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ORIGINAL ARTICLES.

I.—Notes on the Palæontology of Western Australia.

(*Continued from the April Number*, p. 155.)

1. Stromatoporoidea. By Prof. H. A. Nicholson, M.D., F.G.S.
2. Corals and Polyzoa. By George J. Hinde, Ph.D., F.G.S.

[PLATES VIII. and VIII.A]

1. Stromatoporoidea. By Prof. H. A. Nicholson, M.D., F.G.S.

Actinostroma clathratum, Nich. Plate VIII. Figs. 8*a*, 8*b*.

Actinostroma clathratum, Nich., Ann. Nat. Hist. ser. 5, vol. xvii. p. 226, pl. vi. figs. 1–3; and Monogr. Brit. Strom. Pal. Soc. p. 131, pl. i. figs. 8–13, and pl. xii. figs. 1–5, 1889.

The specimen here figured is a typical example of *Actinostroma clathratum*. In all its general characters, and particularly in the regular development of the radial pillars and the presence of small astrorhizæ, it resembles the specimens from the Middle Devonian of Germany, which may be regarded as the normal form of the species. Very similar examples, however, occur in the Devonian Limestones of Devonshire. The surface of the specimen is not shown, being concealed beneath a crust of *Stromatoporella Eifeliensis*.

Locality.—Devonian, Rough Range, "opposite Mt. Krauss."

Stromatoporella Eifeliensis, Nich. Plate VIII. Figs. 7*a*—7*c*.

Stromatoporella Eifeliensis, Nich., Ann. Nat. Hist. ser. 5, vol. xvii. p. 235, pl. viii. figs. 5–7.

The specimen here figured (Figs. 7*a*, 7*b*) is a small example of the common *Stromatoporella Eifeliensis*, Nich., of the Middle Devonian rocks of Germany; and Fig. 7*c* gives a good general idea of the aspect of a vertical polished section as viewed under a lens. A crust of the same species covers the surface of the specimen of *Actinostroma clathratum* previously described, and of this three sections have been prepared. The structure of these agrees, in all essential respects, with that of sections of typical examples of *S. Eifeliensis* from Gerolstein, and need not therefore be described in detail. It is a remarkable and highly interesting fact that the Devonian deposits of Western Australia should have yielded examples of two such characteristic European Stromatoporoids as *Actinostroma clathratum* and *Stromatoporella Eifeliensis*.

Locality.—Rough Range, "opposite Mt. Krauss."

2. Corals and Polyzoa. By George J. Hinde, Ph.D., F.G.S.

Genus Amplexus, Sowerby.

Amplexus pustulosus, Hudleston.

1883. *Amplexus pustulosus*, Hudleston, Q.J.G.S. vol. xxxix. p. 591, pl. xxiii. figs. 1*a*–1*c*.

There are several compressed and crushed fragments of this species, which agree in every respect with the forms figured by Mr. Hudleston, save that they have none of the surface spines or nodes, from which the species derives its name. These processes, however, are not essential to the species, since they are not present on some of the figured type examples, which, through the kindness of Mr. Hudleston, I have had an opportunity of examining. The specimens, when uncompressed, are from 25 to 30 mm. in diameter. There are about 40 septa; at the summit of the calice they are 2 mm. apart, from centre to centre; lower down from 1·5 to 1·75 mm. In some instances in the lower portion of the coral, the septa become so thickened by sclerenchyma as to be laterally in contact. The outer surface, when unweathered, merely exhibits annulations of growth and fine epithecal striæ; the weathered examples show vertical lines and furrows, which are the exposed exterior margins of the septa.

Distribution.—Carboniferous Limestone, Gascoyne River.

Genus Cyathophyllum, Goldfuss.

Cyathophyllum virgatum, Hinde, sp.n. Plate VIII. Figs. 1*a*, 1*b*.

Corals simple (?), subcylindrical, elongated, straight or curved. About 56 septa, half of which are long and reach nearly to the centre of the calice; the others only reach from one-third to one-half that distance; there are about five septa in three millimètres. The septa are thick near their parietal margins, but somewhat rapidly diminish in size, and for the greater part of their length are very thin. They are connected by very stout dissepiments, which form a well-marked exterior zone to the calice. The wall is apparently formed by the lateral extension of the septa. The septa are apparently bilaminate, but the median line is not distinctly shown in sections. The outer surface of the coral is smooth or with faintly-marked longitudinal ridges, which correspond with the interspaces between the septa. When the surface is weathered, as in the specimen figured (Fig. 1*a*), the exterior margins of the septa appear as vertical lines connected by the dissepiments.

There are several imperfect examples of this species; the longest measures 70 mm. by about 11 in diameter. One specimen is partly covered by *Aulopora repens*. The specimens are now all simple, but it is not impossible that they may originally have formed fasciculate, compound colonies, like those of *Cyathophyllum cæspitosum*, Goldf. Though the character of the septa in this and the next species corresponds with that of the typical forms of the genus, it is doubtful whether the wall in these Australian forms is structurally similar to the Eifelian types; it is relatively much thicker than those with which I have been enabled to compare it.

Distribution.—Devonian (?). Opposite Mount Krauss, Kimberley District. Also from the Gascoyne River.

CYATHOPHYLLUM DEPRESSUM, Hinde, sp.n. Plate VIII. Figs. 2*a*, 2*b*.

