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XXXV.—*On Astylospongiæ and Anomocladina.*

By KARL A. ZITTEL*.

DR. G. J. HINDE, in his Catalogue of the Fossil Sponges in the British Museum, which will form the foundation for all future spongiological work in England, has expressed some doubt as to the systematic position of the *Astylospongiæ*. The doubts long since communicated to me by Dr. Hinde by letter, have induced me to make a new examination of the skeleton of *Astylospongia* and *Palæomanon*, for which I was able to make use of a considerable number of thin sections of most of the known species.

Astylospongia and *Palæomanon* in their external form, the structure of their skeleton, and their canal-system stand in a certain contrast with the *Hexactinellidæ*. In no typical *Hexactinellid* genus does the skeleton form so thick and massive a wall, in none is the root-tuft or a basal surface of adhesion wanting, and that the canal-system of *Astylospongia* almost exactly resembles that of certain *Lithistidæ*, I have already pointed out in my 'Studien' (Abtheilung i. p. 30; see 'Annals,' ser. 4, vol. xx. p. 412). The skeleton consists of a reticulated latticework, in which from six to nine rays issue more or less regularly from thickened nodes and attach themselves by their extremities to neighbouring crossing knots of the same nature. The skeletal meshes thus formed are sometimes triangular or quadrangular, sometimes irregularly polyhedral.

If we compare this skeleton with that of other Sponges we are struck, in the first place, with a resemblance to some *Dictyonina*. The irregularity of the meshes, the deviation from the rectangular position of the rays, is by no means unusual in typical *Hexactinellidæ*; but in such cases, even when there is great irregularity of the skeleton, the axial canals always show the sex-radiate cross. Nothing of the kind has ever been observed in *Astylospongia*.

Prof. Martin† has very carefully described the skeleton of *Astylospongia* almost simultaneously with myself, and arrived, like myself, at the result that the *Silurian* genus was certainly to be joined with the *Hexactinellidæ*, but that nevertheless considerable differences exist between *Astylospongia* and the typical *Hexactinellidæ*. Martin finds the most important

* Translated by W. S. Dallas, F.L.S., from a separate copy, furnished by the author, of his paper in the 'Neues Jahrbuch für Mineralogie,' &c. 1884, Bd. ii. pp. 75-80, Taf. i. & ii.

† 'Archiv des Vereins der Freunde der Naturgeschichte in Mecklenburg,' Jahrg. xxxi. (1877).

difference in the circumstance that in *Astylospongia* more than six rays generally issue from one nodal point. A positive difference between Martin's description of the skeleton of *Astylospongia* and my own relates to the nature of the "crossing nodes," which are described by me as solid and by Martin as hollow. In this 'Jahrbuch' (1877, pp. 709, 710) I have explained the occasional occurrence of hollow nodes as a consequence of the state of preservation, and I still think I must adhere to this opinion. In another point, however, Martin has completed and corrected my observations. The ramification of the ends of individual bars of the skeleton occurring in *A. pilula* I have since seen not only in the preparation kindly furnished to me by Prof. Martin, but also in sections of other species. This forking is really not the result of later actions, as I formerly thought, but evidently an original peculiarity of the skeletal elements, and, indeed, the solid nodes are produced entirely by the amalgamation of the forked extremities of from six to nine bars. Of this the excellent figure given by Hinde (*l. c.* pl. xxiii. fig. 1 b) leaves scarcely any doubt; but the very accurate drawings

Fig. 1.

Fig. 2.

Fig. 1.—Skeleton of *Astylospongia præmorsa*, Goldf., from the Upper Silurian of North Germany.

Fig. 2.—Skeleton of *Palæomanon cratera*, F. Röm., Upper Silurian, Tennessee.

Enlarged 25 diameters.

which Mr. C. Schwager has had the kindness to prepare for me show very instructively the mode of formation of the "crossing nodes" in both *Astylospongia* (fig. 1) and *Palæomanon* (fig. 2).

