XXVII. *On* Holtenia, *a Genus of Vitreous Sponges.* *By* Wyville Thomson, *LL.D., F.R.S., Professor of Natural Science in Queen's College, Belfast.*

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During the deep-sea dredging cruise of Her Majesty's Ship 'Lightning' in the autumn of the year 1868, the 6th of September was occupied in dredging at the depth of 530 fathoms in latitude 59° 36′ N., and longitude 7° 20′ W., only about 20 miles beyond the 100-fathom line of the Coast Survey of Scotland, slightly to the westward of north of the Butt of the Lews. The minimum temperature indicated by the mean of three thermometers (which registered 47°, 47°·5, and 47°·5 Fahr. respectively) was 47°·3 Fahr., the surface-temperature being 52°·5 Fahr.

During the day there were four successful hauls of the dredge, which came up each time full of a pale-grey tenacious mud, consisting in a great measure of minute amorphous particles of carbonate of lime mixed with "coccoliths" and "coccospheres." There was only a small proportion of the *Globigerinæ* and other minute Rhizopods which are so abundant and characteristic over the whole of the warm or "Gulf-stream" area of the North Atlantic. The mud was glairy, as if it had been mixed with white of egg; and it contained disseminated through it an immense quantity of extremely delicate siliceous organisms, spicules of sponges, and the shells of Radiolarians and Diatoms. Large Rhizopods of the genera *Astrorhiza*, *Rhabdammina*, *Cristellaria*, *Cornuspira*, and others were abundant; and there was a somewhat scanty sprinkling of small forms belonging to the higher groups, Echinoderms, Annulosa, and Mollusca. Besides a number of dead shells, chiefly of the Boreal or Scandinavian type, and several undescribed Echinoderms and Crustaceans, the following species were procured living.

Echinodermata.

†*Rhizocrinus Loffotensis*, Sars.
Amphiura filiformis, Müller.
Amphiura tenuispina, Ljungman.
Amphiura Ballii, Thompson.
†*Amphiura Abyssicola*, Sars.
†*Ophiacantha spinulosa*, Müller and Troschel.
†*Echinocucumis typica*, Sars.
†*Thyone alticola*, Norman, MSS.

Crustacea.

Phoxus plumosus, Kröyer.
Ampelisca æquicornis, Lilljeborg.
†*Œdiceros spinicornis*, Norman, MSS.
Haploops tubicola, Lilljeborg.
†*Diastylis* (sp.).
Pagurus pubescens, Kröyer.
Galathea dispersa, Bate.

MOLLUSCA.

Terebratula cranium, Müll.	*Astarte compressa*, Montfort.
Crania anomala, Müll.	*Venus casina*, L.
Arca nodulosa, Müll.	*Mactra solida*, L.
Pecten vitreus, Chemnitz.	*Neæra costellata*, Deshayes.
Lucina borealis, L.	*Columbella Haliæti*, Jeffreys*.

The species marked with a dagger are new to the British area. The assemblage of higher forms presents generally the character of the abyssal fauna of the Boreal region. Two specimens were procured of the specially interesting *Rhizocrinus Loffotensis*, Sars, a small Crinoid belonging to the family APIOCRINIDÆ, and nearly allied to the fossil *Bourgueticrinus* of the Chalk. *Rhizocrinus* was discovered in the year 1864 by M. G. O. SARS, in 300 fathoms water, at the Loffoten Islands within the Arctic Circle†, and has since been dredged by M. DE POURTALES on the opposite edge of the Gulf-stream, off the coast of Florida‡.

Besides tangled masses of long spicules and fragments of siliceous sponges, we procured during the day about fifty specimens of sponges more or less complete. These were referable to four genera, one of which was the genus *Hyalonema*, Gray, of which we got two species closely resembling the singular glass-rope sponges of Japan and the coast of Portugal; and the remaining three genera were new to science.

One of these new genera is the subject of the present Memoir.

HOLTENIA § (new genus).

H. CARPENTERI ‖ (new species). Plates LXVII. to LXXI.

Provisional characters and general description.—The body of the sponge is globular, elliptical,or subcylindrical. The length of apparently mature examples is from ¶ 90 to 110^{mm}, and the extreme width from 70 to 90. The outer wall is formed of a framework of large separate siliceous spicules, whose rays are so arranged as to give the whole surface a stellate appearance. The external surface is invested with a delicate network of sarcode-threads which define inhalent pores. At the top of the sponge there is one

* The above list of Echinoderms and Crustacea is on the authority of the Rev. ALFRED MERLE NORMAN, and of Mollusca on that of J. GWYN JEFFREYS, F.R.S. The complete lists are in preparation, and will be published hereafter.

† Mémoires pour servir à la connaissance des Crinoïdes Vivants, par MICHAEL SARS, Christiania, 1868.

‡ "Contributions to the Fauna of the Gulf-stream at Great Depths, by L. F. DE POURTALES,"Bulletin of the Museum of Comparative Zoology, at Harvard College, Cambridge, Mass., No. 7, 1868.

§ I have much pleasure in naming this genus in compliment to His Excellency M. HOLTEN, the accomplished Governor of the Faroe Islands, who showed the most intelligent interest in the success of our researches, and to whom we were indebted for the most friendly hospitality.

‖ As this is the most striking of the new forms which have hitherto rewarded our labours in the deep sea, I dedicate it to my distinguished colleague Dr. W. B. CARPENTER, V.P.R.S.

¶ The metrical system of measurement is employed throughout.

large oscular opening about 30^{mm} in diameter, whence a cylindrical cavity passes vertically into the substance of the sponge to a depth of 55. This oscular cavity is cupped beneath, and lined by a network with the same general character as the external network of the sponge. The osculum is fringed by a close range of siliceous spicules placed vertically. The sponge-body between the oscular and external walls is composed of a loose spongy mass of consistent sarcode containing a multitude of minute brownish or greyish granules which make it semiopaque, supported by an irregular framework of stellate siliceous spicules, and containing numerous minute feathered spicules and amphidisci. Close beneath the outer wall the sponge-substance is hollowed into wide anastomosing sinuses, which surround and separate perpendicular spongy columns which support the external stellate wall. From the surface of the upper third of the sponge, bunches of rigid spicules project outwards and upwards from the substance of the sponge through the outer wall; and from the surface of the lower third of the sponge, bundles of enormously long siliceous threads, coated with glairy sarcode, pass out to be diffused to a great distance through the chalk-mud, in which the sponge is buried nearly to the lip.

Four specimens only of this species have as yet been found, at a depth of 530 fathoms in lat. 59° 36′ N., long. 7° 20′ W. One of these, figured in Plate LXVII. of the present Memoir, has the body about a decimeter in length by 8 centimeters in width ; the outline is elliptical. A second specimen, figured in section, Plate LXIX. fig. 1, is nearly spherical, about 9 centimeters in diameter ; a third, in the British Museum, is more cylindrical in form, about a decimeter in length by 7 centimeters in width; and the fourth, in the possession of Dr. CARPENTER, is rather smaller and nearly globular. These four specimens were all procured at one haul of the dredge. They were brought up alive, and with higher organisms, clams and starfishes, also living, attached to them. Unfortunately, from the state of the weather, we were unable to observe them in a living state; we were obliged to put them at once into spirit.

The Structure of the Sponge.

The siliceous spicules.—The spicules which enter into the composition of the sponge may be conveniently divided into three groups, the spicules of the sponge-body, the spicules of the beard, and the spicules of the sarcode.

1. *The Spicules of the Sponge-body.*—The spicule which enters almost exclusively into the structure of the framework of the sponge-body, forming the stellate trellis of the outer wall and of the wall of the inner exhalent cavity, and supporting and defining the trabeculæ of the areolated sponge-substance, is formed on the hexradiate-stellate type; usually, however, only five rays are developed, so that the spicule is quinqueradiate. There are two well-marked sizes of this spicule. The larger form by the symmetrical distribution of their rays, the siliceous framework of the large stars of the outer and inner walls; while the smaller, which are altogether much more delicate in their proportions, support the small secondary stars of the walls, and the meshes of the sponge-substance.

The large spicules of the walls are quinqueradiate (Plate LXVIII. figs. 1, 2, Plate LXIX. figs. 2, 4, 5). Four of the rays, which represent the four secondary rays of a hexradiate spicule, spread nearly on a plane. They spread, however, irregularly, each branch curving independently to suit the plan of structure and the pattern of the particular portion of the network in which it is developed. This irregularity is sometimes extreme, two of the branches in some cases running nearly parallel with one another, while the other two diverge widely; and sometimes all the four branches curve round and run nearly in one direction; more usually, however, they form a more or less regular cross at their origin (Plate LXIX. figs. 2–4). The fifth ray, which represents one half of the primary shaft of a hexradiate spicule, is essentially at right angles to the other four; but this branch is likewise irregular and flexible in its distribution. It usually dips down more or less perpendicularly into one of the columns of the sponge-body, which it thus serves to attach to the wall. Opposite to the point of junction of the vertical ray with the four transverse rays, there is frequently a more or less distinct rounded elevation or tubercle. This tubercle undoubtedly represents the sixth ray, the continuation of the primary axis of the spicule. In some cases, which occur however more frequently in the smaller spicules of this type, the tubercle is developed into a branch, and the spicule becomes hexradiate, recalling the ordinary hexradiate spicule of the sponge-mass of *Hyalonema*.

The length from point to point of two of the cross branches of one of these spicules is about 15^{mm}, and the length of the azygous arm from 7·5 to 10. The diameter of the ray near the point of decussation is from ·1 to ·12. The central cavity in these spicules is very distinct. At the point of origin of the rays it divides evidently into five, and when the prominence representing the sixth ray is well marked, it sends a short branch into it, as in the case of the tubercles on the shaft of some of the long spicules of *Hyalonema*. If the spicule be broken or crushed, the laminated structure so well described by BOWERBANK in *Tethya* *, by MAX SCHULTZE in *Hyalonema* †, and by CLAUS in *Euplectella* ‡, becomes very apparent, Ten to fifteen siliceous layers can usually be easily detected. Near the point of decussation of the rays these siliceous laminæ seem to become further separated from one another, and the intervening layers of sarcode thicker. When the spicule is burned under the microscope, the black films of carbon which represent the burned sarcode may sometimes actually be seen splitting off separate from the transparent siliceous shells.

The smaller quinqueradiate spicules (Plate LXVIII. fig. 3) resemble the larger in general form; they are, however, much more delicate and flexible, and even more desultory in the distribution of their branches. The stretch of these spicules from tip to tip of two rays of the cross is from 8 to 10^{mm}, and the diameter of each ray not more than ·07 to ·05. Some straight fusiform spicules from ·08 to ·5 in diameter, and from

* A Monograph of the British Spongiadæ, Ray Society, London, 1864.

† Die Hyalonemen. Ein Beitrag zur Naturgeschichte der Spongien. Bonn, 1860.

† Ueber *Euplectella aspergillum* (R. Owen). Ein Beitrag zur Naturgeschichte der Kieselschwämme. Marburg und Leipzig, 1868.

10 to 15^{mm} in length, occur in the sponge-substance, but these may, I think, be more properly associated with the spicules of the next group.

2. *The spicules of the "beard."*—It is extremely difficult to isolate the long simple spicules of the beard. The sponges had been rolled about in the mud in the dredge, and the long spicules came up a close tangled mass. One spicule, however, which was not complete, I extricated to the length of 4 decimeters. These spicules are infinitely more delicate, and more flexible and elastic than those of the "glass-rope" of *Hyalonema*, more delicate even than the root-fibres of *Euplectella*. They arise by an extremely fine point in the columns of the sponge-substance (Plate LXX. fig. 1, *a*, *b*). They enlarge gradually, and after passing in bundles through the outer wall of the sponge into the chalk-mud, they maintain nearly the same diameter, from ·1 to 0^{mm}·12, throughout their length. Their structure is not so compact as that of most other spicules. When sharply bent the layers of silica readily separate from one another, and they may be frequently seen with parts of the outer layers broken off (Plate LXVIII. fig. 6). I have never observed more than from ten to twelve layers in the portions which I have examined. The external surface of this spicule is perfectly smooth throughout the greater part of its length. I have not, however, seen a fully developed example complete at the distal extremity.

Along with the bundles of these simple fibres there issue from the interior of the sponge numerous hamate, bihamate, and rarely trihamate spicules (Plate LXVIII. fig. 5, *a–d*, Plate LXX. fig. 1, *a*, *b*). These spicules are from 5 to 10^{mm} in length, from ·02 to ·025 in diameter of the shaft, and the bihamate ones about ·06 across the flukes. They are armed throughout their entire length with longer or shorter, sharper or blunter recurved spines. These spicules are found here and there in the sponge-substance; but usually they run parallel to and are mixed with the sheaves of simple spicules of the beard. They resemble very closely in form the so-called "prehensile spicule" figured by Bowerbank and Claus from the base of *Euplectella*.

Associated with these in the fascicles of spicules of the beard, but much more abundant in the bundles of shorter and more rigid spicules towards the upper portion of the sponge, we find the very beautiful and remarkable spicules, Plate LXVIII. fig. 4.