Corallum compound, consisting of several subcylindrical corallites growing from a simple base: the individuals are for the most part free; when full-grown, about 17 mm. in diameter. There are about 58 septa, alternately large and small; some of the larger extend to the centre of the calice, and slightly curve round. The parietal margins of the septa are very thick, and there is an outer zone of thick dissepiments. The wall and septa of the same character as in the preceding species, from which it is distinguished by its mode of growth, the larger size of the corallites, and the stouter septa.

Distribution.—Devonian? Opposite Mount Krauss, Kimberley District. Another fragmentary specimen, partly incrusted by *Stromatoporella Eifeliensis*, Nicholson, is labelled from the Gascoyne River.

Genus PLEROPHYLLUM,[1] Hinde, gen. nov.

Syn. (?) *Pentaphyllum*,[2] De Koninck, 1872, preoccupied in 1821 for a genus of Coleoptera.

Generic Characters.—Simple, conical, turbinate or subcylindrical corals, with deep calices. There are usually five prominently developed septa (in some species only four), which reach nearly to the centre of the calice; the other septa are subequal. In the species with five prominent septa, the cardinal septum is small and is bounded on either side by a large septum, and the remaining three large septa represent the counter and alar septa. Where only four prominent septa are developed, one of them constitutes the cardinal septum. Both large and small septa exhibit a distinct opaque median lamina, which begins within the substance of the wall, and is inclosed by successive layers of stereoplasm, so that in the lower portion of the coral the septa are laterally in contact, and the interlocular and central areas are filled up with solid tissue. The wall of the coral is thick, and consists apparently of the coalesced parietal margins of the septa with an outer epithecal layer. The outer surface exhibits either shallow annulations of growth with fine concentric striæ, or longitudinal rugæ, or, more rarely, spinous projections.

I had at first placed the Australian Corals on which this genus is based in *Pentaphyllum*, De Kon., but it appears that this term had been previously employed, and as, moreover, some doubt[3] rested on the characters of the Belgian types, it seemed preferable to prepare

[1] Πλήρης, full, in allusion to the way in which the corallum is filled up by stereoplasm.

[2] Nouvelles Recherches sur les Animaux fossiles du terrain Carbonifère de la Belgique, p. 58.

[3] For example, the main characteristic of *Pentaphyllum* is stated to be the possession of five prominent septa, but in the figure of the unique typical species, *P. armatum* (*l.c.* pl. iv. fig. 8*a*.), *six* are clearly shown; whilst in the only specimen of the other species included by De Koninck in this genus, *P. caryophyllatum*, there are but four prominent septa (*l.c.* pl. iv. fig. 9).

a new diagnosis. The genus nearest allied to *Plerophyllum* is *Anisophyllum*,[1] Edwards and Haime, founded on a small coral from the Devonian of Tennessee, in which only three prominent septa are developed, and these, according to Prof. Nicholson,[2] are the cardinal and alar septa. It is, besides, uncertain, whether the basal portion of the corallum in this genus is infilled by stereoplasm.

PLEROPHYLLUM AUSTRALE, Hinde, sp.n. Plate VIIIA. Figs. 1*a*–1*f*.

Small conical, straight or curved corals, about 30 mm. in height, and from 10 to 14 mm. in diameter at the summit. The number of septa is usually 26; of these 5 are large and prominently developed, and 21 are smaller and subequal; sometimes there are two or three additional smaller septa. The cardinal septum is small, with a prominent septum on either side (Pl. VIIIA. Fig. 1*d*). Normally, this cardinal septum is on the dorsal or convex side of the coral; but in some instances the orientation differs, and this small septum between two larger is situated laterally (Figs. 1*e*, 1*f*). The counter-septum is large, and between it and the large alar septa there are on either side four or five smaller septa. The septa are but slightly developed at the summit margins of the calice; lower down the prominent septa extend to about two-thirds of the distance to the centre of the calice; their interior free margins are distinctly tumid or bulbous (Fig. 1*d*), and by successive additional layers of stereoplasm, they become still more so in the lower portions of the coral, until they meet and fill up the central area completely. The smaller septa vary considerably in size and in relative proportions to the larger. Within the calice they are often slender and extend only about one-third the distance to the centre (Fig. 1*d*); at a lower level in other specimens they are relatively much larger (Fig. 1*e*), and their free margins become bulbous by layers of stereoplasm, which finally unites them laterally, and they can then only be separately distinguished by their dense median lamellæ. The corals are not uniformly filled up at the same level with the stereoplasm, and possibly the spaces left vacant may be of the nature of fossulæ (Fig. 1*f*). The median lamellæ of the septa are sometimes curved and wavy; in the Figures (1*d*, *e*, *f*) they are represented by lighter lines as they appear by reflected light; in thin sections by transmitted light this central substance is opaque and dense.

The exterior surface of this species when well preserved is smooth, with delicate concentric epithecal striæ (Fig. 1*b*), but when weathered the median laminæ of the septa are shown as deeply impressed longitudinal lines or furrows (Figs. 1, 1*c*).

This species appears to be not uncommon, but the forms are all imperfect, and the calices are infilled with a hard matrix, so that the interior structures can only be studied from sections.

Distribution.—Carboniferous, Gascoyne River; Irwin River, Little Champion Bay, Victoria District.

