small and delicate form of hexasters, represented in fig. 31, Pl. III. We have here to deal with a rosette which is very much like a floricome in appearance but differs from it in the fact that the terminals end n insignificant pinhead-like knobs, instead of toothed plates. For the sake of reference we may call it a *tylfloricome*. Diameter 38–50 μ. Principal slender; in length about ¼ that of the entire ray, or shorter. Terminals very fine, slightly thickened towards the outer knobbed end; 7–10 in a whorl to each perianth, which is narrow but outflaring at the outer end. I first became aware of the presence of the tylfloricomes in the specimen (No. 434) from Onigasé, in which they are tolerably common, especially near the gastral surface. Not infrequently a tylfloricome is found shifted right to, and hanging on, the tip of the freely projecting ray of a gastralia, after the manner of floricomes on Euplectellid dermalia. A subsequent search in the Okinosé specimens revealed the occurrence of the same hexaster, though never more than sparsely, while in some cases it was entirely absent.

CHAUNOPLECTELLA* IJ.

IJIMA, '96, p. 250; '98, p. 43.

Leucopsacids with moderately large, ovoid or vase-like and thick-walled body, attached by short stalk-like base. Parenchymalia chiefly hexactins and diactins. Dermalia either all pentactinic or with a variable number of rays, none of which however are distally outstanding. Gastralia represented by hexactins similar to those of the parenchyma. Discohexasters always hexasterous, the larger ones with terminal prongs arranged in a whorl like anchor-teeth; with or without sigmatocome in addition.

CHAUNOPLECTELLA CAVERNOSA IJ.

Pl. IV., and Pl. V., figs. 8–13.

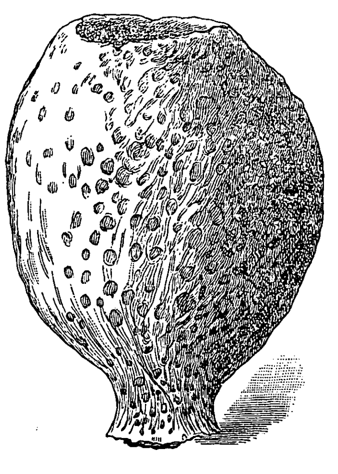
Chaunoplectella cavernosa, IJIMA, '96, p. 250; '98, p. 43.

Since my first description of this species which was based in 1896 on a single fragmentary specimen, I have had opportunities to examine nearly a dozen specimens of various sizes, all preserved complete in the dried state. They all came from the Sagami Sea, though in only two cases can the collecting ground be more exactly specified; *viz.*, the vicinity of Okinosé in one case, and Maye-no-Yodomi, 572 m. (313 faths.), in the other.

* χαῦνος, loose; πλεκτός, interwoven.

In general the sponge is ovoid and goblet-like or more elongate and vase-like. Total height, up to 200 mm. or more. Inferiorly it is attached to the hard substratum by a short, thick, stalk-like base. The wall is thick and consists of remarkably loosely interwoven tissues. It presents quite a cavernous appearance on account of the wide spaces within it. Hence the generic and specific name I have chosen for the sponge.

To make special mention of a few specimens, the one shown in Pl. IV., fig. 1, reduced to one-third the natural size, is the fragment (Sci. Coll. Mus. No. 443) from which I originally described the species. It is a part of a large individual, with the wall as thick as 52 mm. and measuring not less than 160 mm. in diameter of body as judged from the curvature of the external surface. The piece includes a portion of the stalk-like base. In general shape the entire individual must have closely resembled the one shown in the woodcut given below.



A complete specimen *Chaunoplectella cavernosa* (O. C. No. 106). Reduced to $\frac{1}{3}$ natural size.

This complete and beautifully preserved specimen belonged to Mr. Alan Owston (O. C.* No. 106). Total height, 185 mm. Diameter in the middle of body, 126 mm. Wall in the middle, 30–44 mm. thick. The osculum at the upper end was oval, measuring 47 mm. by 63 mm. in diameter; the margin was thick and

* O. C. stands for Owston Collection.

rather obtusely edged, without fringing spicules. The gastral cavity was tubular, 165 mm. deep and somewhat narrowed at the bottom. The attachment-surface of the base was covered over with a compact basidictyonal plate, 2 mm. thick, from which the loose parenchymal spicules could be easily separated without injuring their ends.

Another ovoid and complete specimen I examined was 190 mm. high and 15 mm. broad. It was attached to a smooth loose stone.

Some specimens show a more elongate and vase-like shape; they may be cylindrical or more or less laterally compressed. Further, the basal end may sometimes be bent, probably as the result of the sponge happening to grow upon a perpendicular surface.—The tallest specimen I have seen was an erect, laterally compressed, vasiform individual, 200 mm. high. Another elongate but cylindrical specimen (190 mm. long) was remarkable for the fact that it grew with a bent base upon a piece of porcelain ware, a part of an old-fashioned Japanese oil-burner, that had probably been dropped from a sea-faring junk.

Pl. V., fig. 10, represents in half natural size a strongly laterally compressed, pouch-like specimen, exceptionally well preserved as to the delicate spicular texture. It belonged to Mr. Alan Owston (O. C. No. 4386). Height, 156 mm. Breadth, 125 mm. on one side and 65 mm. on the other. Wall, 30 mm. thick in the thickest part. Osculum, irregularly oval, 60 mm. in longest diameter; its margin, sharp but not thin. The stalk-like base is bent towards one side; this bending, it will be noticed, is in the sagittal plane of the compressed body, which fact is the rule with all lyssacine Hexactinellids having a laterally compressed body and bent base.

Here I must turn to a consideration of certain small and young specimens which seem to offer some points of interest. On that most remarkable skeleton of a dead *Chonelasma calyx,* which I have had occasion to mention and figure in Contribution I. of this series of studies (IJ., '01, pp. 25, 31), I have found, amongst the host of other animals attached to it, five young of the present species in different stages of growth (Sci. Coll. Mus. No. 407). Four of these are shown in Pl. V., figs. 8 and 9, in natural size. The three specimens to be seen in the latter figure are all globular in shape, each with a small roundish osculum at the upper end. The smallest of the lot measures only 3 mm. in body-diameter. They all sit together on a common, compact, basidictyonal plate of irregular outline and disproportionally large size. The undulating surface of the plate is finely granulated and shows some furrows in it; below, its substance permeates the underlying *Chonelasma* skeleton to a depth of 2 mm. or more. There can be no doubt whatever that the plate in question belongs to, and is the product of, the little sponges growing on it.—The fourth specimen, which is not figured, is of an elongate ovoid shape, 9 mm. in length; the base, only 2 mm. thick, stands out from the center of an irregularly expanded basidictyonal disc of about 9 mm. diameter.—The fifth and largest specimen is the one shown in fig. 8. It has the form of a thick-walled cup, 31 mm. high. The broad base joins the basidictyonal plate—which clasps a parietal process of the *Chonelasma* and at one place stretches out fully 10 mm. beyond the apparent basal edge of the body proper—making a distinct line of demarcation, which is due to the circumstance that here the loose tissue of the sponge-wall passes abruptly into the rigid reticulum of the plate.—The relatively large size of the basidictyonal plate in the above specimens leads one to the supposition that its growth takes place with considerable—so to say, precocious—activity in the early period of post-larval life. Later, the rate of its growth seems to more closely coincide with that of the body, so that the early ratio in size of the two parts is not maintained in after-life.

The external surface of the sponge is rather uneven. The dermal layer covering it is of a somewhat unusual spicular composition. As seen under a hand-lens, it consists of irregularly interlaced beams, running in quite indefinite directions in the plane of the surface (Pl. IV., fig. 7). The beams, though thin on the whole, are of various degrees of strength, the strongest being as much as $\frac{1}{3}$ mm. in thickness. The thinnest beam consists of no more than a single spicular ray, while others are made up of a varying number of rays grouped together into a more or less compact-looking bundle. Not infrequently, a beam, springing out from another as a branch, is seen to terminate freely, without reaching up to that towards which it is directed. Altogether the dermal latticework is irregular. The meshes often have sides of 1 mm. and more in length, and must be said to be on the whole coarse, besides being irregular in shape.—The meshes are covered with a sieve-like dermal membrane, made up of membranously flattened trabeculæ around and between the closely disposed, roundish pores (Pl. IV., fig. 7).

The want of regularity in the arrangement of dermal spicules and the coarseness of the meshes serve as a convenient mark of distinction between this species and certain Rossellids of a bewilderingly similar external appearance, e. g., *Staurocalyptus glaber* IJ.

On the surface of the stalk-like base, the dermal layer is usually wanting, thus directly exposing the thick, wavy, soft and silky bundles of the parenchymalia.

An unusually wide subdermal space separates the dermal layer from the choanosome (see Pl. IV., fig. 4). In the larger specimens it may in places be nearly 10 mm. wide. Pillars of conical or irregular shape project from the choanosomal surface at intervals of 5–12 mm. or more; these divide at the apex into a number of fibrous bundles which go to join those of the dermal layer.

The oval or round entrances into the incurrent canals are more or less conspicuously visible through the dermal layer. They are on the whole very large, though by no means uniform in this respect, either in the same specimen or in differently sized individuals. In the specimen of fig. 1, Pl. IV., some of the incurrent canalar openings have a width of 15 mm. or even more; in that shown in the woodcut on p. 54, the largest opening measured 10 mm. across.

In all large specimens there exists a continuous gastral layer, covering up the wide apertures of the excurrent canals. This is of much the same irregularly reticular appearance as the dermal layer; only it may be said that in general the meshss are somewhat wider, while the intersecting points of the beams strike the eye as small whitish knots due to accumulations of certain discohexasters. In the interapertural spaces the layer lies closely over, and is often indistinguishable from, the parenchymal tissues. In the medium-sized specimen of fig. 10, Pl. V., the gastral layer leaves a few of the excurrent apertures uncovered, seemingly not as a result of artificial disturbance. In small specimens, such as are depicted in figs. 8 and 9, Pl. V., all the excurrent canals open directly into the gastral cavity. The gastral layer then appears to be a structure which begins to be formed at a comparatively late stage of life.

The excurrent canalar apertures as compared with the incurrent, are on the whole somewhat larger but less numerous. This is evidently in correlation with the difference in extent between the inner and the outer choanosomal surfaces respectively occupied by the two sorts of apertures. The fact just mentioned may be laid down as a rule holding good for a large number of Hexactinellids of similar shape.

The fineness of all the spicules, the wide subdermal space and the broad canals—both incurrent and excurrent—separated by thin septal walls, all combine to give to the sponge a light, delicate and cavernous character, which is especially pronounced in specimens of larger size (fig. 4, Pl. IV).

Spiculation.

The following account of the spiculation refers, unless otherwise stated, to large and full-grown individuals as represented chiefly by the fragment shown in Pl. IV., fig. 1. It may be regarded as holding good also for young specimens, but these are uot without noteworthy points of difference, of which special mention is required.

The *parenchymalia* are, it may be said, mainly hexactins and diactins, although those with 3–5 rays are not uncommon. They are also very variable in dimensions. The rays are smooth, gradually tapering and terminate either simply pointed or with a slight subterminal swelling. The surface for a short distance from the end is always roughened by the presence of microtubercles.

A parenchymal hexactin may attain a considerable size. One of the largest I have picked out from a large specimen had rays as long as 7 mm. and 70 μ thick near the central node. But the majority are much smaller and more slender-rayed, leading down to such oxyhexactins as will later be described as the canalaria (Pl. IV., fig. 8; Pl. V., fig. 12). The hexactins, when of a small size, present a regular or nearly regular appearance, but are otherwise more or less irregular, not only in that the rays are bent—sometimes strongly bent—but often also in having rays of unequal lengths (Pl. IV., fig. 6). This inequality may be sufficient to give a stump-like appearance to some rays in comparison with the others in the same spicule. It even leads over to cases in which one or more rays are reduced to total atrophy; so that, besides the hexactins and diactins there are to be met with among the parenchymalia such intermediate forms as are to be called pentactins, tetractins and triactins (Pl. IV., fig. 5, *b–d*; Pl. V., fig. 12). The tetractins are represented either by stauractins or by those formed by suppression of two rays belonging to different axes. The triactins are usually tauactins, seldom the other form composed of rays representing three half-axes.—The abortive development as well as the crooked state of the rays in many of the above parenchymalia evidently stands in relation to the thinness of the choanosomal septa, which ill affords sufficient space for their free and natural development. Nevertheless, parenchymalia are occasionally found which project one or more of the rays beyond the septal surface and freely into canalar lumen. For instance, in fig. 12, Pl. V., which represents the spiculation of the septal wall as seen in a section, a parenchymal tauactin is seen to send out beyond the surface its short unpaired ray, which, like the outstanding rays of canalar oxyhexactins, is supplied with a sigmatocome at the tip.

In small specimens of the species, such as are shown in fig. 9, Pl. V., all the parenchymal hexactins, which are certainly never so large as in full-grown individuals, are nearly regular in form. In most of them the rays are almost straight or but little bent, and do not show striking differences in their length. Spicules with 3–5 rays are not present or are, at any rate, quite scarce, so that the parenchymalia may be said to consist largely at least, if not entirely, of hexactins and diactins.

The parenchymal diactins are represented by all sizes, from those of the dimensions of ordinary comitalia up to those with a length of 12 mm. and a breadth of 50 μ in the middle. But the thickness never reaches the degree attained by the rays in some hexactins. The center is sometimes externally marked by an annular swelling, but more generally it is not. The diactins are disposed either more or less isolatedly or in bundles, generally in company with other kinds of parenchymal spicules. They are relatively few in number in the main body of the sponge, where by far the greater part of the parenchymalia consist of spicules with more than two rays. The relative proportion becomes however gradually reversed in the lower region of the body. Here, but more especially in the stalk-like base, the parenchymal fibers form anastomosing bundles of very considerable thickness and of exquisitely silky appearance (see Pl. V., fig. 10). The elements of these bundles are preponderatingly diactins, interspersed amongst which are found small slender-rayed hexactins. The diactins at the inferior end of the bundles are inserted into the interstices of the basidictyonal plate, without becoming soldered to the latter.

The *basidictyonalia* (Pl. V., fig. 13) form a dense, irregularly meshed reticulum of beams, the surface of which is thickly beset with sharply pointed conical spines. The beams may be 40 μ thick; the spines, as long as 15 μ. Notwithstanding the irregularity in the arrangement of the beams, it is not difficult to make out that these are fundamentally nothing else than synapticularly fused rays of hexactins and sometimes of pentactins also. The rays in these basidictyonal spicules do not exceed 135 μ in length. Sometimes small, thick-rayed and nearly or quite smooth-surfaced hexactins are met with, lying free in close proximity to the spiny beams. They seem to represent early stages in the formation of basidictyonalia, before the soldering together has set in. This takes place wherever the spicules come in contact with one another. The spiny processes on a beam may grow so as to touch and fuse with another beam lying close by, thus transforming themselves into synapticulæ. (In fig. 13, Pl. V., is seen a spiny siliceous ring standing in connection with basidictyonal beams. This is an accidental formation, without doubt due to the same siliceous secretion, as that which is added to the surface of the beams, having taken place around some round object which no longer remains in the preparation).

As regards the *dermalia,* it would be well to mention first those of quite young specimens (Pl. V., fig. 9). In these, they are nearly all, if not exclusively, pentactins of approximately the same ray-length as an average-sized parenchymal hexactin in the same individual. The unpaired ray is of course directed proximad.

The paratangentials are nearly straight; sometimes they are seen to exhibit an uneven surface throughout their entire length, due to the presence of obsolete warty prominences. Thus, in its composition and in the arrangement of the elements, the dermal layer is here essentially the same as I know it in *Leucopsacus* or in *Chaunoplectella spinifera*.

But a very remarkable difference in the spicular composition of the dermal layer is presented by large individuals. With the growth of the sponge, it seems the dermalia are constantly supplemented by spicules genetically belonging to parts directly underlying the dermal membrane. In other words, a large number of peripherally situated parenchymalia are apparently taken up, as it were, into the constituency of the dermal skeleton. The process seems to be not without analogy in other Hexactinellids. Thus, in some Euplectellids certain hexactinic spicules, which have taken their origin right among the parenchymalia, show indications of being shifted on to the surface, to be taken into the rank of the dermalia (Contrib. I., pp. 47, 74, 235); further, the so-called hypodermalia are in all cases spicules which are apparently most nearly related to parenchymalia but have gone by adaptation into the support of the dermal layer. But it must not be supposed from this that certain spicules in the dermal skeleton of mature *Chaunoplectella cavernosa* are to be regarded as hypodermalia and the rest, as dermalia proper. The fact is, at any rate, that none of the dermalia in any stage of the sponge's growth can be distinguished as hypodermalia, a point common to all the Leucopsacids as well as to the Euplectellids in general.

In surface-view preparations of the dermal layer taken from large specimens (Pl. IV., fig. 7), the spiculation resembles in a measure the parenchymalia as seen in choanosomal septa. This means about the same as to say that the dermalia are but slightly differentiated from the parenchymalia. Like these they are on the whole large, or moderately large; quite variable in the number of rays; and often irregular in shape, not only in having rays of different lengths in the same spicule but also in that these are more or less bent. A large dermalia may show dimensions nearly equal to those of the largest parenchymalia. As regards the number of rays, which in character quite agree with those of the parenchymalia, the dermalia are commonly pentactinic, tetractinic or triactinic, and sometimes even hexactinic or diactinic.

Hexactinic dermalia are generally so situated that the central node lies a short distance below the dermal surface. Four of the rays, representing two axes, run paratangentially and usually associate, soon after their origin from the central node, with other dermalia to form bundles of varying strength. A fifth ray is directed proximad, while the opposite distal ray is either so short that it never projects beyond the dermal surface or is otherwise so bent as to pursue a paratangential course in the dermal layer. Such hexactinic forms occur only occasionally; they are of interest as occupying a position which may be said to be still partly parenchymal.—Pentactinic dermalia usually have the four cruciate rays disposed paratangentially, the fifth unpaired ray dipping inwards into the pillars. Occasionally the spicule may be so unnaturally flattened by the bending of its rays that all five are taken up into the dermal layer, the surface of which is thereby made more or less uneven.—When tetractinic, the dermalia are either stauractins or of the form which shows one complete axis and two half-axes. The stauractins generally lie in the plane of the layer with all the four rays. In the case of the other form of tetractins, either one of the unpaired rays may be directed proximad and the rest run paratangentially, or all the four rays alike may support the dermal membrane in that the two unpaired rays are forced apart from each other so as to form an angle of more than 90° between them.—Triactinic dermalia are most generally in the form of tauactins. Seldom was the form represented by three half-axes met with. Except that a ray is never directed distad, the triactins may lie in all sorts of positions as regards the directions of the rays.—Diactinic elements of the dermal spicules are of the uniaxial form. They are always slender and comitalia-like, occurring but occasionally as components of spicular bundles in the dermal layer.—Altogether the dermalia are irregular in shape and the latticework formed by them is likewise irregular in appearance.

