under side of the lamellæ; their centers are from 6 to 8 mm. apart, and their branches divide repeatedly.

In vertical section, the structure is seen to comprise strong vertical pillars, which average about .3 mm. in thickness, and are separated by from .3 to .5 mm. intervals. Horizontal laminæ crowded, from 5 to 6 to a millimeter. At subequal intervals of from .8 to 1 mm. the interlaminar space is of about twice the normal width. Very fine vertical pillars are occasionally discoverable between the larger radial pillars.

In tangential sections the horizontal laminæ are seen to consist of an exceedingly dense tissue, the open spaces, except in the astrorhizae being very fine and distant. No indication of the radial pillars is seen in tangential section.

This species comes nearest to *C. ristigouchense* Spencer, of the Siluric of Canada (Bull. University State Missouri, p. 49, pl. VI, figs. 12, 12a, 1884), from which it differs chiefly in its denser tissue and the strongly pustulose surface, no such structure having been reported for that species. The radial pillars of that species are also somewhat broader, and the horizontal laminæ are wider apart.

This species is most readily distinguished from *S. galtense* with which it is associated, by the strong pustulose character of the surface.

Horizon and localities.—This species occurs in large masses and in fragments in the coral reef of the Anderdon horizon, below the Dundee, in the Anderdon quarry near Amherstburg, Ontario.

Genus STYLODICTYON Nicholson.

5. STYLODICTYON SHERZERI sp. nov.

(Plate VI, Figs. 4-5.)

Coenosteum typically in the form of a Vienna loaf separating into latilaminæ, each of which, like the external surface, is marked by a closely crowded series of circular pustules. The center of the top of the pustule has the appearance of being the opening of a tube. The pustules are unequally spaced and about their own diameter apart, closer or sometimes wider apart. Their diameter varies from 1 to 1.5 mm. in different parts of the coenosteum, the larger ones being mostly on the outer strata. Between the pustules the surface is finely granulose.

In vertical section the tissue is dense, and traversed by a series

of very dense vertical pillars or rods. These end upwards in the pustules, which are their superficial continuation. The laminæ are arched downward between the rods, their edges appearing to bend sharply upon the rods in the manner of a rope suspended loosely from a series of equally spaced poles. According to the direction of the section, the rods appear from 1 to 2 mm. apart. In tangential section the ends of the pillars form centers around which the cut edges of the laminæ make concentric exposures.

The only other known species of this genus are *S. columnare* Nicholson, from the Devonic limestones (Columbus) of Kelly's island, Lake Erie, and *S. wortheni* Rominger, from the Traverse group of Michigan. These two species are probably identical, as generally held. There may, however, be an additional species in the Lower Traverse. All the species so far recognized are Devonic, and all are large, massive or hemispheric or subglobular forms. The peculiar elongate form of the present species is its most striking characteristic, as are also the closely crowded pustules with their median depressions. In the type species of the genus (*Stylodictyon columnare,* Nich.), the pustules are more rounded, less closely crowded and more irregularly spaced, and altogether less pronounced than in the present species. The course of the vertical pillar is also readily seen on the broken surfaces, but this may be due to the method of fossilization.

In vertical section the pillars are seen to be thicker and more widely separated in *S. columnare* than in *S. sherzeri,* being on the average from 2 to over 3 mm. from center to center. The arched laminæ and the connecting vertical elements are also more distinct in the Devonic species.

On the whole it must be said that the Siluric species differ only in minor characters from the Devonic species. Yet the difference between Siluric and Devonic species of other Stromatoporoids is often not very great. In the present case, however, the external characters seem to make the distinction comparatively easy.

Horizon and Locality.—Anderdon limestone. Represented by a number of fragments in the collection from the coral bed of the salt shaft. It has so far not been found in the other sections.

I take pleasure in naming this species after Prof. W. H. Sherzer of Ypsilanti, Michigan, whose study of the Monroe formation of Michigan has helped to elucidate the puzzling problems of Siluric

stratigraphy, and through whose kindness the material of the coral bed was brought to my attention.

Genus IDIOSTROMA Winchell.

6. IDIOSTROMA NATTRESSI sp. nov.

(Plate IX, Figs. 5, 6 and 7.)

Small, sub-cylindrical, more or less irregularly curving branches, varying in diameter from 2 to 3 mm. in the smaller specimens, 4 to 5 mm. in the larger. Branching frequent and irregular. Surface of stems generally without markings of any kind, except those due to the porosity of the tissue. In some cases a faint grooving of the surface is seen, this being most distinct around the knob-like elevations, or incipient branches found on some specimens. In section the vertical pillars are seen to occupy a radial position. The tissue is dense on the whole, though large, open lacunæ appear at intervals in the section.

This is the only known Siluric species of this branching genus of Stromatoporoid. A number of species from Devonic rocks of America (Hamilton) and Europe are known. The species is not unlike *I. cylindrica* Grabau mss., from the upper Traverse rocks of the Alpena region, but that species is a more frequently branching one, and varies in size from 3 mm. upward. Owing to the poor preservation of the specimens, details of structure are not determinable.

Horizon and Localities.—Common in the coral reef portion of the Anderdon bed in the Anderdon quarry. It generally covers weathered surfaces of other Stromatoporoids, or occurs independently. It is likewise common in the same formation in the salt shaft, occurring in the more shaly beds, often more or less compressed. Silicified specimens largely composed of the species (apparently) occur in the Amherstburg bed in the Detroit river cut.

The dense character of the tissue causes this species to resemble *Amphipora ramosa* of the Devonic of Europe, but the growth and branching of our species are too irregular. In good sections the radial pillars are seen to be distinct.

ANTHOZOA.

HELENTEROPHYLLUM. gen. nov.

General form and proportions those of Enterolasma of which it is a derivative. Calyx deep, septa of uniform thickness, carinated by strong transverse carinæ as in Heliophyllum. Genotype *H. caliculoides.*

The species for which this genus is made would ordinarily be classed as a Heliophyllum, since it has the most characteristic structural feature of that genus, the carinæ. That there is no genetic relation whatever between this and the mid-Devonic *Heliophyllum halli,* is beyond doubt. The present genus is a successor of the Niagaran Enterolasma, the two constituting a lateral branch from the main line of evolution of the Streptelasmoid corals. There is no objection to uniting the type species generically with Enterolasma except that in such case the diagnosis of that genus must be altered.

7. HELENTEROPHYLLUM CALICULOIDES. sp. nov.

(Plate XI, Figs. 2-3.)

Externally in all respects like *Enterolasma calicula* of the Niagara, from which it differs, apparently, only in the carination of the septa. General form, a slightly compressed, gently curving cone, the cross section approaching very closely to a circle. Calyx deep, with sides sloping from the sharp margin to the base of the calyx. Septa about 50, radially arranged, but showing the primitive pinnate character with reference to the cardinal and alar septa, by the costal grooves of the exterior. Carinæ prominent, about 5 to 2 mm. Epitheca thin, concentrically wrinkled, and showing faint growth lines.

Measurements: Diameter of calyx at a length of 10 mm. = 10 mm. by 9.5 mm.

This species resembles in all respects, except the carination of the septa, the Niagaran *Enterolasma calcicula,* from which it is clearly a direct derivative. Externally the two cannot be told apart,—the number of septa is the same in each, the prominence and pinnate arrangement of the costal grooves and the general form and curvature correspond. This species probably represents a terminal member of a lateral branch of the Streptelasmoid genea-

logical tree. The relationship to other species may be expressed as follows:

Siluric.	Upper (Monroan) *Helenterophyllum caliculoides.* Middle (Salinan). Lower (Niagaran) *Enterolasma calicula.*
Ordovic.	Upper (Cincinnatian) *Streptelasma rusticum.* Upper (Trenton) *Streptelasma corniculum.* Lower and Middle *Streptelasma profundum.*

Horizon and Locality.—In the Anderdon coral reef at the Anderdon quarry near Amherstburg, Ont. Several specimens. Also in the Manlius limestone of Manlius, N. Y. (Coll. Columbia University.)

8. CYATHOPHYLLUM THOROLDENSE Lambe.

(Plate XII, Fig. 16.)

1901. *Cyathophyllum thoroldense* Lambe, Contrib. Can. Pal. IV, Pt. II, p. 147, plate XI, fig. 5 a-b.

Conico-cylindrical, or slightly curved, gradually enlarging toward the calicular end. Surface covered with a strongly wrinkled epitheca, showing numerous slight constrictions and swellings. Costal grooves marked. Calyx deep. Septa numerous, alternating long and short, 28 or more reaching the center, where they are somewhat intertwisted. Shorter septa reaching one-third the way to the center occur between these. Still shorter ones only reach part way down the calyx. Dissepiments numerous in the outer zone, less crowded towards the center. They often unite in a cystose manner, and are strongly oblique at the margins where they bend downward.

The specimens here described agree in all essentials with the Siluric species from Thorold, Ont., except that the carination of the septa, described by Lambe, is not recognizable in the cross sections of the specimens. In a fragment of a deep calyx, apparently belonging with these specimens, faint carination is visible on the margins of the septa. If these are more than calicinal, the species should rather be referred to the genus Heliophyllum, or to some other genus.

A specimen externally similar to the present one, but with the septa not preserved, is figured by Weller from the Decker Ferry formation of New York. (Pal. N. Y. III, pl. 17, fig. 10.)

Horizon and localities.—In the coral layer (Anderdon limestone) of the Upper Monroe of the salt shaft, Detroit, Michigan. Rather rare. A specimen, apparently of this species, was obtained from the Anderdon limestone of the Anderdon quarry, Amherstburg, Ont. It was originally described from the Niagaran of Ontario.

9. CYATHOPHYLLUM HYDRAULICUM Simpson.

(Plate XXI, Fig. 1a-d.)

1900. *Cyathophyllum hydraulicum.* Simpson Mss.
(Mss.) Memoir of the New York State Museum. "The Genera of Palæozoic Corals."
1900. *Cyathophyllum hydraulicum.* Grabau, Bull. Geol. Soc. Am., Vol. II, p. 364, pl. 21, fig. 1a-d.

"Corallum simple, conico-cylindrical, usually long and slender. Growth irregular, with numerous abrupt changes in direction. Surface of the mature portion longitudinally ribbed by numerous rounded costal ridges, which are strongly marked and separated from each other by a sharply depressed line. Epitheca well developed, the numerous lines of growth strongly marked on the surface of the costæ. The epitheca is thrown into frequent coarse wrinkles which give the coral a very rugose appearance.

"The young corallum is usually destitute of costæ, and is subcylindrical in form, barely increasing in diameter, through a length of over half an inch. It is strongly marked by wrinkles and lines of growth of the epitheca, which are sometimes quite sharp. At the end of this youthful stage the corallum rapidly expands, often abruptly so, and the costæ quickly become prominent.

"A calyx of moderate depth, the total depth being usually somewhat less than the greatest diameter of the calyx. Septa numerous, strong but thin, and separated by interspaces from 2 to 3 times their width. They retain a uniform width from periphery to center. Bottom of calyx often flattened in the center where the septa meet and become slightly twisted. They not infrequently unite before they reach the center. Dissepimental structures appear to be well developed. No fossula occurs.

"The corallum is not infrequently curved, the primary septum then appearing on the convex side. The remarkable cylindrical non-costate young with strongly wrinkled epitheca, and usually abrupt appearance of the costæ, and the concomitant rapid expan-

sion of the corallum are the most striking features of this coral. No internal structure has been observed, as the fossils are nearly all represented by hollow molds. From these, gutta percha casts can readily be made which will show all the external characters of the corallum in great clearness. No well preserved coral has been found so far, the only cases where the coral was preserved at all being rendered worthless by the crystallization of the whole interior, thus destroying all structural features." (Grabau.)

Horizon and localities.—These corals are abundant in the upper three or four feet of the Akron (Bullhead) dolomite in nearly all its exposures in Erie county. Most of the individuals lie parallel to the bedding plane, having fallen before they were buried.

Genus HELIOPHRENTIS gen. nov.

Corals combining the form and septal arrangement of Zaphrentis with the carinæ of Heliophyllum, with steeply sloping or nearly vertical sides. Calyx deep, septa numerous, alternating, the longer reaching the center. Carinæ more or less prominently developed, though in some of the more primitive species they are restricted to the marginal portion of the calyx, or in immature specimens may be wanting altogether. Fossula present in specialized species. Growth conical to conico-cylindrical and often irregularly restricted.

Genotype HELIOPHRENTIS ALTERNATUM. sp. nov.

The genera of Palæozoic corals are in a most unsatisfactory state of analysis, and a lumping of a heterogeneous mass of material in which superficial resemblances occur, has given us genera which are merely collections of homeomorphic equivalents from numerous diverse genetic series. This is especially the case with such species as are referred to *Zaphrentis*, *Cyathophyllum*, *Heliophyllum*, etc., and so long as this practice is persisted in no permanent advance in the systematic arrangement of these organisms is accomplished. As has been shown by Shimer and Grabau, *Heliophyllum* branches off from *Cyathophyllum* in mid-Devonic time (Hamilton) and all species which cannot be shown to be derivations from *Heliophyllum halli*, cannot properly be referred to that genus, if it is to repose upon a genetic basis. This throws out a large number of forms, which have been commonly referred to this genus, and they must be accommodated elsewhere. The generic name here proposed

applies only to the forms congeneric with the species here described. If it can be shown that such forms as *"Heliophyllum" corniculum* are derivatives of these types, or developed from the same Zaphrentoid ancestor, this generic name must be extended to cover them.

10. HELIOPHRENTIS ALTERNATUM. sp. nov.

(Plate XIII, Figs 2-3.)

Calyx deep, with sides at first sloping inward and then descending more abruptly, in some cases almost vertically, to the bottom of the calyx, which is nearly flat or slightly depressed in the center. In other cases the calyx after a slight constriction widens out again, this being repeated several times, the lower portion then sloping rapidly toward the center of the calyx. Septa in the form of low, sharp ridges on the side of the calyx, alternating in size, the larger ones separated by interspaces of about 1.3 mm., the thickness of the septum itself at that point being .5 mm. The smaller septum occupying the interspace is about one-half that thickness. They extend to within a short distance of the bottom of the calyx. The larger septa unite in bundles of two, three or more on the bottom of the calyx before reaching the center. At the center the septa are very fine and slightly twisted. Fossula rather irregular and coarse, confined to the bottom of the calyx.

The septa are free from carinæ throughout the greater portion of the calyx. Only in the upper fourth or less are carinæ shown, about five occurring in 3 mm. of septal length. In some cases they are absent altogether or are faintly developed only in the very uppermost portion.

Diameter of calyx of a typical specimen (Pl. XIII, fig. 2) at rim 29 mm., in lower part 23 mm.; depth 21 mm.; number of septa 96; carinated portion 6 mm.

Another specimen has its greatest diameter of 25 mm. a little above the middle, below which it slopes rather rapidly to the center, the depth being 29 mm., and the number of septa 88, of two sizes. In the character of the septa and calyx this species is closely similar to *Zaphrentis foliata* Hall, from the Onondaga of the Falls of the Ohio. The septa are, however, more numerous and more strongly alternating. The occurrence of carinæ in the Detroit specimens is a further distinctive feature. The species has also some resemblance

to *"Heliophyllum" (Heliophrentis?) corniculum* which, however, is coarsely carinated with fewer, less strongly alternating septa.

Horizon and localities.—In the brown Amherstburg dolomite from the Detroit river bottom, near Amherstburg, Ont., in the form of molds. Rev. Thomas Nattress collection. The species are most nearly allied to Devonic forms.

The noncarinated individuals of this species also resemble *Zaphrentis racinensis* Whitfield, from the Racine of Wisconsin. In this species the septa alternate, and the larger ones unite into bundles on the flat bottom of the calyx. The fossula is likewise well developed. The number of septa, however, is smaller, a large sized individual showing only 72, with a calicinal diameter of 30 mm., whereas a specimen of *H. alternata* of the same diameter shows 96 septa, which, therefore, are closer together. Moreover, while the cardinal and the alar septa are readily recognizable in *Zaphrentis racinensis*, the new septa coming in next to these principal septa in a pinnate manner, the arrangement in *Heliophrentis* is entirely radial. This would indicate that *Z. racinensis* is the more primitive type, and that *Heliophrentis* may be a derivative of this Niagaran species.

What appears to be a young individual of *H. carinata,* with deep calyx and sloping walls, and with the septa showing pinnate arrangement, a deep fossula and slight twisting of the inner septal ends, occurs in the lower Lucas dolomite of the Silica quarry, near Sylvania, Ohio. (Pl. VII, fig. 2.)

In the Schoharie grit of the Helderbergs occurs a species apparently indistinguishable from this one.

11. Mutation COMPRESSA. mut. nov.

(Plate XIII, Figs. 4-5.)

Large, robust, calyx 4 mm. in depth, compressed dorso-ventrally to a diameter of 25 mm. at the rim, the corresponding transverse diameter being 40 mm. Cardinal portion flatly convex both longitudinally and transversely, as seen in the mold of the calyx; counter side concave. Sides sloping regularly to the bottom. Septa distinctly alternating, both in length and thickness; cardinal fossula extending the entire length of the calyx. Larger septa .9 mm. thick, interspaces 1.6 mm.; smaller septa less than half the thickness of the larger. Number of septa 92. The barest indication of carinæ occurs in the upper part of the calyx on one side.

Horizon and locality.—Associated with the preceding in the Amherstburg dolomite of the Detroit river bed opposite Amherstburg, Ont. Rev. Thomas Nattress coll.

12. Mutation MAGNA. mut. nov.

(Plate XIII, Fig. 6.)

This differs from the typical form of the species only in the large size of the calyx, which is transversely elongate, and slightly constricted at the center of the long faces as if preparatory to division. The lateral septa are not quite parallel but in two groups, those near the center slightly diverging inwards so as to approach radiality with reference to two new centers. Septa strong, but alternating as in the typical form, the larger ones reaching the center, on the bottom of the calyx, but so far as observable not uniting, or at least less frequently uniting, than in the typical form. The septa of both kinds broaden out towards the rim of the calyx. No carinæ have been observed.

Measurements.—Greatest diameter, 70 mm.; transverse diameter, 46 mm.; depth of calyx, 48 mm. Number of septa, 150.

Horizon and locality.—In the Amherstburg dolomite of the Detroit river bed, opposite Amherstburg, Ont.

13. HELIOPHRENTIS CARINATUM sp. nov.

(Plate XII, Fig. 2; Plate XIII, Fig. 7.)

Corallum irregularly conical, with many constrictions and frequent changes in the direction of growth. Epitheca thin but strongly wrinkled and with well-marked lines of growth. Costal grooves pronounced and broad, the interseptal ridges being narrower and sharp.

Calyx deep, generally conical with a regular slope to the bottom. Septa alternating in size as in the preceding species but carinated for the greater part of their extent. The carinæ in some of the less specialized individuals occur only in the upper half of the calyx, while in the more specialized types, they occur throughout. There are about 8 carinæ to 5 mm.

Fossula well developed, extending part way up the side of the calyx. Measurements of a small individual give greatest diameter

of calyx, 19 mm.; depth, 17 mm.; number of septa, 64; carinated for 13 mm. The distinction between this species and *H. alternatum* is to some degree arbitrary, since individuals in which the carination is developed to a greater or less degree occur. In general those with the septa carinated throughout the greater part of their length, must be referred to *H. carinatum,* while those without carination, or with carinæ only near the margin are to be referred to *H. alternatum.*

Horizon and localities.—Associated with the preceding species in the brown Amherstburg dolomite from the bed of the Detroit river at the old Lime Kiln Crossing near Amherstburg, Ont. Also in the same formation in the lower part of the Gibraltar quarry near Gibraltar, Michigan, and the Woolmith quarry (Lucas?).

Genus CYLINDROHELIUM. gen, nov.

Corallum long, slender, frequently curved, or geniculate and of the same diameter throughout most of its extent. Surface marked by regular, sharp, longitudinal, costal grooves and by lines of growth. Calyx deep, sides nearly perpendicular, flat bottomed, septa in the form of low ridges on the side of the calyx. Generally alternate in size and carinated for a part of their entire length. Genotype *C. profundum.* Central area of corallum tabulate, peripheral zone with septa and dissepiments. No inner wall.

14. CYLINDROHELIUM PROFUNDUM sp. nov.

(Plate XI, Figs. 4, 5 and 6.)

Corallum long, slender, and in the form of a more or less irregularly curved cylinder, strongly marked by the costal grooves and not infrequently by constrictions and irregular concentric ridges. Diameter of coral from 7 to 9 mm. or larger. Calyx profound, more than 15 mm. deep in a specimen in which the diameter is 10.5 mm. Sides nearly vertical, very slightly flaring at the top. Septa alternating in size, in the form of ridges, the smaller only extending part way to the bottom; carinated in the upper part, the carinæ in the form of thick spines on the outer edge of the septum, about 8 carinæ to 5 mm. Sometimes the septa seem to be entirely replaced by rows of thick spines, and in some cases the carinæ are absent from the lower part of the calyx, or, at least, very faintly developed.

Horizon and localities.—In the Lucas dolomite of the salt shaft, the Silica quarry near Sylvania, Ohio, and the Gibraltar quarry in Michigan.

A small collection of fossils made by the late Miss Mary W. Adams, a student in Columbia University, from the Palæozoic limestones of the headwaters of the North Fork of the Saskatchewan river, Canada, shows that this species is abundantly represented in that locality. The stems are irregularly cylindrical, from 6. to 7. mm. in diameter, and somewhat flexuous; separated in the specimens seen by from 2 to 4 mm. The epitheca is strongly wrinkled and the costal grooves are well marked. In an average specimen there are 40 septa, the alternating ones being somewhat shorter and thinner than the others. All are marked by minute, but sharp, carinæ. Diameter of calyx, 4.3 mm.; depth, considerable, but not measured. Central area tabulate, about 7 tabulæ in 5 mm., the individual tabulæ varying from .5 mm. to 1. mm. apart. In the narrow outer zone occurs an abundance of dissepiments between the septa, giving the zone a vesicular appearance.

15. CYLINDROHELIUM HELIOPHYLLOIDES sp. nov.

(Plate X, Fig. 7.)

Compare 1883. *Heliophyllum pravum* Hall, 12th annual report, Ind. Geol. Surv., p. 274, pl. 15, fig. 12, pl. 25, fig. 4.

Calyx deep, flaring at the top, sides nearly perpendicular, bottom flat. Septa numerous, thin, in several cycles, 46 nearly uniform septa occurring in a calyx, the maximum diameter of which is 12 mm., and the depth 9 mm. They form short, sharp ridges on the side of the calyx but do not extend inward except at the bottom, which is broad. Carinæ numerous on all the septa, extending for more than the width of the septum on either side. Corallum on the whole coarser and less regular than in the preceding species.

In general form and character this species resembles *Cyathophyllum hydraulicum* Simpson, of the Cobleskill of Buffalo. That species, however, is without carinæ, while these are well developed in the present species. The corallum is also longer than in the Bullhead species.

Clarke and Ruedemann figure the calyx of a species of "Heliophyllum" from the Guelph of western New York (Guelph Fauna, pl. I, fig. 45, p. 28) which seems to be identical with the present

species, so far as the mold of the calyx, the only part preserved, is concerned.

This species differs from the preceding in its uniform septa, strong carinæ, and shallower calyx which is only about half the depth of that species, as well as the less cylindrical corallum.

This species comes nearer *H. pravum* Hall than to any other species described. It agrees with that species in its deep, flat bottomed calyx and character of the septa. The absolute identity of our specimens with that species is, however, not established.

Horizon and localities.—In the Lucas dolomite of the salt shaft, also in the Guelph of New York.

Genus CYSTIPHYLLUM. Lonsdale.

16. CYSTIPHYLLUM AMERICANUM, mut. ANDERDONENSE. mut. nov.

(Plate XII, Figs. 3-5.)

Corallum the size of *C. americanum* and in general similar to it. Calyx deep, slope at first at an angle of 45° or over, for some distance from the rim, and after that abruptly descending to the center which is depressed. Septa represented by rows of narrow, elongate vesicles, which in some cases are so thin and near together as to form a continuous ridge, while in others they are coarser and farther apart. Towards the bottom of the calyx the vesicles become larger, the central area being occupied by half a dozen large and prominent ones. Depth of calyx, 27 mm.; greatest diameter at the rim (the specimen is somewhat compressed), 41 mm. In a typical specimen of *C. americanum* from the Hamilton group of Ontario, the coarse ridges are near the top and the septa become more pronounced downwards.

Several sections of a large *Cystiphyllum* in the Anderdon coral reef rock probably represent this mutation. They show a certain amount of irregularity of outline and curvature, with repeated constrictions, such as are found in most species of this genus. The vesicular tissue is arranged in a rather broadly funnel-shaped manner, the coarsest cysts being generally at the center. Diameter of a section, 38 mm.; depth of center of vesicular lamellæ, 15 mm.; length of fragment, 60 mm.

Horizon and locality.—The calyx described was found as a mold in the Amherstburg dolomite of the Detroit river. The sections are from the coral reef portion of the Anderdon limestone, at the Anderdon quarry. Cystiphylli of this type are common in the upper Siluric of Bohemia (Etage E.). (See *C. Bohemicum* Barr.)

Genus ACERVULARIA.

17. ACERVULARIA. sp.

(Plate XV, Fig. 6.)

