X.—*Observations on Dactylocalyx pumiceus (Stutchbury), with a Description of a New Variety, Dactylocalyx Stutchburyi.*

By W. J. Sollas, M.A., F.G.S., &c., &c.

(*Read 8th January*, 1879.)

Plates V., VI., VII., and VIII.

The specimens of Dactylocalyx which came under the examination of Stutchbury were two, both of which belonged originally to the Bristol Museum; of these, one, a very fine and complete vasiform example, is still preserved there intact; of the other, which is the describer's type, the Bristol Museum only possesses a part, the other part, comprising a half of the originally vasiform specimen, together with a piece broken from the remaining half, having been exchanged with the British Museum for a half of a specimen of *Hyalonema japonica* (Grey).

Thus there now remains at Bristol a complete specimen of Dactylocalyx, together with a fragment of the type, and having had occasion, while arranging the collection of sponges in the Museum, to examine this material anew, I came across some fresh facts relating to it which appear to me worth recording.

DESCRIPTION OF THE PLATES.

Plate V.

Fig. 1.—*Dactylocalyx pumiceus;* var. *Stutchburyi.* Lateral view. × 0·321.
Fig. 2.—The same, seen from above. × 0·34.

Plate VI.

Fig. 1.—*Dactylocalyx Stutchburyi.* Seen obliquely from below. × 0·37.

Fig. 2.—A lantern-spine, supporting an acerate spicule; the ends of the spicule are not represented in the drawing. × 50.

Figs. 3 and 4.—Similar, but more usual form of lantern-spines, exhibiting their ordinary reticulate character. × 50.

Fig. 5.—Sexradiate spicule, from the surface of the perforating tubule in *D. Stutchburyi.* × 50.

Fig. 6.—Quadriradiate spicules, common in the dermal layer of *D. Stutchburyi.* × 50.

Plate VII. (*Dactylocalyx pumiceus*).

Fig. 1.—Fusiform acerate spicule of the outer surface × 15; *a*, middle of spicule × 150.

Fig. 2.—Sexradiate dermal spicule with distal ray suppressed. × 50.

Fig. 3.—Smaller acerate spicule, capitate at both ends. × 25.

Fig. 4.—Sexradiate dermal spicule, with one of the horizontal arms bent backwards, and all except the proximal ray with capitate ends. × 50.

Fig. 5.—Typical sexradiate of the dermal layer. × 50.

Fig. 6.—Sharply-spined fibre of the secondary network. × 100.

Fig. 7.—Secondary network formed on a framework of large sexradiate spicules. × 50.

Fig. 8.—Dermal sexradiate, with long, wavy, branched rays. × 50.

Fig. 9.—Small sexradiates, from the interior of the body-network; *a*, with pointed, *b*, with capitate ends. × 50.

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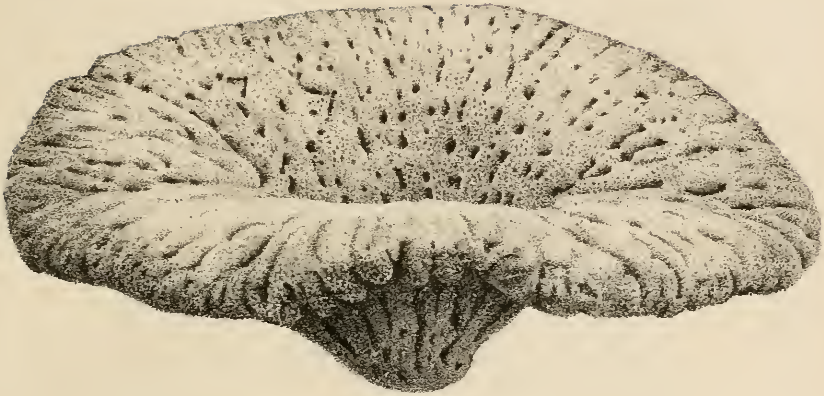

