On the Distinction between the genera Axinella, Phakellia, Acanthella a. o.

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With Plate 15—16.

There exists a hopeless confusion between "species" of the genera *Axinella, Phakellia, Raspailia, Acanthella* and some others, as will be at once clear by the following facts.

Schmidt suggested (1866, p. 15) that *Halichondria ventilabrum* of Johnston, to which Bowerbank had given the name *Phakellia ventilabrum*, might be included in his genus *Axinella*. *Isodictya donnani* Bwk. is called by Dendy (1887*a*, p. 158): *Axinella donnani*; but in 1905 the same author calls the sponge *Phakellia donnani*, adding (p. 191): "if indeed the distinction between these two genera (viz. *Axinella* and *Phakellia*) is to be maintained". *Phakellia egregia* Dy. is called *Axinella egregia* by Topsent (1890*a*, p. 27).

Speaking about *Axinella proliferans* Ridley writes (1884, p. 619): "In general habit it resembles *Acanthella* rather than *Axinella*, but wants the long undulating cylindrical spicule hitherto found in species of that genus; it appears doubtful whether the existence of such species as this should not induce us to unite the two genera."

Acanthella flabelliformis of Keller is considered by Dendy (1905, p. 194) as a connecting link between the genera *Acanthella* and *Phakellia*.

In view of such statements the question arrises: are indeed *Axinella*, *Phakellia* and *Acanthella* three different genera? I wish to show in the following pages that the answer hereon is beyond doubt affirmative.

In order to settle the question we have first of all to carefully examine what the fathers of the genera — Schmidt and Bowerbank meant by them. In the second place we have to see in how far later authors by describing "new species" modified the genera. We will learn then that several of these "species" in fact do not belong to the genus under consideration. If we then have established what the distinctive characters are said to be, we have to reexamine them with our modern improved methods. Before we can compare the different genera we will thus first study them separately.

I. *Axinella.*

This genus is established by Oscar Schmidt in 1862, who gives (p. 60) the following diagnosis: "Halichondriae dendroideae, tenaciusculae, saepe subelasticae et flexibiles. Axis firmior e fibris subcorneis et spicula includentibus formatus. Spicula non insignia, saepe longiora et arcuata." Schmidt states further, and this is important to realise, that the "axis" is "ein, vorzugsweise in der Längsrichtung ausgedehntes Hornnetzwerk", in which spicules are imbedded. Schmidt's *Axinella* is identical with *Grantia* of Nardo (1833); this name, being preoccupied, had of course to be changed. Schmidt described five species; two of these viz. *verrucosa* and *cannabina* correspond according to Schmidt [1]) to *Spongia verrucosa* and *cannabina* of Esper (1794); two other ones, *cinnamomea* and *foveolaria* are said to be identical with Nardo's *Grantia cinnamomea* and *foveolaria*; the fifth species is called *A. polypoides n. sp.* As to *A. cinnamomea* Schmidt says in the text that it is perhaps identical with Esper's *Spongia damicornis*; in the explanation of the plates it is, however, called *Axinella damicornis*. There can hardly be any doubt as to the identity of these two; consequently the name *cinnamomea* is at any rate superfluous. I hope to show elsewhere that no specific distinction can be made between *Axinella verrucosa*, *cinnamomea* (*damicornis*) and *polypoides*; propably *foveolaria* and *cannabina* are likewise to be included. As

1) Confirmed by Ehlers (1870). It seems that this author wishes to bring *Phakellia ventilabrum* likewise to *Axinella*; this is of course a mistake.

this is for our present purpose of no consequence, I will not discuss this point here. If one does not feel inclined to unite them into one species, it remains at any rate an established fact that they belong to *Axinella*. This is, I think, generally accepted and Gray's suggestion (1867, p. 514) to erect a new genus (*Astrospongia*) for *Axinella polypoides* has found no support. Quite correctly Topsent (1894*β*, p. 16) states not to understand why Hanitsch (1894, p. 179, 200) brings the sponge to *Tragosia*.

