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## XXIX.—*On the Structure of* Stromatopora.

By H. J. Carter, F.R.S. &c.

[Plate XV.]

Having published an article "On the Probable Nature of the Animal of *Stromatopora*," and another "On the Mode of Growth of *Stromatopora*, including the Commensalism of *Caunopora*," in which some errors of the former are corrected, I now propose to communicate a third, "On the Structure of *Stromatopora*."

By adopting the "commensalism of *Caunopora*," first noticed by C. F. Roemer, the structure of *Stromatopora* becomes much simplified, and the general features of the whole group more easily defined; but it must not be supposed that this structure can be seen with the unassisted eye, although higher powers than simple lenses of ½-inch to 2-inch focus are detrimental to it, like most other minute fossilizations when in limestone; nor can it be obtained without much sectioning and as minute dissection as the lapidification will permit. Hence nothing of this kind can be done in the quarry, and much must be obtained from the polished specimens of lapidaries; so that when the collector, previously unprepared in this way, visits the quarry where there may be abundance of specimens, he will be very likely to come away disappointed.

STROMATOPORA, Goldfuss.

*Gen. char.* Corallum concentrically laminar, massive, incrusting; curve of the lamina large, simple, and expanded, or small, short, and abruptly undulating, following one or several axes, directed in the same or several ways in accordance with the number and direction of the undulations, composed of cœnenchyma formed of rectilinear or curvilinear fibre, and presenting in the course of the lamina isolated spots of stellate venation, whose flexuous rays, becoming divided and subdivided into branches, finally terminate by anastomosing with those of the neighbouring stellations and cœnosarcal cavities respectively (Pl. XV. fig. 1).

*Laminæ.*—Variable in thickness according to the fineness or coarseness of the specimen or species; in some not more than 1-144th inch, in others wider; but this measurement must not be confounded with the coarse yet characteristic lamination of "weathering" in the mass, where a variable number of the thin laminæ may be left together; again varying in the undulating structure, which frequently resembles the "gnarly grain" of an oak panel, in contradistinction to the less wavy condition of the layer in the "straighter grain," well illustrated in the horizontal section of a tree, where the same lines are sometimes close together and sometimes wide apart in the same concentricity.

*Rectilinear and Curvilinear Structure of the Cœnenchyma.*—Baron Rosen in his 'Thesis,' to which I have before alluded, clearly describes and illustrates these two structures ('Ueber die Natur der Stromatoporen,' 1867, pp. 6, 7, and tabb. 1, 6) in his *S. typica* and *S. Schmidtii* respectively, which in a general way holds good throughout, but, of course, is subject to modifications which more particularly belong to the descriptions of the *species* respectively.

Considering the "rectilinear structure" first (Pl. XV. fig. 2), this may be divided into a horizontal and a vertical facies—in which the former presents a number of triangular or polygonal (fig. 2, *a*), and the latter a number of rectangular spaces (fig. 3, *d d*). In the horizontal section (fig. 2) the triangular spaces are formed by the extension of straight lines between a number of more decided puncta (fig. 2, *d d*), which are the truncated ends of the vertical lines or rods that form the most striking part of the rectangular structure in the vertical section (fig. 3, *a a*). Thus, as this structure is repeated in each lamina, the triangular spaces appear on the upper and under side of it respectively, while the interval, now filled with transparent calcite (fig. 2, *e e*, and fig. 3, *d d*),

was occupied by the fleshy part of the animal, and thus was the cœnosarcal cavity of the cœnenchyma; but, although the horizontal lineation forming the triangular spaces was only *impressed* upon the cœnosarc, it nevertheless alone formed the upper and under lines of the rectangular spaces in the vertical section (fig. 3, *b b*); while such laminæ being successively formed, at last produced the great corallum. That the horizontal lineation was only impressed upon the cœnosarc is evidenced by the *decomposed* fossil structure, in which the parts occupied by the cœnosarc, *i. e.* the transparent, have become opaque calcite, while all the rest have disappeared or only left a brown stain. Thus the white calcite, bearing merely the impressions of the horizontal lines, would remain continuous throughout the lamina in other respects, but for the intervention of the vertical lines or rods—finding its openings only through the triangular spaces in the surface. All this is further confirmed by the structure of the *undecomposed* lapidification, where the reverse of colour is the case, and the horizontal lines and vertical rods are composed of opaque white, while the intervening portion is filled with transparent calcite, presenting, from its transparency, a dark colour. When, from the undulating form of the layer or other causes, the horizontal section is slightly oblique, the pattern of the triangular lineation is not so complete, while where it is entirely absent the ends of the rods of the vertical structure *alone* come into view (Pl. XV. fig. 2, *b*), and *vice versâ*.