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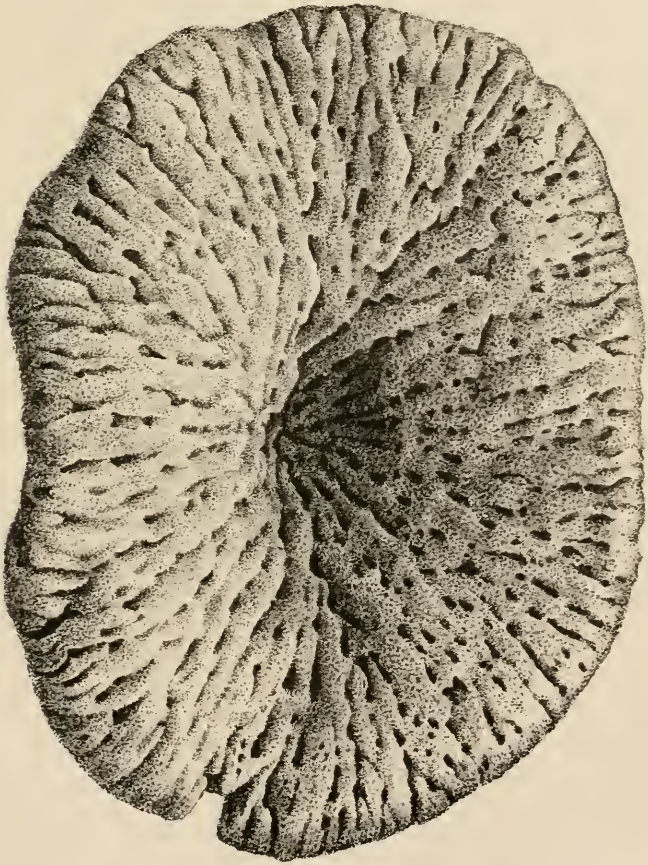
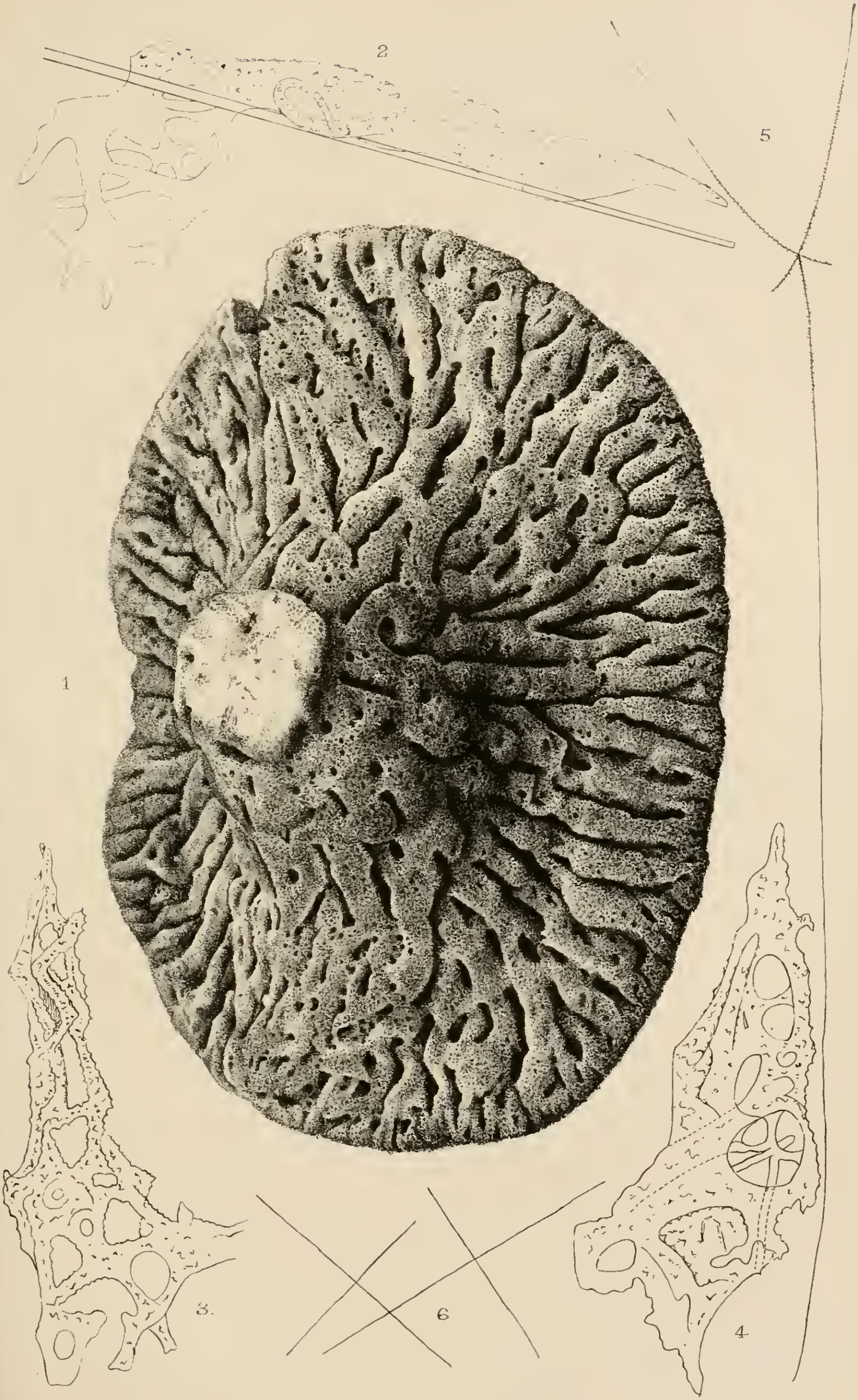


From a Photograph. Mintern Bros. imp.

Dactylocalyx Stuchburyi (Sollas.)



