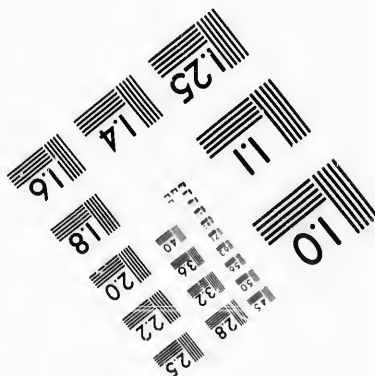
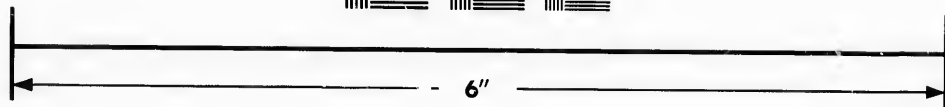
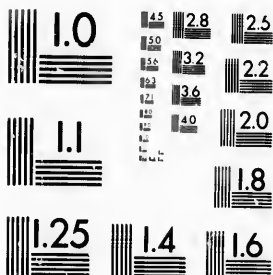


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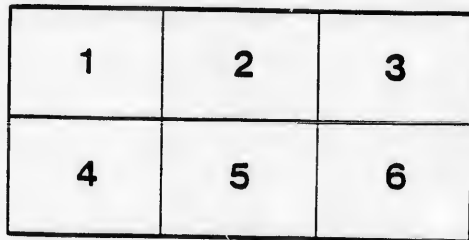
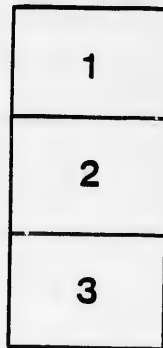
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MAY 26 1914

Billings

ON THE
DEVONIAN FOSSILS
OF
CANADA WEST.

BY E. BILLINGS, F.G.S.

Extracted from the Report of the Geological Survey of Canada
for 1860,—in preparation.

(From the *Canadian Journal* for May, 1860.)

V

THE Devonian Rocks of Canada West consist of portions of the Oriskany Sandstone, Schoharie Grit, Onondaga Limestone, Corniferous Limestone, Hamilton, Portage, and Chemung Groups. The fossils of the first of these formations are about to be published by Professor Hall, in his forthcoming third volume of the *Palæontology of New York*; and I shall therefore postpone the examination of such as we have from that rock until after the appearance of that work. Under the term Corniferous Limestone, as it will be used hereafter throughout this paper, are included all those rocks which would probably in the State of New York be divided into three groups,—the Schoharie Grit, Onondaga Limestone, and Corniferous Limestone. At any rate, the two latter seem to be in Canada united by their palæontological characters. The Hamilton Shales we classify as a separate formation immediately overlying the Corniferous Limestone. The Portage and Chemung Groups are also distinct; but I shall leave the examination of their fossils for some future occasion.

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These rocks are, in Canada West, highly fossiliferous, and in some places even densely crowded with the remains of extinct species of corals, encrinites, molluscs, trilobites, and large fishes. The fossils, however, are for the greater part in so imperfect a condition, that few of the species can be well defined from the collections made thus far, and, on account of the scarcity of good specimens, many years must elapse before anything approaching to a complete description of the whole fauna of the period can be produced. To accomplish this within a reasonable time, will require the co-operation of many local observers, each devoting his leisure hours to the minute examination of all the rocks in the neighbourhood of his residence, and each influenced to do so by the desire of promoting the cultivation of the sciences in this Province. With a number of such men distributed throughout the fossiliferous regions of Canada, the work will advance rapidly. Without some voluntary assistance of this kind, the progress must be extremely gradual, so difficult is it to procure good specimens of most of the species. Few are aware of the importance of long-continued researches in a single locality, or even in a single quarry. I devoted the greater part of the spare time of seven years to the examination of an area of which all the exposed patches of rock, if put together, would not make a superficies of one square mile, and yet its treasures were not exhausted. Since I left, others have entered the same field, and have been rewarded by the discovery of many interesting new facts. There are hundreds of such localities in Canada yet to be explored; and if there were a good observer in or near each of them, and if all would freely communicate the fruits of their labours, the combined results could not be otherwise so important to science, and highly creditable to the country.

In making collections, the mode of procedure is exceedingly simple. All that is to be done is to examine the rocks, and if they contain fossils, collect them. The specimens should then be sent where the species can be determined. Unless the observer publishes some account of his facts, or (in case he does not feel competent to do so himself) communicates them to some other person who can and will give them publicity, the labour is lost. In the following and other articles to be published in this Journal hereafter, I intend to give figures and descriptions of many of our Devonian Fossils, and hope that they may be, to some extent, useful in assisting the local observer to name his specimens. That he can name all that he may

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find, by comparing them with the figures and descriptions, I am well aware, from my own experience, is impossible. There are numerous species concerning which the most experienced practical naturalists would remain in doubt, although assisted in the examination by all the aids that can be drawn from extensive libraries of scientific works. Let no beginner, therefore, feel disappointed or discouraged should he fail to satisfy himself that he has succeeded in naming his specimens correctly from books. These papers will be of some service; but I shall also be most happy to examine and name (so far as I can) collections from any part of the Province, on condition that I shall be permitted to describe the new forms, and retain, for the Provincial Collection, a specimen of each species of which we have not already examples in the Museum. This would be beneficial to all parties, and greatly promote the advance of science in this country. I earnestly hope, that at least a few of those who reside in the vicinity of fossiliferous Devonian rocks in Canada West, may be induced to render me their assistance in this way. The specimens should be carefully wrapped up in paper and packed in a strong box, and sent to the Geological Survey at Montreal. Delicate fossils should be protected, by being placed in a separate box, otherwise they will be crushed by the others. When a fine fossil, such as a well preserved trilobite, encrinite, or othoceratite, is imbedded in a piece of stone, no attempt should be made to chisel it out. Unless the operation is performed by a most experienced hand, in nine cases out of ten the specimen will be greatly injured, if not totally destroyed. The locality of each specimen should be given. I am particularly desirous of procuring specimens of fossil shells which exhibit the inner surface, since it is from such that the characters of the genera can be best worked out. As soon as they are examined, the specimens will be sent back, free of expense.

ZOOPHYTA.

In a paper published in the *Canadian Journal* for March, 1859, I gave an account of forty-three species of corals from the Devonian rocks of Canada West. In the following article I shall describe eleven new species; and there are from ten to fifteen others which must remain until better specimens can be procured. I think it probable that altogether there are eighty species of corals in these rocks in Canada, and many of them were so prolific, that the zoophyta

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must have constituted four-fifths in bulk of the whole fauna of the period. In England and in Germany, the grand coralline horizon of the Devonian era lies in the middle of the series. The fauns of the Corniferous Limestone and Hamilton Shales would therefore appear to be more nearly related to the middle than to the lower Devonian of Europe. Such is the position assigned to them in the third edition of Sir Roderick Murchison's noble work, *Siluria*. But if it can be shewn that the coralline beds of Canada include the Schoharie Grit of New York (as I strongly suspect they do), then this latter formation must also be added to the middle Devonian. On this latter point, however, I can give no positive opinion, as the fossils of the Schoharie Grit of New York are totally unknown to the scientific world.

The following may be given as a table shewing approximately the position of the different American sub-divisions of the Devonian system, as indicated by the evidence of the fossil corals :

Old Red Sandstone, or	}	UPPER DEVONIAN.
Catskill Group		
Chemung Group		
Portage Group		
Genesee Slate	}	MIDDLE DEVONIAN.
Tully Limestone		
Hamilton Group		
Marcellus Shale		
Corniferous Limestone		
Onondaga Limestone		
Schoharie Grit	}	LOWER DEVONIAN.
Cauda-galli Grit		
Oriskany Sandstone		

It is important to observe, that in Gaspé we find some of the characteristic fossils of the Oriskany Sandstone intermingled in the same beds with those of the Upper Pentamerus Limestone, and therefore it may be that when these Gaspé rocks are studied, we shall find it difficult to draw the line between the Lower Devonian and the Lower Helderberg.

Genus STRIATOPORA.—(Hall.)



Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 1. *Striatopora Linneana*.Figs. 2, 3, 4. *Trachypora elegantula*.—Fig. 4 is a portion enlarged: the upper figure a longitudinal section.

Generic characters.—"Ramosae, coralla solid; stems composed of angular cells; apertures of cells opening upon the surface into expanded angular cup-like depressions; interior of the cell rayed or striated, striæ extending beyond the aperture of the cell."—(HALL. *Palaontology of New York*, vol. 2, page 156.)

STRIATOPORA LINNEANA.—*N. Sp.*

Description.—Stems two or three lines in diameter, branching at an angle of from 75° to 80° ; cells variable in size, the greater number with the expanded mouth one line wide, and the circular cavity at the bottom from one-third to one-half of a line; the smaller or younger cells, of all sizes, are somewhat uniformly distributed among the larger. In the perfect specimens the mouths of the cells are everywhere in contact with each other, the edges of the walls between them sharp, and the form more or less polygonal, generally five or six sided. In worn specimens the cells are more nearly circular, and the walls obtusely rounded on the edge. The striæ in the cell mouths not observed. I have seen only two specimens of this species, and am unable, therefore, to state to what extent the stems may vary in thickness. In *S. rugosa* (Hall),* Hamilton Group, Iowa, the cells are distant from each other nearly their own diameter, and the stem is branched at an angle of about 55° (in the specimen figured). In *S. flexuosa* (Hall),† Niagara Group, the cells are, upon an average, more than one line and a half wide, and many of them two lines. Our species, therefore, must be regarded as distinct from either.

* *Geology of Iowa*. Vol. 1, Part 2, page 479, Pl. 1, fig. 6.† *Palaontology of New York*. Vol. 2, page 156, pl. 40 B, fig. 1a.

Locality and formation.—Township of Bosanquet, lot 25, con. 5. Shales of the Hamilton Group.

Collectors.—A. Murray, J. Richardson.

STRIATOPORA FORMOSA.—*N. Sp.*

Description.—Stems from one line and a half to three lines in thickness; cells of an uniform size or very nearly so, three-fourths of a line in width, opening out on the surface at an angle of about 45° with the longitudinal axis of the stem, the cell mouths very gradually expanded, apparently fifteen fine obscure striæ occupying the whole surface of the upper lip.

This species differs from *S. Linneana* in having the cells smaller and of an uniform size. The cell mouths are as wide in stems, one and a half lines in thickness, as they are in the largest specimens seen. I have not ascertained the angle at which the stems bifurcate. In perfect specimens, where the cells are empty, on looking into them obliquely downwards, they are seen to become circular just below the edge of the lower lip, their diameter there being a little less than half the transverse width of the mouth.

Locality and formation.—Corniferous Limestone, near Woodstock.

Collector.—A. Murray.

Genus TRACHYPORA.—(Edwards and Haime.)

Generic characters.—"Corallum dendroid, the branches presenting calyces which are only slightly salient, and in which there are no radiating septa; cœnenchyme very abundant, solid, and with the surface marked by strong, irregular, vermicular, and sub-echinulated striæ."—(EDWARDS and HAIME. *Polypiers Fossiles des Terrains Paléozoïques*. Page 305.)

The only species of this genus heretofore known, is *T. Davidsoni* (E. and H.), which occurs in the Devonian Rocks at Ferques, in France.

TRACHYPORA ELEGANTULA.—*N. Sp.*

(See Figs. 2, 3, 4.)

Description.—Stems (in the specimens examined) from two to two and a half lines in diameter, branching at an angle of about 75°. Cells arranged in four or five rows, parallel with the axis of the stem; they are oval, about one line in length and two-thirds of a line wide, with an elevated margin at the sides, in general effuse above, rarely

effuse below. The space between the cells is marked with irregular, flexuous, broken striae, four or five in the width of one line; the elevated margin at the sides of the cells exhibits from seven to nine short oblique ridges or tubercles. In the longitudinal rows, the cells are sometimes in contact with each other, and often separated by distances equal to half their own length, or a little more. In *T. Davidsoni*, the cells are not arranged in linear series, and the striae are of a different form.

Locality and formation.—Lot 25, con. 5, Bosanquet.

Collectors.—A. Murray and J. Richardson.

Genus ALVEOLITES.—(Lamarck.)

The following three species appear to belong to this genus :

ALVEOLITES ROEMERI.—*N. Sp.*

Description.—Stems from two to three lines in diameter, usually cylindrical, but sometimes sub-palmate, branching. Cells transversely oval, about half a line wide and one-fourth of a line in length; in general distant from each other from half a line to two-thirds of a line in the longitudinal direction of the stem, and half that distance in the transverse direction.

In some specimens the cells are not quite so distant as above said and it may be that these should constitute a distinct species *A. labiosa* (*Canadian Journal*, March, 1859), the cells, when per are scarcely one-fourth of a line wide; *A. cryptodens* (*Loc cit*), upon the whole, a larger species, with the cells about a line distant.

The stems appear to bifurcate at an angle of from 50° to 60°; but the specimens are not sufficiently perfect to determine this character with certainty.

Locality and formation.—Lot 25, con. 5, Bosanquet. Hamilton Shales.

Collectors.—A. Murray, J. Richardson.

ALVEOLITES GOLDFUSSI.—*N. Sp.*

Description.—This species occurs in irregularly circular depressed masses, several inches wide and one or two inches in height. The corallites radiate from a point in the bottom, and the mass, rapidly increasing in width, has a very obtusely turbinate form, flattened and undulated on the top, and apparently composed of horizontal super-

imposed layers. The cells are transversely sub-oval or sub-triangular, usually with one curved side and two straight sides. In some parts of the mass, especially on the edges, they approach the sub-circular polygonal form, but usually they are wider in the one direction than in the other. The width is in general three-fourths of a line (sometimes one line), and the height half a line. The bottom of the mass is either in part or wholly covered by a thin, smooth, but concentrically undulated epitheca.

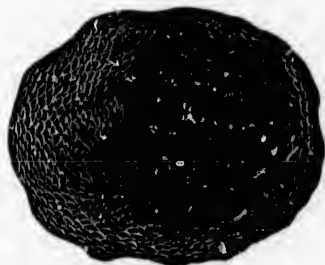


Fig. 5.



Fig. 6.

Fig. 5. *Alveolites Goldfussi*.—Upper side of a small specimen.

Fig. 6. *Alveolites Fischeri*.—One side of a frond.

This species resembles *A. suborbicularis* (Lamarek) of the Devonian Rocks of England, France, and Germany; but in that species there is a groove on one side of the cell, and a corresponding ridge on the side opposite. I have not been able to detect these characters in very well preserved specimens of *A. Goldfussi*, and feel satisfied that it is therefore a distinct species.

Locality and formation.—Lot 25, con. 5, Bosanquet. Hamilton Shales.

Collectors.—A Murray, J. Richardson.

ALVEOLITES FISCHERI.—*N. Sp.*

(See Fig. 6.)

Description.—This species is found in the shape of flattened, palmate, obscurely branching fronds, celluliferous on both sides. Some of the fragments appear to be portions of undulated expansions, two to four lines in thickness, and several inches wide. The majority of the specimens, however, indicate a palmated form, two to four inches

In length, from half an inch to more than one inch wide, and from one to three lines in thickness. The cells, when perfect, are transversely sub-oval or sub-triangular, usually with one curved and two straight sides, from half a line to two-thirds of a line wide; distant from each other about two-thirds of a line in the vertical, and a little less in the transverse direction of the frond. When well preserved, the lower lip, or edge of the cell, is thin, sharp, and uniformly arched. In the very thin fronds (one line in thickness), the cells open out on the surface at a very acute angle, apparently 15° to 20° ; but in the thicker specimens the angle is greater—sometimes 45° .

Locality and formation.—Bosanquet. Shales of the Hamilton Group.

Collectors.—A. Murray, J. Richardson.

ALVEOLITES SQUAMOSA.—*N. Sp.*

Description.—This species is found in wide, flat, irregular expansions, sometimes six or seven inches in breadth, and from half an inch to one inch and a half in thickness; composed of successive, and often much distorted, layers; the cells opening out upon the surface very obliquely, and separated from each other by exceedingly thin partitions, which, when silicified and well brought out by the action of the weather, present a peculiarly rough squamose appearance. The cells are linear, in general about half a line in length, and apparently one-tenth of a line in width. One of the specimens examined exhibits two spots, one-fourth of an inch wide each, where the cells are less than half the average size. There are obscure indications of a central ridge on one side of the cell in this species, as there is in *A. suborbicularis*.

This species differs from *A. Goldfussi* in having much smaller and more compressed cells. In a space one-fourth of an inch square, I have counted ninety-seven cells; and the average appears to be from seventy-five to one hundred, with here and there spots holding double that number. In *A. Goldfussi* there are from sixteen to thirty in the same area. On comparing the figures of *A. suborbicularis* in the works of GOLDFUSS, SANDBERGER, and BRÜNN, it will be seen that in that species there are about fifty cells in one-fourth of an inch square. The difference in the size (great though it be) might not be sufficient to separate these three species, but the form of the cells appears to be also different. *A. Goldfussi* has not the groove on the

outer lip, nor the ridge on the inner, that is exhibited by *A. suborbicularis*; while *A. squamosa*, although possessing the ridge, does not seem to have the groove; and besides, the cells are in general linear, instead of sub-oval or sub-polygonal.

Locality and formation.—Township of Cayuga. Corniferous Limestone.

Collector.—J. De Cew.

SYRINGOPORA MACLUREI.—(Billings.)

SYRINGOPORA TUBIPOROIDES.—(Billings.) *Canadian Journal*, Vol. IV. page 115. March, 1859.

Not *S. tubiporoides* (Yandell and Shumard), nor of M. Edwards and J. Haime. *Polypiers fossiles des terrains palæozoïques*, p. 292.

Since the publication of this species in the *Canadian Journal* in March last, Professor Dana, of New Haven, has informed me that the true *S. tubiporoides* is a much larger form, and is supposed to be an *Eridophyllum*. I thought I could identify ours by the description given in the work of Edwards and Haime, but it now appears quite certain that it is not the same; and also that their fossil cannot be the *S. tubiporoides* of Yandell and Shumard. In order, therefore, to avoid confusion, I propose to change the name of this species to *S. Maclurei*.

In my description, the corallites are said to have a diameter of about one line and a half; but, after examining other specimens, I find that in the greater number it is more nearly one line. In some of the colonies, many of the tubes are full one line and one-third in thickness, and it was upon these my first statement was founded.

Sometimes the groups are exceedingly irregular, the corallites widely separated and straggling through the rock.

FAVOSITES TURBINATA.

FAVOSITES TURBINATA (Billings.) *Canadian Journal*, March, 1859.

The description of this species was published in the *Canadian Journal* for March, 1859. At that time the only specimens I had seen were from the Corniferous Limestone, but we have now several from the Hamilton Group. The species differs from all other *Favosites* known, in its peculiar mode of growth. The form resembles that of a large cyathophylloid coral,—turbinate, the base or smaller

pointed extremity usually curved, but occasionally straight; more or less rapidly expanding upwards; sometimes so much elongated as to become irregularly cylindrical; several inches in diameter, and (though rarely) two feet in length. The more common length is from two to six inches. But the most remarkable character is, that

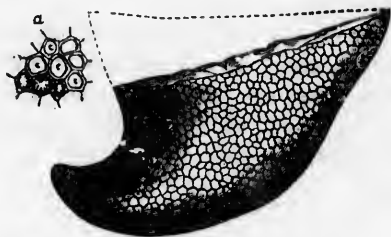


Fig. 7.

Fig. 7. *Favosites turbinata*.—A small curved specimen. a. exhibits the different appearances of the cells.

the whole surface, except the larger end, is covered with a thick epitheca, which completely closes all the tubes. In general, the substance of the epitheca only fills the mouth of the tube, but leaves the walls so far visible that the polygonal form of the cells can be distinctly seen. In such specimens, the disc which closes the mouth of the corallites sometimes retains the impressions of the radiating septa, and thus presents an obscurely stellate appearance. There are some with an epitheca so thick, that it not only fills the cells but also entirely conceals the walls, so that the whole mass exhibits an uniformly smooth surface.

In the original description, the corallites are said to be "usually somewhat less than a line in width." In one of the specimens from the Hamilton Group, the cells are, upon an average, full one line in diameter, with here and there one nearly a line and a half wide; and no doubt others will be found still larger, for in all the species of *Favosites* this character is somewhat variable. The description, therefore, should state that the cells are about one line in width, a little more or less. This species is now known to occur in the Oriskany Sandstone, the Corniferous Limestone, and in the Hamilton Shales. I have ascertained that there are one, two, or three rows of pores; usually two.

F. GOTHLANDICA and F. HEMISPHERICA.

Both of these species occur in the Hamilton Group, at Bosanquet; the former in dome-shaped masses, from three inches to a yard in diameter, with cells about one line and a half wide: the latter in somewhat flat, undulating expansions, from three inches to one foot or more in width, and from less than one to three inches in thickness. In some specimens of the latter, the cells are half a line wide, or thereabouts, and of an uniform size all over the whole surface; but in others there are numerous spots where the cells are only one-fourth of a line in width. In this respect the specimens from the Hamilton Group agree exactly with those of the Corniferous Limestone.

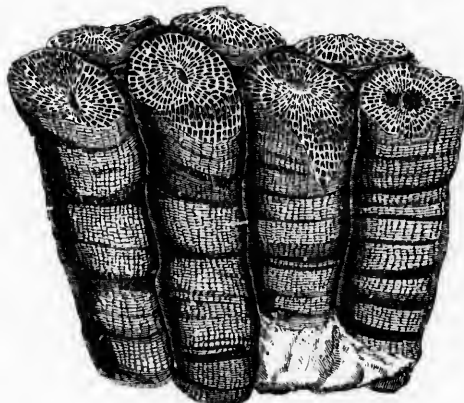
DIPHYPHYLLUM ARCHIACI.—*N. Sp.*

Fig. 8.

Fig. 8. *Diphphyllum Archiaci*.

Description.—Corallum forming large masses of parallel nearly straight cylindrical stems, in contact with each other, or nearly so, and which, when full grown, are from six to eight lines in diameter. The young stems are added by lateral or marginal gemmation, and are at first two or three lines in diameter, their adult size being attained at the length of two or three inches. At the diameter of four or five lines, there are between thirty and thirty-five radiating septa; at six or eight lines, usually about fifty; but occasionally in those of the larger size, from seventy-five to eighty may be seen.

Fifty appears to be the common number. There are two or three transverse diaphragms in one line. In most of the corallites there is a central area, one line or a little less in diameter, into which the radiating septa do not penetrate. Others in the same mass seem to be without this central area. Surface with a somewhat thick epitheca, which, where perfectly preserved, is beautifully ornamented with fine crowded, encircling striæ, from fifteen to twenty in the width of one line. In addition to these fine striæ, there are numerous usually sharp-edged annulations, varying from less than one-fourth of a line in width and depth, to one or two lines. Some of the corallites exhibit sudden constrictions of growth, which give to them the appearance of a series of short turbinate stems inserted into each other.

The epitheca is often entirely or partially worn away, and the fine striæ can only be seen when the surface is in a very perfect state of preservation.

It is probable this coral occurs simple as well as aggregate.

Variety.—A fragment from Lot No. 2, Con. 4, Townsend, three inches and a half in length and seven lines in diameter, and with about fifty radiating septa, appears to belong to this species, but differs in having the surface with only five encircling striæ to one line. Resembles *Cyathophyllum cæspitosum* (Goldfuss); but that is a smoother species, and, according to McCoy, only four or five lines in diameter.

Locality and formation.—Lot 25, Con. 5, Bosanquet. Hamilton Shales.

Collectors.—A. Murray, J. Richardson.

HELIOPHYLLUM EXIGUUM.—*N. Sp.*



Fig. 9.



Fig. 10.

Fig. 9. *Heliophyllum exiguum*.—Side view. Fig. 10. The same.—View of the cup.

Description.—Small, turbinate, more or less curved, often flattened on the side of the convex curvature, radiating septa between sixty and eighty; about six obscure arched striæ to one line on their flat sides, and the same number of spines on their edges. The depth of

the cup is equal to one-fourth or one-third of the whole length of the coral. In small specimens, the margin of the cup is thin and sharp; but in the large ones rounded, and one line or a little more in thickness. About one-half of the radiating septa reach the centre, and form a small rounded elevation on the bottom of the cup. There is a septal fossette on one side, which, in all the specimens I have seen, reaches the centre. The surface exhibits a few sharp constrictions of growth, with rounded annulations between them, the latter often abruptly terminated on their upper sides. In very perfect specimens, fine encircling striae of variable size, apparently from eight to fifteen in the width of one line. The horizontal striae, which indicate the number of the septa, are distinctly visible, but not strongly marked. The position of the septal fossette is indicated on the outside of the cup by two septal ridges, which extend the whole length of the coral, and constitute one of the lines along which the younger septa were added from time to time.