In the Amherstburg dolomite occurs an impression of the upper side of a species of *Acervularia* (*Prismatophyllum?*) which resembles very closely the characteristic Traverse group species commonly referred to *A. davidsoni*. The main difference seems to be the smaller diameter of the central pit of the corallites, the flat surface of the outer part of the calyx, and the thicker, rather abruptly raised intercalicinal rims. The average diameter of the adult corallites is from 8 to 10, rarely 12 mm.

Horizon and locality.—In the Amherstburg dolomite of the Detroit river, opposite Amherstburg, Ont.

Genus SYNAPTOPHYLLUM Simpson.

18. SYNAPTOPHYLLUM MULTICAULE (Hall).

(Plate XII, Fig. 6.)

1852. *Syringopora ? multi-caulis,* Hall, Pal. N. Y., Vol. II, p. 119, pl. 33, figs. 3 a-g.

1876. *Diphyphyllum multi-caule* (Hall) Rominger, Geol. Surv. Mich., Vol. III, Foss. corals, p. 121, pl. 45, figs. 3 and 4.

1901. *Diphyphyllum multi-caule* (Hall) Lambe, Cont. to Can. Pal. Vol. IV, Pt. II, p. 159, pl. XIII, figs. 4, 4 a, b, c.

Specimens in the form of hollow molds penetrating the dolomite. Casts of these give the external characters of this species. They are cylindrical, somewhat irregular or flexuous stems with a somewhat wrinkled epitheca marked by crowded lines of growth and by longitudinal costal furrows. Diameter of corallites varies from 3.5 to 5 mm., the distance between the corallites varying from 2.5 to 7 mm. At intervals where the corallites approach one another they are united by short transverse proliferations, which are from one-third to one-half the thickness of the corallites or less. These proliferations are placed at irregular and rather infrequent intervals.

Depth of calyx exceeding diameter, walls nearly vertical and marked by septal ridges of uniform size. Central tabulated area

shows in some cases with a diameter about one-half that of the entire corallum. Number of septa in an average corallite about 24. The interspaces between the septa are twice the thickness of the septa or more. In other corallites the principal septa extend to the center.

The specimens of this species here described from the Upper Monroe, are somewhat larger, on the average, than those of the Niagaran limestones; the connecting extensions are also somewhat larger. So far as can be judged from the imperfectly preserved molds of the calyx, the septa are somewhat less in number. The specimens are not as large or coarse as *S. simcoense* of the Onondaga, being in a measure intermediate between the Niagaran and Onondagan species. Better preserved material will probably show characters of sufficient distinctiveness, to make it desirable to separate this species under a new name.

Horizon and localities.—As molds in the brown Amherstburg dolomite from the Detroit river, opposite Amherstburg, Ont. Rev. Thomas Nattress coll. Also as crushed specimens in the basal Anderdon limestone (Amherstburg?) of the salt shaft. It was originally described from the Niagaran of New York.

Genus DIPLOPHYLLUM Hall.

19. DIPLOPHYLLUM INTEGUMENTUM. Barrett.

(Plate X, Fig. 1; Plate XV, Figs. 9-10; Plate XVI, Figs. 15 and 17.)

This species is abundantly represented throughout the Monroe. In most cases single stems alone occur and in general these are poorly preserved, often only as external molds. Frequently the interior is separated from the exterior portion and has the aspect of a series of invaginated cups, recalling strikingly the slender species of Blothrophyllum. A number of well preserved specimens show all the characteristic features of the cylindrical stems from the Decker Ferry beds of New Jersey.

The coral consists of more or less irregularly curving, single and simple cylindrical stems, averaging from 6 to 8 mm. in diameter, though sometimes exceeding this. The exterior is frequently contracted and the corallum as a whole is often geniculate. The surface is marked in addition by the crowded concentric growth lines of the epitheca, and by the longitudinal costal grooves between which the wall of the intercostal space bulges out into a rounded, rather broad ridge. In some of the larger specimens these intercostal ridges become strongly marked, the costal grooves being sharply depressed.

Calyx deep, the depth commonly twice as great as the diameter or greater. Sides nearly vertical so that the diameter at the base of the calyx is but little less than at the top and often of the same width. Sides of calyx marked by low, sharp, septal ridges which are distinctly alternating in size, the smallest occurring as mere lines and only extending part way to the bottom of the calyx. They begin a short distance below the rim of the calyx. The bottom of the calyx is generally rather depressed in the center, sometimes almost funnel-shaped. The earlier cycles of septa reach the center, being somewhat irregular in most cases, while the later cycles extend only part way in. In a large specimen there are about 45 to 46 septa which extend into the inner area, but less than one-third of these reach the center. Ordinarily there are only about one-half that number of the long septa. In the largest specimen seen, in which the diameter of the calyx rim was 12.3 mm., the number of large septa was 52, while an equal number of finer septa, which occurred merely as lines on the wall of the calyx, occupied the spaces between the larger ones. The outer zone (1.5 mm. in a specimen 9 mm. in diameter, and 1 mm. in a specimen 6 mm. in diameter) is solid but transversed by the septa.

Dissepiments are numerous, and in several cycles, generally arranged so as to form a resemblance to a series of concentric rings or inner walls, but no true inner wall is present. They are more or less cup-shaped, bending downwards to the center of the coral where they are continuous and of the character of tabulæ. This is the cause of the cup in cup appearance of the central portion when separated from the solid exterior under certain conditions of preservation. Not infrequently hemitabulæ, uniting with the preceding or succeeding one, and not continuous across the entire tube, occur.

No undoubted case of budding has been observed in the material at hand, though frequently individuals are in close enough juxtaposition to have had a common origin. Nevertheless, the simple stem generally more or less curved, seems to be the prevailing type.

This species is readily distinguished from *D. panicum,* the common form of the Traverse beds of Michigan, by its more slender

and more regularly cylindical form, the more pronounced character of the "solid" peripheral portion and the more widely separated, fewer and less continuous dissepimental tabulæ. These latter in *D. panicum* are crowded and predominate over the septa, so that they are the most conspicuous feature in a cross-section, whereas in *D. integumentum* the septa are the more prominent feature. In *D. panicum,* furthermore, the septa scarcely reach the center, dying out successively on the tabulæ. The corallites of *D. panicum* are also crowded, rarely occurring by themselves.

The largest specimen observed has a diameter of 12.3 mm. at the calyx rim; the average is 8 mm. There are about 18 tabulæ in 20 mm. of length.

Not infrequently the smaller individuals are enclosed by a growth of *Stromatoporoid* (*Clathrodictyon,* etc.) giving the "Caunopora" type structure.

Horizon and localities.—This species is most abundant in the Anderdon limestone of the salt shaft. It is less common in the reef portion of the same bed at the Anderdon quarry. In the Amherstburg bed of the Detroit river the species is fairly common, and it also occurs in the same bed in the bottom of the Gibraltar quarry. It occurs in the Cobleskill of New Jersey.

Genus ROMINGERIA Nicholson.

20. ROMINGERIA UMBELLIFERA (Bill).

(Plate XIV, Fig. 7.)

1859. *Aulopora umbellifera* Billings. Can. Journ., Vol. IV. p. 119.

1876. *Quenstedtia umbellifera,* Rominger, Geol. Surv. Mich., Vol. III, Pt. II, p. 71.

1879. *Romingeria umbellifera* Nicholson, Tabulate corals of the Palæozoic period.

1903. *Romingeria umbellifera* (Billings) Beecher, Am. Journ. Sci., 4th series, Vol. XVI, p. 2-6, pl. I-V.

1906. *Romingeria umbellifera* (Billings) Grabau and Shimer, North American Index fossils, p. 79.

Corallum compound, consisting of a loosely arranged agglomeration of slightly flexuous or nearly straight and slender tubes which give rise to verticils of closely crowded tubes, of which from 10 to 12 generally arise from each parent tube. Many of the daughter

tubes again give rise to verticils of tubes of a later generation. The parent tubes first described are often seen to unite into the umbel of an earlier parent tube, thus demonstrating a succession of umbelliferous budding. The length of the parent stems is about 7 mm. and the diameter from 1.5 to 2 mm., there being a gentle enlargement forward. At the point of budding the diameter is from 2.5 to 3 mm. In the most perfect specimen observed, the number of buds is 11. The buds remain closely adjoining for over half their length, after which they diverge. Surface marked by the epithecal lines of growth, which are rarely irregular. Internal structure not shown in our specimens.

The specimens here described are in all respects so like the specimens from the Onondaga limestone, that a specific separation seems impossible. They are almost altogether represented by external molds but the form is characteristic and unmistakable.

Horizon and locality.—In the Amherstburg dolomite of the Detroit river bed, opposite Amherstburg, Ont., associated with *Cladopora dichotoma, Conocardium monroicum,* and other characteristic species of this fauna. Rev. Thomas Nattress Coll. The species has heretofore been reported only from the Onondaga limestone.

Genus CERATOPORA Grabau.

21. CERATOPORA REGULARIS sp. nov.

(Plate XI, Fig. 8.)

Corallum compound, of gently tapering, slightly flexuous, slender branches, of a circular cross section. Branching loose, infrequent, near the mature end of the corallites. Surface formed by a comparatively smooth epitheca, showing only faint concentric growth lines and faint longitudinal costal grooves. Corallum walls comparatively thin, leaving a large empty interior space, commonly represented by cylindrical rock molds. As shown by these molds (pl. V, fig. 8) the successive branches remain in perfect contact. The interior of the tubes is marked by close set vertical rows of fine spines which are so near together as to give the appearance of fine spinose septal ridges, separated by intervals of about twice the width of the ridges.

This species comes nearest to *Ceratopora nobilis* of the Onondaga and Lower Hamilton (Marcellus limestone) of New York, but is not quite as large and robust as that species. The character of the cystose wall in our specimen is unknown.

Horizon and locality.—In the brown Amherstburg dolomite from the bottom of the Detroit river opposite Amherstburg, Ont. Nattress collection.

22. CERATOPORA TENELLA. (Rominger.)

(Plate XIV, Fig. 6.)

1876. *Syringopora tenella* Rominger, Geol. Surv. Mich., Vol. III, Pt. I, p. 81, pl. 30, fig. 4.

Corallum of small tubes varying from 1.3 to 1.8 mm., and in rare cases to 2 mm. or more, in diameter and branching at intervals of 4 or 5 mm. Generally only a single bud is given off, diverging at an angle of 40 to 45 degrees, or more. Surface marked only by faint lines of growth.

Calyx gently contracting downward and continued as an attenuated tube through the corallum, cystose structure occupying more than two-thirds of the diameter of the corallum in the older portion.

Horizon and locality.—Common in the coral reef portion of the Anderdon limestone at the Anderdon quarry, Ont. It is commonly associated with *Idiostroma nattressi,* occupying the interstices between the branches of that hydrocoralline. The species was originally described from the Niagara of Point Detour and Drummonds island, Michigan, and from Indiana and Kentucky.

Genus FAVOSITES Lamarck.

23. FAVOSITES BASALTICA Goldfuss var. NANA. var. nov.

(Plate IV, Figs. 5, 6.)

Corallum forming hemispheric masses with the corallites approximately of uniform size, each face bearing usually a single row of mural pores, though this may become double by a displacement of alternate pores for a short distance. Sometimes two pores occur side by side, but no case of a continuous double row of pores has been observed. Outside of the pores,—between the rows when two exist,—or sometimes in line with the pores, frequently a faint ridge is observable, suggesting the ridges of *F. epidermatus.* Sometimes the pores occur on the angles of the prismatic corallite. The size of the pores varies somewhat in different corallites but averages in diameter perhaps one-fourth the width of the prism face (which is about 1 mm. wide) though sometimes occupying one-third or more. Each pore has a distinct rim which is slightly elevated. Distance between pores in the same line, from two to three times

their diameter, rarely more, the actual distance being about .8 mm. and less (rarely more). On the interior of the corallites the squamulæ are well developed, in a double or single row, in the latter case alternating in position. Tabulæ numerous, often complicated with the squamulæ.

Compared with typical specimens of *F. basaltica* from the Devonic limestones of Kelley's island, Lake Erie, the corallites are seen to be smaller. In the Kelley's island specimens the width of the prism faces ranges from 1.4 mm. to 1.8 mm., whereas in the specimens from the Monroe of Michigan the width of the faces averages 1 mm. The mural pores are also larger in the Kelley's island specimens, but the average proportion between the diameter of pore and width of the face is the same. The tabulæ of the Kelley's island specimens are, however, much farther apart, than is the case in the specimens from the Michigan Siluric, and the squamulæ are much less pronounced.

On the average there are five tabulæ or squamulæ and four interspaces in 2 mm. in the var. *nana,* while in typical *basaltica* from Lake Erie the tabulæ and squamulæ are from .5 mm. to .2 mm. apart.

One fragment, however, from the salt shaft shows characters closely akin to the typical *F. basaltica* from Kelley's island. The width of the faces averages 1.5 mm.; the diameter of the mural pores is about one-fourth this, or something less, and they are separated by a distance of from 1 to 1.5 mm., the same interval occurring between the tabulæ. The squamulæ are not preserved.

Horizon and locality.—In the Anderdon limestone of the salt shaft and the quarry.

F. basaltica has heretofore not been reported from the Siluric. It is a characteristic fossil of the Middle Devonic limestones of northern Ohio, and occurs in the same horizon elsewhere.

24. FAVOSITES RECTANGULARIS. sp. nov.

(Plate XIV, Figs. 3 and 4.)

Corallum cylindrical, sometimes forking, with the corallites slightly diverging from the axis for about one-half their length, after which they bend abruptly outward almost at right angles. The corallites are not uniform in size, smaller ones occurring between the larger. The latter average 1 to 1.1 mm. in diameter. The tabulæ and squamulæ are as in *F. basaltica,* var. *nana,* from which

the specimens are mainly distinguished by their cylindrical mode of growth, with the accompanying abrupt outward bending of the corallites, which describe nearly, or quite a right angle. The squamulæ are especially well developed in this species, occurring in one or two alternating rows. Tabulæ also occur. The mural pores are seldom shown in our series of specimens, but where found they occur in a single row as in the preceding species, except in one or two cases where a double row of small pores was observed. This species represents merely an extreme development of form in the direction of cylindrical growth.

A typical specimen measures 26 mm. in diameter, the fragment being over 70 mm. long. The average size of the adult corallites is 1 mm.

This species differs from those with which it is associated in its cylindrical form, the abrupt outward bending of the corallites, their small size, and the crowded character of the squamulæ and tabulæ. It approaches nearest to *F. basaltica nana* from which it is apparently derived, as is also the next species. In the older portions of the corallites the squamulæ and tabulæ are less crowded, while the tubes diverge upward without bending outward at right angles as in the adult. This portion therefore resembles to a certain degree *Cladopora bifurcata* with which it is associated. The abruptly outward bending adult portion of the corallites and the numerous squamulæ and tabulæ sufficiently distinguish this species. This species is readily distinguished from *Cladopora bifurcata*, with similar growth, by the thickness of its branches, which are seldom less than 25 mm. or more in diameter; also by the abundant tabulæ and squamulæ, as well as by the abrupt outward curvature of the tubes which are at right angles to the surface.

Horizon and localities.—In the Anderdon limestone, especially the reef portion, in the salt shaft and at the Anderdon quarry. Common.

25. FAVOSITES TUBEROIDES. sp. nov.

(Plate XIV, Fig. 2.)

Compare *Favosites tuberosus* Rominger, Geol. Sur. Mich., Vol. III, Pt. 2, p. 31, pl. IX, fig. 1-2.

Corallum massive, apparently in the form of moderate sized heads, with the corallites diverging gently, so as to give the appearance of parallelism of all corallites in a fragment. Corallites smaller than those of the typical *F. tuberosus* Rominger, ranging in diameter from 1.2 mm. to 2 mm., the majority lying between 1.5 and 1.8 mm., while those of the typical species of *F. tuberosus* range from 2 to 3 mm. with larger tubes up to 5 mm., intermingled (Rominger). Sides of tubes with a double (rarely a triple) row of pores, averaging about .5 mm. apart in each row. On the interior the squamulæ are well developed, mostly in a double row, the corresponding members of which are alternately arranged. In general each squamula lies beneath its pore. The squamulæ project as tongue-shaped brackets from the wall to the center, about 13 in 5 mm.

Horizon and locality.—In the Amherstburg dolomite of the Detroit river, opposite Amherstburg, Ont. Often silicified.

Lambe (Cont. to Canadian Palæontology, Pt. 1) has united the *F. tuberosus* of Rominger with *F. forbesi*, Nicholson, *F. epidermatus* (Rominger), and *F. basaltica*, Goldfuss, and included them all under the last name. This practice is to be condemned most emphatically for it leaves us without any designation of types in which a definite association of characters appears,—and further makes the limits of our species so vague and ill-defined, as to make them practically worthless for all but the most superficial work. It is true that within the same head, corallites of different kinds may occur, but this is due to intracolonial acceleration or retardation as pointed out by the writer some years ago. That we may actually have more than one species within the colony is a demonstrated fact, for by acceleration certain individuals may develop the characters of a more specialized type, while others may by retardation retain the characters of more primitive ancestral types. The condition of the majority of the members of a colony determines the norm for that colony, and to that norm the specific name is applied. Thus, if the difference between *F. basaltica* and *F. tuberosus* lies in the single row of pores of the one and the double row of the other, and if it is shown, as I believe it can be, that the single row is the more primitive condition, then we may expect certain accelerated individuals in the *F. basaltica* colony to be advanced beyond the norm, acquiring a double row, and therefore passing into the *F. tuberosus* stage. On the other hand, a colony in which the *F. tuberosus* stage is the norm may have retarded individuals

in the *F. basaltica* stage (single row of pores and squamulæ), and others in which a more complex stage, that of three rows, normally characteristic of a still more specialized type, may develop as the result of acceleration. Thus, considering these features alone, we may have three species within the same colony, the norm being the *F. tuberosus*, which name is applied to the colony.

Another fact must be borne in mind, namely, that the characters we have selected as showing specific diversity are not all the characters of importance. Many of them we may not be able to recognize in our specimens at all. Furthermore, those shown may be homoeomorphic characters, cropping out singly, or in association in diverse genetic series. Thus we may have in distinct lines of evolution types of Favosites with a single row of pores and a corresponding single row of squamulæ (*basaltica* type) and types with a double row of pores and squamulæ (*tuberosus* type) and yet the two would not be related at all. It is very probable that just this thing obtains in the Anderdon and Amherstburg types. Whether we consider these formations as uppermost Siluric or Lower Devonic, the fact remains that a considerable time interval existed between these formations and the Onondaga. We know that few, if any of these corals are long lived, and we also know that similar characters crop out in different genetic series. I am inclined to regard these small Favosites in the *basaltica* and *tuberosus* stages as members of a distinct genetic series, which ran through its series of modifications in Upper Monroe time, and was later, in Onondaga time, paralled by a distinct series of species which passed independently through the same modifications. If this interpretation is correct, the form here named and described is a wholly distinct species from the typical Onondaga, *F. tuberosus*.

26. FAVOSITES CONCAVA. sp. nov.

(Plate XV, Figs. 2-3.)

Corallum forming heads of medium size, corallites diverging regularly but at a slight, and somewhat regularly increasing, angle. Corallites varying from 1.8 to 2.5 mm. in diameter. Tabulæ crowded in certain concentric zones within the colony, farther apart in others. In the crowded portion 9 tabulæ occur within a space of 4 mm., in the other part 4 tabulæ or sometimes only 3, occupy the same interval.

A characteristic feature of the majority of tabulæ is their concavity or downward bending. This is sufficiently marked to be noticeable at the ends of the tubes as well as on broken specimens. Squamulæ small, scarce.

As is to be expected, small young tubes occur plentifully among the larger adults; mural pores in two rows.

This species resembles *F. epidermatus* but is somewhat smaller; the concave tabulæ and their arrangement into zones of crowded and distant tabulæ, form a ready means of distinction.

Horizon and locality.—In the Anderdon limestones of the coral beds of the Anderdon quarry, near Amherstburg, Ont. Common.

27. FAVOSITES cf. MAXIMUS Troost.

(Plate XV, Figs. 4-5.)

1890. cf. *Calamopora maximus* Troost 5th Ann. Rep. Geol. Tenn., p. 73.

A large-celled species from the Flatrock dolomite is represented by a fragment in the collections. The adult corallites are from 3.5 to 4.5 mm. in diameter. The tabulæ are flat or concave and rather distantly spaced. They are frequently drawn down on one side in a sort of funnel-like prolongation. Walls of the tube doubly sinuate, consisting of alternate depressions on one and elevations on the other half, separated by a vertical ridge. The mural pores are situated on the elevated positions and hence are in double rows. They average about a millimeter apart.

This species agrees closely in form and size and in character of the tabulæ with a specimen identified as *F. maximus* Troost from the Columbus limestone of Sandusky, Ohio. No surface features of that specimen have been seen.

Horizon and locality.—In the Flatrock dolomite of the salt shaft at Oakwood, near Detroit, Michigan.

Genus CLADOPORA Hall.

28. CLADOPORA BIFURCATA sp. nov.

(Plate X, Figs. 2-4; Plate XII, Figs. 7-8; Plate XV, Fig. 1.)

Corallum consisting of bifurcating, cylindrical, somewhat flexuous branches. Diameter varying from 5 to 10 mm., though an unusually large specimen measures 13.5 mm. in diameter. The longest straight and unbranched fragment observed is 50 mm. with a diameter of 5 mm. The apertures of the corallites are oblique

to the axis of the branch and approximately at right angles to the final portion of the corallite. The outer lip of the aperture is crescentic, and this side of the corallite projects a short distance beyond the next lower aperture, the outer face of the corallite thus exposed being cylindric. Where the surface is slightly worn the apertures are more oblique and the outer lips less projecting. In well preserved specimens faint longitudinal striations appear on the inside of the calyx. Corallites prismatic, in the smaller specimens (5 mm.) diverging steadily at an angle of 23° from the axis. In larger specimens the outer part of the corallite diverges more so as to make the outer angle about 30° or more. Sometimes, however, stems only 5 mm. in diameter show a change in divergence from 23° in the inner to 45° in the outer portion. The tubes slowly enlarge outwards. Mural pores scattered and comparatively few, small, not forming rows, and situated either on the side or the angle of the tube. Tabulæ few, distant, and rarely complete, often more of the nature of squamulæ. In a branch 7.5 mm. in diameter the tubes at the aperture are .9 mm.

This species is of the type of *Cladopora fibrosa* Hall, of the Niagara limestones, but the tubes are proportionately larger and less numerous, and the apertures less oblique.

Horizon and localities.—In the Anderdon limestone of the salt shaft and the reef portion of the Anderdon quarry, near Amherstburg, Ont. Common. Also in the Amherstburg (and Lucas ?) dolomite of the Detroit river and the lower part of the Gibraltar quarry. A closely related, if not identical, species occurs in the Palæozoic limestones of the headwaters of the Saskatchewan river in Alberta, Canada.

29. CLADOPORA cf. CERVICORNIS Hall.

(Plate XIV, Fig. 5.)

1852. cf. *Cladopora cervicornis* Hall, Pal. N. Y., Vol. II, p. 139, pl. 38, fig. 3 a-b.

Branches of medium size, frequently dividing, cylindrical, bluntly terminating, and only slightly flexuous. Apertures rather distant, very oblique, and transverse, with a slightly projecting, crescentic outer lip. Transverse diameter of the aperture 1.2 mm., longitudinal diameter .7 mm., distances between apertures from 1 to 2 diameters. Diameter of an average branch 4.5 mm.

The method of branching is less precise in this species than in the preceding one. Generally the branches thicken irregularly before division results. This species is preserved only in the form of external molds, in which the long slender fillings of the calices project downward at a uniform angle.

Horizon and locality.—In the brown Amherstburg dolomite from the Detroit river at Amherstburg, Ont. Nattress coll.

30. CLADOPORA sp.

A fragment of a rather large subcylindrical branch with irregularly scattered apertures, curved on one side, occurs in the Lucas dolomite of the salt shaft as an external mold.

Genus SYRINGOPORA Goldfuss.

31. SYRINGOPORA MICROFUNDULUS sp. nov.

(Plate IX, Figs. 7-8.)

Corallum of small, irregularly bent corallites, from 1 to 1.2 mm. in diameter, and distant from each other by a greater or less amount, sometimes in contact. Tabulæ flat around the margin, funnel-shaped in the center, each funnel extending down into the next one, giving the central portion a distinctly solid appearance, not unlike a columella. When the funnel portion is removed, the remaining rim of the tabulæ produces the impression that horizontal tabulæ existed.

This species is of the type of *Syringopora (Cystostylus) infundibulus* Whitfield, of the Niagaran of Wisconsin and the Guelph of Ontario. That species, however, is from two to four times as large as the present one, the diameter varying from one to nearly two lines (2 to 4 mm.), whereas our species rarely exceeds 1.2 mm. The two species have, however, the same type of structure. In general form, this species resembles *S. retiforme,* but the tubes are mostly closer together. In size of tubes and general growth this species also resembles *S. hisingeri,* but the transverse bars are much fewer and more widely scattered than in that species.

Horizon and localities.—A single fragment showing structure was obtained from the base of the Anderdon coral bed of the salt shaft at Detroit. Numerous hollow rock molds in the dolomite of the Detroit river (Amherstburg) and that of the Flat Rock region are apparently of this or the succeeding two species. A fragment from the Flat Rock dolomite of the salt shaft may also belong here.

32. SYRINGOPORA COOPERI sp. nov.

(Plate XIV, Fig. 1.)

