A REVISION OF THE GENERA WITH MICROSCLERES INCLUDED, OR PROVISIONALLY INCLUDED, IN THE FAMILY *AXINELLIDÆ*; WITH DESCRIPTIONS OF SOME AUSTRALIAN SPECIES. Part i. (PORIFERA.)

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(Plates xxi.-xxix., figs.1-2; also xxxix., figs.6,7; and Text-figs.1-9.)

Genus Trachycladus Carter.

Definition.—Axinellidæ(?) typically of arborescent habit; with an axially condensed, reticulate skeleton of spiculo-spongin fibre. The megascleres are diactinal and of a single category, varying in form from oxea to strongyla. The characteristic microscleres are spinispirulæ, to which are usually added smooth microstrongyla.

Type-species, *T. lævispirulifer* Carter.

Inclusive of those here added to it, Trachycladus comprises now seven species (together with several varieties), all of which are from the southern and south-eastern coasts of Australia. The hitherto-described species referable to the genus are four, viz., *T. lævispirulifer* Carter (the type-species), and the three described by Lendenfeld, very imperfectly, under the names *Spirophora digitata*, *S. bacterium*, and *Spirophorella digitata*; but, for reasons already indicated in my previous paper, I reject the last-named, relegating it to the synonymy of *T. digitatus*—a redescription of which is given below. The other two species, *T. lævispirulifer* and *T. bacterium*, are apparently unrepresented among those examined by me; but the latter may prove to be identical with *T. pustulosus*, sp.n. The specimens from Port Phillip recorded and briefly described as examples of *T. lævispirulifer* by Dendy(7) appear to me to represent at least two distinct forms, which I describe below as varieties of *T. reteporosus*, sp.n., and of *T. digitatus* respectively.

In the characters which it combines, the genus is a most anomalous one; and the question of its relationship affords scope for considerable speculation. The form of the spinispirulæ irresistibly suggests their derivation from spirasters; and this view of their origin receives strong support from the fact that identically similar spicules—which undoubtedly are derived from spirasters—occur in *Spirastrella* (?) *spinispirulifera* (Carter) Dendy(7), and *Spirastrella* (?) *dilatata* (Kieschnick) Thiele(39), and from the fact that, in the latter species (which is apparently unique in this respect among the Spirastrellidæ), the megascleres are united into definite fibres by means of spongin. Also in support of this view, is the fact of the presence of microstrongyla. On the other hand, in structural features of the skeleton, the genus conforms to a type which is characteristic of genera in which the microscleres are sigmata or are such as are known to occur in association with sigmata. Trachycladus, therefore, appears to form a connecting link between the Spirastrellidæ and the sigmatophorous section of the Monaxonida, and provides ground for the view that these two groups are derived from a common Monaxonid stem.*

As the several species agree very closely in by far the greater number of their characters, a preliminary general account of them is desirable in order to obviate to some extent the necessity of repetition in their separate descriptions.

With the possible exception of *T. bacterium*—which is described by Lendenfeld as "eiformig, mit schmaler Basis festgewachsen"—all the species are of ramose habit, typically stipitate and more or less arborescent, with branches which are circular or nearly so in cross-section (occasionally somewhat compressed in *T. reteporosus*), and never of considerable stoutness; in *T. pustulosus* alone, the branches generally remain much abbreviated, closely crowded, and more or less coalesced together proximally, thus sometimes (through excessive reduction and fusion) producing a

* In this connection, I may mention that evidence is not wanting which would justify the hypothesis that sigmata and chelæ have originated from spirasters, perhaps independently; and it is even possible that the acanthosclercs of the Desmacidonidæ are similarly derived.

compact solid mass, or head, with digitiform protuberances (Pl. xxi., fig.5); occasionally, in the case of *T. reteporosus*, the sponge may remain unbranched—consisting simply of a long and slender, undivided stem. According to the species (or variety), the branches may be either cylindrical, distally expanded (*i.e.*, more or less clavate), or gradually tapered. Anastomosis between the branches occurs to a greater or less extent almost invariably, except perhaps in the case of *T. reteporosus*. The mode of branching is probably never dichotomous, though occasionally it may appear so; normally at any rate, the branches arise laterally and adventitiously.

The oscula are of small size, very seldom as much as 1 mm. in diameter, and are generally scattered over the surface irregularly; in *T. reteporosus*, however, they show a decided tendency to be arranged in longitudinal series, especially along the edges of the branches when these are compressed. In *T. pustulosus*, the oscula are restricted almost entirely to the distal parts of the branches, while in *T. bacterium* they are said to occur arranged in groups.

The surface is smooth, or is provided with numerous minute prominences (up-pushings of the dermal layer) produced by the extremities of impinging skeletal fibres. These elevations constitute a marked feature of the surface only in *T. pustulosus* (and *T. bacterium*?) in which they have the appearance of small pimples, and in *T. scabrosus* (Pl. xxi., fig.4; Pl. xxviii., fig.6), in which they take the form of minute sharp conuli; in the remaining species, they are either imperceptible or produce merely the appearance of granulation. In any case, whether surface-elevations occur or not, each point on the surface at the extremity of a skeletal fibre is the location of a small area over which the dermal membrane is adherent to the underlying tissues and free from dermal pores, whilst elsewhere it overlies subdermal spaces and is perforated by numerous pores. The pores are either scattered singly and for the most part subequidistantly, at an average distance apart not much exceeding their own diameter, as, for example, in *T. digitatus* and its varieties (Pls. xxvi., xxviii.);

or they are closely arranged in subcircular, sieve-like groups, as in *T. reteporosus* and *T. pustulosus* (Pl. xxvi., figs.4, 5, 7, 8; Pl. xxvii., figs.5, 6). In the latter species, the surface presents a minutely reticulate appearance.

Dried specimens are whitish on the surface, owing to the presence of a thin dermal crust of spinispiral microscleres; in alcohol, the colour varies in the different species, from whitish-grey to pale orange-yellow. The colour of living specimens—known so far only in the case of *T. reteporosus*, in which it is brilliant orange, red or scarlet—is probably always to some extent determined by, or dependent upon, that of a symbiotic Myxophycean alga, which appears to be invariably present in all the species, often in enormous numbers.

The main skeleton, which is composed of non-plumose spiculo-spongin fibres, is almost exactly similar in its conformation (except, presumably, in *T. bacterium*) to that described by Vosmaer* as typical of the genus *Axinella* (s.str.). In the central region of each branch, it forms an abruptly delimited dense core, or axial fune, composed of ramifying and interuniting longitudinal main fibres additionally connected (more or less obliquely) by a greater or lesser number of transverse fibres, and presenting (in longitudinal section) a somewhat lattice-like arrangement (Pl. xxvi., fig.1); and extra-axially it consists mainly or almost solely of very sparsely ramifying, radial fibres, which arising as branches from the longitudinal fibres (usually at some distance within the axial fune), run outwards to the surface at approximately equal distances apart, and are connected, only at irregular and usually distant intervals, by spongin-ensheathed single spicules and by paucispicular fibres of a single spicule's length (Pl. xxv., fig.1). The fibres are composed chiefly or almost entirely of spicules, which are arranged for the most part parallelly or nearly so (though not, as a rule, very compactly nor in a very orderly fashion); and this arrangement is maintained to the very ex-

* Vosmaer, G. C. J., "On the distinction between the genera *Axinella*, *Phakellia*, *Acanthella*, etc." Zool. Jahrb. Suppl. xv., 1912, p.310, Pl. xvi., figs.5, 6.

tremities of the (radial) fibres, the terminal spicules of which show no tendency to spread penicillately. The outlines of the fibres, as seen in cross-section, are very irregular (Pl. xxvi., fig. 9). In the axial region of the skeleton, the fibre-spicules are less compactly and less regularly arranged than in the radial fibres, and the appearance of irregularity is much increased by the presence of many additional spicules lying between the fibres; outside the axial region, interstitial megascleres are exceedingly rare. The characteristic microscleres—the spinispirulæ are scattered always in great abundance throughout all parts of the interior, and at the surface occur closely crowded in a well-defined layer, which constitutes the dermal skeleton. The microstrongyla, when present, are confined to the extra-axial choanosome.

The chief specific differences, in so far as structural features of the skeleton are concerned, are with respect to:—(i.) the density of the axial fune: (ii.) the ratio between the diameter of the fune and that of the whole branch; (iii.) the stoutness of the skeletal fibres; (iv.) the amount of spongin entering into the composition of the fibres; (v.) the frequency of connection between the radial fibres by means of transverse fibres; and (vi.) the angle of inclination of the radial fibres, *i.e.*, their direction relatively to the longitudinal axis of the branch. A further difference, however, is presented by *T. pustulosus*, in which the skeleton is axially condensed only in the stalk and in the lowermost portions of the branches: while in *T. bacterium*, apparently, an axial condensation is not developed. In order most readily to perceive, and also most accurately to determine, the distinctive characters of the skeleton in the different species, it is necessary to study the skeleton freed of the soft parts.

The megascleres are slightly curved oxea and strongyla (and rare styli), occurring intermingled, and connected by intermediate forms; the oxea, on the average, are slightly longer and stouter than the strongyla and not so nearly of uniform diameter, but otherwise differ from them only in the character of their extremities. Both in regard to the shape and the size of the megascleres, the two species differing most widely are *T. scabrosus* and *T. reteporosus:* in the former, strongyla are extremely rare, and the megascleres are almost exclusively sharp-pointed, fusiform oxea, attaining a maximum size of 530 by 27μ; in the latter, strongyla and oxea are about equally numerous, the oxea are mostly more or less blunt-pointed and but very slightly fusiform, and their maximum size usually does not exceed 300 by 8μ. In most of the species, a certain proportion of the megascleres (apparently those alone which occur extra-fibrally in the axial region of the skeleton) are found to attain an increasingly larger size as one proceeds towards the older portions of the sponge, with the result that, in the stalk, the maximum size of the megascleres is notably greater than in the uppermost parts of the branches; and these largest spicules, even in the species in which strongyla abound, are almost without exception oxea. The spicules of the fibres are no larger in the stalk than elsewhere.

The spinispirulæ are minute, entirely spinulous, for the most part regularly corkscrew-shaped spicules, rarely of more than two complete turns; in addition, they comprise a series of simpler forms, of various shapes ranging from that of a much contort S, through C-shaped forms, to straight or nearly straight rods (Text-fig. 3). The proportionate number of these simpler forms varies in the different species, but the degree of variability in this respect, as well as in other characters of the spirulæ, is not sufficient to be of diagnostic value. An exception to this rule, however, is possibly afforded by the spirulæ of *T. lævispirulifer*, which have been described by Carter as smooth; but it is more probable that the spicules, in this case, were not examined under a sufficiently high power to render their spination visible.

The microstrongyla are inconstant in occurrence, and they may be either numerous or scarce, or perhaps sometimes entirely absent, in different specimens of the same species; at any rate, this was found to be the case in *T. digitatus* (typical variety), and *T. reteporosus* (var. ?)—of which alone a number of specimens were available for examination. That they are proper spicules, however, and not merely pathological products, is rendered certain by their degree of uniformity in size and shape. Occasional malformed individuals (occurring least rarely in *T. digitatus*) are met with amongst them; and, in *T. pustulosus*, they are in part reduced to spheres: but otherwise they have the form of short straight rods, rounded at the extremities, often centrotylote, always quite smooth, and usually relatively stout.

The canal-system (Pl. xxiv., fig.3; Pl. xxv., fig.2) is of the aphodal type, with oval to spherical flagellated chambers, though with extremely short aphodi. The chambers measure from 25 to 35μ in diameter, and occur closely scattered throughout the entire extra-axial choanosome; within the region occupied by the axial skeleton, however, they are absent, except in the youngest portions of the sponge (*i.e.*, towards the extremities of the branches). In conformity with the symmetry of the skeleton, the main inhalant canals proceed from the subdermal spaces towards the interior in a radial direction, parallel to that of the radial skeletal fibres, and are traceable inwards almost to the axial fune; at their commencement, they are of such diameter as to be very distinctly visible to the naked eye, when a thin layer is pared from the surface (Pl. xxvi., fig.2). The subdermal spaces are inextensive—least so in *T. pustulosus*. The ectosomal layer, or dermal membrane, varies in thickness in the different species, from 50μ in *T. reteporosus* to (occasionally) 140μ in *T. fastigatus*, and, when best developed, has very much the appearance of a thin cortex; it is densely packed with spirulæ usually throughout, or nearly throughout, its entire thickness.

In none of the species were ova or embryos observed.

Trachycladus scabrosus, sp.nov.

(Pl. xxi., fig.4; Pl. xxiii., fig.9; Pl. xxviii., fig.6.)

Diagnosis.—Branches cylindrical, rather slender; of approximately uniform diameter throughout their length. Surface densely beset with small, sharp conuli formed by the extremities of the radial skeletal fibres. Dermal layer comparatively thin; superficially packed with spirulæ. Oscula and pores(?). Skeleton with an extremely dense axial fune of diameter exceeding the length of the radial fibres. Radial fibres directed nearly perpendicularly to the skeleton-axis, mostly between 120 and 170μ in stoutness, composed almost solely of spicules. Megascleres, sharp-pointed fusiform oxea, rarely passing into strongyla, and less rarely into styli; maximum size, $480 \times 23\mu$ in the branches, occasionally as much as $530 \times 28\mu$ in the stalk. Microstrongyla scarce.

Loc.—Off Port Jackson. ("Thetis" Expedition).

External features.—The species is known from a single example (Pl. xxi., fig. 4), 108 mm. in total height, consisting of an elongated slender stalk and irregularly disposed cylindrical branches from 2·5 to 4 mm. in diameter. The specimen (which is invested over portion of the exterior by a calcareous bryozoan) is only imperfectly preserved, having evidently suffered some amount of dessication prior to being placed in alcohol—in consequence of which the dermal layer, while remaining quite intact, has to some extent shrunken inwards upon the underlying skeleton. To this circumstance, in all probability, is largely due the marked degree in which the surface is rendered conulose by the outer ends of the skeletal fibres (Pl. xxviii., fig. 6): nevertheless, so coarse and stiff are these fibres that, even in the best-preserved specimens, the surface would almost certainly show some decided visible effect of their impingement on it, and at least would be asperous and harsh to the touch. The conuli are seldom much above $\frac{1}{3}$ mm. in height, very close-set, and of hard feel; they are such that the surface has much the appearance of that of a fine rasp. The dermal membrane is very thin and very closely adherent, accommodating itself exactly to the sharply contoured surface-inequalities; presumably it has undergone considerable contraction, since neither pores nor oscula are detectible. In consistency, owing partly to its somewhat dried and shrunken condition, but perhaps mainly to its very dense skeleton, the specimen is tough and hard, almost incompressible; the branches are stiffly flexible. The colour is brownish-grey on the surface, and dark brown in the interior.*

Skeleton.—The prepared skeleton, as seen in its entirety (Pl. xxiii., fig. 9), is of a faintly brownish, light grey colour, and consists of a very stout and solid looking core, with coarse and stiff, bristle-like, short radial fibres projecting therefrom on all sides, in moderately close array, almost at right angles; when dry, it is hard and brittle. The core occupies never less than half the diameter of the branches, and the radial fibres seldom exceed 1 mm. in length. The latter, which are connected only very sparsely by paucispicular transverse fibres (of a single spicule's length), vary in stoutness from about 110 to 190μ or so, and are composed almost solely of spicules,—their spongin being insufficient in quantity to form an external sheath, and becoming discernible only after staining. The fibres of the central axis, which also are but very scantily provided with spongin, have their spicules less closely compacted than the radial fibres, and form so dense a lattice-like reticulation that, except in moderately thin sections, the outlines of individual fibres can seldom be distinguished, and open meshes do not appear.

Megascleres.—These are almost exclusively oxea, slightly and usually somewhat angulately curved, fusiform, with gradually and regularly tapered, nearly always acutely-pointed extremities; but strongyla and scarcer styli also occur—more especially in the stalk, where the proportional number of the former may exceed one in fifteen. In the stalk also, occasional anisoxea are

Text-fig. 1. — *Trachycladus scabrosus.* Megascleres: *a*, from the stalk; *b*, from the branches.

met with, as in *T. digitatus* and *T. pustulosus*; and the megascleres are there of notably greater size than elsewhere. The strongyla are mostly not quite cylindrical in shape, but slightly fusiform; they are of lesser length, on the average, than the oxea, and, in the case of the shortest, are relatively much stouter. Although strongyla are present in far greater number than styli, spicules intermediate in form between them and oxea are of less frequent occurrence than those intermediate between styli and oxea. The maximum size of the megascleres is not greater than $480 \times 23\mu$ in the branches, and about $530 \times 28\mu$ in the stalk; the oxea are very rarely less than 330μ in length, and proportionately slender, but the shortest strongyla (which may exceed 20μ in stoutness) fall below 200μ.

Microscleres.—The spirulæ are mostly of between 1 and 2 turns and from 2 to 3μ in stoutness; C-shaped forms are rather scarce, and straight rods rare. The microstrongyla are very scarce, seldom centrotylote, and from 15×3 to $20 \times 5\mu$ in size.

TRACHYCLADUS FASTIGATUS, sp.nov.

(Pl. xxi., fig.1; Pl. xxiii., fig.10.)

Diagnosis.—Profusely branched. Branches elongated and tapering; anastomosing at points of contact. Surface smooth and glabrous. Oscula (?). Dermal layer strongly developed, dense, opaque; with closely packed spirulæ forming a layer 70-140μ thick. Inhalant pores dispersed singly. Skeleton with a rather dense axial fune, of diameter generally less than the length of the radial fibres. Radial fibres directed at an angle of from 35° to 60° with the skeleton-axis; very rarely more than 20-25μ in stoutness; their spicules cemented by a scarcely perceptible amount of spongin. Extra-axial connecting fibres few, mostly unispicular. Megascleres almost exclusively diactinal, mostly more or less rounded off at the ends, very commonly approximating in form to strongyla, but nearly always more or less (slightly) fusiform; only slighter, if at all, of greater dimensions in the stalk than elsewhere; in maximum size very rarely exceeding $520 \times 9\mu$, and at most $560 \times 12\mu$. Microstrongyla abundant in some parts, scarce in others.

Loc.—Great Australian Bight.

External features.—The single specimen (Pl. xxi., fig. 1) is of luxuriantly arborescent habit, and measures 360 mm. in total height, being thus the largest example of the genus yet obtained: the number of its ultimate branches exceeds one hundred and fifty. The branches are elongated and relatively slender, gradually tapered, distally much attenuated and flagelliform; the stoutest are at most 8 mm. in diameter at their base. They are richly and, in places, intricately anastomosed, forming thus, as well as by their multitude, a dense and somewhat tangled mass. Unfortunately the specimen, although in alcohol, is not very perfectly preserved, owing to its having temporarily become partially dried (through breakage of the vessel containing it) while in course of transit from the collecting ground. In consequence of this—mainly, if not solely—the branches are without exception much wrinkled longitudinally, presenting a shrivelled appearance: in life, apparently, their outline in cross-section was circular. The dermal layer, notwithstanding, remains intact, and exhibits no outward indication of having been detrimentally affected: it has the form of a dense and tough, opaque membrane or skin, with an outward appearance and texture much resembling that of rubber; is composed almost entirely of closely crowded spirulæ; and is even now (after possible shrinkage) usually between 90 and 120μ, and occasionally as much as 140μ, in thickness. Into the dermal membrane the skeletal fibres do not enter, nor do their extremities ever cause the surface to appear granular.

Examined with the naked eye, a transverse section of a branch shows, superficially, a sharply delimited dense layer, 0·2 to 0·4 mm. in width, the appearance of which is extremely suggestive of a cortex. Under the microscope, however, the seeming cortex is seen to consist in part of a layer belonging to the choanosome, which layer, unlike the remainder of the choanosome, is so densely packed with parasitic algal rods as to assume a whitish-opaque appearance similar to that of the dermal layer itself. But, in all probability, this is not a constant feature.

Presumably owing to their having become closed—as a result of the contraction undergone by the specimen—oscula are not indicated; in life, they must, at any rate, have been of very small size. The dermal pores, for the most part, have also disappeared; but traces of them remain, sufficient to show that they are distributed singly as in *T. digitatus* and its varieties.

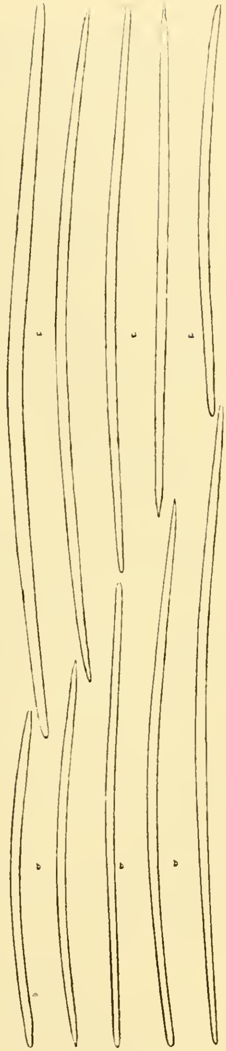
Skeleton.—The prepared skeleton, viewed in the gross (Pl. xxiii., fig. 10), is of a pale creamy-white colour, and shows a sharply-circumscribed, dense core-region, of diameter rarely less than one-third, and frequently exceeding one-half, the total diameter of the branches. The extra-axial skeleton presents somewhat the appearance of fur, being composed apparently only of fine silky-looking *outwardly-directed* (*i.e.*, radial) fibres; under the microscope, however, the radial fibres are mostly found to be connected, though as a rule only at very distant and irregular intervals, by delicate transverse fibres, often in the form merely of single spicules unensheathed by spongin. Even the component spicules of the radial fibres are rarely more than 4- or 5-serial, and the spongin cementing them, seldom sufficient to form a visible sheath, is usually so small in quantity as barely to be perceptible even in stained sections of the skeleton. The main fibres of the axial skeleton, save in the stalk and the basal portions of the older branches, are, for the most part, almost equally deficient in spongin, but the spicules composing them are less compactly arranged than in the radial fibres, and are all mostly somewhat greater in number: they form, with the aid of numerous connecting fibres and spicules, as well as by interunion among themselves, a close and rather intricate meshwork, in which the course of individual main fibres cannot be easily traced.

Megascleres.—The megascleres (which are approximately the same—though, on the average, perhaps not quite so slender—in the stalk as in the branches) comprise a goodly proportion of sharp-pointed oxea; but the great majority are intermediate forms showing every stage of transition between oxea and strongyla; moderately scarce styli also occur. The more sharply pointed spicules are very often irregularly ended, sometimes mucronate.

Their curvature, in proportion to their length, is slight, and often affects only a very limited portion of the central region of the spicule, the actines throughout nearly their whole length remaining straight; they are frequently, therefore, more correctly to be described as symmetrically bent, than as curved. Except in this respect, and in their much greater length, they most resemble, on the whole, the megascleres of *T. digitatus* var. *strongylatus*; the strongyla, however, differ from those of the latter, as well as from those of the other two species in which they occur plentifully, in that they are never quite cylindrical, but always taper slightly, with nearly uniform gradualness, from the middle to either end. Their diameter is rarely more than one-fiftieth of their length, which ranges from about 330 to 560 μ.

Microscleres.—The spirulæ are, without exception, of less than 2 complete turns, and a very considerable proportion (amounting to at least 25 %) are of less than 1 turn—*i.e.*, are more or less C-shaped; they frequently attain to 2·5 or 3 μ in stoutness. Rod-shaped derivatives are common, but are very seldom more than 8 μ in length.

The microstrongyla—which in most parts of the sponge are fairly abundant—are, with rare exception, centrotylote and rather slender, very seldom exceeding 2·5 μ in diameter; but occasional stouter ones without the dilatation also occur,



Text-fig. 2.
Trachycladus fastigatus.
Megascleres: *a*, from the stalk; *b*, from the branches.

which attain a diameter of 4 or 5μ; the length does not exceed 17μ. Malformed individuals, such as are of frequent occurrence in *T. digitatus* and *T. pustulosus*, are rarely to be found.

TRACHYCLADUS DIGITATUS Lendenfeld, et varr.

General diagnosis.—Branches moderately short, cylindrical to clavate, occasionally (abruptly) pointed, but never, so far as known, gradually tapered. Surface even, smooth to faintly granular. Oscula scattered irregularly over the entire surface, or (in the var. *clavatus*) arranged, or tending to become arranged, in two longitudinal rows on opposite sides of the branches. Dermal membrane varying (in the different varieties) from 50 to 120μ in maximal thickness; with closely packed spirulæ throughout its entire thickness (except in the var. *strongylatus*, in which the spirulæ are confined to a superficial layer). Dermal pores dispersed singly, at a distance apart from one another generally greater than their own diameter. Skeleton with moderately dense axial fune of diameter greater or less than the length of the radial fibres. Radial fibres directed at an angle of between 30° and 60° degrees to the axial direction; varying (in different varieties) from 50 to 90μ in maximal stoutness; with spongin rarely sufficient in quantity to form a distinct ensheathing layer external to the spicules. Megascleres—except in the var. *strongylatus* (in which strongyla are the more numerous)—consisting chiefly or almost exclusively of sharp-pointed oxea; of considerably greater maximum size and generally of more fusiform shape in the stalk of the sponge than in the branches; maximal size in the stalk varying (in different varieties) from not less than 350 x 10μ to 530 x 23μ.

Hab.—South-eastern coast of Australia.

TRACHYCLADUS DIGITATUS, typical form.

(Pl.xxii., figs.1, 2; Pl.xxiii., fig.1; Pl.xxvi., fig.2; Pl.xxvii., fig.1.)

1887. *Spirophora digitata*; Lendenfeld(**26**), p.794.

1888. *Spirophorella digitata*; Lendenfeld(**27**), p.236.

1914. *Trachycladus digitatus*; Hallmann(**13**), p.429.

Diagnosis.—Branches moderately slender (4 to 6 mm. in diameter); approximately of uniform diameter throughout their length, or slightly pointed terminally. Oscula scattered irregularly. Dermal membrane up to 80 or 90μ in thickness. Radial fibres of greater length than the diameter of the axial fune; rarely as much as 75μ in stoutness. Megascleres almost exclusively more or less sharp-pointed oxea, varying in maximal size (in different specimens) from 300×9 to $380 \times 11\mu$ in the branches, and from 440×15 to $510 \times 17 \cdot 5\mu$ in the branches.

Loc.—Port Jackson.

Introductory.—The following description is based on four specimens (all in the collection of the Australian Museum), two of which are labelled *Spirophora digitata* in Lendenfeld's handwriting. Examination has also been made of a small piece of a British Museum specimen labelled with the same name, and, so far as one can judge from its spiculation,—the fragment being insufficient to provide all the requisite information as regards other characters—this is of the same species. The specimens, nevertheless, are considerably at variance with Lendenfeld's description of *S. digitata*,—according to which the digitate branches are much compressed (4 mm. broad and 2 mm. thick), the surface shows "ein feines Netz erhabener Leisten," and the megascleres are styli. The statement regarding the megascleres one may reasonably presume to be erroneous, inasmuch as styli are otherwise unrecorded as occurring in the genus except sporadically as variants of oxea; but the other discrepancies are only explicable on the assumption either that the specimens (of both Museums) are mislabelled, or that the species is wrongly described in respect of its external characters. The view here taken is that the latter explanation is the true one.* As regards the evidence for the identification of *Spirophorella digitata* with the present species, the reader is referred to a previous paper (**13**, p.429).

* Certainly no implicit reliance can be placed on the description; for it is beyond question that in "Die Chalineen des australischen Gebietes," as already has been proven to be the case in the "Catalogue of Sponges in the Australian Museum," some (if not many) of the descriptions confound two species (by ascribing to the one the external features of the other),

The specimens labelled by Lendenfeld are in a dried and shrivelled condition, and look as if beach-worn, the more exposed portions of the surface being more or less denuded of their dermal layer and appearing as a consequence (owing to the projecting ends of the skeletal fibres) hispid or slightly shaggy. Their appearance is thus considerably different from that of the other two specimens, which are in alcohol and well preserved. As regards the latter, it is to be noted that in one of them, as in the two dried specimens, microstrongyla are present in great abundance, whereas in the other, microstrongyla are extremely scarce; but as both are exceedingly alike in other respects, and, moreover, were collected in the same haul, it is impossible to regard their differences as other than due to individual variation; and it was perhaps owing to Lendenfeld's having examined a specimen provided with only rare microstrongyla that no mention is made of such microscleres in his description of the species.

External features.—The external habit is sufficiently portrayed in the figures (Pl. xxii., figs.1, 2) illustrating the two better-preserved specimens, the larger of which measures 125 mm. in height. The branches have a diameter of from 4 to 6 mm.; and the peduncle is of about the same stoutness. The surface is smooth, and glabrous or nearly so—the utmost effect occasioned by the impingement of the skeletal fibres upon it being (in the case of the alcoholic examples) a faintly granular appearance here and there; should the sponge be removed from alcohol, however, and allowed partially to dry, the surface assumes a minutely pustulated appearance, much resembling (on a small scale) that of the human tongue. The irregularly, and rather distantly scattered oscula are never much greater than $\frac{1}{4}$ mm. or thereabouts in diameter. Some of the main exhalant canals, in the terminal

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and even the figures cannot always be trusted. In proof of the last assertion, one need only compare, for example, the description with the figure in the cases of the following species:—*Ceraochalina reteplax* (p.785; Pl. xix., fig.17); *Euchalinopsis minima* (p.816; Pl. xviii., fig.3); *Chalinodendron exiguum* (p.819; Pl. xxvi., fig.65); *Chalinodendron minimum* (p.820; Pl. xxvi., fig.71); and *Chalinorhaphis digitata* (p.822; Pl. xxvi., fig.62).

part of their course, run for a short distance close below the dermal membrane, and, being visible through it, present an appearance as of veins radiating to the oscula. The colour (in spirit) is a faintly yellowish pale grey with the least possible tinge of olive-green; at the same time, the sponge has a slightly subtranslucent appearance, somewhat recalling that of wax. The consistency is rather fleshy, moderately soft, yet fairly tough and elastic; the branches stand firmly erect.

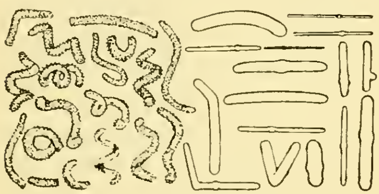
The dermal pores are disposed in the manner shown in Pl. xxvi., fig.2, and Pl. xxvii., fig.1. They vary from 30 to 85μ in diameter, and number, on the average, between 60 and 70 per sq. mm.

Skeleton.—The skeleton, as seen in its entirety (Pl. xxiii., fig.1), is of a light greyish colour, tinted very faintly with brownish pale yellow in the condensed axial region and in its older portions. By reflected light alone, the axial condensation can barely be perceived, being obscured from view by the extra-axial skeleton; but with the opposite illumination,—as when the skeleton is held directly between the eye and the light—it is seen as a sharply delimited, apparently solid core, occupying about one-fourth the diameter of the branches. The extra-axial skeleton appears, at first sight, to consist solely of radially directed fibres—2 to 3 mm. in length—which are inclined to the forward direction of the axis at an angle varying from about 30° in the distal region of the branches to about 45° in the basal; but, on closer inspection, transverse fibres (very rare towards the periphery of the skeleton, but becoming fairly numerous as the axis is approached) connecting these can be made out. The extra-axial skeleton is rather scanty—its effectiveness in concealing from view the axial condensation being due mainly to the very oblique inclination of the radial fibres.

The radial fibres are from 30 to 70μ (rarely more) in stoutness, and, speaking generally, consist almost entirely of megascleres regularly arranged in close parallelism,—the spongin cementing the spicules seldom forming a very well defined sheath, and more usually being so small in quantit as to be barely discernible unless stained. The main fibres of the axial skeleton are mostly coarser—up to 90 or 100μ in stoutness—and much more sponginous, and the spicules composing them are less compactly arranged; they form by interunion among themselves, and with the aid of numerous short connecting fibres, a dense, lattice-like meshwork, in which the course of the individual fibres is rather difficult to trace. The extra-axial connecting fibres occur at irregular intervals, and are either single (spongin-ensheathed) spicules or, more usually, are composed of several (seldom more than five or six) disorderly-arranged spicules interunited by spongin.

Megascleres.—The megascleres are oxea and relatively few styli, the number of the latter being approximately somewhere between one-fifteenth and one-thirtieth that of the former; among them, an occasional strongyle is also to be met with. They are almost invariably curved,—as a rule a little angulately; are (with the exception of the very stoutest) of uniform, or nearly uniform diameter throughout their length to within 25μ or less of their extremities; and usually taper thence, either regularly or with the intermediacy of one or two more or less abrupt contractions, to a sharp or only slightly rounded-off point. Spicules with much blunted extremities, however, are, in some specimens, by no means uncommon. A certain proportion of the irregularly-ended spicules terminate mucronately. Among the megascleres of the stalk—rarely, if ever, in other parts of the sponge—occasional (yet constantly occurring) ones are met with which taper almost (or, if stylote, quite) from end to end in one direction, *i.e.*, are markedly anisoactinal. In the stalk, also, the megascleres attain to a much greater maximum size than elsewhere, and are often slightly more fusiform in shape. In three of the examined specimens (including among them the one with rare microstrongyla) the megascleres are of approximately the same dimensions—ranging from about 160 (but rarely below 200) to 300μ in length, and up to 9μ in stoutness, in the branches, and attaining a maximum size of 440 × 15μ in the stalk: in the fourth specimen—in which, also, the megascleres are much more frequently blunt-pointed—they are notably larger, 180 to 370μ long and (at most) 11μ stout in the branches, and occasionally attaining to $510 \times 17{\cdot}5\mu$ in the stalk.

Microscleres.—(i.) The spirulæ (Text-fig.3) are mostly of less than 2 turns, rarely of more than $2\frac{1}{2}$. Rod-shaped derivatives of them, of all lengths between 4 and 23μ, and from 2 to $3{\cdot}5\mu$ in diameter are fairly common—numbering, say, one to every forty or fifty of the coiled spicules; the latter rarely exceed $2{\cdot}5\mu$ in diameter.



Text-fig.3.*

(ii.) The microstrongyla are imperfectly differentiated into two kinds: (1) slenderer, invariably centrotylote forms ranging in length from 12 to 27μ and in diameter from less than 1μ up to 3 or $3{\cdot}5\mu$, and (2) stouter, rarely centrotylote ones, occasionally as much as 5μ in diameter, and seldom more than 20μ in length. The former are present in great abundance in three of the examined specimens, but are almost, or entirely absent from the fourth; the latter are scarce in all four specimens.

Text-fig.4.†

*Spirulæ and microstrongyla of *Trachycladus digitatus*.

† *Trachycladus digitatus*. Megascleres: *a*, from the stalk; *b*, from the branches.

Abnormal forms among the microstrongyla (of the kind shown in the Text-fig.) are of more frequent occurrence in the present, than in any other of the species excepting *T. pustulosus*, their proportionate number being not less than one in thirty.

TRACHYCLADUS DIGITATUS var. GRACILIS, var.nov.

(Pl. xxii., fig.3; Pl. xxiii., fig.2; Pl. xxvii., fig.2.)

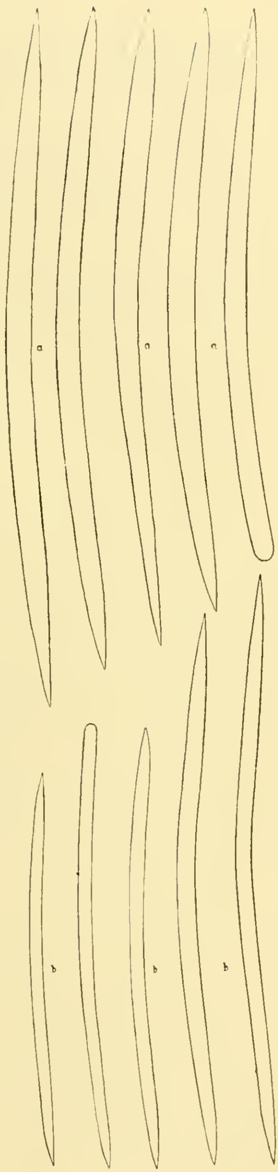
Diagnosis.—Branches slender (2 to 3·5 mm. in diameter); of uniform diameter throughout their length. Oscula scattered irregularly. Dermal layer with closely packed spirulæ throughout its entire thickness. Radial fibres of lesser length than the diameter of the axial fune. Megascleres almost exclusively sharp-pointed oxea; stylote modifications much more frequent in occurrence than strongylote; maximum size, $530 \times 23\mu$ in the stalk, rarely as much as $430 \times 15\mu$ in the branches.