These spicules are from about 5 to 8^{mm} in length and ·015 in diameter. They are cylindrical, and come to a fine point at each end. All along the shaft minute elliptical or nearly linear depressions are arranged in a close double spiral. The distal end of each depression deepens slightly, so that the markings are somewhat like the scars left by the detachment of leaves. From the distal lip of each depression an extremely delicate spine, visible only with a rather high magnifying power, arises, and runs backwards over the depression, and nearly parallel with the axis of the spicule.

Mixed with the rigid projecting spicules of the upper part of the sponge, tufts of extremely fine siliceous fibres pass out of the sponge-substance. I have found it impossible to isolate one of these fibres (Plate LXVIII. fig. 7) for its entire length, which seems to reach about 20^{mm}. These fibres are glossy, like the ultimate fibres of floss silk. Their diameter is about 0^{mm}·002.

3. *The Spicules of the Sarcode.*—The different forms of spicule which have been hitherto described are stationary, woven into certain definite positions in the texture of the sponge. Besides these, three distinct types of extremely minute spicules are imbedded in the sarcode of the sponge and evidently follow its movements, thus occupying varying positions with reference to the permanent skeleton. The most abundant of these are very minute spicules formed on the hexradiate type, but having, as in the case of the large spicules of the skeleton, only five rays developed. The four secondary branches radiate in the form of a transverse cross, and the fifth projects at right angles, and is feathered with diverging spines curved toward the distal extremity of the ray. These spicules differ in form and size in different parts of the sponge. Those of the outer network (Plate LXVIII. figs. 9 & 9 *a*) are about $0^{mm}\cdot15$ from point to point of opposite rays of the cross. The rays of the cross are stout and rigid, and are frequently slightly roughened with small tubercles. The feathered ray averages about ·17 in length; it is robust, and the spines are numerous and close.

Spicules of this type are very numerous in the sarcode of the oscular network, but they have a somewhat different character. The rays of the cross are slightly longer than in the spicules of the outer network, and are usually smoother and somewhat more delicate. The feathered ray is much longer, averaging about ·22 to $0^{mm}\cdot35$ in length; it is much more delicate, and sometimes slightly curved, and the spines on its surface are smaller, less numerous, and more distant (Plate LXVIII. figs. 10 & 10 *a*).

In the substance of the sponge, these spicules present many varieties in form. Sometimes they are very short and thick, with the barbs of the feathered style numerous and long, and the rays of the cross strongly tubercled (Plate LXVIII. fig. 11); more frequently they are altogether very delicate in their proportions, so much so that the rays of the cross curve irregularly, and the feathered style with its spines entirely lose their rigid and uniform outline (Plate LXVIII. figs. 12, 13, & 14).

The spicules of the sarcode of the second type are not nearly so abundant. They are simple and style-like, slightly fusiform, and come to a fine point at each end; they are about $0^{mm}\cdot2$ in length (Plate LXVIII. figs. 8 & 8 *a*). The shaft is covered with extremely delicate adpressed spines. These spicules somewhat resemble a small portion of one of the long spicules (Plate LXVIII. fig. 4) on a very reduced scale. The last spicule of the sarcode is a small "amphidiscus," a cylindrical spicule $0^{mm}\cdot07$ in length, with, at either end, a crown of six or eight long recurved hooks. These spicules are very numerous, especially so, ranged along the branches of the large spicules of the inner network. They vary slightly in form (Plate LXVIII. figs. 15, 16); but the differences do not seem to be connected with their distribution in the sponge.

The general Arrangement of the parts of the Sponge.

1. *The outer wall.*—The external surface of the sponge is formed of an open network, which presents a very beautiful though somewhat irregular stellate appearance. The centres of the stars, in a band round the middle of the sponge, where the star-like

arrangement is most conspicuous, are about 10^{mm} asunder. In the upper portion of the sponge, towards the lip of the osculum, the stars gradually diminish in size and become less obvious, while close to the lip the stellate arrangement disappears, the meshes become close and irregular, and the tissue looks like fine grey felt. Towards the base of the sponge the network also loses its regularity, but it becomes more coarse and open. The stellate effect of the outer wall is due to a multitude of more or less strongly marked centres, from which an irregular number of rays diverge. The most strongly marked of these centres of radiation form the centres of the prominent stars, but the spaces between these, and among their rays, are full of smaller radiating points from 1 to 2^{mm} distant from one another, and having in every way the same character as those which are more obvious.

The centre of each of the large stars coincides with the point of divergence of the rays of one or two of the large five-rayed spicules (Plate LXVIII. figs. 1, 2, Plate LXIX. figs. 2, 3), and very usually, besides the very large spicules, one or more of the smaller spicules of the same class radiate at the same point. The smaller stars indicate the point of radiation of these smaller spicules alone. The spicules are placed thus: four rays of each spicule spread nearly on the same plane, forming the rays of the star and the supporting framework of the outer wall of the sponge, while the fifth ray plunges down into the substance of the sponge, and forms one of the elements of the remarkable spongy trabeculæ which support the outer casing.

The siliceous rays of one star curve towards and meet the rays of the neighbouring stars, and run along parallel with them (Plate LXIX. fig. 2). All the rays of all the spicules are thickly invested with consistent semitransparent sarcode, which binds these concurrent branches together by an elastic union, and fills up all the angles of the meshes with softly curved viscous masses. This arrangement of the spicules, free, and yet adhering together by long elastic connexions, produces a strong, flexible, and very extensible tissue.

In the more open parts of the outer wall, the meshes between the spicules are from ·5 to 0^{mm}·8 in diameter, and even with a hand-lens these spaces may be seen to be covered by an extremely delicate transparent finer netting. This ultimate network, however, has no siliceous frame, but consists simply of irregularly inosculating threads of sarcode, which rise from the sarcode-sheaths of the branches of the spicules, and stretch, anastomosing irregularly, across the spaces; bounding and defining the inhalent pores of the sponge (Plate LXIX. figs. 2, 3). There can be no doubt from its appearance that the sarcode of this network presents the movement which we find so characteristic of this histological element throughout the group. It is soft, very transparent, and of a pale horn-colour. It contains scattered through it, separate or in groups, minute brownish granules apparently of some form of horny matter, with here and there bodies of more definite outline resembling endoplasts, and two forms of spicules. Where the sarcode covers the branches of the five-rayed spicules and forms the border of the meshes of the larger network, the feathered spicules (Plate LXVIII. fig. 9) are very abundant. The transverse crosses are imbedded in the sarcode and, as it were, stand against the large spicules, while their tree-like branches project outwards, thinly covered with transparent sarcode. Frequently one of these spicules is carried away by the stream of sarcode spreading into the ultimate sarcode-net, and may be seen upon the netting, maintaining its position, with the cross in the network and the brush projecting outwards (Plate LXIX. fig. 3).

The small amphidisci (Plate LXVIII. figs. 15, 16) are less numerous. The position of these bodies in the sarcode appears to be perfectly irregular; they lie in all directions. They are usually found ranged along the rays of the large spicules; but they also often follow the course of the sarcode, and may be seen scattered in the threads of the ultimate network (Plate LXIX. fig. 3).

When the sponge is fresh, with only the mud washed off it, if we look at it in water the spaces between the larger stars seem almost transparent, and show deep cavities penetrating into the substance of the sponge, while beneath the centre of each star an irregular column of sponge-substance rises, spreading somewhat and dividing as it abuts against and supports the star. These supporting columns have a great resemblance in form to the *columnæ carneæ* of the human heart.

Over the whole of the lower third of the surface of the sponge, dense tufts, consisting each of from 20 to 100 of the enormously long simple spicules, portions of which are represented in fig. 6, Plate LXVIII., pass through the centre of the tissue of the trabeculæ in which they originate, through the meshes of the outer wall near the centre of the stars, and spread in all directions in the mud. As each spicule is invested by a sheath of very soft sarcode, the whole of the mud to a distance round the sponge is glairy, as if it were mixed with white of egg. Accompanying the long simple fibres there are usually in each fasciculus from three to eight or ten of the hamate spicules (Plate LXVIII. fig. 5); the bihamate form (figs. 5 & 5 *a*) is much the most common. Some of these spicules end close to the outer network of the sponge (Plate LXX. fig. 1, *a*), while others accompany the bundle of fibres to a distance of several millimeters beyond it. The delicately spined spicule (Plate LXVIII. fig. 4) also occurs in these fasciculi, but comparatively rarely.

The middle zone of the sponge is nearly free from projecting spicules, and the stars are there very regular and distinct; but on the upper third, towards the edge of the osculum, the tissue becomes altogether closer and more confused, the meshes of the siliceous network become smaller, and the sarcode fills them up as a finely perforated membrane. Here, again, bundles of fibres pass outward from the trabeculæ of the sponge; but these are shorter and more rigid than the fibres of the "beard," and project outwards and upwards at a definite angle, forming a kind of coronet round the top of the sponge. Each fasciculus consists of a few (ten or twelve) larger and smaller smooth simple spicules, with one or two bihamate spicules, a number of the spined spicules (Plate LXVIII. fig. 4), and usually a bunch of the silky fibres (Plate LXVIII. fig. 7). These fasciculi, which are about 30^{mm} long on the shoulder of the sponge, gradually shorten towards the osculum, till immediately round its lip there is a close continuous vertical fringe, chiefly of smooth spicules about 10^{mm} high.

2. *The wall of the oscular cavity.*—There can be, I think, no reasonable doubt that the inhalation of water takes place through the pores of the ultimate sarcode network over the whole of the external surface of the sponge, and that the whole of the wall of the internal cylindrical cavity is exhalent, the current finally escaping through the single large osculum. The wall of the inner cavity resembles generally the external wall of the sponge. It is composed of a series of stars formed on the same plan, and by a combination of spicules of the same general form as those of the external stellate membrane. The stars are coarser and more open towards the bottom of the cavity, becoming more obscure above, till at length near the oscular opening the tissue becomes close, irregular, and felted, and at the tip of the osculum it joins the upper portion of the outer wall which has assumed the same character. Under the microscope the network of the oscular cavity (Plate LXIX. figs. 4, 5) differs materially in detail of structure from the outer network. The spicules of the supporting frame are rather smaller, but their distribution is the same, the four secondary rays of each spicule forming an elastic union with the secondary rays of the neighbouring spicules to form the stars, and the fifth ray passing down into trabeculæ of sponge-substance, which, however, are smaller than on the outer surface and less definite in form. The most striking peculiarity in the inner wall is the total absence of the ultimate sarcode network. The siliceous rays are bound together by a thick sheathing of firm sarcode, much more consistent and more loaded with granules than the sarcode of the outer wall; but this sarcode merely covers the spicules and reduces the angular meshes of the network to large irregular oval spaces, by forming deep crescentic accumulations in the angles. Close ranges of the transverse crosses of the long delicate feathered spicules (Plate LXVIII. fig. 10) are imbedded in the sarcode and set against the shafts of the large spicules, and the feathered rays turn towards, and project slightly over, the oval openings, which they thus partially obstruct. The amphidisci are very abundant, imbedded in the sarcode. They are usually more or less regularly ranged in rows, their long axes parallel with the axes of the large spicules.

3. *The Sponge-substance.*—Between the outer and the inner walls the structure is very uniform. A greyish consistent sarcode is hollowed out into rounded channels and communicating spaces of all sizes and of very irregular forms (Plate LXIX. fig. 1, Plate LXX. figs. 1 & 2). These spaces are smaller, and the sponge is therefore more compact towards the inner (oscular) surface, where it has somewhat the appearance in section of a slice of very light loaf-bread. About a centimeter from the outer surface the various channels coalesce and form large sinuses, which surround the columns of sponge already mentioned which support the centres of the large stars. The effect of this arrangement is very peculiar; when the sponge is seen in fluid, the outer network from its almost perfect transparency is entirely lost, and one sees only a globular spongy mass, apparently covered with projecting spongy, broad-based, flat-headed spikes. Towards the oscular network there is also a tendency to the coalescence of the channels, but the sinuses formed are much smaller and less definite in form. The sarcode of the substance of the sponge is firmer and more densely loaded with granules, therefore more opaque, than

that of the outer wall; it is apparently the same as that of the oscular wall. It is supported and its spaces are defined by a very irregular elastic meshing of spicules, which resemble closely the smaller five-rayed spicules of the outer network, only they are somewhat more delicate in their proportions and their rays are longer (Plate LXX. figs. 1, 2). The sarcode contains irregularly scattered through it, but not in very great numbers, the feathered five-rayed spicules, and in this situation they exhibit every variety in form. They are most usually extremely delicate, with curved rays (Plate LXVIII. figs. 12, 13, 14); but some of the stoutest and most rigid spicules (Plate LXVIII. fig. 11) were found associated with these. These feathered spicules are arranged in the substance of the sponge in the same way as in the membranes, the crosses imbedded in the sarcode, and the feathered styles projecting into the sinuses. Amphidisci are much less abundant in the sponge-substance than in either of the walls, but in some places the minute fusiform spicules (Plate LXVIII. figs. 8, 8 *a*) are numerous. Here and there throughout the sponge there is one of the bihamate spicules (Plate LXVIII. fig. 5), and over the lower third of the sponge, and over the upper third, wherever a column or rod of sponge rises to the outer network, a fascicle of siliceous fibres and spicules passes along its axis, becoming free beyond the outer wall of the sponge. In the lower third of the sponge the bundles already described of 20 to 100 long cylindrical fibres originate in the perpendicular columns of sponge-substance. The spicules commence in a fine point, gradually acquiring their full diameter as they approach the surface of the sponge (Plate LXX. fig. 2, *a*); they then pass out into the oozy mud, in which they spread. The layer of sarcode covering these fibres throughout their entire length is equal to about the semidiameter of the fibre. The sarcode is soft and nearly colourless. It contains a few scattered granules and compound granular masses, and apparently no spicules. It is so abundant in the silky beard, that when the fresh sponge is held up it falls from it in flakes and glutinous drops loaded with *Globigerinæ* and chalk-mud. The sarcode of this sponge appears to be perfectly uniform and continuous. There is no trace of its differentiation into cell-like bodies surrounding endoplasts.