Apart from the interpretation of *verrucosa*, *cinnamomea* etc. as different species or as such modifications of one species, as I have called tropi (1911, *β*, p. 26), they must forcibly form the starting point, they are i. o. t. typical representatives. Since Schmidt's paper of 1862, various authors have described "new species" of *Axinella*; the number has increased to between 80 and 90! Some of them are obviously mere synonyms of existing species. By such forms the character of the genus is not altered. Some others are quite insufficiently described to allow an opinion. Again others are most certainly no *Axinellae*. Thus, for instance, if Ehlers (1870) reckons *Phakellia ventilabrum* to *Axinella* this only gives proof that he did not catch the generic difference. Carter described (1885, p. 359—360) an *Axinella atropurpurea*; according to Dendy (1896, p. 47) the type specimen of this sponge contains acanthostyli and is consequently removed from *Axinella*. Carter's *Axinella flabellata* possesses sigmata; therefore it cannot be an *Axinella*. Such examples are numerous.

With a few exceptions we have very little certainty; but we do know what sort of thing Schmidt's *Axinella verrucosa* is. For my present purpose, viz. to show that *Axinella* and *Phakellia* are certainly two different genera it is sufficient to study the skeleton. I will, therefore, only speak about the structure of this part of the sponge. Schmidt says (1862, p. 62): "Auf dem Querdurchschnitt (through the sponge) hebt sich sehr bestimmt die dichtere, fast wie ein Knorpelstreif aussehende Axe von der braungelben pigmentierten Rinde ab. An der Basis nimmt die Axe fast den ganzen Durchmesser des Stammes ein und sendet einige kurze Haft- oder Wurzelläufer aus. Im Verlauf der Äste verliert sich der Gegensatz zwischen Axe und peripherischem Parenchym mehr und mehr, indem das Hornnetzwerk weniger hart wird und schwindet."[1]) Indeed we may

1) It is of course meant, that this phenomenon appears at the tops of the branches.

distinguish a firm, more or less cylindrical axial skeleton or axis and a much looser peripheral or extra-axial skeleton. The ratio between the diameter of the axis and the whole branch is variable in different specimens. But the fundamental arrangement remains the same. As stated before, Schmidt has already observed that the axis is not massiv; it is composed of a large number of spongin [1]) fibres enveloping a very variable number of spicules. These elementary fibres I will call funiculi [2]); they ramify and anastomose, thus forming a network, together establishing a thicker string or funis [3]) (Taf. 15 Fig. 1). The soft parenchyma of the sponge, including connective tissue, canals and mastichorions enters in the meshes between the funiculi. As a rule this funis is, in one branch of the sponge, undivided and consequently represents the axis. But sometimes the axis of a branch contains two or (very seldom) three such funes. Alongside the axis funiculi diverge at rather regular intervals and, gradually curving, finally run towards the sponge surface at about right angles to it, resp. the axis. These extra-axial funiculi not unfrequently are ramified and united together by spicules and a scanty quantity of spongin. They terminate into groups of a few diverging spicula, thus forming brushes (Taf. 16 Fig. 5). Examined from the sponge surface, the terminal brushes are seen to be irregularly dispersed; focussing a little lower one observes the spicules uniting the funiculi, forming an irregular network, with some more or less quadrangular meshes (Taf. 15 Fig. 2).

II. *Phakellia.*

The genus *Phakellia* is established by Bowerbank, who gives the following diagnosis (1862, p. 1108—1109): "Skeleton composed of a multitude of primary cylindrical axes, radiating from a common base and ramifying continuously, from which emanate at about right angles to the axes a secondary series of ramuli, which ramify continuously as they progress towards the surface, but never appear to anastomose." The type of this genus is said to be *Halichondria ventilabrum* of Johnston-Bowerbank and several other authors de-

1) For the sake of convenience I use this word in the sense as it is generally taken; it is, however, quite certain that the spongin of Euspongia, Spongelia, Aplysina, the so-called Chalineae, Reniera etc. etc. is by no means the same substance.

2) funiculus, a thin rope or thread.