Loc.—Port Jackson.

Occurring in the collection is a single specimen (labelled as from Port Jackson, and well-preserved in alcohol) which, while presenting the more essential features displayed by the typical form of the species, yet differs in many respects so appreciably from the above-described specimens that it seems advisable, provisionally at least, to regard it as constituting a separate variety. The differences which distinguish it externally (Pl. xxii., fig.3) are chiefly these: the cylindrical, untapered branches are comparatively slender, measuring only from 2 to 3·5mm. in diameter (the specimen itself being 115 mm. in total height); the consistency is very firm, the branches being stiffly flexible and but slightly compressible; and the colour superficially is a subtranslucent slaty-grey. The size and distribution of the pores and of the oscula are much the same as in the typical variety, except that the pores are smaller (not exceeding 65μ in diameter), and their linear reticulate arrangement (Pl. xxvii., fig.2) is more pronounced. As in the typical variety also, the main exhalant canals leading to the oscula are visible through the dermal membrane, presenting an appearance as of veins; but they are here very much more distinct, and are traceable for a much greater distance from the oscula. The dermal membrane varies from 50 to over 100 (rarely to 130μ) in thickness, and is closely packed throughout with spirulæ.

The distinctive internal features are the very much greater relative development of the axial fune as compared with the extra-axial skeleton, the slightly stouter and more sponginous fibres, and the greater dimensions of the megascleres. In the first-mentioned respect, as may be seen from the figure (Pl. xxv., fig. 2), the skeleton (which is of a pale brownish-grey tint) approaches rather closely to that of *T. scabrosus*—inasmuch as, throughout the greater part of the length of the branches, the axial condensation occupies not less than three-fourths of their diameter; only towards the extremities of the branches do the radial fibres become distinctly apparent, and even there their length never much exceeds 1 mm. The diameter of the radial fibres varies from 30 to over 80μ, and their spicules are always surrounded by a well-defined, though usually very thin layer of spongin. The spongin does not extend to the very extremities of the fibres, but terminates quite abruptly a short distance therefrom, leaving the endmost spicules free.

In correspondence with their greater stoutness, the megascleres (*cf.* Text-figs. 4 and 5) are slightly more fusiform than in the typical variety; and their apices



Text-fig. 5.—*Trachycladus digitatus* var. *gracilis*. Megascleres: *a*, from the stalk; *b*, from the branches.

are nearly always sharply and regularly pointed. Styli are of rather frequent occurrence, their proportionate number being approximately one in ten; anisoxea are met with in the stalk and very rarely also in the branches. They range in length from about 280 to 420 or 430μ (with a maximum stoutness of 14 or 15μ) in the branches, and up to 530μ in length by 23μ in stoutness in the stalk.

The spirulæ and their derivatives are without distinctive features, either as regards size or relative numbers.

The microstrongyla appear to be exclusively of the *stouter* kind occurring in the typical variety, and never centrotylote; they are moderately scarce, and attain a size of 20 by 5μ.

TRACHYCLADUS DIGITATUS var. CLAVATUS, var.nov.
(Pl. xxii., fig.4; Pl. xxiii., fig.3; Pl. xxv., fig.2; Pl. xxvii. fig.3; Pl. xxviii., fig.5; Pl. xxix., fig.1.)

Diagnosis.—Branches gradually increasing in diameter distally, thus becoming elongately club-shaped and attaining to fair stoutness. Oscula in part scattered irregularly, and in part (or sometimes almost without exception) arranged more or less distinctly in two longitudinal series on opposite sides of the branches. Radial fibres generally nearly twice the diameter of the axial fune. Megascleres chiefly sharp-pointed oxea, but intermediate forms between these and strongyla are more or less frequent; stylote modifications comparatively rare; maximum size varying (in different specimens) from 400 × 14μ to 480 × 17μ in the stalk, rarely exceeding 300 × 9μ in the branches.

Loc.—Port Phillip.

This variety is based upon three specimens markedly distinguished from all the remaining available examples of the species by the shape of the branches, which gradually increase in diameter upwards from their base, attaining their maximal stoutness at no great distance from their extremities. Two of the specimens are comprised amongst those recorded by Dendy(7) as examples of *Trachycladus lævispirulifer* Carter,—being, namely, the two (with the reg. nos. 415 and 1046) referred to by him as distinguished from the others by their more robust and stouter branched habit and the more evident microspination of their spirulæ; the third, which I select as the type-specimen, is in the collection of the Australian Museum.

External characters.—Of the three specimens, two (which are excellently preserved in alcohol)—viz., the Australian Museum specimen and R.N. 1046—are exceedingly alike in all but size; the former (Pl. xxii., fig.4) measures 145 mm. in total height, the latter 100 mm. Their branches are, without exception, circular or nearly so in cross-section, attain a maximal stoutness distally of from 10 to 12 mm., and are seldom more than 5 mm. in diameter at the base; the extremities of the branches are never in the least degree pointed. The surface is perfectly even and glabrous, without the faintest trace of granulation. The oscula are minute, seldom as much as 0·4 mm. in diameter, and for the most part are scattered irregularly; in places, however, they exhibit a tendency towards a longitudinal serial arrangement. Excurrent canals leading to the oscula are not visible through the dermal membrane. The colour in alcohol, both superficially and for some distance interiorly, is an opaque pale creamy-white; proceeding towards the axis, it gradually becomes more yellowish, owing to the closer approximation of the spongin-ensheathed skeletal fibres. The consistency, in the more expanded, distal parts of the branches, is soft and resilient; the branches are flexible and elastic.

The other specimen (R.N. 415), measuring 108 mm. in total height, exhibits the following differences (Pl. xxix., fig.1): (i.) The branches (which vary from 10 to 14 mm. in stoutness) are mostly pointed at the extremities, and rendered irregular by occasional swellings and protuberances (incipient secondary branches); (ii.) the oscula, almost without exception, are arranged along the branches in irregular opposite rows, and the largest are nearly 1 mm. in diameter; (iii.) the surface is minutely wrinkled, and in parts slightly granular; and (iv.) the consistency is comparatively firm and hard, and the branches are brittle rather than flexible. Otherwise, however, with the exception of the single difference mentioned in the next paragraph, the specimen agrees in all essential respects with the preceding; and, furthermore, the differences (iii.) and (iv.) are, almost undoubtedly, due merely to the fact of the specimen's having been allowed to become partially dried before being placed in alcohol.

Text-fig. 6.*

The pores are notably larger in size than in the two preceding varieties, varying in diameter from 40 to 120μ, and are more uniformly distributed (Pl. xxvii., fig. 3). The dermal layer is from 40 to 90μ in thickness, and, in the case of the two similar specimens, is closely packed throughout with spirulæ. But in R.N. 415, only a superficial layer of the dermis—usually less than 25μ in thickness—is packed with spirulæ, the remaining portion being occupied by numerous parasitic algal cells.

The skeleton presents no appreciable point of difference from that of the typical variety excepting that the radial fibres are generally much longer—their length, in the expanded portions of the branches, being about twice the diameter of the axial fune (Pl. xxv., fig. 3). The fibres attain, at most, a stoutness of 70 to 80μ, but are usually much slenderer, and are always provided with a distinct, though thin sheath of pale-coloured spongin. The skeleton, seen in its entirety, is pale golden-yellowish.

The megascleres of the stalk are scarcely different from those of

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* *Trachycladus digitatus* var. *clavatus*. Megascleres: *a*, from the stalk; *b*, from the branches.

the typical variety, while those of the branches are different only in the fact that their extremities are most frequently more or less blunt-pointed, and strongylote forms are common. The branch-spicules are of the same dimensions in all three specimens, ranging in length from about 170 to slightly above 300 μ and attaining to about 9 μ in stoutness: the stalk-spicules have a maximum size, in the type-specimen, of (rarely) 480 × 15 μ; in R.N. 1046, of 450 × 17 μ; and in R.N. 415, of 400 × 14 μ.

The spirulæ are not distinguishable from those of the typical variety. Microstrongyla are rather scarce in R.N. 415, and in the other two specimens are extremely rare or absent; apparently they are never centrotylote, and are at most 15 × 3 μ in size. Abnormal forms of the microstrongyla, such as occur in the typical variety, were not observed.

TRACHYCLADUS DIGITATUS var. STRONGYLATUS, var.nov.

(Pl. xxii., fig.5; Pl. xxiii., fig.4; Pl. xxvi., figs.5, 6; Pl. xxvii. fig.4.)

Diagnosis. — Branches cylindrical, untapered, moderately slender. Oscula irregularly scattered. Dermal membrane with closely packed spirulæ confined to a superficial layer seldom as much as 25 μ in thickness. Radial fibres of lesser length than the diameter of the axial fune. Megascleres chiefly strongyla and very blunt-pointed oxea,—those in the branches rarely exceeding 290 by 7 μ in size.

Loc.—Port Phillip.

This variety is represented by a single incomplete (but excellently preserved) example (Pl. xxii., fig.5)—consisting only of a pair of united branches—the appearance (of the proximal part) of which suggests its having grown from a small broken-off piece of another specimen. As compared with the representatives of the preceding varieties, the specimen is distinguished chiefly by the more or less strongylote character of the majority of its megascleres—in which respect it rather resembles an example of *T. reteporosus*; this statement, however, is possibly true only as regards the megascleres of the branches, since a stalk is lacking. The branches are cylindrical and slender, 3·5 to 5 mm. in diameter.

The surface is minutely granular. The oscula are scattered irregularly, and vary in diameter from 0·3 to 0·75 mm. The colour superficially is pale brownish-grey. The dermal pores (Pl. xxvi., figs.3, 6; Pl. xxvii., fig.4) are for the most part scattered singly and irregularly, as in the variety *clavatus*, but here and there, especially on some parts of the surface, they exhibit also a tendency to become arranged several together in incipiently sieve-like groups; they range from 40 to 110μ in diameter. The dermal membrane is rarely, if ever, more than 50 or 60μ in thickness; and the dermal spirulæ are confined to a superficial layer which is at most 25μ in thickness.

Text-fig.7.*

Examined in its entirety, the prepared skeleton (Pl. xxiii., fig.4) is of a pale golden-yellow colour, fine-textured, and of soft feel, and of denser appearance extra-axially than that of any other of the varieties or species owing to the greater number and closer arrangement of the radial and connecting fibres, which quite conceal the axial core from view; the core itself is less dense than that of the other varieties. The radial fibres, which are of slightly lesser length than the diameter of the core, are mostly between 30 and 50μ—rarely as much as 60μ—in stoutness, and are seldom provided with spongin sufficient in quantity to form a distinct ensheathing layer.

The megascleres in the uppermost part of the branches consist almost entirely of strongyla and blunt-pointed oxea (the former somewhat the more numerous), and rarely if ever exceed 300 by 7·5μ in size; the length of the shortest spicules is less than 150μ, and individuals below 200μ in length are common. At the

*\[Trachycladus digitatus var. strongylatus.\] Megascleres.

lowermost extremity of the (incomplete) specimen, the megascleres are still chiefly strongyla, but they comprise also a quite appreciable number of more or less sharp-pointed oxea, and range in size up to 350 by 10μ. The spinispirulæ and their more or less rod-shaped derivatives (the latter of which are rather rare) are very seldom, if ever, more than 2μ in stoutness. Microstrongyla were not observed.

TRACHYCLADUS RETEPOROSUS, sp.nov. (et varr.?).

General diagnosis.—Branches elongated and tapering. Surface smooth to slightly granular. Oscula entirely, or for the most part, disposed in longitudinal series. Dermal membrane at most 50μ in thickness; with closely packed spirulæ occurring only in a thin superficial layer. Dermal pores arranged wholly or in part in subcircular sieve-like groups; in any case, the distance separating adjoining pores is generally very much less than their own diameter. Skeleton with a relatively very dense axial fune of diameter equal to or less than the radial fibres. Radial fibres directed at an angle varying from (rarely less than) 45° to nearly 90° to the skeletal axis; never more than about 50μ in stoutness; generally with a well-defined, though thin spongin-sheath. Megascleres chiefly strongyla and very blunt-pointed oxea, the former somewhat the more numerous; only occasionally slightly larger in the stalk than elsewhere; varying in maximum size (in different specimens) from 290 × 7 to rarely (in the stalk) 330 × 10μ.

Loc.—Port Phillip.

The specimens which I ascribe to this species exhibit in certain respects considerable variability, so that it is impossible to be certain whether they are representative of several genetically distinct forms or owe their differences merely to individual variation. A second difficulty in connection with the species arises from the fact that, in certain of the specimens, the mode of disposition of the dermal pores approaches somewhat closely to that characteristic of *T. digitatus*, and in others again, owing to their shrunken condition, the pores are not discernible: in the case of these specimens, accordingly,—since no appreciable difference exists in spiculation between the present species and *T. digitatus* var. *strongylatus*,—the only definitely definable character justifying their inclusion in the present species, rather than in *T. digitatus*, is the elongate tapering habit of their branches. Among the remaining specimens, however, there is one which in various respects stands considerably apart from all the rest, and in these respects also is by far the most divergent from *T. digitatus*. I therefore select this specimen to represent the typical form of the species, and the remainder I refer provisionally to an undesignated variety, leaving the problem of their correct allocation to be determined in the future.

T. RETEPOROSUS, typical form.

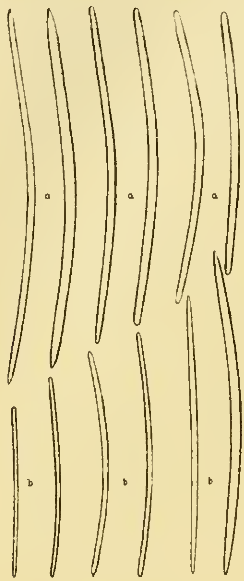
(Pl. xxi., fig.2; Pl. xxiii., fig.5; Pl. xxiv., fig.3; Pl. xxvi., figs.1,4,7; Pl. xxvii., fig.5.

The single, excellently preserved specimen (Pl. xxi., fig.2),—which measures 340 mm. in total height—consists of a half-score of long, lax, straight, gradually tapered, main branches (160 to 250 mm. in length), arising dichotomously and sub-dichotomously within a comparatively short distance of the short stalk, and of about the same number of shorter (10 to 120 mm. long), but otherwise similar, sporadically occurring secondary branches. But for overlapping and occasional slight torsion, the branches would be disposed in a single plane, and the habit of the sponge flabellate. The branches, in addition to tapering distally, are also more or less narrowed proximally (attaining their maximum stoutness usually at some considerable distance above their base), and, with the exception of a few of the shorter ones, are generally more or less compressed in the plane of branching; the stoutest measure at most 12 or 13 mm. in the major diameter of their cross-section, and 9 to 10 mm. in the direction at right angles thereto. Anastomosis between the branches does not occur. The oscula, which measure up to 0·75 mm. in diameter, are arranged almost exclusively, though not always very regularly, in two longitudinal series situated on opposite sides of the branches, or occasionally in a single longitudinal series. The surface is smooth and even, without the faintest trace of granulation; on close inspection, it presents a minutely reticulate appearance due to the dermal pores (Pl. xxvi., fig.4). The dermal membrane is thin and (owing to the multitude and close apposition of the minute pores) of gauzy appearance,— permitting to be perceived through it, more or less distinctly, the subdermal pinhole-like openings which are the entrances of the incurrent canals. The consistency is rather fleshy, soft, and resilient, and the branches are flexible and lax. The colour in alcohol is pale orange-yellow.

The dermal pores are arranged in closely approximated, oval to circular groups or "pore-sieves" (Pl. xxvi., figs.4, 7; Pl. xxvii., fig 5) containing each from 3 to 8 pores, and measuring up to 350μ in diameter; the pores themselves measure from 50 to about 100μ in diameter. Very commonly, the boundaries between the sieves are scarcely more pronounced or wider than those separating the pores, so that, in places, the lines of demarcation between the sieves become obscure and the pores appear almost to be uniformly distributed. Within the pore-sieves, the dermal membrane is extremely thin, and contains but very few spirulæ sparsely scattered.

Skeleton. The skeletal axis or core is much more sharply defined and delimited than in any other of the species, and is equalled in density only by that of *T. fastigatus*; in comparison with the stoutness of the branches, it is rather slender, measuring in diameter generally not more than two-thirds of the length of the radial fibres. The radial fibres proceed outwards from the axis in a direction inclined to it at an angle of 60° and upwards, and arrive at the surface almost perpendicularly thereto. Connecting fibres between the radial fibres are extremely few; consequently, in the prepared or macerated skeleton (Pl xxiii. fig.5), the radial fibres are easily disarranged and thus usually present a somewhat dishevelled appearance. The colour of the skeleton is pearl-grey except axially, where it is brownish-grey. The radial fibres are rarely as much as 50μ in stoutness, and are usually provided with a distinct layer of spongin external to the spicules. The connecting fibres consist frequently of only a single spicule, and seldom of more than two.

Megascleres.—Contrary to what is the case in the other herein-described species, *T. fastigatus* excepted, the megascleres are but very rarely, and then only very slightly, of larger size in the stalk than in the branches. They are chiefly strongyla and blunt-pointed oxea approximating more or less in form to strongyla; quite sharp-pointed oxea are comparatively scarce. The strongyla are usually cylindrical or nearly so throughout their whole length, the oxea to within a short distance of their extremities. They attain a maximum size of 300 by 8·5μ. Individuals above 280 by 7μ are rare, and these for the most part are slightly fusiform oxea with more or less sharp-pointed extremities. The shortest spicules are less than 130μ in length, and almost invariably strongyla.



Text-fig. 8.*

Microscleres.—The spirulæ are usually of less than 2 complete turns, rarely, if ever, of as much as $2\frac{1}{2}$; they are somewhat slenderer than those of other species, their diameter very seldom slightly exceeding 1·5μ. Rod-shaped derivatives of the spirulæ, attaining a maximum size of about 17 by 1·7μ, are very scarce.

Microstrongyla are apparently absent.

T. RETEPOROSUS, var. (aut varr.?).

(Pl. xxi., fig. 3; Pl. xxiii., figs. 6-8; Pl. xxiv., figs. 1, 2; Pl. xxv., fig. 1; Pl. xxviii., figs. 1-4; Pl. xxix., fig. 2.)

The remaining specimens referable, or seemingly referable, to the present species (but distinguished in various respects from the above-described typical example) are eleven in number,—comprising ten of those recorded by Dendy(7) as *T. lævispirulifer*

* *Trachycladus reteporosus.* Megascleres: *a*, from the stalk; *b*, from the branches.

Carter, together with an incomplete specimen occurring in the collection of the Australian Museum: the register-numbers of the former are 297, 366, 426, 470 (two spms.), 983, 984, 1000 (two spms.), and 1061. So far as skeletal features are concerned, the specimens exhibit no marked differences (either among themselves or from the typical example), except in certain details of their microspiculation; but the extra-axial skeleton is somewhat less sparse than in the type-specimen,—as may be observed from a comparison of the figures illustrating the appearance of the entire skeleton,—and the colour of the skeleton (in the denser portions thereof) is not brownish-grey, but varies from pale straw-yellow to light golden-yellow. The megascleres are, in all of them, of approximately the same forms and dimensions as in the typical specimen, the greatest deviation by far occurring in in the case of R.N. 426, in which the megascleres of the stalk attain a maximum size of 325 by $9{\cdot}5\mu$, while those of the branches rarely exceed 290 by $7{\cdot}5\mu$. All likewise agree with the type-specimen in possessing long and relatively rather slender branches, which attain their maximum stoutness at some distance above their base; and, with rare exceptions, the branches taper more or less distally. On the other hand, in a number of other external features, and especially in the distribution of the dermal pores, considerable variability is displayed. Non-anastomosis between the branches is the rule. The colour, except in one instance, is some shade of pale yellowish-grey.

Exact resemblance to the typical specimen, as regards the mode of disposition of the dermal pores, is shown only by the incomplete specimen which is in the collection of the Australian Museum. In this specimen, the surface is somewhat ruggedly uneven (Pl. xxi., fig.3), the branches (with a maximum stoutness of only 8mm.) are not at all flattened, and the colour is a slightly salmon-pinkish stone-grey. Microstrongyla are absent. (A photograph of the macerated skeleton is shown in Pl. xxiii., fig.6).

R.N. 1061 approaches the typical specimen in general habit (Pl. xxiv., fig.1), but the branches are much less tapered (occasionally of nearly uniform diameter throughout their length), the surface is faintly granular and somewhat uneven, and the oscula are almost as frequently scattered as arranged serially; the consistency, also, is comparatively firm. The branches vary from (rarely) cylindrical to much compressed, and are usually somewhat lenticular in cross-section. The pores are almost or quite as closely situated and numerous as in the typical specimen, but for the most part they are not arranged distinctly in groups. The spirulæ are peculiar in the fact that they are much less closely coiled than in any other example of the genus, the shape of most of them approaching more or less to that of a contort S; more or less C- or (-shaped forms are also common, but straight or nearly straight rods are extremely rare. Scarce (though by no means rare) microstrongyla are present, varying from 9 to 16μ in length and from 2 to 4μ in stoutness, and almost invariably centrotylote. (A photograph of the macerated skeleton is reproduced in Pl. xxiii., fig.8).

The two specimens R.N. 1000 are much alike in general habit, — which probably accounts for their being registered under the same number, — and differ from all the other specimens, with the exception of R.N. 362, 983, and 984, by the occasional coalescence of their branches: the branches are slender (5 to 8 mm. in diameter), gradually tapered, and not at all compressed: and the surface is somewhat uneven and slightly granular. Nevertheless, in one of the specimens the pores are arranged (Pl. xxviii., fig.2) very nearly as in the typical specimen, while in the other they are distributed singly (Pl. xxviii., fig.1) almost in the same manner as in *T. digitatus*. In both, microstrongyla are exceedingly rare.

In R.N. 983 and 984 the arrangement of the pores (Pl. xxviii., figs.3, 4) is intermediate between that obtaining in R.N. 1061 and that characteristic of *T. digitatus* var. *strongylatus*. The former specimen consists solely of two long branches (one simple, the other with a partially coalescent secondary branch towards its upper extremity), measuring respectively 200 and 300 mm. in length, and both arising almost independently from a small common disc of attachment without the intervention of a stalk. The branches are only 4 mm. in diameter proximally and increase in stoutness upwards very gradually, the larger one attaining a maximum diameter of 12 mm. at a distance of about 50 mm. from its apex, and thence gradually tapering to a point, the smaller one 8 mm. in greatest stoutness and distally untapered. The other specimen, R.N. 984, consists only of a broken-off pair of fused branches somewhat similar to those just described.

R.N. 426 is in one respect unique: the surface is finely hispid, being rendered so by the extremities of the radial skeletal fibres, which everywhere project $\frac{1}{2}$ to 1 mm. beyond it, presenting the appearance of delicate hairs. Furthermore, although the specimen appears to be excellently preserved, the dermal pores have entirely disappeared, and even the oscula are completely closed. Since the skeletal fibres are altogether too slender and weak to be considered capable of withstanding the bending strain which a shrinkage of the sponge due to the action of the preservative fluid would exert, the peculiar condition of the specimen must almost certainly be the result of contraction while in the living condition. In general outward habit, as is evident from the figure (Pl. xxiv., fig.2), this specimen rather resembles the typical specimen. Scarce strongyla are present, similar to those of R.N. 1061.

The two specimens R.N. 470 consist each of only a few detached branches, which, apart from being non-hispid, are exactly similar in every way to those of the preceding specimen. In one of these specimens, no microstrongyla were observed; in the other (and in this alone of all the specimens) they are fairly abundant, resembling in form and size those of R.N. 1061. (A photograph of the macerated skeleton is shown in Pl. xxiii., fig.7).

In R.N. 297 and 366,—both of which are in a dried, much shrunken condition, and consequently afford no information regarding the pores,—the spirulæ are distinguished by being mostly of less than one complete turn and hence more or less C-shaped; straight rods of all lengths from 3 to upwards of 15μ are also common, especially the shorter ones. R.N. 366 consists of a main stem or branch, about 200 mm. in length, attached by its base (which spreads to form a thin incrusting disc about 4 mm. in area) to the surface of a shell, and sending off on one side, at the distances of 50, 60, and 80 mm. respectively from its base, three secondary branches which become coalescent with one another. R.N. 297 is unique in consisting solely of a long slender unbranched stem, 250 mm. in length. In both specimens the extremities are tapered. In neither were microstrongyla observed.

TRACHYCLADUS PUSTULOSUS, sp.nov.

(Pl. xxi., fig.5; Pl. xxvi., figs.5, 8; Pl. xxvii. fig.6; Pl. xxxix., figs.6, 7.)

1887. (?)*Spirophora bacterium* Lendenfeld(**26**), p.795.

Diagnosis.—Branches quite short and distally expanded; sometimes so abbreviated as to be little more than mammiform lobes. Surface closely studded with small pimple-like elevations, and exhibiting, on close inspection, a minute reticulate pattern due to the mode of arrangement of the dermal pores. Oscula situated only on the more distal parts of the branches. Dermal pores arranged in close-set, subcircular, sieve-like groups, usually with from 3 to 7 pores in each group. Dermal layer loosely packed with spirulæ usually throughout its entire thickness—which varies from 40 to 80μ. Skeleton in the upper, more expanded, parts of the branches not forming an axial fune. Fibres stout, and provided with much spongin. Megascleres in the upper parts of the branches consisting almost exclusively of strongyla and oxea in about equal numbers, and rarely attaining to 320 x 9μ in size; peduncular megascleres chiefly oxea (together with occasional styli and only rare strongyla), attaining a maximum size of 460 x 15μ. Microstrongyla extremely abundant, frequently assuming various abnormal shapes, and in part reduced to spheres.

Loc.—Port Phillip.

This species,—of which two well-preserved specimens are at hand, one incomplete, consisting only of a few branches,—is characterised especially by its short stunted branches and very noticeably pimpled surface, and by the fact that the skeleton, except in the stalk and the lowermost part of the longer branches, is only slightly or not at all condensed axially (Pl. xxxix., fig.6). Whilst these features sharply mark it off from all the other known species, it is still further distinguished by having the pores arranged in sieve-like groups (Pl. xxvi., fig.5)—in which respect it is approached only by *T. reteporosus*—and by the reduction of the microstrongyla in part to spheres. An adequate idea of the external habit will be obtained by reference to the figure (Pl. xxi., fig.5) of the single complete example, which measures 60 mm. in total height: in the case of the other specimen, the branches are somewhat longer, several of them attaining a length of 25 mm. The colour in alcohol is a minutely mottled, slightly brownish pale grey, and the consistency is firm, fairly tough, compressible and resilient.

The surface-pimples,—which coincide in position with, and to some extent are the expression of, the points of impingement of the skeletal fibres upon the dermal membrane,—are fairly uniformly distributed over the whole surface at a distance apart approximating to their own breadth, which on the average is about 0·4 mm.; they are rounded or flattened above, not conule-like, and are conspicuous not so much by the amount of their projection—which at the most is but slight—as by their whitish colour and more opaque appearance compared with the intervening portions of the surface. At the locations of the small areas formed by these elevations, the dermal membrane is closely adherent and non-porous; but between them it overlies subdermal spaces, and is so perforated by numerous small pore-sieves as to appear minutely reticulate. The pore-sieves (Pl. xxvi., fig.7; Pl. xxvii., fig.6), are oval to circular in outline and generally between 40 and 120μ in distance apart, range from less than 100 up to about 200μ in diameter, and contain each, according to their size, from 2 to 8 pores of diameter varying from 20 to 60μ.

Skeleton.—Except in the stalk and the lower portions of some of the lower branches, the skeleton exhibits no well-marked axial condensation or core, but is rather of the dendritic type (Pl. xxxix., fig.7) consisting chiefly of longitudinally-running and of gradually outward-trending, continually branching main fibres, which are not distinguishable as axial and radial respectively; transverse or connecting fibres are numerous between the main fibres in the central region of the branches, but comparatively scarce and somewhat irregular in occurrence towards their surface The main fibres attain a stoutness occasionally of nearly 200μ in the axial region of the skeleton, but diminish in diameter peripherally to between 60 and 100μ; they are composed of somewhat loosely and irregularly packed spicules united by abundant spongin-cement. The connecting fibres are usually less than 50μ in stoutness and are composed almost entirely of spongin. The spongin shrinks considerably on drying, so that in the dried skeleton the stoutness of the fibres is much less than stated above. The skeleton seen in its entirety (Pl. xxxix., fig 6) is of a golden-yellow colour.

Text-fig. 9.—*Trachycladus pustulosus*. Megascleres: *a*, from the stalk; *b*, from the branches.

Megascleres.—The differences between the megascleres of the stalk and of the branches are more marked than in any other of the species herein described, the former consisting almost entirely of sharp-pointed oxea, ranging from seldom less than 250 up to 460μ in length and up to 16μ in stoutness, and very similar in form and size to those of *T. digitatus* var. *strongylatus*, while the latter are strongyla and more or less blunt-pointed oxea —the strongyla being if anything somewhat the more numerous—ranging in length from occasionally less than 150μ up to about 320 or 330μ, and seldom exceeding 8·5 or 9μ in stoutness. Occasional styli are met with, which are most frequent among the peduncular megascleres; among the latter also anisoxea are not uncommon.

Microscleres.—The spirulæ are of all forms between corkscrew-spirals of a little more than 2 turns and straight rods, the latter fairly common and mostly between 12 and 25μ in length and from 2 to 3·5μ in diameter. The spirulæ are less closely coiled than in any other of the species, and are also slightly larger (occasionally attaining to 18μ in length).

The microstrongyla are rarely less than 2 or more than 3·5μ in diameter, and of all lengths up to 18μ; a notable proportion are reduced to spherulæ. They are mostly not centrotylote. Abnormal forms of various shapes are rather common.

EXPLANATION OF PLATES XXI.-XXIX., figs.1-2; XXXIX., figs.6-7.

Plate xxi.

Fig.1.—*Trachycladus fastigatus*, sp.nov.; from the (partially dried) type-specimen; ($\times \frac{3}{8}$).

Fig.2.—*T. reteporosus*, sp.nov.; from the type-specimen; ($\times \frac{1}{3}$).

Fig.3.—*T. reteporosus*, sp.nov. (var. ?); from an incomplete specimen with slightly rugose surface; ($\times \frac{1}{2}$). *Cf.* also Pl. xxiv., figs.1-2.

Fig.4.—*T. scabrosus*, sp.nov.; from the type-specimen; ($\times \frac{2}{3}$).

Fig.5.—*T. pustulosus*, sp.nov.; from the type-specimen; ($\times \frac{4}{5}$ nearly).

Plate xxii.

Figs.1-2.—*Trachycladus digitatus* Lendenfeld, typical form; ($\times \frac{5}{6}$ approx.).

Fig.3.—*T. digitatus* var. *gracilis*, var.nov.; from the type-specimen; ($\times \frac{5}{6}$).

Fig.4.—*T. digitatus* var. *clavatus*, var.nov.; from the type-specimen; ($\times \frac{3}{4}$ nearly).

Fig.5.—*T. digitatus* var. *strongylatus*, var.nov.; from the (incomplete ?) type-specimen; ($\times \frac{9}{10}$).

Plate xxiii.

Fig.1.—*Trachycladus digitatus* Lendenfeld, typical form; skeleton; (nat. size).

Fig.2.—*T. digitatus* var. *gracilis*, var.nov.; skeleton; (nat. size).

Fig.3.—*T. digitatus* var. *clavatus*, var.nov.; skeleton; (nat. size).

Fig.4.—*T. digitatus* var. *strongylatus*, var.nov.; skeleton; (nat. size).

Figs.5-6.—*T. reteporosus*, sp.nov.; skeleton (of the type-specimen and of the specimen illustrated in Pl. xxi., fig.3, respectively); (nat. size).

Figs.7-8.—*T. reteporosus*, sp.nov., (var. ?); skeleton (of the specimens figured in Pl. xxiv., figs.1-2); (nat. size).

Fig.9.—*T. scabrosus*, sp.nov.; skeleton; (nat. size).

Fig.10.—*T. fastigatus*, sp.nov.; skeleton; (nat. size).

Plate xxiv.

Fig. 1.—*Trachycladus reteporosus*, sp.nov., (var. ?); R.N.1061; (× ½).

Fig. 2.—*T. reteporosus*, sp.nov., (var. ?); R.N.426 (a specimen in which the dermal pores could not be seen); (× ½).

Fig. 3.—*T. reteporosus*, sp.nov., typical form; one-half of a (desilicified) longitudinal median section of a branch of the type-specimen, showing the dermal layer (in part torn away), subdermal spaces, excurrent and incurrent canals, flagellated chambers, and (on the left) portion of the axial skeleton; (× 18).

Plate xxv.

Fig. 1.—*Trachycladus reteporosus*, sp.nov., (var. ?); longitudinal median section of the skeleton; (× 10).

Fig. 2.—*T. digitatus* Lendenfeld, var. *clavatus*, var.nov.; portion (slightly less than one-half) of a transverse section of a branch, showing the arrangement of the flagellated chambers, etc.; (× 18).

Plate xxvi.

Fig. 1.—*Trachycladus reteporosus*, sp.nov., (typical form); longitudinal median section of the skeleton, showing the pattern of the axial fune; (× 10).

Fig. 2.—*T. digitatus* Lendenfeld, (typical form); portion of the surface (from part of which the dermal membrane has been pared off) showing the disposition of the dermal pores, and also of the main incurrent canals; (× 6).

Fig. 3.—*T. digitatus* var. *strongylatus*, var.nov.; portion of the surface, showing the arrangement of the dermal pores and the character of the oscula; (× 6).

Fig. 4.—*T. reteporosus*, sp.nov.; portion of the surface, showing the arrangement of the dermal pores; (× 6).

Fig. 5.—*T. pustulosus*, sp.nov.; portion of the surface, showing the arrangement of the dermal pores; (× 6).

Fig. 6.—*T. digitatus* var. *strongylatus*, var.nov.; portion of the surface, showing the arrangement of the dermal pores; (× 20). (From a drawing).

Fig. 7.—*T. reteporosus*, sp.nov., (typical form); portion of the surface, showing the arrangement of the dermal pores; (× 30). (From a drawing).

Fig. 8.—*T. pustulosus*, sp.nov.; portion of the surface, showing the arrangement of the dermal pores; (× 30). (From a drawing).

Fig. 9.—*T. digitatus* Lendenfeld, var. *gracilis*, var.nov.; moderately thick, transverse section of a branch; (× 18).

Plate xxvii.

Fig. 1.—*Trachycladus digitatus* Lendenfeld, (typical form); surface-section, showing the arrangement of the dermal pores; (×40).

Fig. 2.—*T. digitatus* var. *gracilis*, var. nov.; surface-section, showing the arrangement of the dermal pores; (×40).

Fig. 3.—*T. digitatus* var. *claratus*, var. nov.; surface-section, showing the arrangement of the dermal pores; (×40).

Fig. 4.—*T. digitatus* var. *strongylatus*, var. nov.; surface-section, showing the arrangement of the dermal pores; (×40).

Fig. 5.—*T. reteporosus*, sp. nov., (typical form); surface-section, showing the arrangement of the dermal pores; (×40).

Fig. 6.—*T. pustulosus*, sp. nov.; surface-section, showing the arrangement of the dermal pores; (×40).

Plate xxviii.

Fig. 1.—*Trachycladus reteporosus*, sp. nov., (var. ?); portion of the surface (of one of the specimens R.N. 1000) showing the arrangement of the dermal pores; (×40).

Fig. 2.—*T. reteporosus*, sp. nov., (var. ?); surface-section (of R.N. 1061), showing the arrangement of the dermal pores; (×40).

