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XL.—*Descriptions of Sponges from the Neighbourhood of Port Phillip Heads, South Australia, continued.* By H. J. CARTER, F.R.S. &c.

[Continued from p. 127.]

Order VII. HEXACTINELLIDA.

Families.	Groups.
1. <i>Vitreohexactinellida</i>	<div> 1. Patulina. 2. Tubulina. 3. Scopulifera. 4. Rosettifera. 5. Birotulifera. </div>
2. <i>Sarcohexactinellida</i>	<div> 5. Birotulifera. </div>
3. <i>Sarcovitreohexactinellida</i>	<div> Only one species known, viz. <i>Euplectella cucumer</i>, Owen. </div>

This arrangement, based on a hasty study of almost all the then-known species of Hexactinellida, whose result may be seen in the 'Annals' of 1873 (vol. xii. p. 349, pls. xiii. to xvii.), will be found towards the end of my Classification (*ib.* 1875, vol. xvi. pp. 199 and 200), accompanied only by the names of the species respectively which illustrate the groups that have been more particularly noticed in the paper to which I have just alluded. Two more species were described and illustrated in 1877 ('Annals,' vol. xix. p. 122, pl. ix.) and two or three more in 1885 (*ib.* vol. xv. pp. 387-406, pls. xii. to xiv.), among which is the famous *Farrea occa*, now deposited in the British Museum. Those which have been described by others since the date of publication to which I first alluded, and which are very few in number, must be sought for by the student himself.

Unfortunately all that I have stated has been from dry specimens, and the only instance worth mentioning in which the structure of the soft parts has been described from a Hexactinellid sponge preserved in the *wet* state is the description by Prof. Dr. F. E. Schulze of a specimen of *Euplectella aspergillum*, which he received in "January 1880 from the 'Challenger' Office, Edinburgh," for this purpose ('Challenger' Reports, Sponges Hexactinellidæ, pl. A). To mention the author's name is a sufficient guarantee for the authenticity of this kind of work, in which he has never been equalled and can, with his power of delineation, hardly be surpassed. Referring the student to the paper itself, I would only here observe that, at p. 6 of the "separate copy" which the author

kindly sent me, it is stated that the ampullaceous sacs (Geisselkammern), which have a peculiar elongated shape and are placed side by side, with their apertures directed towards the centre of the exhalant canal, like the radial chambers of *Grantia ciliata* around its cloaca, average "about 100 μ " in length and "about 60 μ " in breadth; while those which he had previously described and illustrated in *Spongelia* (Zeitschrift f. wiss. Zoologie, Bd. xxxii. p. 134, Taf. viii. fig. 5) are stated to have averaged "von 0.06-0.1 mm." in diameter. The radial chambers of *Grantia ciliata* vary of course with the size of the specimen, but may be 1-24th in. long by 1-60th in. in diameter and even more, that is about 1.0159 by .5079 millim., so that there is a great difference in size between the ampullaceous sac of *Euplectella aspergillum* and its apparent analogue in *Grantia ciliata*, however much in other respects they may resemble each other.

As there are no specimens of the order Hexactinellida in Mr. Wilson's collections, let us pass on to the next, viz. the Calcarea, wherein will be included not only the specimens which came "from the neighbourhood of Port Phillip Heads," but those also which were subsequently obtained by Mr. Wilson from "Western Port," about 15 miles to the westward.

Order VIII. CALCAREA.

Here I cannot premise as heretofore any classificatory arrangement of the species of this order, as I had not studied them sufficiently for this purpose when my Classification of the Spongida generally was published ('Annals,' l. c.); and not having done much more since in this way I must still, as I did then, recommend the student to study Hæckel's work entitled 'Die Kalkschwämme' (eine Monographie in zwei Bänden Text und einem Atlas mit 60 Tafeln Abbildungen, 1872), to which, however, I must now add the judicious criticism on this work of Dr. N. Polëjaeff, in his "Report on the Calcarea collected by the 'Challenger' Expedition" ('Challenger' Reports, Zoology, vol. viii. pt. xxiv. 1883), and his proposed alterations, throughout which he has not forgotten the respect due to Hæckel nor the advantage he has derived from that first and brilliant step into this field of inquiry which Hæckel has put forth in 'Die Kalkschwämme.' Doubtless there are shortcomings in every man's work, and thus every man's work helps primarily to supply them; hence, as Dr. Polëjaeff properly remarks, "every one is son of his time" (Report, p. 6).

