

GEOLOGICAL AND NATURAL HISTORY SURVEY OF CANADA.

ALFRED R. C. SELWYN, LL.D., F.R.S., F.G.S., DIRECTOR.

CONTRIBUTIONS
TO THE
MICRO-PALÆONTOLOGY
OF THE
CAMBRO-SILURIAN ROCKS OF CANADA.

BY ARTHUR H. FOORD, F.G.S.,

ASSISTANT PALÆONTOLOGIST AND ARTIST TO THE SURVEY.



OTTAWA:

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NOTE.

At the suggestion of Mr. J. F. Whiteaves, Palæontologist and Zoologist to the Geological Survey, his Assistant, Mr. A. H. Foord, has undertaken the study of certain Cambro-Silurian fossils that require microscopic examination to determine their generic and specific affinities.

In pursuance of this suggestion the three following papers, one on the Monticuliporidae, the second on some Polyzoa from the Trenton Formation and the third on the genus Tetradium, have been prepared, and are herewith submitted.

It must be understood that the author is alone responsible for the correctness of the views expressed.

ALFRED R. C. SELWYN,

Director Geological and Natural History Survey.

OTTAWA, May, 1883.

INTRODUCTION.

Before proceeding to the subject of the present memoir some explanation is necessary with reference to that part of it which treats of the Monticuliporidae. The species referred to are in the Museum of the Canadian Geological and Natural History Survey, and include a fine collection from the vicinity of Ottawa presented by Mr. Walter R. Billings. Much material yet remains to be investigated, and there are some species new to science which require further study before their generic relations can be clearly defined.

The author has followed Mr. E. O. Ulrich's classification and terminology of the Monticuliporidae, contained in his papers contributed to the Journal of the Cincinnati Society of Natural History.

A list is here given of all the genera of the Monticuliporidae at present known, descriptions of which are to be found in Mr. Ulrich's papers just referred to.

Family MONTICULIPORIDÆ, *Nicholson.*

Monticulipora, D'Orbigny, (restricted).

Sub-genus *Trematopora*, Hall.

Peronopora, Nicholson.

Homotrypa, Ulrich.

Prasopora, Nicholson and Etheridge.

Diplotrypa, Nicholson.

Monotrypa, Nicholson.

Monotrypella, Ulrich.

Amplexopora, Ulrich.

Stenopora, Lonsdale.

Batostoma, Ulrich.

Batostomella, Ulrich.
Leioclema, Ulrich.
Atactopora, Ulrich.
Callopora, Hall.
Calloporella, Ulrich.
Aspidopora, Ulrich.
Heterotrypa, Nicholson, (restricted).
Dekayia, Edwards and Haime.
Dekayella, Ulrich.
Petigopora, Ulrich.
Nebulipora, (?) McCoy.
Discotrypa, Ulrich.
Spatiopora, Ulrich.
Stellipora, Hall.
Sub-genus *Constellaria*, Dana.

Mr. T. C. Weston, of this Survey, has skilfully prepared the numerous microscopic sections required for the determination of the genera and species. In the study of the various species a Hartnack microscope was used, and the magnified illustrations were made by means of an Oberhaeuser camera lucida. It was found impossible to give satisfactory magnified representations of the surface characters of the Monticuliporidæ, owing to their bad state of preservation.

In conclusion the author desires to acknowledge his obligations to the following gentlemen who have assisted him: Mr. E. O. Ulrich, of Cincinnati, for valuable notes and critical remarks upon many of the species described. Mr. R. Etheridge, jun., and to Dr. H. Alleyne Nicholson, for friendly assistance and advice. Principal Dawson, of Montreal, for the loan of a series of specimens from the Museum of McGill College, and to Mr. Walter R. Billings for the opportunity of examining a large number of specimens collected by him in the neighbourhood of Ottawa City.

OTTAWA, May, 1883.

ARTHUR H. FOORD.

DESCRIPTIONS OF SPECIES.

I. *On the Monticuliporidae of the Chazy, Black River, and Trenton Formations, with descriptions of ten new species.*

MONTICULIPORA, D'Orbigny, (restricted):

External Characters.—Zoarium massive, lobate, laminar, incrusting, and sometimes irregularly frondescent. Surface sometimes smooth, usually tuberculated. Monticules closely approximated, usually conical, often elongated or compressed. Cells small, their diameter varying in different species from $\frac{1}{80}$ to $\frac{1}{150}$ of an inch, polygonal, and with thin walls; generally groups of cells slightly larger than the average are distributed at regular intervals among those of the ordinary size. Not infrequently a few smaller (young?) cells occupy the summits of the monticules, and they may occasionally be detected between the cells occupying the hollow interspaces.

Internal Characters.—Tubes in the "immature" zones, with very thin walls, and crossed by straight or oblique diaphragms; and often there are large cystoid diaphragms present. In the mature zones the walls become very slightly thickened, and small spiniform tubuli can usually be detected; while numerous cystoid diaphragms are always developed in the greater number of the tubes. Immediately above the point of gemination, the young tube is crossed by numerous straight diaphragms giving it the appearance of an interstitial tube. Subsequently the diaphragms become less crowded, and the young tube assumes the characters of an ordinary cell. The process of gemination seems to have taken place more especially at certain levels, since tangential sections taken at different heights may show in one comparatively numerous small tubes, intercalated among the ordinary cells, while another may show but few or none of them. Trenton and Cincinnati." (E. O. Ulrich, Journ. Cincinnati Soc. of Nat. Hist., Vol. V., p. 232, 1882.)

MONTICULIPORA WESTONI. (N. Sp.)

Plate I., figs. 1, 1a, 1b.

Zoarium irregularly hemispherical. The only specimen collected, which is very imperfect, measures from 20 to 25 mm. in its greatest diameter, and about 15 mm. in thickness. Surface studded with small and incon-

spicuous monticules. Cells of one kind only. Cell apertures polygonal, but very irregular in outline; about five are contained in the space of 1 mm.

In a tangential section the cell walls appear moderately thick, with numerous and conspicuous spiniform tubuli embedded in them. Wherever the spiniform tubuli occur the walls are inflated, so as to make them appear alternately swollen and constricted.

Owing to the highly crystalline condition of the specimen from which the species is described, the longitudinal section does not show satisfactorily this part of the structure of the fossil. The tubes, however, are seen to be traversed for a portion of their course by straight or slightly curved diaphragms, and in other places the characteristic cystoid diaphragms are developed.

This species is allied to *Monticulipora mammulata*, D'Orbigny, the type of the genus; but in *M. Westoni* the cystoid diaphragms are not so numerous, nor are they arranged in a regular series, and the smaller tubes which occur in *M. mammulata* are wanting.

Locality and Formation.—Ottawa City. Trenton Formation.

Collector.—T. C. Weston, after whom the species is named.

MONTICULIPORA BILLINGSI. (N. Sp.)

Plate I., figs. 2-2c.

Zoarium incrusting, forming a thin layer about .5 mm. in thickness. External surface smooth and without monticules. Cells of one kind only; very minute, about five being contained in the space of 1 mm; Cell apertures irregular in outline; walls moderately thick. Spiniform tubuli of small size and few in number occur at the angles of junction of the tube-walls.

Tangential sections show that the zoarium is composed of two kinds of tubes, large and small; the latter are very limited in number and not easily distinguished. Some of the cell apertures of the larger tubes exhibit in the centre, or on one side of them a perforation, due to their possession of cystoid diaphragms. The smaller tubes occupy the spaces between the larger ones, and are very irregular in size and shape.

Longitudinal sections exhibit the cystoid diaphragms in the larger tubes mostly in their basal portion, as well as straight or slightly curved diaphragms nearer the surface. The smaller tubes are almost indistinguishable from the larger ones. The walls of the tubes project above the surface of the zoarium, so as to present in section a spiniform appearance.

This species may be readily distinguished externally from *Monticulipora Cincinnatiensis*, Nicholson, to which it is most nearly related, by the absence of monticules, which are a marked feature of that species; and internally by the very limited number of interstitial tubes.

Locality and Formation.—Hull, Que., near Ottawa City. Trenton Formation.

Collector.—Walter R. Billings, to whom the species is dedicated.

MONTICULIPORA PARASITICA, Ulrich.

Monticulipora parasitica, Ulrich, Journ. Cincinnati Soc. Nat. Hist., Vol. v., p. 238, pl. 10, figs. 3, 3a, 1882.

The author is indebted to Mr. Ulrich for the identification of this species.

Locality and Formation.—Ottawa City. Trenton Formation.

Collector.—Walter R. Billings.

HOMOTRYPA, Ulrich.

External Characters.—Zoarium ramose to subfrondescent; surface smooth, or with more or less prominent monticules. Cells circular, ovate or polygonal, with moderately thin walls. At intervals there are groups of larger sized cells, which again sometimes enclose small stellate maculæ, consisting of much smaller, angular cells. The surface extensions of spiniform tubuli may often be observed at the angles of the cells.

Internal Characters.—In the axial portion of the branches or fronds, the tubes are "immature," and may be crossed by straight diaphragms; usually diaphragms are entirely wanting in this region. The tube-walls are excessively thin until they reach the peripheral regions, when they are much thickened, and bend outward to open at the surface. In the peripheral or "mature" portion of the zoarium, the tubes are provided with a series of cystoid diaphragms; the space intervening between their flexuous inner line, and the opposite wall of a tube, is crossed by equally numerous straight diaphragms. The tube-walls are perforated by rather large connecting foramina. In the tuberculated species the spiniform tubuli are numerous, but very small, and not easily recognized, while in the smooth forms they are much larger, and constitute a conspicuous feature in sections. The internal structure of the small tubes, which form the maculæ of some species, is not remarkably different from that of the ordinary tubes. The only difference that I have been able to detect is found in the fact that cystoid diaphragms are but rarely developed in them." Trenton and Cincinnati. (E. O. Ulrich, Journ. Cincinnati Soc. Nat. Hist., Vol. V., p. 240, 1882.)