Reproduction.

In the specimen of *Holtenia* which was sacrificed in order to investigate the details of internal structure, any indications of the function of reproduction were unfortunately very obscure. Near the base of the sponge, among the granular sarcode bounding the sinuses round the lower part of the exhalent cavity, there were numerous soft, granular, pyriform gemmules. At the particular stage at which they were observed these gemmules were of a bright orange-colour, destitute of spicules, and perfectly uniform in their dense granular structure. Although gemmules and specimens of all ages, of other sponges such as *Tisiphonia* and *Hyalonema*, were detected abundantly in the mud, and even among the fibres of the beard of *Holtenia*, it is singular that neither gemmules nor young specimens of this species were met with.

The Zoological position and affinities of the Genus.

In the 'Annals and Magazine of Natural History' for February 1868, I described a genus of siliceous sponges under the name of *Habrodictyon*, from specimens in the Museum of the Jardin des Plantes. The sponges which are now included in that genus were already well known; but a general external resemblance and want of care in the discrimination of minute characters had previously caused a confusion between one of the species and *Euplectella aspergillum* (Owen), the "Venus's flower-basket" of the Philippines. While studying critically the Paris specimens with the view to the determination of their affinities, I found to my surprise that a number of sponges from very different parts of the world, to which had only been attributed hitherto the common character of extreme beauty and rarity, were associated by structural and histological peculiarities sufficiently marked to distinguish them as a group from all the recognized orders of the Class PORIFERA. For these sponges I accordingly proposed to establish a new order, for which I suggested the name (Porifera) VITREA. It is remarkable that nearly all the genera and species of sponges which we met with in the deep water of the warm area of the Atlantic were referable to the new order, and from their having been found living and *in situ*, the new forms threw a flood of light upon the relation and mode of occurrence of the group.

In defining the position of the vitreous sponges, I have employed the classification proposed by Dr. OSCAR SCHMIDT in his valuable work on the Sponges of the Adriatic*. I have, however, thought it necessary to propose certain slight modifications in his system, and the large number of additional genera which I have now had an opportunity of examining have led me to alter slightly my view of the sequence and affinities of the orders. The following outline of a classification of sponges, slightly modified from that of Dr. OSCAR SCHMIDT, will serve to indicate the position which in the present state of information I should be inclined to assign to the vitreous sponges.

Class PORIFERA, Grant.

Subclass I. (Porifera) CALCAREA, Bowerbank. "Skeleton composed of calcareous spicules which are generally three-rayed stellate" (Gray), equivalent to Dr. O. SCHMIDT'S first family. Examples: *Grantia*, *Sycon*.

Sub-class II. (Porifera) SILICEA, Gray. "Sponges provided with a siliceous or horny skeleton, or with a horny skeleton strengthened with siliceous spicules."

Order I. (P. Silicea) VITREA, Wyville Thomson. Sarcode usually soft, containing but little formed horny matter in the form of minute granules. The skeleton consists entirely of siliceous spicules, either separate (in fascicles or scattered) or soldered together and combined into a continuous siliceous network. The sarcode contains small free spicules, different in character from the spicules of the skeleton, and frequently of complicated forms. In the typical sponges of the order all the spicules whether of the

* Die Spongien des Adriatischen Meeres. Leipzig, 1862 (and Supplements).

skeleton or of the sarcode, may be referred to the hexradiate type. Examples: *Holtenia*, *Hyalonema*, *Dactylocalyx*.

Order II. (P. Silicea) RADIANTIA, Wyville Thomson (=Corticata, Oscar Schmidt, in part.) Globular, tuberous, or branched sponges, supported by regular radiating sheaves of long siliceous spicules, and invested with a more or less dense cortical layer, often containing spicules of special and characteristic forms.

Suborder I. (Radiantia) CORTICATA (=Corticata, Oscar Schmidt). Cortical layer dense and well defined. Examples: *Tethya*, *Geodia*, *Placospongia*.

Suborder II. (Radiantia) LEPTOPHLEA (Wyville Thomson). Cortical layer consisting of a thin, almost membranous, sheet of soft sarcode. Examples: *Tisiphonia*, n. g., *Stylocordyla*, n. g.

Order III. (P. Silicea) HALICHONDRIDA. Sponges tuberous, branching, cup-shaped, irregular, or incrusting; without any definite cortical layer. The sarcode is abundant, consistent, and in all cases is supported by a considerable amount of horny matter, which is fibrous, granular, and diffused, or in the form of more or less distinct membranous expansions. The sponge frequently contains an abundance of siliceous spicules variously arranged.

Suborder I. (Halichondrida) HALICHONDRINA (Lieberkühn). Sarcode abundant, usually consistent. The horny matter is granular or membranous, but is never in the form of a network of solid horny fibres. The skeleton consists mainly of siliceous spicules, which are usually essentially of the same form in all parts of the sponge. In one family, the ESPERIADÆ, the sarcode is soft, and the spicules are of two distinct types. Examples: *Halichondria*, *Spongilla*, *Esperia*.

Suborder II. (Halichondrida) GUMMININA (=Gummineæ, Oscar Schmidt). Sponge-substance compact; skeleton of fine densely interwoven horny fibres. Siliceous spicules in some of the genera. Examples: *Gummina*, *Corticium*.

Suborder III. (Halichondrida) SPONGINA (Lieberkühn). Skeleton an elastic wide-meshed network of anastomosing horny fibres, frequently containing foreign bodies, such as grains of sand and spicules of other sponges, and occasionally having siliceous spicules developed within them, but never associated with free siliceous spicules in the sponge-mass. Examples: *Spongia*, *Chalina*, *Dysidea*.

Order IV. (P. Silicea) ARENOSA (=Arenospongia, Gray).—"Sponge consisting of a disk of agglutinated sand, with a series of diverging spicules on the circumference of the disk, and with a pencil of similar spicules at the mouth of the oscules on the upper surface of the disk" (Gray, Proc. Zool. Soc. May 9th, 1867). Example: *Xenospongia*.

Order V. (P. Silicea) HALISARCINA (Lieberkühn). Sponge destitute of either siliceous or horny support. Example: *Halisarca*.

The following genera and species may, I believe, be referred with certainty to the Order PORIFERA VITREA:—

Genus 1. EUPLECTELLA, Owen.
E. aspergillum, Owen.
Genus 2. HABRODICTYON, Wyville Thomson.
H. speciosum, Quoy & Gaimard (sp.).
H. corbicula, Valenciennes (sp.).
Genus 3. APHROCALLISTES, Gray.
A. beatrix, Gray.
A. bocagei, Wright, MSS.
Genus 4. DACTYLOCALYX, Stutchbury.
D. pumicea, Stutchbury.
D. subglobosa, Gray.
D. Prattii, Bowerbank.
D. callocyathes, Gray (sp.).
D. azorica, Gray (sp.).
D. (?) *torva*, Duchassaing and Michelotti (sp.).
Genus 5. FARREA, Bowerbank.
F. occa, Bowerbank.
Genus 6. HOLTENIA, Wyville Thomson.
H. Carpenteri, Wyv. Thomson.
Genus 7. HYALONEMA, Gray (in part).
H. Sieboldi, Gray.
H. lusitanicum, Gray.
H. Loveni (sp. nov.).
Genus 8. ADRASTA, (gen. nov.).
A. infundibulum (sp. nov.)*.

The characters which the vitreous sponges possess in common are sufficient to combine them into a very natural order. In all, the sarcode is in comparatively small quantity, and spreads in a thin translucent layer over the spicules or network of a highly developed siliceous skeleton. In all the known genera all the spicules, whether of the skeleton or of the sarcode, are modifications of the hexradiate stellate type. In *Euplectella*, *Aphrocallistes*, *Dactylocalyx*, and *Farrea*, large hexradiate spicules are more or less completely soldered together, and form a continuous anastomosing network. In *Habrodictyon*, *Holtenia*, *Hyalonema*, and *Adrasta*, the skeleton is composed entirely of separate spicules, either distinctly hexradiate or quinqueradiate, or triradiate, or simple, by the suppression of one or more of their secondary branches. The sarcode of the inhalent and exhalent surfaces, and of the substance of the sponges, always contains scattered through it, numerous very minute spicules of very characteristic forms. In *Aphrocallistes*, one of the most abundant forms of these spicules of the sarcode is a regular six-rayed star with the principal axis longer than the transverse rays and one half of it feathered. In *Holtenia*, *Adrasta*, and *Hyalonema*, a spicule of the same type is common, but one half of the axis is undeveloped, so that the spicule has become quinqueradiate. In *Euplectella*, *Habrodictyon*, and *Dactylocalyx*, there are several modifications of a very complicated and beautiful spicule, the floricomo-hexradiate of BOWERBANK. The most remarkable spicule, the double grapnel (Plate LXVIII. fig. 15), seems to be the most widely diffused of all in the order. It varies little in form in *Hyalonema*, *Holtenia*, and *Adrasta*, in all of which it is abundant; and modifications differing only in the number, the curve, or the proportions of the flukes, or in the relative length of

* Since this list was written a number of additional vitreous sponges have been described by Dr. BOWERBANK and by Professor BARBOZA DE BOCAGE; and several new forms have been added from the rich collections made by M. DE POURTALES in the Strait of Florida in connexion with the American Coast Survey, and by the Naturalists in charge of the 'Porcupine' deep-sea dredging expedition. The sponges collected by M. DE POURTALES are in the hands of Professor OSCAR SCHMIDT for description; and a report on those procured by the English expedition is in course of preparation by the writer.

the stem, have been found in almost all the soundings from the deep sea, indicating a multitude of yet to be discovered species of vitreous sponges.

Our knowledge is not as yet sufficiently extensive to enable us to form a definite opinion as to the affinities and sequence of the genera of this order. *Holtenia* is undoubtedly very closely allied in general structure and in the form of its spicules to *Hyalonema*, the principal differences between them being in the general form of the sponge, and in the character and arrangement of the long fibres of the "root."

Nor is it yet possible to define with anything like certainty the position of the order in the series of the PORIFERA. There is something in the wonderful complexity of design and profusion of ornament in the siliceous skeleton which recalls the RADIOLARIA, and in some cases even the special forms of the spicules are repeated in the two groups. (Compare pl. 12, fig. 1, pl. 17, fig. 4, pl. 18, fig. 15, pl. 21, fig. 7, pl. 32, figs. 10, 11, pl. 33, figs. 6, 7, &c. of HAECKEL'S 'Die Radiolarien.') The sarcode is certainly more mobile, less loaded with granular matter, and more transparent than in most of the other groups of sponges. For sarcode in this condition one would be inclined to anticipate a somewhat higher form of vital activity. Under an impression that it is through this order that the sponges pass into the RADIOLARIA, I have placed the Porifera Vitrea at the head of the series of siliceous sponges, beginning with those genera in which the siliceous structures are most varied, and the sarcode least consistent. The typical vitreous sponges appear to approach the RADIANTIA through such forms as *Tisiphonia* and *Stelletta*, and the HALICHONDRIDA, probably through *Esperia*.

I believe, however, that it is not to the well-known orders of recent sponges inhabiting shallow water that the vitreous sponges are most nearly allied. A very remarkable group of fossils, the Ventriculites, are highly characteristic of the cretaceous formation. These are tubular or vase-shaped bodies, presenting a great diversity of graceful form and elegant sculpture. The late Mr. TOULMIN SMITH devoted much time and skill to their investigation, and came to the conclusion that they were POLYZOA. This view of their position, however, presents many difficulties, and the study of Mr. TOULMIN SMITH'S careful drawings and descriptions is in itself sufficient to suggest other affinities.

The general resemblance between some of the Ventriculites and *Euplectella* is very striking, while others approach the less regular form of *Aphrocallistes*, and this resemblance extends even to the details of the structure of the network of the wall. The striking difficulty is, that while the skeletons of the vitreous sponges to which the complicated network of delicate tubes forming the wall of the Ventriculites must be compared, are siliceous; as a rule no silica enters into the structure of the Ventriculites. The tubes are empty or filled with loose particles of carbonate of lime, coloured by peroxide of iron. Recent observations have shown that in very many particulars the modern deposits in the "warm area" of the Atlantic resemble most closely the deposits of the cretaceous seas; and, as has already been stated by Dr. CARPENTER, many animal forms identical with chalk fossils, or so nearly allied to them as to justify the assumption of modification by variation, or of direct descent, are now being imbedded in the Atlantic chalk-mud. So remarkable are the resemblances between the two formations and their respective faunæ, that for this and for other reasons which will be fully discussed elsewhere, the conviction has been forced upon my colleague Dr. CARPENTER and myself, that the deposit of "chalk-mud" at present taking place in the Atlantic is continuous with the deposit of chalk-mud of the cretaceous period, and that the margins and the shallower portions only of the cretaceous sea-bed have been elevated into dry land*.