Dr. Hinde thinks that he can distinguish two kinds of nodes in *Astylospongia*, some produced by the amalgamation of the slightly forked ends of the skeletal corpuscles, while the others

indicate the point from which the branches belonging to a skeletal element radiate. On careful examination I have only been able to find one kind of node, and think I may assume that all of them have originated in the same way from the union of the furcate ends of several skeletal elements.

From this, however, it follows that *the latticed skeleton of the Astylospongidae does not consist of sexradiates fused together, but of simple rods, both ends of which are branched and, by union with from six to nine other rods, form the characteristic nodes. Hence the Astylospongidae, as they contain no sexradiates, cannot belong to the Hexactinellidae.*

If we look round the other orders of Sponges it is only the Lithistidae that possess skeletal corpuscles with radicle-like branched ends. The external form, the dense, stony nature of the skeleton, and the complicated canal-system of the Astylospongidae also point towards the Lithistidae. Of the four families distinguished among the Lithistidae, the Rhizomorina, Megamorina, and Tetracladina cannot come into consideration, as the form of their skeletal corpuscles is quite different.

Dr. Hinde has therefore very justly indicated the Anomocladina as the group with which the Astylospongidae can best be compared. The typical genera here are *Melonella*, *Cylindrophyma*, and *Mastosia*; with the first *Astylospongia* almost exactly agrees in its canal-system.

The investigation of the Anomocladina formerly offered me greater difficulties than that of the other Lithistidae. Thus it is very seldom that we find well-preserved specimens fitted for microscopic examination; the skeleton is almost always converted into calc-spar or deformed by subsequent silicification. The correct figures of the skeleton of *Cylindrophyma* ('Studien,' ii. pl. v. fig. 6) show a very irregular latticework with thickened nodes, which, however, sometimes acquires a more regular appearance and then resembles the network of a Hexactinellid (see my figures, *l. c.* pl. v. fig. 6 *d* & fig. 7, as also the slightly enlarged figures in Quenstedt's 'Petrefactenkunde Deutschlands,' Schwämme, pl. cxxi. figs. 3 *x* & 4 *y*). I formerly regarded the Anomocladine skeleton as a latticework of which the elements consist of four or more smooth arms meeting together in a thickened centre and branched at their extremities.

In a short memoir upon two new genera of Sponges from the Upper Jura of Sontheim (Jahrb. f. Min. &c. 1883, ii. p. 59) Mr. G. Linck describes, under the name of *Didymosphæra*, an Anomocladine form supposed to be new, but which, according to a preparation for which I am indebted to

the kindness of Dr. Steinmann, is identical with *Cylindrophyma*. Mr. Linck, however, points out some peculiarities of these skeletal corpuscles which show that my definition of the *Anomocladina* is not quite correct. Thus Linck's figures (*l. c.* Taf. ii. fig. 4) represent isolated skeletal corpuscles, "globularly thickened" at both ends and showing a simple axial canal. The axial canal terminates at both ends *before* the thickened inflations, and thus, as Mr. Linck justly remarks, the supposition that several branches meeting together in a node belong to one skeletal corpuscle becomes impossible. In *Cylindrophyma*, therefore, as in *Astylospongia*, the production of the nodes is to be explained as effected in this way—the thickened or, more properly, branched ends of several skeletal elements meet together and become amalgamated. The distinction between *Astylospongia* and *Palæomanon* on the one hand and *Cylindrophyma*, *Melonella*, and *Mastosa* on the other consists chiefly in the fact that in the Silurian genera the straight, rod-like skeletal elements only emit short root-like branches at their extremities, while in the Jurassic forms a stronger furcation of the ends often occurs, and sometimes larger side branches may issue from the main

Fig. 3.

Fig. 4.

Fig. 3 a-d.—Skeleton of *Cylindrophyma milleporata*, Goldf., Upper Jura ϵ , Sontheim.

Fig. 4 a-e.—Skeleton of *Lecanella pateræformis*, Zitt., Upper Jura ϵ , Sontheim. Enlarged 25 diameters.

bar. Mr. Schwager has drawn figs. 3 a-d from an unusually well-preserved specimen of *Cylindrophyma* from the Upper Jura ϵ of Sontheim; and these show clearly the mode of production of the nodes and the construction of the skeleton, and at the same time prove the typical agreement with *Astylo-*

spongia and *Palæomanen*. In all essential characters *Melonella* and *Mastusia* agree with *Cylindrophyma*; on the other hand, *Lecanella*, which I formerly referred to the Anomocladina, shows peculiarities which it is difficult to bring into harmony with the other forms.

