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VIII.—*On a remarkable Sponge from the North Sea.*

By S. Lovén*.

[Plate VI.]

The Swedish Museum of Natural History at Stockholm possesses two specimens of a siliceous sponge which seem to well deserve a careful examination. One of them belongs to collections made by myself long ago on the coasts of Finmark, while the other was obtained last year by M. G. von Yhlen in the North Sea, on the Storeggen, at the depth of about two hundred fathoms, and presented by him to the Museum. Both are preserved in spirits.

The external form of this sponge is peculiar—a clavate body, which may be called the head, supported by a slender stem thrice as long, round, and somewhat curved, the inferior end of which has been attached to the bottom of the sea by numerous roots (Pl. VI. fig. 1). The whole sponge without the roots is 52 millimetres high, the length of the head 13 millims., that of the stem 39 millims. The colour is pale yellowish grey. The transverse section of the head is oval; its upper surface is flattened, and in one specimen quite plain; in the other (fig. 2) it has a large, oblong, well-defined aperture, from which canals, separated by irregular partitions, are seen to penetrate into the interior. This is the well-known osculum (Bowerbank), which the living Sponge is capable of opening and closing at will, and its interior canal-system. The surface of the head (fig. 3) is smooth, finely and irregularly reticulated, with scattered and somewhat larger lacunæ, and, when seen under the microscope, seems as if covered with very fine hairs from projecting spicules. The stem, which is hard, firm, and elastic, has a distinct, finely hairy

* Translated from the 'Öfversigt af K. Vetenskaps Akademiens Förhandlingar,' Stockholm, 1868, p. 105.

dermal layer. Its inferior end is thickened into a dilated base, from which the fine root-fibres spread in branches, forming loops, and having attached to them numerous grains of sand, spicules of sponges, and Foraminifera.

A closer examination has given the following results. The dermal layer of the stem is thin, but tough, and may be drawn off in long pieces. It then shows a transparent uncoloured protoplasma, full of small yellowish granular corpuscles, with or without larger granules (fig. 4). In this parenchyma is imbedded (fig. 5) a felt of very small siliceous spicules, spindle-shaped, not inflated in the middle, furnished with a central canal (fig. 6). When measured, these were found to be from 0·1 millim. in length and 0·0018 millim. in thickness to 0·08 millim. in length and 0·002 millim. in thickness; the mean length was 0·08 millim., and the relation between length and thickness in one as 100 : 3·6, in another as 100 : 1·8, the mean of eight measurements as 100 : 2·76. The granules of the parenchyma are more discernible if prepared with glycerine, while the spicules are more distinct in Canada balsam.

Within the dermal layer the stem is made up of closely packed spicules, held together by a relatively small quantity of parenchyma (fig. 7). At first sight it seems as if the stem were composed of very long, rather spiral filaments; but a closer examination shows the spicules to be very short, but disposed in strings; so that the whole has the aspect presented in fig. 8. The spicules are all of the same type: they are spindle-shaped needles (figs. 9, 10, 11), having near the middle a slight but distinct globular inflation or nodule, and tapering towards either end from that point, not in a straight line, but forming together a very obtuse angle. It is owing to this peculiarity that the needles, united in rows, produce the slightly spiral structure of the stem. Every needle ends in a fine but rounded point (fig. 12). They are more or less round. The layers of which they consist are not to be discerned; only the exterior one appears in the transverse section (fig. 13) as a very thin ring. They have a fine central canal, which, if the needle is not broken, is closed at the point. When the inflation in the middle is not larger than is shown in figs. 9, 10, 11, the central canal goes through it without branching; but if the nodule has increased a little more in two opposite directions (as is shown in fig. 14), which is very seldom the case, two fine but distinct transverse canals are seen to go off crosswise from the central canal into its nodule or inflation. I have not observed this formation of secondary canals in the middle nodule carried further than shown in fig. 14; it is an incipient branching, and appears also in other parts of the

needle. Figs. 15 and 16 show beginnings of such branches directed towards the middle of the needle; figs. 17 and 18 the same directed towards the point. Sometimes the branching is double crosswise, four branches with four canals (fig. 19), sometimes regularly, sometimes rather irregularly, or in connexion with bifurcation (fig. 20). I have, besides, several times found an irregular heap of round, bladder-like tuberosities (figs. 21, 22, 23), to which the central canal gives no branches. Often there are spicules with graduated points (figs. 24, 25); very seldom their surface is studded with short, pointed projections (fig. 26).

