LIBRARY
OF THE
AMERICAN MUSEUM
OF NATURAL HISTORY

19.78790 - Mar. 18

ARTICLE I.—SILURIAN FOSSILS FROM THE KOKOMO, WEST UNION, AND ALGER HORIZONS OF INDIANA, OHIO AND KENTUCKY.

By Aug. F. Foerste.

In Ohio, the Silurian section was divided by Professor Orton into the following lithological units, named in descending order:

Hillsboro sandstone.
Cedarville limestone.
Springfield limestone.
West Union limestone.
Niagara shale.
Dayton limestone.
Clinton limestone.

In east-central Kentucky, the following horizons can be recognized, also named in descending order:

Crab Orchard formation	Alger member.....	Estill clay
		Waco limestone
		Lulbegrud clay
	Indian Fields member	Oldham limestone
		Plum creek clay
Clinton formation.....		Brassfield limestone.

In this classification, the Brassfield limestone is the southern continuation of the strata which were identified in Ohio, by Professor Orton, as Clinton. The Oldham limestone apparently is equivalent to the Dayton limestone. The Plum creek clay is a local deposit and can not be traced with confidence beyond east-central Kentucky. This is true also of the Waco limestone, so that the northward extension of the Alger member of the Crab Orchard formation consists only of clay and clay shale uninterrupted by limestones, and corre-

sponds to the so-called Niagara shales of Adams and Highland counties in Ohio.

In former years, the name Beavertown marl was used for a very fine grained limestone, 9 inches thick, weathering to a rather soft rock, in which a small depauperate fauna, consisting chiefly of a small species of *Orthoceras* and several gasteropods, was found. This rock occurred at Dayton, Ohio, in an area about 4 or 5 miles in diameter, immediately above the soft, richly fossiliferous clays with which the Brassfield bed terminates in Montgomery, and adjacent counties, in Ohio. The term marl, for the 9-inch layer, at the base of the Dayton limestone, is not appropriate, and at present this layer is included in the Dayton limestone. The richly fossiliferous clay at the top of the so-called Clinton limestone of Ohio carries the same fauna as the underlying limestone, merely more frequently as free specimens, and, therefore, more interesting to the collector. This clay never has received a separate designation, and in my opinion does not need any. It is not the stratum to which the name Beavertown marl was applied originally, but immediately underlies the latter.

In Lewis county, Kentucky, the Alger member of the Crab Orchard formation is overlaid by a variable thickness of Silurian limestone. This limestone was investigated by Mr. W. S. Morse and myself at numerous localities, and a fair fauna was collected, described on the following pages. This limestone may be traced along the bold bluffs of the Ohio river from the neighborhood of Vanceburg, in Kentucky, to the mouth of Brush Creek, in Adams county, Ohio. Stratigraphically it occupies the same position as the West Union bed, in Adams county. No strata equivalent to the Springfield, Cedarville, or Hillsboro divisions of the Ohio Silurian have been identified so far in Kentucky.

In Lewis and Fleming counties, in Kentucky, the upper part of the Crab Orchard formation contains more or less thin-bedded indurated argillaceous shale. This phase continues northward into Ohio, and is well exposed west of

Peebles, in the northern part of Adams county. It is the upper part of the Alger member. In Lewis county, Kentucky, the following fauna has been collected from this upper part of the Crab Orchard formation:

Calymene clintoni, Hall.
Beyrichia lata-triplicata, Foerste.
Chonetes vetustus, Foerste.
Stropheodonta mundula, sp. nov.
Camarotoechia congruens, sp. nov.

This fauna is of interest since *Calymene clintoni* and *Beyrichia lata* may be regarded as representatives of the eastern Clinton, as exposed in Oneida county, New York.

In the lower part of the West Union limestone overlying the Crab Orchard formation, in the vicinity of Martins, in Lewis county, Kentucky, the following fauna was collected in a single, small, strongly weathered sandy block:

Dalmanites limulurus-brevicaudatus, var. nov.
Homolanotus delphinocephalus, Green.
Calymene niagarensis, Hall.
Illaenus depressus, Foerste.
Diaphorostoma cliftonensis, Foerste.
Stropheodonta planus, sp. nov.
Spirifer radiatus, Sowerby.
Camarotoechia pisa (?), Hall and Whitfield.
Camarotoechia acinus-subrhomboidea, var. nov.
Camarotoechia congruens, sp. nov.
Favosites sp.

It is of interest to note that in Oneida county, New York, *Dalmanites limulurus* and *Homolanotus delphinocephalus* occur in the top of the series to which the name Clinton was originally applied, apparently above the *Calymene clintoni* horizon.

The recent investigations of Wm. F. Prouty, in the Meso-Silurian deposits of Maryland, have resulted in finding a fauna containing *Dalmanites limulurus* and *Homolanotus delphinocephalus* immediately above another fauna containing *Calymene clintoni.* This *Calymene clintoni* fauna occurs in the upper fossiliferous division of a series of clays or argillaceous

shales, interbedded with thin sandstone bands, which are more frequent toward the bottom. The thickness of the total section, identified by Prouty as Clinton, is about 550 feet, and of this the upper fossiliferous section, containing Calymene clintoni, occupies a thickness of about 100 feet.

Overlying the Clinton section of Prouty, is a series of strata about 300 feet thick, in which limestones are frequent, although interbedded with more or less argillaceous shale. This limestone section has been identified by Prouty as Rochester. In the lower part of this series, sometimes 30 feet thick, although usually less, the fauna containing *Dalmanites limulurus* and *Homolanotus* is found.

Between the Clinton argillaceous shales and the Rochester section with its numerous limestone layers, there is a sandstone, thicker eastward, thinner westward, in the top portion of which a ferruginous layer is present.

It is significant in this connection to note that the fossiliferous block containing the fauna listed above from Martins, in Lewis county, Kentucky, was distinctly sandy, and that a considerable part of the West Union section at this locality is rather coarse-grained and cross-bedded. It seems possible therefore, to correllate the Crab Orchard clay section of Lewis county, Kentucky, consisting of that part, 100 feet thick, which overlies the Dayton limestone, with the much thicker clay section of Maryland, identified by Prouty as Clinton. In this case, the West Union bed of northern Kentucky may be regarded as approximately equivalent to the lower part of the Rochester section, as identified by Prouty.

In the Maryland section, a ferruginous sandstone occurs in two beds, varying from several inches to six feet in distance apart, at an elevation varying from 120 to 160 feet above the base of the argillaceous section there identified as Clinton. It is not known whether anything corresponding to this lower ferruginous horizon occurs in Kentucky. It may be of interest, however, to note in this connection, that the iron ore of Bath county, Kentucky, traces of which extend into Fleming

county, is found immediately above the sandy layers containing *Whitfieldella subquadrata,* Foerste. The ore is overlaid at the Rose Run quarry by eight feet of Plum creek clay and five feet of Oldham limestone. The sandy layers containing *Whitfieldella subquadrata* appear to locate a stratigraphic break, distinctly sandy layers being rare in Silurian rocks in Kentucky or Ohio, and on this account the sandy rock with the overlying iron ore has been included with the overlying Crab Orchard formation, rather than with the underlying Brassfield bed.

It will be a subject of future inquiry to determine whether the Alger clay division of the Crab Orchard formation of Kentucky corresponds to all or only to the upper part of the Clinton of Maryland, as identified by Prouty.

The most interesting result, however, of this attempted correllation of the Silurian formations of Kentucky with those of Maryland is the conclusion that the low barrier separating the Cumberland gulf, containing the Maryland and eastern New York Silurian deposits, from the interior epicontinental sea, containing the Kentucky and Ohio Silurian deposits, was lowered several times during Silurian times. It must have been lowered during the deposition of the upper parts of the Alger clay, so as to permit of the entrance of *Calymene clintoni* into Kentucky. It probably was lowered again during the deposition of the lower part of the West Union bed, although *Dalmanites limulurus* and *Homolanotus delphinocephalus* occur abundantly in the Rochester shale of western New York. Some of the associated species, at Martins, in Kentucky, however, remind me more of Cumberland Gap and Alabama fossils than of those of western New York.

Again, during the deposition of the Waco limestones, an Atlantic fauna including *Calostylis* appears to have come in from some point eastward.

It should be stated, however, that this incursion of eastern faunas appears to have been local. The Waco fauna is confined practically to Madison, Estill, Powell and Clark counties,

in east-central Kentucky. The *Calymene clintoni* and *Beyrichia lata* fauna is confined practically to Lewis county, in Kentucky. The great numbers of *Dalmanites limulurus* and *Homolanotus delphinocephalus* appear restricted to a single locality in Lewis County: that exposed by the bluff northwest of Martins. Moreover, the barrier does not appear to have remained down long enough to permit any considerable part of the eastern faunas to enter Kentucky and Ohio during any one of the periods of deposition here mentioned. In each case only a small number of species is distinctly eastern, and the great majority remain western.

The Cedarville limestone of Ohio contains a distinctive Guelph element, and its Guelph affinities were recognized by Professor Orton. The fauna of the Springfield limestone is practically unknown.

Overlying the Hillsboro sandstone, in southern Ohio, is the Greenfield limestone, apparently the lowest member of the Monroe formation of Michigan and Northern Ohio.

At Kokomo, in north-central Indiana, at least forty feet of limestone are extensively quarried which are characterized by the evidence of very thin lamination of their bedding planes, often beautifully shown on weathered surfaces, and also by the presence of various eurypterids, or merostomata. This eurypterid horizon is overlaid by a series of limestones of more normal type, not thinly laminated, in which a rather rich brachiopod fauna is present. This brachiopod horizon should probably be distinguished from the eurypterid horizon by a distinct name, and the designation, Kokomo limestone, should be restricted to the eurypterid beds, but at present no suitable name is at hand. The eurypterid horizon, and probably also the overlying brachiopod horizon, are regarded as of Salina age. In New York, the Salina forms the lower division of the Cuyahogan.