One great difference, however, exists between the modern chalk-mud and the ancient chalk. The modern chalk-mud from all deep-sea soundings is full of delicate siliceous organisms, Diatoms, Radiolarians, and Sponges, while the chalk is almost devoid of diffused silica. From the circumstances under which silica occurs in the chalk, forming bands of flint, masses of amorphous silica which have evidently taken the form of any cavities or moulds occurring in the beds, we have been led to believe that the silica existed originally in the form of diffused organisms in the chalk of the cretaceous period as in the modern chalk, and that it was afterwards dissolved out; and filtered through the chalk, and retained in a colloid state in the cavities, by a process of dialysis. If this view be correct, we should be inclined to regard the Ventriculites in their ordinary state of preservation, as the moulds of delicate siliceous fabrics either identical with or very closely allied to the recent vitreous sponges; from which the silica has been removed, its place being occupied by stained carbonate of lime.

The habitat and the conditions of life of the Vitreous Sponges.

The geographical distribution of the order seems to be very wide. *Euplectella* is found in the Philippine Archipelago, and *Habrodictyon* off the Isle of Bourbon. *Hyalonema* is abundant in the seas of Japan, and has been procured in deep water off the coast of Portugal, near the north coast of Scotland, and at Santa Cruz. *Aphrocallistes Bocagei* was procured at the Cape de Verd Islands, and *Dactylocalyx* is abundant in the seas of the Antilles, and has been brought from the Azores and from Madeira. With the exception of *Dactylocalyx*, which, so far as I am aware, has hitherto been only found scattered like pieces of pumice on the sea-shore, but which appears from its form to grow attached to something, the habitat of the whole vitreous order of sponges is oozy calcareous mud. Soundings over a great part of the North Atlantic, embracing the Telegraph Plateau and the greater part of the vast region swept by the Gulf-stream, and also over a large portion of the Pacific, have shown that an important calcareous deposit is taking place throughout the whole of the warmer regions of the ocean. This deposit, so far as it has hitherto been investigated, presents a very uniform character. It consists mainly of fine particles of carbonate of lime, and the sounding-apparatus always brings up a considerable proportion of the fresh shells of *Globigerina* with smaller numbers of the shells of other Rhizopods. The sounding-lead sinks several feet into this fine deposit; and it seems that the deeper

* "Preliminary Report, by Dr. WILLIAM B. CARPENTER, V.P.R.S., of Dredging Operations in the Seas to the North of the British Islands, carried on in Her Majesty's Steam-vessel 'Lightning,' by Dr. CARPENTER and Dr. WYVILLE THOMSON," Proceedings of the Royal Society, vol. xvii.

part of the mud consists chiefly of an amorphous calcareous paste, produced by the disintegration of the Rhizopod shells, partly by pressure and the decomposition of the cementing animal matter, and partly by the solution in the sea-water of a portion of the carbonate of lime in the presence of disengaged carbonic acid; while the surface-layer consists almost entirely of living Rhizopods, principally *Globigerinæ*. The sponges live buried in the upper layer of the mud. They are frequently so coloured and saturated with the chalk-mud up to a certain point, that one can tell at once to what extent they have been immersed. From the low density of the diffused protoplasm of the living forms, the condition of fine division of the carbonate of lime, the slightly increased density of the water, and the stillness, the transition from a semifluid to a gradually solidifying mud must be very gradual. There are two ways in which the bodies of the sponges may support themselves and maintain their position in this treacherous medium, and both seem to be adopted by different genera. *Holtenia* stretches out an unlimited maze of light spreading fibres, thus increasing its surface indefinitely without adding greatly to its weight. *Hyalonema* sends down perpendicularly a coil of strong spicules which gradually spread till they reach a stratum firm enough to give them anchorage.

The question naturally arises, how is this enormously extended layer of animal life nourished? The dredge brings up no plants from great depths; and although from the fact that many of the higher invertebrates which are associated with the sponges and rhizopods have eyes and are brightly coloured, it seems probable that a certain amount of light penetrates to the abysses; it certainly does not appear to be in the form which is necessary for the decomposition of binary compounds by plants. To meet this difficulty it has been suggested that the PROTOZOA, the PROTISTA of HAECKEL, may have the power, though in a minor degree, of assimilating the elements of water, carbonic acid, and ammonia*. It has appeared to us that the nutrition of this animal layer may be explained more simply, and that it may even be found to be a necessary complement to the received doctrine of the "balance of organic nature." All sea-water contains a certain quantity of organic matter in solution, or in a state of minute molecular subdivision. This organic matter is derived from the life (by exosmosis) and the death (by decomposition) of a fringe of sea-weeds round all coasts; of a superficial layer of diatoms and allied forms covering all the warmer seas; in the Atlantic of a meadow of sea-weed two millions of square miles in extent; from the life and death of myriads of pelagic and littoral animals; and from rivers, especially the great rivers of the tropics, whose water is constantly loaded with organic matter. These ternary and higher compounds already gained from the inorganic kingdom, and which would otherwise accumulate indefinitely, might indeed be dissipated by gradual decomposition, but it seems more consistent with the economy of nature that a considerable portion at all events of the organic matter should pass through the complete cycle of organic life, in the ocean as well as on the land.

* Dr. G. C. WALLICH, 'The North-Atlantic Sea-bed.' Part 2. The Bathymetrical limit of Animal life in the Ocean, p. 131.

The Monthly Microscopic Journal, January 1, 1869, p. 32.

The PROTOZOA, to which subkingdom the mass of animal life, Rhizopods and Sponges, occupying the depths of the sea may be referred, absorb through their whole surface matter, organic or inorganic, in solution or in a state of molecular subdivision. They are therefore specially adapted to the task of freeing the sea-water of its excess of organic matter; at the same time they reduce to a solid form the dissolved carbonate of lime and silica, and slowly through countless ages pile up the fine calcareous sediment which forms the amorphous matrix of beds of limestone, and accumulate the colloid silica which yields the cherts and flints.

The higher invertebrate animal forms which are associated with the Protozoa at great depths, though comparatively scarce and of small size, represent nearly equally all the leading types of structure. There is, however, no difficulty as to the nutrition of these higher animals. They simply feed upon the Protozoa, and the conditions of temperature, of light, and of the aëration of the water are such as to sustain them in life, although in a somewhat dwarfed and imperfectly developed condition.

In the present communication I have only referred to these considerations involving the general conditions of the depths of the sea, so far as appeared to be absolutely necessary for the illustration of the economy of the genus *Holtenia*. Those conditions will be fully discussed by Dr. CARPENTER and myself in our general report on the investigation.

ADDENDUM.

Received November 19, 1869.

On the 21st July, 1869, during the Deep-sea Exploring Cruise of H. M. S. 'Porcupine,' the dredge brought up from a depth of 725 fathoms, Lat. 48° 50′ N., Long. 11° 09′ W., off the mouth of the English Channel, several young specimens of *Holtenia Carpenteri*, with the sponge-body from 2 to 200^{mm} in length. The youngest specimens (Plate LXXI. fig. 1) seemed only to have passed out of the condition of gemmules. The contour of these young sponges is more elongated and pyriform than that of mature examples. The external wall consists of a single series of quinqueradiate spicules, much more regular in form than those of the larger sponges; the four secondary branches decussate nearly at right angles, and the fifth branch is quite straight, and plunges into the sponge nearly vertically (Plate LXXI. fig. 8, which represents one of the spicules of the outer membrane of the sponge, fig. 2). It seems to be afterwards, during the growth of the sponge, that the spicules while enlarging greatly, become distorted and irregular in the distribution of their rays. The smaller spicules of the sponge-body (Plate LXXI. fig. 11) are likewise more regular, and a few examples were met with of the very regular hexradiate spicule (Plate LXXI. fig. 10), a form which is very abundant in HYALONEMA.

In the youngest sponges the stellate arrangement of the outer membrane is not yet perceptible; the surface is merely divided by the spreading rays of single spicules into rudely square meshes (Plate LXXI. fig. 1); very early, however, the stars begin to appear by the accumulation and radiation of several of the large spicules at one point, where they send all their azygous branches dipping into the sponge in a sheaf (Plate LXXI. fig. 3 *a*). The osculum is very distinct at the summit of the sponge from the first, and very early the coronet of upright spicules may be detected rising round its edge. The oscular cavity is at first somewhat irregular in form, and its walls are very imperfect and open. The spicules of the sarcode of the young sponges do not differ in any essential particular, either in form or position, from those of the adult. The characteristic spicules (Plate LXXI. figs. 13 & 15) occur ranged as in the adult along the shafts and branches of the spicules of the outer and oscular walls. The 'amphidisci' also occur, although not in large numbers. These latter did not seem even to have attained their full numerical proportion in a young *Holtenia* three centimeters long which we dredged later in the season off the North of Scotland. One example is figured (Plate LXXI. fig. 15) of a regular hexradiate feathered spicule from the young sponge (Plate LXXI. fig. 3). This is the characteristic spicule of the sarcode of the netted lid of the genus APHROCALLISTES. It might easily occur as an abnormal spicule in *Holtenia*, simply by the symmetrical development of the other half of the shaft of the ordinary feathered spicule of the outer wall (Plate LXXI. fig. 14); but as a species of APHROCALLISTES was common on the same ground, I am by no means sure that one of its spicules may not have got accidentally entangled in the young HOLTENIA.

All the young *Holteniæ* in their earlier stages have a beard consisting of a single pencil of long spicules passing out together through one of the meshes of the outer wall, in the centre of the narrow (inferior) end of the sponge, exactly opposite the centre of the osculum. The fascicle consists of from twenty to thirty of the long simple spicules and four or five of the bihamate spined spicules (Plate LXXI. fig. 9). At this stage it is difficult to distinguish *Holtenia*, except under the microscope by the form of the spicules, from *Hyalonema* of the same age. *Hyalonema* seems to retain this embryonic character through life, the single original sheaf becoming enormously enlarged, while in *Holtenia* the fascicles are indefinitely multiplied. Young *Holteniæ* from 20 to 30^{mm} in length are hispid with the finely serrated spicules (Plate LXXI, fig. 19) which pass out singly and quite irregularly through the meshes of the wall. The sponge-substance is very loose, and the cavities, which afterwards become symmetrical, are at first irregular and very large in proportion to the size of the sponge. The long spicules of the beard fascicle do not remain in a single sheaf within the sponge-body, but spread round the osculum, and appear to rise from different parts of the sponge-substance, even close to the sponge-wall. They only approach to pass out of the sponge together.

On the 16th of August, and on the 7th of September, 1869, Her Majesty's Ship 'Porcupine' visited almost precisely the same spot where the specimens of *Holtenia* were dredged in 1868 from the 'Lightning.' With finer weather and much better appliances we were this year much more successful; we got abundance of specimens of *Holtenia Carpenteri*, of various sizes and ages, and many examples of the other vitreous sponges with which it is associated. All the mature specimens, however, seemed to be in precisely the same condition as those procured last year, and threw no additional light upon the structure or physiology of the species. During the past year one or two additional species of the genus *Holtenia* have been observed by Professor OSCAR SCHMIDT, along with several other sponges of the vitreous group, among the sponges dredged by M. DE POURTALES in the Strait of Florida. These species are not yet described.

DESCRIPTION OF THE PLATES.

PLATE LXVII.

HOLTENIA CARPENTERI, new genus and species. Natural size.

PLATE LXVIII.

Figs. 1, 2. The large quinqueradiate spicules of the outer network. ×40.

Fig. 3. One of the smaller quinqueradiate spicules, from the network of the oscular cavity. ×40.

Fig. 4. A spiny spicule from the margin of the osculum. ×150.

Figs. 5, 5 *a* to 5 *d*. Different forms of the hamate spicules from the fascicles of the "beard." ×150.

Fig. 6. A small portion of one of the long simple spicules of the "beard." ×150.

Fig. 7. A portion of one of the delicate silky fibres from the neighbourhood of the osculum. ×250.

Figs. 8, 8 *a*. Fusiform "spicules of the sarcode," from the inner part of the sponge-substance. ×250.

Figs. 9, 9 *a*. Feathered "spicule of the sarcode," from the network of the outer wall. ×200.

Figs. 10, 10 *a*. Spicules of the same type from the wall of the oscular cavity. ×200.

Figs. 11, 12, 13, 14. Spicules of the same type from different parts of the sponge-substance. ×250.

Figs. 15, 16. "Amphidisci." ×600.

PLATE LXIX.

Fig. 1. Vertical section of the sponge, showing the oscular cavity and the general arrangement of the sponge-substance. Natural size.

Fig. 2. A portion of the outer wall, showing the stellate arrangement of the siliceous spicules, and the ultimate sarcode network with the inhalent pores. ×25.

