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,

* 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 *Bienna* (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 *Bienna*), 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 fasci-spiculifera* 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 *Halichœmia* (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

* 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 and 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

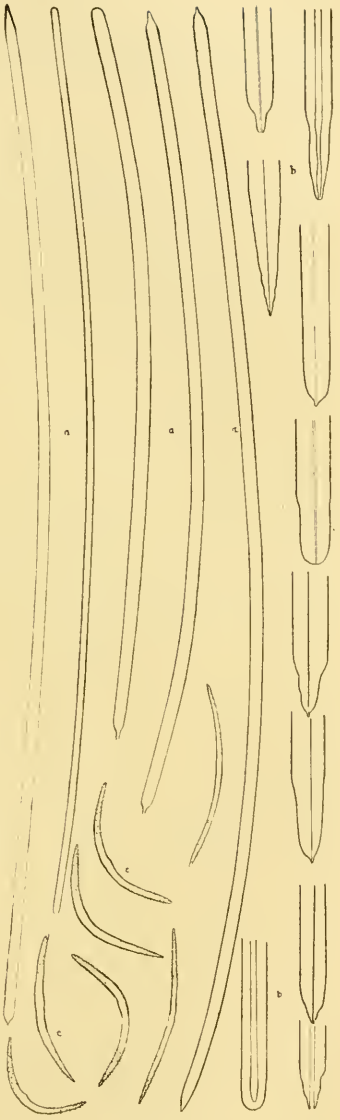
flocculation (consisting mainly of separate spicules); occasionally, however, by the exercise of especial care, one succeeds in obtaining, as part of the residue, small masses of coherent skeleton. From examination of these, the skeleton, which is extremely scanty, is seen to consist partly of slender, 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 Anord-

nung 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. Mega-

scleres: 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 thiclei 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 numerous 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 × 35μ in maximum size; (ii.) exceedingly rare styli occurring interstitially, up to 1100 × 25μ 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.; ($\times \frac{3}{4}$).

Fig.5.—*Desmoxya lunata* Carter; ($\times \frac{3}{4}$).

Fig.6.—*Higginsia coralloides* var. *massalis* Carter; ($\times 1\frac{5}{2}$).

Plate xxxiii.

Fig.6.—*Rhaphoxya*(?) *pallida* Dendy; ($\times \frac{3}{4}$).

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 (?)*Laonæmia*(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* (=*Rhaphidonus 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).

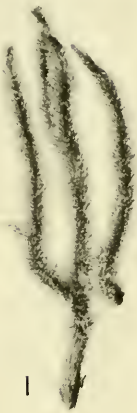
Topsent(49) would include in this genus, in addition to *H. patera*, Bowerbank's *Hymeraphia verticillata*, and the species originally described by him as *Bubaris constellata*,—both of which agree with *H. patera* in the possession of skeletal tylostyli and centrotylote, diactinal dermal megascleres. 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.

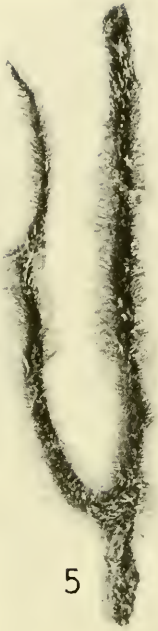
In *Hymeraphia verticillata*, the acanthoxea are of slightly curved form and verticillately spined, and the smooth, diactinal megascleres are trifid at both extremities; and, furthermore, the species is sometimes of massive habit. To replace the (preoccupied) generic names *Laothoë* and *Nænia* already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

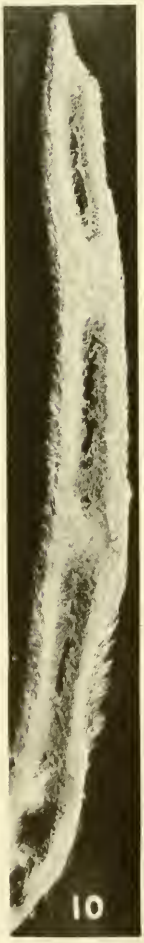
The third species referred to has euasters for microscleres, and, but for its possession of special dermal megascleres, would probably require to be referred to the genus *Timea*. For its reception, I propose the new genus *Paratimea*, which I would include in the family Spirastrellidæ.

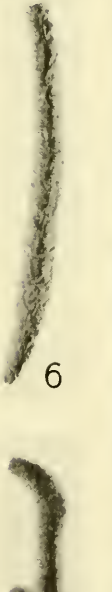
Trachycladus spp.

Trachycladus spp.



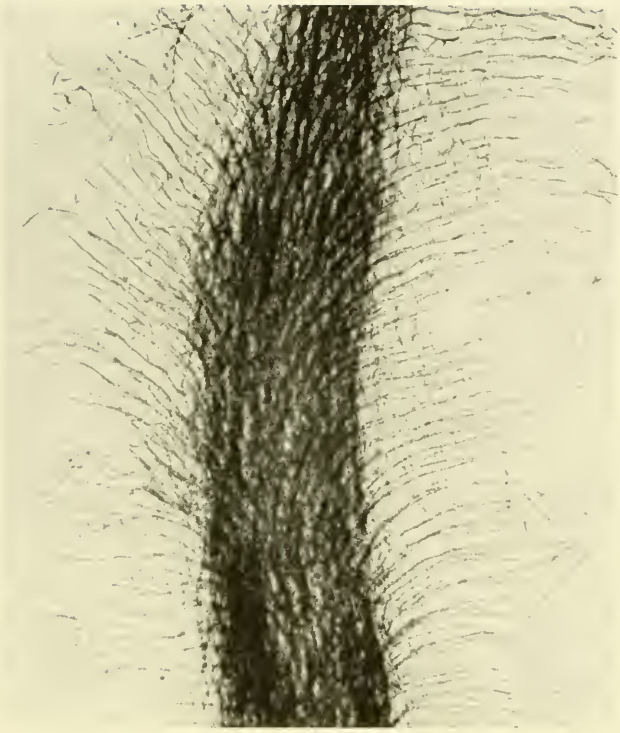






Trachycladus spp.

