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XXIV.—*On the Structure and Arrangement of the Soft Parts in Euplectella aspergillum.* By Professor FRANZ EILHARD SCHULZE, Graz. Communicated by Sir WYVILLE THOMSON, V.P.R.S.E. (Plate XVII.)

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Although, from the careful descriptions which have been given by several competent naturalists, we may now consider ourselves tolerably well acquainted with the structure of the dainty siliceous skeletons of this and several allied Hexactinellid Sponges, this is by no means the case with their soft tissues; and the great cause of our imperfect knowledge of these interesting structures is that no observer has hitherto succeeded in procuring a really well-preserved Sponge of this group. It was with pleasure, therefore, that I accepted the offer of the Director of the Challenger Expedition to place some well-preserved examples belonging to different genera in my hands for investigation. Of all the specimens which have been sent to me, some fragments of *Euplectella aspergillum* in absolute alcohol are much the best preserved, and therefore the best suited for thorough examination. I commence with the description of the soft parts of this well-known and beautiful form, following the classification which has been adopted by Sir WYVILLE THOMSON in his descriptions of the species.

1. ON THE SOFT PARTS OF *Euplectella aspergillum* (R. OWEN).

I received in January 1880, from the Challenger Office in Edinburgh, an entire specimen of *Euplectella aspergillum* preserved with its soft parts in methylated spirit, and six bottles containing fragments of the same species preserved according to different methods, viz.:—

1. In picric acid.
2. In solution of acetate of potash, after previous treatment with osmic acid.
3. In chromic acid.
4. In glycerine, after previous treatment with nitrate of silver.
5. In absolute alcohol, after previous colouring with carmine.
6. In absolute alcohol simply.

I will commence with a short abstract of previous communications on the subject by other naturalists.

In 1868, after examination of dried fragments, Sir WYVILLE THOMSON characterised the soft parts of the Hexactinellidæ, which he supposed to be

simple sarcode, as follows: "It is small in quantity, very soft, probably semi-fluid, extending in a thin layer over the siliceous needles and over the siliceous framework. It appears to contain no trace of the diffused granular horny matter with which the more consistent sarcode of the Halichondridæ is so often loaded."*

On the other hand, BOWERBANK in the following year (1869) maintained, with reference, however, to certain sponges which he erroneously considered genuine Hexactinellidæ, that the soft mass in the Hexactinellidæ was in no less quantity than in other sponges, and that in *Hyalonema* the spicules are held together by a horny substance.† At the same time OSCAR SCHMIDT, after examining spirit specimens of different Hexactinellidæ, agreed with Sir WYVILLE THOMSON as to the consistency and quantity of the sarcode,‡ while on the other hand GRAY,§ in 1872, found two spirit specimens, brought by A. B. MEYER from the Philippines, "entirely covered by a thick coat of sarcode, like the bark on a *Gorgonia*, but softer, so that the siliceous fibres are entirely hidden from view. No one would suspect that this sponge had such a beautiful lace-like structure, but would suppose that it was simply a netted or pierced tube, with irregular, circular, thicker hoops. The flesh or sarcode is of a dark-brown colour, but is most likely coloured by the action of the spirit." More complete information was given in 1875 by MARSHALL,|| who had an opportunity of examining some pieces of a *Holtenia* and of *Euplectella aspergillum*, which were tolerably well preserved in spirit. He described the most of the soft parts as a clear, viscid substance, the sarcodine somewhat consistent only in the neighbourhood of the bundle of needles, and containing here and there some elliptical round nuclei, with nuclear corpuscles and numerous fine granules. The latter appeared sometimes isolated, sometimes united in rounded masses, and sometimes aggregated in the immediate neighbourhood of the nuclei. In *Euplectella* the sarcodine is of a greenish colour, but nowhere so transparent and hyaline as in many parts of *Holtenia*; in which, however, the sarcode is also rendered turbid by very fine rounded particles.

Since MARSHALL'S paper, I am aware of several short notices on the nature of the soft parts of Hexactinellidæ, and especially those of *Euplectella*, which Sir WYVILLE THOMSON has incidentally interwoven with his preliminary report of his great exploring journey, and of which the following are the most important: "In fresh specimens of *Euplectella aspergillum* the crystal framework is covered, and entirely masked by a layer of grey-brown gelatinous matter.¶

* Ann. and Mag. Nat. Hist., New Series, vol. i. p. 120.

† Proc. Zool. Soc., 1869, p. 344.

‡ Prodromus of a Sponge-fauna of the Atlantic region, 1870, p. 13.

§ Ann. and Mag. Nat. Hist., New Series, vol. x. p. 139.

|| Zeit. für Wiss. Zool., Band xxv. p. 142.

¶ The Atlantic, p. 136.

Of the specimens of *Euplectella* from the Challenger collection, preserved in so many different ways, those only which were simply preserved fresh in absolute alcohol proved suitable for the study of the soft parts. In the specimens which, with the adherent sarcode, had been preserved in methylated spirit, as well as in the fragments preserved in glycerine after previous treatment with nitrate of silver, the soft parts had certainly kept their form and arrangement, but they showed little of the detail of structure. In the specimens in picric acid, in the specimen preserved in chromic acid, and in that preserved in acetate of potash after previous treatment with osmic acid, the soft parts had almost entirely separated from the skeleton, and formed a sediment at the bottom of the vessel. In the pieces which had been dyed with carmine, and then preserved in absolute alcohol, the soft parts had become so friable as to break in pieces when touched.

The results of my investigations, which I now communicate, are therefore almost entirely obtained from the pieces preserved in absolute alcohol, and as these pieces were all taken from the side wall of the sponge, I was obliged, in order to study the remaining regions of the sponge, and especially the cribriform opercular plate, and the end portion which was buried in the mud, to use some of the pieces which were not so well preserved, and particularly the large one in methylated spirit.