HOMOTRYPA SIMILIS, (N. Sp.)

Plate II, figs. 2-2d.

Zoarium ramose, consisting of small sub-cylindrical, or compressed branches. Branches from 8 to 15 mm. in their greatest diameter. Surface smooth, with groups of larger cells than the average occupying small areas, very slightly raised above the general surface of the zoarium. Of the ordinary sized cells there are about four in the space of 1 mm., of the larger ones, (that is, those occupying the slightly raised portions of the surface), about three: In well preserved specimens the surface projections of the spiniform tubuli may be detected with the aid of a hand lens.

In tangential sections the tubes are seen to be thin walled and polygonal in outline in the axial region, and to become thickened near the surface, where spiniform tubuli are developed at the angles of junction of the cell-walls.

In longitudinal sections the tubes are first parallel to the axis of the zoarium, but as they approach the surface they bend gradually outwards. A moderate number of horizontal, straight, or slightly curved diaphragms, from one-half to two tube diameters apart, intersect the tubes for the greater portion of their length, till on nearing the surface cystoid diaphragms are developed. These diaphragms are conspicuous in tangential sections, in which they appear as straight or curved lines crossing the cell-apertures; sometimes two of these lines are visible in the same cell-aperture, owing to their overlapping each other. The present species is very closely allied to *Homotrypa obliqua*, Ulrich, from which it differs in its smooth surface and more conspicuous spiniform tubuli.

Locality and Formation.—Ottawa City. Trenton Formation.

Collector.—E. Billings.

PRASOPORA, Nicholson and Etheridge, jun.

“Free, or loosely adhering to foreign objects, forming hemispherical masses, or thin expansions, with a wrinkled opitheca covering the lower surface. Tubes cylindrical or prismatic, and having one or both sides lined with cystoid diaphragms. Interstitial tubes often completely isolating the proper zoecia, and crossed by numerous diaphragms. Spiniform tubuli sometimes nearly absent, in other cases more numerous. Trenton and Cincinnati.” (E. O. Ulrich, Journ. Cincinnati Soc. Nat. Hist., Vol. V., p. 153, 1882.)

PRASOPORA OCULATA. (N. Sp.)

Plate III., figs. 1-1g.

Zoarium free, or attached, discoid, concavo-convex, sharp-edged in the immature state, more or less obtuse in the adult; varying, in the four specimens examined, from 15 to 30 mm. in diameter, and from 2.5 to 3.5 mm. in thickness in the centre. Under surface covered with a thin smooth epitheca, which exhibits in a young example two or three concentric wrinkles. Upper surface conspicuously marked with irregularly rounded, or sub-polygonal depressions, generally a little less than their own diameter apart. In the centre of each of these depressions there is a small somewhat compressed elevation slightly raised (as seen in profile) above the surface of the zoarium. The latter is made up of two kinds of tubes, the larger of which can be seen with a hand-lens on a well-preserved specimen. The smaller series of tubes which fill up the spaces between the larger ones can only be discerned in microscopic sections. Of the larger tubes some exceed the average in size, and appear to occupy the depressed areas of the surface of the zoarium; from three to four of them are contained in the space of 1 mm., while from four to five of the smaller or average sized coll-apertures fill a like space.

Tangential sections shew the larger tubes to be irregularly circular, or polygonal in outline, and usually completely isolated from each other by the smaller tubes. These latter are angular or sub-angular in form, and variable in size; here and there clusters of them form stellate groups or maculæ surrounded by a set of tubes larger than the average; among the latter but few of the smaller sized angular tubes penetrate, so that in many places their walls are completely in contact, leaving only small interspaces at their angles occupied by the smaller angular tubes. The little elevations situated in the centre of the depressed areas appear to be made up of the last named tubes.

In longitudinal sections this species exhibits remarkable characters. The larger tubes are furnished with cystoid diaphragms which are alternate in their arrangement on either side of the visceral chambers; these diaphragms are usually of a conical form, and sometimes narrow and pointed, they vary much in their distance from each other; in some places they are separated by a space equal to a tube-diameter, in others they are closely approximated; occasionally a straight diaphragm unites them with the opposite wall of the tube. There are a few straight hori-

zontal diaphragms crossing the tubes from side to side. The smaller tubes are crossed by very numerous and close set horizontal diaphragms.

Its remarkable external characters render this an easily recognized species, and serve to distinguish it from its nearest ally *Prasopora affinis*, next described.

Locality and Formation.—Somewhat rare in the Trenton Formation of Ottawa City.

Collectors.—E. Billings, T. C. Weston and Walter R. Billings.

PRASOPORA AFFINIS. (N. Sp.)

Plate III., figs. 2-2c.

Zoarium discoid, concavo-convex, about 20 mm. in diameter, and about 2.5 mm. in thickness in the centre. Upper surface, showing the cell-apertures, gently convex, and quite destitute of monticules. Where the surface is well preserved the cell-apertures are seen to be polygonal; groups of from fifteen to twenty cells, larger than the average, may also be detected with the aid of a hand-lens. Of the larger cells, from two and a-half to three are contained in the space of 1 mm., and of the smaller ones about four.

We find in tangential sections that the large tubes, which are sub-polygonal or rounded in outline, have their interspaces filled with the smaller tubes; these are angular in outline, and consist of only one row of cells around each of the larger tubes, which they do not always completely encircle, the larger tubes being sometimes in contact at limited points of their circumference.

Longitudinal sections exhibit a very symmetrical arrangement of the two sets of tubes. The larger of these are filled with conical cystoid diaphragms throughout their entire length, (very similar to those of *P. oculata*), these are alternate in their arrangement on each side of the visceral chambers, and are sometimes joined to the opposite wall by a straight diaphragm, and sometimes the latter running in an oblique direction downwards or upwards, unite together two of the cystoid diaphragms situated on opposite sides of the tube. Very rarely a straight diaphragm crosses the visceral chamber from side to side. The smaller tubes have numerous complete and horizontal diaphragms, and wherever they cross the tubes there is a slight constriction in the walls of the latter. The present species is distinguished from *Prasopora oculata*, (1) by the absence of the surface markings so characteristic of that species; (2) by the fewer

number of its small tubes, and their less numerous diaphragms. It may be separated from *P. Selwynii*, Nicholson, by the much smaller size of its zoarium, and by the smaller number of its interstitial tubes, which are not "collected into stellate groups or maculæ."

Locality and Formation.—Ottawa City. Trenton Formation.

Collector.—A. H. Foord.

PRASOPORA SELWYNII, Nicholson.

Monticulipora (Prasopora) Selwynii, Nicholson, "The genus *Monticulipora*," p. 206, figs. 44 and 45, 1881.

This species is very abundant throughout the Trenton Formation in Canada. It has recently been found also in the upper beds of the Chazy formation, at Nepcan, near Ottawa City. It is figured, but not described, by Billings in the "Geology of Canada," (p. 156, fig. 117,) as *Stenopora petropolitana*, Pander.

DIPLOTRYPA, Nicholson.

"Zoarium free, hemispherical. Spiniform tubuli often present, though never numerous.* In other respects like *Prasopora*, excepting that the tubes are provided with straight diaphragms only. Trenton and Niagara." (E. O. Ulrich, Journ. Cincinnati Soc. Nat. Hist., Vol. V., p. 153, 1882.)

DIPLOTRYPA REGULARIS. (N. Sp.)

Plate I, figs. 3-3c.

Zoarium discoid, with attenuated edges, greatest diameter about 20 mm., and from one and a-half to two mm. in thickness in the centre; tubes directed upwards nearly at right angles to the basal plate, and opening upon the surface of the zoarium, which is strongly convex. Surface apparently destitute of monticules. Cells of two kinds; large and small; the former rounded to sub-polygonal in outline; of these there are groups at intervals somewhat larger than the rest, about two in the space of 1 mm., of the others about three and a-half are contained in the same space.

In tangential sections the large or proper cells (excluding those which exceed the average dimensions) are very uniform in size and shape, and are in contact only at limited points of their circumference, this limitation

*This sentence reads in the original "no spiniform tubuli." The writer called Mr. Ulrich's attention to this inadvertence, and he has supplied the words now inserted.

being dependent upon the size, number and distribution of the interstitial cells. The spaces between the larger cells (including those above the average size) are occupied by triangular, sometimes sub-rhomboidal, interstitial cells, which are very regularly distributed.

In longitudinal sections the larger tubes are seen to be crossed by a few horizontal, inequidistant, often slightly curved, and frequently very oblique diaphragms, which become more numerous near the surface of the zoarium. In the smaller tubes the diaphragms are straight, horizontal and very close-set. Small but distinct spiniform tubuli are present at the angles of the interstitial cells, sometimes giving rise to a slight inflation of the walls where they occur.

The species to which this is most nearly allied is *Diplotrypa Mulleri*, Ulrich, of the Niagara group, of Osgood, Indiana; but it differs therefrom (1) in possessing spiniform tubuli, (2) in the diaphragms of the smaller tubes being relatively much more numerous than those of the large ones, as compared with that species.

Locality and Formation.—Ottawa City. Trenton Formation.

Collector.—T. C. Weston.

DIPLOTRYPA WHITEAVESII, Nicholson.

Monticulipora (Diplotrypa) Whiteavesii, Nicholson. "The genus *Monticulipora*," p. 160, fig. 31, 1881.

