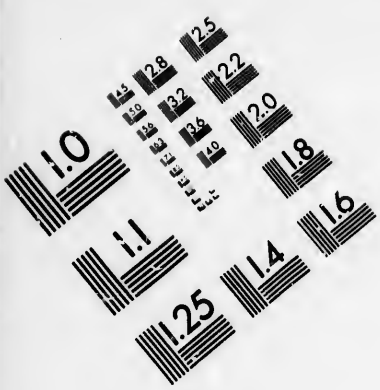


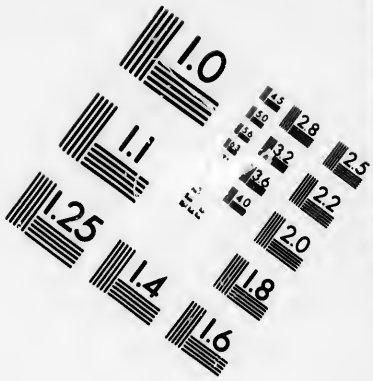
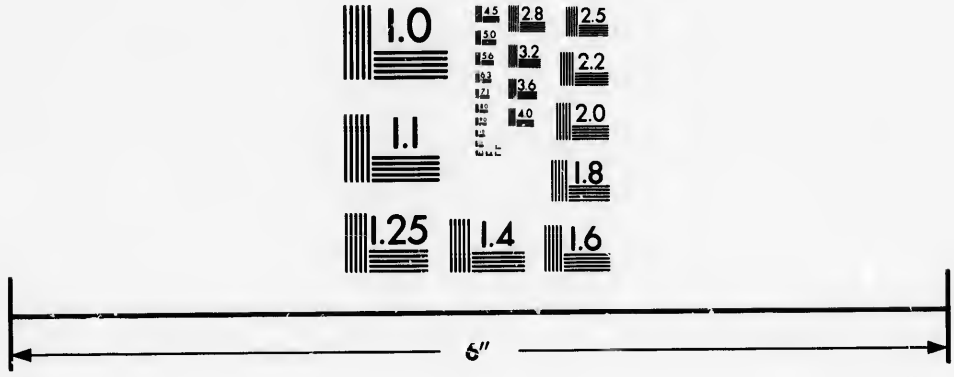
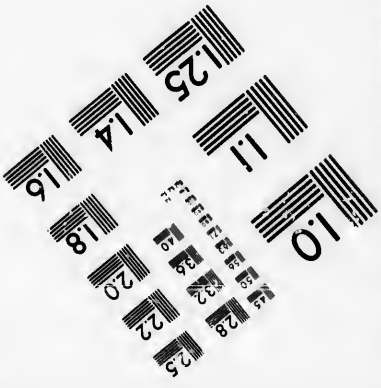


IMAGE EVALUATION TEST TARGET (MT-3)





Photographic Sciences Corporation

23 WEST MAIN STREET
WEBSTER, N.Y. 14580
(716) 872-4503

Technicel and Bibliographic Notes/Notes techniques et bibilogrephiques

The Institute has ettempted to obtain the best originel copy avellable for filming. Features of this copy which may be bibliographically unique, which may elter any of the images in the reproduction, or which may significantly change the usuel method of filming, ere checked below.

- ☐ Coloured covers/ Couverture de couleur
- ☐ Covers demeged/ Couverture endommegée
- ☐ Covers restored end/or lemineted/ Couverture restaurée et/ou pelliculée
- ☐ Cover title missing/ Le titre de couverture menque
- ☐ Coloured meps/ Certes géographiques en couleur
- ☐ Coloured ink (i.e. other then blue or bleck)/ Encre de couleur (i.e. autre que bleue ou noire)
- ☐ Coloured pletes end/or illustrations/ Plenches et/ou illustrations en couleur
- ☐ Bound with other meterial/ Relié evec d'autres documents
- ☐ Tight binding mey cause shedows or distortion elong interior margin/ La reliure serrée peut ceuser de l'ombre ou de la distortion le long de le merge intérieure
- ☐ Blenk leaves added during restoretion mey appeer within the text. Whenever possible, these heve been omitted from filming/ Il se peut que certaines peges blenches ejoutées lors d'une restauration apparaissent dans le texte, meis, lorsque cela ételt possible, ces pages n'ont pes été filmées.
- ☐ Additionel comments:/ Commentaires supplémenteires:

L'Institut e microfilmé le meilleur exemplaire qu'il lui e été possible de se procurer. Les détails de cet exemplaire qui sont peut-être uniques du point de vue bibliographique, qui peuvent modifier une image reproduite, ou qui peuvent exiger une modification dans la méthode normele de filmege sont indiqués ci-dessous.

- ☐ Coloured peges/ Peges de couleur
- ☐ Peges damaged/ Pages endommegées
- ☐ Peges restored and/or lamineted/ Pages restaurées et/ou pelliculées
- ☑ Peges discoloured, stained or foxed/ Peges décolorées, tachetées ou piquées
- ☐ Pages detached/ Pages détechées
- ☑ Showthrough/ Transperence
- ☐ Quelity of print varies/ Quelité inégele de l'impression
- ☐ Includes supplementery materiel/ Comprend du matériel supplémenteire
- ☐ Only edition eveileble/ Seule édition disponible
- ☐ Peges wholly or partielly obscured by errata slips, tissues, etc., heve been refilmed to ensure the best possible imege/ Les peges totelement ou pertiellement obscurcies per un feuillet d'erreta, une pelure, etc., ont été filmées à nouveau de feçon à obtenir le meilleure imege possible.

This item is filmed et the reduction retio checked below/
Ce document est filmé au teux de réduction indiqué ci-dessous.

10X	12X	14X	16X	18X	20X	22X	24X	26X	28X	30X	32X
						✓					

The copy filmed here has been reproduced thanks to the generosity of:

University of Manitoba
Winnipeg

The images appearing here are the best quality possible considering the condition and legibility of the original copy and in keeping with the filming contract specifications.

Original copies in printed paper covers are filmed beginning with the front cover and ending on the last page with a printed or illustrated impression, or the back cover when appropriate. All other original copies are filmed beginning on the first page with a printed or illustrated impression, and ending on the last page with a printed or illustrated impression.

The last recorded frame on each microfiche shall contain the symbol → (meaning "CONTINUED"), or the symbol ▽ (meaning "END"), whichever applies.

Maps, plates, charts, etc., may be filmed at different reduction ratios. Those too large to be entirely included in one exposure are filmed beginning in the upper left hand corner, left to right and top to bottom, as many frames as required. The following diagrams illustrate the method:

L'exemplaire filmé fut reproduit grâce à la générosité de:

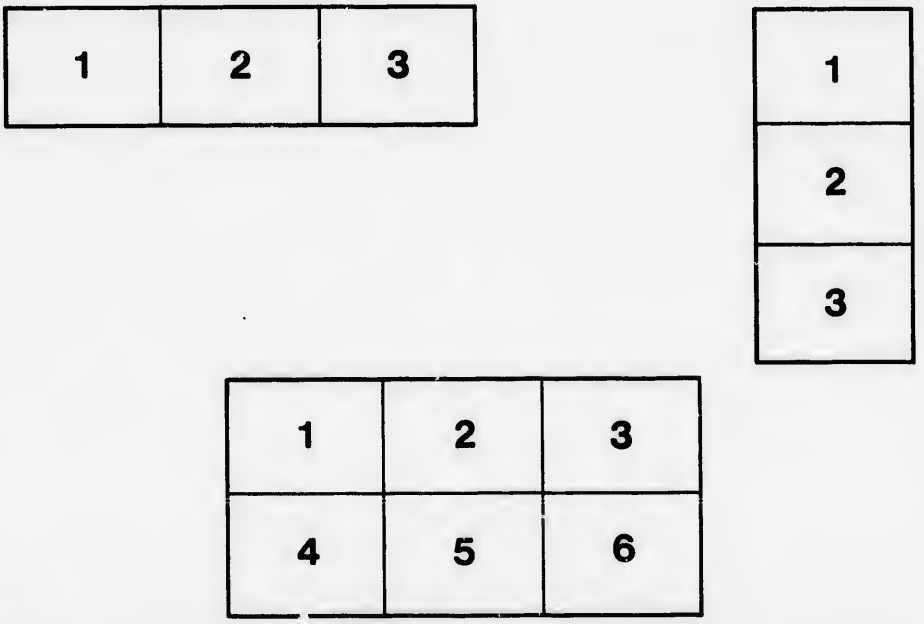
University of Manitoba
Winnipeg

Les images suivantes ont été reproduites avec le plus grand soin, compte tenu de la condition et de la netteté de l'exemplaire filmé, et en conformité avec les conditions du contrat de filmage.

Les exemplaires originaux dont la couverture en papier est imprimée sont filmés en commençant par le premier plat et en terminant soit par la dernière page qui comporte une empreinte d'impression ou d'illustration, soit par le second plat, selon le cas. Tous les autres exemplaires originaux sont filmés en commençant par la première page qui comporte une empreinte d'impression ou d'illustration et en terminant par la dernière page qui comporte une telle empreinte.

Un des symboles suivants apparaîtra sur la dernière image de chaque microfiche, selon le cas: le symbole → signifie "A SUIVRE", le symbole ▽ signifie "FIN".

Les cartes, planches, tableaux, etc., peuvent être filmés à des taux de réduction différents. Lorsque le document est trop grand pour être reproduit en un seul cliché, il est filmé à partir de l'angle supérieur gauche, de gauche à droite, et de haut en bas, en prenant le nombre d'images nécessaire. Les diagrammes suivants illustrent la méthode.



REPORT

UPON THE

PALÆONTOLOGY

OF THE

PROVINCE OF ONTARIO.

BY

H. ALLEYNE NICHOLSON, Esq., M.D., D.Sc., F.R.S.E., F.G.S.

PROFESSOR OF BIOLOGY IN THE DURHAM UNIVERSITY COLLEGES OF PHYSICAL SCIENCE AND MEDICINE.

Printed by Order of the Legislative Assembly, by Command of His Excellency the Lieutenant-Governor.

TORONTO:
PRINTED BY HUNTER, ROSE & CO., 86 & 88 KING STREET WEST.
1875.

To t

Lieu
tolog

in th
rocks
sumi
furth
pend

Col

To the Honourable the Secretary of the Province of Ontario.

SIR,—I have the honour to transmit to you, for the information of His Excellency the Lieutenant-Governor in Council and the Legislature, the following Report upon the Palæontology of the Province of Ontario.

The present Report is supplementary to the one which was published by the Legislature in the year 1874, which was exclusively concerned with the organic remains of the Devonian rocks. This, on the other hand, is a record of the collections which I made during the summer of 1874 from the Silurian Rocks of the Province. I have also carried out some further investigations in connection with the Devonian Series, an account of which is appended at the close of the Report.

I have the honour to be, Sir,

Your most obedient servant,

H. ALLEYNE NICHOLSON.

COLLEGE OF PHYSICAL SCIENCE,
NEWCASTLE-ON-TYNE, October, 1874.

PREFACE.

The Report upon the Palæontology of Ontario, which was published in the beginning of the year 1874, was a record of a series of researches carried on during the year 1873, and comprised descriptions of one hundred and sixty species of fossils, all from the Devonian Rocks of the Province. These researches which were begun in 1873, were continued in the year 1874, and the present Report is their result.

Collections were formed from the various Silurian Formations of the Province, from the Trenton Limestone to the Guelph Dolomites, inclusive. Further investigations were likewise carried out on the Devonian Formations lying between Lakes Erie and Huron.

Owing to want of leisure and to personal circumstances, to which I need not further refer, the present Report is not of such a detailed character as its predecessor. In the case of well known species, I have been compelled to content myself with a simple quotation of the name, and a reference to some well-known work where the Canadian student can readily refer for a description. I have, however, given descriptions, in most cases accompanied by figures, of all new species, as well as of those which have not been thoroughly examined or described in previous or readily accessible works.

As in the case of the preceding Report, I have to acknowledge myself deeply indebted to the admirable palæontological works of Mr. Billings and Professor James Hall. I wish also to acknowledge gratefully the kind assistance which I have received from Mr. George Jennings Hinde, Mr. David Boyle, of Elora; Mr. John Wilkie, of Guelph, and Messrs. C. Clarke, senior and junior, of Elora, all of whom have furnished me with valuable material, and otherwise contributed to the objects which I had in view.

College of Physical Science,
Newcastle-on-Tyne, October, 1874.

REPORT

UPON THE

PALÆONTOLOGY

OF THE

PROVINCE OF ONTARIO.

CHAPTER I.

Fossils of the Trenton Formation.

1. "Fucoids."

The Trenton Limestone, in certain beds contains a large number of remains which would be referred by most palæontologists to the class of so-called "Fucoids." I have been for some time engaged in making a special study of this singular and obscure group of fossils; and I shall at present reserve my remarks upon the forms which are found in the

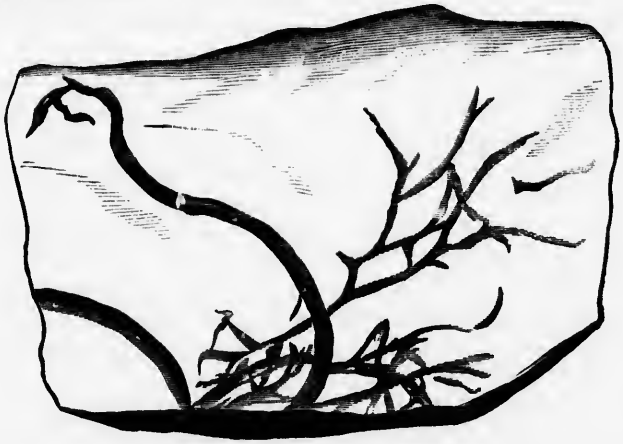


Fig. 1.

Buthotrephis gracilis, Hall; a supposed "Fucoid," from the Trenton Limestone of Ottawa.

Trenton Limestone. I will merely mention, therefore, that the commonest forms are referable to the genus *Licrophycus* of Billings. These are very abundant in the Trenton Limestone of Ottawa and Peterboro'. Others, from the same locality, are referable to the genus *Palæophycus* (Hall). Others, again, very abundant in one particular bed at Ottawa, are composed of a central stem with large flexuous lateral branches, and these would be referred to the genus *Buthotrephis*, of Hall. Lastly, I have one well-preserved example of a singular form, which is closely allied to, if not absolutely indentical with, the remarkable fossil described by Dr. Newberry from the Cincinnati group of Ohio, under the name of *Fucoides Harrisii*. The section of this, as it appears in the stone, presents a close resemblance to sections of species of the Polyzoan genus *Archimedipora*. It has clearly been of a calcareous nature, and its cross-section is acutely elliptical. It is extremely doubtful if this is of a vegetable nature. The locality of this curious form is Ottawa.

2. Stromatopora (sp.).

Examples of *Stromatopora*, often attaining a large size, are very abundant in parts of the Trenton Limestone. None of the specimens, however, which I have seen, were in such a condition of preservation as to allow of their specific determination.

Locality and Formation.—Trenton Limestone, Macpherson's Quarry, Lake Couchiching; Peterboro; Ottawa.

Columnaria alveolata (Hall, not of Goldfuss).

(Ref. Pal. N.Y. Vol. I, p. 47, Pl. XII. Figs. 1 *a*—*c*).

In describing the genus *Favistella*, at a later stage, I shall give a brief account of the genus *Columnaria*. In the meanwhile, it is sufficient to state that the *Columnaria alveolata* of Goldfuss, as originally described and figured (Petref. Germ. p. 72, Pl. XXIV. Figs. 7 *a*—*c*) appears to be undoubtedly identical with the well-known Hudson River coral described by Hall, under the name of *Favistella stellata*. Strict justice, therefore, would demand the suppression of the name *Favistella stellata*, and its replacement by the older name of *Columnaria alveolata*. This course, however, would lead to great inconvenience, for the name *Columnaria alveolata* has been almost universally applied by writers subsequent to Goldfuss to the coral which I am about to describe from the Trenton Limestone. I am inclined, therefore, to think that the best plan is to accept *Columnaria* as defined by McCoy and Hall, and to allow *Favistella* to stand for the species originally referred by Goldfuss to *Columnaria*. On this view, the genus *Columnaria* will include certain aggregate corals, which closely resemble *Favosites* in general appearance, but which are distinguished by the absence of mural pores, and by the presence of distinct septa, which do not, however, reach the centre of the corallites. If it be admitted that the septa are sometimes prolonged to the centre of the corallites, then it becomes necessary to unite *Columnaria* and *Favistella*, as no other essential difference between these two genera has hitherto been pointed out; and it is, indeed, doubtful if they can be maintained as separate groups.

Columnaria alveolata (Hall), is one of the commonest species of the Trenton Limestone, and often attains a large size. It forms hemispherical or irregular masses, composed of hexagonal or pentagonal corallites, which usually appear to be more or less firmly united by their walls. The average diameter of the corallites is about one and a half or two lines. The

tabulæ are complete and very well developed, four or five occupying the space of two lines. The septa are well developed, but are not complete, never extending in any of the specimens which I have seen, more than quite a short distance into the interior of the corallites. They appear, therefore, as a series of closely set longitudinal ridges on the inner faces of the corallites. In general appearance this coral is closely similar to *Favosites Gothlandica* and also to the coral which I described from the Hudson River group under the name of *Columnopora cribriformis*. From the former, however, it is readily distinguished by its absence of mural pores and its comparatively well-developed septal apparatus; whilst it is distinguished from the latter by its imperforate walls.

Locality and Formation.—Trenton Limestone; Belleville; Trenton; Peterborc'; Lake Couchiching; Collingwood; Ottawa.

4. Columnaria Goldfussi (Billings).

Columnaria Goldfussi (Billings), Memoirs of the Geological Survey of Canada, Report of Progress, 1858, p. 166.

Corallum aggregate, of small pentagonal or hexagonal corallites, averaging half a line in diameter, and usually forming sub-hemispherical or sub-globose masses. The radiating septa are rudimentary, and form a series of vertical ridges in the interior of the corallites. Tabulæ imperfectly observed.

I have a number of small specimens from the Trenton Limestone, which appear to be referable to this species, though they are all of inconsiderable dimensions, and do not exhibit certain structural characters in a satisfactory manner. They agree, however, with *Columnaria Goldfussi* (Billings), in the size of the corallites.

Locality and Formation.—Trenton Limestone of Peterboro' and Trenton.

5. Protarea vetusta (Edwards and Haime).

Protarea vetusta (Edwards and Haime), Pol. Foss. des. Terr. Pal., Plate XIV., Fig. 6.
Astræopora vetusta (D'Orbigny), Prodr. de Palćont, 1850.
Porites? vetusta (Hall), Pal. N.Y., Vol. I., p. 71, Pl. XXV. Figs. 5*a*, 5*b*.

Corallum forming thin crusts, about one-third line in thickness, which grow parasitically upon foreign bodies; calices nearly equally developed, about one line or rather less in diameter, shallow; the bottom of the cup tuberculated. Septa twelve in number, sub-equal, extending but a short distance inwards towards the centre of the cup. No columella, dissepiments, or tabulæ. Walls of the calices, thick.

This pretty little coral has been noted by Hall from the Trenton Limestone of the State of New York, but it is much more abundant in the succeeding formation of the Hudson River group.

Locality and Formation.—Trenton Limestone, Peterboro' (also common in the Cincinnati group of Ohio).

6. Favosites Gothlandica (Lamarck)?

I feel considerable hesitation in quoting this species from such a low horizon. I have, nevertheless, a well preserved specimen of a coral, which I collected personally from the Trenton Limestone, which agrees in all essential characters with the above species. Its state

of preservation is not such as to show the mural pores, which would be a decisive test of its affinities; but it clearly does not possess the septa which are so characteristic of *Columnaria alveolata* (Hall).

Locality and Formation.—Trenton Limestone, Macpherson's Quarry, Lake Couchiching.

7. Tetradium fibratum (Safford)?

A species of *Tetradium* is of not uncommon occurrence in the Trenton Limestone, which may be provisionally referred to *T. fibratum* (Safford). Its state of preservation is such as to render any determination of its minute characters impossible; but it agrees in the size of its tubes with the above species, rather than with the form which I shall shortly describe from the Hudson River formation, under the name of *T. minus* (Safford).

Locality and Formation.—Trenton Limestone, Ottawa and Trenton.

8. Chætetes petropolitanus (Pander).

(Plate IV., Figs. 3 and 4).

(For a full description and synonymy, see the same species in the Hudson River formation.)

Chætetes petropolitanus is one of the most abundant and characteristic of the corals of the Trenton Limestone. It usually shows very distinctly its concave base, with its concentrically striated epitheca; but it varies immensely in form. The smaller specimens usually have the form of thick discs, concave beneath, but more or less strongly elevated above. The larger specimens generally form conical or hemispherical masses; but some of them are of a more or less cake-like form, (*Stenopora patula*, Billings).

Locality and Formation.—Trenton Limestone, Ottawa, Belleville, Trenton, Peterboro', Collingwood.

9. Chætetes discoideus (James).

(For description and synonymy of this species, see the same species from the Hudson River formation).

The Trenton Limestone has yielded a few specimens of a species of *Chætetes*, which in most respects agree with the young of *C. petropolitanus*, but are distinguished by their remarkable tenuity. They agree entirely with a number of specimens from the Hudson River formation, in treating of the fossils of which they will be fully described. I do not, however, feel certain that they can really be kept apart from *C. petropolitanus*.

Locality and Formation.—Trenton Limestone, Trenton.

10. Chætetes undulatus (Nicholson).

(Plate IV., Fig. 1).

Amongst the forms included by Hall under the name of *Chætetes lycoperdon* (Say), there is one (Pal. N. Y., Vol. I., Pl. XXIII., Fig. *1—g*), which is far from uncommon in the Trenton Limestone, and which, I think, might perhaps be considered as a distinct species. It is, certainly, very distinct from the typical forms of *C. petropolitanus*, since it never shows a concave base, but on the contrary, appears to have been always fixed. It forms great

lobate masses, sometimes shaped more or less like a funnel, and often deeply indented laterally. Some of the specimens which I have seen have not been sufficiently well preserved to allow of my studying the minute characters of the cells in a satisfactory manner; but, so far as I have been able to make out, the calices are polygonal, thin-walled, about six in the space of one line, destitute of very minute intermediate tubuli, and showing no well-marked tubercles, nor groups of large-sized corallites. If it should turn out that the form here indicated is distinct from *C. petropolitanus*, and that it is not a very massive form of some such species as *C. pulchellus*, I would propose for it the name of *Chætetes undulatus*. It is also of common occurrence in the Hudson River group of Canada, and the Cincinnati group of Ohio.

Locality and Formation.—Trenton Limestone, Belleville and Peterboro'.

11. Chætetes Fletcheri (Edwards and Haime).

(For description and synonymy, see the same species as occurring in the Hudson River Formation.)

Locality and Formation.— Trenton Limestone, Trenton, Peterboro' and Ottawa.

12. Chætetes gracilis (James).

Chætetes gracilis (James). Enumerated, but not figured or described in the Catalogue of the Fossils of the Cincinnati Group, 1871.

Chætetes gracilis (Nicholson), Quart. Journ. Geol. Soc., Vol. XXX., Pl. XXIX., Figs. 7—7*a*.

This species is very closely allied to *C. Fletcheri*, but may be distinguished by the uniform size of the corallites, the minute oval or sub-triangular calices, and the very oblique corallites. This last mentioned character is the one by which *C. gracilis* is most readily separated from *C. Fletcheri;* but it must be admitted that it is often difficult or impossible to make the distinction between these species, unless the observer has to deal with very well-preserved examples.

Locality and Formation.—Trenton Limestone, Peterboro'.

13. Chætetes pulchellus (Edwards and Haime).

Chætetes pulchellus (Edwards and Haime), Pol. Foss. des Terr. Palæon. p. 271.

Monticulipora pulchella (Edwards and Haime), Man. Brit. Foss. Corals, p. 267, Pl. LXII., Figs. 5—5*b*.

Chætetes pulchellus (Nicholson), Quart. Journ. Geo. Soc., Vol. XXX., Pl. XXIX., Figs. 5—5*b*.

Corallum usually of sub-cylindrical branches, which have a diameter from two to six lines; sometimes forming flattened and expanded sub-palmate fronds; sometimes inosculating. Corallites thin-walled, unequal, the average ones being about eight in the space of one line. Surface exhibiting rounded or somewhat stellate groups of large-sized corallites, of which two or three occupy the space of half a line, and which sometimes have very minute cylindrical corallites between them. These groups of large-sized corallites generally comprise from five to seven individuals, and they are little or not at all elevated above the general surface; so that there are no conspicuous tubercles. The groups are placed about one line apart.

C. pulchellus is very nearly related to *C. Fletcheri*, but the corallum is generally of a larger habit and tends more to assume a flattened and sub-palmate form, whilst the large-sized corallites, instead of being indiscriminately mixed with those of average size, are aggregated into distinct and quite conspicuous groups. It is an abundant and very characteristic fossil of the Cincinnati group of Ohio; but I have not yet succeeded in satisfactorily identifying it from the Hudson River group of Canada.

Locality and Formation.—Trenton Limestone, Peterboro'.

14. STREPTELASMA CORNICULUM (Hall).

(For description, see the same species in the Hudson River Formation.)

Locality and Formation.—Trenton Limestone, Peterboro'.

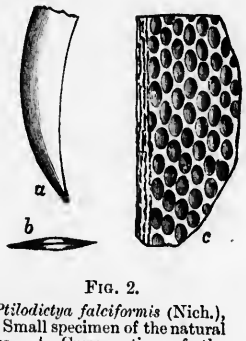


FIG. 2.

Ptilodictya falciformis (Nich.), *a*, Small specimen of the natural size. *b*, Cross-section of the frond enlarged. *c*, Portion of the surface greatly enlarged. Trenton Limestone.

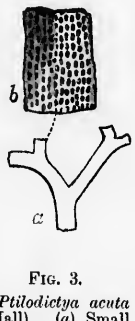


FIG. 3.

Ptilodictya acuta (Hall). (*a*), Small fragment of the natural size. (*b*), Portion of the same enlarged. Trenton Limestone.

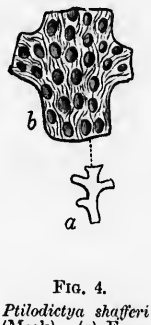


FIG. 4.

Ptilodictya shafferi (Meek). (*a*), Fragment of the natural size. (*b*), Portion of the same enlarged. Hudson River Group.

15. PTILODICTYA ACUTA (Hall).

Fig. 3.

Stictopora acuta (Hall), Pal. N. Y., Vol. I., Pl. XXVI., Fig. 3.

Ptilodictya acuta (McCoy), Brit. Pal. Foss. p. 45.

Polyzoary forming flattened stems, which branch dichotomously at angles of about 50° and at intervals of four or five lines; both the branches and stem having an average width of one line, or a little more. Transverse section acutely elliptical, much flattened; margins sharp, apparently non-celluliferous and striated. Cell-mouths oval, with their long diameter corresponding with the axis of the frond, arranged in longitudinal rows. The cells in contiguous rows are opposite, or more commonly sub-alternate, about six occupying the space of one line measured longitudinally, and about eight occupying the same space, measured transversely or diagonally. There are usually eight or ten rows of cells in the width of the frond. This species (Fig. 3) is very abundant in the Trenton Limestone almost everywhere, and it may be regarded as being the most characteristic Polyzoön of this formation.

Locality and Formation.—Trenton Limestone, Ottawa, Trenton, Peterboro' and Belleville.

16. Ptilodictya falciformis (Nicholson).

Fig. 2.

Polyzoary consisting of a single, unbranched, or slightly branched, elongated, narrow, and two-edged frond, the form of which is falciform, and which expands from a pointed base till it reaches a width of two lines, within a distance of less than half an inch above its origin. The total length may exceed two inches, but the width rarely exceeds two and a half lines. The transverse section is acutely elliptical, the thickness in the middle not exceeding half a line; and the flat faces of the frond are very gently curved, not angulated. The central axis cannot, as a rule, be made out with certainty, though I have seen specimens in which this structure is readily demonstrable. The edges of the frond are thin and sharp, when perfect, longitudinally striated, and occasionally perforated by the apertures of minute and imperfect cells. Both sides of the frond are celluliferous, the cells being apparently perpendicular to the surface, and being arranged in intersecting diagonal lines, which cut one another at 60° thus forming angles of about 30° with the sides of the frond. The mouths of the cells are oval or somewhat diamond-shaped, their long axes coinciding with that of the frond, alternately placed in contiguous rows, about eight in the space of one line measured diagonally, and ten in the same space measured transversely, the outermost rows very slightly smaller than the others. Walls of the cells moderately thick; no surface-granulations, tubercles, spines, or elevated lines. The mouths of the cells parallel with the general surface, neither lip being especially prominent, and the plane of the aperture not being oblique.

As a general rule, the polyzoary (Fig. 2) is simple, unbranched, and falciform. I have seen, however, in the fine collection of Mr. Dyer, of Cincinnati, some specimens which bifurcate at the distal extremity, and at least one example in which the frond splits into three divisions. I have also seen examples of what may ultimately prove to be a distinct species, in which the width of the frond greatly exceeds the measurements given above.

Ptilodictya falciformis is nearly allied to several previously recorded forms. The cells, in their arrangement in intersecting diagonals of extreme regularity, closely resemble those of *Escharopora recta* (Hall). In the latter species, however, the frond is stated to be "cylindrical or sub-cylindrical," whereas it is uniformly greatly flattened and acutely elliptical in *P. falciformis*. The edges, also, of *P. falciformis* are sharp and non-celluliferous, whilst the entire frond is regularly curved and sabre-shaped, instead of being straight.

P. falciformis is readily distinguished from *P. lanceolata* (Goldfuss, Petref, Pl. XXXVII. Fig. 2) more especially by the disposition of the cells in regularly intersecting diagonals; whereas in the latter there is a central series of longitudinally arranged cells, flanked on each side by diagonal rows of cells, directed in opposite directions like the barb of a feather.

With *Ptilodictya gladiola*, (Billings) [Cat. Sil. Foss. of Anticosti, p. 10,] the present, species agrees in the shape of the frond; but it is proportionately twice as wide, whilst the cells of the former have rectangular or oblong mouths, and are disposed in regular longitudinal lines.

Lastly, *P. falciformis* is distinguished from *P. sulcata* (Billings), [Cat. Sil. Foss. of Anticosti, p. 35,] by the fact that the latter has nearly square cells with intervening sulci, and the cells are arranged in longitudinal lines.

Locality and formation.—Trenton Limestone, Trenton, Peterborough, Ottawa (also not uncommon in the Cincinnati group of Ohio).

