GEOLOGICAL SURVEY OF OHIO

Section measured in pit of Central Refractories Co., Lexington, Perry County

		Feet	Inches
Shale, gray		20	--
Shale, blue, concretionary, sparingly fossiliferous	*McArthur*	8	--
Limestone, ferruginous, fossiliferous	*McArthur*	--	5
Shale, calcareous, fossiliferous	*McArthur*	--	5
Coal, *Tionesta*		1	--
Clay, part siliceous		11	8

Strata measured at mine of Ludowici Celadon Co., Section 7, Pike Township, Perry County

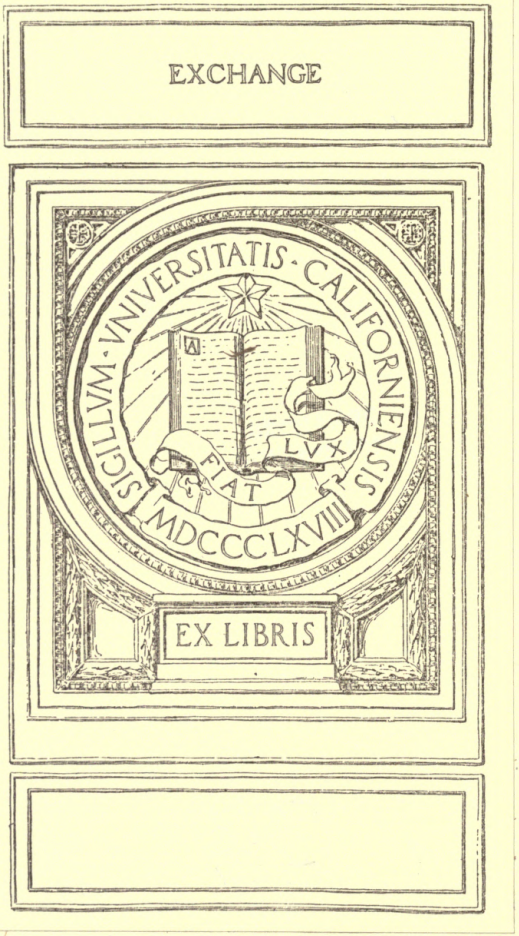
		Feet	Inches
Shale, blue		20	--
Shale, blue, concretionary, sparingly fossiliferous	*McArthur*	8	--
Limestone, impure, very fossiliferous	*McArthur*	--	4
Coal	*Tionesta*	--	9
Shale	*Tionesta*	--	1
Coal	*Tionesta*	1	4
Clay		3	--
Flint, black, irregular, *Upper Mercer*		1	--
Coal, *Bedford*		1	--

Muskingum and Coshocton Counties.—North of Perry County the McArthur member has been found in a number of places, but the deposit is thin and sparingly fossiliferous. In most cases, however, if it is present, it forms a part of the mass of shales which occupy the entire interval between the Tionesta horizon and the Putnam Hill limestone of the Allegheny formation.

Summary

The McArthur member is generally represented by calcareous shale, although impure limestone and sandy shale may mark the horizon or may be interbedded with the calcareous shale. At the type locality near McArthur in Vinton County, the limestone phase is well developed. The stratum is bluish-gray to almost black in color and is everywhere extremely rich in fossil remains. The member is also well developed in Jackson County as far south as Monroe Furnace, and extends northward into Hocking, Perry, Muskingum, and Coshocton counties. In thickness it varies from 1 to 15 feet, and it forms the fifth member of the series of marine limestones of the Pennsylvanian system in Ohio.

The complete list of fossils collected from the McArthur member follows:



GEOLOGICAL SURVEY OF OHIO

J. A. BOWNOCKER, State Geologist

FOURTH SERIES, BULLETIN 25

POTTSVILLE FAUNA OF OHIO

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INTRODUCTION

This bulletin deals with the fauna of the Pottsville formation which, as developed in Ohio, includes thirteen fossiliferous horizons: six marine limestones, four iron ores which contain marine faunas, and three shale horizons associated with coal beds which contain fresh or brackish water fossils. The field of study is practically new, as up to the present time very little work has been done on the Pottsville fossils of this State, with the exception of a few papers which treat of the Lower Mercer fauna of Flint Ridge and vicinity. Collections were made from ninety-three localities, and at many of these places fossils from two or more members were obtained. Exclusive of plant and fish remains, two hundred species were identified, among which are a considerable number of new forms and fossils of particular interest.

The collections were made chiefly during the summers of 1918 and 1919, and the manuscript was prepared for the most part during the summer of 1920 and the following university year. In most instances large quantities of fossiliferous rock were collected, from which the fossils were later obtained and prepared for study in the laboratory. The fossils used in this investigation are the property of the Geological Survey of Ohio, and all types, figured specimens, and forms of unusual interest have been placed in the Geological Museum of The Ohio State University. The portion of this bulletin which deals with the stratigraphy and fauna of the Pottsville formation below the Lower Mercer limestone was submitted in June, 1921, to the faculty of Bryn Mawr College in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

ACKNOWLEDGEMENTS

The writer wishes to express her indebtedness to Dr. J. A. Bownocker, State Geologist of Ohio, for a position on the Geological Survey of Ohio while the necessary field work was being carried on, and for the many helpful suggestions which he has given concerning the work; also to Mr. Wilber Stout, of the Geological Survey of Ohio, not only for his aid in collecting fossils and for the suggestion of localities where collections could be obtained, but also for his help with the stratigraphy of the Pottsville formation and for the kindly interest which he has taken in every phase of the work. It is likewise a great pleasure to the writer to acknowledge her obligation to Dr. George H. Girty of the United States Geological Survey, for the valuable assistance which he has given in the verification of new species and of obscure or doubtful forms. Lastly, thanks are due to Mr. Raymond E. Lamborn, Dr. Guy W. Conrey, and Mr. Clarence F. Moses for the collections of fossils made by them, as given in the register of localities, to Miss Charlotte Morningstar for her assistance in collecting fossils, to Professor J. E. Hyde of Western Reserve University, for the use of his collections of Pottsville fossils, and to Professor G. F. Lamb of Mount Union College, for the suggestion of localities in Stark and Mahoning counties where collections could be made.

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STRATIGRAPHY OF THE FOSSILIFEROUS MEMBERS OF THE POTTSVILLE FORMATION[1]

PENNSYLVANIAN SYSTEM

The rocks of the Pennsylvanian system outcrop in southeastern Ohio over an area of approximately 11,125 square miles. They are divided into four formations, Pottsville, Allegheny, Conemaugh, and Monongahela, and together their entire thickness in the State averages 1,100 feet. This bulletin deals only with the oldest formation of the Pennsylvanian system, the Pottsville.

Pottsville Formation

The Pottsville formation, occurring at the base of the Pennsylvanian system, includes all the rocks between the Mississippian system below and the Allegheny formation of the Pennsylvanian system above; or between the Maxville limestone, or the Waverly formation where the former is wanting, and the Brookville coal, which forms the basal member of the Allegheny formation. In many places, especially in the central part of the outcrop, there is no sharp line of demarcation between the Pottsville and Allegheny formations, as shales form the upper members of the Pottsville and the lower members of the Allegheny, so that there is a gradual transition from one formation to the other. The outcrop of the formation is extensive and crosses the southeastern portion of the State. Beginning at the Ohio River in Scioto and Lawrence counties, the rock exposures extend northeastward as far as Wayne and Stark counties, and then eastward, crossing the Ohio-Pennsylvania State line from Mahoning County. The formation is found in the following counties,—Lawrence, Scioto, western Gallia, Jackson, eastern Pike, Vinton, western Athens, Hocking, Perry, Muskingum, eastern Licking, Coshocton, eastern Knox, Tuscarawas, Holmes, Wayne, Stark, eastern Medina, Summit, Geauga, Portage, southern Trumbull, Mahoning, and Columbiana.

[1]The main divisions of the Pennsylvanian system—the Pottsville, Allegheny, Conemaugh and Monongahela—are here given the rank of formations, while the subdivisions of each are called members, according to the usage adopted by the Geological Survey of Ohio. In other states different values are sometimes assigned to the divisions of the Pennsylvanian system.

Between the Mississippian and Pennsylvanian systems, or at the base of the Pottsville formation, there exists everywhere a great unconformity, as is shown by the extremely irregular upper surface of the Mississippian rocks. The basal members of the Pottsville formation rest sometimes on varying thicknesses of Maxville limestone and sometimes directly upon the Logan formation which occurs below the Maxville. The Maxville limestone is found in patches, which, as shown

Map showing outcrop of Pottsville formation in Ohio

by W. C. Morse, are undoubtedly the remnants of a once continuous deposit laid down at the end of Mississippian time.[1] Uplift, however, caused the withdrawal of the sea, and for a long period the region was subjected to erosion. The duration of this period was great enough

[1]Morse, W. C., Geol. Surv. Ohio, Fourth Ser., Bull. 13, p. 99, 1910.

to remove most of the Maxville limestone, and in some places for streams to cut into the underlying Logan formation. Remnants of the Maxville limestone appear at the present time only as isolated patches or islands surrounded by younger rocks of Pottsville age. At the end of these land conditions, the region was again submerged and the basal members of the Pottsville formation, the Harrison ore and the Sharon conglomerate, were deposited in the low troughs and basins.