Corallum in the form of large, more or less hemispherical masses, or fragments of such, and consisting of fine, subcylindrical tubes from .7 to 1.1 mm. in diameter, and varying in position from closely crowded to 1.7 mm. or more apart. In the most typical condition, the separation is less than the diameter of the tube. Tubes slightly flexuous, the surface of the epitheca characterized by well-marked growth lines, which occasionally become wrinkles. The tubes are connected by short cross stems which arise at frequent intervals and often in verticils. They are circular in section, and their diameter is about one-third that of the tube. There is considerable irregularity in the disposition of the connecting tubes, the distance varying from half a millimeter to a millimeter or more, while in some cases they are so closely crowded that the spaces between them are from a half to .2 mm. wide.

This species is not unlike *Syringopora hisingeri* of the Onondaga, from which it differs chiefly in the more crowded and larger transverse connecting tubes and the more closely crowded condition of the main tubes. From *S. retiformis* of the Niagara group it differs in the smaller size and greater regularity of the tubes as well as the great numbers of the transverse bars.

Horizon and localities.—This species has been obtained from the Flat Rock dolomite at a depth of 390 feet in the salt shaft. A very closely related, if not identical, species occurs in a similar gray magnesian calcilutite on Mackinac island. Named after Mr. W. F. Cooper of the Michigan Survey, through whose energy much of the material described was obtained.

33. SYRINGOPORA cf. HISINGERI Billings.

A number of hollow molds in the brown dolomites (Amherstburg) from the Detroit river and elsewhere show the form and mode of growth of this species, and may possibly represent it, or a closely allied one. The stems are flexuous and have a somewhat strongly wrinkled epitheca. At frequent intervals the tube becomes slightly geniculate, and from the angle thus produced springs a connecting tube which is less than half the thickness of the main tube which measures 1 mm. or slightly more across. The tubes are distant from each other from 1.3 to 2.2 mm. or over. The connecting tubes are not regularly spaced, ranging as high as 2 mm.

apart. A fragment from the Amherstburg bed of the Detroit river, preserving the tubes, shows all the essential characters of this species. The tubes are about 1 mm. in diameter, are distant by their own diameter or more, and the connecting tubes are frequent and irregular.

So far as it is possible to determine, the hollow molds are almost identical with specimens of S. *hisingeri* from the Onondaga of Canada west. There appear to be no features of a sufficiently strong character by which a separation can be effected. It is not unlikely, however, that the hollow molds all belong to *S. microfundulus.*

Horizon and locality.—In the brown Amherstburg bed of the Detroit river. The specimen from Flat Rock dolomite of the salt shaft, referred to *S. microfundulus,* may also belong here. The hollow molds in the brown dolomite which forms the surface rock in the vicinity of Flat Rock, in Monroe county, may possibly be of this species rather than the preceding.

BRYOZOA.

Genus FENESTELLA Lonsdale.

34 and 35. FENESTELLA sp. 1 and 2.

Among the material collected by the Rev. Mr. Nattress from the Amherstburg bed of the Detroit river is a number of specimens representing at least two species of Fenestella. No detailed characters except form and size of branches are preserved.

Horizon and locality.—In the Amherstburg bed from the Detroit river.

BRACHIOPODA.

Genus PHOLIDOPS.

36. PHOLIDOPS cf. OVATA Hall.

(Plate XVII, Fig. 13.)

1859. Compare*Pholidops ovatus* Hall, Pal. N. Y., Vol. III, p. 490, pl. 103 B, figs. 7 a-b.

1903. Compare *Pholidops ovata* Hall, Weller, Pal. N. J., Vol. III, p. 226, pl. XX, figs. 27-29.

Shell small, nearly elliptical. Beak excentric, situated about one-fourth the length from the posterior end. In the ventral (?)

valve the muscular ridges are very strong (represented in the mold by depressions); they converge gently forward, and between them they contain, at the point of greatest approach, a faint median ridge. They are connected by a faint transverse ridge. Posteriorwards they thicken considerably. Posterior adductor impressions small and circular, situated at the posterior ends of the diverging ridges.

Horizon and locality.—In the Raisin river dolomite, Claim 674, T. 6 S., R. 9 E., on the N. Sandy creek, associated with *Whitfieldella prosseri*, etc. It is probably not conspecific with Hall's species, but the one described by Weller from the Decker Ferry formation of New Jersey, may be the same.

Genus SCHUCHERTELLA Girty.

37. SCHUCHERTELLA HYDRAULICA (Whitfield).

(Plate XVII, Fig. 7; Plate XXX, Figs. 1-3.)

1893. *Streptorhynchus hydraulicum* (Whitfield), Ann. N. Y. Acad. Sci., Vol. II, p. 193, 1882; ibid, Vol. V, 1891, p. 508, pl. 5, figs. 1-3. Ibid. Geol. Sur. Ohio, Vol. VII, 1893, p. 410, pl. I, figs. 1-3.

Whitfield's original description: "Shell small to minute, the largest individuals yet observed not exceeding five-eighths of an inch in greatest diameter, while the most of those observed are not more than two-thirds as great. Valves depressed convex, or more commonly, appearing very flat as seen on the surface of the stone. Hinge line straight, nearly as long as the width of the shell below, and the latter usually more than the length, frequently nearly once and a half as great. Ventral valve characterized by a very narrow and nearly vertical cardinal area, and a usually more or less twisted or otherwise distorted beak. Dorsal valve slightly more convex than the ventral, with a perceptible mesial depression extending from beak to base, becoming broad and undefined below the middle of the length. Surface of the shell marked by coarse and somewhat rigid radiating striæ, which are distinctly alternating in size; the principal ones proportionally very strong."

"The small size of the shell, with the strong radiating and alternate striæ, are distinguishing features of the species. There is no species resembling it to any degree among fossils of New York rocks of a corresponding age. It presents much more the features

of forms of the genus from the Coal Measures than any heretofore described from Silurian rocks of America, and will not be readily confounded with any known species."

All the specimens which have come under my observation show the alternation of coarser and finer striæ. Generally about three of the finer striæ lie between the large ones. Only about half the number, or in large shells even fewer, of coarse striæ extend to the beak, the others beginning as intercalations at an early stage in the development. Generally the primary intercalated striæ become coarse toward the front, so that they appear of the same character as the principal ones. In some of the larger shells, however, the second set of intercalated striæ also becomes large, and only the third and fourth set remain smaller.

Concentric lines distinctly crenulate the striæ, both coarse and fine.

Measurements.—The following table gives measurements of average examples:

Locality.	Greatest width.	Hinge line.	Height.
Ballville, Ohio	11.1 mm.	7.3 mm.	7. mm.
Ballville, Ohio	7.6	6.9	6.4
Ballville, Ohio	10.1	9.2	7.5

Horizon and localities.—In the Greenfield dolomite at Ballville, Ohio, and Greenfield, Ohio. This species also occurs in the Raisin river beds of the salt shaft between 87-137 feet below the Sylvania.

38. SCHUCHERTELLA INTERSTRIATA (Hall).

(Plate XVII, Figs. 4-5; Plate XXXII, Fig. 1a-1c.)

1852. *Orthis interstriatus* Hall, Pal. N. Y., Vol. II, p. 326, pl. LXXIV, figs. 1a, b, 2a, b.

1900. *Orthothetes hydraulicus* Grabau (non. Whitfield) Bull. Geol. Soc. Am., Vol. II, p. 365, pl. 22, figs. 1 a-c; ibid. 1901. Geol. and Pal. Niagara Falls, p. 184, fig. 92.

1906. *Orthothetes interstriatus* (Hall) Grabau, Geol. and Pal. of the Schoharie Valley (Bull. 92, N. Y. State Mus. Nat. Hist.), p. 108, fig. 8.

1907. *Schuchertella interstriata* (Hall) Grabau and Shimer. North American Index Fossils, p. 228, fig. 277.

Grabau's original description.—"The pedicle valve has a slightly elevated beak, with a low triangular cardinal area, which is flat and transversely striate; delthyrium moderate, covered in great part by a strong convex deltidium. The cardinal teeth are prominent and supported by two short and narrow dental plates, which have the same angle of divergence as the sides of the delthyrium. The cardinal extremities are obtuse, the hinge line being shorter than the greatest width of the shell, while the front is uniformly rounded.

The brachial valve has a very narrow hinge area which is erect, making a moderately obtuse angle with the hinge area of the pedicle valve. A strong band-like chilidium covers the median fissure. Between it and the delitidum there is a narrow open space through which can be seen the cardinal process, which appears bilobed; surface of both valves marked with strong, rounded, but sharply defined radiating striæ, which curve slightly upward on the lateral margins near the cardinal area. The strongest of these reach close upon the beak. Passing forward, new striæ appear between them, as soon as they have separated by more than their own width. Additional sets of striæ appear as the shell increases in size, these having been observed up to the fifth generation. (Pl. XI, fig. 2.) The striæ are cancellated by uniform, close, fine and regular concentric lines which are most prominent on the striæ.

"A mold of the interior shows the striæ quite strongly, and even the cancellations are visible. It is not improbable, however, that after the solution of the shell, the two molds becoming closely appressed, the stronger external features were impressed upon the weaker internal, thus accounting for the markings, which would otherwise indicate a shell of great tenuity. The muscular impressions have not been retained in the molds."

"This species is so closely related to *Orthis (Orthothetes) interstriatus,* Hall, of the Coralline limestone at Schoharie, that it is practically impossible to distinguish the two. In size, outline, and convexity of valves, form and method of intercalation of striæ and character of cancellating lines, the specimens from the Manlius [Bullhead] limestone of Erie county and those of the Coralline [Cobleskill] limestone of Schoharie appear to be identical. The only difference observed is in the shallow, but broad, mesial depressions in the pedicle valve, which occurs in a number of specimens from Williamsburg and Akron, but has not been observed in the Coralline limestone species; neither does it always or very commonly occur in the Manlius [Bullhead] limestone species in Erie county, N. Y."

This species differs from *S. hydraulica* of the Ohio beds merely in the fact that the striæ are all of uniform strength. The shells also grew to larger size. One of the larger specimens from Buffalo measured about 21 mm. in width by 16.3 mm. in height, with a hinge area 16.5 mm. long. In general, however, the specimens are smaller.

Whether this species is to be considered distinct from *S. hydraulica* depends upon the value placed upon the relative strength of the striæ. In a form with similar surface characters, *Strophodonta varistriata,* specimens with the two types of striæ are generally placed together. In my own opinion the two forms should be distinguished by distinct names.

Horizon and localities.—In the Bullhead (Akron) dolomite of Buffalo, Williamsville, Akron and elsewhere in western New York. The typical form occurs in the Cobleskill of the Schoharie Valley. Typical specimens are not infrequent in the Lower Lucas dolomite of the Webster quarry, north Ohio. They are mostly small.

A single specimen, apparently of this species, has been obtained from the Amherstburg bed of the Detroit river. (Pl. XI, fig. 3.) This specimen is small and corresponds in general to the specimens from the Bullhead of Buffalo except that there is a distinct gradation in the thickness, as well as the length of the striæ of the various orders. Thus the striæ which reach to the beak are the coarsest, those of the second order next between are somewhat finer as well as shorter, those of the third order still finer and shorter and so on. While the specimen at first suggests *S. hydraulica* in the arrangement of the striæ, it is readily seen to differ, since in that species the primary and secondary, and sometimes even tertiary striæ, are all of one thickness, while the remainder are thin, but uniform among themselves.

In the upper Raisin river beds of the salt shaft, occur several individuals closely approaching the forms from the Akron dolomite.

39. SCHUCHERTELLA AMHERSTBURGENSE, sp. nov.

(Plate XVII, Figs. 1-3.)

Shell minute (young?), wider than high, with the hinge line forming nearly the greatest width of the shell. Cardinal angles slightly obtuse; sides and front regularly rounded. Beak of pedicle valve elevated, thick and slightly irregular; hinge area flat, about one-fifth as high as wide. Deltidium strong, convex, and sharply defined. Surface of shell moderately concave below beak, otherwise practically flat in antero-posterior direction, gently arched transversely. Surface marked by about 24 or more rounded, narrow and sharply pronounced striæ which increase forward by bifurcation and intercalation, and are separated by wider interspaces. They are crossed by numerous fine, but sharp concentric lines. Width of small specimen 4.3 mm., height 2.7 mm., height of hinge area .9 mm. Brachial valve unknown. A fragment of a large shell shows narrow, high striæ, rounded at top, and about twice as wide as high, or more. They are separated by spaces equal near the front to nearly the width of two striæ. They become more pronounced towards the front, but towards the beak they become faint, and many of them finally obsolete. They seem to be arranged, in many cases, in bundles of three. Fine, close crowded, concentric striæ occur.

This species, in its general aspect, is very similar to *S. becraftensis*, Clarke, of the Oriskany of Becraft mountain. It is, however, a more flattened shell and the striæ are more prominent and separated by wider interspaces. It also, in some respects, resembles *S. flabellum* (Whitfield) from the Dundee (?) of the Columbus region of Ohio.

Horizon and locality.—In the brown Amherstburg dolomite of the Upper Monroe, from the bed of the Detroit river. Rev. Thomas Nattress collection. Apparently rare.

Genus STROPHEODONTA Hall.

40. STROPHEODONTA VASCULOSA sp. nov.

(Plate XVII, Figs. 8-11.)

Shell robust and with extremely convex pedicle and almost as strongly concave brachial valve. Pedicle valve higher than wide, the umbo well elevated above the hinge line and strongly incurved. Surface of valve regularly curved for two-thirds to three-fourths

the distance from the beak to the front, when a moderate, though recognizable, change in the curvature occurs, the effect being to diminish the convexity towards the front. A similar change occurs in the transverse section, the shell thus having the appearance of flaring out towards the edge of the valve. This anterior portion is strongly marked by regular, parallel, bifurcating, vascular grooves. Hinge line forming the greatest width of the shell. Cardinal angles rectangular and slightly reflexed. Hinge area of moderate height, apparently without delthyrium or deltidium, and crenulated from near the center to the hinge extremities by oblique teeth which are coarser and thicker near the extremities and finer and longer towards the center. Interior of pedicle valve with two low, strongly diverging, dental ridges bounding the large, flabellate, muscular scars. A compound median groove (appearing in the internal mold as a grooved median ridge) divides the adductor scars, which are more deeply impressed than the large radially striate, diductor scars. Just within the rostral cavity, and on either side of the posterior end of the adductor scars, are two small, oval and rather deeply impressed cavities, which in the mold of the interior appear as pronounced calosities on either side of the beak. Interior surface of the valve strongly pustulose between the muscular area and the strongly striate, vascular margin. Surface characters of pedicle valve not observed. Brachial valve strongly concave. In young individuals it follows very closely the convexity of the pedicle valve. (See section, figure 10.) Hinge area less than that of pedicle valve.

Surface of brachial valve marked by fine radiating striæ at distant intervals. These are increased by interpolation of others of the same strength, towards the center and again towards the front.

This shell is of the type of *S. patersoni* from the Schoharie and Onondaga formations. It is, however, more ventricose and of less width. The striæ are of more nearly uniform thickness and the vascular markings are further characteristic. The corrugation of the surface, characteristic of *S. patersoni*, appears also to be wanting.

The shell corresponds much more nearly to the mutation *bonamica* Clarke, from the Lower Devonic of Delhousie, N. B. (Clarke, J. M., N. Y. State Mus. Bulletin 107, p. 271, with figure). It agrees closely with that type in the ventriocosity and the character of

the surface markings, but differs in being more regularly convex, and in the more strongly elevated and overarched umbonal portion. Our species also shows no inclination of the corrugations characterizing the younger portion of mut. *bonamica*. The hinge is furthermore denticulate throughout, whereas in *bonamica* it is denticulate only near the delthyrium. In the character of the vascular markings and muscular impressions it approaches closely to *S. incquiradiata* of the Schoharie.

Horizon and locality.—In the Amherstburg dolomite of Upper Monroe age (Upper Siluric) from Detroit river bed opposite Amherstburg, Ont. Coll. of Rev. Mr. Nattress.

41. STROPHEODONTA DEMISSA mut. HOMOLOSTRIATA mut nov.

(Plate XVII, Fig. 6.)

A number of impressions of brachial valves from the Amherstburg bed of the Upper Monroe show such close similarity to *S. demissa* that only by very careful examination can they be separated. In comparison with the typical form from the Hamilton Group, the Upper Monroe specimens are less convex and of proportionally greater height, though never attaining the actual size of the Hamilton forms. The cardinal extremities are rectangular, the beak of the pedicle valve elevated and increased to a slightly greater extent than in the Hamilton form. The hinge areas of both valves are somewhat narrower proportionally. But the most distinctive character is the regularity and uniformity of the striæ. They are moderately strong, rounded, and separated by interspaces equal to them in width or slightly wider. They increase both by bifurcation and by intercalation forwards. At irregular intervals strong concentric growth lamellæ occur. This mutation is even more closely similar to the representatives of *S. demissa* in the Onondaga and Schoharie formations. In fact, so far as can be judged with the material at hand they are identical.

Horizon and locality.—In the brown Amherstburg dolomite of the Upper Monroe. Specimens obtained from the bed of the Detroit river, opposite Amherstburg, Ont. Rev. Mr. Nattress coll.

42. STROPHEODONTA PRÆ-PLICATA sp. nov.

(Plate XVII, Fig. 12.)

Shell small, coarsely plicated, wider than high. Hinge area forming greatest width of the shell; cardinal angles nearly

rectangular, sides and front regularly rounded. Surface gently convex, except at the beak which is more strongly arched and incurved, being slightly raised in the hinge area. Transverse contour a gentle arch to the cardinal angles which are flattened out or slightly reflexed. About 8 or 10 coarse, rounded, rather strongly divergent plications occupy the center of the pedicle valve. Outside of this are two finer, while a third is suggested on the otherwise smooth cardino-lateral portions. Concentric lines fine, regular, but not strongly impressed, cancellate the plications.

Width 9.6 mm., height 6.5 mm. This species is surprisingly like the small, coarsely plicate Stropheodontas of the Traverse Group of Michigan, though differing in detail. There is no Siluric species known which resemble this.

Horizon and locality.—Amherstburg dolomite of Detroit river bed, opposite Amherstburg, Ont.

43. STROPHEODONTA sp.

Shell of medium size. Pedicle valve strongly convex with an elevated umbonal area, and with the beak closely curved in, so as to project but slightly above the hinge area. Hinge line shorter than the greatest width of the shell which is about one-third the distance from the beak to the front. Cardinal angles rounded. Sides and anterior portion subquadrangularly rounded. Surface marked by from 40 to 50 strong, rounded ribs, the longer of which extend to the beak, the others arising by successive intercalations of shorter ones. Towards the front the ribs are separated by a space somewhat wider than the thickness of the rib. Fine concentric striæ cancellate the ribs.

Width, 13 mm.; length of hinge line, 8.5 mm.; height, 10.5 mm.

Horizon and locality.—In the Amherstburg dolomite from the Detroit river bed. Rare.

Genus PENTAMERUS Sowerby.

44. PENTAMERUS PES-OVIS Whitfield.

(Plate XXX, Figs. 18-22.)

1882, March. *Pentamerus pes-ovis* Whitf., Ann. N. Y. Acad. Sci., Vol. II, p. 195; ibid. Vol. V, 1891, p. 513, pl. V, figs. 11-22; ibid. Geol., Ohio, Vol. VII, 1893, p. 414, pl. I, figs. 18-22.

Whitfield's description.—"Shell quite small, and of a somewhat

broadly triangular form, with depressed convex valves, the ventral side being nearly twice as deep as the dorsal, and more elongated at the beak, giving it the triangular character; cardinal slopes straightened and rapidly diverging; front broadly rounded.

"The species is known only in the condition of internal casts, and as thus seen, the ventral valve is deeply cleft along the median line by the removal of the central septum, the slit often extending more than three-fourths of the length of the valve. The filling of the spoon-shaped cavity is proportionally large, being long and narrow, and not strongly arched. Cast of the dorsal valve characterized by a proportionally large and broad cardinal plate, from which project two long and strongly divergent and distant crural processes, reaching far along the surface of the cast in some cases, while in others they are quite short. The surface of the valves has been destitute of plications, but is usually marked in the larger individuals by several strong varices of growth near the front margin, which give to the shell a prematurely old appearance for so small a species; the individuals seldom exceed five-eighths of an inch in length on the ventral side.

"The species is unlike any known form of a similar size, in the shallowness of the valves, in the erect character of the ventral beak, and in the deeply divided feature of the cast of this valve. The dorsal valve is much less marked, and is often destitute of any distinguishing feature."

Horizon and locality.—In the Lower Monroe formation of Adams county, Ohio. The individuals occur "in numbers densely packed together, but having the shelly substance entirely removed" (Whitfield). No specimens of this species have been seen, and the exact horizon is not determined. It is probably above the Greenfield dolomite, and perhaps above the Put-in-Bay beds.

Genus CAMAROTOECHIA.

45. CAMAROTOECHIA HYDRAULICA (Whitfield).

(Plate XXX, Fig. 17.)

1882. *Rhynchonella hydraulica* Whitfield, Ann. N. Y. Acad. of Sci., Vol. II, p. 194; ibid. Vol. V, 1891, p. 513, pl. V, fig. 17; ibid. Geol. Ohio, Vol. VII, 1893, p. 414, pl. I, fig. 17.

Whitfield's original description.—"Shell rather smaller than

medium size, transversely oval in outline and ventricose in profile, the dorsal valve being highly convex, and the ventral somewhat depressed convex. Beaks small, not prominent or conspicuous; that of the ventral valve moderately incurved. Surface of the shell marked by 16 to 18 simple plications, 4 of which are strongly elevated on the front half of the dorsal valve to form the mesial elevation, which does not extend beyond the middle of the valve, and 6 or 7 may be counted on each side of the valve. The plications are but slightly elevated, are round on the summit, and do not extend beyond the middle of the shell, the upper part of which is smooth, and marked only by concentric lines of growth. The interior of the dorsal valve is marked by a moderately strong mesial septum extending from the apex of the valve to about one-third of its length. The shell appears to have been also marked by fine concentric lines of growth, some of which form distinct varices."

"This species belongs to the semi-plicated group of the genus, of which there are many species having close resemblance to it, but none in rocks of corresponding age or position having very close affinities."

At the front of the shell, the median portion of the pedicle valve is prolonged into a strong linguiform extension, while correspondingly the brachial valve is incised.

Horizon and locality.—In the Greenfield dolomite at the base of the Monroe at Greenfield in northern Ohio.

46. CAMAROTOECHIA SEMIPLICATA (Conrad).

(Plate XVI, Figs. 13-14; Plate XX, Fig. 12.)

1859. *Rhynchonella semiplicata* (Conrad) Hall, Pal. N. Y., III, p. 224, pl. XXIX, fig. 1 a-o.

This species is represented by a number of individuals which are larger than the characteristic specimens of the Coeymans limestone of the Helderberg mountains, with which they otherwise agree.

In outline the pedicle valve is broadly ovoid, with the beak sloping at an angle slightly less than a right angle and scarcely incurved. Anterior half regularly rounded. Convexity of valve pronounced. A broad, flat-bottomed sinus occupies the median third of the anterior end, causing a rather pronounced deflection of the

frontal margin. On either side the sinus is flanked by a low, rounded plication, which becomes distinct about two-thirds the distance from the beak. A second, shorter and scarcely defined third plication is found outside of the first one. A few lines of growth are visible, but otherwise the upper end of the shell is entirely smooth. Dental plates marked by pronounced impressions.

Brachial valve less convex and more rotund in outline, with a less elevated beak, a pronounced median septum and a well marked spondylium. Muscular area marked by faint, radiating ridges.

A characteristic specimen measured 8 mm. in length by 6.75 mm. in greatest width. Another measures 9 mm. in length by about 7.8 mm. in width. The width of sinus from top to top of bounding plication at the anterior end is 4 mm., the bottom width being a little more than half that. Measurements of a characteristic specimen from the Coeymans limestone give: length, 6 mm.; greatest width, 6 mm.

The Monroe specimens further differ from the Coeymans type in having the plications more rounded and less pronounced.

In the Upper Manlius transition layers at Schoharie, N. Y., occurs a small variety (var. *angulata* Grabau, Bull. 92, N. Y. State Mus., p. 118) in which the plications are more angular, the sinus being further supplied with a median fold. A similar form is described from the Coeymans of Flatbrookville, N. J., by Weller. (Pal. N. J., III, pl. XXIX, figs. 12-19, p. 281.) Our own specimens are merely internal molds, and occasionally two very faint plications are suggested, in the sinus. The species compares not unfavorably with the young of *C. acinus* from the Clinton and Niagara.

Nettleroth figures (Kentucky Fossil Shells, p. 76, pl. 33, figs. 18-20) some specimens from the Niagara (Louisville) limestone of Louisville, Ky., which closely resemble our species. He identifies them as *C. (Rhynchonella) indianense*, but states that they differ distinctly from the Waldron forms of the species in the slight development of the plications which are rounded and occur only on the frontal margin. The pronounced median depression at the frontal margin of our specimens seems to be wanting in the Louisville limestone specimens and in that respect they resemble the younger stages of our form.

Rhynchonella gainesi Nettleroth from the "rotten hornstone of the Devonian * * * in Jefferson county, Ky." = Hamilton (Nettleroth, Kentucky Fossil Shells, p. 76, pl. 31, figs. 6-9) appears to be a very closely related type. It is somewhat more triangular and the frontal expression of fold and sinus is somewhat more abrupt. The plication of fold and sinus is faintly suggested in our specimens. Nettleroth's figures of *C. acinus* from the Louisville limestone likewise do not differ much from the specimens here described. (Nettleroth, pl. 26, figs. 6, 13 and 14, pl. 32, figs. 13-16.)