The *gastral layer* closely resembles the dermal in its spicular structure, except in the fact that hexactins with a freely projecting proximal ray are here of somewhat common occurrence. In the smaller specimens of the species, the hexactinic gastralia are below the medium size and have all the rays nearly equally long; they are comparable in all respects to the canalar oxyhexactins soon to be described. In the larger individuals, the same spicules are much larger, being about as large as the dermalia in the same specimen, and have rays of unequal length. The free proximal ray is always much shorter than most others in the same spicule.

Oxyhexactinic *canalaria* of rather small size line the walls of both incurrent and excurrent canals in irregular distribution (Pl. IV., fig. 8; Pl. V., fig. 12). They are nearly regular in shape and measure 200 μ and upward (mostly about 500 μ) in axial length. Rays thin, smooth throughout, gradually attenuating, nearly straight or slightly bent. One of the rays always stands out freely from the septal surface, and where the septum is not sufficiently thick to inclose the entire length of the opposite ray, this may also project from its other surface to a greater or less extent. As before indicated, a sharp distinction can not be drawn between the canalaria and the hexactinic parenchymalia.

The *hexasters* are, broadly speaking, of two kinds, *viz.*, discohexasters and sigmatocomes.

The *discohexasters* occur in abundance everywhere in the body except in the dermal layer. Of them I may distinguish three varieties or forms which I shall designate with the letters *a*, *b* and *c*. All these merge into one another through forms of intermediate shapes and sizes. They occur in different quantitative proportions and also show certain differences in the manner of relative distribution in the body, according to the size of the sponge. As will directly be more fully pointed out, the three forms seem to represent in a great measure different developmental stages of one and the same kind of discohexaster,—stages passed through by it during the post-larval growth of the sponge. Hence it may happen that a quite young sponge lacks discohexasters in the older phase of their development, and that a mature one, on the other hand, is either wanting in those representing their younger phase or shows these in but a limited number; whereas, all the developmental phases are numerously and constantly met with in individuals of certain intermediate ages.

Form *a*, to begin with that discohexaster-phase which seems to represent the earliest stage of development, comprises the smallest discohexasters of the species. Diameter, commonly 100–

120 μ, but may lead down to 50 μ. In general appearance the discohexaster is very much like those I have figured from *Lanuginella pupa* in Pl. V., figs. 1, 2 and 4–6, or from *Chaunoplectella spinifera* in Pl. V., figs. 15 and 16. In fact the two last mentioned figures may just as well be considered as representing the discohexaster-form in question from *Ch. cavernosa*. From the end of each very short principal there arise three or four, obsoletely tubercled or nearly smooth terminals, which are each capped with a small convex terminal disc, provided with 7–9, minute marginal teeth. The terminals to each principal diverge in such a manner that they do not form a separate bunch but give to the entire rosette an approximately spherical shape.—The form occurs numerously in all parts of the body in the three small specimens (under 11 mm. height) shown in Pl. V., fig. 9. It is somewhat more scarce in the nut-sized specimen (31 mm. high) of Pl. V., fig. 8, though quite common in the meshes of its basidictyonal plate. In three much larger specimens (above 156 mm. in height) specially examined in respect of the quantitative proportion of different rosettes, the form *a* was found missing, or at any rate exceedingly rare in the sponge-body proper, though still commonly present in the basidictyonal plate remaining on one (O. C. No. 106) of the said specimens.

Form *b* represents intermediate phases between forms *a* and *c*. It is larger than form *a*, measuring on an average, say, 200 μ in diameter. In general appearance it is quite like the rosette I have figured in fig. 14, Pl. V., from *Chaunoplectella spinifera*. From the swollen end of each stout but very short principal, there arise 2–4, long, slender and obsoletely rough or nearly smooth terminals, which so diverge as to give a spherical shape to the entire spicule. The terminal disc, it may be said, is made up of 4–8, radially arranged, recurved teeth, which give a watchglass-like or hemispherical oultine to the disc.—The form in question occurs sparsely in the small specimens of Pl. V., fig. 9. It is common in the nut-sized specimen of Pl. V., fig. 8, while in still larger specimens it is either scarce again or is not found at all.

Form *c* is the most characteristic and the most constant of the discohexasters in specimens of the species that have attained a growth beyond the nut-size. A good idea of its appearance may be obtained from Pl. IV., fig. 9. It is of a very large size, though subject to a considerable variation in this respect like the other forms of discohexasters. It commonly measures 240–340 μ in diameter; in the larger specimens of the species it may sometimes be even so large as to measure 400 μ in diameter. The short principals are usually, though not always, so thickened that each presents a rounded knob-like appearance. The long and slender terminals, 2–4 (usually 3) in number to each principal, are strongly divergent and not always straight in their course. They are smooth and perceptibly thickened towards both ends but somewhat more towards the outer end, which bears a reverted umbel of 4–6, long, anchor-arm-like prongs. This terminal umbel gives to the hexaster a very striking appearance. The cupola of the umbel is rounded. The sharply pointed prongs may be 30 μ long; unlike those in a codonhexaster, they are often more or less bent in an irregular way and proceed divergingly backwards from the cupola, so that the umbel assumes the form of a bell with a flaring rim.—The above discohexaster-form undoubtedly represents the most advanced stage of development undergone by the discohexasters of the species. It is still undeveloped in the three smallest specimens depicted in Pl. V., fig. 9. With tolerable frequency it occurs in the nut-sized individual of fig. 8 in the same plate. And in all still larger specimens it occurs very commonly. In fact, it is at least the predominant, if not the only, discohexaster-form to be seen in the parenchyma of all full-grown specimens. It is usually most abundantly found among the beams of the gastral layer where it is often seen in patch-like congeries.

The following table may serve to show the relative proportion in which the three above-described discohexaster-forms occur in differently sized individuals of the species:

Specimen.	Size of specimen.	Discohexaster		
		Form *a*. Smallest form like figs. 4–6, Pl. V.	Form *b*. Moderately large form like fig. 14, Pl. V.	Form *c*. Largest form like fig. 9, Pl. IV.
The 3 small specimens shown in fig. 9, Pl. V. (Sci. Coll. Mus. No. 407).	3–11 mm. high.	Numerous in both body and basidictyonalia.	Few.	Not found.
The nut-sized specimen shown in fig. 8, Pl. V. (Sci. Coll. Mus. No. 407).	31 mm. high.	Few, though common in basidictyonalia.	Common.	Common.
The specimen shown in fig. 10, Pl. V. (O. C. No. 4386).	156 mm. high.	Not found. (Basidictyonalia not preserved).	Not found.	Very common.
The specimen shown in the woodcut on p. 54 (O. C. No. 106).	185 mm. high.	Not found in body, but present in basidictyonalia.	Rare.	Very common.
The specimen shown in fig. 1, Pl. IV. (Sci. Coll. Mus. No. 443).	Very large.	Not found. (Basidictyonalia not preserved).	Rare.	Very common.

The above data seem to allow the following general observations to be made. In an early stage of the sponge's growth the discohexasters are mostly of the form *a*, only a few of the form *b* being found and as yet none of the most highly developed form *c*. With the growth of the sponge, *a* diminishes in number and finally disappears altogether in the parenchyma, apparently as the result of its transformation into *b*; though it seems to persist in the original condition in the basidictyonal plate. At the same time, *b* in its turn is constantly developing into *c*, and when this development is quite or nearly completed as in all the larger specimens, the latter form becomes almost the only one that is to be met with in the parenchyma.

The second kind of hexasters constantly present in the species may be called the sigmatocome (Pl. IV., figs. 2 and 3; Pl. V., fig. 11). Here we have to do with small and delicate-looking rosettes measuring only 50–64 μ in diameter. In general shape and in the proportion of parts they closely resemble Euplectellid floricomes, except in that each perianth of terminals is somewhat more expanded and in that the terminals are conically pointed at the outer out-flaring end instead of having toothed plates. About a dozen or more, slender and distally gradually thickened terminals spring in a single whorl from the margin of a plano-convex disc at the end of each moderately long principal. In some rosettes, assumably those in an early stage of development, both the principals and the terminals are considerably thinner than in others.—The sigmatocome is found even in the smallest specimens shown in Pl. V., fig. 9, though not in so great abundance as in all larger individuals. In these it is of common occurrence in the parenchymal septa; it occurs much less frequently in the gastral layer also. On the surfaces of parenchymal septa, it is quite common to see the rosette shifted out to the tip of the free ray of canalar oxyhexactins (Pl. IV., fig. 8; Pl. V., fig. 12), exactly after the manner of Euplectellid floricomes. I have found this to be of much more general occurrence on the excurrent, than on the incurrent, surface of parenchymal septa. Sometimes, as before mentioned, a sigmatocome has been found hanging on the end of an outstanding spicular ray which belonged to an indubitable parenchymalia.

CHAUNOPLECTELLA SPINIFERA. N. SP.

Pl. V., figs. 14–17 and Pl. VI., figs. 1–8.

In the Science College Collection I have discovered a specimen (No. 459) which bears close resemblance to *Chaunoplectella cavernosa* but seems to deserve erection into a distinct species. I propose to call it *Chaunoplectella spinifera,* in view of the spine-bearing character of some of its dermalia.

Another, much smaller and evidently very young specimen (Sci. Coll. Mus. No. 435), which I am inclined to refer to the same species, has also come under my observation. As it differs in some respects from the type-specimen, it will be well to treat of it separately. I shall refer to it as the second specimen.

The type-specimen (Pl. VI., figs. 1–8) comes from Homba, Sagami Sea, where it was taken at a depth of about 572 m. (= 313 fathoms). It is unfortunately incomplete in that it lacks the basal part, which had been torn off and lost. It represents a thick-walled sac of about the size and shape of a small plum, measuring, say, 30 mm. in diameter. The wall is 9 mm. thick in the thickest part; it thins but little towards the sharp-edged oscular margin, which is only partially preserved. The osculum must have been roundish, measuring about 15 mm. across. The texture of the sponge is quite light, soft and fragile.The spicules are all very fine and loosely interwoven; they do not combine to form bundles of a noticeable strength, except in the region of the severed base. Both the external and internal surfaces are covered with a loose, delicate and irregular interlacement of the dermalia and the gastralia respectively, beneath which are seen canalar apertures not more than 2 mm. in diameter.

The second specimen was found in the same bottle together with specimens of *Lanuginella pupa.* The locality is Outside Okinosé; depth unknown. The small body is barrel-shaped, measuring only 9 mm. in length and 4 mm. in breadth at the middle. Wall up to 1½ mm. in thickness. An osculum of 1 mm. diameter occupies one end, while the other end is provided with a basidictyonal mass. Macroscopically the specimen presents no specially characteristic feature. Suffice it to say that, without studying its spiculation, it might easily pass for a young *Chaunoplectella cavernosa* or for a *Leucopsacus* or a *Lanuginella.*

Spiculation.

First, as to the spiculation of the type-specimen. As in general appearance of the sponge, so also in this respect there is observable a near approach to the young *Chaunoplectalla cavernosa.*

The *parenchymalia* consist of hexactins and diactins. No other forms of spicules have been found amongst them.

The hexactinic parenchymalia are of quite variable dimensions, While many exhibit rays about 2 mm. long and 40 μ broad near the spicular center, others are smaller, leading down to those which are one-fourth the size just mentioned or even smaller. Occasionally we meet with very small and fine-rayed hexactins, measuring 200 μ or less in ray-length and only about 2 μ in breadth of rays near the center. In one and the same parenchymal hexactin the rays are frequently of markedly unequal length. They are sometimes nearly straight, at other times somewhat bent. They are usually smooth throughout and taper gradually towards the sharply pointed end. See Pl. VI., fig. 8.

The diactinic parenchymalia play a comparatively less important part in the composition of the parenchyma, though they can not be said to be sparse in quantity. They mostly occur in small loose strands running in company with the rays of hexactinic parenchymalia. In the basal region of the sponge, however, the diactins combine to form bundles of a rather conspicuous strength and seem to constitute the principal mass of the parenchyma in that region. They are long and slender, being mostly under 14 μ in thickness, though there occasionally occur much thicker ones among the bundles of the base. The center is externally smooth or else is provided with an annular swelling, rarely with four cruciate knobs. Ends rough-surfaced, usually slightly swollen and conically pointed.

The *gastralia* are variously sized oxyhexactins which in no way differ from those of the parenchyma. In forming the gastral layer they are loosely and irregularly interlocked with one another, but always projecting one of the rays into the gastral cavity. Diactins are not found in the layer.

The *dermalia* are oxypentactins, which differ but little from parenchymal oxyhexctins except in having one ray less. All the rays are straight or nearly so. The cruciate paratangential rays are in most cases ½–1½ mm. long as measured from the center; the unpaired proximal ray is often twice as long as the paratangential in the same spicule, and sometimes even longer. Uniformity of size can not therefore be attributed to the dermalia. Not infrequently we meet with exceptionally small and fine-rayed dermalia, which likely are still in an incomplete state of development. Now, what seems to constitute a characteristic feature of the species is the fact that the paratangentials in certain dermalia—not in all—are peculiarly spined (Pl. VI., fig. 2). The slender and sharply pointed spines, sometimes small but sometimes 90μ long, are situated in a row on the outer side of paratangentials, at wide but indefinite intervals (of 34–150μ). As seen in lateral views of paratangentials, the spines mostly start out nearly erect at base but are usually gently curved one way or the other. They never occur numerously, their number on a single ray being not more than six; often there are only one or two to a ray. Dermalia thus spined are common among the medium-sized elements of the layer. The largest dermalia are, like the smallest, unspined. The paratangentials with spines are seen to run sometimes over, and sometimes under, those without spines. In fact, it seems there exists no rule as to the relative position in layers of the spiny and the smooth dermalia of various sizes. The thin dermal latticework formed by the intersecting of paratangentials at various angles is irregularly meshed. (In the upper part of fig. 8, Pl. VI., the dermal latticework is represented, not in section, but as seen obliquely *en face*).

The *hexasters* are discohexasters (Pl. VI., figs. 3–7) of varied size and appearance, occurring very commonly in the parenchyma. Of them I may distinguish at least four varieties, which however completely grade over into one another by intermediate forms, so that a sharp demarcation can not be drawn between them.

In the first place, there occur, especially abundantly in the peripheral part of the body, small and spherical or nearly spherical forms of discohexasters, of which fig. 3, Pl. VI., may be considered a typical representative. It closely resembles the form *a* of the discohexasters of *Ch. cavernosa* (p. 66). Diameter, 64–90 μ. Each principal, which can not be said to be very short, bears a bunch of 5, 6, or more terminals. These are smooth-surfaced and thicken slightly towards the outer end; they so diverge that the terminal discs in the entire rosette are nearly equidistant from one another. The discs are small, watchglass-like and outwardly convex; their margin shows 6–8 small teeth.

Common in the deeper parts is a second variety of discohexasters, distinguishable from the first by its larger size and by a tendency of the terminals to each principal to form a separate tuft (Pl. VI., figs. 4 and 5). Diameter, 90–160 μ. The terminals, smooth and outwardly somewhat thickened, number 6–9 to each principal. The discs at the ends have small marginal teeth, just like those exhibited by the variety first mentioned.

A third variety of discohexasters is made up of those which form the largest rosette of the species and in which each long and slender terminal is capped with a disc composed of 4–6, moderately large, recurved prongs arranged in a whorl (Pl, IV., fig. 7). In appearance it is very much like those discohexasters in *Ch. cavernosa*, which I have called Form *b*. Diameter, up to 230 μ. Such large discohexasters are not uncommonly found together with the second variety.

As a fourth variety of discohexasters may be mentioned the form shown in fig. 6, Pl. IV., which form is but rarely met with in the parenchyma. It is characterized by very slim terminals, grouped in separate, narrow and outwardly somewhat expanding tufts. The terminal discs are rudimentary and pinhead-like in appearance. The diameter, in one that I measured, was 144 μ.

The delicate sigmatocome, which I have discovered in even the smallest specimens of *Ch. cavernosa* at my disposal, has not been found in the present species.

The second and much smaller specimen, which I refer to the present species, is, I should say, essentially the same in spiculation as the type, but with such points of deviation as are indicated below.

None of the dermalia show spines on the paratangential rays. This however I consider as due to the young state of the specimen. Probably the spines develope after the sponge has come nearer to maturity.

Of the discohexasters, the commonest form (Pl. V., figs. 15 and 16), corresponding in general shape to that which I have called the first variety in the type specimen, has a smaller number of terminals (usually 3 or 4) to each principal. Diameter, 54μ and upward to 100μ or over.—The second variety of the type seems to be wanting here; but perhaps it is to be considered as being represented by the larger of the rosettes that I have just now compared to the first variety.—The third variety is well represented though not in abundance; an example of it is shown in fig. 14, Pl. V. Diameter, 200μ. The discohexasters thus far indicated as being present in the second specimen are scarcely distinguishable from the like hexasters of *Ch. cavernosa,* and I should possibly have held the specimen to be a young individual of that species, had it not been for the total absence of the sigmatocome and for the not infrequent occurrence, near the gastral surface, of an exceedingly fine-rayed discohexaster-form (Pl. V., fig. 17), which is comparable to that which I have described as the fourth variety in the type specimen of *Ch. spinifera.* This discohexaster-form measures about 80μ or more in diameter; 3–5, filamentous and obsoletely rough-surfaced terminals, each with a small and minutely toothed terminal disc, form a more or less distinct tuft to each principal. It seems to pass over gradationally into the third discohexaster-form, as this likewise does into the first.

A thorough examination of the slide-preparations, into which the entire specimen was converted, revealed a single case of a strobiloplumicome being included in the tissues. I can not but think that this is extrinsic,—that it originally belonged to *Lanuginella pupa,* together with which the specimen had been thrown in the same bottle.

After all, the peculiarities which the spiculation of the second specimen presents in comparison with the type, I consider as due merely to individuality.

The basidictyonalia, preserved in the second specimen, presents much the same characters as that of *Ch. cavernosa* (Pl. V., fig. 13).

CAULOPHACIDÆ.

The idea of this new family has been conceived by me for the reception of certain genera from the ranks of F. E. SCHULZE's Asconematidæ, all the rest of this old family being given over to the Rossellidæ. The genus *Asconema* being one of those thus removed, it is self-evident that the remaining Asconematidæ require a new denomination.