On the portions which were free from mud and other impurities, the soft parts had a pale yellowish-grey colour, and were but scantily developed. They consisted of a substance of the consistency of crum of bread, extending between the meshes of the framework of siliceous threads and the adherent or free siliceous spicules, and the soft matter is traversed by so many passages and hollow spaces that it is nowhere compact, but forms rather a *delicate meshwork* of fibres or membranes. This soft substance is most abundant in the tube-shaped wall which forms the principal part of the sponge, in the flat thinner portion of the tube as well as in the ridges which project from its outer surface, and to which the collar-like border of the terminal cribriform plate also belongs.

We see in a well-preserved piece of the tube-wall that the circular apertures in the skeleton, which are arranged at pretty equal distances in oblique or rather in spiral rows crossing one another, and which mark the angles of rhomboidal fields of nearly equal size, correspond also to circular apertures about 2 mm. in diameter through the entire wall of the tube, by means of which the water surrounding the sponge communicates directly with that contained in its inner cavity.

The margin of these circular wall-openings (as I shall henceforth call them) consists of a rather thin ring of membrane, which lies considerably nearer the inner than the outer surface of the wall which is nearly 3 mm. thick; so that

each opening corresponds with a dimple-like depression on the external surface of the sponge. Between each four apertures which bound each rhomboidal field, a more or less rounded knob projects, which is separated from the nearest similar projection by shallow groove-like depressions, which correspond with the oblique connecting grooves of the wall-apertures (Pl. XVII. fig. 1). In many places, however, the bosses arranged in oblique series are fused together into more or less prominent ridges, sharp along the top and with tolerably steep walls,—the so-called “combs,”—whose form and arrangement is so well seen in the macerated skeleton.

I must, however, draw attention to the fact that the whole external surface of the tube, which shows a rather complicated relief, possesses no openings visible to the naked eye except these wall-apertures, but is covered by a continuous connecting membrane. Every small irregular roundish darker mark which we notice in strong light corresponds to a subdermal hollow space which shines through this thin membrane (Pl. XVII. fig. 1). The inner surface of the tube-wall does not appear so uneven. Between transverse annular beams of spicules, which project only slightly towards the interior, there are flat groove-like depressions, which divide the still less prominent longitudinal beams of the siliceous network into square *areae* of nearly equal size. The *areae* thus separated by bounding ledges of different heights show, alternating tolerably regularly, either regular gaps perforating the tube, or less regular roundish excretory openings of *cæcal* spaces in the wall of the sponge (Pl. XVII. fig. 2). Here and there deviations from the regular alternation of the two kinds of *areae* appear in the longitudinal and transverse rows, but these are only isolated, and occur usually where one of the longitudinally directed bands of siliceous fibres divides towards the broader upper end of the tubes, leading to the formation of a new longitudinal row of *areae*, by which the symmetry of the structure is somewhat disturbed; whilst the *areae*, furnished with wall-openings, only show round the iris-like margin of these central openings a simple circle of small roundish excretory pores, of short water-ducts; the *areae* alternating with these show a somewhat important differentiation, as they sometimes contain only one or two, rarely three, large round openings of well-marked exhalent canals, sometimes a larger number of smaller openings of shorter wall-canals. We find that the *areae* with the larger ducts always lie under a *comb*, whilst those furnished with numerous smaller openings correspond to the boss-like projections which are found where there is no comb. We find accordingly the *areae* with the large openings arrayed in oblique rows, which correspond with the combs (Pl. XVII. fig. 2).

The soft parts are feebly developed on the cribriform plate, more or less arched, and with large irregular meshes, which closes the upper end of the tube. At most the layer of soft matter is developed comparatively thickly here and

there externally, while the side and inner surfaces of the siliceous beams, which are here particularly strong and thick, are only covered by a thin membrane. At the lower extremity of the sponge the soft parts end with the netting of the tube-wall. The terminal tuft of long siliceous hairs, which serve to anchor the sponge in the ooze, show no appreciable soft parts.

As in other sponges, we can only obtain a clear idea of the structure of the soft parts, and of their relation to the skeleton in *Euplectella*, by the preparation and careful study of thin sections.

Tinging with different dye-matters is of essential service for defining the differentiation of tissues and their peculiar cell-elements.

To make preparations which answer both purposes I proceeded as follows:—

Pieces from the size of a pea to that of a bean were cut with fine scissors from the fragments which had been preserved in absolute alcohol, and freed from the excess of alcohol by being laid on blotting paper for a little. They were then tinged, some with picro-carmin, some with aloin-carmin, and others with hematoxylin, for which, as a rule, from six to twenty-four hours was necessary. After the pieces so dyed had been well washed in distilled water, they were laid in alcohol of 52°, then in alcohol of 60°, and by gradual concentration were finally brought to absolute alcohol. Out of this they were put next day in a mixture of absolute alcohol and xylol, and finally in oil of turpentine. Completely drained in this way, they were embedded in paraffin, and divided by Leyser's microtome in different directions into fine sections, which, after the paraffin has been removed by warm oil of turpentine, were preserved in Canada balsam.

A good general view of the arrangement of the soft parts is most easily got by a fine section of the tube-wall, taken transversely through a *comb* at a point where the inner surface of the wall shows a quadrate area with a large canal opening. I have figured such a section (Pl. XVII. fig. 3) in a combination figure, *i.e.*, in a drawing as like nature as possible, made up from several preparations, fifteen times the natural size. We observe, in the first place, that the whole external surface is covered by a delicate membrane, which extends between the outer points of the radiating rapier-like six-rayed spines and the floricome-hexradiate spicules of BOWERBANK* which always lie close to the rapier hilt, in such a fashion that it always appears more or less depressed in the middle between each group of the four rapier hilts and floricomes which mark the four corners of a quadrate area. This membrane, which may be simply called the skin, when seen from above (Pl. XVII. fig. 5), is pierced like a sieve with numerous round or oval holes of different sizes. These dermal pores are only wanting

* For shortness I will call the dainty six-rayed stars, composed of six eight-membered structures like the cup of a flower, "floricomes."

where the skin is stretched above between the sword hilts and the floricoles. The width of the dermal pores corresponds generally with the stricture of the dermal septa which surround them, and it appears, as in other sponges, to alter frequently in life.