Figs. 3, 4.—*T. reteporosus*, sp. nov., (var. ?); surface-sections (of the specimens R.N. 983, 984), showing the arrangement of the dermal pores; (×40).

Fig. 5. *T. digitatus* Lendenfeld, var. *claratus*, var. nov.: rather thin (undesilicified) transverse section of a branch; (×15).

Fig. 6.—*T. scabrosus*, sp. nov.; rather thin (desilicified) transverse section of a branch; (×20).

Plate xxix., figs. 1-2.

Fig. 1.—*Trachycladus digitatus* Lendenfeld, var. *claratus*(?), var. nov.; specimen R.N. 415; (×½).

Fig. 2.—*T. reteporosus*, sp. nov., (var. ?); thin, transverse section of a branch (of specimen R.N. 1000); (×15).

Plate xxxix, figs. 6-7.

Fig. 6.—*Trachycladus pustulosus*, sp. nov.; skeleton photographed by transmitted light; (nat. size).

Fig. 7.—*T. pustulosus*, sp. nov.; showing pattern of the skeleton as seen in thin longitudinal section (passing through three branches and the upper part of their common stem); (×5).

A REVISION OF THE GENERA WITH MICROSCLERES INCLUDED, OR PROVISIONALLY INCLUDED, IN THE FAMILY *AXINELLIDÆ*; WITH DESCRIPTIONS OF SOME AUSTRALIAN SPECIES. Part ii.

[PORIFERA.]

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(Plates xxix., fig.4; xxx.-xxxii.; xxxiii., figs.1-5; xxxiv.-xxxvii.; xxxviii., figs.1-3: and Text-figs.10-16.)

Genus BIEMNA Gray (sens. lat.).

Definition.—Axinellidæ typically of massive or encrusting habit, occasionally tending to become lamellar or calicular, almost invariably provided with conuli or other surface-elevations of less regular form, or with digitate processes either solid or tubular; or, finally, consisting almost entirely of tubular processes. The skeleton varying, sometimes conforming more or less to a halichondroid type, but more frequently consisting of definite fibres, which sometimes are arranged reticulately. The spicules composing the fibres are sometimes (in the less typical species) arranged more or less plumosely, or even in part echinatingly. The megascleres are typically of a single order,—either styli alone, or styli together with oxea of similar dimensions; special dermal megascleres are absent. The microscleres are invariably sigmata and trichites (or microxea), the latter usually or perhaps always occurring (partly at least) in dragmata; and to these may be added commata, microstrongyla, or spherulæ.

Type-species, *B. peachi* Bowerbank.

The species for which the genus *Allantophora* was proposed by Whitelegge(58) differs in the combination of its characters so notably from any species known previously to it, and, in one important respect at least, so considerably also from any which has since been described, that its true affinities were until recently(**13**) unsuspected, while the propriety of maintaining a separate genus for its reception has not hitherto been called into question. Whitelegge, disregarding the evidence afforded by the microscleres present, and attaching overmuch importance to the echinate arrangement of some of the spicules composing the skeletal fibres, arrived at the conclusion that *Allantophora* is intermediate between *Echinoclathria* and *Ophlitaspongia*; whereas I, in my earlier remarks in reference to the genus(**12**), expressed the opinion that, provisionally at least, it should be placed in the Mycalinæ, and suggested the possibility of its relationship with *Crambe*(= *Tetranthella*). Since then, as I more recently have found occasion to remark(**13**), a second species possessing microstrongyla as microscleres in addition to sigmata and trichodragmata, has been described by Hentschel(**15**) under the name *Tylodesma microstrongyla*, which in spiculation accords so closely with *Allantophora plicata* as to leave no room for doubting the close genetic affinity of the two, yet the skeleton of which conforms, or at any rate closely approximates, to a halichondroid type. Hence it seems to follow that the essential feature to be taken into account in deciding as to the proper systematic position of these species is not, in either case, the precise configuration of the skeleton, but rather the constitution thereof from the point of view of the spicular elements composing it, both megascleric and microscleric: and accordingly one is led to suspect the probability of their relationship with such species as *Biemna megalosigma* Hentschel(**15**), and *Biemna chilensis* Thiele(**42**), the spiculation of which is essentially the same as theirs except only in this respect, namely, that instead of microstrongyla the microscleres include spherulæ,—and in which, furthermore, the skeletal arrangement is of a somewhat intermediate type. In support of this, there now comes to light a third species with microstrongyla (and, significantly, with spherulæ also),—described below as *Allantophora victoriana*,—which forms a definite and absolute connecting-link between *A. plicata* and *Sigmaxinella ciocalyptoides* Dendy, it being even questionable, indeed, whether both it and the last-named should not be looked upon merely as varieties of *A. plicata*: and *Sigmaxinella ciocalyptoides*, in turn, is found to provide no feature definitely justifying its separation generically from the majority at least of the species at present included in *Biemna*. Accordingly it becomes necessary to decide upon what grounds, if any, the genera *Tylodesma*, *Allantophora*, and *Sigmaxinella* admit of being retained.

The distinction between *Tylodesma* (olim *Biemna*) and *Biemna* (olim *Desmacella*) deemed essential by Topsent(**46**),—to whom the separation of the species of Ridley and Dendy's group Desmacellinæ into these two genera is due,—was with respect to the mode of conformation of the skeleton, a halichondroid type of skeleton being regarded by him as characteristic of the former genus, a disposition of the megascleres in definite fibres as characteristic of the latter: whether the megascleres were styli or tylostyli was looked upon as of minor importance The same distinction was emphasised by Lundbeck(**30**) in defining these genera, though at the same time he attached equal value to certain differences in their microscleric spiculation; other authors, however,—as Thiele(**41**), Dendy(**8**), and Hentschel(**15**),—seem disposed, like Topsent, to regard it as fundamental. Nevertheless, a critical survey of the species concerned renders it evident that the distinction is an arbitrary one, and incapable of being maintained; in proof of which one need only refer to the fact that in certain instances, as, for example, in the case of *Biemna microxa* Hentschel(**14**), and of the so-called *Biemna humilis* Thiele(**41**), the authors themselves show uncertainty as to the genus to which the species ought rather to be assigned. If, however, the species with tylostyli or subtylostyli as megascleres (typical of *Tylodesma*) be compared with those in which tylostylote megascleres are absent (typical of *Biemna*), it is found in the case of the former that the microscleres present frequently comprise toxa in addition to sigmata, but never trichites or microxea, whereas in the case of the latter, with one highly questionable exception—viz., *Desmacella fragilis* Kieschnick(**24**),—trichites or microxea are invariably present, but never toxa. Accordingly there is excellent ground for the retention of the genus *Tylodesma*, but its definition requires amendment.

The three species, for the reception of which Dendy(7) proposed the genus *Sigmaxinella*, agree in having both monactinal and diactinal megascleres and, as microscleres, sigmata and trichodragmata, but in a number of other important respects they differ very considerably; and, as already indicated, one at least of them equally admits of inclusion in *Allantophora* or in *Biemna* as hitherto defined. However, the first-described of the three, *S. australiana*, as well as several of the species which Kirkpatrick(20) and Whitelegge(60) have ascribed to *Sigmaxinella*, differ from all other known species possessing similar microscleres, firstly in being of ramose habit, and secondly in having an axially condensed skeleton. Consequently, with an amended diagnosis, the genus *Sigmaxinella* also admits of being retained.

The third species assigned by Dendy to *Sigmaxinella*—*S. flabellata*—is (among the species having sigmata and trichodragmata as microscleres) quite unique, not only as regards skeletal structure, but also in the fact that the megascleres are of two distinct kinds, viz., styli composing the fibres, and elongated flexuous strongyla (and tornota) occurring interstitially,—the latter of which are strikingly analogous to the spicules of similar form characteristic of many species of *Axinella*, *Phakellia*, *Acanthella*, and *Tragosia*. Were it not for the presence of sigmata, there would be no adequate reason, apart from the flexuous character of the interstitial megascleres, for excluding the species from the genus *Dragmacidon* (g.n.), which in turn comprises species hitherto assigned to *Thrinacophora*; whilst, if both kinds of microscleres were absent, it would almost certainly have to be included in the genus *Phakellia* as defined by Dendy(8). Being such as it is, however, the species undoubtedly deserves a new genus for its accommodation, and for this I propose the name *Sigmaxia*.

The question whether *Allantophora* admits of separation from *Biemna* is a much more difficult one, and at present cannot be satisfactorily decided; for although there exists with respect to skeletal structure a profound difference between the typical species of the two genera,—as is very obvious from a comparison of Topsent's figure of *B. peachi*(54; Pl. iv., fig.3) with mine of

A. victoriana (Pl. xxxi., figs.1, 2),—yet the descriptions of other species seem to indicate that intermediate (as well as additional) types of skeleton occur, while in not a few instances, furthermore, the requisite information relating to the skeleton is lacking. At the outset, a satisfactory line of division between the two genera seemed to me possibly securable by taking into account the fact that in most if not all of the indubitable species of *Biemna* the microscleres include commata, but never microstrongyla, whereas in the remaining species commata are absent; but the serviceableness of this as a means of distinction appears to be ruled out of court by the circumstance, recently announced by Topsent(**54**), that in *B. peachi* commata are apparently sometimes missing. A further difficulty is created by Topsent's discovery (*loc. cit.*) that "commata" are present in his *Biemna fistulosa*, which have not the form of curved microstyli but "s'y montrent flexueux avec un bout renflé et l'autre un peu aminci," so that their form "rapelle un peu celle de sigmaspires deroulées"; and it is possible that these microscleres are a connecting-link between the styliform commata of *B. peachi*, etc., and the microstrongyla of typical *Allantophora*-species. Consequently, since one is unable so to define the genera as to render them mutually exclusive, there is no alternative for the time being but to combine them, and I have therefore formulated the diagnosis of *Biemna* accordingly. Inasmuch, however, as I am confident that the necessity for this is only temporary, and that a fuller knowledge of the species concerned will furnish occasion for the rehabilitation of the genus *Allantophora*, I have refrained for the present from discarding the name in the designation of the species described below, to which it must necessarily apply if the genus be ultimately readopted.

The amendment which I introduce in regard to the distinction to be drawn between the genera *Biemna* and *Tylodesma* affects the position only of five species, namely, of *Tylodesma microstrongyla* Hentschel, and *T. microxa* Hentschel, which (as their spiculation consists of styli, sigmata, trichites, and, in the former, also of microstrongyla) must be included in *Biemna*; and of *Biemna humilis* Thiele(**41**), *B. vulgaris* Topsent(**45**), and

B. truncata Hentschel(15), which (having a spiculation composed, in the case of the first, of subtylostyli, sigmata, and toxa, and in the others, of tylostyli and sigmata) must be transferred to *Tylodesma*. In order to frame a satisfactory definition of *Biemna*, which will serve effectually to distinguish it from *Dragmacidon* and *Rhaphoxya* (gg.nn.), it is necessary to insist upon the presence of sigmata as an essential character of the genus: for this reason, if for no other, Topsent's *Desmacella aberrans* (with trichodragmata alone as microscleres), which Lundbeck has referred to *Biemna*, must be removed therefrom; and for its reception I propose a new genus, *Dragmatella*, which I provisionally regard as occupying a position between *Dragmacidon* and *Rhaphoxya*. Lundbeck is inclined to refer also Schmidt's imperfectly known *Desmacella vagabunda* and *D. pumilio* to *Biemna*. Of these two species I have not seen the descriptions; but judging from Schmidt's original diagnosis of *Desmacella*, quoted by Ridley and Dendy(53), the microscleres present are sigmata and (or) toxa, in which case the species cannot in my estimation be assigned to *Biemna*, but belong most probably to *Tylodesma*. As regards Kieschnick's *Desmacella fragilis*, referred to above, it is impossible, owing to the unreliability of its description, to express any definite opinion. If it be true that its microscleres are sigmata, trichodragmata, and *toxa*, as stated, I think that this would render necessary the erection for it of a new genus; until rediscovered, however, the species must be regarded as *incertæ sedis*. The only other species about which there can be said to exist any occasion for doubt is *Desmacella cavernula* Bowerbank(1), in which the microscleric spiculation is described as consisting solely of sigmata; but as the megascleres are styli (and *not* tylostyli), and, furthermore, as there is ground to suspect, owing to the dried condition of Bowerbank's single specimen, that the occurrence of trichodragmata therein was overlooked, the probability is that the species is correctly to be assigned to *Biemna*. Nevertheless, the species is peculiar, regarded as a member of this genus, in the fact that the megascleres are distinguishable into two groups, the one kind composing the fibres, the other occurring interstitially and also forming a dermal skeleton: and this peculiarity may possibly prove to be associated with other distinctive features of a character that would justify its exclusion from the genus. According to Thiele(40), a partial differentiation of the megascleres into several groups is exhibited in the case of *B. korenii* also, but apparently this occurs without relation to the particular position which the spicules occupy, since he makes no mention of the fact; and Lundbeck(30) further notes that in *B. capillifera* there are present, in addition to the skeletal spicules proper, smaller styli which are found only in the part of the sponge nearest to the substratum, where they form a thin layer. In all the remaining species of *Biemna*, so far as I am aware, the megascleres are definitely of a single order (though occasionally comprising both monactinal and diactinal forms).

Hentschel(15) has recently referred to *Biemna* (under the name *B. aruensis*) a species possessing neither sigmata nor trichodragmata, but having as flesh-spicules small slender curved tylostyli, which he terms "kommaformige Rhaphiden" and apparently regards as homologous with the commata of species like *B. peachi.* Inasmuch, however, as the remaining spiculation consists of megascleres (of two distinct kinds) in the form of (longer) subtylostyli and (very much shorter) tylostyli respectively, and as, furthermore, the sponge is regularly dome-shaped and prolongs itself upwards into a tubular process, it seems to me practically certain that the species is one requiring to be included in the family Polymastiidæ. Unfortunately Hentschel has neglected to investigate the structure of the skeleton, and one therefore lacks the information necessary to decide whether the species requires a new genus for its reception, or permits of inclusion in the genus *Polymastia* itself. But, for the present, I would recommend that the species be known as *Polymastia*(?) *aruensis.*

Of species referable to *Biemna* which have been assigned to genera other than *Biemna*, *Desmacella*, *Tylodesma*, or *Allantophora*, there is apparently only one, viz., *Sigmaxinella incrustans* Kirkpatrick(20).

A few fragments of a sponge have been recorded from Christmas Island by Kirkpatrick(21) as *Desmacella* sp., in which the megascleres are oxea, fewer styli, and rare strongyla, all of approximately the same dimensions (viz, 180 × 7μ, 150 × 9μ, and 126 × 6μ respectively), and the microscleres are very rare sigmata, rare toxa, and rare trichites; but in which the skeleton is a unispicular renieroid meshwork, with triangular and quadrangular meshes. Obviously, if the microscleres are really proper to it, this species should be assigned, provisionally at least, to the genus *Gellius*.

The genus *Biemna*, as now defined, accordingly comprises the following species:—

i. With commata - typical species of the genus.

B. peachi Bowerbank(**1**; **30**).	English Channel; Scotland; off Norway; off Iceland.
B. capillifera Levinsen(**28**; **30**).	E. Canada; Iceland; Kara Sea.
B. hamifera Lundbeck(**30**).	Off Iceland.
B. grœnlandica Fristedt(**10**; **30**).	E. Coast of Greenland.
B. stellifera Fristedt(**9**). (With asters?).	Sweden.
B. fistulosa Topsent(**48**; **54**).	Amboina.
B. sp. Thiele(**41**).	Ternate.

ii. Without commata (so far as known), and without microstrongyla; but apparently otherwise conforming rather to the species with commata.

B. korenii Schmidt(**35**; **40**).	Off Norway.
B. variantia Bowerbank(**1**).	Bristol Channel.
(?)*B.* (?)*cavernula* Bowerbank(**1**).	Shetland Islands.
B. trirhaphis Topsent(**48**; **41**).	Amboina; Ternate.
(?)*B. fortis* Topsent(**48**).	Amboina.

iii. Without commata (so far as known), and without microstrongyla; but apparently otherwise conforming rather to the species with microstrongyla.

B. incrustans Kirkpatrick(**20**).	Cape Colony.
B. tubulata Dendy(**8**).	Ceylon.
B. macrorhaphis Hentschel(**16**).	Antarctic Ocean.

B. microxa Hentschel(**14**).	Sharks Bay, W. Australia.
B. sp. Hentschel(**15**).	Arafura Sea.
B. chilensis Thiele(**42**). (With spherulæ).	Chili.
B. megalosigma Hentschel(**15**). (With spherulæ).	Arafura Sea.
B. megalosigma var. *liposphæra* Hentschel(**15**).	Arafura Sea.
B (*Allantophora*) *ciocalyptoides* Dendy.	Port Phillip, Victoria.

iv. With microstrongyla.

B. (*Allantophora*) *plicata* Whitelegge.	New South Wales.
B. (*Allantophora*) *victoriana*, sp.n.	Port Phillip, Victoria.
B. (?*Allantophora*) *microstrongyla* Hentschel(**15**).	Arafura Sea.

Allantophora plicata Whitelegge.

(Pl. xxix., fig.4; Pl. xxx., figs.1, 2, 3.)

1907.*Allantophora plicata* Whitelegge(**60**),p.505, Pl. xlv., fig.28.

Diagnosis.—Sponge consisting of a cluster of erect, proliferous lamellæ, sometimes interunited more or less by anastomosis, and frequently tending to become more or less pointed above or to divide distally into digitate processes. Surface irregular, and provided with many slender tapering conuli. Dermal membrane moderately thick, without contained megascleres, and without pores visible to the naked eye. Skeleton an irregular reticulation, of fairly uniform density throughout, consisting of ascending multispicular main fibres (mostly between 100 and 200μ in stoutness) and numerous slenderer, for the most part paucispicular, connecting fibres. Spicules of the main fibres rather loosely (and often somewhat plumosely) arranged. Both main and connecting fibres provided with moderately numerous, more or less nearly perpendicularly-directed, echinating spicules similar in kind to the coring spicules. Spongin present only in moderate quantity. Megascleres: styli and (relatively few) oxea, ranging from less than 300 to upwards of 500μ (occasionally to upwards of 600μ) in length, and (in different specimens) varying from 16 to 22μ in maximum stoutness. Microscleres: (i.) numerous sigmata of two sizes, respectively 11 and 21μ in maximum length; (ii.) trichodragmata typically of two sizes, together with scattered trichites of similar length (viz., up to about 60μ) to those composing the larger dragmata; and (iii.) numerous microstrongyla, the largest measuring 20 by 8μ.

Loc.—Off Crookhaven River, N.S.W. ("Thetis").

Introductory.—In addition to the single example originally described, there are now available three other complete specimens of the species, and a fragment of a fourth. Of these, only the last-mentioned is preserved in alcohol, the remainder (with the exception of the type-specimen, which has been dried—probably after having been some time in alcohol—without complete removal of the sarcode) being washed-out and otherwise more or less damaged beach-specimens.

External features.—In all four specimens, the general habit is the same. The sponge consists of an often more or less intricate cluster of erect lamellæ, which are joined each to another along one lateral edge,—the other edge either remaining free or (less frequently) becoming connected by anastomosis with some portion of another lamella,—and which tend most frequently to become narrowed and more or less pointed above, or sometimes to partially resolve distally into several pointed digitiform processes. The lamellæ vary from 2 to 12 mm. in thickness; and the largest specimen measures 130 mm. in height. Usually, a main or primary lamella is to be distinguished, and from this secondary lamellæ proceed, which in turn give rise in a similar way to others of higher order. The lamellæ are not always directed perpendicularly to those from which they arise, but often more or less obliquely; and occasionally some of the larger ones may be vertically curved or folded. The sponge is sessile, and is sometimes attached only by a limited portion of the base of the primary lamella; but more usually the area of attachment is much more extensive, and is formed partly by the bases of other lamellæ as well. The surface is rendered more or less uneven by irregular, longitudinally disposed ridges and furrows, and by numerous acuminate conuli. The former inequalities are much more marked in dried and washed-out specimens (Pl. xxx., fig.2) than in the perfect sponge (Pl. xxx., fig.1), since in the case of the latter the depressions are largely filled up with fleshy tissue and covered over by dermal membrane. In the washed-out condition of the sponge, numerous lesser inequalities also are in evidence, causing the surface to present a somewhat cellular or roughly pitted appearance, and giving rise here and there—more especially in the case of thinner lamellæ—to actual perforations: it is the depressions producing this appearance that are somewhat misleadingly referred to in the original description as "pores." The conuli are conspicuous in the well-preserved sponge, but may be entirely missing in the case of beach-specimens owing to their fragility and the ease with which they become broken off when dry; they are narrow at the base and thread-like at the apex, are traversed axially by a single skeletal fibre, and vary in length from 2 to 5 mm. Oscula were not observed.

The consistency of the sponge in alcohol is firm, fairly tough, compressible, and resilient; and the colour is yellowish-brown. Dry specimens vary considerably in their consistency and textural appearance according to the extent to which the sarcode has been removed. When thoroughly washed-out, the sponge is tough and elastic, and its texture (as compared with that, say, of an ordinary washing sponge) is loosely and coarsely fibrous: the fibres that terminate at the surface run towards it in an obliquely ascending direction, and being free from one another (*i.e.*, unconnected by transverse fibres) for some distance from their extremities, give to the surface a slightly shaggy appearance (Pl. xxx., fig.3). On the other hand, if dried without (or with only partial) removal of the sarcode, the sponge (as in the case of the type-specimen) is inelastic and rather brittle, and of a texture that might be described roughly as pumiceous (Pl.xxx., fig.2). In this latter condition of the sponge, the interstices of the skeleton are frequently tympanised by delicate parchment-like membranes (erroneously referred to in the original description as being portions of the dermal membrane). The colour of dry specimens varies from light to brownish-grey.

The dermal membrane is very distinct and fairly tough, and overlies numerous, usually not very extensive, subdermal spaces; it is not (to the naked eye) visibly porous. The dermal pores, over limited areas of the surface, are similar in their arrangement to those of *A. victoriana* (*cf.* Pl. xxxviii., figs.1-4), except that the circular groups they form (which, in rare instances, attain a diameter of 130 to 150μ) are relatively less closely apposed; but generally they occur only several together in much smaller groups—or, in rare cases, even singly—and the groups are separated by distances sometimes exceeding their own diameter.

Skeleton.—Whilst in regard to spiculation no definite distinction can be drawn between the present species and *A. victoriana*, the arrangement of the skeleton in the two differs very considerably This will be evident from a comparison of the figures of the skeleton (prepared by treatment with caustic potash) in the two cases, as seen in section,—especially Pl. xxix., fig.4, and Pl. xxxi., fig.1,—the former of which is from a lamella (varying in thickness from less than 1 mm. at one edge to 8 mm. at the other) of the present species, and the latter from a thick vertical slice (from 6 to 10 mm. in thickness) of a massive specimen of *A. victoriana*. The chief points of difference are two. Firstly, there is an entire absence, in the present species, of any observable differentiation in the structure of the skeleton relative to a number of separate axes, and the pattern is accordingly everywhere (including even the incipient processes into which the lamellæ sometimes tend to resolve) much the same; and secondly—in necessary correlation with this—the main fibres are never transversely directed, but always run in a more or less ascending direction, with gradual trend surfacewards, branching (not very frequently) as they go. As in *A. victoriana*, the connecting fibres are numerous, and interunite with one another to form (along with the main fibres) a rather small-meshed reticulation; but the reticulation is here very irregular, and there is no marked tendency on the part of the connecting fibres to be confined (as in *A. victoriana*) to vertical planes; in some parts, however,—more especially in the processes—a slight tendency towards such an arrangement is occasionally exhibited. A further notable point of difference is the frequency of occurrence, in the present species, of megascleres disposed more or less perpendicularly to the fibres,—with their bases implanted therein,—in the manner of echinating spicules. The main fibres are composed chiefly or (not seldom) almost entirely of spicules, arranged usually in a loose, often in a more or less dishevelled or somewhat plumose fashion, and are usually between 100 and 200μ in stoutness; in the oldest portions of the sponge, however, they occasionally attain a diameter of from 300 to 400μ. The amount of spongin cementing their spicules is rather variable, but is seldom sufficient to form a well-defined sheath; as seen in cross-section, the outline of the fibres is very irregular. The connecting fibres are uniserial to multiserial in spiculation, and are relatively more sponginous than the main fibres. But very few megascleres are scattered between the fibres. Sigmata (of two sizes) and microstrongyla occur in great abundance throughout all parts of the interior, together with moderately numerous trichodragmata and singly scattered trichites; the last-mentioned, however, are not very evident owing to their extreme tenuity. In the dermal membrane, sigmata are again very abundant, and single trichites almost equally so, but trichodragmata and microstrongyla are extremely rare, and megascleres are altogether absent.

Spicules.—(i.) The megascleres are styli and relatively few oxea—the proportionate number of the latter variable, ranging from less than 1 in 100 (in the type-specimen), occasionally to as many as 1 in 10. Though somewhat scarce as echinating spicules, the oxea occur in all the same situations in the skeleton as the styli, and are undoubtedly only variants of them; nevertheless, transitional forms between the two are extremely rare. The styli are slightly curved, with the curvature most pronounced in, and usually confined to their basal moiety; are evenly rounded at the base, and of uniform or nearly uniform diameter thence to beyond the middle of their length; and taper gradually to a sharp point. The oxea—apart from their being diactinal—

differ from the styli only in being curved symmetrically and more strongly, and also somewhat angulately. In different specimens, the megascleres vary from 520 to 670μ in maximum length and from 16 to 22μ in maximum stoutness; and the shortest spicules in any specimen are between 200 and 300μ in length. The longest spicules are seldom much more than one-half (very rarely, if ever, as much as two-thirds) the maximum stoutness, the greatest diameter being attained by those of intermediate and lesser lengths.

Text-fig. 10.

Allantophora plicata. *a*, megascleres; *b*, *c*, larger and smaller sigmata; *d*, *e*, microstrongyla from each of two different specimens.

(ii.) The sigmata are, almost without exception, more or less contort, but seldom to such an extent as to appear S-shaped when viewed from the side. They are of two sizes, the larger 15 to 21μ, the smaller 7 to 11μ, in length, and measure respectively 1·5 and about 0·75μ in maximum stoutness. The latter are by far the less numerous, but are nevertheless by no means scarce.

(iii.) The trichites are typically of two sizes; the longer ones immeasurably thin, 50 to 65μ in length in some specimens, only 35 to 50μ in others, and occurring both in dragmata and scattered singly; the shorter ones relatively stouter and slightly fusiform in shape, 15 to (rarely) 30μ in length, and apparently occurring only in dragmata. In two (dry) specimens, however, the shorter trichites were not observed. The dragmata frequently take the form of dense roundish masses of trichites, sometimes exceeding 300μ in breadth, which refract the light in such a way as to appear blackish and opaque.

(iv.) The microstrongyla are seldom less than 10μ in length and 2μ in diameter, but are usually much stouter, and have a maximum size of 20 by 8μ. They are nearly always slightly curved and more or less distinctly centrotylote. Abnormal forms occur, in which the annular swelling is irregular in shape, excentric in position, or several times repeated, but they are not very numerous and seldom depart from the normal shape to any considerable extent.

Allantophora victoriana, n.sp.

(Pl.xxx., figs.4, 5; Pl.xxxi., figs.1-4; Pl.xxxii., figs.1-5; Pl.xxxviii., figs.1-4; Pl. xl., figs.5, 6.)

Diagnosis.—Sponge erect, either entirely massive or subdividing superiorly into separate tapering digitations. Surface slightly irregular, and provided with numerous, fairly uniformly distributed, more or less acuminate conuli. Dermal membrane very distinct; without contained megascleres; usually showing to the naked eye a minutely reticulate pattern due to the mode of arrangement of the dermal pores. Skeleton (in the body of the sponge) consisting of a congeries of similar components, each constructed on the same plan as the entire skeleton of a single digitation. In each component, the main fibres (excepting, usually, one or a few longitudinally-directed primary fibres occupying its axis) are disposed more or less perpendicularly to the axial direction of the component, *i.e.*, in a radial or pinnate fashion; and these are joined together by connecting fibres which are almost exclusively confined to vertical planes. The main fibres are relatively very stout (up to over 300μ in diameter), and are composed chiefly of spicules arranged more or less compactly; the connecting fibres are slender, mostly paucispicular, and composed chiefly of spongin. A few echinatingly-disposed spicules occur on the main fibres, but are rare or absent on the connecting fibres. The spiculation is almost identically the same as that of *A. plicata*, the chief point of difference being that the microstrongyla are much more various in form and size, and frequently pass into spherulæ.

Loc.—Port Phillip.

Introductory.—The species is represented in the Australian Museum by two half-specimens from Port Phillip, and a complete specimen (of somewhat different habit) the locality of which is uncertain; in addition, a third half-specimen is included among the original specimens described, by Dendy, as *Sigmaxinella ciocalyptoides*,—viz., the one referred to by him as R.N.338. The last-mentioned, however, does not constitute a fourth example of the species, but is plainly only the other half of one of the Australian Museum specimens. All the specimens are well preserved in alcohol.

External features.—The two Port Phillip examples are massive sponges, of erect, somewhat quadrangulately prismatic shape, slightly narrowed below to form a broad base of attachment, and with a very rugged, monticulate upper surface (Pl. xxx., figs.4, 5): the slightly larger is 115 mm. in height, and would measure, if complete, about 60 or 70 mm. in breadth and in thickness. The third specimen (Pl. xxxi., fig.3), which is very much smaller,—measuring only 55 mm. in height,—is similarly massive in its lowermost portion, but divides above into many separate (or more or less incompletely separate) tapering digitations of various size, the largest measuring 25 mm. in length and 5 or 6 mm. in diameter at the base. The difference in habit in the two cases, however, is probably to be regarded only as one of degree, since the rugged character of the distal surface of the more massive specimens is such as might be due to incipient digitation.

The whole surface, including that of the processes, is covered with conuli formed in the same manner as in *A. plicata*; they are sometimes low and sharp, sometimes acuminate or even filiform, up to 2 or 3 mm. in length, and situated at an average distance apart varying from one to several millimetres. The surface is rendered uneven by low, irregular undulations and indistinct, longitudinal furrows. On the upper surface only of the more massive specimens, between the monticular elevations, there are many oscula-like openings, the appearance of which (although they are plainly seen to be the orifices of main exhalant canals) suggests that they have been caused by laceration of the dermal membrane; and it is possible, therefore, that in the perfect sponge the dermal membrane is continuous across the debouchures of the exhalant canals, thus producing a condition of lipostomy. This may account for the fact that, in the smaller, digitate specimen, oscula were not observable.

The main exhalant canals run longitudinally upwards through the sponge, increasing in diameter as they ascend; they attain a maximum diameter, in the largest specimen, of about 3 mm., but in the smallest specimen, only of about 1 mm. Many of the canals, especially in the upper part of their course, run for a considerable distance immediately below the surface, their outer wall consisting of scarcely more than the dermal membrane. Immediately underlying the dermal membrane, also, there are, elsewhere, numerous and fairly extensive incurrent spaces.

The consistency of the sponge in alcohol is firm, fairly tough, compressible, and resilient; and the colour varies from pale cream to light yellowish-brown. The colour in life, as recorded in the case of a single specimen by Dendy, is "cinnamon, [with] the projections deep chrome." The skeletonised sponge is very loose-textured, and not of uniform density (Pl. xxxi., fig.1): the coarseness of the fibres is about the same as in *A. plicata*, but, in the present species, the skeleton is of considerably smaller bulk relatively to the bulk of the entire sponge.

The dermal membrane—owing partly to the many spaces immediately underlying it, and partly to its being of considerable thickness—is very distinct, and, except on the upper surface of the sponge (*i.e.*, in the region of the oscula-like openings) presents a minutely reticulate appearance due to the mode of arrangement of the dermal pores (Pl. xxxviii., figs.1-4). The reticulate pattern is conspicuous, even to the naked eye, in the two massive specimens, but requires a lens for its detection in the case of the digitate example. Where the reticulation is apparent, the dermal pores are arranged in closely situated, oval or rounded groups, or "pore-areas" (Pl. xl., figs.5, 6) measuring up to 0·5 mm. in diameter, the pores themselves varying in diameter from less than 20 to upwards of 80μ; within the pore-areas, the dermal membrane is reduced, owing to the presence of the pores, to a fine, lace-like network. Where the dermal membrane is apparently non-reticulate, this is due to the fact that the pore-areas are much smaller and much more widely separated.

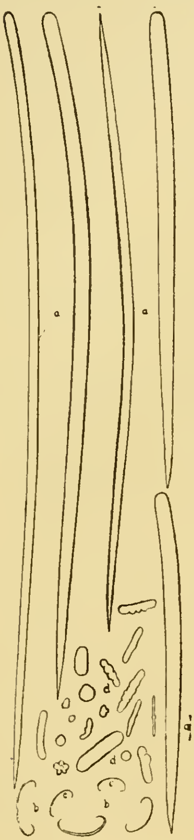
Skeleton.—The structure of the skeleton is such as would result if the sponge had consisted, in the first place, of a number of independent, simple or branched, digitiform upgrowths, each with its own separate skeleton, and if subsequently these individual upgrowths, by lateral expansion and coalescence, had grown together into a single mass,* and their skeletons become more or less interunited: or, in other words, the skeleton is resolvable into similarly constituted, simpler components, the arrangement of which conforms to that of a system of ascending, branched axes. In order to convey an idea of the general conformation of the skeleton, therefore, it will be sufficient to describe the structure and mode of arrangement of the skeleton in a single such component (as shown to best advantage in a digitate process of the semi-massive specimen), and to explain the manner in which interunion is effected between the skeletal fibres of different components.

In each simple digitation, the skeleton consists (Pl. xxxi., fig.4; Pl. xxxii., fig.1): (i.) of stout multispicular main fibres radiating outwards, almost invariably without branching, from the axis of the process in a direction perpendicular or nearly perpendicular thereto, and at a considerable distance (usually not less than 1 mm.) apart from one another; and (ii.) of very much slenderer connecting fibres, most abundant towards the axial region of the

* The occurrence of pebbles and small patches of coarse sand here and there in the interior of all these specimens, more especially towards their base, lends colour to the view that the massive body of the sponge actually has been formed by the coalescence of originally separate digitations.

digitation, which reticulate among themselves to form a narrow-meshed network between the main fibres (*cf.* Pl. xxxii., figs. 3, 4, 5). The first-mentioned, or radially directed fibres appear usually to arise by the branching of one or a few axially situated fibres running lengthwise; but, in some instances, no such primary main fibres are observable, the radially-directed fibres each arising independently. In addition to the paucity or absence of longitudinal main fibres, the skeleton also presents two other characteristic and distinctive features: the radial fibres are arranged for the most part in a more or less orthostichous manner, and, almost without exception, the connecting fibres between them occur only between those belonging to the same orthostichies. Hence it follows that the connecting fibres are confined almost exclusively to vertical (or, as one might almost say, to meridional) planes; and thus, in a transverse section of a digitation (Pl. xxxii., fig.2), the main fibres appear to be without connections. The pattern of the reticulation formed by the connecting fibres is also characteristic, the meshes usually being elongated and narrow, with their long axis in the direction perpendicular to the main fibres. The main fibres vary in stoutness from 120 to 350μ; the spicules composing them are fairly closely and regularly packed, seldom slightly plumose in their arrangement, and are cemented by a relatively small amount of spongin, seldom sufficient in quantity to form a distinct sheath. The connecting fibres are peculiar in being thin and ribbon-shaped, and are mostly paucispicular and composed chiefly of spongin. Echinating spicules occur similarly as in *A. plicata*; but they are here very rare upon the connecting fibres, and are scarce even upon the main fibres. Interstitially scattered megascleres are relatively very few. The microscleres have the same distribution, and are equally as abundant as in *A. plicata*.