It is impossible, at present, to determine what are the relations between the Greenfield limestone of Ohio and the Salina horizons at Kokomo. Both areas undoubtedly were connected

during early Cuyahogan times with lower Michigan, northern Ohio, and western New York.

At the old George W. Defenbaugh quarry, southeast of Kokomo, Indiana, at present owned by Wilbur Defenbaugh, and run last by Charles Driggs, the following section is exposed:

Heavy bedded fossiliferous limestone.....	1 ft. 8 in.
Chert, thin bedded, with ostracods.....	1 in.
Thin bedded fossiliferous limestone.....	2 ft.
Base of the brachiopod horizon.	
Darker layer of limestone.....	2 in.
Thin bedded limestone.....	10 in.
Heavier bedded limestone, but thinly laminated,	1 ft. 4 in.
Thin bedded limestone.....	9 in.
Darker limestone	3 in.
Layer with merostomata.	

At the McReynold or Interurban quarry, in the southwestern corner of Kokomo, there is a much thicker exposure of the upper or brachiopod horizon. No merostomata have been found here.

South of the center of Kokomo, within the town limits, there is a deep quarry, covering a considerable area, where merostomata are common at an elevation of three to three and one-half feet above the base of the quarry. This belongs to the lower thinly laminated part of the section, and the richly fossiliferous brachiopod beds appear to be absent. The base of the quarry must be at least thirty feet below the top of the exposures, but no measurements were made.

At the George W. Hawker quarry, now owned by Vess Guinn, a mile southwest of Kokomo, merostomata are said to occur ten feet below the top of the quarry. At the Chaffin quarry, they occur very low in the quarry, and about twenty feet below the top.

It is not improbable that several merostomata horizons occur in the thinly laminated limestones of the Kokomo region, and that different species occur at the different horizons. No

attempt has been made so far to collect any of these species by horizons.

The following descriptions of fossils are offered as an addition to our present knowledge of Silurian fossils at three horizons where at present our knowledge is most defective: the Kokomo limestone, the West Union limestone, and the top of the Alger division of the Crab Orchard limestone, which was included in Ohio by Orton under the term Niagara shale.

Amplexus septatus, **sp. nov.**

Plate I, Figs. 12 A, B.; Plate II, Figs. 16 A, B, C.

Corallum simple; no evidence of gemmation in the specimens at hand. Form conico-cylindrical or gently enlarging from the base. The largest specimen found so far has a length of about 60 mm., and a width of approximately 12 mm. at the top. The exterior is marked by comparatively strong vertical septal ribs of which six to seven, sometimes eight, occupy a width of 10 mm. Transverse striations and moderate annulations or constrictions also present. Transverse tabulæ comparativly flat, not deflected at the margins. Radiating septa differentiated into primary and secondary septa. Of these the primary septa extend for a distance of about 2 mm. from the exterior surface of the corallum toward the center, in specimens having a diameter of about 10 or 11 mm. The secondary septa frequently do not extend more than three-quarters of a millimeter from the exterior surface. This method of measurement is adopted since the wall of the corallum appears more or less thickened by the process of silicification in some specimens. Judging from other specimens, the thickness of the wall exceeds a quarter of a millimeter only slightly. The number of primary septa varies from eighteen to twenty-one in specimens about 10 mm. in diameter. There is an equal number of secondary septa. The transverse tabulæ vary in number from two to four in a length of 3 mm. In some specimens their number may be even less.

Kokomo limestone, in the upper part of the exposure at the old George W. Defenbaugh quarry.

Compared with *Amplexus cingulatus,* Billings, the septa are less numerous and extend farther toward the center of the corallum. The tabulæ are more nearly flat. The genus *Pycnostylus* differs in the compound growth of the corallum, the corallites forming colonies due to gemmation.

Favosites sp.

An unknown species with corallites 1.5 mm. in diameter, interspersed with rather numerous smaller corallites which probably are merely the initial stages of the larger ones. Septal spines and pores on the walls of the corallites are present. Tabulæ not well preserved.

West Union bed, one mile south of Carrs, in Lewis county, Kentucky.

A small globose specimen of *Favosites,* with corallites 1.5 to 2 mm. in diameter, with rather numerous tabulæ, occurs in the West Union bed northwest of Martins, in Lewis county, Kentucky.

Favosites pyriforme-kokomoensis.

Plate I, Figs. 17 A - D; Plate II, Fig. 15.

Corallum apparently small and globose, as far as may be determined from the fragment at hand. This fragment has a height of 26 mm., measuring from the point from which the corallites radiate. The presence or absence of an epitheca can not be determined. Corallites between 1.5 and 1.7 mm. in diameter, occasionally equalling almost 2 mm. Cross-section of the corallites, polygonal; walls thin, but thickened during the process of silicification in a part of the specimen. Pores large and distant, with elevated margin, apparently with a tendency toward arrangement in vertical rows, one row on each wall of the corallite. Diameter of pores estimated at 0.2 mm., and the vertical distance between them varies from 0.4 to 0.7 mm. They have a tendency to occur so that several are found at about the same level. Septal spines apparently short, not exceeding a third of a millimeter in length, as far

as may be determined in the present silicified condition of the fragment here described. They tend toward arrangement in vertical rows, varying apparently from six to twelve in number; from three to four spines occupy a length of 1 mm. Tabulæ present, apparently from 1.2 to 1.7 mm. apart, where preserved.

Kokomo limestone at Kokomo, Indiana, in the upper part of the exposures at the old George W. Defenbaugh quarry.

This specimen appears to be closely related to *Favosites pyriforme.* This relationship is shown by the spheroidal form, small size of the corallites, and the presence of the septal spines. In the Kokomo specimen, however, the spines appear short, not bent upward at the tip, and the pores are so large that it seems difficult to believe that they could have escaped attention in the New York specimens if of equal size there. Probably the Kokomo specimen should be regarded as a variety of *Favosites pyriforme.* A fuller description of the New York species is needed.

HALYSITES CATENULARIA, *Linnæus.*

Specimens with corallites 2 mm. wide along their greater diameter; the tubules between the corallites are crossed by numerous closely set and strongly arched tabulæ. Found in the West Union bed at the Clarksburg chapel or Church of Christ, three miles south of Vanceburg, on the road to Valley, in Lewis county, Kentucky.

HALYSITES NEXUS, *W. J. Davis.*

A variety with four corallites in a width of 15 mm. occurs in the upper part of the George W. Defenbaugh quarry, southeast of Kokomo, Indiana. It appears to be identical with the form figured by W. J. Davis, on plate 67 of Kentucky Fossil Corals as *Halysites nexus.*

CORNULITES CLINTONI, *Hall.*

A small fragment of this species was found in the West Union bed, at the spring one mile south of Glen Springs, on Big Salt Lick creek, in Lewis county, Kentucky.

Clathropora frondosa, *Hall.*

A wretchedly preserved specimen showing the fenestrules occurs in the West Union bed at the spring on Big Salt Lick creek, one mile south of Glen Springs, in Lewis county, Ky.

Rhynchotreta americana, *Hall.*

Similar to *Rhynchotreta americana* from the Waldron clay of Indiana, but in some specimens the beak is less prolonged, although equally acute. In some specimens the two middle plications on the median fold are conspicuously more elevated than the other two, but in others all four plications on the fold reach about the same elevation. Sinus of the pedicel valve with three plications. Lateral plications usually three, but sometimes two or four.

West Union bed, in the quarry at the southeastern corner of West Union, Ohio. Also at the spring on Big Salt Lick creek one mile south of Glen Springs, and one mile south of Carrs station, in Lewis county. At the locality south of Carrs, an aberrant specimen was found with two plications on the fold, one in the sinus, and two lateral plications on each side of the fold and sinus.

Camarotoechia congruens, **sp. nov.**

Plate II, Figs. 3, A, B.

Shell small, 6 mm. long, 6.5 mm. wide, both valves moderately and rather evenly convex. Four plications occupy the median fold of the brachial valve, and about eight lateral plications are found on each side. The most characteristic feature is the very low elevation of the median fold, in some cases almost imperceptible, combined with the slight difference in size of the plications occupying the median fold and those immediately adjacent. While usually the plications on the fold are slightly larger, in some cases the difference is almost imperceptible.

In the upper part of the Alger clay division of the Crab Orchard formation, between Valley and the W. H. Lawrence store, in Lewis county, Kentucky.

The nearest relative of this shell appears to be *Camarotoechia indianensis,* but that species attains a larger size, the plications appear coarser, and the shell usually is more or less flattened anterior to the beak.

Similar shells occur in the West Union bed, northwest of Martins, in Lewis county, Kentucky. They attain a length of 7 mm., a width of 8.5 mm., with a depth of about 3.5 mm. There are about 14 radiating plications, of which the median four are slightly elevated in case of the brachial valve, while the median three of the pedicel valve are slightly depressed below the general level.

CAMAROTOECHIA ACINUS-SUBRHOMBOIDEA, **var. nov.**

Plate II, Fig. 4.

A small rhynchonelloid, 6.5 mm. long, and 6 mm. wide, not strongly flattened on the sides, and having an ovate-subrhomboidal, rather than elongate ovate outline. The plications limiting the median sinus of the pedicel valve form angles varying from thirty to forty-five degrees. The sinus is very shallow, and is marked along the anterior half of the internal cast by a single plication. In addition to the plications limiting the sinus, there is, on each side of the internal cast, one lateral plication, indistinct toward the posterior half of the shell, and a trace of a second lateral plication in some specimens.

West Union bed, northwest of Martins, in Lewis county, Kentucky.

This form is distinguished from *Camarotoechia acinus* chiefly by the absence of lateral flattening and the smaller number of lateral plications.