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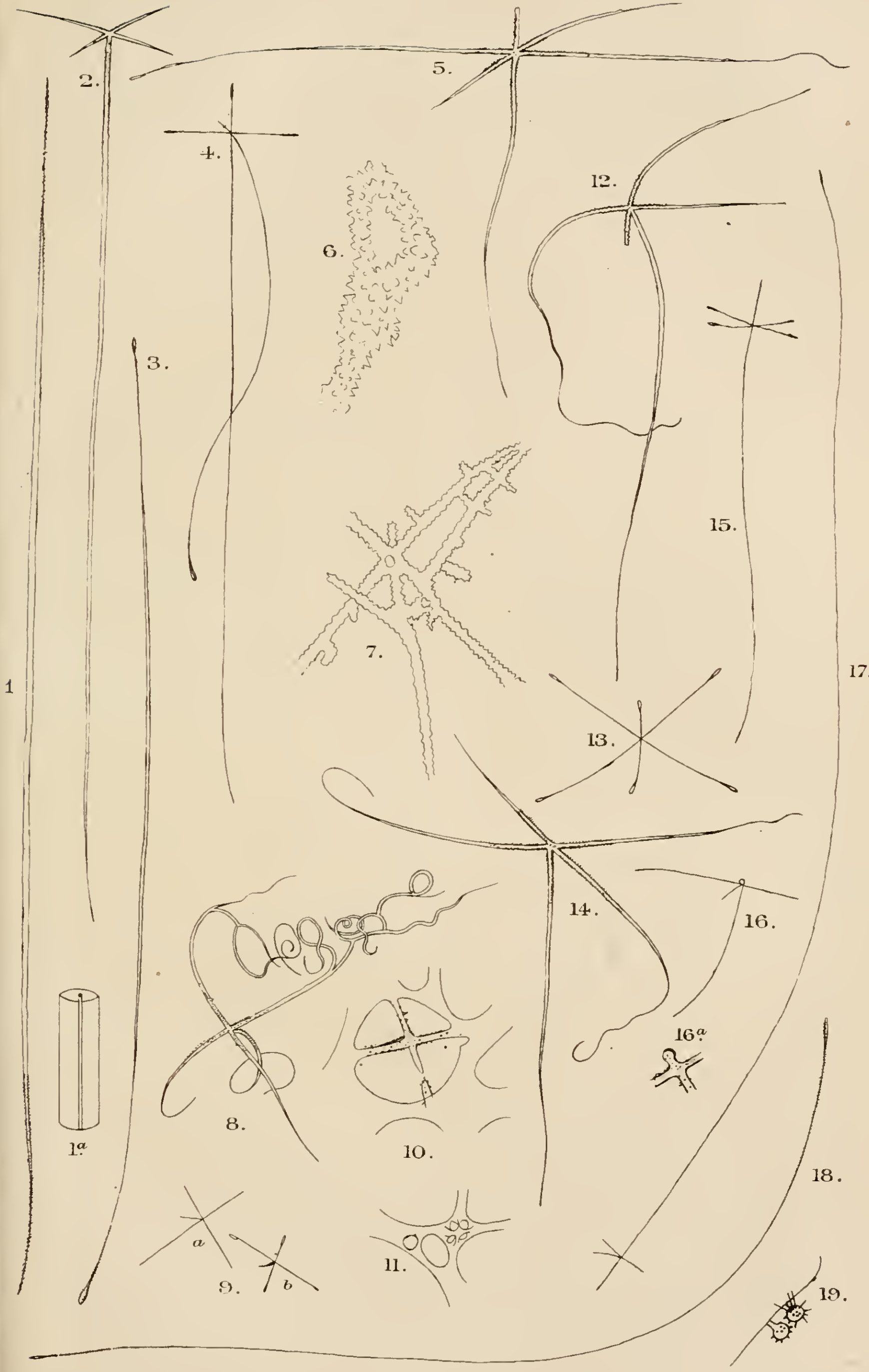
Dactylocalyx Stuchburyi. (Sollas.)



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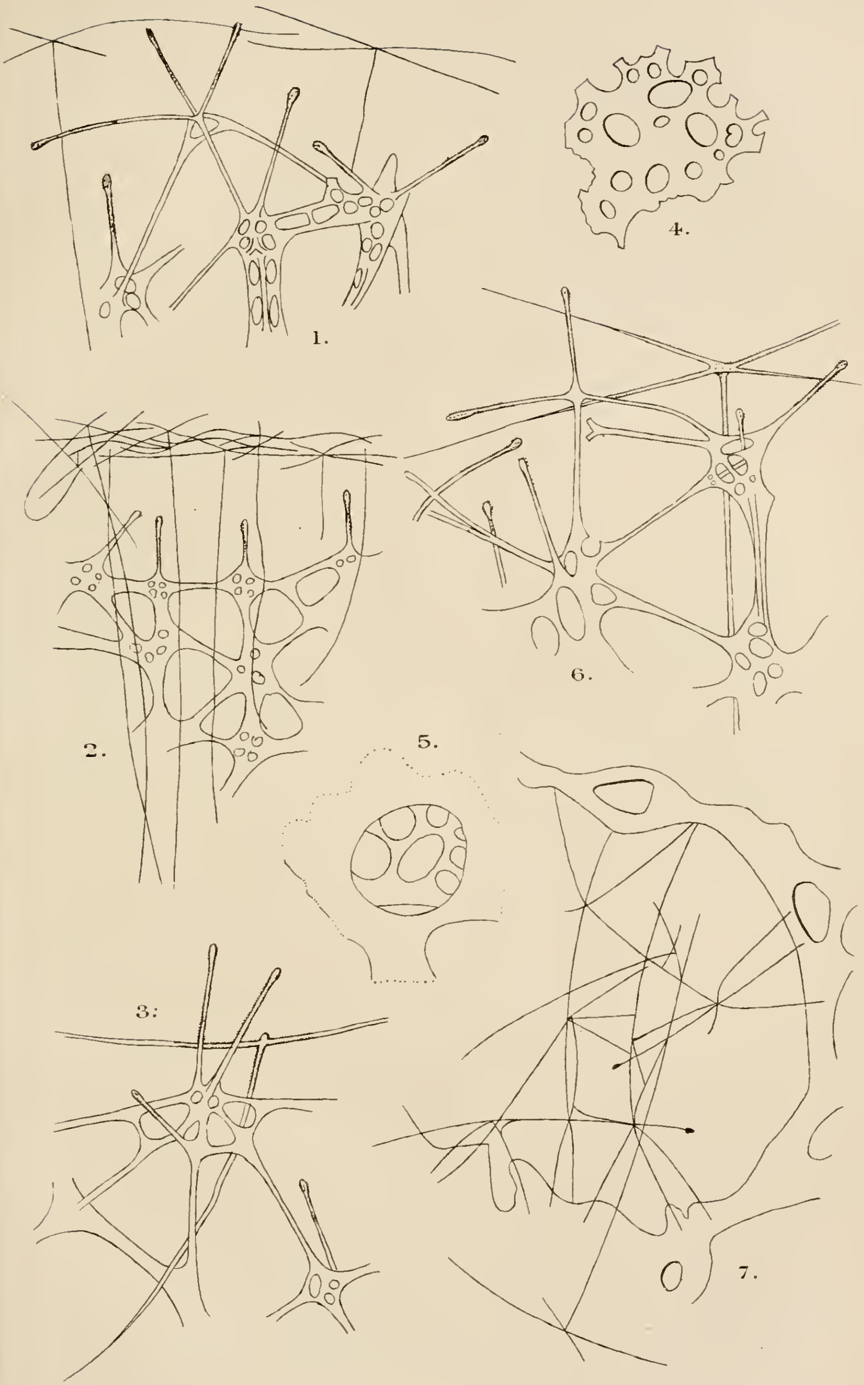
Spicules of Dactylocalyx pumiceus.



