CONTRIBUTIONS FROM THE MUSEUM OF PALEONTOLOGY

UNIVERSITY OF MICHIGAN

VOL. VII, No. 10, pp. 271–366 (19 pls.) MARCH 29, 1950

PRE-TRAVERSE DEVONIAN PELECYPODS OF MICHIGAN

BY

AURÈLE LA ROCQUE

UNIVERSITY OF MICHIGAN PRESS
ANN ARBOR

CONTRIBUTIONS FROM THE MUSEUM OF PALEONTOLOGY

UNIVERSITY OF MICHIGAN

Director: LEWIS B. KELLUM

The series of contributions from the Museum of Paleontology is a medium for the publication of papers based entirely or principally upon the collections in the Museum. When the number of pages issued is sufficient to make a volume, a title page and a table of contents will be sent to libraries on the mailing list, and also to individuals upon request. Correspondence should be directed to the University of Michigan Press. A list of the separate papers in Volumes II–VI will be sent upon request.

VOL. I. The Stratigraphy and Fauna of the Hackberry Stage of the Upper Devonian, by C. L. Fenton and M. A. Fenton. Pages xi+260. Cloth. $2.75.

VOL. II. Fourteen papers. Pages ix+240. Cloth. $3.00. Parts sold separately in paper covers.

VOL. III. Thirteen papers. Pages viii+275. Cloth. $3.50. Parts sold separately in paper covers.

VOL. IV. Eighteen papers. Pages viii+295. Cloth. $3.50. Parts sold separately in paper covers.

VOL. V. Twelve papers. Pages viii+318. Cloth. $3.50. Parts sold separately in paper covers.

VOL. VI. Ten papers. Pages viii+336. Paper covers. $3.00. Parts sold separately.

(Continued on inside back cover)

VOL. VII, No. 10, pp. 271–366 (19 pls.) MARCH 29, 1950

PRE-TRAVERSE DEVONIAN PELECYPODS OF MICHIGAN

By

AURÈLE LA ROCQUE

CONTENTS

INTRODUCTION

GENERAL STATEMENT

THIS study deals with the pelecypod fauna of the pre-Traverse Devonian rocks of Michigan. The pelecypods of the Traverse formation are excluded as they have been the subject of a special study by Tsun-Yi Yang (unpublished thesis, Yale University). The classification and succession of the rocks from which the pelecypods were collected are shown in Table I (page 329).

Pelecypods are not a conspicuous element of the Devonian faunas of Michigan. Assemblages of pelecypods are rare; the number of species or individuals is small in any given formation. The few species present in Michigan contrast greatly with the abundance of forms from the Devonian strata of New York. In Michigan, pelecypods are common only in some strata of the Detroit River group of the southeastern part of the state, in a dolomitic limestone of the basal part of the Rogers City limestone, and in a few beds of the Traverse group of the northern part of the Lower Peninsula.

PREVIOUS WORK

No previous paper has been devoted exclusively to the Devonian pelecypods of Michigan. Most of the species in the state had already been described from other areas; few new species have been recorded from Michigan. Because of this lack of comprehensive treatment, it seems advisable to give here a brief review of the literature on the pelecypods of the Devonian rocks below the Traverse group.

Rominger (1876, p. 26) mentioned *Lucina elliptica* and *Conocardium trigonale* from the quarries of Trenton Village, Wayne County; *Conocardium trigonale* from the sand rock (? Sylvania) of the Bond farm, Raisinville Township, Monroe County (p. 27); *Megambonia aviculoidea* and "several other bivalves" from Plum Creek quarries, Monroe County (p. 34); *Lucina elliptica* from False Presque Isle, Presque Isle County (p. 51); *Lucina elliptica*, *Myalina carinata*, *Avicula flabella*, and "casts of other large bivalves" from Middle Island (p. 51); and *Lucina elliptica* and *Lucina*, sp. nov. from Crawford's quarry (p. 52).

Sherzer and Grabau (1909) listed *Conocardium monroense* Sherzer and Grabau from the Anderdon bed of the salt shaft and the Anderdon quarry (p. 547); *Panenka canadensis* Whiteaves, *Cypricardinia canadense* Grabau, and *Conocardium monroense* Sherzer and Grabau from the Amherstburg bed (p. 548); and *Panenka canadensis* Whiteaves, *Pterinea bradti* Sherzer and Grabau, *Goniophora* sp., and *Conocardium monroense* Sherzer and Grabau from the Lucas dolomite (p. 550).

Grabau (1910) in his detailed work on the Monroe formation recorded several species of pelecypods. The Devonian species included are *Panenka canadensis* Whiteaves (pp. 163–64), *Pterinea lanii* Sherzer and Grabau (pp. 164–66), *Pterinea bradti* Sherzer and Grabau (pp. 166–68), *Goniophora?* sp. (pp. 169–70), *Cypricardinia canadensis* Grabau (p. 170), and *Conocardium monroicum* Grabau (pp. 171–73), an emendation of *C. monroense* Sherzer and Grabau (1909).

Grabau (1913, pp. 349–53) listed the following species from the Dundee limestone of Michigan: *Sanguinolites sanduskyensis* Meek, *Actinodesma erectum* Conrad, *Conocardium trigonale* Hall, *Actinopteria decussata* Hall, *Aviculopecten similis* (Whitfield), *Aviculopecten* sp., and *Paracyclas elliptica* Hall.

Pohl's (1929*a*, 1929*b*) study of the Middle Devonian pelecypods of Wisconsin yielded important information on the Middle Devonian of Michigan. His systematic descriptions include a number of observations on Michigan species, all of which have been noted under the appropriate headings in the systematic part of this paper.

Bassett (1935) in his careful stratigraphic study of the Dundee limestone recorded several pelecypods. In his section of the Sibley quarry (pp. 429–31) he cited *Paracyclas elliptica* Hall from Unit 25, *Actinodesma occidentale* (Hall) from Unit 23, and (p. 430) "several species of pelecypods" from Unit 10 ("Anderdon limestone"; locality 17) of the Detroit River group. He noted (p. 434) *Conocardium subtrigonale* D'Orbigny from the Dundee limestone of the second Detroit salt shaft, sunk in 1923, and *Paracyclas elliptica* from the Dundee limestone of the shore shaft of the new water intake tunnel at Detroit. In Table I two additional species, *Panenka* sp. aff. *P. grandis* Whiteaves and *Pterinea flabellum* (Conrad) are listed from an unknown position in the Dundee limestone in the Sibley quarry.

Ehlers and Radabaugh (1938, p. 443) recorded *Paracyclas* sp. in

Unit 1 (Dundee) of their section of the strata exposed in the quarry of the Michigan Limestone and Chemical Company at Rogers City, Michigan.

Ehlers (1945) recorded several pelecypods from formations exposed in the Mackinac Straits region. From the Bois Blanc formation he listed *Cypricardinia?* sp. (pp. 83, 85, 94), *Conocardium* sp. (pp. 92, 95, 100, 104, 105), *Limoptera* sp. (p. 95), *Paracyclas?* sp. (p. 100), *Paracyclas* sp. cf. *P. elliptica* (p. 102), and *Panenka*, sp. nov., related to *P. canadensis* Whiteaves (p. 104). From the Dundee limestone he recorded *Paracyclas* sp. (p. 115).

CLASSIFICATION

Many systems of classification have been proposed for the pelecypods, some of which have been modified from time to time to accommodate newly created families, genera, and species. For convenience the system adopted in this study is that of Maillieux (1937, pp. 11–13). His classification includes several families erected specially for certain Devonian genera, some of which are discussed in this paper.

MATERIAL

Most of the material upon which this study is based is in the Museum of Paleontology of the University of Michigan. The types are preserved there unless otherwise stated.

ACKNOWLEDGMENTS

It is a pleasure for me to express my indebtedness to the many friends whose help has greatly contributed to the completion of this study. I am especially grateful to Professor George M. Ehlers, who suggested the problem and supervised the work. I am indebted to Professor Henry van der Schalie, of the Museum of Zoology, University of Michigan, for the use of much comparative material and information on Recent pelecypods; to Professor Lewis B. Kellum for many courtesies and for the extension of the facilities of the Museum of Paleontology; and to Professor Erwin C. Stumm for much helpful information and constructive criticism.

Professor Norman D. Newell, of Columbia University and the American Museum of Natural History, has been most generous in lending

type specimens. Dr. G. Arthur Cooper, of the United States National Museum, and Dr. J. Marvin Weller, of the Walker Museum, University of Chicago, were most helpful in lending material in their custody. Dr. Walter A. Bell, of the Geological Survey of Canada, allowed me to examine Whiteaves' types of pelecypods in Ottawa and generously supplied rubber molds, made by Mr. Barford Botte of the Geological Survey staff, of those from the Devonian rocks of Manitoba.

I am indebted to Dr. J. Brookes Knight, of the United States National Museum, and to Professor Grace A. Stewart, of Ohio State University, for special information. I acknowledge gratefully the enthusiastic co-operation of Mr. F. Ridlen Harrell, Librarian of the University Museums, University of Michigan, and of Miss Helen Wills, Librarian of the Geological Survey of Canada, whose efforts made possible the consultation of many books not readily available.

SYSTEMATIC DESCRIPTIONS

FAMILY PTERINEIDAE

Genus *Pterinea* Goldfuss

Pterinea lanii Sherzer and Grabau

(Pl. I, Fig. 1)

Pterinea lanii Sherzer and Grabau, 1909, *Geol. Soc. Amer. Bull.*, Vol. 19, p. 546.
Pterinea lanii Grabau, 1910, *Mich. Geol. and Biol. Surv. Publ.*, 2, Geol. Ser. 1, pp. 164–66, Pl. 20, Fig. 13; Pl. 30, Fig. 23.

The Upper Silurian species *Pterinea lanii* is included here because Grabau stated that "a single imperfect specimen, apparently of this species, is associated with *Pterinea bradti* in the Lucas dolomite of the salt shaft." The specimen mentioned has not been found. It is doubtful whether *P. lanii*, which is particularly characteristic of the Raisin River dolomite, occurs in the Lucas dolomite of Devonian age.

Genus *Cornellites* Williams

Cornellites Williams, 1908, *Proc. U. S. Nat. Mus.*, 34, p. 89.

Diagnosis from Williams, 1908.—

A strongly marked Pterinoid shell with gibbous, rather narrow oblique body (left valve); large ear, set off from body by well defined sulcus; a large, broad, flat

wing, abruptly set off from body; the right valve slightly convex in umbonal region, flat to resupinate ventrally. Ligamental area striate; both cardinal and lateral teeth present; posterior muscular scar distinct and anterior muscular scar smaller and strongly impressed. The surface marked by a few strong radial ribs, with generally finer radial lines between them, and the fine concentric lamellae of growth generally evident over the radial sculpture. The radial sculpture covers the body and both wing and ear of the left valve in the type species. In other species which may be referred to the genus, the sculpture on the ear is restricted to concentric lines of growth, and the radial markings on the wings may be obscure. The right valve generally lacks radial sculpture except on the posterior wings where it is obscure; occasionally the stronger radial ribs are evident upon the body of the right valve.

Genotype.—Pterinea fasciculata Goldfuss, by original designation.

Remarks.—In addition to the genotype, the following species were placed in this genus by Williams: *C. costata* (Goldfuss) and *C. flabella* (Conrad). Maillieux (1937, p. 25) accepted the term *Cornellites*, but gave it only subgeneric rank.

Cornellites macrotis, sp. nov.

(Pl. I, Figs. 2–3, 5)

Description.—Species known only from left valves. Shell of medium size. Left valve convex, with large anterior and posterior wings, body directed obliquely backward, length and height subequal. Surface with about fifteen strong costae on the body of the shell, about four on the anterior wing, and about five on the posterior wing; costae of unequal size, slightly nodose, and crossed by fine concentric lines of growth. Umbo in the anterior third of the valve, markedly convex but raised little above the hinge line. Ventral margin with a strong emargination just under the anterior wing and in front of the umbo, thence rounded obliquely backward, curving gently into the broad, shallow emargination of the posterior wing, somewhat produced posteriorly in the vicinity of the cardinal margin. Left valve thickest in the dorsal third of the shell, directly under the umbo, sloping abruptly into an anterior sulcus, more gently into a posterior sulcus. Byssal notch broad, well defined. Ligament and interior unknown.

Dimensions of two valves, the types, are as follows: holotype, length 43 mm., height 41 mm., thickness 11 mm.; a paratype, length 42 mm., height 42 mm., thickness 12 mm. The other paratype is too poorly preserved to measure.

Remarks.—This species differs from *C. flabella* (Conrad) in having a more convex left valve, relatively larger anterior wing, and more prominent umbo.

Occurrence.—Dundee limestone; localities 28 and 29.

Types.—Holotype No. 15286; paratypes Nos. 24570 and 24571.

Cornellites? sp. A

(Pl. I, Fig. 4)

A poorly preserved left valve, No. 24569, of a pterinoid pelecypod from the Bois Blanc formation, locality 4, is assigned doubtfully to the genus *Cornellites*. It has poorly preserved but strong radiating costae on the anterior, ventral, and posterior regions which resemble similar structures of *C. flabella* (Conrad). The specimen is 27 mm. long, 24 mm. high, and 5.5 mm. thick.

Cornellites? sp. B

A single fragmentary specimen, No. 24581, from the Detroit River group, Amherstburg dolomite, locality 19, may belong to this genus. It is too poor to illustrate but is mentioned here in the hope that better specimens may be secured by future workers.

Genus *Follmannella* Williams

Follmannella Williams, 1908, *Proc. U. S. Nat. Mus.*, 34, p. 87.

Diagnosis from Williams, 1908.—

Pterinoid shells with low convex left valve, and flat or concave (resupinate) right valve; hinge line produced, wider than body of shell in young, but much shorter than greatest width of mature shells. Body of shell oblique, in young shells inclining backward 25 to 40 degrees from the hinge line in a straight line; in mature shells (50 mm. long or over) the lower part of the body curves backward forming a broad posterior extension, the extreme margin of which reaches considerably beyond the posterior end of the wing. This is a characteristic expression of full-grown shells of this genus. Radial sculpture on outer surface of nondecorticated left valves usually fine and numerous as in *Tolmaia*; similar sculpture on body of right valves of type species but less distinct than on left valves. Cardinal teeth, posterior lateral teeth, muscular scars, and resupination of right valve as in *Pterinea* (*sensu stricto*), *Tolmaia*, and *Cornellites*. Teeth not as in *Micropteria*.

Genotype.—*Pterinea mainensis* Clarke, by original designation.

Remarks.—Examples of the genus appear to be rare in the Devonian

rocks. The genotype is from the Moose River sandstone of Maine (Williams and Breger, 1916, p. 179). This formation is of Lower Devonian to lower Middle Devonian age (Cooper, 1942, p. 1772). In addition to the type locality, Williams and Breger (1916, p. 179) cited a probable occurrence of the type species in the Devonian of the Gaspé Peninsula, Quebec. *F. obliquata* (Hall) has been recorded from the Pentamerus limestone (Coeymans) of the lower Helderberg group of New York; *F. fronsacia* (Clarke) from the Devonian of Maine and Gaspé. Williams and Breger assigned to the genus *Follmannella* the species identified by Walcott as "*Leiopteria rafinesquii*" from the Middle Devonian Nevada limestone of the Eureka district, Nevada. In Europe the genus is found higher in the Devonian: *F. ostreiformis* is recorded from the Eifelian near Gerolstein, Germany. The genus occurs also in the Silurian of Bohemia and Great Britain, and in the lower Coblenzian of Para, Brazil. To these a new species from the Bois Blanc formation of Michigan may now be added.

Follmannella michiganensis, sp. nov.

(Pl. I, Figs. 6–7; Pl. II, Figs. 1–2; Pl. III, Fig. 1)

Description.—Species known only from left valves. Shell large, length and height subequal. Left valve depressed convex, with a small anterior wing and a large posterior one; body of shell directed slightly backward in young specimens, more so in older individuals. About twenty-four prominent major costae on the body of the valve, thirteen on the posterior wing, none on the anterior wing; space between the major costae occupied by much smaller minor costae. Concentric growth lines numerous, crowded, subequidistant, incised on the radiating costae. Hinge line imperfectly preserved; straight in the region behind the umbo, not preserved in the region of the anterior wing in any of the specimens studied. Umbones low, inconspicuous. Ventral margin deeply concave under the anterior wing, rounded evenly in the ventral region, slightly concave posteriorly under the broad posterior wing. Ligament not preserved. Valves consisting of two distinct layers, the outer one with costae crossed by concentric growth lines, the inner almost smooth, foliaceous, with only traces of radial ornamentation. Internal characters and dentition unknown.

Dimensions of several valves, the types, are as follows: holotype,

length 61 mm., height 60 mm., thickness 1 mm.; three paratypes, length 80, 66, 47 mm.; height 81, 45, 45 mm.; thickness 6, 5, 2 mm., respectively.

Remarks.—This species differs from *F. mainensis* (Clarke) in the less pronounced obliquity of the adult shell. From *F. ostreiformis* (Frech) it differs in being much less convex. It is larger than *F. humboldti* (Clarke), *F. obliquata* (Hall), and *F. fronsacia* (Clarke). From *F. fronsacia* it differs also in having a larger anterior wing and a smaller concavity in the posterior wing.

Occurrence.—Bois Blanc formation; localities 1, 4, 5, 7, and 8.

Types.—Holotype No. 24572; paratypes Nos. 24573, 24574, 24575, and 24577.

Genus *Actinopterella* Williams

Actinopterella Williams, 1908, *Proc. U. S. Nat. Mus.*, 34, p. 87.
Actinopterella Williams and Breger, 1916, *U. S. Geol. Surv. Prof. Paper*, No. 89, pp. 182–84.

Original description from Williams, 1908.—

Oblique pterinoid shells with posterior wing and anterior ear both well developed; both valves strongly convex, left valve ventricose, with narrow oblique body; right valve generally less convex than left but convex from beak to ventral margin, not becoming resupinate. Umbones protruding slightly beyond the hinge line. Ligamental area well developed, striated; cardinal teeth present, three or four in number; lateral teeth (or tooth) well developed and close to ligamental area. A small deep, anterior muscular scar situated on the ear; the large posterior muscular scar is obscure. Surface ornamentation fine or strong radial ribs on body and wing and occasionally on ear of left valve; radial ribs on body of right valve occasionally strong but generally obscure. Size smaller than many pterinoids; largest specimens from Maine collections rarely over 35 mm. long.

Several species of this type have been recognized in the Chapman fauna of Maine, the description of which was in process when Clarke's paper on Some new Devonic Fossils was issued. The species referred to were found to differ from *Actinoptera* Hall in their interior characters, and they differ also from the radially sculptured *Pterineas* of Goldfuss in having the right valve convex from the beak out to the ventral margin, though less convex than the left valve (not resupinate as in my new genus *Tolmaia*).

Genotype.—*Pterinea radialis* Clarke, *partim*, by original designation.

Remarks.—Although well defined by Williams (1908) and Williams and Breger (1916) this genus was either disregarded or overlooked by

Pohl (1929*b*, pp. 42–47) and Caster (1930, pp. 64–65). The genus is placed in the family Pterineidae following Williams (1908) and Maillieux (1937, p. 11).

Actinopterella peninsularis, sp. nov.

(Pl. III, Figs. 2–7)

Description.—Species known only from left valves. Left valve with a small anterior wing, separated from the body of the shell by a shallow sulcus; body directed obliquely backward, its greatest thickness just under the umbo; posterior wing large, not distinctly separated from the body of the valve, its posterior extremity with a wide, shallow emargination. Surface of left valve with two or three costae on the anterior wing, thirteen to fifteen on the body of the valve, and seven to nine on the posterior wing. Hinge line straight, almost as long as the shell. Umbo moderately large, a little elevated above the hinge line. Ventral margin with an obscure byssal notch just below the anterior wing, ventral margin obliquely rounded posteriorly, shallowly concave in the region of the posterior wing. Ligament, pallial line, and muscle scars unknown.

Dimensions of several valves, the types, are as follows: holotype, length 26 mm., height 18 mm., thickness 3.5 mm.; five paratypes, length 25, 22, 17, 13, and 22 mm.; height 20, 17, 16, 11, and 18 mm.; thickness 3, 2, 1.75, 1, and 3 mm., respectively.

Remarks.—This species is closely allied to *Actinopterella boydi* (Conrad), *sensu stricto*, as defined by Pohl (1929*b*, p. 43) and *Actinopterella rhombolineare* (Pohl) (1929, p. 42). It differs from both of these species in having fewer costae on the body of the shell.

Occurrence.—Dolomitic limestone composing the basal eight to nine feet of the Rogers City limestone; localities 39, 40, 41, 42, and 43.

Types.—Holotype No. 24544; paratypes Nos. 24545, 24546, 24547, 24548, and 24549.

Actinopterella calliotis, sp. nov.

(Pl. III, Figs. 8–11)

Description.—Species known only from exteriors of left valves. Left valve with a comparatively large, well-defined anterior wing, separated from the body of the shell by a strong sulcus; body of the valve

directed obliquely backward, its greatest thickness just under the umbo; posterior wing small, its posterior extremity with a shallow emargination. Surface of left valve with numerous, distinct, close-set, subequidistant costae, ten on the anterior wing, twenty-eight on the body of the shell, and eight or nine on the posterior wing. Hinge line straight, almost as long as the shell. Umbones small, very slightly elevated above the hinge line. Ventral margin with a distinct byssal notch just below the anterior wing, obliquely rounded posteriorly, slightly concave in the region of the posterior wing. Ligament and interior unknown.

Dimensions of three valves, the types, are as follows: holotype, length 11 mm., height 6 mm., thickness 1.5 mm.; two paratypes, length 10.5, 7 mm.; height 6.5, 5.5 mm.; thickness 1.25, 1.25 mm., respectively.

Remarks.—This species resembles *Actinopterella boydi* (Conrad), *A. aroostooki* Williams and Breger, and *A. radialis* (Clarke) in having about the same type of costae. It differs from them in being one-third their size.

Occurrence.—Dolomitic limestone composing the basal eight to nine feet of the Rogers City limestone; locality 43.

Types.—Holotype No. 24556; paratypes Nos. 24557, 24558.

FAMILY LEIOPTERIIDAE

Genus *Leiopteria* Hall

Leiopteria Hall, 1883, *Nat. Hist. N. Y., Paleontol.*, Vol. V, Pt. I, p. xiii, Pl. xvii.

Revised description from Williams and Breger, 1916, p. 209.—

Shell obliquely aviculoid; biconvex; right valve convex, equal to the left in many specimens, but generally a little less convex; never resupinate. Auricle distinctly developed, rounded, usually not pointed; separated from the body by a well-developed byssal sinus. Body of the shell elongated ovoid; oblique, generally about 30 degrees from the vertical, rarely if ever 45 degrees or more; deeply rounded below. The umbones are near the anterior end but never terminal and are directed forward. The posterior wing is distinctly developed, flat to concave, and with a concave posterior margin. The body of the left valve is of moderate convexity; the wing is flat to concave; the auricle is convexly rounded; and the byssal sinus is typically represented on the surface as well as in the margin. Ligament external, extending the length of the hinge line; usually very thin or linear and marked by only a single striation (*Leiopteria laevis, conradi, greeni, rafinesqui, sayi, bigsbyi*

mitchelli, and *gabbi* Hall); occasionally slightly broader and with two or three striations (*L. dekayi* and *linguiformis* Hall), rarely with several striae (*L. riesiana*). No cardinal teeth yet reported or observed. Posterior lateral teeth not generally observable, but in a few shells apparent traces of a ridge or posterior lateral tooth have been recorded by Hall close under the ligament. Posterior muscular scar large, broadly oval to subcircular, situated mainly or entirely upon the body of the shell (*L. linguiformis* Hall). The anterior scar has been observed only in the Chapman species *L. riesiana*, where it is minute and not very well impressed and is situated in the forward part of the rostral cavity (compare *Glyptodesma*, *Leptodesma*, *Limoptera*) and not upon the auricle, as in *Pterinea*, *Cornellites*, *Follmannella*, *Actinopterella*, and *Pteronitella*. In Hall's description of *L. dekayi* Hall, the genotype of *Leiopteria*, he mentions a low, septum-like ridge between the auricle and rostral cavity. This may possibly be the posterior boundary of a small anterior muscular scar; if so, it would seem to indicate that the scar is really situated on the auricle. Pallial line simple. Shell thin. The surface ornamentation consists of concentric striae, strongest on the posterior half of the body and on the wing. No radial ornamentation except, very rarely, a few faint radial lines on the body of the right valve.

Genotype.—*Leiopteria dekayi* Hall.

Remarks.—The genus was emended by Spriestersbach in 1909 and reviewed by Williams and Breger (1916, pp. 208–11). Maillieux (1931, p. 65) placed *Leiopteria* in his family Leiopteriidae with the genera *Actinodesma* and *Micropteria*, each of the three in a separate subfamily.

Leiopteria peninsularis, sp. nov.

(Pl. IV, Figs. 1–2)

Description.—Species known only from left valves. Shell large for the genus. Shell directed obliquely backward, with large anterior and posterior wings. Ornamentation of irregular concentric growth lines with obscure radial striae; the concentric lines of unequal thickness, ending abruptly or anastomosing with each other. Hinge line straight posterior to the beak, straight but directed slightly downward in front of it. Umbo in the anterior third of the valve, low, not convex. Ventral margin incurved below the anterior wing, obliquely rounded to the region of the posterior wing where it is concave, ending in a sharp point at the hinge line. Ligament not preserved. Valve thickest just under the umbo, sloping abruptly into the anterior sulcus and more gently into the posterior one. Interior and dentition unknown.

Dimensions of two valves, the types, are as follows: holotype, length 42 mm., height 39 mm., thickness 5.5 mm.; paratype, length 26 mm., height 27 mm., thickness 4 mm.

Remarks.—*Leiopteria peninsularis* resembles *L. laevis*, *L. conradi*, *L. greeni*, *L. rafinesqui*, *L. gabbi* Hall, and *L. riesiana* Williams and Breger, but from all of them it differs in having a much larger anterior wing. It has weaker and less regular concentric growth lines than *L. cornelli* Caster.

Occurrence.—Dundee limestone; locality 28.

Types.—Holotype No. 24579; paratype No. 24580.

Genus *Actinodesma* Sandberger and Sandberger

Actinodesma Sandberger and Sandberger, 1856, *Verstein. rhein. Schichtensyst. Nassau*, p. 282.

Revised description translated from Maillieux, 1937, pp. 61–62.—

Shell inequivalve, left valve convex, right valve flat or concave. The two wings are prolonged into points. Immediately under the ligamental area is an uninterrupted row of teeth which are short in front of and under the umbones, more oblique and longer behind them. Ornamentation of concentric striae or lamellae only in the subgenus *Actinodesma sensu stricto* (Synonyms: *Glyptodesma* Hall, *Dolichopteron* Maurer). Ornamentation reticulate, composed of radiating costae, crossed by wide concentric lamellae, undulating where they cross the radiating costae: subgenus *Asselberghsia* Maillieux 1931. Ornamentation of radiating costae: subgenus *Ectenodesma* Hall 1884.

Genotype.—*Actinodesma malleiformis* Sandberger and Sandberger, by monotypy.

Remarks.—Maillieux' opinion (1937, p. 62) that *Glyptodesma* Hall is a synonym of *Actinodesma* Sandberger and Sandberger is accepted with some reservations, for some of the species described by Hall may belong elsewhere.