Trachycladus formosus, n.sp.



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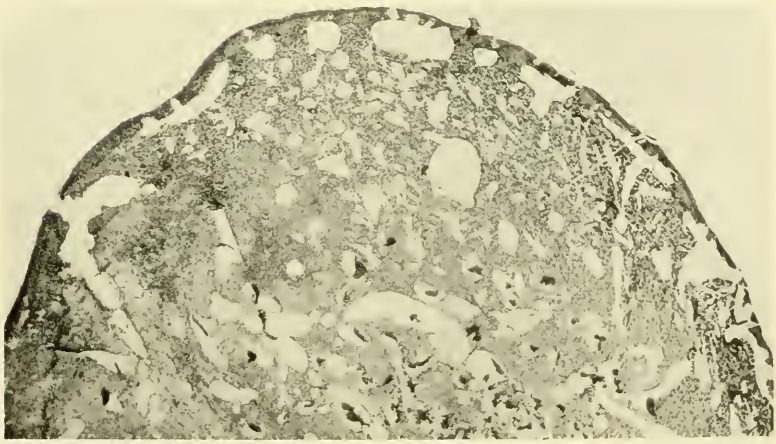

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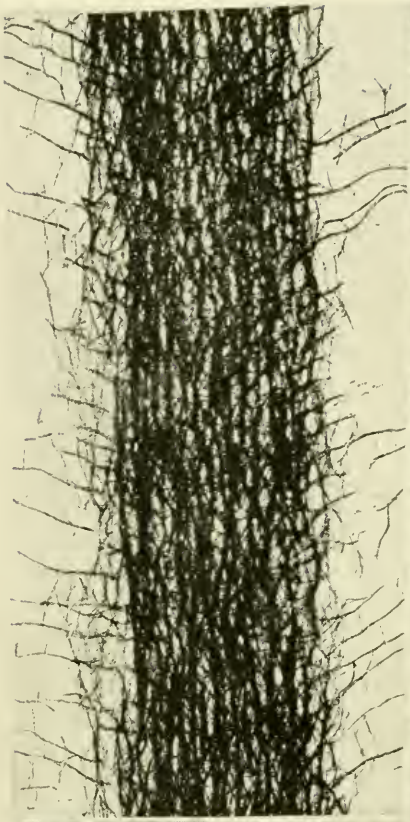
1. *Trachycladus reteporosus*, n.sp. 2. *T. clavatus*, n.sp.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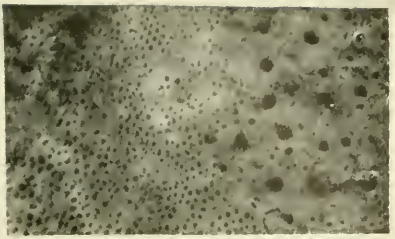
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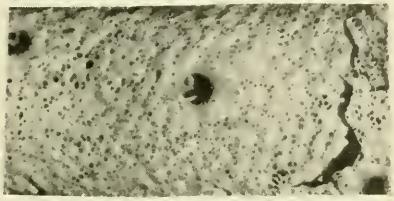
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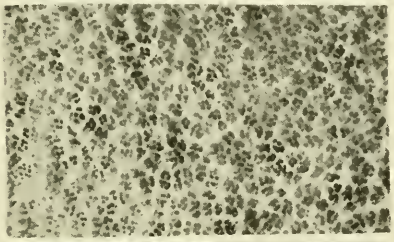
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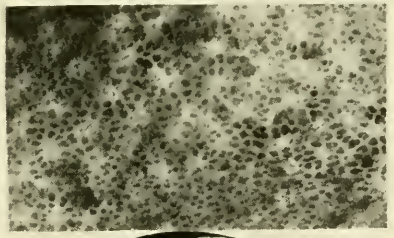
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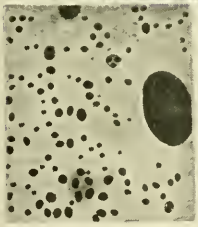
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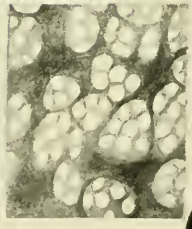
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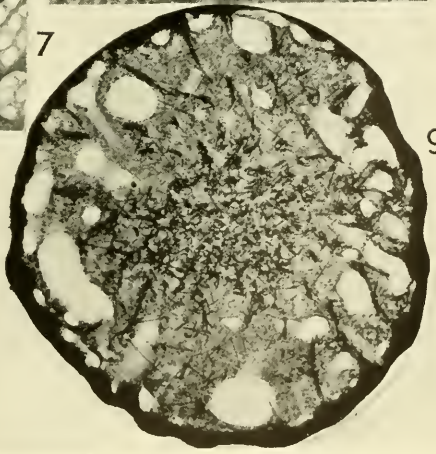
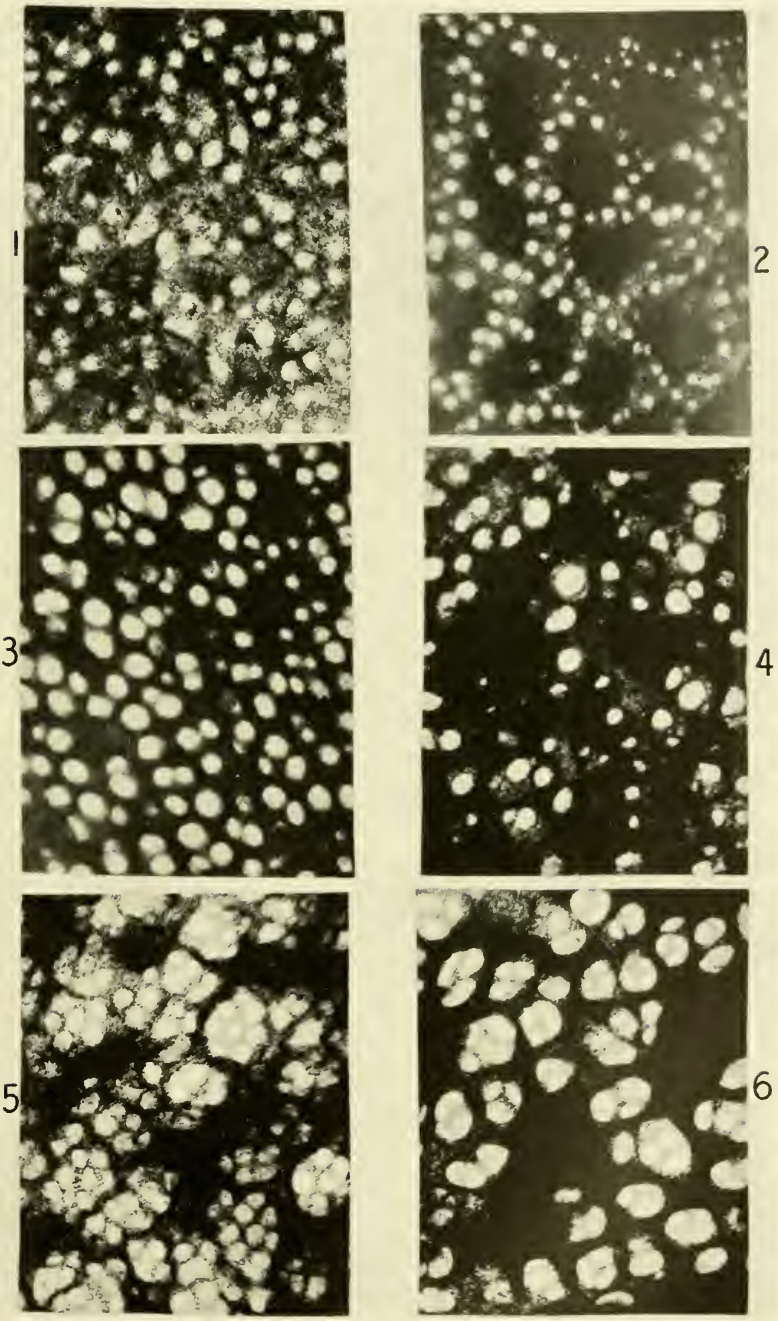
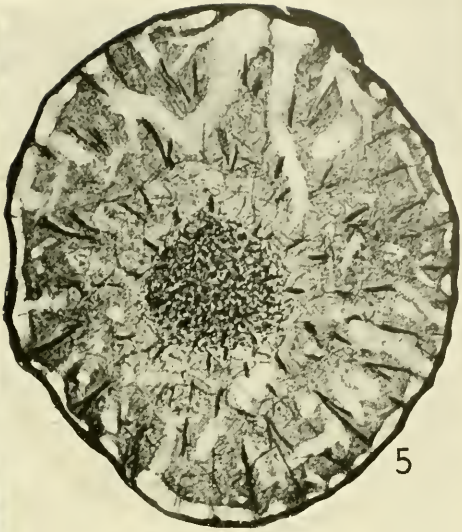