[1] British Fossil Corals, Pal. Soc. 1850, p. lxvi. Polyp. foss. des terr. pal. p. 351, pl. i. figs. 2, 2*a*.

[2] Manual of Pal. 3rd ed. vol. i. p. 296.

PLEROPHYLLUM SULCATUM, Hinde, sp.n. Plate VIIIA. Figs. 2, 2*a*.

Corallum curved, approximately subcylindrical, showing in the upper portion repeated renewals of growth. The only specimen, which is imperfect, is 40 mm. in height and 11 mm. in diameter. There are in all 28 septa, of which 4 are prominently developed and the others are subequal. The cardinal or dorsal septum is large; between it and the alar septa there are on one side 7, and on the other 8 smaller septa, whilst the large counter-septum has between it and the alar septa 4 smaller on one side and 5 on the other. The septa are about 1 mm. apart; they are of precisely the same characters as in *P. australe*, and they are similarly inclosed and consolidated by stereoplasm, so that in a transverse section of the lower portion of the coral the individual septa can only be recognized by their median lamellæ (Fig. 2*a*).

The outer surface in this species has well-marked longitudinal ridges and furrows about half a millimètre in width, which appear to be quite independent of the septa.

There is only a single example of this species in the collection. From *P. australe* it is readily distinguished by not having more than four prominent septa and by the different characters of the outer surface.

Distribution.—Carboniferous, Irwin River, Little Champion Bay, Victoria District.

Genus PACHYPORA, Lindström.

PACHYPORA TUMIDA, Hinde, sp.n. Pl. VIII. Fig. 3.

Corallum branching; branches subcylindrical, tumid; ranging from 10 to 13 mm. in diameter. Corallites nearly circular in section; walls moderately thick, both in the central portions of the branches as well as near the surface; calices elongate-oval, subcircular or rhomboidal, about 1 mm. in diameter, moderately oblique to the surface. No septa or septal spines shown; tabulæ apparently few and complete; mural pores rare.

There is but one fragment of this species in the collection; it is about 40 mm. in length. The weathered upper surface shows the calices in fairly good preservation. From its surface aspect, this form would perhaps be regarded as belonging rather to *Alveolites* than to *Pachypora;* but judging from the thickened walls of the tubes, it may more properly be included in this latter genus. The calices however look much more like *Alveolites* than those of *P. cervicornis*, De Blainv., and they are larger and more oblique than in *P. meridionalis*, Nich. & Eth. jun. (Ann. & Mag. Nat. Hist. ser. 5, vol. iv. (1879) p. 280). On the other hand, the calices are less oblique and less regular than in *Alveolites* (*Cladopora*) *robusta*, Röminger (Fossil Corals, Geol. Surv. Michigan, p. 54, pl. 32, figs. 1, 2), which is regarded by Nicholson, though not with absolute certainty, as referable to *Alveolites*. As regards its mode of growth, *P. tumida* stands on the boundary-line between *Pachypora* and *Alveolites*.

Distribution.—Devonian? Opposite Mount Krauss, Kimberley District.

Genus SYRINGOPORA, Goldfuss.

SYRINGOPORA RETICULATA, Goldfuss, var. PATULA, var. nov. Pl. VIII. Fig. 4.

1826–33. *Syringopora reticulata*, Goldfuss, Petref. Germ. vol. i. p. 76, pl. xxv. fig. 8.
1852. *Syringopora reticulata*, Edwards and Haime, Brit. Foss. Corals, p. 162, pl. xlvi. figs. 1, 1*a*.
1872. *Syringopora reticulata*, De Koninck, Nouv. Rech. sur. les Anim. foss. pt. i. p. 123, pl. xi. figs. 7, 7*b*.
1879. *Syringopora reticulata*, Nicholson, Tabulate Corals, p. 215, fig. 30; and pl. x. fig. 5.
1880–1. *Syringopora reticulata*, Nich., Proc. Roy. Soc. Edinburgh, p. 225, fig. 3.

Corallum forming low bushy masses of cylindrical, flexuous radiating corallites, rangiug in diameter from 1·6 to 2·15 mm. The largest specimen examined is 50 mm. in height by 110 mm. wide. The distance between the corallites varies from ·5 to 2 mm.; they are connected at irregular intervals, more by the interosculation of proximate corallites than by horizontal processes between them. The corallites also increase by frequent lateral buds given off from the stems, the young stems having the same general direction of growth as the parents.

The corallites have thick uniform walls about ·25 mm. in thickness; the septal spines appear to be irregularly developed, and reduced to small conical projections from the inner surface of the wall; in some transverse sections not more than three or four are visible, whilst in others there are five or six in about one-fourth the circumference of the corallite. The infundibuliform tabulæ are of the usual character, and there is no special infilling of sclerenchyma within the corallites.