The Asconematidæ, when last treated of by F. E. SCHULZE ('99, p. 98), were made to comprise those "lyssacinen Hexasterophora, deren Autodermalia und Autogastralia aus pentactinen oder hexactinen Pinulen mit vorragendem bedornten Radialstrahle bestehen." Seven genera were then referred by him to that family, *viz.*, *Asconema* SAV. KENT, *Hyalascus* IJ., *Caulophacus* F. E. SCH., *Aulascus* F. E. SCH., *Sympagella* O. SCHM., *Calycosoma* F. E. SCH. and *Calycosaccus* F. E. SCH. At the same time that experienced writer himself expressed, as on an earlier occasion, his conviction that the Asconematidæ and the Rossellidæ would not hold out long as separate and distinct families. That he kept up the former family, as he did, was due more to his careful consideration of our yet defective knowledge of the forms concerned, than to any other reason.

After some deliberation I have come, as already indicated, to entertain the view that, while a total amalgamation of the two families seems not advisable, several of the genera mentioned above may even now be annexed to the Rossellidæ with advantage to the system.

From the above assemblage of seven genera may be separated *Caulophacus*, *Aulascus* and *Sympagella*, as having a number of important systematic characters in common, by virtue of which common points they, as a group, seem to be clearly distinguishable not only from all the remaining genera, but also from the Rossellidæ. This group — an intimately coherent group — it is, which, I think, deserves institution into a distinct family, the Caulophacidæ. Since *Aulascus* appears to me as unitable with *Sympagella*, this family may in fact be said to be made up of only the two genera, *Caulophacus* and *Sympagella*. In both these genera the body is probably always provided with a long and distinct stalk;* the dermalia and gastralia are invariably *pinules*, in which the freely projecting pinular ray is always of a characterization *markedly different* from that of any other ray in the same spicule; the rosettes are mainly discohexasters, while oxyhexasters may be said to be generally totally wanting.**

Whereas, what remain of the Asconematidae, *viz.*, the four genera *Asconema*, *Hyalascus*, *Calycosoma*, and *Calycosaccus*, constitute a rather heterogeneous assemblage. In contrast to the Caulophacidæ, they have a body which never seems to exhibit a long, distinct stalk; the freely projecting ray of the dermalia and gastralia is either not at all or comparatively but little differentiated from other rays in the same spicule; the rosettes always include an abundance of oxyhexasters, occurring in addition to either discohexasters or some other hexaster variety. The combination of the above-indicated common features suffices to

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* Only in *Sympagella* (*Aulascus*) *johnstoni* has the presence of a stalk not been determined, the species being known from an incomplete specimen lacking the basal part.

** Oxyhexasters are known from *Sympagella nux* only, in which they occur but rarely and inconstantly; so that, they have been put by F. E. Schulze ('99, p. 34) under the uncharacteristic hexaster varieties or aberrations of the species.

distinguish every one of the genera in question from the Caulophacidæ (*cfr.* above), while at the same time it seems to bring them within the diagnostic scope allowable for the Rossellidæ.

F. E. SCHULZE ('99, p. 101) looks upon the absence of a *pinular* distal ray to dermalia as the principal family-character of the Rossellidæ. Not that Rossellid dermalia should always lack a distal ray, but he in fact includes, and quite rightly I believe, the hexactinic form within the range of their legitimate variation, with the restriction that the one necessarily distally directed ray in such hexactins should not be pinularly developed but simple and similar in appearance to the other rays. Thus, in *Aphorme horrida* F. E. SCH.* ('99, p. 41), and in a manner also in *Trichasterina borealis* F. E. SCH. ('00 *b*, p. 103), the dermalia are said to be hexactins, while cases of other Rossellids with well-developed hexactins occurring sporadically among the dermalia are by no means rare (e. g., *Rossella nuda* TOPS., *R. racovitzæ* TOPS., *Rhabdocalyptus tener* F. E. SCH., *Acanthascus platei* F. E. SCH.). I have expressly referred to the above point because the dermalia of the Rossellidæ were originally considered to be always without a distal ray (Chall. Rep., pp. 129, 374) in contrast to those of the Asconematidæ,—a fact which apparently has had influence in maintaining the *status quo* of the latter group.

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* I must say that the small slender-rayed "oxyhexactins," taken by F. E. SCHULZE for the dermalia of *Aphorme horrida*, are probably not real hexactins but oxyhexasters of hexactinose shape. I was strengthened in this belief on viewing under the microscope a preparation of the type-specimen, kindly shown me by Professor F. E. SCHULZE. The real dermalia of the species seem to be the stauractins called by him the hypodermalia, while these seem to be really represented in the large pentactins occurring as prostalia. A part of the hexactinose oxyhexasters had apparently secondarily taken up a position outside the dermal layer, a process probably analogous to the shifting of Euplectellid floricomes to the extreme outer end of dermalia. Notwithstanding the above facts, it is plain that F. E. SCHULZE is at one with me in the idea that forms with entirely hexactinic dermalia may be taken up under the Rossellidæ, if other characters permit it.

Now, as regards *Asconema* (with the single species, *A. setubalense*), the unpaired ray of its pentactinic dermalia and gastralia is, to judge from F. E. SCHULZE's description and figure (Chall. Rep., p. 117; Pl. XXI., fig. 4), scarcely differentiated in appearance from the paratangential rays. It is exceedingly doubtful if it can at all be called pinular. The mere fact that the unpaired ray in those pentactins projects freely outwards and does not dip into the body-wall, appears to me a much too slight and unreliable ground for excluding the genus from the Rossellidæ. This I say, not only on a general consideration of the wide variability—ranging from hexactins down to diactins or even to monactins—exhibited by dermalia in that family, but also in view of the fact that in *Lophocalyx spinosa* F. E. SCH. ('00, p. 37) we have a Rossellid in which there occur, together with stauractinic dermalia, others that are pentactinic and have the unpaired ray directed outwards. I consider the dermalia of *Asconema* to have been directly derived, by atrophy of the proximal ray, from such simple hexactinic forms as are sometimes shown by certain Rossellids,—not from such hexactinic *pinules* as are possessed by *Caulophacus*, as the pentactinic *pinules* of *Sympagella nux* unquestionably are. The same should hold good *mutatis mutandis* for the gastralia also. Exceptional as the condition certainly is, the pentactinic dermalia and gastralia with the unpaired *simple* ray directed away from the body are, in my estimation of their bearing on the systematic, no farther removed from the original simple hexactinic form than are those—so commonly met with in the Rossellidæ—in which the unpaired ray is directed the other way. After all, I think that, if *Asconema* is to be kept separate from the Rossellidæ, it should rather be removed from association in the same family with *Caulophacus* and *Sympagella*.

Hyalascus is a genus instituted by me in '96 to receive the single species then known to me, *H. sagamiensis* IJ. In this species the dermalia are partly pentactins and partly hexactins, the former with the unpaired ray directed *proximad* and the latter with the distal ray in no way differently characterized from the other rays. In a second species, referable to the same genus which has since become known to me (*H. giganteus* n. sp.), the dermalia are mostly pentactins with the unpaired ray directed proximad and a distal sixth ray represented by a knob, and occasionally stauractins and simple hexactins. In '96 I was not quite certain as to which family *H. sagamiensis* should be referred and therefore had to satisfy myself with the remark that it was probably to be considered as a near ally of *Asconema*, without denying at the same time its close affinity to the Rossellidæ. I now see, in the nature of the dermalia or in any other respect of the spiculation, nothing that seems to stand in the way of placing the genus under the Rossellids, but much that indicates that it properly should be so placed.

I think the same may fairly be said of *Calycosoma* and *Calycosaccus*. In both, it may be said collectively, the dermalia are either hexactins or pentactins, in the latter case the unpaired ray being outwardly turned. So far the dermalia fall within the range of variability as assigned by me to those of the Rossellidæ (*cfr. supra*). But the one point, which might possibly be considered—as indeed it was considered by F. E. SCHULZE—to interfere with the introduction of the two genera among the Rossellids, is he fact that the distal ray of the said dermalia shows a spindle-like swelling and exhibits prickles somewhat more strongly developed than those on the other rays, thus causing its resemblance to a pinular ray. But the resemblance can by no means be called complete, and probably nobody will hold it, by itself, as a character adequate to base a family on. In all other respects the two genera in question are both quite like Rossellids; the somewhat special development shown by the freely projecting ray of their hexactinic gastralia is of no moment, since the same feature is not infrequently observable in Rossellids of unquestionable status (e. g., *Rhabdocalyptus nodulosus* F. E. SCH., *Rh. tener* F. E. SCH., *Rh. mirabilis* F. E. SCH., &c.). With respect to *Calycosaccus*, it has even been stated by F. E. SCHULZE the describer, ('99, p. 100), that he would not have hesitated to regard it as identical with the Rossellid genus *Aulosaccus* IJ., if only the unpaired ray of its pentactinic dermalia had been directed proximad instead of distad. So that, while the two genera seem unitable to the Rossellidæ, they may, for the reason already advanced, be kept separate from the group that I have called the Caulophacidæ.

Calycosoma (with the single species, *C. validum*. F. E. SCH.) had probably best be received into the subfamily Lanuginellinæ, espesially on account of the strobiloplumicome present in it. Whereas, *Calycosaccus* (likewise with a single spceies, *C. ijimai*) is to be placed in the subfamily Rossellinæ in direct proximity to, if not in amalgamation into *Aulosaccus*. I may here add that to the same subfamily should also belong *Hyalascus* and *Asconema*. The three genera herewith referred to the Rossellinæ show no sign of specially close bonds of relationship between them, when considered in relation to other Rosselline genera.

But to return to the Caulophacidæ. Its near affinity to the Euplectellidæ is undeniable, so much so that *Saccocalyx pedunculata* F. E. SCH., now recognized as an Euplectellid, was at first regarded as an Asconematid evidently on account of its resemblance in both general shape and spiculation to *Caulophacus* or *Sympagella*. On the other hand, a relationship, about equally close, to the Lanuginellinæ under the Rossellidæ seems to be indicated by the fact that *Sympagella* is in possession of the strobiloplumicome, a peculiar form of rosette present in all the Lanuginelline genera. An intermediate position between the Euplectellidæ and the Rossellidæ is therefore to be ascribed to the Caulophacidæ.

I define the family as follows:

Lyssacine Hexasterophora of cup-like or mushroom-disc-like body; always stalked and firmly attached at base; solitary or forming a small branched colony by budding. Dermal skeleton composed of small hexactinic or pentactinic pinular dermalia and of large pentactinic hypodermalia. Hexasters represented mainly by discohexasters, either alone or in company with strobiloplumicome.

The two genera composing the family are so joined to each other by an interchange of their characters that a statement of their differential points, which will hold good for all the cases of species, can only be made in the most meager terms as follows:

A.—With strobiloplumicome among the hexasters ....*Sympagella* O. SCHM.
B.—Without strobiloplumicome among the hexasters.............. *Caulophacus* F. E. SCH.

CAULOPHACUS F. E. Sch.

Balanites, F. E. Sch., '86 ; '87, pp. 122,372.
Balanella, F. E. Sch., '87 (postscript).
Caulophacus, F. E. Sch., '86 ; '87, pp. 124, 373 ; '97, p. 525.

Caulophacids of cup-like or fungiform body; solitary (always ?). Parenchymalia chiefly diactins but including also large regular hexactins. Dermalia, hexactinic pinules; on the stalk these may be replaced by pentactinic forms. Gastralia, either hexactinic or pentactinic pinules. Discohexaster present in varying forms; *without* strobiloplumicome.

Noteworthy is the fact that in most species (probably all except *C. lotifolium* n. sp.) of the genus the unpaired ray of the pentactinic hypodermalia and hypogastralia is beset with prickles throughout nearly its entire length. Further, in most species (the exception being again *C. lotifolium*) the discohexaster occurs in two easily distinguishable types, which I shall call, for the sake of easy reference, the *pachydiscohexaster* and the *lophodiscohexaster*. The former has thick, thorny or barbed, widely diverging terminals ; it is frequently hemihexactinose or hexactinose, and in some species occurs in the hexactinose form only. The latter has much thinner terminals, which form a distinctly separate tuft of bell-like or elongate-conical shape to each principal.

The following is a key to the five known species of this genus :

a.—Body cup-like; or, the principals of hexasterous discohexasters (of both types) much longer than the terminals .... *C. pipetta* F. E. SCH. (Antarctic Ocean).

b.—Body fungiform, with the gastral surface outwardly exposed; or, the principals of hexasterous discohexasters (of both types) nearly equal to or shorter than the terminals.

a^1.—Gastralia are predominantly pentactinic pinules; or pachydiscohexasters represented by hexactinose forms only.

a^2.—Pinular ray of dermalia mostly ovoid; or, the slender pinular ray of gastralia nearly 1 mm. or more in length; or the terminal tuft of lophodiscohexaster nearly as long as the principal; or, the unpaired radial ray of hypodermalia and hypogastralia echinated throughout nearly the entire length .... *C. latus* F. E. SCH. (South Indian Ocean).

b^2.—Pinular ray of dermalia slender and sharply pointed at apex; or, the slender pinular ray of gastralia less than ½ mm. in length; or, the terminal tuft of lophodiscohexaster 3–4 times longer than the principal; or, the unpaired radial ray, as also other rays, of hypodermalia and hypogastralia echinated at base.... .... *C. agassizi* F. E. SCH. (Atlantic Ocean).

b^1.—Gastralia are hexactinic pinules; or, pachydiscohexasters represented by hexasterous, hemihexactinose and hexactinose forms.

c^2.—The unpaired radial ray of hypodermalia and hypogastralia echinated throughout; or, pachydiscohexasters over 150μ in diameter .... *C. elegans* F. E. SCH. (North Pacific Ocean).

d^2.—The unpaired radial ray of hypodermalia and hypogastralia smooth, being rough-surfaced only at the end; or, pachydiscohexasters under 115 μ in diameter. Lophodiscohexaster not present........... *C. lotifolium* IJ. (Sagami Sea).

Besides the five species* embodied in the above, a case of undeterminable *Caulophacus* from off the coast of Maryland is mentioned in F. E. SCHULZ'ES "Amerikanische Hexactinelliden" ('99, p. 39). The specimen consisted of only the stalk and the basal disc, but the hexactinic pinular dermalia and the nature of the hexasters found in it attest the correctness of the generic identification. As to the completely macerated pieces of tubular stalk from the Antarctic mentioned by TOPSENT ('01) as *Caulophacus* sp., nothing can be said except that that writer was perfectly justified in attaching a query to the name.

* The specimen from the Antarctic, on which F. E. SCHULZE based his *Pleorhabdus oviformis* (Chall. Rep., p. 121 and P. S.) is evidently a Caulophacid. Were it not for the fact that that genus and species was withdrawn from the system by the original describer ('97), I might have regarded *Pleorhabdus*, on the strength of the description and figures given in the Chall. Rep., as identical with *Caulophacus* and thus added a sixth species to the list; but as the matter now stands, it has to be entirely left out of consideration.

Here let me give the description of the only sepcies that has as yet been obtained in the Sagami Sea.

CAULOPHACUS LOTIFOLIUM. N. SP.

Pl. VII.

This species is founded on a unique specimen which was obtained by KUMA from a depth of about 572 m. (313 fms.) in Maye-no-Yodomi, Sagami Sea. It passed into the possession of MR. ALAN OWSTON, while a small piece cut from it and thrown into alcohol on the spot was sent to me by the collector. The specimen, well preserved in the dried state, was subsequently purchased by DR. LAMPERT of the Kgl. Naturalien Kabinet in Stuttgart, in which institution it is now preserved.

In general shape and appearance the type specimen (Pl. VII., fig. 1) reminds one of a drooping lotus-leaf; hence the specific name. The apex of the inverted-conical body is continued below into a long crooked stalk. The latter expands at the lower end into an irregular basal mass, by means of which the sponge was attached to a tufaceous substratum.

If the stalk had been straight, the entire specimen would have measured no less than 410 mm. in height, about three-fourths of this measurement appertaining to the stalk. The body proper measures 132 mm. across the broadest part. The stalk is 8–11 mm. thick in the middle part.

As in *C. elegans*, *agassizi* and *latus*, the gastral cavity is turned entirely inside out, its surface thus forming the upper terminal surface of the inverted-conical sponge-body. A not inconsiderable part of the periphery of this surface is reflected outwards and backwards, forming at one place an ear-like flap almost touching the lateral surface. The irregular gastral surface is much folded and creased, which may have occurred in the desiccating process. It is covered all over with an extremely delicate gastral layer, which is supported on fine hypogastral fibers barely distinguishable to the naked eye. Through and close beneath the layer are seen the apertures of excurrent canals. These are minute near the oscular rim but become larger towards the center, where they mostly measure about 2 mm. though some are as much as 6 mm. in diameter. The larger apertures lie separated from one another by a space usually narrower than their own width.

That the above considered terminal area of the sponge is the gastral surface, is placed beyond the reach of doubt by the fact ascertained by direct observation, that the chamber layer beneath it has the apopyles turned towards that surface.

The oscular edge is sharp, though not thin. No prostalia marginalia are seen along it.

The lateral surface of the sponge-body shows a dermal skeleton of exquisite beauty. The dermal layer is exceedingly fine and delicate; its minute meshes are just discernible as such with the naked eye. It is borne on two sets of hypodermal latticework. Of these one is formed by the paratangentials of pentactinic hypodermalia (Pl. VII., fig. 19). This is quite delicate, presenting small meshes which are generally regularly rectangular and measure only about half a millimeter in the length of sides. The other hypodermal latticework is formed of fibrous bundles of varying caliber. It is the coarsely and irregularly meshed latticework that is prominently visible in fig. 1, Pl. VII. In some places the bundles are fully 2 mm. thick; in others they are quite fine. The coarser bundles are seen to run from the narrow end of the body divergingly towards the oscular edge, interposed between the dermal layer and the choanosomal mass. On the way thither they frequently divide and unite or send out anastomosing branches. The finer bundles stretch over the subdermal space entirely separate from the choanosome but in union with the dermal layer.

Through the dermal layer and separated from it by the subdermal space which varies in width in different places, are seen the roundish or oval entrances into incurrent canals. These do not exceed 6 mm. in diameter.

Towards the narrow end of the body and on the stalk, the dermalia lose the lattice-like arrangement and become so densely crowded together as to form a smooth compact coating of frosted appearance. The coating easily falls off and, in the greater part of the lower two-thirds of the stalk, is lost. The surface thus exposed is soiled and has given attachment to a creeping Hydroid stolon. Except in the upper end the stalk is quite firm, owing to an extensive synapticular fusion of spicules. This fusion is however not participated in by the dermal pinules and the hypodermal oxypentactins, nor by the hexasters present in that region. Superiorly the fusion gradually disappears and at the junction with the sponge-body all the spicules are loose, the parenchymalia here running parallel and densely packed together but soon to split above, as far as seen on the surface, into the coarse hypodermal bundles before mentioned.