The water first passes through the dermal pores into subdermal spaces, which are here represented by a wide-meshed lacunar network between the external skin and a fenestrated layer of tissue extending in the plane of the lateral cross-rays of the radiating rapier-like spines.

In his "Untersuchung über Hexactinelliden," MARSHALL described and figured (fig. 62) as *skin* a membrane which extends between the lateral cross-rays of the rapier-shaped spines in such a way that one quadrate area limited by these cross-rays contains a single round hole, which may be called a dermal pore. Though I am willing to believe that in young individuals the outer layer may, under certain circumstances, contain only such distant and isolated pores, certainly in fully developed animals the outer film does not extend between the cross-rays of the rapier hilt, but, as above described, further out between the ends of the rapier hilts and the floricoles appended to them. What really stretches between the cross-rays of the rapier hilts is not so much a true membrane as a very wide-meshed network of delicate threads, from which similar bands or cords of tissue proceed not only towards the exterior to be connected with the true outer membrane, but also mid-cords in the form of an open, very irregular meshwork. They traverse wide lacunar spaces, extending from the cross-rays of the rapiers between their long processes, which correspond with the sword-blade, and here and there, by extension to deep fissures and passages, at length acquire the significance of water canals. In fact the periphery of this very irregular system of lacunæ and canals becomes towards the interior a complete system of flagellate chambers (ampullaceous sacs, CARTER), which I now proceed to describe.

Each individual chamber has the form of a sac more or less deep, nearly circular in transverse section, with the blind end semicircularly arched, and the almost circular opening placed transversely to the long axis of the sac. The length is on an average about 100 μ ., but may vary between 60 μ . to 150 μ .. The breadth is usually about 60 μ ., varying, however, between 40 to 80 μ .. Besides accidental flaws, which are frequently caused by the hardening and further treatment of the preparation, there are often actual variations in form. I will only draw attention here to one of these, which occurs so repeatedly that it can hardly be regarded as a mere abnormality. There are sometimes chambers which are bisected at the bottom by a larger or smaller constriction, while the remaining portion and the aperture remain single. I leave it an open question whether or not in such cases we have to deal with an actual process of division.

The membranous wall, which is usually very delicate and thin, is furnished with smooth-edged roundish *pores* of different sizes, irregularly arranged, and varying very much in number. These form an open communication between the cavities of the chambers and the duct-like spaces surrounding them, which as cleft-like diverticula of the inhalent lacunar system, penetrate everywhere between the ciliated chambers, and extend even to the oral edges of the chambers, where they end in a somewhat tough and solid membrane, which bounds and connects laterally the chamber walls (Pl. XVII. fig. 4). Besides this membrane there extends beyond the oral edges of the neighbouring chambers, which here and there touch one another and partly adhere, numerous flat or linear cords of tissue proceeding from the chamber walls, traversing the surrounding spaces, and serving to keep the chambers expanded and in position.

The general arrangement of the chambers is best understood by the disposition of the exhalent canal system, as they almost all run into it. These exhalent passages begin with digitate cæca of 100 to 200 μ . in transverse sections, which open terminally or laterally into wide canals. These latter open either directly by a round aperture through the inner wall of the sponge-tube, or are again united into still larger canals, which open with a circular aperture about 3 mm. wide into the large cavity of the sponge.

It is to be observed that in the whole inner surface of this exhalent canal system there stretches a network consisting of flat or thread-shaped bands of tissue, in which, besides the long five- or six-rayed spicules, numerous free starlets appear, which BOWERBANK called "trifurcate hexradiate stellate spicules," and which, although in lesser number, are also found in the cords of tissue which traverse the inhalent lacunar system. I may here incidentally remark that the number of pointed secondary rays proceeding from each of the six principal rays of these stars need not necessarily be three, but may be four, or even five, but the number is always the same at all the six points of one and the same star.

The inner surface of the large excretory canals coming out from the ridges is formed of an extended, almost membranous, network, which stretches between the terminal crosses of the long-stalked five-rayed spicules, which are numerous here, and surround the quadrate meshes.

The structure of each portion of the tube-wall, which projects externally between the ridges in the form of flattened bosses, corresponds essentially to this structure of the ridges. As a difference it may, however, be noted that the exhalent canals, which are here naturally much shorter, are not united into one or two larger principal excretory openings, but open directly into a large number of pores close to one another in a quadrate area in the inner side of

the sponge-tube: this is the cause of the groups already mentioned of smaller roundish excretory openings under each external boss, and which may be easily distinguished even by the naked eye from the large pores in the area under the ridge.

The portions of the sponge-tube surrounding the wall-openings in the form of a flat circular margin differ essentially from the thicker parts, as they have no ciliated chambers, and are not traversed by a lacunar system. MARSHALL had already conjectured that the wall-openings may act like a sphincter by means of a membranous margin supported by a circle of siliceous spicules, and that in this way the openings may vary in size. These wall-spaces cannot, however, be compared with the oscula of other sponges, as the latter always serve as the exhalent openings for the water canal system. The cribriform operculum at the upper end of the sponge may be rather considered as representing an oscular region, whilst the round wall-openings in *Euplectella* probably only serve for the free lateral entrance or exit of the surrounding water.

The idea expressed by CLAUS* that the *Euplectella* as a whole may be compared to a tube-shaped *sycon*, in which the separate boss-shaped projecting thickenings of the wall, as well as their corresponding ridges, may be considered as homologous to the radial tubes; the circular wall-openings to the intercanals, and finally the upper cribriform opercular plate to the wider oscular opening of the *sycon*, is therefore inadmissible, as we can only possibly compare the single sac-shaped ciliated chambers of *Euplectella* to the single radial tube of a *sycon*, and not an entire system of such chambers with branched excretory passages such as we have in each projecting knob or ridge. MARSHALL had already observed this, and, with more special reference to the relations of the spaces in the tube-wall of *Euplectella*, had attempted a more justifiable comparison with a *Leuconpersona*.