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Spicules of Dactylocalyx pumiceus & D. Stuchburyi.

Dactylocalyx pumiceus (Stutchbury).*

Outer surface.—The under or outer surface of this widely expanded vasiform sponge is folded into a number of ridges and deep grooves, which radiate in an irregular sinuous fashion from the base towards the edge of the vase, the ridges frequently anastomosing laterally in their course, so as to circumscribe the grooves, which thus seldom extend continuously for more than 2 inches in length, and never beyond $2\frac{1}{2}$ inches. The greatest depth attained by these channels is $\frac{15}{16}''$. The exterior of the ridges is marked by circular openings from which more or less cylindrical tubes are continued inwards into the sponge at right angles to its surface; these tubes either open directly into the excurrent canals which we shall mention presently, or more frequently, after branching once or twice, lose themselves in the large meshes of the skeletal network.

On the inner surface of the cup a number of round holes occur, each elongated a little in a radiate direction, looking obliquely

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Fig. 10.—Spicule involved in siliceous material, which has failed to completely invest one ray. At the point where the ray has been left bare it appears to have been reabsorbed, so that its extremity is quite disconnected with the centre of the spicule. × 50.

Fig. 11.—An octahedral node of the young fibre. × 50.

Fig. 12.—Dermal sexradiate spicule. × 50.

Fig. 13.—Sexradiate spicule from the interior of the body skeleton, very similar in size and form to those which furnished the framework of the secondary network in Fig. 7, Pl. VIII. × 50.

Fig. 14.—Dermal sexradiate spicule. × 50.

Fig. 15.—Dermal sexradiate with distal rays pointed and horizontal rays capitate. × 50.

Fig. 16.—Dermal sexradiate with the distal ray reduced to a capitate termination. × 50. *a*, distal ray on a larger scale. × 100.

Fig. 17.—Sexradiate spicule with very long shaft, probably so disposed in the sponge that the horizontal rays projected some distance beyond the dermal surface. × 50.

Fig. 18.—Curved small form of acerate spicule, capitate at both ends. × 50.

Fig. 19.—Two flesh spicules cemented on to the skeletal fibre.

Plate VIII.

Fig. 1.—Young fibres of *D. pumiceus*, showing their position relative to the dermal spicules. × 100.

Fig. 2.—Dermal layer of *D. pumiceus*, with the acerate spicules omitted. The young fibres are represented in their relative position beneath it.

Fig. 3.—Young fibre of *D. pumiceus*. × 100.

Fig. 4.—A part of the network from the base of *D. Stutchburyi*. × 50.

Fig. 5.—A single mesh of the basal network filled in with secondary fibres. × 50.

Fig. 6.—Young fibres of *D. pumiceus*. × 100.

Fig. 7.—Secondary reticulation of "darning" fibres from *D. pumiceus*. × 50.

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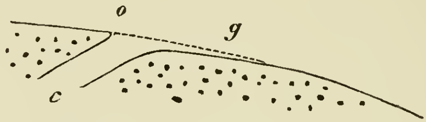
* Stutchbury, 'Proc. Zool. Soc.,' 1841, pt. ix. p. 86; 'Ann. and Mag. Nat. Hist.,' vol. ix. p. 504. Bowerbank, 'Proc. Zool. Soc.,' 1869, p. 77, pl. iii. fig. 1. Carter, 'Ann. and Mag. of Nat. Hist.,' ser. 4, vol. xii. p. 363.

upwards and towards the axis of the cup, and frequently prolonged at the sides into a little gutter, as in Fig. 1.

Fig. 1.



o, oscule; *c*, excurrent canal; *g*, groove.

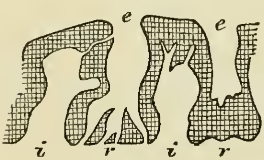
These holes are the mouths of the excurrent canals, which descend into the walls of the sponge, passing especially into the ridges of the outer surface, where, after branching once or oftener, they terminate, either in small round openings on the surface, or by losing themselves in the coarse meshes of the skeleton.

In a similar manner the grooves or gullies of the outer surface are prolonged into tubes which tend towards the inner surface of the cup, ramifying in their course till they open into the excurrent canals, or lose themselves in the large meshes of the skeletal network.