The size of the triangular spaces varies slightly with the structure of the cœnenchyma, which may be finer or coarser according to the specimen or species, or from the variable size of the polyps which had to protrude through them; but while they slightly vary among themselves, perhaps the average diameter of the largest may be from 1-180th to 1-120th inch. Those of *Hydractinia pliocena* * are only 1-360th inch, of *H. calcarea* 1-600th inch, and of *H. echinata* about 1-266th inch in diameter, the smaller triangular spaces being for younger polypites and other appendages that might have existed in *Stromtopora*, as seen in the living *Hydractinia echinata*, or when it has been preserved in spirit with the polyps still exserted.

The size of the rectangular spaces in the vertical section

* *Hydractinia pliocena*, Allman, should, as Dr. G. Steinmann has stated ('Neues Jahrbuch f. Min., Geol. u. Paleontologie,' 1879, Heft v.–viii. p. 733), be now *Hydractinia incrustans*, Goldfuss, from a gigantic specimen over 50 centims. in extent, at the Strasburg Museum, called by Goldfuss "*Stromatopora incrustans*" (Bronn, Ind. Pal. p. 1203).

(Pl. XV. fig. 3, *d d*) would, of course, be influenced by the thickness of the layers &c., as stated under "*Laminæ.*"

On the other hand, the "curvilinear structure" (Pl. XV. figs. 4, 5), although also divisible into a horizontal (fig. 4) and vertical (fig. 5) facies, is not so strongly differentiated as the rectilinear one; for the curvilinear element enters into the vertical lineation sufficiently to give it a mixed character of vertical and inflected lines (fig. 5), while the triangular lineation is quite excluded from the vertical section in the rectilinear structure. Still, while the curvilinear structure is *alone* seen in the horizontal section (fig. 4) and the mixed form in the vertical one (fig. 5), the difference is sufficiently marked to obviate confusion; besides, there is an indistinct horizontal lineation in the vertical which is never seen in the horizontal section, arising not from actual lines, but from structural arrangement influenced by the laminar growth.

In the horizontal section the curvilinear structure is represented by a vermicular fibre or thread (Pl. XV. fig. 4, *a a a a*), which, branching and anastomosing repeatedly, is not confined to the surface as the triangular lineation in the rectilinear form, but, descending perpendicularly (fig. 5, *c c c*), gives rise to the straighter curvilinear structure observed in the vertical section (fig. 5, *a a a a*); so that, in short, the curvilinear thread is horizontal in the horizontal and somewhat verticalized in the vertical section of the layer, which, being repeated concentrically, leads at last to the production of the general mass of this kind of *Stromatopora*, as the rectilinear does to its corallum.

Here the intervening cavities (Pl. XV. figs. 4 and 5, *b b*, *b b*, respectively, now filled with transparent calcite), which held the cœnosarc, are, of course, as vermicular in form as the curvilinear thread of the cœnenchyma, so that, in the *decomposed* fossil, where the same change takes place as that mentioned in the rectilinear structure, a vermicular form makes its appearance in opaque white calcite, which in the *undecomposed* lapidification was transparent, while hardly any thing but a brown stain remains of the *formerly* white curvilinear structure; in short, as before stated, the colouring is reversed.

While, however, as also before stated, these are the extreme forms of the cœnenchymal structure of *Stromatopora*, there are intermediate and modified forms (always remembering, of course, the influence that various kinds of lapidification may produce)—such, for instance, as a condensation of the horizontal layer of the rectilinear structure in the finer species, wherein the ends of the rods are so expanded that the straight lines between them can hardly be seen, and the interstices

indicative of the holes of the polyps, being thus reduced to various diameters below 1-600th inch, causes them to look like apertures in the midst of a layer composed of the puncta (*i. e.* ends of the rods alone). Or, in the curvilinear structure, the interspaces representing the cœnosarcal cavities become so uniformly contracted that both the horizontal and vertical sections indicate a composition of vertical tubes *alone*, in juxtaposition like those of *Favosites gothlandicus*, but *with* the stellate venation to be mentioned hereafter and *without* the *tabulæ*, though still communicating with each other as freely as the cœnosarcal cavities in the more typical form.