9

Trachycladus spp.



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

1



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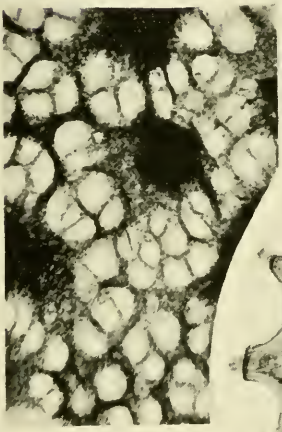

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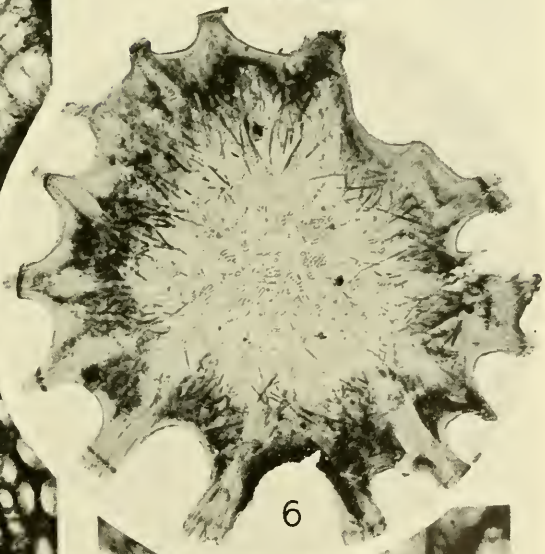

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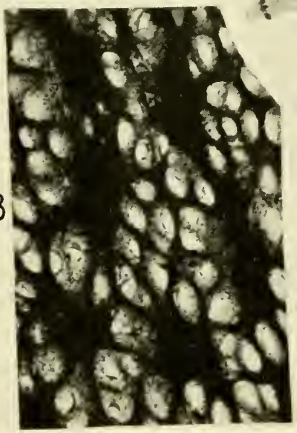

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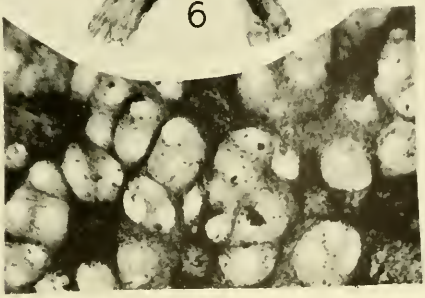
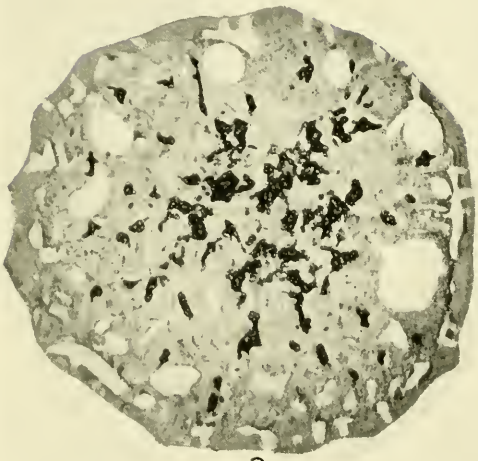


4

Trachycladus spp.

