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XII.—*Descriptions of two new Genera and Species of Polyzoa from the Devonian Rocks.* By H. Alleyne Nicholson, M.D., D.Sc., M.A., F.R.S.E., Professor of Natural History in University College, Toronto.

In the following communication I propose to describe two new genera of Polyzoa which I have been compelled to found for the reception of two remarkable fossils from the Devonian rocks of Western Ontario. Both of these belong to the family of the Fenestellidæ; but they differ in an extraordinary manner from all previously recorded genera, and present certain points of structure of a very anomalous nature.

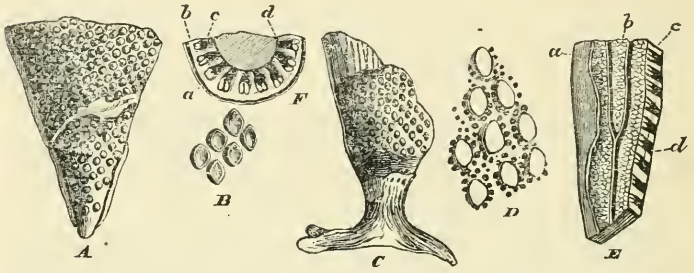
Genus Cryptopora (Nicholson).

Polyzoary forming a rigid, infundibuliform, calcareous expansion, springing from a strong solid branching root-stalk or rhizome. Exterior of the cœnœcium forming a continuous non-perforated calcareous layer, internal to which is a second or intermediate layer, the two being composed of the amalgamated and coalescent branches ("interstices"). The intermediate layer is marked by shallow and bifurcating longitudinal sulci, corresponding with the lines between the branches; and its surface exhibits reticulating lines which correspond with the bases or proximal ends of the cells beneath; but no fenestrules are present. The internal surface of the intermediate layer carries the cells, which are flask-shaped, and

are arranged in double alternating rows forming regularly flexuous lines enclosing oval interspaces, exactly as in *Retepora*. The oval interspaces, however, instead of constituting so many "fenestrules," are the bases of so many pillars, which proceed perpendicularly inwards, across a central space, to join with an internal calcareous membrane which forms the innermost lining of the funnel-shaped frond.

It follows from the above description that the mouths of the cells in *Cryptopora* neither open on the exterior of the frond, as is commonly the case in *Fenestella*, nor upon the interior of the frond, as is the case in the infundibuliform species of *Retepora*. On the contrary, we have in this extraordinary genus the unique arrangement that both the internal

Fig. 1.



Cryptopora mirabilis, Nich.: A, a partially decorticated specimen, natural size; B, a small portion of the same, showing the inner ends of the perpendicular columns, enlarged; C, another partially decorticated specimen, springing from a strong footstalk, natural size; D, part of the internal surface of the intermediate layer, showing the mouths of the cells and the broken perpendicular columns, enlarged; E, a small portion of the frond, enlarged and somewhat diagrammatically represented; F, transverse section of part of the frond, enlarged and also slightly diagrammatized (*a*, the external smooth membrane; *b*, the intermediate sulcated layer; *c*, the central space containing the cells and traversed by the perpendicular columns; *d*, the internal membrane).

and the external aspects of the funnel-shaped polyzoary are to all appearance closed by a continuous calcareous membrane. The cells are not placed upon either of the free surfaces of the polyzoary, but occupy a central space, which has its internal wall formed by the innermost membrane, and its external wall by an intermediate layer composed of the laterally coalescent branches. The cells are situated upon the internal face of the outer wall of this central space; and the two walls are kept apart by a system of pillars, which traverse the central space perpendicularly, and correspond in position with the fenestrules

of a *Retepora*. It would thus appear that the water must have been admitted to this central space, and thus to the cells, by openings in the free edge or lip of the infundibuliform polyzoary; but none of my specimens exhibits this portion of the frond.

In the genus *Hemitrypa*, Phillips, the fenestrules do not perforate the cœnœcium so as to reach the outer face of the frond, but are filled by a calcareous membrane. The cells, however, open upon the external surface, instead of into a central space; and the structure of the polyzoary is in other respects very different.

The following is the only species of the genus that I have as yet met with, though additional forms will probably be afterwards detected.

Cryptopora mirabilis (Nicholson).