When the spicule is perfectly entire and uninjured, the contents of the central canal, even after boiling in nitric acid, retain their transparency; but if the spicule has been broken, even scarcely perceptibly, at the outermost point, the canal is partly filled with long, interrupted columns of gas, less transparent than the lumen of the canal (figs. 28, 29, 30).

Prof. Lieberkühn observed the first formation of siliceous spicules in young individuals of *Spongilla**. In a cell with nucleus and nucleolus there appears among the granules a little ball of silica, from which, in opposite directions, but not exactly in the same straight line, shoot out two points, which are little by little elongated, until they form spindle-shaped needles, the ball remaining near the middle as the nodule. It is hardly to be doubted that the inflation or nodule in the spindle-shaped needles of our sponge, and which, as long as it is of small size, receives no branches from the central canal, is the part earliest formed—the siliceous ball. Of the growth of the needle, free in the parenchyma, we know at present very little. It increases by layers one over another. Prof. Kölliker, who regards the canal as a solid fibre of soft organic matter, on which, within the cell and from its contents, silica is deposited, supposes that the spicule increases by secretion of silica from the parenchyma in layers one above another†. In our sponge these layers are scarcely discernible. But another siliceous sponge from the Arctic Sea has offered some observations which may deserve to be previously mentioned here. The layers are very distinct, and seem to be alternately soft and hard. A spicule has lost, near the end, its exterior layer, so that the point projects beyond the remaining part of it, as out of a sheath. Between the outermost broken lamella and the exterior surface of the uninjured point there is a space, the former contents of which, a soft substance, have disappeared, the Canada balsam now occupying their place. If one of the

* Müller's Archiv, 1856, p. 408, t. 15. f. 17–23.

† Icones histiologicæ, i. p. 61.

spicules, boiled in nitric acid, has been a little damaged, its inner parts are altered; if the point is broken, there appears in the canal, and between two or more layers of silica, besides some gas, a black substance—the carbonized soft matter. If the point is not damaged, but the side, this substance is spread between the outermost layer and the next, but the canal and the inner layers retain their transparency unaltered. In one spicule a part of the canal and the interval between the innermost and the following layer is filled with the dark substance, which has been pressed out right through a third layer, by very fine pores, at right angles from the longitudinal axis. From this it seems to follow that the canal, normally closed at the ends, contains a soft organic matter alternating with the lamellæ of silica in such a manner that one of these is the exterior, and that the layers are perforated with minute pores. The fluid contents of the needle accordingly may be in contact with the exterior, and an exchange of substance take place. That this is really the case is shown by the manner in which branches are first formed, when the hitherto firm and straight lamellæ, as if yielding to a force from the interior, without fracture, bend outwards with undiminished thickness, and, bulging out, soon take up in the interior a branch from the central canal. The silica of the exterior layers has its source in the surrounding parenchyma. The spicule is by degrees covered with new layers of silica. If an anchorate spicule, which is of the same structure, with central canal and lamellæ, is brought into contact with a needle, it is soldered to it, covered with layers of silica, and finally partly immersed in the needle, thick and with blunted outlines, whilst in the interior the originally slender and elaborate form is well discerned through the glassy mass.

The spicules of our sponge are of various lengths. I have found them from 2·93 millims. in length and 0·047 millim. in thickness to 0·79 millim. in length and 0·01 millim. in thickness, the mean length 2·12 millims.,—the relation of length to thickness being in one as 100 : 1·95, in another as 100 : 0·93, the mean relation as 100 : 1·42.