Thus the only connection between the excurrent canals which open on the inside of the cup, and the deep gullies of the exterior, is by means of very minute intervening canals, or through the large meshes of the skeleton.

The ridging and grooving of the exterior, combined with the excavation of the ridges by the excurrent canals, produce a folding of the sponge wall, very similar to that which occurs in the Ventriculites and other fossil sponges. In both cases the folding serves to give great strength to the sponge wall, and a large inhalent surface at a great economy of space.

Fig. 2.



Section across the wall of *D. pumiceus* ($\frac{2}{3}$ natural size); *r r*, exterior ridges; *i i*, intervening furrows; *e e*, excurrent canals occupying interior of ridge.

The whole arrangement reminds one also of what is seen on a smaller scale in *Halisarca lobularis*, where likewise we have, according to the beautiful sections of F. Eilhard Schultze,* incurrent canals opening externally and branching within into minute canals, which again gather together to form the large excurrent canals that open on the interior of the sponge. Here, however, having a fresh specimen before us complete in all its parts, we can see the ampullaceous sacs on the ultimate ramifications of the incurrent canals, and so understand clearly the mechanism by which water is

* 'Zeitschrift f. wiss. Zool.,' Bd. xxviii. Taf. I. fig. 8; Taf. II. fig. 15; Taf. III. fig. 16.

caused to enter at the inhalent orifices, to pass through the fine canals, and finally to empty itself out of the sponge by the excurrent tubes. But having regard to analogy, one cannot but feel that a similar mechanism once existed in our specimens of Dactylocalyx: the minute canals which unite together the ultimate ramifications of the excurrent and incurrent tubes, were the seat of those ampullaceous sacs which by driving the water continually out at one end of the minute canals, caused a continual influx at the other; the single current entering at one inhalent aperture was immensely subdivided to supply a large number of ampullaceous sacs; the many currents leaving those sacs were united together to flow out at an exhalent aperture in a single stream.

Skeleton.—On examining the skeleton of the sponge with the naked eye, one observes a regular network of fibres, the meshes of which may be called "large" meshes to distinguish them from others of which we speak next; similarly, the fibres may be known as "large" fibres.

Under the Microscope the large fibres are found to consist of a network of much finer fibres, and with correspondingly small meshes. These are what are usually understood as the meshes and fibres of the skeleton, so that the terms may be used without any distinctive qualification.

The large meshes may possibly serve in some cases to give passage to the minute ramifications of the water-canals of the sponge.

Dermal layer.—Bowerbank states that he could not find any trace of dermal structure in the half of the type specimen which he examined, but predicts that when a specimen perfect enough to show it is obtained, it will present the characters of the same structure in *Dactylocalyx Prattii* or *D. Masoni.* Unable to believe that the work of cleaning so large a specimen as ours could have been so thoroughly accomplished as to have removed all vestiges of the dermal skeleton, I set to work to find the missing structure, being at the same time well assured that if found it would *not* in a Hexactinellid sponge like *D. pumiceus* present the same characters as in Lithistids such as *D. Prattii* and *D. Masoni.* Nor did I have long to look, for down in a tubule, which completely perforated the sponge, a perfect forest of long acerate spicules was seen, bristling erectly from the surface, and forming, together with a layer of sexradiate spicules, the structure of our search. This tubule, as already remarked completely perforates the wall of the sponge, passing freely from one side to the other; it thus differs from an ordinary excurrent or incurrent canal, and in all probability represents a part of the surface of the edge of the sponge, which became simply enclosed by growth and not incorporated with the body substance. If this is so, one will have no difficulty in explaining why a dermal layer was found here and nowhere else—not in a single excurrent canal, nor on the sides of the exterior grooves; although, had it at any time existed in these places, it must almost certainly have left some trace of its existence behind. The truth is, the dermal layer must have been confined to the general surface of the sponge, and covered the walls of our tubule, because these were originally a part of the general surface, and only by accident, as it were, came to assume a tubular form. When the specimen was cleaned the dermal layer would readily be removed from exposed surfaces, but would easily escape destruction in this secluded recess. The absence of a dermal layer from the sides of the grooves on the under surface is most noteworthy, and leads one to infer that the dermal layer on the under surface was continued from ridge to ridge, so as to roof over the intervening gullies without in any case dipping into them.

The piece of the sponge exhibiting the dermal layer was carefully cut out and variously mounted for microscopical examination.

If we commence our observation of a transverse section from its outermost face, we shall see first the distal ends of a number of acerate spicules, which when traced inwards for a distance of about a quarter of an inch, are found to enter, normally to its surface, the skeletal network of the sponge, penetrating through its meshes for about the same distance as they project beyond it. Next we find just outside the skeletal network a dermal layer of sexradiate spicules, each with four long horizontal arms extended in the plane of the dermal layer, and with the two remaining arms at right angles to it, the distal one short and frequently aborted, the proximal one descending perpendicularly into the meshes of the skeleton like a little rootlet into the soil. The horizontal arms do not appear to be arranged into a regular square-meshed network.

Beneath the dermal layer we reach the outermost layer of the reticulate skeleton, consisting of framework spicules only just connected together by siliceous cement. The skeletal layer succeeding this is still very young, so that its fibres still retain an open lace-like character, not having yet become filled up with the siliceous deposit, which subsequently in the third or fourth layers renders them solid throughout. In the third and fourth layers then the fibres have assumed the form of solid homogeneous threads which only differ from those of the quite adult skeleton by their greater smoothness and less abundant tuberculation.