The stalk is hollow, being axially traversed by a canal measuring 3 mm. or less in diameter. It may therefore be said to be a thick-walled tube. The lumen is evidently an extension of the excurrent canal-system. There certainly does not exist any direct connexion between it and the gastral surface.

The texture of tissues in the sponge-body is markedly soft and delicate, which is due to the fineness of all the spicules.

Spiculation.

The *parenchymalia* consist mainly of diactins, intermixed with which are however a not inconsiderable quantity of regular hexactins.

The diactins run either isolated or in loose or compact bundles. They are all short and thin, seldom exceeding 2 mm. in length and 15μ in breadth. The spicular center is usually plain, only occasionally supplied with an annular swelling. The breadth generally remains nearly the same in the greater part of the rays. The terminal roughened portion is often slightly swollen before ending in a rounded or a conical point. In the compact wall of the stalk, the diactins, in the main longitudinally disposed, are generally somewhat longer and frequently as thick as 35μ. Here the rough ends are often swollen in a knob-like manner. There is nothing in the synapticular formations in the stalk requiring particular mention.

The parenchymal hexactins have straight smooth rays, which gradually taper towards the sharply or bluntly or conically pointed, slightly rough-surfaced end. In these characters they agree well with both the hypodermal and the hypogastral pentactins; so also in dimensions in the generality of cases, but sometimes they are considerably larger and stronger (figs. 18 & 21). The axial length may reach 1.6 mm.

The hypodermal, anastomosing bundles of fibers, which may be considered as a part of the parenchymal skeleton, seem to consist of the diactinic elements only.

The *hypodermal pentactins* in the sponge-body measure commonly between 300μ and 600μ in length of paratangential rays. The proximally directed, unpaired ray is usually longer than, but never so much as twice, the length of the paratangentials in the same spicule. Thickness of rays near the center 23–30μ. The rays gradually attenuate towards the more or less conically pointed end. Their surface is smooth except for a very short space at the ends, which are rough. This holds true of all the rays, not excepting the proximal ray, which in all other known species of the genus seems to be echinated throughout almost its entire length. The paratangentials form the delicate, more or less regularly quadrate-meshed, hypodermal latticework before mentioned (fig. 19).—In the stalk, especially in its lower part, the hypodermal pentactins (of which two are shown in fig. 20) are much smaller than in the body. Length of paratangentials 100μ on an average; the proximal ray 3–4 times as long, sometimes bearing on the surface a small number of minute prickle-like points. The pentactins are here irregularly scattered.

As *hypogastralia* there occur pentactins similar in all respects to the hypodermalia of the body (fig. 21); only they are distributed without order as to the mutual relation of the cruciate paratangentials, so that these do not exhibit a checker-like arrangement. They may associate with some parenchymal diactins in forming the thin hypogastral strands.

The *dermalia* (fig. 3) are exclusively hexactinic pinules, so far as those of the body proper are concerned. The pinular ray as a whole is spindle-shaped; it is 120–140 μ long and 30–42 μ broad in the middle, which is about the broadest part. In this part, the obliquely upwardly directed, elongate conical spines may be as long as 23 μ. The rhachis is smooth for a short distance at the base, which is about 11 μ thick; its conically pointed, outer end forms the tip of the pinular ray. The remaining five rays are all more slender, and gradually taper towards the conically or bluntly pointed end. They are beset with small, generally erect prickles, sparingly at the base but more numerously at the end. Length 88–120 μ. The proximal ray is usually slightly shorter than the paratangentials of the same pinule. As is usual, two paratangentials of every two adjoining pinules lie side by side for nearly their entire length, the result being the fine, quadrate-meshed dermal latticework (fig. 19), in which each mesh has sides approximately equal in length to that of the rays concerned in inclosing it. As ascertained on sections, the said latticework does not lie in direct contact with the underlying hypodermal paratangentials but is separated from these by a space about as wide as, or slightly less wide than, the length of the dermal proximal rays (fig. 18).

Here and there among the dermalia of the body I have met with such forms as may appropriately be regarded as early stages of their development. They are comparatively small and slender-rayed hexactins, in which the distally directed (the future pinular) ray is not at all or but little differentiated from the other rays, being nearly as prickly as these.

In the upper part of the stalk, the pinules retain the characters described above; but they are here much more closely packed together, the checker-like arrangement of paratangentials totally disappearing. Lower down on the stalk, where the parenchymalia have undergone ankylosis, the hexactinic pinules gradually pass over into a peculiarly modified, pentactinic form, in which the suppressed proximal ray is however frequently indicated by a small prominence (figs. 9–11). The persisting rays are much thicker than the corresponding rays in a normal pinule of the body, and what at once strikes the eye is the greatly swollen state of the unpaired free ray, especially at its distal end. In this way that ray acquires a club-like, or more generally a balloon-like, shape. The swollen end is densely covered with short but stout, conical tubercles, which become less numerous below on the stalk-like part of the ray, finally to disappear altogether at the base of that part. The terminal globular knobs often measure 95 μ in diameter, but are of various sizes leading down to a club-like shape of 35 μ breadth. In surface view under a low power of the microscope (fig. 20), the dermal coating of the stalk appears as if consisting of rough-surfaced spherules closely crowded together. A similar change in the character of dermalia on the stalk has been known in *Caulophacus elegans* F. E. Sch. ('87) and *C. agassizi* F. E. Sch. ('99, p. 39).

The *gastralia* (figs. 2, 21) are likewise hexactinic pinules; rarely pentactinic, the aborted distal ray being represented by a mere knob. The free pinular ray, compared with the same of normal dermalia, is much longer and proportionally more slender. It is 220–300 μ long and about 30 μ broad as measured across from tip to tip of the strongest lateral spines in about the middle of the ray. The axial rhachis, about 12 μ thick at base, gradually tapers towards the sharply pointed free end. The five remaining rays are exactly comparable to the corresponding rays of dermalia, except in the fact that they are perceptibly longer. Length of paratangentials 110–132 μ; that of the distal ray 88–100 μ. The paratangentials are so arranged as to bring about a rectangularly meshed latticework, in the same manner as those of the dermalia.

The *hexaster* of the species consists of rough and thick-rayed discohexasters—evidently the pachydiscohexaster of other *Caulophacus* species—and their variations. Lophodiscohexasters are not present.

As the starting point of our description may serve the spherical or nearly spherical, normally developed discohexasters shown in figs. 4 and 5. Such a form occurs, together with certain varieties soon to be mentioned, in tolerable abundance in both the subdermal and subgastral regions, more commonly in the latter than in the former. It measures 60–92 μ in diameter. In the larger and well developed cases (fig. 5), the principals are obsolete, making it difficult to determine the number of terminals borne on each. However, the usual number seems to be 3 or 4, perhaps occasionally 5. In smaller specimens of the hexaster (fig. 4) the principals are only just long enough to be distinguishable and each bears only 2, at most 3, terminals. In all these cases the terminals are thick (up to 4 μ in breadth) and nearly straight or but slightly bent; they are profusely beset, throughout their length, with rather strong, retroverted prickles. The convex terminal disc exhibits 4–6, strong, recurved, marginal teeth.

The form just described is occasionally hemihexactinose (fig. 6) and frequently hexactinose (figs. 7 and 8). The hexactinose type is especially common in the choanosome; in fact, it may be said that almost all the discohexasters here present are of this form. The terminals are exactly comparable to those of normally developed discohexasters. When hexactinose, the axial length may reach 115 μ, showing an increase in diameter over normal forms,—a fact which, according to my experience, is generally observable in all lyssacine Hexactinellids having a hexaster in the two varietal forms mentioned. Fig. 7 shows a case of the hexactinose discohexaster, in which one of the six rays is bent at base, i. e., at the junction of the terminal with the principal, indicating its derivation from a dilophous ray by loss of one of the two terminals. Fig. 17 shows the extent of the axial cross in a hexactinose discohexaster, it being limited in extent to the spicular center and the basal parts of the rays corresponding to the original principals.

Further variations—or possibly early developmental stages—of the discohexaster are seen in unusually thin-rayed and obsoletely rough or nearly smooth surfaced forms, such as are represented in figs. 12–16. Transitional forms connect them with the thick-rayed discohexasters, and they occur, together with these, not uncommonly in both the subdermal and subgastral regions, but especially in the latter. Sometimes they have all the principals supplied with 2, occasionally 3, terminals (fig. 14); at other times they are either hemihexactinose (figs. 12, 13, 16) or quite hexactinose (fig. 15). The terminal discs in a rosette of the kind may be in appearance similar to those in the thick-rayed discohexaster, except in being smaller and more weakly developed (figs. 12 and 13); or they may occasionally consist of 2–4, nearly transverse or outwardly diverging, slender claws at the ends of tapering terminals, in which case the rosette deserves to be called an onychaster (figs. 14, 16). The said variation in the development of terminal discs occurs irrespective of the rosette being normally developed, hemihexactinose or hexactinose. In certain cases I have found the terminal claws branched (fig. 15).

SYMPAGELLA O. Schm.

Sympagella, O. Schmidt, '70, p. 15.—F. E. Schulze, '86; '87; p. 119; '97, p. 528; '99, p. 32; '00 *a*.
Aulascus, F. E. Schulze, '86; '87, p. 118; 97, p. 527.

Caulophacids of cup-like body, showing tendency to form small colonies by budding. Parenchymalia as in *Caulophacus*. Dermalia, either hexactinic or pentactinic pinules. Gastralia, hexactinic pinules. Besides discohexasters, strobiloplumicome always present.

The new species to be presently described under the name of *Sympagella anomala* might, apparently with equal propriety be referred to the same genus as *Aulascus johnstoni* F. E. Sch. In fact, it appears to me that the genus *Aulascus* is scarcely sufficiently differentiated in characters to justify its separation from *Sympagella*. Hence I have placed it under the synonymy of the older name O. Schmidt's in spite of F. E. Schulze's ('97) opinion to the contrary. It seems to me fairly assumable that the fragmentary specimen, on which the single species of *Aulascus* (*A. johnstoni*) is based, originally formed a part of an individual shaped somewhat like *Sympagella anomala* n. sp. The small rough "discohexactins" mentioned by F. E. SCHULZE as occurring in the parenchyma of *Aulascus* are evidently nothing else than hexactinose discohexasters. To them, as also to the presence of the pentactinic hypogastralia or of a proximal ray to the dermalia in that sponge, I can attach no more than specific importance.

The following contains all the more important differential points in the characters of, and will serve as a key to, the three species contained in the genus as defined by me.

a.—Body ellipsoidal and with a single osculum; borne on ends of branches of the ramified stalk. Dermalia pentactinic pinules; gastralia hexactinic with very slender pinular ray. Without hypogastral pentactins................*S. nux.* O. SCHM. (N. Atlantic, Mediterranean)

b.—Body irregularly sacciform; incompletely divided into persons, each with an osculum. Dermalia and gastralia hexactinic; both with similarly shaped pinular ray.

- a¹.—Predominant discohexaster with rough-surfaced terminals, each ending in a small, slightly arched, transverse disc which marginally runs out into recurved prongs. With hypogastral pentactins..........*S. johnstoni* (F. E. SCH.). (Prince Edwards Is.)
- b¹.—Predominant discohexaster with nearly smooth terminals, each ending in a whorl of 2–6, very fine straight, forwardly and outwardly diverging branchlets (not recurved). Without hypogastral pentactins.............*S. anomala* n. sp. (Sagami Sea).

SYMPAGELLA ANOMALA. N. SP.

Plate VIII.

A score or more of specimens of this new species have been at my disposal for study. They were all collected by KUMA from depths of 430–572 m, (235–313 fms.) in the Sagami Sea.

The more exact localities are: Maye-no-Yodomi; Okinosé, both Inside and Outside; Homba; Gokeba.

The specimens are usually attached to the dead skeletons of other Hexactinellids, such as *Chonelasma calyx*, *Periphragella elisœ*, *Hexactinella ventilabrum*, etc. In one case (Pl. VIII., fig. 1) about half a dozen small individuals of the species were seated on a large irregularly branching mass of a dead Hexactinellid skeleton, which on examination proved to be the stalk of an old individual, or individuals, of the same species as the living specimens borne on it.

The entire configuration of the stalked sponge is quite irregular; hence the specific name I have given to it. The sponge-body proper may in general be said to be saccular or cup-like and more or less laterally compressed. The wall is moderately thick; the oscular edge is simple and sharp, but not thin. In size the body may be nearly as large as one's fist. It usually bears, in indefinite positions, bud-like or tubular evaginations, each having an osculum at the end and leading into the common gastral cavity. In other words, the body appears to be composed of variously sized and incompletely divided persons. The number of these in each case is never numerous, being limited to four or five at the most.

The stalk is firm, branching and anastomosing; it is at times moderately long, at other times rather short.

To illustrate with concrete examples, I have shown in fig. 2, Pl. VIII., a specimen measuring 168 mm. in total height in which the stalk is about as long as the compressed pouch-like body. The latter has a wall about 5 mm. thick in the thickest part. It seems to have originally borne no less than five buds or secondarily formed persons, of which two remain intact while the rest have been torn off. The stalk shows an open perforation in the upper part; lower down it splits into two branches, each of which is inserted in a piece of dead *Chonelasma*.

Fig. 3, Pl. VIII., represents one of the largest specimen I have seen. It is 185 mm. high. The main body consists of two large persons joined together at base. One of them is irregularly tubular; the other is funnel-like, expanding above, and distinctly laterally compressed. Maximum thickness of wall, 9 mm. Four short and comparatively slender stalks proceed from the common base but unite below into one before forming a knob for attachment. On one side, one of the stalks sends out, obliquely downwards, a free ending branch which probably at one time was likewise fixed to the substratum.

The dead, irregularly branching stalk before mentioned and seen in fig. 1, Pl. VIII., is at places 15 mm. or more thick. Probably it represents fused stalks of several individuals. Of far greater interest are the small young specimens which are seen growing on it. These are of the size of a walnut or smaller and represent various stages of the change in form undergone by the sponge during growth. In an early stage the entire body is simply elongate-ovoid, being attached by the narrower end while in the opposite end opens a round simple osculum. One specimen in this stage of development measured only 14 mm. in length and 6½ mm. in breadth in the broadest part; breadth of stalk-like base 2¾ mm; diameter of osculum 2 mm.; thickness of wall 2 mm. and under. This simple original form of the body is soon lost with the formation of buds. These are at first mere thickenings of the sponge-wall. They gradually take the form of a papilla-like protuberance and sooner or later a new osculum opens at the rounded apex. The gastral cavity of the bud in an early stage of its formation either widely communicates with that of the mother or is apparently separate from, and independent of, this. The latter condition however passes ultimately into the former evidently by the widening of a connecting excurrent canal, as assumably the new gastral cavity itself likewise arose by the widening of an excurrent canal of the mother.

In some young specimens I have found, apart from the terminally situated osculum, a roundish gap in the wall, this being in no degree specially elevated at the spot. The gap is sometimes surrounded by a thin iris-like membrane. I consider this to be a secondarily formed osculum, formed either precociously at a place where an evagination of the wall may yet take place or as standing alone by itself for a person in suppression of the evaginating process. In the latter case, it would be exactly comparable to the openings which I have called parietal or secondary oscula in the Euplectellidæ.

The originally simple stalk may possibly send out off-shoots and thus change into the ramified condition seem in old specimens; but there are also other ways by which this may be brought about. Some of the little specimens above-mentioned are in contact with, and fixed to, the substratum at more than one point; in other cases, individuals of apparently separate origin but growing side by side are fused together in the upper part. In both cases the result is much the same, and it is easy to imagine that with the growth of the sponge there should arise as many stalks as there are points of attachment to the substratum with variations in their arrangement according to circumstances.

The even but gently undulating, external surface of the sponge-body is covered with the extremely fine and approximately quadrate-meshed dermal latticework (Pl. VIII., fig. 20), in which the pinular rays can be discerned under the hand-lens as minute white spots. The meshes measure mostly 100–135 μ in length of sides. The hypodermal latticework presents meshes of triangular, trapezoidal, rectangular or irregular shape, with sides of 400–700 μ length. At places, especially in the lower part of the body, the thin hypodermal beams are more or less augmented in strength so as to appear like sinuous and intersecting fibrous bundles which are in no way distingnishable from those in the choanosoma. Through the dermal layer are visible the entrances into incurrents canals measuring 2 mm. and under in diameter.

The gastral surface (see fig. 3) is not covered over by a continuous gastral layer, but leaves open all the apertures of excurrent canals. These apertures are round and pit-like; they may measure 2 mm. across, but there exist all sizes down to those that can be called minute pores. Any two of the larger apertures may be separated from each other by a space up to 5 mm. in width which in turn is occupied by much smaller apertures down to the smallest. Altogether the appearance of the gastral surface closely resembles that in *Hyalonema affine*.

The stalk is firm. Unless denuded and the deeper fibrous texture exposed, it is densely covered with dermalia forming a pure-white powdery crust, which can be easily rubbed off. Internally it is almost solid, being at most traversed by a system of insignificant excurrent canals.

The color of the sponge in the fresh state is, according to the statements of KUMA the collector, light pinkish on the stalk, fading above into colorlessness on the body. The small specimens shown in fig. 1 retained that coloration for some time even after they were brought to me in the desiccated state.

As to the histology, no point of particular interest has attracted my attention. The cup-like or thimble-like chambers measure 65–100 μ in diameter. In a certain specimen an unusually large quantity of yellow, refractive, fat-like spherules were observed hanging on the subdermal trabeculæ (see fig. 22). In all probability they were products of the thesocytes.

Spiculation.

The *parenchymalia* are predominantly slender diactins, arranged in loose bundles or running singly in indefinite directions. They are generally under 1.5 mm. in length and 27 μ in breadth in the middle; occasionally, somewhat longer than 2 mm. and 35 μ broad. The center is commonly even-surfaced; occasionally supplied with an annular swelling or with four knobs. The rays generally taper towards the end, which is conically pointed and subterminally rough-surfaced.

Included here and there among the parenchymalia are oxyhexactins of medium and small dimensions. In the character of rays these oxyhexactins are exactly comparable to the pentactinic hypodermalia, except that they are generally somewhat less strong. Axial length, mostly under 700 μ; breadth of rays near the center, 15 μ and under. The smaller parenchymal oxhexactins seem to pass over gradationally into the canalar oxyhexactins.

Exceptienally the parenchymalia are tauactinic and stauractinic. These forms are especially met with directly beneath the gastral layer and also along the canalar (both incurrent and excurrent) surfaces.