17. Ptilodictya fenestelliformis (Nicholson).

In my Report on the Fossil Corals of Ohio (in course of publication), I have described a species of *Ptilodictya* from the Cincinnati group, under the name of *P. fenestelliformis*, with the following characters:

"Polyzoary palmate or subpalmate towards the base, dividing distally into small branches. Basal expansion and branches flattened and sharp-edged, the branches being acutely elliptical in cross section, and about three-fourths of a line in thickness centrally. Cells covering the whole surface on both sides, with the exception of the sharp lateral margins, which are non-celluliferous, as well as certain non-poriferous areas, to be subsequently noticed. The cells on the two aspects of the flattened frond respectively have their bases separated by a thin laminar axis. The cells in the middle of the frond are about three eighths of a line in height, gradually diminishing towards the margins. Cell mouths ovate, slightly longer than broad, arranged in longitudinal rows, alternate or sub-alternate in contiguous rows, about five cells in one line measured longitudinally, and six in the same space measured diagonally. The longitudinal spaces between the rows of cells are broad and slightly elevated, and are faintly striated longitudinally or obscurely punctate. On the other hand, the spaces between the *ends* of the cells are very much narrower; and the surface thus closely resembles that of a small *Fenestella*, the cell-mouths looking like 'fenestrules,' the longitudinal interspaces between the cells representing the "interstices," and the narrow spaces between the ends of the cells corresponding with the "dissepiments." The only specimens examined exhibit numerous, apparently solid, rounded, or stellate areolæ, of an average diameter of two thirds of a line, which are not occupied by cells, but exhibit an obscurely pitted surface."

The specimens from which the above description was taken, were collected by Mr. U. P. James from the Cincinnati group of Ohio, and were all portions of the frond close above the base. Whilst showing the broken bases of the branches, none of them, therefore, exhibited the actual branches themselves. I have obtained, however, from the Trenton Limestone a number of specimens which I believe to be the branches of this form. They agree in all their minute characters altogether with the above description; but they are, naturally, more flattened and of less thickness.

They have the form of thin expanded stems, varying from two and a half lines to nearly six lines in width, and dividing at intervals of from four to six lines into two or three bran che which have about the same diameter as the main stem. The cells have precisely the same, form, arrangement, and "fenestelliform" appearance as in the above description; and there may be from fourteen to thirty or more rows in the width of the stem. The edges are sharp, with a broad non-celluliferous margin. The frond invariably exhibits a greater or less number of the peculiar obscurely pitted solid areolæ above noticed.

In the form and disposition of the rows of cells, this species approaches *P. acuta* (Hall), and *P. costellata* (McCoy). It is, however, distinguished from both of these species by its much larger dimensions, and by the conspicuous feature of the presence of solid areolæ, similar in many respects to the well-known non-poriferous spaces which are seen in some species of *Chætetes* and *Callopora*. The present species appears also to be a much larger form than *P. elegantula* (Hall), or *P. fenestrata* (Hall), and to differ in other very important respects;

but the descriptions of these last named species are not sufficient to allow of a minute comparison.

Locality and Formation.—Trenton Limestone, Peterborough, Trenton, Belleville, Ottawa.

18. Clathropora (sp.).

The Trenton Limestone yields examples of a species of *Clathropora* apparently identical with the fossil figured in the "Geology of Canada," p. 158, Fig. 122, under the name of *Coscinium proavium* (Eichwald). I am unable at this moment to refer to Eichwald's description of this form; but there is no doubt, but that it belongs to the genus described by Hall, under the name of *Clathropora*. I have, however, previously expressed the opinion that the genus *Clathropora* (Hall), will have to be abandoned, and that its members may be regarded as nothing more than reticulated *Ptilodictyæ*.

The present species occurs in the form of thin reticulated expansions, of which the branches are about a line and a half wide, whilst the oval interspaces or fenestrules are about one line in their long diameter. The margins of the perforations or fenestrules are non-celluliferous, concentrically-striated and sharp-edged, and there are fourteen or fifteen rows of cells in each stem. The cells have oval mouths, arranged in diagonal lines, often with very minute tubuli at their point of junction. The species is closely related to the forms of *Clathropora* which occur in the Niagara Limestone and Corniferous Formation.

Locality and Formation.—Trenton Limestone, Peterborough and Trenton.

19. Retepora Trentonensis (Nicholson).

(Plate II., Figs, 4—4*b*).

Polyzoary forming a fan-shaped expansion, composed of slightly diverging branches, which have a width of about one-third of a line. The branches are more or less sinuous in their course, and divide dichotomously at short intervals, the branches usually uniting with adjacent stems so as to form an open network, the fenestrules of which have an approximately oval shape and are from one to two lines in length. The cells have the appearance of being oblique to the surface, and there are from four to five rows of them in a branch. They are also present upon the surfaces of junction of contiguous branches. The cell-mouths are of a long-oval shape. The non-celluliferous side of the branches is very strongly striated with wavy longitudinal striæ or ridges.

This species is only known to me by several more or less imperfect specimens, from which all the essential characters cannot be satisfactorily determined. It appears to be a genuine *Retepora* and to be most nearly allied to *R. Hisingeri* (McCoy); but the fenestrules of the latter species are much smaller and more regular in their dimensions, whilst the non-poriferous side is minutely granular; whereas in the present species the fenestrules are large and irregular, and the non-poriferous side is strongly striated. The general shape of the frond resembles some of the lattor *Fenestellæ* such as *F. laxa*, but it is clearly not referable to this genus.

Locality and Formation.—Trenton Limestone, Peterborough. (Collected by Mr. George J. Hinde.)

20. LEPTÆNA SERICEA (Sowerby).

Locality and Formation.—Very abundant in the Trenton Limestone of Peterboro', Belleville, Trenton, Collingwood and Ottawa.

21. ORTHIS TESTUDINARIA (Dalman).

Locality and Formation.—Very abundant in the Trenton Limestone of Peterboro', Ottawa, and Collingwood.

22. ORTHIS BIFORATA (Schlotheim).

Fig. 5*a*.

(*Ref. Delthyris biforatus* var. *lynx*, Hall, Pal. N.Y., Vol. I., p. 133, Plate XXXII., Figs. 1*a* —*u*, and *A*—*U*).

Locality and Formation.—Trenton Limestone, Peterboro', and Trenton.

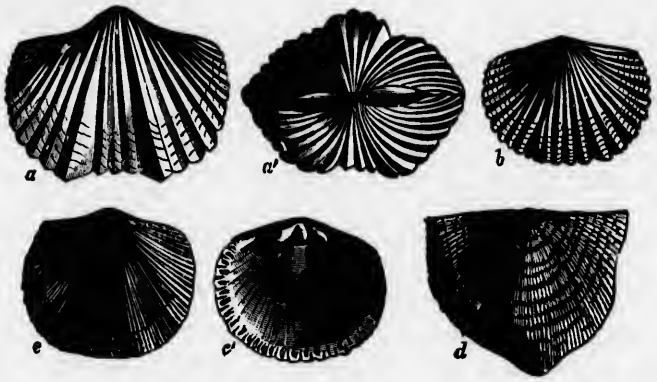


FIG. 5.

a, *Orthis biforata* (Schloth). *a'*, View of the same from above. *b*, *Orthis flabellulum* (Sow). *c*, *Orthis subquadrata* (Hall). *c'*, Interior of the dorsal valve of the same. *d*, *Strophomena deltoidea* (Hall). Trenton Limestone. (*d* is after Hall).

23. ORTHIS SUBQUADRATA (Hall).

Fig. 5*c*.

(*Ref.* Pal. N.Y., Vol. I., Plate XXXII., A. Figs. 1*a*—*o*).

Locality and Formation.—Trenton Limestone, Peterboro'.

24. STROPHOMENA ALTERNATA (Conrad).

Locality and Formation.—Very abundant in the Trenton Limestone. The individuals are generally smaller than those which occur in the succeeding formation of the Hudson River group.

25. STROPHOMENA FILITEXTA (Hall).

(*Ref. Leptæna filitexta*, Hall, Pal., N.Y., Vol. I., p. 3, Plate XXVI., B., Figs. 3*a*—*f*.

Locality and Formation.—Trenton Limestone of Ottawa, Peterboro', Belleville, Trenton, and Lake Couchiching.

26. STROPHOMENA DELTOIDEA (Conrad).

Fig. 5*d*.

(*Ref. Leptæna deltoidea*, Hall, Pal. N.Y., Vol. I., p. 106, Plate XXXI, A., Figs. 3*a*—*e*).
Locality and Formation.—Trenton Limestone, Peterboro', and Trenton.

27. STROPHOMENA FLUCTUOSA (Billings).

(*Ref.* Palæozoic Fossils of Canada, Vol. I., p. 123, Fig. 102.)
Locality and Formation.—Trenton Limestone, Collingwood.

28. STROPHOMENA RHOMBOIDALIS (Wahlenberg)

Locality and Formation.—Trenton Limestone, Peterboro', and Ottawa. The specimens are usually of comparatively small size.

29. RHYNCHONELLA RECURVIROSTRA (Hall).

Fig. 6*c*.

(*Ref. Atrypa recurvirostra*, Hall, Pal. N.Y., Vol. I., p. 140, Plate XXXIII., Figs 5*a* —*d*.)
Locality and Formation.—Very abundant in the Trenton Limestone of Trenton, Belleville, Peterboro', and Ottawa.

30. RHYNCHONELLA INCREBRESCENS (Hall).

Fig. 6*d*.

(*Ref. Atrypa increbrescens*, Hall, Pal. N.Y., Vol. I., p. 146, Plate XXXIII., Figs. 13*a* —*y*.)
Locality and Formation.—Abundant in the Trenton Limestone, Trenton, Peterboro, and Ottawa.

31. ORTHIS PLICATELLA (Hall).

(*Ref.* Hall, Pal, N.Y., Vol. 1,, p. 122, Plate XXXII., Figs. 9*a* *y*).
Locality and Formation.—Trenton Limestone, Trenton.

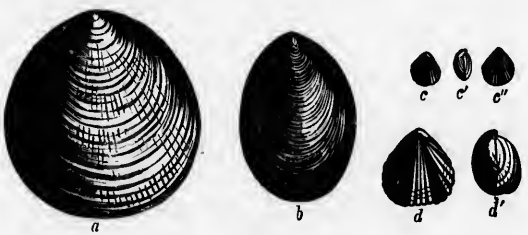


FIG. 6.

a, A small example of *Dinobolus magnificus* (Billings). *b*, *Lingula Coburgensis* (Billings) (after Billings). *c*, *Rhynchonella* (*Zygospira ?*) *recurvirostra* (Hall); dorsal view. *c'*, Profile view of the same. *c''*, Ventral view of the same. *d*, *Rhynchonella increbrescens* (Hall); dorsal view. *d'*, Profile view of the same. Trenton Limestone.

32. ORTHIS FLABELLULUM (Sowerby)

Locality and Formation.—Trenton Limestone, Peterboro.

33. DINOBOLUS MAGNIFICUS (Billings).

Fig. 6*a*.

Obolus Canadensis, (Billings), Mem. Geol. Survey of Canada, Report for 1857, Fig. 19 (cæt. exclusis.)

Obolellina magnifica, (Billings), Canadian Naturalist April, 1872, p. 17, Fig. 7.

Dinobolus magnificus, (Davidson and King), Quart. Journ, Geol. Soc., May, 1874.

Locality and Formation.—Trenton Limestone, Trenton. I have seen no more than two well preserved dorsal valves.

34. TREMATIS OTTAWAENSIS (Billings).

(*Ref.* Palæozoic Fossils of Canada, Vol. I, p. 53. Fig. 58).

Locality and Formation.—Trenton Limestone, Trenton.

35. LINGULA COBURGENSIS (Billings).

Fig. 6*b*.

(*Ref.* Palæozoic Fossils of Canada, Vol. I., p. 50, Fig. 54).

Locality and Formation.—Trenton Limestone, Peterboro'.

36. MURCHISONIA BELLICINCTA (Hall).

Fig. 7*a*.

(*Ref.* Pal. N.Y., Vol. I, Plate XXXIX., Figs. 1*a*—*e*).

Casts of this fine species are quite common in various parts of the Trenton Limestone; but I have never been fortunate enough to discover a specimen in which the shell was preserved. The casts are readily distinguished from those of *M. subfusiformis*, (Hall) by the much smaller obliquity and the greater convexity of the whorls; and from those of *Murchisonia gracilis*, (Hall), by their much greater size.

Locality and Formation.—Trenton Limestone, Ottawa and Collingwood.

37. MURCHISONIA GRACILIS (Hall).

Fig. 7*c*.

(*Ref.* Pal. N.Y., Vol. I, Plate XXXIX., Figs. 4*a*—*e*).

Casts of this species may usually be distinguished by the small size and slender form of the shell, and the convex, not angulated whorls.

Locality and Formation, Trenton Limestone, Trenton and Collingwood.

38. MURCHISONIA SUBFUSIFORMIS (Hall).

Fig. 7*b*.

(*Ref.* Pal. N.Y., Vol. I., Plate XXXIX., Figs. 2*a*—*b*).

This species has also only come under my notice in the condition of casts, which are readily distinguished by the comparative flatness of the whorls, and their obliquity. The body-whorl is ventricose and considerably elongated. It is quite probable that this shell should really be regarded as belonging to the genus *Subulites*.

Locality and Formation.—Trenton Limestone, Collingwood.

39. PLEUROTOMARIA UMBILICATA (Hall).

Fig. 7*e*.

(*Ref.* Pal. N.Y. Vol. I, p. 43, pl. X. figs. 9, *a—h* and p. 172, pl. XXXVII. figs. 5, *a—d*).

Locality and Formation.—Abundant in the condition of casts of the interior, in the Trenton Limestone of Collingwood.

FIG. 7.

a, *Murchisonia bellicincta* (Hall); cast of a large specimen. *b*, *Murchisonia* (*Fusispira ?*) *subfusiformis* (Hall); cast of a large specimen. *c*, *Murchisonia gracilis* (Hall); cast of a large specimen. *d*, *Pleurotomaria lenticularis* (Sow.); cast. *e*, *Pleurotomaria umbilicata* (Hall); cast. Trenton Limestone.

40. PLEUROTOMARIA LENTICULARIS (Sowerby).

Fig. 7*d*.

(*Ref. Pleurotomaria lenticularis*, Hall, Pal. N Y. Vol. I, p. 172, Pl. XXXVII, Figs. 6 *a—d.*)

Locality and Formation.—Abundant in the condition of casts of the interior, in the Trenton Limestone of Collingwood.

41. BELLEROPHON BILOBATUS (Sowerby).

Locality and Formation.—Trenton Limestone, Trenton and Collingwood.

42. CONULARIA TRENTONENSIS (Hall).

(*Ref.* Hall, Pal. N. Y. Vol I, p. 222, Pl. XVIII, Figs. 1, *a—f*).

Locality and Formation.—Trenton Limestone; Ottawa and Collingwood.

43. ENDOCERAS LONGISSIMUM (Hall).

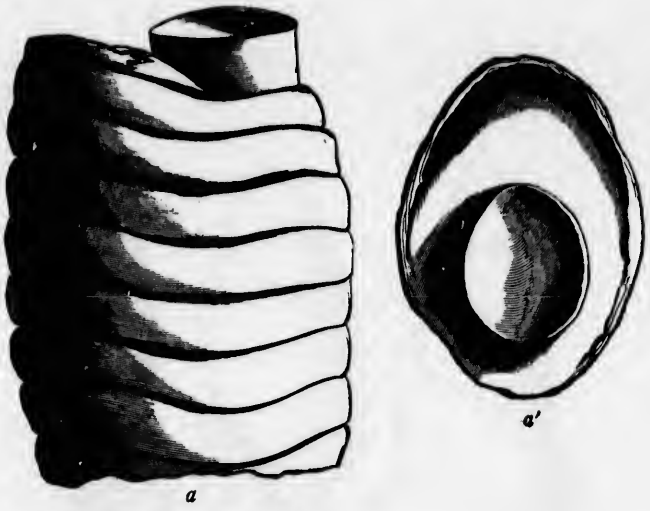


FIG. 8.

a, Fragment of *Endoceras longissimum* (Hall)? showing the siphuncle. *a'*, Summit of the same. Hudson River Group.

(*Ref.* Hall, Pal., N. Y., Vol. Pl. XVIII, Figs. 1, 1 *a*.)

A fragment about nine inches long and three and a half inches in diameter, showing a large excentric siphuncle, the diameter of which is about one inch. The septa are about four lines apart. The condition of preservation of the specimen is such as to render a positive specific determination impossible.

44. ORTHOCERAS TERETIFORME (Hall).

(*Ref.*, Pal., N. Y., Vol. I, Pl. XLII, Figs. 8, *a. b.*)
Locality and Formation.—Trenton Limestone, Collingwood.

45 LEPERDITIA CANADENSIS (Jones).

(*Ref. Leperditia Canadensis*, Geological Survey of Canada, Decade III, p. 91. Pl. XI, Fig 1—5.)
Locality and Formation.—Abundant in a bed of lithographic stone near the base of the Trenton Limestone, Lake Couchiching.

46. ASAPHUS PLATYCEPHALUS (Stokes).

Ref. Isotelus gigas, Hall, Pal., N.Y. Vol. I, p. 231, Pls. LX, LXI, LXII, and LXIII.)
Locality and Formation.—Trenton Limestone, Trenton; also in the same formation at Cobourg and Belleville.

47. CALYMENE BLUMENBACHII (Brongniart).

Locality and Formation.—Trenton Limestone, Peterborough.

48. GLYPTOCRINUS SP.

Columns and detached plates of a species of *Glyptocrinus* are very abundant in the Trenton Limestone of Peterborough and Trenton.

CHAPTER II.

FOSSILS OF THE HUDSON RIVER FORMATION.

Genus FAVISTELLA (Hall).

Corallum hemispheric or sub-globose, massive, aggregate, composed of prismatic or cylindrical corallites with imperforate walls, usually, but not always, firmly amalgamated with one another ; septa well developed, lamellar, of unequal sizes, the primary ones extending nearly or quite to the centre of the visceral chamber. No columella. Tabulæ well developed, complete.

The relations of the genus *Favistella* to the older genus *Columnaria* are so complicated that it will be necessary to enter here upon a somewhat detailed discussion as to whether the former name can be retained at all, and, if so, to what forms it must be restricted. The genus *Columnaria* was originally founded by Goldfuss to include certain massive aggregate corals which closely resemble *Favosites* in general appearance, but differ in having the septal system better developed, whilst the walls of the corallites are not perforated by any mural pores. The species originally referred by Goldfuss to *Columnaria* are distinctly stated to have septa sufficiently developed to nearly, or quite, reach the centre of the corallites, and this fact is clearly shown in most of the figures accompanying the text. Most of the authorities who followed Goldfuss came, however, to the conclusion that some error had been committed by Goldfuss, and that the septa in *Columnaria* were rudimentary and marginal. Hence the name of *Columnaria* became gradually fixed upon a group of corals with small or rudimentary septa, the type of the group being the form now generally known as *Columnaria alveolata* by American and English observers. Under these circumstances the genus *Favistella* was proposed by Hall, (Pal. N. Y., Vol, I, p. 275, 1847,) for a Hudson River coral which closely resembled *Columnaria alveolata* in general character, but differed in having the septa extended nearly or quite to the centre of the visceral chamber, whilst the walls of the corallites are inseparately united with one another. Subsequently, Milne Edwards and Jules Haime pointed out that *Columnaria alveolata*, as originally described by Goldfuss, possessed complete septa, and they therefore expressed the opinion that the genus *Favistella* should be suppressed, and that *Favistella stellata* (Hall), should be regarded as a synonym of *Columnaria alveolata* (Goldfuss). Finally, Mr. Billings, whilst retaining the name of *Columnaria alveolata* for the coral regarded as such by Hall and McCoy (in which the septa are marginal),

described other species of *Columnaria* in which the septa varied from a rudimentary to an almost complete condition.

As I shall shortly point out, there can be little doubt as to the complete identity of Hall's *Favistella stellata* with the *Columnaria alveolata* of Goldfuss; and there can, therefore, be no doubt that the strict law of priority would demand the abandonment of the former in favour of the latter, both generically and specifically. In the meanwhile, however, the name of *Columnaria alveolata* has become firmly attached to a familiar Trenton Limestone coral, which possesses rudimentary septa; and hence it has come to pass that an imperfect condition of the septa has generally been regarded as one of the most important characters of the genus *Columnaria*. It would, therefore, cause great confusion to apply the law of priority in this instance, and there are three courses open to us under the circumstances:—

1. We may, as strict justice demands, consider *Columnaria* and *Favistella* as synonymous and adopt the definition of the former laid down by Goldfuss. This course, though unquestionably the proper one, would be attended with the grave inconvenience that another and a new genus would probably have to be created for the corals which have usually been regarded as the typical *Columnariæ*.

2. We may adopt the genus *Columnaria* as re-defined by McCoy and Hall, restricting it to forms with rudimentary septa, whilst we may retain the genus *Favistella* of Hall for the forms with complete septa. This course would cause less confusion than any other, though it certainly would not be compatible with strict justice.

3. We may consider that the development of the septa is not a character of itself sufficiently important to justify generic separation, though repeatedly employed for this purpose. In this case, the genus *Columnaria* would simply have to be expanded, so as to receive both the original forms described by Goldfuss with complete septa, and the later ones described by Hall, McCoy, and Billings with marginal septa. In this case, also, *Favistella* would simply be merged in *Columnaria*, or it might be retained as a sub-genus for the reception of the forms with a complete septal apparatus. For my own part, I am disposed to think that this course would probably be the best, but I shall in the meanwhile retain the genus *Favistella* as distinct from *Columnaria*, and shall adopt for it the definition given by Hall. If, however, this last course be adopted, then the following forms will have to stand as *Columnaria stellata* and *Columnaria calicina*.

49. Favistella stellata (Hall).

Favistella stellata (Hall) Pal. N. Y. Vol. I. Pl. LXXV. Figs. 1*a*, 1*c*.

Corallum sub-hemispheric or pyriform, massive. Corallites prismatic, usually hexagonal or pentagonal, from rather more than one line to two lines in diameter, completely amalgamated with one another by their walls. Septa unequally developed, alternately large and small; the large ones fifteen, sometimes fourteen, in number, reaching to the centre of the corallites or nearly so. The smaller septa marginal and rudimentary. The total number of septa is thus from twenty-eight to thirty. Tabulæ well developed and complete, about three in the space of one line. No columella. Increase by fissiparous development of the old tubes.

According to Hall there are usually twelve septa, more or less, in this species; but in this enumeration he has evidently counted the larger septa only, and has disregarded the smaller ones. The number of the primary septa, however, appears to be almost always fifteen,

and the rudimentary secondary septa alternate with the former, and are therefore the same in number. In this respect the Canadian specimens which I have examined appear to agree altogether with those from Ohio.

Favistella stellata (Hall) attains a large size, and is one of the most conspicuous corals of the Hudson River group of North America. Whilst its specific distinctness is beyond question, and its specific characters are most readily recognisable, there is, nevertheless, considerable doubt as to the name which it ought properly to bear. Milne Edwards and Haime, in their great work on the Palæozoic Corals, regard *Favistella stellata* (Hall) as identical with *Columnaria alveolata* (Goldfuss), and in this they are almost certainly right. As we have already seen, the name of *Columnaria* was originally given by Goldfuss to a group of corals with a complete septal system. In spite, however, of the clearness with which this fact was brought out in the descriptions and figures of the German observer, McCoy and most subsequent palæontologists insisted that this was an error, and that the septa in the genus *Columnaria* were marginal and rudimentary; and this view has been generally adopted. The result of this has been that a very abundant Trenton Limestone coral, which possesses merely rudimentary septa, has been universally recognised by American palæontologists as *Columnaria alveolata* (Goldfuss), and has been generally accepted as the type of the genus *Columnaria*.

It is quite certain, however, that the Trenton Limestone coral just alluded to is *not* the form described originally by Goldfuss, and carefully figured by him under the name of *Columnaria alveolata* (Petref. Germ. Pl.XXIV. Fig. 7). On the contrary, the latter is almost certainly identical with the coral subsequently described by Hall under the name of *Favistella stellata*. This is rendered the more certain by the fact that the specimens of *Columnaria alveolata* described by Goldfuss are said to come from the shores of Seneca Lake, in the State of New York, where the Lower Silurian rocks do not occur in place; so that they must have been derived from a travelled boulder. This also would harmonize with the assertion of Edwards and Haime, that *Columnaria alveolata* (Gold.) and *Favistella stellata* (Hall) are one and the same coral.

Whilst fully believing that these two corals, as described by their original discoverers, are identical, it nevertheless remains certain that the corals now recognised universally in America as *Columnaria alveolata* and *Favistella stellata* are entirely distinct from one another, specifically if not generically. It remains, therefore, to consider what course is to be adopted in practice as to the nomenclature of these forms. If the strict law of priority, with its utmost rigour, is to be carried out, then the name of *Favistella stellata* must be abandoned; the coral now known by this name must be called *Columnaria alveolata* (Goldfuss); and the coral to which this latter title has been generally applied will have to be baptised by some quite new name. As to the strict justice of this proceeding there can be little doubt; and those who attach great importance to the rigid enforcement of the law of priority will doubtless carry this proceeding into actual practice. For my own part, I think less confusion would be caused by the adoption of another, if less strictly regular, course. The name of *Columnaria alveolata* has now by general consent become attached to an abundant and well-known coral from the Trenton Limestone. To abandon this arrangement would be productive of much confusion: and I would therefore leave this coral in possession of this name, although it is the *Columnaria alveolata* of McCoy and Hall, and not of Goldfuss. On the other hand, the coral described by Hall from the later formation of the Hudson River group under the name of *Favistella*

stellata, though almost certainly identical with the original *Columnaria alveolata* of Goldfuss, may be allowed to retain its specific name; and it may be left in the meanwhile an open question whether it should be called *Favistella stellata* or *Columnaria stellata*.

With regard to the species of *Favistella*, now for the first time described as *F.* , the present form is distinguished by its much larger size, the prismatic form and complete amalgamation of the corallites, and the increase of the corallum by fission of the tubes.

Locality and Formation.—Hudson River group, River Credit, and Manitouwaning.

50. Favistella calicina (Nicholson).

Fig. 9.

Favistella calicina (Nicholson), Brit. Assoc. Report, Belfast, 1874.

Corallum, sub-hemispheric or pyriform, not attaining a large size. Corallites more or less cylindrical, rarely prismatic, in shape; from less than one to two lines in diameter, averaging about one and a half lines. The corallites are never completely amalgamated by their walls, and are rarely in direct and actual contact throughout their entire height. Each corallite, on the other hand, is enveloped in a complete and separate epitheca, and as they diverge from the base, they are generally separated by more or less conspicuous intervals as their calices are approached. Epitheca of the corallites with strong vertical ridges, of which four or five occupy the space of one line, and also with regular encircling striæ and grooves. Septa alternately large and small, twenty-eight in number altogether, the primary ones being continued over the upper surfaces of the tabulæ to near the centre of the corallites, whilst the secondary ones are marginal and rudimentary. Tabulæ well developed and complete, about three in the space of one line. Increase by calicular gemmation, combined with parietal budding.

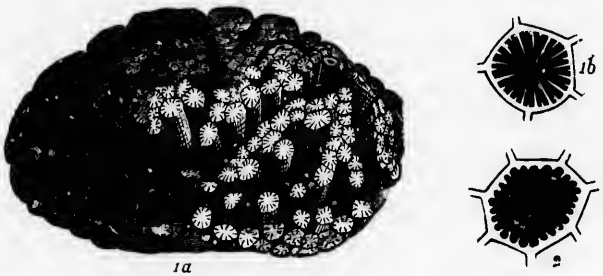


Fig. 9.
1a, *Favistella calicina* (Nich.) 1b, Calice of one of the corallites of the same enlarged. 2. Calice of *Columnaria alveolata* enlarged. Hudson River Group.

This pretty little species is very distinct from *F. stellata* (Hall), from which it may be readily separated by the following characters:—1. It is much more diminutive in average size than *F. stellata*, its colonies rarely exceeding three inches in diameter and two inches in height, a.. being often much smaller than this. 2. The corallites are comparatively lax and discrete in their mode of growth. Rarely they may be more or less contiguous and prismatic in form. More usually, they are cylindrical or sub-cylindrical, and, as they radiate from the base, become more or less widely separated towards their terminations. Hence, the surface of a mass of *F. calicina* often presents an appearance similar to the convolutions of the human cerebrum or to a colony of *Fascicularia*. 3. The corallites are never completely amalgamated by their walls, but each on the contrary, is enclosed on a strong and very distinct epitheca, which carries powerful vertical ridges and fine encircling striæ. 4. The increase of the colony is effected

by means of calicular gemmation, with or without lateral budding, and not by means of fission of the old tubes.

If the genus *Favistella*, in accordance with the remarks laid down in treating of *F. stellata*, be subsequently abandoned, then this species will take the name of *Columnaria calicina*

Locality and Formation.—Very abundant in the Hudson River group, Credit River.

Genus COLUMNOPORA (Nicholson).

Corallum aggregate, massive, composed of hexagonal corallites, which have distinct walls, but are firmly united with one another. Septa well developed and close set, but short and not nearly extending to the centre of the visceral chamber. A row of large and closely approximated mural pores between each pair of septa. Tabulæ horizontal, not vesicular or infundibuliform, complete. Epitheca unknown. No cœnenchyma, nor columella.

I have established this genus for the reception of some beautiful corals from the Hudson River group of Canada and the corresponding formation (Cincinnati group) of Ohio. The genus in most respects may be regarded as intermediate between *Favosites* and *Columnaria*, agreeing with both in the general form of the corallum, the prismatic closely-approximated corallites, and the absence of any cœnenchyma. *Columnopora* further resembles *Favosites* in possessing mural pores, but it is distinguished by its distinct and comparatively well-developed septal system, and by the fact that the mural pores are arranged in very numerous rows and are of very large size, so that the walls of the corallites have a regularly *cribriform* aspect. With *Columnaria*, as this genus is usually understood, *Columnopora* agrees in possessing distinct septa, but is fundamentally distinguished by the perforated walls of the corallites. Lastly, *Columnopora* is distinguished from *Favistella*, not only by the possession of mural pores, but also by the much less developed condition of the septa. The following is the only species of the genus which has as yet been noticed.

51. COLUMNOPORA CRIBRIFORMIS (Nicholson).

(Ref. Geological Magazine, June, 1874.)

Corallites mostly hexagonal or pentagonal in shape, averaging about one line and a half in diameter, sometimes more or less. Septa in the form of strong vertical ridges, from twenty to twenty-four in number, equally developed, and never reaching the centre or extending more than quite a short distance into the interior of the corallite. Between each pair of septa is a row of large circular or oval mural pores, so that there are from twenty to twenty-four rows of these openings in each corallite, generally four rows on each face. Not only are the rows very numerous, but the pores are extraordinarily large, and are placed close together, about three of them occupying the space of one line measured either vertically or transversely. The walls of the corallites thus assume a completely cribriform appearance, looking as if composed of a series of vertical pillars (the septa), united by horizontal cross-bars. Tabulæ, in perfect specimens, complete, from three to four in the space of one line.

Superficially this coral is very like that usually regarded as *Columnaria alveolata* (Goldfuss), both as regards the general form of the corallites, and the dimensions and characters of the septa. It is, however, at once distinguished by the mural pores. From all the massive species of *Favosites*, the present form is distinguished by the well-marked septa, and the large size, great number, and close approximation of the pores. From *Favistella stell-*

it is separated by its comparatively rudimentary septa and perforated walls. Lastly, from *Michelinia*, it is distinguished by not having vesicular tabulæ, by the larger and more closely set mural pores, and the much better developed septal system.