Fig. 3. A small part of the same preparation. ×100.

Fig. 4. A portion of the wall of the oscular cavity. ×40.

Fig. 5. A part of the same. ×200.

PLATE LXX.

Fig. 1. A section of one of the trabeculæ of the substance of the sponge, showing the origin of two of the fascicles of spicules of the beard, which pass through the outer wall of the sponge at *a* and *b*. ×20.

Fig. 2. Vertical section of the sponge-substance from the upper part of the sponge, near the edge of the osculum. ×20.

PLATE LXXI.

Fig. 1. Holtenia Carpenteri, young. ×50.

Fig. 2. Holtenia Carpenteri, somewhat more advanced. ×5.

Fig. 3. Section through the specimen, fig. 2. ×5.

Fig. 4. Another specimen. ×5.

Fig. 5. Oscular surface of the same, seen from above. ×5.

Fig. 6. A somewhat younger specimen. ×5.

Fig. 7. One of the spicules of the outer wall of the sponge, fig. 3. ×50.

Fig. 8. Bihamate spicule of the beard. ×100.

Fig. 9. Regular six-rayed spicule from the substance of the sponge, fig. 2. ×100.

Fig. 10. Nearly similar spicule from the same sponge. ×100.

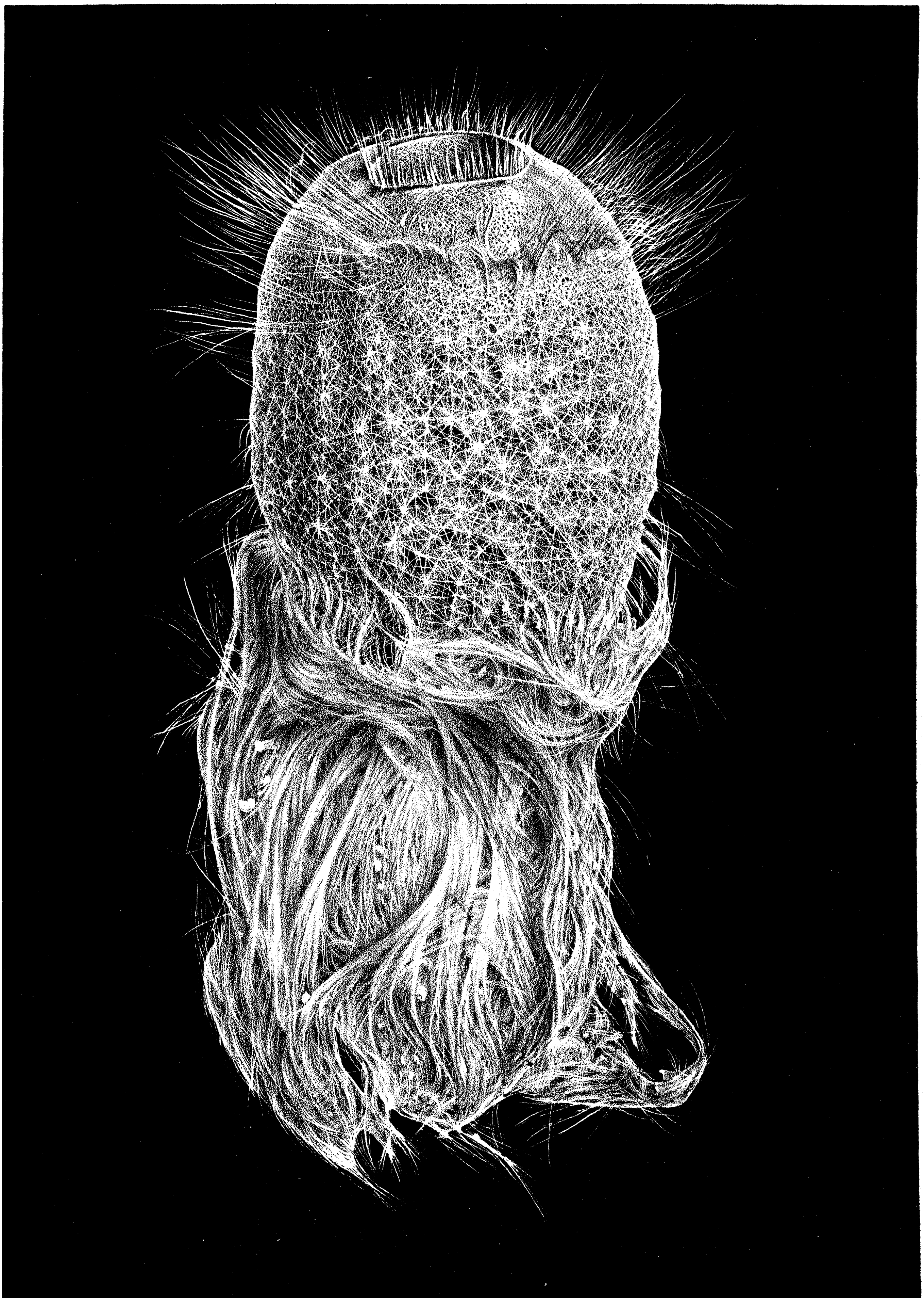
Fig. 11. Small serrated spicule of the sarcode. ×100.

Figs. 12, 13. Feathered spicules of the sarcode from the outer wall. ×100.

Fig. 14. Hexradiate feathered spicule, possibly from the netted lid of Aphrocallistes, and accidentally entangled in the young *Holtenia* (fig. 2). ×100.

Figs. 15, 16, 17. "Amphidisci." ×100.

Fig. 18. Serrated projecting spicule from the surface of the sponge. ×100.



J. J. Wild, del. et lith.

Ward Bros. Belfast.