I have ventured to place these specimens as a variety of *S. reticulata*, since, though the corallites are of about the same dimensions, they appear to increase more rapidly by lateral budding, and thus to diverge more in their mode of growth, and the connecting processes between them, if not altogether absent, are so reduced as to be scarcely distinguishable. The specimens are now imbedded in nodular masses of compact limestone, and their minute structural characters are very clearly shown in thin sections. The corallite walls consist, as pointed out by Prof. H. A. Nicholson (Proc. Roy. Soc. Edinburgh, 1880–1, p. 225), of two layers, an exterior, which is formed of compact sclerenchyma either granular or radiately fibrous, and an inner layer of concentrically arranged wavy fibres, which are interlaced together. In these Australian forms the exterior layer of the walls is of the same tint as the inner, and can scarcely be distinguished from it. It appears, however, to be present, and can be recognized in transverse sections as a thin outer zone of a granular character, whilst the inner layer is markedly of wavy fibres; there is, however, no definite line between the two layers. It is worthy of note that this wall-layer of wavy interlacing fibres seems to be very characteristic of *Syringopora* and its allies. In *S. Maclurei*, Billings, from the Devonian of Canada, the walls, which are very thick, appear to be wholly of this wavy structure, whilst in *Rœmeria minor*, Schlüter, from the Devonian of the Eifel, there is a well-marked exterior layer of radiating fibres, within which is

the layer of wavy concentric fibres, thus corresponding in character to *S. reticulata.*

Distribution.—Gascoyne River. Not known whether Devonian or Carboniferous.

Genus Aulopora, Goldfuss.

Aulopora repens, Knorr and Walch. Pl. VIII. Fig. 5.

1775. *Milleporites repens*, Knorr & Walch, Recueil, etc., tome iii. p. 157, pl. vi. fig. 1.
1826–33. *Aulopora serpens*, Goldfuss, Petref. Germ. vol. i. p. 82, pl. xxix. figs. 1*a*.
1879. *Aulopora repens*, Nich., & Eth., jun., Ann. & Mag. Nat. Hist. ser. 5. vol. iv. p. 282.

There is a single example of this species growing on the surface of *Cyathophyllum virgatum*, which, as far as its outward characters are concerned, cannot be distinguished from the type forms of the species from the Eifel. The corallites range from 2·5 to 4·5 mm. in length, and from 1 to 1·25 mm. in thickness. The oval or elliptical apertures are between ·75 mm. and 1 mm. in width.

Distribution.—Devonian? Rough Range, Mount Krauss, Kimberley District. This form has been already recorded by Messrs. Nicholson and Etheridge from the Devonian Limestone of Arthur's Creek, North Queensland.

ANNELIDA.

Genus Spirorbis, Daudin.

Spirorbis omphalodes, Goldfuss, sp.

1826–33. *Serpula omphalodes*, Goldf. Petref. Germ. pl. lxvii. fig. 3.

There are several specimens of a small *Spirorbis*, attached to the surface of *Cyathophyllum virgatum*, which appear to belong to the above species. They are about 2 mm. in diameter and ·75 mm. in height, the upper edge of the outer whorl is obtusely angular or rounded, surface apparently smooth.

Distribution.—Devonian? Gascoyne River.

POLYZOA.

Genus Polypora, M'Coy.

Polypora australis, Hinde, sp.n. Pl. VIIIa. Figs. 3, 3*a*.

Polyzoary flabellate, dimensions uncertain. Branches nearly straight, radiating from the base and bifurcating at intervals of about 6 mm.; they are from 1 to 1·2 mm. in width, flattened, with the dissepiments on the same plane. The fenestrules are elongate oval, about 2 mm. in length by ·6 mm. wide, and about 2 mm. apart longitudinally. The cells are regularly arranged in quincuncial rows; there are five cells in an oblique row; the rows are continued across the dissepiments. The cell-apertures are circular, not apparently elevated, small, about ·15 mm. in diameter, and separated from each other by about their own diameters. The branches are about ·5 mm. in thickness. The reverse side of the frond is concealed by the matrix.

This species appears to be nearest allied to an Indian form,

referred by De Koninck to *P. fastuosus* (Q.J.G.S. vol. xix. 1863, p. 5, pl. i. fig. 4); but it differs in the narrower fenestrules; the dissepiments are also larger and carry cells. Only a single fragmentary specimen known.

Distribution.—Carboniferous, Gascoyne River.

Genus HEXAGONELLA, Waagen and Wentzel.

HEXAGONELLA DENDROIDEA, Hudleston, sp. Plate VIII. Fig. 6 and VIIIA. Figs. 5–5*d*.

1883. *Evactinopora dendroidea*, Hudleston, Quart. Journ. Geol. Soc. vol. xxxix. p. 594, pl. 23, figs. 3*a*—3*d*.
1886. *Hexagonella dendroidea*, Waagen and Wentzel, Mem. Geol. Surv. India, ser. xiii. p. 913.
1889. *Evactinopora dendroidea*, R. Etheridge, jun., Proc. Linn. Soc. New South Wales, vol. iv. p. 207.

The examples of this species appear to be more abundant than those of any other fossil from the Carboniferous Limestone strata of the Gascoyne River, and the numerous specimens in the collection afford an excellent opportunity of ascertaining its minute characters. Since this form was described by Mr. Hudleston in 1883, several other species of the same genus have been recorded by Waagen and Wentzel from the Carboniferous strata of the Punjab, and these authors have proposed the new genus *Hexagonella* for their reception. As will be shown later on, the characters of this genus are so similar to those of *Fistulipora*, M'Coy, that it may be doubted whether it should be considered as more than a subgenus; but at the same time the species included in it possess in common some slight structural features, which make it desirable to place them in a distinct group, and I propose therefore to retain Waagen and Wentzel's name. Considerable interest attaches to this genus, since, according to these authors, it exhibits a mode of increase by so-called cœnenchymal gemmation, which, in their view, indicates distinctly that this and similar allied forms should be considered as Corals rather than Polyzoa. This evidence in favour of the cœlenterate nature of these organisms has been quoted by Prof. Nicholson,[1] and by the late Prof. Neumayr,[2] as strong proof of the correctness of the view that they are Corals. As the result of a careful study of numerous sections of the Australian species, which there can be no doubt is closely similar to the Punjab forms, I can find no indication of this alleged cœnenchymal gemmation, but, on the contrary, a mode of growth from a basal lamina which is strongly characteristic of Polyzoa, and as in other structural features these forms resemble Polyzoa, I accept this view of their character, which, it may be said is that originally held by Mr. Hudleston.