In the specimens which originally came under my notice, the tabulæ were incomplete, and nothing was left of them except their bases. A similar state of things is quite common in *Favosites* and *Columnaria*, and I surmised at the time that this was merely accidental and due to the condition of preservation. I have now obtained specimens from Ohio which fully confirm this surmise, and which show that the tabulæ of this form were really complete and in all respects well-developed.

Locality and formation.—Rare in the Hudson River group, River Credit (discovered by Mr. George Jennings Hinde). Not very uncommon in the Cincinnati group, south-western Ohio.

Genus STREPTELASMA (Hall).

Corallum simple, turbinate, free; epitheca well developed. Septa well developed, twisted and united with one another towards the centre of the visceral chamber, where they often form a kind of vesicular tissue. No columella, nor dissepiments. Tabulæ remote, irregular, and poorly developed. A single septal fossette.

This genus stands on a somewhat dubious position, but I see at present no other option but to retain it, if *S. corniculum* (Hall) is to be taken as a type of the genus. The badly characterised genus *Petraia* (Münst), is said to have no tabulæ; otherwise *Streptelasma* would certainly have to be regarded as a synonym of this; as has been proposed by McCoy and Billings. On the other hand, Milne Edwards and Haime declare (Brit. Foss. Cor. Introduction, p. xviii.) that *Streptelasma* is characterised by the fact that the wall is "destitute of an epitheca and covered by sublamellar costæ." This statement I am unable to comprehend, as all the specimens of *Streptelasma corniculum* which have come under my notice, have the epitheca remarkably well developed, except when they have been much weathered. Lastly, from *Cyathophyllum* proper, the genus *Streptelasma* is distinguished solely by the total absence of dissepiments and the comparatively rudimentary condition of the tabulæ.

52. STREPTELASMA CORNICULUM (Hall).

Streptelasma corniculum (Hall), Pal. N. Y. Vol. I., Pl. XXV., Figs 1 *a*—1 *e*.
Streptelasma crassa (Ibid.), Pl. XXV., Figs, 2 *a*—2*e*.
Streptelasma multilamellosa (Ibid.), Pl. XXV., Figs. 3 *a*—3 *c*.
Streptelasma parvula (Ibid.), Pl. XXV., Figs. 4 *a*—4 *c*.
Streptelasma corniculum (Edwards and Haime), Pol. Foss. des Terr. Pal., Pl. VII., Fig. 4.

Corallum conical, slightly curved or nearly straight, averaging from one to four inches in length, and from ten to eighteen lines in diameter. Septa numerous, from ninety to one hundred and sixty in number, alternately large and small. The small septa rarely extend much beyond the margin; but the large ones extend to the centre, in approaching which they become more or less twisted and unite with one another, in such a manner as sometimes to produce a central mass of vesicular tissue. Calice moderately deep. Septa very thick, and often appearing as if composed of two coalescent lamellæ. Tabulæ remote and irregular, often elevated towards the centre of the coral. No dissepiments. A single septal fossette, usually placed on the curved side of the coral. Epitheca exhibiting longitudinal ridges cor-

reponding with the septa, but otherwise smooth, or, rarely, with a few encirling shallow folds of growth.

This species, if I have rightly referred to it all the specimens here placed, is very variable as regards its size, the amount of curvature, and the number of the septa. The following are the dimensions of a number of apparently typical examples:—

1. Length four inches; diameter at summit nearly one inch and a half. Septa one hundred and sixty in number, alternately large and small. This is the largest specimen observed by me, but it is imperfect above.

2. Length over three inches; diameter at summit fourteen lines; septa one hundred and twenty-six, alternately large and small.

3. Length one inch and a half; diameter at summit fourteen lines. Septa one hundred and twenty-six, alternately large and small. The specimen is broken above.

4. Length one inch and a half; diameter at summit ten lines. Septa one hundred and fourteen alternately larger and smaller. This is a less broadly expanding example than the preceding.

5. Length one inch; diameter at summit nine lines. Septa ninety-six, alternately large and small.

6. Length fourteen lines; diameter at summit nine lines. Septa ninety, alternately large and small.

7. Length six lines; diameter at summit four and a half lines. Septa thirty, all equal and large sized. I do not feel at all sure whether this last specimen is the young of *S. corniculum* or a distinct species. It appears to be the *S. parvula* of Hall.

The above measurements are taken from specimens collected in the Cincinnati group of Ohio, and all the Canadian examples that I have seen are of comparatively small size, averaging about one inch and a half in length.

The average number of the septa in a typical example would seem to be about one hundred and twenty. Hall gives the number at sixty, but he, probably, in this enumeration, neglected the small and rudimentary septa which alternate with the large ones. Hall gives, however, one hundred and twenty septa as the number in his *S. multilamellosa*, which would appear to be identical with *S. corniculum*.

Locality and Formation.—Hudson River group, Manitouwaning, Georgian Bay.

Genus Tetradium (Dana).

"Coralla massive, consisting of four-sided tubes and cells with very thin septa or parietes; cells stellate, with four narrow laminæ."

"This genus is near Receptaculites, but differs in having very thin parietes, and four distinct rays between the cells, one to each side. The specimen answering to the description is a fossil of uncertain locality in the collections of Yale College, New Haven. The cells are about half a line in breadth." (Dana, Zooph. vol. VIII., p. 701, 1846).

To this description, Prof. J. M. Safford (Amer. Journ. Sci. and Arts, 2nd Series, vol. XXII., p. 236, 1856) adds the following:—"The tubes in the different species vary from $\frac{1}{4}$ line to nearly one line in breadth; they are very long and are most frequently united throughout laterally, forming massive coralla, resembling more or less those of *Favosites* or *Chætetes*; sometimes, however, they are united in single intersecting series, as in *Halysites catenulata* (Linn.);

not unfrequently, too, the tubes are isolated, or only united at irregular intervals, thus forming loose fasciculated coralla resembling certain forms of *Syringopora*." Safford further states that *isolated* tubes are nearly quadrangular, with more or less rounded edges, and a slight external longitudinal depression opposite to each of the septa. The walls are more or less rugose; and increase is by fission of the old tubes. Only one specimen was seen in which tranverse septa (tabulæ) were recognised, and these were confined to one end of the mass and distant about twice the breadth of the tubes. Prof. Safford regards the genus as intermediate between the Favositidæ and the Rugosa, the quadripartite character of the septa sufficing to place it in the latter group. Four species of the genus were described.

Upon the whole, Safford's views as to the nature of this curious genus, and its intimate structure can be safely accepted. The existence of tabulæ, however, in the specimens which I have examined, so far from being exceptional or difficult to demonstrate, could almost invariably be made out with the utmost ease. The genus is most nearly allied to *Chætetes*, (Fischer,) but differs in its possession of four septa, and in the somewhat petaloid shape of the corallites as seen in transverse section. *Tetradium fibratum* has been enumerated from the Trenton Limestone of Canada (Billings, "Geology of Canada," p. 139, fig. 71); but I have not been able to identify it with complete certainty. In the Hudson River group of Ontario, however, there occurs very abundantly a species of *Tetradium*, which I have identified with *T. minus* (Safford).

53. Tetradium minus (Safford).

Tetradium minus (Safford), Amer. Journ. Sci. and Arts, 2nd Series, vol. XXII., p. 238.

Corallum massive, hemispheric, or amorphous, composed of slender, closely approximated tubes, which diverge from the base, or from an imaginary axis. Corallites of great length, sometimes exceeding three inches, with a width of from one-third to one-fourth line; their walls tolerably thick, and their shape irregularly four-sided or five-sided. The septa are badly preserved, and can only be occasionally detected; they vary in number from one to four. Tabulæ very well preserved, remote, complete, from three to five occupying the space of one line.

I should think it questionable if the specimens from which the above description is taken, are really distinct from *T. fibratum;* but I have thought it best to keep them separate in the meanwhile, since they agree with *T. minus* (Safford), and differ from the former species, in the small size of the corallites, of which three or four occupy the space of one line. They also differ from *T. fibratum*, as described by Safford, in the greater closeness of tabulæ, these structures being generally quite readily recognisable. On the other hand, the peculiar septa of the genus can only be occasionally detected, and the corallites in polished transverse sections appear rhomboidal, rounded, reniform, shaped like a trefoil-leaf, or sometimes shaped like a flower with four petals.

Locality and Formation.—Abundant and attaining a large size in the Hudson River group of the River Credit, and at Manitouwaning. Also in the Cincinnati group of Cincinnati, Ohio.

Genus Chætetes (Fischer).

Corallum varying very much in form, but always aggregate, and composed of prismatic basaltiform corallites, sometimes more or less cylindroidal. Wall imperforate; tabulæ numerous and well developed. Septa absent or rudimentary.

The genus *Chætetes* was originally founded on an error, since Fischer believed it to differ from *Favosites* in the absence of tabulæ, which is not the case. Lonsdale (Geology of Russia, Vol. I., Appendix A.), pointed out that this was a mistake, and expressed the opinion that *Chætetes* might be separated from *Favosites* by the absence of mural pores, and by the fact that the walls of the corallites are inseparably united, so that fractures expose the *interior* of the corallites. This last-mentioned phenomenon is due to the fact that in *Chætetes radians*, the type-species of the genus, the young corallites are produced fissiparously by the subdivision of the parent tubes; whereas in *Favosites* the new corallites are produced by gemmation from the sides of the old ones. Later observers, however, included under the head of *Chætetes*, various corals in which the increase was by gemmation, as in *Favosites*, and in which a rough fracture exposed the *exterior* of the tubes. To remedy this, D'Orbigny (Prodrome de Paléont, Vol. I., p. 25) proposed to separate from *Chætetes* these forms in which the increase was by gemmation, and to constitute for their reception a new genus for which he proposed the name of *Monticulipora*. The confusion thus caused was further increased by the fact that Lonsdale had previously founded a genus which he termed *Stenopora*, in which the corallum was in all essential respects similar to that of *Chætetes*, but in which the increase was effected by gemmation. Without entering further into this complicated question, I may simply state that it appears to me to be advisable to re-unite the genus *Chætetes* and *Monticulipora*, abandoning the name of the latter altogether. At the same time, without pronouncing any opinion as to the affinities of the coral upon which Lonsdale originally founded his genus *Stenopora*, it appears to me that the forms which have been referred to this genus by later palæontologists can not be separated from *Chætetes* (including *Monticulipora* under this head). Finally, the genus *Nebulipora* (McCoy) is to be regarded as a synonym of *Chætetes* as above defined.

The species *Chætetes* may be roughly divided into four groups:—1. *Ramose forms*—In these the corallum is ramose or dendroid, the corallites of the branches springing in a radiating manner from an imaginary axis. The corallum is usually rooted at the base (in *C. briareus*, Nich., it is apparently free), and the extremities of the branches are rounded. Some of the forms of this group are slender, others are more or less swollen and tumid; and these latter seem to constitute a transition into certain lobate forms, which may be variously regarded as the last term of the ramose series or the first term of the massive series.

Frondescent Species:—In these, the corallum forms a flattened or undulating expansion, often sub-palmate or palmate, and composed primitively of two layers of corallites, the bases of which are in contact, and which are directed in opposite directions from a common calcareous membrane. The corallum is rooted at the base, with which exception the entire surface on both sides is both covered by the calices. In old examples, additional strata of corallites appear to be superimposed upon the two primitive layers, in some instances at any rate, and the corallum thus passes into the massive form.

3. *Massive Species.*—Corallum free or fixed, massive, discoidal, hemispherical, spherical, or irregular in shape. The typical forms of this group have the inferior surface of the corallum more or less concave, and covered with a concentrically striated epitheca, and these forms must have lived a free existence. Others are fixed by their basis to some solid object, and the mode of life of other examples is unknown. The massive species of *Chætetes* pass on

the one hand, by almost invisible gradations, into the ramose, and on the other hand, they show a well-marked transition into the frondescent group.

4. *Encrusting Species.*—In these the corallum is parasitic, and forms a thin crus usually consisting of a single stratum of corallites, growing upon various foreign objects, such as the epitheca of corals or the shells of Brachiopods. In this group the corallites are excessively short, whereas in general they have a length considerably exceeding their diameter.

Species of *Chætetes* are extraordinarily abundant in the Lower Silurian Rocks of North America, apparently attaining their maximum in the Cincinnati group. In the Hudson River group of Canada, of the corresponding age, the number of species hitherto detected is not so large, but the number of individuals is very great.

54. Chætetes Fletcheri (Edwards and Haime).

Favosites spongites (pars.); Lonsdale, in Murchison, Silur. Syst.,pl.XV., bis. Figs.9,9*a*,9*b*.
Chætetes Fletcheri (Milne Edwards and Jules Haime), Pol. Fos. des Terr. Pal. p. 271.
Chætetes lycoperdon (pars) ; (Hall) Pal. N. Y. Vol. II. p. 40, Pl. XVII. figs. 1*g*—*i*.
Monticulipora Fletcheri (Edwards and Haime) ; Brit. Foss. Corals, p. 267.
Chætetes Fletcheri (Nicholson) ; Quart. Journ. Geo. Soc. Lond., Vol, XXX., Pl. XXIX., Figs. 6—6*a*.

Corallum ramose ; branches cylindrical or sub-cylindrical, dividing dichotomously, usually at somewhat remote intervals, often irregularly swollen here and there, from one and a half to three lines in diameter. Corallites with moderately thick walls, unequally sized, the average ones being about eight in the space of one line. Interspersed with the ordinary corallites, in well-preserved specimens, are others of exceedingly minute size. Surface smooth, destitute of tubercles, but occasionally showing groups of corallites very slightly larger than the average.

This species is very closely allied to *C. pulchellus* (Edw. & H.), but differs in not having distinct groups of corallites of a much larger size than the average. It is the most common and characteristic form of the Hudson River group of Canada, When it occurs in some beds of this formation it very readily weathers out, leaving a series of sinuous and intersecting tubes in the rock, which, unless closely examined, might very readily be mistaken for the burrows of worms.

Locality and Formation.—Hudson River group, River Credit, Don Mills near Toronto, Weston, Manitouwaning, &c.

55. Chætetes delicatulus (Nicholson).

Chætetes delicatulus (Nicholson), Quart. Journ. Geol. Soc. Lond., Vol. XXX., Pl. XXIX., Figs. 8—8*b*.

Corallum very slender and delicate, ramose, of cylindrical branches terminating in rounded and sometimes swollen extremities, and occasionally seeming to spring from a horizontal footstalk. Stems sometimes simple, more commonly dichotomously branched at acute angles, from one quarter of a line to half a line in diameter, rarely reaching two-thirds of a line. Corallites very oblique to the surface, opening by oval apertures, the length of which corresponds with the axis of the stem and exceeds the breadth. Calices arranged in diagonal

rows, about eight in one line measured longitudinally, and twelve or fourteen in the same space measured transversely or diagonally. When perfect, the lower lip of the calice is thin and prominent. The cells are all of equal size, without minute intermediate tubuli, and the surface is destitute of monticules.

This is one of the commonest fossils of the Hudson River group both in Canada and the United States. It is probably identical with one of the forms figured by Hall, from the Trenton Limestone under the name of *Chætetes lycoperdon* (Pal. N. Y., Vol. I, Pl. XXIV, fig. 1 *k*, cæt, excl.). It is also, I think, certainly, one of the forms which has usually been quoted as *Stenopora fibrosa* (Goldfuss). It is readily recognised by its slender habit, uniformly sized calices, and oblique corallites.

Locality and Formation.—Hudson River group, Weston, Toronto, River Credit, Georgian Bay, &c.

Chætetes petropolitanus. (Pander).

(Plate IV, Figs. 3—4.)

Favosites petropolitanus (Pander), Russ. Reiche, p. 105, Pl. I, Figs. 6, 7, 10, 11.

Calamopora fibrosa (pars), (Goldfuss), Petref. Vol. I, p. 215, Pl. LXIV, fig. 9.

Favosites lycopodites (Vanuxem), Geol. of New York, 3rd Part, p. 46, fig. 3.

Chætetes petropolitanus (Lonsdale), in Murch., Vern., and Keys, Russ. and Ural, Vol. I, p. 596, Pl. A., fig. 10.

Favosites petropolitana (McCoy), Syn. of the Silur. Foss. of Ireland, p. 64, Pl. IV, fig. 21.

Chætetes lycoperdon (Hall), Pal. N. Y., Vol. I, Pl. XXIII, Fig. 1, and Pl. XXIV, Figs. 1 *a*—*h* and Vol. II, Pl. XVII, Figs. 1, *a*—*f*.

Chætetes rugosus (Ibid), Vol. I., Pl. XXIV., Fig. 2.

Chætetes petropolitanus, lycoperdon and *subfibrosus* (D'Orbigny), Prodr. de Paléont., Vol. I, pp. 25 and 108.

Chætetes petropolitanus (Edwards and Haime), Pol. Fos. des Terr., Pal. p. 263.

Monticulipora petropolitana (Edwards and Haime), Brit. Foss. Corals, p. 264.

Chætetes petropolitanus (Nicholson), Quart., Journ. Geol. Soc., Vol. XXX, Pl. XXX, Figs. 5—8.

"Corallum in general free; its basal plate flat or concave and completely covered with a concentrically wrinkled epitheca. Upper surface regularly convex, in general hemispherical and presenting obtuse tuberosities, about one line broad and varying much in height. In some specimens these tuberosities appear to have been worn away, and their existence is indicated only by the presence of small groups of large calices with thick walls; the calices are rather unequal in size, generally polygonal, sometimes almost circular; the largest are about one-fifth of a line in diameter; the walls are not perforated; the tabulæ are horizontal, complete, and placed at about one-twelfth of a line from each other. Some vestiges of septa are often visible. Young specimens are flat and discoidal." (Edwards and Haime.)

The Trenton and Hudson River formations, but more especially the former, yield a great many examples which correspond with the above description in essential characters, some altogether so, others with more or less striking variations. In external form this species is protean, being more or less discoidal when young, but being, when adult, sub-spherical, hemispherical, sub-pyriform, lobate, mushroom-shaped, or not uncommonly of the shape of a cardinal's

hat. The surface is sometimes mammillated with obscure and blunt tuberosities or elevations of variable height and form ; but quite commonly it is perfectly smooth. As a rule, no definite groups of large sized corallites can be recognised, and in all the typical specimens, which I have examined, the calices are polygonal or sub-polygonal, generally from eight to ten in the space of one line, and without any very minute intermediate tubuli.

Typical examples of *C. petropolitanus* can be recognised without difficulty by their concave under-surface (showing that the coral was free), concentrically-situated epitheca, and rounded and more or less elevated upper surface. We have, however, to bear in mind the following points:—

1. The very common corals of the Hudson River group of Canada which have generally been referred to as the "puff-ball variety" of *Stenopora fibrosa*, only occasionally exhibit the typical characters of *Chætetes petropolitanus*. Most commonly (Pl. IV, Figs. 2—2*a*) they do not exhibit a concave base covered with an epitheca, but on the contrary are more or less spheroidal in shape, and are composed of corallites radiating in all direction from a central point. In other cases, they are certainly not free, but can be shown to have grown parasitically upon the column of a Crinoid, which passes through their centre.

2. The Cincinnati group of Ohio yields a number of forms which agree, in most respects with *C. petropolitanus*. but which were attached to the exterior of Brachiopods and other foreign bodies. These forms have, therefore, no concave base or concentrically wrinkled epitheca, but have the form of hemispherical, sub-spherical, or nodulated masses, usually of inconsiderable size.

3. To the genus *Lichenalia* of the Lower and Upper Silurian have been often referred the concentrically striated epithecæ of this and allied species of *Chætetes ;* the epitheca being commonly thin enough to allow of the bases of the superjacent corallites being seen through it.

Locality and Formation.—Common in the Hudson River group of Toronto, Weston, Credit River, Georgian Bay, &c. Also, in the Trenton Limestone.

57. Chætetes discoideus (James).

Chætetes discoideus (James), Catalogue of the Lower Silurian Fossils of the Cincinnati *Group*, 1871. (Named, but not figured or described).

Chætetes discoideus (Nicholson), Quart. Journ. Geol. Soc., Vol. XXX, Pl. XXX, Figs. 4—4*d*.

Corallum discoid, concavo-convex, sharp-edged, from five to eight lines in diameter, and from one to nearly two lines in its greatest thickness. Under surface concave, covered with a thin, smooth, or slightly wrinkled epitheca, which in general is so thin as to reveal clearly through its substance the bases of the overlying corallites. Upper surface gently convex, not exhibiting any tubercles or elevations of any kind. Corallites sub-equal; calices with moderately thin walls, polygonal, about eight or ten in the space of one line. No groups of larger corallites, nor any very minute intermediate tubuli.

I do not feel certain that this form is distinct from the young of *C. petropolitanus ;* but it differs in some points of importance, and it is at the same time both of common occurrence and very constant in its shape and dimensions. I think it is, therefore, safest to describe it under a separate title. Apart from its discoidal plano-convex form, it is distinguished by

its great comparative tenuity with the resulting shortness of the corallites, the sharp thin edges of the disc, the evenly and gently curved upper surface, the absence of surface-monticules or groups of large-sized corallites, and the thinness and smoothness of the epitheca. The corallum, of course, must have been free in habit. It is very closely allied to *Chætetes* (*Nebulipora*) *lens* (McCoy), with which I should have considered it to be identical, except for the fact that the latter species is described as possessing distinct groups of large-sized corallites.

Locality and Formation.—Not uncommon in the Hudson River Group at Weston. Also in the Cincinnati Group of Ohio.

58 Chætetes undulatus (Nicholson).

The lobate and sub-massive form of *Chætetes*, which I have briefly noted in speaking of the corals of the Trenton Formation under the provisional name of *Chætetes undulatus*, is far from uncommon in the Hudson River Group. Whether it is really a distinct species, or a lobed and fixed form of *C. petropolitanus* (which I think very unlikely), or a sub-massive variety of one of the ramose species, the materials in my hands do not allow me to decide.

Locality and Formation.—Hudson River Formation; River Credit, and Weston.

59. Ptilodictya Schafferi (Meek).

Fig. 4.

Ptilodictya Schafferi (Meek), Proc. Acad. Nat. Sci., Philadelphia. Feb. 1872, and Palæontology of Ohio, Vol. I. p. 69, Pl. V, Figs. 1*a-c*.

"Polyzoum small and delicate, consisting of slender compressed divisions that give off on each side rather closely arranged, regularly alternating, lateral branches of the same breadth as the main stems, from which they diverge at an angle of about forty degrees; lateral branches, in the same way, giving off on each side, very short, lobe-like, alternating projections; flattened lateral margins of all parts very narrow, sharp, and minutely striated longitudinally, in well-preserved specimens; pores apparently without raised margins, more or less oval longitudinally, alternately disposed in longitudinal and oblique rows, so as to present a quincuncial arrangement; the number of longitudinal rows varying from five to about seven in the breadth of a stem or branch; spaces between the pores, measuring transversely to the stems and their divisions, about equal to the breadth of the pores, but greater, measuring in the direction of the oblique and longitudinal rows, all ornamented, in perfectly preserved specimens, by very minute more or less waved or flexuous striæ." (Meek).

Breadth of stems and branches from one twentieth of an inch to nearly one line. Cells about six or seven in one line measured longitudinally, and eight to ten in the same space measured obliquely.

This species is readily recognised by its mode of growth, the remote cells, and the beautifully striated intercellular spaces. Though not previously recorded from Canada, I have detected it in considerable numbers in the Hudson River beds of the River Credit. It is a well known species from the Cincinnati Group of Ohio.

Locality and Formation.—Hudson River Group, River Credit.

60. LEPTÆNA SERICEA (Sowerby).

Fig. 10*e*.

Locality and Formation.—Very abundant in the Hudson River Group, River Credit; Lake Shore, Toronto; Weston; and Don Mills, Toronto.

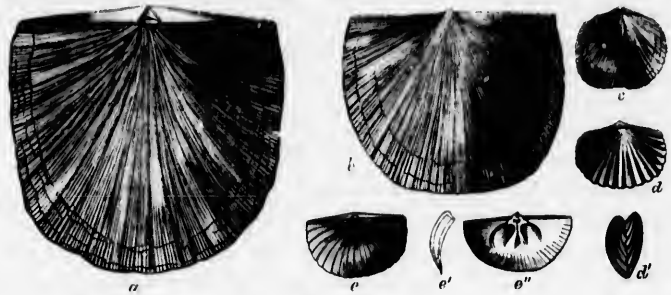


FIG. 10.

a, Dorsal valve of *Stuphomena alternata* (Conrad). *b*, Dorsal valve of *Stuphomena filitexta* (Hall). *c*, Dorsal valve of *Orthis testudinaria* (Dalman). *d*, Dorsal valve of *Orthis plicatella* (Conrad). *d'*, Profile of the same. *e*, *Leptaena sericea* (Sow.); dorsal valve. *e'*, Profile view of the same. *e''*, Interior of the dorsal valve of the same. Hudson River Group.

61. STROPHOMENA ALTERNATA.

Fig. 10*a*.

(*Ref.* Pal. N.Y., Vol. I, Pl, XXXI and Pl. LXXIX, Fig. 4.)

Locality and Formation.—Abundant in the Hudson River Group, Weston.

62. STROPHOMENA FILITEXTA.

Fig. 10*b*.

(*Ref. Leptæna filitexta* (Hall), Pal. N. Y., Vol. I, p. 111. Pl. XXXI B., Figs. 3 *a-f*).

This species is very closely related to *S. alternata*, from which, however, it may be distinguished without difficulty by the fact that the radiating striæ are nearly uniform in size, whilst the fine concentric striæ are so conspicuous as to give the surface a woven appearance.

Locality and Formation.—Abundant in the Hudson River Group, Weston; and Wood Point, Georgian Bay.

63. ORTHIS TESTUDINARIA.

Fig. 10*c*.

Locality and Formation.—Hudson River Group, Weston,

64. DISCINA SP.

A single valve of a species of *Discina* or *Orbiculoidea* was collected by Mr. George Jennings Hinde from the Hudson River Group at Weston. The specimen is the free valve, and is conical and moderately elevated. The apex is nearly or quite central, and the surface is covered with strong rounded concentric ridges, separated by about their own width. The diameter of the valve is four lines, and its height is about one line. I know of no species to which this could be certainly referred, but the material in my hands is insufficient for its determination.

Locality and Formation.—Hudson River Group, Weston.

65. AMBONYCHIA RADIATA (Hall).

Fig. 11 *d*.

(*Ref.* Pal. N.Y., Vol. I. p. 292, Pl. LXXX, Figs. 4, *a*, *b*.)

Locality and Formation.—Abundant in the Hudson River Group, Weston; and Lake Shore, Toronto.

66. AVICULA DEMISSA (Conrad).

(*Ref.* Hall, Pal. N. Y., Vol. I. p. 292, Pl. LXXX, Figs. 2, *a*, *b*).

Locality and Formation.—Abundant in the Hudson River Group, Weston.

67. MODIOLOPSIS MODIOLARIS (Hall).

(*Ref.* Hall, Pal. N.Y., Vol. I, p. 294, Pl. LXXXI, Figs. 1. *a*—*g*.)

Locality and Formation.—Abundant in the Hudson River Group; Weston; and Lake-Shore, Toronto.

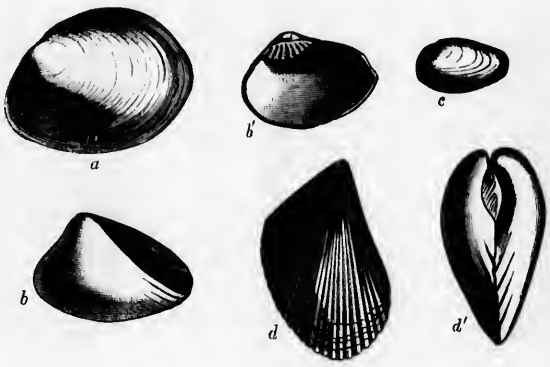


Fig. 11.

a, Cast of *Modiolopsis curta?* (Hall) *b*, *Lyrodesma poststriata* (Emmons), left valve; *b'*, interior of the same, showing hinge teeth; *c*, *Cleidophorus*, sp, probably *C. planulatus* (Hall); *d*, small specimen of *Ambonychia radiata* (Hall); d', Anterior view of the same. Hudson River Group.

68. MODIOLOPSIS CURTA (Hall).

Fig. 11 *a*.

(*Ref.* Pal. N.Y., Vol. I. p. 297, Pl. LXXXI, Fig. 4).

Locality and Formation.—Hudson River Group, Weston.

69. CLEIDOPHORUS PLANULATUS (Hall).

Fig. 11 *e*.

(*Ref.* Pal. N.Y., Vol. I, Pl. LXXXII, Figs. 9, *a*—*c*.)

Locality and Formation.—Hudson River Group; Lake-Shore, Toronto.

70. LYRODESMA POSTSTRIATA (Emmons).

Fig. 11 *b*.

(*Ref. Nucula poststriata,* Hall, Pal. N.Y. Vol. I, Pl. XXXIV, Figs. 2*a*, 2*b*. and Pl. LXXXII, Figs. 10*a*, 10*b*.)

Locality and Formation.—Common in the Hudson River Group, Weston.

71. MURCHISONIA GRACILIS (Hall).

(*Ref.* Pal. N.Y., Vol. I, Pl. XXXIX Figs. 4, *a*—*c*, and Pl. LXXXIII. Figs. 1*a*, and 1*b*.)

Locality and Formation.—Common in the Hudson River Group, Lake-Shore, Toronto.

72. CYRTOLITES ORNATUS (Conrad).

(*Ref. Cyrtolites ornatus*; Hall, Pal. N.Y. Vol. I., Pl. LXXXIV. Figs. 1 *a*—*g*).

Locality and Formation.—Common in the Hudson River Group, Weston.

73. TENTACULITES TENUISTRIATUS, (Meek and Worthen).

(*Ref.* Geology of Illinois, Vol. III, Pl. IV. Figs. 7*a*, 7*b*.)

Locality and Formation.—Rare in the Hudson River Group, Weston.

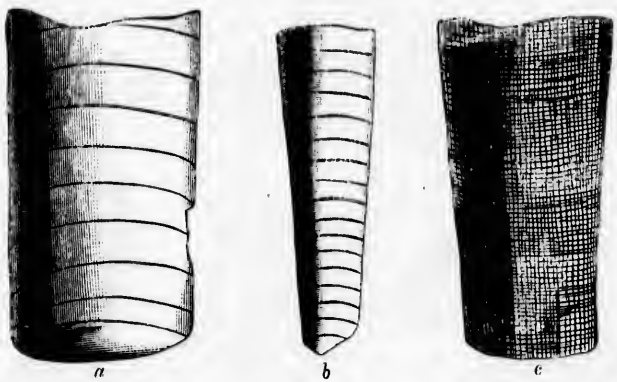


Fig. 12.

a, Fragment of *Orthoceras multicameratum* (Conrad?); *b*, Fragment of *Orthoceras lamellosum*, (Hall); *c*, Fragment *Endoceras proteiforme* (Hall). Hudson River Group.

74. ORTHOCERAS LAMELLOSUM (Hall.)

Fig. 12 *b*.

(*Ref.* Pal. N.Y. Vol. I, Pl. LXXXVI. Figs. 2, *a*—*d*.)

Locality and Formation.—Abundant in the Hudson River Group; Weston; Lake-Shore Toronto.

75. ENDOCERAS PROTEIFORME (Hall).

Fig. 12 *c*.