Acerate fusiform spicules (Plate VII., Figs. 1, 3, and 18).—These are cylindrical in the middle and taper very gradually towards each end, till they terminate in extremities of remarkable tenuity. The longest complete example measured $\frac{1}{2}''$ in length and $0 \cdot 0015''$ in breadth; but these dimensions may be slightly exceeded in some other cases, though one cannot say so definitely, owing to the fact that the great majority of these spicules are incomplete at one end, and thus incapable of exact measurement. In some cases the end has been apparently broken off, in others it appears to have yielded to some solvent action, either after the death of the sponge, or quite as possibly during its life; for the sponge appears to have been alive when first procured, and the eroded umbones of Anodon and Unio shells show that such contemporaneous solution is not an unknown phenomenon in the animal kingdom.

The ends of the acerates are roughened by minute spines, which give them a ragged appearance, and their tenuous extremities are pointed. Associated with them are other acerate spicules (Figs. 3 and 18) which differ in a number of minor characters; thus the latter are usually smaller than the former, more often curved, and though sometimes pointed, yet very frequently capitate clavately at one or both ends. The larger acerates are excavated by a well-defined axial canal which, however, never exhibits any trace of a sexradiate cross in any part of its course. I have repeatedly examined a large number of perfect acerate spicules with a view to making sure on this point, and I am able to state therefore with full confidence that none of them show the least signs of a sexradiate character.* Instead of being aborted sexradiate spicules, they are from my point of view the least modified descendants of the simple acerate spicules of which the early ancestral sponge was composed; the sexradiates on the other hand having departed the most widely from the original type.

The coarse meshes where they open at the surface of the sponge, appear as the circular mouths of minute tubes, walled in with the large fibre, and reminding one somewhat of the structure of *Aphrocallistes.* It is into the large fibre surrounding these tubes, but not into that forming their floor, that the acerate spicules are inserted, which thus leave the tubes unencumbered within, but form a beautiful fringe to them externally.

Sexradiate spicules of the dermal layer.—These are remarkably variable in all their characters; the most typical form being that of Fig. 5, Plate VII. This possesses the full complement of six rays, four lying on the surface of the sponge, one descending into its network, and the sixth projecting distally: the distal ray is short, straight, and rounded off at the end, the other five rays are much longer, more or less curved, and attenuated to very fine pointed extremities. All are minutely microspined for the whole or a portion of their length. The greatest breadth of the rays is 0·0003″.

In other instances we find the distal ray becoming much shorter, frequently capitate (Fig. 16, Plate VII.), and often disap-

* On referring to Mr. Carter's paper (*loc. cit.*) I find that his examination of the acerate fusiform spicules of *Dactylocalyx subglobosa* led him to the same results.

pearing altogether; the horizontal rays, though sometimes capitate, more frequently extending into long sinuous whip-like filaments (Fig. 14, Plate VII.), which often become branched, and thus give rise to such forms as that of Fig. 8, Plate VII. The curvilinear filaments of different spicules intertwine with one another in the dermal surface, giving it a loosely woven texture, like a single layer of cotton-wool filaments: in some cases they touch without uniting, in others they are soldered together at the point of contact.

The branched rays of Fig. 8 cannot be explained by supposing secondary siliceous fibres to have been independently developed in the dermal sarcode, and subsequently to have become united with the spicular rays; these branched rays can only be regarded as a further development of such undulating forms as that of Fig. 12.

Another form of sexradiate is shown in Fig. 18: in this the proximal ray has become excessively long, the horizontal arms remaining comparatively short; Figs. 2 and 4 are similar, but in the latter, one horizontal ray is bent backwards in an elongate S-like curve, and all its rays are capitate, except the proximal one, which is sharply pointed. In Fig. 18 one of the horizontal arms is suppressed, and in Fig. 2 the distal ray; the number of rays suppressed in different spicules is very variable, sometimes both proximal and distal rays disappear, and only the horizontal arms remain forming a simple cross. The microspining of the spicules on the other hand is very constant, but the mode of termination just the opposite, one, two, or three rays, or any number up to six sometimes becoming capitate, the proximal ray, however, usually remaining pointed.

Some of the sexradiate spicules, those for instance with very long proximal rays (Fig. 18) appear to accompany the bundles of acerates which project beyond the dermal surface, their four horizontal arms not being given off in the dermis, but at some distance outside it, after the manner of anchoring spicules.

One cannot but feel some curiosity as to the function of these various spicules, though without actual observation of the habits of the living sponge it seems idle to speculate upon them. The dermal spicules, however, evidently serve to support the dermal membrane of the sponge; the long acerates have probably, as Bowerbank would maintain, a "defensive" action, and it certainly seems just possible that both they and the projecting sexradiates, especially the latter, may serve to capture and secure any minute worms or other animals which in wandering over the sponge should come in contact with their points. Nutritious material would be freed from such animals at every puncture on becoming wounded, and when subsequently decomposition set in, swarms of Bacteria and other organisms would result, and a vast quantity of edible material so be set free to be conveyed by the inhalent currents into the interior of the sponge. A similar function might perhaps be assigned to the avicularia of the Polyzoa which hold fast for a long while any little victim which may have been caught between their beaks.