Hexagonella dendroidea occurs as solid, straight or curved stems or branches, ranging from 30 to 80 mm. in length, from 10 to 22 mm. in width, and from 5 to 15 mm. in thickness. The specimens are all fragmentary, the stems are usually compressed, sometimes nearly cylindrical, of an even width and thickness, except where

[1] Manual of Palæontology, third edition, vol. i. p. 352.
[2] Die Stämme des Thierreichs, p. 324.

they dichotomize (Plate VIIIA. Fig. 5). They are of a hard, greyish limestone, completely weathered out of the matrix; but the tubular cells and interstitial vesicles are partly infilled with chalcedony, and in part with calcite.

The outer surface of the branches is divided into irregular polygonal areas by raised lines or ridges, sometimes scarcely visible without a lens, at others elevated above the surface so as to form margins to depressed areas (Figs. 5, 5*c*). These ridges are given off from the angles of a zig-zag line, having a generally vertical direction on the narrow sides of the branch. The ridges pass indifferently across the cell areas and the maculæ, but they frequently meet in the centre of these latter. In weathered specimens these ridges are not recognizable, and they are not often visible in sections, unless tangential, where they appear as rows of bead-like dots, with dark centres and lighter borders, not unlike the spines in Monticuliporoids.

The surface of the branches is dotted over with maculæ; these are oval or subcircular spaces free from cells (Fig. 5); without definite boundaries, from 2 to 3 mm. in width, and from 5 to 8 mm. apart, from centre to centre. The maculæ are usually even with the general surface, though sometimes slightly below it. The general surface of the branches, both of the maculæ and of the areas between the cell-mouths, is, when well preserved, covered with microscopically minute blunted tubercles which appear to be solid and imperforate (Fig. 5*c*). As a rule, however, the branches are now smooth and imperforate.

The centre of the branches has a median lamina extending from end to end, from which the cells are given off. This axial lamina is double in character; in thin sections it appears as a dark line with a layer of lighter material on either side of it, the whole being about ·05 mm. in thickness. It seems to be quite imperforate (Figs. 5*a*, *b*).

The cells (= autopores) in this species are relatively long tubes, circular, elliptical, or oval in section (Fig. 5*d*); they commence their growth on the central lamina as conical tubes, semi-elliptical in section; in the first stage they are recumbent on the lamina for a distance of about ·75 mm., they then curve abruptly outwards and extend directly to the surface, to which they open nearly at right angles (Fig. 5*b*). The cell-walls are distinct from the interstitial substance, imperforate, of an even thickness throughout their length, not thickened near the surface, and in their upper portions apparently of concentric fibres. At irregular intervals, from ·25 to ·75 mm. apart, they are partitioned by complete tabulæ (Fig. 5*b*); but they are not infilled in any way with sclerenchyma. Measured in transverse section, the cells are from ·2 to ·25 mm. in diameter, but a few of the larger ones on the borders of the maculæ are ·37 mm. wide. The cell-walls are from ·03 to ·05 mm. in thickness; in some instances they exhibit a decided thickening or lip at one side; this is of a more opaque character than the rest of the wall (Fig. 5*c*). Beyond this thickening, there are no projections of the lip-margins within the cell or distinct trifoliation of the cell itself, as in many

species of *Fistulipora*, and also in *Hexagonella lævigata*, Waagen and Wentzel (Pal. Indica, ser. 13, pl. 115, fig. 5).

On the surface of the branches, the cells are arranged in rows which radiate from the maculæ as centres. The cells in the rows are somewhat less than half a millimètre from centre to centre, and about the same distance between the rows. The cell-apertures are slightly oblique to the surface, and there is a distinct elevated lip, in some cases semilunate or crescentic in form (Fig. 5*c*). The cells near the maculæ are larger, more oblique, and with thicker lips than others.

As a rule, the cell-apertures are open, but in many instances the cells are partially or entirely closed by calcareous lids, placed just within the lip of the cell (Fig. 5*c*). These lids are flat or slightly convex, and usually incomplete, a central or sub-central space remaining open. In other cases this aperture is wholly closed by a minute central papilla. Occasionally the lid is evenly convex, and projects beyond the rim of the cell-wall. These lids appear to be distinct from the tabulæ in the lower portion of the cell; they are thicker; convex, instead of flat or concave; and they are frequently incomplete.