Polyzoary infundibuliform, apparently from one to three inches in height and three quarters of an inch or more in diameter distally. External layer thin, imperforate, smooth or obscurely striated. Intermediate layer formed of the coalescent branches, and marked externally by vertical shallow grooves, which are placed about half a line apart and sometimes bifurcate. Between these grooves the external surface is mapped out by inosculating lines into small oval or polygonal spaces corresponding with the cells. The internal surface of the intermediate layer carries the cells, which are arranged biserially in flexuous lines, and enclose oval or rhomboidal interspaces. These interspaces are arranged in very regular diagonal lines, about four in the space of two lines; and they give origin to a series of short rounded pillars, which extend inwards at right angles to meet the internal layer. The central space, in which the cells are situated, is about half a line to two thirds of a line in depth. The internal layer is apparently thin and membranous. The entire frond springs from an exceedingly strong, horizontal, branched stalk, the surface of which is marked by vermicular striæ.

The materials in my hands are not sufficient to permit of an entirely satisfactory elucidation of the characters and structure of this remarkable species. Different specimens, however, or different parts of the same specimen, show the following appearances:—

1. The external membrane is thin, and is only preserved in parts of any specimen that I have seen; and as it corresponds with the reverse or non-poriferous face of an ordinary *Retepora*, it is to be regarded in reality as nothing more than the exterior portion of the intermediate layer.

2. The intermediate layer (together with the external layer, as just remarked) is clearly formed by the coalescent branches. When viewed from the outside, where the thin outer layer has been stripped off, it exhibits shallow vertical grooves, marking out the original branches, and it also shows in outline the proximal ends of the cells below (fig. 1, E, *b*).

3. Specimens which exhibit the hollow interior of the funnel, from which the innermost membrane has been removed in whole or in part (fig. 1, D), exhibit the mouths of the cells as rounded pores placed on the inner aspect of the amalgamated branches. The cells are arranged in double alternating rows forming regularly bent or undulated lines, each of which corresponds with the inner surface of a branch, and which, by their inosculation, enclose oval spaces corresponding to fenestrules, but occupied by short solid columns.

4. Specimens which are broken across transversely (fig. 1, F) show that, instead of fenestrules or perforations between the anastomosing branches, we have a series of stout pillars, which run perpendicularly inwards from the poriferous face, and have their internal ends connected together by a thin calcareous membrane, which forms the innermost lining of the funnel-shaped frond. There is thus formed a central space (*c*), which is lined outwardly by the cells, and to which water can apparently not have been admitted otherwise than by openings in the margin of the funnel.

5. Specimens which are *casts* of the interior of the frond, to which the innermost membrane with the ends of the perpendicular columns still remain adherent, are not uncommon (fig. 1, A & C). These show that the columns are so arranged as to form beautifully regular diagonal lines; and their inner ends seem to have been convex, as they in many cases leave concave or cupped scars of an oval or rhomboidal shape upon the outside of the cast (fig. 1, B).

6. One specimen exhibits a strong horizontal footstalk, from which the cœnœcium grew up vertically (fig. 1, C). This footstalk is branched at both ends; its surface is covered in parts with vermiculated striæ; and its structure seems to have been minutely tubular or cellular.

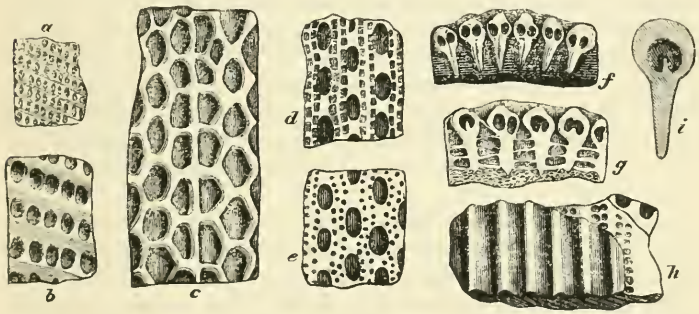
7. Lastly, some specimens show the extraordinary character of a second frond, quite similar in structure to the first, invaginated within the outer one, so as to give rise to an internal cone closely applied to the external funnel. I am at present, with the comparatively imperfect materials in my possession, unable to offer any explanation of this remarkable feature.

Locality and Formation.—Not uncommon, though always more or less imperfect, in the Corniferous Limestone (Devonian), Port Colborne and Lot 6, Con. 1, Wainfleet.

Genus Carinopora (Nicholson).

Polyzoary infundibuliform, calcareous, and reticulated. The external layer of the cyathiform frond is composed of regularly undulated flexuous branches ("interstices"), which anastomose with one another, after the manner of a *Retepora*, so as to form a series of oval fenestrules. Exteriorly the branches are angulated or carinate, and are smooth and non-celluliferous. Internally each branch gives origin to an enormously developed keel or vertical lamina, which corresponds in direction with the branch, and is directed inwards towards the centre of the funnel. The inner surface of the branches thus presents a series of parallel ridges of great height, separated by deep grooves, at the bottom of which, to all appearance, the cells open. The fenestrules also open at the bottom of these grooves. In parts of the frond, however,

Fig. 2.