Locality and Formation.—Somewhat rare in the Trenton formation of Ottawa City. Dr. Nicholson states that this species is "not uncommon in the Trenton limestone of Peterboro', Ontario, in association with *Prasopora Selwynii*, Nich."

Collector.—T. C. Weston.

MONOTRYPA, Nicholson.

"Irregular, hemispherical or globular masses. Surface smooth, or with low monticules carrying groups of larger cells than the average. Tubes thin-walled, prismatic, and traversed by straight diaphragms. No interstitial cells nor spiniform tubuli. Trenton to Carboniferous." (E. O. Ulrich; Journ. Cincinnati Soc. Nat. Hist., Vol. V., p. 153, 1882.)

MONOTRYPA UNDULATA, Nicholson.

Monticulipora (Monotrypa) undulata, Nicholson. "The genus *Monticulipora*," p. 170, figs. 32 and 33, 1881.

Locality and Formation.—This species, which is the type of the genus is described by Dr. Nicholson as "rare in the Trenton Limestone of

Peterboro', Ontario," and "common (the 'puff-ball variety') in the Hudson River group of Toronto, Weston, and other localities in Ontario." It has now to be recorded from the Chazy Formation of the Island of Montreal, an individual in the Museum of the Geological and Natural History Survey, having been identified with this species.

Collector.—E. Billings.

MONOTRYPELLA, Ulrich.

"Ramosc, smooth or tuberculated. Cells apparently of one kind only. Walls very thin in the axial portion of the branches, but much thicker in the peripheral region. Diaphragms straight. No spiniform tubuli. Trenton and Cincinnati." (E. O. Ulrich, Journ. Cincinnati Soc. Nat. Hist., Vol. V., p. 153, 1882.)

MONOTRYPELLA TRENTONENSIS, Nicholson, Sp.

Monticulipora (Heterotrypa) Trentonensis, Nicholson. "The genus *Monticulipora*," p. 149, fig. 28, 1881.

Locality and Formation.—Dr. Nicholson records this species as "abundant in the Trenton Limestone of Peterboro', Ontario." It covers large surfaces of the strata in the Trenton Formation in and around Ottawa City, and is common throughout this formation in Canada. It is difficult to distinguish this species from *Homotrypa similis*, Foord, by its external characters alone, and microscopic sections are necessary in order to separate the two species with certainty. The specimen figured by Billings in the "Geology of Canada" (p. 156, fig. 116, 1863), as *Stenopora fibrosa*, Goldfuss, should probably be referred to *Monotrypella Trentonensis*.

Collectors.—Sir W. E. Logan, W. R. Billings, H. M. Ami, A. H. Foord.

MONOTRYPELLA ÆQUALIS, Ulrich.

Monotrypella æqualis, Ulrich, Journ. Cincinnati Soc. Nat. Hist., p. 247, plate II., figs. 3, 3a, 3b, 1882.

Locality and Formation.—Not uncommon in the Black River Formation at Paquette's Rapids, on the Ottawa River.

Collector.—J. Richardson.

AMPLEXOPORA, Ulrich.

"Ramosc, free or incrusting. Cellular structure as in *Monotrypella*, excepting that more or less numerous spiniform tubuli are developed, which sometimes completely encircle the tubes. Cincinnati to sub-carboniferous." (E. O. Ulrich, Journ. Cincinnati Soc. Nat. Hist., Vol. V., p. 154, 1882.)

AMPLEXOPORA SUPERBA. (N. Sp.)

Plate IV., figs. 1-1c.

Zoarium irregularly ramose, very robust in its habit of growth; branches cylindrical, measuring from 10 to 12 mm. in their greatest diameter, the longest measured gives about 20 centimetres as its greatest length. Surface of the branches studded with slightly raised monticules, which consist of cells rather larger than the average. Cell-apertures sub-polygonal in outline, about three occupying the space of one mm., except upon the monticules, where two or two and a-half suffice to fill the same space.

In tangential sections the cells appear to be somewhat rounded at their angles, the original walls, which are quite distinct, being considerably thickened near the surface of the zoarium by a secondary deposit of sclerenchyma. Large and conspicuous spiniform tubuli are distributed at the angles of junction of the cell walls, and occasionally one is situated on the line between two of these angles, and when this occurs a slight inward protrusion of the cell wall is the result.

Longitudinal sections show the tubes to be thin-walled in the axial region of the zoarium, and to be somewhat sparingly supplied with straight, horizontal diaphragms; these become much more numerous, and sometimes coalescent, near the periphery, where also the walls of the tubes are much thickened. The tubes bend gradually upwards and outwards as they approach the surface.

The present species may be distinguished from *Amplexopora robusta*, Ulrich, to which it is closely allied, by the possession of monticules, by its more conspicuous spiniform tubuli, as seen in tangential sections, and by the absence of the funnel-shaped diaphragms occurring in that species.

Locality and Formation.—This beautiful species appears to be rare. Montreal, Que., Trenton Formation.

Collector.—Sir W. E. Logan.

AMPLEXOPORA CANADENSIS. (N. Sp.)

Plate IV., figs. 2-2d.

Zoarium ramose, consisting of stout, sub-cylindrical, somewhat compressed branches, measuring from 20 to 25 mm. in their greatest diameter. Surface smooth and quite destitute of monticules. Cell-apertures polygonal, nearly equal in size, about three and a half occupying the width of 1 mm.

In tangential sections the cell-walls are seen to be moderately thick, and to be provided at their angles of junction with spiniform tubuli of medium size.

Longitudinal sections show that the tubes have moderately thin walls in the axial region, and that they are provided with very numerous horizontal, slightly curved diaphragms, three or four of which occupy a space equal to a tube diameter; these diaphragms sometimes coalesce. Towards the periphery the proper wall of the tubes is considerably thickened by an investment of light coloured sclerenchyma of fibrous texture.

This species may be separated from *Amplexopora superba*, Foord, which is its nearest ally, by the absence of monticules, and by its very abundant horizontal diaphragms.

Locality and Formation.—St. Joseph Island, Lake Huron, Black River Formation; Joliette, Que. Trenton Formation.

Collectors.—T. C. Weston, H. M. Ami.

AMPLEXOPORA DISCOIDEA, Nicholson, Sp.

Monticulipora (Monotrypa) discoidea, James. "The genus *Monticulipora*," p. 193, Plate IV., figs. 3, 3f, 1881.

Locality and Formation.—Ottawa City. Trenton Formation.

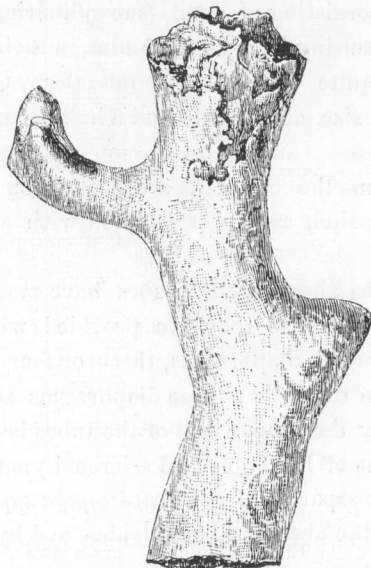
Collector.—Walter R. Billings.

BATOSTOMA, Ulrich.

"Irregularly ramose, with a large basal expansion, by means of which the zoarium is attached to foreign bodies. Cell-apertures in the outer portion of the branches irregularly ovate or circular, and surrounded by a distinct ring-like wall. Interstitial tubes more or less numerous, very irregular in shape and size. Spiniform tubuli numerous and well developed." Black River, Trenton and Cincinnati. (E. O. Ulrich, Journ. Cincinnati Soc. Nat. Hist. Vol. V., p. 154, 1882.)

BATOSTOMA OTTAWAENSE. (N. Sp.)

Plate II., figs. 1-1f.



Batostoma Ottawaense. (N. Sp.) A silicified fragment of the ramose zoarium of this species, from the Black River Formation of Paquette's Rapids on the Ottawa River. Natural size.

Zoarium ramose to frondescent. The ramose forms consist of stout, cylindrical or sub-cylindrical, dichotomous branches, varying in thickness from 10 to 16 mm. The frondescent forms are palmate with compressed branches measuring from 10 to 18 mm. in breadth at their bases and tapering towards their extremities to an obtuse point. Greatest breadth of the frond 4 cent.; thickness about 6 mm. Surface of both forms covered with small and inconspicuous monticules placed at variable distances apart and occupied by from ten to fifteen cells slightly larger than the average. Cell-apertures very variable in outline, usually sub-circular, especially on weathered surfaces. They average about .5 mm. in diameter.

Tangential sections show that in the axial portion of the zoarium the larger tubes are angular, polygonal, thin-walled and very variable in size and shape. As they approach the surface they become greatly thickened by a secondary deposit of sclererechyma of fibrous structure. The cells

in this region consequently lose their angularity, and become rounded or semi-oval, sometimes narrow and bean-shaped. In some places the walls throw out slender prolongations or blunt spines, these are the incomplete diaphragms to be described further on. (See plate II., fig. 1*b*.) The interstitial tubes fill up the spaces between the larger ones and are best seen in sections, ground a little below the surface of the zoarium where they have not become obliterated, as in the peripheral region, by the secondary deposit of sclerenchyma. In the axial region they are not met with at all, as they do not extend far below the surface. Large spiniform tubuli occur at the angles of junction between the larger tubes or in the substance of their walls; the sections of these tubuli are strongly defined by a dark ring with a white spot in the centre, making them very conspicuous objects in a tangential section. Excepting in places where the tubes have been cut a little deeper, their original walls are barely distinguishable in the dense secondary deposit of sclerenchyma; but they may be detected here and there as somewhat obscure lines connecting the spiniform tubuli together.