(*Ref.* Pal. N.Y. Vol. I, Pls. XLV to L and LIII.)

I have detected in the Hudson River Group examples showing the cross-striation of the surface, which is so characteristic of this species. I have, therefore, no hesitation in referring them here.

Locality and Formation.—Hudson River Group, Weston.

76. ORMOCERAS CREBRISEPTUM (Hall).

(*Ref.* Pal. N.Y., Vol. I, Pl. LXXXIV, Fig. 2*a* and Pl. LXXXVII, Figs. 2 *a*—*e*.)
Locality and Formation.—Hudson River Formation, Weston.

77. CALYMENE BLUMENBACHII (Brongniart).

Locality and Formation.—Hudson River Group ; Weston ; Lake-Shore, Toronto.

78. ASAPHUS PLATYCEPHALUS (Stokes).

(*Ref. Isotelus gigas*, Hall, Pal. N.Y., Vol. I, Pls. LX, LXIII and LXVI.)
Locality and Formation.—Hudson River Group, Weston.

FIG. 13.

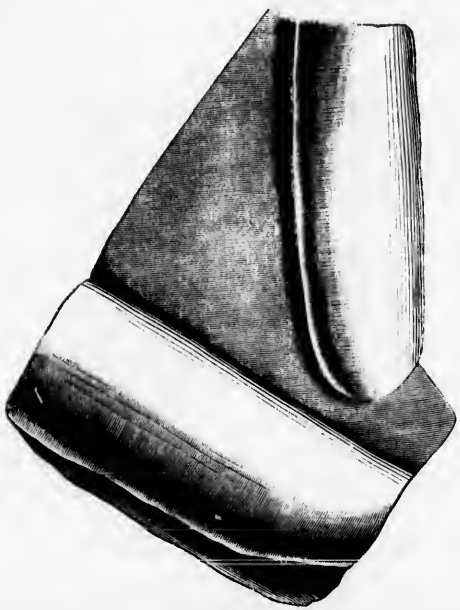


Fig. 13.

Palæophycus virgatus (Hall), of the natural size. Hudson River Group.

Fig. 14.

Rusophycus bilobatus (Hall), of the natural size Hudson River Group.

PALÆOPHYCUS VIRGATUS (Hall).

(*Ref.* Pal. N. Y., Vol. I., p. 263, Pl. LXX., Fig. 1).

Locality and Formation.—Hudson River Group, Weston. Common.

80. RUSOPHYCUS BILOBATUS (Hall).

FIG. 14.

(*Ref.* Pal. N. Y., Vol. II., p. 24, Pl. IX., Figs. 1, 2, 3).

Locality and Formation.—Hudson River Group, Weston.

81. DIPLOGRAPSUS HUDSONICUS (Nicholson).

Frond simple, diprionidian, from five to nine lines in length, its width being uniformly about two-thirds of a line, except in the immediate vicinity of the base. Base and distal prolongation of the axis unknown. Cellules narrow, about forty in the space of one inch, inclined to the axis at an angle of about 45°. Cellules free in the outer third of their extent, tapering somewhat to the cell-aperture, which is nearly or quite parallel with the axis of the frond. Lower lip of the cell-aperture furnished with a single, short, and straight spine.

Fig. 15.

a Fragment of *Diplograpsus Hudsonicus*, Nich., of the natural size. *a'* Portion of the same, enlarged. Hudson River Group.

This species is somewhat allied to the form which I described some years ago, under the name of *D. Harknessii*, (*Geological Magazine*, June, 1867, Pl. XI., Fig. 6). It appears, however, to be distinguished by characters of specific value. *D. Hudsonicus* differs from the typical *Diplograpsi*, in having the cell-mouth nearly parallel with the axis, instead of forming a considerable angle therewith. The presence of a short spine proceeding from the lower lip of the aperture is also a characteristic feature, together with the freedom of the outer portion of the cell, both above and below. From *Diplograpsus mucronatus* (Hall), the present species is distinguished by the fact, that the extremity of the cellule is broad and obtuse, with a short and straight spine attached to its lower border; whereas in the former species, the extremity of the cellule is drawn out into a fine tapering point, to which a delicate wavy spine is fixed.

Locality and Formation.—Hudson River Group; Lake-Shore, Toronto; Weston. The best examples in my possession were obtained by Mr. George J. Hinde, from a heap of Hudson River flags, which must have been brought to Toronto from some quarry on the River Humber.

CHAPTER III.

FOSSILS OF THE UTICA SLATES.

82. DIPLOGRAPSUS PRISTIS (Hisinger).

A diprionidian Graptolite, apparently identical with this well-known European species is common in the Utica slates of Whitby and Collingwood; but none of the specimens which have come under my observation, are in such a state of preservation as to render its determination absolutely certain.

83, CLIMACOGRAPSUS TERETIUSCULUS (Hisinger).

The Utica slates of the above-mentioned localities, yield also specimens of a *Climacograpsus*, which is probably identical with the common *C. teretiusculus*, (Hisinger). None of the specimens that I have seen, however, exhibit the base, and it thus remains uncertain whether they may not truly be referable to *C. bicornis* (Hall).

84. LINGULA PROGNE (Billings).

(*Ref.* Palæozoic Fossils of Canada. Vol. I., p. 47, Fig. 50).
Locality and Formation.—Abundant in the Utica slates of Whitby and Collingwood.

85. LEPTAENA SERICEA (Sowerby).

Locality and Formation.—Utica Slates, Whitby and Collingwood.

86. ORTHIS TESTUDINARIA (Dalman).

Locality and Formation.—Utica shales, Whitby and Collingwood.

87. ORTHIS PLICATELLA (Hall).

(*Ref.* Pal. N. Y., Vol. I., p. 122, Pl. XXXII., Figs. 9*a–g*).
Locality and Formation.—Utica shales, Whitby.

88. ENDOCERAS PROTEIFORME (Hall).

FIG. 12*c*.

The Utica shales of Whitby and Collingwood very commmonly yield a species of *Orthoceras*, which may be provisionally referred to the protean *Endoceras proteiforme* of Hall, var. *tenuistriatum*. The specimens in question are usually of a pointed triangular form, sometimes acutely so, sometimes with the lateral margins more nearly parallel. They are all extremely delicate in texture, as shown by the presence of a longitudinal depression, indicating where the shell has given way to pressure; and all are marked with fine encircling striae, without any evident longitudinal striae. The pointed examples might easily be referred to the genus *Theca*; but their Cephalopodous nature is rendered certain by the presence of distinct septa, which are placed about one and a half lines apart. It must be admitted, however, that these septa cannot by any means universally be recognized, though their existence in some examples is clear enough.

Locality and Formation.—Utica slates, Whitby and Collingwood.

89. TRIARTHRUS BECKII (Green).

(*Ref. Calymene Beckii;* Hall, Pal. N. Y. Vol. I. p. 237, Pl. LXIV. Figs. 2, *a. e.* and p. 250. Pl. LXVI., Figs. 2 *a — k*, and p. 250, Pl. LXVII., figs. 4, *a — e*.

Locality and Formation.—Abundant in the Utica shales of Whitby and Collingwood. Most commonly, the specimens consist of nothing more than the glabella with the fixed cheeks. I have only come across one perfect specimen, and that is a cast of the exterior.

90. ASAPHUS CANADENSIS (Chapman).

(*Ref. Asaphus Canadensis ;* Chapman, *Canadian Journal*, new series, Vol. III. p. 230.)

Locality and formation.—Extremely abundant in the Utica shales of Whitby and Collingwood. I have never seen a completely perfect specimen. The tails are the most abundant, but it is by no means unusual to meet with the detached glabella, the free cheeks, or the labrum.

91. BEYRICHIA, sp.

Locality and formation.—The Utica shales of Whitby and Collingwood contain, in enormous numbers, a little *Beyrichia*, which has not yet been specifically determined.

CHAPTER IV.

FOSSILS OF THE CLINTON FORMATION.

The fossils of the Clinton, Niagara, and Guelph formations constituted the subject of a joint memoir by Mr. George Jennings Hinde and myself, which was published in the *Canadian Journal* in the early part of 1874. With regard to the Guelph formation, in particular, I am now able to add a considerable amount of fresh information, derived partly from additional researches of my own on the spot, and partly from materials kindly placed in my hands by Mr. James Boyle, of the Public School of Elora, and Mr. John Wilkie, of Guelph; but with regard to the other formations in question, I shall freely avail myself of the memoir above referred to. As in so many other instances, my leisure has not allowed me, in the case of well known fossils, to do more than simply quote the same along with a leading reference ; but the more uncommon forms are noted at greater length.

92. BUTHOTREPHIS GRACILIS (Hall).

Buthotrephis gracilis, Hall, Pal. N. Y. Vol. II.. Pls. V. & V. bis.
Buthotrephis gracilis, Nicholson & Hinde, *Canadian Journal*, April, 1874.

Specimens, in all essential respects identical with the obscure fossils figured by Hall under this name, are far from uncommon in the Clinton Group. They are chiefly referable to the forms described under the titles of var. *intermedia* and var. *crassa*, and present themselves as branching flexuous bodies, sometimes in the form of hollow moulds or casts, at other times in the form of flattened impressions, differing in colour and texture from the matrix in which they occur. That these enigmatical bodies branch, after a more or less regular fashion, is indubitable, and it does not appear possible that they should have been produced by Annelides or other marine animals. If they are plants, however, their affinities are doubtful, and their mode of preservation very obscure.

Locality and Formation.—Clinton Group, Dundas and Hamilton.

93. SCOLITHUS VERTICALIS. (Hall).

Scolithus verticalis, Hall, Pal. N. Y., Vol. II., Pl. III, Fig. 3.
Scolithus verticalis, Nicholson and Hinde, *Canadian Journal*, April, 1874.

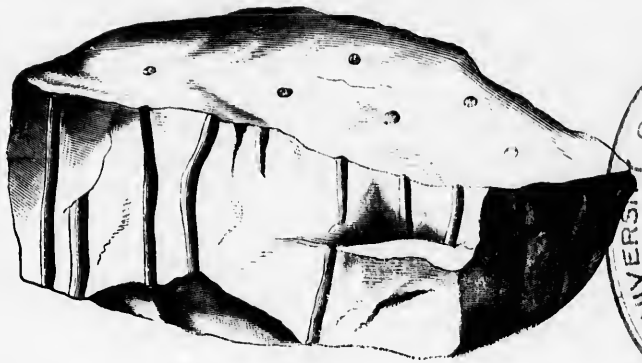


Fig. 16.
Burrows of *Scolithus verticalis*. (Hall), of the natural size, Clinton Formation.

This species is founded upon vertical circular tubes, sometimes slightly curved, which penetrate the strata more or less in a perpendicular direction, and which open on the surfaces of the laminæ of deposition by regular rounded apertures. The average diameter of the burrows is about one line, and their vertical extent is unknown. Often they are hollow; at other times they are more or less filled up with loose peroxide of iron; or they may be completely filled up with sediment, when they present themselves as smooth, rounded or cylindrical, vertical stems. That they are truly Annelide burrows can hardly be doubted. They differ from *Scolithus linearis*, Hall, in their smaller dimensions, and from *S. Canadensis*, Billings, in not having an expanded aperture, and in apparently not being curved towards their lower ends. The species is recorded by Hall from the thick-bedded sandstones of the Medina Group, of Monroe County, State of New York; but our examples are from a higher horizon.

Locality and Formation.—Clinton Group, Dundas.

94. ARENICOLITES SPARSUS (Salter).

Arenicolites sparsus, Salter, Quart. Journ. Geol. Soc. Vol. XIII, p. 203.

Arenicolites sparsus, Nicholson and Hinde, *Canadian Journal*, April, 1874.

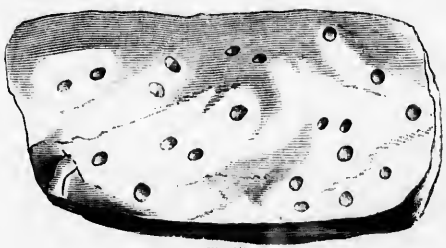


Fig 17.
Arenicolites sparsus, (Salter). Clinton Formation.

Paired burrows, with circular and comparatively remote apertures, are not unfrequent in the Clinton Group. They vary considerably in size; but they do not appear separable from *A. sparsus* of Salter, which commences in the lower Cambrian Rocks of the Longmynd, and is also not very rare in the Skiddaw Slates of the North of England. The mouths of the burrows vary from half a line to rather more than a line in diameter, and they are usually placed about a line apart.

Locality and Formation.—Clinton Group, Dundas.

Genus PLANOLITES (Nicholson).

(Gr. *planos*, a wanderer; *lithos*, stone.)

This name was formerly proposed by me. (Contributions to the study of the Errant

Annelides of the Older Palæozoic Rocks; Abstract, Proceedings of the Royal Society, No. 144, 1873.) for a group of fossils of constant occurrence in the sandy and shaly sediments of the Palæozoic Rocks, and consisting of the filled-up burrows of marine Annelides, more or less nearly allied to the existing lob-worms. These burrows are not vertical as in *Scolithus*, *Histiodermia*, *Arenicolites* and the like, but they are irregular in their course and direction, sometimes being more or less horizontal, then running obliquely, and then perhaps taking a vertical direction for a space. The actual burrows themselves are not now preserved to us, but we have in their stead the *fillings* of the burrows, consisting, in general, if not universally, of the sand and silt which has actually been passed by the worm through its alimentary canal. The fossils referred to *Planolites* consist, therefore, of *casts* of the burrows of marine worms formed by the ejecta of the animal, and they appear usually in the form of cylindrical or flattened stem-like bodies, which are often more or less matted together, and which may cross one another in every imaginable direction. From the filled-up burrows of *Scolithus* (which have actually been "burrows of habitation"), the burrows of *Planolites* are readily distinguished by the fact, that, though they often pass obliquely to the bedding so as to penetrate several layers of the rock, they are usually more or less nearly horizontal, and they are never vertical except for a short distance at some abrupt bend in their course.

The genus *Planolites* includes a large number of the supposed vegetable fossils from the Palæozoic Rocks which have been referred to the genera *Palæophycus* and *Chondrites*.

95. Planolites vulgaris (Nicholson).

Planolites vulgaris, Nicholson, Proc. Roy. Soc. No. 144, 1873.
Planolites vulgaris, Nicholson and Hinde, *Canadian Journal*, April, 1874.

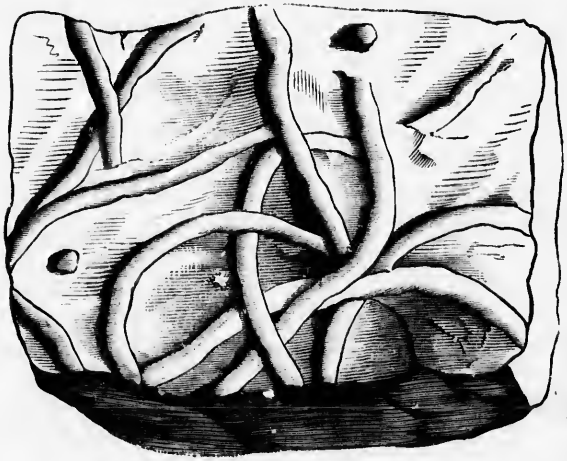


Fig 18.
Planolites vulgaris (Nicholson). Clinton Formation.

Fossil consisting of the casts of tortuous worm-tubes, which are usually of an irregularly cylindrical form, sometimes thickened in parts, and varying from a line to two or three lines in diameter. Surface smooth. Specimens referable to this widely diffused and variable species are common in the Clinton Rocks. They agree doubtless with some of the species of *Palæophycus* described by Hall and Billings from the Silurian Rocks of North America; but they are undoubtedly casts of the burrows of Annelides, and it seems better to abstain at present from any attempt to found separate species upon the innumerable varieties which they present.

Locality and Formation.—Clinton Group, Dundas.

96. STROMATOPORA HINDEI (Nicholson).

Stromatopora Hindei, Nicholson, Annals and Magazine of Natural History, Jan. 1874.
Stromatopora Hindei, Nicholson and Hinde, *Canadian Journal*, April, 1874.

The Clinton beds of Owen Sound yield examples of a large *Stromatopora*, which show no internal structure, but which exhibit large rounded oscula. These may be provisionally regarded as being referable to the above species, which will be noticed at length further on.

97. FAVOSITES SP.

A small hemispheric mass, with remarkably round thick-walled tubes, which are of nearly equal size throughout, and have a diameter of about two-thirds of a line. Tabulæ flat and tolerably remote. Allied to *F. Gothlandica*, Lam., but apparently distinct.

Locality and Formation.— Clinton Group, Owen Sound.

98. ZAPHRENTIS STOKESI (Edwards and Haime).

(*Ref.* Pol. Foss. des Terr. Pal. Pl. III, Fig. 9).

Common in the Clinton Group at Owen Sound. Also, or a nearly allied but smaller form, at Dundas.

99. HELIOLITES SP.

A form closely allied to and probably identical with *H. interstincta* (Wahl). but too much metamorphosed to permit of specific determination.

Locality and Formation.—Clinton Group, Owen Sound.

100. CHÆTETES FLETCHERI (Edwards and Haime.)

(For synonomy of this species, see the description of the species as occurring in the Hudson River Group. In the paper by Mr. Hinde and myself it was referred to under the name of *Chætetes lycoperdon*, Say., but I am now satisfied of its identity with the *Chætetes Fletcheri* of Edwards and Haime).

The massive and convex examples of *Chætetes* which Hall places under *C. lycoperdon*, and which are now generally regarded as belonging to *C. petropolitanus*, (Pander), have not come under my notice as occurring in the Clinton Group, though recorded in this position by Hall. On the other hand, the ramose examples which are probably identical with *Chætetes Fletcheri*, (Edw. and H)., are far from uncommon. They consist of cylindrical or subcylindrical branching or sub-palmate coralla, composed of numerous cylindrical or prismatic corallites which radiate obliquely from an imaginary central axis, and open on the surface by polygonal, oval, or circular calices. The walls of the corallites are thin, and there are about eight calices in the space of one line. The calices are for the most part of equal size, and there are no elevations or "mamelons" occupied by corallites of larger size than the average. The diameter of the branches varies from one to three lines.

Locality and Formation.—Clinton Group, Dundas.

101. CHÆTETES SP.

A branching form nearly allied to the preceding, but differing in the much larger size of the corallites, of which only four or five occupy the space of one line. I am, at present, unable to

identify this species, but it is nearly allied to a Devonian species (*C. Barrandi*, Nich.) and is certainly distinct from *C. Fletcheri*.

Locality and Formation.—Clinton Group, Dundas.

102. Helopora fragilis (Hall).

Fig. 19, 3 and 3 *a*.

Helopora fragilis, Hall, Pal. N.Y. Vol. II. Pl. XVII. Figs. 3 *a—f*.

Helopora fragilis, Nicholson and Hinde, *Canadian Journal*, April, 1874.

Polyzoary composed of cylindrical stems, which have a length of from [illegible] and a half to three lines, and a diameter of from a third of a line to half a line. Usually the stems are quite straight or slightly curved proximally, very rarely branched, and very generally tapering towards the base and thickened into a swollen, rounded, or clavate distal extremity. Cells tubular, springing obliquely in a radiating manner from an imaginary central axis, and opening at the surface by oval or sub-angular mouths, the lower lips of which are, in perfect specimens somewhat prominent. About ten or twelve cells in the space of a line measured vertically. The cells are arranged in longitudinal rows, those of contiguous rows alternating with one another, so as to give rise to a series of diagonally spiral rows. According to Hall, the cells are arranged between longitudinal lines which are elevated above the general surface, but this character does not appear to be universally recognizable.

In many respects this curious little form presents a close resemblance to the more slender examples of *Chætetes* or *Stenopora*, from which, indeed, it is chiefly separable by the absence of *tabulæ* and by its general form.

Locality and Formation.—Clinton Group, Dundas (exceedingly abundant).

103. Rhinopora verrucosa (Hall).

Fig. 19, 1 and 1*a*.

Rhinopora verrucosa, Hall, Pal. N. Y., Vol. II.,Pl. XIX., figs. 1 *a—c*.

Rhinopora verrucosa, Nicholson and Hinde, *Canadian Journal*, April, 1874.

Polyzoary forming laminar expansions, in some instances of a funnel-shaped form, which are celluliferous on the two sides, and have a thickness of from a hundredth of an inch to a third of a line. The surface is in general even, but is sometimes traversed by irregular anastomosing and reticulating ridges, and it exhibits the mouths of the cells, which are quincuncially arranged. The cell mouths are strongly elevated above the surface, and have the form of rounded pustules, perforated centrally by a minute circular aperture surrounded by a thickened lip. About five cells occupy the space of one line, and they are separated from one another by about their own diameter.

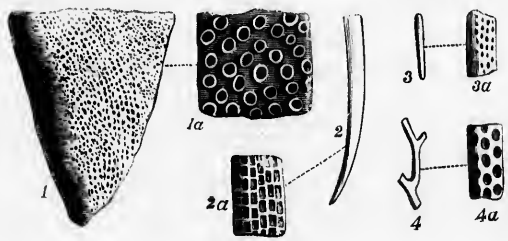


Fig. 19.
1 & 1 *a*. *Rhinopora verrucosa* (Hall), natural size and enlarged.
2 & 2 *a*. *Phænopora ensiformis* (Hall), natural size and enlarged.
3 & 3a. *Helopora fragilis* (Hall), natural size and enlarged.
4 & 4 *a*. *Ptilodictya (?) ramipora* (Hall), natural size and enlarged. Clinton formation.

Locality and Formation.—Abundant in the Clinton Group at Dundas.

104. Phænopora ensiformis (Hall).

Fig. 19, 2 and 2*a*.

Phænopora ensiformis, Hall, Pal. N. Y., Vol. II., Pl. XVIII. Figs. 8 *a—c*.
Phænopora ensiformis, Nicholson and Hinde, *Canadian Journal*, April, 1874.

Polyzoary forming a thin flattened expansion of an ensiform shape, curved and tapering towards the base, and varying in length from half an inch to one inch. Cells arranged in longitudinal rows, separated by elevated longitudinal thread-like lines, the number of rows increasing as we proceed from the base towards the proximal end. Apertures of the cells, oval or oblong, alternating in contiguous rows, about seven in the space of one line measured longitudinally. No striated and non-celluliferous marginal zones appear to exist; but none of our specimens exhibit the internal structure; and we are therefore uncertain whether the species should not really be referred to *Ptilodictya*.

Location and Formation.—Common, though usually fragmentary, in the Clinton Group at Dundas.

105. Ptilodictya crassa (Hall).

Stictopora crassa, Hall Pal. N. Y., Vol. II., Pl. XVIII. Figs. 4*a—c*.
Ptilodictya crassa, Nicholson and Hinde, *Canadian Journal*, April, 1874.

Polyzoary composed of linear flattened expansions which branch dichotomously at short intervals, and have a width of from a line to a line and a half. Cell mouths long-oval, arranged in longitudinal rows, about five in a line measured vertically, and seven or eight measured in the same space measured transversely. According to Hall, the margin of each cell aperture is surrounded by a shallow groove, which gives the surface a striated appearance; but this feature has not been observed by me. The margins do not appear to exhibit a distinct striated and non-celluliferous border; and as the internal structure is still unknown, there is some doubt if the species is truly referable to *Ptilodictya*.

Location and Formation.—Clinton Group, Dundas.

106. Ptilodictya (?) raripora (Hall).

Fig. 19, 4 and 4*a*.

Stictopora raripora, Hall, Pal. N. Y., Vol. II., Pl. XVIII. Figs. 5*a—c*.
Ptilodictya (?) raripora, Nicholson and Hinde, *Canadian Journal*, April 1874.

Polyzoary composed of small sub-cylindrical branching stems, about half a line in diameter. Cells large, three rows occupying the width of the stem, the apertures oval, about four in the space of one line measured longitudinally, and six in the same space measured transversely. The cells are arranged in longitudinal alternating rows, and their apertures are surrounded by thick but not elevated margins. The rows of cells are not separated by elevated lines; there are certainly no non-celluliferous, striated marginal zones or borders to the frond, and there is no evidence as to the existence of a central laminar axis. It is thus more than doubtful if the species can be referred to *Ptilodictya*; but in the absence of any certain knowledge as to its internal structure, its generic affinities must remain uncertain.

Locality and Formation.—Rare in the Clinton Group at Dundas.

107. FENESTELLA TENUIS (Hall).

(*Ref.* Pal. N. Y., Vol. II., Pl. XIX., Fig. 5 *a—c*).

Fragments of this species are not uncommon in the Clinton Group at Dundas, but they are ill-preserved, and their more minute characters cannot be made out.

108. PTILODICTYA PUNCTATA (Nicholson & Hinde).

(*Ref.* Canadian Journal, April, 1874).

Polyzoary forming a thin flattened expansion, or explanate frond, which probably had a circular form when perfect. Cells arranged in sub-alternate rows, separated by elevated thread-like ridges, which are curved in such a manner as to lead to the belief that the rows of cells were concentrically disposed of round a central point. Mouths of the cells nearly circular, from seven to eight in the space of one line measured across the rows, and about five in the same space measured longitudinally or in the direction of the rows. The cells are separated in a longitudinal direction by well marked spaces, which are occupied by from three to six minute rounded pores, the apertures of as many small cells. No such pores are to be detected on the longitudinal ridges which separate the rows of cells, or on the lateral aspects of these.

FIG. 20.—*Ptilodictya (?) punctata*, Nich. & Hinde. A, A fragment enlarged; B, Part of the same still further enlarged. Clinton Formation.

The internal structure of this singular fossil cannot be made out, and its generic affinities are thus uncertain. Only one side of the cœnœcium is known; it is therefore uncertain whether both aspects were celluliferous or not. So far as can be judged, the fossil is a *Ptilodictya* belonging to the same group as *P. excellens* and *P. superba*, Billings, in which the ends of the cells are separated by minutely poriferous interspaces—a group which will probably be found to be of at least sub-generic value. It is, however, just possible that the larger openings in the cœnœcium are not the apertures of cells, but actual perforations passing through the whole thickness of the frond, in which case the fossil would be a very aberrant member of the *Fenestellidæ*. There is, however, no direct evidence to support this view; and but for the porous or punctate intercellular spaces, the fossil has all the characters and appearance of one of the explanate *Ptilodictyæ*.

Locality and Formation.—Clinton Group, Dundas.

109. LEPTOCŒLI PLANO-CONVEXA (Hall).

FIG. 21*a*.

(*Ref. Atrypa plano-convexa*, Hall, Pal. N. Y., Vol. II, Pl. XXIII. Figs. 11 *a—h*).
Abundant in the Clinton Group at Dundas and Hamilton.

110. ATHYRIS (ATRYPA) NAVIFORMIS (Hall).

(*Ref.* Pal. N.Y. Vol. II, Pl. XXIV. Figs. 1 *a—k*).
Clinton Group, Dundas.

111. ATRYPA RETICULARIS (Linn).
Clinton Group, Dundas.

112. RHYNCHONELLA NEGLECTA (Hall).

FIG. 21*b*, *b'*.

(*Ref.* Pal. N. Y., Vol. II, Pl. XXIII. Fig. 4 *a*—*f* and Pl. LVII. Fig. 1 *a*—*p*).
Clinton Group, Dundas.

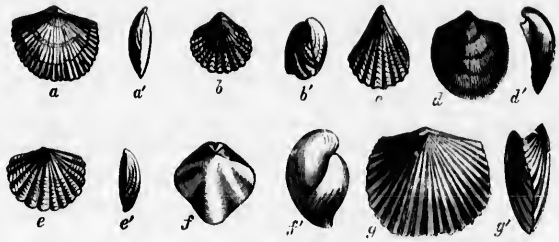


Fig. 21.
a, *Leptocœlia plano-convexa* (Hall) ; *a'*, Profile view of the same. *b*, *Rhynchonella neglecta* (Hall) ; *b'*, Profile view of the same. *c*, *Rhynchonella cuneata* (Hall). *d*, *Orthis elegantula* (Dalm.) ; *d'* Profile view of the same. *e*, *Atrypa hemispherica* (Sowerby) ; *e'*, Profile view of the same. *f*, *Atrypa congesta* (Hall) ; *f'*, Profile view of the same. *g*, *Orthis calligramma* var. *Davidsoni* (Vern.) ; *g'*, Profile view of the same. Clinton Formation.

113. ORTHIS ELEGANTULA (Dalman).

Fig. 21, *d*, *d'*.

Clinton group, Dundas and Owen Sound.

114. ORTHIS CALLIGRAMMA var. DAVIDSONI (De Verneuil).

Fig. 21, *g*, *g'*.

Clinton group, Dundas.

115. ORTHIS FLABELLULUM (Sowerby) ?

Clinton group, Dundas.

116. LEPTAENA SERICEA (Sowerby).

Clinton group, Dundas and Hamilton.

117. STROPHOMENA RHOMBOIDALIS (Wahlenberg).

Clinton group, Owen Sound.

Fig. 22
Strophomena rhomboidalis, Wahl. (After Billings). Trenton, Hudson River, Clinton, Niagara, and Devonian Formations.

118. AVICULA ALATA (Hall).

(*Ref. Posidonia ? alata*, Hall, Pal. N. Y., Vol. II, Pl. XXVII. Fig. 4.)

Clinton group, Dundas.

119. MODIOLOPSIS ORTHONOTA (Conrad).

(*Ref. Modiolopsis orthonota*, Hall, Pal. N. Y. Vol. II, Pl. IV, A. Figs. 1 *a—c*).

Clinton group, Dundas.

120. CTENODONTA, SP.

Casts of a small but undeterminable species of *Ctenodonta* are of common occurrence in the earthy hæmatite of the Clinton group at Dundas.

121. TENTACULITES DISTANS (Hall).

Tentaculites distans, Hall, Pal. N. Y. Vol. II, Pl. XLI. A. Figs. 9 *a—c*.

Tentaculites distans, Nicholson & Hinde, *Canadian Journal*, April, 1874.

Tube straight, conical, from six to eight lines in length, and about one line in diameter near the mouth. Annulations remote, nearly or quite half a line apart near the mouth, and about a third of a line apart near the middle (from four to five in the space of one line and a half). Spaces between the annulations marked with close-set, sharp longitudinal striæ. This species is readily distinguished by the remoteness of the annulations, and the longitudinally-striated interspaces.

Locality and Formation.—Rare in the Clinton group, Dundas.

122. TENTACULITES NEGLECTUS (Nicholson & Hinde).

(*Ref. Canadian Journal*, April, 1874.)

Tube straight, conical, about three lines in length, and two-thirds of a line in diameter at the mouth. Annulations five in the space of one line near the mouth, and nine in the same space at the small end of the tube. Spaces between the annulations marked by fine sharp longitudinal striæ.

This species is referable to the same section of *Tentaculites* as *T. distans* (Hall), and *T. Sterlingensis* (Meek & Worthen), but it is distinguished from the former by its smaller size and much more closely approximated annulations, and from the latter by its straight, not curved, form, its smaller size, and its closer annulations. The walls of the tube appear to have been of more than usual tenuity, as it generally is found in a crushed condition in its upper portion. The longitudinal striæ are confined to the spaces between the rings, and do not encroach upon the annulations themselves.

Locality and Formation.—Clinton Group, Dundas. Not very uncommon.