Actinodesma occidentale (Hall)

(Pl. IV, Figs. 3–4)

Glyptodesma occidentale Hall, 1883, *Nat. Hist. N. Y., Paleontol.*, Vol. V, Pt. I, plates and explanations; Pl. XV, Fig. 12; 1884, *ibid.*, p. 157, Pl. XV, Fig. 12; Pl. LXXXVI, Fig. 9.

Hall's description is easily accessible, so it is not repeated here. A slab of Dundee limestone from Macon Creek, Monroe County, Michigan, shows four good and three fragmentary specimens of the left valve of this species which agree in every respect with Hall's diagnosis

and figures except that they are slightly larger. The best of these specimens, No. 15265, is figured (Pl. IV, Fig. 3). The dimensions are: length 74 mm., height 70 mm., thickness of left valve 7 mm. In all the Macon Creek specimens the concavity of the margin of the posterior wing is roundly concave, not angulated as in the specimens described in the next paragraph.

Two large left valves from the Dundee limestone of the Sibley quarry are referred with some hesitation to this species. The better specimen, No. 24582 (Pl. IV, Fig. 4), shows a strong angulation in the concavity of the concentric lines on the posterior wing, which is not shown in Hall's figures of his species nor in the specimens from Macon Creek. Should this character prove to be constant in a number of specimens, it may be sufficient to separate the Michigan form from Hall's species. For the present it is considered best not to do so but to place the Michigan specimens doubtfully in *A. occidentale*. The better specimen, hypotype No. 24582 is 87 mm. long, 85 mm. high, and 21 mm. thick. The second specimen, No. 24583, is 79 mm. long, 78 mm. high, and 17 mm. thick as preserved.

Occurrence.—Dundee limestone; localities 27 and 28.

Types.—Hypotypes Nos. 15265, 24582.

FAMILY KOCHIIDAE

Genus *Leptodesma* Hall

Leptodesma Hall, 1883, *Nat. Hist. N. Y., Paleontol.*, Vol. V, Pt. I, plates and explanations; Pl. XVII, Fig. 12.

Leptodesma Williams and Breger, 1916, *U. S. Geol. Surv. Prof. Paper*, No. 89, p. 209.

Leptodesma Caster, 1930, *Bull. Amer. Paleontol.*, Vol. 15, No. 58, pp. 42–43.

Revised diagnosis from Caster, 1930.—

The genus *Leptodesma* differs essentially from *Leiopteria* in the acuteness of its anterior cardinal angle and the absence of a lobate ear. The hinge is narrow and bears a small lateral tooth just behind the beak and nearly parallel to the hinge line. The ligament is external and the area extends the entire length of the hinge line and is longitudinally striate. The surface bears concentric growth lines.

Genotype.—*Leptodesma rogersi* Hall, by subsequent designation.

Remarks.—Hall (1884, p. 175) described numerous species of this genus and attempted to group them according to the shape of the

shell. His various groups may correspond to different patterns of dentition which would afford a more solid basis for separation of the genus into subgenera, but it is impossible to establish this until the dentition of the various species is better known. Caster (1930, p. 43) has compared the classification of the species of *Leptodesma* to that of the Recent Unionidae. The comparison is not exactly accurate, for at the time that Caster wrote, the Unionidae had been revised by a number of workers, especially Charles T. Simpson, Arnold E. Ortmann, and Bryant Walker, who rearranged them into genera and species on the characters of the soft parts. As will be shown later (pages 288–89) at least two *Leptodesma*-like pelecypods can be separated from that genus on the basis of different dentition. There is a possibility that a satisfactory arrangement of *Leptodesma* will be attainable when the characters of the hinge are known for all the species. For the present, it seems best to leave in *Leptodesma* those species which have external characters comparable to those of other members of the genus, as has been done for the next species to be described.

Leptodesma furcistria, sp. nov.

(Pl. V, Figs. 1–5)

Description.—Species known only from left valves. Shell small, longer than wide, directed obliquely backward. Surface with concentric lines of growth, irregular, wavy, and often bifurcating, with sometimes one of the bifurcations ending abruptly after forking. Hinge line straight, almost as long as the shell. Umbo in the anterior quarter of the valve, low, not much raised above the hinge line. Ventral margin concave just below the anterior wing, forming a shallow byssal notch, obliquely rounded posteriorly, concave in the region of the posterior wing. Greatest thickness of the valve posterior to the umbo, thence decreasing gradually toward the anterior and posterior parts without forming definite sulci. Byssal notch obscure. Ligament and interior unknown.

Dimensions of several valves, the types, are as follows: holotype, length 25 mm., height 13.1 mm., thickness 1 mm.; three paratypes, length 26, 17, 6 mm.; height 14, 9.5, 3 mm.; thickness 1, 1, 0.5 mm., respectively.

Remarks.—*Leptodesma furcistria* resembles *L. lesleyi* Hall (1884,

p. 223, Pl. 91, Fig. 7) in outline and in the character of the concentric growth lines; it lacks the "broad, distinct, oblique byssal depression" of that species and is less than half its size. The same bifurcating, irregular growth lines are found in *L. jason* Hall (1884, p. 213, Pl. 91, Fig. 4), but this species is relatively much higher than *L. furcistria*. *L. jason* has been recorded by Whiteaves from the Devonian of the Athabasca River, Canada, but the exact horizon is not given. His specimens may be close to or perhaps identical with *L. furcistria*, but it is impossible to be certain because of the poor preservation of his specimens, which I have seen in the collection of the Geological Survey of Canada, Ottawa.

Occurrence.—Dolomitic limestone composing the basal eight to nine feet of the Rogers City limestone; localities 40, 42, and 43.

Types.—Holotype No. 24564; paratypes Nos. 24565, 24566, 24567.

Leptodesma sp. cf. *L. furcistria*, sp. nov.

A single specimen, No. 24615, from the Dundee limestone, locality 32, is referred doubtfully to *L. furcistria*. The specimen, too poorly preserved to illustrate, is a left valve, 10 mm. long, 4 mm. high, and 1 mm. thick. The lines of growth are concentric, similar to those of *L. furcistria* but less frequently bifurcated. The wing, only partly shown, is of the same character as that of *L. furcistria*.

Leptodesma? sp.

(Pl. V, Fig. 6)

A comparatively large aviculoid represented by a single specimen occurs in the dolomitic limestone composing the basal eight to nine feet of the Rogers City limestone at locality 42. It is a left valve, No. 24596, 51 mm. long, 21 mm. high, and 3 mm. thick. The specimen is somewhat crushed and the outline of the valve is not complete. The specimen closely resembles *Leptodesma aliforme* Hall of the Chemung of New York in the general outline of the shell and the almost total absence of a concavity in the outer part of the posterior wing. In earlier growth stages the wing had a pronounced posterior concavity as indicated by the curvature of the earlier growth lines. Williams and Breger (1916, p. 195) have noted that *Leptodesma aliforme* Hall probably should be assigned to the genus *Pteronites* McCoy.

Diodontopteria, gen. nov.

Description.—Shell equivalve or nearly so, inequilateral, small. Surface with numerous weak concentric lines, no radial ornamentation. Anterior wing small, distinctly separated from the body of the shell by a strong sulcus; the wing itself with a weak sulcus which divides it into two parts. Posterior wing sharply pointed but not prolonged into a spine. Hinge line straight, almost as long as the shell, ending anteriorly just behind the gently rounded extremity of the anterior wing. Umbones relatively large, distinctly raised above the hinge line, curving slightly forward, situated within the anterior third of the shell but not terminal. Ventral margin constricted anteriorly to form a byssal notch, moderately convex, concave posteriorly, forming a large but shallow notch in the posterior wing. Ligamental area external, as long as the hinge, faintly striated. Valves thickest just posterior to and ventrally from the umbones, sloping abruptly into both the anterior and posterior sulci. Valves not gaping. Test thin, except in the region of the hinge where it is slightly thicker. Muscle scars not seen, probably very indistinct. Hinge narrow; the left valve has two anterior teeth, with a socket between them, and one posterior tooth; the right valve has one anterior tooth, two anterior sockets, and one posterior socket. Umbonal cavity relatively deep, pallial line not seen.

Genotype.—Diodontopteria ehlersi, sp. nov.

Remarks.—This new genus is closely allied to *Leptodesma* Hall, from which it is indistinguishable externally. It differs from *Leptodesma* by the character of its dentition: *Diodontopteria* bears two anterior teeth and one posterior tooth in the left valve and one anterior tooth, two anterior sockets, and one posterior socket in the right valve; *Leptodesma* has only one posterior tooth and apparently no anterior ones. *Diodontopteria* also differs from *Leiopteria* Hall in its dentition.

In discussing *Leptodesma,* Caster (1930, p. 185) stated that "it is now very difficult to make any specific determinations in this genus and the problem will grow in complexity so long as individual specimens constitute a species and intermediate forms are unknown." Hall (1884, p. 175) attempted a separation of the genus into groups on the basis of shell form, but without convincing results. *Leptodesma* should be restricted to the species with only posterior laterals; *Dio-*

dontopteria has been created for those forms in which the dentition is known to differ from *Leptodesma.*

Diodontopteria is doubtfully assigned to the family Kochiidae on the basis of the resemblance to *Leptodesma*, which Maillieux (1931, pp. 69–70) placed in this family. Maillieux created for *Leptodesma* Hall and *Ptychopteria* Hall a special subfamily Leptodesminae. If *Diodontopteria* is to remain in the Kochiidae, the concept of the family must be extended, for according to Maillieux's diagnosis it includes only genera with a single cardinal tooth and a single lateral.

Diodontopteria ehlersi, sp. nov.

(Pl. V, Figs. 7–16)

Description.—Shell equivalve or nearly so, inequilateral, small. Surface with numerous fine concentric lines, without radial ornamentation. Anterior wing small, distinctly separated from the body of the shell by a shallow sulcus; posterior wing large, separated from the body of the shell by a strong sulcus and bearing a shallow sulcus which separates it into two parts. Posterior wing sharply pointed but not prolonged into a spine. Hinge line straight, almost as long as the shell, extending from a point just behind the gently rounded extremity of the anterior wing to the extremity of the posterior wing. Umbones relatively large, distinctly raised above the hinge line, situated within the anterior third of the shell but not terminal, curving slightly forward. Ventral margin constricted anteriorly to form a distinct byssal notch, moderately convex posteriorly, and curving into a large but shallow emargination in the posterior wing. Ligamental area external, small, as long as the hinge, faintly striated longitudinally. Valves most convex just posterior to and ventrally from the umbones, sloping abruptly into both the anterior and posterior sulci. Valves not gaping. Test thin, except in the region of the hinge where it is slightly thicker. Concentric growth lines of the exterior reflected as low corrugations on the interior of the shell. Muscle scars not seen, probably very indistinct. Hinge narrow, bearing two anterior teeth and one posterior tooth in the left valve, and one anterior tooth, two anterior sockets, and one posterior socket in the right valve. Umbonal cavity relatively deep, pallial line not seen.

Dimensions of three valves, the types, are as follows: holotype,

length 13 mm., height 7 mm., thickness 4 mm.; two paratypes, length 15, 15.5 mm.; height 8, 8.5 mm.; thickness 2.5, 3 mm., respectively.

Occurrence.—Detroit River group ("Anderdon limestone"); locality 17.

Types.—Holotype No. 24536; paratypes Nos. 24537, 24538, 24539, 24540, 24541, and 24542.

Diodontopteria kellumi, sp. nov.

(Pl. VI, Figs. 1–4)

Description.—Species known only from left valves. Shell inequilateral, small. Surface with relatively widely spaced concentric lines, sharply defined near the ventral margin; no radial ornamentation. Anterior wing small, separated from the body of the shell by an obscure sulcus; posterior wing relatively large, bounded by a posterior angulation of the body of the shell. Hinge line straight, almost as long as the shell, extending from a point just behind the gently rounded anterior wing to the end of the posterior wing. Umbones large, distinctly raised above the hinge line, situated close to the anterior end of the shell but not terminal, curving slightly forward. Ventral margin evenly rounded in front with no discernible byssal notch, moderately convex behind, forming a large but shallow notch in the posterior wing. Ligamental area not preserved in the specimens seen. Valves most convex just under the umbones, sloping evenly into the anterior and posterior wings. Concentric growth lines showing faintly on the mold of the interior. Muscle scars not seen. Hinge narrow, bearing one posterior and two anterior teeth in the left valve. Umbonal cavity relatively deep, pallial line not seen.

Dimensions of three valves, the types, are as follows: holotype, length 13.5 mm., height 7 mm., and thickness 3 mm.; two paratypes, length 9, 7.5 mm.; height 6, 4.5 mm.; thickness 2.25, 2 mm., respectively.

Remarks.—*D. kellumi* differs from *D. ehlersi*, the type of the genus, in having no byssal notch and a less concave margin in the region of the posterior wing. The concentric growth lines are more widely spaced than those of *D. ehlersi*, but much more prominent, especially in the ventral area of the valve.

Occurrence.—Dundee limestone; locality 36.

Types.—Holotype No. 24584; paratypes Nos. 24585 and 24586.

Diodontopteria? bradti (Sherzer and Grabau)

(Pl. VI, Fig. 5)

Pterinea bradti Sherzer and Grabau, 1909, *Geol. Soc. Amer. Bull.*, Vol. 19, p. 550.
Pterinea bradti Grabau, 1910, *Mich. Geol. and Biol. Surv. Publ.*, 2, Geol. Ser. 1, pp. 166–68, Pl. XVI, Figs. 9–10.

This species is placed doubtfully in the genus *Diodontopteria*. Only two specimens were available for study. One of these, syntype No. 13060, is a mold of the interior of a left valve which shows traces of two teeth with a socket between them in the region anterior to the beak. The other specimen, hypotype No. 13092, is a poorly preserved mold of the interior of the right valve; the dentition is not preserved. *D.? bradti* is distinct from *D. ehlersi* in having a much fainter byssal sinus and somewhat higher beaks. Its generic position and relation to the genotype of *Diodontopteria* cannot be given more exactly until further material is available for study. The dimensions of the only syntype seen, No. 13060, are as follows: length 10 mm., height 6.5 mm., and thickness 3 mm.

Occurrence.—Detroit River group, Lucas dolomite; locality 24.

FAMILY AVICULIDAE

Genus *Limoptera* Hall

Limoptera Hall, 1869, *Prelim. Notice Lamellibr. Helderb.*, p. 15.
Limoptera Williams and Breger, 1916, *U. S. Geol. Surv. Prof. Paper*, No. 89, pp. 202–4.

Revised description after Williams and Breger.—

The shells of the genus Limoptera are distinguished from the pterinoids which they superficially resemble by the large, only slightly oblique, nearly erect forms; the anterior ear usually small or absent; the posterior wing large; both valves frequently convex; radial ribs, if present, simple, not fasciculate, in many specimens obsolescent. The ending of the pallial line in the umbonal apex rather than in a more distinct anterior scar, situated on the ear, removes Limoptera from the pterinoids and indicates the affiliation of the genus with the primitive aviculoids. . . .

Limoptera s. str. will, then, be restricted to strongly convex, radially ribbed limopteroid shells in which there is at least trace of an ear or auriculate expansion in front of the umbones and in which the umbones are subterminal, not quite terminal.

Genotype.—*Limoptera macroptera* (Conrad), by original designation.

Remarks.—Williams and Breger (1916, pp. 202–3) recognized that

the shells referred to *Limoptera* could be separated into several sections. They indicated that besides the typical section, *Limoptera* sensu stricto, two others might deserve recognition. One, *Myalinodonta* Oehlert 1888, differs from typical *Limoptera* by the following characters: ". . . there is not the slightest trace of an ear, the beaks are not at the forward termination of the hinge line, the forward extremity of the body is far in advance of the beaks, and the upper anterior margin to the beaks is concave." *Myalinodonta* "is depressed convex, equivalve, and radially striate or finely ribbed . . . [with] a triangular patch under the beak in the horizontally striated ligament." A second, *Paropsis* Oehlert, "is characterized by the absence of radial ribbing, the body being only concentrically striate."

Maillieux (1937, p. 74), in a key to the subgenera of *Limoptera*, placed the species with radial ornamentation in the subgenus *Limoptera* s.s. and listed *Myalinodonta* Oehlert and *Monopteria* Meek and Worthen 1866 as synonyms. He placed the species with concentric ornamentation, or rarely with obscure rays, in the subgenus *Stainieria* Maillieux 1930, and included *Paropsis* Oehlert 1888 as a synonym, but added "of which the exact meaning has not been given by its author." These two interpretations of the genus, the one stressing the presence or absence of the wing, and the other the character of the external ornamentation, should be re-examined and brought into harmony. In my opinion the presence or absence of the wing is of greater systematic importance than the character of the costae and concentric striae. It is impossible, however, to revise the genus until more material, particularly from Europe, has been studied. For the present I am following Williams and Breger's classification.

Limoptera (sec. **Myalinodonta**?) **migrans,** sp. nov.

(Pl. VI, Figs. 6–11)

Description.—Shell equivalve, small; surface with numerous flat, relatively wide, unequal and unevenly spaced costae, crossed by fine, incised concentric striae. Hinge line straight, slightly shorter than the total length. Umbones almost terminal, slightly convex. Anterior part of the ventral margin almost perpendicular to the hinge line, without alation, forming a blunt angulation with the remainder of the ventral margin, which is evenly rounded except for a shallow notch in

the region of the posterior wing, just below the hinge line. Ligamental area not seen. Interior imperfectly preserved, known only from an incomplete right valve in which there is no trace of adductor muscle scars. Hinge in the right valve with two slightly oblique posterior lateral teeth; interior of the left valve unknown. Pallial line not seen.

Dimensions of several valves, the types, are as follows: holotype, length 13 mm., height 14.5 mm., thickness 2.5 mm.; four paratypes, length 34, 16, 16, and 11 mm.; height 32, 16, 15, and 11.5 mm.; thickness 2.5, 2, 3, and 2.5 mm., respectively.

Remarks.—This species is doubtfully placed in the section *Myalinodonta* of the genus *Limoptera.* If it is a member of this section it may be the first to be recorded from North America. The occurrence would not be surprising, since the specimens were associated with a fauna having marked affinities with one in Germany which contains *Myalinodonta. Limoptera migrans* is closely related to *L. semiradiata* Frech, *L. bifida* (Sandberger and Sandberger), and *L. longialata* Drevermann, but differs from them in having a shorter, less pointed posterior wing and in having the beaks nearer the anterior end of the hinge line.

Occurrence.—Dolomitic limestone composing the basal eight or nine feet of the Rogers City limestone; localities 39 and 43.

Types.—Holotype No. 24559; paratypes Nos. 24560, 24561, 24562, and 24563.

FAMILY AMBONYCHIIDAE

Genus *Gosseletia* Barrois

Gosseletia Barrois, 1882, *Mém. soc. géol. du Nord*, Vol. 2, No. 1, p. 273.
Gosseletia Maillieux, 1937, *Mém. soc. roy. hist. nat. Belgique*, Vol. 81, p. 86.

Diagnosis translated from Maillieux, 1937.—

Shell equivalve, inequilateral, gibbous, oblique, with an obtuse posterior wing, the anterior wing absent, or marked by a more or less pronounced swelling of the antero-cardinal portion of the valves. The valves are generally divided by a carina in the direction of the height. The beaks are prominent, inclined forward. Ligamental area flattened, rather wide, with numerous longitudinal striae. Cardinal margin straight; hinge with three cardinal teeth converging forward in front of the beak, the anterior one often bifid. Lateral teeth strongly developed, more or less oblique with respect to the cardinal margin, extending along almost the entire length of the cardinal margin. Anterior muscle scar small, deeply sunk very near

the beak, usually under the first anterior cardinal tooth, its shape rounded. Posterior muscle scar large, flat, generally but little distinct. Pallial line simple. This genus groups together forms with concentric ornamentation, to which belongs the genotype *Gosseletia devonica* Barrois 1882, and forms with radiating ornamentation, of which the type is *Gosseletia truncata* (F. Roemer 1844). In 1920 we have suggested grouping the species of *Gosseletia* in two subgenera: the subgenus *Gosseletia sensu stricto* for those species with concentric ornamentation, whereas we have given the name *Stappersella* to the species with radiating ornamentation, bearing in addition a more or less sharp carina.

Genotype.—*Gosseletia devonica* Barrois, by monotypy.

Remarks.—There is little or no difference in structure to separate the genus *Gosseletia* Barrois, as emended by Follmann and Maillieux, from *Lophonychia* Pohl. The differences in sharpness of the carina in these two genera is relative and could not, in my opinion, be given more than specific or at most subgeneric value. When dealing with imperfectly preserved specimens, it would seem best to place them in the older genus, which would have priority if the two are synonymous.

Gosseletia sp.

(Pl. VI, Fig. 12–14)

A single specimen from the Dundee limestone is referred to the genus *Gosseletia*. I believe that the specimen may represent a new species, but much better preserved shells are necessary before determination of the specific characters and relationships to other species can be made.

Occurrence.—Dundee limestone; locality 34.

Figured specimen.—No. 24614.

FAMILY MYTILIDAE

Liromytilus, gen. nov.

Description.—Shell equivalve, elongate, compressed, expanded posteriorly. Surface with strong concentric ridges, individual ridges varying in thickness, with intercalated, more numerous lirae. Hinge line two-thirds of the length, rounding gently into the posterior part of the ventral margin and abruptly into the anterior part of the ventral margin. Umbones small, blunt, and inconspicuous, situated in the anterior one-sixth of the shell but not terminal. Anterior part of the

ventral margin evenly rounded; mid-ventral margin sinuate; posterior part of the ventral margin broadly rounded. Ligament not preserved. Interior with a small anterior adductor scar and a large posterior one, the latter occupying more than one-half the posterior part of the shell. Anterior border of the posterior muscle scar bounded by a raised ridge, the latter flanked by a broad parallel depression on its anterior side. Umbonal cavities very shallow. Two small pyramidal cardinal teeth just in front of the umbo in the right valve. Dentition of left valve unknown. Lateral teeth not seen. Pallial line faint, with a series of small, shallow, elongated pits above it; longer axes of pits arranged perpendicularly to pallial line.

Genotype.—Modiomorpha attenuata Whiteaves.

Remarks.—Liromytilus differs from *Modiolopsis* Hall in possessing well-developed teeth, from *Modiomorpha* Hall in lacking a well-developed callosity on the hinge line, and from *Eurymyella* Williams in having two cardinal teeth in the right valve. It cannot be placed in the family Modiolopsidae if Dall's diagnosis of the family (1913, p. 462) is accepted, because the adductor scars can scarcely be described as "sub-equal." At present the better place for this genus seems to be in the Mytilidae as understood by Dall. *Liromytilus* resembles *Modiolus* Lamarck of this family, but differs from it in the more posterior position of the umbones, the great disparity in size between the adductor scars, and in the presence of cardinal teeth. Hall (1884, pp. 267–68) described a few Devonian species of *Modiolus*, but all of these are small and their outlines quite different from that of *Liromytilus*. *Liromytilus* is easily distinguished from *Mytilus* by the nonterminal position of the beaks.

Liromytilus differs from *Solenomorpha* Cockerell in possessing cardinal teeth, in the peculiar ornamentation of the exterior of the valves, and in the absence of a postumbonal ridge. Beushausen's reference of *Modiomorpha attenuata* Whiteaves to *Solenopsis* McCoy (=*Solenomorpha* Cockerell) is discussed on page 297.

Liromytilus attenuatus (Whiteaves)

(Pls. VII–X)

Modiomorpha attenuata Whiteaves, 1891, *Proc. and Trans. Roy. Soc. Canada*, 1890, Vol. 8, Pt. 4, p. 96, Pl. V, Figs. 1, 1*a*.

Modiomorpha attenuata Whiteaves, 1892, *Contrib. Can. Palaeontol.*, Vol. I, Pt. 4, No. 6, pp. 295–96.

Modiomorpha attenuata Tyrrell, 1893, *Ann. Rept. Geol. Surv. Canada*, Vol. V, Pt. E, p. 174.

Solenopsis attenuata Beushausen, 1895, *Abhandl. der K. Preuss. Geol. Landesanstalt*, N. F., Heft 17, pp. 220–21, Taf. XVIII, Fig. 8.

Description.—Shell large, very elongate, three times as long as high, thickness approximately half the height of the shell; anterior part narrower than the posterior part. Surface with strong concentric ridges, individual ridges varying in thickness, with numerous lirae intercalated between them. Hinge line two-thirds of the length, curving gradually into the posterior part of the ventral margin and abruptly into the anterior part of the ventral margin. Umbones anterior but not terminal, situated in the anterior sixth of the shell; small, blunt, inconspicuous, with fine concentric growth lines. Ventral margin sinuate; anterior part evenly rounded, posterior part broadly rounded. Ligament not preserved; the apparent place of attachment on the outside of the shell marked by an excavation bounded by a sharply serrate ridge along the dorsal edge of each valve. Test thin, thickest in the umbonal region and gradually thinning toward the ventral margin. No evidence of a byssal notch or of a gap in the shell for the protrusion of a byssus. Interior of the shell with a small anterior adductor muscle scar and a large posterior one, the latter occupying more than one-half the posterior part of the shell. Anterior muscle scar ovate-pyramidal; posterior scar pear-shaped, with the narrower part pointing anterodorsally. Both muscle scars with low concentric ridges. Anterior and ventral margin of the posterior adductor muscle scar bounded by a low sigmoidal ridge; latter flanked anteriorly by a slightly wider depression. Hinge narrow, with two low but distinct cardinal teeth just in front of the umbo in the right valve; dentition of the left valve unknown, but probably consisting of one cardinal tooth and two sockets on each side of it for the reception of the cardinals of the right valve. Umbonal cavity shallow, scarcely perceptible in casts of the interior of the shell. Pallial line faint, with a series of small, shallow, elongated pits above it; longer axes of pits arranged perpendicularly to the pallial line.

Dimensions of several valves, the types, are as follows: holotype,

length 172 mm., height 57 mm., thickness 27 mm.; two hypotypes, length 135 mm., 100 mm.; height 64 mm., 41 mm.; thickness 26 mm. and 19 mm., respectively.

Remarks.—The specimens in Whiteaves' possession consisted of "one nearly perfect, and three very imperfect casts of the interior of the shell." Only the specimen figured by him and later labeled as the type is now in the collection of the Geological Survey of Canada. A search through the Survey material failed to produce the "three very imperfect casts" mentioned by Whiteaves.

Whiteaves' description of *Modiomorpha attenuata* is exact for the specimens available to him. His material did not show the exterior nor the hinge teeth. Lack of knowledge regarding these characters led him to assign the species doubtfully to *Modiomorpha.* Whiteaves' statement that the posterior muscle scar is unknown seems strange at first glance. This scar is clearly marked on the type specimen which he had before him, and its outline is indicated, though not very clearly, in Whiteaves' figure. A reasonable explanation may be that Whiteaves had in mind the comparatively small scar of a *Modiomorpha* and refused to interpret as such the large scar which was shown in his specimens. Had he seen the Michigan specimens, which also show this feature clearly, he probably would have interpreted it correctly as a posterior muscle scar, enormous as it may seem for a *Modiomorpha,* though not remarkably so for a mytilid.

Beushausen (1895, p. 220) correctly interpreted the posterior muscle scar, but he did not have specimens showing the dentition. His reference of the species to *Solenopsis* McCoy cannot be accepted. McCoy definitely stated that the hinge lacked teeth, and Beushausen, in emending McCoy's genus, seems to have thought that this applied to Whiteaves' species as well, for he states "Schlossrand lang, zahnlos," which he could not have done had his specimen shown the dentition. The presence of teeth on the hinge line is sufficient in itself to exclude *Liromytilus attenuatus* from the genus *Solenopsis*, but this is supported also by the peculiar ornamentation of the surface of the valves, the much greater size of Whiteaves' species and the characters shown on the interior of the valves.