Horizon and locality.—In the Lucas or Upper Dolomite of the salt shaft at Detroit. Not uncommon. It is abundant in the Helderbergian (Coeymans).

47. CAMAROTOECHIA sp.

A broad species of the hemi-plicate type with well marked median septum occurs in the rock from the Monroe quarries. There are three well defined, rounded plications on each side of the median fold in the brachial valve. They reach about one-third the distance to the beak, the remainder of the shell being smooth. They are separated by spaces equal to them in width. About 4 similar plications constitute the median fold. The septum extends a little less than half the distance to the front of the valve. Width 7 mm., height 5.3 mm.

Horizon and locality.—In the Raisin river beds of the Monroe stone quarry. Rare.

Genus RHYNCHOSPIRA Hall.

48. RHYNCHOSPIRA PRÆ-FORMOSA sp. nov.

(Plate XX, Figs. 2, 3; Plate XXX, Figs. 15 and 16.)

1891. *Retzia formosa*, Whitfield, Ann. N. Y. Acad. Sci., Vol. V, p. 512, pl. V, figs. 15 and 16, ibid. Geol. Ohio, Vol. VII, 1893, p. 413, pl. I, figs. 15 and 16.

Whitfield's description.—"Shell small, the specimens observed not exceeding five-eighths of an inch in length, by about one-fourth of an inch or less in width; elongate-ovate in form, widest below the middle and narrowing at the beak on the ventral side, the apex being slightly incurved. Valves highly convex, with a slight de-

pression along the middle. Surface of the shell marked by about 22 simple, rounded, radiating plications, two of which in the middle of the valves are more slender than the others and depressed below their level, forming a slight mesial sinus on each valve."

"The shell, or rather the impression of the shell, of this species left in the rock, appears to represent an adult specimen, but is very much smaller than those of the Lower Helderberg group of New York, or those of *R. evax* in the Niagara group at Waldron, Indiana, but possesses all the essential specific characters of the species except in this one particular. The species as recognized in the Silurian rocks of Perry county, Tenn., resembles exactly this from Ohio, both in size and general characters. It has proven hitherto quite rare, but might possibly be found in greater abundance were it sought for, the specimens noticed occurring on blocks of stone selected for other fossils."

This species differs from *R. formosa* of the Helderbergian, with which Whitfield identified it, in several respects. It is smaller, as already noted by Whitfield; the brachial valve is more rotund, and the front is scarcely emarginate. In the center of the brachial valve a single thinner plication extends to the beak, and this is flanked on either side near the front by two shorter plications, which only extend half way or a little nearer to the beak. Outside of these on each side is a stronger one, and then the plications increase in strength to the middle one of each lateral group (7 in the specimens figured) beyond which they decrease again, the last plication on each side being thin, faint and short. In the pedicle valve a single median plication bifurcates almost one-third the distance from the beak. On either side of this are 7 plications, gradually decreasing towards the lateral margins. The beak of the pedicle valve is more closely incurved over that of the brachial valve than in the Helderberg species. On the whole the shell appears more robust than is the case with *R. formosa*.

Horizon and locality.—In the Greenfield limestone of Greenfield, Ohio. Rare. It may be looked for in the Lower Monroe beds of Michigan at a depth of 300 to 400 feet or more below the Sylvania.

Genus SPIRIFER.

49. SPIRIFER ERIENSIS Grabau.

(Plate XXXI, Figs. 2a-2b.)

1900, May. *Spirifer eriensis* Grabau, Bull. Geol. Soc. Am., Vol. II, p. 366, pl. 21, figs. 2 a-b.

1901. *Spirifer eriensis* Grabau, Geol. & Pal. of Niagara Falls, (Bull. 45 N. Y. State Museum, p. 199, fig. 119).

Grabau's original description.—"Shell small, pedicle valve strongly convex, almost ventricose, subrhomboidal in outline, with the beak much elevated and gently incurved. Mesial sinus pronounced; angular in the center with the sides nearly flat, gradually and uniformly increasing in width from beak forward. Sometimes it is slightly rounded in the bottom. It is prolonged at the front of the shell as a prominent rounded lip. On either side of the sinus is a moderately strong, broad, rounded, but not very prominent plication, in addition to which there are about three or four on either side, which are fainter and progressively become narrower, away from the sinus. Interspaces narrow, having the form of a depressed line, the broadest next to the plications adjoining the sinus. Brachial valve almost semicircular, moderately convex, with a straight hinge line, which is shorter than the greatest width of the valve. Beak elevated above the hinge line and incurved. Fold distinctly defined by a sharp, depressed line on either side, but not elevated much above the general surface of the valve. It gradually and uniformly widens forward, is broadly rounded on top, and is occasionally marked by a slight central depression. Ribs almost obsolete, a faint depression outlining the first on either side of the fold in some specimens. Surfaces of both valves marked by fine, uniform, and subequally spaced concentric lines which curve forward in the sinus of the pedicle valve. Occasionally strong lines mark a temporary resting stage during growth. The whole surface appears to be covered with fine radiating striæ, which are interrupted by the concentric striæ, thus giving the surface a fimbriate appearance.

"On the interior of the pedicle valve are two short dental plates diverging slightly more than the sides of the sinus.

"The cardinal area of this species is high, occupying, in some specimens, as much as a third of the total height of the valve. The strength of the ribs on the brachial valve varies somewhat in dif-

ferent specimens, but they are always much less marked than those of the pedicle valve, and they are usually quite obsolete.

"The species to which this most nearly approaches is the variety of *S. crispus* Hisinger, found in the Coralline limestone at Schoharie. In this variety the ribs are much fainter than in the normal *S. crispus* of the Niagara shales and limestones of western New York. In many specimens from Schoharie the ribs are almost obsolete, comparing well with their character in *S. eriensis*. In general the ribs of the later species (*S. eriensis*) are slightly broader and rather more flattened on top than is the case in the Coralline limestone species, and the interspaces are somewhat narrower. Taking all the variations into consideration, a very close relation must be accepted as existing between the two species.

"Width of the pedicle valve illustrated, 10 mm. length, 8.5 mm. Width of the brachial valve illustrated, 7.5 mm.; length, 6 mm."

Horizon and localities.—In the Akron dolomite, locally known as "Bullhead rock" of Williamsville, and more rarely at North Buffalo. The species has been recorded from the Cobleskill of Schoharie, but it appears that a very careful comparison of these types is necessary before the identity of Cobleskill and Bullhead species can be fully accepted. Species of a much higher horizon than the Akron have the extreme characters of this species.

50. SPIRIFER OHIOENSIS sp. nov.

(Plate XVIII, Figs. 1, 2 and 3; Plate XXIX, Figs. 4-5.)

1891. *Spirifer vanuxemi* Whitfield (non Hall). Ann. N. Y. Acad. Sci., Vol. V, p. 509, pl. V, figs. 4 and 5, and Geol. Ohio, Vol. VII, 1893. p. 411, pl. I, figs. 4 and 5.

Whitfield's description in part.—"The form is transversely oval in outline and convex in profile, on each side; the ventral being the most rotund, cardinal angles rounded and cardinal line short, ventral beak strongly incurved. The shell is marked on each side of the mesial fold or sinus by about four strong, rounded plications which are separated by concave spaces, which on the ventral valve appear of about equal width with the plications, but on the dorsal are narrower and somewhat sharper in the bottom. The mesial fold is fully twice as wide as the strongest plication, is somewhat regularly rounded or depressed convex, while the mesial sinus of the ventral valve appears narrower and deeply concave. The surface of the shell is marked by fine transverse or concentric striae which are strongly undulated in crossing the plications and fold, and under a magnifier are seen to present considerable regularity in size and arrangement."

The species is large for the *crispus* group to which it belongs; the length of the pedicle valve is proportionately less than in *S. vanuxemi* of the Manlius to which it bears a close resemblance. The plications are pronounced and well defined, largest on either side of the sinus and becoming smaller and shorter towards the cardinal margin. The interspaces are widest and deepest next to the largest plication which they nearly equal in width. They become less pronounced and almost obsolete away from the center. The fourth plication of the pedicle valve is generally very faint and short, and beyond that the valve is free from plications. The sinus is deep, broad and round bottomed. In one specimen only the first pair of plications, those next to the sinus, are developed. In a specimen with four strong and a fifth weak plication, a low median plication occurs in the bottom of the sinus, and the interplical space next to the sinus is nearly as wide as the sinus. The brachial valve has the beak but slightly elevated and incurved, the cardinal angles are rounded, and the greatest width of the shell is less than a third the length of the valve from the beak. Median fold pronounced and rapidly broadening forward, commonly with a groove down the center. Plications rarely more than 5 on either side of the fold. A very wide one occurs next to the fold, and beyond this the plications decrease in thickness and length rapidly. Interspaces narrow and sharp. Surface marked by fine regular concentric striae.

This species differs from *S. vanuxemi*, its closest relative, in the large size, which is about twice that of normal *S. vanuxemi*. The character of the plications is also distinctive. They are generally fewer and wider apart, but the chief difference is the rapid diminition in size of the plications from the center outward. The broad interspace next to the first plication in the pedicle valve is very pronounced, and the first pair of plications corresponding to it in the brachial valve is unusually large. The proportional greater width over height in the dimensions of our species is another distinctive feature.

Measurements.—A characteristic pedicle valve measured, width 17 mm., height 12 mm., length on curvature 14 mm. Another measured, greatest width 16 mm., height 12.3 mm. A large brachial valve measures 20 mm. in greatest width by 14 mm. in height.

This species is, in a measure, intermediate between *S. eriensis* and *S. vanuxemi* and may possibly form a connecting link between the two, though the geological position is not such as to warrant that assumption.

Horizon and locality.—Rather abundantly represented in the Put-in-Bay dolomites of Peach Point, Put-in-Bay island, Ohio. (Lake Erie.) Types in the Newberry collection of Columbia University (Cat. 3140, 3537, 12140 and 12139) associated with *Eurypterus eriensis.* The species should be looked for in the dolomites approximately 300 or 400 feet below the Sylvania in the Michigan well sections.

51. SPIRIFER SULCATA Hisinger mut. SUBMERSA mut. nov.

(Plate XVII, Figs. 4-6.)

Shell small, transverse, coarsely plicate. A small pedicle valve (fig. 4) is subsemicircular; twice as wide as high; strongly convex, with the hinge line forming the greatest width; the sides and front regularly rounded. Cardinal extremities acute. Beak moderately elevated and incurved. Surface marked by a deep median sinus which broadens rapidly and regularly forward, and the bottom of which is regularly rounded. It is flanked on either side by a strong, pronounced plication. A second weaker plication and a third faint or nearly obsolete one occur on either side, the intercostal spaces being wider than the ribs. Strong concentric lines at intervals, but the main sculpture of the concentric type not preserved. Dental lamellæ pronounced, outside of and parallel to the first pair of plications. They extend more than half way to the front. A well marked median septum occurs in this valve and extends more than half way to the front. One side of the shell is somewhat more extended than the other. Width 7.8 mm., height 4 mm. Brachial valve of another and much larger individual, somewhat wider proportionally than the pedicle valve, with a straight hinge line forming the greatest width of the shell, and ending in acute but not mucronate angles. Beak but slightly elevated above the hinge line. Median fold sharply defined, strongly elevated and flattened at the top but without median depression. On either side are four rounded plications, the strongest next to the median fold but separated from it by a wider depression; the fourth plication is short and faint. The interspaces are round bottomed, deep, and wider near the front than the plications and like these diminish in size and depth towards the cardinal extremities. Concentric lines mostly not preserved, but the indications are that they were strong. A second brachial valve is still larger and has an additional plication.

Measurements of two brachial valves (figs. 5 and 6).—Width 13.5 mm. and 20 mm., respectively; height, 6 mm. and 10.2 mm.

This mutation is much more like those from the Wenlock limestone of Dudley (Davidson, Sil. Brach., pl. X, fig. 5) than those from the American mid-Siluric. The British forms referred to have fewer plications, mostly only 1 or 2 on each side of the fold and sinus, and the intercostal spaces are narrower. The American Niagaran species have generally much more numerous plications and are proportionally less wide. The European form is also, as a rule, much larger than the American and in this respect comes nearer to our mutation.

Horizon and locality.—In the brown Amherstburg dolomite of the Upper Monroe (Detroit river series) from the bottom of the Detroit river opposite Amherstburg, Ont. Rev. Thomas Nattress collection. Two pedicle and two brachial valves.

52. SPIRIFER MODESTUS. Hall.

(Plate XVI, Figs. 11, 12, 24 and 25.)

1859. *Spirifer modestus* Hall, Pal. N. Y., III, p. 203, pl. XXVIII, figs. 1 a-e.

This little shell is represented by a number of external and internal molds in the Lucas dolomite of the salt shaft. The pedicle valve is smooth except for faint growth lines. The beak elevated and slightly incurved; the area is high, triangular and with a narrow base, forming scarcely more than a flat boundary of the large delthyrium. Dental lamellæ strong, converging slightly towards the bottom of the valve, and extended as thin sharp ridges for more than half way to the front of the valve, and much more widely separated than in the succeeding species.

Horizon and locality.—Not uncommon in the Lucas dolomite of the salt shaft, associated with *Prosserella lucasi,* etc. It was originally described from the Manlius formation of Cumberland,

Md. A comparison of our species with typical ones from Cumberland, Md., show their close correspondence, though it is not impossible that our specimens represent young of one of the larger species of Prosserella in which the separation of the dental lamellæ is more than a millimeter.

Width of average pedicle valve (figs. 29 and 25) is 9 mm.; height, 5 mm.+ (the entire shell is not preserved). Another smaller specimen measures, width 6 mm., distance between dental lamellæ on bottom of valve 1.2 mm.

Subgenus PROSSERELLA. s. g. nov.

This group is of the *glabrati* type of the fimbriate Spirifers. Smooth or with faint plications, with or without median sinus and fold and with a very narrow hinge area on the pedicle valve. The most characteristic feature is the disposition of the dental lamellæ which are mostly well developed and rest close together on the bottom of the pedicle valve, the separation being often not more than the thickness of the individual lamella. In rare cases, a complete union of the lamellæ is effected before the bottom of the valve is reached, when they form a spondylium supported by a single septum as in Cyrtina and Pentamerus. On the bottom of the valve or on the outside of the internal mold, the septa are parallel or even slightly convergent, whereas in other Spirifers they mostly diverge forwards. Outwards the lamellæ diverge gradually, thus producing a sharply defined, deep and narrow median cavity, occupying the rostral portion and extending forward about one-third the length of the shell. The brachial valve is always more transverse than the pedicle valve. It has a narrow, but sharply defined, area with a broad median chilidium, and a well developed, thickened, concave hinge plate which rests on the bottom of the valve and carries a well defined cardinal process more or less divided on its summit, but rarely projecting above the hinge area. Crural plates laterally define the hinge plate, and a faint median septum commonly divides the muscular area.

The fold, when developed at all, is mainly confined to the anterior portion of the shell.

This subgenus differs from Martinia McCoy in the presence of the well developed and closely parallel dental lamellæ. The type of Martinia (*M. glaber* Mart.) according to Waagen, is without dental lamellæ, but Dr. Hans Scupin (Die Spiriferen Deutschlands, Palaeontographische Abhandlungen von Dames & Koken, N. F. Bd. IV, Heft 3, p. 7, 1900) has found, in what he considers typical examples of that species, short and low dental lamellæ which are parallel on the bottom of the valve. The illustrations given show these plates to be very short, and though parallel, much farther apart than in our species. It should be noted in this connection that the dental lamellæ of *S. modestus* from the Manlius sometimes are approximately parallel, but they are never as close together as in Prosserella. The subgenus Martiniopsis was erected by Waagen (Pal. Indica Sec., XIII, Vol. 1, p. 524), for punctate Spiriferoids of the type of the more rounded of our species, but with the dental plates diverging forward, and with similar crural plates in the brachial valve. This genus probably has no close relation to any species, the similarities being homoeomorphic. The only American examples of this type so far recorded are from the Upper Monroe (Detroit river series) of Michigan and Ohio, to which division the genus seems to be restricted. It has many factors in common with *S. modestus*, its nearest relative, but the close set, parallel dental lamellæ form a markedly distinct feature. The specimens of this group have heretofore been referred to species of Meristella and to *Gypidula galeata*, to both of which individuals not infrequently bear a close resemblance. A species probably identical with our typical species is found in the Cobleskill of New York. In Europe *Spirifer inflatus* Schnur (*S. unquiculus* A. Rominger) seems to be the last representative of this type of structure. This species is characteristic of the mid-Devonic, and it is succeeded by the Carbonic Martinias to which it appears to form a transition. Judging from the specimens of this species from Grund, Hartz, the dental lamellæ of the Eifelian species are still strong enough to cause it to be placed in the subgenus Prosserella.

53. PROSSERELLA MODESTOIDES sp. nov.

(Plate XVI, Figs. 20, 22 and 23; Plate XVI, Figs. 28-30.)

Smooth or faintly plicate, general outline of pedicle valve quadrangular, with a strongly projecting and overarching beak, and with the sides sloping at an angle of from 50° to 60°. A very faint median depression, sometimes only a line, marks the center, and the anterior portion is moderately extended; cardinal margins

subangular to rounded; area moderate in size, divided by a narrow triangular deltidium.

Brachial valve transverse with the beak slightly elevated, but not incurved; area narrow. Anterior margin regularly rounded, as are also the cardinal angles. No median fold or depression.

Surface of valves in exfoliated specimens showing only concentric growth lines; but when the shell is preserved, and sometimes in the exfoliated specimens also, radiating lines are seen. These are sharply rounded, and distant several times their diameter, except near the front, where their number is increased by intercalation of new ones.

A characteristic internal mold from the Amherstburg brown dolomite of the Detroit (pl. XXI, figs. 28-30) shows scarcely any depression down the center but has a marked anterior prolongation. Indications of three to five faint rounded ribs are seen on either side of the median portion, becoming fainter away from the center. In all cases plications are absent on the young stages of the individuals. Concentric wrinkles are not infrequently seen on the molds.

The dental septa are from .5 to .8 mm. apart on the bottom of the valve in typical specimens. From this they diverge until at the aperture they are from 4.5 to 6 mm. apart. Where the dental lamellæ are more widely separated, a faint depression is often shown on the interseptal portion of the internal mold, corresponding to a faint median septum. This is sometimes more strongly developed in young individuals.

The best preserved pedicle valve measured in width 21 mm. by 18 mm. in length, without considering curvature. Actual length from tip of beak to base, measured along curvature, 24 mm. Length of hinge line, 15 mm. Greatest convexity, 7 mm.

A brachial valve measured 16 mm. in width, 12 mm. in height. Greatest convexity, about 3.75 mm.

A typical pedicle valve (pl. XXI), from the dolomites of the Detroit river, measures 22.5 mm. in width, and height, not considering curvature. In actual length the shell measures 30 mm. The width of the hinge area on the hinge line is 12 mm. and that of the delthyrium 5 mm. The length of the dental plates is 9 mm. on the bottom of the valve, and their distance apart is 0.5 mm.

This species is probably identical with the one figured and described by Hall as *Spirifer sp.* from the Coralline (Cobleskill) limestone of Schoharie (Pal. N. Y., II, p. 327, pl. 74, fig. 8). The specimen figured (Hall's fig. 8) agrees closely in form and size with the present species. Clarke (Guelph Fauna, pl. 4) figures a number of Spirifers of this type from the Shelby (Guelph) dolomite of Rochester, referring them provisionally to *S. bicostatus* and *S. crispus*. They show concentric striæ and a median depression in the pedicle valve. The brachial valve shows a faintly outlined fold. The dental plates in most of the specimens figured by Clarke diverge forward on the bottom of the valves, whereas those of the specimens from the Detroit river remain parallel. In the elongate specimen figured by Clarke as *Sp.* cf. *bicostatus* (pl. IV, fig. 21-22) and which appears to be identical with our elongate form (mut. *depressus*), the dental lamellæ remain parallel but they are much farther apart.

Sp. indifferens Barrande from Div. F, 2, is very similar to our species, differing chiefly in the more pronounced sinus. (Barrande Syst. Sil., Vol. V, pl. 3, figs. 5 a, c.)

Horizon and localities.—This species is represented by only a few individuals in the coral layer (Anderdon) of the Monroe, in the Detroit salt shaft. It is associated with Diplophyllum and other fossils characteristic of this bed. It is also found common in the Amherstburg brown dolomite from the Detroit river bed, opposite Amherstburg, Ont., associated with the mutation *depressus* and is also, though more sparingly, represented in the Amherstburg bed of the Patrick quarry on Grosse Isle.

54. Mutation DEPRESSUS nov.

(Plate XXI, Figs. 24-26, 31-33.)

This mutation differs from the typical form in having a more pronounced quadrangular outline, higher cardinal portion, more angular cardinal margins, smaller hinge area, a more pronounced median sinus, stronger plication and somewhat more widely separated dental plates. The sinus is generally shallow, flat-bottomed and widens gradually to the anterior end. In some cases, where the specimens become broader, the sinus is more rounded and the anterior end becomes more strongly depressed, in some cases forming a pronounced frontal emargination. The brachial valve in this case bears a strong, but ill defined, fold near the front only.

The plications are generally of moderate strength, broadly rounded and with narrow separations. There are from 5 to 6, rarely more, on either side of the center. The sinus sometimes also shows two very low, broad plicæ, one on each side of the center. In rare cases the plications are obsolete in this mutation. The dental lamellæ of this mutation are from 1 to 1.5 mm. apart on the bottom of the valve. Not infrequently they converge slightly forward. They are often continued forward for about half the length of the shell. A low median septum sometimes occurs between the dental lamellæ. The young of this mutation agrees quite closely with the typical form of the species in the absence of the median sinus, and the slight development of the plications. This is quite in accord with the stratigraphic relations of the forms, the mutation *depressus* being most characteristic of the Amherstburg bed while the species proper is characteristic of the Anderdon.

In the molds of the interior the sides of the ventral portion are flattened, while the hinge area is very narrow, sometimes hardly recognizable. In the species proper the cardinal sides are rounded and the hinge area well marked. The crural lamellæ of the brachial valve are moderately prominent, extending forward at the bottom of the valve for about a fourth of the distance. They diverge slightly, and between them a faint median septum occurs.

Horizon and locality.—This is the common form of the Amherstburg dolomite, being especially abundant in the Detroit river bottom opposite Amherstburg, Ont.

This mutation is not dissimilar to the specimen called *Spirifer* cf. *bicostatus* (Vanuxem) and figured by Clarke and Ruedemann from the Upper Shelby dolomite (Guelph) of western New York (Guelph Fauna, pl. 4, figs. 21 and 22). Our specimens are larger, the median sinus and plications are more strongly developed, and the dental lamellæ are closer together than in the Guelph species.

55. PROSSERELLA LUCASI sp. nov.

(Plate XVI, Fig. 21; Plate XIX, Figs. 2, 3; Plate XXI, Fig. 23.)

Subquadrate, smooth with pronounced median sinus and fold.

Pedicle valve strongly convex, with elevated, scarcely incurved beak, from which the sides of the shell diverge in nearly straight lines at an angle somewhat over 90°, for a little less than half the height of the shell, after which the margins become gently rounded to the slightly produced anterior end. A well marked

median sinus begins at the beak and gradually widens forward without much deepening. Rarely is the sinus represented by a mere flattening of the shell. In some of the broader mutations which lead to the next species, the sinus is broad and deep and faintly margined by elevated plications. Fine lines of growth and occasional coarser concentric wrinkles characterize the surface.

The dental lamellæ are close together and extend forward for about one-third the height of the shell. They converge perceptibly towards the front. Hinge area high but narrow.

Brachial valve shorter and more transversely extended, with a pronounced median fold which is strongest towards the front of the shell where it extends forward in a nasute manner. Strong, short and closely set crural lamellæ characterize this valve, while a faint median septum extends nearly to the center of the valve. Growth lines as in pedicle valve.

A characteristic pedicle valve of this species from Lucas county, Ohio, measures, length 21 mm., height 16 mm., greatest width 17 mm.; a brachial valve measures, height 14.4 mm., greatest width 16.3 mm. A pedicle valve from the Upper Lucas dolomite of the salt shaft measures, height 14 mm., greatest width 15 mm.

Horizon and localities.—This species is quite common in the Lucas dolomite (upper dolomite) of the salt shaft. It is abundantly represented in the Lucas dolomite of the Webster quarry near Sylvania, in Lucas county, Ohio, and not uncommon in the same formation on Grosse Isle. It is rarely found in the Woolmith quarry. A single brachial valve has been found in the Anderdon of the Anderdon quarry. This species appears to have its European analogue in *Spirifer superstes* Barrande of Etage G. 1.[2] in the Bohemian Basin, the form figured by Barrande from Dworetz (Syst. Sil., Vol. V, pl. 123, fig. 3 a-c) comes nearest to our species though the median portion in the pedicle valve is characterized only by a narrow depression. In the variety from Chotecx (Barr. fig. 2) the pedicle sinus is, however, well developed.

56. PROSSERELLA SUBTRANSVERSA sp. nov.

(Plate XXI, Fig. 27; Plate XVIII, Figs. 7, 9; Plate XIX, Figs. 1, 4, 5-6, 7-8, 12, 13.)