123. MURCHISONIA SUBULATA (Conrad).

(*Ref. Murchisonia subulata*, (Hall), Pal N. Y. Vol. II, Pl. XXVII. Figs. 7 *a—d*).

Clinton Group, Dundas.

124. PLATYOSTOMA NIAGARENSIS, (Hall).

(*Ref.* Pal. N. Y. Vol. II, Pl. LX. Figs. 1 *a—v*).

Clinton group, Dundas.

125. GLYPTOCRINUS PLUMOSUS (Hall).

(*Ref.* Pal. N. Y. Vol. II, Pl. XLI. A. Figs. 3 *a—g*).

Clinton group, Owen Sound and Dundas.

126. CALYMENE BLUMENBACHII (Brongniart).

Clinton group, Dundas.

CHAPTER V.

FOSSILS OF THE NIAGARA FORMATION.

127. STROMATOPORA STRIATELLA (D'Orbigny.)

(*Ref.* D'Orbigny, Prod. de Paléont. p. 51).

The species of *Stromatopora* which has usually been quoted from the Niagara Limestone, is the *S. concentrica* of Goldfuss. Whilst not denying its possible occurrence on this horizon, all the examples which have come under my notice are referable to the *S. striatella*, (D'Orbigny) a species which is nearly allied to *S. concentrica*, but is readily distinguished by its much more delicate and closely set laminæ.

Locality and Formation.—Common in the Niagara Limestone of Thorold. Rare at Rockwood.

128. STROMATOPORA HINDEI (Nicholson).

(*Ref.* Ann. and Mag. Nat. Hist. Jan. 1874.)

Fossil forming thin crusts or subhemispheric masses composed of successive concentrically disposed strata, each stratum made up of parallel calcareous laminæ separated by interspaces. Sometimes the component laminæ of each stratum are parallel with the upper and lower surfaces of the stratum or nearly so; but more commonly they are oblique to these surfaces. The result of this is that the interspaces between the laminæ open on the surfaces of each stratum as so many elongated and oblique apertures, which have usually the form of fissure-like sinuous slits, but sometimes present the appearance seen in weathered specimens of *Alveolites*. The laminæ of each stratum are sometimes connected by transverse pillars, but more commonly they are so bent and curved as to inosculate with one another at points closely approximated, thus giving the whole mass a vesicular structure. Well preserved specimens show about eight laminæ in the space of one line. The upper surface of the fossil not only exhibits the linear and vermicular openings above spoken of as produced by the interlaminar spaces, but

also a series of large rounded or oval openings, which are more or less irregularly disposed, and which are the orifices of so many canals which penetrate the mass vertically or obliquely. The size of these oscular apertures varies; but most of them have a diameter from a line to a line and a half. They also vary greatly in their number in a given space, some fragments exhibiting many of them placed close together, whilst others only show a few, and these remote. The walls of the canals leading away from these openings are not lined by a continuous calcareous membrane (as in *S. perforata*), but are perforated like a sieve by the elongated slits produced by their intersection with the interlaminar spaces. Lastly, the general surface is undulating, and the oscula are not elevated upon eminences or papillæ.

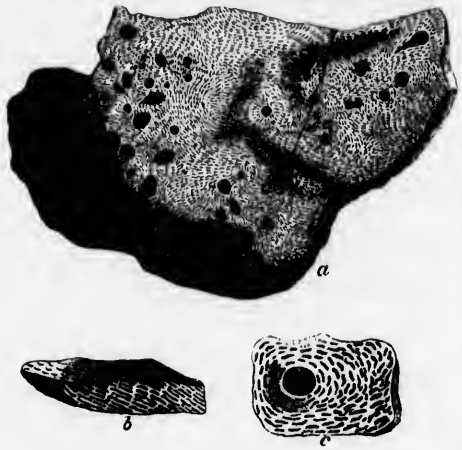


FIG. 23.

Stromatopora Hindei (Nich): *a*, upper surface of a fragment, natural size, showing the pores and oscula; *b*, vertical section of a fragment, enlarged, showing the obliquely arranged laminæ and interlaminar spaces; *c*, upper surface of a fragment, enlarged.

This remarkable species departs in some important respects from the structure of the typical species of *Stromatopora;* but it presents at the same time such a close resemblance to forms like *S. tuberculata* that it does not seem necessary to form a new genus for its reception. The chief peculiarity of the present form depends upon the fact that the component laminæ of the mass are not arranged concentrically as regards the entire mass; but the fossil is composed of concentric layers, each of which is composed of parallel or subparallel laminæ disposed obliquely to the surface of the stratum. Hence the interlaminar spaces, instead of being parallel with the surface of the mass (as in *S. tuberculata* and *S. granulata*,) open upon the surface in the form of oblique, sinuous, or vermicular openings, sometimes rounded or subtriangular, but more commonly linear and having a transverse diameter of about one hundredth of an inch. It can hardly be doubted that these minute openings, which cover the greater part of the entire surface, are of the nature of inhalant apertures or "pores;" and they communicate to fragments of this fossil very much the aspect of worn and weathered examples of certain forms of *Alveolites* and *Cœnites*. All those portions of the surface which are not occupied by the pores are taken up by very much larger openings, which are certainly exhalant apertures or "oscula." Very often the laminæ are arranged in any given stratum in a subspiral manner round certain points of the mass, and the pores on the surface have a corresponding arrangement.

Upon the whole, little doubt can be entertained as to the propriety of referring this species to the Calcispongiæ; and its structure would strongly corroborate the view that the surface-tubercles in *S. tuberculata* are truly perforated, and are of the nature of pores, though examples of this species as ordinarily preserved do not exhibit this feature clearly. I have

named the present species after its discoverer, Mr. George Jennings Hinde, who has kindly furnished me with specimens for examination.

Locality and Formation.—Common in a magnesian limestone of the age of the Niagara Limestone (Upper Silurian), at Owen Sound, Ontario. Collected by Mr. G. J. Hinde.

129. Halysites catenularia (Linn.)

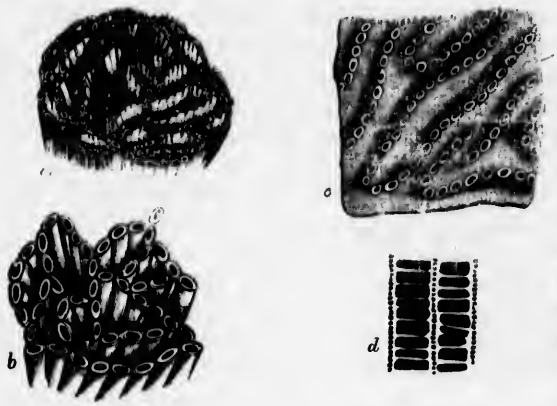


Fig. 24.

a. Halysites catenularia, Linn., small variety; *b.* Large variety of the same; *c. Halysites agglomerata*, Hall; *d.* Section of two corallites of the same. Niagara Limestone.

The Niagara Limestone yields this species in great abundance. Different examples vary immensely both as regards the meshes of the network, and still more as to the size of the individual corallites. Thus, examples occur, on the one hand, in which the long diameter of the corallites is no more than one-third of a line, whilst others, on the other hand, have a long diameter of one line and three-quarters or more than five times as great. Nevertheless, too many intermediate forms occur to allow us to suppose these to be other than varieties of a single species. The examples here included under the above name comprise both *H. catenularia* and *H. escharoides*, as characterized by Milne Edwards and Haime.

Locality and Formation.—Owen Sound and Rockwood. Niagara Limestone.

130. Halysites agglomerata (Hall).

(Fig. 24, *c* and *d*.)

(*Ref. Catenipora agglomerata*, Hall, Pal. N. Y., Vol. II., Pl. XXXV., figs. 2*a–g*.)

This form appears to us to be rightly separated from *H. catenularia*, with which it is united by Edwards and Haime. It is distinguished chiefly by the general form of the corallum, and by the fact that adjoining corallites are separated by transversely septate interspaces.

Locality and Formation.—Niagara Limestone, Rockwood.

131. Heliolites interstincta (Wahlenberg).

(*Ref. Heliolites pyriformis?* Pal. N. Y., Vol. II., Pl. XXXVI., A. Figs. 1*a–m*.)
Niagara Formation, Owen Sound.

132. Favosites Gothlandica (Lamarck).

(*Ref. Favosites Niagarensis*, Hall, Pal. N. Y., Vol. II., Pl. XXXIV. A. Figs. 4*a–i*.)

Specimens undistinguishable from this species are not uncommon in the Niagara Limestone, though not so abundant as *F. venusta.* The corallites usually average one line in diameter, though there are always smaller ones intercalated amongst the larger; and the septa are commonly represented by spiniform projections.

In the Niagara Limestone of Owen Sound occur specimens which attain much larger dimensions than is ordinarily the case with *F Gothlandica.* In these examples, the corallites are hexagonal, with a normal diameter of from two and a-half to three lines, and in some instances with a long diameter of from four to five lines; the average diameter in *F. Gothlandica* being about one line. The mural pores are of large size, in two or three rows, the third row sometimes occupying the prismatic angles of the corallites. The tabulæ are for the most part horizontal, not curved, about seven in the space of two lines. It is uncertain whether this form is new or not, and in the latter case whether it is to be regarded as an extremely large variety of *F. Gothlandica* or *F. favosa,* (Goldf.).

Locality and Formation.—Niagara Limestone, Rockwood, Thorold, and Owen Sound.

133. Favosites favosa (Goldfuss).

(*Ref. Calamopora favosa,* Goldfuss, Petref. Germ., Pl. XXVI., Figs, 2*a*—*e.*)

The corallum in this species is massive and in all essential respects quite like *F. Gothlandica,* except for the fact that the tabulæ are strongly and uniformly curved, with their convexities directed upwards. The corallites are prismatic, from one line to one and a half lines in diameter; the tabulæ are about six in the space of two lines; the mural pores are in two alternating rows upon the faces of the corallites; and the septa are represented by spiniform projections. The very large examples above referred to may possibly be a variety of this species, though wanting the distinguishing feature that the tabulæ are curved.

Locality and Formation.—Niagara Limestone, Owen Sound.

134. Favosites venusta (Hall)

(*Ref. Astrocerium venustum,* Hall, Pal. N. Y., Vol. II., Pl. XXXIV., Figs. 1*a*—*i.*)

The genus *Astrocerium* (Hall) cannot be retained, as its distinguishing character, viz., the possession of spiniform septa, is shared by *Favosites;* but the present species appears nevertheless to be a valid one. It forms large hemispheric or spherical masses, which are usually composed of a succession of concentric layers. The corallites are slender and variable in size, prismatic or polygonal, rapidly increasing in number by fission. The larger corallites are usually about half a line across; but they have many smaller ones intercalated amongst them, the diameter of which varies from the fiftieth of an inch to half a line. The calices are hexagonal, polygonal, or sub-cylindrical, and our specimens show only rudimentary septa, in the form of very short spiniform projections. The tabulæ are complete, straight or flexuous, four or six in the space of one line. The mural pores are not determinable.

There can be little doubt as to the distinctness of this species from *F. Gothlandica,* the much smaller size of the corallites alone constituting a good ground of separation. It most resembles the *F. hemispherica* of the Devonian, but it is distinguished by its complete and more remote tabulæ and by its mode of growth.

Locality and Formation.—Common, and attaining a large size, in the Niagara Limestone at Rockwood.

135. Favosites (?) multipora (Hall).

(*Ref. Cladopora multipora*, Hall, Pal. N. Y., Vol. II., Pl. XXXIX., Figs. 1*a—g*; *non Favosites multipora* (Lonsdale).

The Niagara Limestone of Ontario yields various forms, which are referable to the genus founded by Hall under the name of *Cladopora*, and characterized by him as follows.

" Ramose or reticulate ; branches cylindrical or slightly compressed ; terminations terete ; coral composed of a series of tubes or cells radiating equally on all sides from the axis, and opening upon the surface in rounded or sub-angular expanded mouths ; cells more or less closely arranged but not always contiguous, and apparently destitute of septa or rays."

We are unable, so far as our specimens enable us to judge, to separate the forms referred to *Cladopora* from *Favosites*. The chief point relied upon by Hall in separating the two genera is the supposed absence in the former of tabulæ and mural pores. This would be amply sufficient, if it could be proved that these structures are really wanting ; but this is not the case. Thus, we have examined some hundreds of well preserved specimens of *Favosites dubia*, (De Blain.), *F. reticulata* (De Blain.), and *F. polymorpha*, (Gold.), from the Corniferous Limestone, without meeting with more than two or three examples in which either the tabulæ or the mural pores could be detected. It is therefore quite possible, judging from their state of preservation, that the Niagara Limestone specimens referred to *Cladopora* also at one time possessed tabulæ and mural pores, and that these structures have simply been obliterated by the process of fossilization. The prominence of the lower lip of the calice is likewise a character common to the above quoted species of *Favosites*, and cannot be used to define *Cladopora*. So far, therefore, as our materials permit us to come to a decision, we are of opinion that most, if not all, of the species of Hall's genus *Cladopora* are truly to be regarded as ramose species of *Favosites*.

If this view be established by more extended researches, the present species will have to change its name, since the specific title " multipora " has been already pre-occupied by Lonsdale for a different pecies of *Favosites*. In this case we would propose to call the present species *Favosites Halliana*.

The characters of the species are as follows :—Corallum ramose, the branches cylindrical, nearly a line and a half in diameter, dividing dichotomously at intervals of three lines and upwards, sometimes inosculating. Corallites oblique to the axis of the branches, moderately thick-walled, in contact with one another. Calices circular or polygonal, sometimes wider than long, from four to five in the space of a line measured vertically or diagonally, the lower lip of the aperture slightly or not at all prominent. For the most part the calices are of the same size, but sometimes smaller ones are intercalated amongst the others.

The species is distinguished from the more slender forms of *Favosites dubia* (De Blain.), and *F. reticulata* (De Blain.), by the much greater closeness of the calices, and the comparatively thin walls of the corallites. In other respects no difference can be pointed out between our Niagara examples and specimens of the last mentioned forms of the Corniferous Limestone. From *Chætetes* the species is separated by the thicker walls of the corallites and the form and aspect of the calices.

Milne Edwards and Haime identify *Cladopora multipora* (Hall) with *Alveolites* (?) *seriatoroides*, (Edw. and H.) which is certainly not an *Alveolites*, and which is distinguished by its

abundant cœnenchyma, its vertical corallites, and the arrangement of the calices in nearly vertical rows. We cannot, however, accept this identification, since our examples, as well as those figured and described by Hall, have no true cœnenchyma, have corallites with a slight but well marked obliquity, and have not got the cells arranged in vertical rows, but rather in obliquely transverse rows.

Locality and Formation.—Niagara Limestone; Rockwood, and Thorold.

136. Favosites (?) seriata (Hall).

(*Ref. Cladopora seriata,* Hall, Pal. N.Y. Vol. II., Pl. XXXVIII, Figs. 1, *a—m.*)

Two or three specimens in our collections have the mode of growth of this species, but in other respects differ little or not at all from the preceding. It is perhaps doubtful, indeed, if the distinctions between *Cladopora multipora, C. seriata, C. cæspitosa, C. cervicornis,* and *C. macrophora* (Hall), are of specific value; but as we have not access to authentic specimens, and as Hall only in the case of the first of these gives any measurements, we are unable to decide this point.

Milne Edwards and Haime identify *Cladopora seriata* (Hall) with *Alveolites repens,* which it much resembles in general form and mode of growth. We have not seen any authentic specimens of the latter, but, judging from their figures and description, its calices are entirely unlike those of the former in their characters.

Locality and Formation.—Niagara Limestone, Rockwood.

137. Favosites dubia (De Blainville)?

The Niagara limestone of Rockwood yields examples of a form which may, perhaps, be referable to one of the species of Hall's genus *Cladopora,* but which appears to us to be altogether inseparable from certain slender branching corals which occur abundantly in the Corniferous Limestone, and which we have been in the habit of regarding as the young of *Favosites dubia,* (De Blain). In this form the corallum is composed of slender cylindrical stems which have a diameter of from three quarters of a line to a line and a quarter, and which divide at short intervals without anastomosis. The corallites have thick walls, and the calices are polygonal, circular, or transversely oval, about three in the space of one line measured diagonally or vertically. In perfect specimens the lower lip of the calice is decidedly prominent, but the calices are nearly of equal size.

In the larger and more typical specimens of the *F. dubia,* such as occur in the Devonian Rocks, there are very small corallites interspersed amongst the larger ones. This character, however is not conspicuous in the small specimens from the Corniferous Limestone which appear to be referable to this species, nor can it be detected in the Niagara examples. It hardly seems, in the absence of any other distintive character, to be a point of specific value.

Locality and Formation.—Niagara Limestone, Rockwood.

Genus Cœnites (Eichwald).

(= *Limaria,* Steininger.)

Generic characters.—Corallum encrusting, massive, or sometimes ramose, extremely like *Alveolites,* but having the corallites remote, embedded in a cœnenchyma, or with walls so

thick and fused together as to simulate a cœnenchyma. Calices triangular, crescentic, or lunate, usually prominent, and generally furnished with one or more projecting teeth. Tabulæ distinct, mural pores large and few.

The Niagara Limestone of Ontario has yielded to our researches the following two species of *Cœnites*.

138. Cœnites laminata (Hall.)

Fig. 25 *d*, *e*.

(*Ref. Limaria laminata*, Hall. Pal N.Y., Vol. II, Pl. XXXIX. Figs. 6. *a*—*d*.)

Corallum encrusting or massive, the calices somewhat crescentic, with two prominent rounded teeth in the concave side of the crescent (Fig. 25 *e*.). Calices not prominent, about one third of a line in their long diameter, and one sixth of a line across, separated by about their length; six or seven in the space of two lines on an average.

The calices appear to be separated by a well-developed cœnenchyma; but it is probable that this is only an appearance, and that it is really due to the great thickening of the walls of the corallites and their amalgamation with one another.

Locality and Formation.—Niagara Limestone, Rockwood.

139. Cœnites lunata (Nicholson and Hinde).

(*Ref. Canadian Journal*, April, 1874.)

Corallum forming a thin crust, apparently about two-thirds of a line in thickness. Calices strongly curved, crescentic or lunate, their form being due to the projection into their cavity of a single strong rounded tooth developed from the concave lip (Fig. 25, *b* and *c*.. Calices about one fourth of a line in their long diameter, and one eighth of a line across; eight in the space of two lines. Corallites perpendicular to the surface, appearing as if embedded in a dense cœnenchyma, though this is most probably due simply to the great thickening of their walls.

Fig. 25.

a, Fragment of *Cœnites lunata* (Nich. and Hinde), natural size; *b*, Portion of the same enlarged; *c*, single calice of the same still further enlarged; *d*, Fragments of *Cœnites laminata* (Hall), natural size; *e*, Single corallite of the same enlarged. From the Niagara Limestone.

Of all the described species of the genus, *C. lunata* is most nearly allied to *C. laminata* Hall, but it is distinguished by the smaller size of the calices, their more markedly crescentic form, and the possession of a single rounded calicine tooth instead of two such.

Locality and Formation.—Niagara Limestone, Owen Sound.

140. Striatopora flexuosa (Hall).

(*Ref.* Pal N.Y., Vol. II., Pl. XL., B. Figs. 1 *a*—*e*).

Locality and Formation.—Not uncommon in the Niagara Limestone, of Thorold.

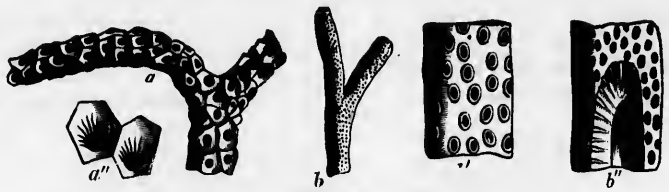


Fig. 26.

a, Fragment of *Striatopora flexuosa*, Hall (after Hall), of the natural size. *a''*, Two calices of the same enlarged. *b*, *b'* and *b''* *Trematopora ostiolata*, Hall (after Hall) Niagara Formation.

141. Alveolites fischeri (Billings).

(*Ref. Canadian Journal*, New Series, Vol. V., p. 256, Fig. 6).

From the Niagara Limestone of Owen Sound, we have obtained several examples of an *Alveolites*, which in general characters and dimensions resembles *A. Fischeri*, (Billings), of the Corniferous and Hamilton Formations, and which we are unable to separate specifically from this form. The corallum forms a thin laminar expansion about one line in thickness, celluliferous on the two sides, and either continuous or rarely partially reticulated. The calices are transversely oval or subtriangular, usually with one curved and one straight side, sometimes with one curved and two straight sides. The long diameter of the calices is from one-third of a line to half a line, and they are separated from one another by about the same distance.

Locality and Formation.—Niagara Limestone, Owen Sound.

142. Alveolites Niagarensis (Nicholson & Hinde).

(*Ref. Canadian Journal*, April, 1874).

Corallum dendroid, branches cylindrical, about two lines in diameter, dividing dichotomously. Calices small, distinctly triangular, with the apex of the triangle directed downwards, about six in the space of two lines. The upper side of each calice carries a single prominent septal tooth in the form of a vertical plate, which is placed in the median plane of the aperture, dividing it into equal halves and giving it an almost crescentic appearance.

Fig. 27.—*Alveolites Niagarensis*, (Nicholson and Hinde). *a*, Fragment, of the natural size; *b*, Small portion enlarged; *c*, Single calice still further enlarged. Niagara Limestone.

We cannot identify this with any previously recorded form, though it bears a general resemblance to more than one known species. It is most nearly allied to *A. labiosa* (Billings), from the Corniferous Limestone. All the unquestionable examples of the latter which we have examined show, however, no septal teeth at all; whilst one or two specimens which we have doubtfully referred to *A. labiosa*, and which possess a single vertical septal ridge on the upper side of the calice, have this ridge placed altogether on one side instead of centrally.

Locality and Formation.—Niagara Limestone, Rockwood.

Genus Astræophyllum (Nicholson and Hinde).

Corallum aggregate, composed of slender cylindrical corallites, united laterally by numerous successive mural expansions or horizontal outgrowths of the cance, which are placed at

the same level in contiguous corallites, and form a series of complete floors. Walls of the theca complete and well developed, meeting in the centre of the theca, with a distinct and well developed columella. Costal radii prolonged over the successive exothecal floors. Tabulæ rudimentary or absent (?)

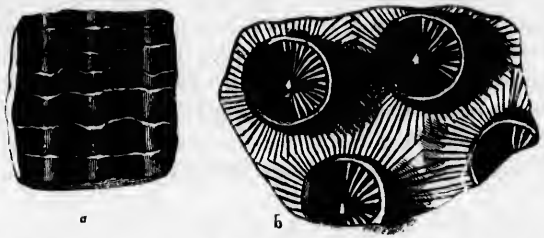


Fig. 28.—*Astræophyllum gracile* (Nicholson and Hinde); *a*, Side view of a fragment, enlarged, shewing the mural expansions; *b*, Fragment viewed from above and greatly enlarged, showing the calices, the confluent mural expansions, and the costal radii.

There are some points in the structure of the corals here referred to which we cannot actually make out with the materials at present in our hands; and we are therefore uncertain whether they really constitute a new genus, though we cannot place them under any genus already described.

From *Smithia*, Edw. and H., the genus *Astræophyllum* is distinguished by the possession of a distinct columella, and by the fact that the corallites are united not only by costal radii, but by well developed exothecal floors.

From *Phillipsastræa*, the present genus is distinguished by not having the corallites united laterally along their whole length, and in having the calices definitely circumscribed.

From *Haimeophyllum* (Billings), the genus is separated by the well developed, not rudimentary, septa, and by the fact that the latter possesses vesicular tabulæ.

From *Heliophyllum colligatum* (Billings), which probably forms the type of a separate group, *Astræophyllum* is distinguished by the possession of a distinct columella, and the apparent absence of septal spines or tabulæ.

From *Thecostegites* (Edw. and H.,) the genus is distinguished by its well developed septa and columella, and the apparently obsolete tabulæ. Lastly, *Astræophyllum* is distinguished from *Cannapora* (Hall), by the possession of a columella, and the apparent absence of tabulæ.

143. Astræophyllum gracile (Nicholson and Hinde).

Fig. 28.

(*Ref. Canadian Journal*, April, 1874).

This being the only known species of the genus, the generic characters form part of the specific description. In addition to these characters, however, the corallites are cylindrical, and about three-quarters of a line in diameter, placed at distances apart of two lines, less or more. The calices are expanded, about two lines in diameter, deep, with a prominent columella. The septa are from twenty-six to thirty in number, unequally developed, the greater number apparently reaching the centre. The mural expansions are nearly horizontal, from two to four in the space of two lines measured vertically, placed at the same levels throughout the

mass. At the last formed surface, the calices project slightly above the layer formed by the coalescent mural expansions; and this layer is traversed by radiating ridges corresponding with the septa of the corallites. The calices, however, are circumscribed by very distinct and well developed walls.

The upper surface of the coral somewhat resembles, on a small scale, that of *Heliophyllum colligatum* (Billings); but the mural expansions and costal radii are confluent, and are not marked off for each corallite as they are in the latter. The mural expansions are variable in number, sometimes very close, at other times remote. Owing to the silicification of the specimens, it cannot be determined what are the characters of the free edges of the septa, nor whether, rudimentary tabulæ may not be present, though no signs of the latter can be detected. In *Heliophyllum colligatum*, on the other hand, there is a well marked central tabulate area.

Locality and Formation.—Common in the Niagara Limestone, Owen Sound.

144. CANNAPORA ANNULATA (Nicholson and Hinde).

(*Ref. Canadian Journal*, April, 1874).

Corallum aggregate, composed of numerous slender cylindrical corallites, which form flattened expansions or crusts, and are united together by exothecal growths. Corallites from half a line to nearly one line in diameter, usually the former, nearly in contact, about four or five in the space of two lines. The corallites are strongly annulated with close-set annulations, which are developed into so many mural expansions which unite together contiguous tubes. About four of these annulations and expansions in the space of one line. Tabulæ well developed and close-set. Septa distinct but rudimentary, only extending a short distance into the theca, about twelve in number in each corallite.

Cannapora annulata is closely allied to *C. junciformis* (Hall), from the horizon of the Clinton Group. The latter species, however, has the mural expansions placed at intervals of about a tenth of an inch apart; so that there are only ten in the space of an inch, instead of between forty and fifty, as in the present species. Our examples, also, do not appear to have attained anything like the dimensions of *C. junciformis*, the corallites rarely exceeding half an inch in height.

Locality and Formation.—Niagara Limestone, Owen Sound.

145. SYRINGOPORA RETIFORMIS (Billings).

(*Ref. Canadian Naturalist*, Vol. III., p. 424).

This beautiful species is of common occurrence, and attains a large size in the Niagara Limestone of Owen Sound. Specimens often show the radiating septa very distinctly, much more so than is usually the case in examples of this genus.

147. ZAPHRENTIS RŒMERI (Edwards and Haime).

(*Ref. Pol. Foss. des Terr. Pal.* p. 327).

Locality and Formation.— Niagara Limestone, Owen Sound.

147. ZAPHRENTIS STOKESI (Edwards and Haime).

(*Ref. Pol. Foss. des Terr. Pal.* Pl. III., Fig. 9).

Locality and Formation.—Niagara Limestone, Owen Sound.

148. ZAPHRENTIS BILATERALIS (Hall).

(*Ref. Caninia bilateralis*, Hall, Pal. N. Y., Vol. II., p. 41, Pl. XVII., Figs. 3*a–h*).

Locality and Formation.—Niagara Limestone; Owen Sound, and Niagara River.

149. CYSTIPHYLLUM VESICULOSUM (Goldfuss).

Transverse sections of a species of *Cystiphyllum*, most probably referable to the above species, are not uncommon in the Niagara Limestone at Thorold.

150. PETRAIA PYGMÆA (Billings).

(*Ref.* Palæozoic Fossils of Canada, Vol. I, p. 103).

Locality and Formation.—Niagara Limestone, Thorold.

151. DIPHYPHYLLUM CÆSPITOSUM (Hall).

(*Ref. Diplophyllum cæspitosum*, Hall, Pal. N. Y., Vol. II, p. 116, Pl. XXXIII, Fig. 1 *a—r*).

Locality and Formation.—Abundant, and forming large masses, in the Niagara Limestone of Thorold.

152. CARYOCRINUS ORNATUS (Hall).

(*Ref. Caryocrinus ornatus*, Hall, Pal. N.Y., Vol. II, Pls. XLI A, XLIX and XLIX A).

Locality and Formation.—Niagara Limestone; Thorold and Niagara River.

153. DICTYONEMA GRACILE (Hall).

(*Ref.* Pal. N. Y., Vol. II, p. 175, Pl. XL G. Fig. 1*a—d*).

Locality and Formation.—Niagara Limestone, Hamilton.

154. CLATHROPORA FRONDOSA (Hall).

Clathropora frondosa, Hall, Pal. N. Y., Vol. II, p. 160, Pl. XL B. Figs. 5*a*—5*e*).

Clathropora frondosa, Nicholson & Hinde *Canadian Journal*, April, 1874.

It seems certain that Prof. Hall has included under this name two quite distinct species. The one which we have met with in the Niagara Limestone has the frond perforated with rounded perforations of comparatively small size. (*See* Pal. N. Y., Vol. II., Pl. LX. B, fig. 5*b*). The perforations are not more than from half a line to three-fifths of a line in diameter, and are placed at intervals of from a line and a quarter to a line and a half, about fourteen rows of cells occupying the space of one line measured transversely. The name of *C. frondosa* should be restricted to forms agreeing with the above measurements. On the other hand, the forms with perforations varying from one line to a line and half in diameter (*see* Pal. N. Y., Vol. II, Pl. XL, B. Fig. 5*a*) have elsewhere been described by me, from Devonian specimens, under the name of *Clathropora intertexta*.

Locality and Formation.—Niagara Limestone, Thorold. Not uncommon, and attaining a large size.

155. CLATHROPORA INTERMEDIA (Nicholson & Hinde).

(*Ref. Canadian Journal*, April, 1874.)

Polyzoary forming a spreading expansion which is cellulliferous on the two sides, and is perforated by a series of rounded perforations which are arranged in regularly diagonal lines. Perforations somewhat irregular in size, oval or circular, usually from two-thirds of a line to a line in diameter. Intervals between the perforations rather more than half a line. Cells

oblong, not so wide as long, about six or seven rows in the space of half a line measured transversely ; so that seven or eight rows of cells occupy the space between any consecutive pair of perforations.

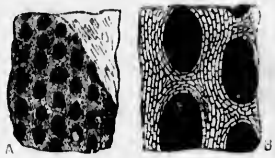


FIG. 29.

Clathropora intermedia (Nich. and Hinde). *a*, Fragment of the natural size ; *b*, Portion of the same greatly enlarged.

Clathropora intermedia (fig. 29) in some respects approaches the genus *Retepora*, and is intermediate in its characters between *C. frondosa* (Hall) and *C. intertexta* (Nich.). The differences will be most clearly brought out between these nearly allied species by the following summary of their respective characters.

1. *Clathropora frondosa*, (Hall).—Perforations minute, averaging one half line in diameter, placed at intervals of one and a quarter to one and a half lines, about fourteen rows of cells in one line measured transversely.

2. *Clathropora intermedia*, (Nich. and Hinde). Perforations moderately large, from two-thirds to one line in diameter, placed at intervals of rather more than half line, six or seven rows of cells in half line, and seven or eight rows between any two perforations.