The Pottsville formation varies in thickness from 100 to 350 feet but averages about 255. The deposit thickens toward the south, and in southern Ohio attains its maximum development; there is also a general thickening from the western to the eastern part of the outcrop. The extremely irregular line of contact between the Pottsville formation and the Mississippian system below is responsible for the great variation in the thickness of the formation in different regions. Where the Maxville limestone has been largely or entirely eroded, the lowest members of the Pottsville formation, the Harrison ore and the Sharon conglomerate, are present, while successively higher members form the base of the formation where increasing thicknesses of Maxville limestone are found. In Hopewell Township, Muskingum County, on Poverty Run, the Quakertown coal forms the base of the Pottsville, while elsewhere any of the horizons from the Harrison ore to the Quakertown coal may be in contact with rocks of Mississippian age.

The Pottsville formation in Ohio is composed for the most part of shales and sandstones, interbedded with clays, coals, iron ores, and marine limestones. The accompanying generalized section of the formation shows the succession of the various members and their relations to each other. The members vary greatly in character and thickness from place to place. Some, such as the Black Flint at the top of the formation, are local in their occurrence and are found only in the southern part of the outcrop; others, such as the McArthur limestone and Sciotoville clay, are more extensively developed in southern Ohio but to the northward become thin and finally disappear. There are certain strata, however, of great importance for stratigraphic study, as they are very persistent and can be traced from the Ohio River northward along the Pottsville outcrop to the Ohio-Pennsylvania state line. At the base occurs the Sharon conglomerate which, although patchy in appearance, can be found everywhere in the deepest troughs eroded in pre-Pottsville times. Among the coals, the Quakertown or No. 2 coal, the Lower Mercer or No. 3 coal, the Middle Mercer or No. 3a coal, and the Tionesta or No. 3b coal are the well-defined stratigraphic units. By far the best developed and most persistent horizons, however, are the Lower and Upper Mercer limestones with their accompanying iron ores; these members, especially the Lower Mercer, are found in every county where they may be expected, and

form datum planes of extreme importance for determining the stratigraphic relations of the overlying and underlying formations.

Economically the Pottsville formation is of considerable value, and it has added much to the natural resources and wealth of the State. Most of the iron ores which have been worked for the purpose of smelting in the old charcoal furnaces, particularly in Scioto, Lawrence, Jackson, and Vinton counties, were from this formation. The Lower and Upper Mercer ores especially are of sufficient thickness and are high enough in iron content to be of some importance commercially. However, they in no way rival the ores of the Lake Superior region, and at the present time are used only to a very limited extent if at all. The coals are utilized mostly for local purposes, but a few beds, such as the Sharon coal and particularly the Quakertown or No. 2 coal, have been mined for commercial use for the past forty years and have been important factors in the development of industry in southern Ohio. In Jackson County, the Quakertown coal is of good quality and thickness, and is responsible for the rapid growth of Jackson, Wellston, and other towns in the mining district. Pottsville clays are also of importance economically, and the Sciotoville clay has been used for many years in Scioto and Jackson counties for the manufacture of refractory wares, for which purpose it sets a standard of excellence in Ohio.[1]

A study of the Pottsville fossils shows that with the exception of the coal formations, the members are marine in origin for the most part. The marine conditions which produced these members alternated with the swamp conditions under which the coal was deposited. During six periods marine conditions favored the deposition of limestone, and the first six members of the series of limestones of the Pennsylvanian system were laid down, namely the Lowellville (Poverty Run), Boggs, Lower Mercer, Upper Mercer, McArthur, and Black Flint members. The marine sediments were deposited in shallow waters, and as they grew in thickness the water level was approached until swamp conditions, necessary for the formation of coal, were brought about. A slow depression, however, successively brought the swamp conditions to an end and shallow marine waters again occupied the region, and another series of marine sediments was deposited. The slow periodic sinking of the region and the subsequent building up of the sea bottom to the water level were necessary for the alternation of marine sediments and coals.[2]

In the following discussion the faunal horizons of the Pottsville formation are treated successively, so as to show the stratigraphic relations, character, and extent of each of these strata.

[1]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 20, pp. 514, 73, 1916.

[2]Stout, W., Manuscript on Clays of Ohio.

COMPOSITE SECTION OF THE POTTSVILLE FORMATION IN OHIO

Formation	Member	General Description The horizons from which fossils were collected are marked X	Thickness Ft.	Thickness In.
POTTSVILLE, 255 ± FEET	Brookville	Clay, not persistent	4	0
	xBlack Flint	Ore, nodular, sparingly fossiliferous } very local	--	6
		Flint, black, or Limestone, very fossiliferous } very local	1	0
	Homewood	Shale and Sandstone	1	0
	xMcArthur	Shale, in places sparingly fossiliferous	4	0
		Limestone, impure, or Shale, calcareous, not persistent, very fossiliferous	1	6
	Tionesta or No. 3b	Coal, rather continuous, usually thin	2	0
		Clay, light, siliceous	5	0
		Shale and Sandstone	16	0
	xUpper Mercer	Ore, nodular, sparingly fossiliferous, locally present	--	5
		Shale, in places fossiliferous	--	7
		Limestone, dark blue, or Flint, black, fossiliferous, not persistent	1	0
	Bedford	Coal, not persistent	1	0
		Clay, variable	2	0
		Shale and Sandstone	7	0
	xSand Block	Ore, nodular, siliceous, in places sparingly fossiliferous	--	3
		Shale and Sandstone	4	6
	Upper Mercer or No. 3a	Coal, not persistent	1	0
		Clay, not persistent, siliceous	2	6
		Shale and Sandstone	9	0
	xLower Mercer	Ore, kidney, sparingly fossiliferous, local	--	3
		Shale	4	6
	xLower Mercer	Limestone, blue, very fossiliferous, very persistent	2	0
	Middle Mercer	Coal, thin, rather persistent	--	6
		Clay, siliceous	3	6
		Shale and Sandstone	5	0
	Flint Ridge	Coal, not persistent, thin	--	6
		Clay, flint, blue, local	1	0
		Clay, siliceous, light	3	0
		Shale and Sandstone	5	0

COMPOSITE SECTION OF THE POTTSVILLE FORMATION IN OHIO—Concluded

Formation	Member	General Description The horizons from which fossils were collected are marked X	Thickness Ft.	Thickness In.
POTTSVILLE 255 ± FEET	xBoggs	Limestone, blue, or Ore, fossiliferous, local	--	6
		Shale	1	0
	Lower Mercer or No.3	Coal, not persistent	1	0
		Clay, siliceous	3	0
		Shale and Sandstone	21	0
	xLowellville (Poverty Run)	Shale, calcareous, very fossiliferous	1	0
		Limestone, hard, ferruginous. fossiliferous, very local	--	6
		Shale	1	6
	Vandusen	Coal, thin, often wanting	1	0
		Clay, impure	2	0
		Shale and Sandstone	15	0
	xBear Run	Shale, blue, locally fossiliferous	2	0
		Coal, unsteady	1	6
		Clay, siliceous, impure	3	0
		Shale and Sandstone	24	0
	xQuakertown or No. 2	Coal, locally well developed	3	0
		Clay, siliceous	2	0
		Shale and Sandstone	20	6
	Guinea Fowl	Ore, siliceous, very local	--	6
		Shale	3	0
	xAnthony	Shale, bony, in places fossiliferous	--	3
		Coal, local	--	3
	Sciotoville	Clay, flint, plastic, not persistent	4	0
		Shale and Sandstone	19	0
	xSharon	Ore, fossiliferous, seldom present	--	6
		Shale	5	6
	Sharon or No. 1	Coal, locally well developed	3	0
		Clay, siliceous	2	0
		Shale, usually wanting	5	0
	Sharon	Conglomerate, not persistent	20	0
	xHarrison	Ore, seldom present, fossiliferous	--	6

HARRISON ORE

Stratigraphy and Extent

The oldest fossiliferous member of the Pottsville formation, the Harrison ore, occurs at the base of the Pennsylvanian system and marks the line of contact between that and the underlying Mississippian system. Although the ore is extremely patchy in its occurrence, it is of comparatively wide extent and has been traced from Scioto County on the south, where it is best developed in Hamilton Township, northward through eastern Pike, Jackson, western Vinton, and Muskingum counties. It is also present in the Killbuck and Walhonding valleys of Coshocton County. In thickness it varies from 6 inches in Scioto County to a maximum of 4 feet in Jackson County;[1] to the northward in central Ohio it thins again, attaining a thickness of 10 inches in Muskingum County.[2]

The Harrison ore is of special interest on account of its position with reference to the Mississippian-Pennsylvanian unconformity, for it consists of the first materials deposited after the long period of erosion at the end of Mississippian time. The ore lies directly upon the eroded Mississippian surface—sometimes upon the Maxville limestone, or where that formation has been entirely removed, upon the Logan shales. In places it is so intimately associated with the Maxville limestone that it was formerly considered the upper part of that formation;[3] but Morse in his detailed work on the Maxville of Muskingum and Perry counties proves the horizon to be of Pennsylvanian age.[4] In southern Ohio at most localities, the ore appears as a distinct horizon above the Mississippian-Pennsylvanian unconformity.

In lithologic character the Harrison ore varies greatly from place to place. It is generally coarse in texture, and is composed of a conglomeratic mass of quartz pebbles, cherty material, and fragments of sandstone which have been cemented together by iron oxides. The cherty material seems to have been derived from the Maxville limestone which had been weathered into small fragments during the long period of erosion after the withdrawal of the Mississippian sea. These products of decomposition were later reworked by the incoming Pennsylvanian sea and were cemented by iron compounds. Many of the rounded quartz pebbles resemble those of the Sharon conglomerate which lies only a few feet above the ore or sometimes rests directly upon it. The member is generally poor in fossils, and where these occur, they appear mostly as internal casts and present an extremely dwarfed aspect.