CAMAROTOECHIA PISA ? , *Hall and Whitfield.*

Plate II, Figs. 1 A, B.

A small specimen of a very globose rhynchonelloid may be a diminutive representative of the species *Camarotoechia pisa.* Its length is 7 mm., its width 7.2 mm., and the depth 6.5 mm. There are four plications on a very low fold, the

anterior part of which follows the general convex curvature of the shell. Three plications occupy the very shallow sinus. There are five lateral plications on each side, which are indistinct over the middle and posterior parts of the cast. The anterior slope of the shell is fairly abrupt. There is a distinct median septum in the brachial valve, and there are traces of dental plates in the pedicel valve.

West Union bed, northwest of Martins, in Lewis county, Kentucky.

This shell is much smaller than *Camarotoechia pisa,* as figured by Hall and Whitfield, and may have come from a different horizon.

WILSONIA KOKOMOENSIS, *Miller.*

Described from Kokomo, Indiana, but not found by the writer.

ATRYPA RETICULARIS-NIAGARENSIS, *Nettelroth.*

A single valve, 10 mm. in length, with six radiating plications in a width of 5 mm., was found at Harin Hill, four miles west of Valley, also at the Clarksburg chapel, three miles south of Vanceburg, in Lewis county, Kentucky, in the West Union bed.

ATRYPA RUGOSA, *Hall.*

Plate II, Fig. 6.

A cast of the external surface of the pedicel valve, 10 mm. long. A single plication occupies the sinus. The plications bordering the sinus are rather prominent and bifurcate near the anterior end, but the bifurcations remain close together. Next, on each side, comes an intercalated plication, then a primary plication bifurcating distinctly toward the end, the bifurcations spreading considerably. Then, another intercalated plication, followed by a primary plication, and one or two smaller plications near the anterolateral margin. The characteristic feature is the presence of both bifurcating primary and intercalated secondary plications.

West Union bed, at the quarry in the southeastern part of West Union, Ohio.

Coarser specimens, with several plications in the sinus, and with rather strong and distant concentric striations, in the Osgood bed of Indiana, are more nearly related to *Atrypa calvini,* Nettelroth, from the Louisville limestone in the vicinity of Louisville, Kentucky. *Atrypa marginalis,* as identified from the Brownsport formation of western Tennessee, belongs to the same group.

Spirifer radiatus, *Sowerby.*

Plate II, Fig. 8.

An internal cast of the pedicel valve of a nonplicate form of *Spirifer,* with a rather quadrate outline posteriorly, and with a distinctly defined median sinus. Length 15 mm., width 19 mm. Dental plates continuing for 5 mm. from the beak. Apparently a trace of a median septum.

West Union bed, at the bluff northwest of Martins, in Lewis county, Kentucky.

Spirifer radiatus-obsoletus, **var. nov.**

Plate II, Figs. 10 A, B, C.

Spirifer belonging to the group typified by *Spirifer radiatus,* differing chiefly in the nearly complete obsolescence of the median sinus and fold. In a specimen 22 mm. in length, 48 mm. in width, and 17 mm. in thickness, the sinus is indicated only by a slight flattening of the anterior part of the pedicel valve, while the fold is represented by a broad but only slightly elevated median part which is not distinctly limited laterally, as in *Spirifer radiatus.* However, there are specimens from the same locality in which there is a narrower slightly elevated median part with a distinct lateral boundary. These specimens evidently indicate the close relationship of this form to typical *Spirifer radiatus.* The interior of the pedicel valve exhibits two dental lamellæ extending from 8 to 10 mm. anterior to the beak, and also a low acute median septal ridge

extending one or two millimeters farther. The crural plates of the brachial valve are short, nearly vertical, and only moderately divergent; there is no distinct median septum in this valve. In the type specimen there are about eleven radiating striæ in a width of 5 mm. at a distance of 17 mm. from the beak of the brachial valve, but in some specimens the number of striæ is greater, so that the smaller number of radiating striæ seen in the type specimen does not seem to be a constant feature. The anterior of the shell is deflected so as to indicate the relationship of this form to shells with a distinct sinus and fold.

West Union bed, at the spring on Big Salt Lick creek, one mile south of Glen Springs, on the road to Noah, in Lewis county, Kentucky.

The sharp median septum of the pedicel valve has not been noted in typical forms of *Spirifer radiatus*. The beak appears to be somewhat less incurved. The most conspicuous difference, however, is the absence of a distinct median sinus, giving the pedicel valve a more evenly convex surface.

Spirifer nanus, **sp. nov.**

Plate I, Fig. 7; Plate II, Fig. 7.

Shell apparently small, the largest specimens found not exceeding 10 mm. in length, 11 or 12 mm. in width, and 4 mm. in convexity. Considering the size of the shell, the brachial valve is strongly convex, especially along the median fold. Only the internal casts of the brachial valve have been found so far, and these show the presence of the crural ridges, about 2 mm. in length, and also a faint median septal striation, about 5 mm. in length. If our interpretation of the shell be correct, it may be related to the form represented by figures 14 to 18 on plate 21, Volume VIII, of the New York Paleontology. In our specimens, however, the median fold is less distinctly limited, especially toward the beak, where it is but slightly elevated above the general convexity of the shell. There are no traces of radiating striæ on these casts.

West Union bed, at the spring on Big Salt Lick creek, one mile south of Glen Springs, in Lewis county, Kentucky, on the road to Noah. Also at the same horizon in the quarry southeast of west Union, in Adams county, Ohio.

At first glance the shell does not have a strongly spiriferoid appearance, and the casts of the pedicel valve will be necessary to make the generic reference certain. Externally, it resembles *Hyatella congesta,* but its internal structure is different.

SPIRIFER EUDORA, *Hall.*

Plate II, 14 A, B.

A small form of *Spirifer eudora,* 15 mm. in length. Sinus and fold distinct, the latter flattened on top anteriorly, and slightly depressed along the median line. Four lateral plications on the brachial valve, and four on each side of the sinus in the pedicel valve. One specimen with traces of longitudinal striations.

West Union bed, in the quarry at the southeastern corner of West Union, Ohio.

SPIRIFER REPERTUS, **sp. nov.**

Plate I, Figs. 14 A, B; Plate II, Fig. 5.

This species evidently belongs to the group typified by *Spirifer niagarensis.* From this it differs chiefly in being smaller, shorter, and having fewer radiating plications. Of these there are seven on each side of the median fold in a brachial valve 11 mm. long and 20 mm. wide. The convexity of this valve was about 3 mm. The grain of the rock is not fine enough to preserve any trace of the delicate longitudinal striations characteristic of this group of species.

West Union bed, at Harin Hill, four miles west of Valley, in Lewis county, Kentucky. Also at the same horizon at the quarry in the southeastern corner of West Union, Ohio.

SPIRIFER HARINENSIS, **sp. nov.**

Plate II, Fig. 2, A. B.

Shell small, 5 mm. in length. The fold of the brachial valve is low but is distinctly limited laterally by grooves

extending as far as the beak. On each side there is a single, much less distinct lateral plication. Beyond this, there is room for an additional plication, but this area is smooth. The sinus of the pedicel valve is distinct as far as the beak, and the limiting plications may be traced the same distance. Beyond the latter, there is a much less distinct plication, disappearing posteriorly. The surface does not preserve any indication of striæ, but may not be fine grained enough to preserve them.

West Union Bed, at Harin Hill, four miles west of Valley, in Lewis county, Kentucky.

The presence of distinct dental plates in the casts of this species separates it from *Reticularia,* entirely aside from the fact that no evidence of strong fimbriate concentric striæ has been discovered. It appears to belong to the *Spirifer vanuxemi* type of shells. *Spirifer simplex* is a distinctly more globose, and more strongly plicate shell.

Spirifer exiguus, **sp. nov.**

Plate I, Figs. 8, A, B, C.

Shell small. The largest specimen found so far equals 9 mm. in length, 10 mm. in width, and 6.4 mm. in thickness; the length of the brachial valve is 8 mm. and the width of the median fold at the anterior margin is 3 mm. The brachial valve is moderately convex. The median fold is low and broad, but is distinctly defined on each side by the limiting grooves; anteriorly it is flattened, with occasionally a very faint trace of a median depression. Lateral plications four, usually faint, the first occasionally distinctly broader than the rest, the second still fairly discernible, the last two almost obsolete. Median groove of the pedicel valve shallow, not angular or narrow; the limiting plications are distinctly more conspicuous than the lateral plications, being both broader and more elevated. Lateral plications faint, four in number, the last two almost obsolete. Hinge area rather low. Beak of the pedicel valve strongly incurved but not extending beyond

the plane of separation of the valves. All lateral plications on both valves become more or less indistinct or obsolete toward the beak. Surface smooth, with no distinct evidence of concentric striæ. Dental plates high near the beak, rapidly thinning to their anterior extremity, about 3mm. from the most elevated part of the beak, divergent at an angle of about twenty degrees.

Kokomo limestone, at Kokomo, Indiana, near the top of the exposures at the George W. Defenbaugh and Traction quarries.

Compared with *Spirifer vanuxemi,* the beak is less elevated, the shell is less angular laterally, and the lateral plications are much less distinct. Compared with *Spirifer eriensis,* Grabau, the absence of a subrhomboidal outline, of a high area, and of a pronounced angular median sinus are sufficient characteristics. Compared with *Spirifer corallinensis,* Grabau, the wider median sinus, more rounded outline, and the presence of lateral plications, though faint, are sufficient characteristics. Compared with *Spirifer bicostatus,* the beak is less elevated, the lateral plications are more narrow, and the concentric striæ are practically obsolete.