The greater number of the specimens are from six to nine lines in length, but some are full one inch. The width of the cup is always a little less than the length of the entire fossil. The most common number of septa is sixty. The arched striae and spines are not often preserved.

Locality and formation.—Rama's Farm, near Port Colborne. Corniferous Limestone.

Collector.—E. Billings.

CYATHOPHYLLUM ZENKERI.—*N. Sp.*

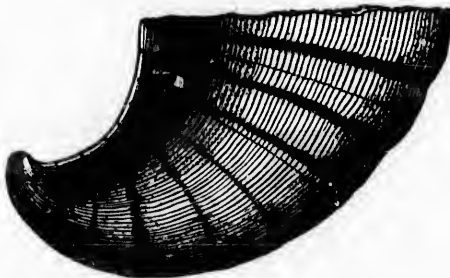


Fig. 11.

Fig. 11. *Cyathophyllum Zenkeri*.—Side view of a large specimen.

Description.—Corallum simple, turbinate, strongly curved at the pointed base, gently and uniformly arched above, gradually enlarging

to the diameter of one inch and a half at a length of two inches and a half. Cup about three-fourths of an inch in depth, the form of the bottom variable, either with a smooth space or a small pit in the centre, or covered with the prolonged radiating septa; these latter about one hundred and fifty in number; the interseptal spaces filled for a short distance from the outer surface with small sub-lenticular cells, of which there are about four in one line; a small space beneath the bottom of the cup in full-grown specimens, with flexuous transverse diaphragms. Surface, when perfect, with sometimes a few inconspicuous encircling annulations of growth, but often with a somewhat smooth aspect, longitudinally marked with the septal striae, of which there are, on an average, five or six in the width of two lines; when partially decorticated, the interseptal spaces roughened with small subimbricating projections or notches, with their sharper edges usually turned upwards—about four of these in one line. The largest specimen that I have seen is three inches and one-fourth in length, measured along the surface of the side with the larger or convex curve, and one inch and a half on the lesser curve. The diameter of the cup, in the same specimen, is one inch and a half. Several others that I have seen are from one to two inches and a half in length.

The arrangement of the septa in the bottom of the cup appears to vary a good deal in different individuals. In one specimen two inches in length, there is a deep septal fossette on one side, and a pit in the centre of the cup. The septa branch off, as it were, on each side of a depressed line, extending from the central pit to the fossette. In another, about the same size, the septa all reach the centre in the bottom of the cup, and are there somewhat twisted together. There is a septal fossette in this specimen also. In a third individual, with a cup one inch in diameter, there is a smooth space two lines wide in the centre, with an obscurely indicated septal fossette. I think it probable that most of the large individuals will be found to have the bottom smooth.

The form of the walls of the cup also varies according to the age of the individual. In the immature it is thin, and the septa alternate somewhat in size. But in the large ones (three inches in length) the interseptal spaces are filled with the cellular tissue nearly to the free edges of the septa, and the wall of the cup is thus rendered solid for the thickness of two lines, or a little more.

In those large ones, also, it is to be observed that the septa are of a nearly uniform size when seen in the upper part of the wall of the cup.

There are several species of fossil corals in the Corniferous Limestone, which resemble this one in external appearance :

1. *Zaphrentis prolifica*.—The greater number of the specimens are about the same size as those of *C. Zenkeri*, but are more slender towards the base, seldom uniformly curved, the septa alternating in size in the walls of the cup, and the septal striæ four in two lines. The worn specimens do not exhibit the roughened nodulose exterior presented by *C. Zenkeri* when partially decorticated.

2. *Cyathophyllum Lesueuri*.—This is a somewhat larger species, with the septa (just within the margin of the cup) distant nearly one line from each other, but with the septal striæ as closely arranged as they are in *C. Zenkeri*; and further, under certain conditions, exhibiting ten striæ to two lines.

3. *Zaphrentis cornicula*.—(Edwards & Haime.) This species has not been found to my knowledge in Canada, but I have before me two specimens from Ohio (from Dr. Shumard.) The surface resembles *C. Zenkeri*, but then the septa inside of the cup are denticulated on their edges and, besides, are large and small alternately. *Z. cornicula* appears to be a *Heliophyllum*.

4. *Clisiophyllum Oneidaense*.—The perfect specimens are marked with numerous sharp annulations, but when the outer surface has been worn away, the interseptal spaces exhibit either transverse diaphragms, nearly a line distant from each other, and turned upwards, or small projections similar to those of *C. Zenkeri*, but two or three times more distant.

Locality and formation.—Rama's Farm, near Port Colborne.
Collector.—E. Billings.

CHONOPHYLLUM MAGNIFICUM.—*N. Sp.*

(See Plate I.)

Description.—Short, turbinate, expanding to the width of six or seven inches at a height of four inches and a half; upper surface constituting a nearly flat circular disc, with a rounded cavity in the middle, one inch and a half wide, from which radiate one hundred and twenty-five depressed convex ridges; the grooves between them

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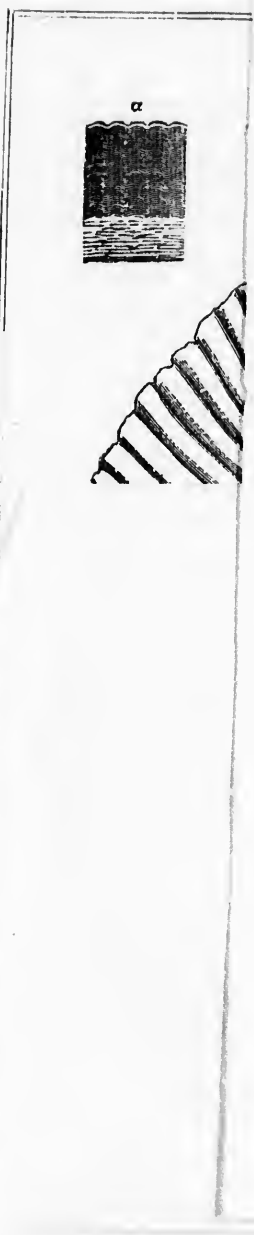
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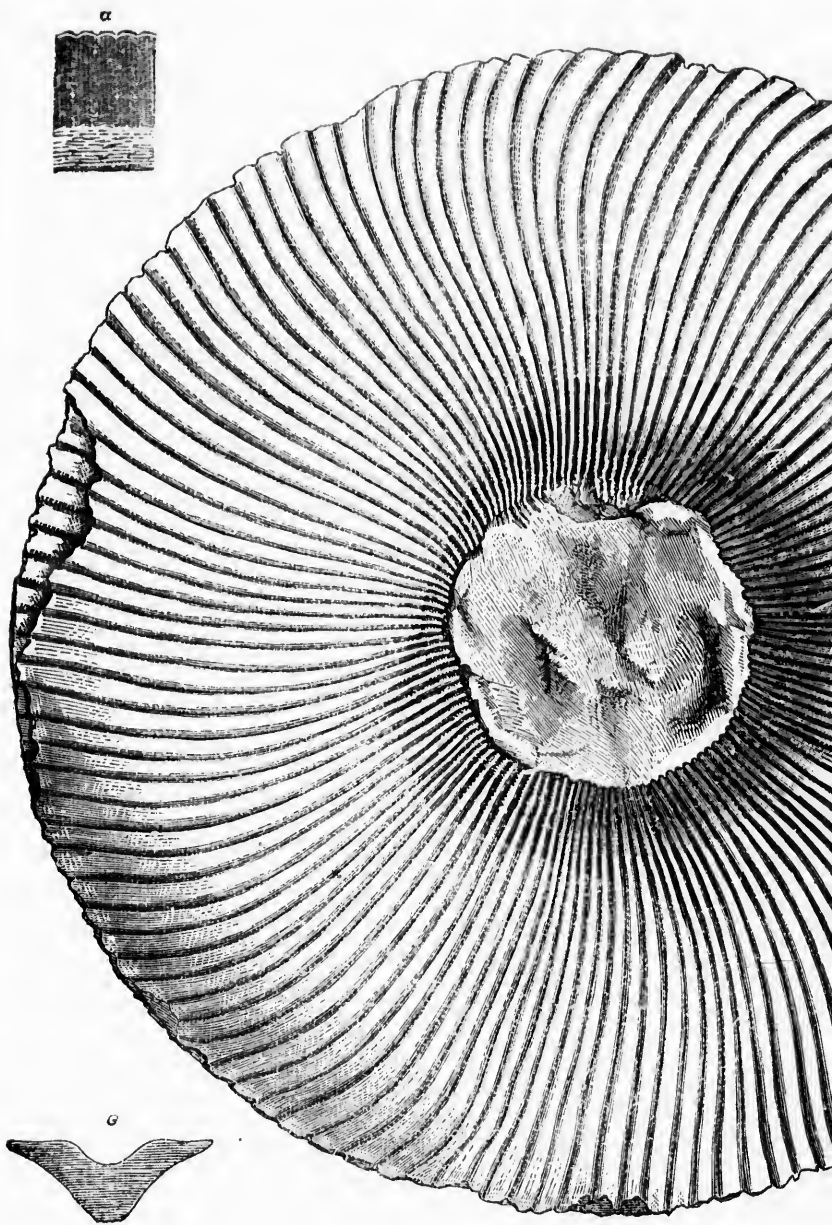
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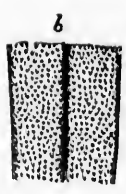
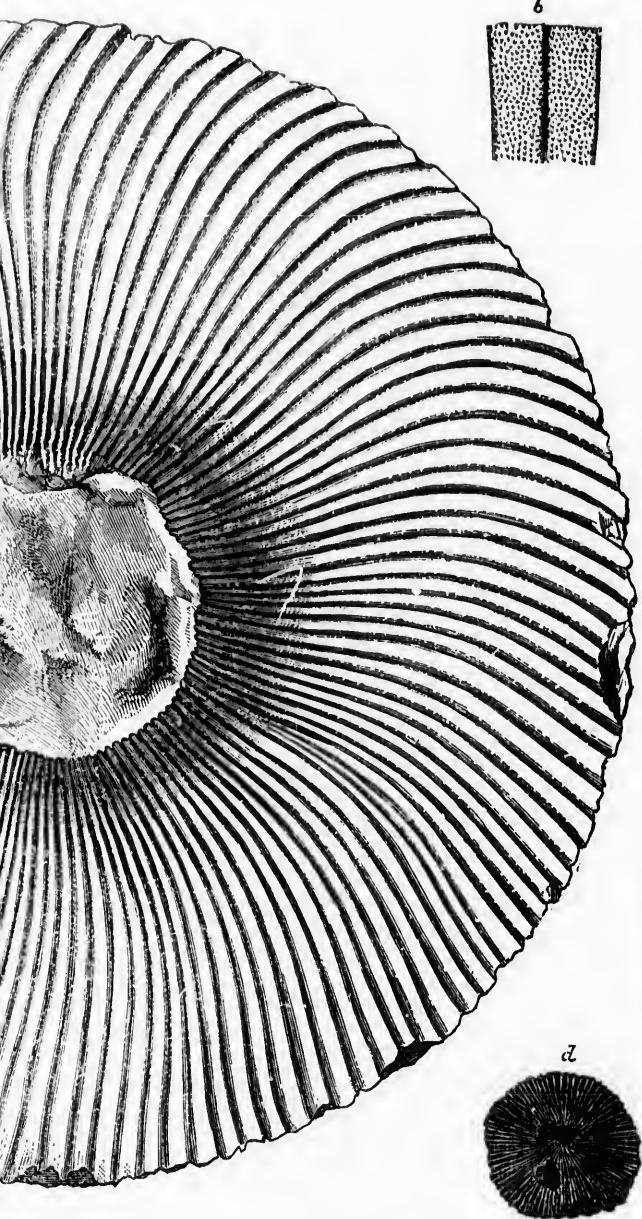
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CHONOPHYLLUM MAGNIFICUM.—(See page 16)

The large figure is a view of the cup. Fig. a, vertical section of a portion near surface of two of the rays a little enlarged. Fig. c, vertical section reduced to Transverse section near the base.



ENIFICUM.—(See page 16.)

ical section of a portion near the side. Fig. b, portion of the vertical section reduced to one-sixth natural size. Fig. d,

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narrow, and somewhat angular in the bottom. These ridges are gently curved in crossing the broad flat margin of the cup. The depth of the central cavity is about one inch. A transverse or horizontal section shows that many of the septa (probably one-half of them) reach the centre. In a vertical section, extending downwards, so as to cut off the outer extremities of a few of the radiating ridges, it is shewn that the grooves on the floor of the cup indicate the position of the septa, and that the ridges are the interseptal spaces. The structure, as exhibited in this section, consists of excessively thin, parallel, horizontal laminae (apparently from thirty to forty in the thickness of one line.) These laminae are arched upwards between the septa, the curve corresponding with the convexity of the radiating ridges. In the lower part of the corallite, the interseptal tissue is much coarser. The surfaces of the radiating ridges appear to be covered with small tubercles. (See Pl. I. *b*.)

The only specimen of this truly magnificent coral that I have seen, is imbedded in an upright position in the rock, the broad circular disc of the cup (with the greater number of the rays well exposed by the action of the weather) being just on a level with the surface of the stratum. The width of the disc or cup in this individual is six and a half inches; and it exhibits one hundred and twenty-five radiating ridges, which attain a breadth of about two lines at the margin. It is highly probable that in other specimens the number of rays may be a little less or greater than it is in this one. The thickness of the piece of rock in which it is imbedded is three inches; and on the under surface a transverse section of the coral is exhibited, with a diameter of one inch and a half, and consequently it expands from that size to a width of more than six inches in the length of three inches. At this rate of tapering, the total length of the perfect fossil must be about four inches and a half. Most probably a small portion of the pointed base is more or less curved. I have not seen the surface below the edge of the disc.

This species resembles *Chonophyllum perfoliatum* (Goldfuss), but is much larger, and has double the number of radiating septa.

Locality and formation.—Let No. 1, cen. 14, Township of Walpole.

Collector.—J. De Cew.

BRACHIOPODA.

Genus LINGULA.—(Bruguière.)

Of this genus, only one species has been found in the Devonian rocks of Canada West. The specimens are too imperfect for description.

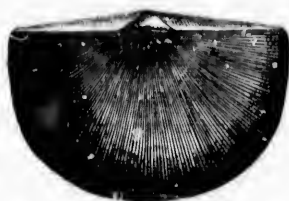
STREPTORHYNCUS PANDORA.—N. Sp.

Fig. 12.



Fig. 13.

Fig. 12. *Streptorhynchus Pandora*.—View of the dorsal valve.

Fig. 13.—Longitudinal section.

Description.—Shell semioval, or sub-quadrate; length about three-fourths the width, hinge line equal to the greatest width of the shell, sometimes a little less, usually forming a right angle with the sides of the cardinal extremities; front margin broadly rounded. Ventral valve depressed semiconical, most elevated at the beak, thence descending with a slightly concave or nearly flat slope in all directions, to the margin. Area of ventral valve, large triangular, extending the whole length of the hinge line, sloping outwards at an angle of about 100° , with the plane of the lateral margin; foramen triangular, very conspicuous, its width at base nearly twice the height, nearly or altogether closed by a convex deltidium. Dorsal valve moderately convex, gently compressed towards the cardinal angles. Surface with very narrow, strongly elevated, radiating ridges, of which there are from four to six in the width of one line; the increase appears to be both by bifurcation and interstitial addition, the latter mode being the most common.

Width of a specimen of medium size, sixteen lines; length of same, from the beak of the ventral valve to the front margin, twelve lines; height of area of ventral valve at the beak, two lines and three-fourths; width of foramen at base, four lines and a half. Another specimen is twenty lines wide and sixteen in length. Besides these,

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Fig. 14.

there are other imperfect specimens from two inches to two inches and a half in width, which I have no doubt belong to the species.

The inclination of the area of the ventral valve, judging from several fragments that I have examined, appears to vary considerably.

This species belongs to that group of the genus of which *O. umbraculum* (Schlotheim) is a characteristic form. Mr. Davidson has recently placed the species of this type in the genus *Streptorhynchus* (King) with the following remark: "The shells composing this sub-genus, are closely related to *Strophomena*; they are usually semicircular, convex or concavo-convex, and externally striated; the ventral valve possessing a prolonged and oftentimes bent or twisted beak."—(GEOLOGIST, March, 1860.) The species vary greatly in size and form, and Mr. Davidson has, therefore, united under one name (*S. crenistria*) no less than twelve varieties, which have all been considered to be distinct by various authors. Our fossil closely resembles *S. crenistria* in external form, but differs in not having the radiating striae crenulated, and further in the form of the ocluser muscular impressions in the dorsal valve. According to Davidson's figure, there is a small process between the two branches of the cardinal process of the dorsal valve, which does not exist in ours. I shall give some further illustrations of this species hereafter. It is only since this article was sent to the press that I have procured specimens which exhibit the interior of both valves.

Locality and formation.—Lot No. 6, Con. 4, Townsend. Also at Rana's farm, near Port Colborne, and near Woodstock.

Collectors.—A. Murray, E. Billings and J. De Cew.

ORTHIS LIVIA.—*N. Sp*

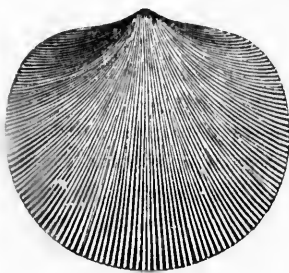


Fig. 14.



Fig. 15.



Fig. 16.

Fig. 14. *Orthis Livia*.—Ventral valve.

Fig. 15.—Longitudinal section of the same.

Fig. 16.—Dorsal valve.

Description.—Sub-orbicular or sub-quadrate; length about eight-ninths of the width; greatest width, usually a little in front of the middle; length of hinge line, one half to two-thirds the width of the shell; cardinal extremities rounded; sides in most specimens somewhat straight, often sufficiently curved to give a circular aspect to the shell; front angles obtusely rounded; front margin in general broadly convex, sometimes with a small space in the middle nearly straight. Dorsal valve of a medium convexity, most elevated about the middle; the outline forming a uniform arch from the depressed beak to the front margin; the slope from the umbo towards the cardinal angles, gently concave; sometimes a barely perceptible mesial depression, commencing in a point at the beak, and becoming obsolete at one half or two-thirds the length; area small, lying in the plane of the lateral margins; beak minute, forming a small triangular projection, rising scarcely one-fourth of a line above the edge of the area, the point not incurved over, but situated in the plane of the area. Ventral valve moderately convex, most elevated at between one-fourth and one-third the length from the beak, thence descending with a somewhat flat or gently convex slope, to the front and sides, and with a more sudden and somewhat concave slope to the hinge line and cardinal angles; the umbo small, prominent, neatly defined, terminating in a small rounded beak, which is incurved so as to overhang the edge of the area, either not at all or scarcely one-tenth of a line; area triangular, about one-fourth larger than that of the dorsal valve, forming an angle of about 105° with the plane of the lateral margin. The foramen not observed, but appears to be wider than high. On looking at the dorsal valve in a direction perpendicular to the plane of the shell, the small rounded umbo of the ventral valve can be seen rising about one-third of a line above the dorsal beak.

Surface with small sub-angular radiating ridges, of nearly a uniform size, from eight to ten in the width of three lines, increasing by bifurcation, strongly curved outwards to the upper part of the sides and cardinal angles, the intervening grooves sub-angular in the bottom, and equal to the ridges in width. In very perfect specimens, very fine concentric sub-lamellar concentric striæ are visible, seven or eight to one line. In certain conditions of preservation also, the radiating ridges are seen to be sub-tubular, and exhibit numerous small oval or circular openings on their edges, each about the eighth or tenth of a line in width, and from one-fourth to two-thirds of a line distant from each other.

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Fig. 17. *Orthid*

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Width of largest specimen examined, eighteen lines; length, sixteen lines; thickness or depth of both valves, seven lines; height of area of ventral valve at the beak, one line; area of dorsal valve, four-fifths of a line; distance between the beaks, one line; length of hinge-line, ten lines. The most common size appears to be one inch in width. The beak of the ventral valve is incurved, so that it would touch a plane projected horizontally through the valve, at one-half the depth of the cavity.

In some specimens the ventral valve has a faint, barely perceptible mesial fold, extending from the umbo towards the front.

This species is allied to *O. Vanuxemi*, but is more coarsely striated. It may be identical with one of the other species described in the Report of the Regents of the New York University, but as it is impossible to identify it with any of the descriptions, I propose to name it as above.

Locality and formation.—Township of Walpole. Corniferous Limestone.

Collector.—J. De Cew.

ORTHIS VANUXEMI.—(Hall.)

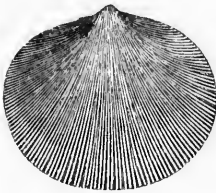


Fig. 17.



Fig. 18.

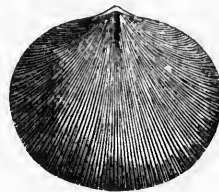


Fig. 19.

Fig. 17. *Orthis Vanuxemi*.—Ventral valve. Fig. 18.—Longitudinal section of the same.
Fig. 19.—Dorsal aspect.

ORTHIS VANUXEMI.—Hall. *Tenth Annual Report of the Regents of the University of the State of New York*, p. 135, 1857.

This species is closely allied to *O. Liria*, but is more nearly a perfect ellipse, or more nearly circular, and has about fifteen radiating striae in the width of three lines. Its width is from nine to eighteen lines, and its length about one-sixth or one-seventh less than its width.

It occurs in the Hamilton Shales, in the Township of Bosanquet.

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RHYNCONELLA TETHYS.—*N. Sp.*



Fig. 20.



Fig. 21.



Fig. 22.

Figs. 20, 21.—Side views of the specimens of *R. Tethys*.

Fig. 22.—Front view.

Description.—In this species the body of the shell, excluding the beaks, is transversely sub-oval; from the beaks the sides diverge at an angle of about 110° , and are nearly straight, or gently concave, for about one-third the length of the shell, below which they are regularly rounded; front margin broadly rounded, nearly straight in the middle for the width of the mesial fold. On a side view the outline is obliquely sub-conical, the base obtusely rounded, the lower three-fourths of the ventral valve straight, forming an angle of about 100° with the ventral half of the base; the dorsal contour gently arched, and the dorsal half of the base rounded. The mesial sinus of the ventral valve commences at about mid-length, and increases only slightly in depth, until the front margin is reached, when the middle portion of the shell, for the width of the sinus, is rather suddenly bent towards the dorsal valve, with an abruptly rounded curve, and forms about three-fourths of the depth of the base. There are five angular ribs in the sinus, their extremities deeply forked to receive the projecting points of the grooves between the ribs of the dorsal valve; on each side of the sinus there are six principal ribs, their extremities a little turned upwards; above these, three or four smaller ones. The upper part of this valve is narrowly convex, with a prominent umbo, and incurved beak; in the lower half, a little concave towards the lateral margins, owing to the elevation of the extremities of the ribs. Dorsal valve with all the central region depressed convex, the margin of the shell on each side of the mesial fold in front abruptly bent towards the ventral valve; the umbo obtuse, divided along the middle for a short distance by a narrow, barely perceptible depression, the beak strongly incurved under that of the ventral valve. The mesial fold dies out at two-thirds the length, the shell (of the fold) at the lower extremity bent towards the ventral valve at an obtuse rounded angle, and extending about one-fourth across the base. On the mesial fold there are six ribs, the middle four most

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prominent; on each side of the fold there are also six, their extremities strongly curved towards the ventral valve.

I have seen no specimens with the true surface of the shell preserved.

Length of specimen upon which the above description is founded, nine lines, greatest width at about one-third the length from the front, ten lines; depth of both valves at the front, six lines; width of mesial fold at front, five lines, and of the sinus, five lines and a half.

Judging from the appearance of several imperfect specimens, the depth of both valves at the front must be very variable.

I have seen some small specimens from four to six lines in length, with a beak nearly erect. These, I think, are the young of *R. Tethys*.

Locality and formation.—County of Haldimand. Corniferous Limestone.

Collector.—J. De Cew.

