

GEOLOGICAL AND NATURAL HISTORY SURVEY OF CANADA.
ALFRED R. C. SELWYN, C.M.G., LL.D., F.R.S., DIRECTOR.

CONTRIBUTIONS

TO THE

MICRO-PALÆONTOLOGY

OF THE

CAMBRO-SILURIAN ROCKS OF CANADA.

PART II.

BY

E. O. ULRICH.



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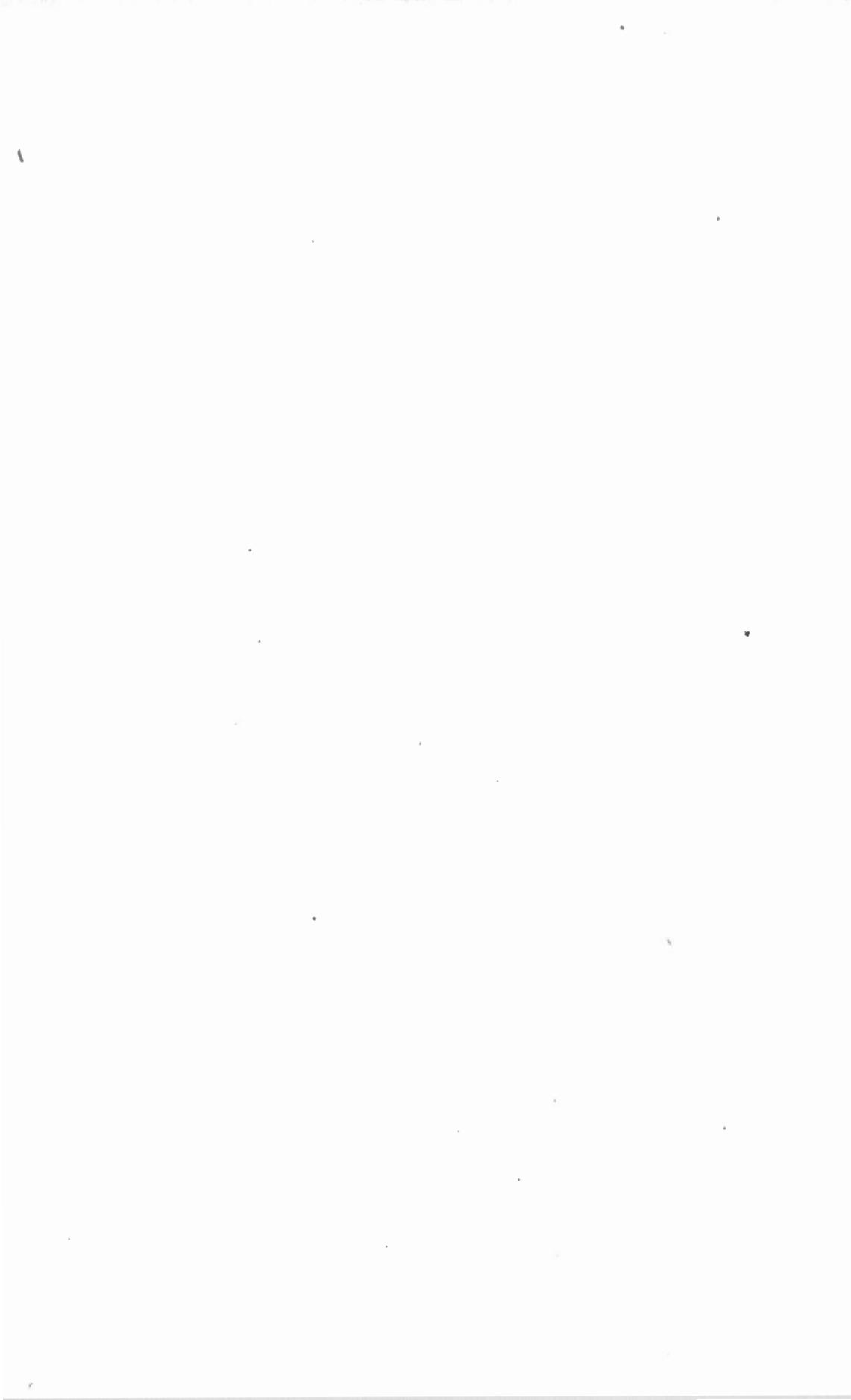
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NOTE.

The second part of the Contributions to the Micro-Palæontology of the Cambro-Silurian rocks of Canada herewith submitted, has been kindly prepared by Mr. E. O. Ulrich, of the Geological Survey of Illinois.

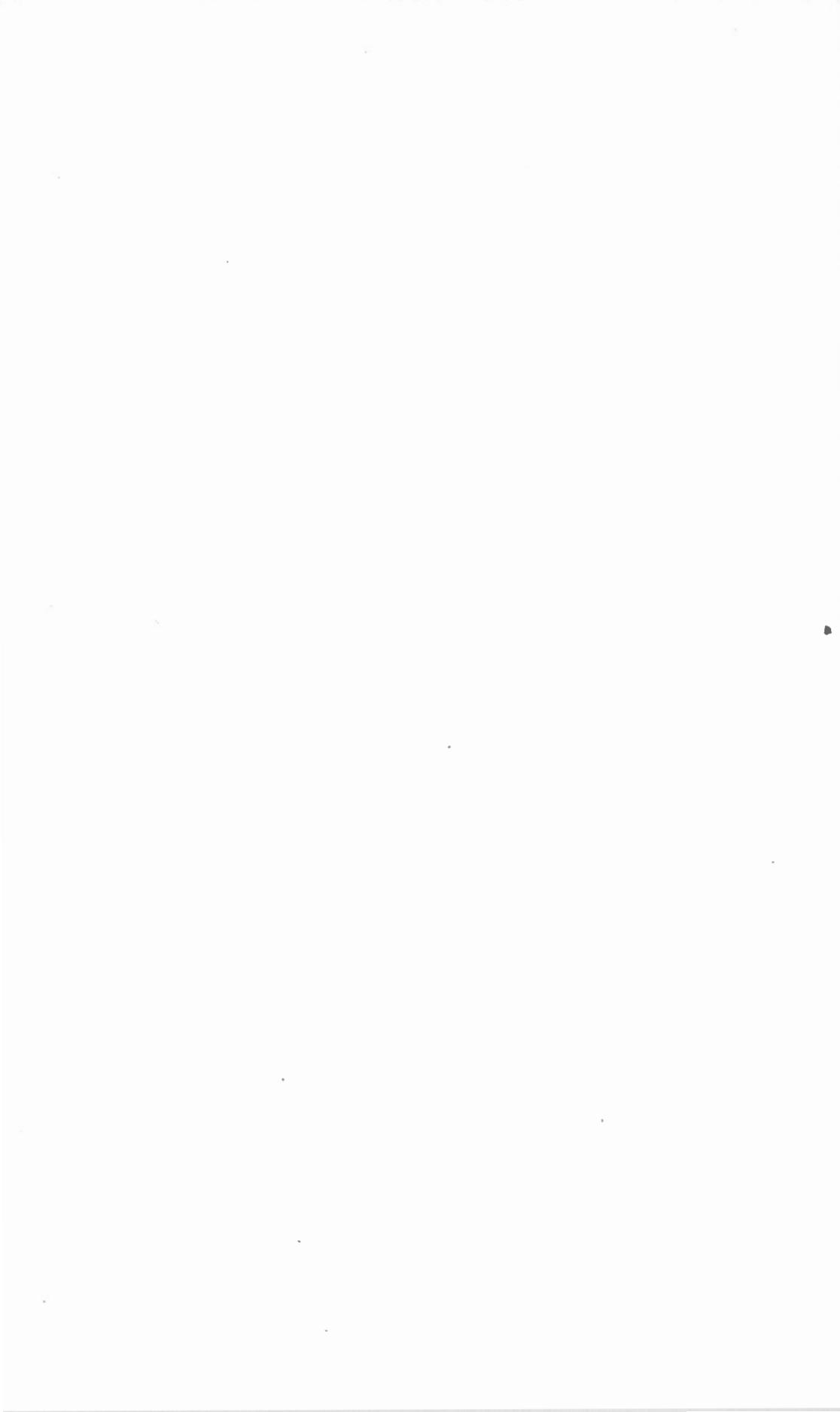
It consists of a descriptive report on some fossil Polyzoa (Bryozoa) and Ostracoda from Manitoba, and is illustrated by two full page lithographic plates.

To facilitate the binding of the present Part with Mr. Foord's previously published Report, the pagination and numbering of the plates of both have been made consecutive.

ALFRED R. C. SELWYN,

Director Geological and Natural History Survey.

OTTAWA, November, 1889.



GEOLOGICAL AND NATURAL HISTORY SURVEY OF CANADA.

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

PART 2.

BY E. O. ULRICH.

4.—*On some Polyzoa (Bryozoa) and Ostracoda from the Cambro-Silurian rocks of Manitoba.*

INTRODUCTION.

The following report on some fossil Polyzoa* (Bryozoa) and Ostracoda from Manitoba is based upon a small collection of specimens which had been made at various times between the years 1875-84, both inclusive, by different members of the Survey, but mostly by Mr. T. C. Weston. This material, together with thirty-five microscopic sections of most of the species represented, prepared by Mr. Weston, which were an important aid to me in their study, was sent to me in February, 1887, for examination, by Mr. J. F. Whiteaves, the palæontologist to the Survey.†

The fossils were studied, the drawings made and the two plates printed in 1888, but, in consequence of adverse circumstances entirely beyond my control, the descriptions could not be written out until quite recently.

The terminology employed in describing the Polyzoa (Bryozoa) is the same as that adopted in my report on the Illinois Bryozoa, in the forthcoming volume (VIII.) of the Illinois Geological Survey Reports.

E. O. ULRICH.

NEWPORT, Kentucky, April 3rd, 1889.

*In conformity with long usage in the Survey Reports and with that of most British writers, the term Polyzoa (Thompson) is here adopted rather than Bryozoa (Ehrenberg) though Mr. Ulrich, in common with the majority of European and U.S. naturalists, prefers the latter.—J.F.W.

† The Ostracoda sent had not been critically examined in Ottawa, but among the Polyzoa three species, viz., *Bythopora delicatula*, *Monotrypella quadrata*, and *Phylloporina Trentonensis*, had been recognized, as well as *Solenopora compacta*, whose systematic position is still doubtful, though it is placed by Zittel among the Bryozoa.—J.F.W.

November, 1889.

DESCRIPTION OF SPECIES.

POLYZOA.

PROBOSCINA AULOPOROIDES, Nicholson.

Alecto auloporoides, Nicholson. 1875. Pal. Ohio, vol. 2, p. 267, pl. 25 figs. 2-2b.

The collection affords a small and rather badly preserved fragment of a species of *Proboscina* indistinguishable from Nicholson's *Alecto auloporoides*. The cells are mostly uniserial, or rather alternating biserial, without, however, having their sides exposed, the outer margins of the adnate zoarium forming a nearly straight line. The zoecia, consequently, are to be regarded as "immersed," the same as in *P. frondosa*, Nicholson, sp., and the typical species of *Proboscina*. This immersion of the zoecia is the character relied upon in separating the genus or sub-genus *Proboscina* from *Stomatopora*, the true species of the latter having the sides of their cells exposed and the margins of the zoarium conforming to their shape. Of Silurian species *S. Proutana*, S. A. Miller, *S. arachnoidea*, Hall, and *S. elongata*, Vine, are true species of *Stomatopora*.