The spaces between the cells, where they radiate upwards to the surface from the axial lamina, are occupied by interstitial tissue or cancelli (= mesopores) (Fig. 5*b*). This is of two kinds; one, occupying principally the central portion of the branches, is mainly vesicular, and formed by convex vesicles arranged sometimes in linear series, sometimes irregularly overlapping and dovetailing into each other (Fig. 5*b*). The peripheral portions of the branches on the other hand mainly consist of a solid imperforate tissue deposited in thin concentric zones. Occasionally, however, there is a layer of vesicles within the exterior solid zone, and sometimes a thin solid band intercalated in the central vesicular area. The solid substance does not, however, seem to be a mere infilling of the vesicles; but it is of a distinct character replacing the vesicles. On polished surfaces, and in sections viewed by reflected light, this substance can be seen to consist of delicate rods or spines vertically arranged and imbedded in a lighter material, and it appears that the minute tubercles with which the surface is covered are the upward extensions of these bodies. In transparent, transverse sections, this solid tissue has an indistinct cloudy appearance, due to innumerable, opaque dots—the section of the rods—in a lighter substance (Fig. 5*d*). The thickened portion or lips of the cells likewise consists of these solid spines or rods.

No mention is made of this solid interstitial tissue in the Punjab species of *Hexagonella*, but it is shown in the figures of *H. ramosa* (Pal. Indica, ser. 13, pl. 107, fig. 3*c*). Similar tissue is likewise present in certain specimens of *Fistulipora incrustans*, which have been described by Mr. John Young, F.G.S. (Ann. & Mag. Nat. Hist. April, 1888, p. 245), and in *Goniocladia cellulifera*, R. Eth., jun. (Geol. Mag. Dec. I. Vol. X. p. 433, Pl. XV.)

The general question as to the relation of *Hexagonella* or *Fistulipora* to Polyzoa or Corals is too wide to be properly discussed here; but

there is no doubt that the alleged cœnenchymal gemmation—the special point brought forward by Waagen and Wentzel in favour of the alliance of these forms to Corals—certainly does not take place in *H. dendroidea*, and there is no satisfactory evidence that it occurs in the Indian species of the genus described by these authors. They further appeal to the figure given by Nicholson and Foord of *Fistulipora incrustans* (Ann. and Mag. Nat. Hist. ser. 5, vol. xvi. p. 501) as showing the same mode of increase by cœnenchymal gemmation; but it is evident that the figure referred to gives no indication of the development of the cells or autopores from the mesopores; it merely shows that the former have been sectioned obliquely. The real origin of the cells or autopores in this species is by growth from the basal lamina, precisely in the same manner as in *Hexagonella dendroidea* described above.

This species was originally placed by Mr. Hudleston in the genus *Evactinopora*, Meek and Worthen, but it has no close relationship to *E. radiata*, the type of this genus. It appears to me very doubtful whether the form named *H. (Evactinopora) crucialis*, Hudleston, is really distinct from *H. dendroidea*, as the difference consists merely in the mode of growth, a feature hardly of specific importance. *H. ramosa*, W. & W., though similar in mode of growth to *H. dendroidea*, has its cells only about half as large as in the latter species, and is consequently distinct.

Distribution.—Carboniferous, Gascoyne River.

Genus Rhombopora, Meek.

Rhombopora tenuis, Hinde sp.n. Pl. VIIIa. Figs. 4, 4*a*.

Imbedded in some pieces of rock from the Gascoyne River are several fragments of a small branching polyzoon, which in microscopic characters are similar to the genus *Rhombopora*. The specimens are cylindrical and branching, about 1·5 mm. in diameter; the cells spring from an imaginary central axis, and at first are nearly vertical or slightly oblique; they then curve somewhat abruptly and open approximately at right angles to the surface of the branch (Fig. 4*a*). In the axial portions the cells are subcircular in section, with thin walls; at the point where the outward curve commences, the walls are considerably thickened. The cell-apertures are oval, about ·2 mm in width with definite fibrous margins; in the interspaces between them there are well-marked interstitial tubes and spines (Fig. 4). I have not recognized any tabulæ in the cells.

From a comparison with specimens and sections of *Rhombopora interporosa*, Phill. sp., kindly supplied me by my friend Mr. John Young, F.G.S., I find a very close resemblance in microscopic structure to the Australian species; at the same time there is also a certain resemblance to such forms as *Monticulipora ? tumida*, Phill. sp., and more particularly to a slender variety of this species from the Carboniferous strata of Northumberland, which has been named var. *miliaria* by Prof. Nicholson (Genus *Monticulipora*, p. 123, pl. iii. figs. 2, 2*c*).

Distribution.—Carboniferous, Gascoyne River. The specimens are associated in the same matrix with *Hexagonella dendroidea*.

EXPLANATION OF PLATES VIII. AND VIIIA.

PLATE VIII.

FIG. 1.—*Cyathophyllum virgatum*, sp.n.; 1*a*, a fragmentary specimen, natural size; 1*b*, transverse section enlarged two diameters.

,, 2.—*Cyathophyllum depressum*, sp.n.; 2*a*, the upper surface, showing the weathered summits of the corallites; 2*b*, a transverse section, enlarged.

,, 3.—*Pachypora tumida*, sp.n., natural size.

,, 4.—*Syringopora reticulata*, var. *patula*. Portion of a specimen, showing the corallites in section. Natural size.

,, 5.—*Aulopora repens*, Knorr and Walch.

,, 6.—*Hexagonella dendroidea*, Hudleston, sp. A section showing the thickness of the branch.

,, 7.—*Stromatoporella Eifeliensis*, Nicholson; 7*a*, 7*b*, specimens natural size; 7*b*, vertical section enlarged.

