On an Undescribed British Sponge of the Genus *Raphiodesma* (Bowerbank.)

By J. G. Waller.

(Read April 23rd, 1880.*)*

PLATE V.

During a stay of two months at Torquay, engaged eight hours a day, there was but little opportunity for recreation in Natural History. Nevertheless, each evening I was down by the sea-side, either at Anstey's Cove or at Meadfoot, and, occasionally, when tide served, at that very interesting spot, Hope's Nose, the eastern promontory of Torbay. Abundance of the *Laminaria* here often strews the coast, and their roots are incrusted with sponges and other organisms. It afforded a very ready means of collection, and thus I became possessed of some rare examples, and of the one, I am about to describe as, new to our fauna, as well, also, of many early states of growth, which is always interesting to observe.

It was upon a small pebble held in the root grapple of *Laminaria saccharina* that I found the sponge in question, but before I proceed to describe it, I must call attention to another, found under similar conditions in many different stages of development, and generally in the deepest recesses. It was very small and insignificant, and might easily have escaped attention. When examined, it was seen to be crawling over the rootlets in a very regular manner, sometimes over small pebbles held within them. Upon this one of limestone, we see it in its youngest development, and it is interesting and instructive to note its peculiar mode of growth. It begins with a few spicules, arranged in a somewhat semi-circular form, and, at nearly right angles, are fasciculi of the same disposed with almost rhythmical regularity, with about equal distances between each fascicle ; and thus it proceeds in *one* direction only, moving forwards, and never reversing its steps (Fig. 1). This is remarkable in a sessile sponge, which, in general, developes all round from a centre, and spreads in every direction ; it is, therefore, a feature to be noted, as it ceases to be visible, when, in a further development, there

are accumulated layers, one over the other, which may start from a base having another axis.

Procuring a portion for microscopic examination, after giving it a rigid scrutiny, I became convinced that it was the sponge to which Dr. Bowerbank had given the name of *Hymeniacidon macilenta*, the specific term being very expressive of its meagre condition or habit. His description, however, in no way alludes to the peculiarity to which I have drawn attention, or to its fascicular arrangement of the spicules. The specimen, therefore, from which he made his description, must have been so developed as to have concealed this structure, which could scarcely, otherwise, have escaped the attention of so good an observer. Let me, however, now refer to the intimate characters of *Hymeniacidon macilenta* as set down in Vol. ii., p. 176, of the "British Spongiadæ."

It is described as thinly coating zoophytes, and in the living condition to be of a bright scarlet colour. The skeleton spicules are sub-clavate acuate, those of the membranes of the same character, but longer and slender; and amongst the latter a few tricurvate-acerate. Retentive spicula, inequibidentate and dentato-palmate anchorate, small, and few in number, and the latter also very minute. One of the most characteristic forms, which are most abundant, are contort bihamate spicules of a large size.

It is unnecessary to give any further details. But we must now turn our attention to another genus, which Dr. Bowerbank divided from this of *Hymeniacidon* on account of some special characteristics, which bear directly upon the subject in hand. *Hymeniacidon* is specialised, as having its spicules disposed without any kind of order on the membranes. It is obvious, therefore, that the sponge I have been describing as *H. macilenta* cannot be consistently considered as belonging to the genus thus defined. It is impossible to say that the spicules are arranged without order. Yet there can be no doubt, that it is the same as that above-named, but in a different state of development. That this not only belongs to the genus separated from *Hymeniacidon* under the name of *Raphiodesma*, but must also be referred to a species described by Dr. Bowerbank in Vol. iii., p. 230, I will now proceed to consider.

The genus *Raphiodesma* is distinguished from that of *Hymeniacidon* in that its skeleton is composed of bundles of spicules unconnected with each other, the fascicules being represented as compacted at their centres, but free at each end. But this latter character will require some modification, as I shall presently show.

Furthermore, these fasciculi are stated to be carelessly thrown together in every possible direction, the interstices forming elongated, angular areas, like that of a confused mass of netting extended in one direction only. Sufficient for our purpose this to comprehend the character of the genus, so we will now go to the special form within it, to which allusion has been made, and to which I propose to combine *H. macilenta*. This is *Raphiodesma sordida*, described in the "Spongiadæ," Vol. iii., p. 230.