3) funis, a thick rope, composed of several threads.

scribed a number of "species" of the new genus; as far as I know this number amounts to 40. But here we find the same as we stated for *Axinella*. Part of them are mere synonyms; others are too insufficiently described to allow an opinion; again others do certainly not belong to it. I shall not enter in discussion here about the whole synonymy. I wish only to state that FLEMING (1828, p. 523) applied the name *Halichondria ventilabra*, which JOHNSTON correctly changed into *ventilabrum*, to *Spongia ventilabra* of LINNÉ (1767, p. 1296). However, LINNÉ refers to the illustration given by SEBA (1758, tab. 95, fig. 8) and to PALLAS's *Spongia strigosa*. ESPER (1794, p. 210) likewise identifies *Spongia strigosa* Pall. with *Spongia ventilabra* L. I found in the collection of the Museum in Leiden a dried sponge (numbered by me M. L. B. 3), which so much resembles the figure of SEBA, that it might be the type. As this specimen (M. L. B. 3) is certainly a *Phakellia*, corresponding to BOWERBANK's *Ph. ventilabrum*, we may safely accept the views of LINNÉ and ESPER. Consequently are *Ph. ventilabrum* and *Sp. strigosa* identical, and the type of *Phakellia* has to be called *Ph. strigosa* (PALL.).

Leaving further argumentation to another opportunity, I only mention here that I include as synonyms: *Spongia zetlandica* JAMESON, *S. xerampelina* LMK., *S. scypha* MONT., *S. ventilabriformis* GRAY, *Phakellia robusta* BWK.

Sections of our sponge show that in the axial skeleton the spicules are generally quite imbedded in spongin, forming elementary fibres or funiculi. These funiculi ramify and anastomose in order to form a network, which thus represents a funis (Taf. 15 Fig. 4). The number of funiculi composing a funis is very variable; hence is the diameter of the latter exceedingly variable. Whereas in *Axinella* the axis is formed by one or at any rate very few funes, we find in *Phakellia* that the axis is built up by a large quantity of funes, which give off branches (generally smaller), which anastomose with other funes. In this way again a network is formed with rather large meshes (Taf. 16 Fig. 7), easily seen with the naked eye. The extra-axial skeleton of *Phakellia* is composed of funiculi, rather abruptly starting from the axial skeleton and for the greater part placed perpendicularly on the axis, resp. the sponge surface (Taf. 16 Fig. 8). They ramify sparingly and are hardly united to neighboring ones. Hence there is not seen such a more or less rectangular network as in *Axinella*. If they are united it is generally by one or two single spicules, which diverge much from their funiculus. On

the other hand they form at the periphery very distinct brushes of diverging spicules (Taf. 15 Fig. 3).

III. *Acanthella.*

This genus is again established by Oscar Schmidt (1862, p. 64—65), who gave the following diagnosis: "Halichondriae ramosae et fruticosae, tanquam spinis obsitae. Cutis laevis, porosissima, quae in ramis crassioribus sola pigmento infecta est et verae pellis instar a parenchymate distinguitur. Parenchyma spisse impletum spiculis simplicibus longioribus, substantia firmiori non inclusis." Schmidt described two species, *A. acuta* and *A. obtusa*; by later authors the number increased to 19. As the type of the genus I will take the species, which Schmidt described first, viz. *A. acuta*. Both species, *acuta* and *obtusa* are very well described and illustrated by Schmidt; they are easily recognised. The difference between them is, however, greater than might be supposed by the original descriptions. Not only is the canalsystem different, but also the skeleton, although the elements of the latter, viz. the spicules, resemble each other very much. The difference in their arrangement is best seen in preparations the soft parts of which are removed. Fig. 3 and 4 (Taf. 16) represent a part of the skeleton of *A. acuta*, Fig. 1 and 2 that of *A. obtusa*. I arrived at the conclusion that the differences are large enough to justify even a generic distinction Consequently we have, with regard to *Acanthella* only to do with specimens corresponding to Schmidt's *A. acuta*.

The skeleton of *Acanthella* shows no distinction between an axial and an extra-axial part. Herewith the genus is at once distinguishable from *Axinella* and *Phakellia*. We find that the spicules are united by spongin in order to form funiculi, which, by their ramifications and anastomoses form a network, composing in this way a funis (Taf. 15 Fig. 6 and 7). The meshes between the funiculi are rather small; hence the funis is compact, and as the composing spicules hardly project beyond it, the funis is on the whole smooth (Taf. 16 Fig. 3). At the base of the sponge the funis is thick; it soon divides itself into two or three — at any rate a few — branches, slightly less in diameter than the basal stem. Each branch likewise divides itself and so on till the periphery is reached. Here, by gradually diminishing the diameter the branches are composed of only a few spicules. As the branches in ramifying always diverge and never

form anastomoses, we find large portions of the sponge entirely destitute of spicules (Taf. 16 Fig. 3).