The pentactinic *hypodermalia* are of a moderately large size. Paratangentials as long as 600 μ; the unpaired proximal ray somewhat longer than the paratangentials of the same spicule; thickness of rays near the center, up to 34 μ. All the rays, the unpaired ray not excepted, are straight and gradually taper towards the sharply pointed end, which is subterminally nearly smooth or sparingly supplied with obsolete microtubercles.

Pentactinic *hypogastralia* are, as a general matter, not present in this species. In this respect it is like *S. nux* (F. E. SCH., '97, p. 529) but unlike *S. johnstoni*. It is possible that their absence is in a measure compensated for by the occurrence, before mentioned, of parenchymal tauactins and stauractins in touch with the gastral layer.

The *dermalia* (Pl. VIII., figs. 4 and 5) are exclusively hexactinic pinules. The stoutly developed pinular ray is club-like or spindle-like in shape. Starting from the base, it is smooth for $\frac{1}{5}$–$\frac{1}{3}$ the entire ray-length; then it commences to thicken as the rhachis and to send out obliquely upwards and outwards a number of elongate-conical scale-like spines. The conically pointed apex of the rhachis projects more or less at the tip as the central conus. The development of the entire ray is subject to a not inconsiderable variation according to individuals, as may be seen by comparing figs. 4 and 5 which are taken from two different specimens. In a certain specimen, the ray never exceeded 100 μ in length and 35 μ in greatest breadth, while in another it often reached a length of 148 μ and a breadth of 40 μ with a greater number of lateral spines.—The five remaining rays are all much more slender and taper gradually towards the conically pointed end. A number of rather sparsely set conical microtubercles roughen the surface for the outer $\frac{2}{3}$ or $\frac{3}{4}$ of their length. They are 75–100 μ long, the proximal ray being generally somewhat shorter than the paratangentials in the same spicule. Sections through the wall show that, where the dermalia are superposed upon the hypodermalia, the paratangentials of both are not in direct contact, but there intervenes a space which is nearly as wide as the length of the dermal proximal rays (see fig. 22).

The *gastralia* (figs. 7 and 8) are likewise hexactinic pinules. As compared with the dermalia in the same specimen, they show a general agreement in shape and arrangement but are distinguished by an appreciably weaker development of all the rays. This concerns not so much the length as the thickness of these. The pinular ray, besides being thinner, has spines somewhat smaller in size and less in number. It does not exceed 33 μ in the broadest part.

The above gastral pinules are replaced on the wall of excurrent canals by a less differentiated kind of hexactins, the oxyhexactinic *canalaria* (fig. 9). These present about the same axial length as, or are somewhat larger than, the gastralia; but the rays are very much thinner. All the six rays are alike in appearance; generally straight but sometimes bent; and sparsely beset with conical microtubercles on the outer half or less of their length. The transition of the gastralia into the canalaria at the edge of excurrent apertures is rather abrupt; nevertheless, there are not totally wanting in this position certain intermediate forms—such as have a pinular ray in an incipient degree of differentiation—which may be considered as connecting links between the two. On the other hand, as before mentioned, the canalaria seem also to pass by gradations insensibly into the smaller parenchymal oxyhexactins, there being such forms as stand between the two in respect of both the situation and the characters of rays.—The canalaria occur at places in tolerable abundance, placed side by side in irregular disposition but always with one ray freely projecting into the canalar lumen. At other places they are found only in scattered distribution. The incurrent canals seem to be totally wanting in specialized canalaria of the kind.

The *hexasters* of the species consist of the strobiloplumicome and a peculiar onychaster-like kind of discohexasters, leaving out of account all those which occur but inconstantly or which in their distribution are confined to the stalk.

The *onychaster-like hexasters* (figs. 12–15) occur in the choanosome, not very abundantly but still in moderate frequency. They are slender-rayed and rather small, measuring 68–100 μ in diameter. Each short principal bears 2 or 3, sometimes 4, widely divergent, nearly straight or slightly bent terminals, which are thickest at base and thin out to a very fine caliber towards the end. They are obsoletely rough-surfaced or nearly smooth. Occasionally the rosette is hemihexactinose (fig. 13). Now the very terminal point of the terminals is without a trace of a disc-like expansion but bears a whorl of 3–6, sometimes only 2, short and exceedingly fine prongs or branchlets, not more than 4 μ long. Unlike the claws in a true onychaster the terminal branchlets are straight—not recurved—and are directed sometimes nearly transversely, but generally obliquely forwards and outwards, so as to form a strongly divergent fork or umbel (fig. 15). The branchlets easily fall off, and then, as also when they are over-looked under an insufficient power of the microscope, the hexaster might readily be mistaken for an oxyhexaster.

The *strobiloplumicome* (figs. 10 and 11) is common, sometimes quite abundant, in the subgastral space. In the subdermal region it occurs only occasionally. Diameter, 34–64 μ. The smaller ones have much finer and more delicate-looking terminals, and probably represent a not fully developed state of the rosette. The knob at the end of principals is hemispherical, and from its convex surface arise the terminals in about four closely set whorls (fig. 11). As usual the terminals of the innermost whorl are the longest and measure about 27 μ in length ; those of the outermost whorl, only about 10 μ. The small central process at the distal end of the terminal-bearing knob is frequently difficult to see, but seems to be generally present. Exceptionally was I impressed of its being really absent. Under favorable circumstances I have distinctly seen the axial filament go right through the knob into the distal process.

As hexasters of inconstant occurrence I consider the peculiar kind of discohexaster shown in fig. 16. I have discovered it in a limited number in the body of a medium-sized specimen (Sci. Coll. Mus. No. 473, from Outside Okinosé by the Iwado-line, 500 m.) together with the usual hexasters of the species. It has never been met with in any other specimen. In its general appearance and in the character of its terminal discs, the disco-hexaster in question is not unlike certain others (fig. 17) which occur in the stalk ; but the remarkable difference consists in the fact that either all or some of the terminals split into disc-bearing branchlets at a point near the outer end. Diameter, 42 μ and under. Terminals, 3–4 to each short principal, rough-surfaced. Branchlets, 2–5 to a terminal in an umbel-like tuft ; their length is not uniform in the same hexaster but reaches up to 15 μ. Terminal disc, small, either rudimentary or convex with five, distinct, marginal teeth.

It now remains to consider the spiculation of the *stalk*. As usual it is only the parenchymalia of this part of the sponge that are synapticularly fused together. The thicker beams of the rigid framework thus formed are beset with small prickles on the surface. Superiorly in the stalk the ankylosis becomes confined to the axial portion and finally ceases to exist before the body proper is reached.

In the upper part of the stalk the dermalia and the hypodermalia exhibit essentially the same characters as on the body; only they are both more closely set together. Towards the basal end, the dermalia change their character very considerably (fig. 6). They are here small regular hexactins in which all the six rays, being beset all over with nearly vertically outstanding prickles, are alike in appearance; they can not therefore be called pinules.

Besides the usual onychaster-like hexaster and the strobiloplumicome, there occur with tolerable frequency in the stalk certain discohexasters which seem to be peculiar to it (figs. 17–19). These vary considerably in size and general appearance. A large specimen (fig. 17) of them may have a diameter of 90 μ. Each short principal is supplied with 2 or 3, sometimes 4, rough-surfaced, diverging terminals, which perceptibly thicken towards the small, convex, terminal disc with 5, recurved, marginal teeth. Smaller specimens (figs. 18 and 19) of the same may be so small as to measure only 30 μ in diameter. While diminishing in size, the terminals become more slender in caliber while the number of them (4–8) to each principal increases. The minute terminal disc may be marginally toothed or simply pinhead-like. Transitional forms of the above discohexasters leading into the onychaster-like hexasters have not been discovered.

DIAGNOSES OF THE FAMILIES, GENERA AND SPECIES TREATED OF IN THIS CONTRIBUTION.

By way of a summary and conclusion, I reproduce here the definitions I have given to the families and genera treated of in this Contribution, also giving in proper places short diagnoses of the species described.

EUPLECTELLIDÆ.

Lyssacine Hexasterophora of tubular, cup-like or massive body; sometimes stalked; either rooted by a tuft of basal spicules or firmly attached by compact base; generally possessing numerous separate oscula. Dermal skeleton composed of hexactinic dermalia, the proximal ray of which is as a rule much longer than any other in the same spicule; no hypodermal pentactins. Hexasters various.

For a list of the genera referable to the family, see p. 20.

The family I divide into two subfamilies, viz.:

1. *Euplectellinæ.* Euplectellidæ rooted in the substratum by a tuft of basal spicules.

2. *Corbitellinæ.* Euplectellidæ firmly attached to the substratum by a compact base.

To the latter belongs

PLACOSOMA Nov. Gen.

With one species.

Placosoma paradictyum, n. g., n. sp.—Corbitellinæ with laterally compressed, massively developed, soft body and moderately long, firm stalk. On top, a comparatively small primary osculum leading into the shallow gastral cavity. One side (the front) of the body is covered with a regularly quadrate-meshed, dermal latticework which is supported on another latticework composed of hypodermal fibrous bundles; the other side (the back) presents a more dense-looking surface in which open a large number of secondary oscula leading into the excurrent canal-system. Parenchymalia, principally diactins and occasionally hexactins. In certain positions on the front the dermalia may have tho proximal ray so reduced in length as to be not longer than the short distal ray. Gastralia, hexactins. Hexasters in three varieties: the hexactinose discohexaster (30–60 μ dia.), smallest and most numerous; the spherical discohexaster (160–240 μ dia.), large and extremely beautiful, confined to the back side of the sponge; and the hexactinose codonhexaster (110–176 μ dia.) found under the gastral layer. Floricome and graphiocome, not present.

LEUCOPSACIDÆ IJ. N. FAM.

Lyssacine Hexasterophora of thick-walled, cup-like or ovoid body; sometimes stalked; firmly attached by base (? or rooted by basal spicules). Dermal skeleton composed as a rule of moderately large pentactins with the unpaired ray directed proximad; hypodermalia not distinguishable. Hexasters represented mainly by discohexasters (no oxyhexaster).

A key to the genera and species of this new family is found on p. 33.

LEUCOPSACUS IJ.

Leucopsacids with small, ovoid or spindle-like body, which may be stalked. Parenchymalia chiefly hexactins; diactinic parenchymalia present, but play a subordinate part. Gastralia represented by hexactins similar to those of the parenchyma. Discohexasters in part hexactinose and in part hexasterous.

Leucopsacus orthodocus IJ.—*Leucopsacus* with the inferior end of body narrowed into a stalk. Parenchymal hexactins regular and straight-rayed; forming an approximately regularly quadrate-meshed framework. Besides hexactinose discohexasters (110–168 μ axial length), there occur smaller hexasterous forms (60–75 μ dia.) in which the terminals to each principal form a distinct bell-shaped tuft.

Leucopsacus scoliodocus IJ.—*Leucopsacus* without a long stalk. Parenchymal hexactins with curved rays. The hexasterous discohexaster (46–70 μ dia.), present besides the hexactinose form (100–180 μ axial length), is spherical in shape. Of inconstant occurrence is the small and delicate tylflorícome.

CHAUNOPLECTELLA IJ.

Leucopsacids with moderately large, ovoid or vase-like and thick-walled body, attached by short stalk-like base. Parenchymalia chiefly hexactins and diactins. Dermalia either all pentactinic or with a variable number of rays, none of which however are distally outstanding. Gastralia represented by hexactins similar to those of the parenchyma. Discohexasters always hexasterous, the larger ones with terminal prongs arranged in a whorl like anchor-arms; with or without sigmatocome in addition.

Chaunoplectella cavernosa IJ.—*Chaunoplectella* of moderately large size; sometimes laterally compressed; with wide canals and subdermal space. In young and small specimens the dermalia and parenchymalia are as in *Leucopsacus;* but in the larger ones both consist of irregular spicules with a varying number of rays, though the dermalia never show a freely outstanding distal ray. Discohexasters of varying size and appearance; when fully developed, they may attain a diameter of 250–400 μ, and then have the terminal whorl of reverted prongs shaped like a bell expanding towards the rim. Small delicate sigmatocome present in addition to the above.

Chaunoplectella spinifera n. sp.—*Chaunoplectella* of ovoid body. Dermalia and parenchymalia as in *Leucopsacus;* the former consisting of oxypentactins and the latter, mostly of oxyhexactins. Some, but not all, dermalia with bent spines along the outer side of paratangentials. Discohexasters of varying size and appearance, but not larger than 114 μ diameter. Sigmatocome not found.

CAULOPHACIDÆ Ij. n. fam.

Lyssacine Hexasterophora of cup-like or mushroom-like body; always stalked and firmly attached at base; solitary or forming a small branched colony by budding. Dermal skeleton composed of a layer of small hexactinic or pentactinic pinular dermalia and of large pentactinic hypodermalia. Hexasters represented mainly by discohexasters, either alone or in association with strobiloplumicome.

The family comprises two genera, *Caulophacus* and *Sympagella.*

CAULOPHACUS F. E. Sch.

Caulophacids of cup-like or fungiform body; solitary (always ?). Parenchymalia chiafly diactins but including also large regular hexactins. Dermalia, hexactinic pinules; on the stalk these may be replaced by pentactinic forms. Gastralia, either hexactinic or pentactinic pinules. Discohexaster present in varying forms. Without strobiloplumicome.

A key to all the species, at present known, of this genus is given on p. 86.

Caulophacus lotifolium n. sp.—*Caulophacus* with inverted-conical body, continued below into a long stalk. Dermalia and gastralia, hexactinic; the former with a spindle-shaped, and the latter with a slender, elongate, pinular ray. On the lower part of the stalk the dermalia lose the proximal ray, while the distal ray assumes a club-like or balloon-like shape. Spherical discohexasters (60–115 μ dia.) with thick, barbed terminals; sometimes hemihexactinose or hexactinose; they lead by gradual transition into much thinner-rayed, onychaster-like forms. Without lophodiscohexaster.

SYMPAGELLA O. SCHM.

Caulophacids of cup-like body, showing tendency to form small colony by budding. Parenchymalia as in *Caulophacus.* Dermalia, either hexactinic or pentactinic pinules. Gastralia, hexactinic pinules. Besides discohexasters, strobiloplumicome always present.

For a key to species referred to this genus, see p. 97.

Sympagella anomala n. sp.—*Sympagella* with irregularly-shaped body, composed of a small number of incompletely divided persons in each of which an osculum opens at the upper end; stalk multiple, or branched and anastomosing. Both dermalia and gastralia, hexactinic; similarly developed, though the former is much stouter; pinular ray, spindle-like. Discohexaster, mainly an onychaster-like form (up too 100 μ dia.) in which the terminals are finely attenuated towards the end and bear at the point 2–6, short and exceedingly fine branchlets in forwardly and outwardly directed (not retroverted) arrangement. Strobiloplumicome of the usual shape and structure.

ROSSELLIDÆ.

Lyssacine hexasterophora of cup-like or sacciform body; sometimes stalked; generally firmly attached at base and exceptionally rooted by tufts of basal spicules. A few secondarily formed oscula may occur besides the main terminal osculum. Dermal skeleton composed of small dermalia with a variable number of rays and of large hypodermalia. The latter are generally pentactins which often show a tendency to protrude outwards in such a way that the paratangentials form a veil-like covering over the dermal surface. The dermalia, when hexactinic, have the distal ray not pinular but much like the rest in appearance. The hexasters are various but mainly oxyhexasters and discohexasters, these generally occuring together; but sometimes one kind occurs to the exclusion of the other. Oxyhexasters are often hemihexactinose and hexactinose. Discohexasters frequently modified into discoctasters.

Though this family has not formed a subject for treatment in the present Contribution, the diagnosis is here given for the sake of comparison with those of other lyssacine hexasterophorous families.

Postscript I.

At a time when the printing of this memoir was nearly finished I received A. SCHRAMMEN'S paper "Zur Systematik der Kieselspongien" (Mitth. Roemer-Museum. No. 19. Hildesheim 1903). This contains an emendation of the Hexactinellidan system advanced by the same writer in '02 and to which I have had occasion to refer critically in the foot-note on pp. 23–25 of this Contribution. It is satisfactory to observe that SCHRAMMEN'S new system shows a great approach to that which I have in my mind and of which I have made a brief exposition in the foot-note just mentioned, though it still differs from mine in an important point, as will presently be pointed out.

SCHRAMMEN accepts F. E. SCHULZE'S Amphidiscophora and Hexasterophora as the two suborders of the order Hexactinellida, while the little known palæozoic forms formerly put together by him under a distinct suborder, the Stauractinophora, are placed in an appendix under the families *incertæ sedis.* This is, I think, quite in accordance with the present stage of our knowledge about the sponges in question. The Hexasterophora are divided by him into two tribes, the Hexactinosa and the Lychniscosa; the former defined as "Hexasterophora, deren Stützgerüst aus Hexactinen besteht" and the latter as "Hexasterophora, deren Stützgerüst aus Lychnisken besteht." It is decidedly an advance that the lychniscophorous forms (the Lychniscosa) are brought under the Hexasterophora, which they certainly are. The tribe Hexactinosa SCHR. is made to comprise three subtribes, the Uncinataria, the Inermia and the Euplectellaria. Of these, the first and the last exactly correspond in scope, each to each, to two of the three Hexasterophora tribes in my system which I have provisionally designated with the first three letters of the alphabet (p. 25, *l. c.*), namely, to the tribes C and A respectively. On the other hand, SCHRAMMEN's Inermia differs from the tribe B of my system in that all the lychniscophorous forms (which, as above mentioned, are made by him into the Lychniscosa) are excluded from it; whereas I place them under the tribe B, together with, but as representing a family or families distinct from, the Dactylocalycidæ (*Dactylocalyx*, *Myliusia*, *etc.*). This is the point in which I stand in disagreement with SCHRAMMEN, —a disagreement which I am strongly inclined to regard as due to an over-estimation, on his part, of the lychnisc as a systematic character.

The diagnoses of the Hexactinosa and the Lychniscosa, as given by SCHRAMMEN and cited above, appear to me as wholly inadequate to characterize the groups. The Hexactinosa is stated to have the supporting framework composed of *hexactins*. This may be said to hold good for the dictyonine forms of that group but not for all: a mere reference to the parenchymalia in the Euplectellaria is sufficient. Be that as it may, the lychnisc, which should characterize the Lychniscosa as opposed to the Hexactinosa, is, fundamentally, likewise a hexactin or a part of a hexactin; it is clearly a secondary structure or complication which has for its basis hexactins, such as compose an ordinary dictyonal skeleton (see MARSHALL u. MAYER, Mitth. kgl. Zool. Mus. Dresden, 1877, p. 267; F. E. SCHULZE, Hexactinelliden des Rothen Meeres, 1900). Therefore, the supporting framework of the Lychniscosa is, in my way of thinking, as really composed of hexactins as that of certain Hexactinosa. The lychnisc as a systematic character can only be utilized to characterize a group standing subsidiary to another and more comprehensive group in which the supporting skeletal framework consists of hexactins,—of dictyonally fused hexactins, I may add. Thus, the Hexactinosa and the Lychniscosa, as defined and placed in the system by SCHRAMMEN, seem to lose all ground for existence and may be entirely dispensed with.