Again, although the differences between the rectilinear and curvilinear structures are so marked, they are very analogous in their growth, inasmuch as the end-to-end anastomosis of the old fibre with the new in both instances leads to a continuity of structure in the mass, differentiated only by the characters above mentioned.

Lastly, the "vertical rods" may be thick or thin; and although *par excellence* confined to the rectilinear (Pl. XV. fig. 3, *a a*), similar ones also occur in the curvilinear structure *but not always*, and therefore are not inserted in the illustrations; they are, however, just as much in connexion with the curvilinear structure, which they simply pierce, as they are with the triangulated layers of the rectilinear structure, which they as simply unite together. They may also present the same appearance of original hollowness. Mr. Champernowne informs me that he has several specimens bearing these "rods" both with and without the presence of the *tubes* which characterize the specimens called "*Caunopora*;" so that the rods do not depend upon the presence of the tubes. In my own small collection the only specimens of curvilinear structure (viz. two) which bear the "rods," happen to be accompanied by the tubes of *Caunopora*. But the most remarkable feature in them is that their axial structure, as well as the connecting fibre being transparent, indicates that they were originally hollow (figs. 2 and 3, *e e e*).

How far this hollowness was in connexion with the cœnosarcal cavities of the cœnenchyma or with the axial portions of the rectilinear and curvilinear fibre respectively, which, as just stated, also gives evidence of similar hollowness, I am not able to say; but hereafter I shall show that the rods were probably closed where they projected beyond the free or natural surface.

The composition of all the fibre in the cœnenchyma, too, always appears to be granular, and so open in some parts that it appears almost cribriform. For this I have endea-

voured to account by the fact that the calcareous fibre in *Millepora alcicornis*, as the horny fibre in *Hydractinia echinata*, appears first in small increments, which afterwards become continuous in both instances; but in vain do we look for the granular appearance in the fresh fibre of *Millepora alcicornis* after it is fully formed; so that it is just possible that lapidification may have had a hand in this appearance.

*Stellate Venation.*—The stellate venation consists of points in the cœnenchyma more or less uniformly distant from each other, from which flexuous rays, now represented by transparent calcite, radiate in all directions, becoming branched and subdivided as they go, until finally they terminate in anastomosing with those of the neighbouring stellations and in the cœnosarcal cavities of the cœnenchyma respectively (Pl. XV. fig. 1). They appear to come into existence with each lamina, as testified by the larger masses of rectilinear cœnenchyma produced by the prevailing species of *Stromatopora* in Pit-Park Quarry at Dartington, wherein the lamina may not be more than 1-96th inch in thickness; hence the least abrasion in making a section of such specimens may take them away or bring them into view. The flexuous ray and its branches may vary from 2 lines or less to 2 inches, chiefly according to the species, with a diameter at its origin generally proportionate to its length, that of the latter being 1-24th inch *. The rays appear to be generally centred in an elevation, and to descend, branching as they go, over the sides of it to the plane surface of the species, following the layer, whose undulation may be in proportion to the mamillary projections on the free or natural surface, being greatest in species like *S. polymorpha*, Goldf., while in others there may be hardly any elevation perceptible, yet still the stellate venations exist. Generally, too, they are centred in a special enlargement like a cell, which may in some species have more or less vertical extension; but, whatever the centre may be, it does not appear to have had an *external* opening, as shown by Rosen's magnified illustration of a stellate venation from *Stromatopora astroites* (see tracing fig. 6, from tab. ii. fig. 7), which had *not even a central enlargement.* How far the extension of the flexuous ray may be confined to the

* This is the largest that I have seen, and occurs in a species apparently peculiar to Pit-Park Quarry, Dartington, of which Mr. Champernowne has a specimen wherein the flexuous ray even exceeds these dimensions. The largest seen by Baron Rosen is that of *Stromatopora astroites*, of which I have given a tracing (fig. 1) of the natural size.