Spirifer corallinensis, *Grabau.*

Several small and relatively wide Spirifers, with a narrow fold and sinus, but without any indications of lateral folds, were found at the Traction quarry in the southwestern part of Kokomo, Indiana. These can not be distinguished from the Spirifers represented by figures 9 a-h, on plate 74, volume 2, of the New York Paleontology.

Trematospira camura-pauciplicata.

Plate II, Figs. 9 A, B.

A pedicel valve, 6.5 mm. in width, and 4.5 mm. in length, with two low and narrow central plications, and four strong and angular lateral plications, resembling figure 24 on plate 49, volume VIII, of the Paleontology of New York, but of

much smaller size, occurs in the West Union bed in the quarry in the southeastern corner of West Union, Ohio. These specimens agree fairly well with some of the pauciplicate forms illustrated by Hall, in volume 2 of the Paleontology of New York, but not with the multiplicate forms illustrated by Hall and Clarke in volume 8 of the same series. As far as may be determined by a comparison with the figures accompanying the original description, our specimen is more strongly plicated.

WHITFIELDELLA NITIDA, *Hall.*

Specimens not exceeding 15 mm. in length; the cast of the brachial valve marked by a distinct median septum extending 3 mm. from the beak; the cast of the pedicel valve showing the presence of two vertical dental lamellæ, without any strongly developed muscular impressions. A faint median depression marks the anterior margin of the pedicel valve.

West Union bed, at the spring on Big Salt Lick Creek, one mile above Glen Springs, and at Harin Hill, four miles west of Valley, in Lewis county, Kentucky. Also at the quarry in the southeastern part of West Union, Ohio.

WHITFIELDELLA ERECTA, **sp. nov.**

Plate I, Figs. 9 A, B, C.

Shell small. The largest specimen found so far has a length of 9 mm., a width of 9.5 mm., and a thickness of 4.5 mm. The outline of the pedicel valve is rounded ovate; that of the brachial valve is more nearly circular. The valves are approximately equally convex, the convexity being moderate in the case of smaller valves but increasing with age. A median depression becomes distinct about 3 mm. from the beak and increases in width and depth anteriorly, though remaining rather shallow and comparatively narrow. Most of the brachial valves are evenly convex, but occasionally a valve is found which has a faint median depression anteriorly. The beak of the pedicel valve is short and erect; it does

not curve over the beak of the brachial valve, but exposes the unclosed triangular delthyrium. The surface of the shell is smooth. The number of volutions of the spires forming the brachidium is about 7; the remainder of the brachidium has not been observed.

Kokomo limestone at Kokomo, Indiana; common in the Traction quarry, but found also in the old George W. Defenbaugh quarry.

The exposure of the delthyrium even in mature specimens is the chief diagnostic characteristic of this species, although this feature is shared by *Whitfieldella didyma* from the Silurian of Gotland. This characteristic probably will serve to distinguish the Kokomo species from *Whitfieldella nucleolata,* which it otherwise resembles. The more conspicuous depression along the median part of the pedicel valve, anteriorly, and the absence of concentric striæ also are distinguishing features.

ANOPLOTHECA CONGREGATA, *Kindle.*

A small species of *Anoplotheca,* differing from the form described by Kindle from Logansport, Indiana, only in its much smaller size, occurs abundantly in the Traction quarry, and in smaller numbers also in the upper part of the old George W. Defenbaugh quarry, at Kokomo, Indiana.

LEPTAENA RHOMBOIDALIS, *Wilckens.*

Width 22 mm., length estimated at 13 mm.; with 11 or 12 concentric wrinkles, of which the anterior 4 or 5 are rather prominent. Six or seven radiating striæ in a width of 2 mm.

West Union bed, at the bluff northwest of Martins, also at Harin Hill, four miles west of Valley, in Lewis county, Kentucky. A similar specimen, from the spring a mile south of Glen Springs, on Big Salt Lick creek, appears to be more coarsely striated.

A very small form of *Leptæna rhomboidalis,* about 12 mm. in width, occurs both at the Traction and at the old George W. Defenbaugh quarry, at Kokomo, Indiana.

STROPHEODONTA MUNDULA, **sp. nov.**

Plate II, Fig. 18.

Brachial valve concave, pedicel valve convex. Width about 14 mm., length 9 mm., depth approximately 2 to 2.5 mm. Surface covered with very fine radiating striæ, visible under a lens, of which some at more or less regular intervals are more conspicuous. Of the latter there are about 9 in a width of 4 mm. near the anterior margin.

Cardinal process not preserved. Immediately in front of the position which should be occupied by this process there is a thickened area 1.3 mm. in width which narrows anteriorly to a median ridge about a third of a millimeter in width, and which thickens again slightly toward the end. This ridge may be traced to a point 6 mm. from the beak; slightly over 7 mm. from the beak the valve, as seen from the interior, is deflected downward and this marginal part preserves the traces of vascular markings. From the broad, thickened area near the beak one very divergent low ridge extends off on each side at an angle of about 20 degrees with the hingeline, limiting the posterior part of the posterior diductor impressions. These are separated from the anterior diductor impressions by indistinct ridges which extend from the same broad, thickened area near the beak forward at an angle of about 25 degress with the median line. The anterior part of the anterior diductors may be traced to a point about 3 mm. from the hingeline, while the posterior diductors extend to a point about 2 mm. from this line. Corresponding to the indistinct ridge between the anterior and posterior diductors, an irregular ridge extends forward and becomes thickened and more conspicuous anteriorly. It may be traced, on each side of the valve to a point 5 mm. from the beak. The thickened terminations of the two divergent ridges just described, and that of the median ridge form characteristic features of this species. The space between these terminations and as far back as the hinge line is distinctly granulose or papillose, as in the interior of *Strophomena vetusta.* Indistinct traces of

minute denticulations along the hingeline appear to occur. The affinities of this species are believed to be with *Brachyprion.*

Geological position: In the upper part of the Crab Orchard clay shales, between Poplar Flats and Martin's store, in Lewis County, Kentucky, in the same slab with *Calymene clintoni, Beyrichia lata-triplicata, Chonetes vetusta,* and *Camarotoechia congruens.*

STROPHEODONTA (BRACHYPRION) PLANUS, **sp. nov.**

Plate I, Figs. 13 A, B, C; Plate II, Figs. 11 A, B.

The largest specimen found so far has a length of 25 mm. and a width of 31 mm. The convexity of the pedicel valve is about 3 mm. The brachial valve is unknown, but is assumed to be practically flat or slightly concave. The pedicel valve is gently and evenly convex in small specimens, becoming flatter near the anterior margin in larger specimens. The postero-lateral angles vary from 80 to 90 degrees. The dental lamellæ are continued anteriorly as conspicuous ridges limiting the postero-lateral boundaries of the muscular area. Anteriorly, they disappear entirely, and here the boundaries of the muscular area are uncertain. A distinct median low septal ridge is present in all specimens. Usually it extends as far from the cardinal margin as the dental ridges, or a little farther. At the beak this median ridge is distinctly wider. Radiating striæ fine, about 8 or 9 in a width of 2 mm., subequal, except where other striæ are intercalated, and here they are alternately larger or smaller.

West Union bed, at the bluff northwest of Martins, and at Harin Hill, 4 miles west of Valley, in Lewis county, Kentucky. Also at the same horizon in the quarry at the southeastern edge of West Union, Ohio.

This species is distinguished from *Stropheodonta orthididea* by the presence of the median septal ridge in the pedicel valve, the less orthoid appearance of the muscular area owing to the absence of any distinct anterior boundary, and

also the absence of fasciculation among the radiating striæ. Its relations to the species described by Hall as *Stropheodonta prisca* are unknown, but Whitfield and Hovey interpret the type specimen as an imprint of the ventral valve of a species of *Strophonella.* In that case our specimens are distinct.

SCHUCHERTELLA CONFERTUS, **sp. nov.**

Plate II, Figs. 13 A, B.

Shells attaining a length of 18 mm. and a width of 26 mm.; very flat and thin. The pedicel valve is gently and evenly convex, the convexity usually not exceeding 2 mm. The brachial valve is almost flat, the convexity toward the beak being almost imperceptible; occasionally, it is even slightly concave. The postero-lateral angles vary from 75 to 90 degrees. The dental lamellæ diverge at an angle of 75 to 85 degrees and extend between 1.5 and 2 mm. beyond the hinge-line. There is no evidence of a broad deltidium arching over the delthyrium. Muscular area not distinctly outlined. Crural ridges of the brachial valve distinct, forming a crescent-shaped elevation. At the beak there are two, apparently rather narrow elevations which represent the cardinal process. The surface of the shell is marked by numerous radiating striæ, of which there are 5 in a width of 2 mm. at a distance of 10 mm. from the beak; in larger shells the number may be reduced to 6 in a width of 3 mm. These striæ are subequal in size except at those distances from the beak at which additional striæ are intercalated, where the striæ are alternately larger and smaller.

West Union bed. In the bluff northwest of Martins, in Lewis county, Kentucky.

The generic relations of this shell are uncertain. The very distinct convexity of the pedicel valve, and the flatness or even slight concavity of the brachial valve apparently exclude it from any close relationship with *Schuchertella subplanus,* in which it is the brachial valve which is distinctly convex and in which the pedicel valve is distinctly less con-

vex, especially anteriorly. Nevertheless, the general appearance and structure of our specimens appear to correspond more nearly to that of *Schuchertella subplanus* than to that of any other genus. The strong dental lamellæ exclude it from *Stropheodonta;* moreover, there is no evidence of crenulations along the hinge line. The strong crural ridges are unknown in *Rafinesquina;* moreover, the dental lamellæ are too long, and the faint indications of the muscular areas in both valves are not in favor of such a relationship.