RHYNCONELLA MEDEA.—*N. Sp.*

Description.—Oval or sub-triangular, body of shell, excluding the beaks, transversely sub-elliptical; greatest width a little below the middle; apical angle, about 100° ; both valves rather convex. Ventral valve with a neatly defined, rounded umbo, and closely incurved beak; a wide, shallow, concave, mesial sinus, which becomes obsolete at about two-thirds the length from the front. Dorsal valve, with a broad, depressed, convex, mesial fold, extending two-thirds the length of the shell, umbo rather prominent, obtusely rounded, beak incurved beneath that of the ventral valve. Surface with between thirty and thirty-five small sub-angular ribs on each valve; ten on the mesial fold, and nine in the sinus.

Length, eleven lines. Width, twelve lines. Depth, seven lines; width of sinus at front margin, six lines.

The specimen is a little distorted towards the front, so that all the details of the outline cannot be given. The sides diverge from the beak at an angle of about 100° , and are straight for half the length of the shell. They then appear to be somewhat narrowly, but regularly, curved round to the front, which is also, I think, broadly rounded.

Locality and formation.—Township of Rainham, Concession 3, Lot No. 2.

Collector.—J. De Cew.

RHYNCONELLA THALIA.—*N. Sp.*

Fig. 23. Fig. 24. Fig. 25.

Fig. 23. *Rhynconella Thalia*.—Dorsal view. Fig. 24.—Front view. Fig. 25.—Side view.

Description.—Shell small, apical angle varying from about 70° , in very small specimens, to 105° in the large ones; sides straight in the upper half, regularly curved in the lower half; front broadly rounded with usually a portion in the middle straight, or even slightly concave; valves about equally convex. Ventral valve with a sinus which gradually dies out at one half, or a little more, of the length from the front; beak acute, much elevated, slightly incurved; three simple acutely angular ribs in the mesial sinus, and six or seven on each side. Dorsal valve a little more strongly convex than the ventral valve; the front of the mesial fold elevated so that on the side view the base of the shell is a nearly straight line almost at a right angle with the lower part of the outline of the valve; umbo rounded with a faint mesial depression; beak incurved into the cavity of the ventral valve; surface with four ribs on the fold, and six or seven on each side.

Length of the largest specimen examined, four lines; width, four and one-fourth lines; depth, two and a half lines; width of the sinus, nearly two lines; apical angle, 102° .

Another specimen is four lines wide, three and a half in length, two in depth, sinus, two lines, and apical angle 105° .

A third is two lines and three-fourths in length, and the same in breadth; depth, one line and three-fourths; apical angle, 88° . The sinus is distinct but not deep.

Specimens less than two lines in length exhibit scarcely a trace of a sinus, and have the apex more acute than any of the above-mentioned.

This species closely resembles the ordinary Lower Silurian forms, such as *R. plena*, and young individuals of *R. increbescens*.

Locality and formation.—Near Woodstock. Corniferous Limestone.

Collector.—A. Murray.



Fig. 27.

Description.—Length from the front of the gape, convex, sinuate above the beak, showing the dorsal valve half the length of the ventral valve.

Surface elevated, sinus five or six lines.

Length of individual specimens.

Localities.—*Collection*.

There are three specimens of this genus, the ventral valve showing the beak in favor of *Athyris*. The Devonian foramen appears to

RHYNCONELLA (?) LAURA.—*N. Sp.*

Fig. 26.



Fig. 27.



Fig. 28.

Fig. 27. *Rhynconella Laura*.—Dorsal aspect.

Fig. 27. The same; ventral aspect.

Fig. 28. Side view.

Description.—Ovate; greatest width at about one-third of the length from the front; sides gently arched from the beak to the line of the greatest width; front angles narrowly rounded; both valves convex, sometimes rather gibbous. Ventral valve most elevated a little above the middle; umbo rather obtusely rounded, not very prominent; beak short, obtuse, closely incurved, in contact with the umbo of dorsal valve: a broad mesial sinus which usually becomes obsolete at one half the length, but can be sometimes traced nearly to the beak. Dorsal valve with a mesial fold, corresponding with the sinus of the ventral valve in length.

Surface with about seventeen rather large rounded obscure slightly elevated ribs, of which there are four or five in the mesial sinus, and five or six on the mesial fold. A few squamose rings of growth.

Length of large specimen twelve lines; width eleven lines. Another individual from the same locality is nine lines long and ten wide.

Locality and formation.—Bosanquet. Hamilton Shales.

Collectors.—T. Richardson, A. Murray.

Genus ATHYRIS.—McCoy.

There is much difference of opinion as to the propriety of retaining this generic name. It implies that the shells have no foramen in the ventral valve, and yet many species are placed in the genus which have the beak distinctly perforated. Some palæontologists are, therefore, in favor of using De Orbigny's appellation *Spirigera*, instead of *Athyris*. Nearly all of the Silurian species, and some of those from the Devonian rocks, have the beak so strongly incurved, that no foramen can be seen. For such, at least, the name *Athyris* does not appear to be very inappropriate. Mr. Davidson still retains it, not

only for those which have the foramen concealed, but also for those with it open. It appears probable that the genus will sooner or later be sub-divided, and in that case *Athyris* might be retained for the species with closely incurved beak, and *Spirigera* for some of the others. I shall give some account of the generic characters of this group of shells in another article. The following species are placed in the genus provisionally.

ATHYRIS CLARA.—*N. Sp.*



Fig. 29.



Fig. 30.



Fig. 31.



Fig. 32.

Fig. 29. *Athyris Clara*.—Ventral view of large specimen.

Fig. 30.—Dorsal view of the same.

Fig. 31.—Side view.

Fig. 32.—Dorsal view of a smaller specimen.

Description.—Nearly smooth, ovate or sub-rhomboidal, greatest width, about the middle, a short linguiform projection in the middle of the front margin, both valves convex, ventral valve the larger, with

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its beak strongly incurved. Length from one to two inches; width equal to, a little less or a little greater than the length. The ordinary size is about one inch and a half in length.

The ventral valve is strongly and smoothly convex, the outline evenly arched from beak to front, more abruptly curved above than below, the umbo prominent, the beak rather small, neatly rounded at the sides, and closely incurved. The linguiform projection in the middle of the front margin, is often a simple extension of a portion of the shell, without a sinus, but occasionally there is either a short, shallow depression, or a narrow rounded mesial fold, which seldom, however, extends towards the beak more than three or four lines. The upper half of the dorsal valve is sometimes evenly convex, but in general an indistinct, more or less broadly rounded carination, can be traced from the umbo along the middle to the front, where it becomes abruptly elevated into a short, prominent, rounded fold, which extends into the linguiform projection. On each side of the median line, this valve is gently convex, and often exhibits a rather flat slope to the lateral margins. The beak is strongly incurved, and appears to be deeply buried in the cavity beneath the umbo of the ventral valve.

If a line be drawn across the shell at mid-length, and another at one-fourth the length from the front, the greatest width will be found to range between the two. Many of the specimens are obtusely angular at the sides, and in such the margins above and below the angles are somewhat straight, the upper two sides converging to the beak, and the lower two to the linguiform extension in front, giving to the shell a rhomboidal instead of an ovate outline.

At first sight, the surface appears to be smooth, with a few concentric squamose lines of growth. On closer examination, numerous indistinct, radiating lines, may be seen. Of these, there are from two to four in the width of one line, and they sometimes appear to lie beneath the surface of the shell. In very perfect specimens, the surface exhibits fine concentric striæ, from ten to fifteen in the width of one line, and these are most distinct towards the front margin.

Beneath the beak of the detached ventral valves, there is a wide, triangular foramen, not visible when the valves are united. The inside of the beak is entirely hollowed out into a deep pit or channel, which opens directly into the cavity of the shell. The impressions of the divaricator muscles occupy part of a sub-triangular space, the upper angle of which is situated just where the excavation beneath the beak

opens out into the visceral cavity. The lower side of this space is nearly straight, and the two lower angles rounded. The lateral margins of the space are usually sub-parallel in the lower half, while in the upper half they approach each other, and meet above to form the upper angle. In some specimens the space is more nearly triangular, and it would appear, therefore, that its form is a little variable. The length of the space is about one-third the whole length of the ventral valve, and its width at the lower margin a little less than its length. The lower margin is situated a little above a line drawn across the shell at mid-length. The lower three-fourths of the space is striated longitudinally, and divided into two equal portions by an obscure median groove.

On each side, at the base of the foramen, there is a short, stout tooth. The dental plates below the teeth extend but a short distance into the visceral cavity, when, becoming suddenly much diminished in height, they form a low ridge along the upper margin of the muscular space. The upper part of the muscular space is deeply excavated into the substance of the shell, which is very thick and solid in the rostral half.

I have not seen the interior of the dorsal valve.

Externally this species resembles *A. tumida* (Dalman,) but the muscular impressions in the interior of the ventral valve are widely different in the two species.

Locality and formation.—Rama's farm, near Port Colborne, and at many places in the County of Haldimand. Corniferous Limestone. Specimens, with the valves united, are rare, but the upper part of the ventral valve, with the umbo and beak preserved, is not uncommon.

Collectors.—A. Murray, J. De Cew, E. Billings.

ATHYRIS MAIA.—*N. Sp.*

Description.—Smooth, ovate, or sub-rhomboidal. Ventral valve strongly convex, most gibbous in the upper half; umbo prominent, large, giving to the shell, on a side view, somewhat of the aspect of a *Pentamerus*; beak strongly incurved, but not touching the surface of the dorsal valve; a shallow, concave mesial sinus, extending from the front all the way to the beak. Dorsal valve moderately convex, with a convex mesial fold, which becomes obsolete near the beak. Length, from one inch to one inch and a half. The proportional width is variable. In some specimens it is exactly equal to the length, but in

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others it is either a little greater or a little less. Greatest width, about the middle, or a little in front of the middle, at which point the rhomboidal specimens are angular, but in the more oval forms, gently convex.



Fig. 33.

Fig. 33. *Athyris Maia*.—Dorsal aspect.

Fig. 34.

Fig. 34.—The same; ventral aspect.

The following characters may be more particularly noted :

The umbo of the ventral valve is rather large and prominent, the beak well defined, strongly incurved, but in general not in contact with the umbo of the dorsal valve; a short false area beneath the beak. The mesial sinus is shallow, evenly rounded in the bottom, or sometimes with an indistinct fold along the middle. Its width at the front margin is somewhat variable, but is usually about five lines, and it becomes gradually narrower and shallower upwards, but is more or less distinctly visible quite to the beak. On a side view, the outline of this valve presents a continuous curve, most abrupt in the upper half, the greatest elevation being at about one-third the distance from the beak to the extremity of the linguiform extension in front.

The dorsal valve has a smooth, rounded fold, extending almost to the beak, but is otherwise pretty evenly convex. It appears to possess a straight hinge-line, the length of which is greater than half the whole width of the shell; the beak small, not much incurved. The greatest convexity of this valve is about the middle, and on a side view the outline, in consequence of the elevation of the mesial fold, continues at the same height, and somewhat parallel to the lateral margin until it reaches the front.

The linguiform projection is sometimes considerably extended, and the shell has then a rounded, rhomboidal form, but in other specimens this part of the shell is truncated, and a fifth side, situated in the front margin, is thus formed.

The specimens that have come under my observation have in general the same amount of convexity, the depth of both valves being in all about two-thirds the greatest width.

The surface is nearly smooth; a few obscure concentric undulations of growth and fine striæ,—of the latter, twelve to fifteen in the width of one line are visible on well preserved shells. There are also faint indications of longitudinal radiating lines. A fragment of one individual of this species exhibits a surface uniformly marked with fine rounded concentric undulations (not striæ), of which there are four or five in the width of one line.

This species has, to some extent, the aspect of a *Pentamerus*; but its internal structure, as exhibited in the numerous broken specimens that I have examined, shews it to be congeneric with *A. Clara*. It differs from that species in having the mesial fold and sinus extending the whole length of the shell, and the beak of the ventral valve not touching the umbo of the dorsal valve.

Locality and formation.—St. Mary's, Township of Blanshard. Corniferous.

Collectors.—Mr. W. G. Tomkins, C. E., St. Mary's, C. W.; A. Murray; J. Richardson.

ATHYRIS (?) SCITULA.—(Hall.)

ATRYPA SCITULA.—Hall. *Geology of the Fourth District of the State of New York*, p. 171, fig. 1.

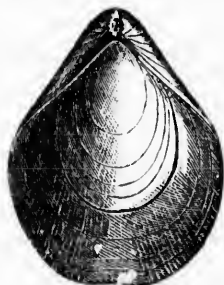


Fig. 35.



Fig. 36.



Fig. 37.



Fig. 38.

Figs. 35 to 38.—Different views of a small and large specimen of *A. scitula*.

The above figures represent different views of two specimens of a species which appears to me to be identical with that figured in the work above cited. It varies greatly in size. The length of the

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largest specimen that I have seen is seventeen lines, the greatest width fourteen lines, depth eight lines. The smallest is about two lines in length, and many of intermediate sizes have been observed to make out the series. It is not certain that this species belongs to the genus *Athyris*.

Locality and formation.—County of Haldimand. Corniferous Limestone.

Collectors.—J. De Cew, E. De Cew.

ATHYRIS (?) CLUSIA.—*N. Sp.*

Description.—Elongate oval; greatest width at about one-fourth the length from the front margin; sides diverging at an angle of about 75° and somewhat straight, or gently convex, for rather more than half the length; front angles rounded; front margin nearly straight, or gently convex. Both valves depressed convex, smooth in the upper half, the front margin with four or five wide shallow concave indistinct folds or grooves which become obsolete at less than half the length. Beak of ventral valve erect, apparently a little incurved at the tip.

Length five lines; greatest width at one-fourth the length from the front margin, three lines; depth of both valves at one-third the length from the beak, one line and one-fourth.

The above description is founded on a single small specimen. I have seen a fragment of another that must have been, when perfect, seven lines in length, and I am inclined to think that the one described is a young individual of the species.

This species differs from *A. scitula*, principally in being proportionally much flatter, and in having the front margin undulated by several obscure folds.

Locality and formation.—Lot No. 45, Con. 1, Cayuga. Corniferous.

Collector.—J. De Cew.

ATHYRIS (?) UNISULCATA.—(Conrad.)

ATRYPA UNISULCATA.—Conrad. *Annual Report Geological Survey, New York.* 1841, p. 56.

RHYNCONELLA UNISULCATA.—Hall. Tenth Annual Report of the Regents of the University of the State of New York. 1857, p. 125.

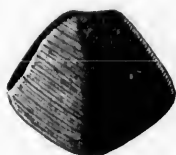


Fig. 39.

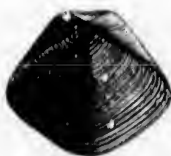


Fig. 40.

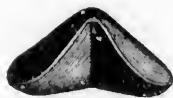


Fig. 41.



Fig. 42.

Fig. 39. *Atrypa unisulcata* —Ventral view.
Fig. 41.—View of front margin.

Fig. 40.—The same; dorsal aspect.
Fig. 42.—Side view.*

Description—Shell quadrilateral or sub-triangular; greatest width near the front margin; sides nearly straight from the beak to the line of the greatest width, where there is a prominent angle on each side of the shell, thence converging and nearly straight to the middle of the front margin. Dorsal valve with a mesial fold which occupies the whole of the shell except a small portion on each side in the upper half; the slope from the ridge of the fold to the sides usually gently concave. In some specimens a single strongly impressed groove along the ridge of the mesial fold. The ventral valve has a deep mesial sinus equal to its whole width; a small strip of the margin between the beaks and the point of the greatest width inflected at a right angle or thereabout towards the dorsal valve. The beak is incurved over the umbo of the dorsal valve, but its tip not quite in contact with the surface of the dorsal shell. The surface is nearly smooth, a few obscure concentric undulations, and, in some specimens, indications of fine radiating striae visible.

Length of large specimen, nine lines; width, eleven lines.

This species varies greatly in form. Some have the front margin nearly straight, and are thus almost triangular. Others are quadrangular or rhomboidal from the great projection in the middle of the front margin. The sinus of the dorsal valve is sometimes so shallow

* These figures are not very good, but as they will serve to give an approximate idea of the form of one of the varieties, I have thought it best to use them.

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that the valve has the appearance of a flat space along the middle. The groove on the ridge of the dorsal valve either extends to the front margin of the shell, or dies out at a greater or less distance from the beak.

The length of the shell ranges from two to nine lines, and is always a little less than the width.

Locality and formation.—County of Haldimand. Corniferous Limestone. Not common.

Collectors.—J. De Cew, E. De Cew, and E. Billings.

ATHYRIS (?) ROSTRATA.—(Hall.)

ATRYPA ROSTRATA.—Hall. *Geology of the Fourth District of New York*, page 202, fig. 2.



FIG. 43. FIG. 44.

Figs. 43, 44. *Athyris rostrata*.—Dorsal and side views.

Description.—Elongate oval, both valves evenly convex and smooth. Ventral valve the larger, most ventricose in the upper half; beak proportionally large, sub-cylindrical, incurved, not in contact with the umbo of dorsal valve, apparently perforated by a large foramen. Dorsal valve smaller than the ventral, but proportionally as strongly convex, umbo rather broadly rounded, beak incurved and deeply buried beneath that of the ventral valve.

Length about six lines; greatest width a little in front of the middle of the ventral valve, five lines; depth of both valves a little above the middle, three lines and a half.

The surface at first sight appears to be quite smooth, but upon a closer examination it will be found to exhibit some fine obscure concentric rings of growth.

This neat little fossil is smaller and proportionally broader, and more ventricose than *A. scitula*.

Locality and formation.—Lot 26, con. 3, Bosanquet. Hamilton Shales.

Collectors.—A. Murray and J. Richardson.

ATHYRIS (?) CHLÖE.—*N. Sp.*

Fig. 45.

Fig. 46.

Fig. 47.

Fig. 45. *Athyris Chlöe*.—Ventral valve.

Fig. 46.—Side view.

Fig. 47.—Dorsal view.

Description.—Transversely sub-oval; greatest width usually about the middle, sometimes a little above or below; front margin often with a rounded projecting lobe in the middle; both valves convex. Ventral valve with a concave mesial sinus which occasions a linguiform projection in the middle of the front margin, and becomes obsolete at about half the length of the shell; umbo well defined; beak closely incurved down to the umbo of the dorsal valve, usually, if not always, perforated at the tip by a small circular aperture. Dorsal valve with a rounded mesial fold which elevates the middle of the front margin and becomes obsolete at about half the length.

Surface with somewhat obscure rounded but apparently much depressed, simple or undivided radiating ribs, of which there are on an average in the specimens examined, three in the width of one line. There are also, especially towards the front margin, a few squamose rings of growth. There appear to be some fine concentric striæ, but the surface in the specimens is not quite perfect.

Width, from five to nine lines; length, a little variable, according to the greater or less development of the mesial fold.

In one specimen with the fold large, the length is seven lines to a width of nine lines.

In this species I have detected no appearance of an area, but in perfect specimens the hinge-line is extended to three-fourths the width of the shell, and in such cases the cardinal angles, although rounded, are elevated and much compressed.

Locality and formation.—Lot No. 26, con. 3, Bosanquet. Hamilton Shales.

Collectors.—A. Murray, J. Richardson.

As the nomenclature of the important and widely-distributed genus *Athyris* is somewhat confused, it seems advisable to give, in this place, a short account of the leading points of its history. Professor McCoy was the first to separate the species, of which this genus is

composed, which they was published in "Ireland," in tracts:—

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composed, from *Terebratula*, *Atrypa*, *Spirifera*, and other genera to which they had been previously referred. His original description was published in the "Synopsis of the Carboniferous Fossils of Ireland," in 1844. From this work we shall make the following extracts:—

"The family *Delthyridæ* appears to be divided into the five following genera: 1. *Spirifera*, Sow., composed of those longitudinally-ribbed species, in which the hinge-line is equal to, or exceeds the width of the shell, the cardinal area with parallel sides, the cardinal teeth of the ventral valve (now called the dorsal valve) large, spirally rolled, and having a triangular foramen beneath the beak of the dorsal (ventral) valve. 2. *Martinia*, McCoy, or the smooth Spirifers, in which the hinge-line is less than the width of the shell, and the cardinal area triangular. 3. *Athyris*, McCoy, in which there is no vestige of either foramen, cardinal area, or hinge-line. This remarkable genus is frequently confounded with those shells usually named *Terebratula*, in the older rocks, but is distinguished by the large, spiral appendages, which are wanting in the other group. 4. *Brachythyris*, McCoy, in which we find the longitudinally-ribbed surface of *Spirifera*, united with the short hinge-line of *Martinia*. 5. *Orthis*, Dal., in which there are no spiral appendages, the hinge-line and striae frequently spinose (as in *Leptæna*), and the cardinal area common to both valves, and its sides inclined towards each other at its angles; dorsal valve smallest."—Work cited, page 126.

On page 146 of the same work, he thus concisely describes the genus:—

"*Gen. Ch.*—Nearly orbicular, small; no cardinal area or hinge-line; spiral appendages very large, filling the greater part of the shell.

"This very interesting group possesses all the external characters of the *Terebratulide*, united to the internal structure of the Spirifers, to which latter family it truly belongs. Professor Phillips is the only author who has recognized the group: he forms of it his last division of the genus *Spirifera*, but gives no characters to distinguish it from *Terebratula*; the internal structure is, however, a sure guide."

The above descriptions include all the more comprehensive and important characters, or those which connect the species together into one group by general affinities pervading the whole. In this respect nothing more has been done for this genus since 1844, although several minor and highly interesting points of the internal arrangements, such as the complicated structure of the spires and the form of the muscular impressions, have been ascertained by other authors; (especially by Messrs. Davidson, Bouchard, and Suess.)

McCoy was under the impression that all of the species were desti-

tute of an aperture in the ventral valve, but it now turns out that many of them have a small circular perforation in the beak. Some are therefore disposed to reject the name *Athyris* (which means "without a door;" or, "deltidium," as Mr. Woodward construes it) altogether as inappropriate; and accordingly D'Orbigny, in 1847, re-described the genus under the name of *Spirigera*. His description is in substance the same as that of McCoy, but more in detail, and, with the additional character, that the ventral valve is truncated at the beak by a circular orifice.* This would exclude more than half the species that he placed in his genus; as all those which belong to the group typified by *A. tumida*, *A. Ceres*, *A. passer*, &c., have the beak entire. With respect to this part of the shell, therefore, D'Orbigny's definition is quite as defective as McCoy's.

In 1851, Professor Suess, of Vienna, proposed the name of *Merista* for some of these shells, but did not define his genus nor give the names of any species to be included in it.†

In 1852, McCoy, in the 2nd Fasciculus of the "British Palæozoic Fossils," page 196, re-defined *Athyris* as follows:—

"*Gen. Ch.*—Nearly orbicular or ovate, both valves convex; no cardinal area, foramen, or hinge-line; spiral appendages to beak of entering valve very large, nearly filling the shell; a strong mesial septum in the rostral part of entering valve; dental lamellæ moderate; tissue of shell apparently fibrous.

"One specimen [of *A. tumida*] shews the pallial and ovarian impressions to be thick, numerous, and dichotomising frequently from beak to margin."

Afterwards, in 1854, Suess objected to the term *Athyris* being applied to such species as *A. tumida*, on the ground that it was originally used to include *Spirigera concentrica*, *S. lamellosa*, and other similarly organized forms.‡ He therefore proposed to suppress *Athyris* altogether, substituting *Spirigera* for those with the beak perforate, and his own genus *Merista* for the others with entire beak, or mesial septum in the dorsal valve and a shoe-lifter process in the ventral. It is quite certain now, however, that some of those with a non-perforate beak have no shoe-lifter process, and cannot be included in *Merista*.

In Davidson's "Introduction, on the Classification of the Brachiopoda," *Spirigera* is retained for those with the beak perforate, and no

* *Paléontologie Française*, vol. iv. page 357.

† *Jahrbuch der K. K. Geologischen Reichsanstalt, Vienna*, ii. pt. 4, pp. 150, 160. 1851.

‡ This is taken from a note by Mr. Davidson, on page 4 of the Appendix to his *British Oolitic and Liasic Brachiopoda*.

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mesial septum in the dorsal valve, (type *S. concentrica*), and *Athyris* for those of which *A. tumida* is the typical form. This is the most just arrangement of the difficulty that has yet been proposed, and has been adopted by F. Rømer in the last edition of Bronn's "Lethæa Geognostica."

Mr. Woodward in the "Manual of the Mollusca," adopts *Athyris* in the wide sense as intended by McCoy, but admits *Merista* as a sub-genus for those with a shoe-lifter process.

In the New York Reports, the species of this genus, until within the last four or five years, have been placed in the genus *Atrypa*.

In the tenth annual report of the Regents of the University of the State of New York, published in 1857, Professor Hall describes six species from the Upper Silurian rocks, under the genus *Merista*, and one from the Hamilton group, under *Spirigera*. This latter, which he calls *Spirigera spiriferoides*, is considered by many authors to be identical with *S. concentrica*.