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[1]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 20, pp. 28, 481, 1916.
[2]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 21, p. 48, 1918.
[3]Orton, Edward, Geol. Surv. Ohio, Vol. V, pp. 373-379, 1884.
[4]Morse, W. C., Geol. Surv. Ohio, Fourth Ser., Bull. 13, pp. 35-55 and elsewhere, 1910.

The Harrison ore is too poor in iron content to be of economic importance; its high percentage of silica and patchy outcrop also render it undesirable for commercial use. At present it is nowhere used commercially, although in the early history of the State it was utilized to a very limited extent in the charcoal furnaces of Scioto, Jackson, and Muskingum counties.

Description of Geologic Sections and Collecting Localities

Scioto County.—In Scioto County the ore is found only in Harrison Township, from which locality it was named by Stout in 1916.[1] The following strata measured on Munn Hill, in Section 32, show the variable character of the deposit:[2]

	Feet	Inches
Pottsville formation		
Shaly sandstone	20	--
Coal, bony, *Anthony*	--	6
Clay, flint, *Sciotoville*	3	6
Shales, and parts covered	38	--
Conglomerate zone, flint, bowlders, shale, ferruginous clay, *Harrison horizon*	2	--
Logan formation		

Jackson County.—The Harrison ore outcrops in the stream bed and valley walls of a small tributary which the Little Scioto River receives from the south, in the central part of Section 22, Hamilton Township. Excellent collecting is afforded from the bed of the stream below the house of Phillip Meldick, as the fossils are abundant, well preserved, and easily obtained. The deposit is buff or red in color, coarse-grained, siliceous, and filled with numerous soft, decomposed pebbles, resembling to a marked extent the Sharon ore above. The collection of fossils from this locality is the only one made from the Harrison ore. These fossils were *not* found in fragments of older Mississippian rock enclosed in the Harrison ore, and therefore are distinctly of Pennsylvanian age. The following section was measured here (Locality 1):[3]

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[1]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 20, p. 481, 1916.
[2]Idem., p. 482.
[3]Idem., p. 29.

Strata measured in valley of small tributary of Little Scioto River, Section 22, Hamilton Township, Jackson County

		Feet	Inches
Sandstone, coarse-grained, ferruginous	*Sharon conglomerate equivalent*	1	10
Shale, blue		--	1
Sandstone, coarse-grained, ferruginous		1	10
Ore, composed of small nodules, *Harrison*		--	10
Clay shale, light		2	--
Sandstone, with parts covered	*Logan*	15	--
Shale, soft, yellowish		1	6

The fossils collected from the Harrison ore at this locality are listed below:[1]

Crinoid segments

Orbiculoidea stoutella n. sp.
Orbiculoidea capuliformis (McChesney)?
Schizophoria sp.
Spiriferina kentuckyensis (Shumard)?
Hustedia mormoni (Marcou)
Composita subtilita (Hall)

Nucula subrotundata Girty mss.
Nucula beyrichi von Schauroth
Nuculopsis ventricosa (Hall)
Parallelodon tenuistriatus (Meek and Worthen)
Myalina pernaformis Cox var.
Schizodus affinis Herrick
Schizodus subcircularis Herrick
Aviculopecten coxanus Meek and Worthen

Bellerophon crassus Meek and Worthen?
Euphemus carbonarius (Cox)
Pleurotomaria ornatiformis n. sp.
Pleurotomaria, three or more species, undetermined
Schizostoma catilloides (Conrad)
Sphaerodoma humilis (Keyes)?

Muskingum County.—The section below, measured on the land of Frank Fink, southeastern part of Section 13, Hopewell Township, shows the character of the member in Muskingum County as well as its relation to the underlying Maxville limestone.[2]

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[1]In the treatment of fossils in this bulletin the name of the author who originally founded a species is inclosed in parentheses if the generic name of that species has been changed from that under which the fossil was originally described.

[2]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 21, p. 49, 1918.

	Feet	Inches
Pottsville formation		
Shale, blue	3	--
Shale, dark, fissile	--	10
Clay, siliceous	1	10
Ore, siliceous	--	3
Shale	--	1
Ore, siliceous	--	3
Harrison		
Maxville limestone	0 to 6	--

SHARON ORE

Stratigraphy and Extent

The next fossiliferous member of the Pottsville formation above the Harrison ore, namely the Sharon ore, is of very limited outcrop, and with the exception of Mahoning and Trumbull counties, is found only in the extreme southern part of Ohio,—in the eastern part of Scioto and Pike counties and in Jackson County.[1] The ore is very patchy and uncertain, and where present, either lies directly on the Sharon coal (Jackson Shaft coal, or Coal No. 1) or is separated from it by not more than 15 or 20 feet of sandstone and shale. In Jackson County it forms a deposit from 4 to 6 inches thick, while in Pike and Scioto counties it reaches a thickness of 10 inches to 1 foot 6 inches. The ore is buff or brown in color, highly siliceous, and coarse in texture, and is filled with numerous decomposed fragments of Mississippian material. Living conditions during the period of deposition of the Sharon ore were such as to support an abundant fauna, which, however, is small and dwarfed in aspect, owing probably to the high percentage of iron which the waters contained. The fossils which are for the most part well preserved generally occur as casts of the interior as in the case of the Harrison ore.

Description of Geologic Sections and Collecting Localities

Scioto County.—In Section 14, Porter Township, at the mouth of Lick Run, the ore is exposed on the farm of Joseph Jenkins, where it is extremely fossiliferous and furnishes good collecting material; the fossils resemble to a marked degree those of the Harrison ore both in species and condition of preservation. The deposit is brown in color and contains much soft, light brown, chalky material formed by the decomposition of inclosed pebbles. The section at this locality follows (Locality 2):[2]

[1] Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 20, pp. 71, 455, 493, 1916.
[2] Idem., p. 494.

Section at mouth of Lick Run, Section 14, Porter Township, Scioto County

	Feet	Inches
Pottsville formation		
Ore, *Guinea Fowl*	-	6
Shale	3	--
Covered	3	--
Ore, soft, siliceous, very fossiliferous, *Sharon*	1	--
Covered	3	--
Shale	6	--
Ore, with flint and pebbles, *Harrison*	1	--
Waverly formation		
Sandstone, *Vinton*	22	--

The collection of fossils made at this locality includes the following forms:

Crinoid segments

Pustula pertenuis Meek
Spiriferina kentuckyensis (Shumard)?
Composita subtilita (Hall)

Solenomya ?? sharonensis n. sp.
Solenomorpha lamborni n. sp.
Nucula elongata n. sp.
Nucula subrotundata Girty mss.
Nucula lunulata Girty mss.
Nuculopsis ventricosa (Hall)
Leda inflata Girty mss.
Anthraconeilo bownockeri n. sp.
Aviculopecten coxanus Meek and Worthen
Pleurophorus oblongus Meek

Bellerophon crassus Meek and Worthen?
Euphemus carbonarius (Cox)
Pleurotomaria ornatiformis n. sp.
Pleurotomaria, three or more species, undetermined
Schizostoma catilloides (Conrad)
Sphaerodoma primigenia (Conrad)?

Orthoceras n. sp.
Coloceras ? sp.

Phillipsia trinucleata Herrick

Fish teeth

In the northern part of Section 15, Madison Township, near the head of Higgins Run, specimens of the fresh or brackish water pelecypod, *Naiadites ohioense* n. sp., were found in the dark shales which lie directly above the Sharon coal; they are not abundant, however, and constitute the only fossil discovered at this locality. The samples of

shale which were examined were taken from the roof of the mine on the farm of John Alexander, where the geologic section below was measured (Locality 3):

Strata measured on farm of John Alexander, near head of Higgins Run, northern part of Section 15, Madison Township, Scioto County

	Feet	Inches
Pottsville formation		
Shale, gray	10	--
Shale, dark, sparingly fossiliferous	2	--
Coal, *Sharon*	2	2
Sandstone, *Sharon conglomerate* equivalent	30	--
Waverly formation		
Sandstone and shale	40	--

In the western part of Section 15, Madison Township, *Naiadites elongata* Dawson was obtained from the Harry Odle mine in the creek bed, where the dark shales afford good material for collecting (Locality 4). This fossiliferous shale is also present at the other mines in the vicinity. In Section 11, the Sharon ore is present above the shales, but it was not examined for fossils. The ore is 10 inches thick and lies nearly 10 feet above the Sharon coal. This bed was formerly mined in Section 22, Madison Township, for use in the charcoal furnaces.

Jackson County.—At the old, abandoned Glen Nell mine in Section 21, Washington Township, about 4 miles northwest of Wellston, the Sharon ore lies practically on the Sharon coal. It is very sparingly fossiliferous, and a diligent search in the coal dumps around the mouth of the mine revealed only a few specimens of *Orbiculoidea stoutella* n. sp. The geologic section at the Glen Nell mine is given below (Locality 5):[1]

	Feet	Inches
Sandstone, coarse-grained, interbedded	12	--
Ore, *Sharon*, irregularly bedded with pebbles in places	--	7
Shale, dark, carbonaceous	--	4
Coal, *Sharon*	3	1

In the central part of Section 34, Hamilton Township, the ore horizon is replaced by black bone shales which contain abundant fossil remains. Collections were made from the shales outcropping in the road just east of Tattle Creek, where the following section was measured (Locality 6):

	Feet	Inches
Shale, gray	5	--
Shale, bony, black, fossiliferous, *Sharon* ore equivalent	--	8
Shale and covered	2	--
Sandstone, *Sharon conglomerate* equivalent	3	--

[1]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 20, p. 71, 1916.