1

3



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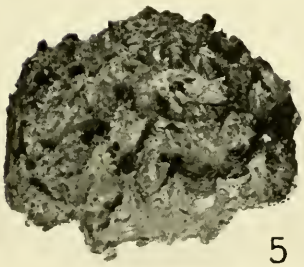
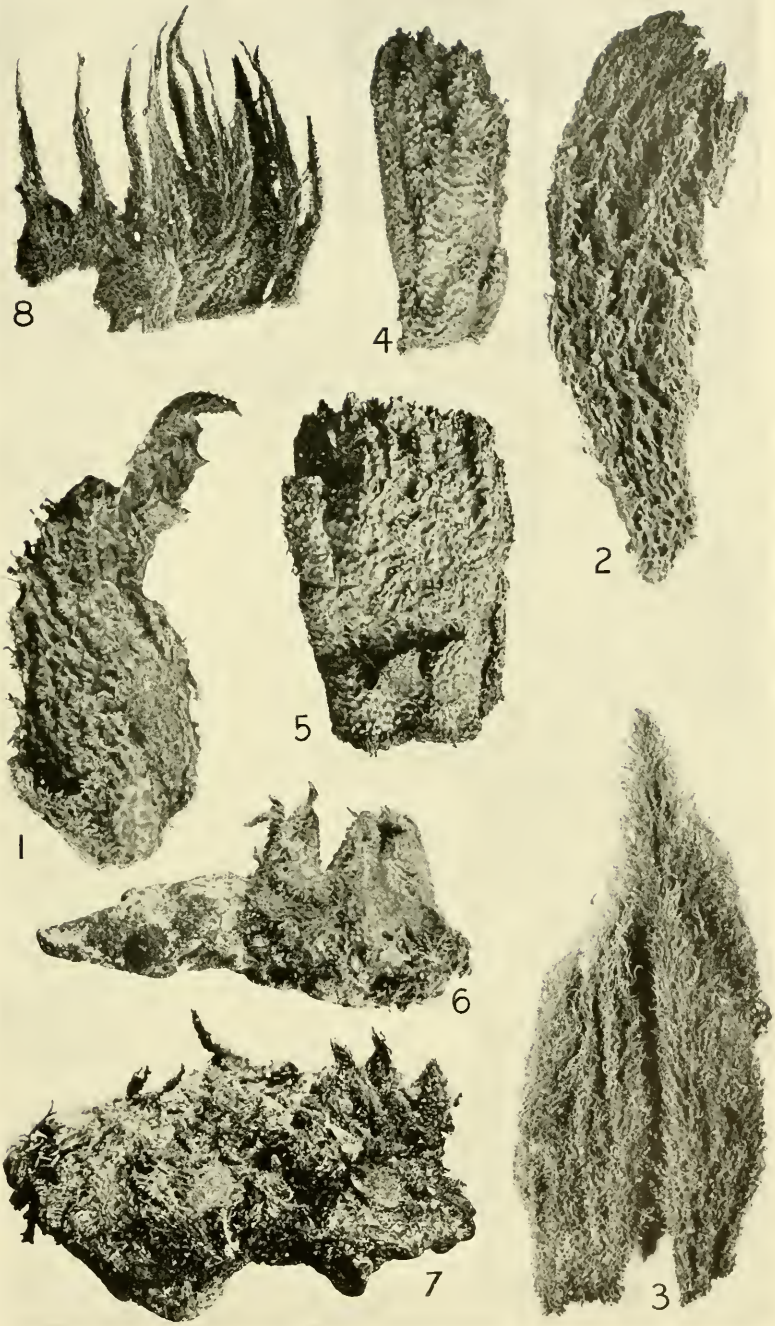


5

6

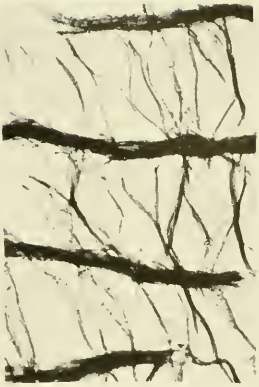
1. *Trachycladus digitatus* var. *clavatus*. 2. *T. reteporosus*. 3. *Rhaphoxya typica*.
4. *Allantoxhora plicata*. 5. *Desmoxya lunata*. 6. *Higginsia coralloides* var. *massalis*.



Biemna (*Allantophora*) spp.

Bicrisia (Allantophora) victoriana, n.sp.