3. *Clathropora intertexta*, (Nich.). Perforations large, usually about a line and a half in diameter, placed at intervals of from one and a third to one and a half lines, about five or six rows of cells in one line, or about eight rows between any two perforations.

Locality and Formation.—Niagara Limestone, Thorold.

156. RETEPORA ASPERATO-STRIATA (Hall).

(*Ref.* Pal. N. Y., Vol. II., p. 161, Pl. XL, C. Figs. 2*a*—2*b*).
Locality and Formation.—Niagara Limestone, Thorold.

157. TREMATOPORA OSTIOLATA (Hall).

Fig. 26*b*, *b'* and *b''*.

(*Ref.* Pal., N. Y., Vol. II, Pl. XL, A Figs. 5*a*- *n*.)
Locality and Formation.—Niagara Limestone, Niagara River.

158. FENESTELLA TENUICEPS (Hall).

(*Ref.* Pal. N. Y., Vol. II, Plate XL, D. Figs. 2*a*—*h*).
Locality and Formation.—Niagara Limestone, Niagara River.

159. ATRYPA RETICULARIS (Linn).

Locality and Formation.—Abundant in the Niagara Limestone at Thorold.

Fig. 30.

Atrypa reticularis (Linn), after Billings. Clinton, Niagara, Corniferous and Hamilton Formations.

160. PENTAMERUS OBLONGUS (Sowerby).

Locality and Formation.—Very abundant in a particular bed at the base of the Niagara Limestone at Thorold.

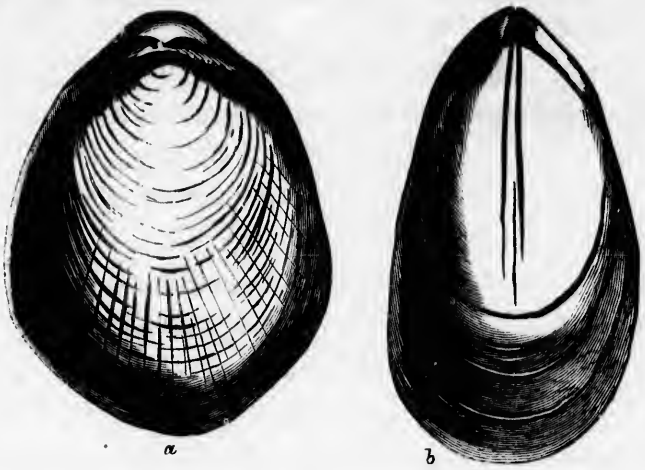


Fig. 31.
Pentamerus oblongus (Sowerby). *a*, Exterior; *b*, cast. Niagara Limestone.

161. ATHYRIS INTERMEDIA (Hall).

Fig. 32*a*, *a'*.

(*Ref. Atrypa intermedia*, Hall, Pal. N.Y., Vol. II, p. 76, Plate XXIV. Figs. 3*a*—*f* and 4*a* —*d*).

A species apparently undistinguishable from this occurs commonly in the Niagara Limestone at Thorold.

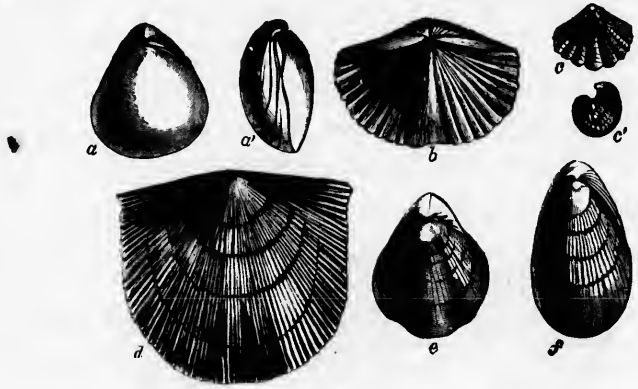


Fig. 32.
a, *Athyris intermedia* (Hall); *a'*, Profile view of the same; *b*, *Spirifera Niagarensis* (Conrad); *c*, *Spirifera crispa* (Linn); *c'*, Profile view of the same; *d*, *Strophomena* (*Streptorhynchus*) *subplana* (Hall); *e*, *Athyris naviformis* (Hall); *Athyris* (*Meristella*) *cylindrica* (Hall). Niagara Formation.

162. ATHYRIS NAVIFORMIS (Hall).

Fig. 32*e*.

(*Ref. Atrypa naviformis*, Hall, Pal. N.Y., Vol. II, p. 76, Pl. XXIV. Figs. 1*a*—*k*).
Locality and Formation.—Niagara Limestone, Dundas.

163. RHYNCHONELLA NEGLECTA (Hall).

(*Ref. Atrypa neglecta*, Hall, Pal. N. Y., Vol. II, Pl. LVII. Figs. 1*a*—*p*).
Locality and Formation.—Niagara Limestone, Thorold.

164. ORTHIS ELEGANTULA (Dalman).

Locality and Formation.—Niagara Limestone, Rockwood.

165. STROPHOMENA RHOMBOIDALIS (Wahlenberg).

Locality and Formation.—Niagara Limestone, Owen Sound and Thorold.

166. STROPHOMENA SUBPLANA (Conrad).

(Fig. 32*d*.)

(*Ref. Leptæna subplana*, Hall, Pal. N. Y., Vol. II., p. 259, Pl. LIII. Figs. 8, 9, 10.)
Locality and Formation.—Niagara Limestone, Thorold.

167. STROPHOMENA, SP.

A form very similar to, if not absolutely identical, with *S. punctulifera*, (Conrad,) from the Lower Helderberg. Not only is the general form and aspect of the shell the same, but one specimen exhibits precisely similar punctations.
Locality and Formation.—Niagara Limestone, Thorold.

168. LEPTÆNA TRANSVERSALIS (Dalman).
Locality and Formation.—Niagara Limestone, Niagara River.

169. DISCINA TENUILAMELLATA (Hall).

(*Ref. Orbicula tenuilamellata*, Hall, Pal. N. Y., Vol. II. Pl. LIII. Fig. 3.)
Locality and Formation.—Niagara Limestone, Rockwood.

170. DISCINA FORBESII (Davidson).

(*Ref. Orbiculoidea Forbesii*, Davidson, Monograph of the *British Brachiopoda*, Part VII, p. 73, Pl. VII. Figs. 14—18.)
Locality and Formation.—A form very nearly allied to this, if not absolutely identical with it, occurs in the Niagara Limestone of Hamilton.

171. LINGULA LAMELLATA (Hall).

(*Ref.* Pal. N. Y., Vol. II., p. 249, Pl. LIII. Figs. 1 and 2.)
Locality and Formation.—Niagara Limestone, Hamilton.

172. SPIRIFERA NIAGARENSIS (Conrad).

Fig. 32*f*.

Ref. (*Spirifera Niagarensis*, Hall, Pal. N. Y., Vol. II, p. 254, Pl. LIV. Figs. 5*a*—*t*.)
Locality and Formation.—Niagara Limestone, Niagara River.

173. ORTHIS BIFORATA (Schlotheim).

Locality and Formation.—Niagara Limestone, Thorold.

174. PHACOPS CAUDATUS (Brongniart.)

Locality and Formation.—Niagara Limestone, Hamilton.

175. CALYMENE BLUMENBACHII (Brongniart).

Locality and Formation.—Niagara Limestone, Niagara River and Thorold.

CHAPTER VI.

FOSSILS OF THE GUELPH FORMATION.*

176. STROMATOPORA CONCENTRICA (Goldfuss).

The Guelph Limestones contain, throughout their whole extent, very numerous and very large specimens of a species of *Stromatopora*, which appears to agree in the coarseness of its lamination with *S. concentrica*, (Goldfuss). Owing, however, to the very imperfect state of preservation in which these specimens occur, it is impossible to determine with any positiveness whether they are really referable to this species or not. One very interesting specimen, kindly submitted to me for examination by Charles Clarke, Esq., M. P. P., exhibits the surface, which is studded with remote circular apertures or "oscula" from one to two lines in diameter. If really referable to *S. concentrica*, this is the first example of the species in which these openings have been recorded.

Locality and Formation.—Guelph formation; Elora, Galt, Guelph, Hespeler, &c.

176 *bis*. STROMATOPORA OSTIOLATA (Nicholson).

Stromatopora ostiolata, Nicholson, Annals of Natural History, August, 1873. Report on the Palæontology of Ontario, 1874. Pl. I. Figs. 1, 1*a*.

Fossil forming large hemispherical masses, several inches in diameter, composed of innumerable delicate laminæ, arranged concentrically, and separated by interspaces which are broken up by numerous slender vertical pillars, giving the whole a finely reticulate structure. The laminæ are as thin as writing-paper; and, with the intervening interspaces, there are about

* I take this opportunity of saying that I am indebted for many valuable specimens from the Guelph Formation to the generosity of Mr. David Boyle, Public School Teacher, Elora, who is an indefatigable and zealous collector, and whose museum in connection with the School over which he presides, is a work of great public utility.

ten of them in the space of one line. The upper surface of the mass is undulated and is quite smooth, except for the presence of small rounded or conical elevations, perforated at the apex with rounded openings, and arranged with tolerable regularity in diagonal lines. These elevations have a width of about half a line, and appear to be of the nature of exhalant apertures or oscula. The lines of oscula are placed at distances apart of from four to five lines; and the oscula in each line are about the same distance from one another. When the mass is broken, similar osculiferous surfaces are found to exist throughout the whole, arranged concentrically with one another, and separated by spaces varying from two to three lines in thickness, these spaces being occupied by the ordinary laminated or reticulated tissue of the fossil. Laterally the laminæ and osculiferous surfaces, instead of being concentrically arranged as regards the entire mass, terminate in a series of rounded, nipple-shaped prominences, each of which is composed of thin concentric laminæ which scale off like the coats of an onion. The lateral surfaces of the fossil thus come to exhibit an extraordinary nodulated and botryoidal appearance.

It is impossible to give in a few words any adequate diagnosis of this most remarkable fossil, which appears to throw considerable light upon the affinities of the genus *Stromatopora*, if indeed, it does not truly constitute a new genus. In the fact that its main bulk consists of a succession of thin calcareous laminæ, with intermediate vertical props, pillars, or dissepiments, marking off minute cellular compartments, *S. ostiolata* agrees entirely with the typical species of *Stromatopora*; and in the great number of laminæ in a given space it closely resembles *S. striatella*, (D'Orb.). It exhibits, however, two peculiarities which, so far as I am aware, are altogether unique.

In the first place, it is not composed, as are *S. striatella*, (D'Orb.), and *S. concentrica*, (Goldf.) which it most nearly resembles in general form, of a succession of laminæ concentrically arranged round an imaginary centre or centres. On the contrary, in the present species, intercalated amongst the general enveloping concentric laminæ of the mass is a series of cylindrical masses, each composed of laminæ concentric with its long axis, and each terminating (probably at both ends, though this is not shown) in a rounded nipple-shaped extremity. Superiorly these laminated cylinders are enveloped by laminæ which are concentric to the whole mass, so that the outermost surface is simply undulating. On two of the sides of the fossil the ends of the above-mentioned cylinders protrude as so many nipple-shaped conical prominences, giving these aspects of the mass very much the appearance of the peculiar inorganic structure known as "cone-in-cone."

In the second place, a still more remarkable feature is presented by the upper surface of the fossil. The specimens are so highly mineralized (as is always the case with the fossils of the dolomites of the Guelph formation), that the smooth undulating upper surfaces of the laminæ exhibit no structure that can be made out with the lens. If any pores existed, as is most probable, they cannot now be detected. The upper surface, however, exhibits tolerably regular diagonal lines of small conical papillæ, some of which at any rate are unmistakeably perforated by rounded apertures. It is true that some of these eminences do not show any sign of being perforated; but this is probably, indeed almost certainly, due to the peculiar condition of mineralization of the fossil. The perforated eminences are distant from two to four lines from one another; and the diagonal rows stand about as far apart. The appearance presented by the upper surface, with its perforated papillæ, thus comes to simulate somewhat

the root of a fossil plant like *Stigmaria*, with the points whence the rootlets proceeded. The eminences themselves are but slightly elevated above the general surface; and the apical aperture has a diameter of about one thirtieth of an inch. Not only does the outermost or highest lamina of the fossil exhibit the above appearance, but the same structure reappears at intervals of two or three lines all through the mass, each surface being concentric with the preceding one, and separated from it by reticulated tissue. It is probable, therefore, that we should regard the fossil as really consisting of thin crusts, which are only accidentally superimposed one above the other.

A structure apparently analogous to the above has been described (M'Coy, Pal. Foss. pp. 12 & 65) as occurring in *Stromatopora striatella* (D'Orb.), *S. concentrica* (Goldf.), and *S.* (*Caunopora*) *placenta*, (Phill). In the first of these, according to M'Coy, the general laminated structure of the mass is traversed nearly at right angles by "vertical vermicular perforations about one fourth of a line in diameter," at distances varying from one to two lines apart; and essentially the same thing is seen in the other two species above mentioned. In the present species, however, there is no evidence that the apertures on the surfaces of the successive osculiferous layers communicate internally with vermicular tubes, though it is possible that they do; whilst the apertures are placed at the summit of small rounded or conical elevations, and are comparatively remote and large.

It can hardly be doubted that the perforated eminences of *Stromatopora ostiolata* correspond with the "oscula" of the genuine sponges. Indeed the surface of this species reminds one very strongly of the well-known genus *Porospongia* or *Manon*. The probability that *Stromatopora* is truly referable to the Calcispongiæ is thus rendered stronger than it would have appeared from the evidence formerly in our possession. If, however, it should be found that these oscula are not present in all the species at present referred to *Stromatopora* (and they have certainly not hitherto been recognised in the majority of forms), then it might be advisable to divide the genus into two, retaining *Stromatopora* for the species without oscules, and forming a fresh genus for those in which these apertures are present. The former would thus be nearly allied to the Foraminifera, whilst the latter would lead from the Foraminifera to the Calcispongiæ.

The specimens of *Stromatapora ostiolata* from which the above description was taken, were presented to the Museum of the University of Toronto, by their discoverer, Mr. John Wilkie. The species itself cannot possibly be confounded with any previously described form.

Locality and Formation.—In the yellow crystalline dolomite of the Guelph formation (Middle Silurian), Guelph, Ontario, associated with numerous specimens of *Stromatopora concentrica* (Goldf.).

177. Favosites polymorpha (Goldfuss).

Locality and Formation.—Guelph formation; Hespeler, Elora.

178. Favosites venusta (Hall).

(*Ref. Astrocerium venustum*, Hall, Pal. N. Y., Vol. II, Pl. XXXIV. Figs. 1*a*—*i*.)

Locality and Formation.—Common in the Guelph formation; Hespeler, Elora, Guelph.

179. FAVOSITES GOTHLANDICA (Lamarck).

Fig. 33.

(*Ref. Favosites Niagarensis*, Hall, Pal. N. Y., Vol II. Pl. XXXIV A, Fig. 4).

Locality and Formation.—Guelph Formation ; Hespeler.

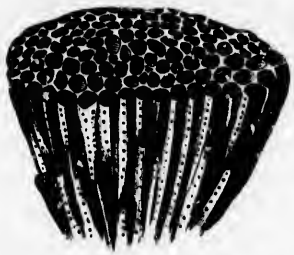


Fig. 33.
Favosites Gothlandica (Lam). Niagara, Guelph, Corniferous, and Hamilton formations. (The specimen figured is from the Corniferous Limestone.)

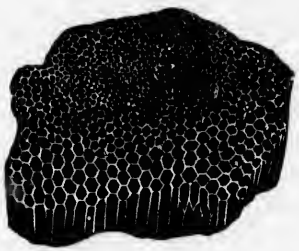


Fig. 34.
Favosites hemispherica (Yandell and Shumard) after Billings. Guelph, Corniferous, and Hamilton formations. (The specimen figured is from the Corniferous Limestone.)

180. FAVOSITES HEMISPHERICA (Yandell and Shumard).

Fig. 34.

(*Ref. Emmonsia hemispherica*, Edwards and Haime, Brit. Foss. Corals, Pl. XLVIII. Figs. 4—4*a*).

Locality and Formation.—Guelph formation ; Elora.

181. FAVOSITES FORBESI (Edwards and Haime).

(*Ref. Favosites Forbesi*, Edwards and Haime, Pol. Foss. des Ter. Pal. p. 238).

Locality and Formation.—Guelph Formation ; Hespeler.

182. HALYSITES AGGLOMERATA (Hall).

Fig. 24.

(*Ref. Catenipora agglomerata*, Hall. Pal., N. Y., Vol. II, Pl. XXXV. Figs. 2, *a.—g.*)

Locality and Formation.—Guelph formation ; Guelph.

183. AMPLEXUS (?) SP.

The Guelph Limestones contain in abundance a species of coral, which I am unable to refer with certainty to its proper genus. Some specimens have the form of detached cylindrical tubes, irregular in their thickness, but varying in diameter from a line and a half to three lines. These tubes are more or less flexuous, and are furnished both with very well developed tabulæ, and with marginal septa in the form of strong longitudinal ridges. Examples of this nature present precisely the characters of the genus *Amplexus*, and I have been under the impression that they were referable to *Amplexus laxatus* of Billings, a form which is quoted in the "Geology of Canada," as occurring in the Guelph Limestones, but the des-

cription of which I have been unable to consult. Other specimens, equally or more abundant, consist of numerous closely approximated tubes, similar in their structure to the above, and apparently forming parts of a composite mass. This would lead one to separate these specimens from *Amplexus*, which contains only simple forms; but one would still be left uncertain where to place them. The genus to which such specimens would be referable by their general form and mode of growth is *Diphyphyllum;* but they differ from this genus and agree with *Amplexus*, in the presence of complete tabulæ (not a mere central tabulate area), and in the rudimentary condition of the septa. The same form occurs in the Corniferous Limestone; but I must at present leave its position unsettled.

Locality and Formation.—Guelph formation; Hespeler, Elora.

184. AMPLEXUS YANDELLI (Edwards and Haime).

Examples of a species of *Amplexus*, which I am unable to separate from the Devonian form, *Amplexus Yandelli*, occur, not very rarely, in the Guelph Formation, at Hespeler, and Guelph.

185. PENTAMERUS OCCIDENTALIS (Hall).

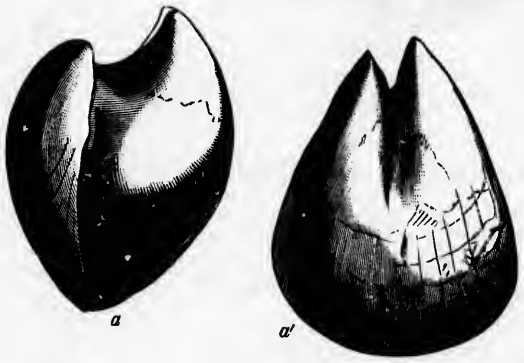


Fig. 35.
Pentamerus occidentalis (Hall); *a* Profile view; *a'* Ventral view. Guelph Formation.

(*Ref. Pentamerus occidentalis;* Hall, Pal. N. Y., Vol. II., p. 341, Pl. LXXIX).

Locality and Formation.—This is one of the most characteristic Brachiopods of the Guelph Formation, and occurs at Guelph, Elora, and Hespeler.

186. PENTAMERUS VENTRICOSUS (Hall).

(*Ref. Pentamerus* [*Pentamerella?*] *ventricosus*, Hall, Twentieth Report on the State Cabinet, p. 374, Pl. XIII., Figs. 18–21.)

Localily and Formation.—Guelph Formation, Hespeler, and Elora.

187. CHARIONELLA HYALE (Billings).

(*Charionella Hyale*, Billings, Palæozoic Fossils of Canada, Vol. I., p. 166, Fig. 150).
Locality and formation.—Guelph Limestone, Elora.

188. TRIMERELLA GRANDIS (Billings).*

Fig. 37.

(*Ref. Trimerella grandis*, Billings, Palæozoic Fossils, Vol. I., p. 166. Fig. 161.)
Locality and Formation.—Guelph Formation; Hespeler, Elora, and Guelph.

* The *Trimerellidæ* of the Guelph Formation have been kindly determined for me by Thomas Davidson Esq., F. R. S., who, in conjunction with Professor King, has made the group the subject of a most exhaustive memoir.

189. TRIMERELLA ACUMINATA (Billings).

Fig. 36.

(*Ref.* Palæozoic Fossils, Vol. I., p. 167. Fig. 151, bis).
Locality and Formation.—Guelph Formation; Elora and Hespeler.

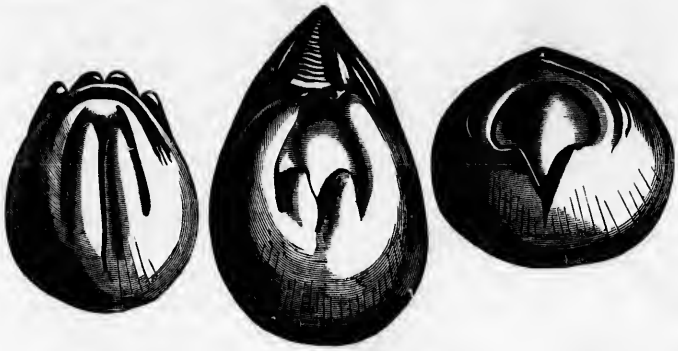


Fig. 36.

Trimerella acuminata (Billings). Guelph Formation. (After Davidson and King.)

Fig. 37.

Trimerella grandis (Billings). Guelph Formation. (After Davidson and King).

Fig. 38.

Monomerella prisca (Billings). Guelph Formation. (After Davidson and King).

190. MONOMERELLA PRISCA (Billings).

Fig. 38.

(*Ref. Monomerella prisca*, Billings, *Canadian Naturalist*, Vol. VI., p. 221).
Locality and Formation.—Guelph Formation; Elora and Hespeler.

191. TRIMERELLA DALLI (Davidson and King).

(*Ref. Quarterly Journal*, Geol. Soc. May, 1874. Pl. XV., Figs. 1–3).
Locality and Formation.—Guelph Formation; Elora and Hespeler.

192. MEGALOMUS CANADENSIS (Hall).

(*Ref. Megalomus Canadensis*, Hall, Pal. N. Y., Vol. II., Pl. LXXX., Figs. 1*a–c;* Pl. LXXXI., Figs. 1*a–f;* and Pl. LXXXII., Figs. 1*a–i.*)

Casts of this wonderful shell are not at all rare in the upper portion of the Guelph Formation, and sometimes almost form whole beds. Good specimens, however, are not so readily obtainable, and examples in which the actual shell is preserved, are of comparatively rare occurrence. The largest cast in my possession has a length of five and a half inches, and a width of four and a half inches, the depth of both valves being three and a half inches. The smallest cast in my possession, has a length of two inches, and a width of one inch and three-quarters, the depth of the closed valves being one inch and four lines.

Locality and Formation.—Guelph Formation; Hespeler, Elora, Galt, and Guelph.

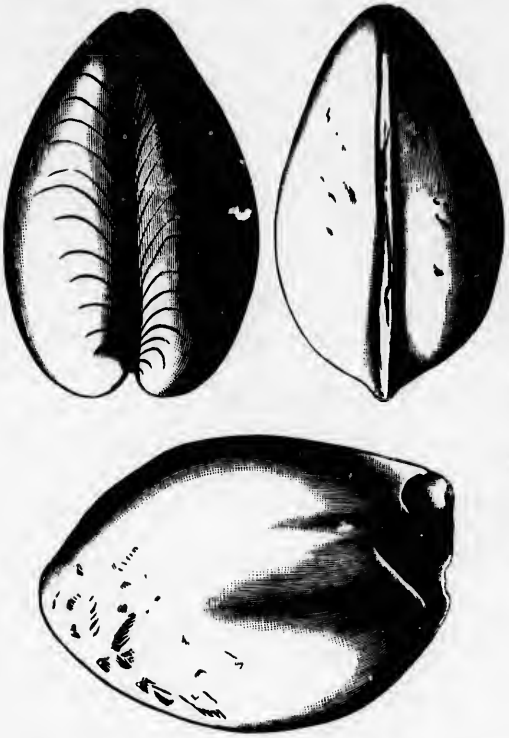


Fig. 39.

Megalomus Canadensis (Hall); *a*, Side-view of cast; *b*, Dorsal view of the same; *c*, Another specimen in which the shell is preserved. All reduced one-half. Guelph Formation.

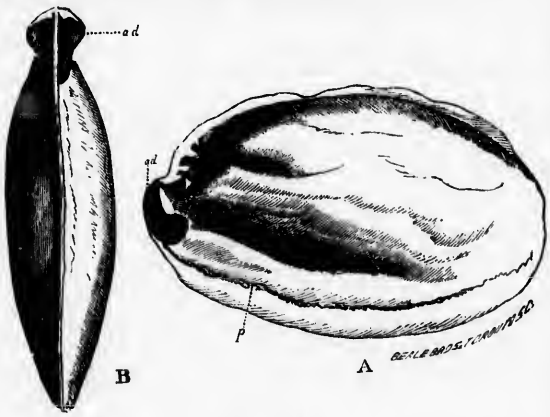


Fig. 40.

Melagomus compressus (Nicholson and Hinde). *A*, Side view of the cast of the shell, natural size. *B*, The same viewed from above. *ad*, Cast of the adductor impression; *p*, Pallial line.

193. MEGALOMUS COMPRESSUS (Nicholson and Hinde).

Megalomus compressus, Nicholson and Hinde, *Canadian Journal*, April, 1874.

Shell equivalve, valves compressed, the depth of both valves being little more than one-third of the width. Form elliptical, the length nearly one-third greater than the width. Umbones anterior, incrassated, with apparently one cardinal and two lateral teeth. A single, deep, concentrically-striated muscular impression placed just in front of and beneath the umbones, with a small circular pit above it. Pallial line simple. Surface of the shell unknown.

In many respects this singular species agrees with *M. Canadensis* (Hall); from which, however, it is clearly distinct. It is only known to us by the cast, which is entirely free from distortion, and may therefore be relied upon as giving the true characters of the interior of the shell. The cast forms an almost complete ellipse, which is very much compressed laterally, and has a length of twenty-eigh lines, a width of nineteen lines, and a depth of seven lines. In *M. Canadensis*, on the other hand, the depth of the valves is nearly or quite equal to the width. Our species, therefore, entirely wants the great ventricosity of the dorsal portion of the shell, which so distinguishes *M. Canadensis*. In the latter species the beaks are enormous-

ly thickened, and the cast exhibits a great contraction or excavation situated anteriorly above the casts of the muscular impressions. In *M. compressus*, on the contrary, the thickening of the anterior portion of the shell must have been much less, and this contraction of the cast is wanting. In both species alike, the ventral portion of the cast is the thinnest, and a well marked shallow depression or groove extends backwards from the muscular impression, parallel with the margin of the shell and ultimately becoming obsolete posteriorly. This indicates a corresponding ridge or elevation on the interior of the shell.

Locality and Formation.—Guelph Formation, Hespeler.

194. MURCHISONIA LOGANII (Hall).

(Plate III, Figs. 3 and 4).

(*Ref. Murchisonia Loganii*, Hall, Pal. N.Y., Vol. II, p. 346, Pl. LXXXIII. Figs. 4*a*—*b*).

Locality and Formation.—Guelph Formation ; Elora and Hespeler.

195. MURCHISONIA MACROSPIRA (Hall).

(Plate III, Fig. 9).

(*Ref. Murchisonia macrospira*, Hall, Pal. N.Y., Vol. II, p. 346, Pl. LXXXIII. Fig. 5).

Locality and Formation.—Guelph Formation. Elora.

This species is insufficiently characterised; but I have two or three specimens which would appear to be referable to it.

196. MURCHISONIA BIVITTATA (Hall).

(Plate III, Figs. 7 and 9).

(*Ref.* Hall, Pal. N.Y., Vol. II, p. 345, Pl. LXXXIII. Figs. 1*a*—*b*).

In the condition in which the fossils of the Guelph dolomites are preserved, this species is most readily recognised by its columella, which is marked with a double spiral fold. In other respects, the shell is not unlike that of *Murchisonia Loganii*.

Locality and Formation.—Guelph Formation ; Elora and Hespeler.

197. MURCHISONIA LONGISPIRA (Hall).

(Plate III, Figs. 11 and 12).

(*Ref. Murchisonia longispira*, Hall, Pal. N.Y., Vol. II, p. 345, Pl. LXXXIII Figs. 2*a*—*b*).

This species is readily recognised by its long and slender spire, consisting of numerous volutions which expand very slowly in proceeding from the apex to the mouth. The columella is remarkably thick, and is simply rounded, without being in any way twisted.

Locality and Formation.—Guelph Formation ; Elora, Hespeler and Guelph.

198. MURCHISONIA TURRITIFORMIS (Hall).

(Plate III, Fig. 10).

(*Ref. Murchisonia turritiformis*, Hall, Pal. N. Y., Vol. II, p. 347, Pl. LXXXIII. Figs. 6*a*—*b*).

This species is distinguished by its long, turreted spire, which is composed of numerous volutions. The whorls increase very slowly in size, and their outer surfaces are very slightly

convex or nearly flat, so that the two sides of the shell are approximately parallel about its middle. The whorls are marked by a carina a little below their centre.

Locality and Formation.—Guelph Formation, Elora.

199. MURCHISONIA HERCYNA (Billings).

(Plate III, Fig. 2).

(*Ref. Murchisonia Hercyna*, Billings, Palæozoic Fossils of Canada, Vol. I, p. 158, Fig. 141).

In this species, the shell is conical or trochoid, with a nearly flat base, the apical angle being about 65°. There are five or six gently rounded whorls, the surface being covered with fine lamellose striæ, which curve obliquely backwards from the suture to the lower edge of the whorl. The length of the shell is fourteen lines, and its width at the base one inch.

Locality and Formation.—Guelph Formation, Elora.

200. MURCHISONIA VITELLIA (Billings).

(Plate III, Fig. 6).

(*Ref. Murchisonia Vitellia*, Billings, Palæozoic Fossils of Canada, Vol. I, p. 156, Fig. 138).

In this species, the shell is furnished with an elevated and conical spire of about four angular volutions. The body-whorl is ventricose, and, in common with all the other whorls, is furnished with a broad flat spiral band along its centre. Above the band, the whorls are flat or slightly concave; below, moderately convex. In the best preserved specimen in my possession, the length of the shell is somewhat over two inches, of which the body-whorl takes up one inch, the width of the body-whorl being an inch and a half.

Locality and Formation.—Guelph Formation, Elora.

201. MURCHISONIA BOYLEI (Nicholson).

(Plate III, Fig. 1).

Shell turreted, with a long conical spire, the apical angle of which is about 18°. Whorls ten or eleven in number, increasing regularly from the apex to the mouth, flat, with a well marked spiral band or angulation situated just above the suture. Suture canaliculated. Body-whorl little larger than the succeeding whorl, not ventricose. Base somewhat produced below, apparently with a small umbilicus. Length two inches and a half, width of body-whorl eleven lines.