Our specimens apparently agree with the species originally described as *Leptæna obscura,* by Hall, in the slight convexity of the pedicel valve, and in the general outline. Moreover, figure 6a on plate 21 of volume 2 of the Paleontology of New York apparently agrees also in the coarseness of the radiating striations. Unfortunately this type has been lost, and the associated figure on the same plate, figure 6b, indicates a form with much shorter and less conspicuous dental lamellæ, and the reference of this form to *Rafinesquina* suggests entirely different generic affinities.

Chonetes vetustus, *Foerste.*

Plate I, Fig. 16.

This species attains a width of 9 mm. and a length of 6 mm. There are about 60 to 70 radiating striæ. Compared with *Chonetes cornutus,* our specimens are wider, have more numerous striæ, and the hinge spines are more inclined and relatively shorter.

Near the top of the Alger clay at numerous localities in Lewis county, Kentucky. The types were found between Valley and the W. H. Lawrence store.

Chonetes colliculus, **sp. nov.**

Plate I, Figs. 10 A, B, C.

Shell small. The largest specimen found so far has a width of 8 mm. and a length of 6.5 mm. Pedicel valve strongly convex. In shells 7 mm. in width this convexity usually does not exceed 2 mm., but in the more mature shells it may equal

fully 3 mm. The general outline of the shell is semi-circular, the width being greater near the hinge line than across the middle of the shell. The convexity of the pedicel valve is greatest along the median parts of the shell, producing a semi-globose area in the more convex specimens, beyond which the postero-lateral parts project with a more or less concave outline when viewed from the side of the hinge area. Radiating striations 10 in a width of 2 mm. at a distance of 3.5 mm. from the beak; this results usually in about 40 striations within 4 mm. of the beak, although in the more convex specimens the number of radiating striations may increase to 50. Concentric striations are fine, close, and not conspicuous even when seen under a lens. A vertical spine one millimeter in length is located about 1.5 mm. from the middle line of the shell on each side of the beak. A slightly longer spine, inclining outward at an angle of 35 to 45 degrees, is located about 2.5 mm. from the middle line, on each side of the beak. In one specimen spines were found three and a quarter mm. from the middle line, but it has been impossible so far to distinguish more than 4 spines on the same shell.

Kokomo limestone at Kokomo, Indiana; common in the upper part of the exposures at the Defenbaugh quarry.

Compared with *Chonetes cornutus, Chonetes novascoticus, Chonetes tenuistriatus,* and *Chonetes jerseyensis,* the distinctly greater width near the hinge line, compared with the width across the middle of the shell, is a distinguishing feature. Moreover, the convexity of the pedicel valve is considerably greater. Compared with *Chonetes undulatus,* the convexity is greater, and the radiating striations are much more numerous.

Platystrophia pauciplicata, **sp. nov.**

Plate I, Fig. 15.

This specimen of *Platystrophia* is distinguished by the presence of only two plications on the median fold, and three plications on each side of this fold, with a faint indication

of a fourth plication near the hinge line. The hinge line is distinctly shorter than the width of the shell across the middle. The crural plates are strongly developed, and the ridge in the cavity between these plates, representing the cardinal process, is distinctly indicated by a depression along the middle of the cast of this cavity, as presented by the specimen figured, but this depression is not indicated in the accompanying drawing.

West Union bed, in the quarry in the southeastern corner of West Union, Ohio.

Since only a single specimen of *Platystrophia* was found, it is doubtful whether an even number of plications is a constant feature of this species. However, the greatly reduced number of lateral plications is probably a feature which may be expected in other specimens from the same locality.

A single, poorly preserved specimen of *Platystrophia*, from the Osgood bed, south of Nebraska, Indiana, shows 3 plications in the sinus and 7 or 8 lateral plications on each side. No other specimens from this horizon are at hand.

In the Waco limestone member of the Crab Orchard formation, at Waco, Irvine, and Panola, in Kentucky, the variety *Platystrophia reversata,* Foerste, is represented by specimens beginning with two plications in the sinus, increasing to from 5 to 8 plications on the larger individuals.

Platystrophia is cited by Orton from the Springfield limestone, at Springfield, Ohio. It is not known from the Waldron bed of Indiana, Kentucky, or Tennessee. In the lower part of the Louisville limestone it is represented by a medium-sized species with 5 plications on the fold of mature specimens, with 7 lateral plications on each side. *Platystrophia* occurs also in the Louisville limestone at Bledsoe, in Tennessee. It has not been found at any horizon in the Brownsport formation.

Platystrophia is fairly common in the Clinton or Brassfield limestone of Ohio, Indiana and Kentucky, and occurs much more sparingly in the overlying Osgood and Crab

Orchard clays and limestones. Above this horizon, in the states mentioned, is it a rare fossil.

One mile south of Carrs, in Lewis county, Kentucky, a single specimen with three plications on the fold, and with five lateral plications was found, probably in the West Union bed. This is similar to the form called *Platystrophia daytonensis.*

DALMANELLA ELEGANTULA, *Dalman.*

Small, poorly preserved specimens, 4.5 mm. in length, are found in the West Union bed at Harin Hill, 4 miles west of Valley, in Lewis county, Kentucky.

Another small variety occurs at both the George W. Defenbaugh and the Traction quarry, in Kokomo, Indiana.

RHIPIDOMELLA MAGNICARDINALIS, **sp. nov.**

Plate I, Figs. 11 A-D; Plate II, Figs. 12 A, B.

Shell with a length of 12 mm., a width of 15 mm., and a depth of 9 mm. Both valves evenly and rather strongly convex. Hinge line distinctly shorter than the width across the middle of the shell. Postero-lateral angles rounded. General outline of the shell nearly circular. Radiating striæ rather coarse, about 10 or 11 in a width of 5 mm. along the antero-lateral margin, less numerous directly in front. Muscular area of the pedicel valve deeply impressed, flabelliform, occupying about half the length of the shell. Dental plates short but strong. Crural plates of the brachial valve strong, divergent, pointed, separated by a strong cardinal process which begins a short distance anterior to the bases of the crural plates, and extends back for a length of fully 4 mm. For half its length it projects as a strong process beyond the cardinal area of the brachial valve into the space beneath the beak of the pedicel valve. At the tip the process becomes broader than at mid-length, and apparently is supplied with three vertical ridges. Owing to the preservation of the shell in the form of casts, it has been impossible to decipher a part of its structure, but the deeply impressed muscular area

of the pedicel valve, and the remarkably long cardinal process of the brachial valve, together with the strong crural plates, are distinctly shown. Anterior to the cardinal process the shell is thickened interiorly, forming a rather wide though low elevation, narrowing anteriorly, and disappearing before reaching the middle of the valve.

West Union bed, at the Spring on Big Salt Lick creek, one mile south of Glen Springs, in Lewis county, Kentucky.

The very strong and prolonged cardinal process suggests that of some forms of *Triplecia,* but it is not divided anteriorly, and the deeply impressed muscular area of the pedicel valve gives unmistakable evidence of the real affinities of this shell.

PENTAMERUS DIVERGENS, **sp. nov.**

Plate I, Figs. 5 A-E; Plate II, Figs. 17 A, B.

Shell rather small. In one specimen, preserving both valves but considerably deformed by pressure, the length of the brachial valve is 26 mm.; the width, 18 mm.; the length of the pedicel valve is estimated at 29 mm.; and the original thickness of the complete shell, at 10 or 11 mm. The general outline of the shell is ovate. The anterior outline is rounded, and the postero-lateral margins are flattened and converge toward the beak. This flattening is most conspicuous in case of the pedicel valve, where it results in a strong lateral compression of the posterior parts of the valve. The anterior margin of the shell is rounded, occasionally with a faint indication of the trilobation seen in other species of this genus. In the deformed specimen, mentioned above, the middle third of the brachial valve is raised slightly above the remainder. The margins of the delthyrium of the pedicel valve slope backwards from the plane of separation of the valves at angles varying from 45 to 60 degrees, causing the beak of this valve to be divergent from the remainder of the shell. The brachial valve is moderately convex, the beak curving over the lower part of the delthyrium of the pedicel valve.

The spondylium of the pedicel valve encloses a long, narrow, and deep cavity extending to within one-third of the length of the shell from the anterior margin. This spondylium is supported by a median septum extending almost to the anterior edge of the valve.

The interior of the brachial valve is marked by two sharp septal ridges, only moderately divergent anteriorly, extending fully a third of the length of the shell from the beak. Near the anterior part of the space between these septal ridges, a third septal ridge begins, extending to within a third of the length of the valve from the anterior margin. Posteriorly, the two septal ridges first mentioned become elevated into septal plates, supporting the crural plates. In a specimen, etched by means of acid, the top of the septal plates curves smoothly into the crural plates, there being no evidence of the former extension of the inner margins of the crural plates beyond the line of junction with the septal plates. The exterior margin of the crural plates defines the inner margin of the dental sockets. Enclosed by the two septæ, the crural plates, the remainder of the hinge plate, and the posterior part of the valve are two cavities, one on each side of the shell. Immediately in front of the beak, there is a thickening of the posterior part of the crural plates, extending in a semi-lunate fashion around the posterior extremity of the depression limited by the septal plates already described. This semi-lunate thickening, indistinctly defined posteriorly, apparently is part of the cardinal process.

Kokomo limestone, at Kokomo, Indiana, near the top of the exposures at the Defenbaugh and Traction line quarries.

Compared with *Pentamerus pes-ovis,* Whitfield, from the Greenfield limestone in Adams county, Ohio, the beak of the pedicel valve is less incurved at its extremity, and the septal plates of the brachial valve are less distant from each other. Moreover, the size of the Kokomo species is distinctly larger, although apparently it is closely related to the Greenfield limestone specimens described by Whitfield.

Conchidium colletti, *Miller.*

Common in the upper part of the old George W. Defenbaugh quarry, in the southeastern part of Kokomo, Indiana.