In the Geology of Iowa, dated 1858, he describes three species from the carboniferous rocks of the Western States, under *Athyris*. These appear to be perfectly congeneric with *S. concentrica*, or, *S. spiriferoides* as he calls it.

In the twelfth Annual Report of the Regents, dated 15th March, 1859, published October, 1859, he proposes a new generic name (*Camarium*,) for those with a shoe-lifter process. This genus is identical with *Merista*.

In the thirteenth Annual Report of the Regents, published January 1861, Professor Hall abandons his genus *Camarium*, finding it to be identical with *Merista*, and then for those shells which have *Athyris tumida* for the type he proposes a new name, *Meristella*.

Some of the European authors, such as Pictet and Sandberger, retain *Spirigera*, and in his recent highly instructive papers in the "Geologist," Mr. Davidson places all the species under *Athyris*, but says that sub-genera may be admitted provided they be founded on good and sufficient distinctive characters.

It is not necessary to extend this list of references to the opinions of palæontologists. Sufficient appears in the above to shew that the nomenclature of this genus is in a state of confusion. I think the best way of getting out of the difficulty, is to fall back upon the arrangement proposed by Mr. Davidson in his Introduction.

1. McCoy's several definitions should be construed literally or

according to his intended meaning, and confined to such species as have the beak imperforate, and usually a mesial septum in the dorsal valve. For these the name *Athyris* is perfectly proper and involve no contradiction whatever. The type of this group would be *Athyris tumida*, as given by Davidson in his Introduction.

2. D'Orbigny's definition also literally, and it would include all the species with perforated beaks which have *Spirigera concentrica* for the type. The mesial septum in the dorsal valve in this genus is either rudimentary or entirely absent.

3. the genus *Athyris* being limited as above, two sub-genera might be subtracted from it, that is to say, *Merista*—Suess, and *Nucleospira*—Hall.

According to Professor Hall's recent proposals, *Spirigera* must be suppressed, and *Athyris* made to take its place. This would leave the first of the above groups without a name, and thus his genus *Meristella* would be accommodated.

The following figures represent some of the internal characters of the above mentioned genera :

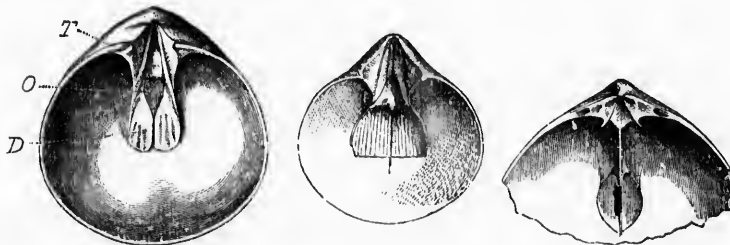


Fig. 48.

Fig. 49.

Fig. 50.

Fig. 48.—*Athyris tumida*.—Dalman.—Interior of ventral valve. D.—divaricator impressions O.—occlusor impressions. T.—teeth.

Fig. 49.—Interior of ventral valve of *Athyris Clara*—Billings.

Fig. 50.—*Athyris Clara*, interior of dorsal valve.

In the interior of the ventral valve of *A. tumida*, Fig. 48, the two elongate oval scars which indicate the place of the attachment of the divaricator muscles or those whose function it was to open the valves, are situated side by side about the centre of the shell. Above, or partly between, is the small heart-shaped scar of the occlusor, the muscle that served to close the valves. Beneath the beak is seen the wide triangular foramen which, in consequence of the close incurvation of the beak is always completely closed. This foramen is a different

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thing from the small circular aperture which occurs in the point of the beak of *Spirigera*. On each side is a short stout tooth, beneath which a strong nearly vertical septum extends a short way towards the front. These two septa are the dental-plates. Fig. 49 shows the form of the muscular impressions in *A. Clara*. At first sight they appear to be widely different from those of *A. tumida*, but this is owing to the greater thickness of the shell in the upper half of the ventral valve of this species. Since this species was described in this Journal, in May last, I have ascertained that the same variations in the form of the muscular impressions occur in the genus *Spirifera*. In the thick-shelled species it is deeply excavated, and is represented on the east of the interior by an abrupt prominence, longitudinally or diagonally striated.

In the thin-shelled species it is superficial, and presents a different appearance. There are other variations in the form of the sears in the ventral valve not represented in the above figures. Sometimes they extend nearly to the front of the shell, as is the case in an undescribed species from Anticosti, and in a Corniferous species of which I have some fragments.

In the dorsal valve, fig. 50, there is a horizontal plate (the hinge-plate) just beneath the beak, with a triangular depression in the middle, from which a thin vertical septum extends about one-half the length of the shell. On each side of the central depression the hinge-plate of the specimen figured shows two short, slender, spine-like projections, these are simply the bases of the spiral arms, which were here attached to the anterior edge of the plate. At the extremities of the hinge-plate are two small pits,—the sockets for the reception of the teeth of the opposite valve. The ocluser muscular impressions are four in number, and elongate oval, the anterior pair about the middle of the shell, and the posterior pair between the anterior and the beak.

Fig. 48 is copied from Mr. Davidson's paper in the "Geologist," Vol. I., Plate 12. Figs. 49 and 50 are from specimens in the collection of the Geological Survey.

In the sub-genus *Merista* the dental plates are connected by a peculiar arched plate, resembling a shoe-lifter, hence its name,—the shoe-lifter process or septum. (See fig. 53). In the species on which Prof. Hall founded his genus, *Camarium*, and also in some of the European forms, it extends from the beak downwards half the length

of the valve, and the dental plates are partly supported by it. I think this process is an abnormal form of the pseudo-deltidium, that occurs in some of the Spirifers.

In all of the genera, *Spirifera*, *Cyrtia*, *Spiriferina*, *Suessia*, *Cyrtina*, *Athyris*, *Spirigera*, *Merista*, *Nucleospira*, and *Uncites*, the spiral appendages have the apices of the cones which they form directed outwards, towards the sides of the shell, as represented in the following figure, 51.



Fig. 51.

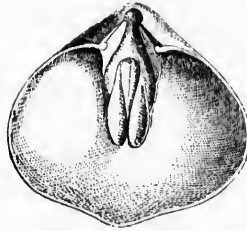


Fig. 52.

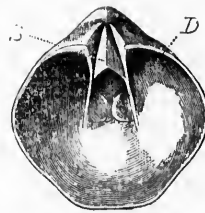


Fig. 53.

Fig. 51. Interior of *Athyris* (*Spirigera*) *ambigua*, showing the disposition of the spiral appendage. Copied from Davidson.—(*Geologist*, Vol. III. Plate 1.

Fig. 52. Interior of ventral valve of *Spirigera concentrica* showing the muscular impressions and the circular aperture in the beak.

Fig. 53. Interior of ventral valve of *Merista Herculea* (Barrande), a Bohemian species, S.—the shoe-lifter process. D.—the divaricator muscular impressions.

It will be seen on examining fig. 51 closely, that the first coils of the spiral appendages are connected on the dorsal side by a transverse bar, from which an upright process springs, sloping upwards slightly towards the beak, and giving off two half coils,—one on each side. It

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Fig. 54. Sp

is yet to be ascertained in how many species this complicated structure prevails. We may expect to find by continued search in our Canadian rocks, specimens which will enable us to make out the structure of these peculiar organs in such species as we have. As yet, I have only seen five or six specimens of *A. Clara* and *A. Maia* in which the spires could be seen, but none are sufficiently perfect to exhibit the details.

In Mr. Davidson's earlier writings, the muscle called the "DIVARICATOR" in this article, is styled the "RETRACTOR," while the "OCCLUSOR" is designated the "ADDUCTOR." But in his recent papers in the *Geologist* he uses both. It appears that the new names, "Divaricator" and "Retractor," were devised by Mr. Hancock.

I shall hereafter, from time to time, as materials are collected, publish in this Journal such other particulars of the structure of these interesting genera as may seem to be of importance.

Of this genus, *Spirigera*, we have, as yet, clearly recognized only one species in Canada, but it is, in the opinion of some good palæontologists, identical with the famous *S. concentrica*, the type of the group. Three species, described in May last in this Journal, which have the beak perforated, may possibly belong to *Spirigera*, and would have been so referred, but at that time I had not made up my mind what course to take with regard to the sub-divisions of *Athyris*. The three species in question are not yet generically determined, and I have therefore marked them doubtful thus: *Athyris* (?) *scitula*, *Athyris* (?) *rostrata* and *Athyris* (?) *Chlœe*.

SPIRIGERA CONCENTRICA.—(Bronn, *Sp.*)

TEREBRATULA CONCENTRICA.—Bronn, 1829. ATRYPA + SPIRIGERA + ATHYRIS CONCENTRICA,—of the generality of authors. SPIRIGERA SPIRIFEROIDES, Hall.—*Tenth Annual Report of the Regents of the University of the State of New York*, p. 153. 1857.

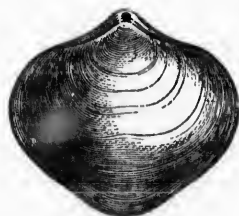


Fig. 54.

Fig. 54. *Spirigera concentrica*.—Dorsal view.

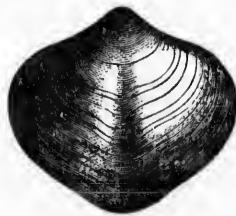


Fig. 55.

Fig. 55. The same.—Ventral view.

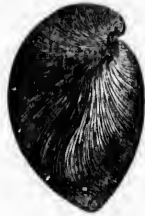


Fig. 56.



Fig. 57.

Fig. 56.—Side view.

Fig. 57.—Dorsal view of a specimen with a truncated front margin.

Description.—Transversely sub-oval; greatest width about the middle or a little above; the front margin sometimes extended into a short, broadly-rounded linguiform projection, and sometimes nearly straight, or even a little concave for about one-third the width. Both valves moderately convex; the ventral valve usually with a shallow mesial sinus, or depression, which becomes obsolete before reaching the beak; dorsal valve with a broad slightly elevated mesial fold. Beak and umbo of ventral valve of moderate size, the former incurved, and perforated at the point by a circular aperture. The umbo of the dorsal valve is small and neatly rounded, the beak buried beneath that of the opposite valve. Surface marked by sharp concentric ridges, which are sometimes so greatly developed as to cover the whole shell with thin overlapping scale-like plates.

Length from nine to fifteen lines; width a little greater than the length.

This well known fossil has a very wide geographical distribution, being found in the Devonian rocks of Russia, Germany, France, Spain, England, and America.

It varies a good deal in form, according to the sediment in which it is found. Where the shell is thin, the middle of the front margin is straight or concave, as in Fig. 57; but the thick-shelled individuals have the front margin more or less pointed. Some think our species different from the European form; but others, such as De Verneuil, Roemer, Lyell, Sharpe, and others, who have compared specimens from both sides of the Atlantic, have pronounced them to be identical.

Locality and formation.—Occurs in the Corniferous Limestone in

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p. 137.

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Fig. 58.—*Retzia*

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the Township of Cayuga, and in the Hamilton Shales at various places in the Township of Bosanquet.

Collectors.—A. Murray, T. Richardson, J. De Cew.

Genus RETZIA.—(King.)

RETZIA.—King. *Monograph of the Permian Fossils of England*, p. 137. 1850.

RETZIA.—Woodward. *Manual of the Mollusca*, p. 224.

Generic characters.—The species of this genus are in general smaller than those of *Athyris* or *Spirigera*. The form is ovate or sub-globular; the ventral valve the largest, with an elevated beak, which is perforated at the tip by a small circular aperture; a small flat area beneath the beak. In some species there is a shallow mesial fold and sinus, or more usually two or three of the ribs in the middle smaller than the others. The surface is covered with radiating ribs, as in *Rhynchonella*. The internal characters are not yet well known, but it is certain that the spiral appendages have their apices turned outwards, as in *Spirigera*. The shell structure is punctate.

Retzia differs from *Spirigera* in being strongly ribbed, smaller, the beak of the central valve erect, or nearly so, and in having a small flat area beneath the rostral aperture.

Rhynchospira,—Hall, does not appear to me to differ from *Retzia*. The genus is said to range from the Silurian up to the Permian.

Dedicated (by King) to the celebrated naturalist *Retzius*.

RETZIA EUGENIA.—*N. Sp.*



Fig. 58.

Fig. 58.—*Retzia Eugenia*. a, b, c, dorsal, side, and ventral views of a specimen; d, a smaller specimen—dorsal view.

Description.—Shell small, sub-globular, with from ten to twelve strong angular ribs on each valve. Ventral valve convex, most prominent on the upper half, a slight mesial depression the width of three or four of the ribs in the lower half; beak elevated, incurved, but not in contact with the umbo of the dorsal valve, perforated at

the point; a flat, solid deltidium or area beneath the aperture. Dorsal valve rather strongly and uniformly convex, most prominent along the middle, where slight indications of a mesial fold are evident; umbo small, rounded; beak buried beneath the lower edge of the deltidium or area of the ventral valve.

Length of the largest specimen seen, six lines; width about the same, or slightly less than the length; elevation of the beak of the ventral valve above the umbo of the dorsal valve, half a line.

We have one small specimen three lines in length, which appears to belong to this species. In form it is rather more elongate-oval, and not so convex as the larger specimens.

Closely allied to *Retzia globosa* (*Trematospira globosa*), Hall, but in that species when there are any indications of mesial fold or depression, it consists of one, two, or three ribs, which are smaller than the others, and do not reach the beak. It may be that specimens will be found connecting the two species, but at present I think it best to keep them separate.

Locality and Formation.—Lot No. 5, Con. 4, Township of Walpole.

Collector.—The only specimens I have seen were collected by J. De Cew.

Genus *Spirifera*.—Sowerby.

SPIRIFER.—Of the generality of Authors.

Generic characters.—Hinge-line straight and either greatly elongated, or equal to, or less than the width of the shell; the general form, triangular, quadrate, oval, or sub-circular. The ventral valve the largest, with a flat or concave area varying greatly in its dimensions; a triangular foramen beneath the beak, usual but sometimes partially closed by an arched plate called a deltidium or pseudo-deltidium. Area of dorsal valve smaller than that of the ventral valve. Surface either ornamented with radiating ribs, or finely striated, or smooth. In the interior the spiral cones have their apices turned outwards as in *Spirifera*, but they are destitute of the complicated appendages of this last-named genus. The muscular impressions are somewhat similar in their general form and relative position to those of *Athyris*, but subject to great variation according to the species. Shell structure not punctated.

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This genus ranges from the Lower Silurian up to the Trias. In Canada we have found no species below the Clinton group.

A great many species of this genus have been described as occurring in the Devonian rocks of the United States; and in Canada West there are apparently fifteen or twenty, but owing to the imperfection of the specimens, several of these must remain for a while undetermined.

SPIRIFERA MUCRONATA.—(Conrad.)

DELTHYRIS MUCRONATUS.—(Conrad.) *Annual Report of the Geological Survey of New York*, 1841, p 54. Hall, *Geology of New York*, part 4, 1843, p. 198.

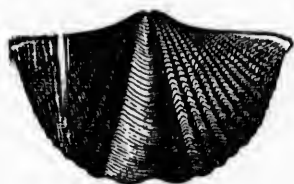


Fig. 59.



Fig. 60.



Fig. 61.



Fig. 62.

Fig. 59. *Spirifera mucronata*. Ventral view. Fig. 60. Side view. Fig. 61. Dorsal view.
Fig. 62. A long-winged variety of the same species.

Description.—This species varies from the semi-circular to the sub-triangular form. In general the hinge line is twice, and sometimes thrice the length of the shell; the cardinal angles acute, the side either straight or gently rounded and converging to the front margin, which is either straight or concave, and of the width of the mesial fold. The valves are moderately convex; the ventral more tumid than the dorsal; the mesial fold and sinus are rounded, and extend quite to the beaks; from fifteen to twenty not very prominent ribs on each side. The area of the ventral valve is very narrow, in the largest specimens scarcely more than half a line in height; the beak small, pointed and incurved over the area, but not in contact with the

umbo of the dorsal valve, a space of one-fourth to one-half of a line intervening. Area of dorsal valve sub-linear or about one-third the height of that of the ventral valve. The whole surface, in well preserved specimens, is covered with zigzag concentric imbricating striæ, from two to four in the width of one line.

Width on the hinge-line from one to two inches, usually one inch and a half. Length from beak to front from eight to twelve lines.

Locality and Formation.—Hamilton Group. Townships of Plympton and Bosanquet. Also found loose, or in boulders in the drift in numerous localities in the extreme western Counties of the Provinces.

Collectors.—A. Murray. J. Richardson. Also from W. B. Wells, Esq., Judge C.C. Chatham, C. W.

SPIRIFERA VARICOSA.—(Hall.)

SPIRIFER VARICOSUS.—(Hall.) *Tenth Annual Report of the Regents of the University of the State of New York, 1857, p. 125.*

SPIRIFER SUBMUCRONATUS OR SUBATTENUATUS + S. INUTILIS.—(Hall.) *Geology of Iowa.*

The species above quoted are all closely allied to each other, and also to *S. mucronata*. They differ from the latter in being in general a little smaller, and in having the umbo and beak of the ventral valve more prominent—the area of the same valve being consequently larger.

In the corniferous limestone numerous fragments and single valves have been collected, which most probably belong to *S. varicosa*, or to one or both of the others. I have referred them all to the former for the present provisionally not being able to decide whether they are or are not identical with. At all events they must be most closely allied species.

Some of them have the mesial sinus regularly concave, while in others it is divided by an obscure ridge along the middle. The mesial fold on the dorsal valve is sometimes marked by a central groove, but often it is entire. The individuals thus marked should probably be referred to *S. bimesialis*. (Hall.) *Geol. Iowa.*

The following figures represent a specimen from the Corniferous, near Woodstock, with the length greatly less than the width and no median rib in the sinus.

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Fig. 67

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Fig. 63.



Fig. 64.

This only differs from *S. mucronate* in the larger area of the ventral valve, as shewn in Fig. 60, and from *S. bimesialis* by the absence of the median rib in the sinus, and no groove on the mesial fold.

I do not pretend to decide that the above all belong to one species, or that they should be all referred to *S. varicosa*. There are numerous species of brachiopoda described by Prof. Hall and others, without figures or measurements, which never can be recognized or identified except by the persons who have the original specimens in their possession.

SPIRIFERA DUODENARIA.—(Hall.)

DELTHYRIS DUODENARIA.—Hall. *Geology of the 4th District of New York*, p. 17. Fig. 5. 1843.



Fig. 65.



Fig. 66.



Fig. 67.

Fig. 65. SPIRIFERA DUODENARIA.—(Hall.) Dorsal view of a large specimen.

Fig. 66. Shews the narrow area and the close approximation of the beaks.

Fig. 67. Dorsal view.

Description—This species is distinguished by its smooth rounded ribs. The form is sub-semicircular or sub-triangular; the hinge-line straight extended, equal to the greatest width of the shell; both valves moderately convex; the dorsal valve usually flattened or concave near the cardinal extremity; the areas very narrow; beaks small, short, pointed, incurved, nearly in contact with each other. From twelve to fourteen strong rounded ribs, gradually decreasing in

size from the middle of the shell outwards, the grooves between them rounded. Surface usually smooth, but when well preserved, with fine concentric striæ. The mesial sinus is represented by the middle furrow of the ventral valve, and the fold by the middle rib of the dorsal.

The ordinary width of this species is ten or twelve lines on the hinge line, but some are sixteen lines. In a specimen of this latter size the area of the dorsal valve is scarcely half a line high, and that of the ventral valve two-thirds of a line. The former lies nearly in the plane of the margins of the shell, while the latter slopes a little outwards. The beak of the ventral valve is incurved so as to project a little over the plane of the area, and its point is within half a line of the umbo of the dorsal valve.

This species may be easily distinguished from *S. mucronata* and *S. varicosa*, by the form of the ribs, which are round instead of angular, twice the size of those of the other species, and separated by rounded grooves. The mesial groove or sinus is only slightly larger and more conspicuous than those next it on each side.

Locality and Formation.—Rama's Farm near Port Colborne. Near Woodstock.

Collectors.—A. Murray, E. Billings.

SPIRIFERA FIMBRIATA.—(Conrad.)

DELPHYRIS FIMBRIATA.—Conrad. *Journal of the Academy of Natural Sciences of Philadelphia*, Vol. VIII, p. 263.

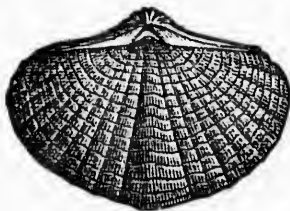


Fig. 68.



Fig. 69.

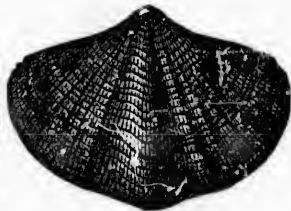


Fig. 70.

Fig. 68. *Spirifera fimbriata*.—Conrad. Dorsal view. Fig. 69. Ventral view. Fig. 70. Side view.

Description.—Transversely oval; hinge line shorter than the greatest width of the shell; cardinal angles rounded; mesial fold and sinus moderately rounded; from three to eight obscure ribs on each side;

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width from nine to eighteen lines; length a little more than half the width.

The dorsal valve is moderately and pretty uniformly convex, gently or not at all depressed towards the cardinal angles; area, sub-linear, lying nearly in the plane of the lateral margins, not reaching the extremities of the hinge line; beak, small pointed, scarcely at all projecting over the area; mesial fold, rounded, not prominent, extending quite to the point of the beak; usually a large space at the cardinal angles, and extending thence along the hinge line to the sides of the beak without ribs; the latter in general obscure, rounded, not much elevated, and becoming obsolete before reaching the hinge line.

Ventral valve rather strongly convex in the upper half, the outline in a side view forming about one quarter of a sphere; the beak small, pointed, and incurved over the area; the latter shorter than the hinge line, sloping outwards at an angle of about 115° at its base with the plane of the lateral margins, above rather strongly incurved; foramen broad, and with a sharp ridge on each side, not always preserved. The mesial sinus is rounded or sub-angular, and extends quite to the point of the beak; a smooth space at the cardinal extremities as in the dorsal valve.

Surface of the perfect specimens beautifully ornamented with shallow rounded concentric furrows, from three to four in two lines, the ridges between the furrows having from five to eight small elongated tubercles in the width of one line.

Locality and Formation.—Occurs in the Corniferous Limestone at Rama's Farm, and at many places in the County of Haldimand. Also in the Hamilton Shales in the Township of Bosanquet. Good specimens rare.

Collectors.—J. DeCew, E. Billings, A. Murray.

SPIRIFERA RARICOSTA.—(Conrad.)

DELTHYRIS RARICOSTA.—Conrad. *Journal of the Academy of Natural Sciences of Philadelphia*, Vol. VIII., p. 262. Pl. 14, fig. 18. 1839.

DELTHYRIS UNDULATUS.—VANHUXEM. *Geology of the Third District of the State of New York*, p. 132, fig. 3. 1842.

Description.—Sub-quadrate, sub-semicircular or oval; hinge-line equal to the greatest width of the shell or a little less; dorsal valve with five, and ventral valve with six, large rounded or sub-angular ribs;

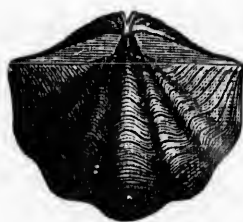


Fig. 71.



Fig. 72.



Fig. 73.

Fig. 71. *Spirifera varicosta*.—Conrad. Dorsal view. Fig. 72. Side view.
Fig. 73. Ventral view of a specimen with the shell exfoliated.

length of full grown individuals about one inch; width equal to or a little greater than the length.

The dorsal valve is most convex in the middle and more or less flattened or concave towards the cardinal angles; the area narrow sub-linear; the beak small pointed and together with the area strongly incurved over the hinge line; the middle rib corresponding to the mesial fold of an ordinary *Spirifera* is usually very prominent, rounded or sometimes a little flattened on the top; its width at the front margin, in a specimen fourteen lines wide, is about five lines, and it is well defined and prominent all the way to the point of the beak; the ribs next to it on each side, also reach the beak, but the two outer ribs become obsolete on approaching the hinge-line.

The ventral valve is most gibbous in the upper half, the umbo rather small but prominent, and the cardinal angles not flattened. The area is somewhat variable in its dimensions; and cannot be seen when the shell has been compressed; in large perfect specimens it is two lines high at the beak and half a line at the cardinal angles, and slopes outward at one angle of about 100° at its base, but is more or less arched towards the dorsal valve, so that its general direction is more nearly in the plane of the lateral margins. The beak is small pointed, always incurved over the area; the mesial furrows and four of the ribs extend quite to the point of the beak; the mesial furrow in all the specimens that I have seen is broadly rounded, while the lateral furrows are somewhat angular in the bottom.