This species is readily recognised by its turritiform shape; its more rapid expansion than is the case in *M. longispira* (Hall), *M. turritiformis* (Hall) or *M. Estella* (Billings); its canaliculated suture; and the existence of an angular band a little above the suture, causing the lower part of each whorl to project over the upper portion of the whorl next below. The above description is taken from a gutta-percha cast of a natural mould presented to the Museum of Toronto University by Mr. David Boyle, Public School Teacher, Elora, to whom I have dedicated the species.

Locality and Formation.—Guelph Formation, Elora.

202. SUBULITES VENTRICOSA (Hall).

(Plate III, Fig. 5).

(*Ref.* Pal. N. Y, Vol. I, p. 347, Pl. LXXXIII. Figs. $7a-b$, and Twentieth Report on the State Cabinet, p. 346, Pl. XV, Fig. 1).

Locality and Formation.—Guelph Formation, Hespeler.

203. CYCLONEMA ? ELEVATA (Hall).
(Plate III, Figs. 16, 16*a*).

(*Ref. Cyclonema ? elevata*, Hall, Twentieth Report on the State Cabinet, p. 342, Pl. XV. Fig. 4).

I have a couple of very well-preserved casts from the Guelph dolomites of Elora, which agree in dimensions, apical angle, and other essential characters with the shell described by Hall under the above name. The only difference to be noted is that one specimen exhibits distinct indications of an obscure and shallow band on the body-whorl, which is not the case in the specimens described by Hall.

Locality and Formation.—Guelph Formation, Elora.

204. PLEUROTOMARIA SOLARIOIDES (Hall).
(Plate III, Fig. 15).

(*Ref. Pleurotomaria solarioides*, Hall, Pal. N. Y., Vol. II, p. 348, Pl. LXXXIV, Figs. 4*a*—*b*).

Locality and Formation.—Not uncommon in the Guelph Formation of Hespeler, Guelph and Elora.

205. PLEUROTOMARIA DEIOPEIA (Billings).

(*Ref. Pleurotomaria Deiopeia*, Billings, Palæozoic Fossils of Canada, Vol. I, p. 155).

Locality and Formation.—Guelph Formation, Hespeler.

206. STRAPAROLLUS HIPPOLYTA (Billings).

(*Ref. Straparollus Hippolyta*, Billings, Palæozoic Fossils of Canada, Vol. I, p. 160, Fig. 144).

207. HOLOPEA GUELPHENSIS (Billings).
(Plate III, Fig. 18).

(*Ref. Holopea Guelphensis*, Billings, Palæozoic Fossils of Canada, Vol. I, p. 159. Fig. 143).

Locality and Formation.—Guelph Formation, Elora.

208. HOLOPEA GRACIA (Billings).
(Plate III, Fig. 17).

(*Holopea Gracia*, Billings, Palæozoic Fossils of Canada, Vol. I, p. 159).

Locality and Formation.—Guelph Formation, Elora.

CHAPTER VII.

FOSSILS OF THE DEVONIAN FORMATIONS.

In my report on the Palæontology of Ontario for the year 1874, I gave descriptions of one hundred and sixty species of fossils from the Devonian Rocks of Upper Canada. To these I have now to add a considerable number of fresh forms, derived from additional mate-

rials which I obtained during the summer of 1874, in some further investigations which I carried out in the Corniferous and Hamilton Formations. Some of these additional species are new to science; others are now recorded for the first time as occurring in Canada; and others, again, have been previously recognised as Canadian, by Mr. Billings, but had not come under my notice at the time when my last years' report was written.

209. Cystiphyllum fruticosum (Nicholson).

(Plate I, Fig. 3).

Cystiphyllum fruticosum, Nicholson, Geological Magazine, December, 1874.

Corallum aggregate, composed of numerous, cylindrical, straight or slightly flexuous corallites, which grow side by side, but are not connected by epithecal processes or expansions, and which often form colonies of several feet in circumference. Corallites about three lines in diameter or rather less, and placed usually at intervals apart of two lines less or more. Epitheca thin, but distinct, marked with very numerous fine, encircling striæ, as well as irregular annulations and constrictions of growth. Calice moderately excavated, from one and a half to two lines in depth, exhibiting numerous bullæ, sometimes with septal striæ near the margin. Internal structure wholly vesicular, the vesicles having a diameter of from half a line to nearly one line.

With the exception of the present very remarkable form, and the equally singular *C. aggregatum* of Billings, all the known species of *Cystiphyllum* are simple. Its compound character is therefore, of itself sufficient to distinguish *C. fruticosum* from all the hitherto recorded species of the genus except *C. aggregatum*, and from this it is separated by its wholly different form and mode of growth. In its general appearance *C. fruticosum* presents the very closest resemblance to *Diphyphyllum arundinaceum* (Billings), with which it not uncommonly occurs associated, and with which it would certainly be confounded if its internal structure were not examined. By this, however, it is at once separated, and is proved to be conclusively a genuine *Cystiphyllum*.

Locality and Formation.—Not uncommon in the Corniferous Limestone of Port Colborne and Hagersville.

210. Cystiphyllum superbum (Nicholson).

(Plate I. Fig. 1.)

Cystiphyllum superbum (Nicholson), Geological Magazine, December, 1874.

Corallum of large size, simple, turbinate, very broadly expanding. Calice extremely large, circular, moderately deep, and very oblique, making, with the dorsal surface, an angle of about 50 degrees and one of about 150 degrees with the ventral surface. The septa are marked by distinct rows of bullæ, which radiate from the bottom of the cup, and are not less than one hundred and forty to one hundred and fifty in number. The vesicles are small, not exceeding half a line in diameter in the circumferential portion of the coral. Epitheca well developed, with numerous fine encircling striæ and annulations of growth. Owing to the obliquity of the calice, the dorsal surface of the corallum is nearly twice as long as the ventral surface; and the greatest thickness is attained at about three inches above the base, or at about half the total length.

The only individual observed had the following dimensions :—Length measured along the dorsal surface, six inches ; along the ventral surface, three inches and a half. Greatest thickness, at three inches above the base, about three and a half inches. Diameter of calice, four and a half inches ; depth of calice, about one inch.

This fine species is most nearly allied to *C. vesiculosum*,(Goldfuss.), but it is distinguished from this and all other recorded species of the genus by its comparatively gigantic dimensions, its very rapid expansion from the base upwards, and the striking obliquity of the calice. When viewed in profile its outline appears to be somewhat rhomboidal. This, however, is not a natural or essential appearance, but is due to the fact that the dorsal surface, in the individual examined, is abruptly geniculated about the middle of its length. There is, however, no reason for supposing that this feature would prove to be a normal one in the species.

Locality and Formation.—Hamilton Group, Arkona, Township of Bosanquet.

211. Eridophyllum strictum (Edwards & Haine).

Eridophyllum strictum, Edwards & Haime, Pol. Foss. des Terr. Palæoz. p. 424, Pl. VIII, Fig. 7.

Eridophyllum strictum, Billings, *Canadian Journal* New Series, Vol. IV, p. 133.

Corallum fasciculate, of elongated cylindrical corallites, which have a diameter of from two to five lines, and are placed at intervals varying from half a line to two lines apart. The corallites are sometimes annulated by sharp-edged epithecal projections at intervals of from one and a half to three lines, and at each of these annulations arise small processes by which the separate corallites are united to one another. At other times these periodic annulations, and the processes which spring from them, are not nearly so well marked, and may hardly be developed at all. In any case, the epitheca is marked by longitudinal and fine encircling striæ, of which the latter often have an oblique direction. Increase is chiefly, or entirely, by calicular gemmation, three or four young being often produced simultaneously from the oral disc of the parent corallite. A well marked internal tabulate area is present. The septa are well developed in the external area of the corallites, where they are united by delicate dissepiments. The septa are apparently alternately developed, and rarely encroach much upon the internal tabulate area, their number seeming to be about sixty in a full-sized corallite.

This species is somewhat variable. The specimens which I have seen from the Corniferous Limestone of Ohio and Kentucky exhibit very conspicuously periodic annulations of growth, from which the connecting processes are developed in a whorled manner ; but this feature is not marked in the Canadian specimens. The species is most nearly allied to *Eridophyllum Simcoense* (Billings), in general appearance and dimensions; but I am satisfied that the two forms are really distinct. When the connecting processes between the corallites are not conspicuous, then *E. strictum* may usually be readily distinguished from *E. Simcoense* by its calicular gemmation.

Locality and Formation.—Corniferous Limestone, Woodstock. Hamilton Formation, Riviére aux Sables, Bosanquet.

212. Diphyphyllum Archiaci (Billings).

Diphyphyllum Archiaci, Billings, *Canadian Journal*, New Series, Vol. V, p. 260, Fig. 8.

Corallum aggregate, forming large masses of straight or slightly flexuous cylindrical cor-

rallites, which are placed nearly or quite in contact, and have a diameter of from six to nine lines. Increase is by lateral gemmation, and the young corallites rapidly attain the dimensions of the adult. Generally there is a small central tabulate area, into which the septa do not extend. The septa are usually from fifty to sixty in number, alternately large and small, united by delicate dissepiments in the external portions of the corallites. Epitheca with fine concentric striæ, and also with numerous annulations and constrictions of growth. The annulations of growth are usually sharp-edged, and contiguous corallites are often united together by their coalescence.

Fig. 41.
Diphyphyllum Archiaci (Billings), Hamilton Formation. (After Billings).

This species is readily recognised by its mode of growth, the large size of its corallites, and the characters of its epithecal covering.

Locality and Formation.—Hamilton Formation ; Riviére aux Sables, Bosanquet.

213. ZAPHRENTIS CORNICULA (Lesueur).

Caryophyllia cornicula (Lesueur), 1820.
Zaphrentis Phrygia (Rafinesque & Clifford), 1820.
Caninia punctata (D'Orbigny), 1850.
Cyathophyllum Ammonis, dilatatum and *conicum*, De Castelnau, Terr. Sil. de l'Amer. du Nord, Pl. XXI, Figs. 1, 2, 3.
Zaphrentis cornicula, Edwards & Haime, Pol. Foss. des Terr. Pal. Pl. VI, Fig. 1.

Fig. 42.
Zaphrentis cornicula (Edwards & Haime), Hamilton Formation

Corallum turbinate, rapidly expanding, about three inches in length when fully grown, and two inches in diameter at the calice, more or less curved towards the base. A large and deep fossette, usually placed on the curved side of the corallum, sometimes on one side. Septa unequally developed, usually from sixty to seventy or eighty of the larger ones, with smaller ones intercalated between them. The larger septa more or less closely reaching the centre, where they may be more or less twisted. Tabulæ well developed, bent downwards towards the circumference of the corallum. Epitheca with a few shallow annulations of growth, and with longitudinal striæ corresponding with the septa within.

I see no reason to doubt the identity of our Hamilton specimens with this species, as they agree perfectly with the numerous examples of *Z. cornicula* which I have examined from the Corniferous Limestone of Ohio and Kentucky. Mr. Billings has expressed the opinion (*Canadian Jour.* New Series, Vol. V, p. 264) that *Zaph-*

rertis cornicula will prove to be truly a *Heliophyllum*; but all the specimens which have come under my notice are clearly referable to the genus *Zaphrentis*.

Locality and Formation.—Not very uncommon in the Hamilton Group, Arkona, Township of Bosanquet.

214. Cyathophyllum Zenkeri (Billings).

Cyathophyllum Zenkeri, Billings, *Canadian Journal*, New Series, Vol. V. p. 262, Fig. 11.

Corallum simple, turbinate, usually strongly curved towards the base, which is small and pointed; septa from one hundred and forty to one hundred and fifty in number, sometimes equally developed, sometimes alternately large and small. In the circumferential zone of the coral, the interseptal loculi are rendered vesicular by the development of a number of fine dissepiments, and longitudinal sections show the existence in the centre of the corallum of a not very well developed tabulate area. Surface with fine encircling striæ and low rounded annulations of growth, marked with longitudinal striæ which correspond with the septa within and of which there are usually five or six in the space of two lines. Calice deep, usually with a more or less flattened space at the bottom. The principal septa, more or fewer of them, reach the centre of the calice, where they are often more or less twisted, and may even be elevated so as to form a pseudo-columella. A septal fossette in several of the examples observed.

The largest individual examined had a length of about two inches and a half, and a diameter at the cup of twenty lines, the depth of the cup being rather over half an inch. The smallest example observed had a length of an inch and a half, and a diameter at the top of fourteen lines, the depth of the calice being eight lines.

The specimens upon which Mr. Billings founded this species were obtained from the Corniferous Limestone; but I have obtained a number of examples, agreeing in all essential respects with his description of the species, from the Hamilton formation.

Locality and Formation.—Hamilton Formation, Arkona; Township of Bosanquet.

215. Michelinia favosoidea (Billings).

Michelinia favosoidea, Billings, *Canadian Journal*, New Series, Vol. IV. p. 114.

Corallum forming large, spherical, hemispherical, or depressed masses composed of polygonal corallites the diameter of which is usually about two lines and a half. Tabulæ well developed, flat, or slightly curved with the convexity directed upwards, sometimes vesicular towards their outer margins. Septa represented by obscure striæ or by rows of minute spiniform projections. Mural pores variable in size and situation. Usually they form oval perforations in the walls of the corallites, having their longer axis vertical; or they may be in rows of five or six on each plane surface of the corallite, in which case they are of small size; or they may be quite irregular in their distribution in which case they are of larger size.

This species in general appearance is closely similar to *Favosites favosa* (Goldfuss), but the characters of the mural pores and the sub-vesicular tabulæ prove it to be a *Michelinia*. It is very nearly related to *Michelinia convexa* (D'Orbigny), but the corallites are more uniform in size, the tabulæ are not so highly vesicular, and the mural pores are more numerous.

Locality and Formation.—Corniferous Limestone, Walpole. (Also at the same horizon at Louisville, Kentucky.)

216. Amplexus laxatus (Billings)?

Amplexus laxatus (Billings), *Canadian Naturalist.*

The Corniferous Limestone of Ontario has yielded numerous examples of a species of *Amplexus*, which I believe to be identical with the *A. laxatus* of Billings. I have not, however, access to the description of this species, and I am therefore obliged to leave this determination uncertain. Precisely the same form occurs in the Niagara Limestone, and also very abundantly, in the Guelph Formation. All my specimens are fragmentary, and I cannot made out their mode of growth accurately. Certain examples appear to be simple, and to have the form of cylindrical flexuous stems, which are irregularly constricted at intervals, and have a diameter of from one line to a line and a quarter. The tabulæ are well developed, and are placed generally about half a line apart. The septa are in the form of strong marginal ridges. Other examples consist of numerous tubes similar to the above, and placed about two and a half lines apart. Whether these actually form part of a compound mass or not, I am unable to say. If they do, then the species should probably be removed from *Amplexus*, and placed provisionally in the genus *Diphyphyllum*. At the same time, the characters of the septa are those of *Amplexus*, and by no means those of *Diphyphyllum*.

Locality and Formation.—Corniferous Limstone, Lot 6, Con. 1, Wainfleet. (Also in the Niagara Limestone and Guelph formations of Canada.)

217. Callopora minutissima (Nicholson).

Corallum forming thin crusts, not exceeding one quarter or one half of a line in thickness, upon foreign bodies. Corallites exceedingly minute, about one hundred and fiftieth of an inch in diameter. Calices not elevated above the general surface, oval or circular in shape, separated by interspaces varying from half the diameter of the calices to equal the diameter, about eight or ten in the space of one line. Interspaces between the corallites filled with excessively minute circular or polygonal tubuli. There do not seem to be any areolæ or vacant spaces filled simply with cœnenchymal tubes.

a *a'*

Fig. 43.

Callopora minutissima (Nich.); *a* small frament, of the natural size; *a'* portion of the same, enlarged. Hamilton Formation.

This species forms thin crusts growing upon *Heliophyllum Halli*, or *H. sub-caespitosum*, or enveloping the columns of Crinoids. It is at once distinguished from all other recorded species of the genus by the extreme slenderness of the corallites, and the excessive fineness of the cœnenchymal tubuli.

Locality and Formation.—Hamilton formation, Arkona.

218. Phillipsastræa gigas (Dale Owen).

Astræa gigas, Dale Owen, Geol. Survey, Iowa, &c., 1844, p. 70. Pl. XIV. Fig. 7.
Phillipsastræa gigas, Billings. *Canadian Journal*, New Series, Vol. IV., p. 128.

Corallum, forming large, spherical or hemispherical masses, the surface of which is covered with corallites averaging one inch in diameter. The width of the calices is from four to six lines, and the corallites are destitute of walls, and are united with one another throughout

their entire height by the confluence of their septa. The number of septa appears to be from fifty to sixty, and they carry arched striæ on their sides, and spine-like processes on their edges, precisely as in the genus *Heliophyllum*.

Locality and Formation. Common in the Corniferous Limestone of the Township of Walpole.

219. Phillipsastræa Verneuilli (Edwards and Haime).

Phillipsastræa Verneuilli, Edwards and Haime, Pol. Foss. des Terr. Pal. Pl. X. Fig. 5.

Phillipsastræa Verneuilli, Billings, *Canadian Journal*, New Series, Vol. IV., p. 127, Fig. 24.

This species agrees in all the essential details of its structure with the preceding; but the corallites are considerably smaller, having an average diameter of not more than half an inch, whilst the calices are only about a quarter of an inch across. The septa are from thirty-five to fifty in number, and their edges are denticulated with minute spines.

Locality and Formation.—Common in the Corniferous Limestone of the Townships of Walpole and Oneida.

220. Stromatopora nulliporoides (Nicholson).

Fossil ("Sarcodeme") forming thin crusts, generally from one quarter of a line to half a line in thickness, growing parasitically upon the exterior of corals. Surface conforming with that of the body on which it is parasitic, quite smooth and apparently compact and imperforate. Under a high magnifying power, the surface appears to be obscurely dotted, indicating the existence of minute pores. Here and there, also, irregularly distributed, are circular openings about one quarter of a line in diameter; but these are only occasionally present, and often cannot be detected at all. The surface usually presents more or less numerous conical projections or eminences, from half a line to one line in height; but these appear to be usually imperforate at their summits. The internal structure is composed of horizontal laminæ, separated by vertical dissepiments, about ten laminæ occupying the space of one line.

This species is allied to *S. granulata*, (Nich.), and *S. striatella*, (D'Orb.,) but is distinguished by forming thin crusts which are attached parasitically to foreign bodies by the whole of their inferior surfaces; by the smooth, non-granulate, non-tuberculate and apparently solid and imperforate surface; and by the general presence of numerous small, sharp-pointed, conical eminences. The fossil, in its general appearance very closely resembles the crusts of a Nullipore; but there is no doubt as to its being a genuine *Stromatopora*. All the examples which I have seen are investing specimens of *Cystiphyllum vesiculosum* (Goldfuss).

Locality and Formation.—Hamilton formation; Arkona. Also in the Corniferous Limestone, Port Colborne.

221. Ceramopora Huronensis (Nicholson).

(Plate II., Fig. 5–5*a*.)

Polyzoary forming small patches or crusts, of a rounded or irregular form, from one-quarter to one-third of a line in thickness, growing parasitically upon foreign bodies, and rarely exceeding three or four lines in diameter. Cells radiating from a central or excentric

point, about six in the space of one line, partially immersed, elevated towards their mouths, which are of a sub-triangular or crescentic form when perfectly preserved.

This species resembles young examples of *Ceramopora Ohioensis* (Nicholson); but is distinguished from adult examples of the same by forming small parasitic crusts, composed of a single layer of cells, which radiate from a central point. The cells also are to a much greater extent immersed than is the case in *C. Ohioensis*, and are not so closely set. From *C. incrustans* (Hall), the present species is separated by its smooth, not nodulose or tuberculated surface. *C. Huronensis* somewhat resembles the figures of *Berenicea* (*Diastopora ?*) *irregularis* (Lonsd.), but the latter is stated to possess round cell-mouths, and the published description is not sufficient to allow of a detailed comparison.

Locality and Formation.—Hamilton Group; Arkona. Growing on the exterior of *Cystiphyllum vesiculosum* and *Heliophyllum Halli*.

Genus HETERODICTYA (Nicholson).

Polyzoary (?) forming a simple, flattened, unbranched, two-edged frond, with sub-parallel sides; consisting of two series of cells, the bases of which rest upon opposite sides of a thin longitudinally-striated central membrane or laminar axis, from which they are directed obliquely outwards in opposite directions. The cells open in longitudinal rows on the two flat or slightly convex surfaces of the frond, and have the form of more or less cylindrical tubes, which are septate or divided transversely by a series of well developed *tabulæ*. Cell-mouths unknown.

In most essential characters, and in general appearance, the genus *Heterodictya* entirely resembles *Ptilodictya*. We have, however, the very anomalous, and very important feature that the cells in the present genus are as thoroughly and regularly *tabulate* as in the genus *Chætetes*. This clearly necessitates the removal of *Heterodictya* from *Ptilodictya*, and establishes a very interesting transitional link between the *Polyzoa* and the *Tabulate Corals*. I am only acquainted with a single species referable to this genus, but this is of large size.

222. HETERODICTYA GIGANTEA (Nicholson).

(Plate II., Fig. 1*a*, *b*, *c*, *d*, *e*.)

Polyzoary (?) forming a single, flattened, unbranched, two-edged frond, the dimensions of which are unknown, though certainly very great. The largest specimen observed, expands gradually in width in proceeding from the base upwards. Its length is three inches and a-quarter, the breadth of the broken base is nine lines, and the breadth of the broken distal extremity is fifteen lines. Both ends of this fragment are broken away, and its real length may be estimated with every probability as being at least half a foot. The edges of the frond are quite sharp, and its thickness in the centre is two lines. Its cross section is thus acutely elliptical, and the two poriferous surfaces are gently and regularly convex, without any central angulation. The frond is completely divided into two halves, by a central laminar axis, which is marked by longitudinal striæ, corresponding with the rows of cells, but does not exhibit transverse arched striæ. The cells are arranged in longitudinal rows, in three series. The first series is central, and consists of a few rows in which the successive cells are themselves longitudinal, and are not obliquely disposed. The remaining two series of rows are lateral, and each consists of a number of rows in which the cells are directed obliquely outwards and

upwards as regards the direction of the row itself. The general arrangement of the cells is thus penniform. There are about six rows of cells in one line measured transversely, and thus there are ninety rows altogether at the broader end of the frond. There are four or five cells in the space of one line measured longitudinally, and the cells alternate in contiguous rows. The cells have the form of cylindrical tubes directed upwards towards the surface at an angle of about 70° with the laminar axis. Each tube is partitioned off transversely by well developed tabulæ. Most of the tabulæ are complete; but some do not quite reach across the tube; and there are five or six of them in the space of one line. The bases of the cells, as seen by decortication of the laminar axis, have mostly the form of narrow ovate slits. The free surfaces of the frond, and consequently the character of the cell-mouths are unknown.

This remarkable form resembles *Ptilodictya lanceolata* (Goldfuss), in its general shape and in the penniform arrangement of its cells; and it seems by no means impossible that the latter species may ultimately be shown to possess tabulate cells, and thus to belong to the genus *Heterodictya*. Under any circumstances, however, *P. lanceolata* is separated from the present form by its comparatively diminutive dimensions; and I know of no other recorded species of the genus *Ptilodictya* with which *Heterodictya gigantea* could be confounded.

Locality and Formation.—Rare in the Corniferous Limestone of Jarvis, Township of Walpole. (Collected by Mr. George Jennings Hinde).

223. Ptilodictya Gilberti (Meek).

(*Ptilodictya Gilberti*, Meek, Palæontology of Ohio, Vol. I, Pl. XVIII, Figs. 1*a*—*c*).

This species is nearly allied to *P. Meeki*, which I formerly described from the Corniferous Limestone of Canada (Report on the Palæontology of Ontario, p. 98, Fig. 34, 1874); but it is distinguished by the following differences:—1. The longitudinal rows of cells are much wider than in *P. Meeki*, about four or five being present in the space of one line measured transversely. 2. The cell-mouths have well-marked raised lips or margins, and are thus distinctly elevated above the general surface. 3. The laminar axis is marked with distinct transverse arched striæ. 4. The frond divides at much shorter intervals, and the mode of division is not dichotomous, the branches being given off more or less nearly at right angles to the main stem.

Generally speaking, therefore, *P. Gilberti* may be recognised by its general form and mode of division; the remote, quincuncially arranged cells, with their elevated mouths; the well-marked elevated lines between the rows of cells; and the transversely striated axis.

Locality and Formation.—Corniferous Limestone, Jarvis. (Collected by Mr. George Jennings Hinde).

224. Ptilodictya cosciniformis (Nicholson).

(Plate II, Fig. 2*a*—*b*).

Polyzoary rooted by a strong foot-stalk, which is partly striated longitudinally, partly covered with the apertures of cells interspersed with numerous minute interstitial tubuli. At the summit of the foot-stalk, the frond divides into a number of flattened branches, which ultimately divide and coalesce with one another, so as to form a network with oval meshes. The branches of this network are flattened and sharp-edged, with gently rounded surfaces. Their cross-section is acutely elliptical, their thickness in the middle being half a line, their width being two lines, and the meshes which separate them being about two lines in their long

diameter. The sharp borders of the branches are marked with longitudinal and oblique striæ, interspersed with the apertures of minute tubuli, a complete margin of this nature surrounding each mesh of the terminal network. The cells are not disposed in longitudinal rows separated by elevated lines; but are arranged quincuncially so as to form two series of intersecting curved diagonals. The cell-mouths are regularly oval, each with a distinct rim, not elevated above the general surface, about six or seven of them occupying the space of one line measured diagonally. The interspaces left by the apposition of the oval cell-mouths are entirely filled by very minute interstitial tubuli, the apertures of which are circular or oval.

This beautiful species forms in many respects a transition between the typical *Ptilodictyæ* and the thin reticulated expansions to which the name of *Clathropora* or *Coscinium* has been applied. It is distinguished by the following more important characters:—1. The mode of growth is peculiar. The polyzoary springs from a strong and thick root-stalk, from the top of which proceed several branches, which do not lie in the same plane, but are so disposed as to form a tuft or cluster similar to that of such a recent form as *Flustra truncata*. These branches subdivide, and their divisions inosculate so as to form a network, the characters of which are similar to those of *Clathropora*. 2. The cells are not arranged in longitudinal rows separated by elevated lines. 3. The cell-mouths are oval, and are quincuncially disposed. 4. All the interstices between adjacent cells are filled up with numerous minute interstitial tubuli, similar tubules being present on the striated margins of the branches, and over considerable portions of the footstalk. The only example, I have seen, is growing upon *Heliophyllum Halli*, to the exterior of which the footstalk is attached by a widely expanded base.

Locality and formation.—Hamilton Group, Arkona.

225. Fenestella Davidsoni (Nicholson).

(Plate III. Fig. 3*a*—*c*.)

Frond small, flabelliform, the branches ("interstices") keeled on both sides of the frond with very high, thin, and sharp-edged carinæ. Three or four branches in the space of one line, dividing dichotomously, usually with great regularity, at intervals of from two to three lines. Both the branches and the keels are more or less wavy or sinuous, sometimes as regularly so as in some *Reteporæ*; and the dissepiments are very wide, deeply sunk below the level of the celluliferous surface of the frond, and looking as if formed by anastomosis of the branches. The dissepiments are about one-third of a line in width, and do not carry cells. The fenestrules are oval, about one-third of a line long, very slightly longer than wide, alternately placed in contiguous rows, about two of them in one line, measured longitudinally. Cell-mouths rounded or transversely oval, about three of them opposite to each fenestrule. Non-poriferous side of the branches smooth, with the same thin, sharp and prominent keel as is seen on the celluliferous side.

This species, in its mode of growth and division, and in the sharpness of the carina between the rows of cells, strongly resembles *F. Milleri* (Lonsdale); but the latter is stated to possess narrow and slender dissepiments, placed two lines apart, with fenestrules five or six times longer than wide, about twelve pores going to the length of a fenestrule. I cannot therefore, but think that the present species is clearly distinct, and I have dedicated it to my friend, Thomas Davidson, Esq., F.R.S., one of the most eminent of living palæontologists. *F.*

Davidsoni is distinguished by its regularly dichotomising branches, with prominent sharp-edged keels on both sides; the undulated character of the branches, and the great width of the dissepiments, which look as if formed by the anastomosis of the branches, whilst the fenestrules are little longer than wide. In the aspect of the celluliferous surface and the sinuous course of the branches, the species makes a close approach to some species of the genus *Retepora*; but the presence of non-poriferous dissepiments, and the existence of a keel separating two rows of cells seem sufficient to justify the reference of the species to *Fenestella*. The keels are so prominent that specimens, especially when viewed from the non-celluliferous side often exhibit nothing except these structures projecting above the matrix.

Locality and Formation.—Hamilton Group, Arkona and Widder.

226. Crania Hamiltoniæ (Hall).

Crania Hamiltoniæ, Hall, Thirteenth Report on the State Cabinet, p. 77.
Crania Hamiltoniæ, Hall, Pal. N. Y. Vol. IV, p. 27, Pl. III, Figs. 17—23.

Ventral valves of this fine species of *Crania* are not uncommon in the Hamilton Formation, adhering to the epitheca of *Cystiphyllum vesiculosum*. They are readily recognised by the presence of four strong impressions for the adductor muscles, the two posterior being distant, and the two anterior placed near together with the pit for the protractor muscles between them. The valve is somewhat oval in shape, and about six or seven lines in diameter when fully grown.

Locality and Formation.—Hamilton group, Arkona.

227. Spirifera granulifera (Hall).

Spirifera granulifera, Hall, Tenth Report on the State Cabinet, p. 163 and Pal. N. Y. Vol. IV, p. 223, Pl. XXXVI.

This handsome species of *Spirifera* has not, so far as I am aware, been hitherto recognised in Canada. Mr. George Jennings Hinde, however, last summer collected a number of Spirifers from the Hamilton Formation of Ravenswood, which agree in all essential respects with the above form. Hall describes the species as having the entire surface of the plications, fold and sinus covered by extremely fine interrupted longitudinal striæ, which form numerous minute pustules or short slender spines, which give a strongly granulose aspect to the shell. This distinguishing character, however, can only be seen, where the outer surface of the shell has been well preserved. This species, according to Hall, has a very wide distribution in the Hamilton Formation, it having been found in Maryland and Virginia, as well as in various parts of the State of New York.

Locality and Formation.—Hamilton Formation; Ravenswood, Township of Bosanquet.

228. Spirifera sculptilis (Hall).

Delthyris sculptilis, Hall, Geol. Rep. Fourth Dist. New York, p. 202.
Spirifera sculptilis, Hall, Pal. N. Y. Vol. IV, p. 221, Pl. XXXV, Figs. 10—14.
Spirifera sculptilis, Billings, *Canadian Journal*, New Series, Vol. VI, p. 262, Fig. 79.

Mr. Billings enumerates this species with some doubt as occurring in the Hamilton Formation. I have, however, undoubted examples from this horizon. The species is readily re

cognised by the presence of from three to five elevated plications on each side of the mesial fold and sinus; these plications being crossed by strong imbricating concentric striæ, and leaving a well-marked space at each cardinal angle which is corrugated by the concentric striæ alone.

Locality and Formation.—Hamilton group, Arkona.

229. GONIATITES UNIANGULARIS (Conrad).

Goniatites uniangularis, Conrad, Journ. Acad. Nat. Sci. Philadelphia, Vol. VIII, p. 268, Pl. XVI, Fig. 4.