1



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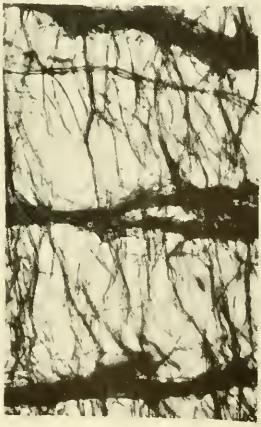
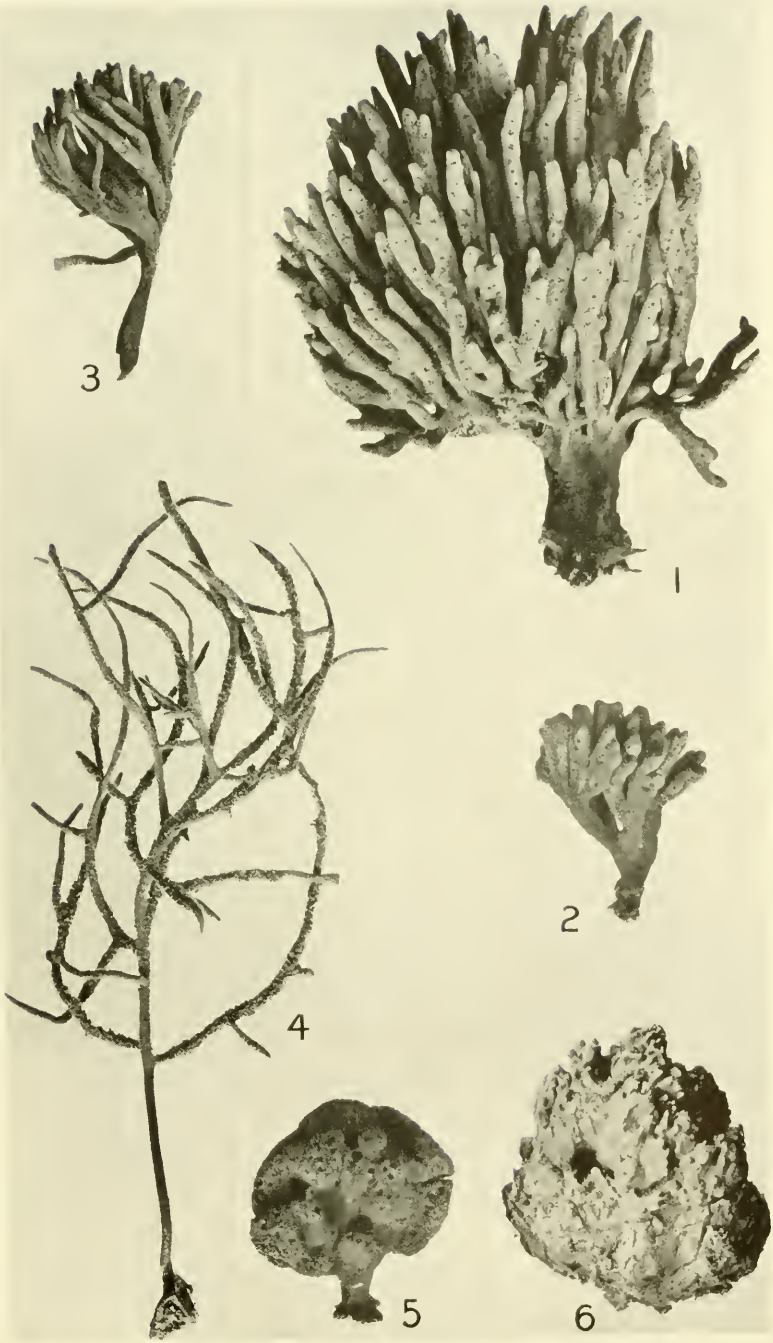
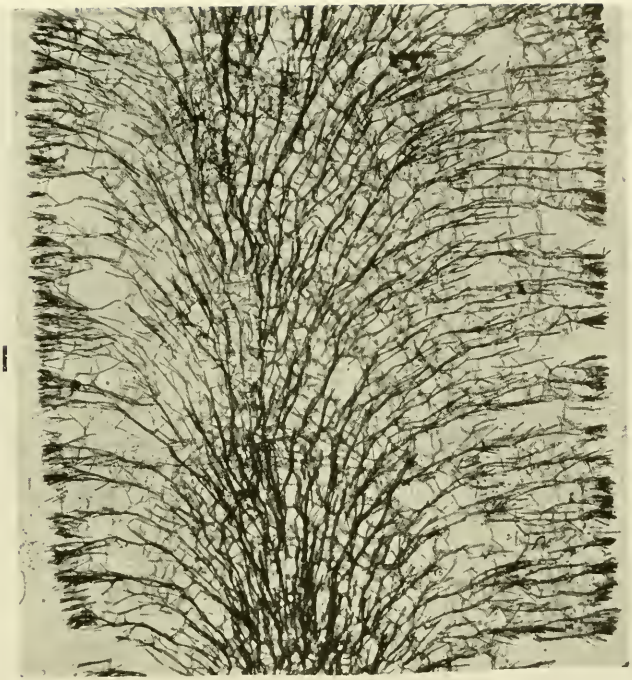


5

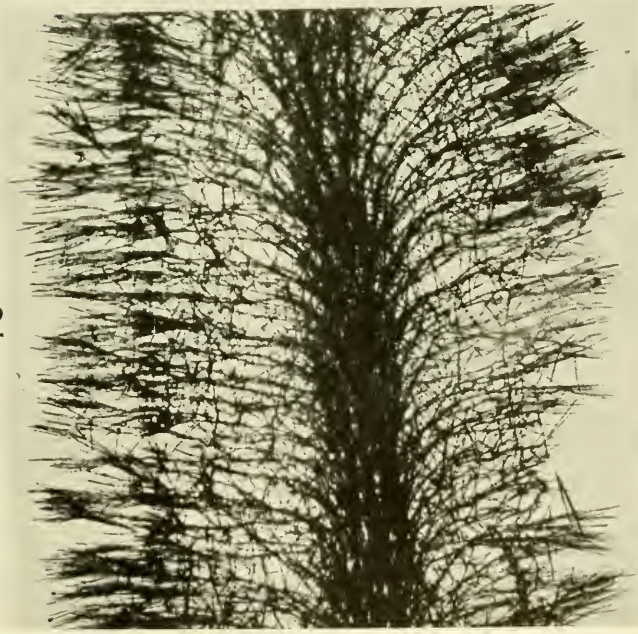
Biemna (Allantophora) victoriana, n.sp.