In the massive body of the sponge, as already stated, the skeleton consists of interunited components each constructed on the same plan as the above-described skeleton of a single digitation. The interconnection between the components is effected simply by the prolongation of the radial (main) fibres of one component, and their ultimate union with connecting fibres of another; as a rule, the fibres only of one of any two connected components are thus prolonged. A feature not observed in the skeleton of a separate digitation is provided by the fact that the fibres proceeding surfacewards from some of the more peripheral components (more especially from such as are situated not very close to the surface) run in a more or less upward direction (instead of perpendicularly outwards), and may thus attain a considerable length, and may also several times branch (Pl. xxxi., fig.2).



Text-fig.11.*

Spicules.—The spiculation is almost identically similar to that of *A. plicata*, not only as regards the forms, but also the sizes, both of the megascleres and microscleres,—the only noteworthy point of difference in the case of the present species being the much greater irregularity in the forms of the microstrongyla and the frequency of occurrence among them of spherulæ. In all three specimens, the megascleres are of about the same dimensions, ranging in length from about 230 or 240μ (rarely, however, less than about 300μ) up to 680μ, and having a maximum stoutness of 16 or 17μ; the sigmata, which appear not to be separable into two groups as regards size, vary in length from 8 to 20μ, and up to 1·5μ in stoutness; the longer trichites attain a maximum length of 70μ, while the shorter ones are rarely longer than 30μ; and the microstrongyla vary in diameter from less than 1 up to 5 or 6μ, and in length up to 17 or 18μ.

ALLANTOPHORA CIOCALYPTOIDES Dendy, (et var.).

1896. *Sigmaxinella ciocalyptoides* Dendy(7), p.243.

Diagnosis. – Sponge in the typical form of the species incrust-

* *Allantophora victoriana.* *a*, megascleres; *b*, *c*, sigmata; *d*, microstrongyla.

ing to lowly-massive, rising above into short, slender, digitiform processes; in the varietal form (so far as known) consisting of a compressed, plate-like, sessile basal portion soon completely dividing above into a single series of long, slender, tapering digitations. Surface acutely conulose, the conuli usually not very distinct except on the processes, where they are slender and acuminate. Surface minutely reticulate, though not always visibly so to the naked eye. Skeleton in the typical form of the species approaching in structure to that of *A. victoriana*; in the variety similar to that of *A. plicata*. Spiculation differing from that of the foregoing two species only in the absence of microstrongyla.

Loc.—Port Phillip (typical form). Off Botany Bay (variety).

It is very probable that the two forms which I associate under this species,—one of which I distinguish as a variety, *reducta*,—have separately originated from, and should be regarded as no more than varieties of, *A. plicata* and *A. victoriana* respectively. In the absence of more conclusive evidence than is furnished by the specimens available, however, it has seemed to me advisable to regard them as constituting a species distinct.

Allantophora ciocalyptoides (typical form).

(Pl. xxx., figs.6, 7.)

Of this, there are four examples,—the three originally recorded by Dendy,* and an additional one in the collection of the Australian Museum Two of these (the last-mentioned and one of the originals) are almost identically similar (Pl. xxx., fig.7), each having the form of a comparatively thin crust which spreads extensively over the surface of a flattened water-worn stone, and from which arise, short, tapering, digitiform processes—in part occurring singly at wide and irregular intervals, and in part disposed closely in clusters (usually with some amount of coalescence). The digitations are from 5 to 15 mm. in length and seldom more than 2 or 3 mm. in stoutness except near their base, and are provided with moderately numerous, filosely acuminate

* In the original description, four specimens are referred to; but, as already mentioned, one of them (R.N. 338) is an example of *A. victoriana*.

conuli, 1 to 2 mm. in length, which give to them a somewhat spinose aspect. The encrusting base of the sponge attains a maximum thickness of about 10 mm. centrally, and thins out peripherally almost to a film; its upper surface is slightly irregular and uneven, and provided with usually inconspicuous conuli. The thin and semitransparent dermal membrane is underlain, between the conuli, by extensive subdermal spaces, and is not of reticulate appearance. The other specimens (one of which is shown in Pl. xxx., fig.6) are much less extended horizontally, and are relatively more elevated than the preceding two, and might be described as intermediate in form between them and the specimen of *A. victoriana* illustrated in Pl. xxxi., fig.3. Otherwise, they exhibit no noteworthy point of difference, excepting that the dermal membrane is, for the most part, minutely reticulate. The colour in life has been described as "cinnamon, with the projections deep chrome." The consistency, especially of the encrusting specimens, is rather soft and lacking in toughness.

The skeleton in the digitate processes is similarly constructed as in the processes of *A. victoriana.* In the encrusting base of the sponge, it consists, in the thinnest portions thereof, simply of single, vertically-running, stout main fibres connected in a somewhat irregular fashion by inter-reticulating slender transverse fibres; but, in the thicker portions of the base, the main fibres, as they ascend, become irregularly branched and also interunite with one another by anastomosis. On approaching the surface, the main fibres (which vary from 150 to 300μ in stoutness) usually become slightly plumose. The spiculation differs in no way, except in the complete absence of microstrongyla (and of spherulæ), from that of the preceding species.

ALLANTOPHORA CIOCALYPTOIDES(?), var. REDUCTA.

(Pl. xxx., fig.8.)

The single specimen (Pl. xxx., fig.8) consists of a sessile erect plate,—5 to 10 mm. in thickness, 110 mm. in length, and 35 to 45 mm. in height,—prolonged above, in a pectinate fashion, into a series of very gradually tapered, almost subuliform, digitate processes varying in length from 35 to 70 mm. The specimen is in a much macerated condition, the dermal membrane and most of the superficial fleshy substance having disappeared, leaving exposed the surface of the skeleton. The texture is coarsely fibrous and fairly dense, and the consistency is flexible and moderately tough. The exposed surface, both of the basal plate and of the processes, is irregularly and closely furrowed in the vertical direction. From the surface, at distances of from 1 to 2 mm. apart, there project single bristle-like fibres, which are most conspicuous on the processes, where they frequently attain a length of 1·5 to 2 mm.; these fibres no doubt represent the remnants of conuli.

The skeleton is of the same structure as in *A. plicata*. In the processes (in which it is but very slightly condensed axially) it consists of numerous more or less longitudinally-running, stout, multispicular main fibres, frequently branching and interuniting with one another, and connected by numerous, inter-reticulating, slender transverse fibres. The bristle-like fibres, which project from the surface, arise as branches from longitudinal fibres situated towards the axis, and run surfacewards in a direction obliquely upward and outward; at first they are comparatively slender and paucispicular, but increase in stoutness and become more densely spicular as they proceed, finally attaining a diameter of between 150 and 200μ. Without removal of the sarcode, the pattern of the skeleton is rather difficult to determine owing to very faint outlines of the almost colourless spongin, and to the numerous, mostly longitudinally-directed megascleres lying scattered between the fibres.

TYLODESMA Thiele.

Diagnosis.—Axinellidæ(?) typically of massive (or rarely incrusting) habit, the outward form irregular or somewhat compressed, occasionally more or less leaf-shaped. Skeleton consisting of a more or less irregular network of spicules, or of fibres that are most frequently not very well-marked and reach no great length, or finally, of well-developed spicular fibres. Spongin present only in relatively small amount, or altogether wanting.

Megascleres of a single order: tylostyli, subtylostyli, or tylostrongyla, occasionally in part reduced to styli. Microscleres: sigmata and (or) toxa, the latter sometimes in dragmata.

Type-species.—*T. inornata* Bowerbank.

In proposing the name *Tylodesma*, in lieu of *Desmacella*, for the genus wrongly designated *Biemna* (misspelt *Biemma*) by Topsent(**46**), Thiele(**41**) omitted to indicate which species was to be considered the type: since, however, two species only (other than those described by him as new) were enumerated by Topsent as belonging to *Biemna*,—viz., *B. inornata* Bowerbank, and *B. corrugata* Bowerbank,—it is one of those, no doubt, which should be preferred, and I select the former, both because it is that which was named first in order by Topsent and is the better known. The name *Tylodesma* is adopted here in preference to *Desmacella*, not so much from conviction of the correctness of Thiele's contention accepted by Wilson(**61**) and some other authors, but not by Dendy(**8**)—that the latter name is properly a synonym of *Hamacantha*, as owing to the fact that the original species of *Desmacella* described by Schmidt—viz., *D vagabunda* and *D. pumilio* are imperfectly known, and may possibly prove not to belong to the present genus

For reasons already stated above in my remarks on *Biemna*, a slightly amended definition of *Tylodesma* is here proposed, necessitating the removal therefrom, to the former genus, of Hentschel's *Tylodesma microstrongyla* and *T. microxa*, and the addition thereto of *Biemna humilis* Thiele, *B. truncata* Hentschel, and *B. vulgaris* Topsent.

Leaving out of account Topsent's *Biemna dautzenbergi* and *B. chevreuxi*, the former of which is stated by Lundbeck(**30**) to be identical with *T. rosea* Fristedt, and the latter by Topsent(**53**) himself to be identical with *T. annexa* Schmidt, the species which I regard (provisionally) as belonging to *Tylodesma* are as follows:—

T. inornata Bowerbank(**1**); (**46**); (**53**).	Shetland Is.; Azores.
T. corrugata Bowerbank(**1**); (**46**).	British Is.; Azores.
T. annexa Schmidt(**36**); (**30**).	North Atlantic; widely distributed.

T.(?) *pumilio* Schmidt(**35**).	Florida.
T.(?) *vagabunda* Schmidt(**35**).	Florida.
T. infundibuliformis Vosmaer(**56**);(**30**)	Arctic Ocean.
T. rosea Fristedt(**9**); (**30**); (**53**).	E. Greenland; Azores.
T. vulgaris Topsent(**38**).	Banyuls.
T. grimaldii Topsent(**44**); (**46**); (**53**).	Azores.
T. humilis Thiele(**41**).	Ternate.
T. jania Verrill(**55**).	Bermudas.
T. alba Wilson(**61**).	E. of Galapagos Is.
T. vestibularis Wilson(**61**).	E. of Galapagos Is.
T. truncata Hentschel(**15**).	Arafura Sea.
T. informis Stephens.*	W. Coast of Ireland.

Under the name *Desmacella arenifibrosa*, Hentschel(**14**) has described, from Western Australia, a species which evidently cannot be referred with propriety either to *Tylodesma* or to *Biemna*: for although the megascleres are styli and subtylostyli, and the microscleres toxa (of two sizes, the longer measuring 303 to 340μ in length and much resembling rhaphides), the main skeleton consists of stout fibres formed chiefly of sand-grains, without visible spongin-cement. The constitution of the skeleton and the rhaphide-like character of the longer toxa suggested to me that the species might belong to Dendy's *Stylotrichophora*(**6**), established for a single species—*S. rubra*—from Port Phillip, and defined thus: "The main skeleton is a network of horny fibre cored with foreign bodies. In addition to this, there are smooth monactinal megascleres (styli) and hair-like microscleres (rhaphides)." Examination of the type-specimens of *S. rubra*, which were kindly forwarded to me by the Curator of the Melbourne National Museum, has shown that such really is the case: for in this species also, small toxa are present, and the long rhaphide-like megascleres are frequently curved more or less in the manner of toxa. The chief points of difference between the two species are their somewhat different external habit, and the fact that in *S. rubra* the megascleres are styli only, the fibres are provided with a well-defined spongin-sheath, and the

* Stephens, J.—"Preliminary Notice of some Irish Sponges." Ann. Mag. Nat. Hist. (8), xvii., 1916, p.234.

foreign skeletal elements are broken spicules. *Stylotrichophora* was placed by Dendy in the family Haploscleridæ (Heterorrhaphidæ), in vicinity to *Phoriospongia* Marshall, and *Chondropsis* Carter, but for reasons which I intend to publish in a subsequent paper, it appears to me rather that these genera are degraded Desmacidonidæ, requiring at present to be included in the subfamily Mycalinæ.

Sigmaxinella Dendy (emend.).

Definition.—Axinellidæ of ramose habit, with cylindrical or compressed branches, and without conuli or other kind of surface-processes. Skeleton symmetrically arranged, consisting axially of a more or less condensed or core-like region formed by a reticulation of spongin-ensheathed spicule-fibres; extra-axial skeleton consisting of paucispicular main fibres radiating outwards to the surface, sometimes (when of considerable length) connected by frequent, typically aspiculous, transverse fibres, but more usually with relatively few, or altogether without, transverse connections. Megascleres typically of a single order: styli, sometimes in part transformed into oxea or strongyla. Microscleres: sigmata and trichites (or microxea), the latter either in dragmata or scattered singly.

Type, *S. australiana* Dendy.

As amended, the genus will include only three of the species which have formerly been assigned to it. Of the remaining four, *S. ciocalyptoides* Dendy, and *S. incrustans* Kirkpatrick, are transferred to *Biemna*; *S. flabellata* (Carter), redescribed below, is made the type of a new genus, *Sigmaxia*, while *S. mammillata* Whitelegge(**60**), with its rhabdostylote megascleres (which are found to show traces of spination, and are accompanied by sigmata only), possesses a type of spiculation very similar to that of Carter's *Microciona intexta*,—a species referred with hesitation by Topsent(**53**) to his genus *Rhabderemia*,—and requires for its reception a new genus, to be included in the Myxillinæ, for which I propose the name *Rhabdosigma*. On the other hand, two species are now added to the genus,—one new, the other long since described by Carter under the name *Phakellia ramosa*.

Sigmaxinella accordingly comprises at present five species, as follows : –

S. australiana Dendy. *S. arborea* Kirkpatrick(20),
S. dendroides Whitelegge. *S. viminalis*, sp.n.
S. ramosa Carter(4).

Whether *S. arborea* strictly belongs to the genus as above defined is not quite certain, inasmuch as its megascleres are stated by Kirkpatrick to be of three kinds, (i.) basally attenuated styli, 800-1150 × 25-37μ; (ii.) strongyla, 700-800 × 25-30μ; and (iii.) "rhaphide-like" oxea (very rare), 700-870 × 12·5μ. The probability is, however, that the strongyla are merely variants of the styli and connected with them by intermediate forms; while very possibly the oxea are of foreign origin.

SIGMAXINELLA AUSTRALIANA Dendy.
(Pl. xxxiii., figs.1-3; Pl. xxxiv., fig.1.)

1896. *Sigmaxinella australiana* Dendy(7), p.240.

Diagnosis.– Ramose, erect, stipitate ; with cylindrical or slightly compressed, moderately slender, dichotomously dividing branches, usually of medium length and more or less arborescently outspread, but occasionally remaining much abbreviated and partially coherent together proximally. In outward appearance much resembling a Chalinine sponge. Surface even; non-hispid. Oscula in the form of shallow stelliform depressions, scattered or serial along the branches. Dermal membrane thin and delicate, aspiculous. Skeleton fairly regularly reticulate, more or less condensed axially; formed of spicule-cored, non-plumose main fibres, and wholly sponginous connecting fibres. Megascleres : subcylindrical styli and oxea and forms intermediate between, often irregularly pointed, and rather variable in size in the same specimen; with a maximal size, in different specimens, of from 360 to 450μ by 7 to 17μ. Microscleres : slender sigmata of two sizes, respectively 16 to 20μ and 45 to 50μ in maximal length; and trichites, almost exclusively in dragmata, 20 to 45μ in length.

Loc.—Port Phillip; Maroubra Bay, near Port Jackson.

Introductory.—Of this species, there have been examined, for the purpose of the present description, six specimens, four of which, well preserved in alcohol, are from the original locality, while the other two are washed-out beach-specimens obtained in the vicinity of Port Jackson; examination was also made of a mounted section of one of the type-specimens. As the possibility of a mistake regarding the identity of the species was out of the question, and, moreover, as the available specimens presented a greater range of variation than that recorded in the case of the original specimens, the latter were not sent for to be consulted. The two specimens from the northern locality differ slightly from the Port Phillip ones (more especially in certain details of spiculation), but not sufficiently, I think, to warrant their being regarded as constituting a distinct variety. In order briefly to distinguish the specimens, the former are referred to in the description as the P.J. specimens, the latter as the P.P. or typical specimens.

External features.—The typical habit of the species, so far at least as regards the shape and mode of disposition of the branches, is that displayed by the specimen illustrated in Pl. xxxiii., fig.1—the largest and most profusely branched of those before me, measuring 180 mm. in total height—which may be very satisfactorily described, in the precise terms of the original description, as "consisting of a bushy bunch of rather slender, short, subcylindrical or somewhat compressed branches, sometimes anastomosing, and supported on a short stalk." But in two respects this specimen is perhaps exceptional: namely, in the great multitude and closely crowded arrangement of the branches (the number of which exceeds two hundred), and, secondly, in possessing oscula which in comparison with those of other specimens are conspicuously noticeable. In the four P.P. specimens available, the branches vary from 5 to 8 mm. in stoutness, and, except when somewhat compressed, are usually nearer to the latter figure than the former; but in the P.J. specimens, in the case of which also the stalk is comparatively long and narrow, they are slenderer, 3 to 5 mm. in diameter, and much more uniformly cylindrical (Pl. xxxiii., fig.3). Branching takes place chiefly, if not entirely, by dichotomy, and successive dichotomies, as a rule, are in the same plane, the consequence being a well-marked tendency, most clearly expressed in sparsely-branched specimens, towards a flabellate disposition of the branches; but with their multiplication in number and consequent displacement due to mutual interference, the branches gradually come to assume a more or less regularly arborescent arrangement. The maximum length attained by the branches rarely exceeds 80 mm., but is usually greater than 40 mm ; occasionally, however, as in the single case of one of the P.P. specimens (Pl. xxxiii., fig.2), they remain quite short (even the longest not exceeding 25 mm.) and more or less coherent with one another proximally, thus forming, or tending to form, a cluster or "head" of (somewhat palmately) lobed or digitate lamellæ.

The oscula are characteristic, having the form of shallow stelliform depressions, 1 to 2 mm. in diameter, at the centre of each of which is a group of several (usually 3 or 4) minute exhalant orifices; their stellate shape is frequently enhanced by short, shallow grooves radiating from them. Most frequently, they are arranged along the branches more or less distinctly in two rows, but sometimes only one such row is apparent, and sometimes they are in part disposed in a scattered fashion; their arrangement appears generally to be the more irregular in proportion as the branches are the more compressed. In most cases, the oscula are not conspicuous, and they are less evident in the desarcodised than in the perfect condition of the sponge; indeed, in the case of the two washed-out P J. specimens, they were altogether unobservable.

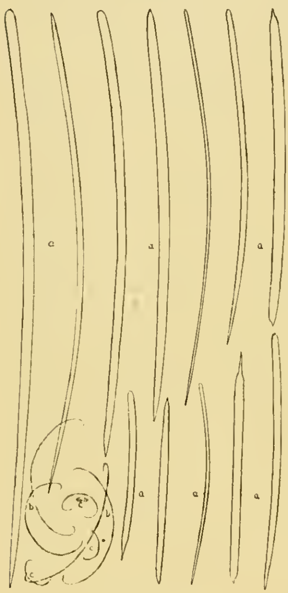
In general appearance and in texture, the sponge is nearly similar to an ordinary Chalinine sponge. The consistency is fairly tough and elastic; moderately soft, but not fleshy; compressible and resilient. The colour in life is recorded in the original description as brownish-red or orange-rufous; in alcohol, it varies from pale greyish-yellow to light brown.

The dermal membrane is extremely thin and delicate, and without spicules; it appears to be very easily destroyed, since, even in the specimens which otherwise are excellently preserved, only portions of it remain. The dermal pores are arranged in small oval or circular groups, averaging about 150μ in diameter but somewhat variable in size, scattered over the entire surface, and containing usually less than 10 pores each. Where the dermal membrane has disappeared, the surface is closely perforated with minute pinhole-like apertures, which are the openings of the inhalant canals: the presence of these is discernible also where the dermal membrane is intact, but, as a rule, only faintly and indistinctly.

Skeleton.—The skeleton which remains, after complete maceration of a specimen by means of caustic potash, preserves exactly the external form of the perfect sponge; it is composed of pale-coloured, highly sponginous fibres, and is fine-textured and of sufficient density to render it difficult for one to perceive from external inspection whether a condensed axial region is present or not. In section, under the microscope, the pattern is seen to be fairly regularly reticulate, the reticulation being formed by longitudinal and obliquely outward-trending main fibres pauciserially cored with spicules, and by numerous short connecting fibres containing no spicules (Pl. xxxiv., fig.1). The reticulation is condensed axially, though not in any very marked degree except in the older, more basal parts of the branches, the condensation being the result merely of a progressive increase of stoutness of the fibres,—most rapid in connection with the axially situated ones, and scarcely at all affecting those situated near the periphery,—with increasing age. Within the axial region of the oldest part of the branches, the fibres may attain a stoutness of over 100μ; but throughout the greater part of the skeleton, they are comparatively slender, even the main fibres seldom exceeding 40μ, while the connecting fibres are of all degrees of lesser stoutness down to below 5μ. Irregularity in the pattern of the skeleton is due to the fact that the connecting fibres rarely pass singly and directly between the main fibres (in such manner as to produce a rectangular or scalariform reticulation), but to a greater or less extent,—depending on the distance apart of the main fibres,—interunite among themselves, thus giving rise to an irregularly-meshed, somewhat plexiform reticulation. The average width of the meshes is less than 100μ, while the average distance apart of the main fibres is not less than 200μ. As the main fibres trend surfacewards,—with gradually increasing deflection from the longitudinal direction as they proceed, they increase in number, mainly by branching, but partly also (at least in proximity to the surface) through the formation of additional ones which take origin from connecting fibres; and they arrive at the surface almost at right angles. The spicules of the main fibres are seldom more than 4- or 5-serial in their arrangement, very rarely as many as 9- or 10-serial; as a rule they lie fairly closely together, forming a moderately compact core. The most superficially situated fibres of the skeleton, including the outermost of the connecting fibres, give support to relatively numerous outwardly-directed spicules, for the most part collected, or tending to be collected, into loose divergent tufts surrounding the extremities of the main fibres.

In balsam-mounted sections of the perfect sponge (*i.e.*, with the soft tissues intact), the above-described features of the skeleton are to a very considerable extent obscured or disguised. This is due partly to the very pale colouration of the spongin,—in consequence of which the outlines of the fibres are usually almost or quite indiscernible,—and partly to the fact that the bulk of the megascleres are located externally to the fibres. These extra-fibral megascleres for the most part are not scattered irregularly through the mesogloea, but are situated chiefly in proximity to the main fibres, lying in approximate parallelism therewith. As a consequence, it is often difficult, or even impossible, to distinguish between spicules lying immediately adjacent to the fibres and others enclosed within them; and the skeleton may thus appear as if composed solely of spicules, for the most part directed parallelly to the directions of growth of the sponge, and more or less collected loosely into ill-defined strands. Irregularly scattered megascleres also are present, as well as relatively few transversely-directed ones, the latter of which always occur singly. Sigmata and trichodragmata are present in moderate number, but the former are not readily perceived owing to their slenderness; rare singly-scattered trichites also occur.

Spicules.—The megascleres are slightly curved, subcylindrical to subconical styli, fewer oxea, and scarce strongyla, the three forms differing in general only with respect to the character of their extremities, and connected with one another by numerous intermediates. They are often irregularly ended and more or less blunt-pointed, and many of the oxea are markedly anisoactinate. Their size is very variable both as regards length and stoutness. In the P.P. specimens, they range in length from 120 or 130 to 360μ in some cases, up to over 400μ (rarely to 450μ) in others, and vary in diameter, irrespective of length, from 2 to 7 or (rarely) to 10μ. In the P.J. specimens, they are generally much stouter, attaining a maximum diameter of from 15 to 17μ, and range in length from about 150 to 420μ. The styli are, on the average, stouter than the oxea, and the stoutest spicules are mostly those of intermediate and lesser lengths. In the case of the P.P. specimens, the shortest spicules,—those of lesser length than, say, 200μ,—are chiefly oxea, generally with abruptly, often mucronately pointed ends; but, in the P.J. specimens, the shortest spicules are nearly always styli.



Text-fig. 12.*

(ii.) The sigmata are extremely slender,—invariably less than 1μ in diameter,—and of two kinds, the smaller (and less numerous) varying in length from 9 to 16μ, the larger from 25 to 45μ, measured from bend to bend. Both kinds are mostly more or less contort,—the smaller, however, usually only slightly so, the larger often to such an extent as to appear S-shaped; both kinds

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* *Sigmaxinella australiana.* *a*, megascleres; *b*. *c*, larger and smaller sigmata.

occur in dragmata, as well as scattered singly, but the shorter dragmata are rare.

(iii.) The trichites, both forming the dragmata and scattered singly, are exceedingly slender microxea, varying in length from 20 to 45μ.

SIGMAXINELLA DENDROIDES Whitelegge.

(Pl. xxxiv., fig.2.)

1907. *Sigmaxinella dendroides* Whitelegge(**60**), p.513, Pl. xlvi., fig.42.

Diagnosis.—Ramose, erect, stipitate; with cylindrical, tapered, dichotomously dividing, slender branches of moderate length. Surface even. Oscula presumably either very small or very shallow, at any rate not apparent in the skeletonised specimen. Dermal features unknown. Skeleton consisting (i.) of a condensed axial reticulation, the fibres forming which are moderately rich in spongin, and (ii.) of fibres radiating therefrom which are poor in spongin, are united only sparingly by (entirely sponginous) transverse fibres and by single spicules, and run (with occasional branching) in nearly parallel courses to the surface, becoming multispicular and somewhat plumose on nearing it, and terminating each in a subpenicillate tuft. The spicules of the radial fibres are of greater average length than those of the axial reticulation. Megascleres: subcylindrical styli, usually tapering gradually to a sharp or slightly rounded point at the apex, and usually slightly curved, sometimes bent; frequently tending to become abruptly blunt-pointed at the base; occasionally passing into strongyla, very rarely into oxea; 300 to 640μ long by 10 to 26μ in diameter. Microscleres: slender sigmata of two sizes, respectively 20 to 40μ in maximal length; and scarce trichites (microxea), 25 to 35μ long, scattered singly.

Loc. South of Port Hacking, N.S.W. ("Thetis").

External features.—The only known specimen—a figure of which has been furnished by Whitelegge—is a stipitate arborescent sponge, 180mm. in total height, with moderately elongated, cylindrical, distally tapered branches, 4 to 6 mm. in diameter, rising erectly from an equally slender stem, and occasionally anastomosing. The mode of branching is dichotomous, and successive dichotomies are usually in the some plane, but owing to irregularities, partly resulting through mutual interference, the branches come to be disposed in various planes: it is very probable, however, that specimens occur in which the branching is confined entirely to the one plane. The division of the stem to form the first two branches takes place 25 mm. above the base, each of those again dichotomising at about the same distance above their origin, and each of the resultant four branches also at about the same distance above theirs; the subsequent divisions for the most part occur at increasingly longer intervals, some of the terminal branches having an uninterrupted length of 70 mm.

The specimen is imperfect, consisting only of the dried skeleton,—in which condition it appears to have been also when first described. Nothing can be said, therefore, in regard to the dermal features; but evidently the outer surface was even, without conuli or elevations of any kind. Oscula are not indicated. The skeletonised sponge being held between the eye and the light, the skeleton is plainly perceived to consist, in each branch, (i.) of a sharply circumscribed cylindrical core, of diameter generally less than one-fourth and (except in the lowermost parts of the sponge, up to about as far as the third dichotomy) not greater than one-half the diameter of the branch, and (ii.) of an outer region formed of slender radiating fibres, which are inclined to the longitudinal direction of the branch at an angle varying from 60° to nearly 90°, and present collectively an appearance somewhat resembling that of fur. The colour is a faintly creamy-tinted pale grey or dirty white, its paleness being due to the extremely small amount of spongin entering into the composition of the radial fibres. In the original description, the consistency is described as "tough, resilient, and compressible," but this is not strictly correct: the axial region is fairly tough and slightly compressible (and the branches consequently are flexible), but the extra-axial layer is soft, and on compression remains partially crushed.

Details of skeletal structure (Pl. xxxiv., fig.2).—Except towards the extreme apices of the branches, the demarcation between the axial region of the skeleton and the extra-axial, as seen in longitudinal section, is very pronounced (more especially if the spongin has been stained) notwithstanding there is no discontinuity between the main fibres of the two regions (*i.e.*, between the longitudinal fibres of the former and the "radial" fibres of the latter), such as might be inferred from the terms "primary" and "secondary" used in the original description to distinguish them. The contrast is partly due to the much greater density of the axial skeleton, and also partly (i.) to the rapidity with which the fibres change in direction from longitudinal to almost perpendicularly transverse, and (ii.) to the sudden and very considerable diminution in the amount of their constituent spongin,— as they pass from the one region to the other; but there are other differences also.

In the axial region, the main or longitudinal fibres, which have a maximal stoutness of 80 or 90μ, usually contain multiserial spicules, for the most part not very compactly or regularly arranged; are rather closely juxtaposed, and frequently coalesce with each other for short distances; and are connected at close intervals by short, aspiculous, transverse fibres. Participating in the formation of the axial skeleton also are many spicules whose relation to the fibres is more or less indefinite, as well as many transversely and obliquely directed ones occurring singly. In the older portions of the skeleton, the meshes of the reticulation become much reduced in size, often to the point of obliteration, through the continued growth in stoutness of the fibres. The more peripherally situated of the main fibres run, not longitudinally, but with a slight, and gradually increasing, trend outwards; ultimately they pass into the extra-axial region, and, curving surfacewards, immediately subdivide each several times in rapid succession to form the radial fibres.

The radial fibres, throughout the greater part of their length, are only two or three spicules broad; the spongin cementing their spicules is usually so small in quantity as scarcely to be discernible unless stained; and the connecting fibres between them occur only at comparatively wide and irregular intervals.

They run with slight divergence (gradually becoming more nearly parallel to each other as they proceed), and with occasional branching, generally at a distance of from 200 to over 300μ apart, to meet the surface almost at right angles. As the surface is approached, their spicules increase in number and become disposed for the most part in a some what plumose manner, the fibre undergoing a gradual change in character culminating in the formation, at its extremity, of a corymbiform, slightly divergent tuft consisting frequently of as many as 10 or 12 spicules. Elsewhere in the radial fibres the spicules lie mostly with their long axis in, or only very slightly inclined to, the direction of the fibre; but obliquely directed spicules, disposed more or less in an echinating fashion, are by no means uncommon. Some of the latter become united at their apices, by means of spongin, with adjoining fibres, and thus assist in the task performed by the connecting fibres; occasionally such spicules are ensheathed with spongin. The connecting fibres proper, of which mention has been made above, are formed entirely of spongin, like those of the axial region; they are very slender, varying in stoutness from less than 5μ to at most 20 or 25μ, and occur at distances apart usually exceeding, say, 300μ; where occurring closely together, they generally interunite among themselves.

Text-fig. 13.
Sigmaxinella dendroides.
a, megascleres; *b*, *c*, larger and smaller sigmata.

The megascleres forming the radial fibres are notably longer, on the average, than those of the axial skeleton; while the longest spicules of all are found in the surface-tufts. Sigmata are present in great number, and occur for the most part arranged uniserially along lines which probably coincide with the courses of the main canals; they are of two sizes, the larger being much the more numerous. Short, slender microxea (unmentioned in the original description) are also present, but appear to be rare; apparently also, they occur only singly scattered, never in dragmata.

Spicules.—(i.) The megascleres are almost exclusively styli, usually of slightly lesser diameter at the base than at some distance therefrom, and tapering towards the apex; frequently more or less blunt-pointed apically, and occasionally passing into strongyla, those of the latter form being almost invariably of less than the average length; often abruptly somewhat blunt-pointed at the basal end, but very rarely becoming oxea; ranging in length from about 300 to 640μ, and in stoutness from rarely less than 10 to about 26μ. The shorter spicules are generally straight or nearly so, the longer are nearly always slightly curved, or sometimes bent, the flexure as a rule being mainly in the basal moiety of the spicule.

(ii.) The two kinds of sigmata are scarcely different except with respect to size. The smaller vary in length from 12 to (rarely) 20μ, the larger from 25 to 40μ, measured from bend to bend; the maximal stoutness is in each case about 2μ. They are, without exception, more or less contort,—often (especially in the case of the larger ones) to such an extent as to appear S-shaped.

(iii.) The microxea (trichites) are fusiform, 25 to 35μ in length, and at most 1·5μ in diameter.

Sigmaxinella viminalis, sp.nov.

(Pl. xxxiii., fig.4; Pl. xxxv., figs.1, 2; Pl. xxxvi., fig.1.)

Diagnosis.—Ramose, erect, stipitate; with elongated, slender, cylindrical, tapered branches, disposed irregularly. Surface hispid. Oscula, if present, small and inconspicuous. Dermal membrane thin, without contained megascleres. Skeleton with a central axis, in which the megascleres for the most part are so disposed as to produce a lattice-like pattern, and in which (except in the older portions of the sponge) spongin is only scantily developed. Extra-axial skeleton consisting of numerous, short, pauciserial lines of (relatively very long) spicules, radiating from the central axis to the surface,—the spicules composing which are more or less divergently directed, and are not united by visible spongin. Megascleres: slightly curved styli, 320 to 1525μ in length by 18μ in maximal stoutness. Microscleres: sigmata of two sizes, respectively 18μ and 50μ in maximal length, the larger ones in part occurring in dragmata; and fusiform trichites, 22 to 48μ in length, occurring both in dragmata and scattered singly.

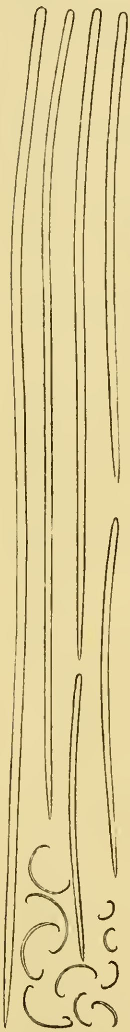
Loc.—Great Australian Bight (exact locality unknown).

External characters.—The single specimen (Pl. xxxiii., fig.4)—280 mm. in total height—consists of about half-a-dozen more elongated or main branches, 130 to nearly 200 mm. in length,—one of which is a direct continuation upwards of the stalk and gives off the others at different levels,—and of a score or so shorter branches, ranging from 5 to over 100 mm in length, which arise from the former at distant intervals, and nearly always proceed off from them at very wide angles, often almost or quite perpendicularly. The mode of branching, therefore, is not dichotomous (as it usually is in the case of ramose sponges) but irregular. The branches are at most 5·5 mm. in diameter proximally, and diminish in stoutness to slightly less than 2·5mm. at their extremities. The stalk has a length of 55 mm. measured from its base to the origin of the first branch, and terminates below in a tuft of branched rootlets. The species is very similar, in general habit, to *Raspailia tenuis* Ridley and Dendy(**33**).

The specimen, although in alcohol, is not in a very good state of preservation, the superficial layer being much damaged and the dermal membrane almost completely destroyed through maceration. Whether there are oscula or not, is accordingly not evident; but, if present, they must be rather small and inconspicuous. The surface is everywhere hispid with far projecting spicules. The branches are flexible and tough, with an outer layer of softer consistence; this layer has disappeared from the stalk, which is dense and tough throughout, and has a smooth and even surface. The colour in spirits is greyish-yellow.

Skeleton.—The formation of the skeleton differs from that of *S. dendroides*, described above, mainly in two respects; and these differences are to some extent consequent upon the much greater length (up to 1·5 mm.) of the megascleres in the present species, and upon the relative narrowness of the external layer intervening between the central axis and the surface. In the central axis, there are not to be distinguished, as in *S. dendroides*, definite longitudinal fibres joined by transverse ones in more or less ladder-like fashion, but the megascleres are disposed rather loosely in ill-defined tracts which cross one another at acute angles, thus giving rise to a somewhat lattice-like arrangement. And, secondly, the extra-axial skeleton (Pl. xxxv., fig.2) is entirely without transverse fibres, and consists simply of numerous, short, pauciserial lines of spicules running outwards to the surface in a direction nearly perpendicular thereto,—these spicules being arranged more or less penicillately and united by, at most, an infinitesimal amount of spongin, and the terminal ones projecting far beyond the surface.