IV. *Phacanthina.*

This new genus I establish for *Acanthella obtusa* of Oscar Schmidt. In *Phacanthina* no distinction can be made between an axial and an extra-axial part of the skeleton. Herein it agrees with *Acanthella*; it also agrees with the latter by the way the latter branches, without anastomosing. But in *Phacanthina* there is still less spongin, uniting spicules, and the long styli project everywhere far beyond their branch. The result is that all the branches are very hirsute indeed and that the places, where no spicules occur are far less than in *Acanthella* (Taf. 16 Fig. 1 and 2). This is also partly due to the fact that on the whole the branches in splitting up, do not diverge so strongly as in *Acanthella* (compare Fig. 1 and 3 on Taf. 16). Although I suppose these differences important enough to justify a generic distinction, I may add perhaps that the canal-system in both genera is likewise different.

V. *Raspailia.*

Pick (1905, p. 7) has stated that; according to the generally accepted rules of nomenclature Schmidt correctly changed Nardo's *Raspelia* or *Raspaila* into *Raspailia*; we will, therefore, use the latter orthography. About fifty "species" are described by various authors, but it is quite certain that some of these do not belong to the genus; others are insufficiently described. Moreover a great many synonyms are among them. I cannot enter into discussion about this point; the question is fully worked out in my Monograph of the Sponges of Naples (in M. S.). For my present purpose it is sufficient to say, that I take as types of the genus such specimens as correspond to *R. viminalis* of Oscar Schmidt.

We find then that the skeleton consists of a firm axis, which is composed of a network of funiculi — spicules wholly or almost wholy imbedded in spongin, forming together a funis. This funis represents the axis. Its meshes are wide; the funiculi thin (Taf. 15 Fig. 5). At about right angles funiculi start, composed of one, two or three spicules, kept together by a smaller or greater quantity of spongin. They terminate into one single large style, projecting far beyond the sponge surface. Frequently the extra-axial funiculi

are represented by one single spicule. There, where the long terminal extra-axial spicules perforate the dermis, they are surrounded by a tuft of diverging small spicules (generally styli); this is very characteristic for *Raspailia*.

The chief mass of spicules are long, slender styli, occasionally tylostyli or strongyli, generally also oxea. In the second place acanthostyli occur, either dispersed in the parenchyma or with their bases imbedded in the spongin of the funiculi. Finally we find, as stated before, small styli or oxea in the peripheral tufts.

If we compare the skeletons of these five genera, which are so often mixed up, we see that indeed they are very clearly distinguishable from each other. But we learn at the same time, that in all these genera sponges are described which do not belong to them. The confusion partly originated by neglect of careful anatomical study of the specimens, more especially by neglect of an examination of the skeleton — i. e. the study not only of the sort of spicules, but also of the way how they are arranged. In applying this method it will become evident to everybody that Ridley & Dendy were mistaken if they say that *Axinella* and *Raspailia* are difficult to distinguish. They write (1887, p. 178) about *Axinella*: "This is a very critical genus, and it is impossible to give a satisfactory diagnosis of it. It comes very near to *Raspailia*, but the latter is conveniently kept distinct on account of its very characteristic, whip-like external form." And again (l. c. p. 188), speaking about *Raspailia*: "The most characteristic feature of this genus is the external form, taken in connection with the absence of microsclera: like *Axinella*, it is a difficult genus to diagnose. and the two genera, as we have already indicated, come very near to one another." On the contrary: *Axinella* and *Raspailia* are very different. They agree with regard to the main construction of the axis (leaving out for a moment the presence of acanthostyli in the latter). Whereas, however, in *Axinella* the extra-axial skeleton is composed of funiculi of styli (or modified styli), terminating into tufts of diverging spicules slightly smaller than the bulk of the spicules, we found in *Raspailia* the extra-axial skeleton composed of funiculi of long and slender styli, each funiculus terminating into one single far projecting, stylus, surrounded at its proximal part by a tuft of diverging, very much smaller styli. In addition to an axial skeleton, which is fundamentally the same in both genera, they possess an extra-axial skeleton, which is entirely different. We have seen before, that the external appearance of