Occurrence.—Middle Devonian; southeast side of Dawson Bay, Lake Winnipegosis, four or five miles north of Shoal River, Mani-

toba, "Whiteaves Point" of Tyrrell (1893, pp. 173–74). Rogers City limestone; localities 45, 46, 47, 49, 54.

Types.—Holotype No. 4144 Geological Survey of Canada; hypotypes Nos. 23918, 23919, 23920.

FAMILY MODIOLOPSIDAE

Genus *Modiomorpha* Hall

Modiomorpha? sp.

Six fragmentary and poorly preserved pelecypods from various Devonian strata of Michigan are doubtfully referred to the genus *Modiomorpha.* Too poorly preserved for more definite identification or to illustrate, they are included here to complete the tables showing the occurrence of Michigan pelecypods.

Occurrence.—The specimens are from the following formations and localities: No. 24602 is from the Bois Blanc formation, locality 4; No. 24605 is from the same formation, locality 15; No. 24601 is from the Rogers City formation, locality 48; No. 24603 and No. 24604 are from the basal dolomitic limestone of the same formation, locality 42.

Genus *Goniophora* Phillips

Goniophora Phillips, 1848, *Geol. Surv. Gt. Brit. Mem.*, Vol. 2, Pt. 1, p. 264.
Goniophora Williams and Breger, 1916, *U. S. Geol. Surv. Prof. Paper*, No. 89, pp. 223–30.
Goniophora Maillieux, 1937, *Mém. mus. roy. hist. nat. Belgique*, No. 81, pp. 128–29.

Diagnosis translated from Maillieux, 1937.—

Shell equivalve, very inequilateral, trapezoidal; umbones small, near the anterior end, scarcely projecting above the hinge line, directed forward, lunule small, not delimited by a sharp crest. Cardinal margin long, straight or slightly curved. From the beak to the postero-inferior angle is a distinctly developed carina, generally with a sharp crest. Ornamentation consisting of striae or fine concentric ribs which in front of the carina multiply by bifurcation or intercalation. Behind the carina the ornamentation is often finer and more regular. Hinge with one triangular tooth in the left valve, and a corresponding socket in the right. Under this tooth, there is often another, poorly developed tooth. Lateral teeth absent. Interior with a ridge, represented in the internal mold by a groove, along the cardinal margin. Ligament external, situated in a long groove, under the umbones. Anterior muscle scar small, oval, deep, situated very near the hinge; besides it is the small, obscure impression of the pedal muscle. Posterior muscle scar larger, more flattened, situated

near the posterior border. The impression of the pedal muscle is more or less merged with the posterior muscle scar.

Genotype.—Goniophora cymbiformis Sowerby, by original designation.

Remarks.—The history of the genus has been thoroughly reviewed by Williams and Breger (1916, pp. 223–30); they distinguish it from *Mecynodon* Keferstein with which it is most likely to be confused.

Goniophora nucella, sp. nov.

(Pl. XI, Figs. 1–2)

Description.—Shell small for the genus, equivalve, longer than high; outline rhomboidal, with an oblique angulation from the umbones to the posterior ventral margin of the shell; angulation with a thin, acute crest. Surface of the anterior half of the shell in front of the crest with strongly incised concentric striae; surface ornamentation not preserved behind the crest. Umbones large, produced well above the hinge line, situated in the anterior part of the cardinal margin, but not terminal. Lunule small but distinct. Ventral margin evenly rounded in front, thence straight until it reaches the carina, where it turns sharply upward and forward to the posterior end of the cardinal margin. Ligament not preserved. Test thin, with strongly incised concentric striae which are but faintly visible on the inner surface of the valves. Anterior adductor scar small, deep, almost round; posterior adductor scar indistinct. Hinge line short, teeth not preserved in the specimens available. Umbonal cavity large, deep, sharply angulated behind. Pallial line not preserved.

Dimensions of two specimens, the types, are as follows: holotype, length 11.5 mm., height 8 mm., thickness 9 mm.; paratype, length 13 mm., height 7 mm., thickness 8.5 mm.

Remarks.—Goniophora nucella is much smaller and relatively more obese than any of the species described by Hall (1885, pp. 293–305) and Williams and Breger (1916, pp. 230–33). Its nearest allies appear to be *G. eifeliensis* Kayser, from the lower Coblenzian, and *G. schwerdi* Beushausen, from the lower and upper Coblenzian of Germany, from both of which it differs in having weaker concentric striae and the carina directed less strongly downward at the postero-ventral angulation.

Occurrence.—Probably Dundee limestone; locality 35. Rogers City limestone; locality 54.

Types.—Holotype No. 24591; paratype No. 24592.

FAMILY NUCULIDAE

Genus *Nuculoidea* Williams and Breger

Nuculoidea Williams and Breger, 1916, *U. S. Geol. Surv. Prof. Paper*, No. 89, pp. 173–74.

Genotype.—*Nucula opima* (Hall) 1843 (=*Nucula randalli* Hall, 1870), by original designation.

Remarks.—*Nuculoidea* was proposed by Williams and Breger as a subgenus of *Nucula* Lamarck from which it was distinguished by the presence of a distinct cartilage pit and a nonpectinated ventral margin. Quenstedt (1930) assigned the Devonian species formerly referred to *Nucula* to *Palaeonucula*, a new genus which he distinguished from *Nucula* by the absence of a tooth behind the chondrophore. Maillieux (1937, p. 152) gave full generic status to *Nuculoidea* but pointed out that differentiation between it and *Palaeonucula* Quenstedt is difficult. He said "two genera have been recognized in the Paleozoic: *Palaeonucula*, whose beaks are opisthogyrous, and *Nuculoidea* Williams and Breger 1916, with prosogyrous beaks. This distinction, however, is rather subtle, for the beaks of *Nuculoidea* are sometimes slightly opisthogyrous and then the two genera grade more or less into each other" (translation). If the two genera are equivalent the name *Nuculoidea* would have priority.

Nuculoidea? sp. A

(Pl. XI, Figs. 4–5)

A nuculoid, probably belonging to a new species, is represented by a single specimen. It is placed in *Nuculoidea* on the basis of the resemblance of the external characters to those of the genotype, *N. opima* (Hall) of the Hamilton of New York and Maryland. The Michigan specimen has somewhat more anteriorly placed beaks and is proportionally longer than the specimens of *N. opima*, figured as *Nucula randalli* by Hall (1885, Pl. 45, Figs. 6–10, 23, 26–27), but the character of the growth lines, which are fine, sharp, and closely set, is similar.

The specimen illustrated measures 21.5 mm. in length, 12.5 mm. in height, and 14 mm. in thickness. The internal characters are unknown, so the assignment to *Nuculoidea* is somewhat doubtful.

Occurrence.—Rogers City limestone; locality 54.

Figured specimen.—No. 24626.

Nuculoidea? sp. B

(Pl. XI, Fig. 6)

Another nuculoid, represented by a weathered internal mold, is larger than *Nuculoidea?* sp. A, is not as obese, and the umbones are more centrally placed. The specimen is 33 mm. long, 20 mm. high, and 15 mm. thick.

Occurrence.—Rogers City limestone; locality 54.

Figured specimen.—No. 24627.

FAMILY LEDIDAE

Genus *Palaeaneilo* Hall

Palaeaneilo Hall, 1869, *Prelim. Notice Lamellibr. Helderb.*, p. 6.
Palaeoneilo Hall, 1885, *Nat. Hist. N. Y., Paleontol.*, Vol. V, Pt. II, pp. xxvii–xxviii.
Palaeoneilo Dall, 1913, Zittel (ed. Eastman) *Text-book of Palaeontology*, p. 440.
Palaeoneilo Maillieux, 1937, *Mém. mus. roy. hist. nat. Belgique*, No. 81, p. 162.
Paleoneilo Williams and Breger, 1916, *U. S. Geol. Surv. Prof. Paper*, No. 89, pp. 168–70.

Description from Hall, 1885.—

Nuculiform shells, transversely ovate or subelliptical, the posterior end extended, often subrostrate, with a more or less defined sulcus along the umbonal slope. Cardinal line arcuate. Surface marked by striae of growth, which are often lamellose and elevated into concentric ribs. Hinge furnished with a row of regular small transverse teeth, which is somewhat interrupted beneath the beak by a change in the direction of the teeth, or by several oblique teeth. Ligament external, contained in a shallow and narrow groove along the cardinal border. Muscular scars not strongly impressed, situated below the extremities of the hinge-line. Pallial line simple. This genus differs materially from *Nucula*, *Leda* and *Yoldia*, in having an external ligament and a sulcus on the post-umbonal slope. It differs from *Nuculites* in form, and in the absence of a clavicular ridge on the anterior end. In general form and internal characters this genus very closely resembles *Tellinomya*, and it is probable that further study will prove that the two are congeneric.

Genotype.—*Nuculites constricta* Conrad, by subsequent designation of Hall (1885, p. xxvii).

Remarks.—The original spelling of the generic name was *Palaeaneilo* but Hall later changed it to *Palaeoneilo* (1885). This change may have been justified on etymological grounds, but the later change to *Paleoneilo* by Williams and Breger (1916, p. 168), accepted by Caster (1930, p. 73), appears to be unjustified. The genus is placed in the family Ledidae following Dall (1913, p. 440) and Maillieux (1937, p. 162).

Palaeaneilo? sp.

(Pl. XI, Fig. 3)

One poorly preserved specimen, an incomplete right valve with a large umbo situated only a little forward of the center of the shell and part of the left valve, is doubtfully referred to this genus. The area of the hinge is not completely preserved, but in the right valve it is widely excavated under the umbo. As preserved, the specimen is 24 mm. long, 13.5 mm. high, and 8.5 mm. thick. In the complete specimen these dimensions probably were a few millimeters greater. The doubtful assignment to *Palaeaneilo* is made because of the elliptical outline, elevated and subcentrally placed umbones, and excavated hinge area.

Occurrence.—Dundee limestone; locality 29.

Figured spec men.—No. 24593.

FAMILY TRIGONIIDAE

Genus *Schizodus* King

Schizodus King, 1844, *Ann. Mag. Nat. Hist.*, Vol. XIV, p. 313.

Schizodus sp.

(Pl. XI, Figs. 8–11)

Three specimens, too poorly preserved for specific determination but apparently referable to this genus, are mentioned here to complete the list of pelecypods for the localities in which they occur.

Occurrence.—Rogers City limestone; localities 48, 49, and 51.

Figured specimens.—Nos. 24616, 24617, and 24618.

FAMILY PLEUROPHORIDAE

Genus *Cypricardinia* Hall

Cypricardinia Hall, 1859, *N. Y. Geol. Surv., Paleontol.*, Vol. 3, p. 266.

Genotype.—*Cypricardinia lamellosa* Hall, by subsequent designation of Hall (1869, p. 82).

Remarks.—The generic description is easily accessible so is not reproduced.

Cypricardinia canadensis Sherzer and Grabau

(Pl. XI, Fig. 7)

Cypricardinia canadense Sherzer and Grabau, 1909, *Geol. Soc. Amer. Bull.*, Vol. 19, p. 548.

Cypricardinia canadensis Grabau, 1910, *Mich. Geol. and Biol. Surv. Publ.*, 2, Geol. Ser. 1, p. 170, Pl. 23, Figs. 14–15.

The only specimen belonging to this species that I have seen is a syntype, No. 14014, from the Amherstburg dolomite of the bed of the Detroit River, opposite Amherstburg, Ontario (locality 21). This specimen corresponds to Figure 14 on Grabau's Plate 23 (1910). Another specimen figured by him (Pl. 23, Fig. 15) may be in the collections of Columbia University. No other specimen which unquestionably belongs to this species has been seen by me. A single other specimen, No. 24612, too poor to figure, from locality 19, may be referable to *C. canadensis*, but shows too few characters for a positive identification.

Cypricardinia? sp.

Seven poorly preserved and fragmentary pelecypods are doubtfully identified as members of the genus *Cypricardinia* on the basis of the resemblance of their external ornamentation to that of *Cypricardinia planulata* Hall and *C. indenta* Hall. The material is unfortunately too poor for more precise identification, but the occurrence of these forms is noted in order to complete the list of pelecypods for the Bois Blanc formation.

Occurrence.—These specimens are from the Bois Blanc formation at the following localities: No. 24606, locality 2; No. 24607, locality 8;

No. 24608, locality 3; No. 24609, locality 10; No. 24610, locality 4; No. 24611, locality 15.

FAMILY LUCINIDAE

Dall (1901, p. 797) distinguished the family Lucinidae from the Diplodontidae, Thyasiridae, and Corbidae chiefly by the characters of the soft parts. These four families, together with the Tancrediidae, Unicardiidae, and Cyrenellidae, constitute his superfamily Lucinacea, which he had previously defined (1900, p. 484) as follows: "Shell with the anterior adductor scar narrower, produced ventrally; posterior scar shorter, rounded; pallial line simple; foot elongate, sub-clavate; hinge feeble, teeth radial, often obsolete."

Dall (1901, p. 780) made a statement which is significant for the interpretation of fossil species: "Contrary to my own anticipations, the superficial and ornamental characters are those which appear to be most strongly conserved from one horizon to another, through a series of geological epochs. Such features frequently come down from the Cretaceous or Lower Eocene with practically no change." Assuming that the same generalization would hold true for earlier representatives of the family, I have examined all the genera of lucinids available in the Division of Mollusks, Museum of Zoology, University of Michigan, before writing the section of this paper dealing with this family and have kept the Recent lucinids in mind when evaluating the characters of the Devonian genera.

The external characters of the modern lucinids exhibit three general patterns: (1) Shells in which the concentric ornamentation is strong, but the radial ornamentation is so poorly developed as to be discerned only with difficulty under a lens. This group is exemplified by *Lucina jamaicensis* Lamarck, *L. floridana* Conrad, and *L. filosa* Stimpson. (2) Shells in which the concentric and radial ornamentation are about equally developed. Examples of this group are *L. interrupta* Lamarck and *L. exasperata* Reeve. (3) Shells in which the ornamentation is neither radial nor concentric, but has the appearance of a series of chevrons whose apices are directed toward the umbo. This group is represented by *Divaricella dentata* Wood and a close analogue, *D. divaricata* (Linnaeus) of the Mediterranean Sea.

Within these groups there are other structures which are not re-

stricted to a particular species or genus but which form part of the lucinid pattern. Among these the pre- and postumbonal sulci are of special importance. Both may be present and well developed as in *L. jamaicensis* Lamarck and *L. pennsylvanica* Linnaeus or considerably reduced as in *L. floridana* Conrad; in other species they are so reduced and confused with strong radial ornamentation that they can be seen only with difficulty. In the genus *Divaricella* they are absent.

With such variation among the living representatives of a family, it is not surprising that there is at least as much in the Paleozoic representatives of the same family. Different combinations of shell characters may be correlated in the living lucinids with generic differences established primarily on the soft parts. If such is the case, it seems logical to give considerable weight to the external characters in differentiating Paleozoic genera, since they probably correspond to differences in soft parts which justify generic separation.

The Devonian representatives of the Lucinidae of North America have been assigned to the genera *Paracyclas* and *Ilionia*. *Ilionia* is a Silurian genus quite different from the Devonian forms which have been placed in it, and some species assigned to *Paracyclas* do not belong in that genus. In the Devonian of Europe the family is represented by *Paracyclas*, *Crassatellopsis* Beushausen, and *Montanaria* Spriestersbach, the last two of which Beushausen (1895 p. 146) placed in the Crassatellidae, but Spriestersbach (1920) has shown them to be true lucinids.

Genus *Ilionia* Billings

Ilionia Billings, 1875, *Can. Nat.* (2d Ser.), Vol. VII, p. 301.
Ilionia Whiteaves, 1884, *Geol. Surv. Canada, Palaeozoic Fossils*, Vol. 3, Pt. I, p. 13.
Platymermis Nötling, 1883 (*fide* Williams and Breger, 1916, p. 258; Nötling's original description not located).
Prolucina Dall, 1900, Zittel (ed. Eastman) *Text-Book of Palaeontology*, Vol. I, p. 408.

Original description from Billings, 1875.—

The above generic name is proposed for such forms as *Tellina prisca* (Hisinger), *Anatina sinuata* (Hall), and the species herein described. All the specimens I have seen are internal casts, and the characters of the hinge line, therefore, cannot be given. The form is irregularly ovate, compressed or sub-lenticular; one extremity larger than the other; beaks turned towards the larger end, which is, therefore,

supposed to be anterior. In all the species a concave depression commences on the umbones and extends downwards to the posterior ventral margin. A large sub-ovate muscular impression in the upper half of the posterior extremity.

Genotype.—Ilionia canadensis Billings, by subsequent designation of Whiteaves (1884).

Remarks.—Discussion of this genus is necessary because of the assignment to it of *Paracyclas ohioensis* (Meek) and other related forms by Pohl (1929*b*, pp. 69–70). It must be emphasized that the genus is not present in the Devonian rocks of Michigan, and probably is absent in the Devonian strata of other parts of North America.

Billings did not himself designate a type. Unless one was designated prior to Whiteaves' (1884, pp. 13–14) republication of Billings' description, the footnote which Whiteaves (1884, p. 13) added to the diagnosis of the genus may be construed as a type designation. It reads as follows: "As the original definition of this genus and of the *typical species* [*I. canadensis*] may not be readily accessible to the reader, they are reprinted here, with the figures which accompanied them." The italics and the insert have been added by me. I accept Whiteaves' type designation as valid. Two important characters of the genotype species are the "escutcheon" (lunule) mentioned by Billings and shown in his Figure 4 and the postumbonal sulcus shown in his Figure 3 as extending from the umbo to the posterior margin *in front of* the adductor muscle scar. The same characters are present in specimens of *Ilionia prisca* (Hisinger) from the Silurian of Gotland. I have no doubt that the two species are congeneric.

The types of *Ilionia canadensis* are recorded as missing in the type catalogue of the Geological Survey of Canada. I could not find any other material of this species in the collections of the Survey in December, 1947. In the absence of genotype material, some idea of the generic characters can be derived from *I. galtensis* Whiteaves, which Whiteaves (1884) assigned without doubt to this genus, and from *I. prisca* (Hisinger), which Billings considered as belonging to his genus. Whiteaves seems to have had Billings' type before him when he described *I. galtensis;* his discussion of this species and of *I. canadensis*, indicates that his concept of the genus was essentially that of Billings. Williams and Breger (1916, pp. 257–58) recognized *Ilionia* and noted that both *Platymermis* Nötling 1883 and *Prolucina* Dall 1900 may be synonyms.

The first paleontologist who recorded the genus from Devonian strata appears to have been Pohl. He stated (1929*b*, pp. 69–70) that the genus "was first described from Lower Devonian rocks of the Gaspé Peninsula by Billings in 1875." Pohl's statement in regard to the geologic occurrence of the genus is in error. Billings said that his type species was from the Upper Silurian rocks at Port Daniel on the Bay of Chaleurs, Quebec. An examination of the latest map of the area (McGerrigle, 1946, p. 46) shows only Ordovician, Silurian, and Carboniferous strata in the immediate vicinity of Port Daniel. Earlier reports by Schuchert and Dart (1926), Alcock (1935), and Kindle (1938) confirm the absence of Devonian rocks in the region of Port Daniel. Billings' type is unfortunately missing from the Geological Survey collections in Ottawa, but the evidence of geologic maps and reports leaves no doubt as to the accuracy of his original statement concerning the age of *Ilionia canadensis*.

I am concerned here only with the Michigan species which Pohl assigned to *Ilionia*. He said (1929*b*, p. 69): "Perhaps the most beautiful example is an undescribed species from the so-called Dundee with Manitoba affinities in the northern portion of southern peninsular Michigan." In this paper (pages 316–17) the species is described as new and made the type of a new genus. I believe that the genus *Ilionia* should be restricted to those species which fit Billings' diagnosis, that is the genotype, *I. canadensis; I. prisca* (Hisinger); and *I. galtensis* Whiteaves.

Genus *Paracyclas* Hall

Paracyclas Hall, 1843, *Geol. of N. Y.*, Pt. IV, Geol. Surv. Fourth District, p. 171.
Paracyclas Hall, 1885, *Nat. Hist. N. Y., Paleontol.*, Vol. V, Pt. II, p. xxxviii.
Paracyclas Beushausen, 1895, *Abhandl. der K. Preuss. Geol. Landesanstalt*, N. F., Heft 17, p. 164.
Paracyclas Williams and Breger, 1916, *U. S. Geol. Surv. Prof. Paper*, No. 89, p. 257.
Paracyclas Spriestersbach, 1920, *Jahrb. Preuss. Geol. Landesanstalt*, 1918, Band 39, Teil I, p. 2.

Description from Hall, 1885.—

Shell equivalve, sub-equilateral, sub-orbicular or broadly sub-elliptical. Anterior end regularly rounded; posterior end rounded or sub-truncate, somewhat more produced below than the anterior; beaks small and low, generally rising little above the hinge-line. Hinge-line short. Post-cardinal slope more or less defined by an

oblique furrow or depression, which sometimes leaves the extremity subalate. Surface concentrically striated; sometimes with strong concentric ridges marking the exterior. Structure of hinge not fully observed. Ligament supported on each side, internally, by a narrow plate, and leaving in the cast two diverging grooves, directed forward from the beak. Muscular impression on the post-umbonal slope. Pallial line parallel with and a little within the margin of the shell.

This fossil possesses many of the external characters of the finely striated forms of modern *Lucina*; and the distinguishing characters are not strongly marked.

The original specimen on which the genus was founded is somewhat vertically compressed; giving it an elliptical form. In well-preserved specimens the length is but little greater than the height. The genus is very distinctly limited, and usually easy of recognition among the Devonian forms of this class of fossils.

Genotype.—Paracyclas elliptica Hall, 1843, by monotypy.

Remarks.—The genus is here dated 1843, not 1869 as given by Williams and Breger. Hall did not give a generic diagnosis with his description of *Paracyclas elliptica* in 1843 (see page 309 for his original description) but he let it be understood that the genus was new when he wrote "Generic name from its similarity to the *Cyclas*." There is no doubt concerning the identity of the genotype because only *P. elliptica* is described and no other species is mentioned by Hall until much later. The type locality is also automatically designated for only "Le Roy, Genesee county" is mentioned. Since the description appears under "Organic Remains of the Corniferous Limestone" the geologic age of the species in question is fixed. It is evident that in spite of the absence of a generic diagnosis the genus was quite properly established according to the standards of the time.

Hall gave a generic diagnosis in 1885 (pp. xxxviii–xxxix), the one reproduced on pages 307–8. It will be noted that the generic concept is considerably broader than is necessary to accommodate the type species alone, probably to include *P. lirata* and *P. tenuis*, given as examples of the genus (p. xxxix), and also *P. ohioensis* (Meek) 1871 which Hall included in his genus. The inclusion of the last species may account for the statement that the shell is "sub-equilateral, sub-orbicular or broadly sub-elliptical" and that the post-cardinal slope is "more or less defined by an oblique furrow or depression, which sometimes leaves the extremity sub-alate." As will be shown later, *P. ohioensis* should not be left in *Paracyclas* and the characters of this species which Hall included in his description should be expunged from it.

Numerous European species have been assigned to *Paracyclas*. Beushausen (1895, p. 164, *et seq.*) recorded seven species, *P. marginata* Maurer, *P. proavia* (Goldfuss), *P. rugosa* (Goldfuss), *P. praecursor* Beushausen, *P. antiqua* (Goldfuss), *P. rectangularis* (Sandberger and Sandberger), and *P. dubia* Beushausen, from the Devonian rocks of the Rhineland. Many other European species have been referred to *Paracyclas*, but it seems unnecessary to list them here. *P. proavia*, *P. rugosa*, and *P. antiqua* are of special interest because they may be identical with or at least closely related to species described from North America.

According to Beushausen (1895, p. 169, *et seq.*), *P. elliptica* Hall is a synonym of *P. proavia* (Goldfuss), *P. lirata* Conrad a synonym of *P. rugosa* (Goldfuss), and *P. ohioensis* (Meek) a synonym of *P. antiqua* (Goldfuss). The relationships of these species will not be discussed except for *P. proavia* which is thought to be present in the Devonian strata of Michigan (see page 312). The proper specific name to be applied to the genotype is discussed under *P. elliptica* Hall, page 310.

Paracyclas elliptica Hall

(Pl. XII, Figs. 1–7)

Paracyclas elliptica Hall, 1843, *Geol. of N. Y.*, Pt. IV, Geol. Surv. Fourth District, p. 171.

Paracyclas elliptica Hall, 1885, *Nat. Hist., N. Y., Paleontol.*, Vol. V, Pt. II, p. 440 (in part), Pl. 72, Figs. 25–26.

Original description from Hall, 1843.—

Shell broad oval; beaks scarcely prominent; surface marked by concentric lines; valves equally convex; very much elevated on the umbones. Shell the size of the figure, and larger; it is readily distinguished by the figure alone.

I am indebted to Dr. Everitt, of Batavia, for specimens of this fossil.

Generic name from its similarity to the *Cyclas*.

Remarks.—Through the courtesy of Dr. Norman D. Newell, I was able to examine some of the types on which this species is based. Type No. $\frac{4002}{2}$ 25, 26 American Museum of Natural History (Pl. XII, Figs. 1, 2) corresponds in every respect with the original figure of Hall (1843, p. 171), except that Hall's illustration shows the growth lines as much more distinct and regular than they are in the specimen. The specimen was refigured by Hall (1885, Pl. 72, Figs. 25, 26). Its dimen-

sions are: length 27 mm., height 20.5 mm., thickness 14.5 mm. A label attached to the specimen reads: "Lucina proavia, Corn. Leroy." This specimen is regarded as the holotype, because it was designated, among others numbered $\frac{4002}{2}$, $\frac{4002}{1}$, and $\frac{4002}{4}$ by Whitfield and Hovey (1900, p. 298) as "Gen. and Sp. Type" and is the only one which corresponds to Hall's original figure. The specimen numbered $\frac{4002}{2}$ 30, carries the label "Lucina proavia, New York, Corn. Leroy" and is a hypotype illustrated by Hall (1885, Pl. 72, Fig. 30). It is 32 mm. long, 12 mm. high, and 12.5 mm. thick. Specimen No. $\frac{4002}{1}$ 29, is labelled "Lucina proavia, W. New York" and bears a green ticket with the numeral 29, which refers to Figure 29, Plate 72 of Hall's 1885 paper. This specimen, a hypotype, is 44.5 mm. long, 40 mm. high, and 20 mm. thick. Another specimen under No. $\frac{4002}{1}$ 23, is labelled "Lucina proavia, Clarence, N. Y." and bears a green ticket with the number 23 which refers to Figure 23, Plate 72 of Hall's 1885 publication. This hypotype is 29.5 mm. long, 28 mm. high, and 14.5 mm. thick.

Hall's original concept of the species was not quite the same as that which he had when he wrote the description published in 1885 (see pages 307–8). Unless further material from the type locality proves otherwise, it is possible that Hall's holotype may not be conspecific, perhaps not even congeneric, with the specimens generally identified as *P. elliptica.*

Beushausen (1895, p. 171) had already pointed out that *P. elliptica* is very close to if not identical with *P. proavia* (Goldfuss). My opinion is that the majority of the specimens identified in North America as *P. elliptica* belong to *P. proavia.* Hall's hypotype No. $\frac{4002}{1}$ (23), if among German specimens, would easily pass as a young specimen of *P. proavia.* Absolute identity of specimens of *Paracyclas* with the holotype cannot be established because the holotype may have been crushed. If *P. elliptica* is to be considered distinct from *P. proavia,* the name *P. elliptica* must be restricted to forms agreeing with the holotype.