The fossils listed below were obtained at this place:

Lingula carbonaria Shumard
Orbiculoidea capuliformis (McChesney)?
Marginifera muricata var. missouriensis Girty
Phillipsia trinucleata Herrick

Trumbull and Mahoning Counties.—In the southcentral part of Trumbull and in the northcentral part of Mahoning County along Mineral Ridge, the Sharon coal is reported to be accompanied by a layer of black band ore which is doubtless the equivalent of the Sharon ore of southern Ohio.[1] The ore varies in thickness from 6 to 10 inches and overlies 2 feet of black shale; both the ore and the shale divide the Sharon coal into two beds. Remains of the fresh water, bivalve crustacean, *Estheria*, are said to occur in great abundance.

Summary

The complete list of fossils collected from the Sharon member follows:

Crinoid segments

Lingula carbonaria Shumard
Orbiculoidea stoutella n. sp.
Orbiculoidea capuliformis (McChesney)?
Pustula pertenuis (Meek)
Marginifera muricata var. missouriensis Girty
Spiriferina kentuckyensis (Shumard)?
Composita subtilita (Hall)

Solenomya ?? sharonensis n. sp.
Solenomorpha lamborni n. sp.
Nucula elongata n. sp.
Nucula subrotundata Girty mss.
Nucula lunulata Girty mss.
Nuculopsis ventricosa (Hall)
Leda inflata Girty mss.
Anthraconeilo bownockeri n. sp.
Naiadites elongata Dawson
Naiadites ohioense n. sp.
Aviculopecten coxanus Meek and Worthen
Pleurophorus oblongus Meek

Bellerophon crassus Meek and Worthen?
Euphemus carbonarius (Cox)
Pleurotomaria ornatiformis n. sp.
Pleurotomaria, 3 or more species, undetermined
Schizostoma catilloides (Conrad)
Sphaerodoma primigenia (Conrad)?

[1]Newberry, J. S., Geol. Surv. Ohio, Vol. III, p. 790, 1878.

A—Sciotoville clay with Anthony coal above. Along Baltimore and Ohio Southwestern Railroad near Gephart, Scioto County

B—Breccia of Maxville limestone on Harrison ore horizon. Lucasville, Pike County

Orthoceras n. sp.
Coloceras ? sp.

Phillipsia trinucleata Herrick
Estheria sp.

ANTHONY COAL

Stratigraphy and Extent

The Anthony coal horizon consists of a thin deposit of coal and interbedded dark carbonaceous shales, lying directly over the Sciotoville clay. Although not a continuous deposit, it has been traced from the Ohio River through eastern Scioto and Pike, Jackson, Hocking, Perry, and eastern Licking counties, as far northward as southwestern Muskingum County.[1] In Scioto County, where the lowest members of the Pottsville formation are present,—including the Harrison ore, the Sharon conglomerate, coal, and ore, with their associated sandstones and shales,—the Anthony coal and the underlying Sciotoville clay occur as much as 60 feet above the base of the formation. In Jackson County the interval is only one-half as great, while in Hocking County at Logan it lies a few feet above the Logan sandstone, and rests directly upon the Maxville limestone at Maxville in Perry County.

The Anthony coal does not form a continuous, well-marked horizon, and where present, is thin, varying from a mere trace to 3 feet in thickness. It attains its maximum development in Scioto and Jackson counties, where the thickness averages less than a foot, but it is often represented by a layer of only 2 or 3 inches. A trace was noted in two localities in Vinton County;[2] near Logan in Hocking County and at Maxville in Perry County a few inches of shaly coal was reported, while in Muskingum County a thin layer of carbonaceous shale or sometimes only a soot streak marks the horizon. The coal, where thick, is of good quality and is in many places cannel; it is, however, generally shaly or interbedded with dark, carbonaceous shales. In a few places in Scioto and Jackson counties, it is mined for household use.

Description of Geologic Sections and Collecting Localities

Scioto County.—At the mine of the Wm. E. Dee Clay Product Co. near Scioto Furnace, the dark carbonaceous shales on the Anthony coal horizon were found to be fossiliferous. Small, excellently preserved specimens of *Lingula* occur in great profusion between the layers, and with the exception of a few other rare forms, are the only fossils found. The section at this locality follows (Locality 7):

[1]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 20, pp. 73, 455, 543, 1916; Bull. 21, p. 55, 1918.
[2]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 20, p. 86, 1916.

Section at mine of the Wm. E. Dee Clay Product Co., near Scioto Furnace, Scioto County

	Feet	Inches
Shale	15	--
Shale, dark, fossiliferous	--	4
Coal, *Anthony*	--	4
Clay, flint	1	7
Clay, semi-flint, *Sciotoville*	2	8
Clay, "pink eye"	1	--

The fossils collected here are listed below:

Lingula carbonaria Shumard
Naiadites sp.

At the mine of the Buckeye Fire & Clay Co., at Scioto Furnace, the black bone shale above the Anthony coal also contains an abundance of large *Lingulas*. The coal occurs about 25 feet above the Waverly formation. The following section was measured at this place (Locality 8):

Section at mine of the Buckeye Fire & Clay Co., Scioto Furnace, Scioto County

	Feet	Inches
Sandstone	10	--
Shale, bony, with softer layers, partly fossiliferous	4	--
Coal, *Anthony*	--	2
Clay, impure, *Sciotoville*	--	--

The fossils from this locality include:

Plantae
Lingula sp.

Summary

The complete list of fossils from the Anthony coal horizon follows:

Plantae

Lingula carbonaria Shumard
Lingula sp.

Naiadites sp.

QUAKERTOWN OR No. 2 COAL HORIZON

Stratigraphy and Extent

The next horizon above the Anthony coal in which fossils are found is the Quakertown or No. 2 coal, the fossils occurring in the dark, tough shales immediately overlying the coal. The deposit is of very wide extent, and is present in every county where the Pottsville rocks occur, although, except in northern Jackson and southern Vinton counties, it is of importance for stratigraphic purposes only. In the latter counties, however, where the member attains its greatest development, the coal forms one of the most valuable beds in Ohio, and adds materially to the wealth and economic resources of the State. Jackson County owes much of its development to the presence of this bed which has been mined for more than fifty years.

At its southern limit in Scioto County, the Quakertown coal lies half-way between the Anthony coal below, and the Bear Run coal above, the average interval in each case being 35 feet. Northward in Jackson County the latter interval varies from 20 to 30 feet, while that between the Quakertown coal and the Sciotoville clay averages 40 feet.[1] In Muskingum County the horizon measures from a few to 70 feet above the base of the Pennsylvanian system, the variation being due to the irregular upper surface of the Mississippian rocks.[2] At the extreme northeastern extension of the Pottsville formation in Mahoning County, the Quakertown varies from 50 to 80 feet above the Sharon coal.[3]

The Quakertown coal reaches its maximum development in Coal and Milton townships, Jackson County, where it is mined over an area of forty square miles. Among the principal mining centers are Wellston, Coalton, and Glenroy. The bed reaches a thickness of 4 feet in places, but averages for the county 2 feet 6 inches. It is of excellent quality, and for the most part is free from shaly partings, though shales form the roof of the coal except where they are occasionally replaced by sandstone. The productive field extends northward into southern Vinton County as far as Allensville, Elk Fork, and Vinton Furnace. To the north and south the bed becomes thin and of slight economic value although it is mined in places for local domestic use. In Scioto County it is often wanting, but where present reaches a maximum thickness of 1 foot 10 inches, while in Muskingum County the average thickness measures 1 foot 8 inches. Its value in the latter county, however, is lessened by shaly partings $\frac{1}{8}$ to 6 inches thick. Farther northward carbonaceous shales with very thin coal layers mark the horizon, while in Mahoning County, Dr. Newberry reports

[1]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 20, pp. 90-114, 550-552, 1916.
[2]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 21, pp. 56-60, 1918.
[3]Newberry, J. S., Geol. Surv. of Ohio, Vol. III, pp. 793-794, 1878.

that the member consists of alternating gray and black shales and sandstones with an occasional thin coal bed.[1]

The shales which form the roof of the Quakertown coal in Jackson County have been found to be very sparingly fossiliferous. A diligent search in the shales associated with the Quakertown coal at various localities in southern Ohio was rewarded by only a few crushed specimens, all of the same species, from three places in Coal Township, Jackson County. With the exception of *Lingulas* from one locality in Summit County, these forms constitute the only fossils discovered on the horizon.