Longitudinal sections exhibit numerous diaphragms, some of which are complete, but the greater number do not extend more than half way across the tubes; in some places they appear merely as obtuse spinous projections of the walls of the tubes. The diaphragms are generally straight, sometimes slightly curved, and often rather oblique to the axis of the tubes. Many of the incomplete diaphragms are thickened at their distal extremity into a little knob. Like the walls of the tubes, the diaphragms in the axial region of the zoarium are very slender and only become thickened as they approach the periphery. They are about half a tube diameter apart.

This species may be readily separated from its nearest ally—*Batosloma Jamesi*, Nicholson, Sp. (the type of the genus)—by its numerous transverse diaphragms and their peculiar incomplete development in many of the cells.

Locality and Formation.—This species is not uncommon in the upper beds of the Trenton Formation in the vicinity of the City of Ottawa. It has also been found at Paquette's Rapids (Ottawa River) in the Black River Formation.

Collectors.—Walter R. Billings, Ottawa City; J. Richardson, Paquette's Rapids.

HETEROTRYPA, Nicholson, (Restricted.)

"Zoarium frondescant, rarely incrusting. Tubes prismatic. Interstitial cells developed in moderate numbers, sometimes collected into 'maculae.' Spiniform tubuli small, more or less numerous. No cystoid diaphragms." Trenton and Cincinnati. (E. O. Ulrich, Journ. Cincinnati Soc. Nat. Hist., Vol. V., p. 155, 1882.)

Since the above was written Mr. Ulrich has published a more detailed description of the genus, which is here subjoined:—

"Zoarium growing from an expanded base, attached to foreign objects, upward into simple, often undulated or irregularly inosculated fronds, and occasionally into flattened branches. Cell-apertures varying in shape from polygonal to circular. They are separated from each other by walls or interspaces, which may be comparatively thin (*H. solitaria*, Ulrich), or nearly as thick as their own diameter (*H. Vaupeli*, Ulrich). Interstitial cells from few to very numerous, always angular or sub-angular. Spiniform tubuli small, usually numerous (sometimes excessively so, as in *H. Vaupeli*), occasionally inflecting the walls, and giving the cell-apertures an irregularly petaloid appearance. Internally we find that the walls of the tubes are more or less thickened as they enter the 'mature' region, and apparently amalgamated with one another. The diaphragms are straight, of one kind only, more numerous in the interstitial tubes than in the proper zoecia, and always more crowded in the 'mature' regions than in the 'immature' or axial regions." (E. O. Ulrich, Journ. Cincinnati Soc. Nat. Hist., Vol. VI., p. 85, 1883.)

HETEROTRYPA SOLITARIA, Ulrich.

Heterotrypa solitaria, Ulrich, Journ. Cincinnati Soc. Nat. Hist., Vol. VI., p. 88, plate I, figs. 3, 3a, 3b, 1883.

A basal expansion of this species.

Locality and Formation.—Ottawa City. Trenton Formation.

Collector.—Walter R. Billings.

SPATIOPIORA, Ulrich.

"Incrusting, and forming very thin, large expansions, with a smooth or strongly tuberculated surface. Cells shallow, with oblong or irregular apertures. Interstitial cells sparingly developed. Spiniform tubuli generally of considerable size." Trenton and Cincinnati. (E. O. Ulrich, Journ. Cincinnati Soc. Nat. Hist., Vol. V., p. 155, 1882.)

SPATIOFORA AREOLATA. (N. Sp.)

Plate V., figs. 1, 1*i*.

Zoarium parasitic (?) forming very thin, circular, flattened expansions, from which proceed projecting cylindrical processes, which become thickened gradually from their centre towards the proximal and distal extremities. The zoarium varies in size from one to two centimetres in diameter, and from .75 to 1 mm. in thickness. The longest of the projecting processes attains a length of one centimetre, and varies in thickness from 1 to 2.5 mm. The upper surface of the zoarium is covered with low, somewhat inconspicuous monticules, upon which the cells appear to be smaller than they are on the general surface of the zoarium. The under surface, which is the one most frequently met with, is marked by very conspicuous, hexagonal, shallowly concave areas, giving to this aspect of the fossil very much the appearance of *Comarocystites punctatus*, Billings, for weathered examples of which it has often been mistaken. The projecting processes appear to originate from the margin of the zoarium, at short intervals, though there are obscure indications of their attachment to other parts of the disc. The cells, which are seen on both surfaces of the zoarium, are of two kinds; of the larger ones there are about three in the space of 1 mm.

Tangential sections show that the cells of both kinds are thin-walled; that the larger ones are polygonal in outline, and that the small interstitial cells fill up the spaces between them. Spiniform tubuli are developed at the angles of junction of the cell-walls.

Longitudinal sections exhibit rather remote, straight diaphragms in the larger tubes, and these are much more numerous and close set in the smaller ones.

Mr. Ulrich, of Cincinnati, has suggested to the writer that the concave areas of the under surface of this species may be accounted for by supposing that it "grew parasitically upon a foreign body, marked with polygonal convex spaces, which, during the process of fossilization, was destroyed." He adds in another place: "as the markings of a *Pasceolus* (e. g. *P. globosus*, Billings), would just fit the impressions [in the *Spatiofora*,] I naturally came to the conclusion that the zoarium was attached to such an object." Mr. Ulrich further remarks: "In our rocks [those of the Cincinnati group, at Cincinnati], there are several species, which having decayed, are as yet known only by their impressions in parasitic bryozoa, and in most cases where parasitic bryozoa are found in our rocks the

supporting object has decayed, and left a clear and distinct impression of even its most fine markings in the membranaceous epitheca of the zoarium." There is one circumstance which makes the writer hesitate to concur in Mr. Ulrich's opinion that *Spatiopora areolata* was parasitic upon a *Pasceolus*, and that is the fact that the former has been found only in the lower beds of the Trenton formation, in which *Pasceolus* does not occur; the latter is found only in the upper shaly beds of the Trenton, about 180 feet above the lower ones, and near the horizon of the Utica Formation.

Locality and Formation.—Hull, Que., in the lower beds of the Trenton Formation.

Collectors.—Walter R. Billings, H. M. Ami, A. H. Foord.

STELLIPORA ANTHELOIDEA, Hall.

Stellipora antheloidea, Hall, Pal., N.Y., Vol. I., p. 79, pl. XXVL, figs. 10a, 10b, 1847.

Stellipora antheloidea, D'Orbigny, Prodr. de Paléont., t. 1, p. 22, 1850.

Constellaria antheloidea, Edwards and Haime, Pol. Foss. des Terr. Pal., p. 279, pl. XX., figs. 7-7b, 1851.

Constellaria antheloidea, Nicholson, Pal. of Ohio, Vol. II., p. 214, 1875.

Constellaria antheloidea, Nicholson, Ann. Nat. Hist., ser. 4, Vol. XVIII., p. 92, pl. V., fig. 10, 1876.

Locality and Formation.—Ottawa City. Trenton Formation. Two fragments of this species, imperfectly preserved, have been identified.

Collector.—Walter R. Billings.

CONSTELLARIA FLORIDA, VAR. PLANA, Ulrich, MS.

This species has been identified by Mr. Ulrich.

Locality and Formation.—Ottawa City. Trenton Formation.

Collector.—E. Billings.

II. On some previously unrecorded Species of *Ptilodictya*, *Stictopora*, and *Arthronema*, from the Trenton Formation.

PTILODICTYA PAVONIA, D'Orbigny.

Ptilodictya pavonia, D'Orbigny, Prodr. de Paléont., Vol. 1, p. 22, 1850.

Chaetetes pavonia, Milne-Edwards and Haime, Pol. Foss. des Terr. Pal., p. 267, pl. XIX., figs. 4, 4a, 1851.

Chaetetes pavonia, Rominger, Proc. Acad. Nat. Sci. Phil., 1866, p. 116.

Stictopora clathratula, James, Cat. Foss. Cincinnati Group, 1871.

Chaetetes? clathratulus, Nicholson, Quart. Journ. Geol. Soc., Vol. XXX., p. 509, pl. XXX., figs. 1-1b, 1874. Pal. Ohio, Vol. II., p. 209, pl. XXII., figs. 2-2b, 1875. Ann. Nat. Hist., ser. 4, Vol. XVIII., p. 91, pl. V., figs. 9, 9a, 1876.

Heterodictya pavonia, Ulrich, Cat. Foss. Cincinnati Group, p. 10, 1880.

Ptilodictya pavonia, Ulrich, Journ. Cincinnati Soc. Nat. Hist., p. 163, 1882.

A single example of this beautiful form has been collected, the first found in Canada. It consists of a fragment of the frond measuring about 6 centimetres in length, about 3·5 centimetres in its greatest breadth, and from 3 to 5 mm. in thickness.

Locality and Formation.—Ottawa City. Trenton Formation.

Collector.—Walter R. Billings.

PTILODICTYA MACULATA, Ulrich.

Ptilodictya maculata, Ulrich, Journ. Cincinnati Soc. Nat. Hist., Vol. V., p. 163, Plate VI., fig. 17, and Plate VII., figs. 4, 4a, 1882.

This species appears to be not uncommon in the lower beds of the Trenton Formation near Ottawa City. The largest specimen in the Survey collection measures about 9 centimetres in length, and about 2·5 centimetres in its greatest breadth.

This is doubtless the species referred to by Dr. Nicholson in his description of *Ptilodictya falciformis*, (Pal. Ontario, p. 13, 1875), where he says he has seen "examples of what may ultimately prove to be a distinct species, in which the width of the frond greatly exceeds" that of *P. falciformis*.