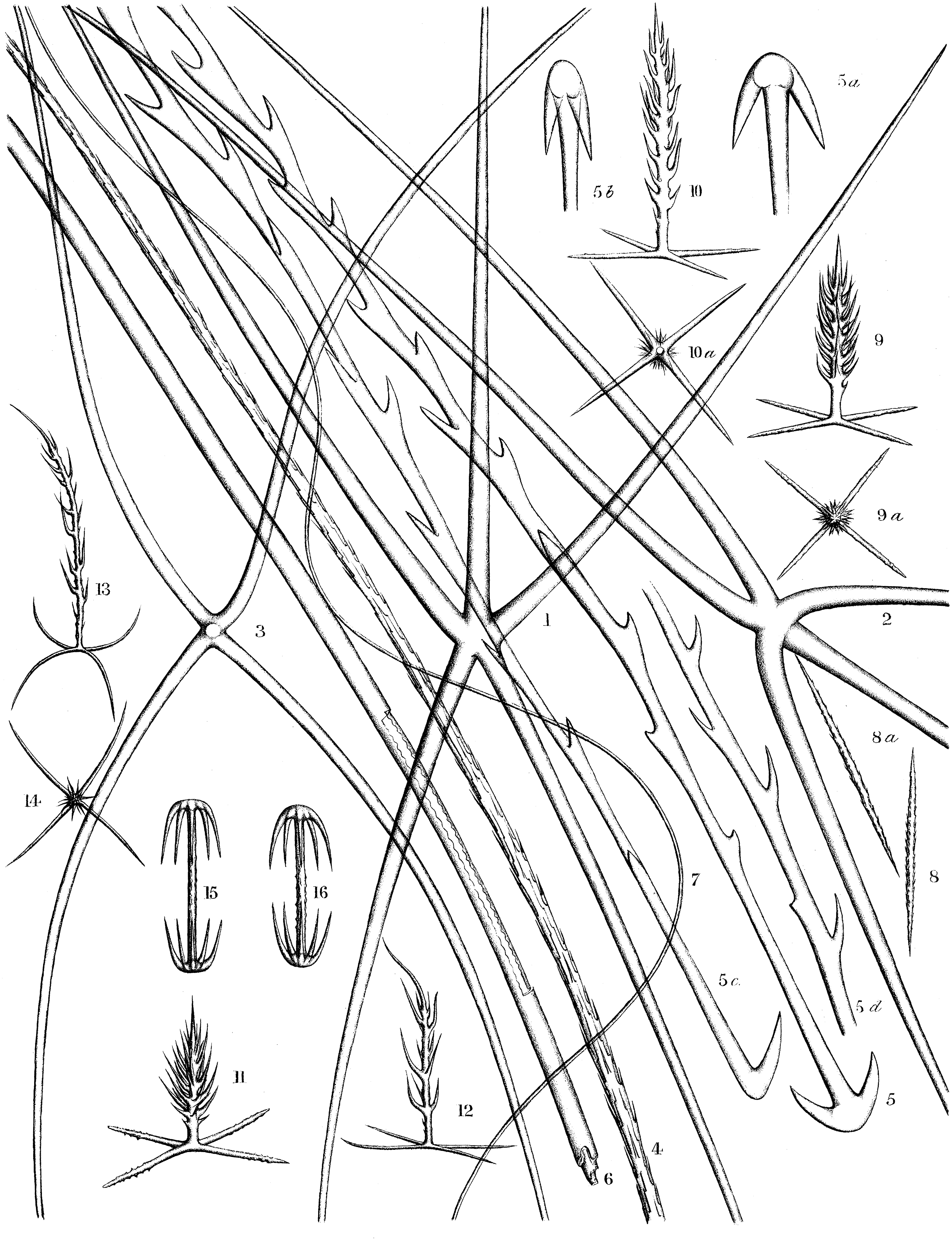

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Fig 3

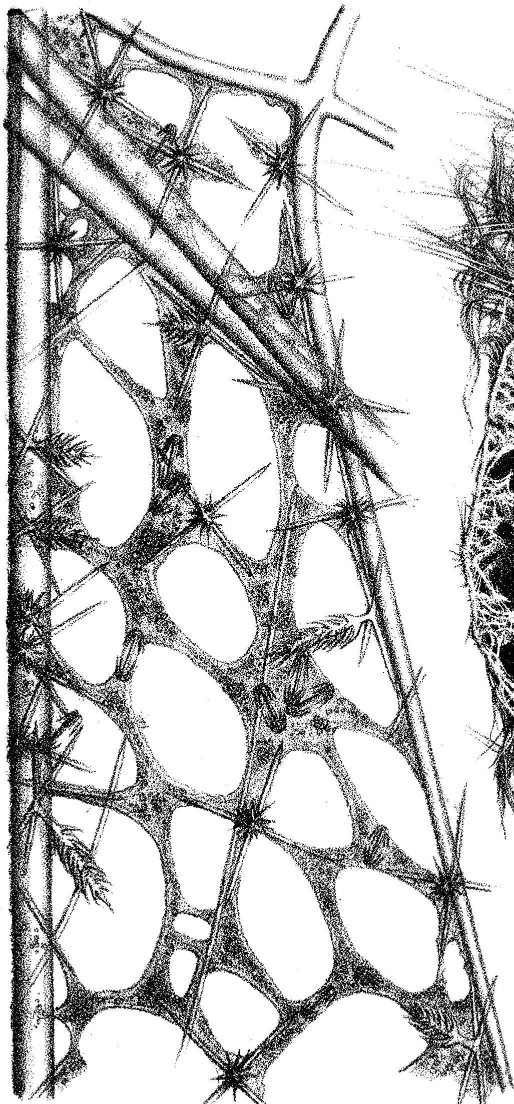


Fig. 1

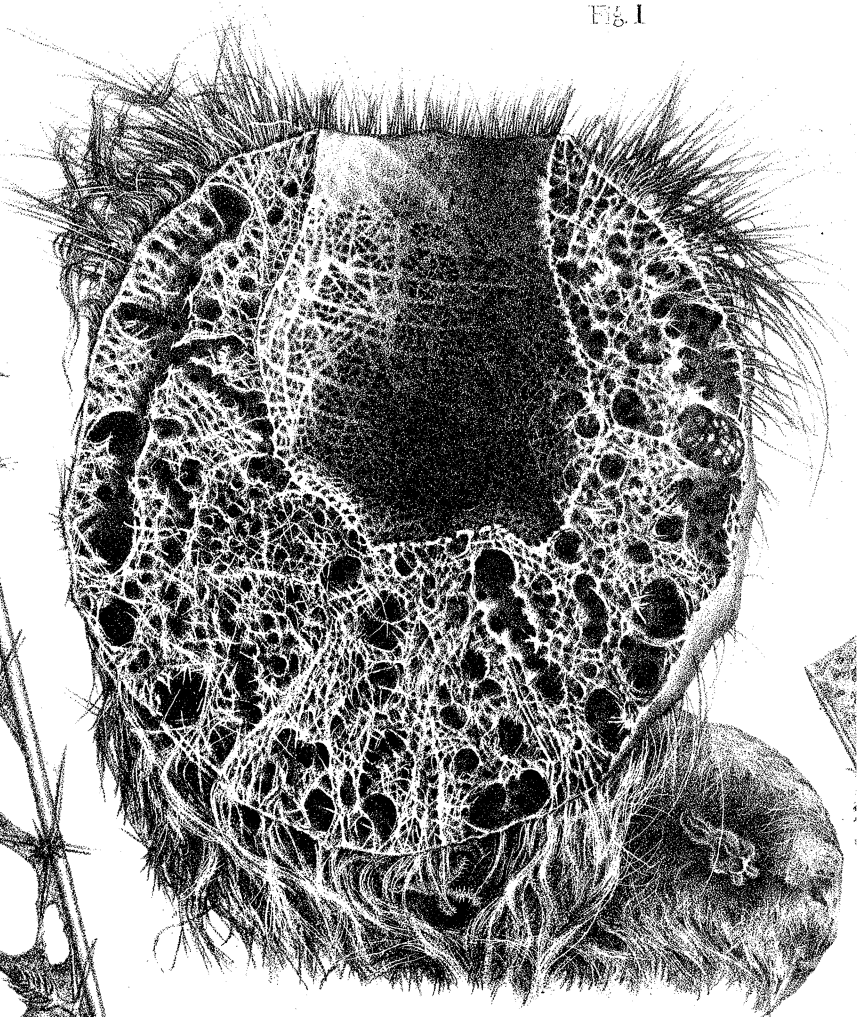
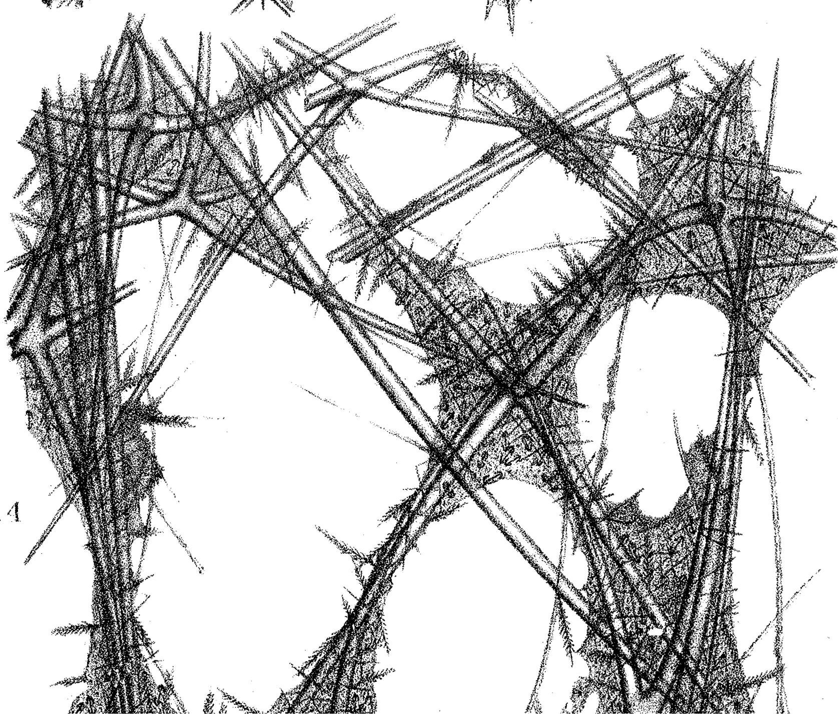


Fig. 4



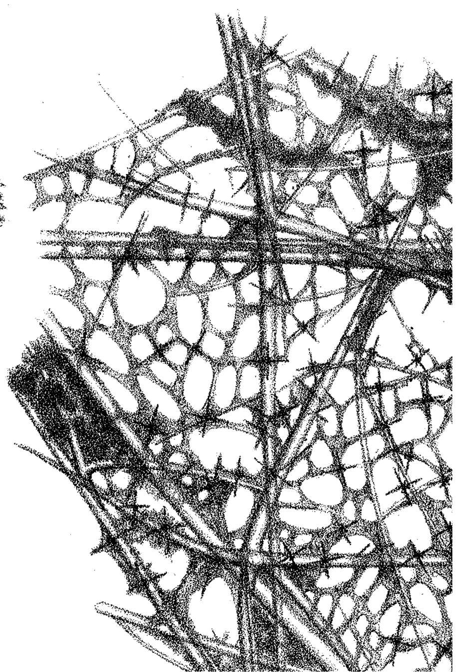


Fig 5

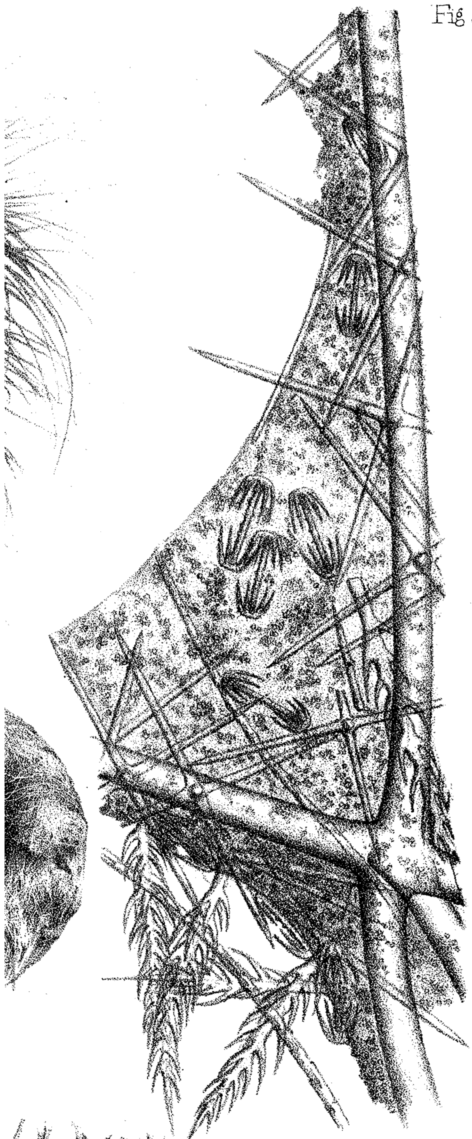
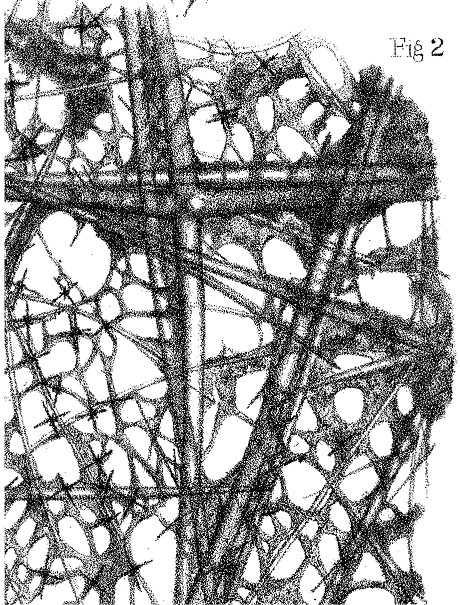
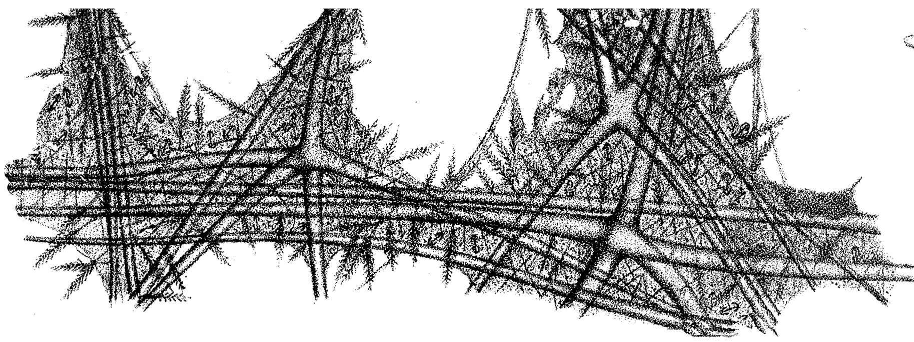
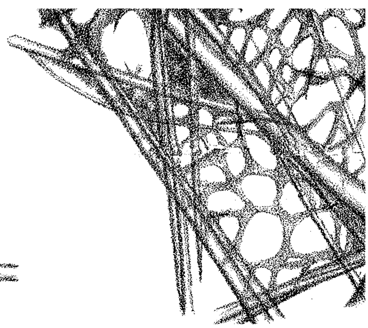


Fig 2







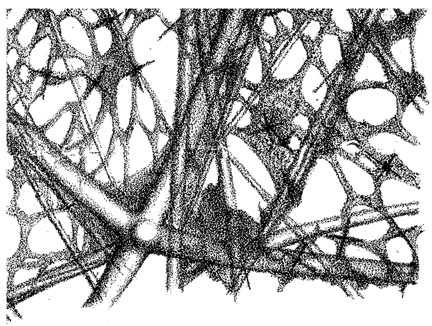


Fig 2

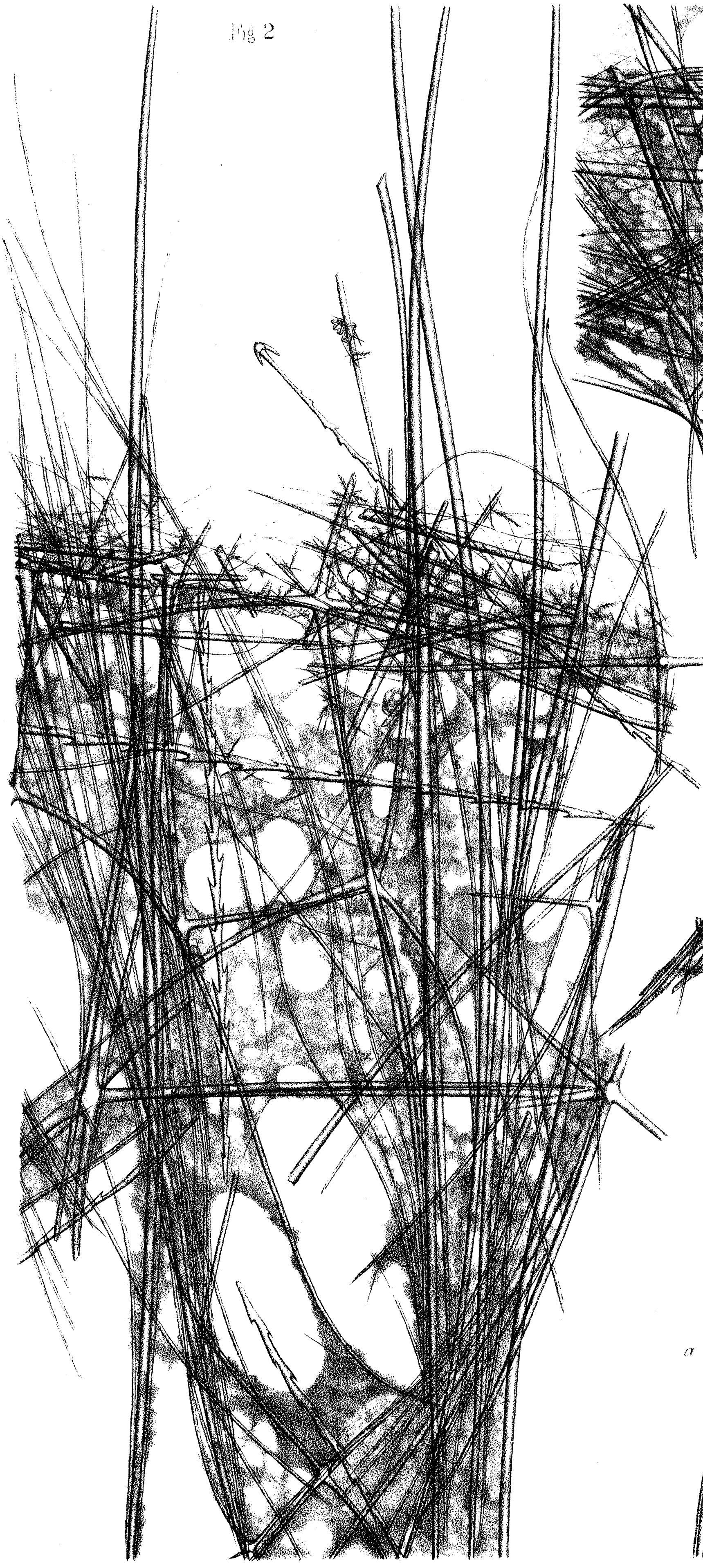
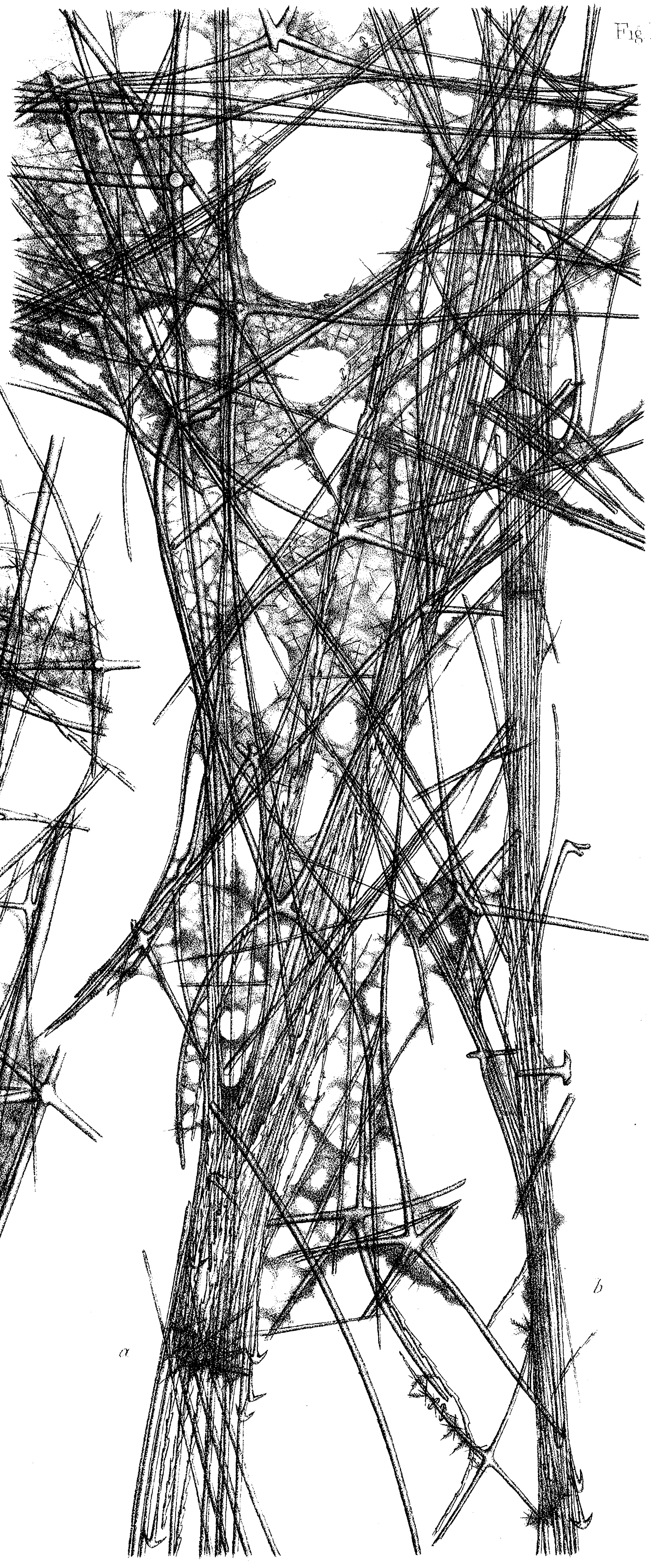