The surface is usually covered with small lamellose, somewhat rough ridges of growth; but in the more perfect specimens with fine imbricating concentric lines, of which there are from four to eight in one line; all of these are undulated upwards in crossing the ribs.

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The specimens vary in form from oval (those with a short hinge-line) to sub-quadrate or sub-semicircular.

This species is easily recognized even in fragments by its large rounded ribs. When partially exfoliated the ribs sometimes exhibit from one to three large rounded knobby prominences. In general, however, they are smooth.

Locality and Formation.—Near Port Colborne, and various places in the County of Haldimand.

Collectors.—A. Murray, J. DeCew, E. DeCew, E. Billings.

SPIRIFERA GREGARIA.—(Clapp.)

SPIRIFER GREGARIA.—Hall. *Tenth Annual Report of the Regents of the University of New York*, p. 127, 1857.



Fig. 74.



Fig. 75.



Fig. 76.

Fig. 74. *Spirifer gregaria*.—Dorsal view. Fig. 75. The same.—Side view.
Fig. 76. Ventral view.

Description.—Shell semi-oval or sub-globular, varying greatly in the amount of the convexity. Hinge-line straight, equal to the greatest width of the shell; cardinal angles sometimes rounded. Ventral valve very convex, strongly and uniformly arched from beak to front, the outline sometimes forming a semi-circle; a deep angular mesial sinus extending from the front to the beak, on each side of which there are from seven to nine ribs. Umbo very much elevated, beak strongly incurved; area concave, next to the hinge-line inclining outwards at an angle of 45° to the plane of the lateral margin, but above suddenly arched over the hinge-line by the strong incurvation of the beak. Dorsal valve convex, with a strong mesial fold either somewhat angular or a little flattened along the ridge, or obscurely marked with an indistinct groove; seven to nine ribs on each side surface, often nearly smooth but sometimes marked with concentric zigzag lines. Width about three-fourths of an inch; length varying from a little less to a little more than the width.

In very convex specimens the umbo of the ventral valve is so

greatly developed that it rises above the hinge-line to a height equal to nearly one-half the length of the whole valve. Sometimes the beak of the ventral valve is incurved down nearly to the dorsal umbo, but in general there is a space of about half a line intervening.

Locality and formation.—This species has been found rather common on lot 43, concession 2, township of Middleton, in the Corniferous Limestone. According to Prof. Hall, it occurs "in the limestone of the Upper Helderberg, (Onondaga and Corniferous) rarely in Eastern New York, common in Genesee and Erie counties, and in Ohio and Kentucky, in the same geological position."

I am indebted to Dr. B. F. Shumard for specimens from the Falls of the Ohio for comparison. These are more convex than any of ours, but of about the same size.

Collector.—J. De Cew.

SPIRIFERA PARRYANA.—Hall.

SPIRIFER PARRYANUS.—(Hall.) *Geology of Iowa*, Vol. I., page 509. Plate 4, fig 8 a, 6.

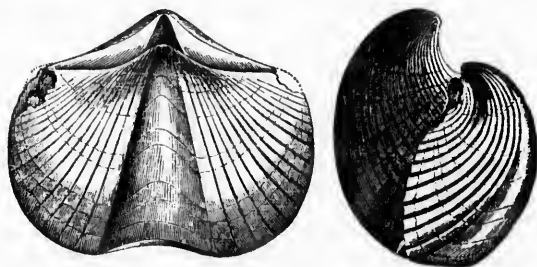


Fig. 77.

Fig. 78.

Fig. 77.—*Spirifera parryana*.—Dorsal view. Fig. 78. Side view of the same.

Description.—Transversely sub-elliptical or sub-quadrate; cardinal angles generally rounded; sides and front angles rounded; front margin somewhat straight or a little concave for about one-third the width in the middle. Both valves rather strongly convex, giving a sub-globose form to the whole shell; mesial fold and sinus rounded, and extending to the beaks. Area of ventral valve somewhat arcuate, and forming an angle of about 48° to the plane of the lateral margins. Surface with about eighteen flat, rounded ribs, separated by grooves one-fourth the width of the ribs; mesial fold and sinus not ribbed.

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Width from one inch and a half to two inches. Length about five-sixths of the width.

Locality and formation.—Lowe's Mill, township of Bosanquet, Hamilton Shales.

Collector.—The only specimen found was collected by C. Robb, Esq., C. E.

SPIRIFERA SCULPTILIS?—(Hall.)



Fig. 79.

The above figure represents an imperfect ventral valve (found by Mr. Robb along with *S. Parryanus*,) which appears to be identical with the species figured by Hall in the *Geology of New York*, Vol. IV., p. 202, under the name of *S. sculptilis*.

Genus CYRTIA.—(Dalman.)

Generic Characters.—Shell semi-circular or triangular; ventral valve extremely prominent and of a pyramidal shape; area large, usually incurved; foramen extending quite to the beak, closed except a small aperture near the beak by a convex deltidium. Dorsal valve flat or only moderately convex. The internal characters do not appear to differ greatly from those of *Spirifera*.

The shells of this genus are smaller in general than *Spirifera*, and the species are closely allied to each other.

CYRTINA is another genus exactly resembling *Cyrtia* in shape, but with the interior of the ventral valve divided by a mesial septum, which supports near the foramen a triangular chamber as in *Pentamerus*.

Not having seen the interior of the two following species, I leave them in the genus *Cyrtia* where they have been hitherto placed.

CYRTIA HAMILTONENSIS—(Hall.)

CYRTIA HAMILTONENSIS.—Hall. *Tenth Annual Report of the Regents of the University of the State of New York*, p. 166. 1857.

Description.—"Shell more or less obliquely triangular, pyramidal: hinge equalling the greatest breadth, and obtusely (or acutely) an-



Fig. 80.



Fig. 81.



Fig. 82.

Fig. 80.—*CYRTIA HAMILTONENSIS*.—Hall. Ventral view.

Fig. 81.—Side view,

Fig. 82.—Dorsal view. (The perforation not shewn near the beak in the figure, but exists in the specimen.)

gular at the extremities; dorsal valve depressed, nearly flat; beak scarcely elevated above the hinge-line; mesial fold small, bounded on each side by deeper and wider grooves than those between the plications, with sometimes a faint, narrow, longitudinal depression in the middle; ventral valve very convex, most prominent near the beak, which is very variable in elevation, and either straight or a little arched from the hinge, sometimes twisted on one side; sinus distinct, rounded or angular; area variable, triangular, generally high, often wider than high, arcuate or plane, finely striate in both ways, the vertical striæ scarcely visible; foramen very narrow, usually perforate above by an ovate aperture, and has at its base a small transverse arcuate slit. Surface ornamented by six to eight simple rounded plications on each side of the mesial fold and sinus, and marked by very fine concentric lines of growth. Under a good lens, minute granules may be seen on all parts of the exterior except the area and deltidium: interior minutely punctate."—(Hall. *Tenth Regents' Report*, above cited.)

Our specimens agree so exactly with the above description, that there can be no doubt of the identity of the species.

Locality and formation.—Townships of Bosanquet and Plympton. Hamilton shales.

Collectors.—A. Murray, J. Richardson, E. Billings.

CYRTIA ROSTRATA.—(Hall.)

A species of *Cyrtia* occurs in the Corniferous Limestone, only differing from *C. Hamiltonensis* in having the ribs larger and the surface marked with concentric imbricating lamellæ, instead of fine striæ. The only perfect specimen I have seen has five ribs on each side of the mesial fold and sinus. It is referred to *C. rostrata* provisionally.

Locality and formation.—Lot 45, Con. 1, Cayuga.

Collector.—J. De Cew.

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Genus ATRYPA.—(Dalman.)

SPIRIGERINA.—D'Orbigny.

Generic characters.—Shell circular, ovate or sub-quadrate. Ventral valve with a small closely incurved or sometimes elevated beak. Surface smooth, striated, or with small ribs, and often strongly marked with concentric squamose lines of growth. Shell structure fibrous, impunctate. The spiral appendages are placed with their bases flat upon the inner surface of the ventral valve, and their apices directed into the hollow of the dorsal valve. In the interior of the ventral valve, the divaricator muscular scars occupy a large oval space in the upper half; the ocluser a much smaller circular or oval space near the beak, and inserted, as it were, between the others on rostral side. In the dorsal valve the oclusors are four in number near the beak, two on each side of an obscure median ridge.

In fig. 83, a specimen of *A. reticularis* is represented lying on the ventral valve, the dorsal valve uppermost, shewing the position of the internal spires. The figure is taken from "Sandberger's Atlas."



Fig. 83.

ATRYPA RETICULARIS.—(Linn.)

ATRYPA RETICULARIS.—Of the generality of Authors.

ATRYPA IMPRESSA.—Hall, *Tenth Annual Report of the Regents of the University of New York*, p. 122.



Fig. 84.



Fig. 85.



Fig. 86.



Fig. 87.

Fig. 84.—*Atrypa reticularis*.—Dorsal view. Fig. 85.—Side view.
Figs. 86 and 87.—A specimen with coarse ribs.

Description.—This species is variable in form (as are all that range through a number of formations). Specimens the size of those above figured are ovate; length a little greater than the breadth; sometimes both valves nearly equally convex, but in general the ventral valve is convex in the middle portion of the upper two-thirds, flattened to-

wards the sides, and with a broad shallow mesial depression towards the front. The dorsal valve is in general strongly convex; the hinge extremities rounded. The umbo and beak of the ventral valve are small, the latter sometimes a little elevated, but in general closely incurved.

Large specimens, twice the size of those above figured, are not uncommon in the Corniferous limestone. These are more elongate oval, or sometimes, owing to the wide straight hinge-line and projecting cardinal extremities, the form is sub-triangular.

The surface is covered with small radiating ribs, usually two or three in the width of one line. These are crossed by undulating concentric lines of growth, which give to the ribs a nodose or rugged aspect. In large specimens from the Devonian rocks of the Hudson Bay Company's Territory, the striæ are much finer, there being four or five in one line. In others they are much stronger. The shell when partially exfoliated, exhibits a whitish silken or pearly lustre. Individuals are sometimes found with the surface around the front margin covered with imbricating concentric lamellæ. Length usually about one inch or a little less, sometimes three inches.

Locality and Formation.—This species ranges from the base of Middle Silurian to the Devonian, and is found in most countries where these rocks have been recognized. In Canada West it occurs in numerous localities in the Clinton, Niagara, Oriskany, Corniferous, and Hamilton formations.

Genus STRICKLANDIA.—(Billings.)

STRICKLANDIA.—(Billings.) *Canadian Naturalist and Geologist*, Vol. 4, p. 132, April, 1859.

RENSELERIA.—(Hall.) part. *Twelfth annual Report of the Regents of the State of New York*, p. 39, October 1859.

Generic Characters.—Shell, usually large, clongate-oval, transversely oval, or circular, sometimes compressed; valves nearly equal; a short mesial septum in the interior of the ventral valve, supporting a small triangular chamber beneath the beak as in *Pentamerus*; in the dorsal valve no longitudinal septa spires or loop yet observed; the whole of the internal solid organs, (so far as is yet known) consisting of two very short or rudimentary socket plates, which support prolonged calcified processes for the support of the cirrated arms. In all the

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species known, the ventral valve has an area more or less developed. The valves articulate by teeth and sockets.

The genus *Rensselaria* (Hall) is closely allied to *Stricklandia*, the shells being of nearly the same shape and size. Prof. Hall has shewn that in the dorsal valve the calcified processes, in his genus, after being prolonged about two-thirds the length of the valve, are united so as to form a loop, (as in *Centronella*) with a backward projecting spine. I think it probable that when better specimens are procured it will be found that *Stricklandia* has a similar loop. In *Rensselaria* there is no triangular chamber in the ventral valve.

This group of shells, (*Stricklandia*), although closely related to *Pentamerus*, differs from that genus in the following particulars:—

- 1st. In *Pentamerus* the form is globular and the ventral valve much the largest. In *Stricklandia* the valves are nearly equal in size, and the form oval or heart-shaped, never globose.
- 2nd. In *Pentamerus* the dorsal valve has two and sometimes three well developed longitudinal septa, which in most of the species sustain a small triangular chamber, as in the ventral valve. In *Stricklandia* these septa are not developed, and the triangular chamber is entirely absent. It might be thought that the difference between the short or rudimentary socket-plates of *Stricklandia*, and the elongated mesial septa of *Pentamerus* should not be regarded as of sufficient importance to constitute a generic distinction, because it is only a difference in the extent to which identical parts are developed, the socket-plates of the former genus being a rudimentary state of the latter. When, however, we examine any group of closely allied genera, we find that all the grounds for separation consist in the various modifications of the same set of organs. The difference in the degree of the development of an organ is not always a good character, but when it is carried to such an extent that the whole form of the animal is affected in a particular manner, manifested in a number of species, then it becomes of generic value. If we take the several species of *Stricklandia* and compare them with the ordinary forms of *Pentamerus*, such for instance as *P. Knightii*, *P. galeatus*, *P. Sieberi*, *P. acutolobatus*, *P. caduceus*, &c., the difference in the external form of the two groups is so remarkable, that we would almost be warranted in separating them into two genera upon this ground alone; but when to the dissimilarity in the general form we add the difference in the internal structure, then there can be little doubt as to the correctness of the separation.

The following figures exhibit the difference between the generic forms of *Stricklandia* and *Pentamerus*.

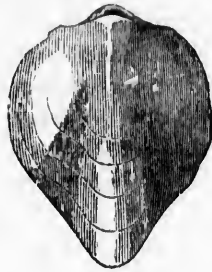


Fig. 88.

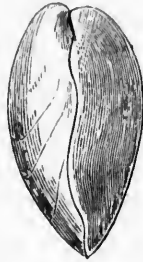


Fig. 89.



Fig. 90.

Fig. 88.—*Stricklandia lens*, dorsal view.

Fig. 89. The same side view, shewing that the valves are nearly equal in size.

Fig. 90.—*Pentamerus Knightii*, side view shewing the great difference in the size of the valves.

This genus ranges from the Middle Silurian up to the Devonian. It includes three English species long known under the names of *Pentamerus lens*, *P. liratus*, and *P. levis*. In Canada we have these three in the Clinton group at Anticosti, and also *Stricklandia Gaspensis*, (Niagara group) Gaspé, *S. Canadensis* (Clinton group) Thorold, C. W., *S. brevis*, perhaps a variety of the latter (Clinton) Anticosti. *Stricklandia elongata* is the only species known to me in the Devonian rocks.

STRICKLANDIA ELONGATA. (Vanuxem.)

PENTAMERUS ELONGATUS.—(Vanuxem.) *Geology of the Third District of the State of New York*, p. 132. 1842.

PENTAMERUS ELONGATUS.—(Hall.) *Geology of the Fourth District of the State of New York*, No. 34, Fig. 1.

MEGANTERIS ELONGATUS.—(Hall.) *Tenth Annual Report of the Regents of the University of the State of New York*, p. 123. 1857.

RENSELERIA ELONGATA.—(Hall.) *Twelfth Annual Report of the Regents of the University of the State of New York*, p. 38. October, 1859.

Description.—Elongate-oval, somewhat variable in form, the sides convex, as in the above figure, or nearly straight and parallel, and in the latter case the front truncated or nearly straight. Valves varying in the amount of their convexity, sometimes nearly cylindrical above

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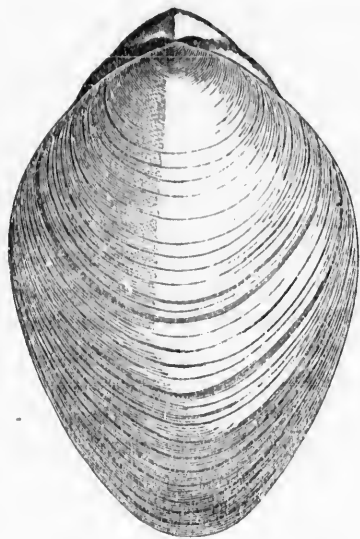


Fig. 91.

Fig. 91. *Stricklandia elongata*.—(Vanuxem.) Dorsal view of a specimen of a more nearly oval shape than usual.

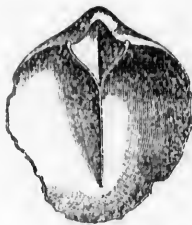


Fig. 92.

Fig. 92. The same, interior of ventral valve, showing the small triangular chamber beneath the beak.

and compressed towards the front; the ventral valve in general the most convex, obtusely carinated from the beak along the middle in the upper half; the dorsal valve in the upper half often much flattened and broadly carinated in the middle, sometimes evenly convex. In many specimens the sides are abruptly compressed, so that a transverse section through both valves would be somewhat hexagonal in outline. The beak of the ventral valve is closely incurved over the umbo of the dorsal valve. Surface smooth but usually with several rough concentric imbricating ridges of growth most strongly developed towards the front.

Length from two to three or even four inches; width from one half to two-thirds of the length.

This appears to me to be a variable species, many of the specimens being somewhat broadly-oval, while others are elongate-oval or sub-cylindrical. So great are these differences that, without the intermediate forms, the extremes might readily be classified as distinct species. The specimens are seldom found perfect.

Locality and Formation.—At most localities of the Devonian rocks in the County of Haldimand, Oriskany Sandstone, and Corniferous Limestone.

Collectors.—E. D. Cow. J. DeCew. E. Billings.

Genus PENTAMERUS.—(Sowerby.)

Generic Description.—Shell, globular or sub-globular, the ventral valve the larger, and usually with a prominent, greatly developed umbo. A strong mesial septum in the interior of the ventral valve, supporting a triangular chamber beneath the beak. "In the interior of the smaller (or dorsal valve) there are two distinct longitudinal septa, of variable dimensions; (between which a small median ridge is occasionally found), to these the socket walls converge and join, forming two more or less developed and inclined plates, to the produced extremities of which were affixed the spiral cirrated arms." (Davidson, Introduction, p. 98.)

This genus ranges from the base of the Trenton Limestone up to the carboniferous rocks.

PENTAMERUS ARATUS.—(Conrad.)

ATRYPA ARATA and ATRYPA OCTOCOSTATA.—(Conrad.) *Annual Report on the Palaeontology of New York*, p. 55, 1841.

PENTAMERUS ARATUS.—(Hall.) *Tenth Annual Report of the Regents of the University of the State of New York*, p. 120, 1857.

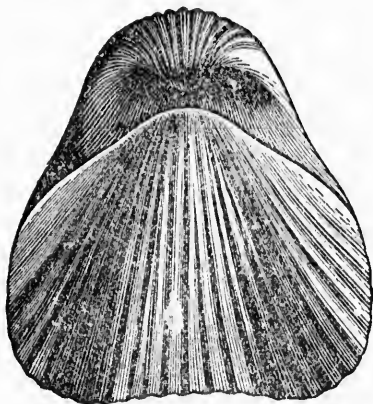


Fig. 93.

Fig. 93.—*Pentamerus aratus*, Dorsal view of a very large specimen.

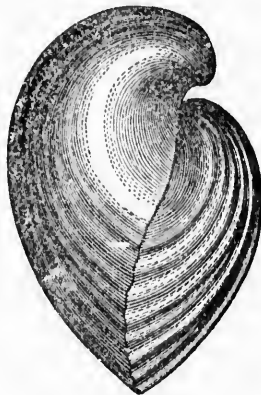


Fig. 94.

Fig. 94.—Side view of the same specimen.

Description.—Shell, varying greatly in size and shape, ovate or sub-triangular, very convex or irregularly sub-globular. In large specimens the ventral-valve is very convex, with an exceedingly prominent and tumid umbo; the outline on a side-view is strongly arched from the beak to the front, the most rapid curvature being in the upper half; the beak is incurved, but not in contact with the umbo of the dorsal valve; a broad shallow mesial sinus originates at the front margin and becomes narrower and shallower, until, at length, it dies out before reaching the beak; in a front view the outline is sub-triangular. In small specimens the umbo and beak are proportionally much smaller, the form more nearly oval or nearly circular, and the mesial sinus occasionally obsolete. The dorsal valve is much the smaller, depressed convex, with a broad, slightly elevated mesial fold on each side of which the shell is usually a little flattened, or even slightly concave; the mesial fold sometimes not at all developed. The surface is covered with coarse, unequal, sub-angular, or obscurely rounded ribs, from one line to one line and a half in width. These ribs increase in number from the beak towards the front, both by sub-division and the insertion of smaller ones between the larger. On each side of the beak there is a smooth space.

The only difference between this species and the well-known *Pentamerus galeatus* appears to be that, in the latter, the mesial sinus is on the dorsal and the fold upon the ventral valve.

In the following figures a small specimen is represented.

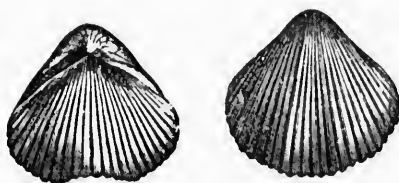


Fig. 95.

Fig. 96.

Locality and Formation.—This species occurs in the Oriskany Sandstone, and Corniferous Limestone, in various places in the County of Haldimand.

Collectors.—J. DeCew. E. DeCew. E. Billings.

Genus CENTRONELLA.—(Billings.)

CENTRONELLA.—Billings. *Canadian Naturalist and Geologist*, Vol. IV., p. 131. April, 1859.

Generic characters.—Shells, having the general form of *Terebratula*. Dorsal valve with a loop consisting of two delicate riband-like lamellæ, which extend about one-half the length of the shell. These lamellæ at first curve gently outwards, and then approach each other gradually, until at their lower extremities they meet at an acute angle; then becoming united they are reflected backwards towards the beak, in what appears to be a thin, flat, vertical plate. Near their origin each bears upon the ventral side a single triangular crural process.

This genus appears to stand between *Terebratula* and *Waldheimia*. In the former, the loop is short, not exceeding greatly one-third the length of the shell, and not reflected. In the latter, it extends nearly to the front, and is reflected, but the laminae are not united until they are folded back.

CENTRONELLA GLANS-FAGEA.—(Hall.)

RHYNCONELLA GLANS-FAGEA.—Hall. *Tenth Annual Report of the Regents of the University of the State of New York*, p 125. 1857



Fig. 97.

Fig. 97.—*Centronella glans-fagea*. Three views of a specimen of the usual size. These figures are too much rounded at the sides.

Description.—Shell smooth, ovate or sub-rhomboidal, greatest width about the middle, from which point the sides are nearly straight in the upper half, and converge to the beak at an angle of about 85° ; front half rounded, sometimes with a sinus in the front margin. Ventral valve the larger, its outline forming a nearly regular arch from the beak to the front margin, strongly and broadly sub-carinate along the middle in the larger individuals, more uniformly convex in the small ones; beak long, strongly incurved over the dorsal valve, but not in contact therewith. Dorsal valve nearly flat, with a wide, shallow, mesial sinus, which, in some specimens, occupies nearly the whole width of the shell, but in others it is almost obsolete, and the

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valve is then nearly flat. Length from two to three lines, width about the same.

The above description applies to the more common form of this species. Larger individuals from six to eight lines in length are occasionally found, but they do not seem to be so numerous as the smaller ones. In these, the dorsal valve is divided along the middle by a narrow, rounded sinus, which extends from the front nearly to the beak; on each side the shell is convex, sometimes rather strongly tumid. The ventral valve broadly carinate along the middle. The following figures represent the largest specimens that I have seen in different views.

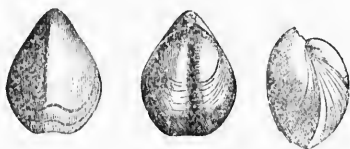


Fig. 98.

Centronella tumida?

There are some intermediate sizes, but not sufficient to make out a series connecting these large individuals with the smaller. Should these constitute a distinct species, I propose to call it *C. tumida*.

Locality and formation.—Oriskany Sandstone and Corniferous Limestone, County of Haldimand. Also at Rama's Farm, near Port Colborne.

Collectors.—J. De Cew, E. De Cew, E. Billings.

CENTRONELLA HECAE.—*N. Sp.*



Fig. 99.

Centronella Hecate.—*a.* A specimen with the dorsal valve removed, shewing the loop, which is covered with minute crystals of silice. *b.* Ventral view of another specimen. *c.* side view, *d.* dorsal view.