Species of the nature of *P. auloporoides* and *P. frondosa* are, in my opinion, more nearly related to *Berenicea* than to *Stomatopora**. In comparing numerous species, it becomes a matter of no small difficulty to determine where *Proboscina* should end and *Berenicea* begin. On the other hand, the non-immersed condition of the zoecia and their strictly uniserial arrangement in *Stomatopora* furnishes us with two characters that, so far as my observation is concerned, enable us to distinguish readily enough between *Proboscina* and *Stomatopora*.

Stony Mountain, T. C. Weston, 1884. This species also is not uncommon in the middle beds of the Hudson River or Cincinnati group, at Cincinnati, Ohio, and other localities in the United States where these beds are exposed.

PROBOSCINA FRONDOSA, Nicholson.

Alecto frondosa, Nicholson. 1875. Pal. Ohio, vol. 2, p. 266, pl. 25, figs. 3-3b.

This form is likewise represented by but a single example. It is of the typical variety, and, though a little worn, preserves here and there the minute perforations in the walls of the zoecia. The latter occur

* *Berenicea* of Lamoureaux, Haime, Reuss and Zittel, not of Busk, Hincks and Vine, who, contrary to accepted rules of nomenclature, use *Diastopora* instead. Lamoureaux originally proposed *Berenicea* for incrusting forms of the type of *B. diluviana*, while *Diastopora* was applied by him to the erect double-leaved forms typified by his *D. foliacea*.

in from two to seven irregularly alternating ranges, and, where best preserved, are provided with strongly elevated apertures.

A careful comparison between this species and *P. auloporoides* will most probably prove that the former is only a variety of the latter. I can see no difference between them except that in the number of ranges of the zoecia. Though I have not given this group of bryozoa the study it demands, I have, nevertheless, examined enough material to learn that when the zoecia form more than one range, their number is too variable to be accorded specific importance.

Stony Mountain, Manitoba, where the only specimen seen was collected by Mr. T. C. Weston in 1884.

MONTICULIPORA PARASITICA, Var. PLANA. (N. VAR.)

Plate VIII., figs. 3-3d.

The typical form of this species* may be described briefly as follows: Zoarium parasitic, forming thin crusts upon shells and *Streptelasma*, frequently consisting of several layers, each about one millimetre thick. Surface studded with small, abruptly elevated, conical monticules, arranged in decussating series, two to five mm. apart. Apices of monticules generally appearing solid, but, when in a good state of preservation, are occupied by a variable number (three to ten) of minute shallow cells. Zoecia polygonal, thin-walled, with thirteen or fourteen of those of the ordinary size in three mm.; those surrounding the monticules are larger, some being three-tenths of a millimetre in diameter. Internally the zoecial tubes exhibit complete series of cystiphragms, between two and three occurring in a space equal to the diameter of a tube. Walls minutely granular or punctate, rather thin, and usually enclosing a small lucid spot (acanthopore?) at the angles of junction.

The Manitoba variety differs from the typical examples of the species in being without monticules. On the other hand, the clusters of large cells are comparatively more conspicuous, some of them being at least four-tenths of a millimetre in diameter. In the minute internal structure they agree very closely. The peculiar structure of the zoecial walls of true species of *Monticulipora* is shown very well in fig. 3c. The new variety is so far known only from a specimen collected by Mr. T. C. Weston at Stony Mountain in 1884. The original examples of *M. parasitica* were collected from the upper beds of the Hudson River or Cincinnati group at Oxford, Ohio. The species is now known

**Monticulipora parasitica*, Ulrich. 1883. Journ. Cin. Soc. Nat. Hist., vol. 5, p. 238, pl. 10, figs. 3-3a.

from several localities in Ohio and Indiana, and a year or more ago it was found at a corresponding horizon in the Hudson River group at Wilmington and Savannah, Ill.

MONTICULIPOBA WETHERBYI, Ulrich.

Monticulipora Wetherbyi, Ulrich, 1882, Journ. Cin. Soc. Nat. Hist., vol. 5, p. 239, pl. 10, fig. 4-4b.

Two examples of a species of *Monticulipora*, growing upon the frond of *Pachydictya magnipora*, (n. sp.,) occur among the material from St. Andrews. The surface of one of them was ground away, so as to exhibit fairly distinct tangential and vertical sections. As near as these permit me to determine, the specimens differ from the types of *M. Wetherbyi* (derived from the Birdseye limestone of central Kentucky) only in having the acanthopores somewhat less strongly developed. In other respects there seems to be perfect agreement.

St. Andrews, Manitoba, Dr. R. Bell, 1880.

HOMOTRYPA, Sp.

Four or five fragments of a smooth species of this prolific genus are contained in the Manitoba material before me. They are unquestionably identical with an undescribed form not unfrequently met with in the upper beds of the Hudson River or Cincinnati group at various localities in Ohio, Indiana and Illinois. Being closely related to other species, some of them also undescribed, I prefer to leave it unnamed until an opportunity is offered of describing its internal characters. Without good figures it might not be recognized, a remark which is peculiarly applicable to species of *Homotrypa*.

The Manitoba specimens were collected by Mr. A. McCharles at Stony Mountain, in 1884.

DIPLOTRYPA WESTONI. (N. Sp.)

Plate VIII, figs. 4-4b.

Of this peculiar species the specimen figured is the only one seen. It afforded the following characters: Zoarium a sub-hemispherical mass, about thirty-four mm. in diameter and twenty mm. high, with the lower side concave, and probably lined with an epitheca. The upper

surface, though not well preserved, presents no indications of having been monticuliferous, but small "maculæ" or aggregations of mesopores were probably present. Zoëcia comparatively large, prismatic, with thin walls and polygonal apertures; twelve or thirteen of those of the average size in five mm. At intervals there are groups of larger size, many of them with a diameter of half a millimetre or more. These again usually enclose small and irregular clusters of mesopores, which vary greatly in size, some being quite as large as an average zoëcium. Their number in a given space is usually about equal to that of the zoëcia and, in this specimen, at any rate, are always distinguishable from them by being closed.

Vertical sections show an interesting though not unique feature, a similar peculiarity being characteristic of *Callopora* and one which has been noticed in certain species of *Monticulipora*, namely, that the proximal end of the tubes is, apparently always, crossed by numerous diaphragms whose development ceases suddenly, when the tube or cell may be said to assume the character of a true zoëcium. In the closely tabulated condition it must (as it appears to me) have existed as a "mesopore." The mesopore stage may have been relinquished at almost any height in the zoarium, yet it appears to have occurred simultaneously in nearly all the tubes, the sections showing rather sharply marked zones, the tubes in one being of nearly equal size and with few or no diaphragms, and in the next very unequal and mostly full of diaphragms. These zones are distinguishable even in fractures of the zoarium, the walls in the first being nearly smooth, while in the latter or closely tabulated region they are more or less wavy. In the specimen under consideration six alternating zones may be seen. Diaphragms and mesopores are abundant in the second, fourth and sixth, and few in the first, third and fifth. From this it follows that they represent respectively, what in my "American Palæozoic Bryozoa" is termed the "mature" and "immature" regions. This division of the zoarium into distinguishable zones is probably the most characteristic feature of the *Trepostomata*.

The only tangential section prepared exhibits the characters of the zoarium in its mature condition. Here the mesopores are distinguished from the zoëcia by being smaller, more irregular and of a darker hue than the zoëcia. Acanthopores seem entirely absent.

This species is more nearly related to the European *D. petropolitana*, Pander, than is any other form known to me from American deposits. They differ somewhat in the tabulation of the tubes.

Big Island, Lake Winnipeg, Mr. T. C. Weston, after whom the species is named.

The genus *Diplotrypa*, as now understood, embraces at least three

small but well marked groups of species, each indicating relations to widely different families. The first or typical section, including, apparently, only *D. petropolitana*, *D. Westoni*, and one or two undescribed species, is characterized by comparatively large zoecia, more or less wavy walls, and a resemblance to true species of *Monotrypa* (e.g. *M. undulata*, Nicholson and *M. subglobosa*, Ulrich) that, in my opinion, amounts to real affinity. *Monotrypa* itself comprises two very different sections, such species as *M. filiosa*, d'Orbigny, *M. petasiformis*, Nicholson, *M. irregularis*, Ulrich, and *M. monticula*, White, being true *Amplexoporidae*, with very close relations to *Leptotrypa*, while the typical section of the genus presents no very great affinity with any of the families proposed by me.

Batostoma, a genus that has given me no little trouble to place, I am now convinced, is, (especially in its aberrant members, of which several are known to me) more intimately related to the typical sections of both *Diplotrypa* and *Monotrypa* than any of the others. The obvious relationship between these three groups strongly suggests the erection of a new family, which may be known as the *Diplotrypidae*, the genus *Diplotrypa* being selected as the type. By establishing this family, three troublesome genera are satisfactorily placed, and the families comprised in the amended classification of the *Trepostomata* proposed in my forthcoming work on Illinois bryozoa assume a degree of definition and compactness which they would not possess otherwise. With this happy result comes another less fortunate, a reconstruction of *Diplotrypa* and *Monotrypa* being necessitated thereby. Thus, the second section of *Diplotrypa*, comprising *D. regularis*, Foord, *D. infida*, Ulrich, *D. patella*, Ulrich, (Rept. Ill. Geol. Sur., vol. VIII.) and, perhaps, *D. Whiteavesi*, Nicholson, approaches very near to *Prasopora*, and ought to go with the *Monticuliporidae*. That disposition, however, would necessitate the adoption of one of two courses,—either a new genus would have to be established for their reception, or the species would have to be placed under *Prasopora*,—neither of which I am prepared to adopt. More study and very detailed comparisons are required before I shall consider myself justified in proposing a final arrangement. In the meantime it is best to leave these species with *Diplotrypa*. *D. Milleri*, Ulrich, a Niagara species with a decided leaning toward the *Calloporidae*, should likewise remain in its original association, while the same course may be pursued, provisionally, with the species at present referred to *Monotrypa*.

BATOSTOMA MANITOBENSE. (N. Sp.)

Plate 9, figs. 3-3c.

Zoarium irregularly ramose, branching at unequal intervals, diameter of branches varying between six and twelve mm. Surface nearly even, but exhibiting at intervals of about five mm. more or less conspicuous clusters of large cells. Zoecia with broad-oval or sub-polygonal apertures, averaging three-tenths of a millimetre in diameter; those in the clusters attaining a diameter of half a millimetre. Over the spaces between the clusters the apertures of the zoecia are ranged in moderately regular series, with about thirteen in five mm. When in a good state of preservation these apertures are surrounded by an exceedingly thin peristome, upon which an occasional very small acanthopore may be detected. The interspaces in this condition are slightly depressed with the mouths of the mesopores closed. As usual in species of this genus the number of mesopores varies greatly in different specimens. When they are the most abundant, then the apertures of the zoecia are also the most rounded. When, on the other hand, the latter are more nearly polygonal, the mesopores are correspondingly few, and care must often be exercised or they may be overlooked.