Description of Geologic Sections and Collecting Localities

Lawrence and Scioto Counties.—In Lawrence County the Quakertown coal does not appear at the surface and is known only from well records. In Scioto County, however, the member is locally well developed. The following section measured on the land of William Tripp, Section 14, Bloom Township, shows its relation to the Sciotoville clay below and to the Bear Run coal above:[2]

	Feet	Inches
Coal blossom, *Bear Run*	--	6
Clay shales, dark	3	6
Shales, gray, and parts covered	28	--
Sandstones, flaggy and medium bedded	13	--
Coal outcrop, *Quakertown*, seen to the south	1	8
Shales and covered	33	--
Sandstones	7	--
Coal, *Anthony*	--	2
Clay, flint, dark, *Sciotoville*	6	--

Jackson County.—With the exception of Summit, this is the only county from which fossils were obtained, all of them being from Coal Township. Specimens are very rare, and all belong to the fresh or brackish water pelecypod, *Naiadites elongata* Dawson. Collections were made from the Wilson mine, northeastern part of Section 32 (Locality 9); from the Twin-Ada mine, central part of Section 35 (Locality 10); and from the Grace mine, just east of Davisville in the northeastern part of Section 10 (Locality 11). The following section was measured in the Grace mine and in the hollow to the east:[3]

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[1]Newberry, J. S., Geol. Surv. Ohio, Vol. III, p. 793, 1878.
[2]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 20, p. 551, 1916.
[3]Idem., p. 146.

Strata measured in Grace mine and in hollow to the east, Section 10, Coal Township, Jackson County

		Feet	Inches
Limestone	*Lower Mercer*	--	11
Shale, dark	*Lower Mercer*	1	10
Limestone	*Lower Mercer*	1	--
Covered		9	--
Coal, cannel, *Lower Mercer*		--	--
Top of Shaft			
Covered		97	--
Coal, *Quakertown*		3	--

Summit County.—No other fossils were found on the Quakertown coal horizon except in the extreme eastern part of Summit County where *Lingula carbonaria* Shumard is present in great abundance in the fossiliferous shales associated with a thin coal bed at Mogadore Station, five miles east of Akron (Locality 12).

Summary

The fossils collected from the Quakertown or No. 2 coal horizon are:

Lingula carbonaria Shumard

Naiadites elongata Dawson

BEAR RUN COAL HORIZON

Stratigraphy and Extent

The shales and black band ore associated with the Bear Run coal constitute the next fossiliferous horizon above the Quakertown coal. Although absent in some localities, the stratum is fairly persistent in southern Ohio, and extends from Scioto County through Jackson and Vinton as far north as Muskingum County.[1] In Scioto County the interval between the Bear Run coal horizon and the Sciotoville clay with the associated Anthony coal varies from 62 to 86 feet with an average of 71 feet; northward in Jackson County the interval is somewhat less,—from 20 to 80 feet with an average of about 60 feet.[2] In Muskingum County this distance measures about 45 feet.

The Bear Run coal attains its greatest development in the Dever Valley in Hamilton Township, Jackson County, where it is of good quality and has been mined for local use for many years. Its thickness varies from 1 foot to 2 feet 6 inches, with an average of almost 2 feet. The character of the deposit varies greatly from place to place,

[1]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 20, p. 15, 1916; Bull. 21, p. 60, 1918.
[2]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 20, pp. 115, 552, 1916.

and the coal may be interbedded with or replaced by shales and black band ore. In Scioto County the coal is thin or is replaced entirely by carbonaceous shales, while along Tattle Creek, south of Dever Valley, the deposit gives way to sandstone. In Lick Township, Jackson County, the coal is interbedded with dark fissile shales and black band ore; in Muskingum County the member is thin and is usually represented by dark, carbonaceous shales. Fossils are fairly abundant in number of individuals, but with the exception of a single fish plate, all the specimens discovered belong to a single species of the fresh or brackish water pelecypod,—*Naiadites elongata* Dawson. Collections were made from various parts of Scioto and Jackson counties.

Description of Geologic Sections and Collecting Localities

Scioto County.—In Section 3, Bloom Township, on the land of H. H. Stevenson, *Naiadites elongata* Dawson occurs in the dark shales overlying the Bear Run coal. The following section was measured here (Locality 13):[1]

	Feet	Inches
Sandstone, massive	6	0
Shale, blue, tough, lower part fossiliferous	7	--
Coal, *Bear Run*, upper part somewhat bony	2	4

Jackson County.—Along the Dever Valley in the southern part of Hamilton Township, the shales above the coal are everywhere fossiliferous, and collections of *Naiadites elongata* were made at various places along the valley. One of the best collecting localities was found on the land of Edward Toffin, in the southern part of Section 25, where the geologic section below was measured (Locality 14):[2]

Rock succession on land of Edward Toffin, Section 25, Hamilton Township, Jackson County

		Feet	Inches
Coal blossom, *Tionesta*		1	--
Covered		40	--
Ore, *Sand Block*		--	4
Covered		133	--
Shale, blue		10	--
Shale, blue, tough, lower part fossiliferous		2	--
Coal, good		1	7
Coal, bony	*Bear Run*	--	3
Shale, black, carbonaceous		--	6

[1]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 20, p. 556, 1916.
[2]Idem., p. 116.

In Lick Township, several miles northeast of Jackson, the same fossil occurs in the fissile shales and black band ore interbedded with the coal. In the western part of Section 21 at the mouth of the old coal mine on the land of D. D. Evans, good collecting material is supplied by the piles of shale thrown out from the mine. The section below was made at this place (Locality 15):[1]

		Feet	Inches
Shale		35	--
Coal, part cannel	*Bear Run*	1	8
Bone, shale, tough, fissile		--	8
Ore, black band		--	10
Bone shale, tough, fissile		--	4

Black band ore with *Naiadites elongata* is exposed in the stream bed on the property of Mrs. John Butts in the central part of Section 5. The material is shaly, red or gray in color, and slabs containing fossils can be obtained easily from the stream bed. The following members constitute the section here (Locality 16):[2]

Strata measured in stream bed on property of Mrs. John Butts, central part of Section 5, Lick Township, Jackson County

		Feet	Inches
Shale, dark		4	--
Coal, cannel nature	*Bear Run*	--	9
Shale		--	2
Coal, cannel		--	2
Ore, black band, fossiliferous		--	3
Coal, bituminous		--	4
Sandstone		4	--
Shale		10	--
Coal blossom		--	3
Shale, blue, sandy		3	9
Shaly sandstone, plant marked		1	3
Shale, sandy, with carbonate ore nodules		5	10
Coal, bony	*Quakertown*	--	4
Coal, good		--	9

Vinton County.—The black band ore above the Bear Run coal is sparingly fossiliferous on Elk Fork, in the western part of Section 6, Elk Township. The ore occurs about 100 feet below the Lower Mercer limestone. The geologic section and the fossils collected here follow (Locality 17):

[1]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 20, p. 121, 1916.
[2]Idem., p. 122.

	Feet	Inches
Sandstone, shaly	10	--
Ore, black band, sparingly fossiliferous	--	2
Coal, *Bear Run*	--	2
Clay	1	--

Naiadites elongata Dawson
Fish plate

Specimens of *Naiadites elongata* Dawson were obtained from the black shales of the Bear Run coal horizon three-fourths of a mile south of Stella, in the northern part of Section 14, Jackson Township (Locality 18).

LOWELLVILLE (POVERTY RUN) LIMESTONE

Stratigraphy and Extent

The Lowellville limestone is the next faunal horizon above the fossiliferous shales associated with the Bear Run coal, and is the oldest of the series of marine limestones which occur in the Pennsylvanian system. The limestone was named *Poverty Run* by Stout in 1918 because excellent outcrops of it occur along a stream of that name in Hopewell Township, Muskingum County, and this name has been used in the report of the Geological Survey on Muskingum County.[1] It is present locally in the western part of Muskingum County and extends northward into the southwestern part of Coshocton, where it has been found outcropping in Opossum Hollow, Washington Township.[2] No other outcrops are reported to the north except in Mahoning County where Lamb describes a "black, very hard, tough" limestone which "seems to lie just below the horizon of the Quakertown coal," to which in 1910 he gave the name *Lowellville limestone* from exposures in the town of Lowellville, in the eastern part of the county.[3] This limestone apparently forms the northeastern extension of the Poverty Run limestone of Muskingum County, and the two deposits are alike not only lithologically, but also faunally, as a comparison of their fossil content shows. In Muskingum County along Poverty Run the member is found about 37 feet above the base of the Pottsville formation and 55 feet below the Lower Mercer limestone; the latter interval averages for the county 52 feet.[4] At Lowellville in Mahoning County, the horizon lies 64 feet above the Sharon coal and 83 feet below the Lower Mercer limestone.[5]

[1]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 21, p. 65 and elsewhere, 1918.
[2]Idem., p. 64.
[3]Lamb, G. F., Pennsylvanian Limestones of Northeastern Ohio below the Lower Kittanning Coal, Ohio Naturalist, Vol. 10, March, 1910, pp. 128, 129.
[4]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 21, p. 65, 1918.
[5]Lamb, G. F., Pennsylvanian Limestones of Northeastern Ohio below the Lower Kittanning Coal, Ohio Naturalist, Vol. 10, March, 1910, pp. 128, 129.

Where typically developed in Muskingum County, the Poverty Run limestone consists of several divisions, the lowest of which is an extremely hard, gray, fossiliferous limestone with a maximum thickness of 6 inches. It is characteristically affected by two systems of joints causing the limestone to break up into comparatively small blocks. In places concretions of iron ore are present, and on Poverty Run these are especially numerous and resemble the stems of plants. Fossils, although abundant, consist largely of fragments, and it is difficult to find specimens in a condition perfect enough to permit identification. The extreme hardness of the limestone also makes work with the fossils difficult. On top of the limestone, however, there occurs a soft, friable, black, calcareous shale, generally about 1 foot in thickness, which contains a wealth of fossils, at least in number of individuals. Collecting is good as the fossils are easily obtained and well preserved. For the most part the shells are white in color and show up remarkably well against the dark background. In some places a thin layer of iron ore not more than 4 inches thick overlies the shale. It is reported to be sparingly fossiliferous, but no collections were made from it.