Diaphorostoma cliftonensis, *Foerste.*

Several specimens closely related to *Diaphorostoma cliftonensis,* but less strongly elevated, occur in the West Union bed northwest of Martins, in Lewis county, Kentucky.

Isochilina panolensis, *Foerste.*

Plate I, Fig. 1.

In the Waco limestone member of the Crab Orchard formation, at Panola and Irvine, Kentucky.

Isochilina musculosa, **sp. nov.**

Plate I, Fig. 2.

Carapace large, in one specimen with a length of 8 mm. A better preserved right valve has a length of 6.5 mm., a height of 4.6 mm.; the length of the hingeline is 4 mm.; the center of the muscular tubercle is 2.3 mm. from the anterior margin and 1.5 from the dorsal margin. Anterior to the muscular tubercle is a second tubercle, half a millimeter in width and slightly over a millimeter in length. A faint striation crosses the middle of the second tubercle and extends toward the antero-dorsal angle of the valve. Between this striation, the second tubercle, and the dorsal margin, the carapace is slightly elevated, an additional but very narrow elevation occurring at the extreme antero-dorsal angle of the body of the valve. From the groove surrounding the muscular tubercle, vascular markings radiate, chiefly toward the ventral margin. A deep depression is on the postero-dorsal side of the muscular tubercle, and a short, narrow, low elevation is found along the groove extending postero-dorsally from this depression. A narrow marginal border extends around the anterior, ventral, and posterior sides, widening posteriorly.

Kokomo limestone, in the thin-bedded cherty layers at the top of the old George W. Defenbaugh quarry, southeast of Kokomo, Indiana.

Closely related to *Isochilina grandis-latimarginata,* Jones, but distinguished by the much more oblique postero-dorsal margin, the less extended anterior margin, and the distinct tubercle immediately anterior to the muscular tubercle.

BEYRICHIA LATA — TRIPLICATA, *Foerste.*

Plate I, Fig. 4.

Closely related to *Beyrichia lata,* Hall, from the Clinton at New Hartford, in Oneida county, New York, where that species occurs both in the ferruginous shale associated with the iron ore and in the underlying ferruginous sandstone. *Calymene clintoni* occurs in the iron ore beds in Herkimer county, and in the overlying shale in Cayuga county. *Homolanotus* and *Dalmanites* occur as low as the ferruginous sandstones associated with the iron ore at New Hartford. *Beyrichia lata-triplicata* occurs associated with *Calymene clintoni,* Vanuxem, in the upper part of the Crab Orchard shales at numerous localities in Lewis county, Kentucky. The types were found between Valley and the W. H. Lawrence store.

Beyrichia lata-triplicata: anterior margin less convex than the posterior margin, with the greatest curvature nearer the ventral margin. The ventral margin usually distinctly curved but sometimes more or less straightened along the middle. Anterior lobe large, ovate, distinctly connected at the base with the attenuated lower end of the narrow middle lobe. The posterior lobe in some specimens appears to unite at the base with the anterior lobe, in others its attenuated base appears to continue for a short distance beyond the point of junction of the other two lobes. The highest part of the posterior lobe forms a ridge immediately in front of the furrow separating the posterior and middle lobes. From this ridge the surface of the posterior lobe slopes toward the

furrow limiting the narrow marginal border. The groove between the posterior and middle lobes is only slightly narrower than that between the middle and posterior lobes. Considering the amount of variation shown by the specimens found in Lewis county, it is doubtful whether the specimens from the Crab Orchard beds of Kentucky are to be considered distinct from the typical *Beyrichialata* from the Clinton of New York.

KLOEDENIA KOKOMOENSIS, **sp. nov.**

Plate I, Figs. 3 A, B.

Carapace small, length 3 mm., height 1.7 mm. Ventral edge nearly parallel to the dorsal, the height of the carapace increasing slightly posteriorly. Left valve with a vertical groove about 1.3 mm. from the anterior end, extending for more than half the distance to the ventral margin. Posterior to this groove is a small, globose lobe, similar to that of *Kloedenia sussexensis,* Weller, but more distant from the dorsal margin. Posterior to this middle lobe is a groove, the center of which is about 2 mm. from the anterior margin of the carapace. Ventrally the middle lobe is not well differentiated from the remainder of the carapace, and the groove bordering this lobe on the posterior side is less distinct than that on its anterior. Near the dorsal margin, the posterior edge of the lobe is slightly elevated. A broad and relatively steep marginal area borders the ventral margin; it is less conspicuous along the anterior margin, and merges posteriorly into the relatively steep slope of the posterior part of the carapace. This marginal area is slightly concave, seen from the anterior or posterior ends of the carapace, and it is sufficiently conspicuous to form a characteristic feature. The marginal border is widest antero-ventrally; it is less conspicuous anteriorly, and disappears as a distinct border posteriorly. Surface smooth.

Kokomo limestone in the thin-bedded chert at the top of the old George W. Defenbaugh quarry, in Kokomo, Indiana.

This species is distinguished from *Kloedenia sussexensis,* Weller, chiefly by the position of the middle lobe, which is more remote from the dorsal margin. The steep, slightly concave marginal area along the ventral and anterior margins is an additional feature.

Illaenus depressus, *Foerste.*

An excellently preserved specimen, closely resembling figure 2 on plate 26 of volume 7 of the Geology of Ohio, occurred at the Spring on Big Salt Lick creek, one mile south of Glen Springs, in Lewis county, Kentucky, and a similar specimen was found in the same county, northwest of Martins, in both cases in the West Union limestone. Compared with *Illaenus americanus,* Whitfield, this pygidium is broader anteriorly, more triangulate, and hence more angularly rounded posteriorly. Compared with *Illaenus triloba,* Weller, the anterolateral angles are less truncated and the depression along the border is less conspicuous and disappears before reaching the anterior margin.

Calymene clintoni, *Vanuxem.*

Plate I, Fig. 6.

Cephalon short and broad, with the width about three and a half times the length. Compared with *Calymene niagarensis,* the glabella is considerably flatter, shorter, and broader, especially posteriorly. In one specimen the width across the posterior lateral lobes is 11 mm.; across the middle pair, 7.4 mm.; across the anterior pair, 7 mm.; and across the frontal lobe the width is slightly more than 7 mm., while the length of the glabella anterior to the middle of the occipital furrow is only 7 mm. The posterior lateral lobes are large and rather triangular in form, owing to the diagonal course taken by the furrows separating these lobes from the middle pair. Along the median line of the glabella these furrows are scarcely 2 mm. apart. The other furrows are short and approximately at right angles to the median line of the glabella.

Those between the middle and anterior lateral lobes are scarcely 2 mm. in length, and those between the anterior lateral lobes and the lateral extension of the frontal lobe are scarcely more than a millimeter long. The base of the outline bordering the eye, as far as can be determined from a free cheek, is 2.2 mm. in length. No raised marginal border is present on this free cheek.

Axial lobe of the pygidium distinctly outlined by a narrow, shallow furrow; marked by seven annulations of which only the first three or four are distinct across the entire width of the lobe, while the remainder are successively more indistinct along the median parts of the lobe. Lateral lobes of the pygidium without indications of the pleuræ, moderately deflected about 2 mm. from the margin.

Geological position: Near the top of the Crab Orchard clay shales, at several localities along the road between Poplar Flats and Martin's store, also opposite the home of W. A. McEldowney, at Valley, and elsewhere in Lewis county, Ky.

Calymene niagarensis, *Hall.*

West Union bed, at the bluff northwest of Martins, also at Harin Hill, at the same horizon, in Lewis county, Kentucky.

Homolanotus delphinocephalus, *Green.*

Plate II, Figs. 19 A, B, C.

The pygidium of *Homolanotus delphinocephalus* is characterized by its acute posterior termination; by the presence of 11 to 13 axial annulations, of which the last three or four are likely to be indistinct; by seven distinct and one or two indistinct pleural segments; and by subtriangular, papulose granules. The nuchal furrow of the cephalon is very faint, and the glabella usually is rather indistinctly defined from the remainder of the cephalon, being but slightly elevated above the general convexity.

In our specimens, the cast of the inner surface of the cephalon shows a narrow and sharply defined nuchal furrow, bent slightly forward at the middle. The lateral borders of

the glabella usually are distinctly defined. The removable part of the anterior border of the cephalon not being present, its outline can not be determined.

There is no indication that the posterior part of the pygidium ever was acute. As far as may be determined from the specimens at hand, it was blunt. Two forms of pygidia appear to be at hand. The smaller specimens, attaining a length of 20 mm., have a narrower axial lobe anteriorly and both the annulations and pleural segments are better defined. Of the annulations, nine or ten are distinct, and of the pleural segments six or seven are distinct. The posterior border extends only a short distance beyond the rather distinctly defined posterior termination of the axial lobe. In the larger pygidia, attaining a width of 53 mm., both the annulations and pleural segments are less distinct, especially posteriorly. In one specimen there are seven distinct annulations, and the axial lobe merges posteriorly into the surrounding parts of the pygidium.

None of the specimens preserves any surface granules.

West Union bed, at the bluff northwest of Martins, in Lewis county, Kentucky.

An excellent pygidium of *Homolanotus,* corresponding to the larger specimens at Martins, Kentucky, was found at West Milton, Ohio, in the thin limestones which overlie the typical Dayton limestone. The width of the axial lobe anteriorly is about 23 mm. There are ten distinct and one or two indistinct annulations. There are six distinct pleural segments. The axial lobe merges posteriorly into a rather large, smooth border.

It is possible that more than one form is present among the New York representatives of this species.

Homolanotus occurs in the Waldron bed of Indiana.

DALMANITES LIMULURUS-BREVICAUDATUS, **var. nov.**

Plate II, Figs. 20 A, B, C.

Dalmanites limulurus is characterized by the slight angular prolongation of the median part of the anterior border of the

cephalon, and by the prolongation of the pygidium posteriorly into a long spine.