,, 8.—*Actinostroma clathratum*, Nicholson; 8*a*, vertical section natural size; 8*b*, portion of the same enlarged.

PLATE VIIIA.

FIGS. 1–1*f*.—*Plerophyllum australe*, Hinde.

,, 1*a*, 1*b*, 1*c*.—Three imperfect examples natural size; 1*b* shows the exterior surface in its natural condition; in 1*a* and 1*c* the surface has been weathered, and the median laminæ of the septa are exposed.

,, 1*d*.—A transverse section of the calice, with the small cardinal septum inclosed between two larger septa above. Enlarged 2½ diameters.

,, 1*e*.—A transverse section of another specimen, similarly enlarged, in which the smaller septa are proportionately more developed, and the small septum between the two larger is lateral in position.

,, 1*f*.—Another transverse section, similarly enlarged, in which one portion has been completely infilled by stereoplasm.

,, 2, 2*a*.—*Plerophyllum sulcatum*, Hinde.

,, 2.—An imperfect specimen, showing renewals of growth and the longitudinal rugæ of the surface.

,, 2*a*.—A transverse section of the same, enlarged 2½ diameters, showing complete solidification by stereoplasm.

,, 3, 3*a*.—*Polypora australis*, Hinde.

,, 3.—A fragmentary specimen showing the celluliferous surface, natural size.

,, 3*a*.—A portion of the same, enlarged 5 diameters, showing the form and disposition of the fenestrules and cell-apertures.

,, 4, 4*a*.—*Rhombopora tenuis*, Hinde.

,, 4.—A portion of the surface showing the cell-apertures and the interstitial tubes and spines. Enlarged 20 diameters.

,, 4*a*.—A portion of a longitudinal section, showing the disposition of the cells and the thickening of the walls near the surface.

,, 5—5*d*.—*Hexagonella dendroidea*, Hudleston, sp.

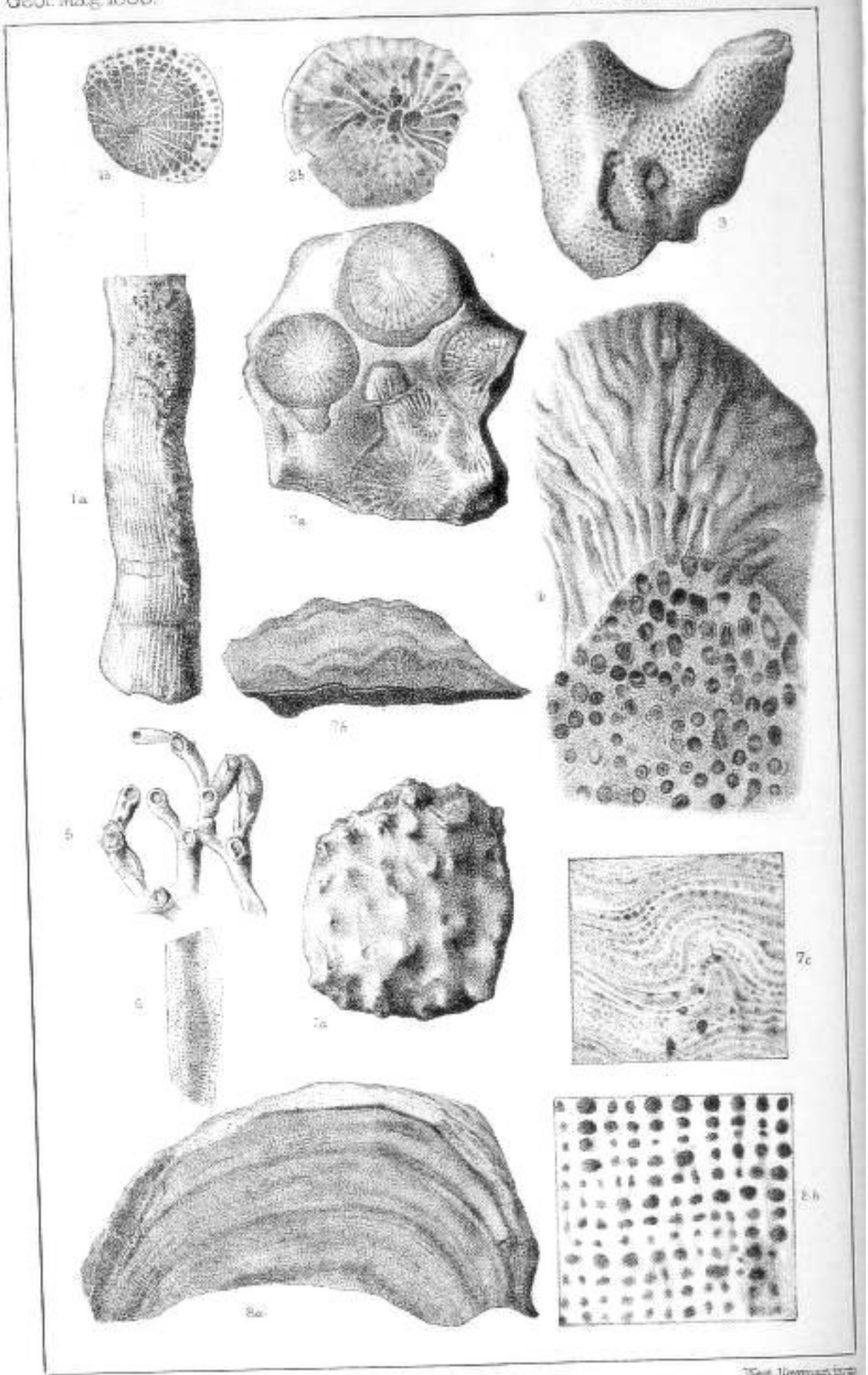
,, 5.—An imperfect stem or branch, showing the mode of growth, the linear ridges, the maculæ, and the cells of the exterior surface. Natural size.