The axial skeleton changes considerably in character with age, owing to gradual increase in the amount of spongin developed in connection therewith, and presents a very different appearance in the older and more basal parts from that which it exhibits in the uppermost portions of the branches. In the latter region, for a considerable distance (several centimetres at least) from the extremities of the branches, the amount of spongin present is so slight that its existence is apparent only in sections from which the fleshy tissue has been removed by maceration (Pl. xxxv., fig 1). In this portion of the skeleton also, the spongin appears diffused, and is without definite outlines. Proceeding towards the base of the sponge, the spongin gradually becomes more and more concentrated upon the sides of the lattice-like meshwork formed by the megascleres, which is thus converted into a reticulation of spiculo-spongin fibre. The elongated, narrow meshes of this reticulation ultimately (in the stalk of the sponge) become reduced in size slmost to the point of obliteration.



Text-fig. 14.*

In addition to a gradual increase of density, the central axis also undergoes with age a gradual increase in diameter. This is effected by the continued formation, and addition to it externally, of fresh tracts of megascleres, which later similarly become ensheathed in spongin. In this way, the axial skeleton eventually comes to include within it the lines of spicules which previously constituted the extra-axial skeleton (Pl. xxxvi., fig. 1). The extra-axial layer, however, maintains about the same width —viz., about 1 to 1·5 mm.—throughout the whole length of the branches.

Sigmata of two sizes are scattered throughout all parts, the smaller in extreme abundance, more especially in the extra-axial layer; the larger ones, which are only moderately abundant, occur also in dragmata. Trichodragmata and singly scattered trichites are also moderately abundant, except in the axial region, where they are rare.

Megascleres.—These are slightly curved, occasionally slightly flexuous styli, almost without exception evenly rounded at the base, and of uniform diameter therefrom to beyond the middle of their length, whence they taper gradually to a sharp point; in very rare cases only, the basal extremity also is more or less pointed, and the spicule may become an anisoxea. They range from 320 to 1525μ in length and up to 18μ in stoutness. Spicules much below 700μ in length are relatively scarce.

Microscleres.—(i.) The larger sigmata are always more or less contort, though rarely to such a degree as to appear S-shaped when seen from the side; the smaller are usually C-shaped or but very slightly

* *Sigmaxinella riminalis.* Megascleres and sigmata.

contort. The former vary in length from 27 to 50μ, the latter from 12 to 18μ, measured from bend to bend; and their maximal stoutness is respectively 1·5μ and 1μ.

(ii.) The trichites or microxea, whether in dragmata or scattered singly, are all of the same kind. They are slightly fusiform, from 22 to 48μ in length, and from 0·5 to 0·75μ in stoutness.

SIGMAXIA, gen.nov.

Definition.—Axinellidæ typically of erect habit, stipitate, without conuli or other kind of surface-processes. Skeleton a reticulation of spiculo-spongin fibre; the main fibres more or less plumose, the connecting fibres typically few. Megascleres of two distinct kinds,—styli forming the fibres, and flexuous strongyla occurring interstitially. Microscleres: sigmata and trichites (or microxea), the latter in dragmata and scattered singly.

Type, *S. flabellata* Carter; the only species.

SIGMAXIA FLABELLATA Carter.

(Pl. xxxiii., fig.5; Pl. xxxvi., figs.2, 3.)

1885. *Axinella flabellata* Carter(3), p.361.

1896. *Sigmaxinella flabellata* Dendy(2), p.241.

Diagnosis.—Sponge composed of one or several proliferous, thick lamellæ, or of a single more or less flabelliform lamella, springing from a short stalk. Surface coarsely granular. Oscula minute, marginal (or scattered ?). Dermal membrane very thin; no dermal skeleton. Skeleton chiefly formed of loosely constituted, semi-plumose, stout main fibres, comparatively poor in spongin, running longitudinally side by side in moderately close apposition, and gradually curving towards the surface; connecting fibres few, arranged irregularly, mostly paucispicular, sometimes without contained spicules. Megascleres: styli, curved or slightly bent, and gradually sharp-pointed, occasionally passing into oxea, from 300 to 350μ in maximal length and up to 18μ in stoutness; and slender, flexuous strongyla and (fewer) tornota, 200 to (rarely) 580μ in length, and at most 7μ in diameter. Microscleres: slender sigmata 15 to 20μ long; and trichites of two sizes, respectively about 30 to 60μ in maximal length, the former occurring only in dragmata, the latter in part also scattered singly.

Loc.—Port Phillip.

The species is known now from six specimens, one of which forms the subject of the original description, while four in addition have been taken account of in the summary of specific characters furnished by Dendy. The present description, so far as it relates to the structure of the skeleton, is based almost entirely upon the sixth, the identity of which with the preceding has been established by comparison of it with a mounted preparation of one of Dendy's specimens.

External characters.—The sponge may be simply flabelliform, consisting of a single, erect, stout lamella narrowed below and prolonged into a stalk, as, for example, in the case of the single immediately accessible specimen (Pl. xxxiii., fig.5),—in which, however, the lamina is not of uniform thickness, but is rendered irregular by a number of rounded hummocks and several low, compressed ridges, the latter evidently of the nature of incipient secondary lamellæ; this specimen, 65 mm. in total height, has an orbicular lamina about 50 mm both in height and breadth and from 8 to over 20 mm. in thickness, and a cylindrical stalk, 7 mm. in diameter, expanded proximally into a broad disc of attachment. Of somewhat similar, but of less regular form,—and of larger size, measuring 88 mm. high by 112 by 37 mm. horizontally,—was also the original example, described by Carter thus: "compressed, expanded, thickish, lobate; margin irregular: stem short, angular, and thick." But more usually, it seems, the form assumed is one of less simplicity owing to the development of additional lamellæ, perhaps both primary and secondary: for the specimens upon which Dendy's account is based are described as composed of "proliferous lamellæ about a quarter of an inch thick, springing from a short thick stalk."

Oscula, unobserved by Carter, are stated to be present by Dendy, who describes them as minute, marginal or scattered; in the present specimen they are certainly absent from the lateral surfaces, and are not distinguishable on the margin,—but the latter circumstance may be owing to the slightly damaged condition of the surface there. The dermal membrane is thin and delicate, and easily destroyed. The undamaged surface has a finely to coarsely granular appearance, due to minute pimple-like elevations of the dermal membrane produced by the impingement upon it of the outer ends of the main skeletal fibres; where the membrane has disappeared, the projecting ends of the fibres render the surface slightly shaggy. The texture is tough, fibrous, resilient. The colour in spirit is pale brownish or yellowish-grey.

The dermal pores are distributed singly, though often in rather close apposition; they are variable in size, 20 to 50μ in diameter.

Three of the four specimens recorded by Dendy are noted by him as being beset with parasitic Anthozoa. The present specimen is likewise infested, no doubt with the same organism : it is a small, solitary anthozoan, only 1 to 2 mm. in height and diameter, occurring almost completely imbedded in the sponge.

Skeleton.—The structure of the skeleton, as revealed in sections of the completely desarcodised sponge, in which nothing remains but the spongin-cemented elements (or skeletal framework), is very definite and uniform in character, and at first sight, more especially under the lowest powers of the microscope, appears as if more correctly to be described as dendritic than as reticulate (Pl. xxxvi., figs.2, 3). It consists almost entirely of ascending, frequently branching, stout main fibres, running moderately closely side by side in subparallelism (at an average distance apart, say, of from 300 to 400μ), gradually curving outwards, as they ascend, towards the surface. Connecting fibres, however, are by no means rare, but for the most part they are comparatively inconspicuous. The main fibres, which are seldom less than 100μ, and occasionally surpass 200μ in stoutness, are formed chiefly of spicules, for the most part rather loosely and confusedly arranged, a variable proportion (generally a small minority) of which are disposed with their points directed more or less obliquely outwards. As the surface of the sponge is approached, however, the spicules composing the fibres become gradually more and more divergingly disposed, as well as more loosely compacted, and the fibres finally assume, in consequence, a typically plumose aspect. The spongin cementing the spicules, —though necessarily fairly considerable in amount owing to their loose arrangement,—is, except in the stalk and oldest portions of the skeleton, usually of scarcely more than the minimal quantity required to hold them together, and seldom or never forms a distinct sheath; where the spicules lie more widely apart, it often becomes reduced to a mere film between them, and here and there even leaves small open spaces or fenestræ. Running upwards from the stalk, and continuing for some distance into the body of the sponge, gradually dissolving as they proceed, are a number of relatively stout strands of spicules, or funes, evidently formed each by the fusion of several originally separate fibres (Pl. xxxvi., fig.2). Connection between the main fibres, apart from occasional anastomosis or direct union between them by inosculation, is partly by means of relatively few, obliquely-running multispicular fibres, similar in character to the main fibres except in being usually of lesser stoutness, and partly by means of connecting fibres proper. The latter are mostly very slender, and usually contain few spicules or are composed of spongin alone; they occur at irregular intervals, sometimes singly, sometimes several together, and in the latter case usually interunite also among themselves

In sections of the sponge with the soft tissues intact, the appearance of the skeleton is somewhat different. The presence of spongin is scarcely apparent; the main fibres have a much looser and more plumose aspect; and the connecting fibres are seldom definitely recognisable as such, owing to the difficulty of distinguishing between the megascleres actually constituting them and others that are merely scattered between the fibres. The more diffuse and plumose appearance of the main fibres is probably due to the fact that some proportion of the more exteriorly situated (and likewise more obliquely directed) spicules entering into their formation are not attached by spongin, and consequently are absent from the skeleton that remains after maceration. In the more peripheral parts of the skeleton, the megascleres scattered between the fibres are relatively few, and consist of styli only, similar to those composing the fibres. But at some distance from the surface,—usually a somewhat considerable distance,—megascleres of a second kind make their appearance,—flexuous strongyla and tornota,—which increase in number towards the deeper portions of the sponge and eventually become very abundant; indeed, it is almost as much to the increased multitude of the latter, as to augmentation in the quantity of the spongin, that the greater density of the skeleton in the stalk and other older portions of the sponge is due. A considerable proportion of the latter spicules are developed in close contiguity to the fibres, and ultimately, owing to the subsequent formation of additional spongin, become completely united to them. The presence of these flexuous megascleres, owing to their extreme rarity in, or total absence from, those portions of the sponge usually selected for examination, hitherto has escaped notice.

Through all parts of the sponge there are scattered small sigmata singly in moderate abundance, trichodragmata of three kinds, and single trichites of similar size to those composing the larger trichodragmata. The trichodragmata of two kinds are in the form of neat sheaves of extremely slender trichites, and differ from each other only in length; the shorter of these are almost as numerous as the sigmata, while the longer are relatively scarce. The dragmata of the third kind are composed of trichites equal in length to those of the just-mentioned longer dragmata, but stouter and more fusiform, and occur for the most part in dense masses of irregular shape and size, which refract the light in such a way as to appear blackish and opaque, and are, therefore, very noticeable although comparatively scarce; some of the largest of these aggregations exceed 200μ in breadth. The singly scattered trichites, or microxea, are moderately scarce in the interior, but more plentiful near the surface.

Megascleres.—(i.) The styli are invariably more or less curved, are usually evenly rounded at the base and of uniform or nearly uniform diameter therefrom to beyond the middle of their length, and almost invariably taper throughout the remainder of their length gradually (except frequently for slight irregularities near the apex) to a sharp point; a gradual slight narrowing of the spicule towards the basal end, however, is not uncommon. The curvature as a rule is restricted to the basal moiety of the spicule, and is usually well-pronounced, but varies much both in form and degree: frequently it is more or less angulate, the spicule appearing slightly bent; and occasional spicules are biangulate. In odd cases of extreme curvature, the form of the spicule makes some approach to that of a rhabdostyle. Variability exists also in the shape of the spicule at its basal extremity, which frequently shows a tendency to become abruptly more or less sharp-pointed, either hastately or mucronately so; but sometimes the attenuation is more gradual, and the form assumed is that of an oxea. The proportion of oxeote forms is greatest amongst the slenderer, presumably immature spicules, which only occur scattered between the fibres, and are relatively few in number. The maximal size of the spicules in the case of Dendy's specimens is given as $290 \times 16 \cdot 6\mu$; in the present specimen, the size attained is $350 \times 15\mu$, but individuals much exceeding 320μ in length are scarce; those composing the fibres are seldom less in stoutness than 10μ. Developmental forms of all sizes down to less than $140 \times 1\mu$ are to be met with. (In the

Text-fig. 15.—*Sigmaxia flabellata.* *a*, megascleres of the fibres; *b*, interstitial megascleres; *c*, sigmata.

original description, the size of the spicules is given as 70 by 2-6000ths of an inch—*i.e.*, $296 \times 8 \cdot 4\mu$, but this, I think, must be due either to an error of measurement or to a misprint).

(ii.) The variously curved, usually more or less flexuous megascleres are mostly strongyla, but individuals with sharp-pointed ends are also numerous. They range from about 200 to 580μ in length and from $1 \cdot 5$ to 7μ in diameter. The acutely-ended spicules, as a rule, are more or less abruptly-pointed, *i.e.*, are tornota; but more or less oxea-like forms are not rare. Some of the shortest among the latter spicules are hardly to be distinguished from the oxea that derive from the stylote megascleres.

Microscleres.—(i.) The sigmata are invariably more or less contort, though seldom to such a degree as to appear S-shaped when seen from the side; they are 15 to 20μ in length measured from bend to bend, and about 1μ in stoutness.

(ii.) The trichites are of two sizes as regards length, the shorter measuring from 15 to 28μ, the longer from 37 to about 60μ. As already mentioned, the former occur only in dragmata, the latter both in dragmata and scattered singly.

Ceratopsis Thiele.

Definition.—Axinellidæ of erect, lamellar or ramose habit; typically with an axially condensed skeleton deficient in spongin. Megascleres either of two distinct kinds—styli (sometimes in part secondarily diactinal) and elongated flexuous strongyla,—or the latter spicules are absent. Microscleres: smooth microxea only, typically occurring most abundantly in the dermal layer.

Type, *C. expansa* Thiele.

The genus was instituted by Thiele(**38**) for four species from Japan, differing from all previously known Axinellidæ by the presence of microscleres of a single kind in the form of smooth microxea, and further characterised according to the generic diagnosis—(i.) by the presence of smooth stylote megascleres "die ein festes Axenskelett bilden, von dem nach Peripherie radiäre Style ausgehen", (ii.) by the very small amount of spongin present, and (iii.) by the almost complete restriction of the microscleres to the ectosome, where they constitute a dermal skeleton. The only additional information provided regarding the skeleton is to the effect that the "feste Axe" is similar in character to that of the genus *Acanthella*; whether the radially-directed styli are collected into fibres or not, or in what respects, if any, the several species differ in skeletal structure, is not stated. Three of the species,—viz., *C. expansa*, *C. erecta*, and *C. ramosa*,—agree in their described characters very closely, and are undoubtedly congeneric; but the fourth, *C. clavata*, is distinguished not only by its non-lamellar (cauliform) habit and conulose surface, but also by the fact that the megascleres are of two distinct kinds,- styli composing the main skeleton, and relatively few long flexuous strongyla (presumably occurring interstitially). Since it is not unlikely that *C. clavata* will be found to differ from the remaining three species in other important respects also, its inclusion in the present genus must be looked upon as provisional.

More recently Kirkpatrick(**20**) has described from Cape Colony, under the name *Phakellia microxephora*, a fifth species with microxea, which it seems necessary also to include provisionally in the genus *Ceratopsis*. This species agrees with *C. clavata* in the possession of elongated flexuous strongyla, but the accompanying megascleres are relatively few, and chiefly oxeote, and the external habit of the sponge is lamellar as in the case of the typical species of the genus. Concerning the structural characters of the skeleton in this species, no information is available.

By Thiele and Kirkpatrick, the oxeote microscleres were regarded as indicative of affinity with the genus *Higginsia*. The evidence afforded by the spiculation of *C. clavata* and *C. microxephora*, however, much more strongly justifies the view that *Ceratopsis* is related to *Sigmaxia*, and that it constitutes a connecting-link between the latter and such genera as *Axinella*, *Phakellia*, and *Acanthella*.

It is necessary to refer here to the species designated *Axinella frondula* by Whitelegge(**60**), the spiculation of which has been described as consisting of smooth styli of two sizes and of scarce small oxea 110 by $3{\cdot}5\mu$ in size, occurring "chiefly in or near the dermal portion of the sponge",—and which consequently might be thought to be related to *Ceratopsis.* I have re-examined this species, and find that the oxea are merely variants of the smaller styli (differing from them neither in size nor in situation), and that the latter are differentiated into two kinds, one of which is distinguished by having the distal moiety vestigially spined, and by being very slightly stouter and of more conical shape than the other. The species belongs, in fact, to the Myxillinæ, and requires a new genus for its reception, for which I propose the name *Echinaxia.* The sponge is thinly lamellar, flabelliform; and the skeleton consists (i.) of a condensed axial region formed mainly of an irregular reticulation of the smaller smooth styli (which vary from 90 to 150μ in length and up to 5μ in stoutness) and partly of fairly numerous, longitudinally directed, singly-occurring, long slender styli (varying in size from less than 200 by 2μ to upwards of 700 by 12μ), and (ii.) of short, fairly stout, echinated fibres radiating from the axial region towards the surface, composed both of smooth and spined short styli, and terminating in a compact bundle or tuft of long stout styli (apparently similar to the longer of those occurring in the axial region) the extremities of which project somewhat beyond the surface. I am inclined to think that the genus *Echinaxia* should be so defined as to include also the two species described by Thiele(**38**) as *Raspailia folium* and *Raspailia hirsuta.*

Dragmaxia, gen.nov.

Definition.—Axinellidæ of lamellar habit, typically flabellate or cup-shaped. Skeleton composed of dense spicule-axes ramifying in the midplane of the lamina, and of plumose spicule-columns radiating therefrom, between which interconnection by means of transverse fibres is rare. Megascleres: styli only; either of a single sort, or more or less completely differentiated into two sorts,—one (of shorter length) forming the fibres, the other occurring interstitially. Microscleres: trichodragmata accompanied or not by singly scattered trichites.

Type, *D. variabilis* Whitelegge.

The species for which I propose the genus was referred by its author to the genus *Spongosorites*, under the erroneous impression that the microscleres present—which are exceptionally slender trichite-sheaves, peculiar in being often more or less fusiform in shape—were microxea. Even had the microscleres been as stated, however, it is not to *Spongosorites* that the species would have required to be assigned, but probably to *Ceratopsis*. Hitherto, all species with a plumose or with an axially-condensed type of skeleton, and with trichodragmata only as microscleres, have been included in the single genus *Thrinacophora*, but I now propose to regard them as representative of several distinct genera.

DRAGMAXIA VARIABILIS Whitelegge.

(Pl. xxxviii., figs.1, 2, 3.)

1907. *Spongosorites variabilis* Whitelegge(**60**), p.513, Pl. xlvi., fig.45.

Diagnosis.—Thinly lamellar, varying from flabelliform to caliculate. The lamina alternately denser and less dense along lines running towards the margin, and thus presenting an appearance as of venation, with corresponding faint ridges and grooves on the surface. The surface otherwise even. Dermal membrane distinct, aspiculous. Oscula inconspicuous. Skeleton consisting of dense spicule-axes corresponding in position with the "veins," and of stout plumose fibres running outwards therefrom to the surface. Spongin rather scanty. Megascleres: styli only, not quite perfectly differentiated into two kinds; those forming the fibres are shorter, stouter, and more curved, attaining a maximum size of about 900 by 33μ; the others, which are relatively few and occur only interstitially, occasionally surpass 1300 or 1400μ in length and are not more than 18μ in diameter. The trichodragmata vary from about 100 to 200μ in length and up to 5μ in stoutness; singly scattered trichites, similar to those forming the dragmata, also occur.

Loc.—Off Crookhaven River, N.S.W. ("Thetis.").

External features.—The original specimen was rudely cup-shaped or, rather, compressed funnel-shaped, with a few laterally arising secondary lamellæ disposed in vertical planes; and measured, when complete, approximately 130 mm. in height by 120 and by 80 mm. respectively in the greatest and least diameters of the cup-orifice, and from 2 mm. (at the margin) to about 5 mm. in the thickness of the lamina or cup-wall: it exists now in two pieces, one of which—figured by Whitelegge—is in a dried but otherwise undamaged condition, while the other is well-preserved in alcohol. According to the original description, the lateral lamellæ occur on both the inner and the outer surfaces of the cup, but this is really not the case; they are confined entirely to the interior side.

A second specimen (also obtained by the "Thetis" Expedition, but from an unknown locality) is now known, which is simply flabelliform without secondary outgrowths. This measures 90 mm. in height by only 2 to 3 mm. in thickness, and is in a dried, completely washed-out condition.

An exceedingly characteristic feature,—very clearly evident when the sponge is examined by transmitted light,—is the structural peculiarity of the lamina, which is alternately denser and less dense along slightly diverging, ever multiplying lines, or rather strips, running in a direction from stalk to margin: along the denser strips, the lamina is usually slightly thicker than it is between them, and the surface is accordingly marked with radiating faint grooves and slight ridges. With respect to this structure, however, the two specimens exhibit a very appreciable difference, which may prove to be varietally distinctive. In the smaller specimen, the strips (of greater density) are all directed radially, increasing in number upwards by repeated branching, and are all similar in character; they diminish in individual width from somewhat less than 2 mm. in proximity to the stalk to less than 0·5 mm. at the sponge-margin, and the width of the intervening strips of lesser density is about the same. In some portions of the type-specimen, the structure is very similar to this, except that the lines of greater density are generally much broader; but elsewhere there also occur a few relatively very powerful, dense, nervure-like thickenings of the lamina, ramifying through it, upwards from the stalk, in the manner of the palmate leaf, and from these the lesser lines of density, in part, branch off (at small angles of divergence) in pinnate fashion (Pl. xxxvii., fig.3).

As a result of maceration, the less dense portions of the lamina largely disappear, and the sponge becomes abundantly perforated by rounded holes arranged serially along radiating lines.

The surface is somewhat uneven, owing to inequalities in the thickness of the lamina; it is also slightly granular, but not hispid. The dermal membrane is thin and translucent, but not very delicate; situated beneath it, more especially along the grooves marking the less dense portions of the lamina, are numerous small subdermal spaces. Dermal pores occur on both surfaces, but are relatively few and for the most part are scattered singly and irregularly on the one surface (viz., the inner one, when the sponge is cup-shaped), very numerous, and generally so closely arranged as to produce a net-like appearance of the dermal membrane, on the other. In most places where the pores are numerous, the dermal layer appears as if consisting of two incompletely separated membranes, the outer one of which is provided with many, smaller pores, the inner with fewer and much larger ones. On the surface which has the fewer pores, there are also many circular openings, from 0·2 to 0·5 mm. or slightly more in diameter, situated only along the surface-grooves and principally in the positions where the lamina becomes perforated when the sponge is macerated; these openings appear to be oscula.

The consistency of the sponge, when well-preserved in alcohol, is firm and tough, only slightly compressible, and resilient; and the colour is a pale yellowish-brown. Dried specimens are light in weight and rather brittle, and of a pale greyish colour.

Skeleton.—The skeleton is resolvable into (i.) a system of condensed, multifibrous axes or "funes," which ramify dendritically in the midplane of the sponge-lamina, progressively decreasing in stoutness as they ascend,—and which form the midribs, as it were, of the denser strips of the lamina above referred to; and (ii.) of numerous, highly plumose, usually branched, short secondary fibres, which proceed off from the former, apparently from all sides thereof, and run upwards and gradually outwards to the surface. Towards the margin of the sponge, the funes dissolve ultimately into similar plumose fibres (Pl. xxxvii., fig.3), and the skeleton in this region accordingly is composed entirely of such (Pl. xxxvii., figs.1, 2); these fibres are composed of a compact stout core (seldom less than 200μ and frequently surpassing 400μ in diameter) of longitudinally disposed spicules, cemented together by a relatively somewhat small amount of spongin, and of rather numerous, usually very obliquely (often nearly or quite perpendicularly) directed, outwardly-projecting or "echinating" spicules of similar kind, the number of which is greatest towards the outer extremities of the fibres. The echinating spicules of immediately adjoining fibres usually intercross with one another, and very often, where two fibres lie sufficiently close together, the points of some of the spicules of each of them become embedded in the spongin of the other; occasionally, one or a few together of these connecting spicules become invested with a sheath of spongin, and a connecting fibre is thus formed, but such connections are comparatively rare. Megascleres scattered between the fibres are relatively few, and in part are much longer and slenderer than those forming the fibres. The funes are composed each of a dense, irregular plexus of stout, mostly non-plumose fibres with closely compacted spicules arranged usually in a more or less disorderly fashion, and cemented by a relatively small amount of spongin, which does not form an external sheath; the outermost-lying spicules of the fibres, indeed, are usually almost or quite free from spongin. Towards the older parts of the sponge, the meshes of the plexus tend to become obliterated, and the skeleton has the appearance of consisting of a confused mass of spicules. The formation of the plexus appears to be brought about by the continued addition of spicules to, and also in between, the plumose fibres of the original skeleton.

Trichodragmata are scattered fairly plentifully through all parts of the sponge, including the dermal membrane, but are nowhere extremely abundant: within the funes they are rather scarce. Singly scattered trichites in moderate number also occur, but are difficult to perceive owing to their extreme tenuity. The dragmata are unusually slender, and are often notably longer than the individual trichites composing them.

Megascleres.—(i.) The styli composing the fibres are almost invariably more or less curved, and are, without exception, evenly rounded at the base and of uniform or nearly uniform diameter therefrom to beyond the middle of their length, whence they taper gradually to a sharp point. Their curvature, as a rule, is slight to moderate, and most frequently is confined to the basal moiety of the spicule, but it varies in degree very considerably, and when most pronounced is usually somewhat angulate. Quite commonly in the case of the smaller specimen, much less frequently in the larger, the basal part of the shaft, at a variable distance from the extremity, is more or less sharply curved or bent to one side; occasionally such spicules have the form of rhabdostyli. In the latter, or typical specimen, a notable proportion (numbering between 25 and 50 per cent. of the spicules) exhibit a faint annular swelling close to the basal end, at a distance therefrom varying from 15 to about 50μ,—the distance usually being greatest, and the annulation less distinct, in the case of the longest spicules; in some of the shorter spicules, the annular swelling is replaced by a slight basal inflation, the spicule becoming a subtylostyle. In the case of the smaller specimen, this peculiarity is exceedingly rare. In the typical specimen, also, the spicules increase in stoutness towards the base of the sponge, attaining in proximity to the stalk a maximum diameter of 45μ; whereas in the uppermost regions thereof, and throughout all parts of the other specimen, their diameter is at most 33 or 34μ. Their length is about the same in both specimens,—ranging from about 350μ (but seldom less than 400 or 450μ) to somewhat above 900μ.

(ii.) The longer and slenderer styli, occurring only between the fibres, and relatively few, are generally straight or (in comparison

Text-fig. 16.—*Dragmaxia variabilis*. *a*, megascleres of the fibres; *b*, interstitial megascleres.

with their length) but slightly curved, often somewhat flexuously; and with extremely rare exceptions are unprovided with a sub-basal annular inflation: otherwise, in shape, they are similar to the preceding, with which they form a continuous series. In the typical specimen, they range from somewhat less than 1000 to upwards of 1500μ (rarely to nearly 1600μ) in length, and up to 18μ in diameter, spicules between 900 and 1000μ in length being comparatively rare; in the other specimen, they are of equal stoutness, but seldom surpass 1250μ, and very rarely if ever attain to more than 1400μ in length, while individuals between 900 and 1000μ long are comparatively frequent.

Microscleres.—The trichites, both composing the dragmata and scattered singly, are very slender, always less than 0·5μ in diameter, and vary in length from 75 to 110μ; they are very frequently curved or flexuous. The dragmata are seldom as much as 5μ in diameter, and as a rule they are very compactly composed and somewhat fusiform in shape; they are often much longer than the trichites, occasionally attaining a length of 200μ.

EXPLANATION OF PLATES.

Plate xxix., fig.4.

Fig.4.—*Allantophora plicata* Whitelegge; showing the skeleton (photographed by transmitted light) of portion of a lamella of the type-specimen, the lamella varying in thickness from 1-8 mm.; (nat size).

Plate xxx.

Fig.1.—*Allantophora plicata* Whitelegge; portion of a spirit-specimen; ($\times \frac{5}{6}$).

Fig.2.—*A. plicata* Whitelegge; portion of a lamella of the partially macerated, dried type-specimen; (nat. size).

Fig.3.—*A. plicata* Whitelegge; an entire lamella of a dry, washed-out specimen, showing the texture of the skeleton; (nat. size).

Figs.4, 5.—*A. victoriana*, sp.nov.: specimens of massive form (*cf.* Pl. xxxi., fig.3); ($\times \frac{5}{12}$).

Fig.6.—*A. ciocalyptoides* Dendy; a submassive, digitate specimen, attached to a stone; ($\times \frac{5}{12}$).

Fig.7.—*A. ciocalyptoides* Dendy; a semi-encrusting specimen, growing upon a stone; ($\frac{5}{12}$).

Fig.8.—*A. ciocalyptoides*, var. *reducta*, var.nov.; ($\times \frac{5}{12}$).

Plate xxxi.

Allantophora victoriana, sp.nov.

Fig.1.—Skeleton (photographed by transmitted light) as it appears in a thick vertical slice of an entire massive specimen; (nat. size).

Fig.2.—Skeleton of a moderately thick vertical slice of the type-specimen; (nat. size).

Fig.3.—Skeleton (photographed by transmitted light) of portion of a digitate specimen, extending from the base upwards into two digitiform processes; (× $1\frac{1}{3}$).

Fig.4.—Digitate specimen; (nat. size).

Plate xxxii.

Allantophora victoriana, sp.nov.

Fig.1.—Portion of a longitudinal mesial section of the skeleton of a digitiform process, showing the axial region, the radiating main fibres, and the connecting fibres; (× 9).

Fig.2.—Portion of a transverse section of the skeleton of a digitation, showing the paucity of the connecting fibres in the transverse plane; (× 9)

Figs.3, 4, 5.—Portions of the skeleton (of the two massive specimens), showing the pattern of the reticulation formed by the connecting fibres.

Plate xxxiii., figs.1-5.

Figs.1, 2.—*Sigmaxinella australiana* Dendy; (× $\frac{5}{12}$).

Fig.3.—*S. australiana* Dendy, (? var.); (× $\frac{5}{12}$).

Fig.4.—*S. riminalis*, sp.nov.; (× $\frac{5}{12}$).

Fig.5.—*Sigmaxia flabellata* Carter; (× $\frac{5}{12}$). [The oscula-like pits on the surface are due to an epizoic Zooantharian.]

Plate xxxiv.

Fig.1.—*Sigmaxinella australiana* Dendy; longitudinal mesial section of the skeleton of portion of a branch; (× 13).

Fig.2.—*S. dendroides* Whitelegge ; longitudinal mesial section of the skeleton of portion of a branch; (× 13).

Plate xxxv.

Sigmaxinella riminalis, sp.nov.

Fig.1.—Longitudinal mesial section of the skeleton of the terminal portion of a branch; (× 14).

Fig.2.—Longitudinal mesial section of a branch; (× 14).

Plate xxxvi.

Fig.1.—*Sigmaxinella riminalis*, sp.nov.: longitudinal median section of the skeleton of the stalk; (× 14).

Fig. 2.—*Sigmaxia flabellata* Carter: (portion of a) longitudinal section of the skeleton perpendicular to the plane of the sponge-lamina; ($\times 3$).

Fig. 3.—*Sigmaxia flabellata* Carter: portion of the section shown in the preceding figure, more highly magnified; ($\times 13$).

Plate xxxvii.

Dragmaxia variabilis Whitelegge.

Fig. 1.—Skeleton as shown in a thin section parallel to and in the midplane of the sponge-lamina at its upper margin; from a typical specimen; ($\times 15$).

Fig. 2.—Skeleton as shown in a thin longitudinal section perpendicular to the sponge-lamina at its upper margin; from a typical specimen; ($\times 15$).

Fig. 3.—Skeleton (of an entire piece of the sponge-lamina) showing the arrangement of the dense multi-fibrous axes or "funes" and their ultimate resolution into single fibres; ($\times 1\frac{1}{3}$).

Plate xxxviii., figs. 1-4.

Figs. 1, 2, 3, 4.—*Allantophora victoriana*, sp. nov.; photograph of portions of the surface of different specimens, showing the mode of disposition of the dermal pores.

A REVISION OF THE GENERA WITH MICROSCLERES INCLUDED, OR PROVISIONALLY INCLUDED, IN THE FAMILY *AXINELLIDÆ*; WITH DESCRIPTIONS OF SOME AUSTRALIAN SPECIES. Part iii.

[PORIFERA.]

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(Plates xxix., figs.3, 5, 6; xxxiii., fig.6; xxxviii., figs.5-9; xxxix., figs.1-5; xl., figs.1-4, xli.-xliv.; and Text-figs.17-20.)

Genus THRINACOPHORA Ridley.

Definition.—Axinellidæ typically of ramose habit, perhaps also sometimes encrusting or massive, with even or conulose surface, and a skeleton consisting (in the ramose forms) of a dense central axis from which paucispicular fibres (in some species reduced to single spicules) radiate to the surface. Megascleres of at least three kinds: (i.) comparatively short oxea, typically occurring chiefly or only in the central axis; (ii.) long, setaceous styli, composing the radial fibres; and (iii.) monactinal, sometimes apically pronged, dermal megascleres forming surface-tufts or lying in the dermal membrane tangentially, but not necessarily confined to the ectosomal layer exclusively. In addition, oxeote or strongylote modifications of one or both kinds of the monactinal megascleres are commonly present. Microscleres: trichodragmata, accompanied or not by singly scattered trichites.

Type-species, *T. funiformis* Ridley & Dendy.

Originally founded by Ridley(**32**) to designate the peculiar *T. funiformis*, and conceived as being essentially characterised by the possession of dermal megascleres in the form of "cladostrongyla," the genus *Thrinacophora* was next modified by Ridley and Dendy(33) to receive also the species named by them *T. cervicornis*, and was defined by them thus: "Sponge ramose, with a dense central axis of spiculo-fibre; megasclera styli and (or) oxea, and (in some species) cladostrongyla. Microscleres present in the form of trichodragmata." More recently Dendy(8) has amplified the definition so as to embrace in the genus all Axinellidæ in which the microscleres are trichodragmata and the skeleton is more or less plumose. A similar disposition to employ the genus in a wider sense than that in which it had been understood by Ridley and Dendy, had previously been shown by Topsent(46), when he assigned to it provisionally, under the name *Thrinacophora*(?) *spissa*, a species of massive habit and halichondroid skeletal structure, with oxea alone as megascleres. This species was also admitted in the genus by Dendy; but as the result of a second investigation of it Topsent(53) has found that the microscleres include toxa (in addition to trichodragmata), thereby definitely establishing the correct position of the species to be in the genus *Gellius* as defined by Lundbeck(30). The known species that properly admit of inclusion in *Thrinacophora* as defined by Dendy, are ten in number*,—comprising, in addition to those already assigned to the genus, *Axinella padina* Topsent(47), *Raspailia* (*Syringella*) *rhaphidophora* Hentschel(15), and the species originally described by Whitelegge as *Spongosorites variabilis.* The great diversity of spiculation and skeletal structure exhibited by these species renders it obvious that they do not constitute a natural genus; and the only justification for their association together in a single genus would be the impossibility of separating them into simpler and apparently more homogeneous groups susceptible of precise and adequate definition. It is easy, however, to subdivide them into at least four such groups, distinguished by differences sufficiently great to be regarded as generic. I propose, therefore, to restrict the name *Thrinacophora* to the species with special dermal megascleres,

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* Since this was written, I have discovered the existence of trichodragmata in Whitelegge's *Ciocalypta incrustans*(58), which, therefore, constitutes an eleventh species of this kind.

and to distribute the remaining species among three new genera, —*Dragmaxia*, *Dragmacidon*, and *Axidragma*. Forms capable of being referred to *Thrinacophora* in the previously understood sense would result from any of the genera *Biemna* (sens. ampl.), *Sigmaxinella* and *Sigmaxia* by the loss of sigmata, but with the possible exception of those I ascribe to *Dragmacidon* (which, if provided with sigmata, would perhaps require to be included in *Biemna*), none of the known species appear to have been thus derived.