lamina in which it is developed I am not prepared to state; but it often appears to descend through several layers in the mass when this is merely owing to the undulation of the layer; while in flat species a horizontal shave more or less, as before stated, may bring it into view or take it away altogether, showing that in this instance it is confined to the layer. Still, as the cavities of the cœnosarc become continuous by extension upwards, so the branches of the flexuous ray of the stellate venation may be more or less extended vertically. Hence also, as the form presented by the free surface of *Stromatopora* cannot be generic but must be specific, so this must be given, together with the other peculiarities of structure, in the descriptions of the respective species.

We have now to consider the import of the parts that have been enumerated, and see if this can be elucidated by reference to existing species.

It is true that no species of *Stromatopora* is known to exist at the present day; but still there may be organisms of a like nature that reflect back a light which may lead us to a right understanding of what *Stromatopora* was.

That *Millepora alcicornis*, although not growing into such thick masses as *Stromatopora*, does produce a corallum which is composed of a curvilinear cœnenchyma, increasing by lamination, and spreading over or enveloping every hard object with which it comes into contact, like *Stromatopora*, is incontestable.

That the fossil species, viz. *Hydractinia pliocena* (originally and significantly called *Stromatopora incrustans* by Goldfuss, as before stated), was produced by a like organism to that of *Millepora* is equally true.

And, lastly, we have species of *Hydractiniæ* at the present day producing respectively horny and calcareous polyparies analogous to these coralla.

Nor does any one doubt that all these were produced by Hydroid Polyps issuing from holes smaller even than those indicated by the triangular spaces in the rectilinear structure of *Stromatopora*. In short, when we look at a whelk-shell covered with living *Hydractinia echinata* in its natural element, or after having suddenly been plunged from it into spirit and water for preservation, we do not wonder that such an exuberant growth of polyps of all sizes, such as must also be present in *Millepora alcicornis*, could easily produce the coralla of either *Hydractinia pliocena* or any of the *Stromatoporæ*.

So far, then, we can account for the corallum of *Stromatopora* and the animal which produced it.

What part, then, did the "stellate venation" perform? and is there any thing analogous to it in the organisms just mentioned?

From what has been stated of the stellate venation, it does not appear that it had an *external* opening in the fresh state, as will be shown hereafter, whether with or without a central cell or inflation, such as that, in the latter instance, figured by Baron Rosen (*op. et l. c.*)—and therefore that its functions were not excretory like those of the canal-systems of sponges, which, possessing a stellate form like that of the stellate venation of *Stromatopora*, are present on the surface of some species. Again, the stellate venation in *Stromatopora* appears in every layer however thin, which, in some specimens of the rectilinear species from the Pit-Park Quarry at Dartington, split off individually, each bearing its own centres of stellate venation, which are generally situated one over another as they are on the summits of the gentle elevations which characterize the growth of the species. This, too, is not like the character of the stelliform excretory canal-systems of sponges, which are confined to the surface of the few species that present them. We therefore, however like the latter may be to the stellate venations of *Stromatopora*, may dismiss this speculation from our conjecture.

Next, as to any thing like the stellate venation in any of the recent or fossil specimens of organisms apparently allied to *Stromatopora*.

Here we must first advert to what takes place in the development of the *polypary* of *Hydractinia echinata* and *H. calcarea* respectively, all of which may be found detailed and illustrated *in extenso* in my communications on the subject published in the 'Annals' (vol. xi. p. 1 &c. pl. i., 1873; and vol. xix. p. 46 &c. pl. viii., 1877), but which will be briefly repeated here for our present purpose—that is, to show that there is a grooved venation in dried specimens of the recent species to which I have alluded, previously formed by, and afterwards supporting in the living state, a stoloniferous branched tubulation whose office is similar to that of the *hydrorhiza* of the Hydroid Zoophytes, viz. to produce the rudiments upon which the whole of the rest of the *polypary* is erected. This tubulation may be first observed in the proliferous membrane of *Hydractinia echinata*, as well as in that of *H. calcarea*, and is easily recognized by the presence of horny or calcareous points, as the case may be, upon its *external* surface, which are not only the rudiments of the *polypary*, but those of the grooved venation, as before stated, in