Goniatites uniangularis, Hall, Thirteenth Report on the State Cabinet, p. 98, Fig. 6 bis.

Locality and Formation.—Not uncommon in the Hamilton shales, Widder.

230. ORTHOCERAS EXILE (Hall).

Orthoceras exile, Hall, Fifteenth Report on the State Cabinet, p. 78, Pl. VIII, Fig. 5.

Locality and Formation.—Fragments of a slender *Orthoceras* which appear to belong to this species are not rare in the Hamilton Formation at Widder.

231. SPIRORBIS ANGULATUS (Hall).

Spirorbis angulatus, Hall, Fifteenth Report on the State Cabinet, p. 112.

"Discoid or very slightly ascending, making two or more volutions; outer volution robust; the transverse diameter greater than the dorso-ventral, and the sides sometimes subangular. Surface lamellose striate, the lamellæ undulating and sometimes crowded into ridges, and the upper angular side sometimes nodose. The aperture is rounded or oval, and usually nearly rectangular to the plane of volution, but sometimes turned upwards." (Hall, *loc cit*).

I have two or three specimens of a. *Spirorbis*, growing upon *Spirigera spiriferoides*, which agree in their characters with the above description. The entire spiral is about three-fourths of a line in diameter, and the longest diameter of the tube at its mouth is half a line. The species is distinguished by its surface characters, the ventricosity of the last turn of the tube, and the elevation of the aperture at right angles to the plane of volution. It is a dextral species, and is much larger than S. *Arkonensis* (Nich.); whilst its transverse striation is much less regular and close than it is in the latter species.

Locality and Formation.—Hamilton formation; Widder.

232. SPIRORIBIS SPINULIFERUS (Nicholson)

Tube dextral, of two and a half volutions, evenly rounded, and not angulated or carinated, diameter of the entire spiral nearly two lines, the diameter of the tube near the mouth being about three-fourths of a line. The tube is broken close to the mouth; but the last volution

Fig. 44.

a, *Spirorbis laxus* (Hall), *b*, specimen of the same in which the last volution is free (after Hall). From the Lower Helderberg formation. *c*, *Spirorbis spinulifera* (Nich.) Hamilton formation.

is elevated, and the tube is consequently deeply umbilicated on the free side. There is, however, nothing to lead one to suppose that the aperture did not open very nearly in the plane of the spiral. Surface, with fine transverse striæ, and also with numerous strong spiniform, projections or tubercles.

In form and dimensions this species is near *S. omphalodes* (Goldfuss); but it is slightly larger, and its surface characters are quite different. From *S. angulatus* (Hall), it is separated by its regularly rounded, not angulated or compressed tube, its larger dimensions, and its spinulose-surface.

Locality and Formation. Hamilton group; Arkona. Growing upon *Heliophyllum Halli.*

APPENDIX.

HOLOPEA ? OCCIDENTALIS (Nicholson).

Shell conical, with a small but elevated spire; whorls five, convex, with the greatest convexity in the upper fourth; body-whorl extremely large, occupying nearly three-fourths of the length of the shell, moderately expanded towards the aperture, at which point it is almost free. Aperture circular. In the cast there is a large umbilicus.

FIG. 00.

Holopea? occidentalis (Nicholson). Natural size. From the Guelph Formation.

The length of the shell is twenty-one lines, the width of the base (including the aperture) is nineteen lines; the height of the body-whorl is fifteen lines, the height and width of the aperture, each nearly nine lines, the width of the umbilicus is four lines, and the height of the spire is about six lines. The surface characters are unknown.

It is impossible to feel certain whether this form is rightly referable to *Holopea* or not, though its general characters would lead us to place it in this genus. The species is distinguished by its short but elevated spire, its large body-whorl, becoming almost disjunct at the aperture, its circular aperture, and its large umbilicus. The upper whorls are almost uniformly convex, but the body-whorl is obtusely angulated at about its upper fourth, being somewhat flattened from this point to the suture. The suture is deep. There are no traces of a band or carina.

Formation and Locality.—Guelph Limestone, Elora.

Genus LEPTOBOLUS (Hall).

The genus *Leptobolus* has been proposed by Hall (Twenty-fourth Annual Report on the State Cabinet, p. 226) for certain minute Linguloid shells, which occur in the Utica slates of New York and Iowa, and the Hudson River Group of Ohio. The shell in this genus is semiphosphatic, fragile, minute, elliptical, or sub-circular, with usually moderately convex valves, marked externally with concentric striae. The ventral valve shows a distinct area and a pedicle-groove, with an elevated sub-quadrate muscular area in the interior. The interior of the dorsal valve shows slightly elevated trifid muscular impressions.

I am not aware that shells of this genus have as yet been recognised as occurring in Canada, but I have found examples to be tolerably numerous in the Utica slates of Collingwood and Whitby. Hall defines three species of the genus, all differing in slight peculiarities of shape, and I should be inclined to refer the Canadian examples to his *Leptobolus insignis*. The shell is extremely minute, rarely exceeding one line in length, orbicular, or broadly ovate, with regularly convex valves, which are marked externally by concentric lines of growth and fine radiating striae.

Locality and Formation.—Abundant in the Utica slates of Nottawasaga Bay and Whitby.

LIST OF FOSSILS.

The letter T. indicates the occurrence of the species in the Trenton Limestone; H. R. in the Hudson River Formation; U in the Utica slates; Cl. in the Clinton Formation, N. in the Niagara Group; G. in the Guelph Formation; C. in the Corniferous Limestone; and H. in the Hamilton Formation.

I. Protozoa.

1. Stromatopora sp. (T).
2. " striatella, *D'Orbigny* (N).
3. " concentrica, *Goldfuss* (G).
4. " ostiolata, *Nicholson* (G).
5. " nulliporoides, *Nicholson* (C and H).
6. " Hindei, *Nicholson* (Cl. and N).

II. Hydrozoa.

7. Diplograpsus Hudsonicus, *Nicholson* (H R).
8. " Pristis, *Hisinger* (U).
9. Climacograpsus tæniatus, *Hisinger* (U).

III. Actinozoa.

10. Columnaria alveolata, *Hall* non *Goldfuss* (T).
11. " Goldfussi, *Billings* (T).
12. Favistella stellata, *Hall* (H. R).
13. " calicina, *Nicholson* (H R).
14. Columnopora cribriformis, *Nicholson* (H R).
15. Tetradium fibratum, *Safford* ? (T).
16. " minus, *Safford* (H R).
17. Favosites Gothlandica, *Lamarck* (T ? N; G; ; H).
18. " favosa, *Goldfuss* (N).
19. " sp (Cl).
20. " Forbesi, *Edwards and Haime* (G).
21. " hemispherica, *Yandell* and *Shumard* (G).
22. " polymorpha, *Goldfuss* (G).
23. " (Astrocerium) venusta, *Hall* (N; G).
24. " dubia, *DeBlainville* ? (N).
25. " ? (Cladopora) multipora *Hall* (N).
26. " ? (Cladopora) seriata, *Hall* (N).
27. Michelinia favosoidea, *Billings* (C).

28. Chætetes petropolitanus, *Pander* (T ; H R).
29. " discoideus, *James* (T ; H R).
30. " undulatus, *Nicholson* (T ; H R)
31. " pulchellus, *Edwards* and *Haime* (T).
32. " Fletcheri, *Edwards* and *Haime* (T ; H R).
33. " gracilis, *James* (T).
34. " delicatulus, *Nicholson* (H R).
35. " sp. (Cl.)
36. Callopora minutissima, *Nicholson* (H).
37. Coenites laminata, *Hall* (N).
38. " " lunata, *Nicholson and Hinde* (N).
39. Alveolites Fischeri, *Billings* (N).
40. " " Niagarensis, *Nicholson and Hinde* (N).
41. Striatopora flexuosa, *Hall* (N).
42. Halysites catenularia. *Linnaeus* (N).
43. " " agglomerata, *Hall* (N ; G).
44. Heliolites sp. (Cl).
45. " " interstincta, *Wahlenberg* (N).
46. Astræophyllum gracile, *Nicholson and Hinde* (N).
47. Syringopora retiformis, *Billings* (N).
48. Cannapora annulata, *Nicholson and Hinde* (N).
49. Protarea vetusta, *Edwards and Haime* (T).
50. Amplexus laxatus, *Billings ?* (N ; G ; C).
51. " " Vandelli, *Edwards and Haime* (G).
52. Streptelasma corniculum, *Hall* (T. and H R).
53. Zaphrentis Stokesi, *Edwards and Haime* (Cl. and N).
54. " " Rœmeri, *Edwards and Haime* (N).
55. " " bilateralis, *Hall* (N).
56. " " cornicula, *Lesueur* (H).
57. Petraia pygmæa, *Billings* (N).
58. Cyathophyllum Zenkeri, *Billings* (H).
59. Diphyphyllum cæspitosum, *Hall* (N).
60. " " Archiaci, *Billings* (H).
61. Eridophyllum strictum, *Edwards and Haime* (C and H).
62. Phillipsastræa gigas, *Dale Owen* (C).
63. " " Verneuilli, *Edwards and Haime* (C).
64. Cystiphyllum fruticosum, *Nicholson*, (C).
65. " " superbum, *Nicholson* (H).

IV. Crinoidea.

66. Glyptocrinus sp. (T).
67. " " plumosus, *Hall* (Cl).
68. Caryocrinus ornatus, *Hall* (N).

V. Polyzoa.

69. Ptilodictya acuta, (*Hall*) T.
70. " " falciformis, *Nicholson* (T).
71. " " fenestelliformis, *Nicholson* (T).
72. " " Shafferi, *Meek* (H R).
73. " " crassa, *Hall* (Cl).
74. " " punctata, *Nicholson and Hinde* (Cl).
75. " " ? raripora, *Hall* (Cl).
76. " " Gilberti, *Meek* (C).
77. " " cosciniformis, *Nicholson* (H).
78. Clathropora sp. (T).
79. " " frondosa, *Hall* (N).
80. " " intermedia, *Nicholson and Hinde* (N).
81. Retepora Trentonensis, *Nicholson* (T).
82. " " asperato-striata, *Hall* (N).
83. Fenestella tenuis, *Hall* (Cl).
84. " " tenuiceps, *Hall* (N).
85. " " Davidsoni, *Nicholson* (H).
86. Helopora fragilis, *Hall* (Cl).
87. Phænopora ensiformis, *Hall* (Cl).
88. Rhinopora verrucosa, *Hall* (Cl).
89. Trematopora ostiolata, *Hall* (N).
90. Ceramopora Huronensis, *Nicholson* (H.)
91. Heterodictya gigantea, *Nicholson* (C).

VI. Brachiopoda.

92. Leptæna sericea, *Sowerby* (T ; H R ; U ; Cl).
93. " " transversalis, *Dalman* (N).
94. Strophomena alternata, *Conrad* (T ; H R).
95. " " filitexta, *Hall* (T ; H R).
96. " " deltoidea, *Conrad* (T).
97. " " fluctuosa, *Billings* (T).
98. Strophomena rhomboidalis, *Wahlenberg* (T ; Cl ; N).
99. " subplana, *Conrad* (N).
100. " sp. (N).
101. Orthis testudinaria, *Dalman* (T ; H R ; U).
102. " biforata, *Schlotheim* (T ; H R ; N).
103. " subquadrata, *Hall* (T).
104. " plicatella, *Hall* (T ; U).
105. " flabellulum, *Sowerby* (T, Cl).
106. " calligramma, var. Davidsoni, *De Verneuil* (Cl).
107. " elegantula, *Dalman* (Cl. N).
108. Rhynchonella recurvirostra, *Hall* (T).

109. Rhynchonella increbrescens, *Hall* (T).
110. " neglecta, *Hall* (Cl.)
111. Leptocœlia planoconvexa, *Hall* (Cl).
112. Atrypa reticularis, *Linnœus* (Cl; N).
113. Athyris intermedia, *Hall* (N).
114. " (Atrypa) naviformis, *Hall* (Cl; N).
115. Lingula Cobargensis, *Billings* (T).
116. " Progne, *Billings* (U).
117. " lamellata, *Hall* (N).
118. Dinobolus magnificus, *Billings* (T).
119. Trematis Ottawaensis *Billings* (T).
120. Discina sp. (H.R).
121. " tenuilamellata, *Hall* (N).
122. " (Orbiculoidea) Forbesi, *Davidson* (N).
123. Pentamerus oblongus, *Sowerby* (N).
124. " occidentalis, *Hall* (G).
125. " (Pentamerella ?) ventricosus, *Hall* (G).
126. Charionella Hyale, *Billings* (G).
127. Trimerella grandis, *Billings* (G).
128 " Dalli, *Davidson* and *King* (G).
129. " acuminata, *Billings* (G).
130. Monomerella prisca, *Billings* (G).
131. Spirifera Niagarensis, *Conrad* (N).
132. " granulifera, *Hall* (H).
133. " sculptilis, *Hall* (H).
134. Crania Hamiltoniæ, *Hall* (H).

VII. Lamellibranchiata.

135. Ambonychia radiata, *Hall* (H R).
136. Avicula demissa, *Conrad* (H R).
137. " alata, *Hall* (Cl).
138. Modiolopsis modiolaris, *Hall* (H R).
139. " curta, *Hall* (H R).
140. " orthonota, *Conrad* (Cl).
141. Cleidophorus planulatus, *Hall* (H R).
142. Lyrodesma poststriata, *Emmons* (H R).
143. Ctenodonta sp. (Cl).
144. Megalomus Canadensis, *Hall* (G).
145. " compressus, *Nicholson* and *Hinde*, (G.)

VIII. Gasteropoda.

146. Murchisonia bellicincta, *Hall* (T).
147. " gracilis, *Hall* (T; H R).
148. " sub-fusiformis, *Hall* (T).

149. Murchisonia subulata, *Conrad* (Cl).
150. " Loganii, *Hall* (G),
151. " macrospira, *Hall* (G).
152. " bivittata, *Hall* (G).
153. " longispira, *Hall* (G).
154. " turritiformis, *Hall* (G).
155. " Hercyna, *Billings* (G).
156. " Vitellia, *Billings* (G).
157. " Boylei, *Nicholson* (G).
158. Pleurotomaria umbilicata, *Hall* (T).
159. " lenticularis, *Sowerby* (T).
160. " solarioides, *Hall* (G).
161. " Deiopeia, *Billings* (G).
162. Platyostoma Niagarensis, *Hall* (N).
163. Subulites ventricosa, *Hall* (G).
164. Cyclonema ? elevata, *Hall* (G).
165. Holopea Guelphensis, *Billings* (G).
166. " gracia, *Billings* (G).
167. Straparollus Hippolyta, *Billings* (G).
168. Bellerophon bilobatus, *Sowerby* (T).
169. Cyrtolites ornatus, *Conrad* (H. R).

IX. Pteropoda.

170. Conularia Trentonensis, *Hall* (T).
171. Tentaculites tenuistriatus, *Meek and Worthen* (H R.)
172. " distans, *Hall* (Cl).
173. " neglectus, *Nicholson and Hinde* (Cl).

X. Cephalopoda.

174. Endoceras longissinum, *Hall* (T).
175. " proteiforme, *Hall* (H R. ; U).
176. Orthoceras teretiforme, *Hall* (T).
177. " lamellosum, *Hall* (H R).
178. " exile, *Hall* (H).
179. Ormoceras crebriseptum, *Hall* (H R).
180. Goniatites uniangularis, *Conrad* (H).

XI. Annelida.

181. Scolithus verticalis, *Hall* (Cl).
182. Arenicolites sparsus, *Salter* (Cl),
183. Planolites vulgaris, *Nicholson* (Cl).
184. Spirorbis angulatus, *Hall* (H).
185. " spinuliferus, *Nicholson* (H).

XII. Crustacea.

186. Leperditia Canadensis, *Jones* (T).
187. Beyrichia sp. (H. R).
188. Asaphus platycephalus, *Stokes* (T ; H R).
189. Calymene Blumenbachii, *Brongniart* (T ; H R ; Cl ; N).
190. Phacops caudatus, *Brongniart* (N).
191. Triarthrus Beckii, *Green* (U).
192. Asaphus Canadensis, *Chapman* (U).

XIII. Incertæ sedis.

193. Licrophycus sp. (T).
194. Palæophycus sp. (T).
195. " virgatus, *Hall* (H R).
196. Rusophycus bilobatus, *Hall ?* (H R).
197. Buthotrephis sp. (T).
198. " gracilis, *Hall* (Cl).
199. Fucoides sp. (T).
200. Dictyonema gracile, *Hall* (N).

2.8
3.2
2.5
2.2
2.0
1.8
1.1
1.0

INDEX.

Mintern Bros. imp.

Species of Cystiphyllum. (Devonian.)

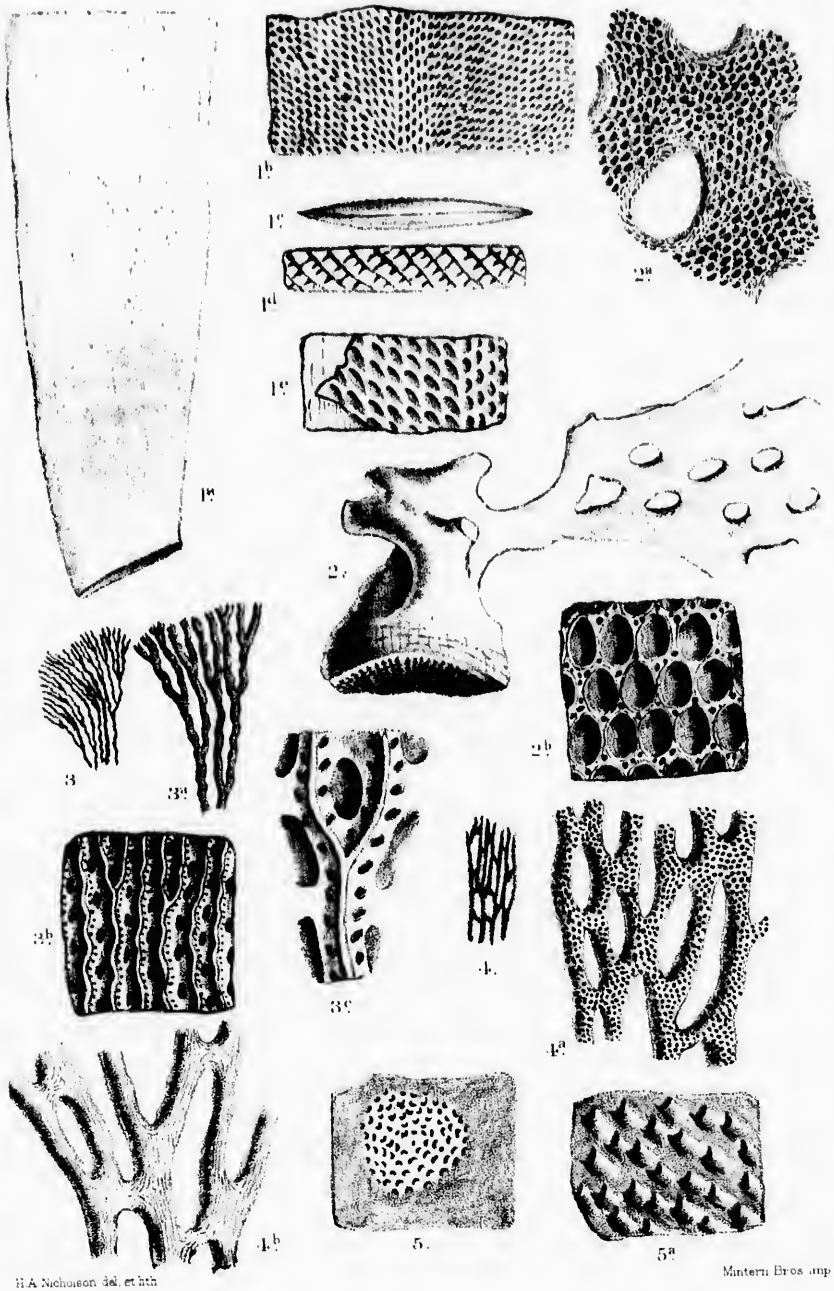
PLATE I.

Fig. 1. *Cystiphyllum superbum*, Nich., viewed in profile, of the natural size. The single dark line shows the outline of the calice as seen in a front view. (P. 73.)

Fig. 2. *Cystiphyllum Ohioense*, Nich., of the natural size. 2*a*. Calice of the same viewed from above.

Fig. 3. Fragment of *Cystiphyllum fruticosum*, Nich., of the natural size. 3*a*. Calice of one of the corallites of the same, slightly enlarged. (P. 73.)

Fig. 4. *Cystiphyllum squamosum*, Nich., of the natural size, viewed from the front 4*a*. Profile view of the same. 4*b*. Profile view of another individual of the same, in which a secondary calice has been produced at right angles to the primary calice.



H A Nicholson del. et lith

Mintern Bros. imp

Devonian Polyzoa

PLATE II.

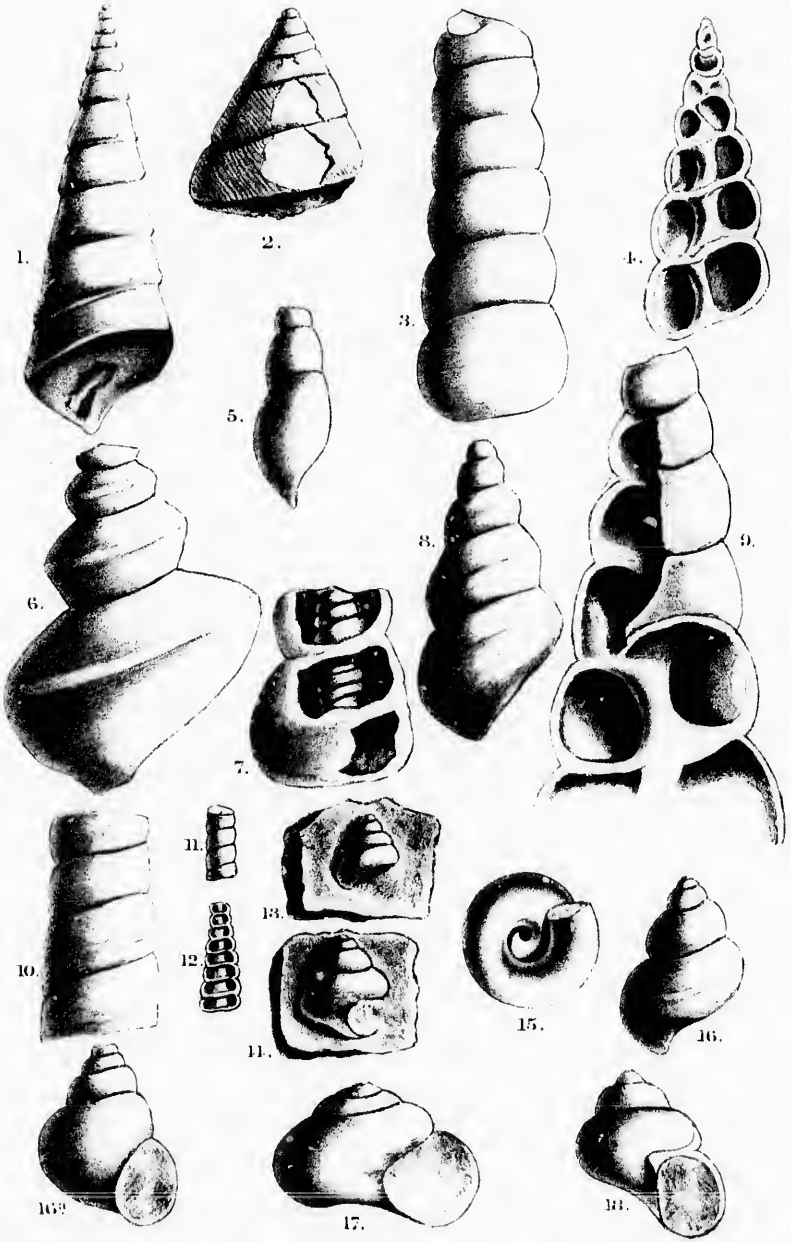
Fig. 1*a*. *Heterodictya gigantea*, Nich., a broken frond of the natural size. 1*b*. Portion of the same, enlarged to show the penniform arrangement of the cells. 1*c*. Transverse section of the frond, natural size. 1*d*. A few of the cells, enlarged to show the tabulæ. 1*e*. A small portion of the surface, greatly enlarged. (P. 79.)

Fig. 2. *Ptilodictya cosciniformis*, Nich., a broken specimen of the natural size. 2*a*. Portion of the same, enlarged. 2*b*. Portion of the same, still further enlarged. (P. 80.)

Fig. 3. *Fenestella Davidsoni*, Nich., a small portion of the non-poriferous side, of the natural size. 3*a*. Portion of the same, enlarged. 3*b*. Portion of the poriferous side of another specimen of the same, enlarged. 3*c*. Small portion of a branch of another example of the same, greatly enlarged. (P. 81.)

Fig. 4. *Retepora Trentonensis*, Nich., a fragment of the natural size. 4*a*. Portion of the same, enlarged. 4*b*. Portion of another example, showing the non-poriferous surface, enlarged. (P. 15.)

Fig. 5. A small crust of *Ceramopora Huronensis*, Nich., growing on *Heliophyllum Halli*, enlarged. 5*a*. Portion of the same, greatly enlarged. (P. 78.)



H A Nicholson del. et lith.

Manten Bros. imp

PLATE III.

Fig. 1. *Murchisonia Boylei*, Nich. (P. 71.)

Fig. 2. *Murchisonia Hercyna*, Billings. (P. 71.)

Fig. 3. Fragment of a large example of *Murchisonia Loganii*, Hall. (P. 70.)

Fig. 4. Section of another example of the same. (P. 70.)

Fig. 5. *Subulites ventricosa*, Hall. (P. 71.)

Fig. 6. *Murchisonia Vitellia*, Billings. (P. 71.)

Fig. 7. *Murchisonia bivittata*, Hall. (P. 70.)

Fig. 8. Small example of the same (?). (P. 70.)

Fig. 9. *Murchisonia macrospira*, Hall. (P. 70.)

Fig. 10. Fragments of *Murchisonia turritiformis*, Hall. (P. 70.)

Fig. 11. Fragments of *Murchisonia longispira*, Hall. (P. 70.)

Fig. 12. Section of another example of the same. (P. 70.)

Fig. 13 & 14. An undetermined species of *Pleurotomaria*.

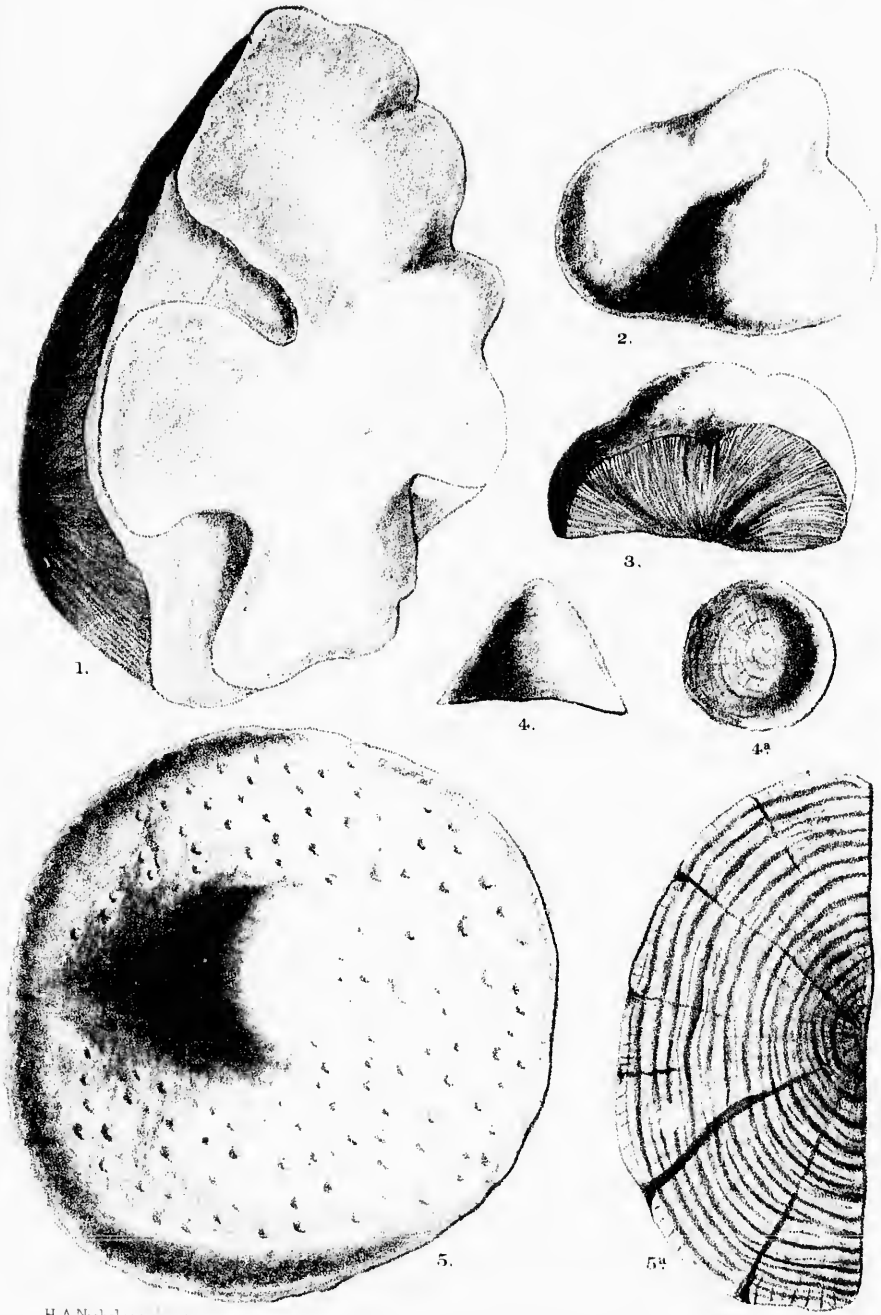
Fig. 15. Base of *Pleurotomaria solarioides*, Hall. (P. 72.)

Figs. 16, 16*a*. *Cyclonema (?) elevata*, Hall. (P. 72.)

Fig. 17. Cast of *Holopea Gracia*, Billings. (P. 72.)

Fig. 18. Cast of *Holopea Guelphensis*, Billings, distorted by pressure. (P. 72.)

(All the figures are of the natural size.)



H. A. Nicholson, del. et lith.

Mintern Bros. imp.

Species of Chaetetes

PLATE IV.

Fig. 1. Portion of a mass of *Chætetes undulatus*, Nich., natural size. Trenton Limestone. (P. 10.)

Figs. 2, 2*a*. "Puff-ball" forms of *Chætetes*, from the Hudson River Group of Canada. Natural size.

Fig. 3. A small example of *Chætetes petropolitanus*, Pander, having the typical form of the species. Natural size. Trenton Limestone. (P. 10.)

Fig. 3*a*. Base of the same, showing the concentrically-wrinkled epitheca. (P. 10.)

Fig. 4. Disc-shaped variety of *C. petropolitanus* (= *Stenopora patula*, Billings), viewed from above. Natural size. Trenton Limestone. (P. 10.)

Fig. 4*a*. Part of the under surface of the same, showing the epitheca. (P. 10.)