In tangential sections, the minute structure appears to conform in every respect with the requirements of the genus, save that the acanthopores are unusually small. Just beneath the surface the mesopores are often nearly filled by deposits of sclerenchyma on the outer side of the zoecial walls. In the average section, however, the ring-like walls of the zoecia are rather thin, though much thicker than the partitions between contiguous mesopores. In some sections the acanthopores are very few, in others, one or two to each zoecium.

Vertical sections show that in the axial region diaphragms are only developed at remote intervals, or they may be absent entirely, and that the tube walls are very thin, and often a little wavy. The tubes bend outward from the beginning and gradually become direct to the surface. As they approach the surface their walls become much thicker, and a greater or less number of mesopores and four or five or more diaphragms are developed. The latter are mostly less than a half tube diameter apart. In the mesopores six or seven diaphragms occur in a space equal to three-tenths of a millimetre.

Compared with other species, *B. Manitobense* is separated by the greater average number of mesopores, rounded apertures of the zoecia, and the unusually inconspicuous acanthopores. *B. Jamesi* and *B. impliatum* (both Nicholson, sp.) have thicker walls and much larger and

more numerous acanthopores. *B. irrasum*, Ulrich, from the Trenton shales of Minnesota, has larger acanthopores and usually fewer mesopores, and *B. fertile*, Ulrich, from the same locality and position, less ring-like and more polygonal zoëcia walls. All of these species differ also more or less in their vertical sections. *B. Girvanense*, Nicholson (sp.), appears to agree more closely than any of the others. It also has very small acanthopores, but they are more abundant. In comparing vertical sections *B. Manitobense* will be seen to differ in having much less numerous diaphragms in the axial region. It may be noted also that some examples (those having subpolygonal zoëcia) resemble *B. variable*, Ulrich, while the surface of the typical form is much like that of certain species of *Trematopora* (e. g. *T. Halli*, Ulrich, and *T. calloporoidea*, Ulrich).

Several small examples are referred here provisionally. These fragments are only three or four mm. in diameter, but no conspicuous differences were noticed in thin sections.

Stony Mountain, Manitoba, Messrs. T. C. Weston and A. McCharles, 1884.

PETIGOPORA, Ulrich, 1882.

This genus includes small parasitic bryozoa, in which mesopores are absent but acanthopores are well developed. The zoëcia are polygonal, diaphragms are very few or absent; and the outer margin of the zoarium is usually formed by a narrow non-celluliferous band. That the affinities of the various species referred here are with *Dekayia* will, I think, scarcely admit of doubt. They might even be disposed of by regarding them as parasitic species of that genus. Still, as *Petigopora* complies with the real purpose of classification in being a convenient designation of a natural group of species, the name should be preserved. The group holds the same relation to *Dekayia* as *Leptotrypa* to *Amplexopora*, *Monotrypa* (pars) to *Monotrypella*, and *Heteroporella* to *Heteropora*. All these groups are not only convenient in classification but natural as well.

PETIGOPORA SCABIOSA. (N. Sp.)

(Not figured.)

Zoarium parasitic, forming subcircular or irregular crusts upon shells and other foreign bodies. Crusts small, slightly convex, thin and in

the three specimens seen, vary in diameter from two and a half to eight mm. Surface even (*i.e.* without monticules), but in the largest example exhibiting clusters of cells of larger size than the average. Zoecia polygonal, thin-walled, with about eight of those of the ordinary size in two mm. Acanthopores of moderate size, being smaller than those of *P. asperula*, Ulrich, and *P. petechialis*, Nicholson, and a little larger than those of *P. gregaria*, Ulrich. Most of the angles of junction between the zoecia are occupied by them. Mesopores absent.

The result of my preliminary examination of these specimens was to refer them to *P. asperula*, but a careful comparison with the types of that form proves that they really belong to a distinct species. Indeed, *P. gregaria* seems to be still more nearly related to *P. scabiosa*, differing therefrom mainly in its flat or concave upper surface and slightly elevated marginal band. *P. asperula* has smaller zoecia (eleven in two millimetres), a monticulated surface, and stronger acanthopores.

Stony Mountain, Manitoba, Dr. R. W. Ells, 1875, and Mr. T. C. Weston, 1884.

BATOSTOMELLA GRACILIS, Nicholson.

Chætetes gracilis, Nicholson, 1874, Quart. Journ. Geol. Soc. vol. 30, p. 504, pl. 29, figs. 7-7a.

“ “ “ 1875, Pal. Ohio, vol. 2, p. 198, pl. 21, figs. 8-8b.

“ “ “ 1876, Ann. and Mag. Nat. Hist., Ser. 4, vol. 28, p. 90, pl. 5, fig. 13.

Monticulipora (Heterotrypa) gracilis, Nicholson, 1881, genus *Monticulipora*, p. 125, fig. 20, and pl. 2, figs. 1-1b.

The typical form of this species is common at the tops of the hills about Cincinnati, Ohio, where it is restricted to a vertical range of about fifty feet. Nearly 300 feet higher in the series a slightly modified form reappears, differing from the typical one mainly in having the zoecial walls somewhat thicker than usual. This variety, if it may be so called, has been found at Oxford, Ohio; Richmond, Ind.; Wilmington, Ill., and Spring Valley, Minn., and at all of these localities it occurs near the top of the Hudson River or Cincinnati group. Its geographical range is now extended to Manitoba, as I have recognized several fragments of it among the material collected at Stony Mountain, by Mr. T. C. Weston in 1884.

BYTHOPORA ? DELICATULA, Nicholson.

- Chaetetes delicatula*, Nicholson, 1875, Pal. Ohio, vol. 2, p. 199, pl. 21, figs. 9-9a.
 " " Whiteaves, 1880, Geol. Sur. Can., Rep. Progr., 1878-79.

A single specimen of this species is attached to a slab collected at Stony Mountain in 1875, by Dr. R. W. Ells. The species is a common one in the upper beds of the Hudson River or Cincinnati group in Ohio and Indiana.

BYTHOPOBA STRIATA. (N. Sp.)

(Not figured.)

This name is proposed for a species represented in the Manitoba collections and sometimes found associated with *B. delicatula*, Nicholson, at Middletown and other localities in Ohio, where the upper beds of the Hudson River group are exposed. The branches of its ramose zoarium are usually more slender than those of that species, being rarely more than one millimetre in diameter. They also bifurcate at shorter intervals, the length of the latter varying between two and four mm. The apertures of the zoecia too, are more oblique and drawn out anteriorly, and are arranged between somewhat irregular rounded longitudinal ridges, with five or six in a space two mm. long. Ten to fourteen of the ridges suffice to encircle a branch. These ridges are strongest near the base of the zoarium, gradually fading away toward the growing extremities of the stems.

In *B. fruticosa*, Miller and Dyer, *B. arctipora*, Nicholson (species) *B. delicatula*, Nicholson, and other species known to me, an arrangement of the apertures of the zoecia in diagonally intersecting series prevails, while in *B. striata*, near its base at any rate, the longitudinal arrangement is the most conspicuous.

The Manitoba specimen was collected by Dr. R. W. Ells at Stony Mountain in 1875.

MONOTRYPELLA QUADRATA, Rominger.

- Chaetetes quadrata*, Rominger, 1866, Proc., Phila., Acad. Nat. Sci., p. 116.
 " *rhombicus*, Nicholson, 1874, Quart. Journ. Geol. Soc., vol. 30, p. 507, pl. 29, figs. 11-11b.
 " " " 1875, Pal. Ohio, vol. 2, p. 201, pl. 21, figs. 12-12a.
 " " " 1876, Ann. and Mag. Nat. Hist., Ser. 4, vol. 18, p. 86, pl. 5, figs. 1-1b.

- Monticulipora rectangularis*, Whitfield, 1878, Annual Rep't. Wis. Geol. Sur., p. 70.
 " " " 1882, Geol. Surv. Wis., vol. 4, p. 294, pl. 44, figs. 11-12.
 " (*Monotrypa*) *quadrata*, Nicholson, 1881, genus *Monticulipora*, p. 179, fig. 36.

The collection contains several fragments of this highly characteristic and persistent species. It is not only an easily recognized form, but it is also to be found more or less abundantly wherever its proper horizon (the upper beds of the Hudson River or Cincinnati group) is exposed, making it an excellent guide in stratigraphical correlations.

The principal characters of the species are the thin walls and quadrate rhomboidal or hexagonal form of the zoecia. In transverse sections of a branch the tubes are *always* largely four-sided.

The Manitoba specimens were collected by Mr. T. C. Weston at Stony Mountain in 1884.

FISTULIPORA ? LAXATA. (N. Sp.)

Pl. VIII., figs. 2, and 2a.

Zoarium massive, probably of hemispheric shape with the under side concave and covered with a wrinkled epitheca. The only specimen seen is a broken mass sixty mm. thick and about 120 mm. wide. From its shape I should judge its complete diameter to have been not less than 170 mm. The surface is too much weathered and obscured by adhering rock to show the minute superficial characters. Good thin sections, however, bring out the more important internal structure in a very satisfactory manner.

Transverse sections exhibit the usual characters of species of *Fistulipora*, only there is an unusual irregularity and *looseness* in the arrangement and size of both the zoecia and interstitial vesicles. The zoecia are irregularly ovate in cross-section and have thin walls. The lunarium, though never a very marked feature, is always determinable by the semi-circular shape of one-half of the circumference of the zoecium, the other half being, if not angular, at any rate always drawn to a circle of greater diameter than is the usually smaller and always more regularly curved lunarial side. A zoecium of the average size measures about four-tenths of a millimetre in length by three-tenths of a millimetre in width; eight to ten occur in a distance of five mm. The vesicles vary greatly in size and distribution, some being very small and others as large and even larger than the zoecia, and scarcely distinguishable from them. They form, generally, but a

single series between the zoecia, yet it is not uncommon to notice a double row for a short distance. An obscure radial arrangement is noticeable about certain points where the interstitial vesicles are more numerous than elsewhere, without, however, at any time, being in sufficient numbers to justify being called "maculæ." These are six mm or more apart.

Vertical sections are, perhaps, even more characteristic since in these the *loose construction* already mentioned is very striking. In these the zoecia appear as long irregular tubes crossed at variable intervals (generally of one millimetre) by very delicate horizontal diaphragms; the vesicles assume all sorts of shapes, but are always remarkably high, and the walls between both the vesicles and the zoecia have that peculiar granular structure noticed, in palæozoic bryozoa, only among the *Ceramoporidæ* and *Fistuliporidæ*.* The section also presents some evidence of minute connecting foramina in the walls between the zoecia and vesicles.

In *F. laxata* I see what may be called the beginning of the *Fistuliporidæ*. As I have elsewhere stated, it is my belief that the *Fistuliporidæ* and *Ceramoporidæ* had a common origin, and in this species we see much to remind us of the latter group of bryozoa. Tangential sections of it are not much unlike those of certain species of *Ceramoporella*, but the long tubes shown in vertical sections and the, though rude, vesicular character of the interstitial spaces are important differences. As a rule the zoecial tubes are short in the *Ceramoporidæ*, still in *Chiloporella*, *Anolotichia* and certain forms of *Crepipora*, they are long enough to bear comparison with *F. laxata*. It is with these, probably, that this prototype finds its nearest relatives, but *Ceramoporella* (despite the differences mentioned) may prove a closer ally.†

Since the above was written, I have had occasion to look over some of my unworked Minnesota bryozoa. Among the material I found several examples of a species differing in no respect from the Manitoba specimen described, save that the zoaria do not exceed seventy mm. in diameter and twenty mm. in height. These specimens enable me to add that the lunarium forms a prominent "lip" at the surface, and that here the vesicles are usually open—a feature probably due to attrition, since they are closed (*i.e.* the interstitial spaces appear solid) over the best preserved portions of one of the examples.