The calcareous sponges were divided by Hæckel into three families, viz. "Ascones, Leucones, and Sycones," which, for very satisfactory reasons, Dr. Polèjaeff (Report, p. 22) has reduced to two divisions, viz. "Homocœla and Heterocœla," the former including the single family of Asconidæ (Ascones), and the latter those of the families Syconidæ (Sycones), Leuconidæ (Leucones), and Teichonidæ (Teichone, Teichonellidæ),—the chief differences between the two being that in the division Ascones or Homocœla there is apparently no parenchymatous tissue, that is, the sponge is almost entirely reduced in structure to a mere tube whose wall hardly amounts to more than a thin layer of spicules held together by and supporting the sarcode (syncytium, H. in part) which contains the soft portions of the species, but branching, anastomosing, and rebranching continually during growth, at length may reach a more definite form; while in the Heterocœla the tissue supporting the soft parts fills up as it were the spaces between the bends of the tortuous tubulation in the Ascones, and thus produces a massive sponge like *Teichonella prolifera*, which in structure closely approaches an ordinary non-calcareous sponge. I have said "as it were," because the "tubulation" does not exactly represent the excretory canal-system of *Teichonella prolifera*, which is dendriform, while that of a tubular Ascon is more or less of the same calibre throughout. However, this broad distinction will do for the present, as I shall have to return to the subject more particularly hereafter.

But in so far as many of the Sycones are as much reduced to a simple tube in their structure as many Ascones, so I shall transpose Hæckel's primary or family divisions as Dr. Polèjaeff has done, by placing the Sycones before the Leucones and the Teichonellidæ last; thus we shall have an uninterrupted evolution in structure from the simple tube in the Ascones to the most complicated form of that in the Teichonellidæ, or, at least, *T. prolifera*, for we shall find by-and-by that it will be necessary to place *T. labyrinthica* among the Sycones, as its structure is almost precisely that of *Grantia compressa*.

Meanwhile it is necessary to begin by defining what a calcareous sponge is, and this may be done by stating that it is a spiculiferous sponge in which all the spicules are calcareous.

After which it may be added that it possesses *no fibre*, which, together with its tender structure generally and the delicate structure of the excretory canals, renders its tissue more or less *fragile* in every instance.

To examine a calcareous sponge for description it is necessary to sectionize the specimen, so that one part or half may be dried and the other kept wet, *i. e.* in a preservative fluid. Thus the sections may be either partial or general, one or more depending on the amount of material at command; but under any circumstances there must be dried sections of the specimen as well as wet for this purpose.

Where time is not an object, as it is with me, for I may have little left, *microscopic* sections of dyed portions should be made, since without this a complete description of no sponge can be written. *My* descriptions therefore will be incomplete so far as this goes; but it is to be hoped that they will fulfil their purpose in other respects, that is in providing an introduction to this inquiry for those who may take it up hereafter.

At first, in the description of a calcareous sponge, the form generally of the specimen should be notified, and, if possible, an accurate sketch of the natural size *recorded* before it may be disfigured by the sectionizing. Then the colour, both in the fresh and dried states, should be mentioned. After this the surface described, generally and in detail. The pores noticed, and also the vent or vents, as the case may be, followed by the cloaca. All this may be regarded as belonging to the *general* form, outwardly and inwardly. After which the internal structure, *viz.* that which is situated between the skeletal layer of the surface on the outside and that of the cloaca on the inner side, should be described in detail. Finally the spiculation or spicules, generally and particularly, followed by the size of the specimen, its habitat, locality, and any further observations that may be desirable. At least this is the plan that will be adopted in my descriptions.