Of medium size, transversely extended for the genus, with rounded cardinal extremities, surface faintly plicate. Sinus and

[2]Now regarded as Devonic.

low fold present. Pedicle valve subrhomboidal, with moderately elevated beak; the cardinal slopes rounded and diverging at an obtuse angle. Greatest width behind the middle; frontal margins regularly rounded to the slightly produced base. Sinus a shallow median depression gradually widening from beak to base, the center often somewhat sharply depressed and the sides smoothly sloping to it. On the internal mold the impressions of two slightly diverging muscular areas produce two faint ridges in the sinus. On either side of the median depression are from 5 to 7 low rounded plications separated by interspaces of similar width or slightly narrower. The plications rarely extend beyond the middle of the shell and generally are found only near the front. Young individuals are nearly or quite smooth (fig. 7). Hinge area narrow, cardinal margins rounded. Dental lamellæ close together, extending for about a third the length forward, and slightly converging. Brachial valve strongly transverse, with hinge line somewhat less than half the width of the valve. Beak slightly projecting above the hinge line. Area narrow, obtusely triangular. Median fold generally only developed near the front, and never definitely outlined. Generally represented only by a faint median accentuation of the curvature of the shell. Crural lamellæ strong and short; rising from bottom of valve close together and diverging outward to chilidial margins. They continue forward for a short distance, then converge and are continued forward in a faint median septum. The hinge plate enclosed by the lamellæ, has the character of a shallow spondylium resting on the bottom of the valve. Adductor scars strongly excavated.

This species is a near relative of *S. eriensis* Grabau. It is larger and more robust and also more transverse, yet the resemblance is close. *S. eriensis,* however, has diverging dental lamellæ and belongs to another subgenus.

Measurements.—Pedicle valve measures, height 13 mm., length 15.5 mm., width 17 mm. Another pedicle valve measures, height 12 mm., length 15 mm., width 14.5 mm., width of area 7.3 mm., height of brachial valve 11 mm. A large specimen measures, height 17.5 mm., length 22 mm., width 20 mm., height of brachial valve 15 mm.

Horizon and localities.—Common in the Amherstburg bed of the Woolmith quarry; also in same bed in Detroit river (Pl. XII, fig. 9). Brachial valves of this type occur in the Lucas of the salt shaft, and the species is not uncommon in the Lucas of the Patrick quarry on Grosse Isle, and in the Gibraltar quarry. It has also been found in the same formation at Silica (Sylvania), Ohio.

A characteristic internal mold of a brachial valve from the Lucas beds of the Gibraltar quarry (Pl. XXI, fig. 27, pl. XIX, fig. 12) shows a narrow, sharply defined hinge area, a little wider than half the greatest width of the valve; a pronounced thickened hinge plate resting on the bottom of the valve and bounded by a short, sharp crural ridges; deep, oblique dental sockets; a slightly elevated, five-lobed cardinal process, and excavated muscular areas divided by a faint median septum, the continuation of the median portion of the hinge plate. The median fold is scarcely defined, and on either side of it, towards the front of the shell, appear five rounded plications. The greatest width of the shell is at the center, the measurements being, width 18 mm., length 15.5 mm., width of hinge area 11 mm.

This species is very closely related to the more transverse forms of *Spirifer inflatus* Schnur (*Spirifer unguiculus* A. Roemer non Sowerby) from the middle and upper Devonic of Germany, etc. Characteristic specimens from Grund, in the Hartz, are with difficulty distinguished from some of our specimens. The tendency to form plications and the rather more prominent median sinus characteristic of our forms are almost the only marked differences. The brachial valves of our species are a little more strongly arched near the front, but in structure they seem to agree closely with the European form. The subgeneric characters also agree. Short dental lamellæ are found in the pedicle valve, these being parallel on the bottom of the valve, and close together. They are, however, much shorter and weaker and somewhat farther apart than in our species.

57. Mut. ALTA. mut. nov.

(Plate XVIII, Fig. 10.)

This mutation is subrhomboidal in outline with strongly elevated and incurved beak. Median sinus rather sharply depressed, and marked alternately by a projecting lip. Hinge area narrow and high, dental lamellæ parallel on bottom of valve and about 3 to 4 times their thickness apart.

This mutation is almost identical in form with *S. eriensis*

Grabau of the Greenfield limestone, being, however, twice as large as that species. It is quite distinct in the character of dental lamellæ.

Horizon and locality.—Occurs rarely with the preceding.

The specimen represented by fig. 4 and figs. 5 and 6 of plate XIII, may also be designated distinct mutations. The first is characterized by narrow, sharp, though not very high plications, extending more than two-thirds the distance to the beak, and separated by wide interspaces. It has a pronounced, though shallow sinus, and short, somewhat distant, but parallel, dental plates. This may be designated mutation X. The other (figs. 5-6) is smooth, without sinus or plications and with a high hinge area, in both valves. The outline is also more rounded. This may be designated mutation B.

58. PROSSERELLA UNILAMELLOSUS sp. nov.

(Plate XIX, Figs. 9-11.)

Pedicle valve subrhomboidal in outline, with a strongly elevated, slightly incurved beak. Cardinal slopes concave; cardinal area high and narrow. Greatest width one-third the distance from hinge line to front. Cardinal angles rounded. Antero-lateral margins gently curving to the front which is prolonged in a round anterior lip. A well marked median sinus extends from beak to base, gradually widening, and with faint indications of plicæ in the sinus. A few rounded or subangular plications occur on each side of the sinus. These become fainter towards the cardinal angles. Upper half of valve without plications. Dental lamellæ uniting into a spondylium, the union being close to the shell but far enough away to allow the formation of a very low, single median septum.

In the formation of the spondylium a distinctly Cyrtiniform stage is reached, the other characters, however, being those of Spirifer (*Prosserella*).

In form and proportion this species coincides with *S. eriensis,* except that it is twice as large. As before noted, the disposition of the dental plates forms one of the readiest means of distinguishing the two. The uniting of the dental lamellæ in this species is a unique feature not known in any other Spirifer and leading directly to Cyrtina.

Horizon and locality.—In the Lucas dolomite of the Patrick quarry, Grosse Isle.

59. PROSSERELLA PLANISINOSUS. sp. nov.

(Plate XVI, Figs. 19 and 26; Plate XVIII, Fig. 8.)

Shell large for the subgenus. Pedicle valve transverse, subrhomboidal; regularly arched from beak to base. Beak strongly projecting, slightly incurved over the moderately high, arched area. Cardinal angles rounded. Area occupying about three-fourths of the greatest width of the shell, with rounded margins. Anterior end regularly rounded; surface smooth, except for a faint median depression, which is very gently convex in the center, but has rather pronounced marginal depressions, which, however, extend but little below the general level of the valve. The general aspect is that of a faintly depressed, flat-bottomed, very slightly diverging sinus. External mold marked by faint concentric lines of growth which are more prominent towards the front.

Greatest width, 26 mm., height 20 mm., or the length 25 mm., taking into account the convexity. At a somewhat earlier stage the width is 24 mm., the height 16.5 mm., or the length 20 mm., considering the convexity. Width of sinus at anterior end, 8 mm. at the top, 6 at the bottom. Convexity about 8 mm. Height of beak above hinge line, 3.5 mm.

A number of brachial valves found associated with the pedicle valve described probably belong to this species, although they are all smaller than the pedicle valve of the individual above described. (Pl. XVI, fig. 29.) Only a fragment of a pedicle valve corresponding to these in size has been found.

The brachial valves are gently convex, subhemispheric in outline, with the beak slightly projecting above the hinge line, which forms somewhat less than the greatest width of the valve. Cardinal extremities rounded. Frontal margin nearly uniformly rounded. Surface smooth, except for the low, convex, and rather flattened, but sharply defined median fold, which gradually widens and increases in strength towards the front. A single impression has been found which indicates faint plications on the lateral margins, as in *S. eriensis,* and rather strong concentric lines of growth.

A characteristic specimen is 13 mm. in width by 9 mm. in height.

Another specimen measures 14 mm. in width, by 10 in height. The width of the fold near the anterior end is 4.75 mm.

The valve is of the type of *Sp. eriensis* Grabau from the Bullhead of western New York. It is, however, larger and somewhat wider proportionally than the specimens from that region, and the cardinal extremities are more rounded. In the Cobleskill of eastern New York occur brachial valves so similar to those described here, that it will be difficult to make a distinction between them. (Pl. XVIII, fig. 8.) They are transverse with a well defined, though low, fold gradually, and toward the front more abruptly, widening forward. There are no plications, but concentric growth lines are marked. Whether these brachial valves belong to the Prosserella type of Spirifer, or are those of a large *S. eriensis,* as commonly held, is undetermined. Greatest width of the brachial valve from the Cobleskill of Schoharie here figured, 17 mm., height 12 mm., length of hinge area 12.5 mm., width of fold at front 6 mm.

Horizon and localities.—In the upper (Lucas) dolomite of the salt shaft associated with *P. lucasi* from which it is readily distinguished by its transverse form, deep, flat-bottomed sinus, and sharply defined fold of the brachial valve.

Genus HINDELLA Davidson.

To this genus are provisionally referred two species from the Greenfield beds heretofore described under Meristella and Whitfieldella. They differ from both in the absence of a median septum in the brachial valve, agreeing in this respect with Hyattella, with which genus the muscular markings and the character of the hinge plate and dental lamellæ also agree. The form, however, is Whitfieldella-like, Hindella apparently agrees with this diagnosis, though Hall and Clarke state that the hinge plate, which is constructed on the same plan as that of Meristina and Whitfieldella, * * * "Is supported by a median septum extending for about one-half the length of the valve." Their cross sections, however, show no such median septum. If the septum is a characteristic feature of Hindella, our species will have to be referred to a new genus. In that case Greenfieldia would not be inappropriate with *Hindella? whitfieldi* as the genotype.

60. HINDELLA? (GREENFIELDIA) WHITFIELDI sp. nov.

(Plate XIX, Fig. 4; Plate XXI, Figs. 11, 17-19; Plate XXX, Figs. 8-10.)

1891. *Meristella bella* Whitfield. Ann. N. Y. Acad. Sci., Vol. V, p. 510, pl. V, figs. 8-10; and Pal. Ohio, Vol. VII, 1893, p. 412, pl. I, figs. 8-10.

1900. *Meristella bella* Sherzer. Geol. Surv. Mich., Vol. VII, p. 223, pl. XVII, figs. 8-10.

Not. 1857. *Meristella bella* Hall, 10th Rep. State Cat. Nat. Hist., p. 93, figs. 1-7; and Pal. N. Y., Vol. III, 1859, p. 248, pl. 40, figs. 1 a-p.

Shell subquadrangular to subpentagonal in outline with the valves strongly convex, the pedicle valve more so than the brachial.

Pedicle valve with the beak slightly incurved and truncated by a circular foramen visible in some cases. Surface regularly convex from beak to frontal margin; greatest convexity about one-third the distance from the beak. Center of valve marked by shallow mesial depression which begins in the region of greatest convexity and becomes more pronounced forward, at the same time becoming broader.

Brachial valve subrhomboidal in outline with the beak scarcely elevated above the hinge line; greatest convexity in the middle third; a very faint mesial fold corresponding to the sinus is occasionally indicated; more generally the surface is regularly convex, or even a faint mesial depression may occur. Frontal margin slightly sinuate from the fold and sinus. Surface marked only by concentric growth lines.

On the interior the muscular scars of the pedicle valve are slightly excavated and bounded by somewhat prominent dental lamellæ. The hinge plate of the brachial valve is medially divided, and there is no median septum. Character of the brachidium unknown. This species is similar to *Hindella prinstana* (Billings) from Div. 1, Anticosti group. Whether the internal characters of the two agree, remains to be ascertained.

A characteristic specimen measures, total height 16 mm., height of brachial valve 13 mm. Greatest width 15 mm.; greatest depth of another pedicle valve 7 mm. Another characteristic brachial valve measures, height 13 mm.; greatest width 15 mm.

Horizon and locality.—This species is common in the Greenfield dolomite of Greenfield, Ohio, where it is associated with *Camarotoechia hydraulica, Retzia præformosa, Schuchertella hydraulica* and *Leperditia alta,* as well as the next species.

61. HINDELLA? (GREENFIELDIA) ROSTRALIS. sp. nov.

(Plate XXI, Figs. 1-2, 7.)

Shell robust, higher than wide, with valves strongly convex, the convexity of the pedicle valve slightly exceeding that of the brachial.

Pedicle valve with the greatest convexity a little behind the center, strongly arching toward the lateral margins, which are regularly curved to a slightly extended frontal portion. Center of valve with a pronounced mesial sinus which produces a marked sinuosity in the frontal margin. Brachial valve subcircular, greatest convexity in the posterior third, center slightly elevated near the front into a rounded median fold. Surface of both valves smooth with the exception of lines of growth.

Interior of pedicle valve with a deep rostral cavity and pronounced dental plates which are nearly parallel, and possess faint lateral supporting plates like those of Whitfieldella. Center of rostral cavity depressed into a deep, narrow, elongate groove, divided by a faint, sharp median septum into the two diductor scars. Forward the sides of the groove diverge, and the median septum thickens bearing the anterior adductor scars. In some cases the septum scarcely begins until the sides of the muscular pit diverge. The internal mold agrees in all its muscular characters with *Hyatella congesta*. The form, however, is Whitfieldella-like. Hinge plate of brachial valve divided medially by a deep cleft. A characteristic internal mold measures, length, 20 mm.; height, 15 mm.; height of brachial valve, 13 mm.; greatest width, 14 mm.

Horizon and locality.—In the Greenfield division of the Monroe formation at Greenfield, Ohio, associated with the preceding. Type in coll. Columbia University, Cat. No. 3540.

62. HINDELLA? (GREENFIELDIA?) ROTUNDATA (Whitfield.)

(Plate XXX, Figs. 11-14.)

1882. *Nucleospira rotundata,* Whitfield. Ann. N. Y. Acad Sci., II, p. 194, pl. V, figs. 11-14, and Geol. Sur. Ohio, VII, 1893, p. 413, pl. I, figs. 11-14.

1900. *Nucleospira rotundata,* Whitfield Sherzer, Geol, Sur. Mich., Vol. VII, p. 223, pl. XVII, figs. 11-14.

Whitfield's description.—"Shell attaining a rather large size for the genus (Nucleospira), being often more than half an inch in transverse diameter, and when of medium or large size, strongly ventricose or rotund. The younger individuals, however, are depressed, convex or lenticular in profile. Length of shell as great or greater than the transverse diameter. Beaks small and incurved, not at all conspicuous. Valves marked by a slight depression along the median line, strongest on the ventral side."

Horizon and localities.—The species described by Whitfield occurs in the Greenfield dolomite of Greenfield, Ohio, where it has been obtained as external and internal molds, often indistinguishable from the internal molds of *Hindella (?) whitfieldi*, the originals from which Whitfield's descriptions were made have not been seen, and none of the specimens from Greenfield, Ohio, in the collection of Columbia University show the characters of this species.

Genus WHITFIELDELLA Hall and Clarke.

63. WHITFIELDELLA cf. NUCLEOLATA Hall.

(Plate XXXII, Fig. 3a-b.)

1852. Compare *Atrypa nucleolata* Hall. Pal. N. Y., Vol. 2, p. 328, pl. 74, fig. 10 a-m. 1900. *Whitfieldella cf rotundata* (Whitfield) Grabau, Bull. Geol. Soc. Am., Vol. XI, p. 68, pl. 22, figs. 3 a-b.

Grabau's description.—"Shell small, subcircular in outline, with valves moderately convex, pedicle valve more strongly convex than brachial, slightly longer than wide, with a pointed, gently incurved, and slightly overhanging beak. The greatest convexity of the valve is a little posterior of the center from which point the contour descends toward the beak, at first with a gentle, and then with a more abrupt curvature. The final portion of the curve of the beak is approximately at right angles to the plane of contact between the valves. Anteriorly the slope is a uniform curve. A faint medial flattening or depression occasionally occurs; rostral cavity deep; teeth supported by short, strongly diverging dental lamellæ, which appear to lie just beneath the cardinal slopes; surface marked by numerous lines of growth and by frequent (in some specimens) stronger concentric wrinkles; brachial valve less convex than the pedicle with the beak closely incurved beneath that of the pedicle valve. In some specimens the cardinal slopes are less rounded, giving the posterior portion of the shell a subtriangular aspect."

"The subcircular expression of the shell, its moderate and uniform convexity, and the gently incurved beak distinguish the species. It was originally compared with Whitfield's *Nucleospira rotundata* from Greenfield, Ohio, but that species is usually represented by larger and more robust shells.

A comparison with *Whitfieldella nucleolata* Hall of the (Cobleskill) limestone of Schoharie shows considerable similarity between the two species, so much so, that it is difficult to consider them other than conspecific.

A brachial valve measures a millimeter in length and 8 mm. in width. The convexity of the valve is 2.5 mm.

Horizon and locality.—In the soft, friable, bituminous "Bullhead" or Akron dolomite. The only locality from which it has so far been obtained is Akron, in Erie county, N. Y. It occurs chiefly in the young molds, both external and internal, the shell being wholly dissolved. Characters of the exterior are often impressed on the internal mold from pressure contact. Occasionally the mold is filled with crystalline calcite, which forms a perfect cast of the shell. The types from western New York are in the state collection at Albany.

64. WHITFIELDELLA PROSSERI sp. nov.

(Plate XXI, Figs. 3, 8, 9, 12-13; Plate XXX, Figs. 6-7.)

1891. *Meristella laevis* Whitfield. Ann. N. Y. Acad. Sci., Vol. V, p. 510, pl. V, figs. 6 and 7, and Ohio Pal., Vol. VII, 1893, p. 411, pl. I, figs. 6 and 7.

1900. *Meristella laevis* Whitfield. Sherzer, Geol. Sur. Mich., Vol. VII, p. 223, pl. XVII, figs. 6 and 7.

Not 1842. *Atrypa laevis* Vanuxem, Geol. Rep. 3rd Dist. N. Y., p. 120, fig. 2.

Not 1859. *Meristella laevis* (Vanuxem) Hall, Pal. N. Y., III, p. 247, pl. 39, figs. 3, 4.

Shell of medium size, elongate, with strongly convex, smooth valves. Pedicle valve arcuate from beak to base; greatest convexity in the umbonal region. Beak curved to a 90° angle with the edge of the valve apparently truncated by a circular foramen. The center of the valve is marked by a median depression which begins a short distance below the beak and, extending forward, gradually broadens without much deepening. Near the anterior end this sinus is gently rounded, sometimes almost flat-bottomed. On the anterior end the sinus is expressed in the form of a slight rounded projection. Surface marked by concentric striæ, which at intervals, in some specimens, become strong wrinkles near the front.

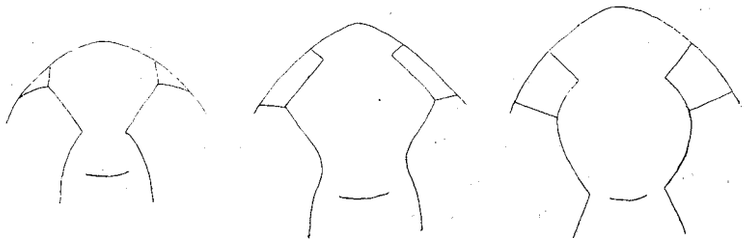
On the interior the deltidial margins are supported by delicate dental septæ. These arise from the bottom of the valve on either side of the center and at first are inclined outwards for about one-half their height, and then turn rather abruptly upwards, making a marked angle. Near the upper end they bend outward again to the margins of the delthyrium. At the lower angle a thin, short plate springs outward and upward connecting the septum with the shell. This plate is marked in the internal mold by a pronounced slit, cutting the mold of the lateral rostral chambers. (Pl. XXI, fig. 9.) The aspect of the whole is that of a broad spondylium resting on the bottom of the valve and supported laterally by the secondary lamellæ. Anteriorly the dental lamellæ extend as low, slightly outward curving ridges, which between them enclose a longitudinally striated muscular area.

Brachial valve subquadrangular, the width slightly greater than the height; somewhat less convex than the pedicle valve, and regularly arched, without median fold. In some cases the faintest longitudinal depressions occur near the front, in the lateral third of the slope, thus giving a suggestion of a median fold. The beak projects slightly above the cardinal line, being incurved. The postero-lateral margins are more or less regular curves, the antero-lateral ones have their outline curved to a larger radius, thus making the sinus appear rather truncate. The anterior margin is slightly emarginate corresponding to the projection of the pedicle valve. Surface marked by lines of growth and in some specimens by irregular wrinkles.

On the interior a strong, sharp septum extends from the beak to something over one-third the distance to the front. Just below the beak it divides at the top, carrying a small but pronounced spondylium (cruralium). The sides of the spondylium curve out to the margin of the shell, joining it about half way between the elongate, narrow dental socket, and the beak.

Observation.—This species seems to be a direct successor of the mid-Siluric Whitfieldellas, suggesting especially in its form *W. nitida* of the Niagara. In that species, however, the posterior

angle of the dental plates, from which the lateral supporting plates spring, is much nearer to the beak, so that it is sometimes hardly recognizable (Fig. 9 A). The spondylioid muscular area is similarly shorter, being confined to a small portion of the rostral cavity. In other respects the muscular scars are quite similar.



(A). *W. nitida* (Niagaran). (B). *W. prosseri* (Lower Monroan). (C). *W. oblata.* (Niagaran).

Fig. 9. Mid Siluric Whitfieldellas.

In *W. oblata,* from the Niagara beds of western New York, the angle carrying the supporting plates is rounded off, while the whole is still further removed from the beak by the lengthening of the posterior outward diverging ends of the septa.

Measurements.—A characteristic pedicle valve measures, length 25 mm., height 20 mm., greatest width 16.25 mm. The specimen figured by Whitfield measures, length 16.5 mm., height 13.5 mm., width 12 mm. Two brachial valves measure respectively: length 15 and 15 mm., height 12.5 and 12.2 mm., greatest width 13.2 and 12 mm. The largest brachial valve seen measures, length 18 mm., height 16.2 mm., greatest width 17.1 mm.

Horizon and localities.—This species is the most characteristic one of the dark, compact calcilutites of the Raisin river dolomite series. It is abundant at Newport and Monroe, Michigan, and in the salt shaft 87 to 138 feet below the Sylvania sandstone, and is also found in the dolomites of Stony Point and N. Sandy Creek, Monroe county, Michigan. It occurs again in the same beds at Holland, Lucas county, Ohio. The species was originally described by Whitfield under the name *Meristella laevis* (see ante) and cited from Greenfield, Highland county, Ohio. Whitfield's type is in the Newberry Palaeontologic collection of Columbia University (Cat. 14251). There are three pedicle and two brachial valves on a fragment of dark calcilutite with typical conchoidal fracture. The rock is identical in every respect with the rock of Newport and of Monroe, containing the same species and also with fragments of rock from Holland, Lucas county, in which this same species occurs. These fragments belong to the Newberry collection and bear the original locality label pasted on the specimen. The fragment credited to Greenfield, Highland county, has no locality label pasted on it, but is accompanied by a label written after the publication of Whitfield's paper. The fragment has not even the catalogue number of the Columbia collection attached to it. Furthermore, the rock is wholly unlike that of all the other material from Greenfield, Ohio, nor does the Greenfield or Ballville material carry this species. It thus seems certain that Whitfield's citation of the locality of this species is erroneous and due to a loss of the original locality label. The lithic identity of this fragment with those from Lucas county and the occurrence of the same species in both, argues strongly for the identity of locality, i. e., Holland, Lucas county, Ohio, in beds below the Sylvania. Typical examples of this species occur in the collection of Columbia University, labeled Peach Point, Put-in-Bay island. They are not associated with any of the typical Put-in-Bay fossils, and this suggests that the beds from which these specimens are derived overlie the Put-in-Bay formation, and form the highest beds of the island.

65. WHITFIELDELLA SUBSULCATA sp. nov.

(Plate XXVII, Fig. 4 a-d.)

1859. Compare *Meristella laevis* (Vanuxem) Hall. Pal. N. Y., Vol. III, pl. 39, fig. 1.

Not 1842. *Atrypa laevis* Vanuxem. Geol. Rep. 3rd Dist. N. Y., pl. 120, fig. 2.

1900. *Whitfieldella* cf. *laevis* (Whitfield) Grabau. Bull. Geol. Soc. Am., Vol. XI, pp. 369-370, pl. 22, fig. 4 a-d; ibid. Bull. 45, N. Y. State Mus. Nat. Hist., 1901, p. 204, fig. 130.

Grabau's original description.—"Shell small, the largest specimen obtained not exceeding 10 mm. in length. Pedicle valve broadly ovoid, gibbous, the greatest gibbosity in the umbonal third. Longitudinal contour, a symmetrical curve, descending more abruptly in the umbonal region. Transverse contour a symmetrical arch flattened at the top, and with steep sides, which approach verticality in the umbonal region. A faint depressed line runs down the center near the beak to the anterior margin. Surface

marked by fine concentric growth lines and by coarser wrinkles appearing at intervals.

"Rostral cavity of moderate depth; teeth strong and rounded, supported by two thin but prominent dental lamellæ which diverge but slightly and arise from the bottom of the valve. Beak apparently truncated by a circular foramen of moderate size. A strong, rather broad, and not distinctly defined median elevation divides the muscular area, which appears to be longitudinally striate. The ridge broadens forward and at the same time becomes more and more obsolete. The rostral portion of the pedicle valve of this species is strongly compressed laterally, the sides converging uniformly. This gives the shell an elongate appearance, while the actual length is but slightly greater than the width. There is some variation in this, in some cases the length being scarcely more than the width.