* The "granular" structure of the walls in species of *Monticulipora* is different.

† A new genus ought, perhaps, to be established to include *F. ? laxata* and one or two species known to me. Of the latter, one (a common form in the upper beds of the Hudson River or Cincinnati group at Wilmington, Ill.) is described provisionally as *Crepipora ? epidermata* in my report on Bryozoa for vol. viii.; Ill. Geol. Surv. Repts., now in press. I prefer, however, to await the completion of my studies in this large and difficult group before proposing the genus.

St. Andrews, Manitoba, where the type specimen was collected by Dr. R. Bell in 1880. The Minnesota examples are from the Trenton shales at Minneapolis, Minn.

STICTOPORA or RHINIDICTYA, sp. indt.

A fragment of a species of this genus occurs among the material collected by Mr. T. C. Weston at Stony Mountain in 1887. It is clearly identical with the species found near the top of the Hudson River or Cincinnati group at several localities in Ohio. The specific relation of these specimens is as yet doubtful. Careful comparisons with *S. Nicholsoni*, Ulrich, a common species from the Birdseye limestone of Kentucky and elsewhere, and *S. mutabilis*, Ulrich, from the Trenton shales of Minnesota, and with another form (*Ptilodictya parallela*, James,) occurring rather rarely in the Utica horizon or lower beds of the Hudson River group, being necessary before they can be disposed of in a final manner. These species are all closely related to each other and to *S. fenestrata*, Hall, the type of *Stictopora*, as reworked by me in the 14th Ann. Rep. Geol. Surv. Minn., 1886,* as well, and it is not possible in the present state of our knowledge to say what changes would result from a monographical study of the genus. In fact, the whole of the palæozoic bifoliate Bryozoa are sadly in need of revision. It is therefore deemed advisable to refer to the species in question as above.

That the form may be recognized by others, it is well to mention that the general aspect of the surface agrees very closely with that of *S. Nicholsoni* (*Rhinidictya Nicholsoni*, Ulrich), Jour. Cin. Soc. Nat. Hist., Vol. V., page 170, pl. 8, figs. 6-6b. The branches are 2.0 to 2.5 mm. wide, having nearly parallel margins, fourteen to eighteen rows of zoecia, with thirteen in five mm. measuring longitudinally.

* Since the publication of Vol. VI. Pal. N. Y., 1887, in which Prof. Hall gives *S. elegantula* as the type of his genus, I have begun to realize that the claims of *S. fenestrata* to that distinction are not likely to meet with general approval. In that case, *Rhinidictya* might stand. The only objection to reinstating that generic name arises from the fact that in 1848, d'Orbigny proposed *Sulcopora* for *Stritopora fenestrata*, which species is most probably congeneric with *Rhinidictya Nicholsoni*. However, I for one, am not inclined to accept *Sulcopora*, nor *Subretepora* and *Ennalopora*, all founded by the same author upon nothing more than Hall's original figures and descriptions in Vol. I. Pal. N. Y. d'Orbigny's descriptions of these genera are not only vague and inadequate, but the very points mentioned by him are either not peculiar to the genera he sought to establish, or they actually do not exist in the original of the figures upon which he relied. Moreover, none of these generic names have been recognized by subsequent workers in the field, and I fail entirely to see what good could result from bringing them forward now after lying dormant for so many years. It would only add confusion to already complicated questions of synonymy.

DICRANOPORA FRAGILIS, Billings.

- Ptilodictya fragilis*, Billings. 1886. Catal. Sil. Fos. Antic., p. 9.
Stictopora fragilis, Whitfield. 1882. Geol. Surv. Wisc., vol. 4, p. 253, pl. 11,
 fig. 24.

This species, though never common, is to be found at many localities where the upper beds of the Hudson River or Cincinnati group (or their equivalents) are exposed. Several segments, more or less complete, were noticed on the slabs from Stony Mountain. The species may be recognized by the oblique direction of the two or three marginal rows of cells. The segments vary from six to ten mm. in length and 1.5 to 2.0 mm. in width, and have the upper or broadest extremity divided dichotomously. The branchlets are short and, when in a good state of preservation, have their extremities slightly thickened and solidified for articulation with the succeeding segment. The lower end of each segment is often obtusely pointed. There are eight to twelve rows of zoecia on each face, of which the four or five central ones are arranged between low longitudinal ridges. On old examples, these ridges are finely granulose.

Collected by Mr. T. C. Weston in 1884.

DICRANOPORA EMACERATA, Nicholson.

- Ptilodictya emacerata*, Nicholson, 1875, Ann. and Mag. Nat. Hist., sec. 4, vol. 15
 p. 179, pl. 14, fig. 3-3b.
 " " " " Pal., Ohio, vol. 2, p. 261, pl. 25, fig. 5-5b.

This species, represented in the Manitoba collection by a single imperfect segment, differs from *D. fragilis* in its smaller size, there being only from four to six rows of cells. The usual number is five, with one on each side oblique and the central rows longitudinal. The segments are also only about four mm. long and one millimetre or less wide. In other respects the species agree very closely.

The specimen is attached to a slab collected in 1884 by Mr. T. C. Weston at Stony Mountain.

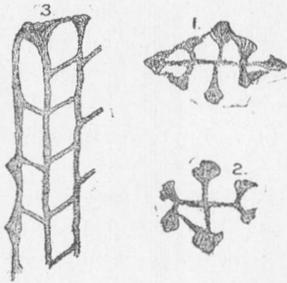
GONIOTRYPA, n. gen. (provisional).

Zoarium jointed; segments small, bifoliate, each face with a strongly elevated central ridge, imparting a lozenge-shape to the segments in cross-sections. Zoecia ranged in longitudinal rows on each side of the median ridge, their apertures oval, and directed more or less obliquely outward.

This genus is proposed, provisionally, for the reception of the peculiar species next described. The genus has very close affinities with *Dicranopora*, and stands in precisely the same relation to that genus as does *Taniopora*, Nicholson, to *Cystodictya*, Ulrich.

GONIOTRYPA BILATERALIS. (N. Sp.)

Plate IX., fig. 1.



1. Transverse section of a segment of *Goniotrypa bilateralis*, dividing it at a point about midway of its length. 2. Transverse section of the lower end of another segment in which, instead of non-celluliferous margins, there is a row of zoecia on each side. 3. Tangential section of the upper half of a segment, showing the form of the primitive portion of the zoecia, and the somewhat pinnate arrangement of the parts with respect to the median keel.

Segments simple, about one millimetre wide and four to six mm. long; lower extremity obtusely pointed; the upper truncate. Median ridges strongly elevated, delicate and sharp in young examples, rounded and somewhat granulo-striate in old specimens; zoecia usually in four rows on each face with two on each side of the median ridges. A third row is occasionally developed along the sharp non-celluliferous margins. Apertures ovate, those of the cells in the outer row usually much larger than those of the inner. Frequently they are also separated by wider interspaces. Normally, however, the number in a given space should be nearly equal in the outer and inner rows. In the latter there are fourteen in four mm. Interspaces obscurely striated. A faint peristome generally surrounds the apertures of the zoecia. The strong central ridges give the segments of this species such a distinct appearance that they are not likely to be confounded with the associated species of *Dicranopora*.

Stony Mountain, Manitoba, Dr. R. W. Ells, 1875, and Mr. T. C. Weston, 1884.

PACHYDICTYA HEXAGONALIS. (N. Sp.)

Plate IX., figs. 2-2c.

Zoarium, a bifoliate expansion of unknown dimensions. The fragment illustrated is two mm. thick. Surface nearly even. Apertures of the zoœcia mostly hexagonal, often quadrate or polygonal; arranged in rather irregular diagonally intersecting series, thirteen in five mm. At intervals of five mm. clusters of cells of slightly larger size than the average are formed. These are made more conspicuous by the thickening of the interspaces. The cells forming these clusters vary considerably in size, the largest being one-third larger than those of the ordinary size, while others are smaller than they. The interspaces are rounded and slope down into the apertures of the zoœcia, there being no sign of a peristome.

A vertical section shows that near the median laminae the zoœcia are separated by exceedingly thin walls, that the vesicles are first developed after the tubes begin to bend outward (*i. e.* above the primary cell), that the vesicles thus cut impart an obscurely beaded character to the middle third of the height of an interstice, and that in the outer regions the vesicles are filled with solid tissue, in which exceedingly minute dots are closely ranged into vertical series, causing the tissue to appear vertically lined. The zoœcial tubes are crossed by from three to six unequally distributed diaphragms. The whole section has an unusually irregular aspect.

From a tangential section we learn that the primary cell, or that portion of the zoœcial tube which rests upon the median lamina, has very thin walls, is of oblong-quadrate shape, that its outline soon changes to lozenge-shape and then becomes elongate sub-hexagonal, with the anterior half rounded and the posterior half with the two sides and end slightly concave. Soon the posterior end is cut away and a vesicle formed, the opening now being of sub-circular form. After this the interspaces become thicker gradually, and at last solid with numerous minute dark spots. This I consider to have been the normal development of the zoarium, and all the stages described may be traced in a single judiciously prepared section. Such a section must cut the zoarium a little obliquely, so as to show its structure at various depths from the surface.

The development of the zoœcia, as above described, is very much as in certain species of *Ptilodictya* (*e. g.* *P. magnifica*, Miller and Dyer), but in that genus the interstitial spaces are always solid, and vertical sections could in no case be confounded with similar sections of *Pachydictya*.

P. hexagonalis differs from all the species of the genus in the superficial characters of the zoœcia, the sub-angular apertures and rounded interstices bringing to mind some of the monticuliporoids, or perhaps more still, such species of *Ptilodictya* as *P. pavonia*, d'Orbigny. *Pachydictya splendens*, Ulrich (Rept. Ill. Geol. Sur., vol. 8) from an equivalent horizon in Illinois I regard as a closely related species, differing mainly in having the apertures of the zoœcia arranged between fine longitudinal lines.

Stony Mountain, Manitoba, T. C. Weston, 1884.

PACHYDICTYA MAGNIPORA. (N. Sp.)

(Not figured.)

This species is founded upon a single example collected by Dr. R. Bell, in 1880, at St. Andrews, Manitoba, together with *Pachydictya acuta*, Hall, *Phylloporina Trentonensis*, Nicholson, sp., and *Monticulipora Wetherbyi*, Ulrich.