In our specimens, the pygidium is merely pointed and not prolonged into a spine. The axial lobe occupies seven-tenths of the length of the pygidium. It is marked by seven or eight distinct annulations. One or two additional but indistinct annulations may be present posteriorly, and at the end there is room for several more, but this part usually is smooth. There are five distinctly grooved pleural segments, one segment occasionally indistinctly grooved, with sometimes a trace of a seventh segment, not grooved. There is no broad flattened border along the sides of the pygidium. The associated cephalons do not preserve the median part of the anterior border. The condition of preservation of the specimens here described is not sufficient to determine the presence of granules, but no tubercles were noted. The length of the largest pygidium was estimated at 24 mm., with a width of 26 mm. From this the length of the complete trilobite is estimated at 67 mm.

West Union bed, at the bluff northwest of Martins, in Lewis county, Kentucky.

DESCRIPTION OF PLATE I.

Fig. 1 — *Isochilina panolensis,* Foerste. Left valve. Panola, Madison county, Kentucky. Waco limestone member of Crab Orchard formation. Magnified 4 diameters.

Fig. 2 — *Isochilina musculosa,* sp. nov. Right valve. In chert at top of the old George W. Defenbaugh quarry, southeast of Kokomo, Indiana. Magnified 4 diameters.

Fig. 3 — *Kloedenia kokomoensis,* sp. nov. Left valve. A, anterior view, showing strong convexity of valve, and the concave elevation along the ventral border. B, left valve. In chert at the top of the old George W. Defenbaugh quarry, southeast of Kokomo, Indiana. Magnified 5 diameters.

Fig. 4 — *Beyrichia triplicata,* Foerste. Right valve. Near top of Alger clay division of the Crab Orchard formation, a mile west of Valley, in Lewis county, Kentucky. Magnified 5 diameters.

Fig. 5 — *Pentamerus divergens,* sp. nov. A, C, lateral views of pedicel valves. B, pedicel valve. D, interior of pedicel valve showing spondylium and septum. E, interior of brachial valve showing septal ridges united to the inner edges of the crural plates, and also a low median septum. The anterior margin of the crural plates is broken and the outline, therefore, is unknown. At the top of the old George W. Defenbaugh quarry, southeast of Kokomo, Indiana. Magnified 1.5 diameters.

Fig. 6 — *Calymene clintoni,* Vanuxem. Near the top of the Alger clay division of the Crab Orchard formation, along the road from Poplar Flats to Martins, in Lewis county, Kentucky. Distinct impression of glabella, anterior margin in front of glabella, and right fixed cheek; the remainder added in outline. Magnified 1.5 diameters.

Fig. 7 — *Spirifer nanus,* sp. nov. Brachial valve, cast of interior. At the spring on Big Salt Lick creek, one mile south of Glen Springs, in Lewis county, Kentucky. West Union bed. Magnified 2 diameters.

Fig. 8 — *Spirifer exiguus,* sp. nov. A, lateral view, outline. B, pedicel valve. C, brachial valve, with top of pedicel valve. At the top of the McReynold or Interurban traction quarry, in the southwestern part of Kokomo, Indiana. Magnified 3 diameters.

Fig. 9 — *Whitfieldella erecta,* sp. nov. A, pedicel valve. B, brachial view. C, lateral view. At the top of the McReynold or Interurban traction quarry, in the southwestern part of Kokomo, Indiana.

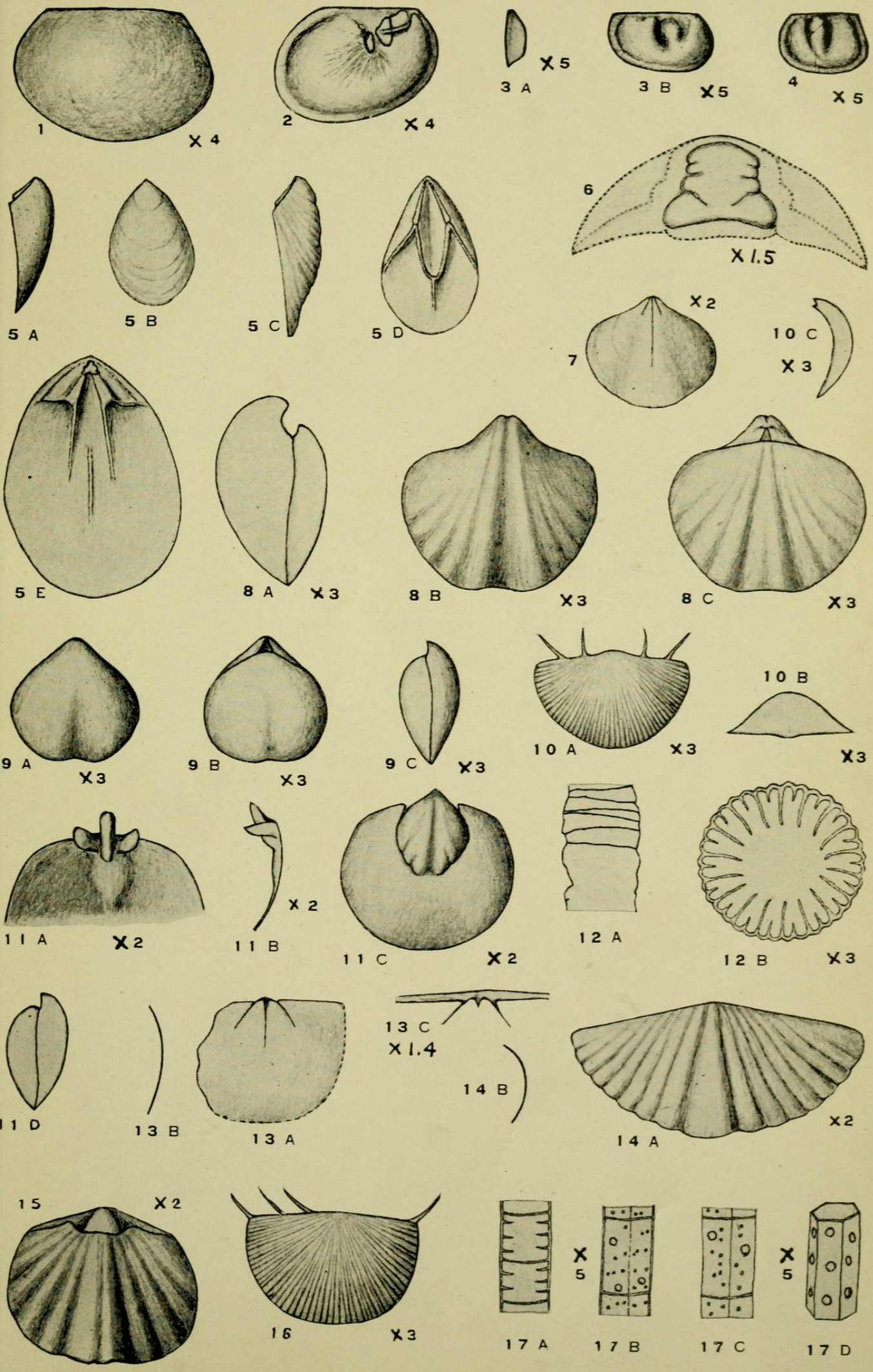
1
X 4
2
X 4
3 A
X 5
3 B
X 5
4
X 5
5 A
5 B
5 C
5 D
6
X 1.5
X 2
7
10 C
X 3
5 E
8 A
X 3
8 B
X 3
8 C
X 3
9 A
X 3
9 B
X 3
9 C
X 3
10 A
X 3
10 B
X 3
11 A
X 2
11 B
X 2
11 C
X 2
12 A
12 B
X 3
11 D
13 B
13 A
13 C
X 1.4
14 B
14 A
X 2
15
X 2
16
X 3
X 5
17 A
17 B
17 C
X 5
17 D

Fig. 10 — *Chonetes colliculus,* sp. nov. A, pedicel valve. B, anterior view, outline, intended to show the convexity. C, vertical section. From the upper part of the old George W. Defenbaugh quarry, southeast of Kokomo, Indiana. Magnified 3 diameters.

Fig. 11 — *Rhipidomella magnicardinalis,* sp. nov. A, interior view of posterior half of brachial valve. B, vertical section, showing the great length of the cardinal process. C, cast of the pedicel valve. Drawings A and B are very imperfect, and serve only to show the great length of the cardinal process. At the Spring on Big Salt Lick creek, one mile south of Glen Springs, Lewis county, Kentucky. West Union bed. Magnified 2 diameters.

Fig. 12 — *Amplexus septatus,* sp. nov. A, natural vertical section. B, cross-section, magnified 3 diameters, showing primary and secondary septa. At the top of the old George W. Defenbaugh quarry, southeast of Kokomo, Indiana.

Fig. 13 — *Stropheodonta (Brachyprion) planus,* sp. nov. A, pedicel valve, cast, showing the dental ridges and the median septal ridge. B, convexity of this valve. C, part of a ventral valve, apparently worn, with only the posterior part of the median ridge preserved. West Union bed, at West Union, Ohio.

Fig. 14 — *Spirifer repertus,* sp. nov. Brachial valve. West Union bed at Harin Hill, four miles west of Valley, in Lewis county, Kentucky. Magnified 2 diameters.

Fig. 15 — *Platystrophia pauciplicata,* sp. nov. Brachial valve, cast of interior; the impression of the cardinal process along the middle part of the cast of the cavity between the crural plates is not shown. West Union bed, at the quarry in the southeastern corner of West Union, Ohio. Magnified 2 diameters.

Fig. 16 — *Chonetes vetustus.* Foerste. Pedicel valve. Only 53 radiating striations are indicated in the drawing. In full-sized specimens the number varies from sixty to seventy. The length of the hinge spines nearest the beak is not known accurately. Near the top of the Alger clay division of the Crab Orchard formation, a mile west of Valley, in Lewis county, Kentucky. Magnified 3 diameters.