In describing the "form" it may be necessary to use the words "individualized" or "agglomerated," the former meaning single or complete in itself, the latter in plurality and more or less sunk into a general mass. Again, the former may be "solitary," that is when alone, or "social," when accompanied by others of the same kind, young or old. Of course the "description" of the "form" can only apply to the specimen in hand, unless there are sufficient examples to afford an average.

In the matter of colour, which is generally the same, I would premise here that this is some shade of "white" or "sponge-brown," approaching more or less to that of snow, as in *Leuconia nivea*, Bk. (*Leucandra nivea*, H.), and that when *dry* the exposed parts, *viz.* the surface and the cloaca, are always whiter than the internal structure, on account of

the greater abundance of sarcode in the latter (where the ova are generally seen), which, when dry, assumes a sponge-brown colour. These observations are premised to avoid unnecessary repetition in the text, so that hereafter in the descriptions the colour may not be noticed, unless differing from that above mentioned.

The "structure of the surface" or cortical portion needs no remark beyond the fact that the holes of the cribrated dermal sarcode, *i. e.* the *pores*, are generally much larger than in the non-calcareous sponges; then the spongozoa are nearly double the size also, and in the fresh state so large that they may often be seen to contain the *green zoospore of an alga*, which, by its colour, contrasts strongly with the translucent white of the spongozoon, thus favouring the view that it was taken in for nourishment, just as when fed with carmine or indigo *paint* the gummy part appears to be retained for the same purpose and the colouring-matter rejected, as I have long since shown ('Annals,' 1857, vol. xx. pp. 28 and 29). In short, as regards this subject I know of no other means of ascertaining these facts satisfactorily than by watching the development of a sponge under water, that is while growing, which can only be done in *fresh* water, with the gemmule or statoblast of a living *Spongilla*, as I have mentioned (*op. et loc. cit.*); for here there is no tearing to pieces or interfering with the sponge, which may be transferred to the field of the microscope (in the watch-glass in which it may be growing) for observation, as long and as often as the student thinks necessary, while a very high power (immersed of course) may be brought to bear upon it during the time that a solution of the carmine paint is added to the water in its neighbourhood. I do not mean to state that this is the only course by which the sponge is nourished, for Lieberkühn has long since shown that an Infusorium may be taken in by the general substance of a sponge, and there digested in a similar manner to the nutritious fragments which the Infusoria themselves employ for this purpose, *ex. gr. Amæba*.

The terms "cortex" and "structure of the surface" will be often used synonymously; but it should be remembered that generally the surface-layer is so thin that it hardly deserves this name, since it is only in one species, *viz. Hypograntia infrequens*, which will be hereafter described, that I have found this layer so thick as to deserve the name of "cortex," and of this it is impossible to get a better idea than that conveyed in Polèjaeff's illustration of *Ute argentea* (*op. cit.* pl. iv. fig. 3).

Returning to our vocabulary: I have used the term "vent"

for what is generally called the "mouth" or "osculum" in a calcareous sponge, after the manner that this would be applied to a sack; and the word "cloaca" for the cavity to which it leads explains itself; while the apertures on the surface of the latter will be termed "holes," and that or those, as the case may be, which are seen to open into them, more or less below the surface, the "openings," that is of the chambers or canals of the internal structure or that of the wall; the whole of which is precisely similar to corresponding parts in the non-calcareous sponges.

For the interval between the surface or cortex of the body and that of the cloaca the term "wall" will be adopted; its structure consists of empty spaces accompanied by a variable quantity of minutely cancellated tissue. The former will be termed tubes, chambers, or canals, according to their shapes respectively. Thus they will be called "radial chambers" (radial tubes, H.) when they are more or less cylindrical or prismatic, straight and extending directly across the "wall" horizontally, from under the pores on the surface to under the holes of the cloaca respectively, as in *Grantia ciliata*, Bk.; or they may be "subradial," that is more or less branched under the same circumstances, as in our *Hypograntia*; or with no appearance of radiation at all, as in our *Heteropia*; or with the empty spaces canalicular and branched, tree-like, as in *Teichonella prolifera*; while the minutely cancellated tissue which accompanies them will be termed "parenchyma."