Fig 1



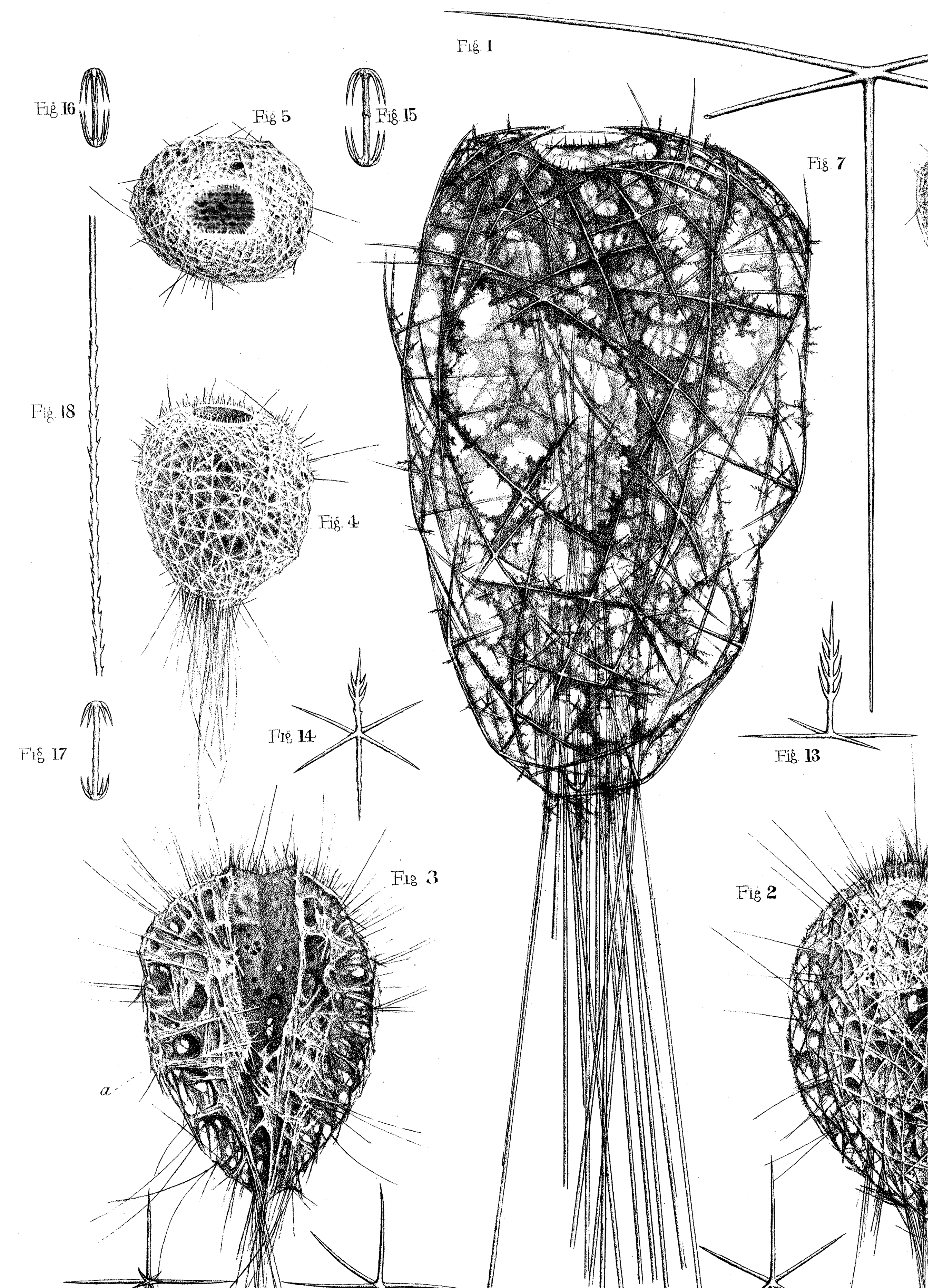


Fig. 1
Fig. 16
Fig. 5
Fig. 15
Fig. 7
Fig. 18
Fig. 4
Fig. 17
Fig. 14
Fig. 13
Fig. 3
Fig. 2
a

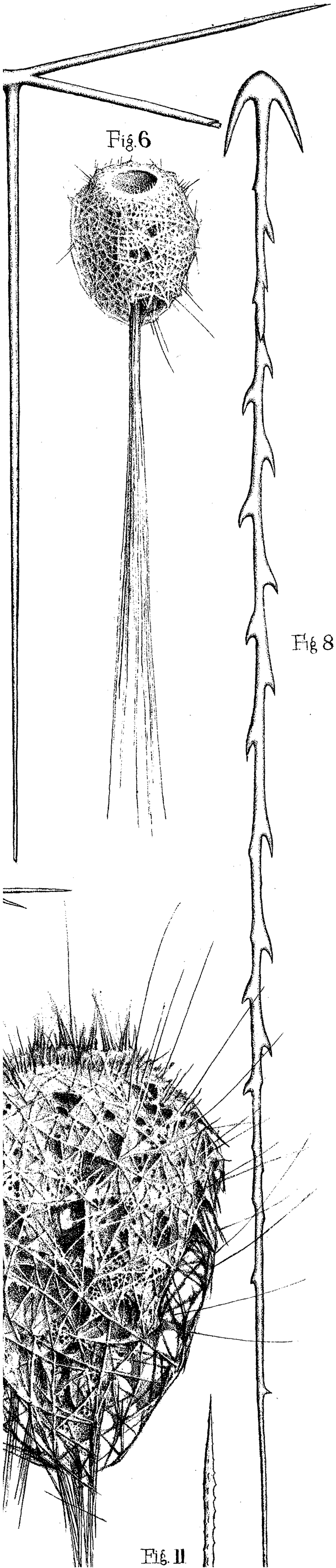
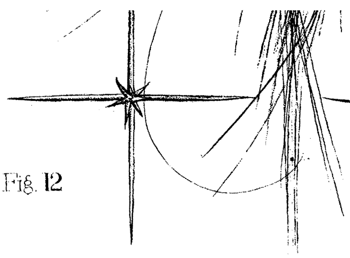


Fig. 6

Fig. 8

Fig. 11



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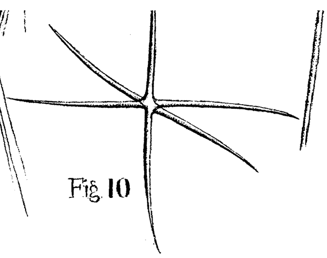

Fig. 10

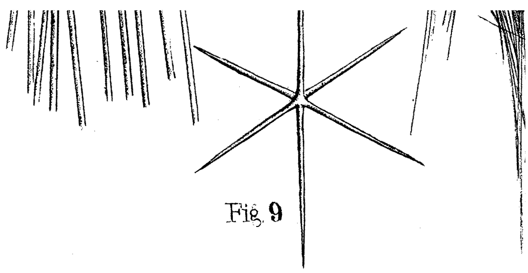

Fig. 9

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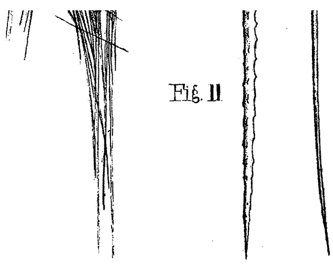