"Brachial valves somewhat less convex than the pedicle, with the beak incurved beneath that of the pedicle valve. The ovoid form, very slightly diverging dental lamallæ, and the median ridge dividing the muscular impression, distinguish this species from the preceding one."

To the above need only to be added that the mesial sinus of the pedicle valve sometimes becomes quite pronounced near the anterior end, where it is the cause of a sinuosity in the frontal margin; that a low, faint fold corresponds to it on the anterior part of the brachial valve; that the upper third of the brachial valve has the greatest convexity, this convexity exceeding that of the pedicle valve, and that the median septum of the brachial valve is pronounced and broadens towards the beak.

Measurements of a characteristic specimen show: length of pedicle valve 12.5 mm., height 11 mm., length of brachial valve 11.5 mm., height 10 mm., greatest width 10.2 mm.

Horizon and localities.—In the Akron dolomite (Bullhead) of Buffalo, Akron and Williamsville in western New York, and apparently also in the Greenfield dolomite of Greenfield and Ballville, Ohio.

66. WHITFIELDELLA SULCATA, (Vanuxem).

(Plate XXXII, Figs. 2 a-d.)

1842. *Atrypa sulcata* Vanuxem, Geol. Report of 3rd Dist. N. Y., p. 112, fig. 5.

1843. *Atrypa sulcata* Hall, Geol. Report of 4th Dist. N. Y., p. 142, fig. 5.

1859. *Merista bisulcata* Hall. Pal. of N. Y., Vol. III, p. 253.

1900. *Whitfieldella sulcata* (Vanuxem) Grabau, Bull. Geol. Soc. Am., Vol. II, pp. 367-368, pl. 22, fig. 2 a-d.

Grabau's original description.—"This characteristic Manlius limestone species is quite common in the Bullhead (or Akron dolomite) limestone of North Buffalo and Akron. The individuals are of the size of the specimens figured by Vanuxem and Hall and agree closely with them in form and proportions. The shell is ventricose, elongately ovoid to subpentagonal in outline, most bulging in the posterior third. The beak of the brachial valve is considerably more elevated. The mesial sinus of the pedicle valve is well developed, narrow and prominent near the front; that of the brachial valve is less prominent, being more of the nature of a flattening near the anterior margin. The concentric lines of growth are very fine and occasionally interrupted by strong wrinkles. Near the front of the pedicle valve, in mature or senile individuals, an abrupt change of growth occurs, the relative size of the valve becoming progressively reduced with further growth. On this portion of the shell the lines of growth are more prominent.

"This shell is readily recognized by its elongate character, strong ventricosity, and well marked, sharp mesial sinus in the pedicle valve. It is not uncommon in the more compact portions of the rock, but in the porous portions it appears usually as hollow molds.

"The measurements of an average pedicle valve are: length 9.5 mm., width 7.5 mm., convexity 3.5 mm."

Horizon and locality.—In the Bullhead or Akron dolomite of North Buffalo and Akron in western New York. Common. Originally described from the Manlius of eastern New York.

67. WHITFIELDELLA sp.

(Plate XXI, Fig. 10.)

Shell large for the genus, broadly ovate with rather contracted and pointed, somewhat incurved beak in the pedicle valve. Dental lamellæ approach closely on the bottom of the valve, rostral cavity deep and narrow. Muscular scars slightly raised, narrow

and elongate, terminating rather abruptly above the middle of the shell; longitudinally grooved.

Surface characterized by concentric lines, stronger ones occurring at intervals. Only one fragmentary specimen is known. The muscular area is different from that of any species of the genus known, but the general character is that of Whitfieldella. It comes perhaps nearest to *W. nitida* but is distinct in its broad outline and large size. The muscular impressions are quite distinct from those of *W. oblata* to which the form corresponds.

Horizon and locality.—In the brown Amherstburg dolomite, associated with *Stropheodonta demissa* mut. *homolostriata,* and other species. One fragmentary specimen.

The form and muscular impression suggest, to some extent, *Meristella haskinsi* of the Hamilton from which it is, nevertheless, distinct.

Genus MERISTOSPIRA. gen. nov.

Shell small, meristoid, subcircular or transversely elongate, with elevated, slightly incurved pedicle beak and a median sinus in one or both valves. Surface smooth except for growth lines. On the interior the pedicle valve is characterized by strong dental lamellæ restricted to the rostral region; a median septum is absent or faintly developed. In the brachial valve the hinge plate is strong and free from the bottom of the valve, being supported by the strong socket plates. It curves upwards and into the cavity of the pedicle valve as in Nucleospira, but not so strongly or abruptly. Just beneath the beak of the brachial valve the hinge plate is pierced by a visceral foramen as in Athyris. A median septum is present, but is independent of the hinge plate.

The essential difference between this genus and Meristella lies in the freedom of the hinge plate from the median septum, the agreement in this respect being with Nucleospira, and in the presence of the visceral foramen instead of the median division of the hinge plate, the agreement in this respect being with Athyris. The pedicle valve differs from these genera, however, in having strong dental lamellæ. The beak of the pedicle valve is also more strongly elevated in this genus than in Nucleospira, agreeing in that respect with Meristella. Except for the visceral foramen the genus might be briefly characterized as combining a Neucleospiroid brachial with a Meristelloid pedicle valve. Character of the brachidium unknown.

Genotype MERISTOSPIRA MICHIGANENSE sp. nov.

68. MERISTOSPIRA MICHIGANENSE sp. nov.

(Plate XXV, Figs. 5-6, 7-11; Plate XVI, Figs. 4-6.)

Shell small, subcircular or transversely extended. Pedicle valve evenly curved, the greatest convexity being behind the middle. Beak slightly curved but projecting above the beak of the brachial valve and apparently truncated by a small circular foramen. Umbonal slopes rounded and making an obtuse angle with each other; sides more strongly rounded; anterior end slightly pronounced in the center, otherwise regularly rounded. A more or less pronounced median sinus extends from beak to front, becoming broad and round-bottomed in some cases, or remaining narrow and becoming deeper in others.

Brachial valve wider than high, somewhat less convex than the pedicle valve, the greatest convexity being above the middle. A low, indistinct median fold comes into existence near the front of the shell corresponding to the sinus of the pedicle valve. Several very shallow sinuses, or low depressions, run forward from the beak, the median one sometimes being strong enough to destroy the median fold.

Surface smooth except for lines of growth. On the interior the cardinal teeth of the pedicle valve are pronounced and parallel or slightly curving towards each other, extending less than one-fifth the distance to the front. A strong rostral cavity is enclosed between them, and this is continued forward from the dental lamellæ in the striated area or in several diverging grooves. Generally a faint median septum divides the muscular area, extending from the beak half way to the front. The brachial valve has a strong hinge plate which rises abruptly from the valve, supported only by the strong socket plates. The median septum is low and does not support the hinge plate. The muscular area is delimited by faint diverging striae or ridges. Strong vascular sinuses are seen in many specimens, being radially arranged in both valves.

This species differs from Whitfieldella in its form, being proportionally wider than any species of that genus. It further differs in the character of its hinge plate. In this latter respect the

species also shows marked differences from Meristella. In typical species of this latter genus the hinge plate is supported by and continuous with a strong septum, whereas in *M. michiganense* the septum is free from the hinge plate, corresponding in this respect to Nucleospira, with which genus the brachial valve agrees rather closely, the only important difference being the presence of the visceral foramen in the hinge plate of our species. The pedicle valve of Neucleospira has moreover no dental lamellæ, but has instead a median septum which is slightly developed in our species. This species, therefore, combines the internal characters in part of a brachial valve of Nucleospira and in part of Athyris, with the internal characters of a pedicle valve of Meristella or Whitfieldella. The form of the shell, moreover, is that of a transverse Meristella or a Nucleospira but the beak of the pedicle valve is too elevated for that genus.

Measurements.—A characteristic specimen measures: length pedicle valve, 13 mm.; height of pedicle valve, 10 mm.; height of brachial valve, 9.2 mm.; greatest width, 12 mm. Another measures: length of pedicle valve, 14 mm.; height of pedicle valve, 11 mm.; height of brachial valve, 10 mm.; greatest width, 12 mm.; thickness, 7.5 mm.

Horizon and localities.—Abundant in the Amherstburg dolomite of the Woolmith quarry, Monroe county, Mich., also doubtfully in the Lower Lucas.

All the specimens obtained so far are internal molds. In these the visceral foramen of the hinge plate is shown by the presence of a connection between the beak of the brachial valve and the rostral filling of the pedicle valve.

Genus MERISTINA. Hall.

69. MERISTINA PROFUNDA sp. nov.

(Plate XXI, Figs. 20-22.)

General form and size as in *M. maria* of the Niagaran with a strong, broad, anterior depression in the pedicle valve. Teeth and dental plates well developed, the latter curving outwards and surrounding the profoundly impressed muscular area. They are continued forward to near the front of the shell, converging again as the mesial depression becomes pronounced. The adductor scars of the pedicle valve form the central narrow depression in the

muscular area, while the adductor scars on either side leave a longitudinally striate surface. The pedicle muscle is attached to an abruptly raised surface, which is grooved centrally and has the grooved portion extending forward on the adductor area. In the internal mold of the pedicle valves, the rock filling of the muscular area stands out prominently and broadly as in some of the Spirifers of the Oriskany. This is a feature markedly different from that seen in *Meristina maria,* though in structure the two muscle areas correspond. It amounts to a more profound development of both adductor and diductor, and the extension of the area of attachment both forward and backward, the latter resulting in a displacement of the pedicle scar farther into the rostral cavity.

Barrande figures a partially broken shell of *Meristina tumida* (Dalm.) from etage E^2 *Colines entre Lodenitz et Bubonitz* (Syst. Sil., Vol. V, pl. 112, XVI) in which the muscular impression closely approaches that of our species. The ordinary expression of this common European species is, however, more nearly like that of our American *M. maria* with a less profound muscular impression than in the species here described. (See Barrande, Vol. V, pl. 11, and Davidson, Sil. Brach., pl. XI.) Brachial valve unknown.

Horizon and localities.—Raisin river beds. Represented by molds in a rock composed of well rounded quartz grains in a matrix of dolomite, the quartz predominating. The rock lies just below the Sylvania sandstone. Collected by the Michigan Survey from the bed of the Raisin river in Claim 467, T. 6 S., R. 8 E., (No. 18103). Original in Mich. Survey coll. Molds in coll. Columbia University. A fragmentary mold apparently of the same species occurs in the brown Amherstburg dolomite from the Detroit river.

70. MUTATION SINOSUS mut. nov.

(Plate XXI, Figs. 14-16.)

This differs from the preceding in having a pronounced angular sinus which extends nearly to the beak. This greatly alters the aspect of the muscular area and of its impression in the internal mold. The adductor scar thus comes to rest on the strongly elevated central area, while the diductors rest on the striated lateral slopes of this central elevation. The dental plates become more nearly parallel towards the front, and finally converge rather

abruptly at the anterior end of the muscular area. This area, as a whole, lacks the width and profoundity of that of the species proper. The pedicle area is less strongly defined, and longer in proportion, in this respect approaching more closely in character the muscular area of the pedicle valve of the Niagaran species. (*M. maria.*)

This strong median depression is a character which appears occasionally in the other species of this genus, though primarily it is not a characteristic feature of the genus, the sinus mostly appearing at the front and then, though deep, being also broad and rounded. It is desirable that this departure from the main form be signalized as a distinct mutation in each case, even though intermediate forms are common. A method of expressing this feature would be to use *Meristina profunda sinosus* for the extreme of the mutation and to express the intermediate types by *M. profunda* if they are nearer to the true species form, and *M. sinosus* if they approach the sinosus type more closely.

Horizon and locality.—This mutation has been found in a siliceous dolomite with rounded quartz grains obtained from the barn well at the county house in Claim 432, T. 6 S., R. 8 E., by Prof. Sherzer (Michigan Survey No. 18114). Casts in coll. Columbia University. The horizon is nearly the same as for the preceding, lying just below the Sylvania, i. e., upper Raisin river bed.

Genus ATRYPA. Dalman.

71. ATRYPA RETICULARIS Linn.

(Plate XX, Fig. 1.)

An impression of a small pedicle (?) valve apparently represents this species. The shell is somewhat distorted and has a faint median sulcus. The striæ are rounded and distinct, repeatedly bifurcate or increase in number by intercalation of new ones. Concentric lines of growth are visible at intervals but no regularly spaced reticulating concentric lines are preserved. The identification with the above species is questionable.

Horizon and locality.—In the brown Amherstburg dolomite in the bed of the Detroit river. One specimen. Rev. Thomas Nattress coll.

PELECYPODA.

Genus PANENKA Barrande.

72. PANENKA CANADENSIS Whiteaves.

(Plate XXII, Figs. 1-2.)

1902. *Panenka canadensis*, Whiteaves, Ottawa Naturalist, Vol. XV, No. 12, p. 265, pl. XV, figs. 1 and 2.

Original description.—"Shell, or rather cast of the interior of the shell, of about the average size, valves regularly and rather strongly convex, varying in outline in different specimens from subcircular to longitudinally subovate, but always at least a little longer than high. Posterior side rather broader and much longer than the anterior, umbones broad, tumid prominent, very oblique and placed considerably in advance of the mid-length, beaks curved inward and forward, hinge line straight, horizontal, considerably prolonged behind in some specimens but apparently not so much so in others.

"Test unknown, surface of the cast (internal mold) marked by numerous (about sixty) narrow but prominent ribs, with concave grooves between them. In the original of figure 1 on plate XV, the ribs are slightly unequal in size. Most of them are simple but they bifurcate, and here and there a few shorter ribs are intercalated between the longer ones, that radiate from the umbones. In the original of figure 2 on the same plate, the ribs are more regularly disposed, and they are all a little larger posteriorly than anteriorly.

"Muscular impressions and hinge dentition unknown.

"Dimensions of a comparatively high and short specimen (fig. 1); maximum length, 74 mm.; greatest height (inclusive of umbo), 67 mm.; do. of a more elongate specimen (fig. 2) that is narrower in the direction of its height, length, 77 mm.; greatest height, which happens to be behind the umbo, 60 mm.

"Corniferous formation, Anderdon township, Essex county, Ontario; a few specimens collected by Mr. Harry Hodgman, U. S. Inspector, in October and December, 1901. According to Mr. Nattress they are from a brown dolomite which underlies the true Corniferous limestone in that neighborhood."

The bed from which these fossils were obtained is the Amherst-

burg bed of late Siluric (Upper Monroe) age. It is not surprising that Whiteaves should refer this species to the Corniferous (Onondaga or Dundee) since it is a type otherwise known only from the Middle and Upper Devonic of this country. The brown dolomite (Amherstburg bed) lies just below the Dundee (true Corniferous) of the Amherstburg region, though a little further inland, even that bed is removed by pre-Dundee erosion, and the "Corniferous" rests directly upon the Anderdon limestone which underlies the Amherstburg bed.

Little can be added to the very full description given by Whiteaves. That author compares the original of his figure 1 with *P. multiradiata* Hall from the Onondaga of western New York, but he states that *P. canadensis* "has broader and more oblique umbones, and a much longer hinge line posteriorly." Figure 2 of Whiteaves "comes nearer to *P. robusta* and *P. dichotoma* Hall, but * * * is more regularly and longitudinally subovate than either. In *P. robusta,* also, the ribs are much fewer and coarser, and in *P. dichotoma* the anterior end is represented as produced and subangular above." In *P. dichotoma* from the Schoharie, the ribs are close together, there is more frequent intercalation, and the posterior expansion is much less prominently marked than is the case in *P. canadensis.* The young of *P. dichotoma* shows characters more nearly like those of adult *P. canadensis.*

Horizon and locality.—In the Amherstburg dolomite of the Detroit river bed opposite Amherstburg, Ont. Also rarely in the Lower Lucas of the Gibraltar quarry.

Genus PTERINEA Goldfuss.

73. PTERINEA LANII* sp. nov.

(Plate XX, Fig. 13; Plate XXXV, Fig. 22.)

1882. *Pterinea aviculoidea* Whitfield, Geol. Rep. Wis., Vol. IV, p. 322, pl. 25, figs. 6-7.

1891. *Pterinea aviculoidea* Whitfield, Ann N. Y. Acad. Sci., Vol. V, p. 514, pl. V, fig. 23; and Geol. Ohio, Vol. VII, 1893, p. 415, pl. I, fig. 23.

Whitfield's original description.—"Shell of proportionally small size, obliquely rhomboidal in outline, with a moderately long,

*Named in honor of Dr. A. C. Lane, State Geologist of Michigan.

straight hinge line, but little shorter than the length of the body of the shell below. Left valve depressed convex, with a small, slightly incurved beak, scarcely extending above the cardinal line. Anterior end short, and the anterior projection scarcely defined; posterior wing concave and the posterior margin nearly at right angles to the hinge line for a short distance below, then gently curving backward to the rounded postero-basal extremity; basal line rounded and on the anterior side of the umbonal ridge curving rapidly upward to the anterior extremity. Body of the valve convex and oblique to the hinge, the umbonal ridge broadly rounded. Surface of the shell marked only by lines of growth, some of which are stronger and form slight varices."

More perfect material since obtained from Michigan permits a more detailed and more accurate description. The hinge line is actually longer than the shell below. In *Megambonia aviculoidea* Hall, with which this species has heretofore been identified, the hinge line is shorter, except in the young. The terminal point of the wing is acute in our species, projecting to the same extent as, or slightly beyond, the shell below, whereas in *M. aviculoidea* it falls considerably short of this point. The posterior margin is gently concave. The umbonal angle is approximately 45°, while in a typical specimen of *M. aviculoidea* from the Manlius it is 60°. The anterior ear is quite well marked in our specimens. It is oblique though the separation from the shell is not pronounced. The umbo is moderately elevated, and the beak is curved and pointing forward. The shell is strongly convex at the umbo, but flattens out on the wing. Concentric lines alternate with subequally spaced stronger symmetrical ridges, which give a definite surface pattern to the shell.

Right valve similar to left but without the strong striæ, the surface appearing smooth. Length of a medium sized left valve (Pl. XX, fig. 13) 18 mm., height 13.8 mm. A larger specimen measures, length 23 mm., height 17.5 mm.

The corresponding measurements of a typical specimen of *M. aviculoidea* from the Manlius are, length 22.7 mm. and 20 mm., height 24.5 mm. and 18 mm.

Horizon and localities.—In the Raisin river dolomites (calcilutites) of the Newport and Monroe quarries and elsewhere in this formation in southeastern Michigan. It is a common form.

The species was originally described by Whitfield from the Monroe beds of Wisconsin under the name *Pterinea aviculoidea* and identified with Hall's Manlius limestone species. It was again described by Whitfield from Put-in-Bay island, Ohio. The original of Whitfield's type from Ohio is in the Newberry collection at Columbia University, and the matrix agrees with the Raisin river beds of Lucas county and Monroe county, rather than with the typical rocks of Put-in-Bay. Moreover it is the only specimen of this species, and is unaccompanied by detailed locality label. With it are associated other Raisin river types found at Newport but not in the Put-in-Bay beds. The inference is that, as in the case of the *Whitfieldella prosseri,* this specimen has had assigned to it the wrong locality. It is possible, however, that the specimen came from the highest beds on Put-in-Bay island, which are apparently the extension of the Raisin river beds. A single imperfect specimen, apparently of this species, is associated with *Pterinea bradti* in the Lucas dolomite of the salt shaft. The species is quite common in the Upper Siluric calcilutites (Lewiston limestone) of southern Pennsylvania.

74. PTERINEA BRADTI sp. nov.
(Plate XVI, Figs. 9, 10.)

Left valve strongly convex, elongate, and oblique. Umbo elevated and subanterior, projecting for a short distance beyond the hinge line, and moderately incurved. A faint depression begins in the beak, and runs to the ventral margin with which it makes a small angle. Anterior portion rounded, rather abruptly to the hinge line, continuing downward and backward in a gentle curve to the posterior margin, which is more abruptly rounded. Posterior wing well defined, with a pronounced concave margin and rather acute terminal angle, which projects slightly beyond the margin of the shell below.

Greatest convexity of the valve in anterior third, sloping regularly towards the ventral and posterior margins, in the neanic portion of the shell; more abruptly deflected in the last or adult portion of its growth, so that in some cases the angle of change approaches 135°. This change in direction of growth is evidence of old age conditions in the group (phylogerontism).

Surface marked by strong, subregular concentric undulations in the younger portion, and by very irregular lines of growth in the adult portion. In the external mold, crowded, strongly impressed lines of growth are shown. Cartilage groove long and narrow.

In some specimens, the sulcus extending from beak to base is quite well marked, becoming broader towards the center. In others, it is scarcely recognizable. There is also a difference in the definition of the posterior wing, which in some young specimens is quite sharply defined.

Right valve as convex as the left valve with the beak sharp, and elevated but scarcely incurved. The sulcus is broader and deeper than in the brachial valve and its posterior margin is a sharp angulation extending from the beak to the medio-ventral margin. Posterior wing less pronounced than in the left valve.

This species is represented by a number of individuals (mostly left valves) in the gastropod layers (Lucas dolomite). It differs from *Pterinea lanii* Grabau (*Pterinea aviculoidea* Whitfield, non Hall) described above in its more elongate character, lesser height and smaller angle of torsion, which is about 35°, while that of *P. lanii* is nearly 50°.

Clarke has figured under the name *Pterinea subplana* Hall a shell which in all essentials appears to be identical with the present species (Guelph Fauna, pl. V, fig. 4). This species, however, is distinct from the *Avicula subplana,* Hall, of the Rochester shale (Pal. N. Y., II, p. 283, pl. 59, fig. 3 a-c) which is a much larger and flatter shell, with less strongly individualized wing, and with the beak not projecting above the cardinal line, as is the case in the Guelph and Monroe species, where also the umbonal portion is more strongly elevated. As to the identity of the Guelph and the Monroe types, there can scarcely be a doubt.

Measurements of characteristic specimens:

	Left valves from the Monroe beds.		Guelph specimens, figured by Clarke.
	1	2	
Greatest length of shell on hinge line	16 mm.	17 mm.	18.5 mm.
Length of oblique axis (beak to posterior margin)	15 mm.	15 mm.	17.7 mm.
Beak to base at right angles to hinge line	7 mm.	7.7 mm.	9 mm.
Greatest height of shell at right angles to hinge	9 mm.	9 mm.	11.5 mm.

Angle of obliquity 35°.

Named in honor of Mr. E. F. Bradt, Superintendent of the Detroit salt shaft, through whose courtesy we were enabled to obtain the material from that salt shaft.

Horizon and locality.—In the Lucas dolomite of the salt shaft, not uncommon.

Genus GONIOPHORA Phillips.

75. GONIOPHORA DUBIA (Hall) Whitfield.

(Plate XX, Figs. 24-26.)

1859. Cf. *Modiolopsis ? dubius* Hall, Pal. N. Y., Vol. III, p. 264, pl. 49, fig. 2.

1891. *Goniophora dubia* Whitfield, Ann. N. Y. Acad. Sci., Vol. V, p. 514, pl. 5, figs. 24-26, and Geol. Ohio, Vol. VII. 1893, p. 415, pl. I, figs. 24-26.

Whitfield's original description.—"Shell small, transversely elongate, nearly twice and a half as long as high. Valves ventricose, most highly convex on the anterior half, becoming more depressed toward the posterior; beaks small, very slightly incurved but not elevated above the cardinal border and rather inconspicuous, situated about half or rather less than half the height of the shell from the anterior extremity, proportionally more distant on the larger specimens than on those of small size. Hinge line long and straight, extending four-fifths of the length of the shell behind the beaks and characterized by a narrow but distinct escutcheon. Anterior end short and full, very obtusely pointed at the longest part, which is at about the middle of the height, above which point there is a very distinct but narrow lunule extending to the extremity of the hinge line. Basal margin of the valve very broadly curved, slightly emarginate just anterior to the middle and the whole subparallel to the cardinal line. Posterior extremity sharply rounded below and the upper margin very obliquely truncated; body of the valve marked by a broad, distinct mesial sulcus extending from behind the beak to the broad sinus of the basal margin. The umbonal ridge is rather sharply marked and angular in the upper portion, but becomes less distinctly marked posteriorly; postero-cardinal slope of moderate width, very slightly concave in the younger stages of growth but less strongly marked as the growth advances. Surface of the valves marked by strong, sublamellose, concentric lines of growth parallel to the outer margin of the valves.

"The shell undergoes considerable change in form and in the strength of the surface characters between the younger and more advanced stages of growth; the sharpness of the features being much reduced on the older portions, by the rounding of the umbonal ridge and of the angularity of both the anterior and posterior extremities of the shell. The shell differs in several of its external features from the genus Modiolopsis, possessing a distinct lunule and escutcheon as well as the angular umbonal ridge, in all of which features it corresponds with Goniophora."

Whether this species is identical with the form described by Hall as *Modiolopis ? dubia* from the Manlius limestone of Herkimer county, cannot be definitely ascertained, since no good specimens of the Manlius form are at hand for comparison.