Again, as regards the form and arrangement of the spicules in the structure of the wall; this, in his Sycones, has been divided by Hæckel into "articulate" (gegliederte) and "inarticulate" (ungegliederte), that is respectively where the skeletal structure of the radial chambers (tubes, H.) is entirely composed of a number of small radiates about the same size, or where it is formed by the simple extension across the wall of the long shafts of large radiates, whose heads support the cortex or dermal structure on one side and that of the cloaca on the other, thus leaving horizontal intervals between them which correspond to the radial chambers; or these two forms of skeletal structure may be mixed, *i. e.* where one portion of the radial chamber is "articulated" and the other "inarticulated;" but in all cases the sarcode tympanizing the intervals of these spicules to complete the chamber is pierced by intercommunicating pores; while in the subradial or branched chambers and the still further divided forms, up to that which is dendritic, the chambers, now as it were become canals, are rendered continuous with one another by larger or smaller holes of intercommunication, according to the species and the degree

of subdivision of these canals, that is, of course, where the latter are very small the holes are in proportion.

It may also be observed that the chambers immediately under the pore-dermis are often much more dilated than further in, thus resembling the "subdermal cavities" of the non-calcareous sponges; and a similar dilatation may often be seen immediately under the cloaca, which, to a certain extent, may account for the plurality of openings in the wall-structure appearing through the holes of the latter, as will be noticed hereafter in the descriptions of the respective species where this presents itself; I say "to a certain extent," because where the holes in the cloaca are in proportion to the number of radial chambers, as in *Grantia ciliata* &c., this cannot occur.

Lastly we come to the "spiculation," *i. e.* a description of the different forms of spicules, which are generally found to be more or less constant in particular parts. Thus, beginning with the acerates, it will be noticed that those which fringe the vent or mouth of the cloaca present a peculiarly glistening aspect *en masse*, which, when they are separate, is found to depend on their long, straight, cylindrical, delicate form, closely resembling "spun glass," and these, similarly pointed at each end and arranged like a palisading around the *inside* of the mouth, where their fixed ends are on a level with the surface of the cloaca and their free ones project more or less beyond the mouth or vent, will be called the "peristome;" on the other hand, when there are *none*, and this feature is consequently absent, the mouth will be called "naked." At the same time it should be remembered that the two states may occur in a group of the *same* individuals, so that the presence or absence of the "peristome" must not be always regarded as an infallible distinction.

Again, the acerates may be more or less scattered over the surface either echinatingly or altogether imbedded in it *longitudinally*, when they will generally be found to be much stouter, more or less curved equally throughout, or more in one half than the other, which is generally the outside one; also more or less equally fusiform, in which case the thickest part is outwards and the other more or less sunk into the wall. Occasionally the outer end is "lanciform," in a line with the shaft, or bent to one side, like a "fixed bayonet" on a musket, and limited in its extent by a more or less prominent annular inflation, which extends obliquely or circularly across the shaft at the point of union; or the outer end may be more or less sharply curved or club-shaped &c.

Lastly, there is often a minute straight or sinuous acerate

with more or less lanceolate or, rather, "fixed bayonet" end, like that just described, sometimes serrated, with which the cribriform sarcode of the dermis is charged. Taking the place of the flesh-spicule in the non-calcareous sponges, and thus also strengthening this structure, while it acts in combination with the sarcode as a kind of cement in binding down the larger spicules of the surface generally, it has been termed by Hckel "Stbchen-Mrtel." Hence these spicules may be termed "mortar-spicules," so that when this term is used the reader will know what is meant by it. This form again sometimes attains a larger size, when, as is the wont of the dermal acerates generally, they become mingled with the internal ends of the spicules of the mouth and thus form part of the proximal end of the peristome.