Description.—Elongate, oval, or sub-rhomboidal; apical angle from 45° to 60° ; sides somewhat straight from the beak to about the middle, where, making a rounded angle, they converge towards the front margin, which is somewhat truncate for about one-third the width. Ventral valve strongly but broadly carinate from the beak along the middle to the front, descending with a flat or gently convex slope to

the sides; in outline only gently arched longitudinally; in some specimens nearly straight; the beak small, elongated, erect, and with a triangular foramen. Dorsal valve gently convex in the upper half, and with a wide shallow sinus in the lower half. Surface smooth. Length from two to four lines; width about three-thirds the length.

Locality and formation.—Oriskany Sandstone and Corniferous Limestone, County of Haldimand.

Collector.—J. De Cew.

CHARIONELLA CIRCE.—*N. Sp.*



Fig. 100.

Charionella Circe.—The first figure exhibits a specimen with the dorsal valve partly removed, shewing the internal spires. The other two figures are a side and ventral view of another specimen.

Description.—Elongate valve, greatest width a little below the mid-length, above which the sides converge with a nearly straight or gently convex curve to the beak; apical angle between 60° and 75° ; front half rounded, sometimes slightly truncate in the middle of the front margin. Both valves moderately and evenly convex. Ventral valve evenly arched from beak to front; beak incurved, but not in contact with the dorsal umbo, truncated by a circular aperture which is formed below by a deltidium; the sides of the umbo very obtusely sub-angular for about one-sixth of the length of the shell. Dorsal valve not quite so convex as the ventral, most prominent a little above the mid-length; the umbo moderately prominent; the shell narrowed and somewhat pointed towards the beak. Surface nearly smooth.

Length of specimen of average size—eight lines; width six lines; depth of both valves, four lines; difference between the length of dorsal and ventral valves, three-fourths of a line.

Associated with the above, are specimens of about the same length, which are proportionally broader, and with a shallow, mesial sinus extending from the front margin of the ventral valve nearly to the beak. The sides of the umbo or cardinal slopes are more angular, and the beak more prominent. The front margin, instead of being rounded, is straight, or even a little concave in the middle. These

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Locality—Haldimand.

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Locality and formation.—Corniferous Limestone, County of Haldimand.

Collector.—J. De Cew.



Fig. 101.

Remarks on the genus Charionella.

A silicified fragment of the dorsal valve of *C. Circe* a little enlarged, shewing the absence of a regular hinge-plate.



Fig. 102.

A fragment of the ventral valve of *C. scitula?* shewing the deltidium and muscular impressions in part.

By treating partially silicified specimens of this genus with acids, I have ascertained that the structure of the hinge-plate differs from that of *Spirigera* in being either obsolete along the middle or anchylosed to the bottom of the valve. In *Athyris* = (*Meristella*, Hall) there is a well developed hinge-plate, supported beneath by a strong mesial septum, which extends sometimes nearly to the front of the valve. In *Charionella* there is either no mesial septum, or, one that is merely rudimentary. In one specimen there is a remarkable partition, which runs obliquely from near the beak to the margin near the front. It completely divides the internal cavity into two parts. This I believe to be not a mesial septum, but a temporary wall formed by disease of the animal, because both spires are crowded into the smaller of the two cavities, the larger being empty.

It is probable that further researches will bring to light other characters of the hinge-plate in other species, and I do not therefore confine the genus to such as have this organ constructed exactly as in *C. Circe* and *C. scitula*.

The species figured by De Verneuil under the names of *Terebratula*, *Schulzii*, *T. Bordii*, and *T. mucronata*, in the Bulletin of the Geological Society of France, 2nd Series, Vol. VII., Plate 3., have the aspect of this genus, and exhibit the same structure of the beak, foramen and deltidium of the ventral valve, and most probably have the same internal organization.

Genus STROPHOMENA.—(Rafinesque.)

STROPHOMENA.—(Rafinesque.) De Blainville. *Manuel de Malacologie*, p. 513, Pl. 53, fig. 2, 2a, 1825. Davidson. *Introduction to the Classification of the Brachiopoda*. p. 106.

LEPTÆNA.—Dalman, and many other authors.

LEPTÆNA. + STROPHOMENA + STROPHODONTA, either wholly or in part, of Hall and American authors.

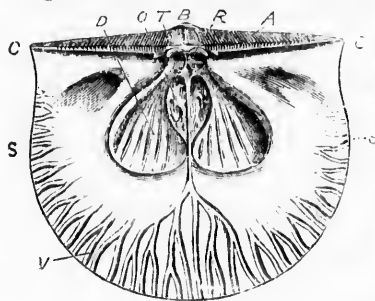


Fig. 103.

Fig. 103.—*Strophomena inequistriata*.—Conrad. Interior of ventral valve; S.S.,—the sides; M.—the front margin; C.C.—the cardinal angles; the edge of the area from C to C is the hinge line; A.—the flat space terminating the shell on the straight side is the area; B.—the beak; the small linear ridge beneath the beak is the deltidium; T.—teeth; R.—the rostral septum; D.—the divaricator muscular scar or impression; O.—the ocluser; V.—the vascular impressions. This figure is drawn as if the shell were flat in order to show all the parts more clearly.

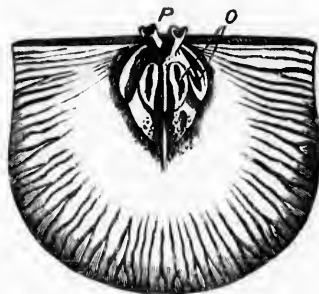


Fig. 104.

Fig. 104.—*Strophomena demissa*.—Conrad. Interior of dorsal valve. P.—the two divaricator processes or levers for opening the valves; O.—the ocluser muscular impressions or scars.

Generic characters.—Shell, semicircular, semioval, sub-quadrate or sub-triangular, with the hinge line straight; one valve convex and the other concave; in a few species both valves nearly flat. Both valves provided with an area, that of the ventral valve usually the larger. Area of ventral valve with a triangular or linear foramen or fissure in the middle beneath the beak, either wholly or partially closed by a deltidium; in some species no foramen. Area of dorsal valve often with a triangular projection in the middle, caused by the protrusion of the bases of the divaricator processes; in some species this is absent. Valves articulated together at the hinge line or inner edge of the area, by teeth in the ventral valve, and sockets in the dorsal, the structure of which varies in different species. Surface ornamented with fine or coarse radiating striæ or small ribs; in a few species smooth.

On the inner surface of the ventral valve there are two large pyriform or subtriangular muscular scars or impressions, situated one on each side of the median line and in the upper half of the valve. These are the impressions of the DIVARICATOR MUSCLES or those whose

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function it was to open the valves. Between them there are two much smaller scars situated also, one on each side of the median line. These are the impressions of the OCCLUSOR MUSCLES, or those whose function it was to close the valves. On comparison it will be seen that the arrangement of the scars in the ventral valve is in a general way the same as in *Athyris* and *Spirigera*. It is nearly the same in *Orthis*, *Chonetes*, *Producta*, *Atrypa*, *Spirifera*, and in most other genera of Brachiopoda.

In some species, but not in all, the cavity within the beak and umbo of the ventral valve is divided into two compartments, by a vertical ridge or septum. This I propose to call the ROSTRAL SEPTUM. It varies greatly in size, and is often absent altogether. It cannot therefore be regarded as an organ of generic importance.

In the interior of the dorsal valve there are four small scars arranged in two pairs, one pair on each side of the median line. These are the OCCLUSORS corresponding to those of the ventral valve. In this valve the divaricators were attached to two small processes situated close to the hinge-line. (See fig. 104, P.) These are notched at their extremities, and grooved on the outside, or side next the area. These I propose to call the DIVARICATOR PROCESSES; their function was to open or divaricate the valves; the mechanical principal upon which they operated was simply that of the lever. This will be more clearly understood by consulting Fig. 105.

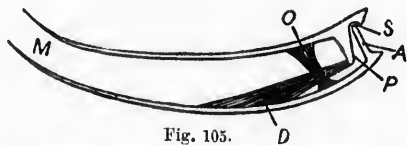


Fig. 105.

Fig. 105.—A longitudinal section through both valves of a *Strophomena* from the beak to the front margin; the dorsal valve uppermost. M.—the front margin; A.—the area of the ventral valve; S.—the socket in the dorsal valve for the reception of the teeth of the ventral valve; P.—the Divaricator Process (or lever); D.—the Divaricator Muscle; O.—the Ocellus. It is evident that by the contraction of the Divaricator muscle the extremity of the process P must be drawn towards the point D, and thus the dorsal valve must turn on the hinge at S, (as a door turns on its hinges.) By this movement of course the valves were separated at the front margin M. By the contraction of the Ocellus O, the valves were drawn together. It appears that in most of the *Palaeozoic* genera of Brachiopoda the muscular apparatus consisted of these two sets of muscles, but a little modified in different groups.

In *Strophomena* the form of the scars and their distinctness varies to some extent in different species, but their arrangement is in a general way the same in all.

In addition to the muscular scars, the inner surface of many species exhibits numerous radiating branching channels, usually most distinct near the margin. These are the impressions of the vessels of the vascular system.

We shall now notice more particularly some of the variations exhibited by the parts above mentioned in connection with the following proposed genus.

Genus STROPHODONTA.—(Hall.)

In 1847, Mr. Sharpe pointed out that in *Strophomena demissa* there was no foramen, and says: "It will probably be found to indicate a distinct genus, as it must be accompanied with a peculiar internal arrangement. Until this can be ascertained this species may remain in *Leptæna*, the genus to which it is most closely related."*

In 1849, Professor Hall proposed his genus *Strophodonta* (giving *S. demissa* as the type) founding it on the characters pointed out by Sharpe, and adding thereto the following remarks on the interior: "In the interior there are no dental lamellæ margining or surrounding the muscular impressions, which are spread out over a considerable surface in the dorsal valve, shewing partially a double or bilateral arrangement. In the ventral valve there is some indication of a limitation, or marginal elevation, to the muscular impression, but the character is quite distinct from the same in *Leptæna*."†

In 1852, Prof. Hall redescribed the genus, founding it upon the striated area and closed foramen, but gave no internal characters, except, "Muscular impression somewhat bilateral."‡

In 1858, Professor Hall, in the *Geology of Iowa* published the following more detailed description of the internal characters:

"In the ventral valve the teeth are much reduced or nearly obsolete, a central more or less prominent bilobed process usually occupying the centre of the area in place of the triangular fissure of STROPHOMENA. Muscular impressions strongly marked, semielliptical or subreniform, separated in the middle by a depressed line, and sometimes margined by a semicircular ridge, which is an extension of the lamellæ from either side. Vascular impressions foliate or flabellate, extending beyond the areas towards the base of the shell.

"Dorsal valve with the muscular and vascular impressions strongly marked: cardinal process bifurcate from the base, with each branch bilobed at the extremity, by which it is articulated to processes beneath the area of the opposite valve, receiving between its forks the cardinal process of the opposite or ventral valve,

* SHARPE, in *Quar. Jour. Geol. Society.* Vol. 6, p. 172.

† HALL. In *Proc. Am. Ass.* 1850, p. 348.

‡ *Pal. N. Y.* Vol. 2, p. 63.

which is bilobed or grooved for the passage of the peduncle. Entire interior surface papillose."*

I hold that the above is simply a description of the internal characters of the genus *Strophomena* with the exception of the passage that I have put in italics, which contains a statement decidedly incorrect. We have a number of specimens of *S. demissa*, *S. inaequistriata* and *S. ampla*, showing clearly the inside of the area of the ventral valve, and there are no such processes as those mentioned by Prof. Hall. It is also evident that if the Divaricator processes were as he says—articulated to processes beneath the area of the ventral valve—the shell could not be opened at all. The notch and groove in the Divaricator levers are simply the scars or marks of the attachment of the muscle.

The divaricator processes *i. e.* the ("cardinal process bifurcate from the base") occur in all species of *Strophomena*, and are not peculiar to those which he has placed in his genus *Strophodonta*. They vary a good deal in their form in different species. The most ancient species in which I have seen them is *S. filitexta*. The following Fig. 106 represents their form in this species, and it will be seen that they differ only specifically from those of *S. demissa*.

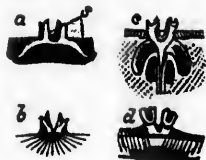


Fig. 106.

Fig. 107.

Fig. 106. *S. filitexta*. *a* Divaricator processes, front view. *b* Viewed from the outside, shewing the groove. The specimen is from the Black River Limestone. *s*. The dental sockets.

Fig. 107. *S. demissa*. Copied from Geology of Iowa, Pl. 3, fig. 5. *c*—Divaricator processes, front view. *d*—The same viewed from the outside.

The specimen of *S. filitexta*, from which the above fig. 106 was drawn, does not show the ocluser muscular scars, and in fact the interior of the dorsal valve is rarely so preserved as to shew them. In *S. rhomboidalis* and *S. Philomela*, the divaricator processes consist of two short ridges, abruptly terminated on the side of the area, their extremities not elevated above the surface of the shell, and if the length of the processes were of generic importance, then these

* HALL. Geology of Iowa. Vol. I, Part 2, p. 491.

two species would belong to a genus distinct from *S. filitexta* and *S. demissa*.

As to the muscular impressions, the following figures will show that, although they are subject to considerable modifications of form, their arrangement does not vary.

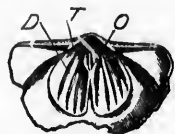


Fig. 108.



Fig. 109.

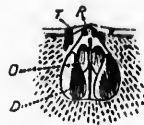


Fig. 110.

Fig. 108.—Represents the muscular scars in a specimen of a species closely allied to, if not identical with *S. alternata*. It is from the Black River Limestone, Pallideau Islands Lake Huron. The scars are deep, and well defined. O.—the oclusors. D.—the divaricators. T.—the teeth.

Fig. 109.—*S. alternata*. Hudson River group. The scars not well defined.

Fig. 110.—*S. Philomela*. Middle Silurian. The scars well defined. R.—the rostral septum, rudimentary. O.—occlusors. D.—Divaricators.

When these are compared with Fig. 103, it will be seen that, although there is some difference in form, the arrangement of the muscular apparatus is the same, *i. e.*, the divaricators outside, and the oclusors between them.

The same rule holds good with respect to the oclusors. In all the species (in which they have been observed) they are arranged in two pairs, one pair on each side the median line, and yet they differ in form according to the species. Even in different individuals in the same species they differ. Thus Fig. 107 differs from 104. Both of the figures differ from that given by Davidson in the *Geologist*, Vol. 2., pl. 4, fig. 15, which was drawn from a specimen procured from Prof. Hall, and all of them differ from a specimen in my possession— from the Hamilton Shales of New York.

With respect to the foramen, the specimens in our collection, and the figures given by various authors, show that there has been a gradual change in the size of the orifice.

1.—SILURIAN. Most of the species with the foramen large, its width greater than the height. Ex.—*S. alternata*, *S. filitexta*, *S. planoconvexa*, &c.

2.—DEVONIAN. Most of the species with the foramen very narrow, sometimes reduced to a mere line across the area of the ventral

valve, and in some entirely absent. Ex.—*S. inæquistriata*, *S. ampla*, *S. demissa*.

In comparing the fine series in our collection (embracing species from every formation, from rocks holding Primordial Trilobites up to the Corniferous), and also the figures given by Barrande, De Verneuil, Davidson, Hall, and others, it is clear that in the size of the foramen there is every shade of gradation from an aperture two lines wide down to nothing. I hold, therefore, that the size of the foramen is too variable to be of value as a generic character.

The same gradation occurs also in the extent to which the hinge line is crenulated.

1.—LOWER SILURIAN.—Most of the species with the hinge-line and teeth smooth.

2.—MIDDLE AND UPPER SILURIAN.—Most of the species with the teeth or a small portion of the hinge-line next the foramen striated. Ex. *S. Leda*. *S. Philomela*. *S. euglypha*, &c.

3.—DEVONIAN.—Most of the species with a large portion or nearly the whole of the hinge-line striated.

The striation of the area appears to have kept pace with the diminution of the foramen; the one gradually increasing from the Silurian upwards to the Devonian and the other as gradually diminishing.

The striated hinge-line and area is not peculiar to *Strophomena*. *Leptaena transversalis* and *Chonetes hemispherica* exhibit the same character, although most other species of these two genera do not.

For the above reasons and also because there is no difference in the form of the shell, I hold that the genus *Strophodonta* is quite superfluous.

Number of species of Strophomena.

On examining the various Reports of the Geological Surveys of the neighbouring States, I find that SEVENTY-THREE species have been named as occurring in the Upper Silurian and Devonian Formations of these countries. According to my view, this number must be greatly reduced. I do not think there can be more than twelve or fifteen. In Canada West I can only recognize nine species in the Oriskany Sandstone, Corniferous Limestone and Hamilton group, and three of these, *S. magnifica*, *S. magniventra* and *S. Pattersoni*, may be only varieties, the first two of *S. perplana* and the last of *S. inæquistriata*.

STROPHOMENA RHOMBOIDALIS.—(Wahlenburg).

LEPTENA DEPRESSA + STROPHOMENA DEPRESSA + LEPTENA RUGOSA + STROPHOMENA RUGOSA + LEPTENA TENUISTRITA? + PRODUCTA DEPRESSA + P. ANALOGA, &c. Either wholly or in part, of the generality of authors.*



Fig. 111.



Fig. 112.

Fig. 111.—*Strophomena rhomboidalis*, with the front straight.
Fig. 112.—The same with rounded front.

Description.—Rhomboidal or irregularly semi-oval, widest on the hinge-line, occasionally somewhat square: visceral disc strongly corrugated by from nine to fifteen deep undulating concentric wrinkles; both valves abruptly bent at one-half or two-thirds the length to form a broad margin deflected towards the dorsal side. In the ventral or convex valve the disc is nearly flat, but with a small portion in front of the beak gently tumid. The curvature of the dorsal valve conforms very nearly to that of the ventral. Area of ventral valve narrow, seldom exceeding half a line in width; the dorsal area still narrower; the two areas inclined towards each other at an angle which varies from 30° to 60° . Foramen of ventral valve large, triangular, wider than high, partly filled by the two projecting extremities of the divaricator processes of the dorsal valve. Surface covered with fine crowded striae of a nearly equal size throughout, five or six in the width of one line.

In the interior of the ventral valve the muscular impressions occupy a subcircular cavity which is about one-third the length of the valve and is bordered by an angular slightly elevated margin. The divari-

* Prof. Hall is desirous of having this species called *S. rugosa*, and says that he has seen specimens of it labelled under that name in Rafinesque's hand-writing. But according to the laws of scientific nomenclature, manuscript names cannot be recognized at all. The first published specific name is (*rhomboidalis*), and this must be retained. The figure of *S. rugosa*, published by De Blainville as the type of the genus, in 1825, in the *Manuel de Malacologie*, certainly does not represent this species.

cators are situated one on each side, and the oclusors (seldom well defined) between them. The form of these sears appears to be at first sight somewhat different from that of *S. inæquistriata* but on a little examination it will be seen that the general arrangement is the same and the form only specifically different. On each side of the foramen is a single short tooth.

In the interior of the dorsal valve the divaricator processes consist of two short elevated ridges terminating abruptly just over the area, their extremities not elevated, and free as they are in *S. demissa*. They are separated in some specimens (but not in all) by a deep oval pit. On each side is seen a small oblique socket or pit for the reception of the tooth of the opposite valve. Just in front of the divaricator ridges are the two small sears of the oclusor muscles, each scar divided into two by an oblique ridge not often well developed, but distinctly seen in a beautiful specimen now before me. These sears are small, each pair occupying a space only one line in length and breadth in a specimen one inch wide. The two pairs of scars are separated by a low mesial ridge, which in some specimens becomes a thin elevated septum towards the front of the shell. The vascular impressions are only well marked round the margin.

Width from one-inch to one-inch and a-half; length about one-third less than the width.

Specimens two inches wide sometimes occur.

Affinities.—This wonderful species has no near relatives in the Devonian rocks. By the form and structure of its foramen, divaricator processes and muscular impressions, it is clearly a Lower Silurian type belonging to the group, which includes *S. alternata*, and its varieties *S. deltoidea* and *S. tenuistriata* (Pal., N. Y., Vol. 1). It commenced its existence just at the close of the Lower Silurian period, or perhaps a little earlier, and lived on, with scarcely any change through the immeasurable ages of the Middle and Upper Silurian and Devonian, and even until the Carboniferous was well advanced.

Locality and formation.—Occurs at nearly all the localities of the Oriskany Sandstone, Corniferous Limestone and Hamilton group in Canada West. Also in all the older formations down to the top of the Hudson River group.

Collectors.—A. Murray, E. Billings, J. De Cew, E. De Cew, Judge Wells, Chatham, Wm. Saunders, London.

STROPHOMENA INEQUISTRIATA.—(Conrad.)

STROPHOMENA INEQUISTRIATA —Conrad. *Journal of the Academy of Natural Sciences of Philadelphia* Vol. 8, p 254. Pl. 14, fig. 2, 1839. Also compare the descriptions and figures in the same work of *S. CREBRISTRIATA*; *S. VARISTRIATA*; *S. RECTILATERIS* and *S. IMPRESSA*.—Conrad. Also, *S. VARISTRIATA*; and *S. VARISTRIATA, var. ARATA*.—Hall. *Pal. N. Y.* Vol. 3, p. 180, 184. Also the following in the 10th Ann. Rep. Regents N. Y. Univ., *S. INEQUIRADIATA*; *S. TEXETILIS* and *S. CONCA*. —Hall.

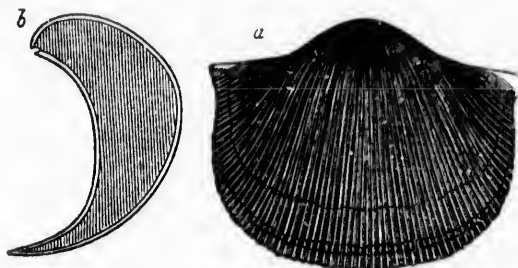


Fig. 113.

Fig. 113.—*Strophomena inequistriata*.—Ventral view of one of the forms of this species *b*, longitudinal section.

Description.—Semi-circular, semi-oval, or sub-triangular, width on hinge-line varying from one to three inches; length from two-thirds to seven-eighths of the width; cardinal angles compressed, forming rounded or acute ears which are more or less extended. Ventral valve varying greatly in the amount and in the form of its convexity; usually with the visceral disc depressed convex and the margin all round abruptly curved down for one-third or one-half the whole length of the shell; sometimes the shell uniformly arched from beak to front; the umbo often so greatly developed as to overhang the hinge-line and bring the area under the body of the shell; in other specimens the convexity of the umbo is continued along the middle to the front, producing a broad mesial carination; in many the front is greatly produced in a gradual slope from the anterior margin of the disc, and occasionally we find specimens with the front margin so much curved as to be to some extent inrolled under the shell; in all the umbo is more or less prominent, there being a somewhat flat or depressed sub-concave space of greater or less extent on each side

extending to the cardinal angles. The dorsal valve is usually not so much curved as the ventral, thus leaving a comparatively large space for the animal.

Area of ventral valve from one-fourth of a line to one line in width, flat or concave, obliquely striated all except about one-tenth the length at each extremity, a wide shallow notch on the edge, in the middle of which is the foramen. Dorsal area about half-a-line wide and not so variable in its dimensions as is the ventral.



Fig. 114.

Fig. 114.—A fragment of the ventral area natural size, shewing the foramen and the wide notch in the edge of the area.

Foramen small, linear, closed, usually about one-fourth of a line wide, sometimes less. Teeth rudimentary, and situated one on each side of the foramen on the edge of the area. Cavity of the beak divided into two compartments by a rather strong rostral septum.

In the interior of the ventral valve the divaricator sears are large, sub-pyriform, and one-third the length of the whole shell. The oclusors are ovate, half the length of divaricators, often with the surface covered with minute corrugated wrinkles like the sears of some species of *Producta*. The vascular impressions are well marked on some of the casts of the interior, but vary in the number of the branches, usually from three to five in the width of one line at the margin. In thin shelled individuals they are not seen at all. Interior of dorsal valve not observed.

Surface very variously striated. In some the striæ alternate in size, there being one set of fine sharply elevated lines distant from half a line to one line from each other, the intervening spaces flat and with from three to seven finer striæ just visible to the naked eye; in others the intervening spaces are concave. In many the principal striæ become coarser and closer together until the whole surface is covered with strong angular bifurcating ridges from one-fourth of a line to half a line in width. In very well preserved specimens of these latter, the coarse ridges are seen to be themselves ornamented with the fine longitudinal striæ. In all cases the whole surface when perfectly preserved, is beautifully cancellated by minute crowded concentric striæ.