First layer of reticulate skeleton.—Notwithstanding a close search was made for them, no instances of framework spicules existing in a free state could be found; they could be seen in the very first stages of cementation, but not earlier: certainly the dermal spicules are very distinct, and never become involved in the skeletal network, unless by rare exception; the acerate spicules likewise, though occasionally involved, as a general rule remain free. In the first stage of cementation we find two or three or more rays of the framework spicules (Plate VIII., Figs. 1, 3, and 6) attached to the rest of the network, from which the spicule seems to have budded forth, the remaining rays projecting freely and usually outwards towards the exterior of the sponge; these free rays are always more or less clavately capitate, and always microspined, although they appear to have already become invested by a thin layer of the ubiquitous siliceous cement. Some of these rays are very persistent, retaining their freedom for a long while, especially those which point directly towards the exterior of the sponge. Near the centre of the attached spicule fine siliceous filaments cross from one adjacent ray to another, subtending the angle formed by them, so that when all six rays have been so connected together, a hollow lantern joint results, which, when regularly developed (Plate VII., Fig. 11), closely resembles the octahedral nodes of *Mylinsia Grayi* or of a Ventriculite. Usually, however, its form is much less symmetrical than this, owing chiefly to irregularities in the form and distribution of the framework spicules themselves, but partly also to the irregular way in which the connecting fibres join them together.

The rays of each spicule are bent in all directions, and the entire spicules are scattered in great confusion, some lying one way, and some another. The rays of adjacent spicules thus exhibit no definite arrangement one with another; sometimes the end of one touches the middle of another ray, and where they touch they unite; sometimes two rays lie parallel to each other at a slight distance apart, then transverse bridges of silica cross from one to the other, and unite them into a fenestrated fibre; frequently one ray traverses the centre of another spicule, and thus multiplies the number of fibres radiating from the resulting node of the finished network.

As the deposition of silica continues, the attached ends of the spicular rays become covered up and disappear, the fenestra of the open fibres are filled in, and solid more or less cylindrical fibres result; so, too, the open lantern of the nodes is in time obliterated, and the whole skeleton, losing all traces of its original composition, exhibits simply a reticulation of solid fibres radiating from equally solid simple knots. The young fibres are at first smooth, but very early, almost as soon as they become optically simple, they become tubercled, and with age the tubercles increase in number and size.

Secondary rete.—After the formation of the adult network, changes appear to take place in the distribution of the canals of the water-system, by which some of the large meshes become no longer needed as water-channels, and so are gradually filled up by a secondary network, of what might appropriately be called "darning" fibres, from the way in which they seem to mend up the gaps in the aged skeleton. In one case I found this secondary network in a very early stage (Plate VIII., Fig. 7), its component spicules having only just become soldered together by silica, and differing considerably in appearance from the budlike spicules, or pullulating fibres of Bowerbank, which likewise unite into a secondary network. As the secondary fibres thicken with the continual deposit of silica over them, they produce a network of a very different appearance to that of the principal skeleton, its fibres are more rodlike, often sharply and conically spined, less thickened at the nodes, and sometimes more rectangularly arranged. Contrast, for example, Fig. 7, which is somewhat like the network of a *Cypellia* (Zittel), or the spined fibre of Fig. 6 with the excellent figure of the ordinary skeletal reticulation given in Bowerbank's Memoir, plate i., *loc. cit.*

Other spicules besides sexradiates which become involved in the siliceous fibre.—That the large acerate spicules may sometimes contribute to the skeletal network has already been mentioned, but I have never before met with an instance in which a flesh-spicule became so involved. Such a case, however, is shown in Fig. 19, Plate VII., where two flesh-spicules are seen closely attached to the surface of a skeletal fibre: in one the process of envelopment has not gone so far as in the other, so that, although the angles between its rays have been to a great extent filled up, yet its characteristic form is more nearly retained, and the rays attached to the fibre are still so far unenveloped as to allow the light to shine through between them; the other, on the contrary, has become converted into a mere globular tubercle, with the yet uncovered ends of its rays projecting as little spines.

In commenting on the foregoing descriptions, one may first point out the analogy which exists between the rude folding of the walls in *Dactylocalyx* and the more perfect folding in such extinct forms as *Cœloptychium* and the Ventriculites. The resemblance between Cœloptychium and Dactylocalyx appears to be especially marked; in both we have radial ridges and gullies, of about the same size in each; in both the ridges are bifurcated, anastomosed laterally, and marked on the exterior with rounded openings leading into interior tubes. In *Cœloptychium*, however, all these features possess a regularity which is not to be found in *dactylocalyx;* the ridges in the former sponge are more uniform in size, straighter in direction, and more regular in their bifurcation and anastomosis; the circular openings upon them are also of very uniform diameter, and are arranged at equal distances apart in regular rows.

Notwithstanding these differences of detail, however, an obvious general resemblance exists between the two sponges when their lower surfaces are alone compared, while, as regards general external form, one must allow that Dactylocalyx, especially the variety *D. Stutchburyi*, represents in a striking manner some of the widely infundibuliform specimens of *Cœloptychium*. In other respects more essential differences are to be found.

The character of the nodes in the newly formed network of *Dactylocalyx* may be also alluded to again, since they are always hollow and reticulate to begin with, and not solid throughout as in the later stages of growth; moreover, as already stated, the young node often exhibits an octahedral arrangement in its reticulation, which clearly resembles that of the true hollow-jointed Hexactinellids, and thus passes through a stage which in the latter sponges has become persistent. From this it would appear that in the ancestral form of Vitreo-hexactinellid the nodes were all characterized by a lantern-like arrangement, and that while in some of its descendants the subsequent deposition of silica at the node took place chiefly along the octahedral fibres, and thus gave the Ventriculite knot, in others it followed no definite direction, but simply filling up the interspaces, produced the solid node of such forms as *Dactylocalyx*.