The whole structure of the cribriform opercular plate indicates that it is an oscular region serving as the last passage of exit for the discharged water, since the inner and side surfaces of the small lattice-beams are quite flattened, as if worn away by the ejected water, while the outer surface only is furnished with a small quantity of soft substance containing ciliated chambers, and is covered by the same skin which we find on the ridges and bosses of the tube-wall.

After this explanation of the general arrangement of the soft parts of *Euplectella aspergillum*, I will now consider its histological structure more in detail.

Here, as in all sponges which I have closely examined hitherto, we can

* Ueber *Euplectella aspergillum*, 1868.

distinguish three different layers of tissue corresponding to the layers of the germ.

The whole free external surface of *Euplectella*, as well as the inner wall and the hollow spaces and canals which conduct the water from the external pores to the ciliated chambers, are covered by an epithelium composed of a single layer of thin flat cells, which, from the developmental observations which I have recently made upon *Plakina*,* I regard as proceeding in this, as in other sponges, from the ectoderm of the larva, and I shall therefore simply call it *ectoderm*.

A like simple layer of epithelium which lines the ciliated chambers themselves, as well as the whole exhalent canal system extending from the mouths of the ciliated chambers to the oscular openings, I call *endoderm* for the same reason. Finally, I consider as *mesoderm* the whole mass of connective tissue between these two layers, which represents the stroma of the skeleton and of the genital products.

The Ectoderm.—In most sponges we can only succeed under specially favourable circumstances in detecting in the living animals the limits of the ectodermal cells, though it is easy to observe them by the use of nitrate of silver. I never succeeded in showing the limits of the cells in spirit specimens, and consequently I could not expect to see them in this case, since they can be brought into view by no known process. Of course, it by no means follows that the layer of ectoderm cells is wanting. On the other hand, I find their presence indicated, if not by the outlines of the cells, by the characteristic cell-nuclei, which, like the nuclei of the ectoderm cells of other sponges, are distinguished by their circular form, by their fine refractive nuclear corpuscles, and here especially by their minuteness compared with the oval, paler, and larger cells of the underlying connective tissue (Pl. XVII. fig. 5).

Besides, the situation of these small round nuclei, in the uppermost layer, directly washed by the water, their partial projection when seen in profile, and their tolerably regular distribution, are in support of the view of the existence of such a layer of ectoderm cells.

The Endoderm.—That part of the epithelial layer termed *endoderm*, which lines the exhalent vessels from the openings of the ciliated chambers to the oscular openings of the cribriform operculum, here, as in all other sponges, closely resembles the flat ectodermal epithelium, whilst that portion of the endoderm which lines the ciliated chambers is of an entirely different character.

Although even the excellent state of preservation of the materials at my

* Zeit. für Wiss. Zool., Band xxxiv.

disposal was not sufficient to allow me to gain a clear idea of the nature of the epithelium of the ciliated chambers, I was able to observe the following facts. I could perceive all the cells in the form of aggregated roundish lumps, in the centre of which a small spherical nucleus, furnished with a smaller strongly refractive nuclear corpuscle (like that which appears in the collar-cells of other sponges), was sharply defined by means of a tinging medium (Pl. XVII. figs. 6 and 7). If, therefore, nothing was to be observed in my preparations of the cylindrical form of the cells, of the peculiar collar-like process, of the collar, or of the flagellum which appears in the collar-cells of other sponges, it by no means follows that they are wanting in the living animal. The fact that in this case the cells of the ciliated chambers do not touch each other immediately laterally, but lie apart at nearly equal distances, did not surprise me, as I had occasionally found the same in other sponges—for example, in *Spongelia*—in pieces which had not been quite sufficiently hardened for examination. On the other hand, the peculiar arrangement and lateral connection of the cells with each other seemed to me highly remarkable.

Even under a comparatively low magnifying power we can see a reticulate arrangement in the ciliated chambers, which has never yet been described in any other sponge. The cells, which are arranged in spiral or oblique rows, and lie somewhat apart, are connected in such a way by tolerably strong refractive straight cords, that rhomboidal quadrangle meshes are formed which are usually of nearly equal size, and only here and there become varied in form and arrangement by the pores of the chambers. While usually four such lateral connecting cords, forming a straight or oblique cross, proceed to the adjacent cells, there are not rarely five or six such processes. I could not find any complete explanation of the nature of these connecting cords and their relation to the cells; but I believe we must consider them as connecting bridges between the viscid cell bodies.

The Mesoderm.—In contrast to most other siliceous sponges, the scanty gelatinous connective tissue of the mesoderm has a semi-fluid colourless fundamental basis, hyaline in itself, but rendered turbid by numerous irregularly scattered fine darker particles. The sort of difference which we have in many horny and siliceous sponges, between the equally dark granuled boundary of the ciliated chambers and the rest of the hyaline masses of connective tissue, is not to be observed here. Besides the small round nuclei of the outer epithelium, more faintly defined and usually oval-shaped nuclei, at whose narrow end we often find a still smaller nuclear mass, may be observed in the cribriform layer, as well as in the flat plates and cords of the remaining soft parts. I have, therefore, less hesitation in referring these pale oblong nuclei to

the cells of the connective substance, as they are tolerably equally distributed in the fundamental basis, and, in conjunction with their scanty protoplasmic areae, resemble the cells of connective tissue in other sponges. Besides these ordinary corpuscles of the connective tissue, I met with roundish balls of strongly refractive spherules, plentiful in some places, scanty in others (Pl. XVII. fig. 8), like those described by MARSHALL in the soft parts of different Hexactinellidæ, and especially of *Euplectella aspergillum*.* I consider these granular balls, which certainly belong to distinct cells, as accumulations of reserve nutrition, somewhat comparable in a physiological sense to fat or starch.

The Genital Products.—I found numerous sperm balls of about 50 μ . in diameter in the meshes of the connective tissue, between the meshes of the ciliated chambers (Pl. XVII., fig. 6). The fine thread-shaped appendages were certainly no longer recognisable on the small sharply-defined, tolerably refractive roundish spermatozoa, which were aggregated in clusters in an enclosed space; but I have no doubt as to their signification, as they coloured deeply with carmine or logwood, like the moving sperm masses of the sponges.