At first I thought it might be the same as the *P. Everetti*, Ulrich, (Ill. Geol. Sur. Rep't., vol. 8), but on comparing it with the types of that species it proved to have much larger zoœcia. The cells are, in fact, larger than in any other species of the genus known to me. *P. foliata*, Ulrich, from the Trenton shales of Minnesota, is probably its nearest congener. The following brief diagnosis will suffice for the recognition of the species:

Zoarium, a thin, slightly undulating, bifoliate expansion, attaining dimensions of probably forty or fifty mm. wide and as much or more high. At intervals of about five mm. the surface exhibits seemingly solid smooth spots or maculæ. Apertures of the zoœcia, oval, large, 0.64 mm. long, by 0.4 mm. wide, arranged in regular longitudinal and diagonally intersecting series, with seven or eight in five mm. longitudinally, and ten in the same space diagonally. This arrangement is not much disturbed by the maculæ. Many of the apertures are closed by a thin calcareous cover, in which I can detect, occasionally, a small central perforation. Interspaces flat or faintly concave, narrow, usually not more than one-third as wide as the apertures of the zoœcia. Internally the interspaces and maculæ are occupied by shallow vesicles. Median laminæ finely striated longitudinally and obscurely wrinkled transversely. The longitudinal striæ are very equal and represent the "median tubuli," which constitute such a characteristic feature of the *Stictoporidæ*.

PACHYDICTYA ACUTA, Hall.

Stictopora ? *acuta*, Hall, 1847, Pal. N.Y., vol. 1, p. 74, pl. 26, fig. 3a-3b.

Stictopora acuta, Ulrich, 1882, Jour. Cin. Soc. Nat. Hist., vol. 5, p. 168, pl. 8, fig. 1-1b.

Pachydictya acuta, Ulrich, 1886, 14th Ann. Rept. Minn. St. Geol, p. 67.

A fragment of this widely distributed species was collected by Dr. R. Bell, in 1880, from a cream coloured or buff limestone of the Trenton group at St. Andrews, Manitoba.

PTILODICTYA WHITEAVESI. (N. Sp.)

Pl. VIII., figs. 1-1e.

Zoarium consisting of a single unbranched, two-edged bifoliate frond, which is either a little curved or straight, and expands upward from the finely striated articulating "head." The central region of the frond is raised into a low broad ridge, and upon this the apertures of the zoecia are ranged into seven or more moderately regular longitudinal series between more or less distinctly elevated longitudinal lines. Young examples, like that represented by fig. 1e, have, with the exception of an oblique series along the sharp non-celluliferous border, only longitudinally arranged zoecia. Fig. 1d represents an older specimen in which the frond has begun to widen, and fig. 1 is a restored representation of a fully matured example. At this stage of growth the surfaces on each side of the median ridge are slightly concave or flat, and upon them the apertures of the zoecia are much less regularly arranged, these latter being also mostly of hexagonal shape. Somewhat irregularly distributed clusters of large cells constitute a marked superficial feature of these lateral areas. The largest cells in these clusters are 0.35 mm. in diameter, while the average diameter of the cells occupying the intermediate spaces is about 0.2 mm., there being about twelve of the latter in three mm. The zoecia on the median ridges have oval apertures situated at the bottom of sloping areas of subquadrate outline; there between nine and ten occur in three mm. longitudinally, and nearly five of the rows in one millimetre transversely.

The internal characters, as brought out by tangential and vertical sections, are very well represented in figs. 1b and 1c. The vertical section shows that the superior hemiseptum is well developed and recurs at successive stages in the growth of the zoarium. A complete diaphragm also occasionally intersects the tubes near their mouths.

It gives me pleasure to associate with this species the name of Mr. J. F. Whiteaves, the palæontologist and zoologist to the Canadian Survey, to whom I am indebted for many favors.

Stony Mountain, Manitoba, Messrs. T. C. Weston and A. McCharles, 1884.

The position of *P. Whiteavesi* is, like that of *P. magnifica*, Miller and Dyer, intermediate between *P. maculata*, Ulrich, and *P. pavonia*, D'Orbigny, and such species of the more typical section of the genus, as *P. variabilis** and *P. plumaria*, James. The longitudinal arrangement of the zoecia on the elevated median portion of the frond distinguishes it from the former species, while it agrees with them and differs from the latter group in having clusters of large cells, and in the circumstance that the apertures of the zoecia are usually arranged in an intersecting manner over the lateral portions of the zoarium. Among species having hexagonal or rhomboidal zoecia, *P. magnifica* forms a broad expansion, the surface of which is elevated at rhythmical intervals into small conical monticules, the apices of which are generally solid. Similar monticules are present on *P. plumaria* and on old examples of *P. variabilis*. In all three of these closely related species the zoecia are also a little smaller than those of *P. Whiteavesi*.

ARTHROCLEMA ANGULARE, Ulrich.

Arthroclema angulare, Ulrich, Rept. Ill. Geol. Sur., vol. 8, pl. 29, figs. 6-6b (in press.)

Several segments, agreeing closely with the Illinois types of this species, were noticed on slabs from Stony Mountain, collected by Dr. R. W. Ells in 1875 and by Mr. Weston, in 1884.

HELOPORA HARRISI, James.

Helopora harrisi, James, 1883, The Palæontologist, No. 7, p. 59, pl. 2, figs. 2-2b.

Associated with *Sceptropora facula* and *Arthroclema angulare*, I find a number of very slender segments of a jointed zoarium which, though not in a very good state of preservation, may still be referred to this species with much confidence. They are much more delicate than those of *Arthroclema angulare*, being about four mm. long and 0.25 mm. in diameter, with five or six rows of narrow elliptical zoecia apertures. The species cannot be recognized from Mr. James' figures, but full

* This name is proposed instead of *P. nodosa*, James, figured in my "American Palæozoic Bryozoa," (Jour. Cin. Soc. Nat. Hist., vol. 5, [pl. 7, fig. 2], the specific name having been preoccupied by Hall in 1847 (*Escharepora nodosa*). The specimen figured by me is an old one, young examples being much more slender, and often entirely without monticules.

illustrations will be found on plate 3 of my forthcoming report on Minnesota Bryozoa (Vol. III. Final Rep't. Geol. and Nat. Hist. Sur. of Minn.).

SCEPTROPORA, Ulrich.

Sceptropora, Ulrich, American Geologist, April, 1888, vol. 1, No. 4, p. 228.

This genus being founded upon specimens from Manitoba, I have thought it well to republish the descriptions given in the "American Geologist."

"Zoarium articulated; segments numerous, short, sceptre or club-shaped, the lower half striated, non-celluliferous, its extremity bulbous; upper half more or less expanded, celluliferous, and with a large socket at the centre of the top; occasionally with two sockets when the segment had articulated with two succeeding joints. Zoëcia sub-tubular, radially arranged about a central axis, their apertures subovate, and arranged between vertical lines."*

SCEPTROPORA FACULA, Ulrich.

Sceptropora facula, Ulrich, American Geologist, April, 1888, vol. 1, No. 4, p. 229.

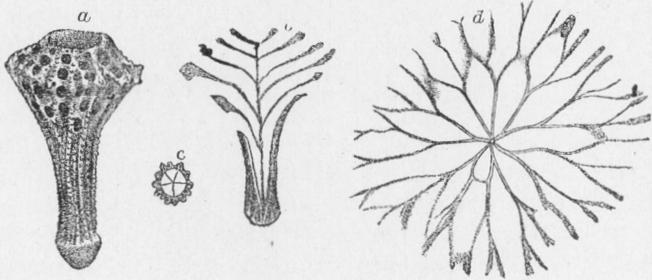


Fig. 2. *Sceptropora facula*, Ulrich, *a*, segment of the average size and appearance; *b*, vertical section of a segment, showing the tubular zoëcia and central axis; *c*, transverse section of the cylindrical lower half of a segment; *d*, transverse section of expanded portion of the largest segment seen. All magnified to eighteen diameters.

*In looking over some of my collections from the Clinton at Hamilton, Ont., I was so fortunate as to find a number of segments of what will probably prove another species of this genus. They have a similar striated base, above which they expand rapidly into the shape of a short thick club. The top is rounded and, like the sides, covered with cell apertures. On young examples, some of which are comparatively slender, the apertures of the zoëcia are ranged in longitudinal series between granulose raised lines. As the diameter of the segments increases, these lines assume a zig-zag direction and new rows of zoëcia are interpolated, each placed so as to alternate with the old cells. The apertures are slightly oblique, of rounded form (sometimes nearly circular), and larger than those of the associated *Helopora fragilis*, Hall; there are three in one millimetre longitudinally. The segments vary in length from less than two mm. to more than four mm., and the diameter of the upper half from 0.5 to 1.8 mm. As this is an easily recognized and quite distinct species, I propose to call it, provisionally, *Sceptropora fustiformis*.

“Segments club-shaped, varying in length from less than one millimetre to nearly two mm.; lower half sub-cylindrical, about 0.23 mm. in diameter, non-celluliferous, covered with fine, granulose, vertical striæ; lower extremity bulbous, smooth; upper half celluliferous, expanding more or less rapidly, the depressed conical top varying in diameter from 0.7 to two mm. The apertures of the zoecia on the top are sub-circular; about 0.09 mm. in diameter and arranged in radial series between raised lines about the large central socket. As the zoarium expands the series increase in number by interpolation. The apertures of the zoecia on the sides are ovate and a little larger, having an average length of 0.11 mm. Like those on the top, they are arranged between elevated granulose ridges.”

Detached segments of this very pretty little bryozoan are abundantly strewn over the surface of some of the slabs from Stony Mountain, Manitoba, and I do not doubt that if searched for, specimens preserving a number of them joined together would be found there. Such must be looked for in shaly layers only. Among the specimens from Savannah, Ill., there is one consisting of two segments still joined together. Those from Wilmington, Ill., consist of isolated segments. Here they are neither abundant nor easily detected, being readily overlooked because of their small size and the peculiar character of the rock.

NEMATOPORA (?) (N. Sp.)*

A fragment of what appears to be an undescribed species of this genus adheres to a small slab collected at Stony Mountain by Mr. T. C. Weston in 1884. It is five-sided and distinguished from all the species known to me in having the thin raised line bordering the two sides of the narrowly elliptical apertures of the zoecia continuous from aperture to aperture. In the space between the ends of the mouths of the zoecia these lines approach each other but do not unite, a narrow channel being left. I wish to see more specimens before proposing a specific name.

PHYLLOPORINA TRENTONENSIS, Nicholson.

Retepora Trentonensis, Nicholson. 1875. Pal. of the Province of Ontario, p. 15, pl. 2, figs. 4-4b.

“ “ Whiteaves. 1881, Geol. and Nat. Hist. Sur. Can., Rep. Prog. 1879-80, p. 58 c.

Phylloporina trentonensis, Ulrich. Rep'ts. Ill. Geol. Sur., vol. 8, pl. 53, fig. 1-1c.

*This genus is proposed in vol. 8 of the Report of the Illinois Geological Survey (in press) for species of the type of *Helopora lineata*, Billings.

A good specimen of this species was found by Dr. R. Bell, at St. Andrews, Manitoba, in 1880, and its occurrence at this locality has been recorded by Mr. Whiteaves. It adheres to a fragment of white and buff mottled limestone, supposed to be from the same bed that furnished *Pachydictya magnipora*, *P. acuta*, *Fistulipora* (?) *laxata*, and *Monticulipora, Wetherbyi*. This bed would, I believe, yield handsome specimens of not only these but of many other bryozoa.

OSTRACODA.

The Ostracoda which form the subject of these notes were all, save one species, discovered on slabs of highly fossiliferous limestone, from Stony Mountain, Manitoba, in searching them for remains of bryozoa. They are, unfortunately, not in very good condition, nor are the specimens numerous. Indeed, the individuals are unusually few when we consider the number of species represented.

I am under great obligations to Prof. T. Rupert Jones, of London, England, our greatest authority on fossil ostracoda, for critical notes on the species.