Locality and Formation.—Hull, Que., in the lower beds of the Trenton Formation.

Collectors.—Walter R. Billings, H. M. Ami.

STICTOPORA PAUPERA, Ulrich, MS.

Mr. Ulrich has identified this species, which is associated with *Spatiopora areolata*, Foord.

Locality and Formation.—Hull, Que., in the upper beds of the Trenton Formation (also in the upper Trenton Group of Burgin, Kentucky).

Collector.—W. R. Billings.

ARTHRONEMA TENUE, James, Sp.

Helopora tenuis, James, "The Palæontologist," Cincinnati, Ohio, No. 1, p. 3, July, 1878.

Arthronema tenue, James, Sp., E. O. Ulrich, Journ. Cincinnati Soc. Nat. Hist., Vol. V., p. 160, Plate VI., figs. 8, 8c, 1882.

Locality and Formation.—Not rare in the Trenton Formation, near Montreal City.

Collectors.—T. C. Weston, T. Curry.

III. On Two Species of *Tetradium* from the Trenton and Hudson River Formations.

TETRADIIUM PEACHII, Nich. and Eth., jun., Var. CANADENSE. (N. Var.)
Plate VI., figs. 1, 1i.

In the Trenton formation there occur very abundantly certain small, rounded masses, the organic nature of which had for a long time been doubted. A microscopic examination of these masses has proved them to be a variety of a species found in pebbles of Upper Silurian Age from the Devonian (Old Red) conglomerate of Habbies Howe, in the Pentland Hills, Scotland, named by Dr. Nicholson and Mr. R. Etheridge, jun., *Tetradium Peachii*.* The species is thus characterized by the authors:—

“Corallum massivo, exceedingly dense and compact, composed of excessively minute, closely approximated corallites, about a thirty-fifth of a line in diameter. The corallites have an undulating course, and are sometimes disposed in superimposed layers, or arranged concentrically round minor centres. Corallites thick-walled, irregularly circular or oval in transverse section, with a few (three or four?) short septa, which are often thickened at their bases. Tabulæ numerous and complete. Corallum perforated by irregular tubes (water canals?) from a fortieth to a fiftieth of an inch in diameter or less.”

The variety occurs in the form of very compact, irregularly rounded, sub-globose masses, varying greatly in size, the smallest measured giving 12 mm. in its greatest diameter and the largest from 5 to 6 centimetres.

It is difficult to detect any trace of structure, even with a hand-lens, on the surface of weathered specimens, but polished surfaces exhibit a series of concentric lines, arranged symmetrically around several centres.

Through the courtesy of Dr. Nicholson and Mr. R. Etheridge, jun., the author was furnished with a specimen of *Tetradium Peachii*, from the typical locality, and this has been compared with the Canadian form. In its microscopic character the variety is essentially similar to the species,

* Ann. Nat. Hist., Ser. 4, Vol. XX. p. 166, figs. d, e, f, g, 1877.

and differs from the latter only in having thicker and more wavy tubewalls, which are in somewhat closer proximity. No tabulæ have been seen in any of the Canadian specimens. As to their occurrence in the Scotch species Mr. R. Etheridge, jun., in a letter lately received by the author writes:—"With regard to the presence of tabulæ I must confess myself in doubt. Some specimens undoubtedly do not possess them, a fact which has already been commented on by Dr. Nicholson and myself, (Girvan Report, facie. 1, p. 32), but again in some sections I have seen horizontal divisions of the tubes, which I could refer to nothing else."

Taking into consideration the excessive minuteness of the corallites, and the sinuosity of their walls in *Tetradium Peachii*, and its variety *Canadensis*, and the doubtful existence of tabulæ in both, it would seem necessary to remove these forms from the genus *Tetradium*. The propriety of this course has perhaps occurred to the authors of the species.

Locality and Formation.—Abundant throughout the Trenton formation of the Province of Quebec, at the following localities: Hull, Joliette, Montmorency and Murray Bay.

Collectors.—Principal Dawson, T. C. Weston, H. M. Ami, A. H. Foord.

TETRADIUM HURONENSE, Billings, Sp.

Plate VII., figs. 1, 1e.

Stenopora Huronensis, Billings, Pal. Foss., Vol. I, p. 185, 1861-1865.

A microscopical examination having been made to ascertain the affinities of the *Stenopora Huronensis*, of Billings, it was found to belong to the genus *Tetradium*. The following is the amended description:—

Corallum very large, massive, rounded, growing in thin concentric laminae, of about 1 to 2 mm. in thickness. Some specimens attain a diameter of about 30 centimetres, and an average thickness of about 7 centimetres. Corallites extremely long, from 6 to 12 centimetres in length. The surface is covered with prominent, rounded, or conical elevations, and these are seen on weathered, or polished sections to have covered the surface of each successive lamina of which the corallum was built up; this lamination gives to the fossil somewhat the appearance of a *Stromatopora*, as observed by Mr. Billings. The elevations are from four to six centimetres apart, measured from their summits; in height they are about 3 mm. The entire surface of the corallum, including the conical elevations, is covered with close-set, rounded granules, of which about three fill the space of 1 mm.; they diverge from the summit of the elevations in a stellate manner.

Corallites slender, usually irregularly four sided, closely approximated, tortuous; having a diameter of .5 to .75 of a mm. The cell-apertures exhibit three or four short septa, usually the latter number. Tabulæ numerous and complete, about four or five in the space of 1 mm. Walls thick. No opitheca has been observed.

This species of *Tetradium* is distinguished from all others by its large size, very characteristic surface ornamentation, and laminated mode of growth.

Locality and Formation.—Cape Smyth, Lake Huron. Hudson River Formation.

Collector.—Dr. R. Bell.

PLATE I.

MONTICULIPORA WESTONI. (page 7.)

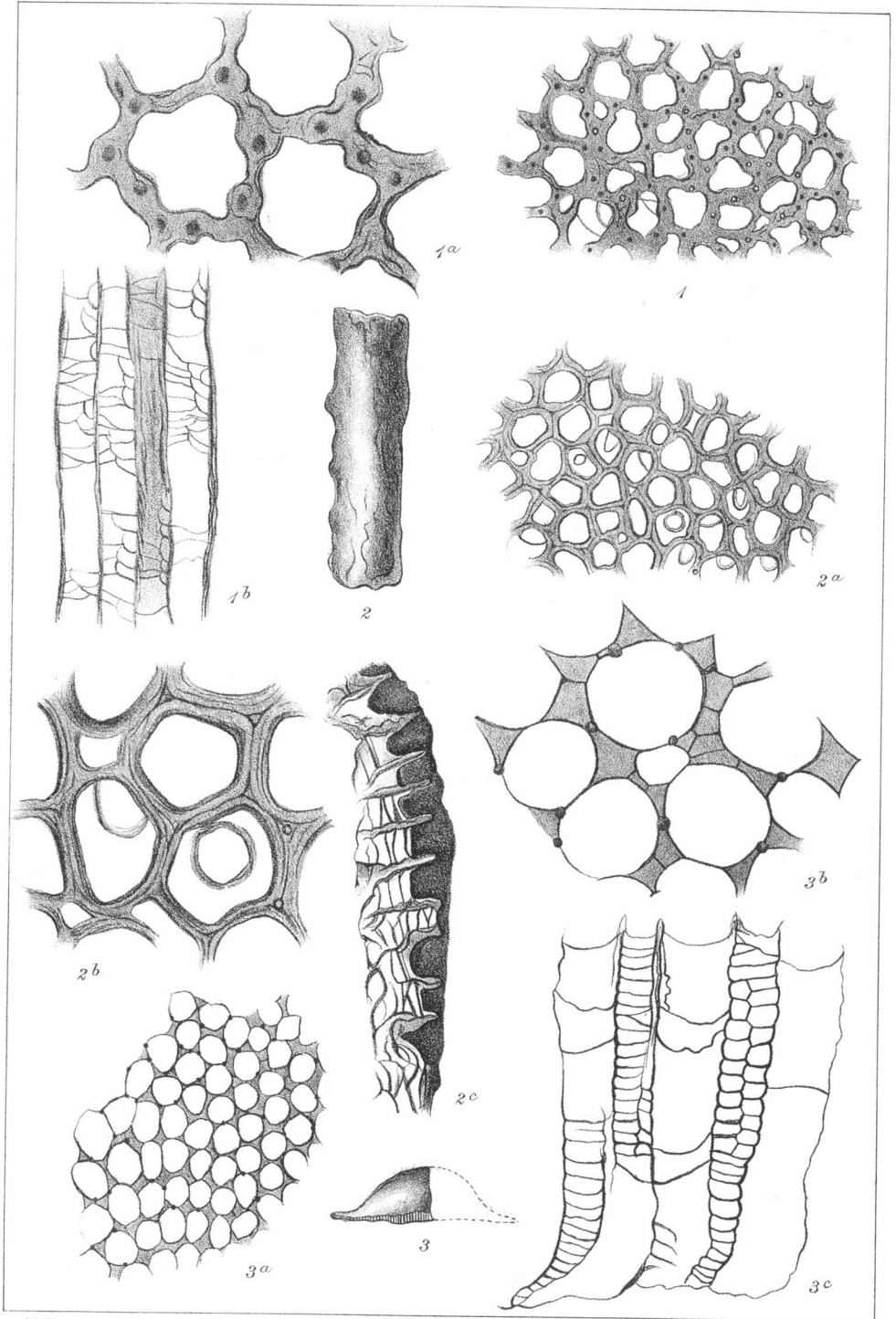
- Figure 1. Tangential section, enlarged about thirty times.
" 1 a. Part of the same section, enlarged about ninety times.
" 1 b. Longitudinal section, enlarged about thirty times.