The stem is continued into the head above its middle, and there ends conically. From that part proceed the spicules which give to the head its structure, form, and consistency (figs. 31, 32). Between the erect spicules of the stem, bundles of needles are inserted (fig. 33), which radiate in different directions (if with any regularity I cannot say), downwards, upwards, and to the sides. These bundles are light and firm as the stem, arcuated, gradually broader and somewhat flattened, soon divided into several almost cylindrical branches;

they consist of spindle-shaped needles, of exactly the same type as those of the stem, but smaller. Ten measurements have given from 1·14 millim. in length and 0·013 millim. in thickness to 0·4 millim. in length and 0·011 millim. in thickness; the mean length was 0·73 millim., and the relation of length to thickness in one as 100 : 2·86, in another as 100 : 1·09, the mean of twelve measurements being 100 : 1·85. Very rarely there appear some few small straight needles without nodules near the middle (fig. 27). The nearer the surface, the more the bundles divide; but, regularly, not one of their spicules reaches out of the dermal layer, in which appear other spicules (fig. 34) of the same type as those in the skin of the stem, but longer, arcuated, without nodule (fig. 35), and placed in the same manner. The measurements gave from 0·45 millim. in length and 0·004 millim. in thickness to 0·34 millim. in length and 0·0046 millim. in thickness; the mean length was 0·39 millim.; the relation of length to thickness in one as 100 : 1·25, in another as 100 : 0·8, the mean being 100 : 1.

The interstices between these bundles of spicules, which form the partitions of the canal-system of the head, are filled with the parenchyma, which, although it has been a very long time under the influence of the alcohol, has a yellowish-brown colour, is firm and tough, has very numerous, mostly oblong corpuscles and granules, among which there are some larger ones with granular contents (fig. 36).

From the rather thickened base of the stem, out of its dermal layer, a great number of roots go off, irregular and branched filaments here and there forming loops and gradually spreading over a surface almost twice as great as the upper surface of the head (fig. 37). The roots consist in greater part of a tolerably transparent colourless substance, the same as that of the skin, covered by a somewhat thin layer of fine, yellowish, granular matter. Very rare, extremely small and straight spicules may possibly belong to this layer, though it is very difficult to refer them to it with certainty among the great number of foreign objects of many kinds which are attached by the granular layer's having crept over them and penetrated even into the canal of the fragments of sponge-spicules (fig. 38).

When the stem of the sponge is broken not far from the root, and the upper part, thus separated from the basal, is turned upside down and placed on the flattened surface of the head, the stump of the stem directed upwards, it has an unquestionable likeness to the well-known *Hyalonema Sieboldi*, Gray, as this has been hitherto exhibited. What we have

called the head answers to "the sponge" of the *Hyalonema*, and the stump of the stem to the splendid "twisted cord" hitherto supposed to rise from the sponge. But the difference of size is very considerable. The large specimen of *Hyalonema* figured by Professor Max Schultze has "the sponge" ten times as high and in volume more than six hundred times as large as the head of our sponge, "the twisted cord" eight times as long and very much thicker.

The opinions as to the true nature of the *Hyalonema* have been widely different among naturalists. That the zoophyte *Palythoa* and the sponge *Hyalonema* are two separate organisms no doubt is possible. Professor Max Schultze's researches have settled this question, on which opinions have been so divided. In another point all who have treated of the *Hyalonema* as a natural production have agreed: they all assume "the sponge" to be the basal part, "the coil" a part arising from it.

But if we regard the *Hyalonema* in the contrary manner, if we place it so that "the sponge" is upwards, "the coil" downwards, and suppose this to be only a part of the stem, torn off by the fisherman's line, the remainder having been left attached to the bottom (in the same manner, for example, as the deeply immersed *Lygus mirabilis* (O. F. M.) is so often cut off by the dredge), and if we then compare it more closely with the sponge here described and figured, we shall have, as I will try to show, a view of its structure and habits approaching more nearly to the truth than that now generally accepted.