BYTHOCYPRIS CYLINDRICA, Hall.

Pl. IX., fig. 6.

- Leperditia (Isochilina) cylindrica*. Hall, 1871. Desc. New Species of Fossils from the Hudson River Gr., etc., p. 7.
 " " " Hall. 1872. 24th Rept. State Cab., p. 230, pl. 8, fig. 12.
 " " " Hall and Whitfield. 1875. Pal. Ohio, vol. 2, p. 101, pl. 4, fig. 5.

One badly preserved valve appears to belong to this species. Its dorsal margin seems to have been more convex than usual, that edge being nearly straight in most specimens. As, however, in a few of the Ohio examples referred here, the dorsal line is even a little concave, the degree of curvature must be regarded as variable, unless future research proves that I have united more than one species under this name. Another specimen, having the dorsal margin rather strongly convex, was collected from near the top of the Hudson River or Cincinnati group, at Savannah, Ill.

Stony Mountain, Manitoba, T. C. Weston, 1884.

Perfect examples of this species from the lower beds of Cincinnati, Ohio, induce me to refer it to *Bythocypris*, Brady, since they resemble *B. testacella*, Jones, and *B. concinna*, Jones, very closely. One of the valves is a little larger than the other, and its edges overlap those of the smaller.

LEPERDITIA SUBCYLINDRICA. (N. Sp.)

Pl. IX., figs. 4-4b.

Valves rather strongly convex, elongate ovate, the posterior half a little the highest. End view sub-elliptical; edge view acutely elliptical. Anterior and posterior ends strongly and nearly equally rounded. Dorsal line straight, the ventral nearly so. Right valve larger than the left, and distinctly overlapping it along the ventral margin. Valves evenly convex; surface smooth, apparently without markings of any kind.

The only specimen seen gave the following measurements: greatest length, 2.1 mm.; greatest height (from posterior extremity of hinge line to ventral edge), one millimetre, height from anterior end of hinge line to ventral edge, 0.9 mm.; greatest convexity of the two valves in conjunction, 0.78 mm.

Stony Mountain, Manitoba: one specimen.

This species belongs to the group of "smooth Leperditia." Its small size will distinguish it from most of the lower palæozoic forms. *L. faba*, Hall, from the Niagara group of Indiana, is closely related to it, but differs in its form, being comparatively shorter and with more curved dorsal and ventral margins.

APARCHITES MINUTISSIMUS, Hall.

Leperditia (Isochilina) minutissima. Hall, 1871. Desc. New Species of Foss. from the Hudson River Gr., etc, p. 7.

" " " Hall. 1872, 24th Rep't. State Cab., p. 231, pl. 8, fig. 13:

" " " Hall and Whitfield. 1875. Pal. Ohio, vol. 2, p. 102, pl. 4, fig. 4.

A single valve from Stony Mountain is referred to this species, specimens of which are not uncommon at several horizons in the Hudson River or Cincinnati group of Ohio, Indiana, and Kentucky. A variety or very closely related species occurs in the Trenton shales of Minnesota.

The relations of this species are somewhat doubtful, still I believe we may assert with confidence that it is neither a *Leperditia* nor an *Isochilina*. It most probably belongs to the group of "nonsulcate Primitia", and, as Prof. T. Rupert Jones has just established the genus *Aparchites* for their reception, we cannot do better than place the species in it.

The convexity of the valves varies, the surface in some individuals being almost evenly convex, while in others it rises into an obtusely pointed subcentral prominence.

Stony Mountain, Manitoba, R. W. Ells, 1875.

APARCHITES UNICORNIS, Ulrich. (Var.)

Pl. IX., fig. 11.

Leperditia unicornis, Ulrich. 1879. Journ. Cin. Soc. Nat. Hist., vol. 2, p. 10, pl. 7, figs. 4-4b.

A single valve which agrees too closely with *A. unicornis* to be distinguished therefrom specifically, adheres to one of the Stony Mountain slabs. It differs from the original examples of the species, which came from the lower or Utica horizon of the Hudson River or Cincinnati group, in having the two ends less equal and the spine a little stronger.

This species is not a *Leperditia*, as its valves meet without overlapping. There seems to be no reason for doubting that it is congeneric with the group of "nonsulcate Primitia," and should, therefore, be placed under the new genus *Ararchites*, Jones.

PRIMITIA LATIVIA. (N. Sp.)

Pl. IX., fig.

Valves rather strongly convex, suboval, slightly oblique, the height and length respectively, as nine is to thirteen. Ends nearly equally convex. Dorsal margin straight, its length equalling two-thirds that of the valve. Ventral margin convex, merging more gently into the posterior than into the anterior margin. Sulcus wide, strongly impressed, extending from the dorsal margin half way across the valve. Posterior border of sulcus more abrupt and more elevated than the anterior. Point of greatest convexity just below and a little behind the centre of the valve. End view of carapace ovate in outline. No distinct border is present, but the margin frequently flares a little.

Length of an average specimen, 1.35 mm.; height, 0.91 mm.; greatest convexity of the valve, 0.3 mm.

This is a true Primitia, with rather close relations to *P. bivertex*, Ulrich. The sulcus, however, is unusually wide, and that species has two strong nodes near the dorsal margin situated one on each side of the sulcus. Of European species *P. renulina*, *P. fabulina*, and certain varieties of *P. mundula*, all of Jones and Holl, should be compared with it. None of these species, however, have so wide a sulcus.

The species is represented by several valves attached to slabs of limestone from Stony Mountain, collected by Dr. Ells, in 1875 and by T. C. Weston in 1884, it also occurs in the upper beds of the Hudson River or Cincinnati group at several localities in southeastern Indiana. At a locality several miles north of Madison, Ind., several specimens were found associated with large numbers of *Leperditia cæcigena*, Miller.

PRIMITIA ? (? BEYRICHIA) PARALLELA. (N. sp.)

Pl. IX., figs. 7-7a.*

Valves oblong subquadrate, about twice as long as high, and moderately convex. Ends subequal, sometimes slightly truncate, the posterior one more blunt than the anterior. Dorsal and ventral margins nearly parallel. Anterior margin with a thick and strongly elevated border, extending slightly beyond the contact margin. Posterior margin also with a border, which is not nearly so much elevated there as at the anterior end, being in many cases almost flat. Along the ventral margin the border is obsolete. A well-marked sulcus extends from about the middle of the dorsal line to near the centre of the valve. At the posterior side of the sulcus a rounded node is more or less completely separated from the posterior lobe by a branch of the main sulcus. In a dorsal view the anterior lobe is very slightly more convex than the posterior, while the anterior border is quite as prominent. In an end view the point of greatest convexity is a little above the middle.

An average specimen gave the following measurements: greatest length, 0.8 mm.; greatest height, 0.4 mm.; greatest convexity of one valve, 0.13.

This species is represented in the Manitoba material before me by two imperfect valves. Fig. 7 (pl. IX), was intended to represent one of these, but it is now known that the illustration is faulty in failing to show an important feature, which, when added, gives it quite a different appearance.

Several years ago I washed a considerable quantity of shale from the upper beds of the Hudson River or Cincinnati group at Oxford, Ohio. The residue of these washings has as yet not been picked over, but a short time ago I spent an hour in looking over a small lot of the material, and found that it contained Ostracoda, among them the species under consideration. The specimens are a little smaller than the Manitoba ones, but their specific identity is scarcely to be questioned. The last fact, however, was not recognized by me till I began my final examination of the Manitoba specimens, preparatory to drawing up the descriptions. It was then noticed that a thick border, now crushed and partly worn away, actually existed at the anterior end of the valve from which fig. 7 was drawn. The posterior border is very faint in this specimen, having evidently also suffered through attrition.

The distinctive features of the species are (1) the absence of a border along the ventral margin and its development at the two ends, (2) the excessive development and prominence of the anterior border, and (3) the oblong shape and nearly parallel dorsal and ventral margins.

*Fig. 7 is very faulty, having been drawn and lithographed from a crushed and macerated specimen before the much better examples from Ohio were seen.

I doubt very much that this is a true *Primitia*, but, as it seems more nearly related to some of the forms placed there by Prof. Jones than to the species of any other genus known to me, I thought it best to describe the species as above. It may be compared with some of the more simple forms of *Beyrichia*.

EURYCHILINA. (N. gen.)

Valves semicircular, suboval, or even nearly circular. Dorsal line straight. Generally with a well-defined sub-central sulcus and a more or less prominent node just behind it. A very broad convex border extends around the valves from the antero-dorsal to the postero-dorsal angle. The border is often striated in a radial manner and, in most cases, terminated by a marginal "frill," or by a plain narrow border, usually directed slightly outward. The main body of the border, however, curves inward to near the plane of contact between the two valves, thus forming a deeply concave outer area. Hingement simple. Surface reticulate, granulose, or smooth.

Type: *E. reticulata*, n. sp., from the Trenton shales of Minnesota.

This genus is related to *Primitia*, Jones and Holl, and to *Primitiopsis*, Jones. The possession of an internal concave marginal area separates it from the first, while the greater extension of the hollow area distinguishes it from the second. In *Primitiopsis* the marginal hollow is developed only at the anterior end.

Ten species and several varieties having the characters ascribed to the genus are known to me from American Cambro-Silurian deposits. Two of these are from the Chazy, three from the Birdseye, three from the Trenton, and two from the upper beds of the Hudson River or Cincinnati group. One of the last has been described by Mr. S. A. Miller, under the name of *Beyrichia striatomarginata*. From sketches just received from Prof. Jones, it appears that *Primitia strangulata*, Salter, sp., should also be referred to *Eurychilina*.

EURYCHILINA RETICULATA. (N. Sp.)

Pl. IX., figs. 9, and 9a.

Valves nearly semicircular in outline, the curve of the anterior end being slightly less rapid than that of the posterior, and the height from the ventral edge to the straight dorsal margin a little greater than it would be if of true semicircular shape. Body of valves moderately convex, with the point of greatest convexity sub-central. Sulcus deep, beginning a little below the dorsal margin and extending half way across the body; its lower and posterior margins somewhat thickened

and sharply defined. Surface, except along the dorsal line, beautifully reticulate. Marginal area wide, its width equal on the anterior and ventral sides: as it rounds up on the posterior end its breadth gradually diminishes till at the postero-dorsal angle it is scarcely more than one-fourth as wide as the antero-dorsal angle. As the area leaves the body of the valve it is convex, but soon the development of a radially marked "frill" makes it slightly concave. The "frill" is free only at its outer extremity, and this may be dentate, entire or terminated with a thickened rim, the variations probably following each other with age. In some examples the line of junction between the body of the valve and the marginal area is marked by a more or less strongly elevated thin ridge. In others there is simply an impressed suture line. The radial lines are strongest along the ventral edge and least distinct at the anterior end.

The interior shows that the width of the marginal hollow is equal to nearly one-fourth of the height of the entire valve, and that its outer edge curves inward nearly to the plane of contact between the two valves. The two sections shown in fig. 9a are faulty in representing the outer and lower extremity of the marginal areas as being simply thickened. The lower ends of the two sections ought really to have been represented by two diverging lines, with the inner one also more extended inward than now appears.