MONTICULIPORA BILLINGSI. (page 8.)

- Figure 2. Zoarium of this species incrusting a small cylindrical body, probably part of a crinoid stem. Natural size.
" 2 a. Tangential section, enlarged about thirty times.
" 2 b. Part of the same section, enlarged about ninety times.
" 2 c. Longitudinal section, enlarged about thirty times.

DIPLOTRYPA REGULARIS. (page 13)

- Figure 3. Fragment of the zoarium. Natural size.
" 3 a. Tangential section, enlarged about fifteen times.
" 3 b. Part of the preceding section, enlarged about ninety times.
" 3 c. Longitudinal section, enlarged about thirty times.



A.H. Foord, del.

A. Mortimer Lith.

MONTICULIPORIDÆ

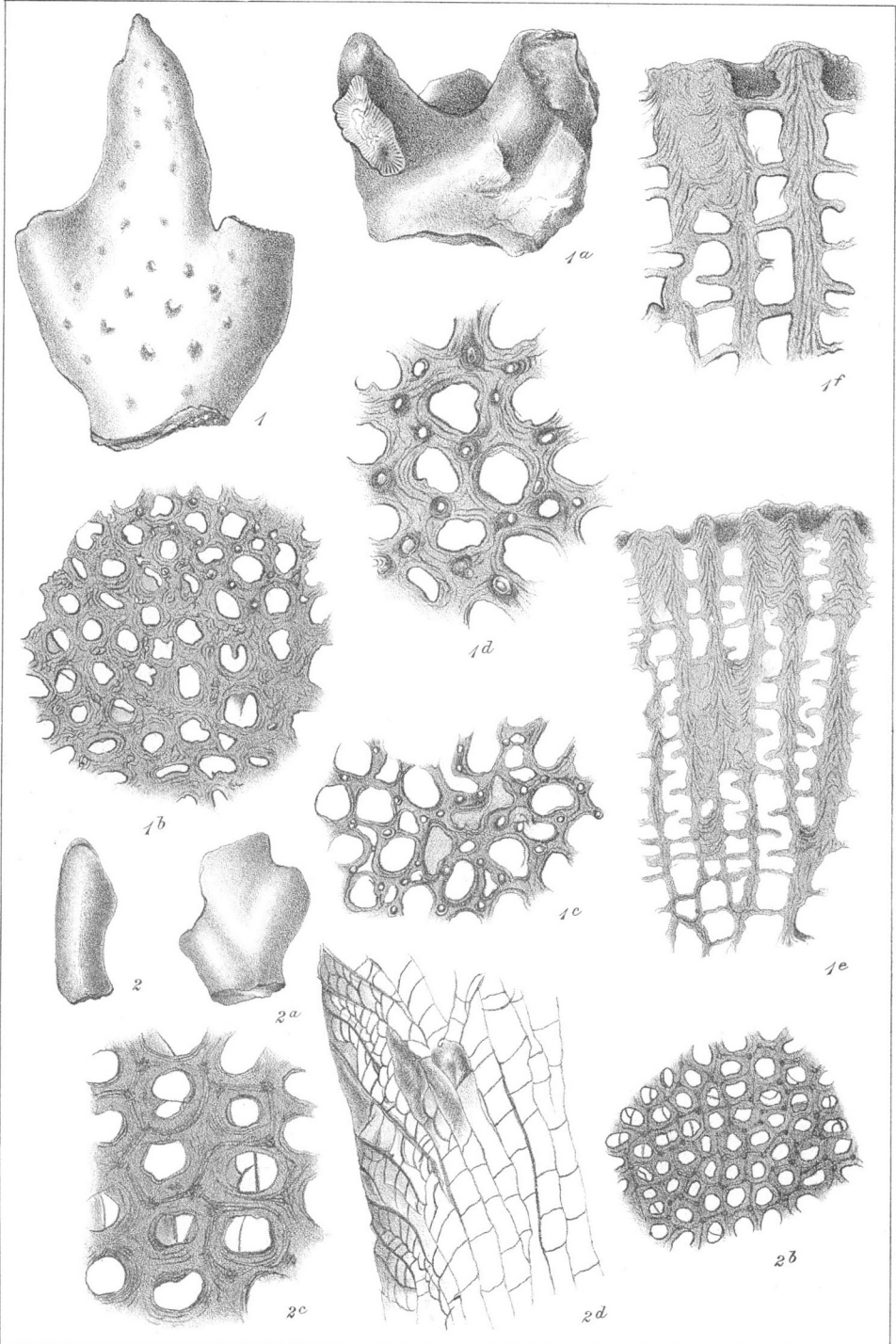
PLATE II.

BATOSTOMA OTTAWAENSE. (page 18.)

- Figure 1. Portion of the frondescent form of the zoarium. Natural size.
- “ 1 *a.* Fragment of the ramose form of the same. (See also wood cut, page .) Natural size.
- “ 1 *b.* Tangential section from a specimen not figured. Enlarged about fifteen times.
- “ 1 *c.* Tangential section, from the frondescent form (Fig. 1), showing the interstitial tubes. Enlarged about fifteen times.
- “ 1 *d.* Portion of 1 *b* enlarged about thirty times.
- “ 1 *e.* Longitudinal section showing the peculiar tabulation of this species. Enlarged about fifteen times.
- “ 1 *f.* Portion of the preceding section, enlarged about thirty times.

HOMOTRYPA SIMILIS. (page 10.)

- Figure 2. Sub-cylindrical form of the zoarium of this species; 2 *a.* Compressed form of the same. Both natural size.
- “ 2 *b.* Tangential section, enlarged about fifteen times.
- “ 2 *c.* Portion of the same section, enlarged about ninety times.
- “ 2 *d.* Longitudinal section, enlarged about fifteen times.



A H Foord, del^r

A Mortimer Lith.

MONTICULIPORIDÆ

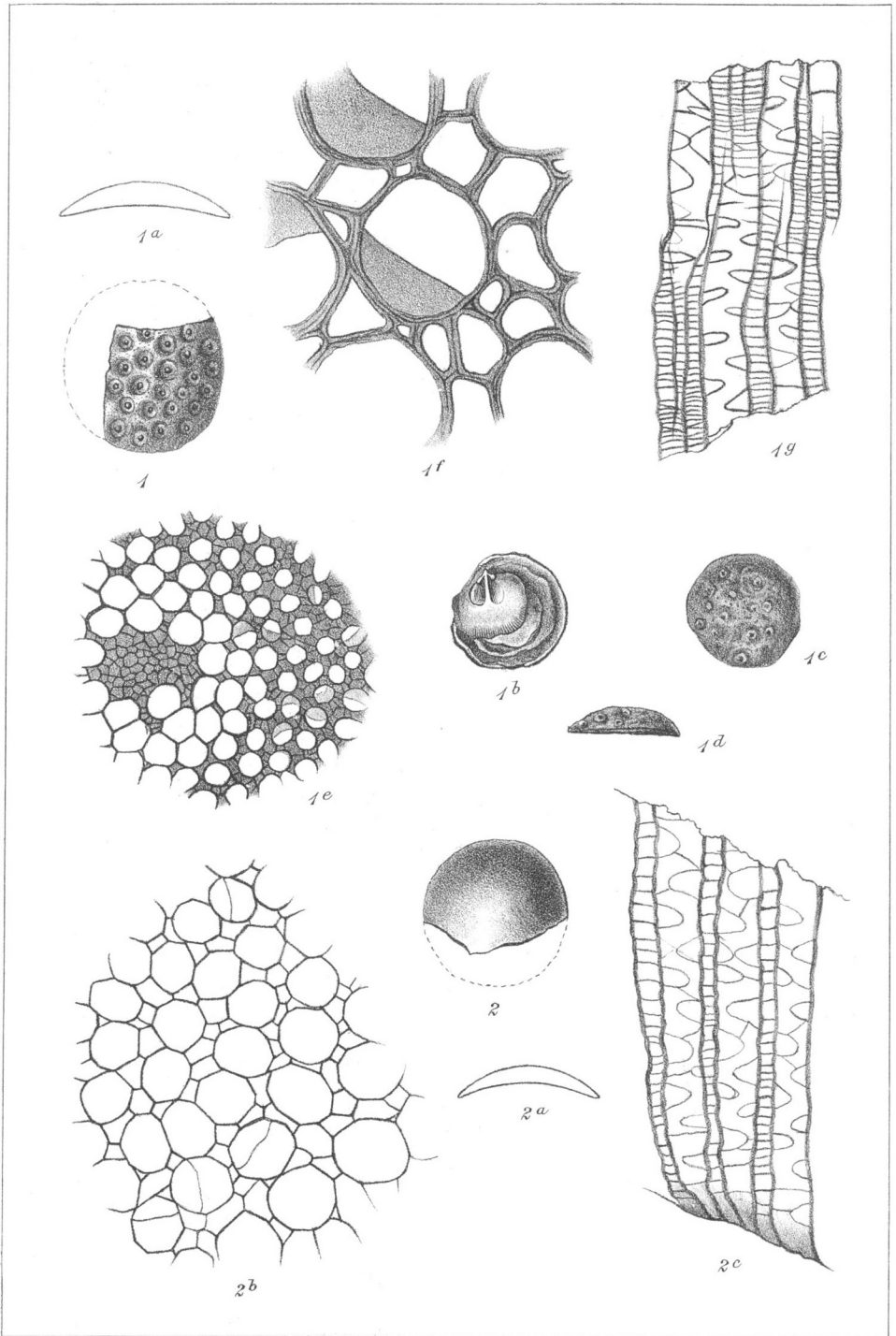
PLATE III.