Like most sponges, *Euplectella aspergillum* is inhabited by different commensals. While some of these, such as the much talked of crabs of the genera *Palæmon* and *Æga*, live enclosed like prisoners in the large cavity of the sponge, and others among the long spicules of the beard, another group are found in the soft parts of the tube-wall. From these last I here select for description a microscopic hydroid polyp, which appeared so abundantly in the *Euplectella* from Zebu, preserved in absolute alcohol, that one or more hydranths are found in almost every microscopic section of the tube-wall.

It belongs to the group of gymnoblastic hydroids of ALLMAN. The simple tube-like cœnosarc of the hydrophyton, which traverses the soft parts of the sponge in the form of a long-meshed net, is attached by isolated pointed ectoderm processes to the inner surface of a delicate annulated perisarc tube. From this cœnosarc tube, which is only about 20 μ . wide, more definitely at right angles than the branches forming the network of the tube, there spring simple club-shaped hydranths, which project without hydrothecæ freely into the inhalent lacunæ, and therefore towards the exterior, from the zones of ciliated chambers.

Each hydranth has, close beneath the short hemispherical hypostoma, with its terminal oral opening, only two opposite annulated comparatively long solid tentacles with a terminal knob richly loaded with sting-capsules, and rather

* Zeitschrift für Wissen. Zool., Band xxv. p. 159, and Pl. xiii. fig. 6 Pl. xv. fig. 60.

below this a semicircular internal transverse enlargement, with a like thickening also with numerous sting-capsules. The remaining portions of the arm are quite flat.

The thread-cells, which, besides appearing in the ectodermal thickening of the arms, are also found, though isolated and not yet in a vertical position, in the endodermal layer of the cœnosarc, resemble in shape the broad sting-capsules of *Hydra*, although they do not attain to so great a size.

The endoderm of the cœnosarc contains flat cells, but in the hydranth bodies it consists of tall clear ciliated cells. As direct processes of the endoderm layer, a single row of columns, formed of clear cells, stretch to the terminal knobs of the arms.

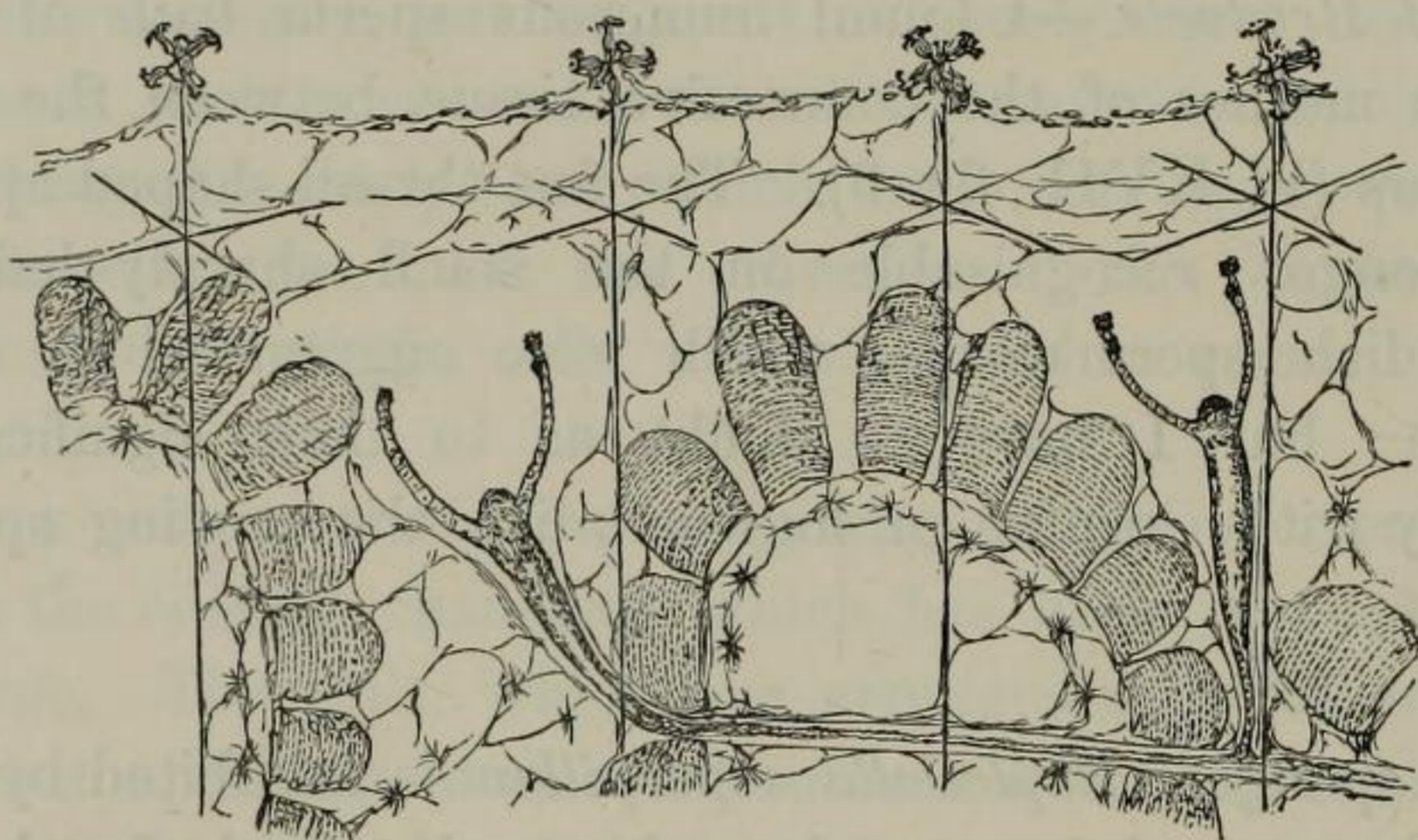


Fig. 1. *Amphibrachium euplectellæ* (Schulze).

The Hydroid *in situ*, infesting the soft tissues of *Euplectella*. × 60.