The dimensions of an average specimen are as follows: Greatest length of valve, including marginal area, 2.5 mm.; length of dorsal line, 2.3 mm.; greatest height of valve (across the posterior third), 1.4 mm.; length of body of valve, 1.8 mm.; greatest width of same, 1.0 mm.; greatest convexity of same (one valve), 0.25 mm.; width of marginal area at the anterior end, 0.47 mm.: width of same at the postero-dorsal angle, 0.12 mm.; width of ventral portion of marginal hollow (inner side of valve), 0.3 mm.

This species is distinguished from all the others known by its neatly reticulated surface. Separated valves are not uncommon in the Trenton shales at Minneapolis, St. Paul, Fountain and other localities in Minnesota. It is described in this connection because it is better adapted to stand as the type of the new genus, *Eurychilina*, than any of the others.

EURYCHILINA MANITOBENSIS. (N. Sp.)

Pl. IX., figs. 10, and 10a.

Valves smooth, semicircular in outline, the body very little convex, its two ends almost equal and forming nearly right angles with the straight dorsal line. Ventral margins of body and marginal area

gently curved. Sulcus deep, well defined, situated just within the posterior half, and extending from the dorsal margin about half way across the body of the valve. Just below the sulcus the surface is somewhat elevated, and about midway of its length, on the posterior side, is a low rounded prominence which projects slightly into the sulcus. The marginal area is strongly convex, especially in the ventral region, being there also terminated by a narrow but sharply reflexed border. As the dorsal angles at each end are approached, this border is gradually lost in the general elevation of the area. On the interior, the marginal hollow does not extend to the dorsal angles, but reaches up on each side only about half the distance to the angles.

Greatest length of valve, including marginal area, 2.2 mm.; length of body of valve, 1.6 mm.; width of entire valve, 1.22 mm.: width of body of valve, 0.94 mm.; convexity of same, 0.18 mm.

This species is represented by two valves from Stony Mountain, one collected by Dr. Ellis in 1875, and showing the exterior, the other by Mr. Weston in 1884, showing the interior. They resemble one of the Birdseye limestone species more than any of the others known to me. Prof. Jones suggests that it is comparable with *M. strangulata*, Salter, sp.

STREPULA QUADRILIRATA, Hall and Whitfield.

Pl. IX., fig. 12.

Beyrichia quadrilirata, Hall and Whitfield. 1875. Pal. Ohio, vol. 2, p. 105, pl. 4, figs. 6-7.

Of several hundred valves of this species examined by me none are as quadrangular in outline as that shown in the figure given by the authors of the species. Indeed, they are remarkably constant in their form, deviating but little in that respect from the example now figured on plate IX. These authors, it appears, failed also to notice the five pits along the anterior half of the free margin, which is a very characteristic feature of the species. The vertical plates which separate the pits often project beyond the depressed border of the valve, appearing in a view of the inner side like so many small spines.

A comparison between Hall and Whitfield's fig. 6 and fig. 12 on plate IX. of the present report shows other differences. In their figures, the depressed outer or contact margin is much narrower, and does not appear as overhung by the semicircular marginal ridge, nor is this ridge represented on the ventral side at all. Their view of a "basal profile outline" fits very well to their fig. 6, but is it true to nature?

When I first found specimens of this type and compared them with Hall and Whitfield's description and figures of their *Beyrichia quadrilirata*, I was struck by the differences here mentioned, and, naturally enough, believed I had found, if not a distinct species, at any rate a well-marked variety. Since then I have succeeded in collecting no less than fifty species of Ostracoda from the Hudson River or Cincinnati group, and still my collection is without an example of *B. quadrilirata* as originally figured and described. It would be strange indeed if, after all my search, this species should have been overlooked. Such an event, though possible, is not at all probable. I am, therefore, reluctantly obliged to believe that the discrepancies between the original figures and the specimens identified by collectors of Hudson River group fossils with *B. quadrilirata*, are really the result of imperfect observation. I would be very diffident about making this charge were I not able to prove inaccuracies in their figures of the much better known species *B. oculifera*, Hall, and *B. Chambersi*, Miller.

This species is one of the most abundant of the Ostracoda of the upper beds of the Hudson River group, and it occurs at many localities in Ohio and Indiana. I have collected it also at High Bridge, Ky., where it occurs in the Birdseye limestone, and from the Trenton shales at Minneapolis, Minn. The specimens from these lower horizons are almost identical with fig. 12, the modifications being too trivial to merit recognition here.

Figure 13, plate IX., represents a variety from Stony Mountain, Manitoba, that may be designated as var. *simplex*. It differs from the typical form in having the postero-median ridge simple instead of bifurcated below. The vertical plates which divide the anterior edge of the typical form into shallow cavities seem also not to have been developed except to a very limited extent. A very similar variety occurs in the Trenton shales of Minnesota.

In placing this and the following species in the genus *Strepula* of Jones and Holl, I follow the suggestion of Prof. Jones. While I agree with him in regarding this as the best arrangement possible at the present time, it is well to remark that there is something peculiarly distinctive about *S. concentrica* and *S. irregularis*, the typical species of the genus, that does not pertain to either *S. quadrilirata* or *S. lunatifera*.

STREPULA LUNATIFERA, N. Sp.

Pl. IX., figs. 14, and 14b.

Valves slightly elongate oval in outline, the posterior half generally a little the highest. Dorsal edge straight, one-fifth shorter than the length of the valve. Ends equally convex, rounding gently into the nearly straight ventral edge. Border strongly depressed, widest at the posterior end. Marginal ridge thin, abruptly elevated, running parallel with the border and overhanging it. Within the marginal ridge the surface is slightly depressed, with two nearly vertical thin ridges in the anterior half and two curved ones in the posterior. The latter unite at their ends and enclose a crescent-shaped concave space, the outer curve of which is almost parallel with the curve of the postero-ventral margin. These curved ridges often extend to and unite with the marginal ridge, and sometimes the upper end of the inner of the two anterior ridges is swollen and forms a more or less prominent node.

Dimensions of a large valve: greatest length, 1.55 mm.; greatest height, 0.87 mm.; greatest thickness of single valve, 0.32 mm. The Ohio specimens are usually a little smaller than this, their average length and height being, respectively, 1.25 and 0.7 mm.

This fine species is represented by a single valve on a small slab collected by Dr. R. W. Ells in 1875 at Stony Mountain, and a number of specimens picked from washings of shale of the upper beds of the Hudson River or Cincinnati group, at Oxford, Ohio. It is related to *S. quadrilirata*, Hall and Whitfield, but the two are not sufficiently similar to make confusion between them at all likely.

The following table has been prepared to shew the stratigraphical range of those Manitoba species which have been found also in the United States.

SPECIES FROM STONY MOUNTAIN.	Trenton.....	Hudson River group.		
		Lower..	Middle.	Upper..
1. Proboscina auloporoides, Nicholson.....			*	*
2. P. frondosa, Nicholson.....			*	*
3. Monticulipora parasitica, Ulrich var.....			*	*
4. Homotrypa, sp. undescribed.....			*	*
5. Batostoma Manitobense, Ulrich.....				*
6. Petigopora scabiosa, Ulrich.....				*
7. Batostomella gracilis, Nicholson (var.).....				*
8. Bythopora striata, Ulrich.....				*
9. B. ? delicatula, Nicholson.....				*
10. Monotrypella quadrata, Rominger.....				*
11. Stictopora, sp. undetermined.....				*
12. Dieranopora fragilis, Billings.....		*		*
13. D. emacerata, Nicholson.....				*
14. Goniotrypa bilateralis, Ulrich.....				*
15. Pachydictya hexagonalis, Ulrich.....				*
16. Ptilodictya Whiteavesi, Ulrich.....				*
17. Arthroclema angulare, Ulrich.....				*
18. Helopora Harrisii, James.....				*
19. Sceptropora facula, Ulrich.....				*
20. Nematopora ? sp. undescribed.....				*
21. Leperditia subcylindrica, Ulrich.....				*
22. Aparchites minutissimus, Hall.....	*	*	*	*
23. A. unicornis, Ulrich (var.).....		*	*	*
24. P. ? (Beyrichia) parallela, Ulrich.....		*	*	*
25. P. lativia, Ulrich.....				*
26. Eurychilina Manitobensis, Ulrich.....				*
27. Strepula lunatifera, Ulrich.....				*
28. S. quadrilirata, var. simplex, Ulrich.....				*
29. Bythocypris cylindrica, Hall.....	*	*	*	*

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SPECIES FROM ST. ANDREWS.	Trenton.....	Birdseye and Black River.
1. Monticulipora Wetherbyi, Ulrich.....	*	*
2. Fistulipora (?) laxata, Ulrich.....	*	*
3. Pachydictya magnipora, Ulrich.....	*	*
4. P. acuta, Hall.....	*	*
5. Phylloporina Trentonensis, Nicholson.....	*	*

Thus, out of 29 species from Stony Mountain, 20 are known to occur in the upper beds of the Hudson River or Cincinnati group at localities in the United States.

PLATE VIII.

PTILODICTYA WHITEAVESI, (page 44).

- Figure 1. Restored view of the specimen from which the thin sections were prepared. Natural size.
- Figure 1a. Portion of median ridge and lateral area of fig. 1, x 9, showing relative size and arrangement of apertures of the zoëcia.
- Figure 1b. Tangential section, x 18, showing the internal structure of a portion similar to that represented by fig. 1a.
- Figure 1c. Vertical section, x 18.
- Figure 1d. } Young examples of this species. Natural size.
" 1e. }

FISTULIPORA (?) LAXATA, (page 37).