In Mahoning County the Lowellville limestone was first referred to by Dr. Newberry as "dark, siliceous limestone" in his section[1] on Grindstone Run at Lowellville, where he ascribes to it a thickness of 1 foot. Lamb describes the deposit at Lowellville thus: "The limestone is black, very hard, tough, and apparently in one layer. It is 2 feet or more in thickness—the full thickness not being obtained due to a sharp dip downstream concealing the base. It is very fossiliferous, the white shells and crinoid stems presenting a striking appearance in the black matrix. A few species of brachiopods and fragments of crinoid stems predominate. The latter are often 6 to 8 inches long,—and lying horizontally, with the section markings showing plainly, they somewhat resemble worms . . . . "[2]

Description of Geologic Sections and Collecting Localities

Muskingum County.—The type exposure of the Poverty Run limestone is found in Hopewell Township on Poverty Run, a small stream which flows from the southwest into the Licking River. The following section was measured on land of Della Wise, Section 18, about two miles northwest of Mt. Sterling (Locality 19).[3] Collections were made from the limestone and from the overlying dark, fossiliferous shale, both of which outcrop in the bed of the stream. The shale furnishes especially good collecting material.

[1]Newberry, J. S., Geol. Surv. Ohio, Vol. III, opp. p. 804, 1878; Lamb, G. F., Pennsylvanian Limestones of Northeastern Ohio below the Lower Kittanning coal, Ohio Naturalist, Vol. 10, March, 1910, p. 128.

[2]Lamb, G. F., Idem., p. 128.

[3]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 21, 1918. Section given in part on page 62.

Section measured on Poverty Run, Hopewell Township, Muskingum County

	Feet	Inches
Allegheny formation		
Limestone, nodular, fossiliferous, *Putnam Hill*	1	--
Pottsville formation		
Shale and covered	9	6
Shale, in part light	7	--
Coal	--	1
Clay and clay shale	4	11
Coal blossom	--	2
Clay	1	--
Shale, gray, with scattered nodules of ore	4	4
Flint, black, fossiliferous, *Upper Mercer*	--	9
Shale	--	3
Coal, semi-cannel, *Bedford*	1	6
Clay, light	3	--
Clay, shale	3	--
Coal, *Upper Mercer or No. 3a*	--	6
Clay	2	6
Sandstone	4	--
Covered	4	--
Limestone, blue, fossiliferous } *Lower Mercer*	--	8
Limestone, blue, fossiliferous }	1	8
Clay, light	3	--
Shale and shaly sandstone	5	--
Clay, flint, dark	1	4
Clay, siliceous, light	5	8
Covered	5	--
Ore, kidney, fossiliferous } *Boggs*	--	3
Flint, dark, fossiliferous }	--	4
Sandstone, ferruginous, hard	--	3
Clay shale	2	--
Sandstone, shaly	5	--
Shale and covered	19	--
Shale, gray	7	--
Shale, dark, calcareous, very fossiliferous, with scattered nodules of fossiliferous limestone } *Poverty Run*	1	--
Limestone, block, fossiliferous }	--	3
Shale, siliceous, light	--	10
Sandstone, light	--	10
Shale, gray, with thin sandstone interbedded	5	8
Coal, *Vandusen*	--	10
Clay, light, siliceous	3	8
Shale, argillaceous	2	--
Shale, blue	3	--
Shale with thin coal bands, *Bear Run*	--	3
Sandstone, hard, plant marked	--	3
Clay shale, light gray	3	--
Shale, siliceous, blue	4	--
Shale, gray	3	--
Sandstone, ferruginous, conglomeratic	--	6

Pottsville formation—Concluded.

		Feet	Inches
Clay shale		2	--
Shale, blue		3	--
Shale, dark, fissile	*Quakertown*	--	8
Shale, black, bony	*Quakertown*	--	2
Clay, siliceous		1	10
Ore, siliceous	*Harrison*	--	3
Shale	*Harrison*	--	1
Ore, siliceous	*Harrison*	--	3
Waverly formation			
Limestone, *Maxville*		6	--

The limestone from this locality is extremely hard and contains many fragments of fossils, which are for the most part too poorly preserved to be identified. The list includes the following identifiable forms:

Crinoid segments and plates

Fenestella sp.

Derbya crassa (Meek and Hayden)
Chonetes choteauensis Mather
Pustula punctatus (Martin)
Marginifera muricata var. missouriensis Girty
Spirifer opimus Hall
Composita subtilita (Hall)

The fossils below were collected from the black shale above the hard limestone on Poverty Run:

Crinoid segments

Orbiculoidea missouriensis (Shumard)
Derbya crassa (Meek and Hayden)
Chonetes choteauensis Mather
Productus cora d'Orbigny
Pustula nebraskensis (Owen)
Marginifera muricata var. missouriensis Girty
Rhipidomella pecosi Marcou)
Spiriferina kentuckyensis (Shumard)
Ambocoelia planoconvexa (Shumard) var.

Edmondia sp.
Leda bellistriata Stevens
Parallelodon obsoletus (Meek)?
Aviculopecten pellucidus Meek and Worthen
Aviculopecten coxanus Meek and Worthen
Euchondria neglecta (Geinitz)
Pleurophorus tropidophorus Meek
Astartella concentrica (Conrad)?

Schizostoma catilloides (Conrad)

Pseudorthoceras knoxense (McChesney)

In Fall Township on land of E. G. Marshall, the Lowellville (Poverty Run) limestone outcrops in the bed of a small stream which flows from the northeast into the Licking River at Holbein. Collections of fossils were made from the limestone and from a dark shale at an undetermined distance above the limestone. The geologic section here shows the following members (Locality 20):[1]

		Feet	Inches
Limestone, shaly	*Lower Mercer*	--	7
Limestone, hard, blue	*Lower Mercer*	--	5
Shale, calcareous	*Lower Mercer*	--	2
Limestone, blue, hard	*Lower Mercer*	1	4
Coal, clay, and covered		10	6
Sandstone, shaly		5	--
Sandstone, massive		10	--
Sandstone, shaly, with siliceous shales		11	--
Shale, gray		3	--
Clay shale with widely spaced papery coal		5	--
Clay, siliceous		3	--
Sandstone, massive, cross-bedded		13	10
Disconformity			
Shale, calcareous		2	5
Shale, hard, black, fossiliferous	*Poverty Run*	--	4
Limestone, gray, very fossiliferous	*Poverty Run*	--	4
Limestone, dark, carbonaceous	*Poverty Run*	--	1
Shale, black, fissile, horizon *Vandusen* coal		7	--
Shale, dark, carbonaceous		2	6

The fossils listed from the limestone follow:

Crinoid segments

Fenestella shumardi Prout?

Derbya crassa (Meek and Hayden)
Chonetes choteauensis Mather
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer opimus Hall
Composita subtilita (Hall)

A black shale containing much carbonaceous material and layers of pyrite, one-eighth of an inch thick, occurs above the Lowellville limestone at this locality, but its exact stratigraphic position was not determined. The following fossils were obtained from this shale:

Cordaites sp.
Calamites sp.

[1]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 21, p. 62, 1918.

Crinoid stems

Lingula carbonaria Shumard
Orbiculoidea missouriensis (Shumard)
Derbya crassa (Meek and Hayden)
Marginifera muricata var. missouriensis Girty
Spiriferina kentuckyensis (Shumard)

Astartella sp.
Posidonia girtyi n. sp.

Pseudorthoceras knoxense (McChesney)
Orthoceras n. sp.

Fish teeth

In Madison Township this limestone occurs in several places. Fossils were collected from the hard limestone which outcrops along the east bank of the Muskingum River about one-half mile north of Symmes Ford. The member here is 4 inches thick, and protrudes prominently from the bank about 6 feet above water level. The section below was measured along the Muskingum River near Symmes Ford (Locality 21):

Section along Muskingum River near Symmes Ford, Madison Township, Muskingum County

		Feet	Inches
Limestone and flint, fossiliferous, *Upper Mercer*		2	6
Coal, bony, *Bedford*		1	--
Covered		3	--
Sandstone, shaly		7	6
Limestone, shaly, fossiliferous	*Lower Mercer*	1	9
Limestone, blue, fossiliferous		1	1
Limestone, somewhat shaly, fossiliferous		--	9
Limestone, blue, fossiliferous		1	7
Shale, dark		--	4
Coal, fair, *Middle Mercer*		1	1
Clay, light, plastic		3	7
Sandstone, shaly		4	--
Shale		7	--
Limestone, dark, fossiliferous	*Boggs*	--	2
Ore		--	2
Limestone, dark blue, fossiliferous		1	3
Covered		8	3
Shale, gray		7	--
Shale, dark		1	--
Limestone, gray, fossiliferous, *Poverty Run*		--	4
Coal, *Vandusen*		--	4

The fossils from this locality are:

Crinoid segments

Derbya crassa (Meek and Hayden)
Chonetes choteauensis Mather
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Spirifer opimus Hall
Composita subtilita (Hall)

Pseudorthoceras knoxense (McChesney)

The member is also well exposed along Symmes Creek about one mile from its mouth, where it has a thickness of 6 inches, but no collections of fossils were made.