The situation is further complicated because the name *"elliptica"* in the genus *Paracyclas* is preoccupied. Williams and Breger (1916, p. 257) have pointed this out and suggested that *P. occidentale* Hall and Whitfield 1872 be employed instead. This name is also preoccupied by *P. elliptica occidentale* (Billings) 1859. The species may, however,

be called *Paracyclas occidentalis* (Billings) 1859, if Billings' specimens are conspecific with Hall's holotype.

In view of this uncertainty, I prefer to identify as *P. proavia* (Goldfuss) all specimens which can be referred to that species with a reasonable degree of certainty. The question of the status of the species from the Onondaga of Leroy, New York, is one which can be answered only by further study on abundant material. Until the uncertainties in regard to the specific name have been cleared up, I shall retain the name *Paracyclas elliptica* Hall for Hall's holotype.

Occurrence.—"Corniferous limestone," Le Roy, Genesee County, New York (type locality). This species has been recorded from many Devonian formations of Michigan, yet no specimen of *P. elliptica*, as restricted above, has been seen by me from Devonian strata of this state.

Types.—Holotype, American Museum of Natural History, No. $\frac{4002}{2}$ 25, 26; hypotypes, doubtfully of this species, American Museum of Natural History $\frac{4002}{2}$ 30, $\frac{4002}{1}$ 29, $\frac{4002}{1}$ 23.

Paracyclas proavia (Goldfuss)

(Pl. XII, Figs. 8–12; Pl. XIII, Figs. 1–2)

Lucina proavia Goldfuss, 1834–40, *Petrefacta Germaniae*, II, p. 226, Pl. 146, Figs. 6a, 6b.

Paracyclas proavia Beushausen, 1895, *Abhandl. der K. Preuss. Geol. Landesanstalt*, N. F., Heft 17, p. 169, Pl. XV, Figs. 1–2.

Paracyclas elliptica auct., non Hall, 1843.

Original description from Goldfuss, 1834–40.—

Lucina testa suborbiculari convexa, umbonibus antemedianis, margine cardinali recto horizontali antice subproducto excavato, lineis striisque concentricis irregularibus. E Montibus Eifeliae. M. B. ——— Convex, fast kreisrund, indem nur der obere Theil des Kreises durch den geraden, horizontalen Schlossrand abgeschnitten ist. Dieser verlängert sich nach vorn über die kurzen, vor der Mitte liegenden Wirbel hinaus, und ist unmittelbar vor ihnen etwas eingedrückt. Die Steinkerne, welche häufiger vorkommen als die erhaltene Schale, haben eine glatte, schwach gerunzelte Oberfläche, die Schale aber zeigt zahlreiche und unregelmässige concentrische Linien und Streifen. Findet sich in der Eifel und bei Bensberg.

Remarks.— Beushausen (1895, p. 171) said of this species:

P. elliptica aus dem Corniferous Limestone und der Hamilton Group Nordamerikas steht unserer Art nach den Abbildungen Hall's und einem mir vorliegenden

Exemplar ausserordentlich nahe und ist vermuthlich ident, wie schon de Verneuil angenommen hat, wenn Hall auch den öhchenförmig vorspringenden Vorderand und stärker abfallenden Schlossrand von *P. proavia* als Unterschiede hervorhebt.

Occurrence.—The species was originally recorded from the Eifel and "bei Bensberg." Subsequently, Beushausen (1895, p. 171) gave the following more precise data on its occurrence: "Calceola-Schichten und Stringocephalenkalk. Gerolstein, Kerpen, Soetenich, Paffrath, Lustheide bei Bensberg, Waldbroel, Karlsbach, Rospe."

Specimens indistinguishable from *P. proavia* occur in many formations at numerous localities in North America, notably in the Silver Creek limestone of Indiana where the remarkably good preservation of the specimens leaves no doubt as to their identity. Whiteaves (1892, pp. 306–7) recorded a *Paracyclas* sp. from the Middle Devonian Stringocephalus zone of Manitoba which he said was larger than *P. elliptica*. In my opinion this specimen is a poorly preserved example of *P. proavia* (Goldfuss). The specimen which Pohl (1929*b*, p. 71, Pl. 14, Figs. 19, 20) distinguished as *P. elliptica incerta* Pohl is probably conspecific with *P. proavia*.

In Michigan, the species is doubtfully identified from the Bois Blanc formation, localities 11 and 13. It is abundant in the Dundee limestone, localities 28, 33, 34, 35, 36, 37, 38; and in the Rogers City limestone, localities 40, 41, 44, 48, 49, 50, 51, 52, 53, and 54.

Types.—Hypotypes Nos. 15274, 24429, 24430, 24427, and 24428.

Phenacocyclas, gen. nov.

Description.—Shell equivalve, irregularly rhomboid. Exterior, known only from young individuals of the genotype species, with a prominent sulcus extending from the umbo to the middle of the posterior part of the ventral margin, concentrically striate, without radial ornamentation; anterior border irregularly plicate. Hinge line straight, short, about one-third the length of the shell; escutcheon narrow, lunule small. Umbones small, moderately convex, marked with sharp, distinct, evenly spaced concentric lines of growth. Ventral margin irregularly rounded, posterior part of ventral margin with a strong notch. Anterior half of each valve larger than the posterior one. Interior of each valve with two adductor scars extending from just below the hinge line well into the ventral third of the valve; posterior muscle scar

deeper but narrower than the anterior muscle scar; both with fine radiating and concentric striae. Interior of both valves with a group of prominent, irregular, sigmoid, widely spaced grooves in the area between the muscle scars, and a second group of smaller, arcuate grooves extending from just in front of the anterior adductor muscle scar to just beyond its posterior margin. Umbonal cavity small, shallow, sharply delimited behind by a thickening of the valves, rounding evenly into the valve in front. Pallial line distinct, simple, closely paralleling the margin of the valve, prolonged well beyond the posterior adductor muscle scar. Hinge imperfectly known but of only moderate width, extending from directly above the anterior adductor muscle scar to directly above the posterior one. Teeth imperfectly shown, probably one small anterior lateral. Cardinal teeth not seen, presumably small.

Genotype.—Phenacocyclas pohli, sp. nov.

Remarks.—Representatives of *Phenacocyclas* may prove to be numerous for they are quite easily mistaken for distorted specimens of *Paracyclas*. The distinctive structures of the interior, however, permit an easy separation of these pelecypods from species of *Paracyclas*.

In addition to the genotype, the species described by Webster as *Paracyclas validalinea* from the Upper Devonian Hackberry formation of Iowa is referred to the new genus. Webster's figures (Fenton and Fenton, 1924, Pl. 33, Figs. 1, 2) illustrate a poorly preserved internal mold of a specimen. The characters of this and of other internal molds in the Walker Museum, University of Chicago, and the Museum of Paleontology, University of Michigan, clearly indicate that the species belongs to *Phenacocyclas*. None of the specimens of *Phenacocyclas validalinea* available to me exhibits the external characters of the valves. *Paracyclas parvula* Fenton and Fenton (1924, pp. 173–74, Pl. 33, Fig. 3) is perhaps the young of *P. validalinea*.

Paracyclas ohioensis (Meek) and *P. antiqua* (Goldfuss), regarded by certain workers, especially Beushausen (1895, p. 173) and Whiteaves (1892, p. 305), as identical may belong in *Phenacocyclas*. I have seen three specimens of *Paracyclas ohioensis*. One (Pl. XIII, Fig. 3), which was located by Dr. Norman D. Newell in the collections of Columbia University, is numbered 12113G (Columbia University catalogue) and starred as a type. The dimensions are 12 mm. in length, 10.5 mm. in

height, and 5.5 mm. in thickness. The specimen consists of the exterior of the left valve and the umbonal region of the right. The remainder of the right valve is probably present but is covered with matrix. The external characters are similar to those of the young of *Phenacocyclas pohli* except for a somewhat less definite posterior sulcus. Unless some other specimen has been designated as the lectotype of *P. ohioensis*, this can be considered as such. It is from the type locality, Dublin, Ohio. The other two specimens, in the collection of the Walker Museum of Paleontology, University of Chicago, kindly lent me by Dr. J. Marvin Weller, are from the "Hamilton" of the Falls of the Ohio. Until the internal characters of the species are better understood, *Paracyclas ohioensis* can be referred only with doubt to *Phenacocyclas*. If left there, whether the species would be called *Phenacocyclas? ohioensis* (Meek) or *P.? antiqua* (Goldfuss) cannot be decided at present. The final disposition of *Paracyclas ohioensis* must wait further study on abundant material of both species.

Phenacocyclas differs from *Ilionia* Billings in shape and in the position of the anterior muscle scar and the posterior notch. No other genus of Paleozoic pelecypods studied by me has the remarkable arrangement of characters exhibited by *Phenacocyclas*.

Phenacocyclas is assigned to the family Lucinidae. Although its relationships to the modern genera of this family are somewhat doubtful, because of lack of complete information on the teeth, some interesting comparisons between *Phenacocyclas* and certain of these can nevertheless be made. The classification followed is that of Johnson (1934, pp. 41–43) for the Lucinidae of the Atlantic Coast of North America. *Phenacocyclas* resembles especially the subgenera *Anodontia* Link and *Pseudomiltha* Fischer of the genus *Lucina* Bruguière, and the subgenus *Jagonia* Recluz of the genus *Codakia* Scopoli. The resemblance to three species, *Lucina* (*Anodontia*) *jamaicensis* Lamarck, *L.* (*Pseudomiltha*) *floridana* Conrad, and *Codakia* (*Jagonia*) *orbiculata* (Montagu), is most striking. All three possess concentric but not radial sculpture, a posterior sulcus, a notch in the internal mold of the valves at the ventral termination of the sulcus, a small lunule, and muscle scars which are strikingly similar to those of *Phenacocyclas*. If these species were found in the Paleozoic, they probably would be classed in a single

genus with representatives of the genus *Phenacocyclas*. The separation of the modern genera is based on characteristics of the soft parts, not available for *Phenacocyclas*, but the shell differences between them would give sufficient grounds for the segregation of *Phenacocyclas* as a distinct genus. All three modern species mentioned differ from *Phenacocyclas* in not possessing the internal grooves and external plications of this genus. Possession of these characters also appears sufficient to separate *Phenacocyclas* from other genera of the Lucinidae.

Phenacocyclas is distinct from other Paleozoic genera of the family Lucinidae. From *Paracyclas* it differs externally in having a strong posterior umbonal sulcus and internally in the relative strength, shape, and arrangement of the adductor scars, the presence of the posterior notch, and the internal grooves of the valves. From *Crassatellopsis* Beushausen it differs in the much smaller size of the hinge teeth—so large in Beushausen's genus as to have led him to compare it with members of the Astartidae. The same smaller size of the hinge teeth separates it from *Montanaria* Spriestersbach.

What the significance of the two sets of subparallel grooves in the interior of the shell is, presents an interesting problem. Similar closely spaced grooves in the shell, located over the gills of the living animal, sometimes appear in the females of the Naiades. In these they are the result of the distortion of the shell-secreting portions of the mantle by the marsupial gills which are much swollen during the development of the glochidia. The occurrence of grooves of this particular kind in the shell of the Naiades is an unusual occurrence, but in *Phenacocyclas* the grooves appear on most of the specimens examined and are thought to be a generic character. In this genus they could be thought of as caused by a swelling of the gills in the female. The grooves bear no relation to either a radial or concentric pattern of ornamentation, for their arrangement accords with neither pattern. If this unusual set of grooves is an internal expression of the ornamentation of the exterior of the shell, members of *Phenacocyclas* must have had a pattern almost unique in pelecypods but comparable to that of certain genera of Naiades such as *Quadrula*, *Amblema*, and *Lasmigona*. It must be noted, however, that in these Naiades the plications are but faintly expressed on the internal surface of the shell.

Phenacocyclas pohli, sp. nov.
(Pl. XIII, Figs. 4–7; Pl. XIV, Figs. 1–6; Pl. XV, Figs. 1–7)

Description.—Shell equivalve, irregularly rhomboid in outline, with a large notch within the lower third of the posterior border; anterior half of each valve larger than the posterior half, greatest convexity just below the umbones. Exterior of each valve with a strong sulcus extending from behind the umbo to the middle of the posterior margin; concentric lines of growth sharp and distinct in the umbonal region, becoming progressively blunter and finer toward the ventral border; no radial ornamentation; anterior border irregularly plicate, almost from the beginning. Hinge line straight, short, about one-third the length of the shell; escutcheon very narrow, lunule very small. Umbones small, moderately convex, marked with sharp, distinct, evenly spaced concentric lines of growth.

Interior of each valve with two strong adductor scars extending from just below the hinge line well into the ventral third of the valve; posterior muscle scar deeper but narrower than the anterior one; both with fine radiating and concentric striae. Interior of each valve with a group of strong, irregular, sigmoid, distant grooves in the area between the muscle scars, and a second group of smaller, arcuate grooves extending from just in front of the anterior adductor muscle scar to just beyond its posterior margin. Umbonal cavity small, shallow, sharply delimited behind by a thickening of the valves, rounding evenly into the valve in front. Pallial line distinct, simple, closely paralleling the margin of the valve, prolonged well beyond the posterior adductor scar. Hinge imperfectly known; in some specimens (Plate XV, Fig. 1) part of the hinge margin appears as a faintly impressed narrow band, showing that the hinge is of moderate width, extending between points just above the anterior and posterior muscle scars. An indistinct, shallow pit, possibly the impression of a weak lateral tooth, is at the end of the anterior groove. Cardinal teeth not shown in any specimen examined; if present they cannot be large, judging by the small amount of space available for them under the very low umbones.

Remarks.—*Phenacocyclas pohli* is distinct from *P. validalinea* (Webster) but congeneric with it. *P. pohli* was designated as the type of the genus because the excellent preservation of the material brings out the generic characters more clearly.

Pohl placed the form here called *P. pohli* in the genus *Ilionia* Billings. It cannot be placed in that genus for the following reasons: (1) *P. pohli* has a peculiar, prominent system of grooves on the interior of the shell, not shown in *Ilionia*; (2) *P. pohli* has the post-umbonal sulcus behind the posterior adductor scar, *Ilionia* in front of it; (3) *P. pohli* has an almost indistinguishable escutcheon, *Ilionia* a moderately large one; (4) in *P. pohli* the height and length are subequal, in *Ilionia* the length is almost twice the height.

Phenacocyclas pohli has not been found in the Eifelian of Germany or the Stringocephalus zone of Manitoba, deposits which contain representatives of many species occurring in the Rogers City limestone.

The species is named in honor of Dr. Erwin R. Pohl, as recognition that he was the first, in his fine work on the Devonian pelecypods of Wisconsin (1929*b*), to remove the species from the genus *Paracyclas*.

Occurrence.—Dundee limestone; localities 28, 35, and 36. Rogers City limestone; localities 44, 48, 49, 50, 51, 52, 54, and 55.

Types.—Holotype No. 24401; paratypes Nos. 24402 to 24412 inclusive, and 24419.

FAMILY CONOCARDIIDAE

Genus *Conocardium* Bronn

Conocardium Bronn, 1835, *Lethaea Geognostica*, Vol. I, p. 92.

Revised diagnosis.—Shell equivalve, thick and gibbous, subcylindrical to short cuneate. Anteriorly more or less alate, gaping ventrally, posteriorly truncate, the margin of the truncation prolonged into a scooplike hood in some, perhaps in all, species. Outer surface with coarse concentric lines of growth overlying prominent ribs crossed by fine transverse growth lines between the ribs. Hood ventrally continuous with the outer layer of the shell, dorsally striate, the striations prolonged on the posterior truncation of the shell. Hinge line long, straight. Umbones situated in the posterior third of the body of the shell, not swollen, their ornamentation continuous with that of the body of the shell. Ventral margin straight or distinctly rounded, curving into the anterior alation and continuing unchanged on the hood. Posterior margin crenulate, the denticulations formed by interlocking ribs of the shell and masked by an overlay of the hood,

prolonged near cardinal margin to form a posterior tube. Ligamental area a large depression, groovelike anteriorly, widely ovate posteriorly. Muscle scars and pallial line imperfectly known. Hinge with a single lateral tooth; an obscure cardinal tubercle present in some specimens.

Genotype.—Conocardium hibernicum Sowerby, by subsequent designation.

Remarks.—Many contradictory statements in regard to the structure and orientation of the shell of *Conocardium* have been made. The resulting controversy need not be reviewed in detail here; much information concerning it will be found in the works of Barrande (1881), Neumayr (1891), Beushausen (1895), and more recently of Branson (1942). The exceptionally well-preserved material from the Devonian of Michigan examined during the course of this study has shed some light on the structural characteristics of the genus but falls far short of providing a solution to all of the problems concerning its morphology. A discussion of the latter is reserved for a later paper. The orientation of the shell advocated by Branson (1942) is adopted in the description of the following species.

Conocardium sibleyense, sp. nov.

(Pl. XV, Figs. 8–16)

Description.—Shell equivalve, small. Anterior half constricted both laterally and vertically, producing a nasute extension; anterior part gaping ventrally. Posterior half truncate, truncate part convex and prolonged into a tube continuous with the cardinal margin. Shell apparently without hood. Surface with low ribs, about twenty-two on the anterior half and about fourteen on the posterior half of the shell. Hinge line straight, as long as the shell. Umbones anterior, small, moderately convex, their ornamentation like that of the remainder of the shell. Ventral margin evenly rounded, curving abruptly into the anterior constriction and the posterior tube. Ligamental area wide. Interior with strong ribs corresponding in position to the external ones but much thicker. Spaces between the ribs with concentric lines which are in line with each other between the several ribs but do not appear on the internal surface of most of the ribs themselves.

Dimensions of the holotype, length 15 mm., height 9 mm., thickness 7 mm.

Remarks.—The species is represented by over fifty specimens, all from the same locality, preserved as calcareous replacements. The internal cavity in most specimens was devoid of matrix and good rubber molds were obtained from it.

There is a possibility, suggested by the fact that all specimens are small and all lack the hood, that these specimens may be immature individuals of another species. They do, however, possess characters that distinguish them from most members of the *Conocardia* of the Middle Devonian of North America with which they have been compared.

Since the species may be represented by immature specimens only, the factor of size has been discounted in making comparisons. *C. sibleyense* is more convex posteriorly than *C. plinthinatum, subtrigonale,* and *crassifrons;* more constricted anteriorly than *C. monroicum, normale, parvulum, bellum, cuneus, tripartitum, cumberlandiae, ventricosum, ohioense, aurilum, semiplenum,* and *vomer;* proportionally higher than *C. eboraceum;* has different proportions of length to height and thickness from *C. ventriculosum;* is more ventricose than *C. concinnum;* more heavily ribbed anteriorly than *C. inceptum* and *emmettense;* possesses more posterior ribs than *C. denticulatum, bifarium, incarceratum,* and *liratum;* lacks the intercalated ribs of *C. gowandense;* and has a rib pattern different from that of *C. intersculptum.*

Occurrence.—Detroit River group, "Anderdon limestone" of Bassett (1935, p. 430); locality 17.

Types.—Holotype No. 24471; paratypes Nos. 24472 to 24478 inclusive, 24630, and 24631.

Conocardium cuneus (Conrad)

(Pl. XVI, Figs. 1–4)

Pleurorhynchus cuneus Conrad, 1840, *Ann. Rept. N. Y. Geol. Surv.*, Vol. 4, p. 206.
Conocardium cuneus Hall, 1885, *Nat. Hist. N. Y., Paleontol.*, Vol. V, Pt. I, Lamellibr., II, p. 409, Pls. 67, 68, 94.

Description from Hall, 1885.—

Shell large, angularly sub-ovate, or trigonal in outline; length less than twice the height; basal margin gently curving from the post-inferior extremity to the anterior end. Posterior extremity abruptly truncate, produced into a tubular extension along the cardinal line. Cardinal line straight, margins inflected toward the anterior end.

Anterior end more or less rapidly attenuate, with the margins gaping before reaching the extremity. Valves gibbous. Beaks subcentral, vertical, prominent and closely incurved over the hinge-line. Umbonal slope angular, usually strongly defined, extending to the post-inferior extremity. Post-cardinal slope flat or concave. Test thick, composed of two distinct layers. Surface marked by numerous radiating plications and intermediate arching lamellose, concentric striae on the body of the shell. The posterior slope is ornamented by curving radii, extending from the beak to the posterior margin, with the interspaces marked by transverse lamellose striae. From the entire periphery of the umbonal ridge there extends a finely striated expansion of the shell, which increases in extent from the beaks downward, and in old shells is supported anteriorly by a thickening of the shell along the basal margins, which often obliterates the radii. At the junction of these thickened portions, along the base of the valves, the shell is excavated, leaving a tubular opening extending backward from the post-inferior extremity, as shown in figs. 27, 29, and 52 of plate lxvii, and more fully in fig. 12 of plate xciv.

Valves crenulated along their margins. Anterior muscular impressions elongate, deeply impressed, narrower behind. Four specimens measure respectively 60, 47, 43, and 21 mm. in length, and 30, 33, 26, and 13 mm. in height.

Remarks.—The well-preserved specimens from the Dundee limestone possess specific characters which indicate that they belong to a single species. They are undoubtedly specifically identical with the ones identified as *C. cuneus* from the Dundee limestone of northwestern Ohio, all of which in turn agree well with the description of *C. cuneus*. In the past some of these specimens have been referred doubtfully to *C. subtrigonale*, but I find it impossible to do this. Further study based on good specimens from the type locality may reveal that Conrad's original *C. cuneus* was a species of restricted distribution and different from the forms usually referred to it from the Columbus limestone of Ohio and the Dundee limestone of Michigan. Until such material is forthcoming the Michigan specimens are best referred to *C. cuneus*.

Drift material from Michigan has been referred to *C. subtrigonale* (Branson, 1942, Fig. 1), but this originated far from the places where it was collected and the presence of *C. subtrigonale* in place in the Devonian of Michigan is not proved.

Occurrence.—Schoharie grit, New York (types); reported from the Jeffersonville limestone and the Pendleton sandstone of Indiana; Oriskany sandstone, Delaware limestone, and Springvale sandstone of southern Ontario; Devonian sandstone at Rolla, Missouri; Grand Tower limestone at Grand Tower, Jackson County, Illinois; Grande

Grève limestone of the Gaspé Peninsula, Quebec; doubtfully from the Salmontrout limestone of the Yukon district, Canada (Branson, 1942); Columbus and Delaware limestones of central Ohio (Stauffer, 1909); and Jeffersonville limestone of Kentucky (Butts, 1931). In Michigan, it has been found in the Dundee limestone, localities 28, 29, 30, 31, and 32.

Types.—Hall's hypotypes are in the New York State Museum (Catalogue Nos. 2308–2316), the American Museum of Natural History (Catalogue No. 2852/1), and the Walker Museum of the University of Chicago (Catalogue No. 12502). Hypotypes from Michigan are Nos. 1799, 7022, 24480, and 24628.

Conocardium monroicum Grabau

(Pl. XVI, Figs. 5–6; Pl. XVII, Figs. 1–5)

Conocardium monroense Sherzer and Grabau, 1909, *Geol. Soc. Amer. Bull.*, Vol. 19, pp. 547–48, 550; *nomen nudum.*

Conocardium monroicum Grabau and Shimer, 1909, *North Amer. Index Fossils*, Vol. I, p. 438; *nomen nudum.*

Conocardium monroicum Grabau, 1910, *Mich. Geol. and Biol. Surv. Publ.*, 2, Geol. Ser. 1, pp. 171–73, Pl. 16, Figs. 1–3; Pl. 20, Figs. 14, 15; Pl. 22, Fig. 3.

Conocardium monroicum Branson, 1942, *Type Invert. Fossils of N. Amer. (Devonian)*, Conocardiidae, card 19.

Revised description.—Shell equivalve, medium to large, abruptly truncated posteriorly, alate and ventrally gaping anteriorly. Beaks low, directed obliquely backward. Anterior alation separated from the anterior slope by a slight constriction, marked by four or five low ribs. Anterior slope low, marked by ten rounded ribs. Body distinct, marked by ten strong ribs of equal prominence. Posterior body rib flat, supporting the hood, shell thick and cellular in this area. Hood large, extending from the ventral margin of the valve to the umbo. It forms a cylindrical, slightly flaring sheath, at least half as long as the body of the shell and probably much longer. Hood longitudinally striate, the striations stronger near the posterior body rib. Posterior slope concave near the posterior body rib, becoming slightly convex as it narrows toward the cardinal margin to form a comparatively small, round posterior tube. Posterior slope marked by eight to ten narrow ribs which are crossed by fine transverse striae continuing on

to the surface of the hood. Interior of the valves distinctly ribbed, ventral margin sinuous, but without strong denticulations. Ligamental area (Plate XVII, Fig. 2) a large depression, groovelike anteriorly, ovate posteriorly, and longitudinally striate.

Dimensions of two specimens, the types, are as follows: lectotype, length 20 mm., height 22 mm., thickness 28 mm.; paratype No. 14017, length 14 mm., height 21 mm., thickness 14 mm. Other paratypes are too crushed to give significant measurements.

Remarks.—The revised description of this species is based on Branson's (1942), but has been expanded to include the data supplied by new material not available to Branson or Grabau. The species is now known from an abundance of specimens which give a good idea of all its characters except the muscle scars and the dentition.

Grabau (1910, p. 172) stated that the species is closely related to *Conocardium cuneus* var. *nasutum* Hall, from which he distinguished it especially by the character of the surface ornamentation. It differs from that variety also in the much greater obliquity of the posterior slope, as shown in well-preserved specimens.

Occurrence.—Detroit River group: Sylvania sandstone, northwestern Ohio (Carman, 1936, p. 261); Anderdon limestone, locality 18; Amherstburg dolomite, localities 19, 20, 21, 22, 23; Lucas dolomite, localities 24, 25, and 26.

Types.—Lectotype No. 14018; paratypes Nos. 13065, 13075, 13084, 14017, 14020; hypotypes Nos. 24522, 24523, 24524, 24526, and 24529.

Conocardium sp. A

(Pl. XVII, Fig. 6)

The Rogers City limestone yielded a few poorly preserved small specimens of species of *Conocardium*. One specimen, which resembles *C. armatum* (Sandberger and Sandberger), is from Unit 10 (Ehlers, 1945, p. 114), at locality 49. Another small specimen, from the same unit at Adams Point, locality 48, shows a badly exfoliated left valve of about the same size as the preceding specimen but too poorly preserved for definite comparison. Two other small poorly preserved specimens are from the upper part of the Rogers City limestone at locality 54.

Conocardium sp. B

Two poorly preserved specimens of a small species of *Conocardium* were obtained from the lower 35 feet of the Dundee limestone in the Michigan Limestone and Chemical Company quarry, Rogers City, Michigan, locality 36.

Conocardium sp. C

Several poorly preserved specimens of a large species of *Conocardium* were found in the Bois Blanc formation. On size alone they are judged to belong to the *C. cuneus* group.

Occurrence.—Bois Blanc formation, localities 4, 5, 6, 7, 9, 11, 13, 14, and 15.

FAMILY PRAECARDIIDAE

Genus *Panenka* Barrande

Panenka Barrande, 1881, *Système silurien du centre de la Bohême*, Vol. 6, pp. 128–29.