On the other hand, if it be justifiable, as I believe it is, to consider *Aulocystis* as the living representative of all the lychniscophorous Hexactinellids that have existed, there can be no tangible reason for not receiving these into the group Inermia. F. E. SCHULZE (Chall. Rep.) placed *Aulocystis* in the same inermate family (Mæandrospongidæ) with *Dactylocalyx*, *Myliusia* etc., and there was a time when it even passed under the name of *Myliusia*. While I do not follow F. E. SCHULZE's opinion as to the family to which *Aulocystis* should belong, I can not but agree with him in regarding it as one of the Inermia. Granted this point, the three subtribes SCHRAMMEN's may be called the tribes—exactly the same as those in my system—into which the suborder Hexasterophora may be directly divided.

It may here be noted that the division I have adopted of the Hexactinellida into the suborders, tribes and subtribes is in complete agreement with F. E. SCHULZE's idea of the Hexactinellid phylogeny as ably enunciated by him in the end of the Challenger Report. If graphically represented, so far as it goes would take essentially the same appearance as the genealogical tree given by that author *l. c.* page 495.

Tokyo, April 5th, 1903.

Postscript II.

Following SCHRAMMEN's paper above referred to, I have received, just in time to add this postscript, F. E. SCHULZE's latest Hexactinellid work in which *Caulophacus arcticus* (A. HANSEN) and *Calycosoma gracile* F. E. SCH. nov. spec. are described in detail (Abh. kgl. preuss. Akad. Wiss. 1903).

With *Caulophacus arcticus*, which comes from a depth of 1977 m. in the Northeast Atlantic, a sixth species is added to the five I have enumerated in this Contribution. As pointed out by F. E. SCHULZE, it shows in the spiculation an extensive agreement with, and therefore seems to be most closely related to, *C. latus* of the South Indian Ocean. So far as can be made out with certainty from the descriptions and figures relating to both, the following seem to be the most important features that characterize *C. arcticus* as distinct from *C. latus*: 1. The pinular ray of the dermalia is narrower and pointed at the apex, being thus spindle-like instead of ovoid.* 2. The slender pinular ray of the gastralia is shorter by one-half or more, measuring 250–500 μ in length as against 1 mm. or more of *C. latus*. 3. The occasional presence of hemihexactinose pachydiscohexasters in addition to hexactinose forms.† 4. The tufts of terminals to

* In the Chall. Report (p. 125) the dermal pinular ray in *C. latus* is stated to be usually 50 μ long; but this scarcely accords with the size of its figure as given *l. c.* Pl. XXIV., fig. 10, magnified 100 times. One is led to suspect a typographical error or errors in this connection; but if it be that the scale of magnification appended is correct, the dermalia of *C. latus* must be said to have the pinular ray strikingly larger than that of the same spicule in *C. arcticus*,—a fact which might conveniently be made use of as one of the differential points between the two species.

† F. E. SCHULZE (*l. c.* p. 8–11) disapproves of applying the term hexaster to the quasi-hexactin called by me the hexactinose hexaster. Grounds for my persisting to use this appellation and the advantage to be derived therefrom, will be dealt with in another publication.

lophodiscohexasters are considerably broader, they being of a narrowly conical shape in *C. latus.* The last point is considered by F. E. SCHULZE to constitute the chief difference between the two species. I have gone into the comparison somewhat more critically than F. E. SCHULZE did, simply in order to contrast them, as far as possible, with respect to the points utilized by me for distinguishing *C. latus* in the key given on p. 86 of this Contribution. The diagnosis of the genus (p. 85) is in no way affected by the addition of the sixth species.

As regards *Calycosoma gracile* F. E. SCH., I regret, with due deference to the judgment of so high an authority as its describer, that I can not readily accept the generic denomination given to it. In studying its characters as embodied in the description, one will at once be struck with the close resemblance to my *Sympagella anomala* in all points of the organization. In fact, I can scarcely discern in it any noteworthy difference from *S. anomala* beyond the facts that parenchymal oxyhexactins (up to 1.5 mm. axial length) and oxydiactins (3–5 mm. long and 60–100 μ broad) are much more strongly developed and that there occur oxyhexasters in addition to the onychaster and the strobiloplumicome. It is possible that the two forms in question may in the future be proved to be specifically identical and that the differences mentioned may be found to be simply matters of individuality; but for the present they may on the ground of those differences be allowed to stand as two very closely related species. Be this as it may, it seems certain that they can not possibly belong to different genera. Either my *Sympagella anomala* is to be re-christened as *Calycosoma anomalum*, or *Calycosoma gracile* as *Sympagella gracilis;* while a further possibility is that they may have to be put into a third genus, in which case

Aulascus (supposing this to be tenable as a genus distinct from *Sympagella*), as being the nearest to both, comes in question, since the creation of a new genus for their reception is scarcely to be thought of. The question whether *Calycosoma* should be amalgamated with either *Aulascus* or *Sympagella*, or with both together, seems to be uncalled for at present.

I completely concur with F. E. SCHULZE (*l. c.*, p. 20; *vide* also my Contrib. I., p. 55) in regarding the onychaster and the oxyhexaster as two hexaster-forms of comparatively trivial difference. At the same time it will be conceded by all that the onychaster is to be considered as a discohexaster with the terminal disc in the most rudimentary state of development, being in fact represented by a whorl of fine claw-like branches. Now in *Aulascus* (*A. johnstoni*) the hexasters in question are all discohexasters, in which the terminal whorl of prongs is by no means strongly developed and many of which indeed present a resemblance to typical onychasters (F. E. SCH., '97, p. 527). On the other hand, *Calycosoma* (as represented by the single species *C. validum*) has the corresponding hexaster represented solely by oxyhexasters; it is of no moment that some of these are in the hexactinose form. Now the new species *C. gracile* shows the same hexaster partly in the form of oxyhexasters and partly in onychaster-like forms; so that it may be said that in this respect it stands midway between *Aulascus* and *Calycosoma*. It merges into the former through the onychaster-like hexaster and into the latter through the oxyhexaster. Recourse must then be taken to some other differential indications than the hexaster in order to decide to which of the two genera the new species is more closely allied. So far as the spiculation goes, a point that can be utilized as such an index seems to be found in the dermalia and the gastralia.

These agree almost completely with those of *A. johnstoni* in general appearance but especially in the character of the pinular ray; whereas, they, as compared with the same of *C. validum*, present (to use F. E. SCHULZE's words) "eine auffällige Differenz" in the development of the lateral spines. It is clear what this points to. Perhaps another not unimportant difference in the spiculation is the presence in *C. validum* of prostal needles in tufts, which are totally wanting in the new species as well as in *A. johnstoni*. Further taking into our consideration the occurrence in the new species of bud-like prominences on the wall which may lead to the formation of such incompletely individualized persons as are known in *Aulascus*, and of a distinct, branched stalk known to be common in the nearest allies of that genus, I can but think the evidence is decidedly in favor of considering the new species to be nearer to *A. johnstoni* than to *Calycosoma validum*. If the two genera are to be kept separate, it should rather be placed under *Aulascus*. But since I hold this genus as unitable with *Sympagella* (p. 96), I should accept F. E. SCHULZE's new species into my system under the name of *Sympagella gracilis* (F. E. SCH.).

With this change, the diagnosis of the genus *Sympagella* as given by me in this Contribution (pp. 96, 113) requires alteration only in so far as the oxyhexaster should not now be excluded from among the hexasters of the genus. The passage concerning these should be made to read "*Besides discohexasters, which are sometimes accompanied with oxyhexasters, plumicomes are always present.*" The family diagnosis given on pp. 84 and 112 may remain as it is.

There is no denying the fact that *Sympagella gracilis* brings the Caulophacids (*Caulophacus* and *Sympagella*), whether as a distinct family as I have made them or as a group taken over into the Rossellidæ, into direct touch with the Lanuginellinæ, the contact point on the part of this Rossellid subfamily being found in *Calycosoma validum*. And whether or not this genus and species should be joined to the rank of the Caulophacids, now appears to be largely a matter of individual opinion.

Tokyo, April 15th, 1903.

List of Literature referred to in this Contribution.

IJIMA, I. **'96.** Notice of New Hexactinellida from Sagami, Bay, II. —Zool. Anz., 1896, No. 504.

" **'98.** The Genera and Species of Rossellidæ.—Annot. Zool. Jap., Vol. II., Pars. II.

" **'01.** Studies on the Hexactinellida. Contribution I.—Jour. Sci. Coll., Tokyo. Vol. 15.

" **'02.** Studies on the Hexactinellida. Contribution II.—Jour. Sci. Coll. Tokyo. Vol. 17.

SCHMIDT, O. **'70.** Grundzüge einer Spongienfauna des Atlantischen Gebietes.

SCHRAMMEN A. **'02.** Neue Hexactinelliden aus der oberen Kreide.—Mitth. aus dem Roemer-Museum, Hildesheim. Nr. 15.

SCHULZE, F. E. **'86.** Ueber den Bau and das System der Hexactinelliden.

" **'87.** The Challenger Report. Hexactinellida.

" **'95.** Hexactinelliden des Indischen Oceanes. II. Die Hexasterophora.—Abh. kgl. preuss. Akad. Wiss. Berlin, 1895.

" **'97.** Revision des Systems der Asconematiden und Rosselliden.—Sitzber. kgl. preuss. Akad. Wiss. Berlin, 1897.

" **'99.** Amerikanische Hexactinelliden. Jena, 1899.

" **'00.** Hexactinelliden des Indischen Oceanes. III.—Abh. kgl. preuss. Akad. Wiss. Berlin, 1900.

" **'00***a*. Mittelmeer-Hexactinelliden.—Denkschr. math.-naturwiss. Cl. d. k. Akad. d. Wiss. Wien, Bd. LXIX.

" **'00***b*. Die Hexactinelliden. In : Fauna Arctica, Bd. I.

TOPSENT, E. **'01.** Éponges nouvelles des Açores. (2me série) (1).—Mém. Soc. Zool. de France. T. XIV.

" **'01***a*. Spongiaires. Résultats du Voyage du S. Y. Belgica en 1897–1899. (Expédition Antarctique Belge).

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PLATE I.

Placosoma paradictyum, N. G.; N. SP.

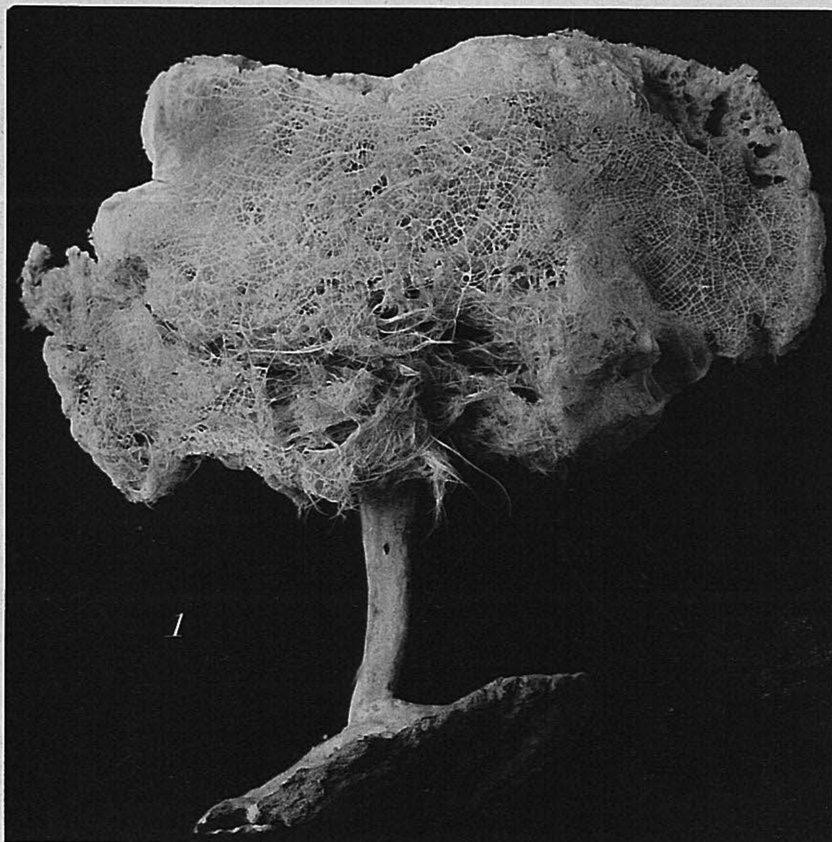
Plate I.

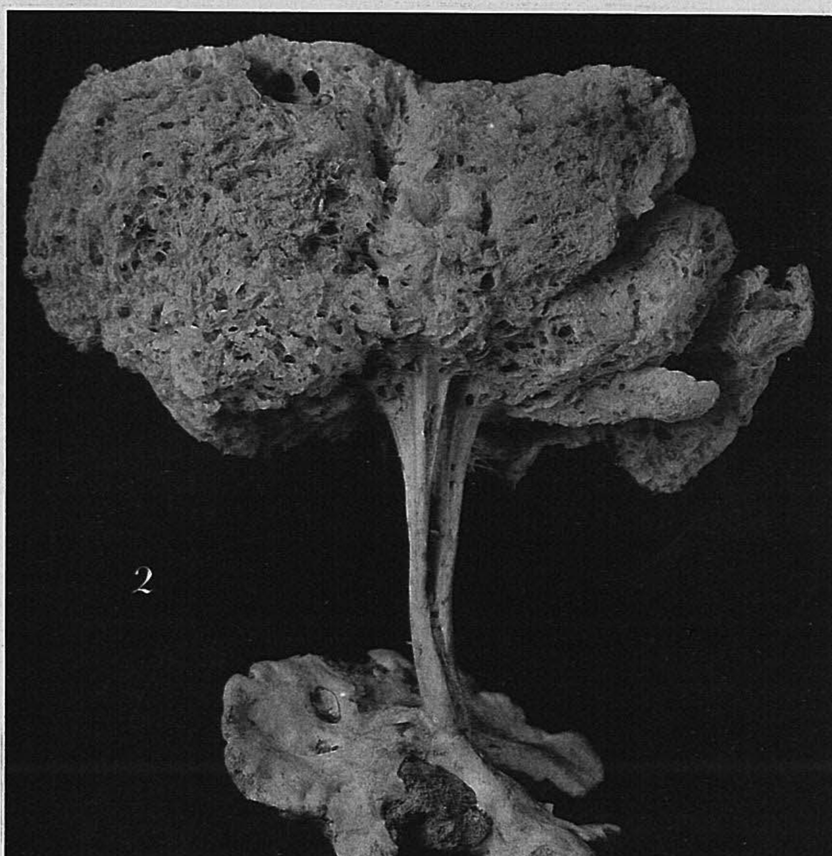
Placosoma paradictyum IJ. Pp. 2–19.

Fig. 1. The type-specimen, seen from the front side. (Sci. Coll. Mus. Sp. No. 506).

Fig. 2. Same, seen from the back side.

Both figures reduced to a size slightly smaller than half natural size.





Placosoma paradictyum Ij.

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PLATE II.

Placosoma paradictyum, N. G.; N. SP.

Plate II.

Placosoma paradictyum IJ. Pp. 2–19.

Fig. 1. A dermalia from the frontal lattice, with greatly elongated proximal ray. 150 ×.

Fig. 2. A dermalia from the frontal lattice, with short proximal ray. Lateral view. 150 ×.

Fig. 3. A gastralia from the gastral cavity inside the primary or main osculum. 150 ×.

Fig. 4. A medium-sized hexactinose discohexaster from a hypodermal beam of the frontal lattice. 300 ×.

Figs. 5, 6. Hemihexactinose discohexasters of occasional occurrence. From the back side of the sponge. 300 ×.

Fig. 7. A large hexactinose discohexaster, from the same side. 300 ×.

Fig. 8. A hexactinose codonhexaster from the main gastral surface. 300 ×.

Fig. 9. A normally developed discohexaster, occasionally found together with the large spherical form of fig. 11. From the back side. 300 ×.

Fig. 10. Another occasional form of discohexaster (codonhexaster) from the same side. 300 ×.

Fig. 11. A large, spherical discohexaster from the same side. 300 ×.

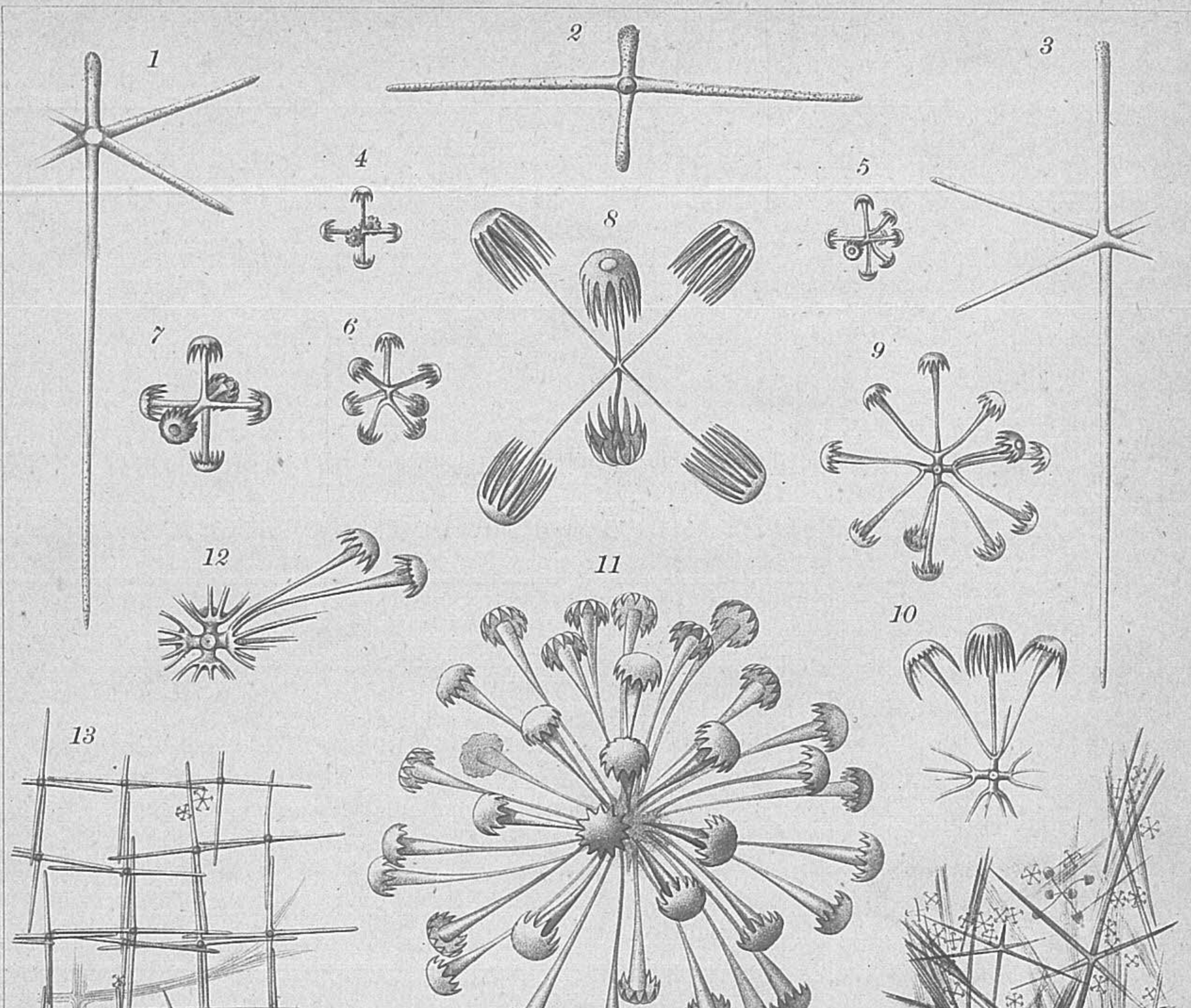
Fig. 12. A portion of the same, showing the central parts. 300 ×.