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



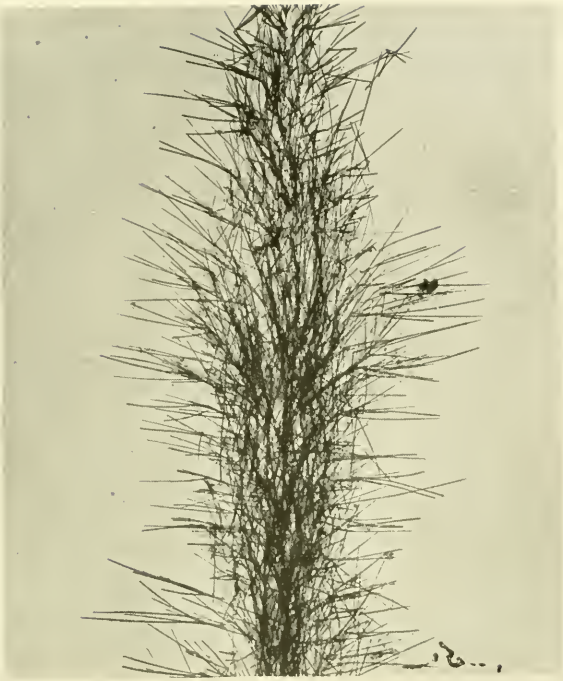
1



2

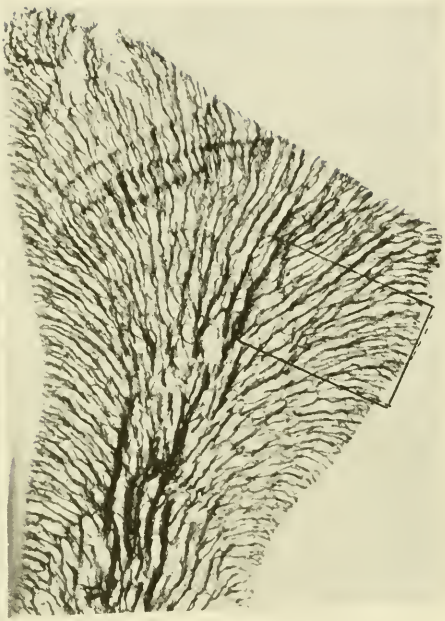
1. *Sigmacinella australiana* Dendy. 2. *S. dendroides* Whitelegge.

1



2

Sigmaxinella viminalis, n.sp.



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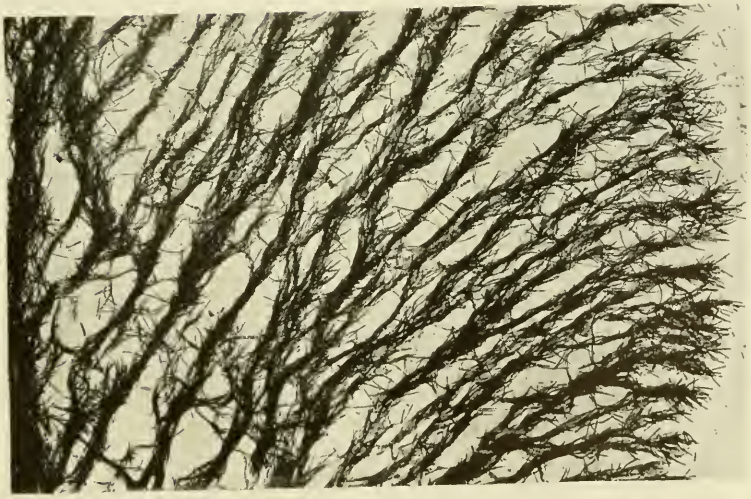
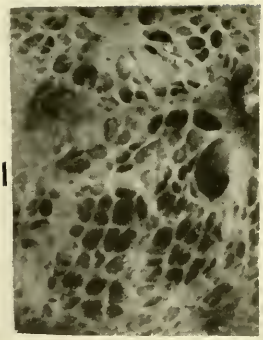
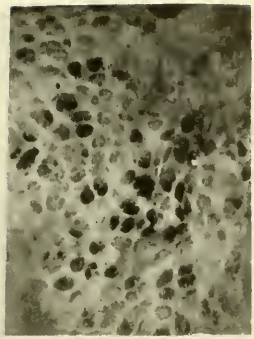


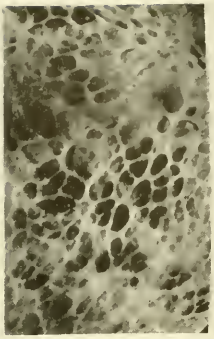
3

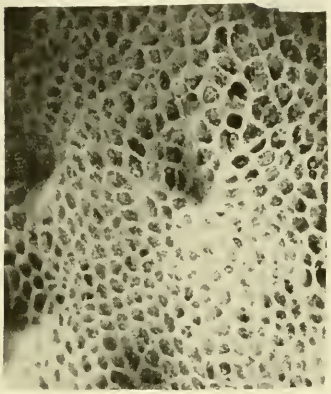
1. *Sigmaxinella viminalis*, n.sp. 2-3. *Sigmaxia flabellata* (Carter).

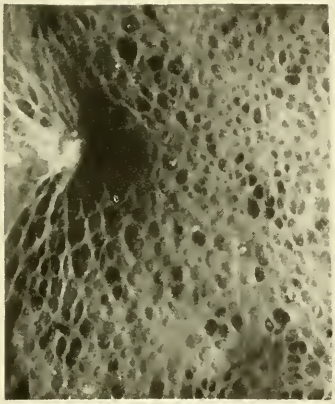
Dragmaxia variabilis (Whitelegge).