Axinella is very variable. Roughly spoken we find branched or unbranched cylindrical forms and broadly expanded flabellate forms. In the "species" *verrucosa* and *polypoides* we have examples of the former extreme; in the "species" *cinnamomea* or *damicornis* an example of the latter. What is stated above with respect to the supposed resemblanc or identity of *Axinella* with *Raspailia* of course only holds true for the cylindrical forms. The flabellate forms, as we saw before, are often confused with *Phakellia*. I refer to what I said about this on the first page. But I hope to have shown that flabellate *Axinellae* are different in structure from *Phakellia*. In *Axinella* the axis is composed of a network of funiculi; in *Phakellia* the network is formed by anastomosing funes, which are in their turn composed of a network of funiculi. The meshes of the axis in the former are bordered by funiculi, in the latter by funes; in accordance herewith is the fact, that on the whole these meshes of *Axinella* are considerably smaller than in the latter: hardly distinguishable to the naked eye in the former, clearly conspicuous in the latter.

According to Ridley (1884, p. 619) there is a sponge, called by him *Axinella proliferans*, which partly resembles *Axinella*, partly *Acanthella*. We have seen, however, that in the typical specimens of the latter genus no distinction can be made between an axial and an extra-axial skeleton, so distinctly seen in *Axinella*. As far as it is possible to form a clear conception of the true arrangement of the spicules without any illustration, I should rather not include Ridley's sponge in *Axinella*. I feel inclined to believe that the arrangement is more like *Phacanthina*, with which the external appearance is in perfect accordance. This can, however, only been settled by making a preparation of the skeleton of one of the specimens Ridley alludes to.[1]) If there is really no distinction to be made between an axial and an extra-axial part, the sponge cannot, according to my views, be placed under *Axinella*.

For similar reasons I doubt whether Dendy (1905, p. 194) is right, where he considers *Acanthella flabelliformis* Kell. as a "connecting link between the genera *Acanthella* and *Phakellia*". Here again the skeleton has to be studied more carefully.

Schmidt mentioned (1880*a*, p. 282) *Phakellia plicata* and *Ph. incisa* — mere nomina nuda — stating that he left them in the Zoological Station at Naples. In my list of the sponges, which I examined in

1) See for the methods at the end of this article.

Naples (1881) I have mentioned them; I will add here that the specimens bear the original labels in Schmidt's handwriting. After examination I came to the result 1° that both are identical and 2° that they do not belong to *Phakellia*, but to *Phacanthina*, being identical with Schmidt's *Acanthella obtusa*.

If it be true that *Axinella*, *Phakellia*, *Acanthella*, *Phacanthina* and *Raspailia* are as many separate, distinct genere. on account of the reasons given above, this involves that several "species" described as belonging to one of these genera are to be removed. Some of these we will now examine.

Species of *Axinella*. Obviously is *Axinella ventilabrum* (Bwk) Wright (1868 p. 224) not an *Axinella* but a *Phakellia*. Nor was Schmidt right in suggesting that *Ciocalypta penicillus* Bwk., and *Dictyocylindrus pumilus* Bwk. were probably *Axinellae*. Carter's *Axinella atropurpurea*, *A. setacea*, *A. cladoflagellata*, *A. coccinea* are already removed by Dendy (1896). Probably with the same right are to be removed: *Axinella chalinoides* Crtr., *A. flabellata* Crtr., *A. meloniformis* Crtr., *A. pilifera* Crtr., *A. mariana* Rdl. & Dy., *A. monticularis* Rdl. & Dy., *A. profunda* Rdl. & Dy., *A. tubulosa* Rdl. & Dy., *A. hispida* Ldfd., *A. crista-galli* Maas, *A. fascicularis* Han., *A. stuposa* Han., *A. vasonuda* Tops., *A. crinita* Thiele, *A. manus* Dy. and others. Most of these possess a spiculation which does not allow to include them in *Axinella*.