which the stoloniferous tubulation is afterwards to be lodged, but which, disappearing in the dried state, leave the latter in the form so beautifully displayed in the surface of the branched species of *Hydractinia* (*H. arborescens*, Ann. 1878, vol. i. p. 298, pl. xvii. fig. 4). The same kind of grooved venation exists in *Millepora alcicornis* either in the surface or immediately beneath the last or outer layer, according to the degree of development to which the layer has arrived, since, as may be gathered from what has been stated of the stoloniferous tubulation in *Hydractinia*, the tubulation soon obscures itself by the development of the *polypary* around and above it. The same grooved venation may be beautifully seen on the surface of the fossil species, viz. *Hydractinia pliocena*, Allman, = *Stromatopora incrustans*, Goldfuss, *ut anteà*, and not only on the surface but in the subjacent layers as they are split off from the fossilized polypary or corallum.

Now no naturalist or comparative anatomist (for it is essential that a palæontologist should be one) could ever confound this structure with that of the excretory canal-system of sponges, however like the latter may be to it; if so, I must refer him to Mr. Moseley's description of it in the living species under the name of "hydrophyton" (Phil. Trans. 1877, vol. clxvii. p. 125, pl. iii. fig. 16, &c.), wherein it will be found to be "lined, and in many places filled with cellular elements" (p. 128, pl. iii. fig. 17), and not hollow like the canal of sponges; while I myself cannot see any difference, except in form, between this grooved venation and the stellate venation—which in the lapidified state of *Stromatopora* in the horizontal section is filled with transparent calcite, but which, of course, when in the interior of the corallum becomes tubular, and in the larger forms of Pit-Park Quarry, to which I have alluded, filled (when under decomposition) with a mould of opaque white calcite, following the same mineral changes as before mentioned under similar circumstances, and thus contrasting strongly, in its branching form, with the dark remains of the decomposed corallum in which it is thus imbedded.

Nature frequently repeats herself in form, although not in function, as if there were a unity of design. Thus there is a specimen of a polyzoon in the Liverpool Free Museum, which was brought to my notice by Mr. T. H. Higgin, F.L.S., where the cœnobium is identical with the general form of the siliceous hexactinellid sponge called *Eurete farreopsis*, which I have figured in the 'Annals' (vol. xix. pl. ix. fig. 1); and I possess the calcareous cormus of a Synascidian still larger,

where the general structure is similar, *i. e.* composed of a branched anastomosing tubulation in which the latter is one third of an inch in diameter, and thus forms a clathrous mass. (By "calcareous" I mean charged with globular spined spicules of carbonate of lime, like those of the *Didemida*, Giard.) Now all these are built upon the same design, and in all the oral orifices of the organisms respectively producing them are on the *outer* side of the tubulation; yet no naturalist would assert that a polyzoon, a spongozoon, and an ascidian were one and the same organism. Hence the form may be the same, but the function different; and so the stellate venation of *Stromatopora* may be like the stellate excretory canal-system of sponges presenting this form, with a totally different function; on the other hand, in *Hydractinia* and *Stromatopora* respectively, the form of the venation may be different and the function the same.

Lastly, we come to the "vertical rods" of *Stromatopora*, to which I have alluded as always existing in the rectilinear and only sometimes in the curvilinear cœnenchyma, presenting an axial transparency indicative of their having once been *hollow* in the whole of their length, except probably at the surface, where the hollow is closed; and that this was probably the case we arrive at in the following way, viz. that the spines in both *Hydractinia echinata* and *H. calcarea* which pass up through the whole layer of the polypary are respectively hollow throughout, but closed at the apex (Ann. 1877, vol. xix. pl. viii. figs. 1 and 4)—also that the spines on the surface of the fossil species, viz. *H. pliocena*, are the same, and appear to be continuous with the vertical tubes in the stroma or corallum, while *Labechia conferta* of the Silurian Formation (which was a species of *Hydractinia*, and to which I shall allude more particularly hereafter) presents the same kind of axial transparency in its vertical rods or columns, which terminate in opaque (closed) conical points respectively on the surface, indicative of their also having been in like manner otherwise hollow (fig. 8, *a*, *b*). Hence too, perhaps, we may account for the axial transparency, indicating original hollowness, in the "vertical rods" of *Stromatopora*.