Description translated from Barrande, 1881.—

The general outline of the shell varies between transverse forms and rarer, elongate ones. In spite of the great number of specimens, which represent this genus in our collection, we have been unable to discover a single one in which the two valves are preserved together. Rev. Father J. Almeira, . . . has been more fortunate, for he has found in Catalonia a fragment which shows the cardinal region with the two valves in place. . . . From this specimen, it will be seen that the two valves are equal and similar in the genus *Panenka* and that the beaks are concordant. All the isolated valves are inequilateral, but in very different degree. Some, whose shape is subcircular, seem almost equilateral. On the contrary, in others, which are more or less transverse, there is great inequality in the development of the two halves. We cite as examples *Panenka patiens* Barr. and *Pan. macilenta* Barr., Pl. 307. We note that the latter may be considered as the extreme limit in inequality of halves. In no species is there the appearance of a lunule, but in some forms the conformation simulates a little lunule besides the beak. Ex.: *Panenka lunulifera* Barrande, Pl. 320. The hinge is very diverse, either as a straight, horizontal line, or as a more or less obtuse angle. The hinge may be very reduced, or very long, according to the general form of the shell. . . . The umbones are always very distinct and project more or less above the hinge line. There is no distinct area, but in certain species, under the beak, there is a ligamental groove. The surface of the valves, in all the species, is ornamented with radiating costae, more often than not distinct from the beak to the margin. When the test is preserved, growth lines or transverse striae may be observed, crossing the costae and the adjacent grooves. They are of very

variable appearance. The internal mold usually preserves the imprint of the longitudinal costae, that is those radiating from the beak to the margin. It also frequently shows traces of the transverse ornamentation. On its surface there is no trace of muscle scars or pallial line. This leads one to believe that the shells grouped under the genus *Panenka* had but a slight thickness.

Genotype.—Panenka bohemica Barrande.

Panenka grandis Whiteaves

(Pl. XVIII)

Panenka grandis Whiteaves, 1891, *Can. Record Sci.*, Vol. 4, pp. 401–4, Pl. 1.

Description from Whiteaves, 1891b.—

Shell very large, attaining to a length of from six to nine inches, strongly compressed at the sides, though perhaps abnormally so, subovate in marginal outline, about one-third longer than high and highest posteriorly, the greatest height, exclusive of the beaks, being at or near the posterior termination of the cardinal border. Anterior side produced and somewhat pointed, its outer margin sloping obliquely and rapidly downward from the cardinal border above, and forming a rather narrowly rounded junction with the ventral margin below: posterior side about equal to the anterior in length, but broader in the direction of its height and much more broadly rounded at the end: ventral margin moderately convex and most prominent posteriorly, nearly straight but ascending very gradually in the centre and anteriorly: superior border nearly straight or but slightly convex on each side of the beaks, curving gradually and somewhat convexly downward at each end, but rather more rapidly so at the posterior end than at the anterior: umbones oblique, prominent, central: beaks curved inward and a little forward. Surface marked by from thirty-five to forty large, simple and rounded radiating ribs, which are nearly straight anteriorly, but slightly curved in the centre and posteriorly, also by numerous and unequal concentric lines of growth. In some specimens an occasional intermediate and very much smaller rib is developed between two of the larger ones. Characters of the interior of the valves unknown.

Remarks.—A single much worn internal mold of a left valve from the Dundee limestone of Sibley quarry, Wayne County, Michigan, is referable to this species. It is 152 mm. long, 106 mm. high, and 22 mm. thick. The specimen agrees with Whiteaves' holotype in size, outline, and in the size and spacing of the radiating plicae.

Occurrence.—"Corniferous limestone" (probably Dundee limestone) at St. Mary's Ontario (Whiteaves); Dundee limestone, locality 28.

Panenka canadensis Whiteaves

(Pl. XVII, Fig. 7)

Panenka canadensis Whiteaves, 1902, *Ottawa Naturalist*, Vol. 15, pp. 263–65, Pl. 15, Figs. 1–2.

Panenka canadensis Sherzer and Grabau, 1909, *Geol. Soc. Amer. Bull.*, Vol. 19, pp. 548, 550.

Panenka canadensis Grabau, 1910, *Mich. Geol. and Biol. Surv. Publ.*, 2, Geol. Ser. 1, pp. 163–64, Pl. 22, Figs. 1, 2.

Description from Whiteaves, 1902.—

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 in others. Test unknown; surface of the cast 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 occasionally 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 the 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.

Remarks.—The mold of the interior of an incomplete left valve, No. 13079 (Pl. XVII, Fig. 7), which was illustrated by Grabau in his Plate 22, Figure 1, is in the collections of the University of Michigan. It measures 56 mm. in length, 53 mm. in height, and 21 mm. in thickness; the length of the valve when complete probably was about 67 mm.

Occurrence.—Detroit River group, Amherstburg dolomite, locality 21; Lucas dolomite, locality 25.

Type.—Hypotype No. 13079.

Panenka coralliophila, sp. nov.

(Pl. XIX, Fig. 1)

Description.—Species known only from an internal mold of one right valve. Shell large, longer than high, with anteriorly placed, high umbones; valves moderately convex. Surface with regularly spaced, subequal radiating plicae, the interspaces a little narrower than the plicae. Umbo large, very convex, projecting far above the cardinal margin, slightly inclined forward. Hinge line slightly curved, relatively short. Ventral margin regularly rounded, posterior part not preserved. Ligament, dentition, and muscle scars not preserved.

Dimensions of the holotype, length 77 mm., height 68 mm., thickness (of right valve) 14 mm.

Remarks.—Although represented only by a mold of one right valve, this species cannot be identified with any other North American species. It is more elongate and has larger umbones than *P. dichotoma* Hall and *P. alternata* Hall; the umbones are placed farther forward and the ribs are of a different character from those of *P. lincklaeni* (Hall); it differs from *P. canadensis* Whiteaves in its more elongate outline and larger umbones, and from *P. grandis* Whiteaves in having more anteriorly placed umbones which are relatively larger.

Occurrence.—Bois Blanc formation, upper part, bioherm core, locality 13.

Type.—Holotype No. 24594.

Panenka sp.

(Pl. XIX, Fig. 2)

A single incomplete mold of a large specimen was collected from the Bois Blanc formation at locality 15. The few characters shown indicate that this specimen does not belong to *P. coralliophila;* it has a rounder outline and less pronounced radiating plicae with narrower interspaces. The umbonal region is not preserved, so it is impossible to compare it with that of *P. coralliophila.*

Dimensions of the specimen, length 85 mm., height 77 mm., thickness 24 mm.

Occurrence.—Bois Blanc formation; locality 15.

Figured specimen.—No. 24595.

FAMILY SOLENOPSIDAE

Genus *Solenomorpha* Cockerell

Solenopsis McCoy, 1844, *Synopsis of the Characters of the Carboniferous Limestone Fossils of Ireland*, p. 47; *non* Westwood, 1841.

Solenella de Ryckholt, 1847, *Mélanges paléontologiques*, Pt. I, Pl. 11, Fig. 17; *non* Sowerby 1833, *nec* d'Orbigny 1844.

Solenomorpha Cockerell, 1903, *Nature*, Vol. 67, p. 559.

Original description from McCoy, 1844.—

Gen. Ch.—Transversely elongate, equivalve, inequilateral, beaks prominent, close to the anterior end; anterior end short, rounded, closed; posterior end elongate, truncated, slightly gaping.

I have instituted the present genus for the reception of a few fossils of the carboniferous series, hitherto ranked by Goldfuss and others with the genus *Solen*; from this genus they are distinguished by their prominent beaks, which are never terminal, and their rounded and closed anterior end. From *Solenocurtus* they differ in being inequilateral; from *Nucula* and *Solenella* they differ in the want of lateral teeth, and in their gaping, posterior end. The few species I know are all from the Palaeozoic rocks, and scarcely differ except in size.

Genotype.—Solenopsis minor McCoy, by monotypy.

Remarks.—Williams and Breger (1916, p. 250) discussed the complicated history of this genus and concluded that, of the three generic names proposed, *Solenomorpha* Cockerell is the only one that is not preoccupied. The genus is placed in the family Solenopsidae on the authority of Maillieux (1937, p. 13).

Solenomorpha peninsularis, sp. nov.

(Pl. XVII, Figs. 8–11)

Description.—Species known only from right valves. Shell small, elongate, three times as long as high, gaping slightly posteriorly, apparently not gaping anteriorly, tapering slightly toward the posterior end. Surface with fine, somewhat irregular concentric lines; no radial ornamentation. Hinge line nearly straight, appearing somewhat concave in some specimens. Umbones near the anterior end of the shell, small, not prominent. Anterior margin evenly rounded, ventral margin nearly straight, posterior margin bluntly angulate. Ligament unknown. Greatest thickness of the valves in the region under the umbo; surface of valves sloping very gently into both anterior and posterior

slopes. Interior without perceptible muscle scars or pallial line, possibly due to faulty preservation; teeth not observed. Umbonal cavity shallow.

Dimensions of several right valves, the types, are as follows: holotype, length 42 mm., height 13 mm., thickness 4 mm.; three paratypes, length 40, 32, 41 mm.; height 12, 11, 12 mm.; thickness 3, 3, 3 mm., respectively.

Remarks.—This species differs from the genotype species in having almost no trace of the postumbonal ridge. This character will also distinguish it from the species of *Solenomorpha* described by Beushausen from the Devonian rocks of Germany. It is referred to *Solenomorpha* rather than to *Palaeosolen* because of the pronounced tapering of the valves toward the posterior extremity and the nongaping anterior margin, characters to which Williams and Breger (1916, p. 250) give great weight in separating *Solenomorpha* from *Palaeosolen* Hall.

Occurrence.—Dolomitic limestone forming the basal eight or nine feet of the Rogers City limestone, localities 41, 42, and 43; Atrypa zone (Units 10 or 11 of Ehlers, 1945, p. 114) of the Rogers City limestone, locality 51 (a single very small specimen doubtfully referred to this species, but too small to show characters sufficient for a positive identification).

Types.—Holotype No. 24597; paratypes Nos. 24598, 24599, and 24600.

STRATIGRAPHIC DISTRIBUTION AND CORRELATIONS

GENERAL STATEMENT

The following is a discussion of the stratigraphic distribution of the pelecypod faunas of the pre-Traverse Devonian rocks in Michigan and their relationships with pelecypod faunas in the Devonian strata of neighboring states and provinces. The order of succession of the stratigraphic units is shown in Table I. The distribution of the pelecypods is shown in Tables II to V.

All the pre-Traverse Devonian rocks of Michigan have yielded pelecypods with the exception of the Garden Island formation and the Flat Rock dolomite of the Detroit River group. No pelecypods have been obtained from the undivided Detroit River group of the northern part of the Lower Peninsula. The absence of records of

TABLE I

CLASSIFICATION OF PRE-TRAVERSE DEVONIAN ROCKS OF MICHIGAN*

System	Series	Stage	Northern Part of the Lower Peninsula		Southern Part of the Lower Peninsula
Devonian	Erian	Cazenovia	Traverse—Lower Part		Traverse—Lower Part
			Rogers City Limestone		Absent
			Dundee Limestone		Dundee Limestone
	Ulsterian	Onesquethaw	Detroit River Undivided	Mackinac Breccia	Lucas Dolomite
					Amherstburg Dolomite
					Anderdon Limestone
					Flat Rock Dolomite
					Sylvania Sandstone
			Bois Blanc		Absent
		Deer Park	Garden Island		Absent
Silurian	Cayugan	Bass Islands	St. Ignace		Several Formations
		Salina	Pointe aux Chênes		Undivided

* Adapted from Ehlers (1945, p. 35) for the northern part of the Lower Peninsula and from Cooper (1942, Chart 4) for the southern part of the Lower Peninsula.

pelecypods from the Garden Island and Flat Rock formations may be the result of the inaccessibility of most of the strata of these formations. The only outcrop of the Garden Island formation is almost covered

by water during high-level stages of Lake Michigan. The only exposure of the Flat Rock dolomite is very small and not visible in the bottom of the Huron River at Flat Rock, Michigan, except at very low stages of the river. The Detroit River rocks in the northern part of the Lower Peninsula of Michigan are in slightly larger exposures than those of the Garden Island and Flat Rock formations but consist of dolomite and limestone which are largely devoid of fossils.

GARDEN ISLAND FORMATION

The Garden Island formation is the oldest known Devonian stratigraphic unit in Michigan (see Table I). It is known only from one small outcrop on Garden Island in the northern part of Lake Michigan and has been correlated with the Oriskany sandstone of southwestern Ontario and New York by Ehlers (1945, p. 75). So far no pelecypods have been collected from this formation.

BOIS BLANC FORMATION

The Bois Blanc formation is exposed at many places in the Mackinac Straits region. According to Ehlers (1945, p. 107), it is "closely related to the Onondaga limestone of southwestern Ontario and western New York." It has yielded a few genera and species of pelecypods, represented by only a small number of specimens, the majority of which are in a poor state of preservation. Two new species are recorded from the formation (see Table II).

The pelecypods listed in Table II yield little information on the correlation of the Bois Blanc formation. *Conocardium*, *Cornellites*, *Cypricardinia*, *Modiomorpha*, and *Paracyclas* sp. cf. *P. proavia* (Goldfuss) have too great a vertical range to be of value in correlating the formation. *Follmannella* has not previously been recorded from the middle western states but it has been found in the Devonian rocks of Maine, Quebec, New York, and Nevada. In Europe it has been found in the Lower and Middle Devonian deposits of Germany, and in South America in the Lower Coblenzian of Brazil. *Follmannella michiganensis*, sp. nov. is not closely related to any of the species so far assigned to this genus, so it is of little help in correlating the formation with others which contain examples of *Follmannella*.

Panenka has been found in the Devonian rocks of New York, On-

tario, and Europe. *P. coralliophila*, sp. nov. because it is not closely related to known species, gives no information in regard to the age of the Bois Blanc formation.

TABLE II

DISTRIBUTION OF PELECYPODS IN THE BOIS BLANC FORMATION OF MICHIGAN

Species	Localities														
	Lower Part			Middle Part									Upper Part		Position?
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Conocardium sp. C	.	.	.	x	x	x	x	.	x	.	x	.	x	x	x
Cornellites? sp. A	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.
Cypricardinia? sp.	.	x	x	x	.	.	.	x	.	x	.	.	.	.	x
Follmannella michiganensis, sp. nov.	x	.	.	x	x	.	x	x	.	.	.	.	.	.	.
Modiomorpha? sp.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	x
Panenka coralliophila, sp. nov.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.
Panenka sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Paracyclas sp. cf. *P. proavia* (Goldfuss)	.	.	.	.	.	.	.	.	.	.	x	.	x	.	.

SYLVANIA SANDSTONE

The Sylvania sandstone is the oldest division of the Detroit River group (see Table I). The type sections are exposed in areas of southeastern Michigan and southwestern Ontario bordering the Detroit River and at several places in northwestern Ohio. According to Lane, Prosser, Sherzer, and Grabau (1909, pp. 553–56), the sandstone is overlain in ascending order by the Flat Rock dolomite, Anderdon limestone, Amherstburg dolomite, and Lucas dolomite.

The Sylvania sandstone, which is typically exposed in the vicinity of Sylvania, Lucas County, Ohio, crops out in the southeastern part of Michigan. It does not reach the surface in the northern part of the Lower Peninsula of Michigan (Landes, 1945). Even the Detroit River strata, which occupy a stratigraphic position above the Sylvania sandstone, are exposed at only a few places in this part of Michigan. The Sylvania outcrops have been studied by Ehlers (1945, pp. 111–16),

who was unable to assign them to stratigraphic divisions of the Detroit River group of southeastern Michigan. They contain no pelecypods. A few remains of other invertebrates have been collected from them, but have proved to be of no value in correlating the strata with the Detroit River rocks of southeastern Michigan.

So far I have seen only four valves of a pelecypod from this formation in Michigan. These specimens were obtained from interbedded chert and arenaceous dolomite formerly exposed in an excavation for a crusher located in the Michigan Silica Company quarry about one mile southeast of Rockwood, Wayne County. According to G. M. Ehlers (personal communication), the interbedded chert and dolomite has a thickness of 15 feet; the top of this rock material is 12 feet below the floor of the quarry at the crusher site.

Carman (1936, p. 261) reported the occurrence of *Conocardium monroicum* and thirty species of other invertebrates from the Sylvania sandstone of northwestern Ohio. *Conocardium monroicum* and twenty-five of the thirty species noted by Carman are also present in either the Amherstburg or the Lucas dolomite, or in both. This occurrence of many species characteristic of the Amherstburg and Lucas dolomites in the Sylvania sandstone led Carman (1936, p. 265) to conclude that "the Sylvania is closely related stratigraphically and faunally to the Detroit River formation, and, whatever systematic disposal is made of the Detroit River formation, the Sylvania sandstone must go with it as of the same general age."

FLAT ROCK DOLOMITE

The Flat Rock dolomite is exposed only in the bed of the Huron River at Flat Rock, Wayne County, and is visible only in low-water stages of this stream. The dolomite at this locality is approximately five miles northwest of the estimated position of the top of the Sylvania sandstone. According to G. M. Ehlers (personal communication), since the general northwestward dip of the rocks of the region is 25 to 35 feet per mile, the dolomite at Flat Rock may be 125 to 175 feet above the Sylvania sandstone and within the Lucas dolomite, which is a higher unit of the Detroit River group. Sherzer and Grabau (1909, pp. 541, 546), Lane, Prosser, Sherzer, and Grabau (1909, p. 555), and Sherzer and Grabau (1910, pp. 41–42) reported the oc-

currence of the Flat Rock dolomite in the salt shaft at Detroit. No pelecypods have been obtained from strata now assigned to the Flat Rock dolomite.

ANDERDON LIMESTONE

The Anderdon limestone is typically exposed in the Bruner Mond Canada, Limited quarry in Anderdon Township, one mile north of Amherstburg, Ontario. Sherzer and Grabau (1909, pp. 540–53) and Lane, Prosser, Sherzer, and Grabau (1909, pp. 553–56) in their classification of the Detroit River strata stated that this limestone occupies a position between the underlying Flat Rock dolomite and the overlying Amherstburg dolomite. If this position of the Anderdon limestone is correct, then all of the Amherstburg and Lucas dolomites were removed by erosion at the Bruner Mond Canada, Limited quarry prior to the deposition of the Dundee limestone, which in this quarry rests disconformably on the Anderdon limestone.

Several beds of limestone in the Solvay Process Company's quarry at Sibley, Wayne County, Michigan, were assigned to the Anderdon limestone by Bassett (1935, pp. 428–32). This limestone, like the type Anderdon limestone of the Bruner Mond Canada, Limited quarry, which is about six miles southeast of Sibley, is overlain disconformably by the Dundee limestone.

In the opinion of G. M. Ehlers (personal communication), the type Anderdon limestone and the beds of the Sibley quarry assigned to this formation most probably occupy a position above the Lucas dolomite. He believes that the Amherstburg and Lucas dolomites are present not only in the Livingstone Channel of the Detroit River, which is located in the region between the Sibley and Anderdon Township quarries, but also in the areas of these quarries and thinks that these dolomites were not removed by erosion in pre-Dundee time.

According to G. M. Ehlers (personal communication), the Anderdon limestone of the Sibley quarry may not be continuous with that at the type locality but may occupy a slightly higher stratigraphic position. In that case the so-called "Anderdon" limestone of Sibley quarry may not be the Anderdon limestone of the type locality, a supposition that is further borne out by the distribution of a few pelecypods listed in Table III. In this table the "Anderdon" limestone at Sibley is

shown as having *Conocardium sibleyense* and *Diodontopteria ehlersi*, two new species which have not been found in the Anderdon limestone of the type locality.

In 1909 Sherzer and Grabau (p. 547) reported the occurrence of *Conocardium monroicum* Grabau in the Anderdon limestone of the Detroit salt shaft and Anderdon quarry; in 1910 Grabau and Sherzer

TABLE III

DISTRIBUTION OF PELECYPODS IN THE DETROIT RIVER GROUP OF MICHIGAN

Species	Localities									
	"Anderdon"	Anderdon Limestone	Amherstburg Dolomite					Lucas Dolomite		
	17	18	19	20	21	22	23	24	25	26
Conocardium monroicum Grabau	....	x	x	x	x	x	x	x	x	x
Conocardium sibleyense, sp. nov.	x	....	....	....	....	....	....	....	....	....
Cornellites sp. B	....	....	x	....	....	....	....	....	....	....
Cypricardinia canadensis Grabau	....	....	....	....	x	....	....	....	....	....
Cypricardinia sp.	....	....	x	....	....	....	....	....	....	....
Diodontopteria? bradti Sherzer and Grabau	....	....	....	....	....	....	....	x	....	....
Diodontopteria ehlersi, sp. nov.	x	....	....	....	....	....	....	....	....	....
Goniophora sp.	....	....	....	....	....	....	....	x	....	....
Panenka canadensis Whiteaves	....	....	....	....	x	....	....	....	x	....
Pterinea lanii Sherzer and Grabau	....	....	....	....	....	....	....	x	....	....

(pp. 44, 46, 173) noted the presence of this pelecypod in the Anderdon of the salt shaft but not in the limestone at its type locality. The specimens of *Conocardium monroicum* which Sherzer and Grabau obtained from the Anderdon limestone of the salt shaft are without doubt conspecific with those found in the Amherstburg and Lucas dolomites. G. M. Ehlers (personal communication) said it is possible that the so-called Anderdon of the salt shaft is not the typical Anderdon limestone but a calcareous phase of the Amherstburg or Lucas dolomite and

occupies a lower stratigraphic position than either the typical Anderdon limestone or the "Anderdon" limestone of Sibley quarry. The absence of *Conocardium monroicum* in the type Anderdon limestone, as indicated by Grabau and Sherzer (1910), lends support to the belief that the type Anderdon occupies a position above the Lucas dolomite.

The preceding discussion suggests that the Anderdon limestone of the type locality is above the Lucas dolomite and not below the Amherstburg dolomite as given in Table I. Its position there, as well as that of other units of the Detroit River group in the table, follows the interpretation of Lane, Prosser, Sherzer, and Grabau. I believe the succession of strata in the Detroit River group, as stated by these geologists, is in need of revision, but refrain from altering the classification of the group until further stratigraphic and paleontologic studies can be made.

AMHERSTBURG DOLOMITE

The Amherstburg dolomite forms the bottom of the eastern channel of the Detroit River about one mile northwest of Amherstburg, Ontario. A section of the dolomite was exposed at the time a ship channel, the Livingstone Channel, was cut in the bottom of this part of the river. This section, the type section, is now covered with water.

G. M. Ehlers examined the rocks of the Livingstone Channel at the time they were first excavated in 1909 and 1910 and again during the deepening of the channel in the period from 1932 to 1935, and, according to him (personal communication), most of the strata of the channel belong to the Lucas dolomite. He considers that the typical Amherstburg dolomite is only shown in a cut through a small anticline the axis of which crosses the northern part of the channel just east of Stony Island.

Most of the fossils, which Sherzer, Grabau, and others obtained from the rocks of the Livingstone Channel, have been labeled as coming from the Amherstburg dolomite. Many of these undoubtedly come from the Lucas dolomite; consequently, the exact stratigraphic position of several species described by Sherzer and Grabau from rocks of the channel is in doubt.

Only one pelecypod, *Cypricardinia canadensis* Grabau, indicated in Table III, seems to be restricted to the Amherstburg dolomite. *Conocardium monroicum* Grabau, which is abundant in the Amherst-

burg dolomite, and *Panenka canadensis* Whiteaves are common to both Amherstburg and Lucas dolomites. Further collecting may result in the finding of specifically recognizable specimens of the species of *Cornellites* and *Cypricardinia* noted in Table III as occurring in the Amherstburg dolomite, and may prove that such specimens are limited to this formation.

LUCAS DOLOMITE

The Lucas dolomite, named from outcrops in Lucas County, Ohio, is exposed at many places in Monroe and Wayne Counties, in Michigan, in northwestern Ohio, and in southwestern Ontario. Outcrops of Lucas dolomite, though more numerous than those of other formations of the Detroit River group, have yielded few species of pelecypods.

The Lucas dolomite (see Table III) contains *Conocardium monroicum* Grabau, *Panenka canadensis* Whiteaves, *Diodontopteria? bradti* (Sherzer and Grabau), *Goniophora* sp., and *Pterinea lanii* Sherzer and Grabau. The first two of these pelecypods, as previously noted, also occur in the Amherstburg dolomite. *Diodontopteria? bradti* (Sherzer and Grabau), which seems to be restricted to the Lucas dolomite, and better-preserved specimens of *Goniophora* sp., when obtained, may prove to be guide fossils of this formation. The only record for occurrence of *Pterinea lanii* Sherzer and Grabau in the Lucas dolomite is a statement by Grabau (1910, p. 166) that "a single imperfect specimen, apparently of this species, is associated with *Pterinea bradti* in the Lucas dolomite of the salt shaft." The single imperfect specimen noted by Grabau has not been located. So far as is known no other specimen of *P. lanii* Sherzer and Grabau has been obtained from the Lucas dolomite or any other formation of the Detroit River group. In my opinion it is very unlikely that *P. lanii* Sherzer and Grabau, which is characteristic of the Upper Silurian Raisin River and Put-in-Bay dolomites, is represented in any Devonian rocks of Michigan.

The common occurrence of several species of pelecypods in the Lucas and Amherstburg dolomites indicates that the faunas of these formations are closely related. This close faunal relationship has been recognized by Carman (1927, p. 499), who has extended the range of a number of Grabau's Amherstburg species into the Lucas dolomite and that of a number of Grabau's Lucas species into the Amherstburg dolomite.

DUNDEE LIMESTONE

The Dundee limestone is exposed in two areas in Michigan. One of these areas, the type area, is in southeastern Michigan. The stratigraphy and paleontology of the formation in this area have been discussed in detail by Bassett (1935). The second area is in Presque Isle County, located in the northeastern part of the Lower Peninsula. The largest exposure in this county is in the quarry of the Michigan

TABLE IV

DISTRIBUTION OF PELECYPODS IN THE DUNDEE LIMESTONE OF MICHIGAN

Species	Localities											
	Southern Area							Northern Area				
	27	28	29	30	31	32	33	34	35	36	37	38
Actinodesma occidentale (Hall)	x	...	...	...	...	...	...	...	...	...	...	...
Actinodesma sp. cf. *A. occidentale* (Hall)	...	x	...	...	...	...	...	...	...	...	...	...
Conocardium cuneus (Conrad)	...	x	x	x	x	x	...	...	...	...	...	...
Conocardium sp. B	...	...	...	...	...	...	...	...	...	x	...	...
Cornellites macrotis, sp. nov.	...	x	x	...	...	...	...	...	...	...	...	...
Diodontopteria kellumi, sp. nov.	...	...	...	...	...	...	...	...	...	x	...	...
Goniophora nucella, sp. nov.	...	...	...	...	...	...	...	...	x	...	...	...
Gosseletia sp.	...	...	...	...	...	...	...	x	...	...	...	...
Leiopteria peninsularis, sp. nov.	...	x	...	...	...	...	...	...	...	...	...	...
Leptodesma sp. cf. *L. furcistria*, sp. nov.	...	...	...	...	...	x	...	...	...	...	...	...
Palaeaneilo? sp.	...	...	x	...	...	...	...	...	...	...	...	...
Panenka grandis Whiteaves	...	x	...	...	...	...	...	...	...	...	...	...
Paracyclas proavia (Goldfuss)	...	x	...	...	...	...	x	x	x	x	x	x
Phenacocyclas pohli, sp. nov.	...	x	...	...	...	...	...	...	x	x	...	...