Species of *Phakellia* (= *Phacellia*). Here again we find several "species", which are to be removed from the genus. Thus e. g. *Ph. tenax* O. S., *Ph. incisa* O. S., *Ph. plicata* O. S., *Ph. ramosa* Crtr., *Ph. arctica* Vosm., *Ph. bowerbanki* Vosm., *Ph. flabellata* Crtr., *Ph. villosa* Crtr., *Ph. crassa* Crtr., *Ph. rugosa* Tops., *Ph. jacksoniana* Dy., *Ph. tumida* Dy., *Ph. microxephora* Kirkp. and others.

Species of *Acanthella*. As stated before *A. obtusa* is to be removed from the genus; probably also: *A. multiformis* Vosm., *A. pulcherrima* Rdl. & Dy., *A. flabelliformis* Kell., *A. insignis* Thiele.

Species of *Raspailia*. Because of the spiculation we shall probably have to remove *R. stelligera* O. S., *R. syringella* O. S., *R. moebii* O. S., *R. australiensis* Rdl., *R. clathrata* Rdl., *R. abyssorum* Frist., *R. flagelliformis* Rdl. & Dy., *R. rigida* Rdl. & Dy., *R. falcifera* Tops., *R. fascicularis* Tops., *R. rigida* Tops., *R. humilis* Tops., *R. incrustans* Swartschewsky, and others. In *Raspailia thurstoni* Dy. the axis is said to be "composed of a solid mass of rather dark ambercoloured spongin" (1887, p. 161). We saw that in *Raspailia* the axis is not

solid. Moreover it is said that the extra-axial skeleton forms a network (more or less in *Axinella*). I think Pick was right in removing the species from *Raspailia*.

Resuming we formulate the following table (p. 12—13):

Technical note.

For the study of the skeleton of sponges it is not sufficient to prepare sections. The spicules have to be carefully isolated by boiling a piece of sponge in diluted hydrochloric or nitric acid; they are afterwards washed, dried and mounted in balsam, unless certain details in structure are to be studied. For such purposes I have given other methods. In order to determine the sort of spicules, which occur in a certain sponge it is, however, quite sufficient to mount in balsam. Transverse and longitudinal sections inform us how the distribution and the arrangement of the various spicules are. Herefore it is absolutely necessary to make, in addition to the ordinary thin sections, thick and very thick sections (50—500 μ and sometimes more). In many cases this is even not sufficient. Preparations have to be made of the skeleton devoid of the "soft parts". The sponges are dissociated in diluted ammonia or caustic potash. For some sponges the best results are obtained by taking fresh specimens, which are then treated as a whole with cold or warm (60°) potash (1—5 %); other species are better first preserved in alcohol and afterwards treated with potash or ammonia. This process demands often much patience, for one has to watch them carefully. I usually try now and then how far maceration is going on by producing a current of fluid on the sponge with a pipette with narrow opening. If the maceration is proceeding one sees clouds of sponge-substance coming out. If the skeleton becomes visible one better removes the sponge from the solution and farther proceeds under water. I cannot give a fixed rule; it has to be found out for every species. Many *Axinellae* I kept for days or weeks in running water, before the skeleton was really "clean". Other sponges are ready within a few hours or a couple of days. If one has time to wait, very beautiful skeletons can be had by placing the fresh sponge in a week solution of formol (to begin with 4, then 2 % formaldehyd). Of course it is only possible to prepare skeletons in this way of we have to do with sponges the spicules of which are kept together by some substance, say spongin. It must, however, be born in mind that in many case sponges contain spicules losely dispersed in the parenchyma, in