But the staple and, therefore, most characteristic spicule of most calcareous sponges is a "radiate," which may be regular or irregular; that is to say, when the arms or rays are all equal in size and all separated from each other at equal angles it may be termed "regular," and when the reverse "irregular."

The radiates, again, may be divided into three-armed and four-armed spicules, *i. e.* triradiates and quadriradiates, which may be more or less equally mixed together according to the species or their position in that species.

Noticing the triradiates first, it may be observed that they are generally more or less elevated in the centre, so that if on a level surface with the points of their arms downwards they would rest on these points, a feature which attains its maximum in the peculiar form that characterizes the surface of *Clathrina tripodifera*, as will be more particularly mentioned hereafter. It may also be observed that when the triradiates depart from their "regular" form they for the most part become more or less bow-and-arrow shaped (whence they have been termed "sagittal"), in which two of the arms may be variously expanded laterally in a more or less curved or undulating form, backwards or forwards, while the third remains more or less straight, and hence will be termed the "shaft." Under this form they may be generally small or generally large. Thus, as before stated, when generally small and numerous they form the skeletal structure of the radial tube or chamber in the Sycones, which has been termed "articulated;" while when large, with long shafts, the latter alone extending across the wall simulates that which has been called "inarticulated."

The "sagittal" form appears to be often used for binding down the subjacent spicular structure, and, following it up-

wards from the surface of the cloaca, this becomes particularly striking and beautiful at the base of the peristome, where the arms are not only expanded almost perpendicularly across the lower ends of the spicules of the peristome, like cross bars in a palisading, but, to still further extend their use, are absolutely flattened vertically, while the shaft remains more or less aborted, thin, round, and directed backwards in a line with the spicules in the layer of the peristome.

The quadriradiates, on the other hand, do not differ from the triradiates except in the addition of what is termed a fourth arm; but inasmuch as this is for the most part different in form from any of the rest, it has been termed by Dr. Bowerbank the "spiculum" or "spiculated ray" (Mon. Brit. Spong. vol. i. p. 241, pl. iv. figs. 85 and 86); we shall call it the "fourth ray." It may be larger or smaller, longer or shorter than either of the other rays, curved or straight, simple or ensiform, according to the species and its position in that species, situated perpendicular to the rest of the rays or inclined forwards in the sagittal forms. In the body of the cloaca, where these spicules constitute a characteristic feature, the fourth arm, which projects into the interior, is perpendicular to the other three (which are fixed in the surface of this cavity), with the curve *always* directed *towards* the mouth, and in this form they may be traced more or less into the canals leading into the cloaca. On the other hand, when the quadriradiate is large or constitutes, from its size and predominance, the greater part of the spiculation, as in *Leuconia Johnstonii*, Carter (*Leucandra Johnstonii*, H.), it may be more or less like the rest; but under these circumstances this spicule may *in situ* be frequently distinguished from the triradiate by presenting a dark triangular space in the centre of the other three rays, whose angles are coincident with those of the triradiate portion, and whose darkness arises from the rays of light at this part passing *through* the surface instead of being reflected from it; while in the triradiate there is no "dark space" visible unless the spicule be viewed laterally, when a similar thing happens through the position of the third ray; but its shape is quadrangular and more or less concave at the sides, like an hour-glass; hence, as these spicules lie *in situ* on the surface in *L. Johnstonii* &c., where the fourth ray is directed inwards and the triradiate portion lies flat on the surface, the "dark space" is only seen in the former.