Limestone and Chemical Company at Rogers City. A detailed section of the formation in this quarry has been described by Ehlers (1945, pp. 114–15); this section shows about 143 feet of Dundee limestone, which Ehlers has divided into eight units.

Only two species of pelecypods are indicated in Table IV as common to the Dundee limestone of the southern and northern parts of the Lower Peninsula. One of these, *Paracyclas proavia* (Goldfuss), has a considerable vertical range in the Middle Devonian section of North America. It is very abundant in the Dundee limestone of the Rogers

City region. Only two specimens of the species have been found in the Dundee limestone of southern Michigan. The second species, *Phenacocyclas pohli*, sp. nov., is relatively common in the Dundee limestone of the Rogers City region but represented by only one specimen in the Dundee limestone of southeastern Michigan.

The reason that the Dundee limestone of southeastern Michigan and that of the northeastern part of the state are not recorded as having more species of pelecypods in common is most probably due to insufficient collecting. The absence of species common to the limestone of the two areas may, of course, be owing to differences in the ecological factors and in the age of some of the strata of the formation.

Ehlers (1945, p. 111) has pointed out that "the Dundee limestone underlies large areas of southwestern Ontario where it is incorrectly designated the Onondaga limestone." In Stauffer's list (1915, p. 246) of the pelecypods of the Onondaga limestone of Ontario only two species, *Conocardium cuneus* (Conrad) and *Paracyclas elliptica* (= *P. proavia* (Goldfuss) of this paper), are present that are also recorded from the Dundee of Michigan (see Table IV). This discrepancy comes from the fact that Stauffer's list included many species from the typical Onondaga limestone as well as from the Dundee limestone. It is possible that the Dundee limestone of Ontario is more closely related to that of southeastern Michigan than to that of the northern part of the Lower Peninsula as indicated by the absence of *Diodontopteria kellumi*, sp. nov.; *Goniophora nucella*, sp. nov.; and *Gosseletia* sp. in the Dundee limestone of Ontario and southeastern Michigan.

The Dundee limestone of northwestern Ohio, which until recently had been designated the Columbus limestone (Ehlers, 1945, p. 111), has the same fauna as the typical Dundee limestone of southeastern Michigan. The limestone in the two areas has the following pelecypods in common: *Actinodesma occidentale* (Hall), *Conocardium cuneus* (Conrad), and *Paracyclas* sp. cf. *P. proavia* (Goldfuss). The Dundee limestone of Ohio, however, contains many genera and species of pelecypods (Stauffer, 1909, p. 181) which have not been recognized in this formation in Michigan.

ROGERS CITY LIMESTONE

The name "Rogers City limestone" was proposed by Ehlers and Radabaugh (1938) for beds formerly included in the upper part of

the Dundee limestone of Michigan. Ehlers (1945, pp. 114–15) has given a detailed section for the beds of this formation exposed in the quarry of the Michigan Limestone and Chemical Company at Rogers City, Michigan, and listed some of the diagnostic fossils for each unit.

Pelecypods have been found in two, possibly three, units of Ehlers' section of the Rogers City limestone at certain of the localities given

TABLE V

DISTRIBUTION OF PELECYPODS IN THE ROGERS CITY LIMESTONE OF MICHIGAN

Species	Localities																
	Dolomitic Limestone					Beds Above Dolomitic Limestone											
	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55
Actinopterella calliotis, sp. nov.					x												
Actinopterella peninsularis, sp. nov.	x	x	x	x	x												
Conocardium sp. A										x			x			x	
Goniophora nucella, sp. nov.																x	
Leptodesma? sp.				x													
Leptodesma furcistria, sp. nov.		x		x	x												
Limoptera (Myalinodonta?) migrans, sp. nov.	x			x	x												
Liromytilus attenuatus (Whiteaves)							x	x	x		x					x	
Modiomorpha? sp.				x						x							
Nuculoidea? sp. A																x	
Nuculoidea? sp. B																x	
Paracyclas proavia (Goldfuss)		x	x			x				x	x	x	x	x	x	x	
Phenacocyclas pohli, sp. nov.						x				x	x	x	x	x		x	x
Schizodus sp.										x	x		x				
Solenomorpha peninsularis, sp. nov.			x	x	x								x				

in Table V. The pelecypod fauna is divided into two groups in the Table. Unit 9 of Ehlers' section contains four species which are found only in this unit. Units 10 and 11 (?) contain eight species not found in Unit 9. Only two species, *Paracyclas proavia* (Goldfuss) and *Solenomorpha peninsularis*, sp. nov., are found in both units.

That the Rogers City fauna has some affinities with the Dundee, is shown by the presence in both formations of *Paracyclas proavia* (Goldfuss) and *Phenacocyclas pohli*, sp. nov. It is worth noting that

P. pohli, which is fairly common in the Dundee, is apparently absent from Unit 9 (the basal unit of the Rogers City limestone), but present in Unit 10 of Ehlers' section.

The fauna of the Rogers City limestone is closely related to the faunas of the Winnipegosis dolomite and the Manitoba limestone of Manitoba. Ehlers and Radabaugh (1938) reported the occurrence of certain diagnostic fossils (gastropods) in all three formations. Radabaugh (1942) discussed a large number of gastropods common to these strata. *Liromytilus attenuatus* (Whiteaves), a pelecypod of very striking appearance, and *Paracyclas proavia* (Goldfuss) occur in the Rogers City limestone and the dolomite and limestone of Manitoba. Of the forms recorded by Whiteaves, "*Actinopteria boydi* Hall" may be identical with *Actinopterella peninsularis*, sp. nov. of this paper, but, unfortunately, Whiteaves' specimens were not available for comparison. Whiteaves' list of fossils (1892, pp. 292–311) does contain representatives of several genera of pelecypods present in Manitoba but not found in the Rogers City limestone of Michigan. Examples of these include *Anodontopsis*, *Cardiopsis*, *Cypricardinia*, *Glossites*, *Kefersteinia*, *Mecynodon*, *Macrodon*, *Myalina*, *Mytilarca*, *Orthonota*, *Pterinea*, and *Spathella*.

The succession of faunas in the Middle Devonian of Manitoba has not yet been worked out satisfactorily. Until this is done it seems best to follow Cooper (1942, p. 1771), in considering the Elm Point, Winnipegosis, and Manitoba formations a unit, part of which correlates with the Rogers City limestone of Michigan.

LIST OF LOCALITIES

LOCALITY

1. Rock pile about 0.6 mile south of Allenville, Mackinac County. Block of limestone of Bois Blanc formation in Mackinac breccia.
2. South side of Trout Island, west of southeast point of island, Lake Michigan, Charlevoix County. Bois Blanc formation, trilobite bed near top of lower part of formation.
3. Field beside little used road, northwest part of sec. 8, Bois Blanc Island, about 600 feet south of north shore of island, Mackinac County. Bois Blanc formation, lower part.
4. Cliff on north side of Cheeseman Road, one mile northeast of St. Ignace, Mackinac County. Fossils collected from a large block of limestone in Mackinac breccia. The block was derived from the lower portion of the middle part of the Bois Blanc formation.

5. South side of Waugoshance Island, Lake Michigan, Emmet County. Bois Blanc formation, middle part.
6. Shore of Big St. Martin Island, Lake Huron, Mackinac County. Bois Blanc formation, middle part; block of limestone of Bois Blanc formation in residual mass of Mackinac breccia.
7. Shore, northeastern part of Beaver Island, 0.75 mile northeast of Beaver Island Coast Guard Station, Lake Michigan, Charlevoix County. Bois Blanc formation, middle part.
8. Shore of Garden Island, Lake Michigan, sec. 7, T. 39 N., R. 9 W., one-third mile northwest of the southeast point of the island, Charlevoix County. Bois Blanc formation, middle part.
9. South shore of Bois Blanc Island, Lake Huron, between Rosie and Packard Points, Mackinac County. Bois Blanc formation, middle part.
10. West side of McGulpin Point, sec. 10, T. 39 N., R. 4 W., 2.5 miles west of center of Mackinaw City, Emmet County. Bois Blanc formation, middle part.
11. Just east of the southwest corner of sec. 14, T. 39 N., R. 4 W., two miles west of the business section of Mackinaw City, Emmet County. Bois Blanc formation, upper portion of middle part.
12. Mill Creek, four miles south of Mackinaw City, Cheboygan County. Bois Blanc formation, upper portion of middle part.
13. U. S. Highway 31, 0.75 mile south of Mackinaw City, on line between Cheboygan and Emmet counties. Bois Blanc formation, upper part, bioherm core.
14. U. S. Highway 31, nearly one mile south of Mackinaw City, on line between Cheboygan and Emmet counties. Bois Blanc formation, upper part.
15. Northeast shore of North Fox Island, Leelanau County. Bois Blanc formation, cherty buff-gray dolomite, position uncertain.
16. Michigan Silica Company pit southeast of Rockwood, Wayne County. Wall of pit excavated for crusher on quarry floor. Sylvania sandstone, from interbedded chert and sandy dolomite 15 feet thick, 12 feet below quarry floor.
17. Solvay Process Company quarry at Sibley, two miles north of Trenton, Wayne County. Detroit River group, "Anderdon limestone," Bed 10 of Bassett's (1935, p. 430) section.

*18. Detroit salt shaft, Detroit, Wayne County. Anderdon limestone, coral bed.

19. Livingstone Channel, Detroit River, Wayne County. Detroit River group, Amherstburg dolomite.
20. Abandoned Cummins quarry, SE.1/4 SE.1/4, sec. 2, T. 8 S., R. 6 E., about six miles south and 1.75 miles east of Petersburg, Monroe County. Detroit River group, Amherstburg dolomite.

*21. "In the Amherstburg bed of the Upper Monroe, in the bed of the Detroit River, opposite Amherstburg, Ontario." Detroit River group, Amherstburg dolomite.

* Localities marked with an asterisk are those of Grabau and Sherzer (1910). They are included in Tables II to V to complete the record.

*22. "Brown transition dolomite (Amherstburg bed), bottom of Gibraltar Quarry." The quarry is now filled with water and is known as Gibraltar Lake (Quarry Lake of U. S. G. S. maps) south central part of sec. 35, T. 4 S., R. 10 E., about 2.5 miles northeast of Rockwood, Wayne County. Detroit River group, Amherstburg dolomite.

*23. "Amherstburg beds of the Woolmith quarry." Now filled with water, SE. 1/2 sec. 29, T. 5 S., R. 8 E., (Exeter twp.) Monroe County. Detroit River group, Amherstburg dolomite.

*24. "Lucas dolomite of the salt shaft." These shafts, now owned by International Salt Co., Inc., Detroit, but formerly by the Detroit Rock Salt Co., are in what used to be the suburb of Oakwood, one mile northwest of River Rouge. Lucas dolomite.

*25. Higher and Lower Lucas beds of Gibraltar quarry (see No. 22 above for details of location). Grabau records *Conocardium monroicum* from the "higher Lucas beds" and *Panenka canadensis* from the "Lower Lucas beds" of this quarry. Lucas dolomite.

*26. "Higher Lucas beds of the Patrick quarry," now filled with water; east side of south end of Grosse Ile, Wayne County. Lucas dolomite.

27. Christiancy quarry, Macon Creek, NE. 1/4 sec. 8, T. 6 S., R. 7 E., (Dundee twp.) Monroe County. Dundee limestone.

28. Solvay Process Company quarry at Sibley, two miles north of Trenton, Wayne County. Dundee limestone, interval not known.

29. Solvay Process Company quarry at Sibley, two miles north of Trenton, Wayne County. Dundee limestone, Interval 17 of Bassett (1935).

30. Solvay Process Company quarry at Sibley, two miles north of Trenton, Wayne County. Dundee limestone, Interval 20 of Bassett.

31. Solvay Process Company quarry at Sibley, two miles north of Trenton, Wayne County. Dundee limestone, Interval 21 of Bassett.

32. Solvay Process Company quarry at Sibley, two miles north of Trenton, Wayne County. Dundee limestone, Interval 24 of Bassett.

33. Solvay Process Company quarry at Sibley, two miles north of Trenton, Wayne County. Dundee limestone, Interval 25 of Bassett.

34. West shore of Black Point, Lake Huron, sec. 11, T. 34 N., R. 7 E., Presque Isle County. Dundee limestone, within upper 65 feet of formation.

35. Michigan Limestone and Chemical Company quarry at Calcite, near Rogers City, Presque Isle County. Probably Dundee limestone, possibly Rogers City limestone.

36. Michigan Limestone and Chemical Company quarry at Calcite, near Rogers City, Presque Isle County. Lower level of quarry, between points 0.25 and 0.5 mile southeast of crusher. Dundee limestone, lower 35 feet, Unit 5 of Ehlers (1945, p. 115).

37. Shore of Presque Isle Point, sec. 17, T. 34 N., R. 8 E., Presque Isle County. Loose blocks, probably Dundee limestone.

38. Michigan Limestone and Chemical Company quarry at Calcite, near Rogers

City, Presque Isle County. Loose blocks of Dundee limestone from floor of quarry.

39. East side of Presque Isle Point, about one mile south of tip of point, Presque Isle County. The outcrop is probably very near the surface here, but no definite bedrock was seen. Rogers City limestone, Unit 9 of Ehlers (1945, p. 114). Blocks of rubble.
40. East shore of False Presque Isle, sec. 7, T. 33 N., R. 9 E., Presque Isle County. Rogers City limestone, dolomitic limestone bed composing basal 8 or 9 feet of formation.
41. East shore of False Presque Isle, Presque Isle County. Rogers City limestone, dolomitic limestone bed composing basal 8 or 9 feet of formation, Unit 9 of Ehlers (1945, p. 114). Loose blocks.
42. East shore of False Presque Isle, Presque Isle County. Rogers City limestone, dolomitic limestone bed composing basal 8 or 9 feet of formation, Unit 9 of Ehlers (1945, p. 114).
43. Michigan Limestone and Chemical Company quarry at Calcite, near Rogers City, Presque Isle County. Rogers City limestone, dolomitic limestone bed composing basal 8 or 9 feet of formation, Unit 9 of Ehlers (1945, p. 114).
44. Michigan Limestone and Chemical Company quarry at Calcite, near Rogers City, Presque Isle County. Rogers City limestone, dolomitic limestone bed composing basal 8 or 9 feet of formation, Unit 10 of Ehlers (1945, p. 114).
45. Michigan Limestone and Chemical Company quarry at Calcite, near Rogers City, Presque Isle County. Rogers City limestone, unit not specified.
46. Crawford's quarry (now Michigan Limestone and Chemical Company quarry) at Calcite, near Rogers City, Presque Isle County. Rogers City limestone, unit not specified.
47. Michigan Limestone and Chemical Company quarry at Calcite, near Rogers City, Presque Isle County. Rogers City limestone, unit not specified.
48. Adams Point, SE. 1/4 sec. 21, T. 35 N., R. 6 E., Presque Isle County. Rogers City limestone, Unit 10 of Ehlers (1945, p. 114).
49. Middle Island, Lake Huron, Alpena County. About 0.25 mile southeast of lighthouse. Rogers City limestone, Unit 10 of Ehlers (1945, p. 114).
50. Middle Island, Alpena County, exact locality not specified. Rogers City limestone.
51. Middle Island, Alpena County, exact locality not specified. Rogers City limestone, Unit 10 or 11 of Ehlers (1945, p. 114).
52. East shore of False Presque Isle, Presque Isle County. Rogers City limestone, Unit 10 of Ehlers (1945, p. 114).
53. East side of Presque Isle Point, about 0.75 mile south of extremity of point, Presque Isle County. Loose block, most probably Rogers City limestone.
54. Beach north of Rockport quarry, along shore of Lake Huron, near west line of southwest quarter sec. 31, T. 33 N., R. 9 E., about one-half mile north of the boundary between Alpena and Presque Isle Counties. Rogers City limestone.
55. West side of Polock Bay, Presque Isle Point, sec. 8, T. 34 N., R. 8 E., Presque Isle County. Rogers City limestone, Unit 10 of Ehlers (1945, p. 114).

LITERATURE CITED

ALCOCK, FREDERICK J. 1935. Geology of Chaleur Bay Region. Geol. Surv. Canada Mem., 183.

BARRANDE, JOACHIM. 1881. Système silurien du centre de la Bohême. 1ère partie: Recherches paléontologiques, Vol. VI. Classe des mollusques. Ordre des Acéphalés. 342 pp., 361 pls.

BARROIS, CHARLES. 1882. Recherches sur les terrains anciens des Asturies et de la Galice. Mém. soc. géol. du Nord, Vol. 2, No. 1.

BASSETT, CHARLES F. 1935. Stratigraphy and Paleontology of the Dundee Limestone of Southeastern Michigan. Bull. Geol. Soc. Amer., Vol. 36, pp. 425–55, Pls. 34–39.

BEUSHAUSEN, LUDWIG. 1895. Die Lamellibranchiaten des rheinischen Devon mit Ausschluss der Aviculiden. Abhandl. der K. Preuss. Geol. Landesanstalt, N. F., Heft 17, 514 pp., 34 figs.; atlas, 38 pls.

BILLINGS, ELKANAH. 1859. On Some of the Silurian and Devonian Fossils Collected by Professor Henry Y. Hind on the Assiniboine and Saskatchewan Exploring Expedition. *In* Northwest Territory; Reports of Progress, Together with a Preliminary and General Report on the Assiniboine and Saskatchewan Exploring Expedition, by H. Y. Hind. Pp. 186–87. Toronto.

——— 1875. On Some New Genera and Species of Palaeozoic Mollusca. Can. Nat., n. s., Vol. 7, pp. 301–2, illus.

BRANSON, CARL C. 1942. Type Invertebrate Fossils of North America (Devonian). Conocardiidae. 30 cards, figs.

BRONN, HEINRICH G. 1834–37. Lethaea Geognostica, oder Abbildungen und Beschreibung der für die Gebirgs-Formationen bezeichnendsten Versteinerungen. 480 pp.; atlas, pls.

BUTTS, CHARLES. 1915. Geology and Mineral Resources of Jefferson County, Kentucky. Frankfort, Ky.: Ky. Geol. Surv., 1914–15. xiv + 270 pp., 65 pls.

——— 1931. List of Fossils from the Jeffersonville Limestone. *In* The Devonian Fauna of Kentucky by Thomas E. Savage, *in* The Paleontology of Kentucky, ed. by Willard R. Jillson. Ky. Geol. Surv., Ser. 6, Vol. 36, pp. 222–29, Pls. 27–29.

CARMAN, J. ERNEST. 1927. The Monroe Division of Rocks in Ohio. Journ. Geol., Vol. 35, No. 6, pp. 481–506, 1 fig.

——— 1936. Sylvania Sandstone of Northwestern Ohio. Geol. Soc. Amer. Bull., Vol. 47, pp. 253–65, Pl. 1, Figs. 1–5.

CASTER, KENNETH E. 1930. Higher Fossil Faunas of the Upper Allegheny. Bull. Amer. Paleontol., Vol. 15, No. 58, 316 pp., 59 pls.

COCKERELL, THEODORE D. A. 1903. The Name *Solenopsis*. Nature, Vol. 67, p. 559.

CONRAD, TIMOTHY A. 1840. Third Annual Report on the Paleontological Department of the Survey (of New York). Ann. Rept. N. Y. Geol. Surv., Vol. 4, pp. 199–207.

COOPER, GUSTAVUS A., and others. 1942. Correlation of the Devonian Sedimentary Formations of North America. Geol. Soc. Amer. Bull., Vol. 53, pp. 1729–94, 1 pl., 1 fig.

DALL, WILLIAM H. 1900. Mollusca. *In* Text-book of Palaeontology, by Karl A. von Zittel, trans. and ed. by C. R. Eastman. New York. 706 pp.

——— 1901. Synopsis of the Lucinacea and of the American species. Proc. U. S. Nat. Mus., Vol. 23, pp. 779–833, Pls. 39–42.

——— 1913. Mollusca. *In* Text-book of Paleontology, by Karl A. von Zittel, ed. by Charles R. Eastman. New York. Pp. 421–689, Figs. 637–1336.

EHLERS, GEORGE M. 1945. Stratigraphy of the Surface Formations of the Mackinac Straits Region. *In* Geology of the Mackinac Straits Region and Sub-surface Geology of Northern Southern Peninsula, with Kenneth K. Landes, and George M. Stanley. Geol. Surv. Mich. Publ., 44, Geol. Ser. 37, pp. 21–120, Pls. 2–16.

——— and RADABAUGH, ROBERT E. 1938. The Rogers City Limestone, a New Middle Devonian Formation in Michigan. Papers Mich. Acad., Vol. 23, pp. 442–43.

FENTON, CARROLL L., and FENTON, MILDRED A. 1924. The Stratigraphy and Fauna of the Hackberry Stage of the Upper Devonian. Contrib. Mus. Geol. Univ. Mich., Vol. 1, 260 pp., 45 pls.

GOLDFUSS, AUGUST. 1834–40. Petrefacta Germaniae. 2 vols., 312 pp., 165 pls. Düsseldorf.

GRABAU, AMADEUS W. 1913. Preliminary Report on the Fauna of the Dundee Limestone of Southern Michigan. *In* Geological Report of Wayne County, by W. H. Sherzer, Mich. Geol. and Biol. Surv. Publ., 12, Geol. Ser. 9, pp. 365–66.

——— and SHERZER, WILLIAM H. 1910. The Monroe Formation of Southern Michigan and Adjoining Regions. Mich. Geol. and Biol. Surv. Publ., 2, Geol. Ser. 1, pp. 27–60, 215–34.

——— and SHIMER, HERVEY W. 1909. North American Index Fossils, Invertebrates. Vol. 1, 853 pp., 1210 figs.

HALL, JAMES. 1843. Geology of New York. Pt. IV. Survey of the Fourth Geological District. 683 pp., map, illust.

——— 1859. Descriptions and Figures of the Organic Remains of the Lower Helderberg Group and the Oriskany Sandstone. N. Y. Geol. Surv., Paleontol., Vol. 3, 532 pp.

——— 1869. Preliminary Notice of the Lamellibranch Shells of the Upper Helderberg, Hamilton and Chemung Groups, with Others from the Waverley Sandstones. Albany, N. Y. Pt. II, 97 pp.

——— 1884. Natural History of New York: Palaeontology, Vol. V, Pt. I, Lamellibranchiata I. 268 pp., pls.

——— 1885. *Ibid.*, Lamellibranchiata II, pp. 269–561, 92 pls.

——— and WHITFIELD, ROBERT P. 1872. Description of New Species of Fossils from the Vicinity of Louisville, Ky., and the Falls of the Ohio. Ann. Rept., N. Y. State Mus., No. 24, pp. 201–4.

JOHNSON, CHARLES W. 1934. List of Marine Mollusca of the Atlantic Coast from Labrador to Texas. Proc. Boston Soc. Nat. Hist., Vol. 40, No. 1, pp. 1–204.

KINDLE, EDWARD M. 1938. The Correlation of Certain Devonian Faunas of Eastern

and Western Gaspé, with Appendix 82A, Devonian Bryozoa of Gaspé, by Madeleine Alberta Fritz. Bull. Amer. Paleontol., Vol. 24, No. 82, 52 pp., 2 pls.; App., 12 pp., 2 pls.

KING, WILLIAM. 1844. On a New Genus of Palaeozoic Shells. Ann. Mag. Nat. Hist., Ser. 1, Vol. XIV, pp. 313–17.

LANDES, KENNETH K. 1945. Geology and Oil and Gas Possibilities of Sylvania and Bois Blanc Formations in Michigan. Oil and Gas Investigs., Prelim. Map 28. Geol. Surv. Div. Mich. Dept. Conserv. and Dept. Geol. Univ. Mich., 1 sheet.

LANE, A. C., PROSSER, CHAS. S., SHERZER, W. H., and GRABAU, A. W. 1909. Nomenclature and Subdivision of the Upper Siluric Strata of Michigan, Ohio, and Western New York. Geol. Soc. Amer. Bull., Vol. 19, pp. 553–56.

MAILLIEUX, EUGÈNE. 1920. Note sur quelques groupes de mollusques acéphales des terrains paléozoïques. Bull. soc. belge de géol., paléontol. et hydrologie, Vol. 29, pp. 140–50.

——— 1931. La Faune des Grès et schistes de Solières (Siegenien Moyen). Mém. mus. roy. hist. nat. de Belgique, No. 51, 90 pp., 2 pls.

——— 1932. Le Genre *Limoptera* J. Hall dans le Dévonien de l'Ardenne. Bull. mus. roy. hist. nat. de Belgique, Vol. 8, No. 10, pp. 1–18, Pls. 1–2.

——— 1936. La Faune des schistes de Matagne (Frasnien supérieur). Mém. mus. roy. hist. nat. de Belgique, Vol. 77, pp. 1–74, Pl. 1.

——— 1937. Les Lamellibranches du Dévonien inférieur de l'Ardenne. *Ibid.*, Vol. 81, pp. 1–273, Pls. 1–14.

MCCOY, FREDERICK. 1844. A Synopsis of the Characters of the Carboniferous Limestone Fossils of Ireland. Privately printed, 1844; re-issued Williams and Norgate, London, 1862. viii + 207 pp., 29 pls., figs.

MCGERRIGLE, H. W. 1946. A Revision of the Gaspé Devonian. Trans. Roy. Soc. Canada, 3d. Ser., Sec. IV, Vol. 40, pp. 41–54.

NEUMAYR, MELCHIOR. 1891. Beiträge zu einer morphologischen Eintheilung der Bivalven. Denkschr. K. Akad. der Wissensch., Math.-Naturw. Cl., Vol. 58, pp. 701–801. Wien.

NEWELL, NORMAN D. 1937. Late Paleozoic Pelecypods: Pectinacea. Kan. Geol. Surv., Vol. 10, Pt. 1, pp. 1–123, 20 pls., 42 figs.

——— 1942. Late Paleozoic Pelecypods: Mytilacea. *Ibid.*, Pt. 2, pp. 1–115, 15 pls., 22 figs.

PHILLIPS, JOHN. 1848. The Malvern Hills Compared with the Palaeozoic Districts of Abberley. Geol. Surv. Gt. Brit. Mem., Vol. 2, Pt. 1.

POHL, ERWIN R. 1929*a*. Middle Devonian Pelecypods of Wisconsin and Their Bearing on Correlation. Journ. Wash. Acad. Sci., Vol. 19, pp. 53–59.

——— 1929*b*. The Devonian of Wisconsin. Pt. I. Lamellibranchiata. Bull. Publ. Mus. Milwaukee, Vol. 11, pp. 1–100, Pls. 1–14.

——— 1930. The Middle Devonian Traverse Group of Rocks in Michigan, a Summary of Existing Knowledge. Proc. U. S. Nat. Mus., Vol. 76, Art. 14, 34 pp., 2 pls.

QUENSTEDT, WERNER. 1930. Die Anpassung an die Grabende Lebensweise in der

Geschichte der Solenomyiden und Nuculaceen. Geol. und Paläont. Abhandl., N. F., Vol. 18, No. 1, 119 pp., 3 pls.

RADABAUGH, ROBERT E. 1942. The Middle Devonian Rogers City Limestone and its Gastropod Fauna. Unpublished doctoral thesis, Univ. Mich.

ROMINGER, CARL. 1876. Geology of the Lower Peninsula. Geol. Surv. Mich., Vol. 3, Pt. 1, pp. 23–25.

RYCKHOLT, P. DE. 1847. Mélanges paléontologiques. Bruxelles, Mémoires couronnés, XXIV.

SANDBERGER, GUIDO F., and SANDBERGER, FRIDOLIN. 1850–56. Die Versteinerungen des rheinischen Schichtensystems in Nassau. 564 pp., figs., map.