Horizon and localities.—This species is extremely abundant in the Put-in-Bay dolomites of Peach Point, Put-in-Bay island, Lake Erie. The shells cover the surfaces of the thin slabs in vast numbers, of various sizes. Also in the same rock at Middletown, Ohio. A single specimen was obtained from the Raisin river dolomites of the Monroe stone quarries associated with *Whitfieldella prosseri.* It is not uncommon in the Raisin river beds of the salt shaft, from 87 to 138 feet below the Sylvania sandstone, associated with *Whitfieldella prosseri.*

76. GONIOPHORA? sp.

Several specimens from the Lucas dolomite of the salt shaft seem to be related to the preceding species and are provisionally referred to the same genus. They are small, transversely elongate shells, strongly ventricose and with the beak near the anterior end. The greatest convexity is near the anterior end. A shallow sulcus runs from the beak to the base, and slightly posterior-ward. Umbonal angle generally less defined than in the specimens of *G. dubia* from Put-in-Bay island.

The specimens from the Lucas dolomite differ considerably from *G. dubia* of the lower horizon. They are more convex, the beak more anterior, the sulcus less oblique, the umbonal angle less angular, and the whole shell less angulate.

A characteristic specimen measures 8 mm. in length by 5 mm.

in height, while a characteristic specimen of *G. dubia* from Put-in-Bay island measures 18 mm. in length by 8 mm. in height.

A fragmentary specimen referred to this species has a sharper umbonal ridge and somewhat less anterior beak, beneath which, at the anterior end, a lunule appears.

The specimens are not perfect enough for a specific description.

Horizon and locality.—In the Lucas dolomite of the salt shaft. Rare.

Genus CYPRICARDINIA Hall.

77. CYPRICARDINIA CANADENSIS sp. nov.

(Plate XVIII, Figs. 14-15.)

Shell equivalve, rather elongate, length about twice as great as height. Valves angularly convex, beak subanterior, low and not prominent. Anterior basal portion slightly produced. A pronounced subangular umbonal ridge curves backward and downward to the posterior basal margin. Below the ridge, the shell is flat or very slightly concave, especially in the posterior part. Above the ridge the shell is rounded to the cardinal margin which is depressed and marked by a pronounced escutcheon. Posterior extremity forming a rectangle with the basal margin, but becoming rounded towards the dorsum. Surface marked only by lines of growth. Anterior adductor muscle large, just below and in front of the beak, and strongly outlined by an elevated rim which appears as a circular depression in the internal mold.

Horizon and locality.—In the Amherstburg bed of the Upper Monroe, in the bed of the Detroit river, opposite Amherstburg, Ont.

Genus TELLINOMYA Hall.

78. TELLINOMYA sp.

A small, elongate shell, with the small beak slightly excentric, and with narrowly rounded ends with a flat or slightly concave surface and well marked concentric growth lines occurs in the Raisin river dolomites of the Newport quarry. It is too poorly preserved for specific identification.

Genus MODIOMORPHA Hall.

79. MODIOMORPHA sp.

Shell small, elongate, about twice as long as high. Anterior end nasute, beak small, situated about one-fourth the length of the shell from the anterior end. Dorsal and ventral borders nearly parallel. Posterior end rounded below, abruptly truncated above. Surface marked by lines of growth of moderate strength. Length 13.5 mm., height 7 mm.

Horizon and locality.—In the Raisin river dolomites of the Newport quarry.

Genus CONOCARDIUM Brown.

80. CONOCARDIUM MONROICUM sp. nov.

(Plate XVI, Figs. 1-3; Plate XX, Figs. 14-15; Plate XXII, Fig. 3.)

Shell of medium size. Valves rather strongly convex, with the posterior end abruptly truncated, the margins of the valve meeting almost in a plane in some specimens, though produced in others, in the ventral portion. Sides of valves somewhat flattened, curving more abruptly towards the dorsal and ventral margins. Umbonal slope making an agle of about 120° with the cardinal line.

Anterior end attenuate and produced slightly into a subcylindrical prolongation. Lateral surface of the shell ornamented by costæ which are rounded or even slightly angular at the posterior end but become broader to flat-topped towards the anterior end, where they are separated by a space equal to the width of the costæ or wider. Fine, sharp, concentric striæ occur throughout both on the ribs and in the interspaces. In a slightly exfoliated specimen the ornamentation consists of broad, flat-topped costæ marginated on each side by a faint, blunt ridge, which gives the top of the costæ a slightly sunken aspect. The costæ are separated by linear, rectangular depressions of about the width of the bordering ridge on the costæ.

When the surface is more strongly worn, the costæ lose their flat upper portion, and only the double down-folded portion of the shell forming the intercostal depression, remains. This gives the shell the appearance of being composed of a series of narrow ribs, separated by a space several times their diameter, which shows the rock surface of the internal mold. In somewhat less worn specimens the narrow ridges are connected by transverse bars, while in still less worn specimens the ridges and interspaces seem to be covered with strong concentric striæ which zigzag across the radiating ridges.

On the interior of the shell, if unworn, the ribs or costæ appear

as faint depressions, flat-bottomed and marked by faint transverse striæ. The intercostal depressions appear as slightly elevated costæ, marginated by a faint ridge on each side, and wider than the depressions representing the costæ. The ribs become wider toward the posterior margin, as is well shown on the internal molds. At the umbonal angle a flattened space occurs, wider than the broadest rib, and showing dorsally curving lines of growth, indicating that the shell here was marked by a faint emargination. This flat rib is flanked on either side by a similar, though narrower, flat rib, separated from it only by a faint depression. Sometimes only one of these flanking ribs, generally the posterior one, seems to be developed. These broad ribs mark the point of departure of the free posterior shell hood characteristic of these shells, which, however, is rarely preserved. Towards the anterior end the ribs become narrower, more sharply defined, and separated by deeper interspaces. The extreme anterior end consists of a coarse, rounded fold, rapidly widening anterior-wards. In some specimens two or even three broad costæ occur just in front of the one at the umbonal angle; after which the costæ begin as narrow and shallow ridges, separated by narrower depressed lines, and gradually increase in width and strength forward, while at the same time the intercostal spaces become progressively wider and deeper.

The truncated posterior end is marked by narrow, sharp radiating ribs, curving in conformity with the curvature of the umbonal ridge, and separated by spaces from one to several times their width. Fine, sharp, transverse striæ cross both interspaces and ribs. These striæ extend onto the posterior prolongation which forms the hood, but not entirely across this (See fig. 3, pl. XXII). At the point of departure of the posterior hood, the shell is thick and coarsely cellular, as seen in fractured specimens.

This species is closely related to *C. cuneus* var. *nasutum* Hall, of the Schoharie grit. In fact it is at first difficult to distinguish the two, but the character of the surface ornamentation is more pronounced in our species, as outlined. It agrees perhaps better with the ornamentation of the young of *C. nasutum*. The curved ribs on the truncated posterior end are narrower, more widely separated, and more sharply defined, than is the case in Devonic species generally. Nevertheless, the relationship is exceedingly close, and the species must be considered as a Devonic rather than a Siluric type.

Horizon and localities.—This species is fairly common in the Anderdon limestone (coral bed) of the salt shaft at Detroit, the specimens mostly preserving the shell. They are associated with Diplohyllum, Cladopora and Favosites. It is also common in the brown transition dolomite (Amherstburg bed) from the bed of the Detroit river, opposite Amherstburg, Ont., where it is associated in the same specimens with *Acanthonema holopiformis;* also in the same brown dolomite, in the bottom of the Gibraltar quarry, and in the higher Lucas beds of that quarry, and the Patrick quarry, where it is associated with the characteristic Gastropods of that bed. It is further common in the Amherstburg beds of the Woolmith quarry, and is in fact widely distributed at this horizon.

GASTROPODA.

Genus HORMOTOMA Salter.

81. HORMOTOMA SUBCARINATA sp. nov.

(Plate XXIV, Figs. 1-5.)

Shell turreted, consisting of numerous regular whorls separated by deep sutures and with the apical angle about 25°. Ambital portion of the whorls marked by two prominent, revolving carinæ, between which is a depressed band. The shoulder above these carinæ is flat or slightly concave, or if a faint convexity obtains, the effect of the concavity is produced by a slight thickening on the whorl at the suture, thus producing a faint rounded subsutural band. Body of shell below the carinæ rounded, with frequently a faint suggestion of another angulation about midway between the carinæ and the suture, and a faint concavity just below the revolving band. The whorls embrace slightly so as to leave a larger space below the carinæ than above them. In some cases the relation of width between shoulder and exposed portion of the whorl is as 2 is to 3. The carinæ are from .5 to .8 mm. apart, according to the size of the whorl. The lines of growth curve obliquely backwards from the suture to the ambitus, near which they are more strongly deflected. They arch over the carinæ and pass across the depressed band in a rather oblique manner and

then curve abruptly forward again, thus indicating a pronounced emargination of the lip, with the center marked by the depressed band margined by the carinæ. The body whorl is prolonged downward and strongly deflected at the base. Aperture apparently subcircular, elongate, oval. This species is somewhat similar to *Hormotoma whitcavesi* Clarke* of the Guelph of Canada and New York, with which it agrees in the relative position of the slit band, but differs in the more prominent carinæ bounding this band, and especially in the flatness or concavity of the shoulder as well as the indication of a third carina. The angulation of the whorl and flattening of the shoulder is less marked in the young whorls of our species, these being scarcely or not at all angulated. It thus appears that the angulation of the whorl by the slit band, the flattening of the shoulder, and further, the strength of the carinæ bounding the band, are progressively intensified in the ontogeny of the earlier species, and it therefore is to be expected that all the characters are still more strongly emphasized in a later species of related series. This is the case in *H. subcarinata* of the Upper Monroe which is not improbably a descendant of the Guelph species. In the Siluric of Gotland are several "Murchisoniæ" of this type and without doubt genetically related to our species. They are *Hormotoma cavum* (*Murchisonia cava* Lindström) found in all three strata of Gotland; *Hormotoma moniliformis* (*M. moniliformis* Lindström) of the lower stratum and *Hormotoma obtusangulata* (*M. obstus angulata* Lindström) and *Hormotoma subplicata* (*M. subplicata* Lindström) both restricted to the upper stratum, besides others. From all of these, however, our species differs in the high position of the slit band, which leaves a larger body than shoulder portion, and in the faint secondary angulation and depression characteristic of most individuals.

The largest specimen found has a length of 20 mm. and a diameter of the last whorl of 7+ mm. Fragments with a diameter of the last whorl of over 8 mm. have also been obtained. Nearly all the specimens so far obtained are external molds (a few internal molds have also been found but no shells).

Horizon and localities.—It is a common form in the Lucas dolomite of the Patrick quarry, on Grosse Isle, and the upper beds of

*Clarke and Ruedemann, Guelph Fauna, Mem. 5, N. Y. State Mus., p. 65, Plate 7-10.

the same age in the Gibraltar quarry. It occurs more sparingly in the same beds in the Woolmith quarry. It is represented by small specimens in the upper dolomites of the salt shaft. In these localities it is always associated with Acanthonema. It occurs in the same association in the brown Amherstburg dolomite from the bed of the Detroit river where internal molds, showing only faint carination, also occur.

82. HORMOTOMA TRICARINATA sp. nov.

(Plate XXV, Figs. 3-4.)

Shell elongate, turreted, with a spire of 6 or more volutions, separated by deep sutures. Slit band about a third of the width of the whorl from the upper suture, bounded by strong spiral ridges. Shoulder strongly concave, the concavity being emphasized by the strong upper carina of the slit band.

This species is derived from *H. subcarinatum* by the accentuation of the shoulder concavity and of the carinæ, and consequently the convexity of this part of the shell.

Horizon and locality.—In the Lucas dolomite, Gibraltar quarry. Rare.

Genus SOLENOSPIRA Ulrich.

83. SOLENOSPIRA MINUTA Hall.

(Plate XVI, Fig. 8.)

1859. *Murchisonia minuta* Hall, Pal. N. Y., III, p. 298, pl. 54, fig. 17.

Shell minute with sharply angulated whorls, of which there are 9 in the space of 7 mm. Spire very slender, apical angle about 17 degrees. The shoulder and body of the whorl are flat or slightly concave, and the slit band margined by two elevated carinæ which give a pronounced angularity to the whorl, the angulations being separated by marked concavities. This shell appears to be identical with the small form described by Hall from the Manlius limestone of Onondaga county. It is not uncommon in the Lucas dolomite of the salt shaft, where it occurs in the form of external molds. It is readily distinguished from the preceding by its slender form and the angulated whorls.

The preceding description is made from specimens found in the Lucas dolomite of the salt shaft. A minute form apparently identical with the above occurs in the Raisin river dolomites of

southern Michigan in the form of external molds. They are sharply carinated at the center of the exposed part of the whorl, the carination being margined by two revolving spirals. Above and below, the surface of the whorls is concave or flat. In a specimen 2.3 mm. long six whorls are seen, the apical angle being 19°. One specimen, possibly referable to this species, was 10 mm. long and showed six whorls but the apex is wanting. It is not unlikely that if more perfect material were available the specimens from the Raisin river beds would prove distinct from those of the Lucas.

Horizon and locality.—The species was originally described from the Manlius limestone of eastern New York. The Michigan specimens identified with it occur in the Raisin river beds of Monroe county, and in the Lucas dolomite of the salt shaft.

84. SOLENOSPIRA? EXTENUATUM (Hall).

(Plate XVI, Fig. 7.)

1859. *Murchisonia extenuata* Hall. Pal. N. Y., III, p. 298, pl. 54, fig. 15.

This species is proportionally shorter than the preceding one, with the whorls more embracing, as a result of which the exposed portion of the body of the whorl has only about two-thirds the width of the shoulder, whereas in the preceding species the width of body and shoulder is about equal. The shoulder angle appears to be simple, though a sharp cast shows faint indication of a double carination as in the preceding species.

This specimen is also of larger size than the preceding. In the larger specimens a spiral is sometimes indicated just above the suture. A specimen showing the last five volutions measures 6.5 mm. in length, with a diameter of body whorl of 3.75 mm.

Horizon and locality.—Not uncommon in the Lucas dolomite, in association with the preceding, in the salt shaft. It was originally described from the Manlius.

Genus LOXONEMA Phillips.

85. LOXONEMA PARVA sp. nov.

(Plate XVI, Fig. 6.)

Shell minute, from six to eight volutions shown. Volutions gently convex, compactly turreted with suture only slightly impressed. Angle of spire about 10°, very regular and with slopes uniform. Faint revolving striæ indicated on one of the whorls.

Horizon and locality.—This species is known only from an impression in the Lucas dolomite of the salt shaft. Its small size is its chief distinguishing feature.

86. LOXONEMA sp.

An impression of a part of a shell referable to Loxonema occurs in the Raisin dolomites of the Newport quarry. The specimen is 10 mm. long and has very oblique whorls. Other somewhat more perfect specimens occur in a rock of apparently the same division from Buena Vista, Fayette county, Ohio. The whorls enclose one-third of the preceding whorl, this not reaching quite to the ambitus, and thus a slight suture remains. The whorls are subcircular in section, ten occurring in a specimen 8.5 mm. long and 3.5 mm. wide at the ambitus of the body whorl. Apical angle about 25°. (Columbia University No. 3538.)

87. LOXONEMA sp. 2.

(Plate XXXII, Fig. 5.)

1900. *Loxonema sp.* Grabau Bull. Geol. Soc. Am., Vol. XI, p. 370.

"An internal mold showing nothing but the general outline of the volutions and the form of the spire, was obtained from the Manlius (Bullhead or Akron) of Buffalo. Only four volutions remain, separated by rather deep sutures. Whorls uniformly rounded. Angle of divergence (apical angle) between 11° and 12°. From the imperfect state of preservation, even the generic determination must be doubtful."

Horizon and locality.—In the Akron (Bullhead) dolomite of Buffalo. One specimen.

Genus HOLOPEA Hall.

88. HOLOPEA SUBCONICA Hall.

1859. *Holopea subconica* Hall. Pal. N. Y., III, p. 294, pl. 54, figs. 1 a-b.

This species appears to be represented by a number of small subconical shells, consisting of three or four whorls, close coiled and with the sides of the whorls (shoulders) nearly flat, giving the whole shell a turboroid aspect. Sutures slightly impressed; whorls rapidly enlarging, the body whorl nearly equal in height to the rest of the spire. Faint lines of growth are visible in some cases, but no revolving spirals have undoubtedly been observed.

Length of a characteristic specimen 4 mm.; diameter of body whorl 2.75 mm.; apical angle about 45°.

Horizon and locality.—This appears to be a common species, generally occurring in the form of external molds in the Lucas dolomite of the salt shaft. It is only about one-half as large as the specimens from the Manlius limestone of New York and it may be that our species should be regarded as distinct from that of the Manlius beds of New York. That some of the molds of this character represent *Acanthonema holopiformis*, in which the impression of the nodose spirals has not been preserved, is undoubted. (See plate X, fig. 4.)

89. HOLOPEA ANTIQUA var. PERVETUSTA (Conrad).

(Plate XXVIII, Figs. 4-5.)

1859. *Holopea antiqua* var. *pervetusta* (Conrad) Hall, Pal. N. Y., III, p. 295, pl. 54, figs. 4 and 5.

Two molds of this species occur among the Anderdon material. The spire is higher than that of typical *H. antiqua,* and the last volution is less strongly rounded. The last whorl is very slightly separated at the suture from the preceding one, leaving a very narrow and shallow groove. In general the sutures are deeply impressed and the whorls regularly rounded. The surface is marked by regular, rather strong lines of growth, which curve gently backward from the suture.

The best preserved mold shows six whorls and has an apical angle of about 52°. The length is probably 15 mm. (the basal portion not being preserved); the basal diameter is 13 mm.

Horizon and locality.—This species has been cited from the Manlius limestone of New York. It is closely related to *H. antiqua,* which is abundant in certain layers of the Manlius limestone of eastern New York, and with which it may prove to be identical. It is sparingly represented in the Amherstburg bed of the Detroit river. A number of small internal molds from this horizon are perhaps directly referable to *H. antiqua.*

90. HOLOPEA sp. (1).

Shell turreted; whorls with subdued angulation above the middle, the shoulder above being nearly flat, the whorl below rounded. Whorls loose coiling, the embracing being such as to leave the exposed part below the angulation, about two-thirds the width of the shoulder. Body whorl rounded below to the umbilicus, which appears to be open. Surface smooth. Though angulated, there is apparently no notch or slit band. The original number of whorls was probably four or five. Original length of specimen described perhaps 3 mm.; diameter of body whorl 2.5 mm.; apical angle about 35°.

Horizon and locality.—In the Raisin river dolomites of the Newport quarry and probably elsewhere in southern Michigan.

91. HOLOPEA sp. (2).

Shell minute, spire low, apical angle about 52°, whorls rounded, very rapidly increasing in size, the later embracing the preceding about one-half or less. Body whorl very ventricose, uniformly rounded; peristome apparently slightly produced below. Surface smooth. Height 3.2 mm.; diameter of body whorl 2.2 mm.; greatest thickness of body whorl 1.2 mm.

This species is of the form of *H. antiqua,* but is much smaller and the body whorl is proportionally more ventricose.

Horizon and locality.—In the Raisin river dolomites of the Newport quarry and probably elsewhere in southern Michigan.

92. HOLOPEA sp. (3).

A small species with rather high spire and somewhat compressed whorls, occurs in the Raisin river dolomites of the Newport quarry in the form of internal molds. It is provisionally referred to this genus.

Genus PLEUROTROCHUS gen. nov.

Shell turreted, generally of from five to ten whorls, which are ornamented by revolving spinose ridges. The early whorls are generally characterized by lamellose rib-like vertical varices which extend from suture to suture and are regularly spaced. These are cancellated by revolving spirals, one of which generally nearer the lower suture, is stronger than the others. On the later whorls the lamellose varices become more or less discontinuous, remaining prominent on the spirals, where they assume the form of elevated emarginations or blunt spines. These are generally more pronounced on the larger spirals, where they become less frequent than on the smaller ones, owing to the merging of several of the emarginations by continuation of the spine until it covers the

interspace between two or more spines on the higher spirals. There is thus a gradual enlargement of the spine for several varical periods until, when it has reached full size, it comes to a sudden end, and a new one begins. The spine is thus of the type of that of modern *Fulgur carica*, or of that of the simpler Murices. It is distinct in this respect from the slit band of the Pleurotomarioid types, which represents a continuous and uniform, instead of a periodically augmented, emargination. Although probably derived from species with a continuous slit band, these forms have started on a distinct line of development.

Aperture subcircular, with columellar lip reflexed, nearly or quite covering the umbilicus.

Genotype PLEUROTROCHUS TRICARINATUS Grabau.

Distribution Siluric. Europe and America. Other examples are *Pleurotrochus tortuosus* (Lindström) and *Pleurotrochus imbricatus* (Lindström).

93. PLEUROTROCHUS TRICARINATUS sp. nov.

(Plate XXVII, Figs. 1-2.)

Shell conical, of five or more volutions and an apical angle of nearly 50°. Earliest whorls marked by sharp, regularly spaced and closely set rib-like varices which extend from suture to suture of the otherwise flat exposed portion of the whorl. These varices are slightly modulated in three points, this being apparently due to the cancellation of the varices by three revolving spirals. They are about equally spaced; the lowest one, which is also the largest, is situated a short distance above the suture, the upper one next in size, a similar distance below the upper suture, while the middle one is scarcely visible in the young whorls; the varices break up into three rows of imbricating spines, the number of such spines no longer remaining uniform in the three rows. Thus the lower row, which consists of large, somewhat obliquely set, broad, rounded imbricating spines has the smallest number; the upper row comes next, while the median row, which has the smallest spines, also has the greatest number. In the later whorls the median row approaches in size closely to the upper one. A single non-spinose or tuberculate carina occurs below the lower row of spines, at a distance equal to about the space between the lowe and middle rows of spines. The whorls embrace up to this carina

which is hence not visible in the earlier whorls. As the spines become prominent the outline of the whorl becomes more angularly convex, and the sutures more deeply depressed.

This species is of the type of the broader form of *Murchisonia imbricata* Lindström from the upper beds of the island of Gotland[3] with which it agrees in most characters including size, form, apical angle and type of sculpture. It differs, however, in the stronger development of the median row of spines, which in the Gotland species is scarcely developed, being shown as a mere series of faint notches on the body whorl. In this respect the Gotland species represents a younger stage of the Michigan species, which passes through this condition in the earlier whorls. The Michigan species is therefore a somewhat more advanced mutation of the same stock. The slender Gotlandic mutation (Lindström, fig. 7) apparently represents another line of development, in which the larger row of spines becomes emphasized. Owing to a somewhat looser coiling, the spire is more slender, and the large row of spines is nearer the center of the exposed part of the whorls. In *P. imbricata* (Lindström) the lowest carina is imbricated but in the Michigan species it seems to be smooth.

Horizon and locality.—In the Lucas dolomite from the salt shaft. Rare.

Genus ACANTHONEMA gen. nov.

Shell elongate, turreted, composed of regularly enlarging whorls, with varying amounts of embracing in different species. Whorls rounded or angulated, marked by three revolving spirals, of which the lower is often covered by the next whorl. In rare cases the median spiral is obsolete. Lines of growth vertical from suture to suture or nearly so. The spirals are cancellated at regular intervals by low, nodose spines due to faint emarginations of the shell. The lowest spiral is commonly free from spines.

The younger stages of these shells often show lamellose lines of growth which correlate with the spinosities on the spirals. In this respect they correspond to Pleurotrochus, from which indeed the present genus may be derived. In the adult it, however, looses all these features, the spirals only with their regular and uniform nodes, remaining.

[3]See G. Lindström, on the Silurian Gastropoda and Pteropoda of Gotland, p. 133, Plate XIII, Fig. 8,

Two species and one variety have been obtained from the Upper Siluric of Michigan and adjoining regions. A third species was previously described as from the limestone of Wood county, Ohio, just above the Glass Sand. This is from the Lucas dolomite and has been described as *Orthonema newberryi* by Meek,[4] who referred it to that genus tentatively. The generic term Orthonema was proposed by Meek and Worthen[5] for turreted shells with flattened whorls and smooth revolving spirals, which are generally found in the neighborhood of the sutures. The species of this genus are Carbonic, and seem to form a compact and natural group.

Genotype ACANTHONEMA HOLOPIFORMIS Grabau. Known range, Upper Siluric.

94. ACANTHONEMA HOLOPIFORMIS sp. nov.

(Plate XXVI, Figs. 1, 2, 3; Plate XXIII, Figs. 6, 8, also Plate XVI, Fig. 4.)

Shell minute, with subtrochiform spire of four or more volutions. Apical angle about 45°. (It appears much too large in figure 2, owing to the fact that the shell is partly buried in the rock). Volutions subangulated above, rounded below.

Three distinct spirals or revolving ridges mark the volutions, one a short distance below the upper suture, and one at or just above the lower suture, and best visible on the body whorl; the third between the others and nearer the lower one. The upper two spirals are marked by regular, sharp, evenly spaced nodes or spines separated by more than twice their width. The lower spiral is free from these except in rare cases where faint spinelets appear on it. This last carina is generally covered by the edge of the next volution and appears prominently only on the body whorl.

When the three spirals are well developed the spaces between them are flat (Pl. XXVI, figs. 2 and 3) thus giving the whorls a pronounced angularity. Where the middle spiral is fainter the whorls are more rounded, and the shell approaches Holopea in form. This condition is shown in the transitional forms to var. *obsoleta*.

Basal portion of whorl regularly rounded to the umbilicus, which is merely in the form of a slight depression. Aperture apparently circular.