The surface of the *Hyalonema* called the lower one of "the sponge" is now the upper one, corresponding to that which is marked *a* in fig. 1, and shown by fig. 2. In our sponge this surface is provided with a great osculum, in the bottom of which the canal-system is seen entering the inner parts of the head. Professor Max Schultze is the only author who has described the same surface in the *Hyalonema*. If ever attached to the bottom, it ought to bear traces of it; sand, fragments of shells, Foraminifera would, as usual (for example, in *Euplectella cucumer*, Owen, and *E. aspergillum*, Owen), adhere to it. This, however, is not mentioned. On the other hand, there open on this surface "not less than six irregularly oval apertures, half an inch wide, which are in connexion with anastomosing canals, bordered by a membranous and porous network of siliceous needles. These canals can be followed as far as two inches deep in the sponge, and form an irregular lacunar system, which is in conjunction, through the fine meshes of the spongious network, with the openings on the surface." It is evidently the oscula of *Hyalonema*, with the

canal-system, which Prof. Schultze here describes; and it is difficult to explain the extraordinary circumstance that these openings, which are so important to the life of the sponge, should have their place where it is adherent to the rock, and where the current issuing from them would meet with such resistance.

By an incision in the head ("the sponge") Prof. Schultze laid open its inner structure. The stem ("the coil") is continued, as in our sponge, deeply into it; and the spicules of the head, inserted among the larger ones of the axis in the form of flattened strings or blades, are regularly disposed all round "the axis." The figure (M. Schultze, 'Die Hyalonemen,' pl. 2. f. 1) shows, though rather indistinctly, this structure, which accords well with that of our sponge. The parenchyma of the specimens examined by Prof. Schultze, was very much diminished by drying.

It is evident that the stem ("the coil") of all the specimens of *Hyalonema* described has been torn off at its free end. Professor Schultze expressly states that its long needles are all broken; they are of the same type of form as those of our sponge—spindle-shaped, more or less round, thickest at the middle, tapering towards both ends, and somewhat spirally bent. The thickest part of many of the smaller and those of middle size has an inflation or nodule, in the interior of which the central canal gives off two short transverse canals, at right angles and in opposite directions. All this is as in our Sponge. From this simple primary type of spicule a number of secondary, more complicated forms are derived, almost without exception the same as in our Sponge, although in the latter not so fully developed. Such are the spicules with graduated ends (*l. c.* pl. 3. f. 5, 6, 7, our figs. 24, 25) or studded with short spines, into which the canal does not enter (*l. c.* pl. 3. f. 1–4, 9–15, our fig. 26), or with branches in two or four crossing directions (*l. c.* pl. 4. fig. 1, our figs. 14, 19); but those of *Hyalonema* are strongly and perfectly developed, forming six-rayed needles, or five-rayed ones where one part of the primitive needle is lost (*l. c.* pl. 4. f. 3, 5, 6). There can be a branch also in only one side (*l. c.* pl. 3. f. 15, to compare with our figs. 15, 18). Whether the arcuated spicules without nodules, found in the dermal layer of our sponge (figs. 6, 35), are to be recognized in the spicules figured by Prof. Schultze (pl. 3. f. 2, 3) may be left undecided.

Besides these affinities, there are also differences. In addition to the spindle-shaped needles, *Hyalonema* has also another type of siliceous spicules, which are not to be found in the specimens of our sponge I have examined. It is the type of

the amphidisci (birotulate spicula, Bow.) described and figured by Messrs. Bowerbank and Schultze. Spicules of this form are found, as far as hitherto known, among marine sponges, so perfect only in *Hyalonema*, and less perfect in *Halichondria* and in the freshwater genus *Spongilla*, where they are well known from the excellent and long-continued researches of Prof. Lieberkühn*. In this genus they enter into the composition of the envelope of the gemmules (ovaria, Bow.) in great number and in regular order. This kind of spicules accordingly is in connexion with the propagation. In *Hyalonema* Prof. Schultze searched in vain for such an arrangement; but this cannot be expected to be recognized in its primitive order in a dried specimen. If the specimens of our Sponge here described, so extremely small in comparison with the gigantic *Hyalonema Sieboldi*, were young, not yet prolific, or if the sexes were separated in this form of Sponges, the absence of the amphidisci might be explained.