In this description, it, like *H. macilenta*, is parasitic—its colour red or orange in the living state. Its skeleton spicules are subclavate acuate, those of membranes the same, but more slender, a few slender tricurvate ones. Retentive spicula contort bihamate numerous, also bi-dentate, inequi-anchorate, dentato-palmate—the latter congregated in rosette-shaped groups.

Now this, as nearly as possible, accords with that of *H. macilenta*, and what differences appear in Dr. Bowerbank's fuller account are too slight to warrant any separation the one from the other. Solely we miss the rosettes in the latter, which distinguish so many of the genus *Raphiodesma*, and are sometimes so abundantly found in the species to which I consider it ought to be referred. But, even this must give way, for in some of my preparations I have detected this very interesting feature, and may also state that it is often scarce in the species, wherein it is really a constant form. I do not, therefore, think, that there can be the smallest doubt, but that these described as two, are really but one species in different stages of development.* And, if this be admitted, it is necessary to point out, that the earlier condition of growth, seen in the fascicules, do not show the peculiarity of being attached at the centre, but rather are fixed at the base and spread out at the apices, somewhat resembling the venerable scholastic institution called "birch." Nor in the full development of *Raphiodesma sordida* is this always lost, though in *R. lingua*, its near ally, the fasces strictly conform to the tabulated characters of the genus.

I have felt myself to be under a double necessity in thus introducing my subject, first, because the sponge I am about to describe to you appeared to me, before I gave it an intimate examination, to be that I have identified as *H. macilenta*, or, as rather the early condition of *R. sordida;* secondly, because I cannot think

* In this opinion our member, Mr. Priest, to whom I am indebted for several specimens of *R. sordida*, perfectly concurs, and was early to express his decision.

that the former can retain its place as a species, nor do I believe that, had Dr. Bowerbank lived to see such facts as I have stated, he himself would have retained it. The new sponge has much in common with it in general mode of growth, especially in the young condition as above described. The fasces proceed in one direction from a base. They spread out birch-like in form, and have precisely the same kind of spicules in the skeleton. Nothing but the microscope could have separated the two, yet that also distinctly allies it to the group of *Raphiodesma*, to which both must now be referred.

The sponge in question was found sessile upon a small pebble of limestone within the roots of *Laminaria saccharina*. It is extremely small, only measuring $\frac{1}{4}$in. by $\frac{1}{8}$. In this, its dry and well bleached condition, no natural colours are preserved ; it is simply of a creamy white, such as most of the siliceous sponges assume when they have been thrown up on the coast exposed to sun and air. We lose, therefore, all features but those of its intimate structure, which makes it a subject for the microscope. Its general appearance under examination is confused. But this confusion, nevertheless, has an order, and, although it may sound paradoxical, is the result of order. The fasciculi, which seem as if culminating one over the other, forming a ridge in the most developed part, nevertheless obey a law which dictates their progression in one direction only from a base, following nearly a right line from it. Nor do they ever reverse their route in an opposite direction (Fig. 2). And in this they conform exactly to the rule obeyed in the sponge I have previously spoken of as *H. macilenta*. But, as I have shown, that as different layers start from another base, they will naturally cover over the one beneath at a different angle, so, in the end, the whole mass may assume an heterogeneous mixture apparently devoid of order.

As the sponge was not found in a fresh condition, one is not able to pronounce an opinion as to the distribution of either oscula or pores. None of the latter are visible, but there are indications of some of the former, though not very conspicuous. The whole of the membranes, which are pellucid, are thickly matted with fine hair-like acerate spicules, somewhat flexuous, as is generally the case when such are delicate in form. These spicules, abundantly interwoven together, (Fig. 5) and combined by a very large number of minute anchorate forms, quite separate it from any of its congeners, though it is intimately allied, in general character, to all others of the genus. A portion of the basal membrane shows us the early mode of develop-

ment, and as all sponges commence by a membranous expansion, it is interesting to take particular note of this feature. The hair-like spicules have a fascicular arrangement though laid in flat bands, the spicules parallel to each other. A few of the skeleton spicules, without any defined order, cross these irregularly, as well as a few of the finer kinds which belong specially to the membranes, and interspersed, as previously stated, are scattered small anchorate spicules (Fig. 3). Upon this membrane the sponge developes its fascicules, proper to the skeleton in that regular order described as belonging to this and to the sponges alluded to, as congeners.