Measurements of a characteristic individual. Length 8 mm.;

[4]Pal. Ohio, Vol. I, p. 217, Plate XX, Fig. 3 a-b.
[5]Pal. Ill., Vol. II, p. 380.

diameter of body whorl 5 mm.; height of aperture 3 mm. Internal molds (Pl. XXIII, figs. 6 and 7) with the carinæ well marked, though seldom sharing their nodose spinous character.

Horizon and locality.—Common in the Lucas dolomite of the Gibraltar, Patrick and Woolmith quarries. Also in the same formation at Otsego, Wood county, Ohio. More rarely in the Lucas of the salt shaft, generally not showing the spirals (Pl. X, fig. 4). It occurs both as external and internal molds in the (transition) Amherstburg dolomite of the Detroit river.

95. Var. OBSOLETA var. nov.

(Plate XXVI, Fig. 1, right half.)

This variety is characterized by the absence of the median carina, the faint development of the nodes on the upper one and the rather strongly impressed suture. The whorl is more rounded than in the species proper. Neither in the young nor the adult of the specimens so far seen is there any indication of the median spiral. The lower spiral appears a short distance above the suture, the embracing of the whorls being slightly less than in the typical form.

Horizon and locality.—Associated with the preceding in the Lucas dolomite at Gibraltar.

96. ACANTHONEMA LAXA sp. nov.

(Plate XXVI, Fig. 4; Plate XXVII, Figs. 3-4.)

Elongate turreted, six or more volutions. Whorls angular and sharply carinated by three revolving spirals, which appear on all except the youngest whorls, the upper two being marked by numerous sharp, more or less regularly disposed nodes or spines, while the lower is smooth. In the youngest whorls the third carina appears just above the suture, but in all the later ones (in the last one only, in the more retarded forms) the carina is prominent, and the suture deep. This is due to looser coiling, each succeeding whorl embracing less. The apical angle of a characteristic specimen is 40°. A number of individuals of this species show phylogerontism, in that their last whorl is looser coiled than the preceding, the spirals diverge more or even become obsolete. When the spirals remain the third or lower one also becomes noded. In extreme cases the spirals become entirely obsolete and the whorl assumes a rounded outline (Pl. XXVI, fig. 4).

Horizon and localities.—This species is not uncommon in the Lucas dolomite of the Gibraltar and Patrick quarries. It occurs also in the Amherstburg bed.

97. ACANTHONEMA NEWBERRYI (Meek).

(Plate XXVII, Fig. 5.)

1871. *Orthonema newberryi* Meek, Proc. Acad. Nat. Sci. Philad., p. 81.

1873. *Orthonema newberryi* Meek, Geol. Surv. Ohio, Pal., Vol. I, p. 217, pl. 20, figs. 3a, b.

Original description.—"Shell turreted, elongate-conical; volutions eight or nine in adult examples, compressed-convex, with a more outward slope than the general slant of the spire, the most convex part being near the lower side of each, a little above the suture; first one or two very small and depressed, and the next one or two more rapidly increasing in size than those below, thus giving a proportionally shorter and more conical appearance to young than adult specimens; suture well defined in consequence of the prominence of the lower part of each turn just above. Surface ornamented by three very slender, raised, revolving lines, one of which is placed a little below the suture, and the other two below the middle of the turns of the spire, and on the middle of the last volution; of these revolving lines, the upper two are broken up into minute, regularly arranged, projecting points, while the other is usually continuous; lines of growth minute, sharply defined, and very regularly and closely arranged, passing vertically and very nearly or quite straight across the volutions. Aperture unknown."

The type specimen is in the collection of Columbia University, and is clearly in the Lucas dolomite. The species is much more slender and more closely coiled than *A. laxa* and the whorls are more nearly flat between the carinæ. This gives the shell a low apical angle, 20° being normal. The length of the type specimen is .63 inches (18 mm.); the width of the basal whorl is .22 inches or 5.5 mm. The closer approximation of the lower two spirals is another characteristic feature.

Horizon and locality.—This species was originally described and figured as from the Corniferous group just above the glass sand in Otsego, Wood county, Ohio. The glass sand is the Sylvania, the rock immediately above it being the Lucas, from which these specimens were obtained.

Genus STROPHOSTYLUS Hall.

98. STROPHOSTYLUS CYCLOSTOMUS Hall.

(Plate XVIII, Figs. 9, 10-11.)

1863. *Strophostylus cyclostomus* Hall, Trans. Albany Inst., Vol. IV, p. 218, ibid., 28th Ann. Rep. N. Y. State Mus., p. 176, pl. 30, figs. 1-13.

Several internal molds, the matrix of one of which preserved a small portion of the impression of the exterior, occur in the Nattress collection from the Detroit river. They consist of several gradually enlarging whorls, of slightly less thickness vertically than transversely. The final whorl does not enlarge as rapidly as in the typical members of the species, but has rather the form of the var. *disjunctus* Hall, but without the loosening of the final portion. Aperture of shell subcircular, umbilicus curved. Surface ornamentation of strong, subequal striæ, parallel to the lip, with occasionally finer, and more rarely, coarser striæ. The concentric striæ are very faintly indicated.

Horizon and localities.—In the Amherstburg dolomite of the Detroit river. Rev. T. Nattress, collector. It occurs in the Guelph and in the Niagara elsewhere.

Genus PLEURONOTUS Hall.

99. PLEURONOTUS SUBANGULATA sp. nov.

Several internal molds, with pronounced characteristics, of the genus cannot be referred to any described species. Since they constitute a characteristic element of the fauna, less mischief is done by describing them under a new name, imperfect as they are, than would be done if they were tentatively referred to a species with which they have only remote affinities, if any.

They consist of about three volutions, increasing rather rapidly in size and forming a flat or slightly elevated spiral. The whorls are subtriangular in section with the apex of the triangle on the umbilical side. Upper (apical) surface flat or gently convex, separated by a more or less blunt angulation from the lateral slope, with which it commonly forms nearly a right angle. The angulation occasionally marked by a faint ridge. Sometimes the

upper surface is depressed towards the inner suture, and the spire thus takes on a slightly sunken aspect. The lateral portion of the whorl slopes somewhat more abruptly on the under side, a sharp basal angulation being formed outside the center of the whorl; sometimes this angulation approaches closely to the laterial margin. Umbilical slope gently sigmoid from the angulation inwards, the innermost portion turning somewhat abruptly upwards.

Lines of growth curving forward from the suture, and backward again to the upper marginal angulation, forming a regular arc. After crossing the angulation they bend forward again, forming a second arc on the lateral slope. After crossing the umbilical angulation they curve gently backwards, converging on the umbilicus. A pronounced, though blunt, sinus or emargination thus characterizes the outer superior angulation.

This species is unlike any Siluric type described, though perhaps approaching nearest to *Euomphalus galtense* Whiteaves. It differs, however, from that in many characters, chief among which are the flat or slightly raised rather than sunken spire, and the umbilical rather than the lateral angulation. *E. gotlandicus* Lindström has the chief characters of our species reversed, the median angulation being on the apical side forming the slit band.

This species comes nearest to *E.* (*Pleuronotus*) *deceni* of the Onondaga, though its spire is not as sunken nor its slit band angulation as pronounced as in that species. Occasionally, however, young individuals of the Onondaga form have the characters of our species, and it is not unlikely that the Devonic species is a derivative of this late Siluric species, which in turn may prove to be a descendant of the Guelph species.

Horizon and locality.—Not uncommon in the Lucas dolomite of the salt shaft, Detroit.

100. EUOMPHALUS cf. FAIRCHILDI Clarke.

(Plate XVI, Fig. 28.)

1903. *Euomphalus fairchildi* Clarke, Guelph Fauna, p. 75, pl. 8, figs. 3, 4.

This species seems to be represented by several large individuals from the Lucas dolomite of the salt shaft. The spire is slightly turreted or nearly flat, the number of whorls being about four or more, gradually increasing in size. Upper surface of the whorls nearly flat, or slightly descending towards the suture, the outer

surface rectangular with it. The angle between the outer and upper faces more or less sharply defined. Outer and under face of the whorls at right angles to each other, with the junction abruptly rounded. The cross section of the whorl thus becomes nearly quadrangular. Umbilicus large and deep. Lines of growth at first arching forward, and then abruptly backward over the upper outer angle of the whorl, making a pronounced re-entrant. On the outer margin of the whorl they arch gently forward, and continue with a gentle backward flexure on the under side, to the umbilical margin, where they bend gently forward again.

Represented only by internal molds and one external mold.

The specimens described by Clarke from the Guelph of Rochester have the spire depressed below the summit of the body whorl, and the upper portion seems somewhat more angular than in our specimens. The whorls also are less quadrangular, and the retral curve of the growth lines is somewhat closer to the sutures. It may be necessary to separate our specimens, therefore, under a distinct specific name, though their affinity with the Rochester Guelph species is very close.

Horizon and locality.—Occasionally in the Lucas dolomites of the Detroit salt shaft, associated with *Pterinea bradti*, Grabau, *Pleuronotus subcarinatus* Grabau, and *Trochonema ovoides* Grabau. It was originally described from the Guelph of New York.

It differs from the preceding species in the rectangular character of the lateral and umbilical portions and the absence of the sharp median basal angulation.

Genus EOTOMARIA Ulrich.

101. EOTOMARIA AREYI Clarke and Ruedemann.

(Plate XVII, Fig. 5.)

1903. *Eotomaria areyi* Clarke and Ruedemann, N. Y. State Mus., Mem. 5, p. 68, pl. 8, fig. 2 and text figures.

Original description.—"This is a large and robust shell bearing somewhat the expression of *P. galtensis* Billings, but its proportions are larger, stouter and distinct in certain other details.

"Shell depressed conic, broader than high, the thick spire being but slightly elevated; apical angle between 85° and 90°; whorls five, increasing slowly in size; suture not deeply impressed, as the upper surface of the whorls slopes gradually to the preceding

ones; but on the casts there is a deep furrow along the suture line. The upper slope of the early whorls is moderately convex, but assumes a gently sigmoidal contour on the body whorl, the upper part being gently convex, the lower concave, markedly so directly above the slit band. This band forms a rather narrow groove with projecting sides a little above the middle of the whorl; on the casts it appears as a quite prominent ridge, and passes on the spire a little above the suture line. Periphery of whorls slightly convex, nearly vertical, imbilical surface strongly convex; umbilicus small, only about one-sixth of the diameter of the base of the shell; surface marked by fine, crowded growth lines, which curve strongly backward at the slit band but on the under side converge directly toward the umbilicus; aperture not observed.

"There is no satisfactory evidence of revolving ridges on the surface."

"Dimensions: The best preserved example has a height of 38 mm., basal width of 47 mm. Another, an incrusted specimen, has a height of 43 mm., a basal width of 47 mm."

Our specimens agree closely with those figured and described by Clarke and Ruedemann. The upper part of the whorls is rather strongly convex, becoming concave towards the slit band, which is prominent, though narrow. Faint marginal carinæ outline the band. The suture in most cases is rather strongly impressed, owing to the fact that the later whorls do not quite reach the slit band of the preceding. In the last whorl the embracing is generally less than in the earlier ones, showing a larger space of the body of the penultimate whorl, and making a deep suture, owing to the slight retreat of the body of the whorl. The lines of growth on the shoulder are gently convex, bending backward at an angle of about 50°, arching over the band and then bending forward again. The under side of the body whorl is regularly rounded, and the lines of growth converge at the umbilicus.

In well preserved external molds the lines of growth are seen to be emphasized at more or less regular and frequent intervals, producing a faint ornamentation of raised, sharp lines several times their diameter apart, and parallel to the outer lip of the shell. This ornamentation is confined to the younger whorls and is most pronounced in the space just below the suture, the ridges becoming fainter towards the suture band. In internal molds the

angulation of the periphery of the whorls is less marked and the shoulder seems to be somewhat more convex.

The largest mold in the collection has a basal diameter of about 40 mm. The height of another shell was in the neighborhood of 40 mm., with a basal diameter of 30 mm. or over.

The young are more ornate and with flatter shoulders and more closely coiled whorls.

Horizon and localities.—This shell is not uncommon in the Lucas dolomite of the Gibraltar quarry and Grosse Isle. Also in the Amherstburg of the Detroit river. The original specimens are from the Guelph of Rochester, N. Y.

102. EOTOMARIA GALTENSIS (Billings).

(Plate XXV, Figs. 1-2.)

1862. *Pleurotomaria galtensis* Billings, Palaeozoic Fossils, I, 154, fig. 136.

1895. *Pleurotomaria galtensis* Whiteaves, Palaeozoic Fossils, Vol. 3, pl. 2, p. 75., pl. II, fig. 7.

1903. *Eotomaria galtensis* Clarke and Ruedemann, Mem. 5, N. Y. State Mus., p. 70, pl. X, figs. 10-12.

Shell trochoid; depressesd conical with apical angle of 85° to 90°. Whorls five or more, sharply angulated in the middle, the angulation occupied by a moderately prominent slit band which is delimited by two moderate spiral ridges or carinæ. Whorls embracing to the base of the slit band which is visible above the suture. Shoulder flat or faintly concave just above the slit band, but very gently convex in the upper half. This and the pronounced embracing of the whorls give an almost continuous slope to the spine. Suture marked by a sharp depression and in some cases a faint revolving subsutural ridge, and by the nearly vertical slit band of the whorl above it. Body of whorls rather abruptly rounded off to the umbilicus; the height of the body is less than that of the shoulder, bringing the slit band below the middle of the whorl.

Surface marked by rather sharp, subimbricating lines of growth which are subequally spaced and often have finer ones interspersed between the larger ones. They start at the revolving sutural ridge, and turn sharply backwards, and these maintain their position at an angle of about 45° to the slit band over which they arch, and then with a gentle forward arch extend to the umbilicus.

This species is readily distinguished from *L. areyi* by its more perfect trochoid form, the shoulder surface being flatter and the body curving in more abruptly than on that species.

Horizon and localities.—This species is known from the Guelph of both Canada and New York. In the Lucas dolomite of the Gibraltar quarry associated with *C. areyi, Hormotoma subcarinata,* etc., and in the Amherstburg bed of the Detroit river. A crushed and imperfect specimen, probably of this species, was obtained from the Anderdon limestone of the salt shaft.

103. EOTOMARIA sp.

Several internal molds of robust species of Eotomaria occur in the material from the Detroit River. They differ from *E. areyi* mainly in the looser coiling and more depressed shoulder, which in places is almost flat, thus exposing a considerable portion of the shell below the suture. This portion descends abruptly without, however, retreating. The slit band is prominent as an angulation, depressed in the center and margined by a raised ridge on either side. The lines of growth extend sharply backward with a very gentle outward curvature to the slit band, across which they arch.

Horizon and locality.—In the Amherstburg brown dolomite from the bottom of the Detroit river. Collected by the Rev. Mr. Nattress.

Genus LOPHOSPIRA Whitfield.

104. LOPHOSPIRA BISPIRALIS (Hall).

(Plate XXIII, Fig. 16.)

1852. *Pleurotomaria bispiralis* Hall, Pal. N. Y., Vol. II, p. 348, pl. 84, fig. 2 a-b.

1895. *Pleurotomaria bispiralis* Whiteaves, Pal. Fossils, Vol. III, Pt. 2, p. 94.

1903. *Pleurotomaria bispiralis* Clarke and Ruedemann, Mem. N. Y. State Mus., V, p. 71, pl. 10, figs. 6-9.

Several internal and one external molds are referred to this species, which is known in the Guelph of Canada and New York. They are larger than any specimens heretofore described. The whorls are obtusely angular with a prominent slit band which is distinctly marked by a ridge in the internal mold. On the body whorl this slit band occupies about the center of the whorl, while

on the other whorls the exposed portion of the body whorl is about half that of the shoulder. The sides of the slit band are marked by two rounded, prominent, parallel ridges and the lines of growth form an acute re-entrant on the slit band. The center of the shoulder is marked by an angulation, the surfaces on either side being nearly flat and forming an angle of about 160°. In the younger whorls the angle seems to be nearer the slit band. It is faintly visible in the internal molds. Suture sharp and especially deep in the internal mold.

Ventrally the whorls in the internal mold are regularly rounded to the umbilicus, which in some of the molds is sufficiently large to suggest its being open in the shell. In one specimen the last portion of the body whorl seems to be loose coiled. A cast of the external mold shows a prominent angulation on the lower side of the whorl. The last whorl embraces the preceding one up to this angulation. The height of the largest specimen is 38 mm., the apical angle being 68°. Diameter of body whorl 16 mm. vertical by 20 mm. horizontal.

Horizon and localities.—The internal molds were found by the Rev. Mr. Nattress in the brown dolomite of the Amherstburg bed in the Detroit river. The external mold is from the Lucas dolomite of the Gibraltar quarry. It was originally described from the Guelph.

EUOMPHALOPTERUS Roemer.

105. EUOMPHALOPTERUS VALERIA (Billings).

(Plate XXVIII, Figs. 1-2 and Fig. 3.)

1865. *Pleurotomaria valeria* Billings, Geol. Sur. Canada, Pal. Foss., Vol. I, p. 169.

1884. *Pleurotomaria valeria* Whiteaves, ibid., Vol. III, Pt. 1, p. 23, pl. 4, fig. 1, 1a.

1895. *Pleurotomaria valeria* Whiteaves, ibid., Pt. 2, p. 71, pl. XI, figs. 2 and 3.

Cf. *Euomphalopterus alatus* var. *obsoletus* Ulrich, Pal. Minn., Pt. 2, 1897, p. 934, figs. 5 g, h, i.

A fragment of the internal mold of the last volution of a specimen showing the characteristics of this species was found in the Grosse Isle dolomite of the salt shaft. It shows a nearly circular cross section of the whorl, the baso-peripheral portion of which

is prolonged into an alar expansion or rim which is curved downwards near its outer extremity. The alar expansion of this specimen is shown by the internal mold, a feature not prominent in either the Canadian specimens of this species, or the closely related *E. alata* of Gotland. In these specimens the section of the internal mold is circular, though a narrow revolving rim is shown in the mold of the type specimen. The presence of the peripheral alation in this mold shows that this alation is hollow, and does not consist of the closely appressed shell lamellæ as in *E. alata*. This species differs further from *E. alata* in the absence of the ridge around the umbilicus, shown in the typical specimens figured by Lindström (Sil. Gast. and Peterop. of Gotland, pl. 10, figs. 20 and 23). That this is absent from the shell as well as from the mold is shown by an external mold of the base of the shell from the Siluric (Guelph) dolomites of Geneva, Ohio, as well as by the Canadian specimens. In other respects our species seem to be identical with the *E. alata* of Gotland. Lindström has called attention to the non-existence of the tubular perforation through the lamellar edge of *Pleurotomaria alata* Wahlenberg, which Roemer made the chief characteristic of his genus Euomphalopterus of which that species was the type. Nevertheless, the name may be conveniently retained for the Siluric Pleurotomarias with pronounced alation, wide umbilicus and trochoid form.

Ulrich has figured a small (?) form from Waldron, Ind., under the name *Euomphalopterus alata* var. *obsoletus Ulrich*. He speaks of it as the only representative of the genus in this country, having evidently overlooked Billings' species. The absence of the revolving ridge around the umbilicus is made the main feature of distinction, but this character is typical of the specimens from Ohio as well as the Canadian Guelph. In the absence of more detailed diagnosis, Ulrich's Waldron variety must be identified with Billings' species.

Horizon and locality.—In the Lucas dolomite of the salt shaft of Detroit,—a fragment. In the Guelph dolomite of Geneva, Ohio, and in the same horizon at various localities in Canada. It has not been recorded from the New York fauna.

106. PLEUROTOMARIA cf. VELARIS Whiteaves.

(Plate XXIII, Figs. 1-2.)

1895. Cf. *Pleurotomaria velaris* Whiteaves, Pal. Foss., Vol. III, Pt. 2, p. 72, pl. XI, figs. 4, 4a.

Cf. *Pleurotomaria lunata* Lindström, Sil. Gast. Pter. of Gotland, p. 144, pl. X, figs. 2-5.

An internal mold together with a portion of the shell, wholly decomposed into a brownish, soft powder, shows some of the characteristics of the above cited species from the Guelph of Elora, Canada and the Upper Siluric beds of Gotland. The whorls, of which less than two are preserved, are compressed elliptical in section. The angulation forms the baso-lateral margin of the whorl, the body of which recedes abruptly, almost at right angles to the axis of the shell. The angle between body and shoulder is about 50°. The latter is gently convex, and in the mold a portion of the preceding whorl is shown above the suture. The shell, however, embraced up to the angulation, thus making a continuous slope. There are further indications in the decomposed shell matter, that the angulation of the shell margin was reinforced by an alate expansion or flange. No indication of the surface ornamentation remains, except faint growth lines converging on the umbilicus. Umbilicus wide, but shallow and scarcely showing the inner whorls.

The specimen described is from the Anderdon limestone near the reef, Anderdon quarry. It is too poorly preserved to allow even close generic determination. The indications of the alate expansion and the size and form of the shell suggest its possible affinities with the Guelph species. The umbilicus, however, is much shallower than in the Guelph species of this type, exposing less of the inner whorls. In this respect the specimens described resemble *P. lunata* from Gotland with which species it also agrees in the more compressed character of the whorls of the internal mold.

Horizon and locality.—Anderdon limestone of Anderdon quarry, Ontario. The species was described from the Guelph.

Genus TROCHONEMA Salter.

107. TROCHONEMA OVOIDES sp. nov.

(Plate XXIII, Figs. 3-4, also Figs. 12-13 (young).

Shell a low, broad cone, consisting of four or five slightly overlapping volutions, with a broad, open umbilicus, showing all the

inner volutions. Volutions vertically flattened, ovoid in section, the more acute end at the umbilicus. Transverse diameter of whorls about twice the vertical diameter. Upper surface of whorls most flattened, with indications of a slight angulation on the outer, upper margin. On the umbilical side the upper surface of the whorl is marked by a narrow concavity, which occupies perhaps one-fifth of the transverse diameter of the whorl. This is the portion overlapped by the preceding whorl. Outer margin of whorls abruptly and somewhat sharply rounded, the curvature being slightly asymmetric, bringing the periphery a little nearer the umbilical side. Umbilical surface of whorls regularly, though gently, rounded.

Surface marked by subangular lines of growth which curve backwards on the umbilical side.

This species has some resemblance to *Pleurotomaria acquilatera* Wahlenberg from Gotland, but differs in the flatter whorls and the looser coiling which shows more of the younger whorls in the umbilicus.

A young specimen (figs. 12 and 13) showing some of the earlier but not the earliest whorls was obtained by Mr. Nattress. In this the upper slopes are somewhat steeper than in the adult whorl and the shoulder angle is somewhat less angular. A second fainter angulation appears near the suture. Lines of growth curve backwards and over the shoulder angle.

This species is not unlike *Trochonema lescarboti* Clarke (Bull. 107, N. Y. State Museum) described from the Lower Devonic of Percé Rock, P. Q. In that the shoulder is very gently concave and the shoulder angle pronounced. The last whorl seems to increase somewhat more rapidly, this and the form of the cross section of the whorl apparently being the only difference of moment. The two species seem to be closely related.

Diameter of the largest complete shell 55 mm.; height about 18 mm. Transverse diameter of aperture 18 mm., vertical diameter 10 mm. A larger fragment measures 22x12 mm. in greatest diameter. Diameter of small individual 15 mm.; height of last whorl 4 mm.; height of spine 10 mm.

Horizon and localities.—In the Amherstburg dolomite of the Detroit river opposite Amherstburg, Ont., several specimens. Also in the Lucas dolomite of the salt shaft associated with *Euomphalus fairchildi* and *Pterinea lanii*. Also in beds of the same age in the Woolmith quarry.

Genus POLEUMITA Clarke.

108. POLEUMITA cf CRENULATA (Whiteaves).

(Plate XVI, Fig. 27.)

1884. Cf. *Straparollus crenulatus* Whiteaves, Palaeozoic Fossils, Vol. 3, pt. 2, p. 21, pl. 3, fig. 8a-b.

Poleumita crenulata (Whiteaves) Clarke and Ruedemann Guelph Faunas, p. 64, pl. 9, figs. 9, 11, 16-24.

A deeply umbilicated, low spired, and round whorled form occurs in the Lucas dolomite. The apical angle is about 120°. Suture very deeply impressed, the whorls hardly embracing each other. Upper surface of whorls nearly flat and making a right angle with the axis of the shell. It is rounded off into the lateral margin, which is also somewhat flattened, and for a short space is parallel with the axis of the shell. Inner margin of whorl obliquely rounded. The umbilicus is deep and wide, occupying more than one-third the width of the shell at the base. Surface features unknown, but apparently smooth or with fine spirals. The shell is not unlike in form to *Poleumita crenulata* Whiteaves of the Guelph of Canada and western New York, but it is impossible to make a detailed comparison.

Horizon and locality.—In the Lucas dolomite of the salt shaft. Originally described from the Guelph.

Genus HERCYNELLA Barrande.

109. HERCYNELLA CANADENSIS sp. nov.

(Plate XXV, Figs. 5-6.)

Shell cap-shaped, non-spiral; outline subcircular, with the posterior end truncated. Beak elevated and slightly incurved over the flattened truncated area; continued forward in a sharp, curved angulation for a little over a third of the diameter of the shell, beyond which it quickly dies away in the general broad convexity of the shell. The truncated posterior end is defined by marked angulations which extend from the beak, where they are sharpest, towards the posterio-lateral margins, gradually becoming less marked. Cross section of shell just in front of the beak subtriangular, near the middle of the shell, a nearly perfect arch. Great-