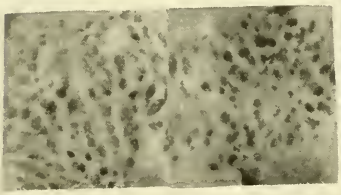


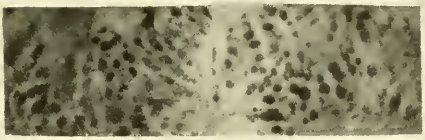


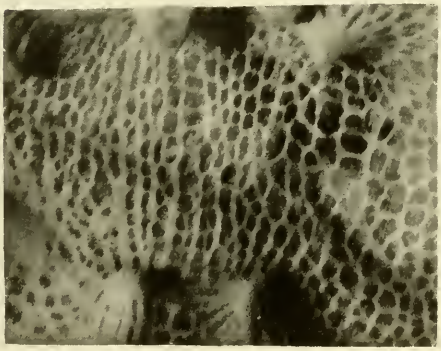


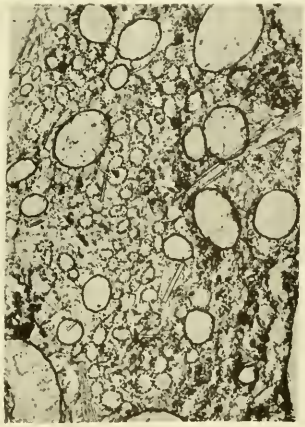












1-4. *Allantophora plicata.* 5. *Desmoxya lunata.* 6-7. *Higginsia coralloides* var. *massalis.* 8 9. *Rhaphoxya typica.*


1

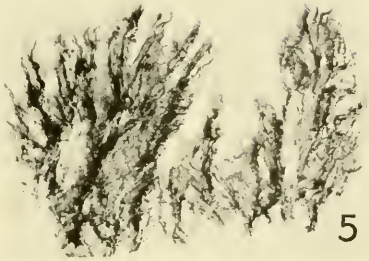

3


2


4


6


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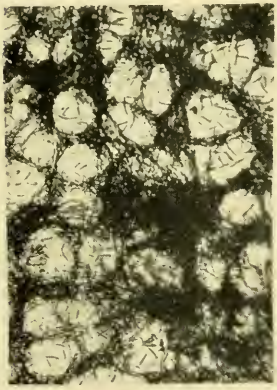
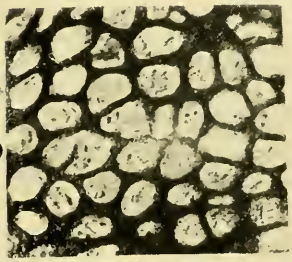
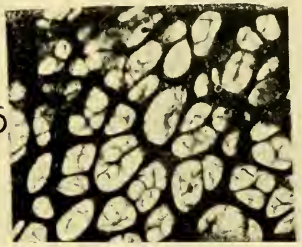
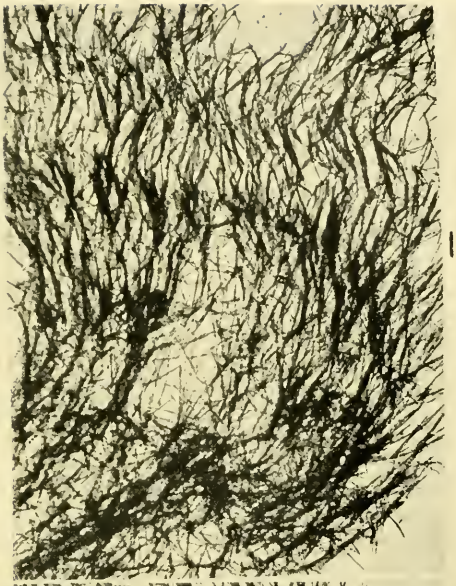
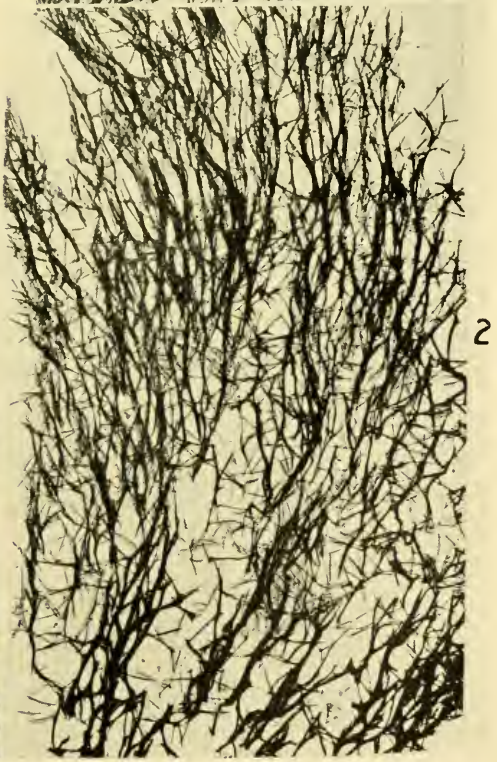
1-3. *Higginsia.* 4-5. *Rhaphospora.* 6-7. *Trachycladus.*