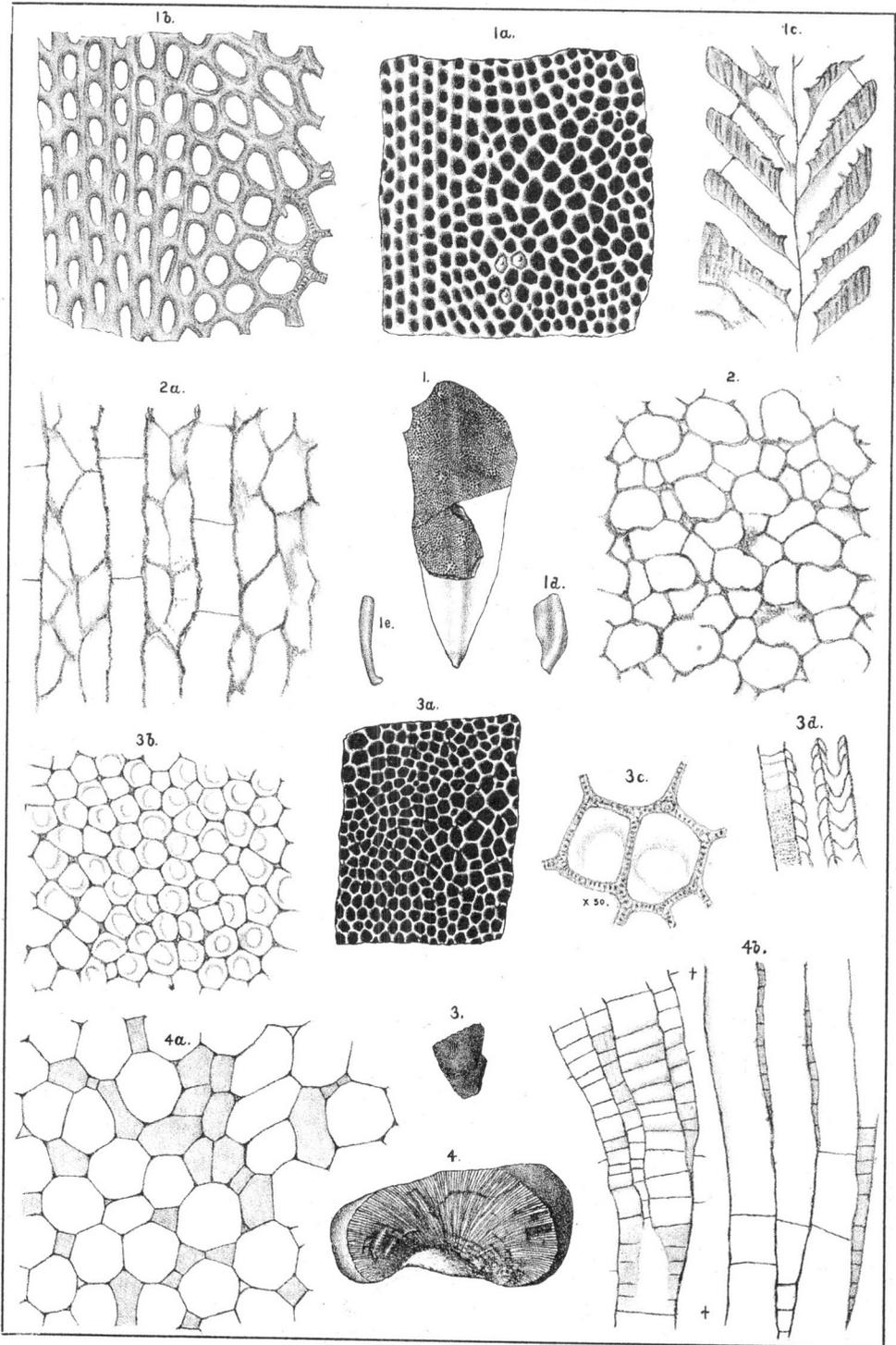
- Figure 2. Transverse section, x 18.
- Figure 2a. Vertical section, x 18.

MONTICULIPORA PARASITICA, var. PLANA, (page 29).

- Figure 3. View of the type specimen. Natural size.
- Figure 3a. Surface of the same, x 9.
- Figure 3b. Tangential section of same, x 18.
- Figure 3c. Portion of figure 3b, x 50, to show the peculiar structure of the walls in true species of *Monticulipora*.
- Figure 3d. Three tubes of a vertical section, x 18, showing the wall structure and varying appearance of the cystiphragms.

DIPLOTRYPA WESTONI, (page 30).

- Figure 4. Side view of the type specimen. Natural size.
- Figure 4a. Tangential section, x 18, showing relative side and arrangement of the zoëcia and mesopores, and one of the small clusters of the latter.
- Figure 4b. Two portions of a vertical section, x 18, that to the right showing the character of the tubes in one of the "immature" regions, and that to the left, one of the tubes followed up through the next region.



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BRYOZOA

PLATE IX.

GONIOTRYPA BILATERALIS, (page 41).

Figure 1. Small segment of the natural size, and portion of same, x 18.

PACHYDICTYA HEXAGONALIS, (page 42).

Figure 2. A fragment of the bifoliate zoarium of this species, of the natural size, showing the arrangement of the apertures of the zoecia and clusters of large cells.

Figure 2a. Portion of same, x 9.

Figure 2b. Small portion of a vertical section, x 18, showing the tabulation of the zoecial tubes, the interstitial vesicles, and the solid filling of the latter just below the surface.

Figure 2c. Small portion of a tangential section, x 18. The upper end of the figure represents the appearance of the section when it passes through the zoarium at a depth from the surface equal to one-half of the thickness of one of its leaves. The lower end shows the character of the interspaces just beneath the surface.

BATOSTOMA MANITOBENSE, (page 39).

Figure 3. Portion of the surface of a specimen with numerous mesopores, x 9.

Figure 3a. Vertical section, x 18, showing the tabulation of the zoecia and mesopores, and the thickened condition of their walls just beneath the surface.

Figure 3b. Tangential section, x 18, showing the ring-like walls of the zoecia, the number and distribution of the mesopores, and the inconspicuous character of the acanthopores of an average specimen.

Figure 3c. Small portion of a tangential section, x 18, prepared from a specimen like that from which fig. 3 was drawn. In it, the zoecia are more circular and their walls thinner than usual.

LEPERDITIA SUBCYLINDRICA, (page 49).

Figure 4. View of the left side of a complete carapace, x 18, showing the overlapping edge of the right valve.

Figure 4a. End view of the same, x 18.

Figure 4b. Ventral profile view of the same in outline, x 18. The irregular line is intended to represent the overlapping edge of the right valve.

APARCHITES MINUTISSIMUS, (page 49).

Figure 5. A right valve of this species, x 18, with the central region unusually prominent. Many specimens are simply strongly convex.

PLATE IX.—Continued.

BYTHOCYPRIS CYLINDRICA, (page 48).

- Figure 6. A valve of this species, x 18, with the dorsal margin more convex than usual. This feature is slightly exaggerated in the drawing.

PRIMITIA ? (? BEYRICHTIA) PARALLELA, (page 51).

- Figure 7. This figure is faulty, but with several strokes of a pencil can be made approximately correct. The ends of a perfect valve are a little more obtuse than represented, but with that exception, the outline and the central portion of the figure are correct. What is lacking is a raised border or fold at each end. These may be supplied as follows: One mm. within the posterior (right) margin a heavy line should be drawn, curving slightly less rapidly than this end is shown to curve. A similar line should be drawn 1.5 mm. within the anterior margin, its curve to correspond with that of the anterior end of the figure. These lines must intersect the dorsal and ventral margins and, if correctly drawn, should cause the ends of the figure to appear elevated and separated from the suboval body of the valve by deep sulci.
- Figure 7a. Sectional view of central portion of the valve, x 18, showing its convexity and the depth of the sulcus.

PRIMITIA LATIVIA, (page 50).

- Figure 8. A left valve, x 18.
- Figure 8a. Sectional view of the same, x 18, showing its convexity and depth of sulcus.

EURYCHILINA RETICULATA, (page 52).

- Figure 9. Perfect right valve of this species, x 18, from the Trenton shales at Minneapolis, Minn.
- Figure 9a. Two sections of different valves of the same, x 18. The lower end of these sections should have been made to bifurcate, and the concave line extended a little further inward.

EURYCHILINA MANITOBEENSIS, (page 53).

- Figure 10. Left valve of this species, x 18. The border at the upper left hand margin is represented as being decumbent, while this edge is slightly elevated in the specimen.
- Figure 10a. Section of the same, showing its convexity and the shape of the marginal hollow.

PLATE IX.—Continued.

APARCHITES UNICORNIS, var. (page 50).

- Figure 11. A valve of this species having the ends less equal than in the typical form, x 18.

STREPULA QUADRILIRATA, (page 54).

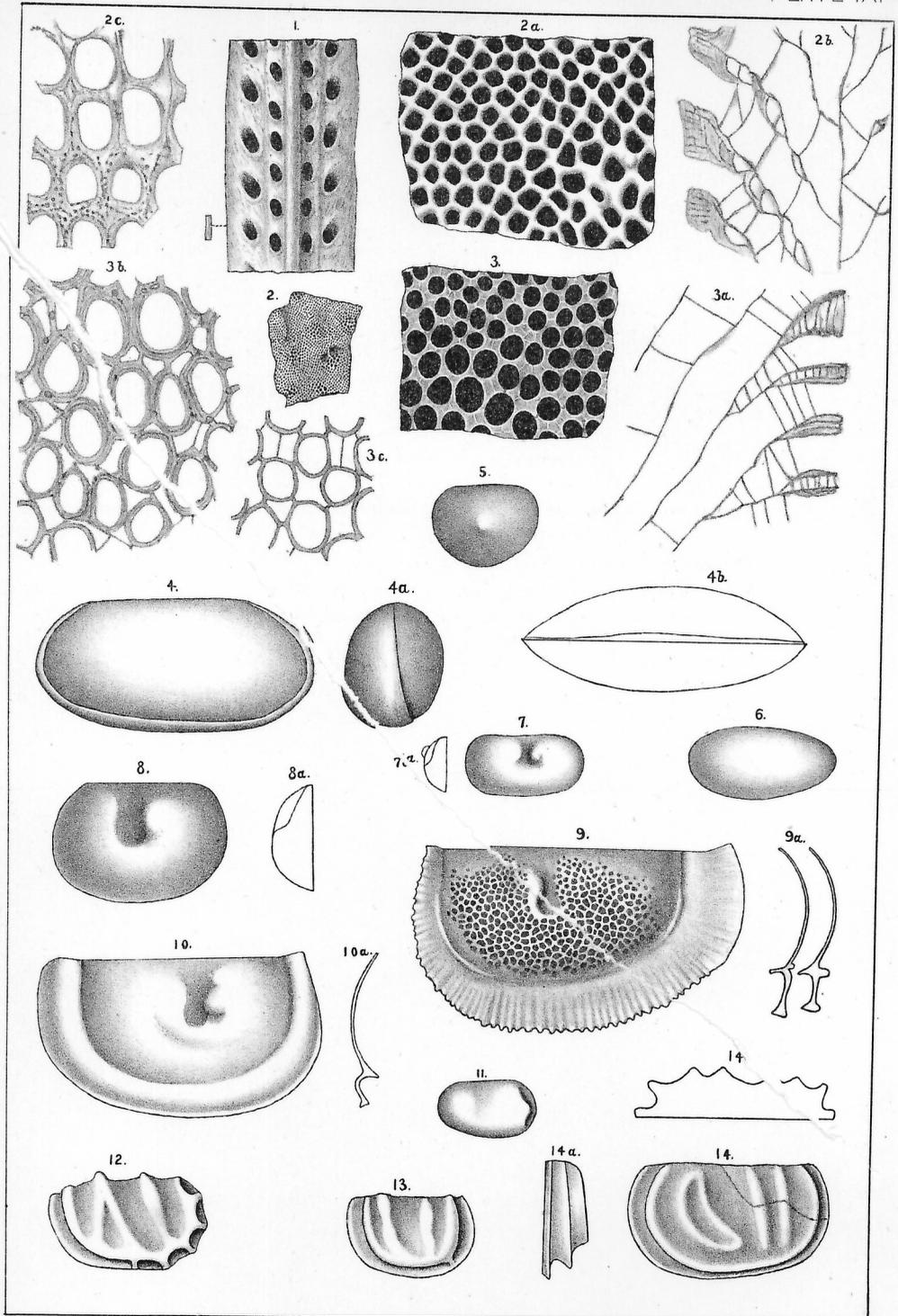
- Figure 12. A perfect right valve of this species, x 18, from the Hudson River group at Clarksville, Ohio.

STREPULA QUADRILIRATA, var. *SIMPLEX* (page 55).

- Figure 13. View of the only specimen of this variety seen, x 18.

STREPULA LUNATIFERA, (page 56).

- Figure 14. Large right valve, x 18, having the crescentic space separated from the marginal ridge.
- Figure 14a. Posterior end view of the same.
- Figure 14b. Longitudinal section of the same, showing the convexity of the valve and the elevation of the ridges.



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OSTRACODA
BRYOZOA