	Axinella	*Phakellia*
Skeleton at large.	Axial and extra-axial part clearly distinguishable. From the basis of the sponge the main stem runs on as a single axis, or it may divide into branches; each branch of the axis represents a funis.	Axial and extra-axial part clearly distinguishable. The basal stem soon divides into branches, each branch representing a funis. Neighboring funes anastomose and form a network.
Axial part.	Composed of a network of funiculi; which only occasionally form more than one funis.	Composed of a network of numerous funes, each consisting of a network of funiculi.
Funiculi.	Each funiculus composed of spongin in which a few (2—20) spicules are wholy imbedded.	Each funiculus composed of spongin in which a few (2—8) spicules are wholy imbedded.
Meshes between funiculi.	About 80—350 μ in transverse diameter.	About 20—200 μ in transverse diameter.
Funis.	Formed by innumerable funiculi.	Formed by comparatively few funiculi.
Meshes of axis.	Formed by anastomosing funiculi. Not or hardly visible to the naked eye.	Formed by anastomosing funes. Easily visible to the naked eye(200—1000 μ).
Extra-axial part.	Composed of funiculi gradually diverging from the axis; then running perpendicularly towards the surface, where they terminate into indistinct brushes. Funiculi not unfrequently branching and united inter se, thus forming a conspicuous, more or less rectangular network.	Funiculi rather abruptly starting from the axis at about right angles and running in the same direction towards the surface. They scantily branch and are hardly united together by spicules. They terminate into distinct brushes.
Spicules.	Styli, strongyli and oxea.	Styli, strongyli and oxea.

Acanthella	*Phacanthia*	*Raspailia*
No extra-axial part distinguishable.	No extra-axial part distinguishable.	Axial and extra-axial part clearly distinguishable.
The basal stem soon divides into branches, each branch representing a funis. Angle between branches often 45° and more. Funes never anastomose; they leave large portions of sponge tissue without spicules. The spicules composing a funis hardly project; hence funis rather mooth.	The basal stem soon divides into branches, each branch representing a funis. Angle between branches seldom more than 30°. Funes rarely anastomose. The spicules composing the funes very much projecting; hence funis very hirsute and places devoid of spicules considerably smaller than in *Acanthella*.	Basal stem for a long while undivided; higher up (almost always dichotomously) ramifying; each branch represents a funis. They only accidentally fuse (no true anastomosis); hence not forming a network.
Composed of a network of funiculy, forming one branched funis.	Composed of a network of funiculi, forming one branched funis.	Composed of a network of funiculi, forming one generally branched funis.
Each funiculus composed of a few (1—6) spicules, only partly imbedded in spongin.	Each funiculus composed of a few spicules. Kept together by still less spongin than in *Acanthella*.	Each funiculis composed of spongin in which a few (1—7) spicules wholly or nearly wholl imbedded.
About 20—100 μ in transverse diameter.	About 20—100 μ in transverse diameter.	About 150—300 μ in transverse diameter.
Formed by innumerable funiculi.	Formed by innumerable funiculi.	Formed by about 100 funiculi.
Formed by anastomosing funiculi. Not visible to the naked eye.	Formed by anastomosing funiculi. Not visible to the naked eye.	Formed by anastomosing funiculi. Not visible to the naked eye.
Absent.	Absent.	Funiculi of 1—3 spicules start at about right angles from the axis. Each funiculus terminating into a single long stylus, far projecting beyond the surface. At the bases of the projecting part a brush of small diverging styli surround the large one.
Styli.	Styli.	Styli and acanthostyli. Maximal size of large styli (projecting) 2500 μ and more; of those in brushes 500 μ.

addition to those which form the skeleton proper. Consequently it is necessary to compare skeletal preparations with ordinary sections, in which, however, a great part of the spicules are broken by the process of sectionising. It is evident that the skeletons prepared in the way mentioned above, first have to be studied in toto; but in the second place portions of it have to be mounted in balsam. If the spicules or some of the spicules are very large, it is difficult to get a fair idea of the maximal size as they easily break. In *Raspailia*, e. g. the greater part of the projecting styles turn out to be broken in mounted specimens.

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Explanation of the Plates.

(Spicules blue, spongin yellow.)

Plate 15.

(All the figures fifty times magnified.)

Fig. 1. *Axinella.* Longitudinal section through a part of the axis. Numerous funiculi (*f*) form a network, thus composing a funis.

Fig. 2. *Axinella.* Surface view, focussed at about the level of the dermis; *br* terminal brushes from the extra-axial skeleton; here and there, they are united by a few spicules.

Fig. 3. *Phakellia.* Surface view; on the left hand side focussed above the level of the dermis, at the right hand side somewhat under it in order to show the faintly visible funes in their relation to the brushes, the spicules of which are marked with blue circlets; *br* terminal brushes of extra-axial skeleton; *F* funes.