In figs. 4 a-f I have had carefully represented some isolated skeletal corpuscles of *Lecanella* which are remarkable for their large size. These were obtained by the action of hydrochloric acid from the still unique original specimen from Sonthelm. If the corroded parts of the sponge-body are examined by direct light it is seen that the skeletal elements are not firmly bound together, but that the furcate ends are only loosely applied to each other without being amalgamated. By treatment with acid, therefore, we never obtain connected parts, but only the isolated corpuscles shown in fig. 4, which evidently represent the primary elements of which the skeleton of *Lecanella* is built up. These, however, can hardly be likened to the simple rods, branched only at the ends, of the typical Anomocladina, for the enlarged nodes are here really the starting-points of 4, 5, 6, or more arms, which are slightly branched at their extremities. The genus *Lecanella* essentially influenced my former incorrect definition of the Anomocladina; if it be removed from that group we find among the Megamorina the genera *Doryderma* and *Heterostinia*, or also *Holodictyon* and *Pachypoteron* of Hinde, the skeletal elements of which show an unmistakable resemblance to those of *Lecanella*.

I therefore do not hesitate to remove *Lecanella* to the Megamorina, and the Silurian genus *Hindia*, Duncan, may also find its right place in the same group.

From the foregoing remarks it appears that, as supposed by Hinde, the Astylospongiidæ do not belong to the Hexactinellidæ, but to the Lithistidæ, and, indeed, to the family Anomocladina. The definition of the latter will then have to be modified as follows:—

Family Anomocladina.

Skeletal elements consisting of simple, generally straight, but sometimes curved rods, more or less strongly branched at the two extremities. The branched ends of several (4-9) neighbouring rods meet together, and by their amalgamation form nodes. In this way is produced a latticework resembling that of certain Hexactinellidæ.

The genera belonging to this family are:—

Astylospongia, F. Römer. Silurian.

Palæomanon, F. Römer. Silurian.

Protachilleum, Zitt. Silurian.

? *Eospongia*, Billings.

Melonella, Zitt. Upper Jura.

Cylindrophyma, Zitt. Upper Jura.

Mastosia, Zitt. Upper Jura and Neocomian.

Vetulina, O. Schm. Recent.

XXXVI.—*Contributions towards a General History of the Marine Polyzoa.* By the Rev. THOMAS HINCKS, B.A., F.R.S.

[Continued from vol. xiii. p. 369.]

[Plates VIII. & IX.]

XIII. POLYZOA FROM VICTORIA (*continued*).

Family Cellulariidae.

MENIPEA, Lamouroux.

Menipea marginata, n. sp. (Pl. IX. fig. 1.)

Zoarium dichotomously branched; branches stout, of considerable width, expanding upwards, with a marginal rib, formed of many tubes closely appressed to one another, which are given off from the dorsal surface. *Zoecia* disposed in 5–7 longitudinal series, alternate, contracted above, expanded below; front wall wholly membranous (no calcareous expansion), margin thin, on the outer edge above three or four tall and stout spines, on the inner two; an operculum springing from the inner side, a short distance below the top of the cell, expanded above, bilobed, and deeply sinuated on the upper margin, placed edgewise; at the bottom of each cell, on one side or both, a small *avicularium* with triangular mandible; the marginal cells larger than the rest and bearing gigantic spines, which form a conspicuous line along the edge of the zoarium (Pl. IX. fig. 1 *b*); below each of these cells a distinct area, on which is placed a very large *avicularium* resembling in many points the articulated avicularium of *Bugula*, but sessile and fixed, the basal region well rounded, the mandibular portion turned upwards, beak strongly uncinat, mandible pointed. *Dorsal surface* flat, the cells showing as fusiform areas; between each pair of marginal zoecia a small rising from which a chitinous tube originates, which unites with the marginal