We are a long way as yet from any cognisance of the laws which separate one species from another, but there is no reason why they should not be similar to those operative in the vegetable kingdom. A slight shift of a plant to fresh earth is sometimes sufficient to produce changes which would move many observers to talk of a separate species, so that it is not only possible, but probable, the development of a sponge under either restricted conditions of growth, or of a more exuberant fertility, may equally change its nature and produce a variation. I have already shown how great is the variation with our freshwater sponge (*Spongilla fluviatilis*), and there can be no reason why it may not operate extensively amongst the marine sponges ; I cannot help thinking that, if more accurate knowledge was obtained, it would reduce the number of species. It is, to my mind, far more interesting and more instructive to combine together groups under the name of variation, than add to our already overweighted terminology by a persistent separation. I shall, therefore, now call upon you to follow me in an examination of the whole of the genus *Raphiodesma*, to show how closely they are allied, and how much of their divergencies may arise from slight differences of conditions under which they have developed.

Three, out of four of the species tabulated by Dr. Bowerbank, are marked by possessing those beautiful rosettes formed of clusters of anchorate spicules. In the species under consideration, one of these also occurs, thus making no doubt of its close alliance (Fig. 6). But in mode of growth, as spreading over thinly, it is nearest to that of *R. floreum*, separated from it, however, as from all others, in the want of the bihamate spicule. This latter form unites *R. floreum* directly with *R. sordida*, indirectly with *R. lingua*, wherein these are found so extremely minute as to require high powers for examination. *R. floreum* wants the tricurvate spicule of *R. sordida*, or it is difficult to see how, in their structural details, you could separate the one

from the other. *R. lingua* is the most robust of the genus, growing to a larger size than any other ; its skeleton spicules are correspondent ; we lose the clavate form, and they are simply acuate. It differs mostly in the larger and more compound character of its fasciculi, in which there is no pretence of the birch-like form or of the bases or apices being coincident. The skeleton spicules ally it to *R. simplissima*, which, however, is wanting in all the other forms found in the genus.*

I have thus shown the natural alliance of the group, and how they diverge the one from the other. Whether they must not hereafter, be brought closer to each other, is a matter we cannot at present decide. I confess the tendency of my mind is to reject as evidence of distinction of species very minute details ; at best it is arbitrary, and the result of our ignorance rather than of our knowledge. It is, therefore, with something of a pang or twinge of conscience I feel compelled to add a new name, but I sincerely hope it may hereafter be disposed of. I propose that of *Raphiodesma minima*, which expresses the smallness of its size as found.

In the Sponge under consideration, the form of the anchorate palmate spicule does not differ materially from that common to the genus (Fig. 7). In its smaller size, it is very abundant on the membranes, intermingled with its fine hair-like spicules. These latter may be analogous to the extremely small acuate spicule of *R. lingua*. It is well to note that spicules which belong to the membranes, and generally of a minute size, are sometimes found nearly obsolete. In few sections of *R. sordida* have I found *in situ* the tricurvate figure given by Dr. Bowerbank, but in those of *H. macilenta*† they are extremely abundant, interweaving with the bihamates. These latter also are often sparsely distributed in *R. sordida*, and vary in size ; but this must naturally be looked for in examples not fully developed. Dimensions of spicula, when given, must be taken with some little reserve, for they are not constant in the same species, and can never be depended upon as a character to distinguish a species.

There is still, however, something further to be said on analogies, and the harmonious alliance between divergent forms. It is interesting to trace the connection of species, still more so, when through

* Refer to Dr. Bowerbank's "Spongiadæ," Vol. iii., Plates xxxvii, xlvii, lxxvii, lxxvi, xc.

† I use this term as referring to examples in my collection which agree with Dr. B.'s description, but my argument is that it is not a species.

them, we trace the connection of genera, and thus extend the genealogy. *Raphiodesma* is a progression, perhaps, we may say, to a higher development, from the simpler structure seen in *Hymeniacidon*. In this latter, there is no sort of regularity in the arrangement of spicules; but, in the former, there is a beginning at least of order in the fasciculi and their disposition, which naturally leads on to another higher development in the genus *Desmacidon*. Now, in following out this natural progression, it is interesting to observe that we carry with us the same character of spicules.

We have seen how, in *Raphiodesma*, there is an attempt to form a more regular skeleton than that of *Hymeniacidon*, but that the network is never connected. In the next genus, *Desmacidon*, we find this done and perfected. Let us now see which of the species allies itself closest with the genus in question.