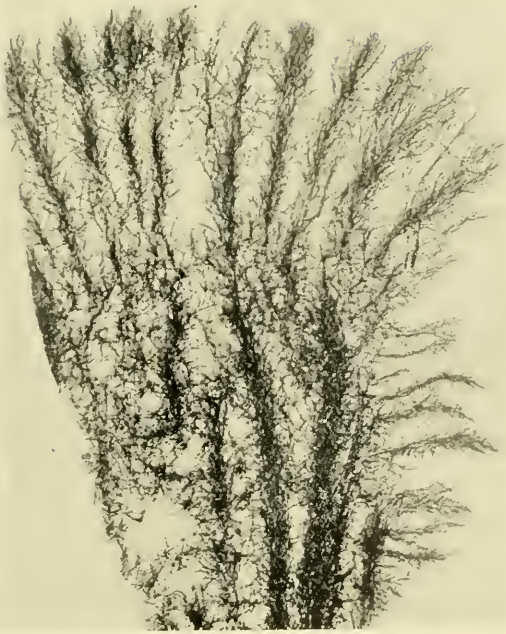


1-4. *Higginsia.*

5-6. *Allantophora.*

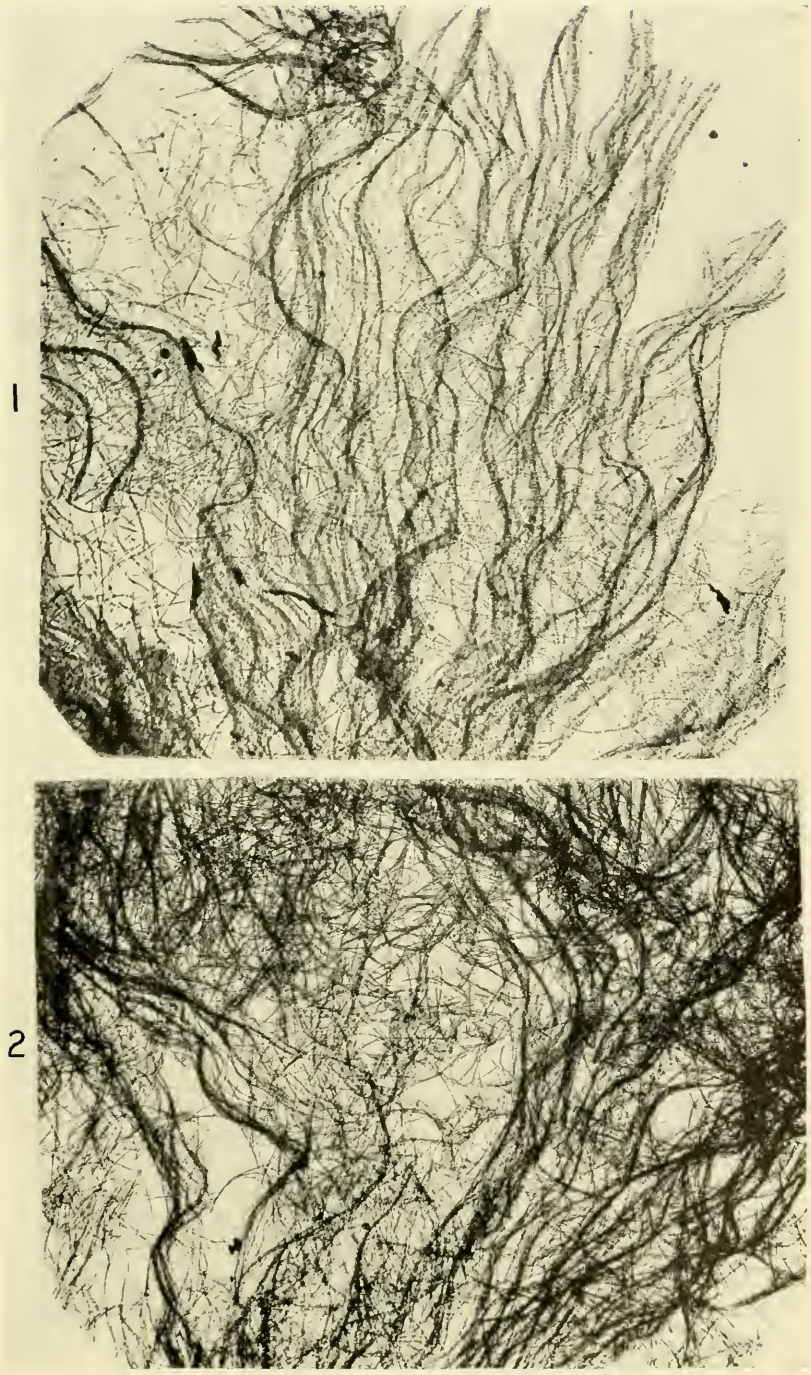
2

3

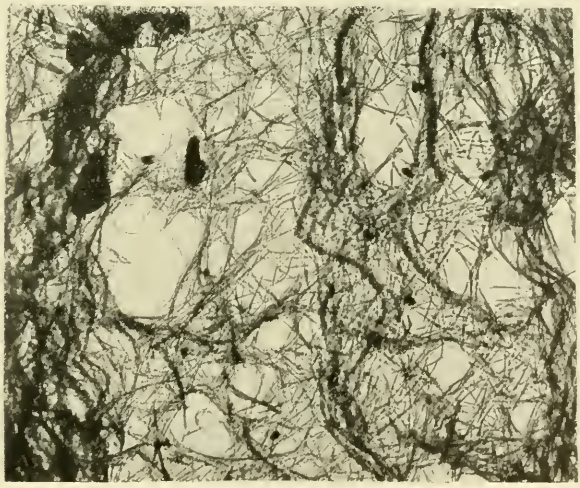


1

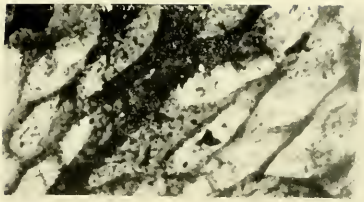
1-3. *Higginsia coralloides* var. *scabra.*

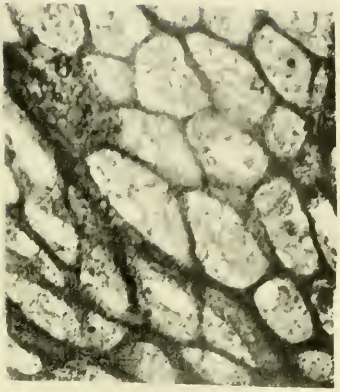


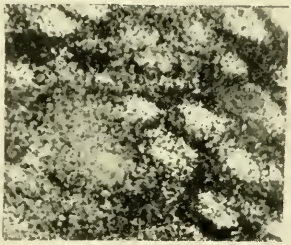
1-2. *Rhaphoeya typica*, n. sp.



1-2. *Rhaphoxya (?) pallida* Dendy.







1-2. *Rhaphoxya typica*, n.sp. 3. *R.* (?) *pallida* Dendy. 4. *Desmoxya lunata* Cart.