Further, if we compare *Favosites gothlandicus* (fig. 7) with *Labechia conferta* (fig. 8—both fossils of the Silurian Formation), both will be found to be composed of vertical spaces tabulated; but while the former was composed of tubes in juxtaposition with horizontal tabulæ (fig. 7, *b*), the latter was composed of thick hollow columns between which the tabulæ were extended in a much less regular manner (fig. 8, *a*, *b*);

and thus in *Labechia* we have a transitional form from *Favosites gothlandicus* to the *rectilinear* structure of *Stromatopora*, which, in the horizontal section (fig. 2, *a*, and fig. 8, *a*), it closely resembles—accounting for Lindström's statement that G. Eisen had pointed out to him "that there are specimens found in Gothland combining the peculiar features of *Labechia* with those of *Cœnostroma*" = *Stromatopora* (Ann. 1876, vol. xviii. p. 5).

That *Labechia* was a species of *Hydractinia* is evident from its structure and mode of growth—*i. e.* more or less laminiform, enveloping small shells and corals in its course of increase. I make this statement from two large specimens now before me, in which there are a number of layers of *Labechia* varying in thickness under one third of an inch, heaped irregularly upon each other with shells, corals, and sand between them, some of the former of which have not only become united to and imbedded in the layers, but also, after the manner of *Hydractinia*, appear to have become partly absorbed into their structure; so that, under this form, *Labechia*, contrary to Messrs. Nicholson and Murie's statement (Journ. Linn. Soc. vol. xiv. p. 235), *is* closely allied to *Hydractinia*, which seems to show that the assertion was made upon a single specimen in which this did not occur.

There is a species of *Stromatopora*, viz. *S. elegans*, Rosen (the well-known "staghorn variety"), among those in the possession of the lapidaries hereabouts, which in the presence and position of the stellate venation has puzzled both Mr. Champernowne and myself; for the pattern in the cœnenchyma exactly represents the stellate venation in the horizontal section, but in its branches will be found to end not like that of the usual venation, namely in the cœnosarcal cavities, but in the fibre of the cœnenchyma itself; and yet the branches of the stellate venation, when it happens by the section to have come into view, follow the course of the cœnenchymal stellation. The stellate figure in the cœnenchyma (however much, in the horizontal section, it may look like the cylindrical branches of the stellate venation) has a *vertical* extension, as well as a horizontal one, in the cœnenchyma, so that the horizontal section might cut off several thin slices and still leave the same figure; while the stellate venation is probably confined to only one part of it, and therefore only now and then, in small fragments, is seen, but, of course, must somewhere become continuous with the cœnosarcal cavities. Hence I should be inclined to infer that the "stellate venation" maintains its horizontal position, however much *vertically* the stellate figure assumed by the

cœnenchyma may be extended. But this, again, although desirable to notice here, is a point which chiefly belongs to a particularization of the structure in connexion with a description of this species.

Budleigh-Salterton,
July 29, 1879.

## EXPLANATION OF PLATE XV.

*Fig.* 1. *Stromatopora astroites*, Rosen, natural size, showing spots of "stellate venation." (After Rosen, tab. ii. fig. 6.)

*Fig.* 2. *Stromatopora*, sp. (Pit-Park Quarry, Darlington). Illustrating the rectilinear structure in a horizontal section of the cœnenchyma. *a*, ends of vertical rods, with the rectilinear lines between them forming the triangular spaces; *b*, the same, with the rectilinear lines removed; *c*, dark shade to represent the transparent calcite indicative of original hollowness; *d d*, ends of rods; *e e*, cavity of cœnosarc.

*Fig.* 3. The same. Illustrating the rectilinear structure in the vertical section of a little more than a single lamina. *a a*, the rods; *b b*, the horizontal lines limiting the lamina above and below, being produced by the edge of the layer (*a*, fig. 2); *c c*, inflated ends of the rods uniting respectively with those of the next laminæ both above and below; *d d*, rectangular or quadrilateral spaces, forming part of the cœnosarcal cavity; the dark shade represents the transparent calcite, indicating original hollowness both in the rods and horizontal lines.