Among the triradiates may be mentioned in particular a form very much like a "tuning-fork," in which the arms are projected forwards almost parallel to each other and closely

approximated, whilst the shaft is continued backwards in the opposite direction. The interest attaching to this spicule is that it was first noticed and represented by Dr. Bowerbank in a mounting from a calcareous sponge, found at or near Freemantle, at the south-western angle of Australia (Phil. Trans. 1862, pl. xxxvi. figs. 18 and 19, repeated in his Mon. Brit. Spongiadæ, vol. i. p. 268, pl. x. fig. 237), of which Dr. J. E. Gray made a genus under the name of "*Lelapia*," and a species under that of "*L. australis*" (Proc. Zool. Soc. 1867, p. 557), and which Dr. G. J. Hinde, F.G.S., discovered in two fossilized calcareous sponges, respectively named *Sestrostomella rugosa* and *S. clavata* ('Annals,' 1882, vol. x. p. 185), confirmed by myself in a specimen of the former from the Jura; and, further, that I have now found it abundantly in a recent calcareous sponge from the neighbourhood of "Western Port," Victoria, S. Australia, among Mr. Wilson's collection from this part, as will be seen hereafter, when it will be found to be described under Dr. Gray's name, i. e. "*Lelapia australis*." Hæckel observed the same form in his *Leucetta pandora*, also from the south coast of Australia (*op. cit.* 'Atlas,' Taf. 23. fig. h), and in his "connective variety" of *Leucortis*, viz. *Leucandra pulvinar* (*ib.* vol. iii. p. 166), from the western coast of Australia &c.; but in neither is the spiculation the same as in our species, which, as just stated, will be called "*Lelapia australis*."

As regards the *measurements* of the spicules, I would premise that, where given, they are intended to represent the largest size of their kind, or the size of the most characteristic forms of the species *that I have seen*; for to go further would be only to multiply assumptions, since in the hasty observation of the minor radiates, which are by far the most numerous, it is difficult to find two which are exactly alike; besides, as I have before stated, the triradiate is always more or less raised in the centre, so as to become tripod-like, whereby it becomes next to impossible to measure *its* arms accurately. Hence, both in the smaller and the larger spicules, the measurements must always be taken as approximative; while they will for the most part be given in "6000ths" of an inch, that the student may realize their relative dimensions. I regret that I cannot go more into detail in this matter; but as stated above respecting the dyeing and making microscopic sections, which is a comparatively long process, it is to be hoped that what I am not able to do now may be supplied by others hereafter.

Also, to avoid unnecessary repetition in the text, I may at once state that, except in a few instances, neither the "habi-

tat" nor the "depth" will be mentioned, and the same with the "locality." For, in the first place, all calcareous sponges are marine; in the second place, most of the specimens that I have discovered among Mr. Wilson's collections have, as a matter of course, been unaccompanied by their "depths," on account of their insignificant size; and, lastly, the "locality" being either "Port Phillip Heads" or "Western Port," about 15 miles further to the west, their neighbourhood may be considered the same from a natural-history point of view.

With these preliminary remarks let us proceed to the description of all the specimens of Calcareous Sponges that I have been able to find in Mr. Wilson's collections generally, beginning with that structure which seems to me most simple, viz. *Clathrina cavata*, and ending with the most complicated, viz. *Teichonella prolifera*. I have no further classification to offer, and therefore must refer the reader to the works of Hæckel and Poléjaeff for this purpose, as before mentioned, my own being regarded as only a contribution to the subject. There are forty species, of which many are represented by several specimens, some of which are of considerable size, viz. 6 to 7½ in. in their longest diameters, and all in a good state of preservation—far exceeding in every way what is to be found on the British coasts.

[To be continued.]

XLI.—*On the British Weevers, the Bib, and the Poor-Cod.*

By Prof. M'INTOSH, M.D., LL.D., F.R.S., &c.

Two species of weever* have been described by most authors who have treated of the fishes of our own and continental countries, viz. the greater and the lesser weever. So far as previous and present examinations, however, can guide me, I am inclined to think there is a very close relationship between them; indeed it is possible that the one is only a young stage of the other, and that certain distinctions, such as the absence of spines above the orbit in the smaller form and its greater depth in proportion to its length, disappear with age. It is well known, indeed, that noteworthy modification in outline occurs during the growth of several fishes. Moreover, in the large form (greater weever) there is considerable variation, for instance, in the semi-membranous prolongation of the free

* *Trachinus draco*, L. (greater weever), and *T. vipera*.