Affinities of this species.—This species belongs to a type which

appeared in the lower Silurian seas, and is found more or less abundantly in every formation from the Chazy up to the Chemung group. Many of the Devonian specimens so exactly resemble some of the varieties of *S. alternata*, the dominant species of the Trenton and Hudson River group, that were it not for the striated area and nearly obsolete foramen, they could not be separated therefrom. The general form, striation of the surface, and some of the internal markings are so nearly the same, that one can scarcely help thinking that those we find in the Devonian rocks are the lineal descendants of those with which the lower Silurian strata are crowded. Professor Hall's description of *S. varistriata* of the Lower Helderberg rocks, of New York, applies exactly to this species (See Pal. N. Y., Vol. 3, p. 180-184) the only difference being that the specimens are in general smaller. I think that on comparison of good series of specimens that species may yet be united to this, or perhaps all those above cited may be united under one name *S. varistriata*. Should only the Devonian varieties be united I think they should all be referred to *S. inæquistriata*, as that form has been more extensively described and illustrated by Conrad and Hall than any of the others.

Locality and formation.—Oriskany Sandstone; Corniferous Limestone; and Hamilton Group at nearly all the localities of these rocks in Canada West.

Collectors.—A. Murray; J. Richardson; J. De Cew; E. De Cew; Wm. Saunders, London, and Judge Wells, Chatham.

STROPHOMENA PATERSONI?—(Hall.)

STROPHOMENA PATERSONIA.—Hall. Tenth Annual Report of the Regents of the University of New York.



Fig. 115.

Fig. 115. *Strophomena Patersoni* Ventral view.

This species has all the characters of *S. inæquistriata*, the only difference being that the surface is marked by numerous concentric wrinkles. I retain the name for the present provisionally, but have strong doubts as to its claims to rank as a distinct species. The shells are always thin, with two sets of radiating striæ, the stronger ones distant from one-fourth of a line to one line, and with from three to twelve very fine ones between.

Locality and formation.—Oriskany Sandstone, and Corniferous limestone. County of Haldimand.

Collectors.—J. De Cew ; E. De Cew.

STROPHOMENA DEMISSA.—(Conrad.)

STROPHOMENA DEMISSA.—Conrad. *Journal of the Academy of Natural Sciences of Philadelphia*. Vol. 8, p. 258, pl. 14, fig. 14, 1839. STROPHOMENA OR STROPHODONTA DEMISSA.—Hall, in various works. Compare also *S. SUBDEMISSA.*—Hall. Tenth Ann. Rep. Regents, N. Y. Univ. p. 145, and *S. ARCUATA.*—Hall. Geology of Iowa. Vol. 1. Part 2, p. 492, Plate 3, fig. 1, *a, b, c, d, 2. a, b, c.*

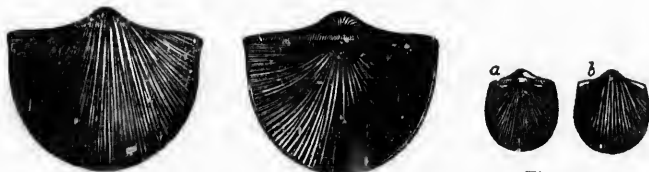


Fig. 116.

Fig. 117.

Fig. 118.

Fig. 116.—One of the forms of *S. demissa*, ventral view.

Fig. 117.—The same specimen, dorsal view.

Fig. 118.—Two views of a very small specimen.

Description.—Semioval, subquadrate or subtriangular; hinge line equal to, greater or less than the width of the shell; cardinal angles often forming extended or short acute ears; in some specimens the sides and front margin are uniformly curved, giving the semioval form represented above, (fig. 116); in others the sides are somewhat straight and parallel for two-thirds of the length, and the front margin broadly rounded, approaching the subquadrate aspect; others are rounded subtriangular, the hinge line being extended and the front narrowed, while some have the greatest width in the front half. The width varies from a little less to one-third greater than the length.

The most common size is from one inch to one inch and a half in width, but very small specimens of from four to twelve lines are often found.

The ventral valve is in general rather strongly convex, uniformly arched from beak to front, sometimes a little flattened in the central region; the umbo small, rounded but prominent, overhanging the area, the shell on each side depressed or subconcave towards the cardinal angles; in some a broad obscure carination extends from the umbo along the middle to the front, with an obscure longitudinal depression on each side.

Dorsal valve moderately concave, usually with a shallow mesial sinus commencing in a point at the beak and growing wider towards the front.

Area of ventral valve in some specimens broad and somewhat flat: usually narrow; often concave beneath and on each side of the beak, either striated the whole length, or with a very small portion at the cardinal angles smooth. Dorsal area not so variable as the ventral; the two areas inclined to each other at an angle which varies from less to greater than a right angle, according to the degree of curvature of the beak of the ventral valve.

No foramen; a smooth triangular space beneath the beak on the area of the ventral valve.

Surface with from ten to fifteen coarse angular ridges on the umbo of the ventral valve which bifurcate several times, and become smaller towards the front margin. In some small specimens the ribs do not bifurcate.

In the interior of the ventral valve the muscular scars are of the same type as those of *S. inaequistriata*, but the occlusors are proportionally nearer the beak. In the dorsal valve the occlusors are situated in the upper one fourth of the length of the shell; they are divided by a median ridge which sometimes is much elevated about the middle of the shell. There are usually two or three large tubercles or short curved ridges just in front of the impressions. In thick shelled specimens, the scars, median ridge and tubercles form a group occupying an oval space which extends nearly half the length, and is narrowed to a point below. In some there is a large space around the muscular area covered with small tubercles; in others this space is smooth. The vascular impressions are only well marked near the margin.

Affinities and varieties.—This species stands nearer to *S. inequistirata* than to any other. It differs from that species in the absence of a foramen, in the area being striated the whole length, in being more uniformly convex, and in the characters of the surface. There is little variation in the aspect, although the general contour differs somewhat. The ventral area varies from half a line to two lines wide, being almost linear in some specimens, and in others so wide as to give a low triangular form. In general the specimens from the corniferous limestone are smaller than those of the Hamilton group. I have seen none from the former rock more than one inch and a quarter wide; but many from the last mentioned formation with a breadth of one inch and a half.

Locality and Formation.—In most of the localities of the corniferous Limestone in Canada West. As yet, we have found none in the Hamilton group in Canada. My comparisons have been made altogether with specimens from the Hamilton shales of New York.

Collectors.—E. De Cew, J. De Cew, E. Billings.

STROPHOMENA PERPLANA.—(Conrad).

STROPHOMENA PERPLANA and *S. PLURISTRIATA.*—(Conrad). *Journal of the Academy of Natural Sciences of Philadelphia*. Vol. 8., p. 257-259. Pl. 14, fig. 11.

S. CRENISTRIA and *S. FRAGILIS.*—(Hall). *Tenth Annual Report of the Regents of the University of the State of New York*. P. 111-143.

Description.—Nearly flat; covered with fine, equal radiating striæ. Width on hinge line from one to two inches; length varying from a little more to one-fourth less than the width. In form, the shell is usually semioval—the front regularly rounded; sometimes the sides are suddenly constricted just beneath the cardinal angles; often the sides are nearly straight and parallel for half the length, then uniformly rounded to the fronts; some have the front rather straight, giving a subquadrate aspect. The ventral valve is slightly convex, most elevated at about one-fourth or one-third from the beak, flattened towards the hinge line, often with a few obscure irregular concentric wrinkles. Dorsal valve gently concave. Area of ventral valve about one line wide at the beak, slightly concave. Area of dorsal valve about half the width of the ventral—the two areas inclined towards each other at an angle of a 90° . Both areas striated. No foramen.

Surface covered with fine equal striæ— from six to nine in the

width of one line; these are crossed by fine concentric striæ eight to twelve in one line. The radiating striæ increase both by subdivision and intercalation of new ones between the old; they are often irregularly undulated, and the surface of the shell has thus a somewhat minutely uneven surface. In some specimens, however, this character is not apparent.

In the interior of the ventral valve the muscular impressions occupy a large sub-triangular depression in the substance of the shell. This is about a line wide at the hinge line, from which point the sides of the depressed space are nearly straight, and diverge outwards at an angle of about 45° to the median line of the shell. The depression gradually disappears, so that it is difficult to define its front margin. Still, in very well preserved specimens, it can be seen that the divaricators are of an elongate oval shape, and that they extend more than half the length of the shell; the oclusors are elongate oval, and situated close to the hinge line, their length one-third of that of the divaricators. These latter are sometimes divided into several lobes by thin, slightly elevated, longitudinal ridges. On each side of the muscular cavity, near the hinge, the shell is covered with small tubercles.

This species is so easily recognized by its flat form and evenly striated surface that a figure of it is unnecessary.

Although it has received a separate name for every formation in which it occurs, yet I cannot point out the slightest difference between the specimens of the Oriskany Corniferous and Hamilton rocks. I think, also, that *S. magnifica* of Hall is only a large variety of this species.

Locality and Formation.—Oriskany Sandstone, Corniferous Limestone, in County of Haldimand. Hamilton Shales, Township of Bosanquet.

Collectors.—E. De Cew, J. De Cew, E. Billings.

STROPHOMENA LEPIDA.—(Hall).

STROPHODONTA LEPIDA.—(Hall). *Geology of Iowa*. Vol. I., part 2, p. 493. Pl. 3, figs. 3a, 3b, 3c. 1858.

Compare *S. NACREA*.—(Hall). *Tenth Annual Report of the Regents of the New York University*, p. 144. Also, *S. LEPIS*.—(Bronn). *Lethæa geognostica*, 3rd edition. Vol. I., p. 367. Atlas. Pl. 2, figs. 7, a, b, c.

Description.—Shell small, smooth or scaly, no radiating striæ, about three-fourths of an inch wide, half an inch long, sub-semicir-

cular, or sub-quadrate, usually rounded in front, cardinal angles either rounded or auriculate. Ventral valve rather uniformly convex, cardinal angles compressed, rarely preserved, but when they are, a little reflected. Dorsal valve concave. Area of ventral valve half a line wide, lying in the plane of the lateral margin; when perfect, longitudinally striated, or nearly smooth; when a little worn, shewing obscure vertical striæ; edge of the area serrated. Area of dorsal valve half the width of the ventral, with a row of small tubercles on the outer edge, and a corresponding row of small pits on the inside. No foramen.

Internal surface of dorsal valve covered with small tubercles, usually about half a line apart; ocluser scars (in a specimen nine lines wide) situated one line from the hinge, each scar longitudinally divided by three elongated tubercles; one line below each scar there is a prominent oval tubercle; half way between these are two others on the median line. The divaricator processes are two short stout projections, with their extremities notched, and the upper side grooved. I have not seen the interior of the ventral valve.

This species is probably only a variety of *S. lepis*, Bronn, of the Devonian rocks of Europe. It is easily recognized by its surface, which is destitute of radiating striæ.

Locality and Formation.—Corniferous Limestone, County of Hal-dimand. Township of Bosanquet, in the Hamilton Shales.

Collectors.—E. De Cew, J. De Cew, J. Richardson.

STROPHOMENA AMPLA.—(Hall.)

STROPHOMENA AMPLA.—Hall. *Tenth Annual Report of the Regents of the University of the State of New York*, p. 112, 1857.

Compare *S. PUNCTULIFERA*.—Conrad, *S. HEADLEYANA*.—Hall, *S. CAVUMBONA*.—Hall, *S. LEAVENWORTHANA*.—Hall, and *S. GENICULATA*.—Hall, all in the 3rd Vol. of the *Palæontology of New York*.

Description.—Shell, large; from two to three inches wide on the hinge line; length from two-thirds to four-fifths the width; ventral valve concave, with a gentle convexity in the region of the umbo; often with a wide rounded mesial ridge, extending from the beak to the front margin. Dorsal valve convex, with a large, flat or gently concave space just in front of the beak; sometimes with a shallow rounded mesial sinus extending from beak to front. Area of ventral valve varying from one to three lines in width at the beak; varying

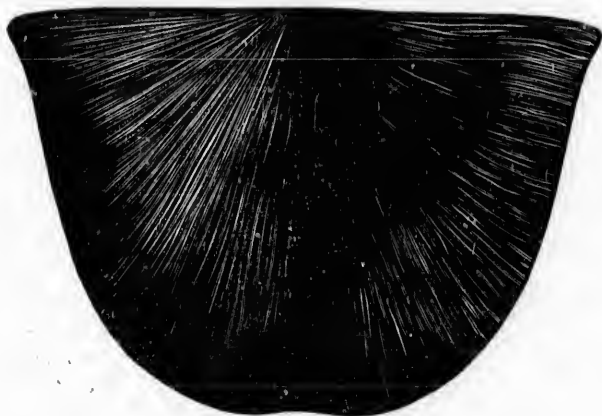


Fig. 119.

Fig. 119—*STROPHOMENA AMPLA*.—Hall. Dorsal Valve.

also in the amount of its inclination to the plane of the lateral margin from 90° to 120° ; obliquely striated for one-third or one-half the distance between the foramen and the cardinal angles. Area of dorsal valve smaller than the ventral, of nearly a uniform width throughout, usually about half a line wide. Foramen small, linear closed, one-third of a line in width. From the point where the striation is discontinued the edge of the area of the ventral valve has a distinct narrow groove extending to the cardinal angle.

Surface with moderately fine, somewhat equal, sharp, irregular striæ, which bifurcate several times before reaching the margin; the number also increasing by interstitial addition; crossed by small concentric striæ, which are usually more distinct in the spaces between the radiating striæ. The radiating ridges are sometimes of a uniform size all over the shell, six to eight in the width of two lines; in others larger near the beak than towards the margin, diminishing in size from three or four in two lines at the beak, to six or eight in the same width at the margin. The surface characters are very variable within a small limit, but the general aspect is that of a sharp or angular somewhat rugose striation. When the shell is partially exfoliated, it is seen to be perforated along the bottom of the grooves between the radiating ridges by small circular or oval pores, of which there are from two to seven in the length of one line. These are indicated on

the inner surface of the shell by irregular rows of small tubercles. It is probable that when perfect the surface is always covered with small spines, as seen in the following figure.

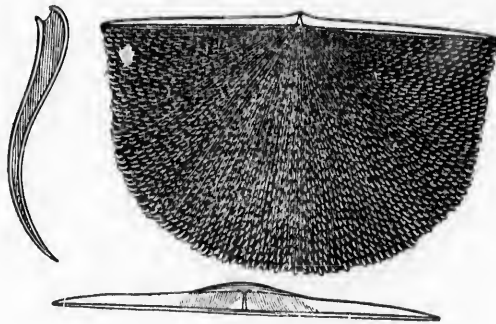


Fig. 120.

Fig. 120. *S. Ampla*.—Dorsal view of a specimen covered with spines, from the Corniferous Limestone. The lower figure shows the area and foramen; the left hand figure, the longitudinal section.

In the specimen above figured the spines are seated upon the crests of the radiating ridges. They are about two-thirds of a line in length, slightly curved, and appear to be tubular. They do not seem to have any connection with the pores of the shell, as these are situated, not on the radiating ridges, but in the grooves between them. In the interior of the ventral valve the muscular scars have very nearly the shape of those of *S. inaequistriata*, except that they are proportionally broader. The divaricators are divided into four or five longitudinal concave lobes by as many obscure ridges. At their anterior margins the shell is thickened so as to make a sort of elevated border. The rostral septum is, in some specimens, rudimentary, in others, well developed. The whole of the internal surface appears to be covered with small tubercles. These leave punctures in the cast of the interior.

I have only partly seen the interior of the dorsal valve. The divaricator processes resemble those of *S. demissa*.

Affinities and variations.—This species has in general a semicircular or broad semioval contour, but it sometimes approaches the triangular form from being narrowed towards the front. The form of the curvature of the valves is subject to innumerable modifications; the only constant curves being the general ones above stated. I think all the specimens in our collection from the Oriskany Sandstone, Corniferous

Limestone, and Hamilton Group, constitute but one species. The only variation that could be regarded as of specific importance are those of the area of the ventral valve above mentioned. In four of our specimens it forms a right angle to the plane of the lateral margin. In several others it forms an angle of about 120° , and taking these extremes it might well be thought that there are two species. But we have one fine specimen in which the angle is about 100° . I therefore think that this is not a variation of specific value.

In all the more general characters this species is precisely identical with *S. punctulifera*, (Conrad) and those allied therewith, which I have cited above from the 3rd vol. of the Pal. N. Y. The corniferous specimens are, upon an average, larger than those figured by Prof. Hall from the Lower Helderberg. This, however, of itself would not be of specific value. The only doubt I have as to the identity of this species with *S. punctulifera* rests upon the characters of the foramen of this latter. It is (at the time of writing this) not figured, but Prof. Hall thus describes it: "*Foramen nearly closed, with a narrow prominent callosity along the centre.*" In *S. cavumbona*, he says, "*Foramen small, narrow, closed by a callosity.*" In *S. Headleyana*, "*Foramen narrow, closed.*" In *S. Leavenworthana*, "*Foramen small, triangular, closed in full grown individuals.*" As there thus appears to be some difference, I strongly suspect that a series might be made out showing a gradation in the size of the aperture in all the above named species. In such poor specimens of the Lower Helderberg species as I have before me, the foramen cannot be observed at all. The surface characters and the form seems to me to be the same, and for the present it should be left an open question whether or not *S. ampla* is distinct from *S. punctulifera*.

Locality and Formation.—County of Haldimand, in the Oriskany Sandstone and Corniferous Limestone, Township of Bosanquet, in Hamilton Group.

Collectors.—A Murray, J. De Cew, E. De Cew, E. Billings.

STROPHOMENA MAGNIFICA.—(Hall).

This is a large, nearly flat species, three or four inches wide. It resembles *S. perplana*. Our specimens are all very imperfect. It occurs in the Oriskany Sandstone, County of Haldimand.

STROPHOMENA MAGNIVENTRA.—(Hall).

Of this species, I have only seen some fragments, shewing casts of the area of the ventral valve and muscular impressions. It appears to be closely allied to *S. magnifica*, and occurs in the rock in the same localities.

The specimens of these two species in our possession agree exactly with Professor Hall's figures. I am endeavouring to procure materials to illustrate them properly.

Genus CHONETES.—(Fischer).

This genus differs from *Strophomena* in some internal characters, which cannot be very well described without the aid of good illustrations. The shells are in general much smaller than those of *Strophomena*: they are more evenly striated, and the cardinal edge of the ventral valve usually displays a row of small slender spines, which become gradually longer towards the angles. The area and foramen are similar to those of *Strophomena*, as are also (very nearly) the muscular impressions and divaricator process of the dorsal valve. The valves articulate by teeth and sockets, and in one species (*C. hemispherica*) the area of the ventral valve is striated.

Between twenty-five and thirty species have been described as occurring in the Devonian rocks in the neighbouring States, and it is thus almost certain that the four or five which occur in Canada include no form that has not been named. At present, I can identify only one.

CHONETES HEMISPHERICA.—(Hall).

CHONETES HEMISPHERICA \times C. ARCUATA.—Hall. *Tenth Annual Report of the Regents of the University of New York*, p. 116-117.



Fig. 121.

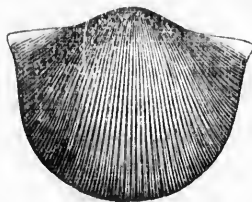


Fig. 122.



Fig. 123.

Fig. 121.—*Chonetes hemispherica*, drawn from the largest specimen seen. Fig. 122.—View of the ventral valve. A portion of the ventral area, shewing the striation and the bases of five species. Since this figure was engraved, other specimens have been procured, shewing seven and eight spines. Fig. 123.—Longitudinal section, shewing the curvature of the ventral valve. [The dotted line representing the dorsal valve; conjectural, the valve not having been seen.]

Description.—This species resembles in shape some of the forms of *S. inæquistriata*, but it can always be distinguished therefrom by the surface, which is covered with fine crowded, rounded or sub-angular striæ of an uniform size, from eight to ten in the width of one-fifth of an inch, presenting that even aspect peculiar to the genus *chonetes*, and rarely exhibited by species of *Strophomena*.

The ventral valve is usually extremely convex, most prominent in the upper half; the umbo large—obtusely rounded, overhanging the hinge line; the cardinal angles compressed, reflected, forming short projecting sears; on the cardinal edge from five to eight small spines, rarely preserved, their bases only being visible. Area of ventral valve, in old specimens, owing to the extreme incurvation of the cardinal portion of the shell, inverted or brought under the body of the shell at right angles to the plane of the margin; in young specimens not so much inverted; its width about half a line, or a little more; obliquely striated, the striæ most distinct at the hinge line. Area of dorsal valve, very narrow—almost linear, the inner edge with a row of small pits for the reception of the serrated teeth of the opposite valve.

The width of this species is usually about one-inch on the hinge-line but it sometimes attains the size of one-inch and a half. Length equal to, or one-third less than the length.

The dorsal valve is seldom found, although the ventral valve is somewhat common. Of the former I have seen only two fragments, consisting of the hinge-line and a portion of the shell. One of these was in its natural connection with the ventral valve, and being silicified came away on immersion in acid; the divaricator processes are united at the base and separated above by a narrow fissure; they are grooved on the outside, the grooves converging towards the hinge-line so that when viewed from the side of the area they have the appearance of four small radiating ridges.

The muscular impressions and foramen have not been observed by me. The triangular opening in the area represented by Fig. 121, may be the foramen, but it seems to me to be a fracture.

Prof. Hall describes two species differing from each other in the size of the striæ; in *C. arcuata*, "sixteen occupying the space of one-fifth of an inch, while only one-half that number can be counted in the same space on *C. hemispherica*." (10th Regents, Rep., p. 117). Our specimens agree with the latter.

Locality and formation.—Oriskany Sandstone and Corniferous Limestone, County of Haldimand.

Collectors.—A. Murray; E. Billings; E. De Cew and J. De Cew.

Other Species of CHONETES and PRODUCTA.



Fig. 124.

Fig. 125.

Fig. 124.—Two species of *Chonetes* undetermined.

125.—*Producta*. A small undetermined species. *a.*—Side view. *b.*—View of ventral valve.

Besides *CHONETES HEMISPHERICA* there are three or four other small species of the genus in the Corniferous Limestone and Hamilton Group in Canada West, but in the present condition of the literature of American Palæontology I cannot determine them. The student is referred to N. Y. Regents' Reports. Fig. 124 represents two species, one with the spines directed obliquely outwards and in the other erect. They are both from the Hamilton Group.

In the Corniferous Limestone we have also two small species of *Producta*. One of these (Fig. 125) is covered with nodular radiating ribs. The other is about the same size as the above but with a smooth tubercular surface.

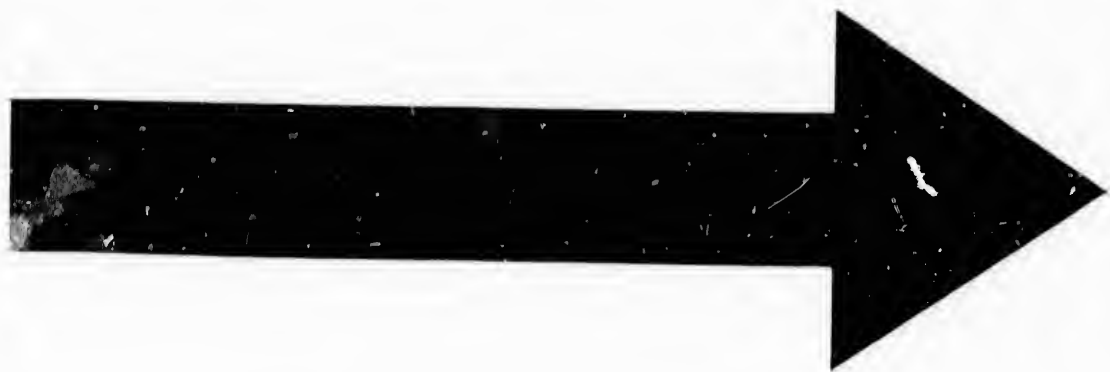
Genus LEPTOCCELIA? Hall.