Desmacidon consists of a fibrous network, well-marked and defined, "composed entirely of spicules arranged in accordance with the axis of the fibre, cemented together, and thinly covered with keratode." Out of twelve species which Dr. Bowerbank has tabulated, six present us with forms of spicules associated together precisely like those in *Raphiodesma*. This is remarkably shown in *D. copiosus*, where are two forms of sub-clavate spicules in the skeleton, as in *R. sordida*, small tricurvate and also two kinds of anchorate spicules very closely resembling those of the latter species, as well as the bihamate form. So that the two species of two different genera are in this particular nearly identical. In *D. ægagropila* there are the same general forms, but without the tricurvate. *D. constrictus* presents us with the same forms as the latter, though with a remarkable development in the anchorate spicules as well as in those of the skeleton. *D. similaris* has acuate skeleton spicules, anchorate tricurvate and bihamate spicules; *D. Peachii* the sub-clavate spicule again with a divergent form of the bihamate, &c. Lastly, that most interesting species, *D. rotalis*, agrees in possessing similar bihamate and anchorate forms with an acuate skeleton spicule.*

Thus, I think, we clearly perceive in these three genera a progressive development from a lower to a higher type, if we can so call that, which has a more complete network in a more definite order; and this progress, associated with similar forms of spicules,

* For these details I must refer to Dr. Bowerbank's "Spongiadæ," Vol. iii., Plates lxxii., pp. 265, 357; lxiii., lxxxiii., lxxi., p. 183; lxxxix., p. 319; lxiii., xc., p. 327.

seems to show that there is a natural connection between them. If so, it would be a strong argument in favour of the general arrangement of Dr. Bowerbank, as founded on natural conditions, which distinguish one genus from another, yet ally them in a close bond of union.

To recapitulate then : this Sponge, referred to the genus *Raphiodesma*, is but little removed from *R. sordida*, and but for the absence of the tricurvate and bihamate spicules, and the possession of long hair-like acerate spicules in the membranes, as it were in substitution, might easily be pronounced to be the same. It is a problem in the future to show why such a slight divergence exists, or to what development it is due.

Raphiodesma minima (J. G. Waller).

Sponge, Sessile, coating. Colour, in living state, unknown. Dried, cream-white. Pores inconspicuous. Oscula, dispersed, simple, minute. Membranes pellucid, spiculous. Spicules acerate, hair-like, flexuous, intermingled with minute inequianchorate dentato palmate spicules in great abundance, and a few of larger size dispersed and congregated in rosettes. Skeleton. Spicules subclavate, subfusiform, acuate, disposed in regular fasciculi, united at the base, but spreading out at the apex, generally keeping to the length of one spicule ; the bases and apices coincident. In development these fasces seem to proceed in one direction only, at nearly right-angles to a basal axis. The same description of spicules are also found in the membranes, but few and dispersed.

DESCRIPTION OF PLATE V.

Fig. 1. Early development of *Hymeniacidon macilenta* (Bowerbank), from a pebble found at Torquay, showing the regular arrangement of fasces of spicules (40 diam.).

„ 2. Development of *Raphiodesma minima*, exhibiting a similar arrangement of fasciculi (40 diam.).

„ 3. Early development of the basal membrane, fasciculi, &c., of the same (90 diam.).

„ 4. Skeleton spicule (200 diam.).

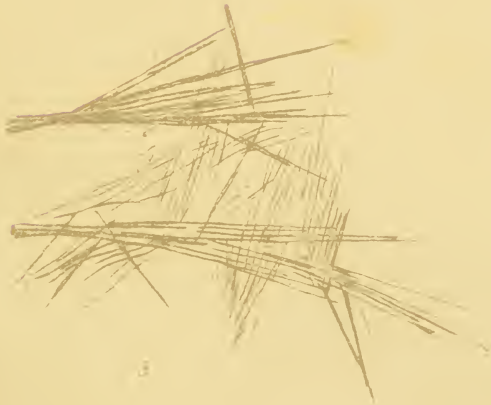
„ 5. Hair-like spicules of the membranes (200 diam.).

„ 6. Rosette of anchorate spicules on one corner of the sponge; the only one preserved (333 diam.).

„ 7. Form of anchorate spicule, showing also side view (333 diam.) The minute examples on the membranes do not differ materially in form, but are about half the size.

1

2



3

4

5

6

7