Fig. 4. *Phakellia.* Longitudinal section through a part of a funis, composed of several funiculi (*f*).

Fig. 5. *Raspailia.* Longitudinal section through a part of the axis. Numerous funiculi (*f*) form a network, thus composing a funis.

Fig. 6. *Acanthella.* Longitudinal section through a part of a funis, which is composed of numerous funiculi (*f*); spicules not entirely imbedded in spongin.

Fig. 7. *Acanthella.* Transverse section through a part of a funis.

Fig. 8. *Raspailia.* id.

Fig. 9. *Phakellia.* id.

Fig. 10. *Axinella.* id.

Plate 16.

Fig. 1. *Phacanthina.* Part of skeleton. 10 : 1.

Fig. 2. *Phacanthina.* Skeleton. Natural size. *o* Outline of the sponge.

Fig. 3. *Acanthella.* Part of the skeleton; *a* sponge-substance devoid of spicula; *o* outline of the sponge. 10 : 1.

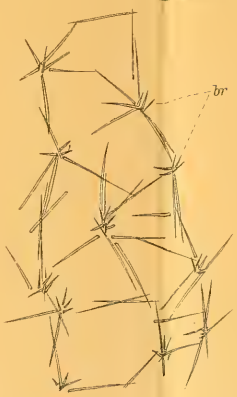
Fig. 4. *Acanthella.* Part of the skeleton. Natural size.

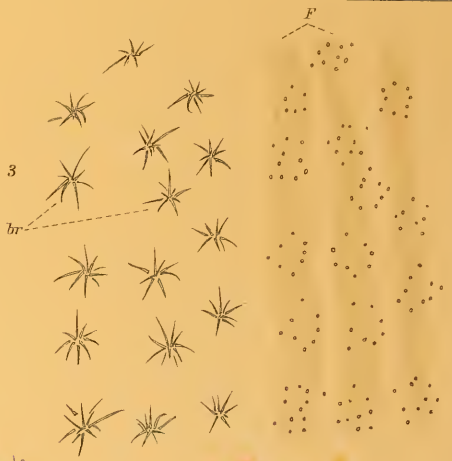
Fig. 5. *Axinella.* Longitudinal section through a part of the skeleton. In the centre is seen the axis, represented by a funis (*F*), which is is formed by a network of funiculi; *e. a* extra-axial part. 10 : 1.

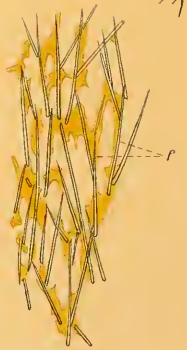
Fig. 6. *Axinella.* Portion of the axis (funis) of a flat specimen, seen from the flat side. The funis is composed of numerous funiculi, which form a network. 10 : 1.

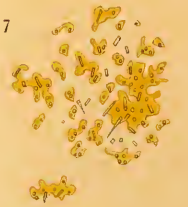
Fig. 7. *Phakellia.* Portion of the axis, seen from the flat side. It is composed of a network of funes (*F*). 10 : 1.

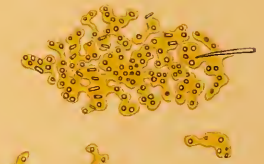
Fig. 8. *Phakellia.* Longitudinal section, at right angles to the flat surfaces, through a part of the skeleton. The centre is formed by the axis, of which only one or two funes (*F*) are cut; *e. a* extra-axial part. 10 : 1.











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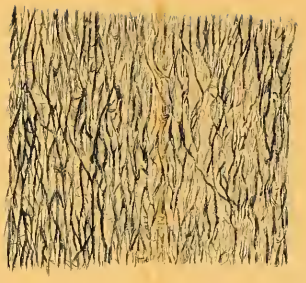
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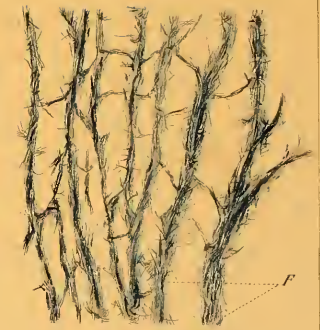
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