Coshocton County.—The member outcrops near the headwaters of Opossum Run in the southwestern part of Washington Township and is composed of the following strata:[1]

		Feet	Inches
Ore, siliceous, sparingly fossiliferous, thickens to 8 inches in places		--	3
Shale, gray	*Poverty Run*	1	--
Shale, dark, calcareous, fossiliferous	*Poverty Run*	--	10
Limestone, gray, very fossiliferous	*Poverty Run*	--	3
Coal, bony, *Vandusen*		--	8

Mahoning County.—The only known outcrops of Lowellville limestone, north of Coshocton County, are found in Mahoning. At Lowellville fossils were collected from the limestone and the associated dark shale, where they occur in great abundance and in an excellent state of preservation (Locality 22). The section given by Dr. Newberry in 1878 from Grindstone Run, Lowellville, follows:[2]

Section on Grindstone Run, Lowellville, Mahoning County

	Feet	Inches
Earth with drift bowlders	--	--
Limestone (*Putnam Hill*)	14	--
Shale and sandstone	50	--
Coal	--	8
Fire clay	2	--
Shale	32	--
Coal	--	6
Fire clay	2	--
Coal	1	--
Fire clay	2	--
Limestone (*Upper Mercer*)	3	--
Coal	1	3
Fire clay	8	--
Shale and sandstone	36	--

[1]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 21, p. 64, 1918.

[2]Newberry, J. S., Geol. Surv. Ohio, Vol. III, opp. p. 804, 1878. The words in parentheses have been supplied by the writer.

	Feet	Inches
Limestone (*Lower Mercer*)	2	--
Gray shale	20	--
Coal	3	--
Fire clay	2	--
Drab shale	50	--
Dark, siliceous limestone (*Lowellville*)	1	--
Shale	20	--
Black shale and iron ore	5	--
Drab shale	50	--
Sandstone	15	--

Mahoning River

The fossils below were obtained from the Lowellville limestone at Lowellville:

Crinoid segments

Orbiculoidea missouriensis (Shumard)
Derbya crassa (Meek and Hayden)
Chonetes choteauensis Mather
Productus cora d'Orbigny
Pustula nebraskensis (Owen)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer opimus Hall
Composita subtilita (Hall)

Parallelodon sangamonensis (Worthen)

Pseudorthoceras knoxense (McChesney)

Summary

The complete list of fossils collected from the Lowellville limestone follows:

Cordaites sp.
Calamites sp.

Crinoid segments and plates

Fenestella shumardi Prout?
Fenestella sp.

Lingula carbonaria Shumard
Orbiculoidea missouriensis (Shumard)
Rhipidomella pecosi (Marcou)
Derbya crassa (Meek and Hayden)
Chonetes choteauensis Mather
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Pustula punctatus (Martin)

Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer opimus Hall
Ambocoelia planoconvexa (Shumard) var.
Composita subtilita (Hall)

Edmondia sp.
Leda bellistriata Stevens
Parallelodon obsoletus (Meek)?
Parallelodon sangamonensis (Worthen)
Posidonia girtyi n. sp.
Aviculopecten pellucidus Meek and Worthen
Aviculopecten coxanus Meek and Worthen
Euchondria neglecta (Geinitz)
Pleurophorus tropidophorus Meek
Astartella concentrica (Conrad)?
Astartella sp.

Schizostoma catilloides (Conrad)

Pseudorthoceras knoxense (McChesney)
Orthoceras n. sp.

Fish teeth

BOGGS MEMBER

Stratigraphy and Extent

The Boggs member is the next fossiliferous horizon above the Lowellville limestone, and in ascending order forms the second limestone of the Pottsville formation. It either directly overlies the Lower Mercer coal (No. 3) or is separated from it by an interval of not more than 3 feet. In Muskingum County it is found about 20 or 25 feet above the Lowellville limestone and about 22 feet below the Lower Mercer limestone. In northern Tuscarawas County the latter interval is increased to 34 feet, while at the southern extension in Scioto County the average distance between the Boggs ore and the Lower Mercer limestone is about 47 feet. The horizon has been traced from eastern Scioto, western Lawrence, and Jackson counties on the south where its appearance is patchy and uncertain,[1] northward through central and western Muskingum County where it attains its greatest thickness.[2] It has also been observed in eastern Licking County, and has been recorded as far north as northern Tuscarawas County.[3]

The Boggs member varies greatly in lithologic character from place to place. In Scioto, Lawrence, and Jackson counties, the horizon is marked only by iron ore irregularly bedded in shales. It is found in

[1]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 20, pp. 141, 292, 567, 1916.
[2]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 21, pp. 70-75, 1918.
[3]Orton, Edward, Geol. Surv. Ohio, Vol. V, p. 68, 1884.

isolated patches, and varies in thickness from 1 to 6 feet in Scioto and Lawrence counties, with an average of 3 feet; however, in Jackson County only about 8 inches is present. Formerly this ore was used commercially to a large extent in charcoal furnaces especially in Jackson and Scioto counties, although at the present time it is no longer utilized for this purpose. Northward in Muskingum County the typical Boggs deposit consists of limestone, but iron ore, shales, sandstone, or flint may be present with the limestone or may entirely replace it. The limestone, where present, is often bluish-gray, very hard, and very fossiliferous, closely resembling the Lower Mercer limestone in lithologic character. The fossils, although essentially similar to those of the Lower Mercer, are much larger and more robust in appearance. The member is here less than 2 feet in thickness. In Tuscarawas County a blue limestone was reported by Dr. Edward Orton to occur occasionally at what appears to be the Boggs horizon,—about 34 feet below the Lower Mercer member; it has a thickness of 1 foot 6 inches near Bolivar in the northern part of the county. Further stratigraphic studies may reveal the presence of the Boggs member in the counties to the northeast.

Description of Geologic Sections and Collecting Localities

Scioto County.—The following section was measured on the William M. Galligher farm, in the southwestern part of Section 24, Bloom Township. No fossils were found in the Boggs ore of southern Ohio, but they were discovered to be present sparingly in the shales associated with the ore (Locality 23).[1]

		Feet	Inches
Shale		5	--
Coal, *Upper Mercer or No. 3a*		1	4
Covered		54	--
Sandstone, with finger coal at bottom		15	--
Unconformity			
Shale, dark, fissile		1	3
Ore	*Boggs*	--	4
Shale		--	2
Ore		--	11
Shale, blue		3	--

The fossils collected from the dark shales on the William M. Galligher farm are listed below:

Lepidodendron sp.

Naiadites elongata Dawson

[1]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 20, 1916. Geologic section given in part on page 568.

Along the road on the long ridge east of Pine Creek, one and one-half miles southeast of Lyra, Vernon Township, *Lingula carbonaria* Shumard was found in great abundance in the dark shales above the Lower Mercer or No. 3 coal, which occupies the Boggs ore horizon. The section here follows (Locality 24):

	Feet	Inches
Ore, *Lower Mercer*	--	4
Shale and shaly sandstone	35	2
Shale, dark	1	--
Shale, hard, fossiliferous	--	1
Coal, part bony, *Lower Mercer*	--	7
Clay, siliceous	1	--
Sandstone	10	--

Jackson County.—Along the road west of Hamden in Section 13, Washington Township, the Boggs ore is also typically exposed. The section at this locality follows:[1]

	Feet	Inches
Limestone, *Lower Mercer*	--	10
Clay shale	2	--
Coal	--	2
Shaly sandstone and covered	14	--
Ore, *Boggs*	--	6
Shale and shaly sandstone	3	--
Sandstone	--	3
Coal, *Lower Mercer*	1	1
Clay and covered	--	--

Vinton County.—At some localities in Vinton County the Boggs ore is well represented, although it is generally sparingly fossiliferous. In the black band ore, which outcrops in Spook Hollow in the bed of Elk Creek, one and one-half miles east of McArthur, *Lingula carbonaria* Shumard is fairly abundant. The section below was measured in Spook Hollow (Locality 25):

	Feet	Inches
Coal, *Brookville*, formerly mined	--	--
Clay	1	--
Flint, gray to black, *Black Flint*	1	8
Covered	52	--
Sandstone and covered	40	--
Ore, black band, *Boggs*	--	3
Coal, *Lower Mercer, No. 3*	--	2

The fossils collected here are as follows:

Plant leaves

Lingula carbonaria Shumard

Fish teeth and plates

[1]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 20, p. 148, 1916.

Muskingum County.—Where the Boggs member is typically developed in Muskingum County, it consists of a limestone associated with or replaced by shale, flint, iron ore, or sandstone. On land of Della Wise, Hopewell Township, flint and iron ore mark the horizon.[1] The limestone phase is shown on land of Delard Fink, Section 18 of the same township, where the following section was measured, but no collections were made:[2]

Section on land of Delard Fink, Hopewell Township, Muskingum County

		Feet	Inches
Coal, *Brookville*		--	4
Clay, light, part covered		6	4
Sandstone, light, argillaceous		3	--
Clay, light, siliceous		5	10
Shale, dark		1	--
Coal, bony, semi-cannel, *Tionesta or No. 3b*		1	--
Clay and covered		5	--
Limestone, flinty, fossiliferous, *Upper Mercer*		--	8
Coal blossom, *Bedford*		--	4
Covered		6	--
Shale		6	8
Coal, *Upper Mercer, No. 3a*		--	4
Clay		1	--
Sandstone		4	--
Covered		3	--
Limestone, blue, fossiliferous	*Lower Mercer*	--	10
Limestone, blue, fossiliferous	*Lower Mercer*	1	4
Covered		10	--
Shale and covered		14	--
Limestone, blue, hard, fossiliferous	*Boggs*	--	10
Limestone, siliceous, ferruginous, fossiliferous	*Boggs*	--	10

On the land of O. J. Riggle in the northeastern part of Section 18, Hopewell Township, the limestone is coarse and siliceous in character, and exceedingly fossiliferous. Extensive collections were made in the bed of the small stream just west of the road (Locality 26). Collecting is good as the fossils are abundant, well preserved, and easily obtained.