,, 5*a*.—A portion of a transverse section of a branch, showing (in section) the median layer and the cells (=autopores) on it. Enlarged 20 diameters.

,, 5*b*.—A portion of a median longitudinal section of a branch, showing the recumbent position of the cells on the median layer in their first stage of growth, their subsequent vertical direction, the tabulæ traversing them at intervals, and the vesicular interstitial tissue of the central area. Enlarged 20 diameters.

,, 5*c*.—A portion of the surface of Fig. 5, enlarged 20 diameters, showing the oblique projection of the lips of the cells, the manner in which they are partially or entirely closed by calcareous lids, the tuberculate character of the interstitial areas, and the raised ridges.

,, 5*d*.—A portion of a tangential section, showing the cells with distinct walls, and the cloudy appearance of the solid interstitial substance of the outer zone of the branch. Enlarged 20 diameters.



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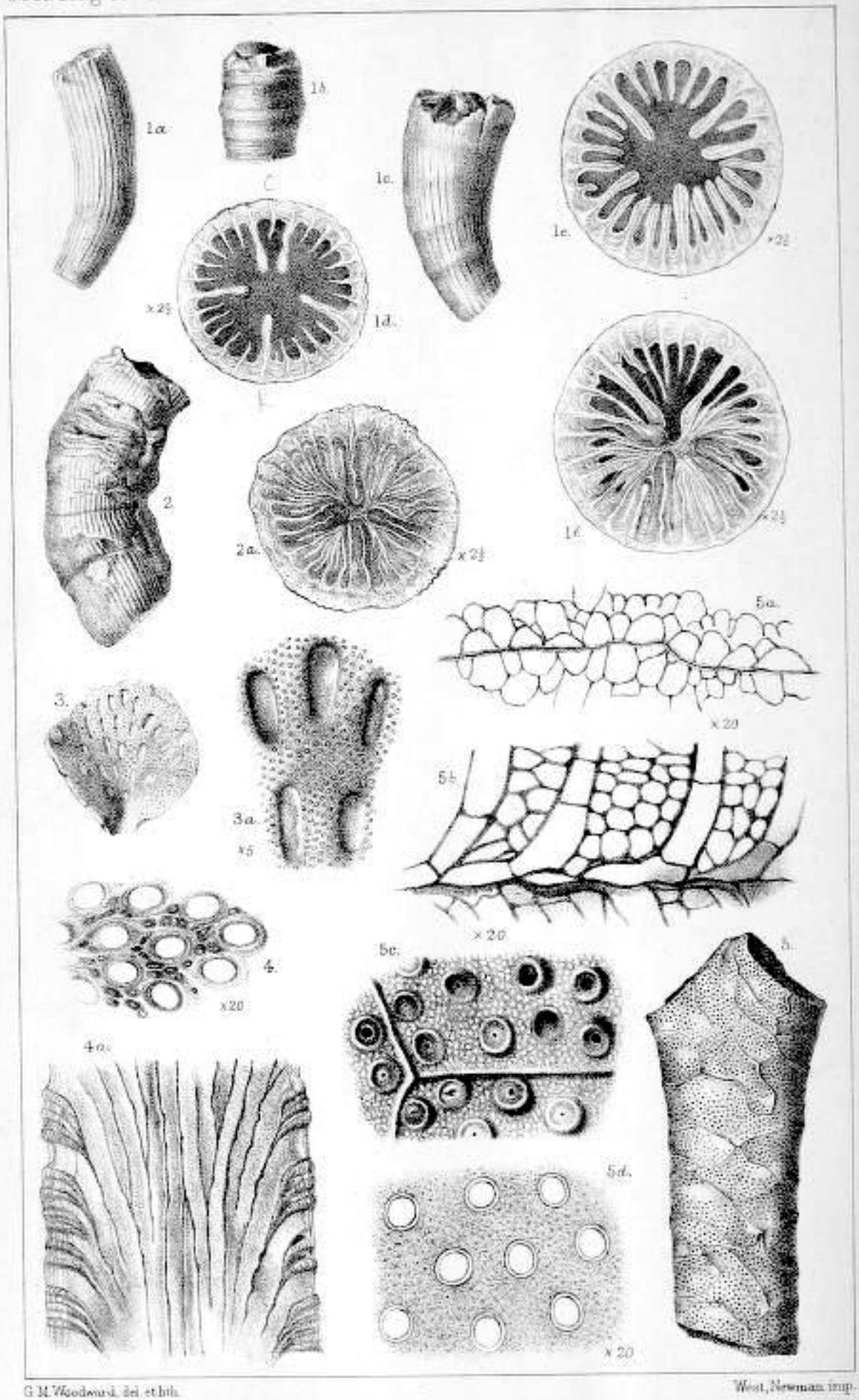

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