A simple layer of very delicate, hyaline, supporting lamellæ, are found in the outer surface of the arms, as well as in the body of the hydranth.

Reproductive buds could unfortunately not be observed.

On account of the number and situation of the arms, I call this commensal of *Euplectella aspergillum*, given sixty times the natural size in the above wood-cut, *Amphibrachium euplectellæ*.

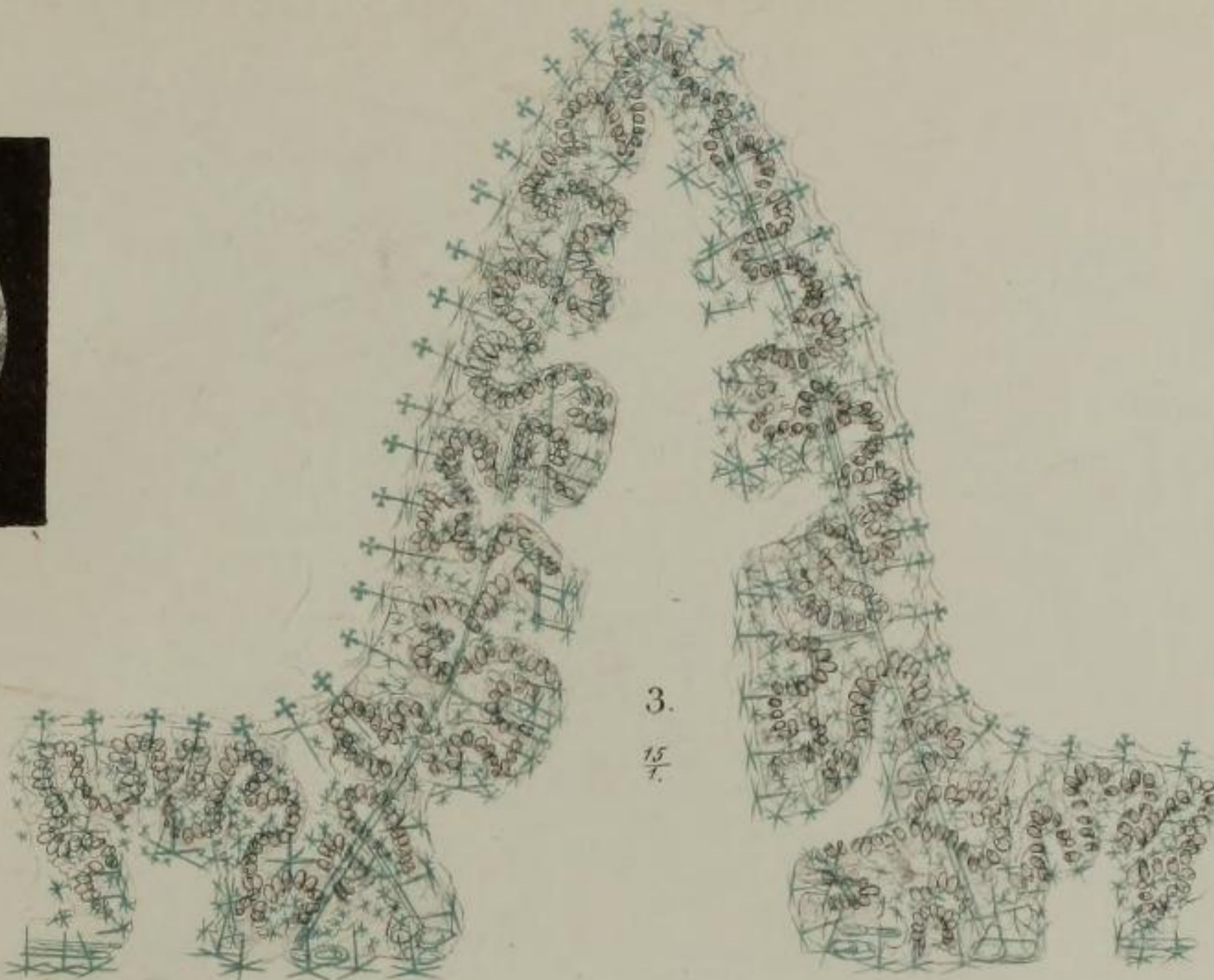
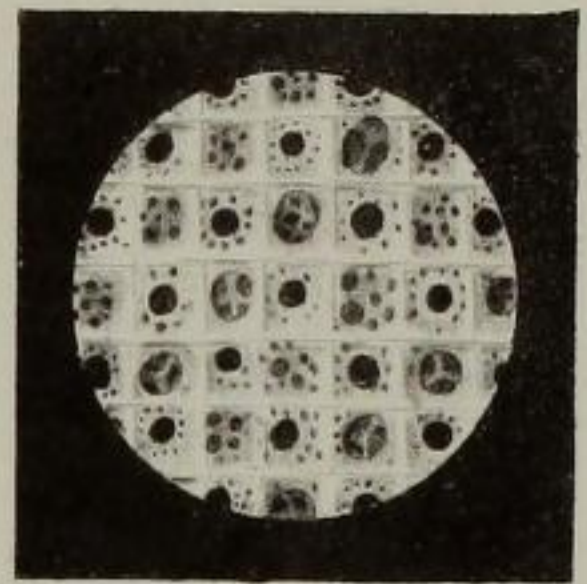
EXPLANATION OF PLATE XVII.

- Fig. 1. Part of the outer surface of the tube-wall of *Euplectella aspergillum*, from the Zebu specimen preserved in absolute alcohol. Natural size.
- Fig. 2. Part of the inner surface of the tube-wall of the same sponge. Natural size.
- Fig. 3. Transverse section of a ridge, with part of the tube-wall of the same sponge. The section corresponds to one of the larger efferent openings of the exhalent canal system. $\times 16$. A combination figure.
- Fig. 4. Outer portion of a thin section taken perpendicularly to the outer surface through the side wall of a ridge. $\times 150$.
- Fig. 5. External view of a small piece of the outer membrane from the side wall of a ridge. $\times 400$.
- Fig. 6. Transverse section of a layer of ciliated chambers with a sperm-sphere. $\times 400$.
- Fig. 7. Part of the wall of a ciliated chamber. $\times 600$.
- Fig. 8. A small portion of the network of the exhalent lacunar system of a ridge. $\times 600$.