Fig. 13. A small portion of the frontal lattice. Above, the dermal latticework. Below, the hypodermal beam. 50 ×.

Fig. 14. Dermal surface of the back. 50 ×.

Fig. 15. A small portion of septum from the choanosome. 50 ×.

Fig. 16. Surface of the main gastral cavity. 50 ×.



Placosoma paradictyum Ij.

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PLATE III.

Leucopsacus orthodocus IJ.
Leucopsacus scoliodocus IJ.

This plate also contains figures (1–13) taken from two small specimens of *Staurocalyptus* sp., not specifically determinable with certainty on account of their young state. Both are from the Sagami Sea. References to these figures will be made in a future Contribution relating to the Rossellidæ.

Figs. 1–6. Young *Staurocalyptus* sp. (Sci. Coll. Mus. Sp. No. 437).

Fig. 1. Spicules of dermal surface, seen from outside. 100 ×.
Fig. 2. Spicules of gastral surface, seen from inside. 100 ×.
Figs. 3, 4. Common oxyhexasters. 300 ×.
Fig. 5. Microdiscohexaster. 300 ×.
Fig. 6. Portion of a discoctaster. 300 ×.

Figs. 7–13. Young *Staurocalyptus* sp.

Fig. 7. Surface-view of dermal layer. 30 ×.
Fig. 8. Combination figure of spiculation of the wall. 30 ×.
Fig. 9. Entire specimen. 2 ×.
Fig. 10, 11. Deformed discoctasters. 300 ×.
Fig. 12, 13. Oxyhexasters. 300 ×.

Figs. 14–26. *Leucopsacus orthodocus* IJ. Pp. 34–46.

Fig. 14. One of the type specimens (Sci. Coll. Mus. Sp. No. 230). Nat. size.

Fig. 15. Longitudinal section of wall stained; above, the oscular edge. (Sci. Coll. Mus. Sp. No. 438). 3 ×.

Fig. 16. Hexactinose discohexaster of an average size. 300 ×. From Sp. No. 230.

Fig. 17. Hexasterous discohexaster, from the same specimen. 300 ×.

Fig. 18–20. Same, from Sp. No. 438. Fig. 20 represents an occasional form. 300 ×.

Fig. 21. Egg-like cell of doubtful origin and nature, found in Sp.No.230. 300 ×.

Fig. 22. A moderately large-sized archæocyte-congeries, drawn from a section. The spherules represent nuclei. 300 ×.

Fig. 23. Larva in an early development stage, yet without spicules. Seen in optical section. 300 ×.

Fig. 24. Older larva of about 70 μ diameter; in optical section, but all the spicules in a hemisphere, seen by different foci of the microscope, are drawn in. Histological elements in the central part a little too distinctly shown. 300 ×.

Fig. 25. Oldest larva observed; all the spicules of the upper hemisphere drawn in. 300 ×.

Fig. 26. Combination of sections to show spiculation of wall. Above, the dermal; below, the gastral, surface. About 50 ×.

Figs. 27–37. *Leucopsacus scoliodocus* IJ. Pp. 46–52.

Fig. 27. Type specimens. The largest in the middle is Sci. Coll. Mus. Sp. No. 233; the two others are from Sp. No. 235. Nat. size.

Fig. 28. Stained longitudinal section of an entire specimen. Basidictyonal mass at base. 3 ×.

Fig. 29. Hexactinose discohexaster. 300 ×.

Fig. 30. Portion of same, showing the extent of axial threads in the central node.

Fig. 31. Delicate tylfloricome of inconstant occurrence, from Sp.No.434. 300 ×.

Fig. 32. Spherical discohexaster, from Sp. No. 233. 300 ×.

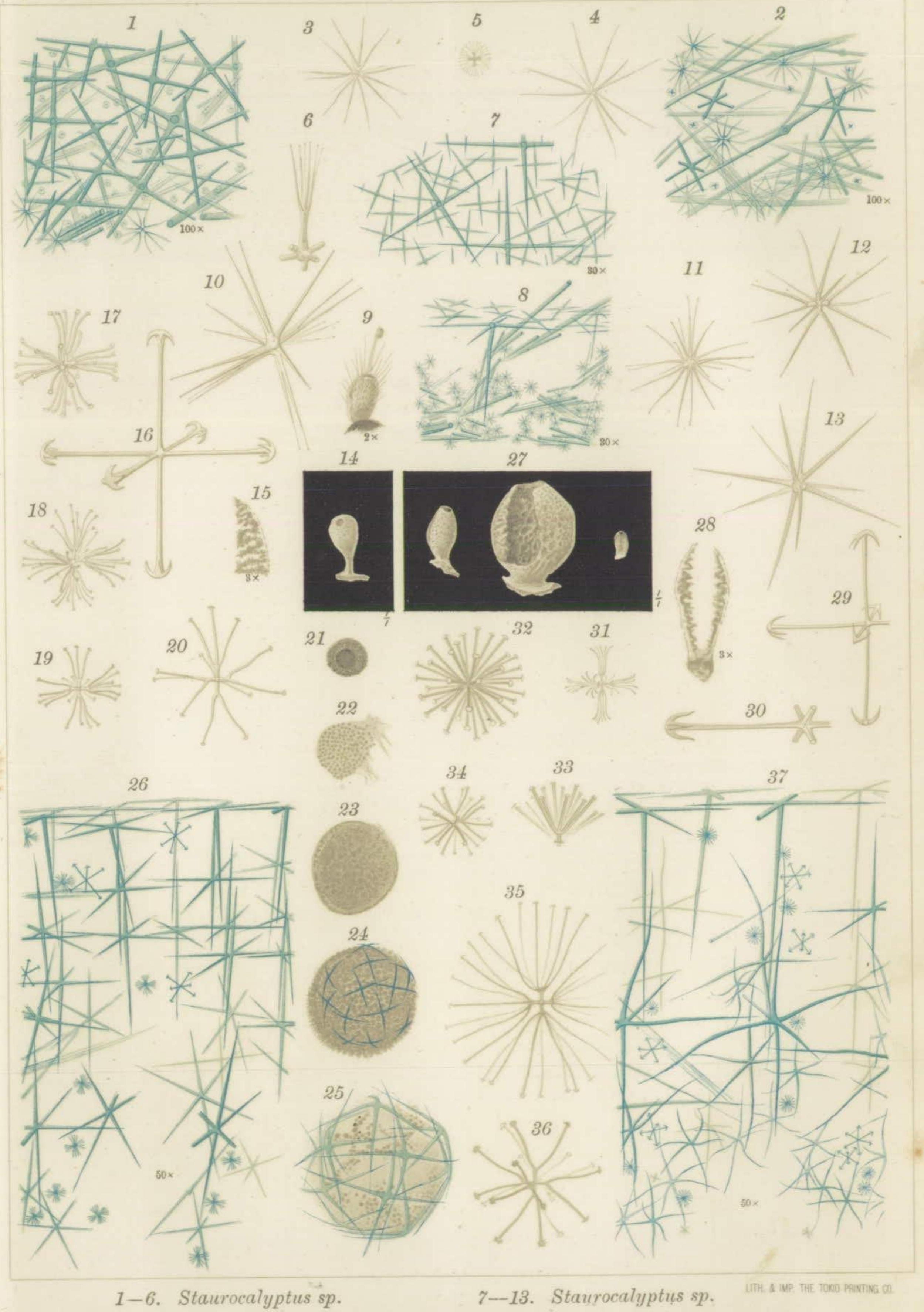
Fig. 33. Portion of same, showing the short principal.

Fig. 34. Small form of spherical discohexaster, from Sp. No. 235. 300 ×.

Fig. 35. Unusually large discohexaster, occassionally met with. From Sp. No. 233. 300 ×.

Fig. 36 Rare form of discohexaster. From Sp. No. 235. 300 ×.

Fig. 37. Combination of sections to show spiculation of wall. Above, the dermal; below, the gastral surface. About 50 ×.



1–6. *Staurocalyptus sp.* 7–13. *Staurocalyptus sp.*

14–26. *Leucopsacus orthodocus* IJ. 27–37. *Leucopsacus skoliodocus* IJ.

PLATE IV.

Chaunoplectella cavernosa IJ.

Plate IV.

Chaunoplectella cavernosa IJ. Pp. 53–71.

Fig. 1. Portion of the wall of a large individual $\frac{1}{3}$ nat. size. All the figures in this plate taken from this specimen (Sci. Coll. Mus. Sp. No. 443).

Fig. 2. Sigmatocome. 300 ×. Same as fig. 11 of the following Plate.

Fig. 3. Two terminals from the same. About 1000 ×.

Fig. 4. Section of the wall. About nat. size. Above, the dermal surface. Arrows show the direction of water current.

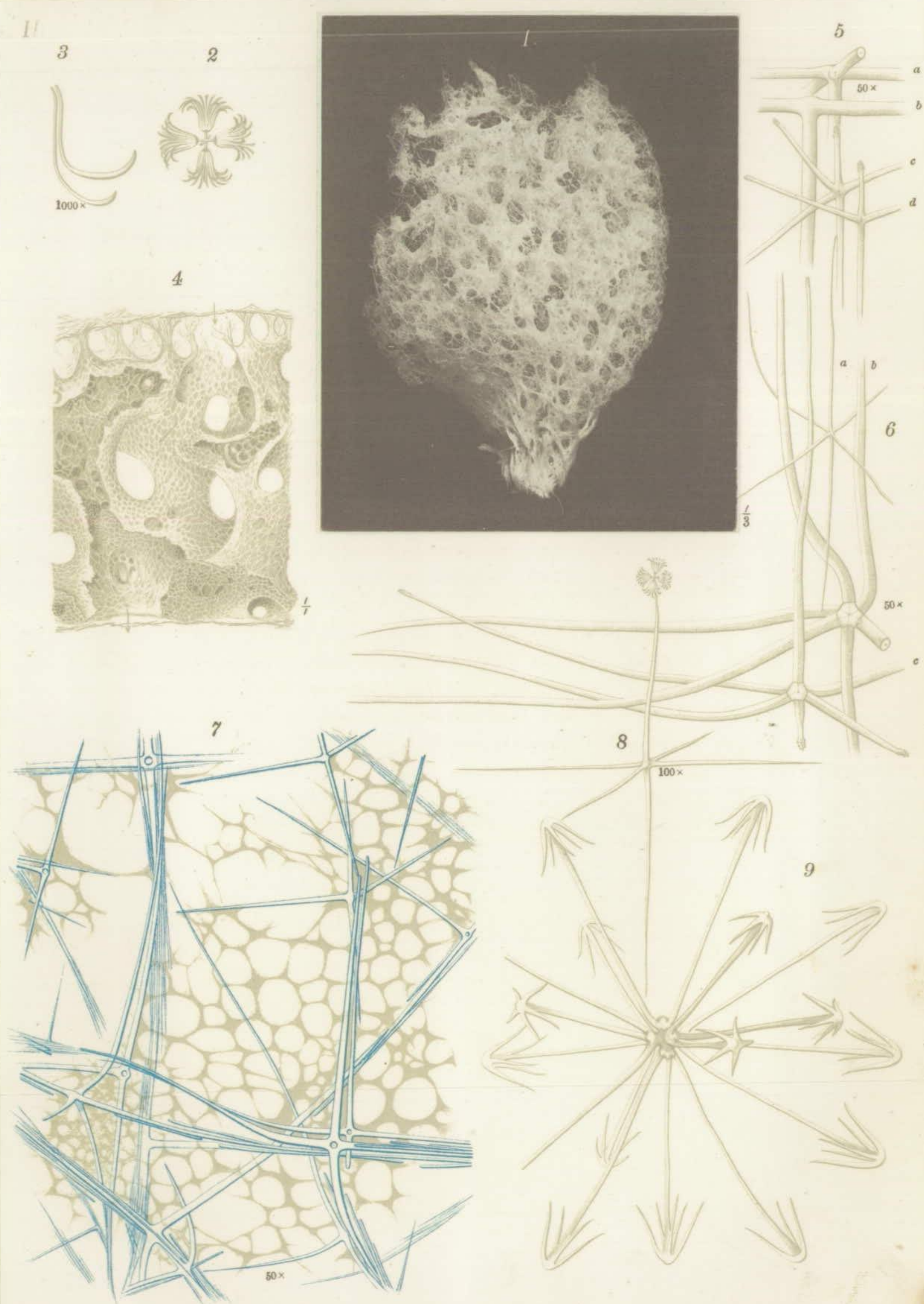
Fig. 5. Portions of spicules in the periphery. a, b, pentactinic and tauactinic dermalia. c, d, two unequally rayed parenchymalia. About 50 ×.

Fig. 6. Parenchymal hexactins of different sizes (a, b, c). About 50 ×.

Fig. 7. Dermal layer seen from outside, with soft dermal reticulum. 50 ×.

Fig. 8. Oxyhexactinic canalaria, with a sigmatocome (fig. 2) at the end of the freely projecting ray. 100 ×. See fig. 12 of the following Plate.

Fig. 9. Large discohexaster with anchorate terminal umbels. 300 ×.



Chaunoplectella cavernosa IJ.

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PLATE V.

Lanuginella pupa O. SCHM.
Chaunoplectella cavernosa IJ.
Chaunoplectella spinifera IJ.

The figures (1-7) relating to *Lanuginella pupa* will be referred to in a future Contribution.

Plate V.

Figs. 1–7. *Lanuginella pupa* O. Schm.

Figs. 1–3. Discohexasters from one and the same specimen (Sci. Coll. Mus. Sp. No. 436). 300 ×.

Figs. 4–6. Same from another specimen (Sp. No. 234). 300 ×.

Fig. 7. Portion of a strobiloplumicome. 1000 ×. The short central boss on the terminal-bearing knob at the end of each principal ray has been omitted through oversight.

Figs. 8–13. *Chaunoplectella cavernosa* IJ. Pp. 53–71.

Figs. 8, 9. Young specimens (Sci. Coll. Mus. Sp. No. 407) of various sizes, attached to a dead *Chonelasma*. Nat. size.

Fig. 10. A dried specimen complete (O. C. No. 4389). $\frac{1}{2}$ nat. size.

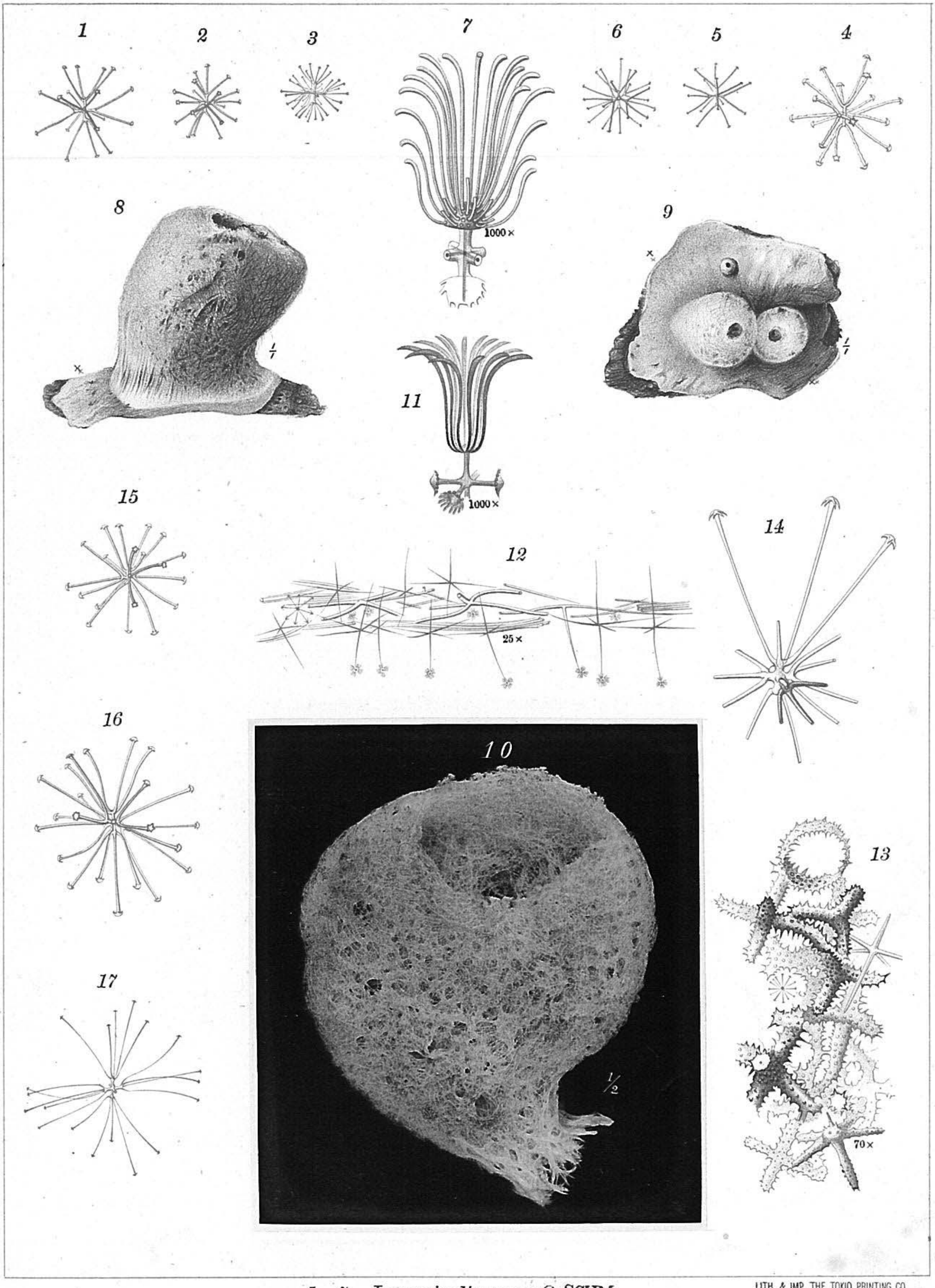
Fig. 11. Sigmatocome. 1000 ×.