Illustrations of the structure of *Carinopora Hindei*, Nich.: *a*, fragment of the exterior, natural size; *b*, portion of the same, enlarged; *c*, another portion of the exterior, still further enlarged; *d*, a fragment from which the external non-celluliferous layer has been removed, showing the cells, enlarged; *e*, a fragment more deeply decorticated, showing the mouths of the cells, enlarged; *f* & *g*, transverse sections of the frond in different parts, enlarged; *h*, a portion of the internal surface, enlarged; *i*, transverse section of a single branch, enlarged.

these grooves are apparently rendered vesicular by the development of a series of delicate calcareous laminæ, which connect together the sides of contiguous ridges. In some cases, also, the inner edges of the ridges are connected together by a continuous calcareous membrane, so that the inner surface of the frond is completely closed. The cells are carried in alternating double rows upon the inner and lateral aspects of each branch, their mouths appearing to be situated at the bottom of the grooves before mentioned and at the base of the great keel which springs from each branch internally. Obviously, how-

ever, the row of cells on one side of any branch opens into one groove, whilst the row on the opposite side of the same branch opens into a contiguous groove, and not into the same one. No cells are carried upon the areas formed by the anastomosis of contiguous branches.

I have only seen a single, very large and well-preserved example of this genus; and a careful examination of this has still left me unable to elucidate and explain some of the most extraordinary structural peculiarities which it presents. There can, however, be no doubt as to the complete distinctness of the genus from any previously described. A comprehension of the very remarkable characters presented by this genus will perhaps be best obtained from a detailed account of the different figures of the above illustration, all of which represent different portions of the only known specimen:—

a. This figure exhibits a portion of the exterior of the frond, showing the fenestrules and the outer non-celluliferous aspect of the branches. In the portion here illustrated of the natural size, and partially shown at *b* on an enlarged scale, the fenestrules are oval and arranged in diagonal lines, and the branches are strongly keeled—the general appearance closely resembling the non-celluliferous aspect of *Retepora prisca*, Goldfuss, and the fenestrules being similarly formed by the simple inosculation of the branches without the development of distinct dissepiments.

c. This represents another portion of the exterior of the frond, nearer to the base, where the fenestrules are polygonal or hexagonal and are not arranged in regular diagonal lines. Here also every fourth or fifth branch has a nearly straight direction, giving the network quite a peculiar appearance. In some cases, lastly, the fenestrules present the appearance of being closed by a delicate external membrane.

d. This shows a small portion from which the outer non-celluliferous layer has been denuded, showing the proximal ends or bases of the cells, arranged in a double inosculating row on each branch, and lying in the same plane as the fenestrules.

e. This figure exhibits, on an enlarged scale, a small portion of the exterior of the frond, from which the outer non-celluliferous layer has been stripped off together with the cells themselves, leaving to view the circular mouths of the cells arranged in two alternating rows, which are still on the same plane as the fenestrules, and which do not encroach upon the spaces formed by the inosculation of the branches.

f. This figure is a greatly magnified representation of a transverse section of the frond at a point considerably removed

from the base, showing the branches cut across. Above, the branches are separated by the fenestrules; and immediately beneath this are seen the dark oval spaces which represent the cavities of the biserial cells, and two of which are contained within the cavity of each branch. Below this, again, each branch is seen to give off an immense keel or ridge, which is directed inwards towards the interior of the frond. These ridges are separated by deep intervening grooves; and there can be no doubt that the cells open at the bottom of these grooves, those of one side of the branch opening on one side of the base of the great keel, and those of the other opening upon the opposite side of the same.

g. This exhibits a greatly magnified transverse section of the frond at a point a little above the base. As in the preceding, we can recognize without difficulty the shallow fenestrules, the divided branches carrying in their interior each a pair of cells, and the great internal keels. Here, however, we have two new features: first, the deep grooves between the keels are subdivided by delicate calcareous laminæ, which connect the opposite sides of contiguous keels, and divide the intervening grooves into shallow transverse chambers; secondly, the grooves between the keels are closed internally by a continuous calcareous membrane which has a minutely porous or vesicular structure.

h. This represents a fragment taken from near the base of the funnel and exhibiting the internal surface of the polyzoary. We see here the inner faces of the great longitudinal keels; but instead of these being separated by deep sulci as in the upper portion of the frond, they are here separated by shallow rounded grooves formed by a continuous calcareous membrane, which is not penetrated by either the fenestrules or the cells. No apertures, therefore, of any kind appear on the interior of the cœnœcium near the base, the open interstitial grooves of the upper portion of the frond being here closed by a continuous connecting layer. At the right-hand corner of the figure the keels and their connecting membrane are broken away, so that we see the cavities of the rows of cells; whilst the extreme corner is still further broken away, so that the fenestrules come into view.

i. This simply represents a single branch in transverse section, greatly enlarged, and shows the cells in the interior of the branch and the great triangular keel proceeding from its internal surface.