Thrinacophora as here defined comprises, at present, five species, viz., *T. funiformis* Ridley & Dendy, *T. spinosa* Wilson,† *T. incrustans* Kieschnick(**23**), *T. cervicornis* Ridley & Dendy, and *T. rhaphidophora* Hentschel. Kieschnick's species—if its extremely meagre description is to be relied upon,—has essentially the same spiculation as that of the type-species, and, if such be the case, must of necessity be included in the genus, notwithstanding its being of encrusting habit; in the face of what has been disclosed by Thiele(**41**, p.935), however, it is questionable whether this species has any real existence. The remaining four species, in spite of their many points of agreement, are extremely well distinguished, and, indeed, might almost be regarded each as the type of a separate genus; since, however, their resemblances appear to be due to genetic relationship, their retention in a single genus has most to recommend it.

It is exceedingly doubtful if the species referable to *Thrinacophora*, in the restricted sense, belong properly to the Axinellidæ at all. In spiculation they present many striking points of analogy with the genera *Raspailia*, *Syringella*, *Axechina*(**15**), *Axiamon*(**13**), and *Trikentrion*,—the significance of which is greatly heightened, in the case of the last-mentioned two genera, by the fact that, in *Trikentrion*, microscleres are sometimes present in the form of trichodragmata and the peculiar acanthostylote megascleres characteristic of the genus are sometimes very scarce, and by the fact that, in *Axiamon*, the dermal megascleres are spined

† H. V. Wilson, Bulletin of the United States Fish Commission, Vol. xx., Pt.2, 1900, p.400.

at the apex, and thus exhibit a feature which might be looked upon as differing essentially only in degree of development from the furcation of the cladostrongyla of *T. funiformis.* Hence I am strongly inclined to think that *Thrinacophora* is of "Ectyonine" origin, and that its correct position is in the Desmacidonidæ.

Genus Dragmatyle Topsent.

Definition.—Axinellidæ(?) of encrusting habit, with a main skeleton consisting of long smooth tylostyli disposed vertically, with their heads based on the substratum, and a dermal skeleton formed of smooth diactinal megascleres disposed tangentially. Microscleres trichodragmata.

Type-species, *D. lictor* Topsent(**53**).

The systematic position of *Dragmatyle*, like that of *Thrinacophora*, is uncertain. The character of the skeleton (in the single known species) affords ground for the view that the genus is of "Ectyonine" derivation; and this view is further supported by the existence of two species of thinly encrusting habit—the so-called *Hymeraphia viridis* Topsent(**46**), and *Microciona fascispiculifera* Carter(**3**),—in which the spiculation consists of vertically directed long smooth tylostyli, trichodragmata and, in addition, acanthostyli. But this evidence is by no means conclusive, since the type of skeleton possessed by *Dragmatyle* is common to quite a number of encrusting genera of very diverse origin,—including, for example, (in addition to several genera provided with acanthostyli), *Timea* and *Halicnemia* (s.str.) in the Spirastrellidæ, and *Bubaris* in the Axinellidæ. On the whole, there is perhaps more to be said in favour of the inclusion of *Dragmatyle* in the Axinellidæ than can be advanced in the case of *Thrinacophora*.

Genus Axidragma, gen.nov.

Definition.—Axinellidæ typically of thin lamellar habit, stipitate, with even surface. Skeleton composed of primary lines of stylote megascleres, traversing the sponge in the direction of its growth, and of secondary lines (connecting fibres?) formed of oxea; there is no special dermal skeleton. The megascleres are of the two forms mentioned, which are quite distinct in kind. The microscleres are trichodragmata accompanied or not by single trichites.

Type-species, *A. padina* Topsent(**47**).

This genus is proposed for the reception of Topsent's *Axinella padina*, described from the Gulf of Lyons. At first I was inclined to include the species in the genus *Dragmaxia*, with the single species of which it presents some striking points of superficial similarity; but consideration of the decided differences between it and the latter in the matter of skeletal structure has confirmed me in the view that their generic separation is advisable. As regards the precise structure of the skeleton in *Axinella padina*, however, Topsent's description is not very explicit, and a quite exact definition of the genus cannot therefore be framed. In speaking of the outward features of the sponge, he mentions that the single specimen, in consequence of its having been somewhat damaged by the trawl, "se trouve en plusieurs endroits usé et percé à jour: de la sorte se trouve mise à nu par place l'espèce de nervation qui monte en éventail du pédicelle jusqu'au bord des lobes, en lignes spiculeuses, épaisses, nombreuses et, par suite, à peine divergentes." And further on, in describing the spiculation (which consists of slightly curved styli, 650 to 900μ in length by 8 to 10μ in diameter at the base, and of curved, sharp-pointed oxea with a maximal size of 275 by 6μ), he merely adds that the styli "forment les nervures et déterminent l'hispidation de la surface", and that the oxea "constituent les lignes secondaires, ordinairement unispiculées de la charpente". It is not clear whether the "nervures" are of the nature of funes, or whether they are formed by single fibres; nor is any mention made as to whether or not the fibres are plumose, nor regarding the extent to which spongin is developed in connection therewith. It is presumable, however, that the "lignes secondaires" are of the nature of connecting fibres, and that the styli producing the hispidation of the surface are the terminal spicules of fibres running outwards to the surface.

Genus DRAGMACIDON, gen.nov.

Definition.—Axinellidæ of more or less massive habit, sometimes provided with incipient conuli, but without surface-processes of other kind. The skeleton consists of irregular plumose columns loosely composed of mingled oxeote and stylote megascleres or of oxea alone, and of (sometimes relatively scarce) connecting fibres formed of the same spicules; typically, spongin is developed in connection with the fibres rather sparingly, and there is no dermal skeleton. In addition to the oxea and styli composing the skeletal columns,—which typically are of similar or nearly similar dimensions,—longer megascleres of a single kind (likewise either oxeote or stylote) may occur interstitially. The microscleres are trichodragmata, accompanied or not by single trichites.

Type-species, *D. agariciformis* Dendy(**8**).

Besides the type-species, the genus will include Dendy's *Thrinacophora durissima* (which likewise comes from Ceylon), and the species originally described by Lendenfeld, from Port Jackson, as *Halichondria clathriformis.** The last-mentioned,—a redescription of the skeletal characters of which, based on a small piece of the type-specimen received from the British Museum, has recently been given by me(**13**),—is distinguished by the fact that its megascleres are almost exclusively oxea; and on that account the propriety of its association in a single genus with

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* Subsequently I have found that Whitelegge's *Ciocalypta incrustans*(**58**), from Funafuti, constitutes a fourth species of this genus. In this, as in *D. durissima*, special interstitial megascleres are wanting and the spiculation consists of styli and oxea in about equal number occurring in the skeleton promiscuously intermingled; but the styli are here larger than the oxea, ranging in length from less than 200 to upwards of 550μ and occasionally attaining to 13μ in stoutness, while the latter rarely if ever exceed a size of 400 by 10μ. The oxea are exactly similar in shape to those of the three species of *Allantophora* described above, and (as in the same species) are not connected with the styli by intermediate forms. The structure of the skeleton closely resembles that both of *D. agariciformis* and *D. clathriformis.* The trichodragmata, which are very scarce, have the form of stout compact bundles 12 to 14μ in length. Singly scattered trichites do not occur.

the other species might seem debatable. Owing to the kindness of Prof. Dendy, I have had the opportunity, however, of examining a section of his *Thrinacophora agariciformis;* and the close resemblance in skeletal pattern, which I find to exist between it and the species in question, leaves no doubt in my mind as to their very near relationship. In these two species, interstitial megascleres occur which are different from those composing the fibres; but whereas in *D. clathriformis* they are very scarce, and are connected with the fibre-forming megascleres by intermediate forms, such is not the case in the type-species. In *D. durissima*, apparently, special interstitial megascleres either have never been developed, or have become lost.

Dragmatella, gen.nov.

Definition.—Axinellidæ of massive habit, provided with digitiform tapering processes. Internal structure cavernous. Main skeleton consisting of well-developed, non-plumose(?), multispicular fibres arranged more or less dendritically. A dermal skeleton is typically present, formed of tangentially-disposed megascleres crossing in every direction. The megascleres are styli of a single kind. The microscleres are trichodragmata alone, or accompanied by trichites singly scattered.

Type-species, *D. aberrans* Topsent(**46**).

To define the genus *Biemna* in such a way as to secure the inclusion in it of Topsent's *Desmacella aberrans*, and at the same time to exclude therefrom certain other species likewise possessing trichodragmata alone as microscleres,—such, for example, as those belonging to the genera *Dragmacidon* and *Rhaphoxya*,—is extremely difficult, if not impossible; and, on that account, the erection of a new genus for this species seems necessary. Even apart from any consideration of expediency, however, it is doubtful if the species could have been allowed to remain in *Biemna*, —since, in addition to being without sigmata, it differs from all strictly acceptable species of that genus in at least one other noteworthy respect, namely, the possession of a dermal skeleton composed of megascleres directed horizontally.

Rhaphoxya, gen.nov.

Definition.—Axinellidæ(?) of massive habit, without surface-processes other than in the form of small, typically papilliform conuli; with a rather meagre main skeleton consisting of an irregular reticulation of slender, non-plumose, longitudinal and connecting fibres, somewhat scantily provided with spongin; and without a dermal skeleton. The megascleres are more or less curved to flexuous, slender cylindrical styli, oxea and strongyla, differing from one another only in the character of their extremities. The microscleres are trichites, in dragmata and scattered singly.

Type-species, *R. typica*, sp.n.

The two species which I ascribe to this genus, while scarcely distinguishable from one another in their skeletal structure and spiculation, nevertheless differ so markedly in some other respects as to render it questionable whether their resemblances may not merely be due to convergence. In one of them, for example,—described originally by Dendy as *Rhaphisia pallida*,—the main efferent canals are surrounded by a broad zone of gelatinous-looking collenchymatous tissue, precisely similar in appearance to that occurring in the same situation in most of the species of Tedaniinæ I have examined; whereas, in the other, the extra-choanosomal layer of tissue bordering the canal is, as usual, comparatively narrow, and appears to be histologically different in constitution. The arrangement of the dermal pores also is very dissimilar in the two species; and, furthermore, oscula are apparently absent in the one, while present in the other. I am strongly inclined to think that the feature in which *R. pallida* resembles the Tedaniinæ is evidence of its very close relationship to that group; but its microscleres, it must be confessed, afford no confirmation of this view, for they are perfectly smooth and quite symmetrically diactinal, whereas in all the species belonging indubitably to the Tedaniinæ that have so far been described, the rhaphides (onychetæ) are not only without exception more or less spinulous, but they are usually (perhaps invariably) also anisoactinal, and are very frequently provided with a bulbous dilation near one extremity. *R. typica* appears to me, on the other hand, not to depart in any important respect, except in the absence of spined microxea, from *Desmoxya* (formerly *Higginsia*) *lunata* Carter.

I hesitate, however, to refer the two species to separate genera, inasmuch as their only differences are such as are not yet recognised as possessing generic value.

With reference to the possible Tedaniine affinities of *R. pallida*, it is interesting to note that the only other two Australian species which have been ascribed to the genus *Rhaphisia*, actually do belong to the Tedaniinæ. This fact I have already made known regarding one of them—*Rhaphisia anonyma* Carter,—in a previous communication(**13**); and for the reception of the species I proposed a new genus, *Hemitedania*. The other, *Rhaphisia ramosa* Whitelegge(**59**), I now find to possess a somewhat similar spiculation,—consisting of oxea (of a single kind) and spinulous onychetæ (of three kinds); but in skeletal structure it differs from *H. anonyma* very considerably.* The species appears to me one which will necessitate the erection of a new genus for its accommodation, but provisionally it may be referred to *Hemitedania*.

Furthermore, of the seven specimens recorded by Dendy as examples of *R. pallida*, two are not correctly identified as such, but again are representatives of a Tedaniine species. In this latter, the microscleres are of three kinds,—nearly similar in form to those of *Hemitedania*(?) *anonyma* (excepting that the styliform ones are very much slenderer and somewhat differently shaped at their basal extremity); but the megascleres are cylin-

* The species is sorely in need of re-description, especially with respect to its skeletal structure; and the information regarding the spicular characters is also misleading. The oxea vary from 220 to 570μ in length and up to 14μ in stoutness; the onychetæ of two kinds are similar in form to those of *H. anonyma*(**13**. Text-fig.20), exhibiting a conspicuous bead-like dilatation close to the blunter extremity, and measuring respectively 150 to 185 by 1·5μ and 45 to 75 by 0·75μ in size; and the onychetæ of the third kind have the form of subfusiform styli with an abruptly truncated basal extremity provided with a central mucro and a circumferential whorl of minute spines, and measure 95 to 125μ in length by 3·5μ in maximum stoutness.

drical styli of a single kind (measuring 320 to 420μ in length by 6μ in stoutness), occasionally transforming into strongyla. This species also appears to me to constitute a new generic type.

Under the name *Chondropsis carteri*, Dendy(6) has described, from Port Phillip, a species in which the microscleres are "hair-like rhaphides," the megascleres are slender strongyla (and of a single kind), and the skeleton consists partly of "numerous stout sandy tracts or fibres running more or less parallel to one another towards the surface," and partly of spiculo-spongin fibres. From its description, therefore, the species is one which might appear as possibly admitting of inclusion in a single genus along with *Rhaphoxya typica* and *R. pallida*. On examination of its type-specimen, I find, however, that *Chondropsis carteri* also belongs to the Tedaniinæ; its rhaphides are spinulous, and of two kinds, measuring respectively 100μ and 55μ in length, the shorter ones styliform in shape, up to 1·5μ in stoutness, and relatively scarce, the longer (and slenderer) usually sharp-pointed at both extremities, and occasionally exhibiting a slight dilatation near one extremity. Since, in the case of this species, a new genus is unquestionably required, I propose, in designation thereof, the name *Strongylamma*.

RHAPHOXYA TYPICA, sp.nov.

(Pl. xxix., fig.3; Pl. xxxviii., figs.8, 9; Pl. xxxix., fig.5; Pl. xlii., figs.1, 2.)

Diagnosis.—Sponge massive, sessile, irregular. Surface rugose, but generally subglabrous: provided with scattered, small, papilliform elevations. Oscula situated chiefly on the uppermost parts. Dermal membrane easily separable; minutely reticulate to the naked eye, with many dermal pores in each mesh of the reticulation. Skeleton lax and rather scanty; consisting chiefly of ascending, slender, multispicular main fibres; connecting fibres more frequent towards the interior. Megascleres slender, cylindrical; comprising oxea, strongyla, and fewer styli; up to 700 by 9μ in size. Trichites 55 to 400μ long, occurring singly scattered and in dragmata, and also forming short fibres.

Loc.—Port Phillip.

External characters.—The single specimen (Pl. xxix., fig.3) is irregularly cake-shaped, with the upper surface deeply incised by several narrow, valley-like or sulciform grooves, and measures 65 mm. in length, 45 mm. in breadth, and 35 mm. in height in its most elevated, central portion; the grooves appear to be due merely to the more rapid upgrowth of the intervening portions of the sponge, and thus to be of accidental origin. The surface is further rendered uneven by many irregular shallow furrows and slight undulations, and by moderately numerous, irregularly scattered, small papilliform conuli; the latter are usually more or less appressed to the surface, and seldom exceed 1 mm. or so in height. The dermal membrane is distinct and easily separable (owing to the presence of subdermal spaces), and over most portions of the surface presents, to the naked eye, a minutely reticulate pattern (Pl. xxxviii., fig.8), due to the mode of arrangement of the dermal pores. Interiorly, the sponge is traversed more or less vertically by numerous, fairly wide, main efferent canals (up to 4 mm. in diameter), which terminate in relatively rather small oscula situated, for the most part, on the more elevated portions of the surface. For some distance before arriving at the oscula, many of the canals run close beneath the surface, separated from the exterior by scarcely more than the dermal membrane.

The consistency in alcohol is rather soft and compressible, imperfectly resilient, somewhat lacking in toughness, but not brittle; and the colour is brownish-grey on the surface, slightly paler in the interior.

The dermal reticulation (Pl. xliv., figs.1, 2) is made up of more or less polygonal meshes, varying in actual shape, in different portions of the surface, from nearly circular (with a diameter of from rarely less than 120 to occasionally 250μ) to almost oblong (measuring up to 350μ in length and often less than half as broad as long), and separated by usually relatively narrow boundaries varying from 25 to rarely more than 90μ in width. The largest meshes occur on those portions of the surface where the main efferent canals run immediately below the surface. Within the interstices of the meshes, the dermal membrane is perforated by numerous pores, the largest of which measure 60 or 70μ in diameter: each mesh is accordingly of the nature of a pore-sieve. The boundaries or sides of the meshes contain numerous, densely staining, coarsely granular pigment-cells, usually of more or less elongate shape and occasionally exceeding 20μ in length, and mostly with their long axes directed parallel to the sides of the meshes. No spicules are present in the dermal layer except a few scattered trichites.

Text-fig. 17.*

Skeleton.—Partly owing to the tenuity of the skeletal fibres, and partly to discontinuities due to the considerable number and size of the main efferent canals, the skeleton forms but a very inconsiderable portion of the total mass of the sponge. It consists throughout (Pl. xxxix., fig.5; Pl. xlii., figs.1, 2) chiefly of ascending multispicular main fibres, running upwards (often more or less sinuously) through the sponge in fairly close apposition with one another, increasing in number by bifurcation as they go. Excepting in the more peripheral region of the skeleton, however, fairly numerous, paucispicular connecting fibres also occur, which form among themselves and with the main fibres an extremely irregular reticulation. The fibres are composed of longitudinally directed, usually fairly closely packed spicules, united (and, in the case of the connecting fibres, also usually ensheathed) by a

* *Rhaphoxya typica.* Megascleres. Showing also the extremities of the same more highly magnified.

small amount of hyaline spongin, which is scarcely perceptible except when stained. The main fibres range from occasionally less than 30 to rarely above 80μ in stoutness: the connecting fibres are much slenderer. Scattered megascleres uncemented by spongin are few or absent. Trichites are plentiful through all parts of the interior, occurring chiefly in dragmata, but also scattered singly; in addition, the longest ones frequently form short fibres running parallel to the main skeletal fibres.

Mastichorions.—The flagellated chambers measure up to 45μ in diameter, and are arranged so closely together that the choanosome is generally reduced to a mere reticulum (Pl. xxxviii., fig.9).

Spicules.—(i.) The megascleres are variously (but seldom very much) curved, frequently more or less flexuous, slender cylindrical oxea, strongyla, and styli, differing from one another only in the character of their extremities, and varying in stoutness from about 2 to 9μ, and in length from rarely less than 100 up to 700μ; individuals less than 350μ long, however, are few. The majority are more or less sharply (and usually irregularly) pointed at both extremities (oxeote or tornote); but strongyla also are common, while stylote forms are somewhat less frequent.

(ii.) The trichites or rhaphides are mostly straight or nearly so, less than 1μ in stoutness, and apparently of all lengths from 55 to 400μ; individuals between 220 and 320μ in length, however, are exceedingly rare, and those between about 100 aud 150μ are scarce.

RHAPHOXYA(?) PALLIDA Dendy.

(Pl. xxxiii., fig.6; Pl. xliii., figs.1, 2.)

1896. *Rhaphisia pallida* (partim); Dendy(7), p.257.

Diagnosis.—Sponge massive, sessile, irregular. Surface rugose, but subglabrous; irregularly beset with small papilliform elevations. Oscula absent. Dermal membrane closely adherent. Dermal pores singly scattered. Skeleton lax and rather scanty; consisting of slender, multispicular main fibres united in a very irregular fashion by a plexus of paucispicular connecting fibres. Spiculation almost identically similar to that of *R. typica.*

Loc.—Port Phillip.

Introductory.—The following description is based upon four of the original examples of the species (viz., those bearing the register-numbers 314, 621, 737, and 879), and an excellently preserved spirit-specimen which is in the collection of the Australian Museum; the type-examples also are in alcohol, but with one exception are imperfectly preserved. As already mentioned above, two of the original specimens, which Dendy somewhat doubtfully referred to this species, prove to belong to a genus closely related to *Tedania.*

External characters.—The sponge (Pl. xxxiii., fig.6) is irregularly cake-shaped, somewhat higher than broad, attaining in the case of the largest specimen a height of 65 mm. The surface is slightly uneven, more or less rugose; and is provided, especially in the upper parts, with irregularly scattered, mostly very small, somewhat conule-like elevations, rather variable, in size and shape, but usually more or less papilliform. The undamaged surface is subglabrous. The dermal membrane is moderately thin and fairly tough, without pores visible to the naked eye or even with the aid of a lens, and is everywhere closely adherent to the underlying tissues. The sponge is traversed in a generally upward direction by many main efferent canals, of inconsiderable size so far as regards the size of their lumina, but each surrounded (and thus rendered conspicuous) by a broad layer of somewhat gelatinous-looking collenchymatous tissue. These canals terminate in proximity to the surface; and there are no oscula.

In alcohol, the colour is pale greyish-yellow to dull white, and the consistency is compressible and resilient, fairly tough and compact, but moderately soft. The colour in life, according to the original description, is greyish, ranging from "very light grey-buff" to "smoke-grey."

The dermal membrane contains numerous finely and densely granular, deeply staining cells, generally more or less ovoidal in shape, averaging about 14μ in length by 9μ in breadth. Actual dermal pores were not observed; but (in the case of the one sufficiently well-preserved specimen) thin tangential stained sections of the dermal layer showed fairly numerous subcircular to oval areas,—up to 200μ in diameter and situated at an average distance apart of about 150μ,—distinguished from the intervening portions of the membrane by their relative transparency due to the fewness of the deeply-staining granular cells occurring within their limits (Pl. xliv., fig.3). In life, presumably, each such area is the site of a single pore (or possibly of several pores).

Text-fig. 18.*

Skeleton.—In most respects the skeleton closely resembles that of *R. typica*,—and, indeed, as seen in section, is scarcely distinguishable therefrom; the character of the skeletal fibres is exactly the same in both. The chief difference consists in the somewhat fewer main fibres in the present species, and the far greater number of the connecting fibres (except in the peripheral parts of the skeleton),—in consequence of which the pattern is more generally reticulate, and, except towards the surface, much more irregular (Pl. xliii., figs.1, 2). The difference in skeletal pattern of the two species is much more clearly marked in very thick sections of their skeleton, as will be seen from a comparison of figs. 3 and 5 in Pl. xxxix.; and from these figures it will be observed also that, in the present species, the skeleton is on the whole more scanty, and characterised by more extensive discontinuities due to the passage of main excurrent canals. As in *R. typica*, the trichites occur both in dragmata and scattered singly, and the longer ones (in part) give rise to fibres; the scattered

* *Rhaphoxya*(?) *pallida*. Megascleres. Showing also the extremities of the same more highly magnified.

trichites are mainly confined to the collenchyma, and the trichite-fibres, which are often of very considerable length, occur chiefly along and immediately within the boundaries of the same tissue, where it adjoins the choanosome.

Mastichorions.—The flagellated chambers are nearly spherical and of small size, rarely more than 20μ in diameter, and situated at an average distance of about 10μ apart.

Spicules.—Both megascleres and microscleres are precisely similar in form to those of *R. typica.* The former vary in maximum size, in different specimens, from 650 by 7μ to 720 by 9μ, and their minimum length in any specimen is less than 200μ; individuals below 300μ long, however, are scarce. The trichites are divisible into two groups, the shorter ones varying in length from about 50 to 220μ, the longer from about 320 to 450μ.

Genus Desmoxya, gen.nov.

Definition.—Axinellidæ(?) of massive form, typically more or less dome-shaped, and provided with well-developed, papilliform processes. Skeleton consisting of an irregular, halichondroid reticulation traversed by ascending multispicular, non-plumose fibres. Spongin almost or quite absent. Megascleres of a single order,—oxea, strongyla and styli, differing only in the character of their extremities. Microscleres terminally-spined, arcuate or slightly sigmoidal microxea, and trichodragmata.

Type-species, *D. lunata* Carter.

The single species, for which this genus is proposed, has hitherto been referred to *Higginsia.* The number and importance of the characters distinguishing it from the remaining species of the latter genus, however, render obvious the necessity of its removal therefrom. The structure of the skeleton is essentially the same as in *Rhaphoxya*, only the main fibres are far fewer, the connecting fibres are reduced to a sparse reticulation of spicules, and spongin is almost completely wanting.

In the several specimens of *D. lunata* examined by me, the microxea are, without exception, simply bow-shaped, *i.e.*, curved in one plane. In the Australian Museum, however, there is a mounted slide of the spicules of a Port Phillip sponge in which (while otherwise closely agreeing in spiculation with *D. lunata*) the microxea for the most part are more or less curved in a distinctly sigmoidal manner.* There is evidence for supposing, therefore, that the microxea of *Desmoxya* are derivatives of sigmata.

DESMOXYA LUNATA Carter.

(Pl. xxix., fig.5; Pl. xxxviii., fig.5; Pl. xliv., fig.4.)

1885. *Higginsia lunata* Carter(**5**), p.358.

1897. *Higginsia lunata* Dendy(**7**), p.244.

Diagnosis.—Sponge massive, sessile, more or less dome-shaped, rising above into short digitiform processes, and provided also with irregularly scattered small conuli. Dermal membrane minutely reticulate; with many dermal pores in each mesh of the reticulation. Skeleton feebly developed, consisting of irregularly ascending, slender, multispicular main fibres, between which there extends a very sparse and irregular reticulation composed chiefly of single spicules. Megascleres slightly curved, cylindrical or nearly so; comprising oxea and styli in approximately equal numbers, and relatively few strongyla; maximum size about 800 by 12 to 15μ. Microxea crescent-shaped, minutely spinulous except in their central moiety, 30 to 45μ long and up to 3·5μ in stoutness. Trichites separable into two groups as regards size, the shorter varying from 60 to 220μ in length, the longer from 560 to 620μ; occurring in dragmata and scattered singly, the larger ones also forming short fibres.

Loc.—Port Phillip.

External features.—The sponge (which is known now from seven examples) appears always to be more or less dome-shaped (Pl. xxix., fig.5),—usually not far from (roughly) hemispherical, sometimes nearly as high as broad, occasionally, however, much depressed, almost flattened,—and is provided with moderately numerous mammiform, or short digitiform, processes; in addition,

* In this presumable second species of *Desmoxya*, the microxea (if they may correctly so be termed) are very small, rarely attaining to more than 25μ in length.

the surface, including that of the processes, is covered with small, usually blunt conuli. The largest specimen measures 95 mm. in length, 80 mm. in breadth, and 70 mm. in height; and the processes, which are generally slightly flattened and somewhat appressed to the surface, average about 4 mm. in diameter at the base, and vary in length up to about 10 mm. The dermal membrane is strongly developed and fairly easily separable, and usually presents to the naked eye a minutely reticulate pattern due to the mode of arrangement of the dermal pores (Pl. xxxviii., fig.5). Internally, the sponge is traversed vertically by rather numerous main efferent canals, measuring up to 3 mm. in diameter, which open into small, usually inconspicuous oscula situated on the upper parts of the surface. The oscula occur on and between the digitiform processes indifferently. The consistency in alcohol is soft and compressible, and lacking in toughness; the texture, however, is compact. The colour in life is some shade of brown, —usually a darkish or slaty-brown, sometimes with a greenish tinge; in alcohol, it is brownish-grey on the surface and pale grey within.

The dermal reticulation (Pl. xxxviii., fig.5) is formed of more ar less polygonal meshes of various size up to about 300 by 200μ, usually longer than broad, but varying in actual shape, in different parts of the surface, from subcircular to nearly oblong, and separated by usually narrow boundaries from 35 to (rarely) 150μ in width. Within each of the meshes, the dermal membrane is perforated by numerous pores. In consequence, no doubt, of their having become closed through contraction, the pores sometimes are apparently absent; and in one of the specimens examined, presumably owing to excessive contraction, even the dermal reticulation was indistinguishable. No megascleres are present in the dermal membrane, and only very few scattered trichites; but in the boundaries of the meshes of the reticulation, spined microxea occur more numerously than elsewhere in the sponge.

Skeleton.—When a piece of the sponge is treated with caustic potash, it usually decomposes entirely, yielding nothing but a flocculation (consisting mainly of separate spicules); occasionally, however, by the exercise of especial care, one succeeds in obtaining, as part of the residue, small masses of coherent skeleton. From examination of these, the skeleton, which is extremely scanty, is seen to consist partly of slender, multispicular (main) fibres running irregularly through the sponge, branching and occasionally anastomosing as they go, and partly of a very sparse and irregular reticulation of single spicules and short paucispicular fibres extending between the main fibres and partly serving to connect them (Pl. xliv., fig.4); the structure is much less dense than would appear from the figure, inasmuch as in the mounted preparation, from which the photograph was taken, the skeleton has been compressed under the cover-glass to less than half its original thickness. The main fibres are rarely as much as 40μ in stoutness, and are composed of fairly closely-packed spicules, directed longitudinally, and barely held together by an evanescently small amount of hyaline spongin, which becomes discernible only when stained. Outside the main fibres, spongin is generally wanting; but here and there, where several spicules cross one another at a point, a faint investment of cementing substance is sometimes detectable.

In ordinary sections of the sponge (*i.e.*, with the fleshy tissues intact) the precise pattern of the skeleton is usually not manifest: for, in thick sections, it is generally more or less obscured in consequence of an opacity due to great numbers of pigmented granules scattered everywhere through the tissues; while, in thinner sections, owing to the sparseness and irregularity of the skeleton, the main fibres are usually more than once cut across, and thus appear not to be continuous, and the intermediate skeleton appears to consist merely of a few scattered spicules. Trichodragmata occur rather abundantly through all parts of the interior, but are not very noticeable owing to the obscuring effect of the pigment-granules and the extreme slenderness of the individual trichites. Singly scattered trichites are scarce. The spined microxea likewise occur in all parts of the sponge, but are nowhere abundant; they are most numerous in the dermal membrane.

Spicules.—(i.) The megascleres are slightly curved cylindrical oxea, styli, strongyla and intermediate forms, differing from one another only in the character of their extremities, and the same in all parts of the sponge; the oxea and styli are present in about equal numbers, while the strongyla are notably fewer. They are of approximately the same dimensions in all the specimens examined, ranging in length from about 520μ to slightly above 800μ, rarely to 850μ, and varying in maximum stoutness (in different specimens) from 12 to 15μ.

(ii.) The trichites are straight or nearly so, almost immeasurably fine, and of all lengths between 560 and 620μ, and between 60 and 220μ; the shorter ones are again nearly separable into two groups, individuals between 100 and 150μ in length being very scarce.

(iii.) The acanthoxea are arcuately curved, crescentiform, often very slightly inflated centrally, 30 to 45μ in length by 2 to 4μ in stoutness, and densely covered with minute spinules for a distance of from 10 to 15μ from their extremities, the remaining portion of their length being smooth. The curvature is sym-

Text-fig. 19.*

* *Desmoxya lunata.* *a*, megascleres; *b*, extremities of the same, more highly magnified; *c*, spined microxea.

metrical, and rather variable in degree; when most considerable, it slightly exceeds that of two-fifths of the circumference of a circle.

Genus Holoxea Topsent.

Definition.—Axinellidæ(?) of massive or encrusting habit; with a more or less irregular, halichondroid, main skeleton, and with or without a dermal skeleton of horizontally-disposed megascleres. The megascleres are oxea of one or two kinds, and the characteristic microscleres are minute microxea, somewhat resembling sanidasters; in addition, trichodragmata are typically present.

Type-species, *H. furtiva* Topsent(**45**).

The considerable agreement which exists between this genus and *Desmoxya* in the matter of spiculation appears to me to justify the supposition of a relationship between them. It is true that, in *H. furtiva*, the type-species, so Topsent informs us in his second description thereof(**51**),—the ectosome is charged with more or less horizontally-disposed oxeote megascleres (differing from those of the main skeleton only in size), and is differentiated to form a cortex "peu epaisse, mais assez resistante"; but the importance to be attached to this feature is minimised by the fact that the other two species which have been ascribed to the genus,—viz., *H. collectrix* and *H. valida* Thiele(**39**),—a specially characterised cortex is, apparently, wanting; moreover, it is to be noted that, in *Desmoxya lunata*, the dermal layer is particularly well-developed, and if provided with a megascleric skeleton would probably constitute what might be termed a cortex. The information at our disposal regarding the structure of the main skeleton in the several species of *Holoxea* is extremely scanty: Topsent merely mentions, in the case of *H. furtiva*, that when the sponge is confined to narrow crevices the megascleres are constrained, owing to their great length, "s'orienter dans un sens déterminée, par faisceaux sur des longueurs variables", and that "il en résulte souvent un faux-semblant de charpente fibreuse"; while Thiele goes no farther than to state that the megascleres (of *H. collectrix*) "lassen keine bestimmte Anordnung erkennen." So far as one can judge, it seems probable that the skeleton, on the whole, is arranged irregularly, in a more or less halichondroid fashion; and this is the type of skeleton-pattern which would result if, in *Desmoxya lunata*, the reticulum of interstitial and connecting spicules merely increased in degree of development and complexity at the expense of the connecting fibres. The spined microscleres of *Holoxea furtiva* are looked upon by Topsent as sanidasters, and he has accordingly referred the genus to his proposed family Streptasteridæ; but these microscleres, it seems to me, might with equal propriety be regarded as microxea,—and, indeed, in Topsent's original description of the species were so designated: furthermore, in *H. furtiva* and *H. collectrix*, as in *Desmoxya*, the spined microscleres are accompanied by trichodragmata, which latter are unknown to occur in association with definitely astrose microscleres elsewhere in the Monaxonida. Whether certain genera with spined microxea, like *Desmoxya* and *Higginsia*, properly admit of inclusion in the family Axinellidæ is open to question; but *Holoxea* certainly appears to resemble *Desmoxya* much more closely than it does any other genus, and on that account, perhaps, ought to be placed in proximity thereto.

Genus Higginsia Higgin.

Definition.—Axinellidæ(?) of various external form; typically erect-lamellar, with entire or lobate margin, or sometimes tending to become palmo-digitate or frondose; seldom ramose; occasionally massive, with or without digitate processes. Skeleton usually more or less condensed axially; typically consisting (extra-axially) partly of more or less plumose main fibres or spicule-columns running to the surface, and partly of an irregular reticulation of spicules connecting the main fibres; either of these components, however, may be much reduced or absent. Or the extra-axial skeleton may consist (either throughout or only in its outer region) of bundles or bands of long styli radiating to the surface, and of sheaves of smaller and slenderer spicules surrounding these. Spongin present in small to moderate quantity. Megascleres: styli and (or) oxea, usually of two or three kinds. Megascleres of a single kind, in the form of centrangulate spined microxea.

Type-species, *H. coralloides* Higgin.

The genus *Higginsia* is here defined so as to include also Ridley and Dendy's *Dendropsis*, with its two species *D. bidentifera* and *D. mixta*,—the latter recently added to the genus by Hentschel(15). The reason for this is not that the differences between *Higginsia coralloides* and *Dendropsis bidentifera*, the respective type-species, are insufficient to warrant their generic separation, but that intermediate species exist between them, forming with them (in so far as skeletal characters are concerned) a gradational series incapable of subdivision into two groups except in an arbitrary way. This fact will be clear from the following synopsis of the chief distinguishing characters of the several species.

Dendropsis bidentifera Ridley & Dendy(33). Dichotomously ramose, with slightly compressed branches disposed in one plane. Skeleton consisting (i.) of a dense axial core of interlacing, comparatively short styli; (ii.) of bundles of much longer styli (up to 1100 by 44μ in size) radiating from the axis to the surface, beyond which the apices of many of them project; (iii.) of sheaves of slender oxeote spicules surrounding (ii.), which are peculiar in being double-pointed at one extremity, and also often project beyond the surface; and (iv.) of long slender styli (up to 1750 by 20μ in size), occasionally passing into strongyla.