PRASOPORA OCVLATA. (Page 11)

- Figure 1. Fragment of the zoarium showing the characteristic surface ornamentation. Natural size.
- “ 1 a. Side view of the same, showing the thickness of the zoarium.
- “ 1 b. Under surface of a young individual, attached to a dorsal valve of *Orthis testudinaria*, shewing the wrinkled epitheca. Natural size.
- “ 1 c. Upper surface of the same.
- “ 1 d. Side view of the same.
- “ 1 e. Tangential section showing the two sets of tubes with a cluster of the smaller ones. Enlarged about fifteen times.
- “ 1 f. Portion of the same section enlarged about ninety times.
- “ 1 g. Longitudinal section, enlarged about thirty times.

PRASOPORA AFFINIS. (Page 12.)

- Figure 2. Fragment of the zoarium. Natural size.
- “ 2 a. Side view of the same.
- “ 2 b. Tangential section, enlarged about thirty times.
- “ 2 c. Longitudinal section showing the whole thickness of the zoarium. Enlarged about thirty times.



A.H.Foord, del^t

A Mortimer Luth.

MONTICULIPORIDÆ

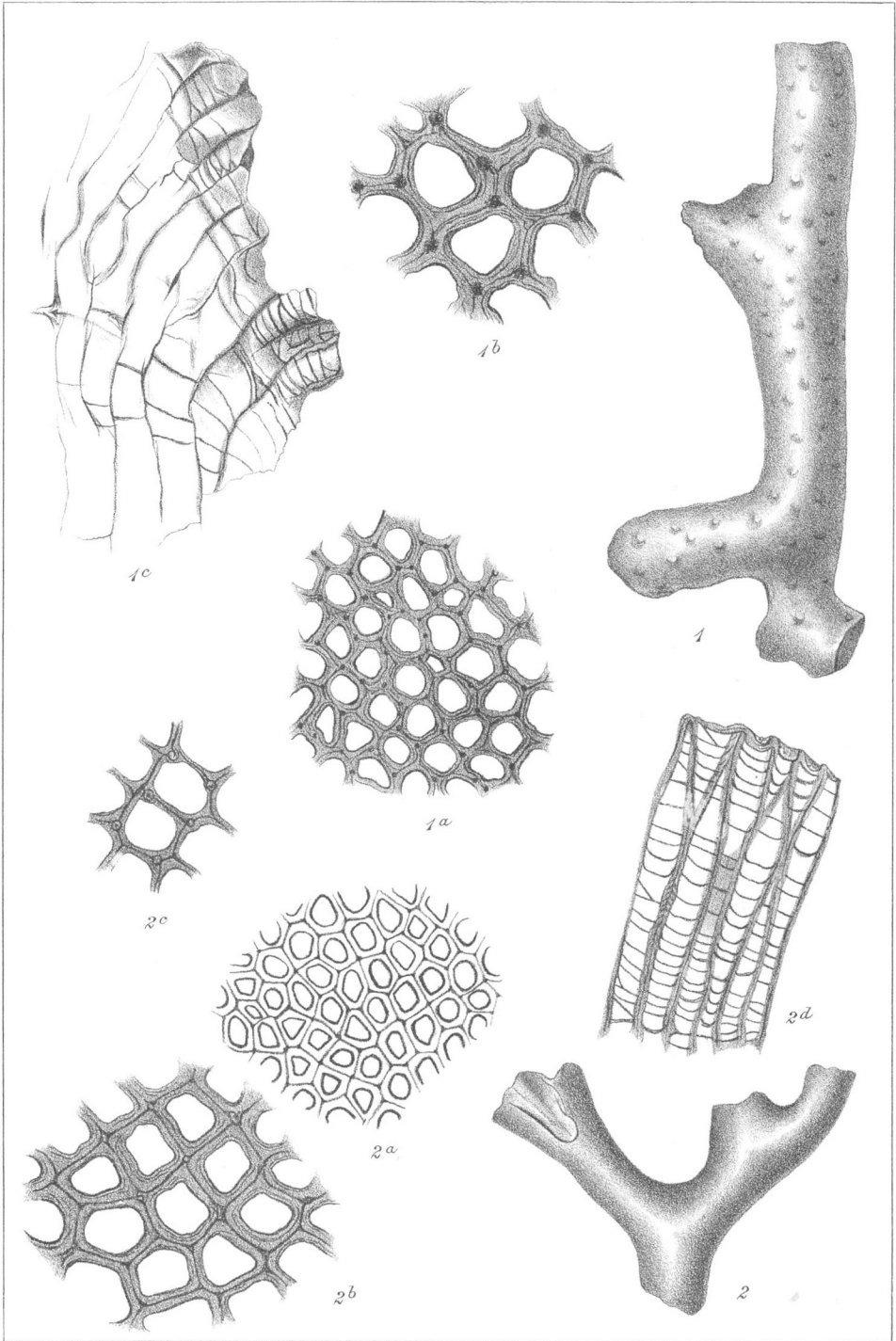
PLATE IV.

AMPLEXOPORA SUPERBA. (Page 16.)

- Figure 1. Fragment of the zoarium. Natural size.
" 1 *a.* Tangential section, enlarged about fifteen times.
" 1 *b.* Portion of the same, enlarged about thirty times.
" 1 *c.* Longitudinal section, enlarged about fifteen times.

AMPLEXOPORA CANADENSIS. (Page 17.)

- Figure 2. Fragment of the zoarium. Natural size.
" 2 *a.* Tangential section, enlarged about fifteen times.
" 2 *b.* Portion of the same, enlarged about thirty times.
" 2 *c.* Portion of a tangential section from another specimen, similarly enlarged to show more clearly the spiniform tubuli.
" 2 *d.* Longitudinal section, enlarged about fifteen times.



A.H.Foord, del

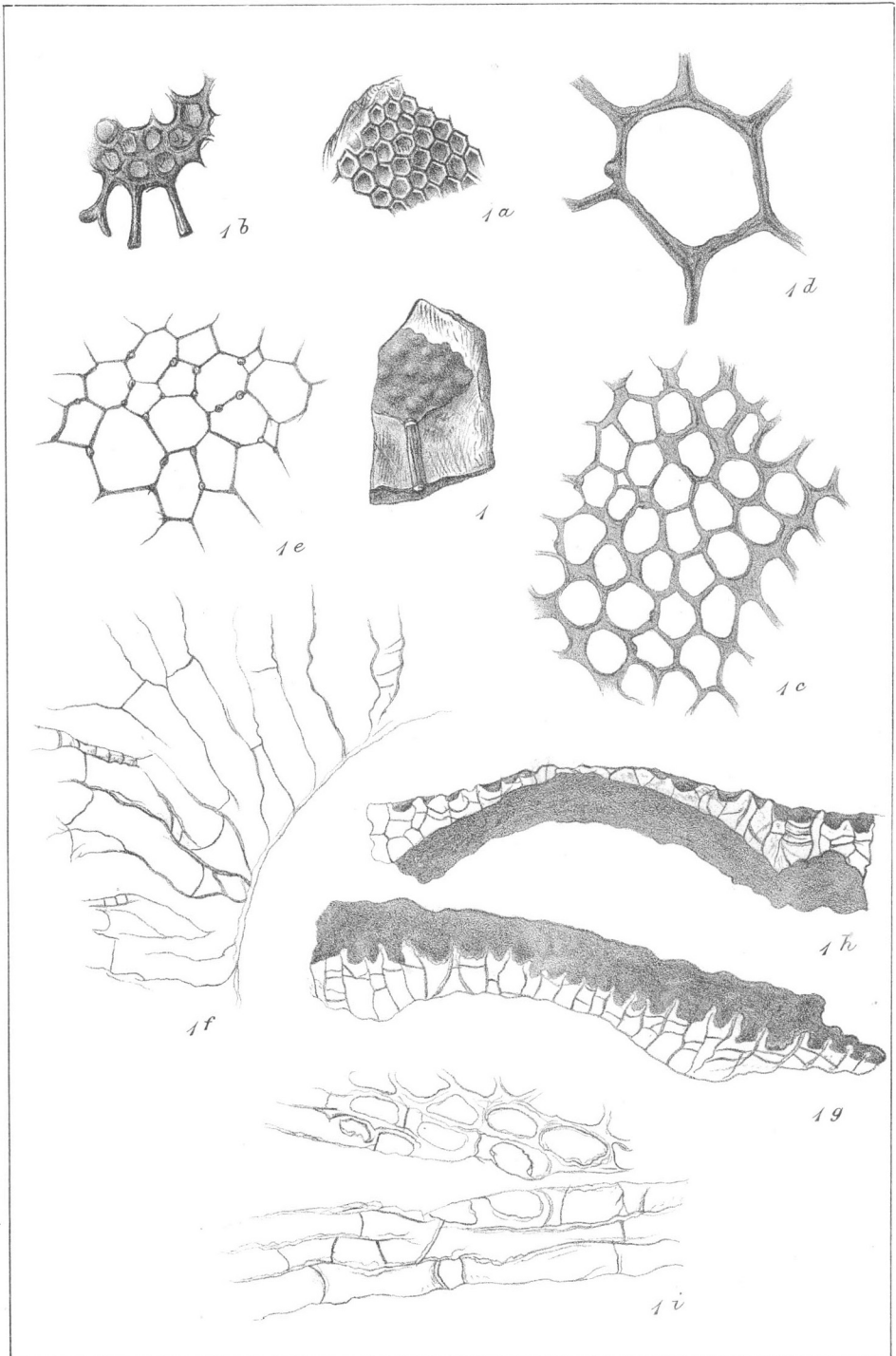
A Mortimer Lith.