From the above description it will be evident that the structure of *Carinopora* is quite anomalous, and wholly unlike any thing that has hitherto been observed in any member of

the Fenestellidæ. The most anomalous point is the position of the cells, or rather their mode of opening on the surface. The cells open towards the interior of the funnel-shaped frond, as in *Retepora*, and in the upper portion they seem to open simply at the bottom of the deep intercarinal grooves, into which the fenestrules also open; so that there is here no special difficulty, if, as seems tolerably certain, the keels are not here connected by an imperforate membrane, and the grooves thus remain open to the access of sea-water. Near the base, however, the keels are clearly connected by a continuous imperforate membrane, and the deep intervening grooves are filled up by a vesicular calcareous tissue, so that the sea-water could not have gained access to the mouths of the cells. The only explanation that I can offer is that the basal portion of the polyzoary may perhaps have been gradually overgrown internally by this layer of vesicular tissue, and may thus have been practically killed, whilst the upper portion remained open to the sea and genuinely alive. If this was not the case, I cannot explain the undoubted facts.

The enormous internal keels, whether free or connected together by membrane, give an extraordinary depth and thickness to the polyzoary; and the fenestrules do not extend to more than about one fourth of this depth from the outside; nor do the cells. In *Hemitrypa*, Phill., the fenestrules do not extend through the entire thickness of the polyzoary; but in this genus the fenestrules are confined to the *inner* surface of the funnel-shaped frond, and the cells open *externally*. In *Cryptopora*, Nich., again, the outer and inner surfaces of the polyzoary are *both* imperforate, and the cells open into a central space, which is crossed by regularly placed pillars having a direction perpendicular to the plane of the frond.

The following is the only species of the genus *Carinopora* which has come under my notice.

Carinopora Hindei (Nicholson).

This being the only species of the genus, it is not needful to recapitulate its structural characters, since these, so far as known, have been fully discussed above. It only remains to give the measurements by which the species is distinguished, along with one or two characters which are not of generic value. The only known specimen exhibits a portion of a very large infundibuliform frond, which, though fragmentary, has a height of four inches, with a diameter at the top of clearly more than half a foot. The actual base is broken off. About six branches occupy the space of two lines. The fenestrules are sometimes oval, sometimes hexagonal or polygonal; and their

arrangement differs in different parts of the frond. Sometimes they are disposed in regular diagonal lines; but even in this case there are often perceptible central longitudinal lines, on either side of which the diagonal rows of fenestrules diverge in opposite directions like the barbs of a feather, giving rise to a most peculiar appearance. At other times the fenestrules are rhomboidal, or hexagonal, or polygonal, and are not arranged in distinct diagonal rows; whilst two contiguous longitudinal rows are often separated by an unusually narrow and apparently quite straight branch (see fig. 2, *c*). The spaces along which the flexuous branches inosculate have a depth of about half a line, considerably exceeding the width of the branches; so that whilst seven fenestrules occupy a quarter of an inch measured diagonally, only four occupy the same space measured longitudinally. The thickness of the frond, measured at right angles to its plane of growth, is one line or a little more, nearly two thirds of this being accounted for by the great internal keels. Lastly, there are generally three cell-mouths to the length of a fenestrule, with two placed opposite the inosculation of each pair of contiguous branches.

The only known example of this singular species was discovered by my friend Mr. George Jennings Hinde, by whom it was submitted to me for examination, and in whose honour I have named it.

Locality and Formation.—Corniferous Limestone, Jarvis, county of Walpole.

XIII.—*The Geographical Relations of the New-Zealand Fauna.*

By Captain F. W. Hutton, C.M.Z.S.

[Concluded from p. 39.]

Fish.

Up to the present time about 134 species of marine fish are known to inhabit the shores of New Zealand. Of these, 51 (or 37 per cent.) are found nowhere else; 38 extend to the Australian and Tasmanian seas, but no further; six range to the Pacific islands, five inhabit South America, four South Africa, and one Kerguelen Land and the Auckland Islands; there are also four others that are common to both Australia and South America, five common to Australia and South Africa, two common to Australia and the Pacific islands, and one common to Australia and the Auckland Islands. Thus the total number of our sea-fishes found in Australia is fifty, in South America and the Cape of Good