SAVAGE, THOMAS E. 1931. The Devonian Fauna of Kentucky. *In* The Paleontology of Kentucky, ed. by Willard Rouse Jillson. Ky. Geol. Surv., Ser. 6, Vol. 36, pp. 217–47, Pls. 27–32.

SCHUCHERT, CHARLES, and DART, J. DORIS. 1926. Stratigraphy of the Port-Daniel-Gascons Area of Southeastern Quebec. Geol. Surv. Canada Bull., No. 44, pp. 35–58, 4 pls.

SHERZER, WILLIAM H. 1900. Geological Report on Monroe County, Michigan. Geol. Surv. Mich., Vol. 7, Pt. 1, pp. 35–40, 43–100, Pl. 1.

——— and GRABAU, AMADEUS W. 1909. New Upper Siluric Fauna from Southern Michigan. Geol. Soc. Amer. Bull., Vol. 19, pp. 540–53.

SPRIESTERSBACH, JULIUS. 1920. Die Stellung von *Montanaria* Spriestersbach und *Crassatellopsis* Beushausen. Jahrb. Preuss. Geol. Landesanstalt, 1918, Band 39, Teil I, pp. 32–40, Pl. 3.

STAUFFER, CLINTON R. 1909. The Middle Devonian of Ohio. Geol. Surv. Ohio, 4th. Series, Bull. 10, 204 pp., 17 pls. Columbus.

——— 1915. The Devonian of Southwestern Ontario. Canada Dept. of Mines, Geol. Surv. Mem., 34, 341 pp., Map 116A.

TYRRELL, J. B. 1893. Report on North-Western Manitoba with Portions of the Adjacent Districts of Assiniboia and Saskatchewan. Ann. Rept. Geol. Surv. Canada, Vol. V, Pt. I, Rept. E, 235 pp., 7 pls., 2 maps. Ottawa.

WARTHIN, ALDRED S., and COOPER, GUSTAVUS A. 1943. Traverse Rocks of Thunder Bay Region, Michigan. Amer. Assn. Petrol. Geol. Bull., Vol. 27, No. 5, pp. 571–95, 2 pls., 4 figs.

WHITEAVES, JOSEPH F. 1884. On some New, Imperfectly Characterized, or Previously Unrecorded Species of Fossils from the Guelph formation of Ontario. Geol. Surv. Canada, Palaeozoic Fossils, Vol. 3, Pt. 1, pp. 1–43, Pls. 1–8.

——— 1891*a*. Descriptions of Some New or Previously Unrecorded Species of Fossils from the Devonian rocks of Manitoba. Proc. and Trans. Roy. Soc. Canada (1890), Vol. 8, Pt. 4, pp. 93–110.

——— 1891*b*. Description of a New Species of *Panenka* from the Corniferous Limestone of Ontario. Can. Record Sci., Vol. 4, pp. 401–4, Pl. 1.

——— 1892. The Fossils of the Devonian Rocks of the Islands, Shores or Immediate Vicinity of Lakes Manitoba and Winnipegosis. Contrib. Can. Palaeontol. Geol. Surv. Canada, Vol. I, Pt. 4, pp. 255–359, Pls. 33–47. Ottawa.

——— 1902. On the Genus *Panenka* Barrande, with a Description of a Second

Species of that Genus from the Devonian Rocks of Ontario. Ottawa Naturalist, Vol. 15, pp. 263–65, Pl. 15, Figs. 1–2.

WHITFIELD, ROBERT P., and HOVEY, EDMUND O. 1900. Catalogue of the Types and Figured Specimens in the Palaeontological Collection of the Geological Department, American Museum of Natural History. Bull. Amer. Mus. Nat. Hist., Vol. 11, Pt. 3, pp. 189–356.

WILLIAMS, HENRY S. 1908. On the Revision of the Mollusk Genus *Pterinea*, Goldfuss. Proc. U. S. Nat. Mus., Vol. 34, pp. 83–90.

——— and BREGER, CARPEL L. 1916. The Fauna of the Chapman Sandstone of Maine, Including Descriptions of Some Related Species from the Moose River Sandstone. U. S. Geol. Surv. Prof. Paper, No. 89, 347 pp., 27 pls.

WINCHELL, ALEXANDER. 1866. The Grand Traverse Region; a Report on the Geological and Industrial Resources of the Counties of Antrim, Grand Traverse, Benzie, and Leelanaw in the Lower Peninsula of Michigan. 97 pp., map. Ann Arbor.

EXPLANATION OF PLATE I

PAGE

Pterinea lanii Sherzer and Grabau 276

1. Side view of a left valve, showing surface characters. Syntype No. 13066. Upper Silurian (Raisin River dolomite); Newport, Monroe County, Michigan. × 1.

Cornellites macrotis, sp. nov. 277

2. Side view of an imperfectly preserved left valve, showing part of the outline and the surface ornamentation. Holotype No. 15286. Dundee limestone; locality 28. × 1.
3. Side view of a fragment of a left valve, showing ornamentation in the posterior region of the body of the valve and part of the wing. Paratype No. 24570. Dundee limestone; locality 28. × 1.
5. Side view of a worn internal mold of a left valve, showing the outline and part of the surface ornamentation. Paratype No. 24571. Dundee limestone; locality 29. × 1.

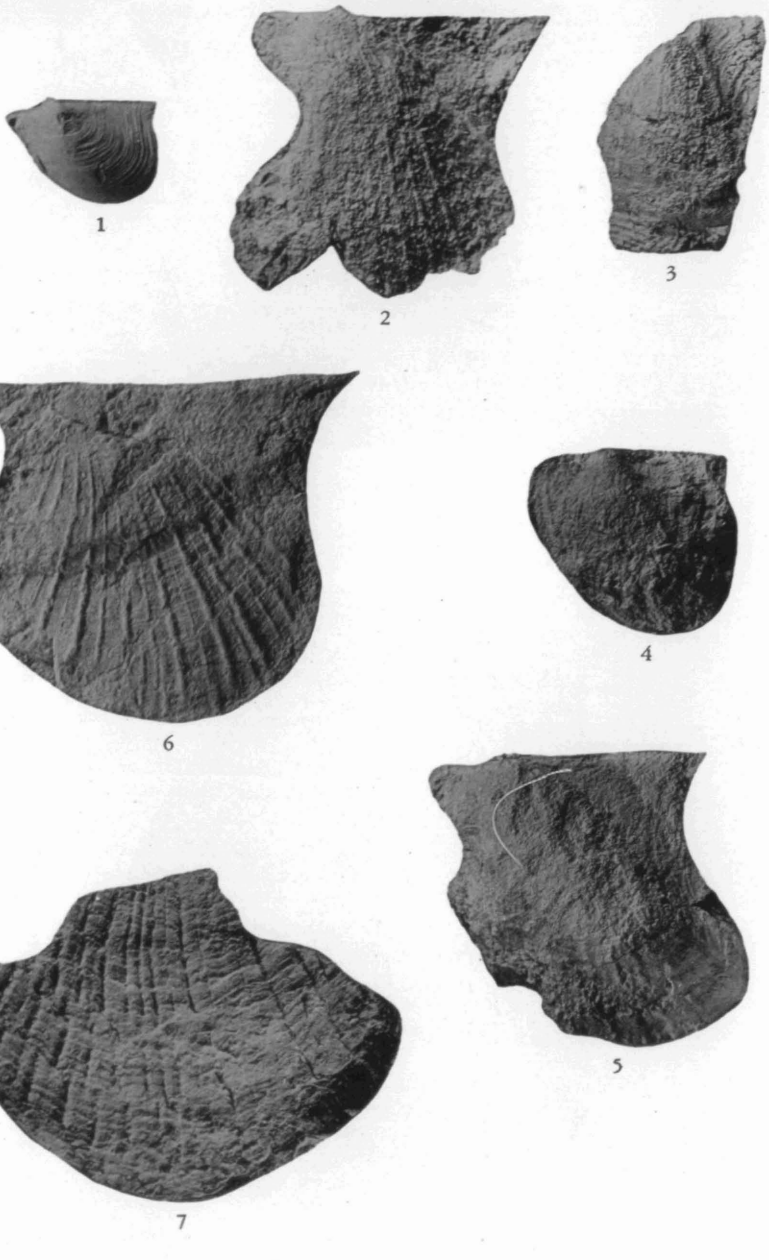
Cornellites? sp. A. 278

4. Side view of a worn internal mold of a left valve, showing outline. Figured specimen No. 24569. Bois Blanc formation; locality 4. × 1.

Follmannella michiganensis, sp. nov. 279

6. Side view of a cast of the exterior of an incomplete left valve, showing internal ornamentation and a trace of the inner foliaceous layers of the shell. Paratype No. 24577. Bois Blanc formation; locality 7. × 1.
7. Side view of an internal mold of a fragment, probably of a right valve, showing external ornamentation and part of the inner foliaceous layer near the ventral margin. Paratype No. 24574. Bois Blanc formation; locality 1. × 1.

PLATE I



1

2

EXPLANATION OF PLATE II

PAGE

Follmannella michiganensis, sp. nov..... 279

1. Side view of an external mold of a right valve, showing outline, ornamentation, and both wings. Holotype No. 24572. Bois Blanc formation; locality 1. × 1.
2. Side view of a cast of the exterior of an incomplete left valve, showing external costae and traces of the inner foliaceous layer of the valve. Paratype No. 24573. Bois Blanc formation; locality 1. × 1.

EXPLANATION OF PLATE III

PAGE

Follmannella michiganensis, sp. nov. 279

1. Side view of a mold of the exterior of an incomplete left valve, showing detail of the wing and the surface ornamentation. The ventral outline is incomplete. Paratype No. 24575. Bois Blanc formation; locality 5. × 1.

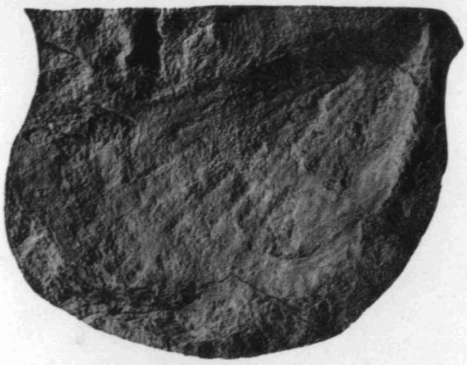
Actinopterella peninsularis, sp. nov. 281

2. Side view of a natural cast of the exterior of a left valve, showing part of the outline and the surface ornamentation. Paratype No. 24547. Rogers City dolomitic limestone; locality 43. × 2.
3. Side view of a natural cast of a very small left valve, showing the surface ornamentation and the anterior and posterior wings. Paratype No. 24548. Rogers City dolomitic limestone; locality 43. × 2.
4. Side view of a natural cast of the exterior of an almost complete left valve, showing outline, surface ornamentation, and both wings. Paratype No. 24549. Rogers City dolomitic limestone; locality 43. × 1.
5. Side view of a wax cast of a mold of the exterior of an almost complete left valve, showing surface characters. Cast of holotype No. 24544. Rogers City dolomitic limestone; locality 42. × 1.
6. Side view of a wax cast of a mold of the exterior of an incomplete left valve, showing surface characters. Cast of paratype No. 24545. Rogers City dolomitic limestone; locality 43. × 1.
7. Side view of a natural cast of the exterior of a left valve, showing surface characters. Paratype No. 24546. Rogers City dolomitic limestone; locality 42. × 1.

Actinopterella calliotis, sp. nov. 281

8. Side view of a natural cast of the exterior of a left valve, showing both wings and the character of the costae. Paratype No. 24558. Rogers City dolomitic limestone; locality 43. × 2.
9. Side view of a wax impression of the mold of a left valve, showing outline and surface ornamentation. Cast of paratype No. 24557. Rogers City dolomitic limestone; locality 43. × 2.
10. Side view of a wax impression of the mold of the exterior of a left valve, showing outline and ornamentation. Cast of holotype No. 24556. Rogers City dolomitic limestone; locality 43. × 2.
11. Side view of an imperfect natural cast of the exterior of a left valve, showing external characters. Holotype No. 24556. Rogers City dolomitic limestone; locality 43. × 2.

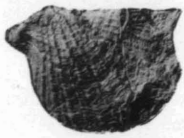
PLATE III



1

2

3



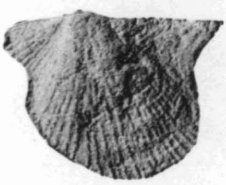
4

5

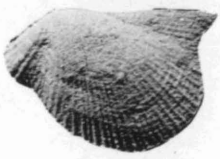
6

7

8



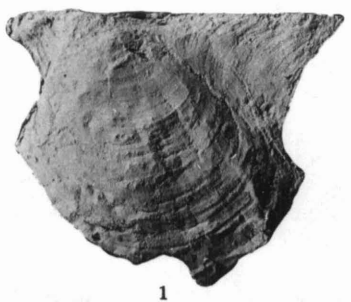
9



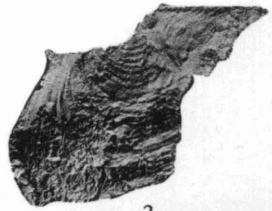
10

11

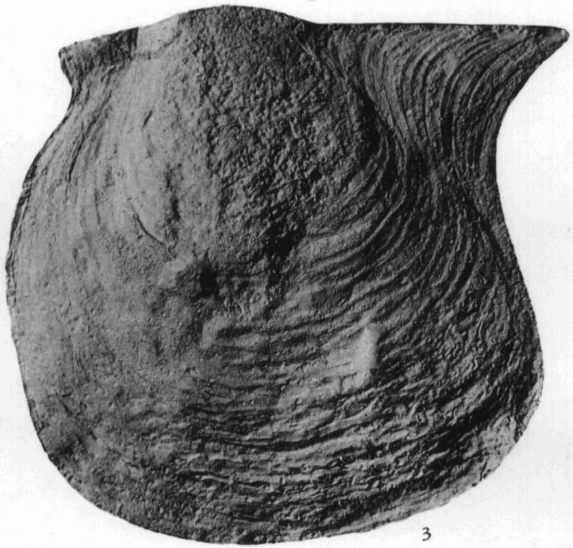
PLATE IV



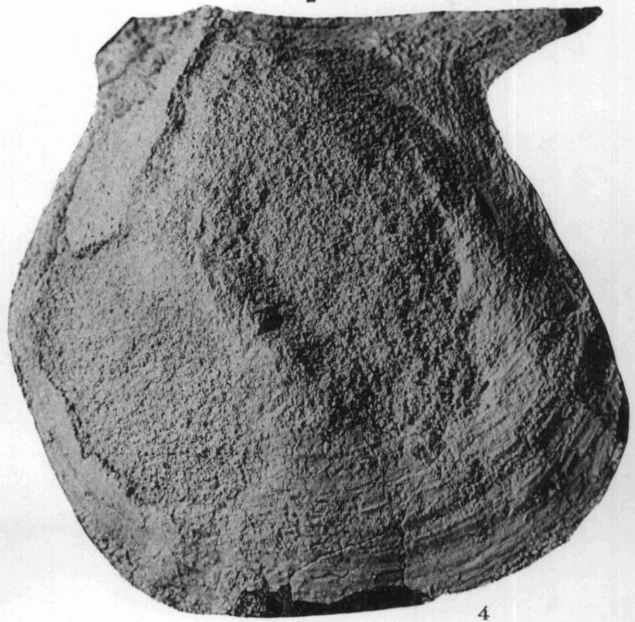
1



2



3



4

EXPLANATION OF PLATE IV

PAGE

Leiopteria peninsularis, sp. nov. 283

1. Side view of a badly worn left valve, showing the surface ornamentation and the two wings. Holotype No. 24579. Dundee limestone; locality 28. × 1.
2. Side view of a badly worn imperfect left valve, showing the posterior wing and part of the surface ornamentation. Paratype No. 24580. Dundee limestone; locality 28. × 1.

Actinodesma occidentale (Hall) 284

3. Side view of a plaster cast of a natural mold of the exterior of a left valve, showing outline and ornamentation. Cast of hypotype No. 15265. Dundee limestone; locality 27. × 1.

Actinodesma sp. cf. *A. occidentale* (Hall) 284

4. Side view of a partly exfoliated cast of a left valve, showing part of the outline and the posterior wing. Note the marked angulation of the growth lines on the posterior wing. Hypotype No. 24582. Dundee limestone; locality 28. × 1.

EXPLANATION OF PLATE V

PAGE

Leptodesma furcistria, sp. nov. 286

1. Side view of a natural cast of the exterior of the left valve of a small specimen, showing the posterior part of the shell and the wing. Paratype No. 24566. Rogers City dolomitic limestone; locality 43. × 2.
2. Side view of a natural cast of the exterior of an almost complete left valve, slightly crushed in the middle portion of the ventral part, showing the outline and surface ornamentation. Holotype No. 24564. Rogers City dolomitic limestone; locality 43. × 1.
3. Side view of a natural cast of the exterior of an almost complete left valve, showing outline and surface ornamentation. Paratype No. 24567. Rogers City dolomitic limestone; locality 43. × 1.
4. Side view of a natural cast of the exterior of a very small left valve, showing outline, posterior wing, and surface ornamentation. Paratype No. 24565. Rogers City dolomitic limestone; locality 43. × 3.
5. Side view of a natural cast of the exterior of a left valve, incomplete anteriorly, showing surface ornamentation. Paratype No. 24566. Rogers City dolomitic limestone; locality 43. × 1.

Leptodesma? sp. 287

6. Side view of a natural cast of the exterior of the left valve of the only specimen, showing outline and ornamentation. Figured specimen No. 24596. Rogers City dolomitic limestone; locality 42. × 1.

Diodontopteria ehlersi, sp. nov. 289

7. Side view of a natural mold of the interior of an incomplete right valve, showing molds of both cardinal and lateral teeth. Holotype No. 24536. Detroit River group, "Anderdon limestone"; locality 17. × 2.
8. Side view of a rubber cast of the same specimen as in Figure 7, showing the dentition. Cast of holotype No. 24536. Detroit River group, "Anderdon limestone"; locality 17. × 2.
9. Side view of a rubber cast of the same specimen as in Figure 12, showing the lateral tooth. Cast of paratype No. 24537. Detroit River group, "Anderdon limestone"; locality 17. × 1.
10. Side view of a natural mold of the interior of a left valve, showing concentric lines of growth and outline of the posterior wing. Paratype No. 24538. Detroit River group, "Anderdon limestone"; locality 17. × 2.
11. Side view of a natural mold of the interior of a right valve, showing cardinal teeth. Paratype No. 24541. Detroit River group, "Anderdon limestone"; locality 17. × 2.
12. Side view of a natural mold of the interior of a left valve, showing the dentition and the outline of the valve. Paratype No. 24537. Detroit River group, "Anderdon limestone"; locality 17. × 2.
13. Rubber cast of the dorsal half of a specimen with closed valves, showing thickness of the shell and position of the umbones. Cast of paratype No. 24542. Detroit River group, "Anderdon limestone"; locality 17. × 1.
14. Rubber cast of the ventral half of specimen in Figure 13, showing thickness and ventral aspect of the shell. Cast of paratype No. 24542. Detroit River group, "Anderdon limestone"; locality 17. × 1.
15. Side view of a natural mold of the interior of a left valve, showing dentition. Paratype No. 24539. Detroit River group, "Anderdon limestone"; locality 17. × 2.
16. Side view of a natural mold of the interior of a right valve, showing dentition. Paratype No. 24540. Detroit River group, "Anderdon limestone"; locality 17. × 2.

PLATE V

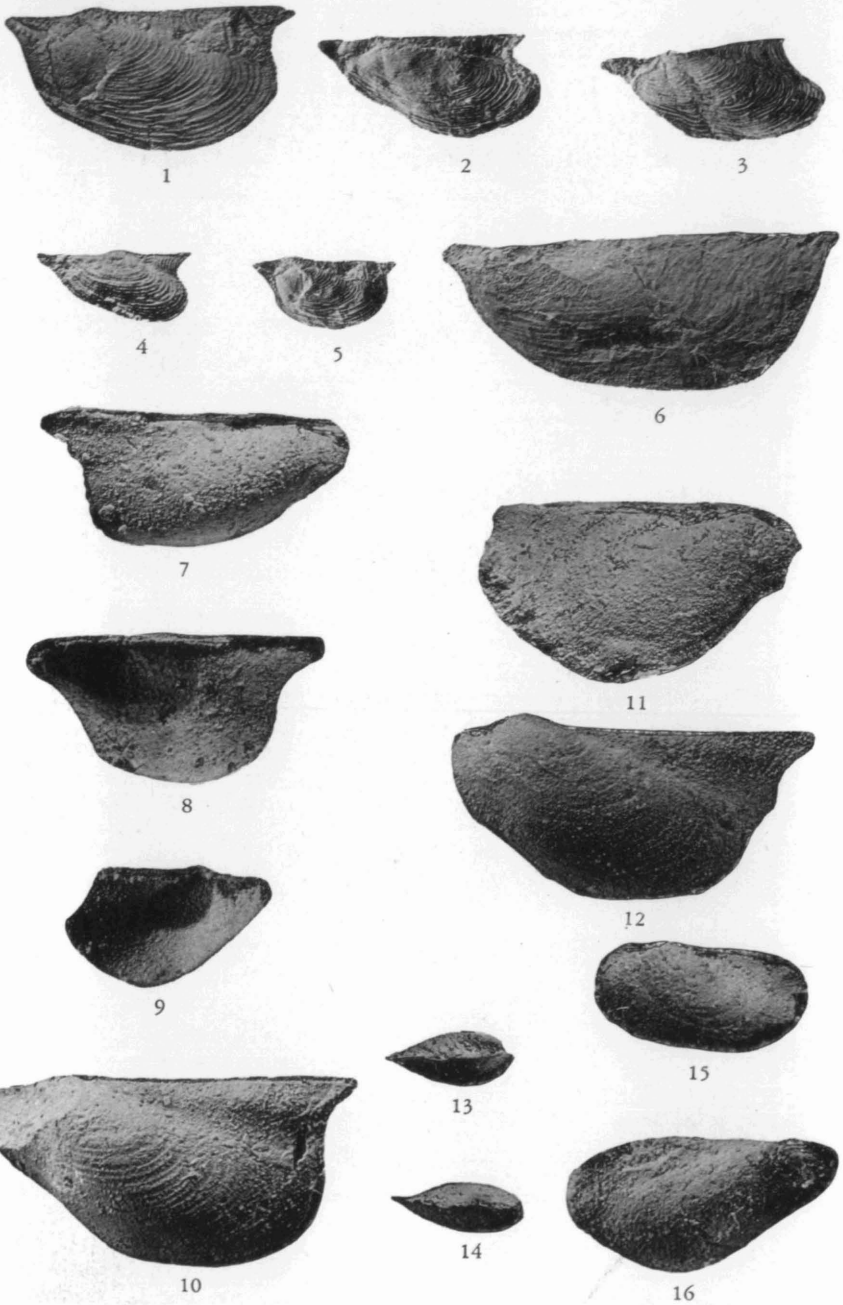
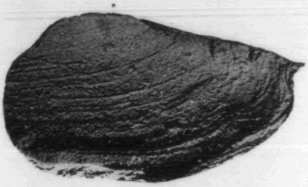


PLATE VI

1



2

3

5

4

6

8

10

7

9

11

12

13

14

EXPLANATION OF PLATE VI

PAGE

Diodontopteria kellumi, sp. nov. 290

1. Side view of a natural mold of the interior of a left valve, showing dentition. Holotype No. 24584. Dundee limestone; locality 36. × 2.
2. Side view of a wax impression of the mold of the exterior of the same specimen, showing surface ornamentation. Cast of the holotype No. 24584. Dundee limestone; locality 36. × 2.
3. Side view of a natural mold of the interior of a left valve, showing outline of the shell and character of the interior. Paratype No. 24585. Dundee limestone; locality 36. × 2.
4. Side view of a rubber cast of the exterior of a left valve, showing outline and ornamentation. Cast of paratype No. 24586. Dundee limestone; locality 36. × 2.

Diodontopteria? bradti (Sherzer and Grabau) 291

5. Side view of a natural mold of the interior of a right valve, showing dentition. Syntype No. 13060. Detroit River group, Lucas dolomite; locality 24. × 1.

Limoptera (*Myalinodonta?*) *migrans*, sp. nov. 292

6. Side view of a natural mold of the interior of a right valve, showing outline and dentition. Paratype No. 24563. Rogers City limestone; locality 39. × 1.
7. Side view of same specimen as in Figure 6, enlarged to show lateral teeth. × 2.
8. Side view of a cast of the exterior of an incomplete left valve, showing the wing and the external ornamentation. Holotype No. 24559. Rogers City dolomitic limestone; locality 43. × 1.
9. Side view of a wax cast of a natural mold of the exterior of an incomplete left valve, showing surface characters. Cast of paratype No. 24560. Rogers City dolomitic limestone; locality 43. × 1.
10. Side view of a natural cast of the exterior of an incomplete left valve, showing surface ornamentation. Paratype No. 24562. Rogers City dolomitic limestone; locality 43. × 1.
11. Side view of a natural cast of the exterior of a somewhat crushed left valve, showing ornamentation. Paratype No. 24561. Rogers City dolomitic limestone; locality 43. × 1.

Gosseletia sp. 294

12. Side view of a natural internal mold of a specimen showing the left valve. Figured specimen No. 24614. Dundee limestone; locality 34. × 1.
13. Anterior view of the same specimen shown in Figure 12.
14. Dorsal view of the same specimen shown in Figure 12.

EXPLANATION OF PLATE VII

PAGE

Liromytilus attenuatus (Whiteaves) 295

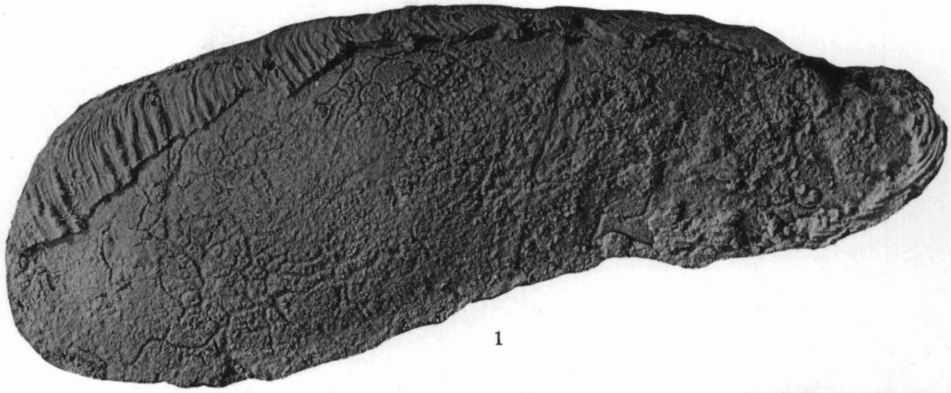
1. Dorsal view of a natural mold of the interior of both valves, showing length, thickness, and hinge. Holotype No. 4144, Geological Survey of Canada, figured by permission. Middle Devonian, southeast side of Dawson Bay, Lake Winnipegosis, four or five miles north of Shoal River, Manitoba, Canada.
2. Side view of a natural mold of the interior, showing internal features of the right valve. Holotype No. 4144, Geological Survey of Canada, figured by permission. Middle Devonian, southeast side of Dawson Bay, Lake Winnipegosis, four or five miles north of Shoal River, Manitoba, Canada.