Dendropsis mixta Hentschel(15). Thick, encrusting; with short digitiform processes. Skeleton consisting (i.) interiorly of irregularly arranged stout oxea (up to 750 by 31μ in size); (ii.) of long slender styli (up to 2240 by 31μ in size) projecting beyond the surface; (iii.) of bundles of slender oxea (up to 1175 by 5μ in size), forming dermal tufts around (ii.) as in the genus *Raspailia*, and also passing inwards towards the interior.

Higginsia papillosa Thiele(42). Massive, ovoidal; with papillose surface. Skeleton consisting (i.) of stout fibres, formed of styli, radiating to the surface and ending in the surface-papillæ,

—their terminal spicules (up to 1500 by 15μ in size) projecting beyond; (ii.) of shorter and relatively stouter styli, partly scattered irregularly between the main fibres, and partly forming lesser fibres running irregularly in various directions; and (iii.) of slender oxea (up to about 1000 by 6μ in size), which "pflegen in grösserer oder geringerer Anzahl die Style zu begleiten."

Higginsia natalensis Carter(**5**). Flabelliform, stipitate; with thin ridges on both surfaces, radiating from stalk to circumference. Skeleton-structure undescribed: megascleres of two kinds, viz., (i.) styli (up to about 1000 by 43μ in size), presumably arranged in fibres; and (ii.) slender oxea (up to 700 by 7μ in size) surrounding (i.) "in great numbers".

Higginsia coralloides Higgin(**17**), et varr. More or less lamellar, varying from submassive (*i.e.*, sessile and only slightly compressed) to stipitate-flabelliform, and then either entire or palmately subdivided; with longitudinal or radiating ridges on both surfaces. Skeleton consisting of more or less plumose main fibres or columns with an irregular reticulation of spicules between. Megascleres almost exclusively oxea, or oxea alone; usually of two kinds.

Higginsia thielei Topsent(**53**). Massive, with irregular surface. Skeleton consisting of "un réseau irrégulier, très solide, de styles robustes disposés par paquets épais et reliés aux entrecroisements par un lien très faible de spongine incolore." Megascleres styli, of a single kind.

In all the species, the microscleres are of the same characteristic form, and occur irregularly scattered through the choanosome and usually also in the dermal layer; they are symmetrically and rather sharply bent (*i.e.*, centrangulate or geniculate) acanthoxea with small spines scattered irregularly over their whole length, and are frequently provided with a bulbous dilatation situated slightly excentrally.

The exact similarity which exists between the microscleres of the present genus and those of *Halicnemia patera* has already been pointed out by Topsent(**49**), who accordingly refers *Halicnemia*, along with *Higginsia*, to the Axinellidæ. It seems to me extremely probable, however, that the acanthoxea of these genera, like those undoubtedly of the recently described genus *Acanthoxa* Hentschel(**16**), are homologous with the acanthoscleres of the Myxillinæ, and that the correct place of *Higginsia* and *Halicnemia* is, therefore, in the family Desmacidonidæ.

The genus is represented on the Australian coast by two varieties of *H. coralloides*,—viz., *massalis* Carter and *scabra* Whitelegge,—re-descriptions of which are given below. The other named varieties of this species (the typical form of which comes from the West Indies) are Higgin's(**17**) var. *liberiensis* from Cape Palmas and var. *arcuata* from Ireland; while the form recorded by Topsent(**48**) from Amboina as *H. coralloides* var. *massalis* probably constitutes a fifth variety. Carter's *H. coralloides* var. *natalensis*, although possessing the external habit characteristic of *H. coralloides*, is distinguished by having the skeletal fibres composed of stylote instead of oxeote megascleres, and may, therefore, conveniently be regarded as specifically distinct.

To supplement the brief diagnosis of *H. coralloides* given above, and at the same time to indicate the main points of difference distinguishing the varieties *massalis* and *scabra* from the remaining forms of the species, the chief characters of the latter (excepting Topsent's var. *massalis*, the description of which I have not seen), may be summarised as follows:—

H. massalis (typical form). Stipitate, flabelliform; "consisting of lobate compressed branches of irregular and luxuriant growth, united clathrously or continuously; surface deeply furrowed in a vertical direction, the ridges between the furrows being narrow and, in the young growths, serrated with tooth-like projections, passing in the older portions into rounded or tubercled prominences." The skeleton is "a spiculiferous network of lozenge-shaped reticulation," consisting (in part) of plumose fibres, the spicules of which are not enclosed in spongin, but merely cemented together by it where they touch or cross each other. The megascleres (oxea) appear to be of two kinds,—those of the fibres more or less curved and attaining a maximum size of 635 by 25μ, the others straight, very much slenderer (only 6μ in diameter), and relatively few in number. The spined microxea attain a size of 200 by 6μ.

H. coralloides var. *liberiensis* Higgin. Similar in outward form to the preceding. Structure of the skeleton undescribed. Megascleres of two kinds: stout curved oxea up to 660 by 32μ in size, and longer, straight, "hair-like" oxea. Spined microxea measuring 75 by 6μ.

H. coralloides var. *arcuata* Higgin. Only slightly compressed, submassive. Surface-features undescribed. Skeleton consisting of main lines of spicules extending vertically from the base, and of secondary lines connecting these at various angles, both being "echinated" with spicules (*i.e.*, more or less plumose). The megascleres (oxea) are not stated to be of two sizes; they are comparatively small, measuring only 300 by 6μ. The spined microxea measure 75 by 3·6μ.

HIGGINSIA CORALLOIDES Higgin, var. MASSALIS Carter.

(Pl. xxix., fig.6; Pl. xxxviii., figs.6, 7; Pl. xxxix., figs.1, 2; Pl. xl., figs.1-4.)

1885. *Higginsia coralloides* Carter(**5**), p.357.
1885. *Higginsia coralloides* var. *massalis* Carter(**5**), p.357.
1896. *Higginsia coralloides* var. *massalis* Dendy(**7**), p.243.

Diagnosis.—Sponge more or less compressed; varying in form from thickly flabellate and stipitate to submassive and sessile; the margin entire. Surface longitudinally ridged and furrowed; the ridges generally more or less discontinuous, appearing as a succession of crenations or knobs; distance apart of the ridges, 2 to 3 mm. Oscula small, marginal. Dermal membrane distinct, finely porous. The "skeleton-sponge" consists of a series of transverse, thin lamellæ, each only about a millimetre in thickness, which are nearly quite separate from each other in their uppermost portions, but become more and more intimately united in the median plane of the sponge proceeding towards its base. The skeleton of each lamella is a dense and intricate reticulation of paucispicular main and connecting fibres and single spicules.

Spongin is present in relatively small quantity. The megascleres are imperfectly differentiated into three kinds: (i.) curved oxea forming the skeleton-reticulation, attaining a maximum size of from 560×14 to $700 \times 18\mu$; (ii.) longer and slenderer, scarce styli, strongyla, and (very rare) oxea, occurring interstitially, ranging in length to upwards of 900μ; and (iii.) smaller interstitial and dermal oxea, commonly between 250 and 350μ in length and 4 or 5μ in diameter, but frequently slenderer, and connected by spicules of intermediate size apparently both with (i.) and (ii.). The acanthoxea are from 40 to 130μ in length and up to 4 or 5μ in diameter exclusive of the spines, and rather seldom exhibit a bulbous dilatation.

Loc.—Port Phillip.

External characters.—The general shape and habit of growth of the sponge are sufficiently indicated in the diagnosis; and the characteristic rugose surface-appearance produced by crenated longitudinal ridges and intervening furrows is well shown by the figure (Pl. xxix., fig.6),—which also illustrates the most frequent form of the sponge, viz., one intermediate between flabellate and submassive. Apparently it is only in its younger stages that the sponge is massive, subsequent growth taking place chiefly in height and breadth, with only slight increase in thickness; occasionally the plate thus formed, instead of remaining simply flabellate, becomes somewhat irregular through formation of perpendicular lateral outgrowths similar to itself. The largest specimen at my disposal measures about 75 mm. in height, 110 mm. in breadth, and 25 mm. in maximum thickness of the plate. The surface-ridges (and furrows) pass without discontinuity across the margin of the sponge from one side of it to the other, and, as necessarily follows, are oppositely situated on the two surfaces. The oscula are situated marginally, and are numerous and of small size, the largest seldom exceeding 1 mm. in diameter. The dermal membrane, which is well-developed, is most distinct within the surface-grooves, where it is underlain by extensive subdermal spaces; it is closely perforated with minute pores, which in some places are sufficiently large to be discerned with the naked eye (Pl. xxxviii., figs.6, 7). Well-preserved spirit-specimens are of firm, compressible, and resilient consistency, and of compact texture, and vary in colour from pale greyish-yellow to light brown, occasionally with a faintly pinkish tinge. The colour in life, according to previous descriptions, varies from "hair-brown" to dull shades of purple.

The dermal pores (Pl. xl., figs.3, 4) are distributed singly in very close order, are circular or oval in shape, and vary from about 100 to occasionally upwards of 300μ in diameter. In the dermal membrane, spined microxea occur scattered in great abundance.

The "skeleton-sponge",—meaning by that the entire coherent skeleton which remains after complete removal of all the fleshy substance of a specimen by maceration with caustic potash,—is of very characteristic gross structure. Its general superficial contour is nearly similar to that of the original entire sponge; but the shallow surface-furrows of the latter are replaced by deep vertical fissures (Pl. xxxix., fig.2) penetrating it (except its older portions) almost or quite to the mid-plane, and thus reducing it (since the furrows on the one side are situated exactly oppositely to those on the other) to a series of nearly separate, transverse lamellæ. A single such lamella, photographed by transmitted light, is shown in Pl. xxxix., fig.1. The lamellæ are each about 1 mm. in thickness, and their distance apart, at their periphery, varies from about 2 to 3 mm.; their edges, which correspond to the discontinuous, crenated surface-ridges of the internal sponge, are irregularly lobed or toothed. Distally (*i.e.*, in the upper parts of the skeleton-sponge) the lamellæ are either quite separate from one another or are barely united together by a thin septiform connection in the mid-plane of the sponge; but proceeding towards the base of the sponge, this connection gradually increases in breadth, and in addition an increasing number of independent, synapticula-like connections arise between them, so that in places a honeycombed appearance sometimes results.

The skeleton-sponge is fine-textured, and (being composed to a greater extent of spicules than of spongin) is, when dry, whitish in colour and somewhat harsh to the feel, and remains slightly crushed when much compressed by squeezing.

Skeleton.—In each constituent lamella the skeleton consists of numerous, closely arranged, pauciserial main lines of spicules running in the plane of the lamella upwards and outwards to its periphery, and of numerous short secondary lines and single spicules connecting these in irregular manner, the whole forming an exceedingly dense and intricate reticulation (Pl. xl., figs. 1, 2). The spicules of the fibres are arranged in a somewhat loose, irregular, and slightly plumose fashion, and are held together and more or less ensheathed by a rather small amount of spongin, which, being of a pale colour, is inconspicuous unless stained; the interfibral spicules, for the most part, are invested with spongin only at their extremities or lie quite free. The skeleton-reticulation is so dense, especially towards the central region of the lamella (*i.e.*, towards the mid-plane of the sponge), that, in sections of the ordinary thickness for studying the skeleton-pattern, it appears as if consisting of a confused mass of spicules without definite arrangement. In the interlamellar regions of the sponge, except where junctions between the lamellæ occur, the skeleton consists solely of spined microxea scattered in great profusion, and of very scarce scattered megascleres. The interlamellar regions are traversed by numerons main canals, the largest of which are about 1 mm. in diameter.

The previous description of the skeleton, given by Dendy, which differs rather considerably from the above, was evidently based upon an insufficiently thin (and "undesarcodised") section cut across the thickness of the sponge obliquely to the mid-plane (and, therefore, intersecting several lamellæ). The description is as follows: "The skeleton is very confused and irregular, without any definite fibre, composed of densely intermingled oxeote spicules, especially aggregated in wide tracts which trend towards the surface and end in the conuli. The presence of these ill-defined tracts of spicules, with intervening spaces almost free from megascleres, gives a somewhat columnar character to the vertical sections. Internally, all the tracts unite into one dense, irregular agglomeration of spicules." It is obvious that the "tracts of spicules" correspond to vertical transections of the lamellæ.

Where the main skeleton abuts on the surface of the sponge (*i.e.*, along the surface-ridges), the terminal spicules of the skeletal fibres project slightly beyond the dermal membrane, and along with these projecting fibral spicules are occasional small clusters of much shorter and slenderer diactinal spicules which are perhaps to be regarded as special dermal megascleres. Elsewhere (*i.e.*, within the surface-grooves) the dermal membrane overlies extensive subdermal spaces, and is generally free from megascleres.

Text-fig. 20.—*Higginsia coralloides* var. *massalis*. *a*, megascleres of the fibres; *b*, interstitial megascleres; *c*, dermal megascleres; *d*, spined microxea; *e*, immature microxea.

Megascleres. — (i.) The spicules of the skeleton-reticulation are somewhat angulately curved oxea (and occasional styli), which in some specimens are of nearly uniform diameter to within a comparatively short distance of their extremities and generally are more or less irregularly pointed (often somewhat blunt-pointed, and occasionally approximating in form to strongyla), while in other specimens they taper very gradually to the extremities (*i.e.*, are more or less fusiform) and with rare exception are regularly sharp-pointed. The full-grown ones (comprising all those ensheathed in spongin as well as the vast majority of the remainder) vary in maximum size in different specimens from $560 \times 14\mu$ to $700 \times 18\mu$, and rarely fall below 350μ in length or below 8μ in diameter; interstitially-occurring immature individuals of all sizes down to about $250 \times 2\mu$, however, are to be met with.

(ii.) Also occurring interstitially, but very scarce (in some specimens exceedingly rare), are longer and generally less curved, mostly stylote spicules, very frequently more or less blunted or rounded off at the apex and not seldom passing into strongyla, and attaining a maximum size of about $900 \times 9\mu$. Between these and the slenderer forms of the preceding, however, there appears to be a complete series of spicules of intermediate forms and sizes.

(iii.) The short slender megascleres occurring in loose bundles and also scattered singly in the dermal layer,—which appear to be special dermal spicules,—are slightly curved oxea, frequently blunt-pointed and more or less resembling strongyla, and usually 4 or 5μ in diameter and between 250 and 350μ (but ranging from about 200 to upwards of 400μ) in length. They are not distinguishable either in form or size from many of the interstitially occurring spicules which appear to be immature forms of (i.) and (ii.).

Microscleres.—With the exception of a few, which are straight, the acanthoxea are invariably sharply bent at the centre,—the maximum angle of inclination of the actines (which are gradually tapered and sharp-pointed) being about 30°. About 5% of the spicules exhibit a peculiarity in the form of a small bulbous dilatation situated at a short distance (10μ or less) from their mid-point. They range from about 40 to 130μ in length and up to 4 or (rarely) 5μ in diameter exclusive of the spines. The spines are perpendicularly-directed, conical, sharp-pointed, usually very numerous, and scattered irregularly over the whole length of the spicule, gradually decreasing in size towards its extremities; the largest of them are $2{\cdot}5\mu$ in length. The spicules in their earliest stage of development are quite smooth. As an occasional abnormality, one actine is prolonged beyond its point of union with the other, as shown in the text-figure; and very rarely both actines are thus prolonged.

HIGGINSIA CORALLOIDES Carter, var. SCABRA Whitelegge.

(Pl. xxxix., fig.3; Pl. xli., figs.1-3.)

1907. *Higginsia scabra* Whitelegge(**60**), p.511, Pl. xlvi., fig.44.

Diagnosis.—Sponge erect, lamellar, perhaps sometimes simply flabelliform, but more usually subdivided into lobes or separate fronds. Surface closely covered with small conuli arranged somewhat indistinctly in longitudinal parallel series about 1 mm. apart. Oscula small, marginal. Dermal membrane very distinct. Internal structure and skeleton-pattern not essentially different from that of the preceding variety Megascleres: (i.) curved oxea in the main skeleton, $770 \times 35\mu$ in maximum size; (ii.) exceedingly rare styli occurring interstitially, up to $1100 \times 25\mu$ in size. Special dermal megascleres apparently absent. Acanthoxea 60 to 130μ in length and up to 5μ in diameter exclusive of the spines; very frequently exhibiting a bulbous dilatation.

Loc. Off Port Jackson, N.S.W.

This variety is so far known only from the two original specimens—obtained from the same locality—one of which (figured by Whitelegge) is in a dried condition, while the other (smaller and incomplete) is imperfectly preserved in alcohol.

External characters.—Both specimens are erect, substipitate, lamellar,—the smaller one apparently flabellate, divided above into several lobes, the other consisting of much more completely separated (though in part secondarily coalescent) lobes or frond-like branches, from some of which, also, secondary sessile lobes or fronds arise laterally; in both, the thickness of the lamina is about the same, viz., from 6 to 10 mm. The larger specimen measures 110 mm. in height. In the dried condition of the sponge, with the dermal membrane shrunken closely in upon the underlying skeleton, the surface is densely and conspicuously conulose,—the conuli attaining in places a height of as much as

2·5 mm., and exhibiting an indistinct arrangement in longitudinal rows; but in the case of the spirit-specimen, except where the dermal membrane has been destroyed, it is scarcely more then minutely pustulose. On complete removal of the sarcode by maceration, the skeleton-sponge is found to be composed, just as in the case of var. *massalis*, of conjoined, parallel, thin lamellæ perpendicular in direction to the plane of the sponge; and it is to a serration of the edges of these lamellæ that the surface-prominences are due. The only oscula observed were marginally situated and of very small size, the largest not exceeding 0·5 mm. in diameter. The dermal membrane is well-developed and very distinct, and is underlain (between the surface-prominences) by extensive subdermal spaces; owing to its imperfect preservation in the present specimens, dermal pores were not observable. The unmacerated dried sponge is somewhat hard and with difficulty compressible, brittle rather than elastic, and pale greyish or almost whitish in colour. In alcohol, the consistency is dense and firm, moderately flexible, compressible and resilient; and the colour is yellowish pale grey.

The structure of the "skeleton-sponge" is essentially the same as in the case of var. *massalis;* but the lamellæ are much thinner (only about 0·5 mm. in thickness), more closely approximated (at most 1·75 mm. apart), and, in proportion to their width (*i.e.*, in proportion to the thickness of the sponge-lamina), more completely united with one another. In the present variety, accordingly, the structure is notably denser, and the texture also is much more coarse.

Skeleton.– In each lamella the skeleton consists, again as in the case of var. *massalis*, of a dense and intricate reticulation of paucispicular main and connecting fibres, and numerous connecting spicules; but the fibres are here less clearly defined, the skeleton-pattern accordingly is somewhat more irregular, the megascleres are larger, and there is a relatively great scarcity of slenderer megascleres occurring interstitially and dermally. In other respects, apart from differences depending upon the greater thinness of the lamellæ and the much lesser width of the interlamellar in the present case, the skeletal characters of the two varieties are practically the same. As seen in a vertical median section of the sponge, cut in a direction perpendicular to the lamellæ, the skeleton appears as if consisting of parallelly-arranged, stout plumose columns of spicules, which in the marginal region of the sponge are nearly or quite separate from one another(Pl. xli., figs.1, 2); these columns represent, of course, transverse sections of the lamellæ. The appearance of the skeleton (of a lamella) in a direction at right angles to the preceding is shown in Pl. xli., fig.3.

Megascleres.— (i.) The oxea of the skeleton-reticulation are curved, fusiform, regularly sharp-pointed spicules, ranging from 550 to 770μ in length and up to 35μ in stoutness; individuals less than 8μ in diameter are very rare, and those forming the fibres very seldom are much less than 20μ. Occasional spicules are styli or substrongyla.

(ii.) Long interstitial megascleres are exceedingly rare, and appear to be invariably styli. The few observed measured from 950 to 1100μ in length and from 15 to 25μ in stoutness.

(iii.) Megascleres corresponding to the slender dermal spicules of the preceding variety are apparently wanting.

Microscleres.—The acanthoxea are exactly similar in form and size to those of the preceding variety, excepting that their minimal length is somewhat greater (about 60μ) and a considerable proportion of them (amounting to about 50%) exhibit a bulbous dilatation.

For Postscript, see p.673.

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EXPLANATION OF PLATES.

Plate xxix.

Fig.3.—*Rhaphoxya typica*, sp.nov.; (× $\frac{2}{3}$).

Fig.5.—*Desmoxya lunata* Carter; (× $\frac{2}{3}$).

Fig.6.—*Higginsia coralloides* var. *massalis* Carter; (× $\frac{5}{12}$).

Plate xxxiii.

Fig.6.—*Rhaphoxya*(?) *pallida* Dendy; (× $\frac{2}{3}$).

Plate xxxviii.

Fig.5.—*Desmoxya lunata* Carter; photograph of portion of the surface to show the dermal pores.

Figs.6, 7.—*Higginsia coralloides* var. *massalis* Carter; photograph of different portions of the surface, showing the dermal pores.

Rhaphoxya typica, sp.nov.

Fig.8.—Photograph of portion of the surface, showing the dermal pores.

Fig.9.—Photograph of part of a section through the choanosome, showing canals and flagellated chambers. (The outlines of the canals and chambers have been retraced with pen and ink to render them more distinct).

Plate xxxix.

Higginsia coralloides var. *massalis* Carter.

Fig.1.—An entire lamellar component of the skeleton; (nat. size).

Fig.2.—Portion of a desarcodised specimen, showing the crenated surface-ridges and the intervening deep grooves, the latter partially obliterated (in the lower portion of the figure) by synapticula-like connections between the former; (nat. size).

Fig.3.—*Higginsia coralloides* var. *scabra* Whitelegge; extremity of a frond-like lobe of the sponge, desarcodised, showing the discontinuous surface-ridges and the deep intervening grooves, the latter almost obliterated (in the lower portion of the figure) by synapticula-like connections between the former; (nat. size).

Fig.4.—*Rhaphoxya*(?) *pallida* Dendy; skeleton remaining after desarcodisation of a (3 mm. thick) vertical slice of an entire specimen by means of caustic potash; (nat. size).

Fig.5.—*Rhaphoxya typica*, sp.nov.; the skeleton remaining after desarcodisation of a (3 mm. thick) vertical slice of an entire specimen; (nat. size).

Plate xl.

Higginsia coralloides var. *massalis* Carter.

Fig.1.—Showing pattern of the skeleton as seen in a thin section in the mid-plane of one of the component lamellæ near its upper margin; (× 15).

Fig.2.—Showing pattern of the skeleton as seen in a thin section parallel to, but at some distance from, the mid-plane of a component lamella near its upper margin; (× 15). (This figure and the preceding one are from sections of two different specimens).

Figs.3-4.—Surface-sections, showing the arrangement of the dermal pores; (× 40).

Plate xli.

Higginsia coralloides var. *scabra* Whitelegge.

Fig.1.—Section of the skeleton (at the extremity of a frond-like lobe), cut in a direction perpendicular to the planes of the component lamellæ; (× $3\frac{3}{4}$).

Fig.2.—Portion of the preceding figure enlarged; (× 12).

Fig.3.—Portion of a single lamellar component of the skeleton; (× 4).

Plate xlii.

Rhaphoxya typica, sp.nov.

Fig.1.—Longitudinal section of the skeleton in proximity to the surface; (× 12).

Fig.2.—Longitudinal section of the skeleton remote from the surface of the sponge; (× 12).

Plate xliii.

Rhaphoxya(?) *pallida* Dendy.

Fig.1.—Longitudinal section of the skeleton in proximity to the surface; (× 12).

Fig.2.—Longitudinal section of the skeleton remote from the surface of the sponge; (× 12).

Plate xliv.

Figs.1, 2.—*Rhaphoxya typica*, sp.nov.; surface-sections, showing the reticulate pattern of the surface and the arrangement of the dermal pores; (× 85).

Fig.3.—*Rhaphoxya*(?) *pallida* Dendy; surface-section, showing dermal pores; (× 85).

Fig.4.—*Desmoxya lunata* Carter; longitudinal section of the skeleton; (× 12).

POSTSCRIPT *(added 15th December, 1916).*

In Part ii. (*antea*, p.500), in my remarks on the distinction between the genera *Biemna* and *Tylodesma*, I expressed the opinion that, if *Desmacella fragilis* Kieschnick, is correctly described as possessing a spiculation consisting of styli, sigmata, trichodragmata, and *toxa*, it would be advisable to establish a new genus for its accommodation (rather than adopt the only seemingly possible alternative, namely, that of merging the two genera *Biemna* and *Tylodesma* in one). Since then I have received a copy of Prof. Dendy's recent "Report on the Non-Calcareous Sponges collected by Mr. James Hornell at Okhamandal,"* in which is contained the information that toxa, in addition to styli, sigmata, and trichodragmata, likewise occur in *Desmacella tubulata*. For the reception of these two species, therefore, and for such others as may be found to possess toxa together with trichodragmata, irrespective of whether the megascleres be styli or tylostyli, or of the presence or absence of sigmata, I propose the new genus *Toxemna*, with *D. tubulata* as the type-species.

The family Axinellidæ, as at present constituted, admits of subdivision into four groups, which I think might conveniently be raised to the rank of subfamilies, with the designations Axinellinæ, Desmoxyinæ, Trachycladinæ, and Desmacellinæ. The first would comprise all the genera without microscleres; the second, *Desmoxya*(g.n.), *Higginsia*, *Halicnemia*, *Heloxea*, and (?)*Laonæenia*(g.n.); the third, *Trachycladus* alone; and the fourth, the remaining genera with microscleres, viz., *Tylodesma*, *Toxemna*

* Dendy, A., in "Report to the Government of Baroda on the Marine Zoology of Okhamandal in Kattiawar," Part ii. London, 1916.

(g.n.), *Biemna* (including *Allantophora*), *Sigmaxinella*, *Sigmaxia* (g.n.), *Ceratopsis*, *Dragmaxia* (g.n.), *Dragmacidon* (g.n.), *Axidragma* (g.n.), *Dragmatella* (g.n.), *Thrinacophora*, *Dragmatyle*, and *Rhaphoxya* (g.n.).

The occurrence of trichodragmata in *Rhizaxinella pyrifera*,—which, according to Topsent(**51**), is identical with *R. clavigera* Keller, the type-species of *Rhizaxinella*,—and in *Spinularia spinularia* (=*Rhaphidorus setosus* Topsent*), renders it possible that these species are more nearly related to the Desmacellinæ than to the Suberitidæ and Polymastiidæ respectively.

The two species described by Row(**34**) under the names *Ophlitaspongia*(?) *arbuscula* and *O.*(?) *horrida*, which certainly do not belong to *Ophlitaspongia*, are perhaps representative of a new genus related to *Tylodesma*. Another species which it may be necessary to include in the Desmacellinæ, under a new genus, is that described by Kirkpatrick(**22**) as *Ophlitaspongia nidificata*.

The genus *Sigmaxinyssa* Kirkpatrick(**22**) I regard as belonging to the Gelliinæ.

The genera *Trachygellius* and *Spirasigma*, established respectively by Topsent† and myself (**12**, p.131, footnote) for *Trachya globosa* Carter, and for *Gellius aculeatus* Whitelegge, are obviously related to the Tetillidæ, and must, I now think, in spite of their apparent non-possession of tetracts, be included in that family. The chief distinction between the two genera is the presence of small, spinulous oxea in the latter (cf. *Tetilla australiensis*) and their absence in the former. In both genera, the sigmata (sigmaspires) are very finely spinulous. The genus *Spirasigma* is identical with that indicated by Lendenfeld‡ by the name *Suberamata*.

At the last moment, after having corrected the proof-sheets of Part iii., I find that two species, which apparently must be added to the Desmoxyinæ, have been described by Keller(**18, 19**) under the names *Axinella pumila* and *Trachytedania arborea*. The former of these may be referred, provisionally at least, to

* *Vide* Stephens, "Fisheries, Ireland, Sci. Invest., 1914, iv.(1915)," p.30.

† Topsent, E., Mém. Soc. Zool. France, vii., 1894, p.8.

‡ Lendenfeld, R., Zool. Jahrb., ii., 1887, p.564.

the genus *Higginsia*; but the latter, in which the microscleres are spined microstrongyla, evidently requires a new genus for its reception, and for this I propose the name *Allantella*.

The new genera proposed in this Paper, in addition to those already indicated in this Postscript, are *Rhabdosigma* (p.520), *Echinaxia*(p.543), *Strongylamma*(p.643), and *Paratimea*(p.675).

Genus HALICNEMIA Bowerbank.

Definition.—Axinellidæ(?) typically of encrusting habit, sometimes disc-shaped, with a main skeleton consisting of smooth skeletal tylostyli disposed (in part, at least) vertically, with their heads based upon the substratum, and with dermal megascleres in the form of smooth, typically centrotylote tornota. The microscleres are centrangulate, spined microxea similar to those of the genus *Higginsia*.

Type-species, *H. patera* Bowerbank(**1**).

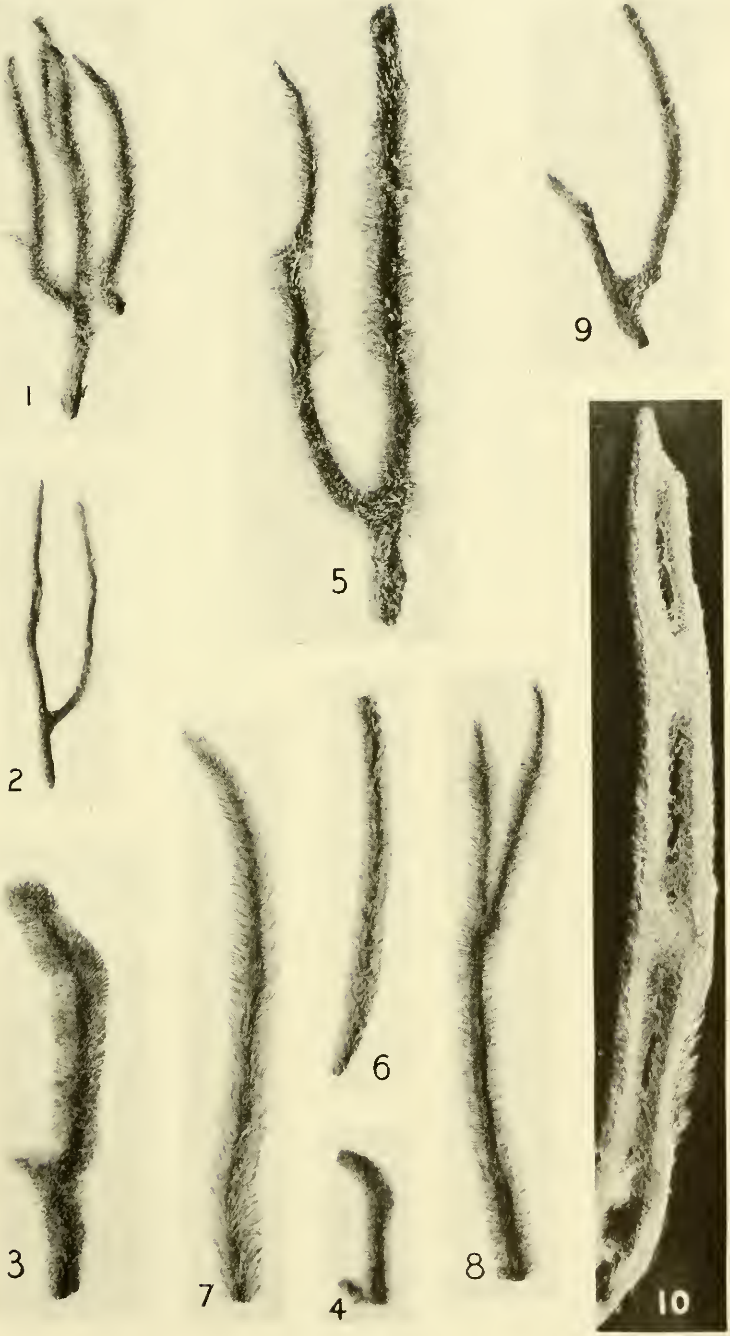
Topsent(**49**) would include in this genus, in addition to *H. patera*, Bowerbank's *Hymeraphia verticillata*, and the species originally described by him as *Bubaris constellata*,—both of which agree with *H. patera* in the possession of skeletal tylostyli and centrotylote, diactinal dermal megascleres. The very decided differences between these three species in certain other respects, however, appear to me to render necessary the allocation of each to a separate genus.

In *Hymeraphia verticillata*, the acanthoxea are of slightly curved form and verticillately spined, and the smooth, diactinal megascleres are trifid at both extremities; and, furthermore, the species is sometimes of massive habit. To replace the (preoccupied) generic names *Laothoë* and *Nænia* already proposed by Gray(**11**) for this species, I propose the name *Laonænia*.

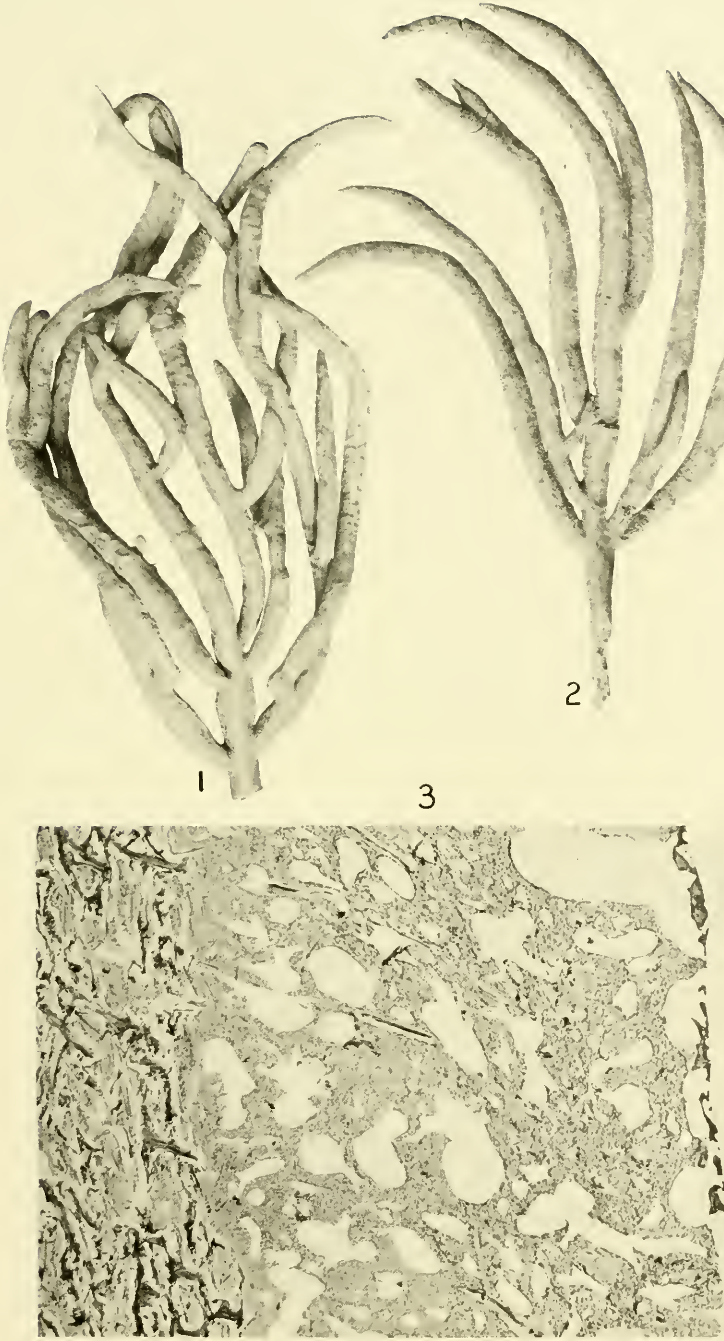
The third species referred to has euasters for microscleres, and, but for its possession of special dermal megascleres, would probably require to be referred to the genus *Timea*. For its reception, I propose the new genus *Paratimea*, which I would include in the family Spirastrellidæ.

Trachycladus spp.