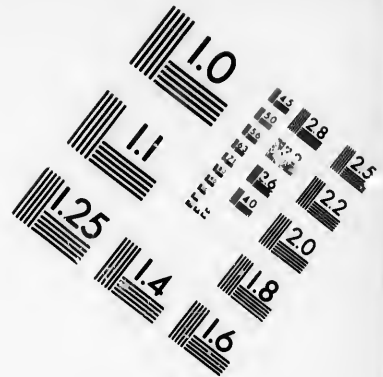
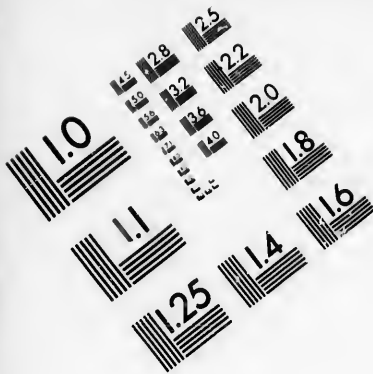
This genus as described by Professor Hall in the 12th Annual Report of the Regents, published in October or November 1859, seems to differ from *Centronella* only in consisting of species which have the surface ribbed instead of smooth. Professor Hall dates his genus back to 1856, but no description was published until the issue of the 12th Regents' Report and therefore should it be the same as *Centronella* it cannot be retained, as the latter has the priority. For the present I shall use it provisionally, not having seen the internal structure myself.

LEPTOCCELIA? FLABELLITES. (Conrad.)

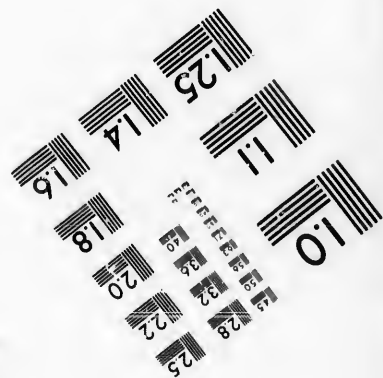
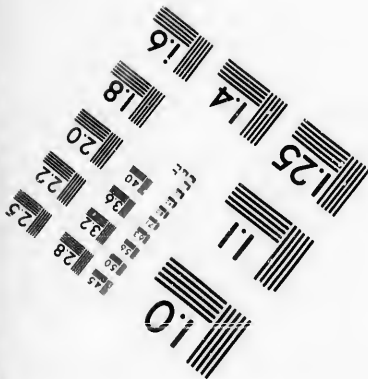
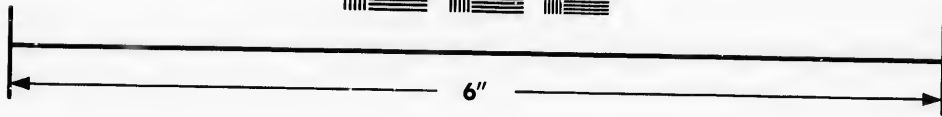
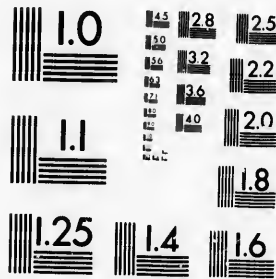
ATYRPA FLABELLITES. (Conrad.) Annual Report on the Palæontology of New York for 1841, p. 55.

LEPTOCCELIA PROPRIA + L. FIMBRIATA + L. DICROTOMA.—Hall, in various works.





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Fig. 126.

Fig. 126.—*Leptocælia flabellites*.—Dorsal and side views.

Description.—Shell semi-elliptical, or sub-circular, or transversely oval. Dorsal valve nearly flat, with from ten to fourteen rounded or sub-angular ribs, one or two of which, in the middle, are usually separated from those on each side by grooves deeper and wider than the others and sometimes depressed so as to give the appearance of a mesial sinus; hinge-line either nearly straight or with the portions on each side of the beak forming an obtuse angle seldom so acute as 150° . Ventral valve moderately convex, often carinate along the middle, beak small, pointed, incurved down to the dorsal area; ribbed like the opposite valve.

Width from six to ten lines. Length a little less than the width.

Locality and Formation.—Oriskany Sandstone and Corniferous Limestone, County of Haldmand, Canada West, also in prodigious numbers in the Oriskany Sandstone at Gaspé, Canada East.

Collectors.—A. Murray; E. Billings; E. De Cew; J. De Cew, in Canada West. Sir W. E. Logan; J. Richardson; R. Bell, Gaspé.

LEPTOCÆLIA CONCAVA. Hall.



Fig. 127.

Fig. 127.—*Leptocælia concava*. Ventral, dorsal and side views.

Description.—Ovate or nearly circular; length three or four lines; width equal to, or a little less than the length. Ventral valve convex sub-carinate along the middle. Dorsal valve flat or often concave. Surface with from ten to fourteen rounded radiating ribs.

This species closely resembles the *L. flabellites* but is never more than half the length or width. On comparison with specimens of *L. concava* from the Lower Helderberg of New York, I find so little difference that I do not see how those of the Corniferous Limestone are to be separated. In several the dorsal valve is not so deeply concave as it is in those from the lower rock, but in others it is. The

ribs are also in general coarser, but occasionally specimens with fine bifurcating ridges are found exactly like those from the shaly limestone of the Helderberg mountains.

Locality and Formation.—Oriskany Sandstone and Corniferous Limestone, County of Haldimand.

Collectors.—E. Billings; E. De Cew; J. De Cew.

LAMELLIBRANCHIATA.—(Blainville.)

In the Oriskany Sandstone, Corniferous Limestone, and Hamilton Group of Canada West, we find about twenty species of lamellibranchiate mollusca, mostly in a bad state of preservation. These with several exceptions must remain for future examination. I shall only notice the following at present:

Genus CYRTODONTA.—(Billings,) 1858.

CYPRICARDITES.—Conrad. *Annual Report on the Paleontology of New York*, 1841, p. 51.

MEGALOMUS.—Hall. *Pal. N. Y. Vol. 2*, p. 243. 1852. *Not characterized.*

CYRTODONTA.—Billings. *Report of the Geological Survey of Canada*, 1858, p. 179. Sub-genus VANUXEMIA, p. 189.

PALEARCA + MEGAMBONIA.—Hall. *Twelfth Annual Report of the Regents of the University of New York*, 1859, p. 10-13. Also CYPRICARDINIA?—Hall. *Pal. N. Y. Vol. 3*, p. 266. *Not characterized.* In part. Also PALEARCA and MEGAMBONIA in same work. 1861.

Generic characters.—Equivalve, inequilateral; umbones near the anterior end; general form obliquely tumid, transversely sub-rhomboidal, ovate or sub-cordiform; posterior extremity larger than the anterior, which latter is often reduced to a small auriculate projection in front of the umbones; two muscular impressions, of which the posterior is superficial, and the anterior sometimes deeply excavated; several linear anterior teeth crossing the hinge plate, backwards and obliquely downwards, usually curved and in some species striated, situated either beneath or a little in front of the umbones; posterior teeth situated at or near the extremity of the hinge line, usually from two to five, elongate; pallial line simple; some of the species with a narrow area between or behind the beaks.

History of the Genus.

The somewhat numerous species which belong to this genus, have been variously distributed and shifted about among the genera *Ambonychia*, *Cardiomorpha*, *Edmondia*, *Modiola*, *Modiolopsis*, *Megambonia*, *Palæarea*, *Cypricardinia*, *Megalomus*, and *Cypricardites* in a very remarkable manner. Conrad, the first Palæontologist of the New York Survey, placed all the species, (twenty-three in number) described by him in a single genus, and I think that the many changes made by his successor in office, have not been productive of any improvement on that simple arrangement. The following are a few of the facts :

In the fifth Annual Report on the Palæontology of New York, Conrad, in 1841, characterized his genus *Cypricardites* and described sixteen species from the Silurian and Devonian rocks of the State. He did not give any illustrations, but it now appears that he prepared a figure, (shewing the characters of the hinge,) which, however, remained in Professor Hall's hands eighteen years without publication. In the 8th volume of the Journal of the Academy of Natural Sciences, Conrad described seven other species from the Devonian rocks of New York. These are all figured.

In 1847, Professor Hall suppressed the genus *Cypricardites* and substituted his own genus *Modiolopsis*, in which he placed all Conrad's Lower Silurian species. The following are his remarks in a note at the foot of p. 157, Vol. 1. Pal. N. Y.

"I find myself compelled to abandon the use of the name *Cypricardites*, as applied to shells differing so widely as these do from *CYPRICARDIA*, and belonging apparently to the *MONOMYARIA* and *DIMYANIA*. So far as it is possible to ascertain, none of the species of the older strata possess two muscular impressions, and therefore do not strictly fall under the genus *Cypricardites* of CONRAD, (Ann. Geol. Report, 1841, p. 51.)"

The principle upon which the above decision was given, is perfectly correct. It is one of the established laws of nomenclature that a name which involves a zoological error (such as referring a genus to the wrong place in the system of classification) should be excluded. The reasons given by Professor Hall for bringing *Cypricardites* within the operation of this law are not so well founded, because both *Modiolopsis* and *Cypricardites* have two muscular impressions. The correct reason is that the name implies a close relationship to the recent genus *Cypricardia*, which belong to the family *CYPRINIDÆ*

while the species in question constitute a group in the family *Arcadae*. No Conchologist would think of admitting such a name as *Cypricardites* among the *ARCADEA*.*

In 1858, I published the genus *Cyrtodonta* and its sub-genus *Vanuxemia*, and illustrated them fully by figures shewing the internal characters of several species. (See my Report for 1858.) About the same time Professor Hall described the same genus under the names of *Palaearca* and *Megambonia* the latter being identical with my sub-genus *Vanuxemia*. His descriptions were (as he says) printed in 1858, in the 3rd volume of the *Palæontology of New York*. At the foot of page 270 of that work the reader will find a note on the genus *Cypricardites* which shews very clearly that at the time the author had his new genera under consideration, Conrad's genus was also receiving some attention as it had on several previous occasions. When my Report was published, Professor Hall seeing that his genus *Palaearca* was too late, resolved if possible to revive *Cypricardites* for the purpose of suppressing *Cyrtodonta*. He therefore issued a small pamphlet of 18 pages, (being part of the 12th Ann. Rep. of the N. Y. Regents, in which he gives his descriptions, and in addition thereto a note pointing out the identity of *Cypricardites* and containing Conrad's figure. This probably appeared in May or June 1859, as it is noticed in the July No. of *Silliman's Journal* of that year. In 1860, the 3rd Vol. of the *Pal. N. Y.*, was published, but without the plates. On page 523 of that work, I find the following statement :

"At the time that my examinations and descriptions of *PALÆARCA* were made (in 1857,) I had overlooked the genus *CYPRICARDITES* of Conrad, which was published in the Annual Geological Report for 1841. The description and figure correspond so nearly with the fossils which I have described that I feel compelled to adopt the prior name, which will include those described in this volume under the genus *PALÆARCA*, as well as those described by MR. BILLINGS under the genera *CYRTODON* and *VANUXEMIA*." (Compare the above with the note at the foot of page 270, *Pal. N. Y.*, vol. 3).

As for myself, I must say that when I described the genus *Cyrtodonta*, I was aware of Conrad's description, but considered, as I do now, that the genus (having been suppressed by Professor Hall, and never acknowledged by palæontologists, or quoted by them except as

* See DANA in *Silliman's Journal*, 2nd Series, Vol. 28, p. 149. 1859.

a synonymi) was perfectly obsolete. And as the name is decidedly inappropriate, I hold that it cannot be restored now.

I shall, in conclusion, direct attention to the uncharacterized genus, *Megalomus*. This name was proposed by Professor Hall in the 3rd volume of the *Pal.*, N. Y., as a generic appellation for a species which is a true *Cyrtodonta*. I have ascertained that it has the same curved anterior teeth, and although I have not seen the posterior teeth, there is not the least doubt but that they do exist. Now, it might be thought that *Megalomus*, having priority over *Cyrtodonta*, should take its place. I contend that this would not be the correct or the just course. In Professor Hall's description he has "overlooked" the generic characters, and only given those which are specific. All that he has described is not sufficient to constitute a genus. The best proof of this is, that the author cannot recognize it himself, as he has since described two other genera, *Palæarca* and *Megambonia*, which, if retained, would include *Megalomus*. I have been the first to describe correctly and illustrate this genus under a name that is in no respect inappropriate, and I have a right to retain that name against those which are objectionable or not founded on an intelligible generic description. I further consider *Megalomus* an inconvenient name, because it so closely resembles *Megaloma*, a genus of Gasteropods.

Sub-genus VANUXEMIA.

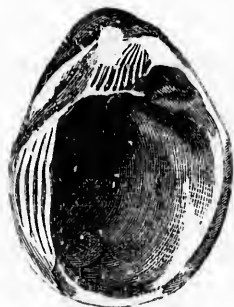


Fig 128.

Fig. 128. — *Vanuxemia Bayfieldii*—Billings, shewing the interior of left valv.

This sub-genus was proposed by me, to include those species of *Cyrtodonta* which have the beaks terminal, or nearly so, and the

anterior extremity reduced to a small auriculate expansion or obsolete. The above figure shews the teeth and muscular impressions of *V. Bayfieldii*, Hudson River Group.

VANUXEMIA TOMKINSI.—(N. Sp.).

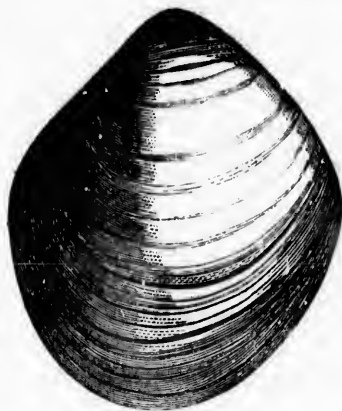


Fig. 129.

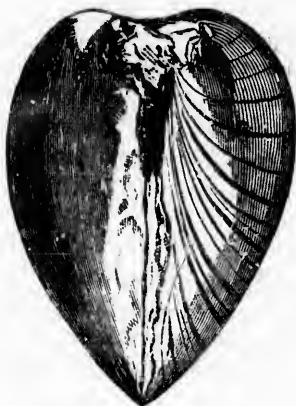


Fig. 130.

Fig. 129.—*Vanuxemia Tomkinsi*.—View of right side.

Fig. 130.—View of anterior side.

Description.—Ovate, exceedingly gibbous, cordiform; umbones very prominent; beaks closely incurved.

Placing the shell with the hinge-line in a horizontal position, we find that the line passing through the greatest length of the shell forms an angle with it (*i.e.* with the hinge-line) of about 45° ; the apical angle, or the angle formed by the slope in both directions from the umbones is about 80° ; both of these slopes extend about half the length of the whole shell; from their extremities the remainder of the margin on the posterior, ventral and anterior sides is rounded, somewhat pointed in the middle. At the anterior extremity of the hinge-line there appears to be a small auriculate projection, but this point is not very well preserved in the specimen.

Surface somewhat smooth, with obscure, concentric striae, three or four in the width of one line. Besides these there are some obscure, shallow, concentric, undulations of growth.

The best preserved specimen is two inches and one-eighth in length—measuring from the umbones to the most projecting or pointed part

of the margin below. The greatest width (which is at mid-length, and nearly at right angles to the greatest length) is one inch and three quarters. Depth of both valves, at a little above the middle, one inch and a half. The umbones are elevated nearly half an inch above the hinge-line. The whole shell is pretty evenly convex, with a slight approach to a concave slope in front of the umbones. There appears to be an area, but our specimens do not shew it with sufficient clearness to warrant a positive opinion.

This species is dedicated to the discoverer, W. G. Tomkins, Esq., C. E. St. Mary's, Canada West.

Locality and Formation.—Corniferous Limestone, St. Mary's.

Collector.—W. G. Tomkins.

GASTEROPODA.—(Cuvier.)

We have in the Devonian Rocks of Canada West about 25 species of Gasteropoda of the genera *Euomphalus*, *Straparollus*, *Murchisonia*, *Pleurotomaria*, *Lozonema*, *Macrocheilus*, *Platystoma* and *Platyceras*. Of these I shall only notice the following at present.

EUOMPHALUS DE CEWI.—N. Sp.

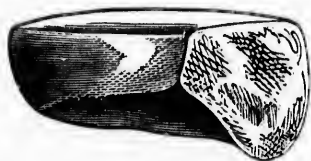


Fig. 131.

Fig. 131.—*Euomphalus De Cewi*.—A small specimen.

Fig. 132.—View of the umbilicus.



Fig. 132.

Description.—Shell from two to four inches in diameter; whorls about three. Spire nearly flat or gently concave; umbilicus deeply concave. The upper side of the whorls is nearly flat, with an angular edge all round the margin, (in casts narrowly rounded). The outside of the whorls nearly at right angles to the upper, but inclining a little inwards and gently convex. On the lower side there is a narrow rounded edge all round, from which there is a nearly uniform concave slope into the deep sub-hemispherical umbilicus.

The surface is marked with large slightly elevated lines of growth four or five in one line which on the upper side of the whorl curve backwards to the outer margin, and, then crossing the marginal edge curve forward for half the depth of the whorl on the outside, then backwards to the edge of the umbilicus within which they are not preserved in any specimen that I have seen. The aperture has the upper outer and inner sides nearly straight and at right angles to each other. The lower side is narrowly convex at the outer angle and then concave conforming to the curve of the umbilicus. In a nearly perfect specimen three inches across, the upper-side of the last whorl is full an inch wide at the aperture and the outer-side an inch and a half.

In general the spire is flat or gently concave but in some of the casts the two inner whorls are a little elevated above the plane of the outer one.

This fine species is closely allied to *Euomphalus trigonalis*.—(Goldfuss) of the Devonian rocks of Germany, but it is flatter above, and, according to Goldfuss' figures, the surface of that species is finely cancellated.

Dedicated to the discoverer Mr. J. De Cew, of Cayuga, C. W.

Locality and Formation.—County of Haldinand, Corniferous Limestone.

Collector.—J. De Cew.

STRAPAROLLUS? CANADENSIS.—(N. Sp.)

Description.—This species consists of a simple, cylindrical, slender, gradually tapering tube, coiled up so as to make a nearly flat disc about two inches and a half across. A transverse section of the tube is very nearly circular, which must also be the form of the aperture. The spire is nearly flat or gently concave. The umbilicus is widely but not very deeply concave. There are about four whorls. In specimens two inches and a half wide the diameter of the aperture is from seven to nine lines. The surface markings are not preserved in the specimens that I have seen. In one there are several concave transverse septa and it may be that this is a Cephalopod of the genus *Trochoceras* and not a Gasteropod. As however species of *Straparollus* are occasionally septate I shall place it in that genus provisionally.

This species is closely allied to *Euomphalus planorbis*, (Archiac and Verneuil) of the Devonian Rocks of Germany but has fewer whorls.

Locality and Formation.—County of Haldimand. Corniferous Limestone.

Collectors.—J. De Cew ; E. De Cew.

LOXONEMA COTTERANA.—(N. Sp.)

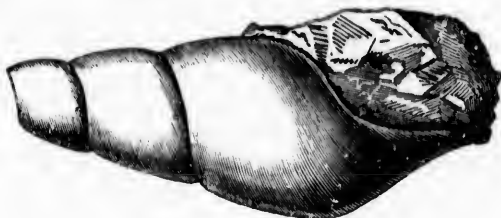


Fig. 133.

Fig. 133.—*Loxonema Cotterana*.

Description.—Elongate, fusiform, acute, apical angle, between 25° and 30° ; whorls four to six; very depressed convex; body whorl large, occupying full one-half the whole length of the shell, descending with a uniform convexity into the aperture; aperture elongate ovate, effuse below, columellar lip extending about three-fourths of an inch below the body of the whorl. The suture in the cast deeply excavated, but narrow, the fissure descending into the fossil obliquely downward, the whorl below presenting a sharp edge over it, and the one above, an obtusely convex slope into it; this is the appearance presented when the suture is completely cleared of the shell. Surface unknown.

Length, three inches. Length of last whorl measured on a line passing longitudinally along the inner lip, one inch and a half; diameter of last whorl, one inch.

Dedicated to the discoverer, Miss Catherine Cotter, daughter of Col. G. S. Cotter, of the Township of Dunn.

Locality and Formation.—Lake Shore, Township of Dunn. Corniferous Limestone.

Collector.—Miss Catherine Cotter.

CEPHALOPODA.—(Cuvier).

In this class I estimate that there are twenty-five species of the genera *Orthoceras*, *Cyrtoceras*, *Phragmoceras*, *Nautilus*, and *Goniatites*.

CYRTOCERAS AMMON.—(N. Sp.)

Description.—Six to eight inches in length; section nearly circular; rather abruptly curved; a specimen, six inches in length, forming a half whorl, which would lie in a circle of four inches in diameter; the apical three inches, curved with a radius of about one inch and a half, more gently curved towards the aperture. Tube tapering from a diameter of fifteen lines at the larger extremity, to six lines at the smaller, in a length of six inches.

The shell of this specimen is beautifully ornamented by strongly elevated, encircling, waved ridges, of which there are forty-seven in the length of five inches and a half; these are distant from each other about three lines at the larger extremity, becoming gradually more and more approximated towards the smaller end—where the last two are scarcely a line distant. In their course round the shell, the ridges are undulated by short, zig-zag curves, from half a line to two lines wide, and one line, or a little less, in depth. In crossing the median line of the ventral aspect, they make a deep curve towards the apex, two lines deep near the aperture, and one line and a half wide, becoming gradually less as the diameter of the shell decreases. The ridges project abruptly from the surface of the shell to a height of half a line, the intervening spaces are flat, and nearly smooth, with apparently obscure, concentric striæ.

The deep flexures of the encircling ridges along the dorsal aspect seem to shew that the siphuncle was situated close to the margin on that side. The septa have not been observed. The aperture is not preserved in the specimen, but it is most probably circular.

The above description is founded upon a single specimen, which is nearly perfect, and has the shell preserved—but silicified.

Locality and Formation.—Township of Rainham, Corniferous Limestone.

Collector.—E. De Cew.

CYRTOCERAS BELUS.—(N. Sp.)

Description.—Six to eight inches long; curved so as to make about half of a whorl, of which the diameter would be about six inches. In a specimen seven inches long, measuring along the ventral aspect, the curve corresponds very nearly to that of a circle with a radius of three inches, and the remainder to one with a radius of about two inches. The cross section of the tube is transversely oval; the great-

est thickness, from side to side; the least, from the ventral to the dorsal aspect; the diameters having a proportion to each other of about ten or eleven to fifteen. The sides are narrowly rounded; the dorsal aspect uniformly depressed convex; the ventral aspect more strongly convex than the dorsal, and most prominent along the median line. In the east of the interior there is close to the aperture a broad, shallow constriction, showing either that the shell is thickened on the inside at this point, or that the aperture is smaller than the greatest size of the tube. There is also an appearance which leads me to suspect that the aperture is obscurely trilobed. In the specimen above mentioned, the chamber of habitation is one inch and a half in depth. The first four septa occupy one inch in length of the tube, and the others become nearer to each other as they approach the apex. The siphuncle is about two lines in thickness and close to the margin, but not in contact therewith, there being in one specimen half a line and in another about a line between it and the shell. The latter appears to thin with obscure encircling striae.

A specimen seven inches in length has a dorso ventral diameter of sixteen lines, at about one inch from the aperture; and it tapers to six lines at seven inches. The remainder to the apex is broken off and not preserved. The lateral diameter of this specimen cannot be ascertained, as it is partly imbedded in the stone. But in another, (a fragment) the diameters are, at the large end, 12 lines to 16 lines, and at two inches nearer the apex 7 to 11 lines.

There appears to be some variation in this species with regard to the distance of the septa. In one specimen the first two next the outer chamber are only two lines distant, and in another which appears to belong to this species there are six septa in one inch at three inches from the aperture:

Locality and Formation.—Corniferous Limestone, County of Haldimand.

Collectors.—E. DeCew, J. DeCew.

CRUSTACEA.

The Trilobites that have been determined are *Calymene Blumenbachii*, *Phacops bufo*, *Dalmanites calliteles*, and *Phillipsia? crassimarginata*. Besides these, there are five other species belonging to the genera *Lichas*, *Dalmanites*, and *Phillipsia*,—in all nine species. There are also two species of *Leperditia*.

PISCES.

There appear to be three or four species of fish in the Oriskany Sandstone and Corniferous Limestone, one or two of them covered with plates resembling those of an *Asterolepis*. Dr. Newbury informs me that one of them is his *Agassizichthys Sullivanti*.

SUMMARY.

The following is a statement of the number of species in the Devonian Rocks of Canada West according to my estimation of the specimens in the Museum of the Survey:

	<i>Determined.</i>	<i>Undetermined.</i>
Zoophyta.....	54	10
Crinoidea.....	0	10
Bryozoa.....	0	13
Brachiopoda.....	47	0
Lamellibranchiata.....	2	18
Gasteropoda.....	4	21
Cephalopoda.....	2	23
Crustacea.....	4	5
Pisces.....	1	3
	<hr/>	<hr/>
	114	113

Nearly all of the species above given as determined will be found noticed in the several papers published in this Journal. Among those undetermined there must be a great many identical with those described in the publications of American Geologists. I shall endeavour to give some account of them in a few months.