Fig. 17 — *Favosites pyriforme-kokomoensis,* var. nov. A, section of a corallite showing the tabulæ and septal spines. B, C, section showing three pores and the location of numerous septal spines. D, corallite, showing location of pores on the walls. Near the top of the old George W. Defenbaugh quarry, southeast of Kokomo, Indiana. Magnified 5 diameters.

DESCRIPTION OF PLATE II.

Fig. 1 — *Camarotoechia pisa ?* Hall and Whitfield, casts of interiors: A, brachial valve. B, lateral view. Martins, Kentucky. West Union bed. Magnified 3 diameters.

Fig. 2 — *Spirifer harinensis,* sp. nov., casts of interiors: A, brachial valve. B, pedicel valve. Harin Hill, four miles west of Valley, in Lewis county, Kentucky. Magnified 3 diameters. West Union bed.

Fig. 3 — *Camarotoechia congruens,* sp. nov. A, brachial valve. B, line indicating the convexity of the brachial valve. Between Poplar Flats and Martins, in Lewis county, Kentucky. In upper part of Alger clay division of the West Union bed. Magnified 4 diameters.

Fig. 4 — *Camarotoechia acinus-subrhomboidea,* var. nov. Pedicel valve. Martins, Lewis county, Kentucky. West Union bed. Magnified 3 diameters.

Fig. 5 — *Spirifer repertus,* sp. nov. Brachial valve. Harin Hill, four miles west of Valley, in Lewis county, Kentucky. West Union bed.

Fig. 6 — *Atrypa rugosa,* Hall. Pedicel valve. Quarry in southeastern part of West Union, Ohio, in West Union bed.

Fig. 7 — *Spirifer nanus,* sp. nov. Brachial valve. At the spring on Big Salt Lick creek, one mile south of Glen Springs, in Lewis county, Kentucky, in the West Union bed.

Fig. 8 — *Spirifer radiatus,* Sowerby. Pedicel valve, cast of interior. Martins, Kentucky, in the West Union bed.

Fig. 9 — *Trematospira camura-pauciplicata,* var. nov. Pedicel valve. A, natural size. B, magnified 3 diameters. Quarry in southeastern part of West Union, Ohio, in West Union bed.

Fig. 10 — *Spirifer radiatus-obsoletus,* var. nov. A, brachial valve. B, lateral view. C, pedicel valve, cast of interior. At the spring on Big Salt Lick creek, a mile south of Glen Springs, in Lewis county, Kentucky. West Union bed.

Fig. 11 — *Stropheodonta (Brachyprion) planus,* sp. nov. Casts of interiors: Pedicel valves. At the spring on Big Salt Lick creek, a mile south of Glen Springs, in Lewis county, Kentucky. West Union bed.

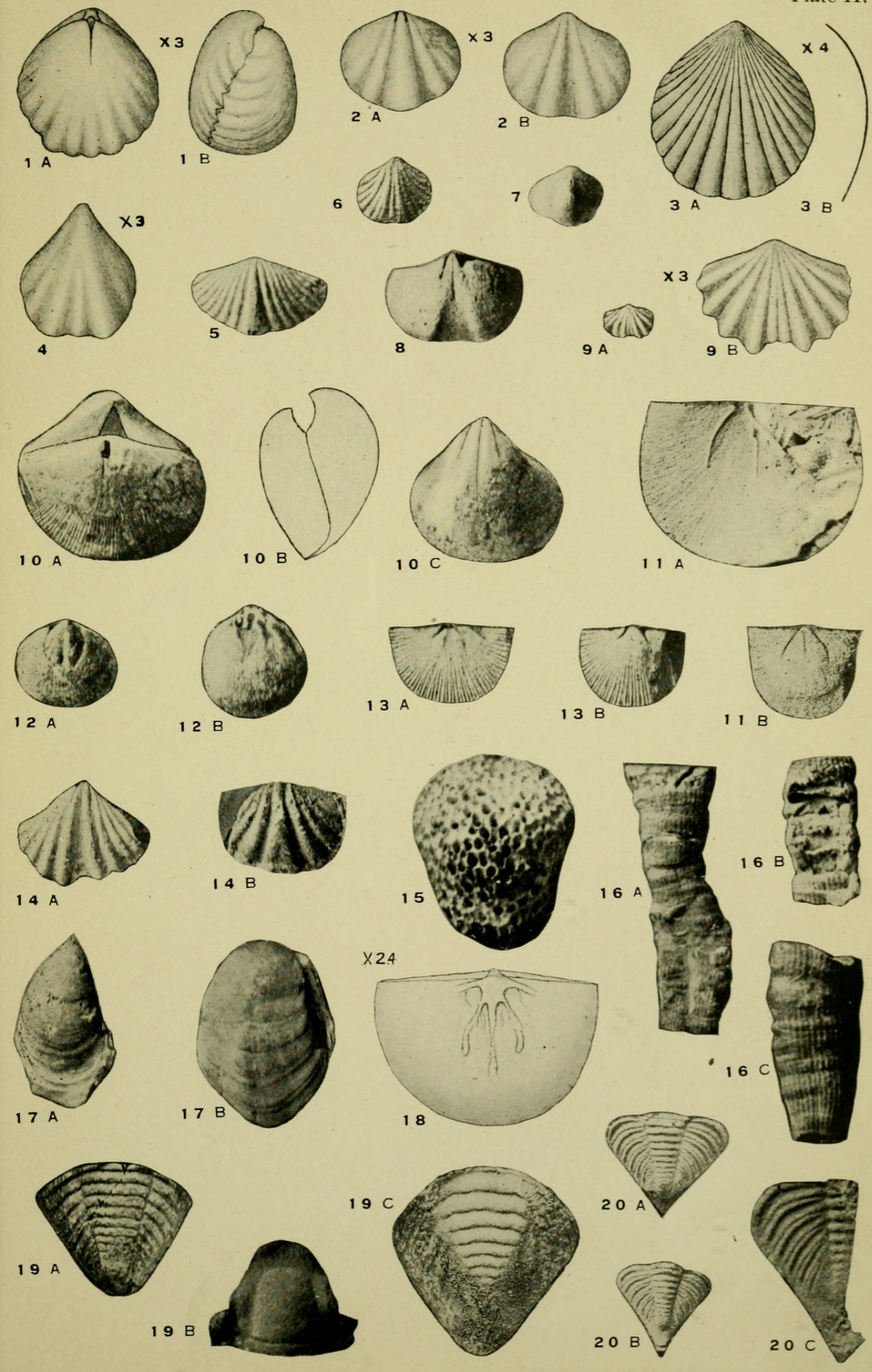
X3
1 A
1 B
X3
2 A
2 B
X4
3 A
3 B
6
7
X3
4
5
8
X3
9 A
9 B
10 A
10 B
10 C
11 A
12 A
12 B
13 A
13 B
11 B
14 A
14 B
15
16 A
16 B
X24
17 A
17 B
18
16 C
19 A
19 B
19 C
20 A
20 B
20 C

Fig. 12 — *Rhipidomella magnicardinalis,* sp. nov. Casts of interiors: A, pedicel valve. B, brachial valve. At the spring on Big Salt Lick creek, in Lewis county, Kentucky, in the West Union bed.

Fig. 13 — *Schuchertella conferta,* sp. nov. Casts of interiors: A, brachial valve. B, pedicel valve. Martins, Kentucky, in the West Union bed.

Fig. 14 — *Spirifer eudora,* Hall. Casts of interiors: A, pedicel valve. B, brachial valve. In the quarry in the southeastern part of West Union, Ohio, in the West Union bed.

Fig. 15 — *Favosites pyriforme-kokomoensis,* var. nov. In the upper part of the George W. Defenbaugh quarry, southeast of Kokomo, Indiana.

Fig. 16 — *Amplexus septatus,* sp. nov. Lateral views. B, weathered so as to show the tabulæ. At the top of the old George W. Defenbaugh quarry, southeast of Kokomo, Indiana.

Fig. 17 — *Pentamerus divergens,* sp. nov. A, pedicel valve. B, brachial valve. contorted by compression. In the upper part of the old George W. Defenbaugh quarry, in the southeastern part of Kokomo, Indiana.

Fig. 18 — *Stropheodonta mundula,* sp. nov. Interior of brachial valve. In the upper part of the Alger clay division of the Crab Orchard formation, between Poplar Flats and Martin's store, in Lewis county, Kentucky.

Fig. 19 — *Homolanotus* cf. *delphinocephalus,* Green. A, pygidium, with only the central part well preserved. B, glabella. C, pygidium, with only the central part well preserved, but the axial lobe merges posteriorly into the wide flattened border. Martins, Kentucky, in the West Union bed.

Fig. 20 — *Dalmanites limulurus-brevicaudatus,* var. nov. Pygidia. Martins, Lewis county, Kentucky, in the West Union bed.

Foerste, Aug. F. 1909. "Silurian fossils from the Kokomo, West Union, and Alger horizons of Indiana, Ohio and Kentucky." *The Journal of the Cincinnati Society of Natural History* 21, 1–41.

View This Item Online: https://www.biodiversitylibrary.org/item/44599
Permalink: https://www.biodiversitylibrary.org/partpdf/167559

Holding Institution
American Museum of Natural History Library

Sponsored by
American Museum of Natural History

Copyright & Reuse
Copyright Status: NOT_IN_COPYRIGHT
Rights: https://www.biodiversitylibrary.org/permissions/

This document was created from content at the **Biodiversity Heritage Library**, the world's largest open access digital library for biodiversity literature and archives. Visit BHL at https://www.biodiversitylibrary.org.

This file was generated 18 September 2023 at 02:35 UTC