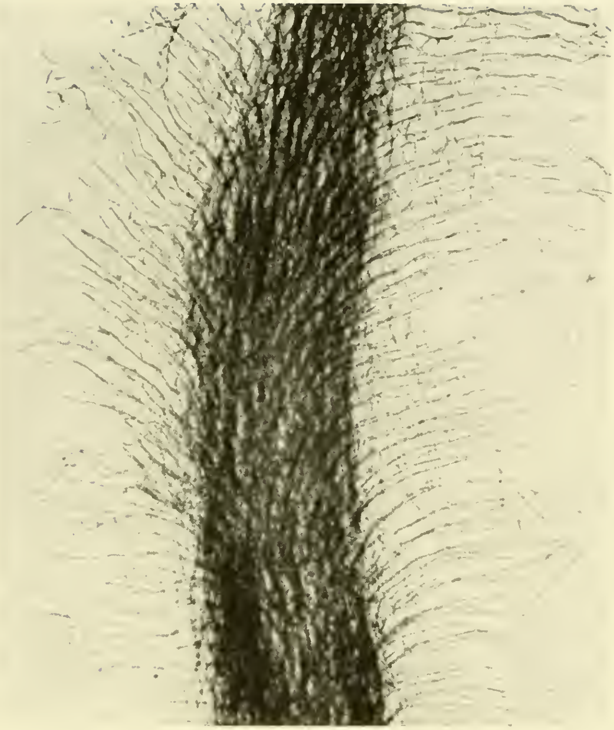
Trachycladus spp.



Trachycladus spp.



Trachycladus formosus, n.sp.



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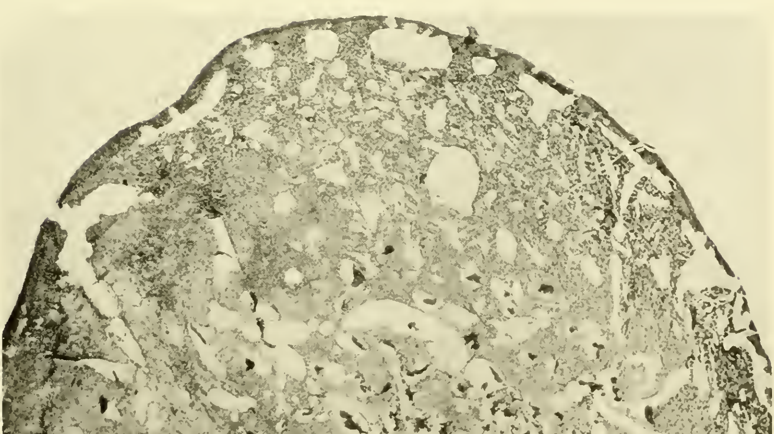
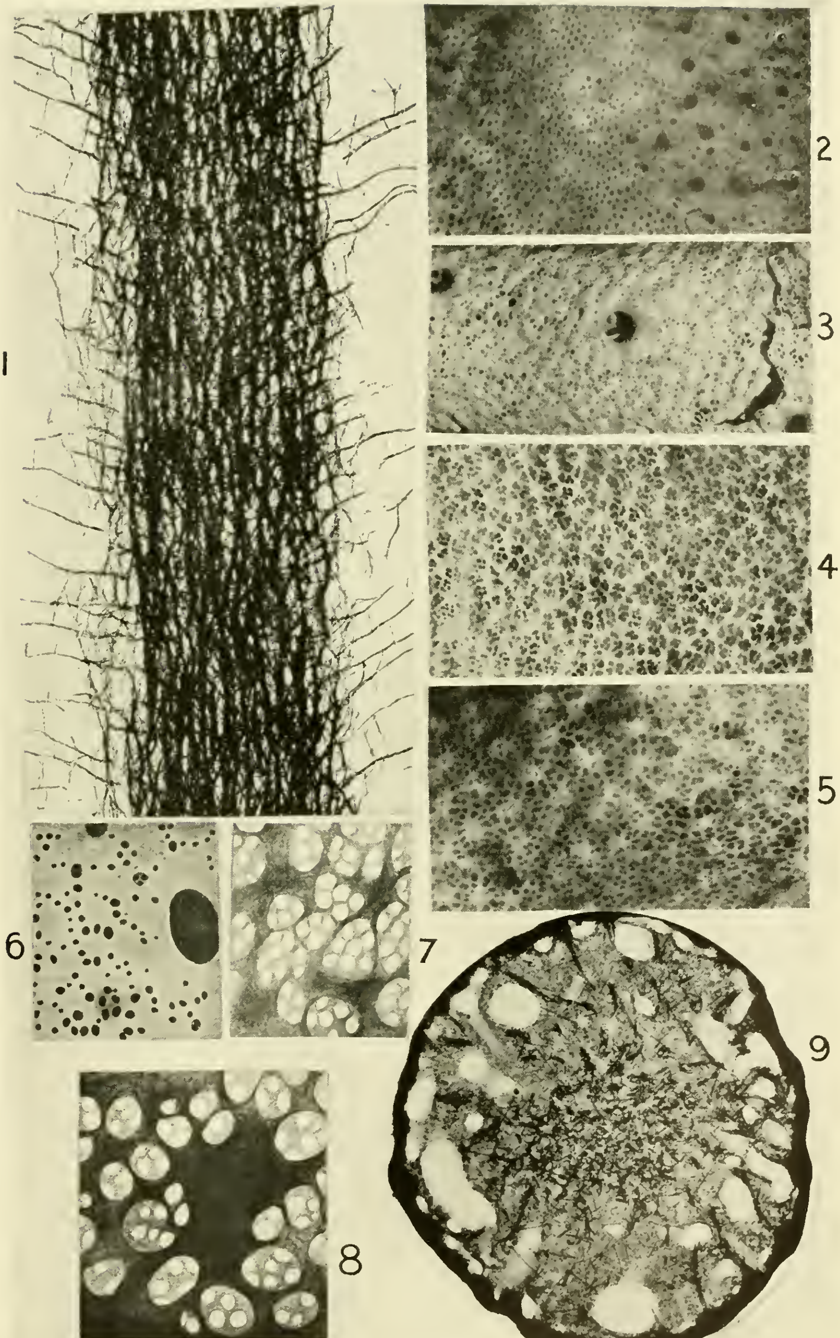
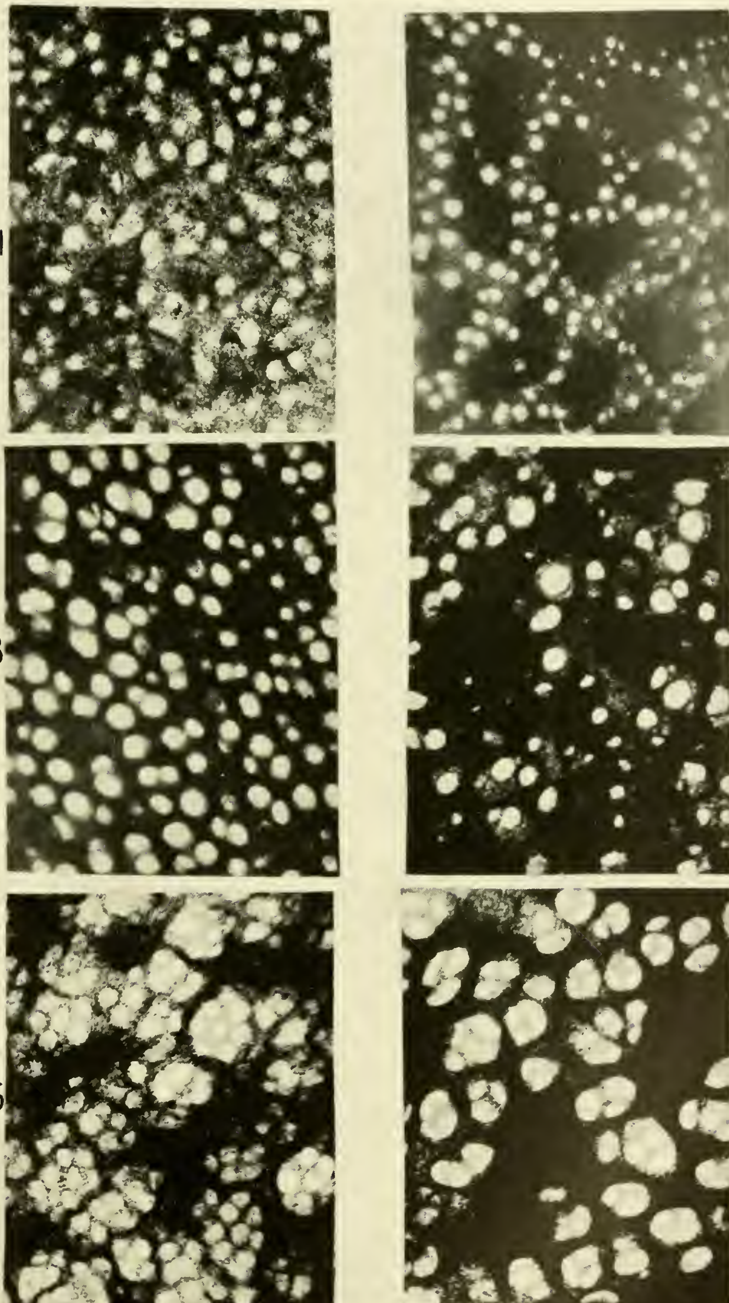


2

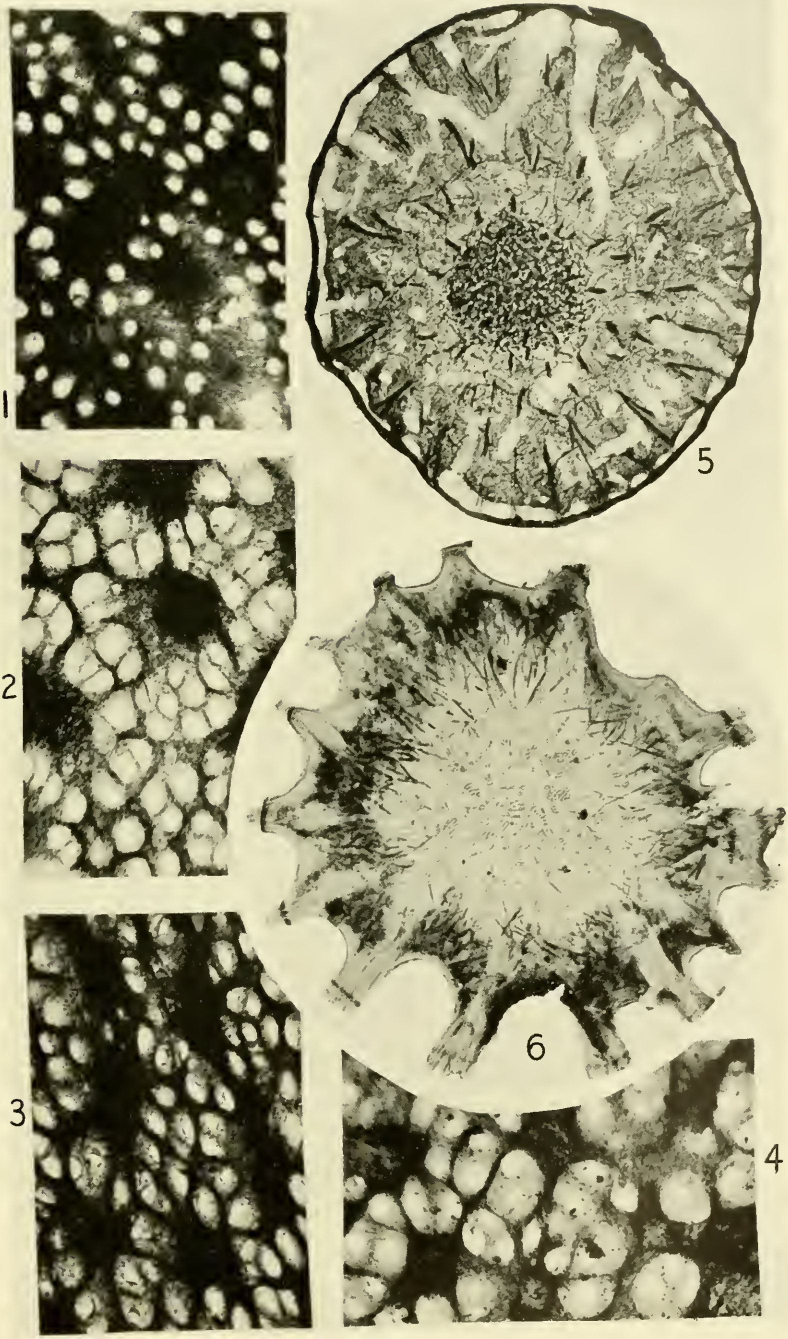
1. *Trachycladus reteporosus*, n.sp. 2. *T. clavatus*, n.sp.



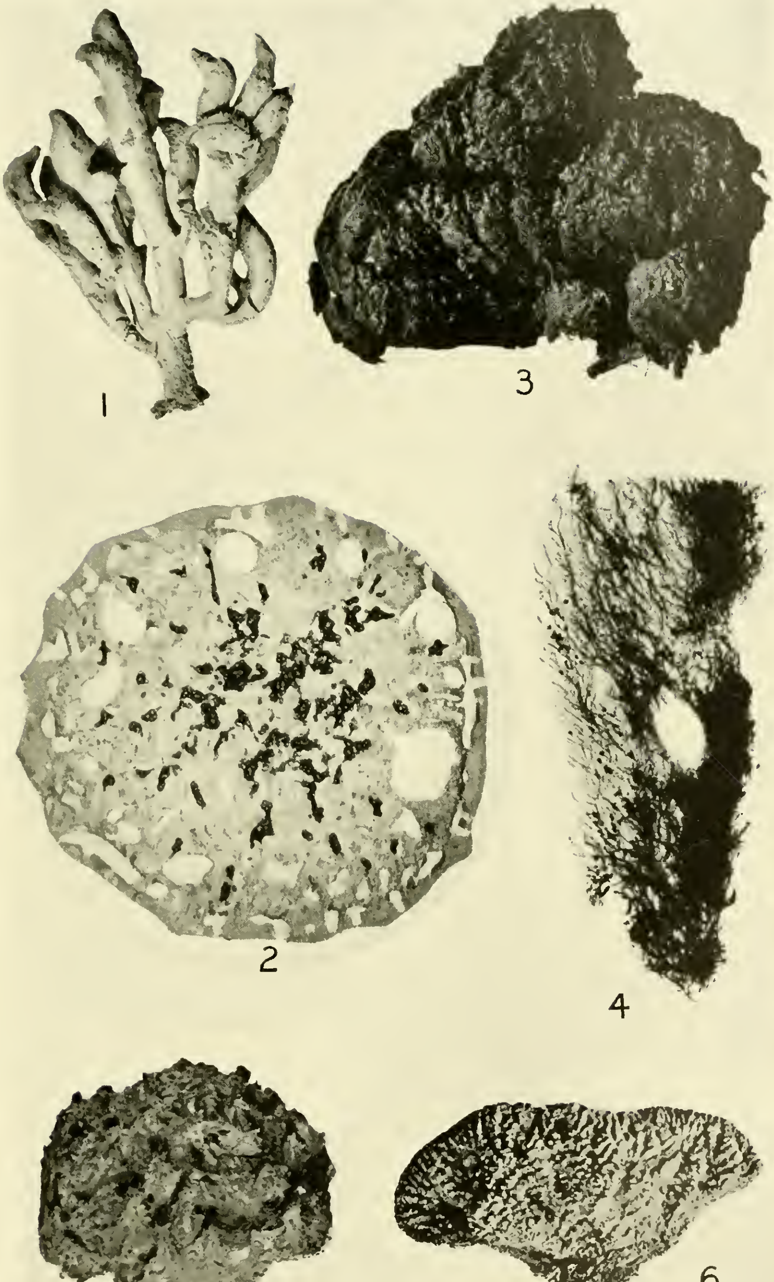
Trachycladus spp.



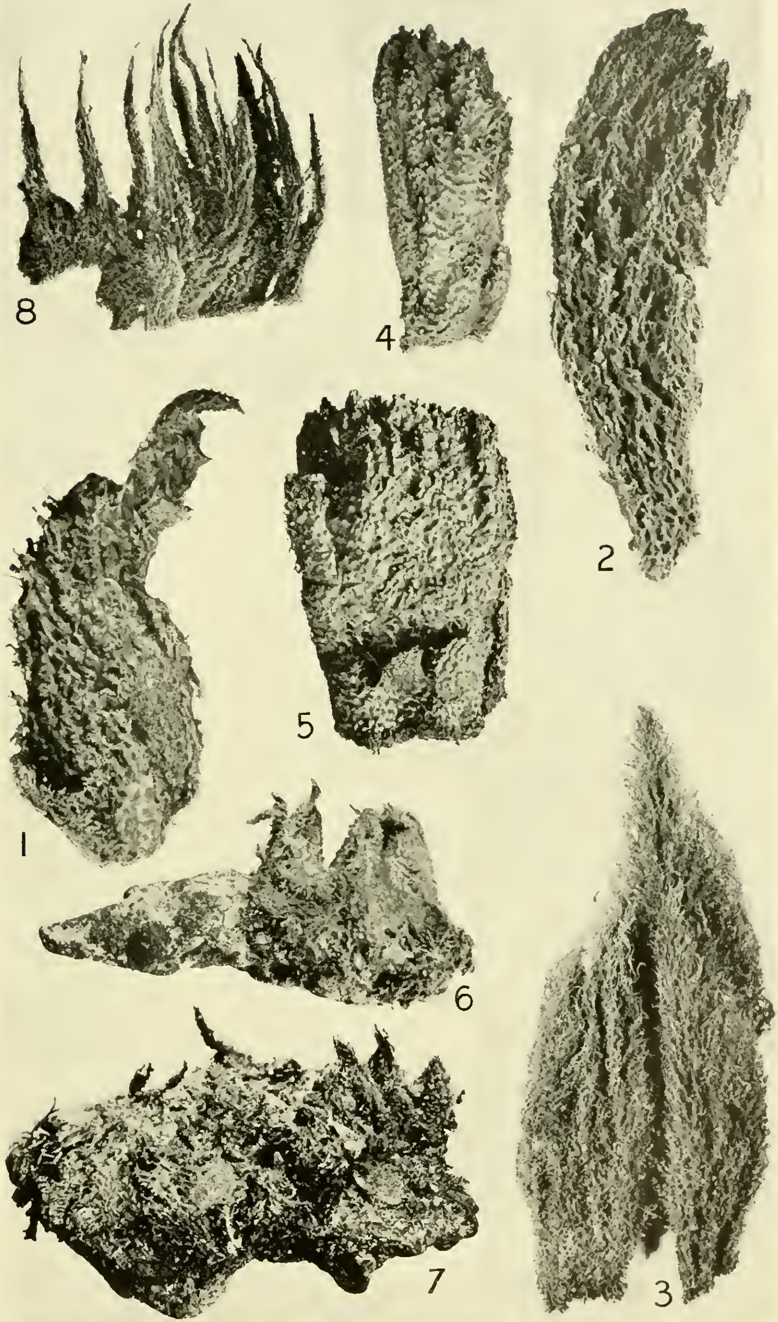
Trachycladus spp.; showing the different arrangement of the dermal pores (× 40).



Trachycladus spp.

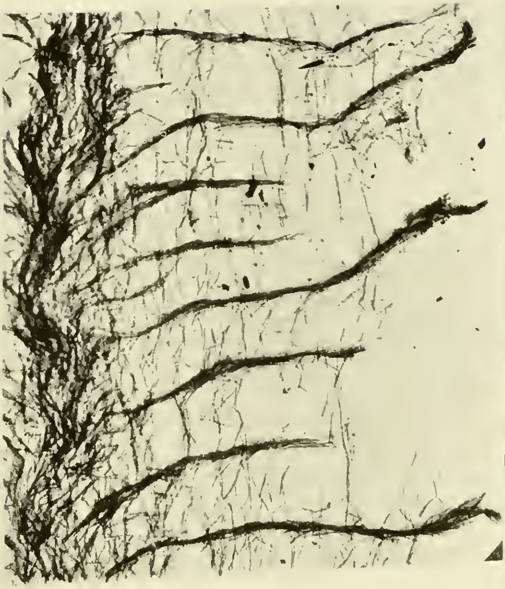


1. *Trachycladus digitatus* var. *clavatus*. 2. *T. reteporosus*. 3. *Rhaphoxya typica*. 4. *Allantophora plicata*. 5. *Desmoxya lunata*. 6. *Higginsia coralloides* var. *massalis*.



Biemna (Allantophora) spp.

Biemna (Allantophora) victoriana, n.sp.



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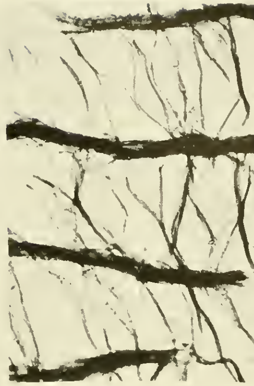

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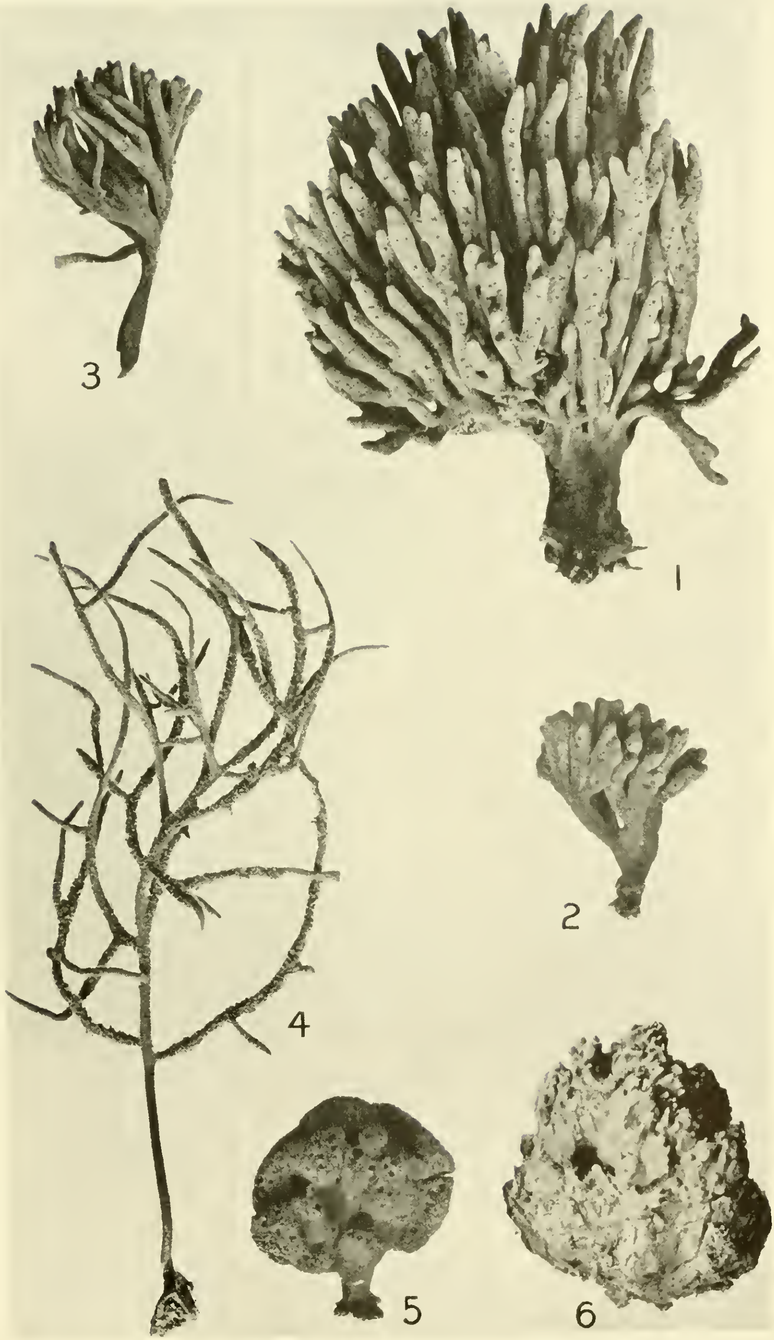
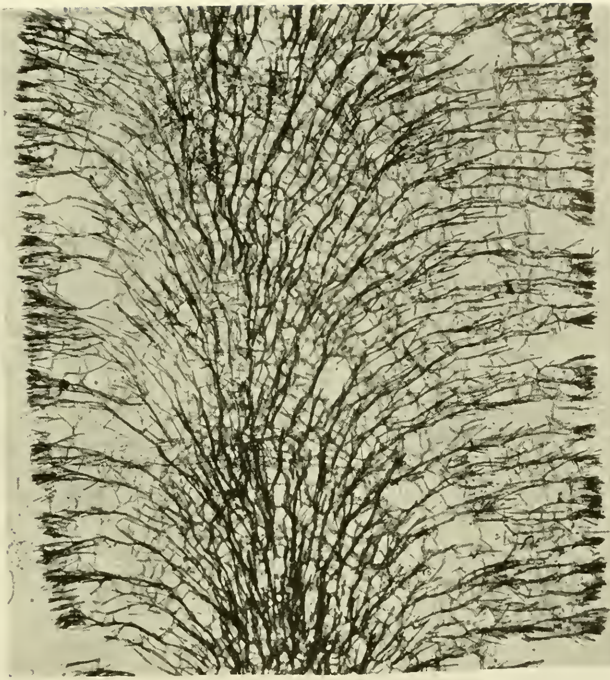
Biemna (Allantophora) victoriana, n.sp.



Sigmaxinella; *Sigmaxia*, n.g.; *Rhaphoxya*, n.g.

1


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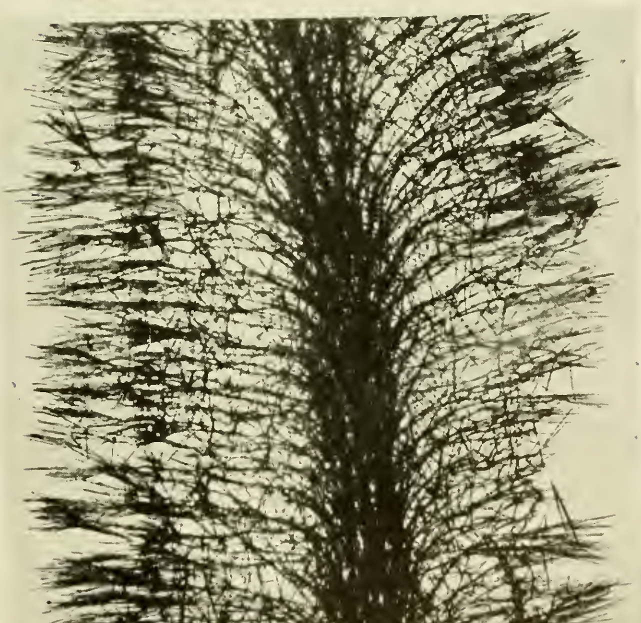
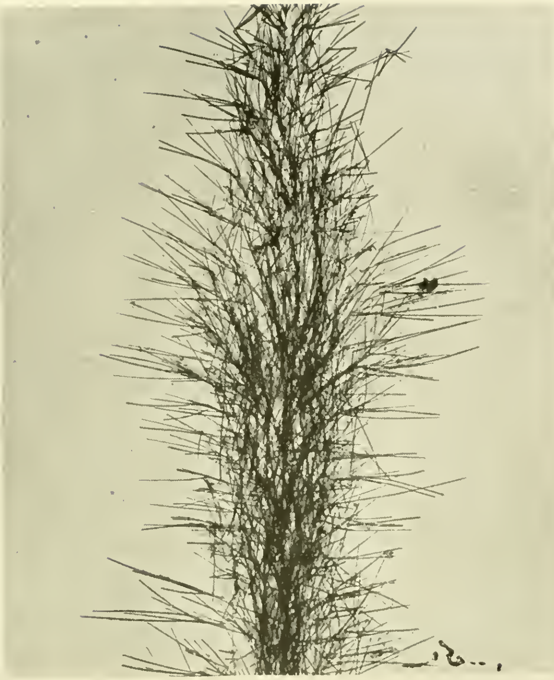


1. *Sigmaxinella australiana* Dendy. 2. *S. dendroides* Whitelegge.

1



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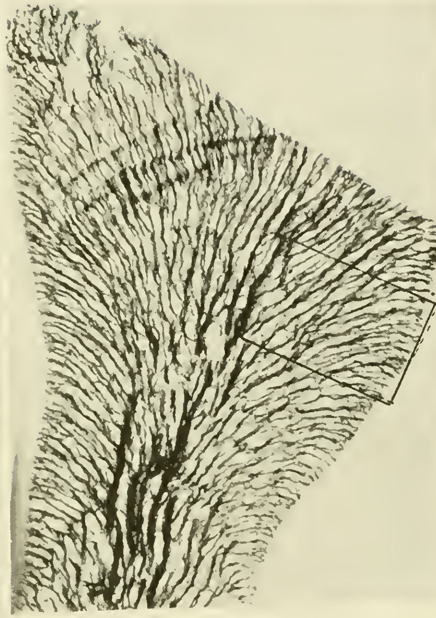
Sigmaxinella viminalis, n.sp.

1

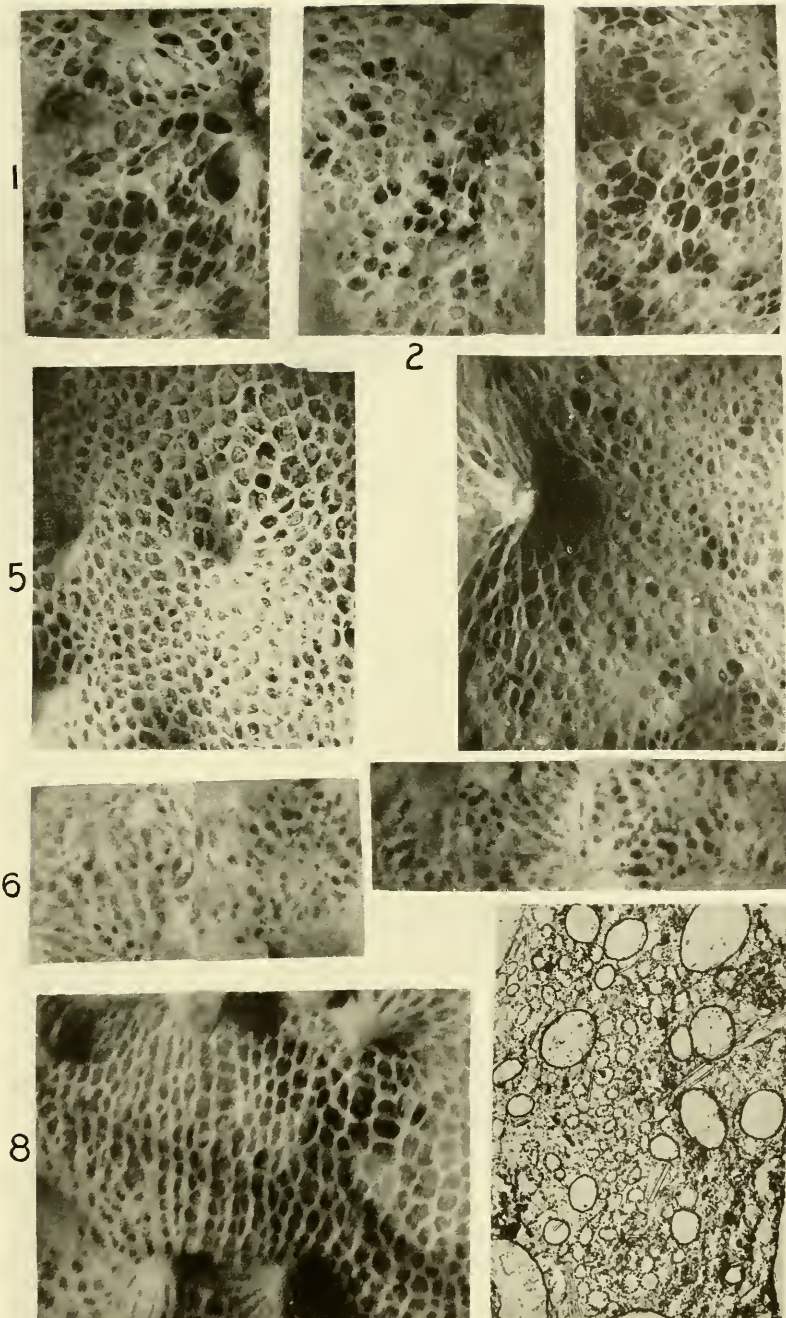


2

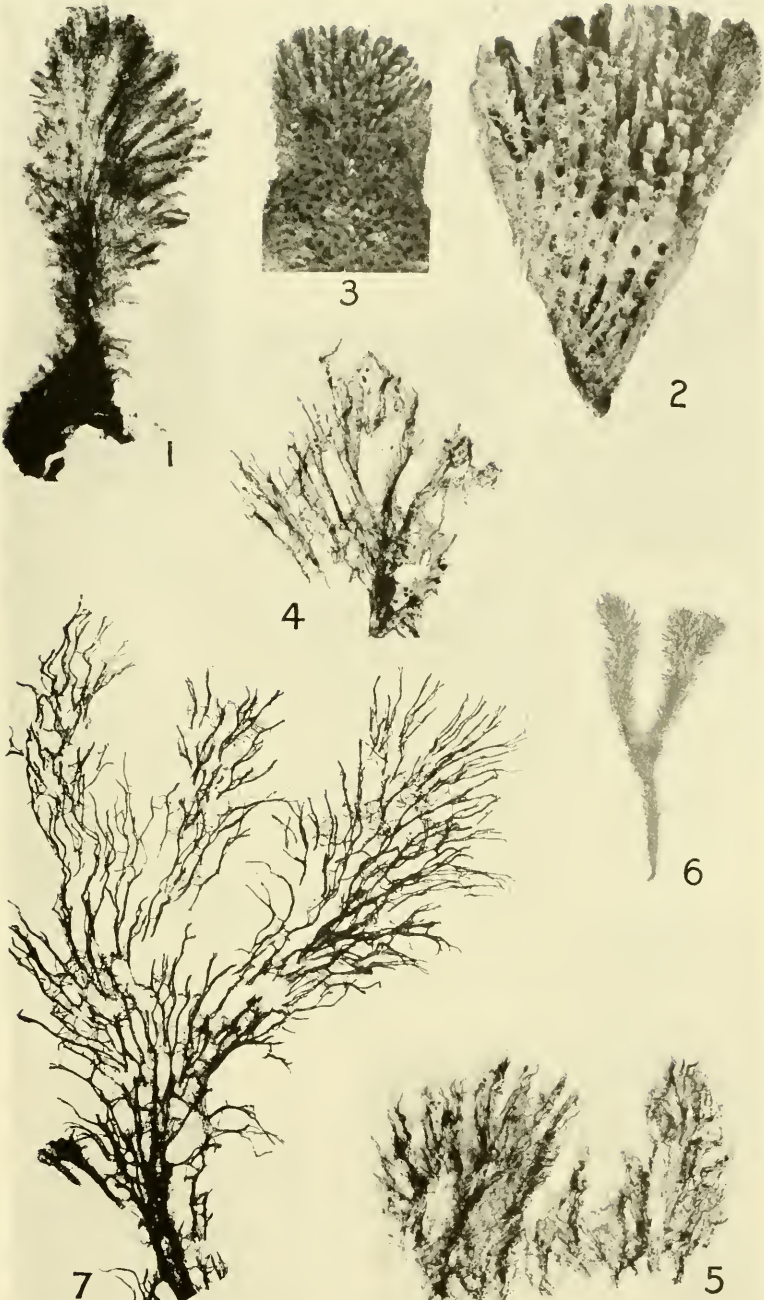
3

1. *Sigmaxinella viminalis*, n.sp. 2-3. *Sigmaxia flabellata* (Carter).

Dragmaxia variabilis (Whitelegge).



1-4. *Allantophora plicata.* 5. *Desmoxya lunata.* 6-7. *Higginsia coralloides* var. *massalis.* 8-9. *Rhaphoxya typica.*



1-3. *Higginsia.* 4-5. *Rhaphoxya.* 6-7. *Trachycladus.*