PLATE VII

1

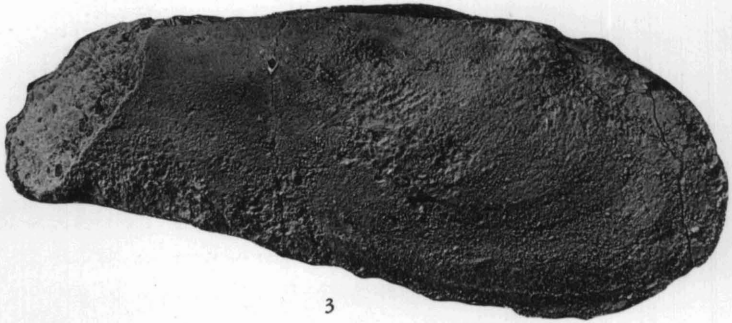
2

PLATE VIII



1

2



3

EXPLANATION OF PLATE VIII

PAGE

Liromytilus attenuatus (Whiteaves) 295

1. Side view of a largely exfoliated right valve, showing ornamentation along dorsal and anterior margins and molds of two teeth in dark area in front of umbo. Hypotype No. 23918. Rogers City limestone; locality 54. × 1.
2. Side view of a wax cast of part of the hinge of specimen in Figure 1, showing teeth. × 1.
3. Natural mold of the interior of a left valve. Hypotype No. 23920. Rogers City limestone; locality 45. × 1.

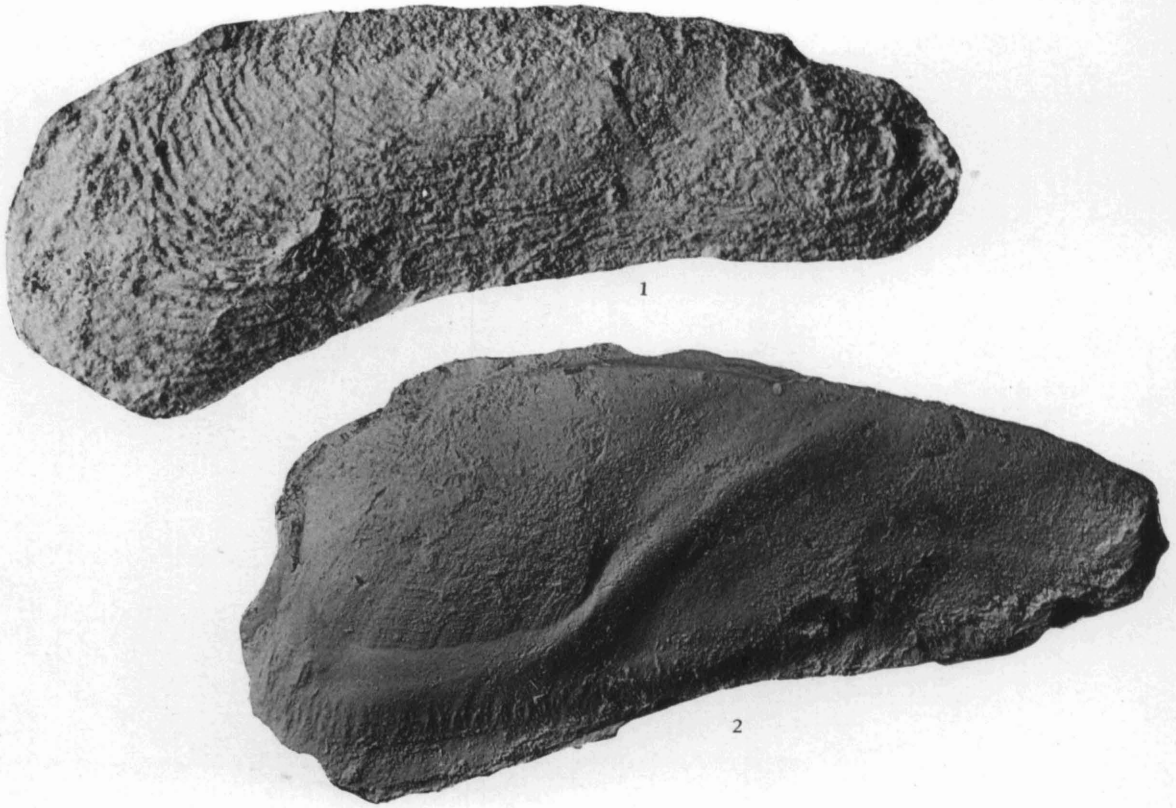
EXPLANATION OF PLATE IX

PAGE

Liromytilus attenuatus (Whiteaves) 295

1. Plaster cast of the exterior of a right valve, showing prominent ridges of shell. Cast of hypotype No. 23919. Rogers City limestone; locality 54. × 1.
2. Natural mold of the interior of a right valve. Hypotype No. 23921. Rogers City limestone; locality 46. × 1.

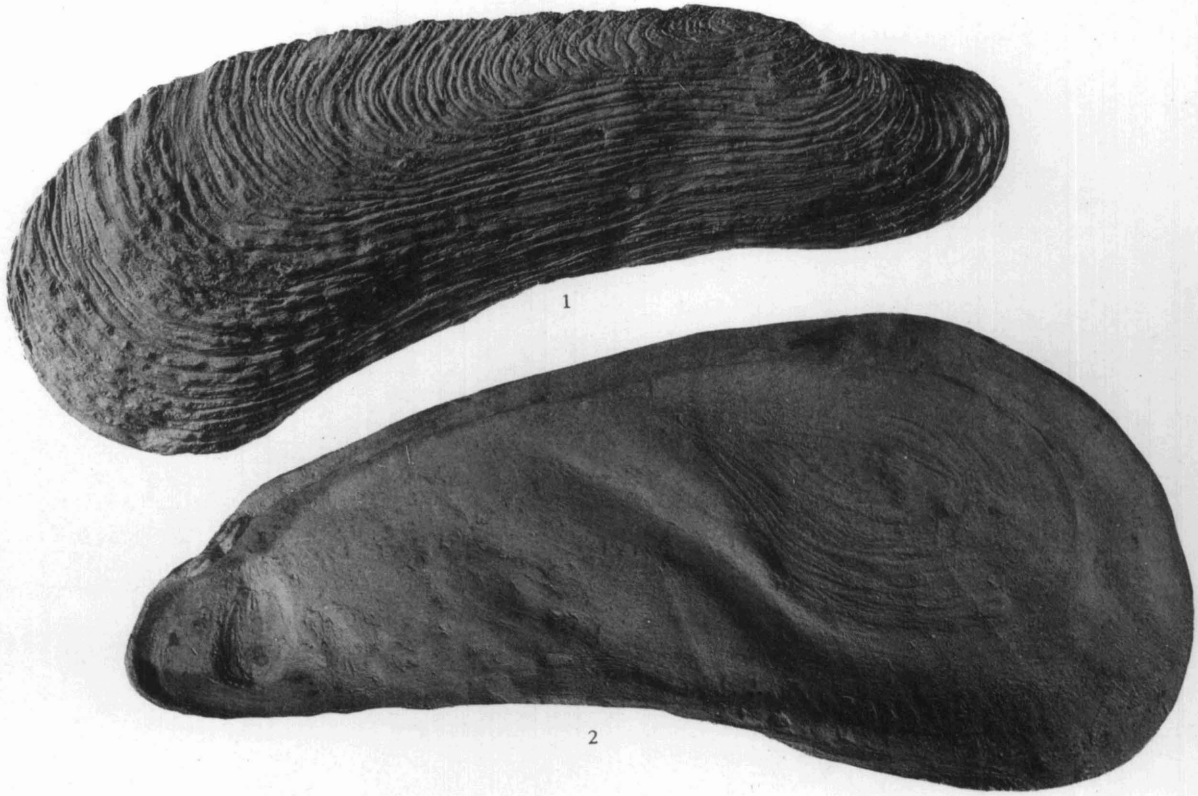
PLATE IX



1

2

PLATE X



1

2

EXPLANATION OF PLATE X

PAGE

Liromytilus attenuatus (Whiteaves) 295

1. Restoration of the exterior of a right valve, based chiefly on hypotype No. 23919. Retouched cast of hypotype No. 23919. Rogers City limestone; locality 54. × 1.
2. Restoration of the interior of a right valve, based chiefly on hypotype No. 23921 and partly on hypotype No. 23918. Retouched cast of hypotype No. 23921. Rogers City limestone; locality 46. × 1.

EXPLANATION OF PLATE XI

PAGE

Goniophora nucella, sp. nov. 299

1. Side view of the exterior of a left valve, showing external ornamentation, strong postumbonal ridge, and beak. Holotype No. 24591. Rogers City limestone; locality 54. × 2.
2. Dorsal view of the same specimen shown in Figure 1.

Palaeaneilo? sp. 302

3. Side view of a badly worn internal mold, the only specimen, showing the outline of the left valve. Figured specimen No. 24593. Dundee limestone; locality 29. × 1.

Nuculoidea? sp. A 300

4. Side view of the exterior of the right valve of the only specimen, showing outline and ornamentation. Figured specimen No. 24626. Rogers City limestone; locality 54. × 1.
5. Dorsal view of the same specimen as Figure 4.

Nuculoidea? sp. B 301

6. Side view of the only specimen, an internal mold, showing the left valve. Figured specimen No. 24627. Rogers City limestone; locality 54. × 1.

Cypricardinia canadensis Sherzer and Grabau 303

7. Side view of a natural mold of the interior of a right valve, showing outline. Syntype No. 14014. Detroit River group, Amherstburg dolomite; locality 21. × 1.

Schizodus sp. 302

8. Side view of a natural mold of the interior of a left valve, showing outline. Figured specimen No. 24616. Rogers City limestone; locality 49. × 1.
9. Side view of a natural mold of the interior of a fragment of a right valve, showing internal structure. Figured specimen No. 24618. Rogers City limestone; locality 48. × 1.
10. Side view of a natural mold of the interior of a right valve, showing outline. Figured specimen No. 24617. Rogers City limestone; locality 48. × 1.
11. Dorsal view of the same specimen shown in Figure 10. × 1.

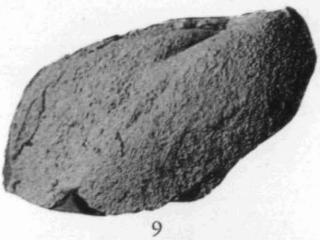
PLATE XI

1

7

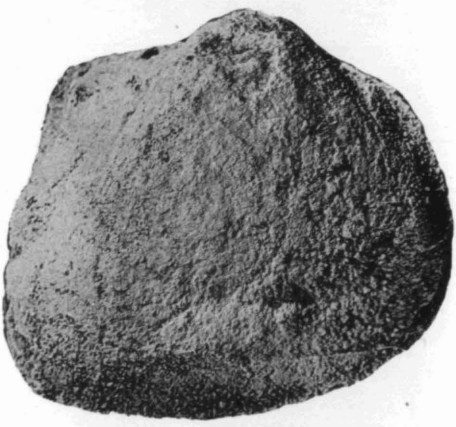
8

2



9

3



10

4

5

11

6

PLATE XII

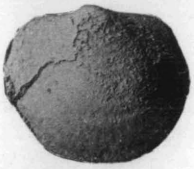
1

3

8

2

4



9

5

10

6

11

7

12

EXPLANATION OF PLATE XII

PAGE

Paracyclas elliptica Hall 309

1. Side view of the left valve of a "vertically compressed" specimen, showing the elliptical outline. Holotype No. $\frac{4002}{2}$, 25, 26, American Museum of Natural History, figured by permission. "Corniferous"; Le Roy, New York. × 1.
2. Dorsal view of the same specimen shown in Figure 1.
3. Side view of an uncrushed specimen, showing rounded outline of the left valve and the concentric growth lines. Hypotype No. $\frac{4002}{1}$, 23, American Museum of Natural History, figured by permission. "Corniferous"; Clarence, New York. × 1.
4. Dorsal view of the same specimen shown in Figure 3.
5. Side view of a badly crushed specimen, showing the greatly altered outline of the left valve. Hypotype No. $\frac{4002}{2}$, 30, American Museum of Natural History, figured by permission. "Corniferous"; Le Roy, New York. × 1.
6. Dorsal view of a large specimen, showing thickness. Hypotype No. $\frac{4002}{1}$, 29, American Museum of Natural History, figured by permission. "Corniferous"; western New York. × 1.
7. Side view of the same specimen as in Figure 6, showing outline of the left valve.

Paracyclas proavia (Goldfuss) 311

8. Side view of an immature specimen, showing an internal mold of the left valve with part of the shell replacement preserved. Hypotype No. 24429. Rogers City limestone; locality 44. × 1.
9. Side view of an immature specimen, showing an internal mold of the left valve with part of the shell replacement preserved. Hypotype No. 24429. Rogers City limestone; locality 44. × 1.
10. Side view of an incomplete left valve, showing external ornamentation. Hypotype No. 24430. Dundee limestone; locality 38. × 1.
11. Dorsal view of a mold of the interior of a specimen showing outline and thickness of the valves. Hypotype No. 24427. Probably Dundee limestone; locality 35. × 1.
12. Side view of the same specimen, showing muscle scars and pallial line. Hypotype No. 24427. Probably Dundee limestone; locality 35. × 1.

EXPLANATION OF PLATE XIII

PAGE

Paracyclas proavia (Goldfuss) 311

1. Side view of a plaster cast made from a natural mold of the exterior of an incomplete left valve, showing surface ornamentation. Cast of hypotype No. 24428. Probably Dundee limestone; locality 35. × 1.
2. Dorsal view of an internal mold of an imperfectly preserved specimen, showing outline and position of beaks. Hypotype No. 15274. Dundee limestone; locality 28. × 1.

Phenacocyclas? ohioensis (Meek) 313–14

3. Side view of the exterior of the left valve, showing outline, surface ornamentation, and position of the beaks. Lectotype No. 12113G, Columbia University, figured by permission. Columbus limestone; Dublin, Ohio. × 2.

Phenacocyclas pohli, sp. nov. 316

4. Dorsal view of a mold of the interior of a specimen with closed valves, showing thickness of the valves and position of the umbones. Holotype No. 24401. Probably Dundee limestone; locality 35. × 1.
5. Side view of the same specimen shown in Figure 4.
6. Side view of a mold of the interior of a right valve, showing muscle scars, grooves, and plication of the anterior border. Paratype No. 24402. Probably Dundee limestone; locality 35. × 1.
7. Anterior view of specimen illustrated in Figures 4 and 5, showing the slight sinuosity of the margins of the valves in the anterior region. Holotype No. 24401. Probably Dundee limestone; locality 35. × 1.

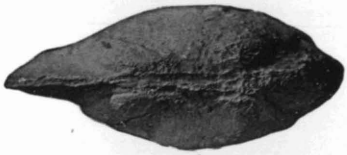
PLATE XIII

1

2

3

6



4

5

7

PLATE XIV

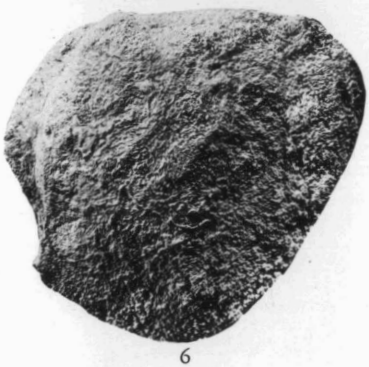
1

2

3

4

5



6

EXPLANATION OF PLATE XIV

PAGE

Phenacocyclas pohli, sp. nov..... 316

1. Side view of a plaster cast of an internal mold showing the internal characters of the right valve. Cast of paratype No. 24402. Probably Dundee limestone; locality 35. × 1.
2. Side view of a plaster cast of an internal mold showing the internal characters of the left valve. Cast of paratype No. 24403. Probably Dundee limestone; locality 35. × 1.
3. Side view of an internal mold, showing the muscle scars and the mold of the grooves between the muscle scars. Paratype No. 24412. Probably Dundee limestone; locality 35. × 1.
4. Side view of an internal mold of the right valve of a specimen without grooves on the valves. Compare Figure 3. Paratype No. 24411. Rogers City limestone; locality 54. × 1.
5. Side view of an internal mold of the right valve, showing plications of the ventral margin but without the grooves of the valves shown on other specimens. Compare Figure 3. Paratype No. 24403. Dundee limestone; locality 28. × 1.
6. Side view of a worn internal mold showing the interior of the right valve. Paratype No. 24419. Dundee limestone; locality 28. × 1.

EXPLANATION OF PLATE XV

PAGE

Phenacocyclas pohli, sp. nov. 316

1. Side view of a specimen showing the external ornamentation of the left valve in the anterior region, the internal features in the posterior region. Paratype No. 24409. Rogers City limestone; locality 51. × 1.
2. Side view of an internal mold of the left valve of a specimen showing internal structures. Paratype No. 24410. Rogers City limestone; locality 51. × 1.
3. Side view of a specimen showing some of the external ornamentation of the right valve. Paratype No. 24407. Rogers City limestone; locality 50. × 1.
4. Side view of a specimen, showing external ornamentation of the right valve. Paratype No. 24404. Rogers City limestone; locality 51. × 1.
5. Side view of an internal mold of a specimen, showing internal characters of the right valve. Paratype No. 24408. Rogers City limestone; locality 52. × 1.
6. Side view of the exterior of a fragmentary specimen, showing ornamentation of the umbonal region of the right valve. Paratype No. 24405. Rogers City dolomitic limestone; locality 44. × 1.
7. Side view of the exterior of a specimen, showing the ornamentation of the left valve. Paratype No. 24406. Rogers City limestone; locality 51. × 1.

Conocardium sibleyense, sp. nov. 318

8. Side view of a rubber cast of the interior of a left valve, showing outline and ornamentation. Cast of holotype No. 24471. Detroit River group, "Anderdon limestone"; locality 17. × 2.
9. Side view of a rubber cast of the interior of an imperfectly preserved specimen, showing ornamentation and part of the outline of the left valve. Cast of paratype No. 24474. Detroit River group, "Anderdon limestone"; locality 17. × 2.
10. Posterior view, slightly oblique, of a rubber cast of the interior of a specimen with closed valves, showing posterior tube. Cast of paratype No. 24478. Detroit River group, "Anderdon limestone"; locality 17. × 2.
11. Ventral view of a rubber cast of the interior of a specimen with closed valves, showing thickness and ventral outline. Cast of paratype No. 24630. Detroit River group, "Anderdon limestone"; locality 17. × 2.
12. Side view of a rubber cast of the interior of a left valve, showing ornamentation and outline. Cast of paratype No. 24472. Detroit River group, "Anderdon limestone"; locality 17. × 2.
13. Anteroventral view of a rubber cast of the interior of a specimen with closed valves, showing ornamentation and anterior gape. Cast of paratype No. 24631. Detroit River group, "Anderdon limestone"; locality 17. × 2.
14. Ventral view of half of the interior of a complete specimen, showing outline of a median section of the shell and characters of the dorsal part of both valves. Paratype No. 24473. Detroit River group, "Anderdon limestone"; locality 17. × 2.
15. Dorsal view of the other half of the same specimen as in Figure 14, showing preservation and ornamentation.
16. Side view of a rubber cast of the interior of a left valve, showing outline and ornamentation. Paratype No. 24475. Detroit River group, "Anderdon limestone"; locality 17. × 2.

PLATE XV

1

2

3

4

5

6

7

8

9

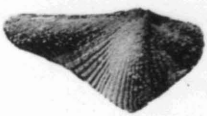
10

11

12

13

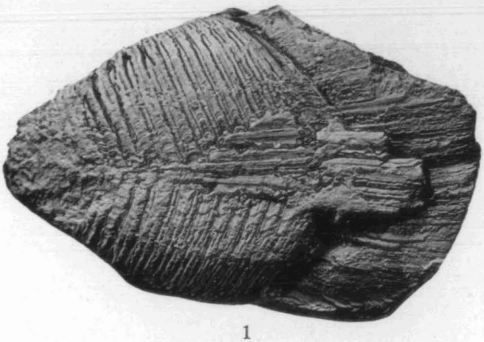
14



16

15

PLATE XVI

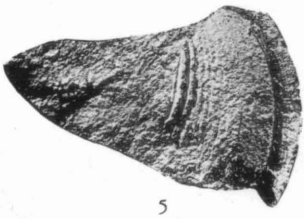


1

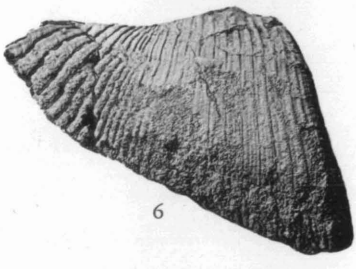
2

3

4



5



6

EXPLANATION OF PLATE XVI

PAGE

Conocardium cuneus (Conrad) 319

1. Ventral view of a partly eroded specimen, showing attachment of hood and twisting of the commissure of the valves in the region of the hood. Hypotype No. 24480. Columbus limestone; quarry of Medusa Portland Cement Company, NE.1/4 sec. 18, Sylvania Township, Lucas County, Ohio. × 1.
2. Ventral view of a specimen with closed valves, in which the external layer of shell is preserved. Note that there is no trace of ribs and that the specimen shows only concentric growth lines. Hypotype No. 1799. "Corniferous"; probably Sandusky, Ohio. × 1.
3. Dorsal view of a rubber cast of a specimen showing most of the hood. Hypotype No. 24628. Dundee limestone; locality 28. × 1.
4. Dorsal view of a specimen tilted to show the structure of the shell in the region of the hood. The two layers of shell are well shown on the posterior slope of the left valve. Hypotype No. 7022. Middle Devonian, drift, Ann Arbor, Michigan. × 1.

Conocardium monroicum Grabau 321

5. Side view of an imperfectly preserved left valve, showing attachment of the hood almost up to the umbo. Hypotype No. 24523. Detroit River group, Amherstburg dolomite; locality 20. × 1.
6. Side view of a left valve in which the outer shell layer has been eroded away, showing outline of the shell without the hood and the character of the ribs. Hypotype No. 24522. Detroit River group, Amherstburg dolomite; locality 20. × 1.

EXPLANATION OF PLATE XVII

PAGE

Conocardium monroicum Grabau 321

1. Dorsal view of a rubber cast of an uncrushed specimen, showing the ornamentation of the postumbonal slope and part of the hood. Hypotype No. 24526. Detroit River group, Amherstburg dolomite; locality 20. × 1.
2. Dorsal view of a rubber cast of an imperfect specimen, showing ligamental area. Hypotype No. 24529. Detroit River group, Amherstburg dolomite; locality 19. × 1.
3. Anterior view of a specimen with closed valves, showing thickness of the shell and a section of the posterior tube. Hypotype No. 14017. Detroit River group, Amherstburg dolomite; locality 23. × 1.
4. Side view of an incomplete left valve, showing character of the ornamentation after exfoliation of the outer layer of the shell. Lectotype (selected by Branson, 1942) No. 14018. Detroit River group, Amherstburg dolomite; locality 21. × 1.
5. Side view of a rubber cast of a partly exfoliated left valve, showing detail of ornamentation. Hypotype No. 24524. Detroit River group, Amherstburg dolomite; locality 20. × 1.

Conocardium sp. A 322

6. Side view of a rubber cast of a left valve, showing outline and ornamentation. Figured specimen No. 24629. Rogers City limestone; locality 51. × 2.

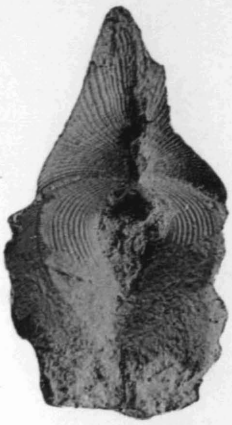
Panenka canadensis Whiteaves 325

7. Side view of a left valve, showing outline and ornamentation. Hypotype No. 13079. Detroit River group, Amherstburg dolomite; locality 21. × 1.

Solenomorpha peninsularis, sp. nov. 327

8. Side view of a mold of an incomplete right valve, showing internal surface. Paratype No. 24599. Rogers City dolomitic limestone; locality 43. × 1.
9. Side view of a mold of the interior of a right valve, showing internal surface. Holotype No. 24597. Rogers City dolomitic limestone; locality 43. × 1.
10. Side view of a mold of the interior of a right valve, showing nearly complete outline of shell. Paratype No. 24598. Rogers City dolomitic limestone; locality 42. × 1.
11. Side view of an external mold of a right valve, showing ornamentation. Paratype No. 24600. Rogers City dolomitic limestone; locality 41. × 1.

PLATE XVII



1

2

3

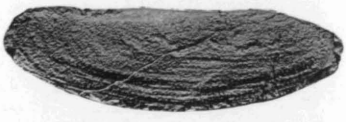
4

5

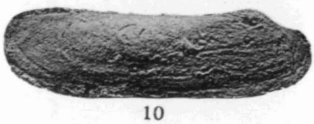
6

7

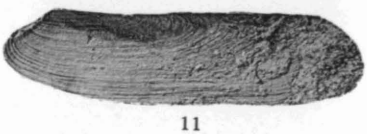
8



9



10



11

PLATE XVIII

EXPLANATION OF PLATE XVIII

PAGE

Panenka grandis Whiteaves..... 324

Side view of a badly eroded left valve, showing the outline and character of the ribs of the valve. Hypotype No. 15266. Dundee limestone; locality 28. × 1.

EXPLANATION OF PLATE XIX

PAGE

Panenka coralliophila, sp. nov. 326

1. Side view of an imperfectly preserved right valve, showing part of the outline, the umbo, and the surface ornamentation in the ventral region. Holotype No. 24594. Bois Blanc formation, bioherm core in the upper part; locality 13. × 1.

Panenka sp. 326

2. Side view of a plaster cast of an incomplete right (?) valve showing the ventral outline and part of the surface ornamentation. The specimen is too poorly preserved to be identified positively as a right or left valve, but the cardinal portion of the valve nearest the right side of the figure is thicker than the left and is taken to be the site of the umbo. Cast of the only specimen, No. 24595. Bois Blanc formation; locality 15. × 1.

PLATE XIX

1

2

Volume VII

1. The Priority of Dana, 1846–48, versus Hall, 1847, and of Rominger, 1876, versus Hall, 1876 (?1877), by Erwin C. Stumm. Pages 1–6. Price $.25.

2. Lower Middle Devonian Species of the Tetracoral Genus *Hexagonaria* of East-Central North America, by Erwin C. Stumm. Pages 7–49, with 14 plates. Price $1.25.

3. A Revision of the Aulacophylloid Tetracoral Genus Odontophyllum, by Erwin C. Stumm. Pages 51–61, with 2 plates. Price $.35.

4. Pleistocene Stratigraphy and Paleontology of Meade County, Kansas, by Claude W. Hibbard. Pages 63–90, with 1 plate. Price $.75.

5. Pliocene Saw Rock Canyon Fauna in Kansas, by Claude W. Hibbard. Pages 91–105. Price $.40.

6. *Tremarctotherium* from the Pleistocene of Meade County, Kansas, by George C. Rinker. Pages 107–112, with 1 plate. Price $.25.

7. New Uncoiled Gastropods from the Middle Devonian of Michigan and Manitoba, by Aurèle La Rocque. Pages 113–122, with 3 plates. Price $.30.

8. Corals of the Devonian Traverse Group of Michigan. Part I, *Spongophyllum*, by George M. Ehlers and Erwin C. Stumm. Pages 123–130, with 3 plates. Price $.30.

9. Fossil Flora of the Michigan Coal Basin, by Chester A. Arnold. Pages 131–269, with 34 plates. Price $3.00.

10. Pre-Traverse Devonian Pelecypods of Michigan, by Aurèle La Rocque. Pages 271–366, with 19 plates. Price $2.00.