Fig. 12. Septal wall in section. Above, the incurrent surface; below, the excurrent surface. Above 25 ×.

Fig. 13. Basidictyonal framework. 70 ×.

Figs. 14–17. *Chaunoplectella spinifera* IJ. Pp. 71–77.

Figs. 14–17. Different forms of discohexasters found in the specimen (Sci. Coll. Mus. Sp. No. 435). 300 ×.



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1—7. *Lanuginella pupa* O. SCHM.

8—13. *Chaunoplectella cavernosa* IJ.

14—17. *Chaunoplectella spinifera* IJ.

PLATE VI.

Chaunoplectella spinifera IJ.
Staurocalyptus japonicus IJ.
Staurocalyptus tubulosus IJ.

The figures relating to *Staurocalyptus japonicus* and *tubulosus* to be referred to in a future Contribution.

Plate VI.

Figs. 1–8. *Chaunoplectella spinifera* IJ. Pp. 71–77.
(All figures from Sci. Coll. Mus. Sp. No. 459).

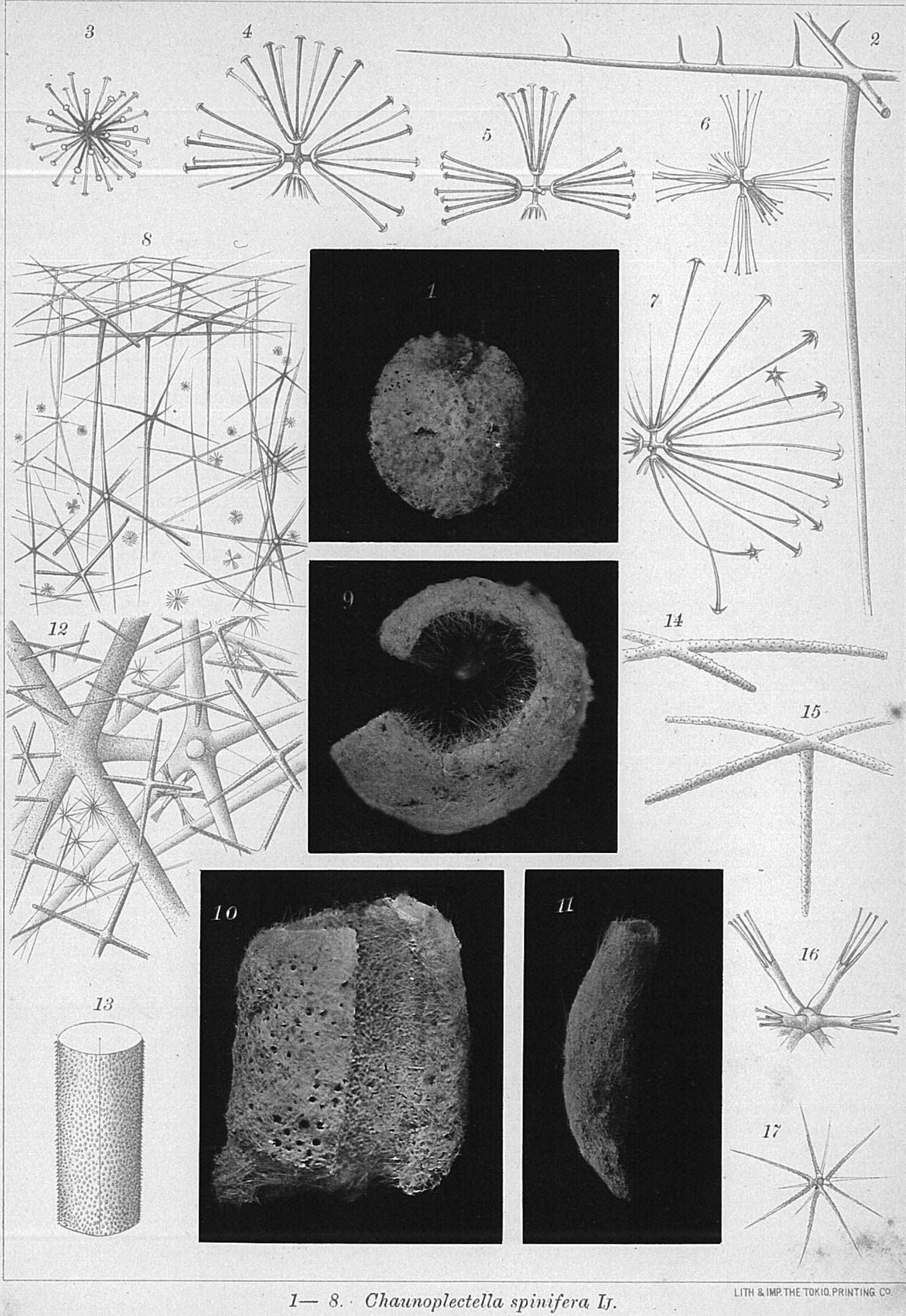
Fig. 1. The type-specimen. Natural size.
Fig. 2. Oxypentactinic dermalia with spine-bearing paratangential rays. 100 ×.
Fig. 3. Spherical form of discohexaster from the periphery of wall. 300 ×.
Fig. 4. Larger spherical form of discohexaster from deep parts. 300 ×.
Fig. 5. Discohexaster with terminals in six separate tufts. From deep parts. 300 ×.
Fig. 6. Discohexaster of similar form but with very slender terminals. From deep parts. 300 ×.
Fig. 7. Largest form of discohexaster. From deep parts. 300 ×.
Fig. 8. Combination-figure to show the arrangement of skeletal elements in the periphery of the wall. Above, the dermal layer. 25 ×.

Figs. 9, 10. *Staurocalyptus japonicus* IJ.

Fig. 9. Sci. Coll. Mus. Sp. No. 403, seen from oscular end. Natural size.
Fig. 10. Same specimen in lateral view. Natural size.

Figs. 11–17. *Staurocalyptus tubulosus* IJ.
(All figures from Sci. Coll. Mus. Sp. No. 241).

Fig. 11. The type specimen. Natural size.
Fig. 12. Dermal layer seen from outside. Several dermalia and two hypodermal pentactins. 100 ×.
Fig. 13. Portion of a paratangential ray of the prostal or hypodermal pentactin, to show the character of its surface. 300 ×.
Figs. 14, 15. Stauractinic and pentactinic dermalia. 300 ×.
Fig. 16. Discoctaster from dermal side. 300 ×.
Fig. 17. Oxyhexaster. 300 ×.



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1— 8. *Chaunoplectella spinifera* IJ.

9—10. *Staurocalyptus japonicus* IJ.

11—17. *Staurocalyptus tubulosus* IJ.

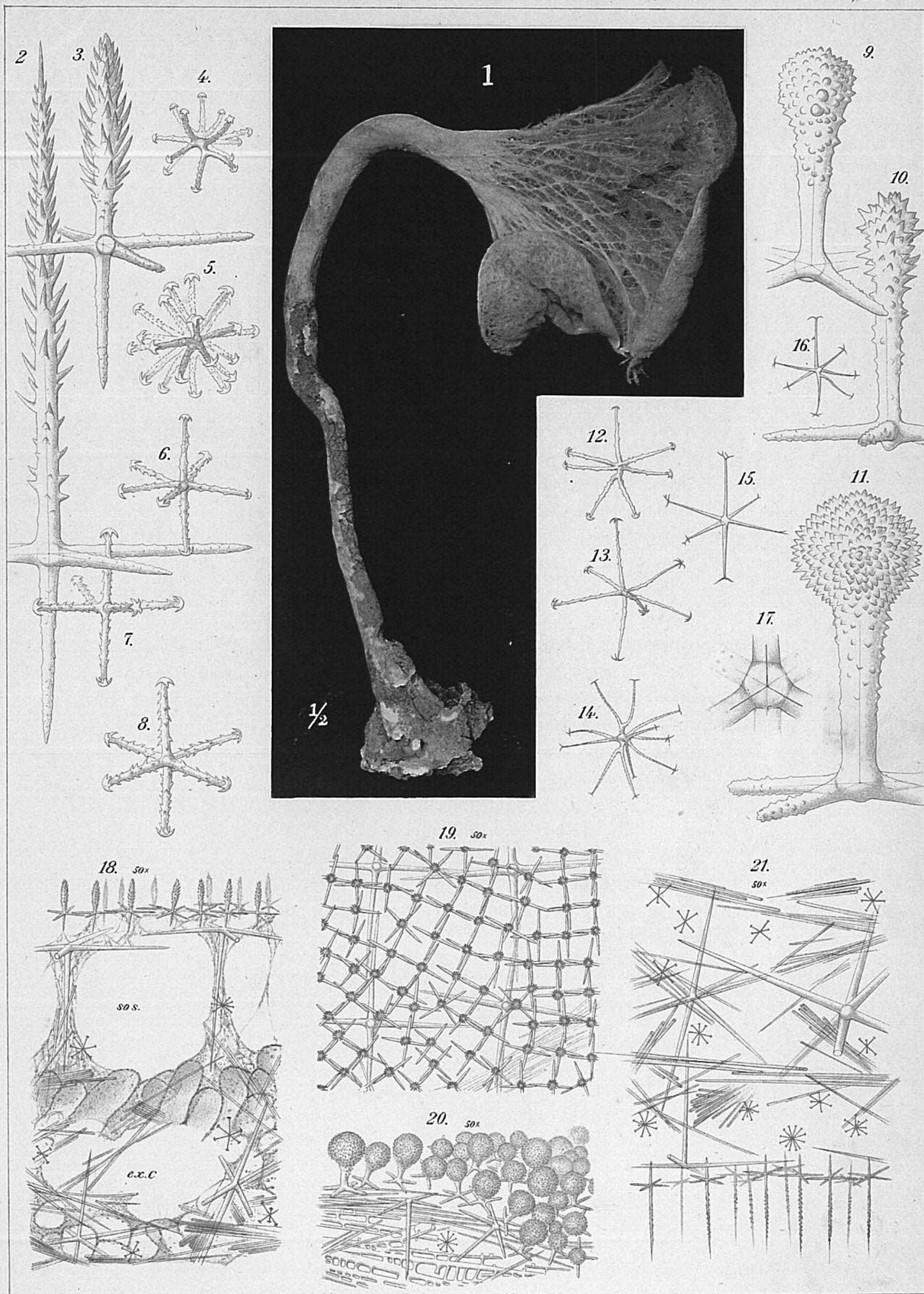
PLATE VII.

Caulophacus lotifolium IJ.

Plate VII.

Caulophacus lotifolium IJ. Pp. 87–96.

Fig. 1. The type specimen, now preserved in the "Kgl. Naturalien Kabinet" in Stuttgart. About $\frac{1}{2}$ natural size.
Fig. 2. Gastral hexactinic pinule of average size. 300 ×.
Fig. 3. Dermal hexactinic pinule of average size. 300 ×.
Figs. 4, 5. Normally developed, thick-rayed discohexasters from subdermal or subgastral region. 300 ×.
Fig. 6. Hemihexactinose form of same. 300 ×.
Figs. 7, 8. Hexactinose form of same; from deep parts. 300 ×.
Figs. 9–11. Pentactinic dermalia from the lower part of stalk. 300 ×.
Figs. 12–16. Slender-rayed discohexasters, which pass over by gradations into the forms of figs. 4–8. Figs. 14–16, onychaster-like. From peripheral region of the sponge. 300 ×.
Fig. 17. Central part of a hexactinose discohexaster, showing the extent of the axial cross. Observed in glycerine. 1000 ×.
Fig. 18. Part of a section through the sponge, with soft parts preserved. Above, dermal layer (ectosome). *sd. s.* subdermal space. Below, periphery of choanosome. *ex. c.*, excurrent canal 50 ×.
Fig. 19. Dermal skeleton, seen surface on. Beneath the dermal latticework, the hypodermal lattice with larger meshes. 50 ×.
Fig. 20. Surface of the stalk in oblique view. Above, the crowded layer of balloon-shaped pentactinic dermalia. 50 ×.
Fig. 21. Part of a section, adjoining the gastral surface. Below, gastral layer. 50 ×.



Caulophacus lotifolium Ij.

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PLATE VIII.

Sympagella anomala IJ.

Plate VIII.

Sympagella anomala IJ.

Fig. 1. A number of small and young specimens attached on an old dead stalk of the same species. $\frac{1}{2}$ nat. size. (Sci. Coll. Mus. Sp. No. 455).

Fig. 2. A medium-sized specimen, attached to a piece of dead *Chonelasma*. $\frac{1}{2}$ nat. size. (Sci. Coll. Mus. Sp. No. 367).

Fig. 3. A large specimen, with a part of the wall removed to show the gastral surface. $\frac{1}{2}$ nat. size. (Sci. Coll. Mus. Sp. No. 355).

Figs. 4, 5. Dermalia from different specimens. 300 ×.

Fig. 6. Modified dermalia from the lower part of stalk. 300 ×.

Figs. 7, 8. Gastralia from different specimens. 300 ×.

Fig. 9. Canalaria from excurrent canal. 300 ×.

Fig. 10. Strobiloplumicome. 300 ×.

Fig. 11. Part of a strobiloplumicome, partially constructed to show the structure. 1000 ×.

Figs. 12–14. Onychaster-like hexasters. 300 ×.

Fig. 15. Outer end of a terminal from an onychaster-like hexaster. 1000 ×.

Fig. 16. Peculiar discohexaster, with branched terminals,—an inconstantly occurring form. 300 ×. (From Sci. Coll. Mus. Sp. No. 473).

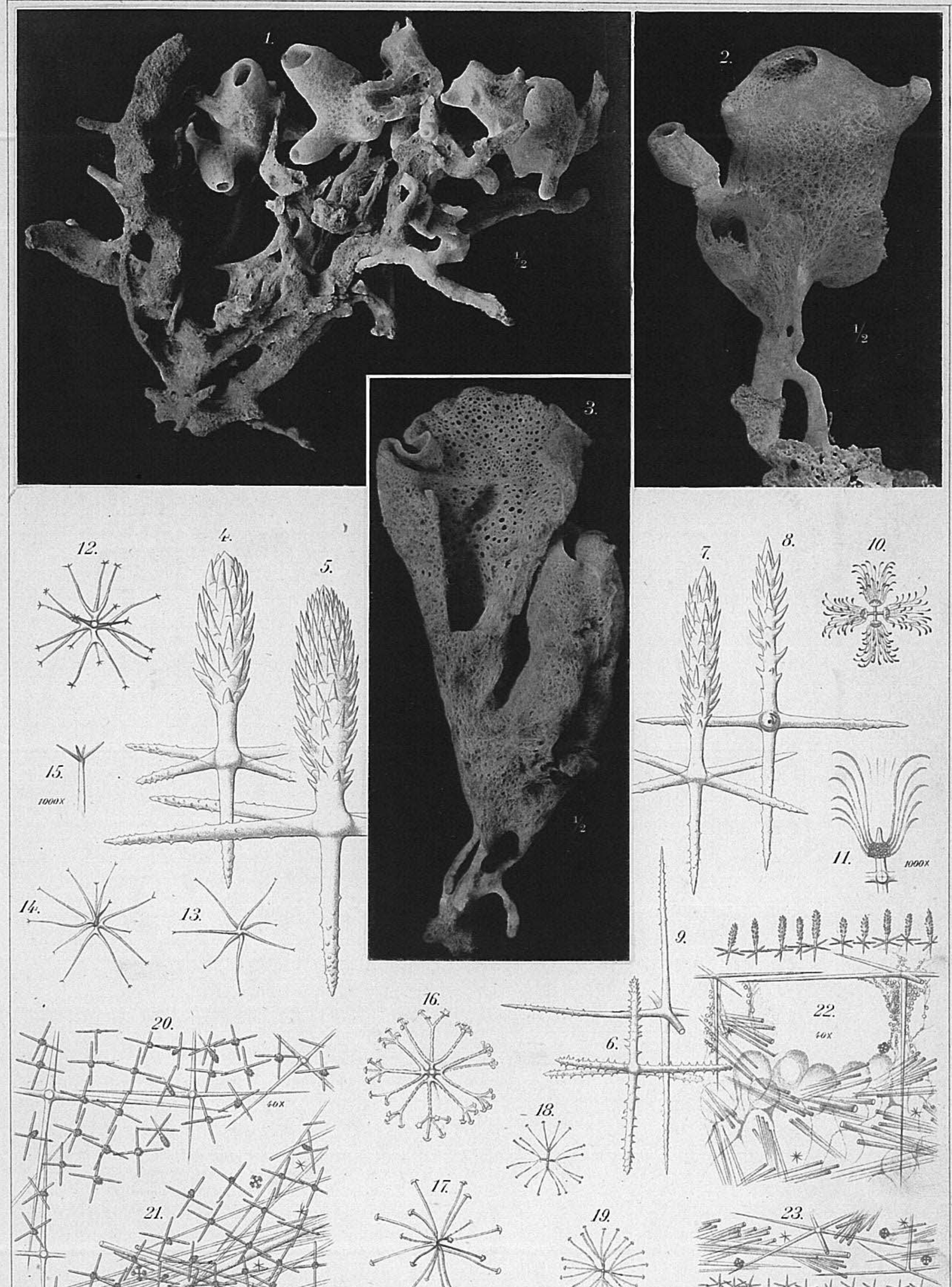
Figs. 17–19. Discohexasters from stalk. 300 ×.

Fig. 20. Dermal skeleton (dermalia and hypodermalia), seen surface on. About 40 ×.

Fig. 21. Gastral skeleton (gastralia and underlying parenchymalia), seen surface on. About 40 ×.

Fig. 22. Peripheral part of a section through the sponge-wall. Above, the dermal layer; below, the periphery of choanosome. About 40 ×.

Fig. 23. Part of a section through the wall. Below, the gastral layer. About 40 ×.



Sympagella anomala IJ.

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