1.



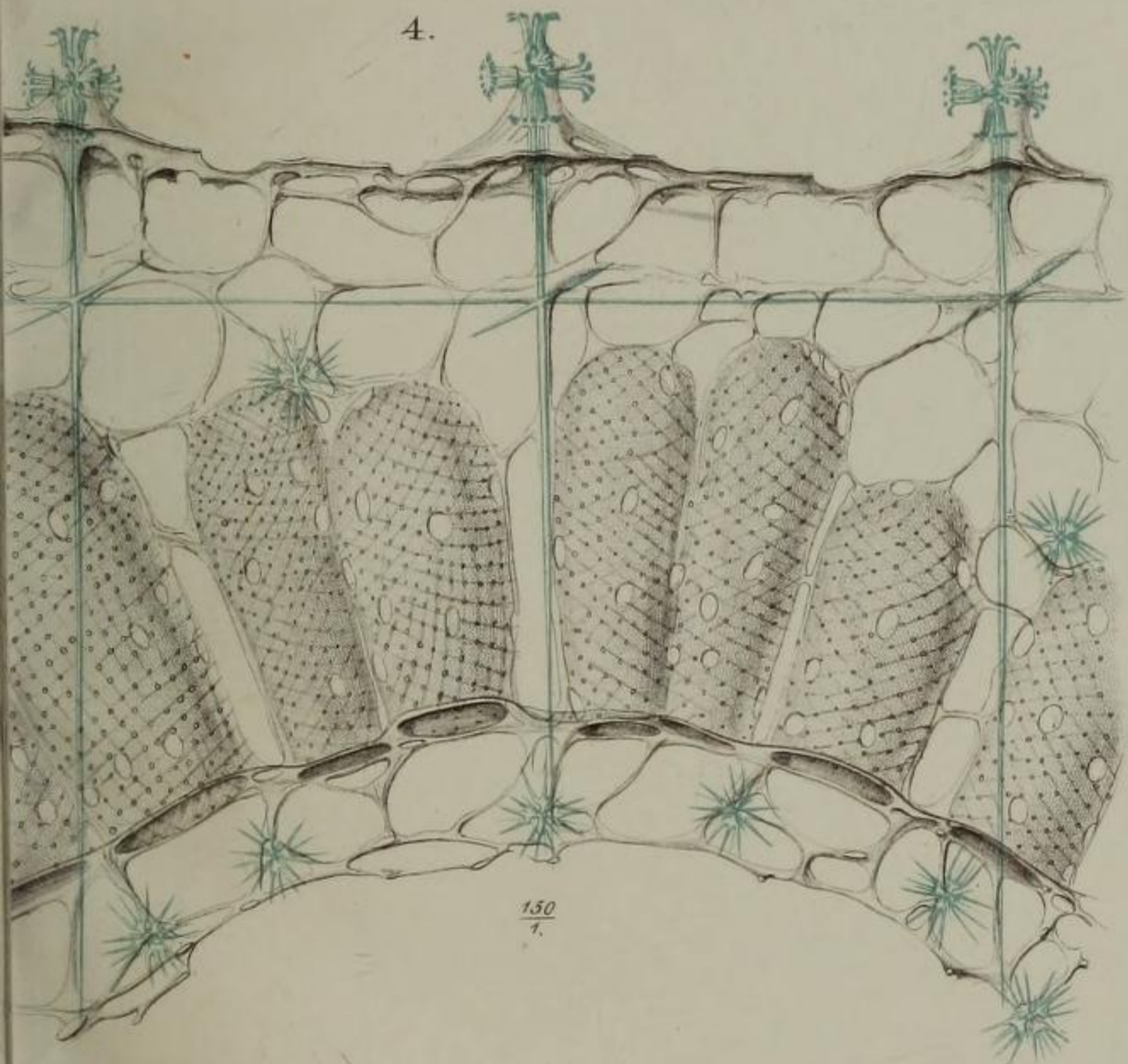
2.



3.