The spindle-shaped needles of the stem of *Hyalonema* are of an immense length. The greater number of them reach from one end to the other; some of them are up to 0·67 metre long. The entire ones have their greatest thickness a little under the middle. The longest, though broken, needles have their thickest part nearer their free end. If this point is supposed to be at a distance of 0·5 metre from the end concealed in the interior of the sponge, then the longest needles, when entire, ought to have had the length of a metre, nearly eight times the longitudinal axis of the head. The longest needles of our sponge are not the fourth part of the length of the head. The stem of the Japanese sponge may have had the length of a single needle; thirteen needles of the longest in our sponge would not, if laid end to end, have attained the length of the stem, which is, however, not more than thrice that of the head. This great difference in the length of the needles cannot be entirely explained by the young state of the individuals; their character of incomplete development, however, appears, as already remarked, by the comparison between their secondary forms, which in our Sponge are much less developed; and the same character is probably also indicated by the circumstance that in our Sponge the nodule very seldom receives transverse branches from the central canal, which appears to be a common case in *Hyalonema*. It may also be remarked that in *Hyalonema* the deposition of siliceous layers in the longest needles has gone so far that the nodule at the middle has been outwardly quite concealed, while its

* Müller's Archiv, 1856, pl. 15. f. 28, 29, 30; Bowerbank, British Spongiadæ, figs. 208–222, 317–319.

innermost layers, by being bent, show that it existed when the needle was smaller. This may also possibly be an indication that the specimens of *Hyalonema* examined are old individuals.

The long needles of *Hyalonema* present a singularity first observed by Dr. Gray, and of which no trace is seen in our sponge. Their free ends have hooks placed in rings or spirals directed towards the thickest point of the needle. Professor Schultze expressly remarks that this cannot depend on the exterior layers having been partly broken. It is an uncommon case.

Professor Schultze, who described the oscula of the flattened surface of the head of his great *Hyalonema*, found this same surface in the smaller younger specimens covered by a network of spicules similar to that which covers the free end of *Euplectella cucumer*, Owen, and *E. aspergillum*, Owen*. Nothing similar is to be found in our sponge.

The head of the large specimen of *Hyalonema* examined by Professor Schultze shows a great number of circular holes, with a diameter of nearly a line, surrounded by bundles of fine siliceous needles, radiating in all directions from their edges. They are not at all to be found in our sponge. Professor Schultze regards them as "chimneys" (that is, oscula); but these are situated, as shown above, in *Hyalonema* as in our and many other species, on the free surface of the head. Pores for entering currents they cannot be. In their present form they are probably foreign to the structure of the sponge, tubes formed by the same parasitic zoophyte which Prof. Schultze discovered in their yellowish-brown clothing, and the urticating organs and arms of which he recognized.

In looking back on what is said above—the differences (which may depend partly on distinction of species or different ages, partly on incomplete observation), the affinities in the most important points (in the form of the head, with its great oscula on the free surface, the spicules in its interior radiating around the upper end of a stem composed of spindle-shaped siliceous needles)—it seems to follow that the little sponge which I have described, from the great depth of the North Sea, is a *Hyalonema* in its complete state, with its stem uninjured, and with its roots. But with regard to certain differences—the absence of amphidisci (which seem to belong to the propagation), the much shorter spindle-shaped needles and their little-developed secondary forms—it seems probable that the specimens I have described are young individuals of a

* *Loc. cit.* p. 9; Owen, Trans. Zool. Soc. iii. p. 203, pl. 13; Trans. Linn. Soc. xxii. pl. 21, see footnote, p. 118.

species of *Hyalonema* distinct both from *H. Sieboldi*, Gray, and from *H. lusitanicum*, Barboza du Bocage. In the present state of our knowledge of sponges, it is not advisable to make a new genus of it.

There exist between the fauna of lower animals living in the North Sea or fossil in the Crag formation, on one side, and that of the Japan seas, on the other, certain analogies which deserve to be kept in view. The crustacean *Geryon tridens*, for instance, described by Kröyer, which lives in the North Sea, always far from the shore, bears a very close affinity to the Japanese genus *Galena* of De Haan.