MONTICULIPORIDÆ

PLATE V.

SPATIOFORA AREOLATA. (page 21.)

- Figure 1. Fragment of the upper surface of the zoarium, showing monticules, and one of the projecting processes at the margin. Natural size.
- " 1 *a*. Fragment of the under surface showing the hexagonal concave areas. Natural size.
- " 1 *b*. Another fragment of the under surface showing three of the projecting processes. Natural size.
- " 1 *c*. Tangential section showing a few spiniform tubuli. Enlarged about thirty times.
- " 1 *d*. Tangential section of a single cell, enlarged about ninety times.
- " 1 *e*. Portion of a transverse section cut as far below the surface as the extreme tenuity of the zoarium would admit; showing spiniform tubuli. Enlarged about thirty times.
- " 1 *f*. Part of a longitudinal section, showing the larger tubes with very few diaphragms, and two or three of the interstitial tubes in which the diaphragms are more numerous. Enlarged about thirty times.
- " 1 *g*. Longitudinal section showing the under surface with one of the concave areas, and the upper surface buried in the matrix. Enlarged about fifteen times.
- " 1 *h*. Longitudinal section showing upper surface of the zoarium, the lower surface being embedded in the matrix. Enlarged about fifteen times.
- " 1 *i*. Transverse section (the upper figure) and longitudinal section (the lower figure) of one of the projecting processes. Enlarged about thirty times.



AH Foord, del.

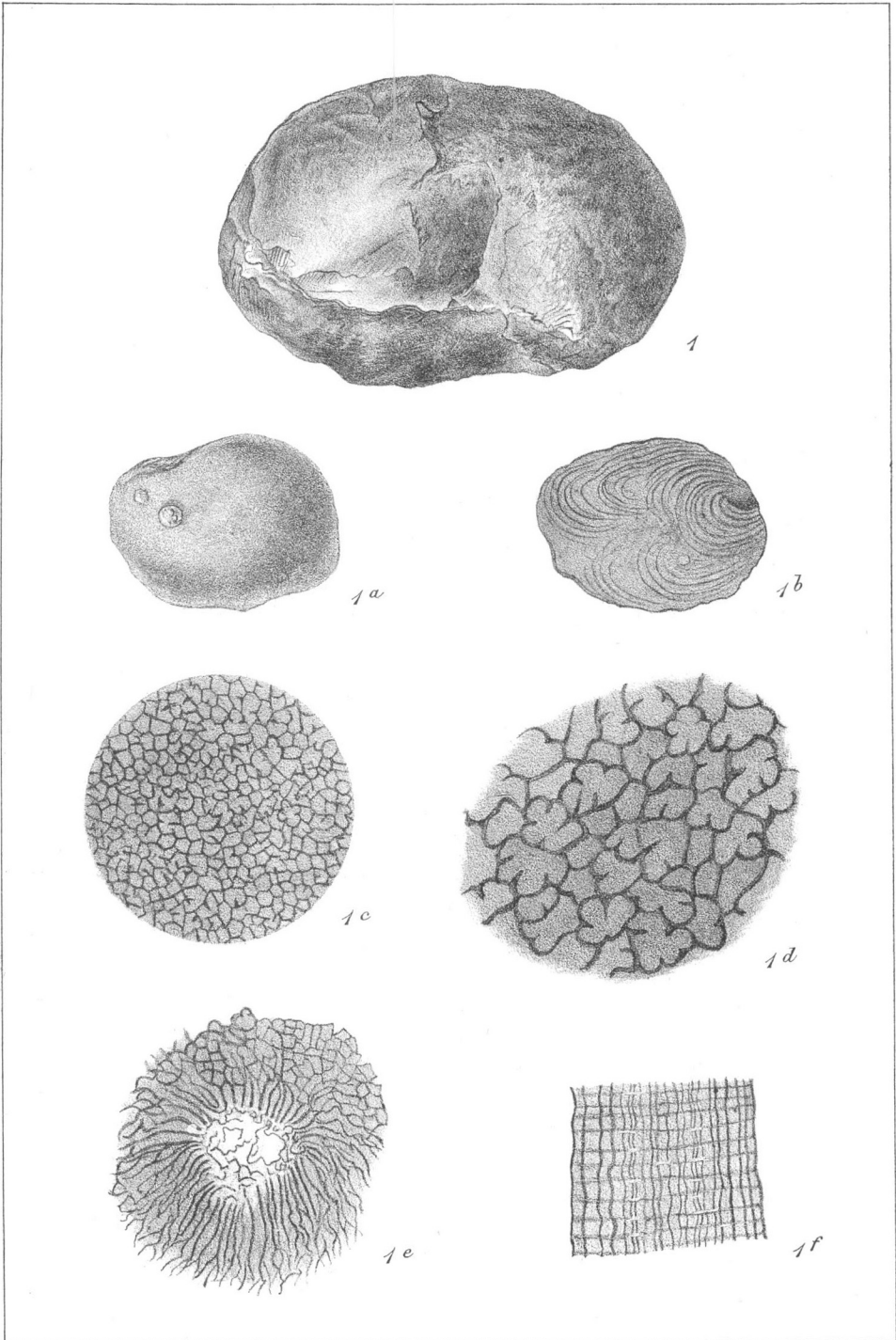
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MONTICULIPORIDÆ

PLATE VI.

TETRADIMUM PEACHII, Nich. and Eth., jun., var. *CANADENSE*. (Page 24.)

- Figure 1. Fragment of a large specimen. Natural size.
- " 1 a. A smaller specimen. Natural size.
 - " 1 b. Polished section of a small specimen, showing concentric lines.
Natural size.
 - " 1 c. Transverse section, enlarged about forty times.
 - " 1 d. Part of the same enlarged about ninety times.
 - " 1 e. Transverse section showing one of the water canals, (?) Enlarged
about forty times.
 - " 1 f. Longitudinal section, showing the wavy walls of the corallites, and
the concentric lines, crossing these nearly at right angles.



A.H.Foord, del^t

A Mortimer, Lith.

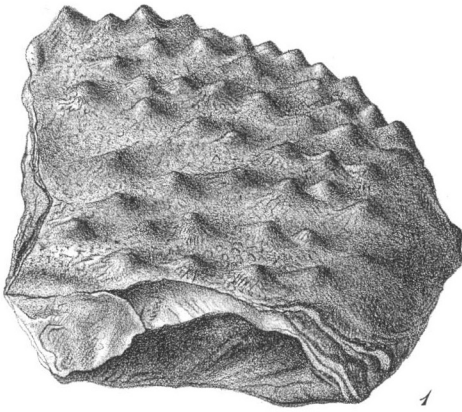
TETRADIIUM

PLATE VII.

TETRADIUM HURONENSE, Billings, Sp. (Page 25.)

- Figure 1. Fragment of the corallum of this species. Natural size.
- “ 1 *a.* Part of a large weathered specimen, showing successive laminæ with some of the conical elevations upon them. Natural size.
- “ 1 *b.* Part of a tangential section showing three or four short septa in the cell-apertures. Enlarged about fifteen times.
- “ 1 *c.* Another part of the same section, similarly enlarged.
- “ 1 *d.* Longitudinal section, showing the tabulæ. Enlarged about fifteen times.
- “ 1 *e.* Longitudinal section showing on the upper edge the surface granules. Enlarged about fifteen times.*

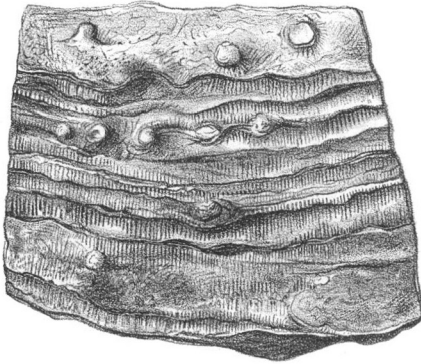
*Through an oversight this figure has been placed obliquely as regards the corallites; it should be in the same position as figure 1 *d.*



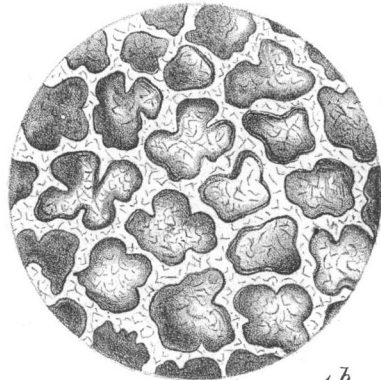
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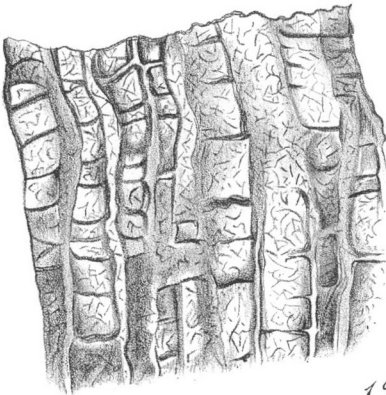
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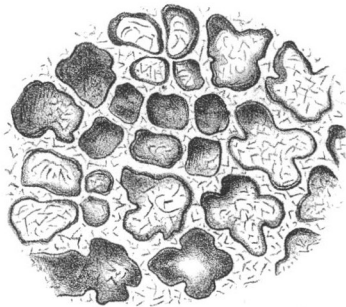
1a



1b



1d



1e

AH Foord, del^r

A Mortimer Lith.

TETRAD IUM