Dactylocalyx pumiceus, var. *Stutchburyi* (Plates V. and VI.)—This form will not require any lengthy description, since it agrees in all important characters with the preceding, and it is only in details of quite trifling value that any difference exists. The general form is that of a vase or flower-basket, but with a much less expanded brim than the type of *D. pumiceus;* its walls are also a trifle thicker than the latter, and the ridges and grooves on its inferior surface are deeper, narrower, and straighter. The elliptical margin of the cup measures 1 foot 1¼ inch along the major axis, and 10 inches along the minor axis. It is 5 inches in height. The surface of attachment, i. e. the base of the pedicel is covered with a layer of denser tissue than occurs elsewhere in the sponge. The fibres of this layer are usually flattened, smooth, seldom tuberculated, and only at intervals connected with the interior body network. Between such points of connection the layer often remains single in thickness, and being flattened and smooth on both faces, presents the appearance of a cribriform plate (Plate VIII., Fig. 4). Sometimes the rounded holes of this plate are filled in with a delicate tracery of secondary fibres, when it closely resembles the (Plate VIII., Fig. 5) dermal layer of some fossil sponges. The chief fibres of the basal layer are formed on a framework of sexradiate spicules, which may be revealed as casts by boiling in caustic potash; the secondary fibres appear to originate in threads of silicifying sarcode, which have crossed from one side of a mesh to the other. These secondary fibres must not be confused with the secondary fibres of the body skeleton; the latter spin across large meshes, and are moulded on spicules, the former across meshes of the small fibre, and are not deposited on spicules.

The oscules of the inner surface of the sponge exhibit a tendency to elongate into channel-like grooves, following a radiate direction with respect to the axis of the vase, and somewhat resembling the grooves of the under surface, though of much smaller dimensions, never exceeding, for instance, an inch and a half in length.

The openings of the upper surface are so abundantly spined by prolongations of the body skeleton as to give to the whole interior of the cup a rough spinose appearance, which is in marked contrast to the smooth, even surface of the unspined fibres of the under side. In Fig. 2, Plate V., the spines produce round the oscules the appearance of a denticulated margin. They may be obtained readily for microscopic examination by breaking off with a fine-pointed pair of scissors, and catching them as they fall on a spread-out sheet of glazed black paper. Three such spines are represented in Figs. 2, 3, 4, Plate VI. They consist of a prolongation of the skeletal network into a generally hollow reticulate and pyramidal spine, which might be very appropriately named a "lantern-spine" from its rough resemblance to the lanterns used in architecture. The longitudinal fibres of the spine usually become much thicker with age than the rest, as may be seen in Fig. 2, where they have entirely obscured the transverse fibres from sight, if transverse fibres ever existed. The subsequent deposit of silica has, indeed, in many cases so thickened the fibres and modified the original reticulate form as to lead one to doubt whether they were ever modelled on a sexradiate form. A little boiling in caustic potash, however, will soon reveal the imbedded sexradiate spicules, which possess here just the same characters as in other parts of the network. The deposit of silica over them is so thick, however, as to overwhelm them altogether in some cases, as, for instance, in the lateral secondary spine (Fig. 3) projecting from a principal one, which is not represented in the figure, but the direction of which is indicated by an arrow: in this instance we have a conical spine moulded over a sexradiate spicule, and the same thing has taken place in the pointed end of a spine shown at Fig. 4. The spines frequently support one or more long acerate spicules, which pass through and project beyond them like a lance in rest. Now and then these acerates become involved in siliceous deposit, and form an integral part of the spine.

Similar spines were detected on the upper surface of the type specimen of *D. pumiceus*, but they are much less abundant in it than in its variety *D. Stutchburyi.*

FIG. 3.

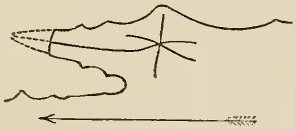


FIG. 4.

Fig. 3, Lateral spine. Fig. 4, Terminal point of a "lantern" spine × 145. The dotted lines indicate the ends, which have been broken off.

At the bottom of the vasiform cup of *D. Stutchburyi*, at one side, is a cylindrical tube ½ an inch in diameter, obliquely perforating the wall from side to side, and in this, as in a similar tube in *D. pumiceus*, remains of the dermal spicular layer were discovered. A fine collection of the spicules was cut out, but, being blown away by a current of air, was lost, and no subsequent searching succeeded in recovering it. Enough was obtained from what remained, however, to show that the characters of its spicules were the same as those of the dermal layer already described, the projecting acerates and dermal sexradiates both being present; a larger number of dermal spicules, however, were found with distal and proximal rays aborted, the four rays remaining being spread out horizontally in the dermal surface.

By holding the sponge upside down, and smartly tapping the bottom of the pedicel, a large number of long acerates were shaken out; they were generally incomplete at one end, and in a single instance one was observed with the extremity rounded off, thus presenting us with an acuate variety of this kind of spicule.

The relations of the excurrent and incurrent canals could be prettily illustrated by holding the sponge up to the light; looking then into the shaded interior of the cup, one saw illuminated patches opposite the incurrent openings, and these patches always fell on the continuous network of the sponge, never coinciding with an excurrent aperture; when the position of the sponge was reversed, the excurrent apertures similarly cast illuminated images on the surface of the outer ridges, but never coincided with incurrent openings, thus demonstrating the absence of completely perforating canals. Of course the perforating tube previously mentioned is an exception, but then that does not belong to the water-system of the sponge.