*Fig.* 4. *Stromatopora*, sp. (Pit-Park Quarry, Dartington). Illustrating the curvilinear structure in the horizontal section of the cœnenchyma. *a a a a*, vermiculated thread or fibre cut through on the surface; *b b b*, vermicular cavities of cœnosarc; *c c c*, descending portions of vermiculated thread of cœnenchyma.

*Fig.* 5. The same. Illustrating the curvilinear structure in the vertical section. *a a a*, vermiculated thread or fibre cut through vertically, showing a tendency to vertical elongation; *b b b*, vermicular cavities of cœnosarc; *c c c c*, descending portions of vermiculated fibre.

N.B. Figures 2–5 inclusive are drawn to the scale of about 1-96th to 1-1800th inch. As the structures vary in size in different species, and, indeed, in different specimens of the same species, so here the rectilinear appears smaller than the curvilinear, but, from what has been stated, it might have been the reverse.

*Fig.* 6. *Stromatopora astroites*, Rosen. One star of stellate venation, magnified five diameters. (After Rosen, tab. ii. fig. 7.) The unfinished state of the ultimate branches here is to indicate that they are sunk into the cœnenchyma of the *Stromatopora*, and, therefore, that the centre is elevated.

N.B. The fact of the structure of the cœnenchyma being much smaller than the stellate venation is evidenced by fig. 1 (viz. *Stromatopora astroites*), wherein the former is too minute to be represented of its natural size, while the latter can be easily seen with the unassisted eye. Hence it must not be expected that the stellate venation can be represented here upon the same scale as the rectilinear and curvilinear structures of the

cœnenchyma respectively (figs. 2–5); but when magnified, as in fig. 6, on a much lower scale, being smaller, it might, without this explanation, lead to the idea that the stellate venation was much smaller than the general cœnenchymal structure, while it is greatly the reverse.

*Fig.* 7. *Favosites gothlandicus.* *a*, portion of surface, to show the hexagonal form of the cells; *b*, portion of vertical section, to show the *vertical* septa or walls of the cylinders traversed by the *tabulæ*.

*Fig.* 8. *Labechia conferta.* *a*, horizontal section, to show the arrangement of the rods or pillars, and the lines (*tabulæ*) traversing their interspaces—also that they were hollow, as indicated by the white centre now filled with transparent calcite; *b*, vertical section, to show the same, but with closure of the pointed free extremities.

N.B. These figures (viz. 7 and 8) are all magnified upon the same scale, viz. two diameters, and are slightly diagrammatic, to show how the rods and tabulæ of *Labechia*, replacing the cylinders and tabulæ of *Favosites*, present an analogous structure to the rectilinear cœnenchyma of *Stromatopora* (figs. 2 and 3).

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## XXX.—*Descriptions of Palæozoic Corals from Northern Queensland, with Observations on the Genus* Stenopora.

By H. A. Nicholson, M.D., D.Sc., F.G.S., &c., Professor of Natural History in the University of St. Andrews, and R. Etheridge, Jun., F.G.S., of the British Museum.

[Plate XIV.]

[Continued from p. 226.]

### Genus Stenopora, Lonsdale, 1844.

*Stenopora*, Lonsdale, Darwin's Geol. Obs. Volc. Islands, 1844, p. 161 (note).

*Stenopora*, Lonsdale, Strzelecki's Phys. Descr. New South Wales &c., 1845, p. 262.

*Tubuliclidia*, Lonsdale, Bull. Soc. Géol. de France, 1844, 2nd ser. i. p. 497.

*Tubuliclidia*, Lonsdale, Murchison's Geol. Russia, 1845, vol. i. pp. 221 and 631 (note).

*Gen. char.* Corallum ramose or sublobate, rarely massive, rooted below, and composed of tubular corallites, which are nearly vertical in the centre of the branches, and radiate outwards, from an imaginary axis, to open on all points of the free surface. Corallites polygonal, thin-walled, and more or less completely in contact in the centre of the branches; but in the outer curved portion of their course more or less cylindrical, and annulated by periodical ring-shaped thickenings, which are placed at corresponding levels in contiguous tubes,