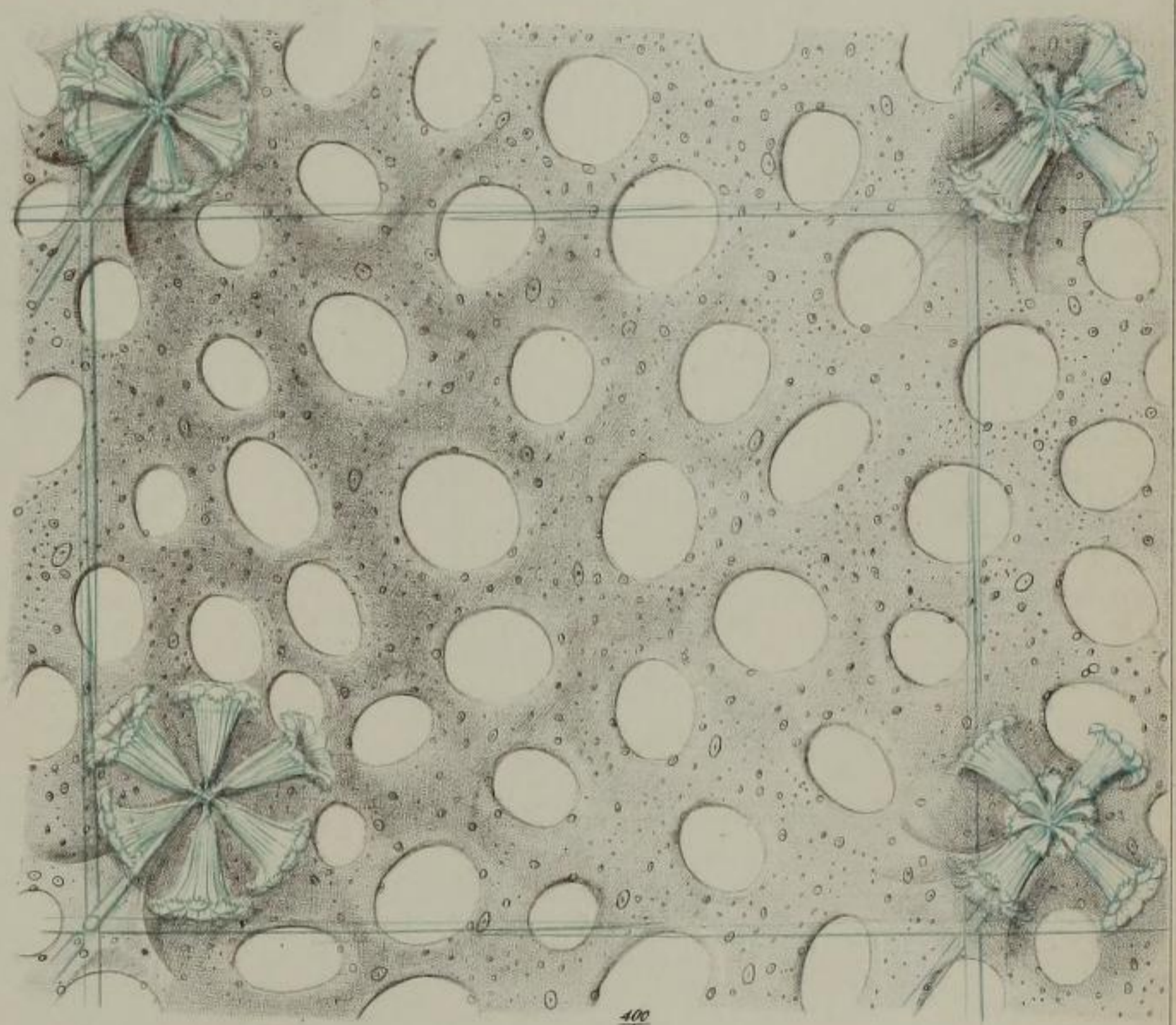
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7.

4.



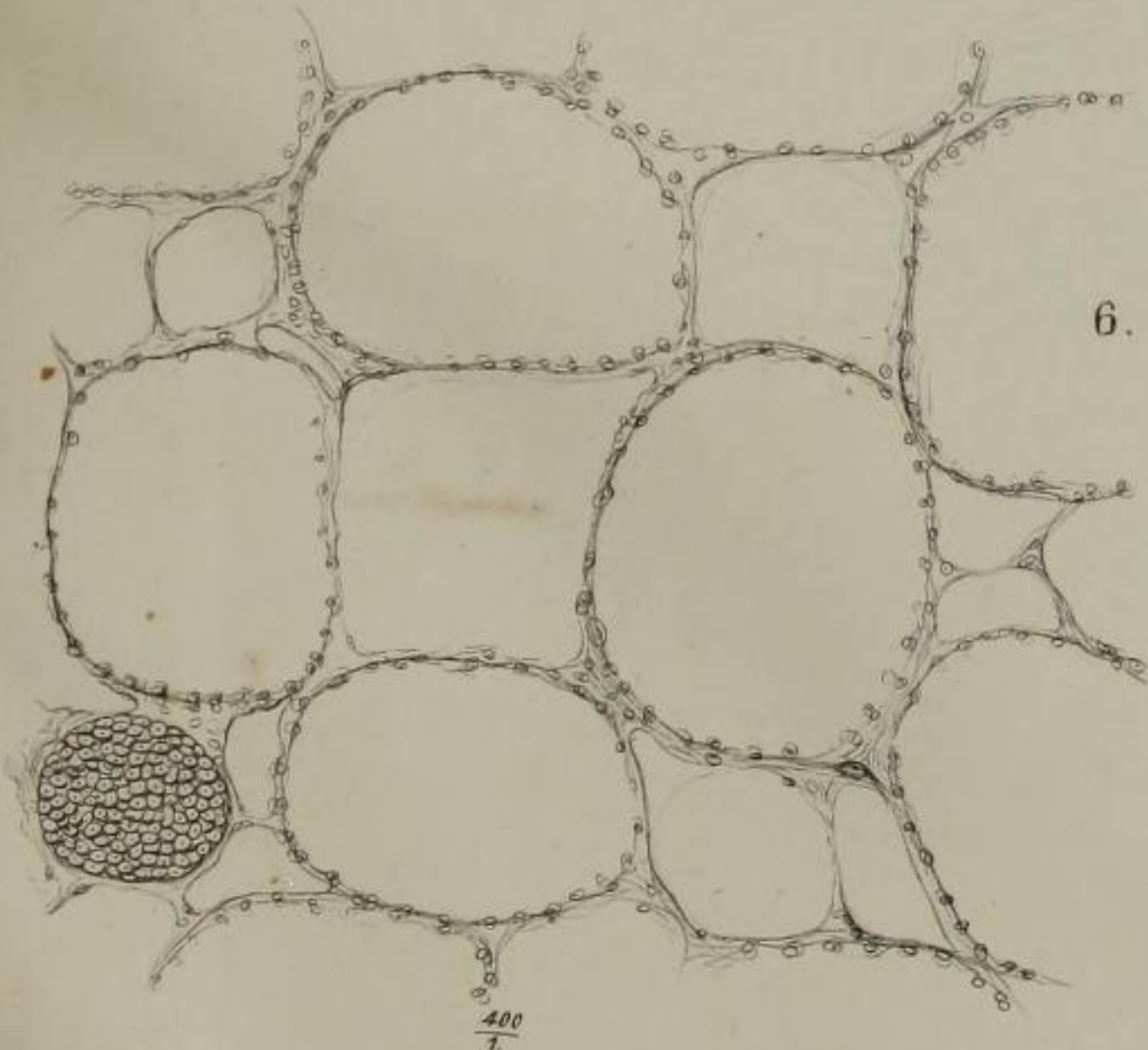
150
7.

5.



400
7.

6.



400
7.

7.



600
7.

8.