Hyalonema may be traced far back in geological time. The sponge from the Greensand figured as *Siphonia pyriformis*, Goldf., by J. de C. Sowerby*, has a strong resemblance to it; and Prof. Suess has recognized it in the *Serpula parallela*, M'Coy, of the Yorkshire Coal-formation †.

The genus *Hyalonema* may be characterized thus:—

HYALONEMA, Gray.

Spongia silicea; corpus clavatum in facie superiore applanata oscula gerens, stipite suffultum intrante, tereti, radiculis affixo. Spicula fusiformia stipitis ad longitudinem spiraliter et arte conjuncta parenchymate tenui; corporis in fasciculos radiantes congesta, interstitiis parenchyma lacunosum amplum continentibus; cuticulæ simplicia arcuata; amphidisci [gemmulas vestientes?].

1. *Hyalonema Sieboldi*, Gray.

Hab. in mari Japoniæ.

2. *H. lusitanicum*, Barboza du Bocage.

Hab. in mari Atlantico extra oras Lusitaniæ.

3. *H. boreale*, nob.

Hab. in mari septentrionali extra oras Norvegiæ, profunditate 200 orgyarum.

EXPLANATION OF PLATE VI.

Fig. 1. *Hyalonema boreale*, nob., magnitudine sesquies aucta.
Fig. 2. Facies superior cum osculo.
Fig. 3. Facies externa strati dermalis.
Fig. 4. Eadem, magnitudine auctiore.
Fig. 5. Spiculorum ejusdem congeries.

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* Fitton, 'Strata below the Chalk,' p. 340, pl. 15 *a*.

† Verhandl. zool.-bot. Gesellschaft Wien, xii. p. 85. (Ann. Nat. Hist. ser. 3. xviii. 404.)

Fig. 6. Spicula singula.
Fig. 7. Stipitis sectio longitudinalis cum parenchymate.
Fig. 8. Stipitis pars, sublato strato dermali.
Figs. 9–11. Spicula fusiformia, simplicia.
Fig. 12. Apex spiculi.
Fig. 13. Sectio ejusdem.
Fig. 14. Spiculi pars media, ramis inchoatis canalem excipientibus.
Figs. 15–26. Spiculorum formæ secundariæ.
Fig. 27. Spiculum minutum simplicissimum, rarum.
Figs. 28–30. Spicula fracta, canali aëre repleto.
Figs. 31, 32. Sectiones longitudinales corporis.
Fig. 33. Finis stipitis in eodem, cum fasciculis spiculorum radiantibus.
Fig. 34. Ramuli ultimi fasciculi.
Fig. 35. Spiculum strati dermalis corporis.
Fig. 36. Parenchyma corporis.
Fig. 37. Radicis pars.
Fig. 38. Spongolithes in parenchymate radicis exceptus.

IX.—*List of Coleoptera received from Old Calabar, on the West Coast of Africa.* By Andrew Murray, F.L.S.

[Continued from vol. i. p. 333.]

[Plate VIII.]

Lycidæ (*continued*).

Metriorhynchus, Guérin-Ménev.

1. *Metriorhynchus sulcicollis.*

Lycus sulcicollis, Thoms. Arch. Ent. ii. p. 78.

I have received two species which, I believe, respectively belong to Mr. James Thomson's *Lycus sulcicollis* and *Lycus semiflabellatus*. His description of the former is as follows:—

"Prothorax of a brownish black, with yellow sides; elytra yellow, with the posterior fourth black; underside black; base of the thighs yellow.

"Very elongated, almost parallel in the male. Female with the antennæ very broad, almost pectinated. Prothorax with the anterior margin very projecting in the middle; sides lightly sinuated, posterior angles sharp; base strongly bisinuated, in the middle a very deep channel, changing into a ridge in front. Elytra each with four strong ridges, the intervals regularly reticulated.

"Length 7 to 11 millims., breadth $2\frac{1}{2}$ to 4 millims."

With all this my specimens agree; but they have also one or two other striking characters, which one would have expected to be mentioned if they were present. The black an-