Fig. 11

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Fig. 3

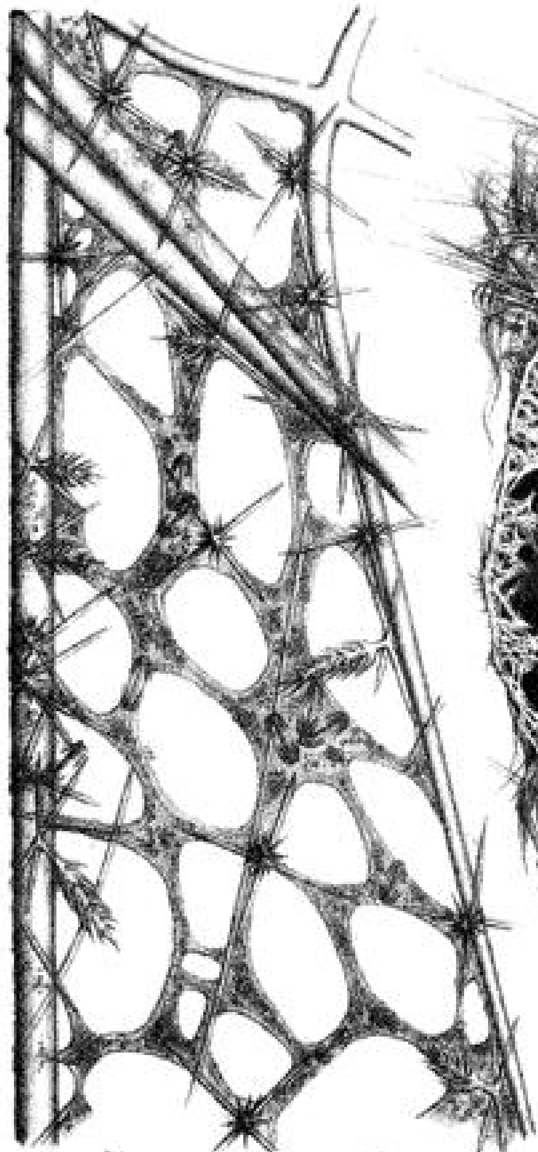


Fig. 1

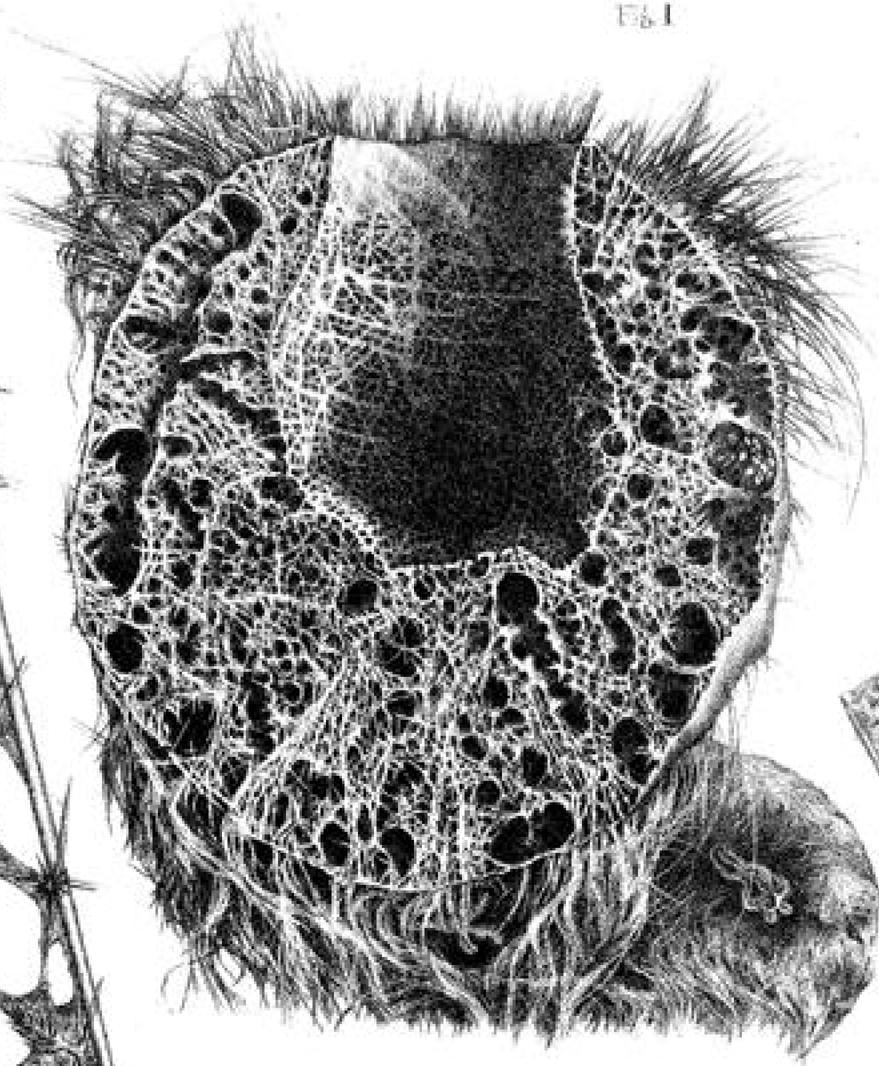


Fig. 5

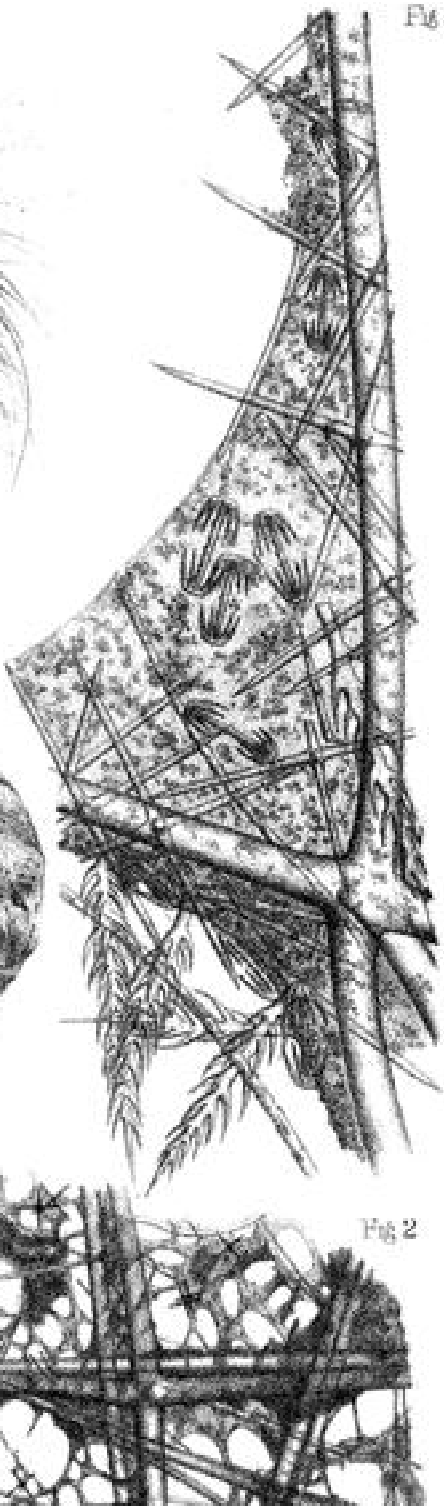


Fig. 4

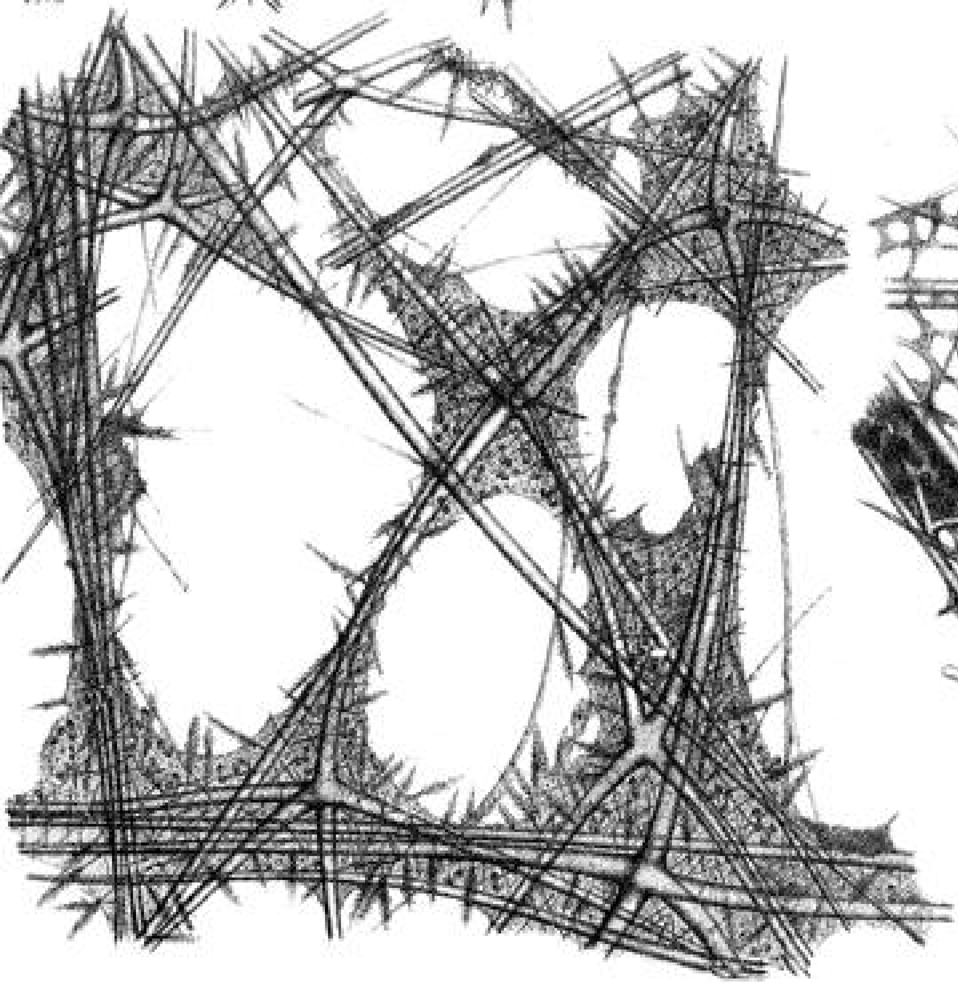
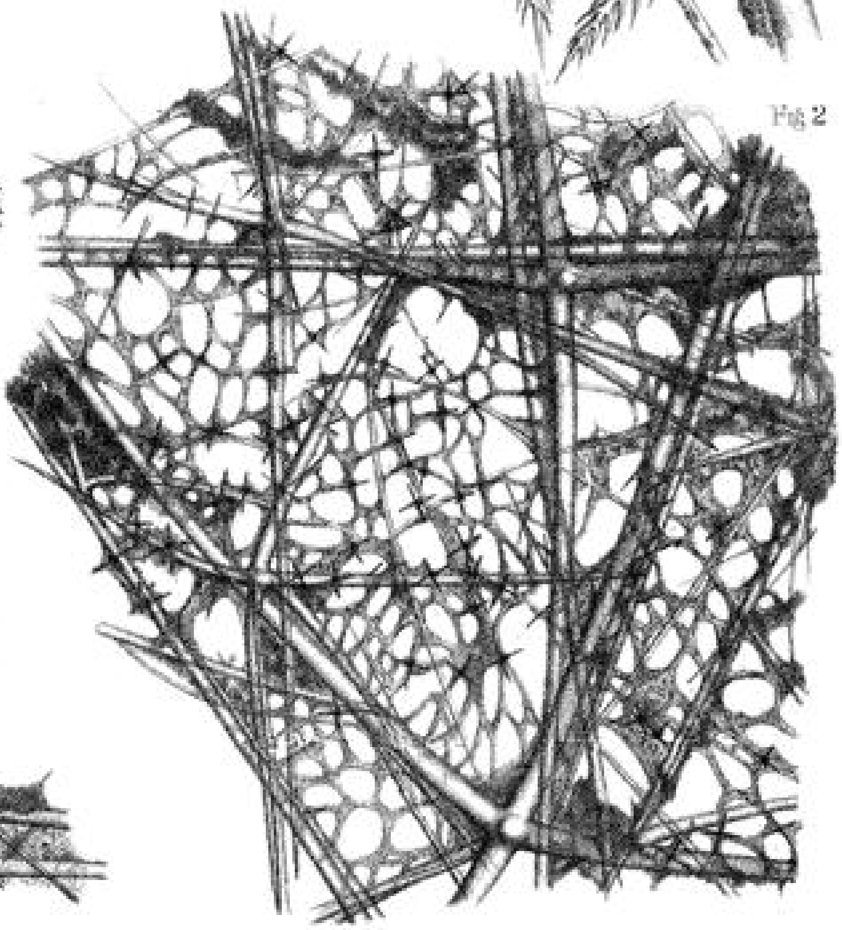
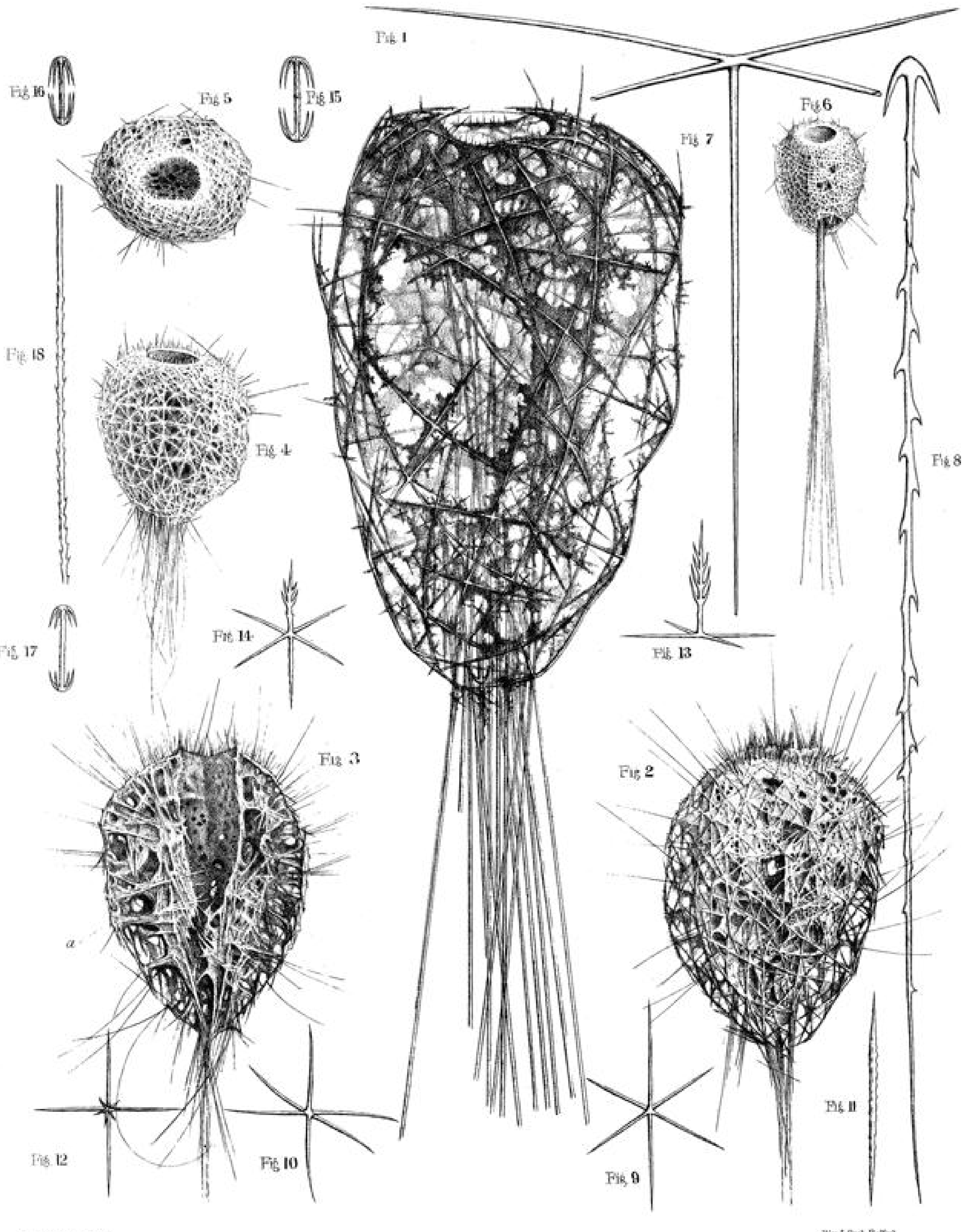


Fig. 2





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