Section on land of O. J. Riggle, Hopewell Township, Muskingum County

		Feet	Inches
Limestone, blue, hard, fossiliferous	*Lower Mercer*	--	6
Limestone, blue, hard, fossiliferous	*Lower Mercer*	1	6
Coal and shale, *Middle Mercer*		--	6

[1]See page 30 of this bulletin for geologic section on land of Della Wise.

[2]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 21, p. 148, in part, 1918.

		Feet	Inches
Clay and covered		5	6
Shale, siliceous		5	--
Coal smut, *Flint Ridge*		--	1
Clay, flint, dark		14	--
Clay, light, siliceous		2	4
Sandstone, light, argillaceous		3	--
Shale and covered		4	--
Ore, yellow, nodular	*Boggs*	--	2
Limestone, dark gray, ferruginous, very fossiliferous	*Boggs*	1	6
Limestone, dark gray, ferruginous, very fossiliferous	*Boggs*	--	6
Shale		2	2
Coal, *Lower Mercer*		--	3
Clay, light, part siliceous		2	5

The fossils listed below were collected from this locality:

Crinoid segments

Tabulipora ohioensis (Foerste)

Orbiculoidea capuliformis (McChesney)
Derbya crassa (Meek and Hayden)
Chonetes choteauensis Mather
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Productus semireticulatus (Martin) var.
Pustula nebraskensis (Owen)
Spiriferina kentuckyensis (Shumard)
Spirifer boonensis Swallow?
Composita subtilita (Hall)
Composita sp.

Edmondia ? peroblonga Meek and Worthen?
Edmondia sp.
Leda prolongata n. sp.
Leda bellistriata Stevens
Parallelodon carbonarius (Cox)
Aviculopinna americana Meek
Myalina pernaformis Cox
Schizodus amplus Meek and Worthen
Schizodus curtus Meek and Worthen
Schizodus wheeleri Swallow
Schizodus affinis Herrick
Aviculopecten coxanus Meek and Worthen
Deltopecten scalaris (Herrick)
Acanthopecten carboniferous (Stevens)
Astartella concentrica (Conrad)?

Euphemus carbonarius (Cox)
Pleurotomaria sp.
Schizostoma catilloides (Conrad)
Naticopsis altonensis (McChesney)

A—Boggs limestone in stream bed; Lower Mercer limestone protruding from bank. Blunt Run, Muskingum County (Locality 27)

B—Boggs limestone below, with Lower Mercer limestone and Middle Mercer coal above. Exposure along Wheeling & Lake Erie Railroad near Rock Cut, Muskingum Township, Muskingum County (Locality 28)

Pseudorthoceras knoxense (McChesney)
Temnocheilus forbesianus (McChesney)

In Muskingum Township along Blunt Run, a small stream which flows from the west into Muskingum River, the Boggs member is a limestone similar in lithologic character and composition to the Lower Mercer. The stratum is extremely fossiliferous and outcrops in the bed of the stream where conditions are especially good for collecting. The section along Blunt Run on land of Carl Crabtree follows (Locality 27):

Section along Blunt Run, Muskingum Township, Muskingum County

		Feet	Inches
Limestone. shaly, fossiliferous	*Lower Mercer*	1	--
Limestone, hard, fossiliferous		--	8
Limestone, shaly, fossiliferous		--	3
Limestone, hard, fossiliferous		1	8
Shale with coal bands		--	6
Coal, bony, *Middle Mercer*		--	8
Sandstone		--	10
Clay, siliceous		1	6
Sandstone, shaly		4	10
Shale, dark blue		7	6
Ore, kidney		--	2
Shale, dark, siliceous, fossiliferous	*Boggs*	4	--
Limestone, dark gray, fossiliferous		1	3
Shale with thin coal bands		--	2
Clay, light, siliceous		3	--

The collection of fossils from Blunt Run includes the following:

Crinoid segments
Eupachycrinus mooresi (Whitfield)

Fenestella shumardi Prout?
Rhombopora lepidodendroidea Meek

Orbiculoidea missouriensis (Shumard)
Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Chonetes choteauensis Mather
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Productus semireticulatus (Martin) var.
Pustula nebraskensis (Owen)
Pustula punctatus (Martin)
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer boonensis Swallow?

Composita subtilita (Hall)
Composita sp.

Edmondia sp.
Parallelodon tenuistriatus (Meek and Worthen)
Myalina pernaformis Cox
Schizodus curtus Meek and Worthen
Aviculopecten coxanus Meek and Worthen
Deltopecten occidentalis (Shumard)
Crenipecten foerstii Herrick

In the exposures along the Wheeling & Lake Erie Railroad, just north of Rock Cut, Muskingum Township, the Boggs limestone is flinty, dark in color, with abundant fossils. The relations of the Boggs, Lower Mercer, and Upper Mercer limestones are exceptionally well shown at this locality, and collections were made from all three members (Locality 28).

Section along the Wheeling & Lake Erie Railroad, just north of Rock Cut, Muskingum Township, Muskingum County

		Feet	Inches
Shale		5	--
Flint, black, fossiliferous, *Upper Mercer*		2	--
Coal, with shale bands	*Bedford*	--	8
Coal, somewhat bony	*Bedford*	2	4
Clay, siliceous		1	6
Sandstone, part shaly		7	--
Sandstone, shaly		5	--
Shale		1	--
Limestone, shaly, fossiliferous	*Lower Mercer*	1	6
Limestone, hard, fossiliferous	*Lower Mercer*	1	--
Limestone, hard, fossiliferous	*Lower Mercer*	1	10
Shale, dark		--	4
Shale, with bony coal	*Middle Mercer*	--	6
Coal, bony	*Middle Mercer*	1	3
Clay		4	--
Shale, dark gray, siliceous		6	--
Limestone, flinty, dark, fossiliferous, *Boggs*		--	10
Coal, *Lower Mercer*		--	8
Clay, light, siliceous		3	--

The list of fossils which were collected from the Boggs limestone along the railroad cut is given below:

Crinoid segments

Fenestella shumardi Prout?
Septopora biserialis (Swallow)

Chonetes choteauensis Mather
Productus cora d'Orbigny
Productus semireticulatus (Martin)

Productus semireticulatus (Martin) var.
Pustula nebraskensis (Owen)
Pustula punctatus (Martin)
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer boonensis Swallow?
Composita subtilita (Hall)
Composita sp.

Myalina pernaformis Cox
Schizodus affinis Herrick

Pseudorthoceras knoxense (McChesney)

The Boggs limestone also outcrops along Symmes Creek in Madison Township. At the crossroads, 2 miles from the place where the creek empties into the Muskingum River and a short distance from the mouth of North Branch, the dark, ferruginous limestone is exposed in the bed of the creek where good collecting material is furnished. The section near the crossroads follows (Locality 29):[1]

Section along Symmes Creek, Madison Township, Muskingum County

		Feet	Inches
Limestone, shaly	*Lower Mercer*	1	8
Limestone, hard		--	10
Limestone, shaly		--	8
Limestone, hard		1	6
Shale, dark		--	6
Coal, bony		1	6
Covered		16	4
Limestone, dark, fossiliferous, *Boggs*		1	8
Clay		1	--
Covered		1	--
Sandstone, shaly		10	--
Shale, gray, siliceous		4	--
Limestone, fossiliferous, gray, *Poverty Run*		--	6
Shale, dark		--	4
Coal, *Vandusen*		--	6

The fossils collected from the Boggs limestone along Symmes Creek are listed below:

Crinoid segments

Fenestella shumardi Prout?
Rhombopora lepidodendroidea Meek

Derbya crassa (Meek and Hayden)
Chonetes choteauensis Mather
Productus cora d'Orbigny
Productus semireticulatus (Martin)

[1]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 21, p. 64, 1918.

Pustula nebraskensis (Owen)
Marginifera wabashensis (Norwood and Pratten)
Spirifer boonensis Swallow?
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Schizodus amplus Meek and Worthen

The Boggs member occurs as an iron ore on the ridges north of Frazeysburg in Jackson Township.

Licking County.—The Boggs limestone extends westward from Muskingum County into Licking. Isolated patches of cherty limestone from 3 inches to 1 foot in thickness were observed at several places along the ridges south of Toboso and north of Black Run. In a few localities the limestone is replaced by siliceous iron ore.

Tuscarawas County.—The blue limestone reported by Dr. Edward Orton, 2 miles northwest of Bolivar in northern Tuscarawas County on the farm of Joseph Hair and elsewhere in the county, belongs undoubtedly to the Boggs horizon. The geologic section northwest of Bolivar is given below:[1]

Section northwest of Bolivar on land of Joseph Hair, Tuscarawas County

		Feet	Inches
1.	*Gray or Putnam Hill limestone*	2	--
2.	Concealed	25	--
3.	Coal, 1 ft. 8 in. Slate, 9 in. Coal, 2 ft. 4 in. } *Tionesta (No. 3b)*	4	9
4.	Concealed	15	--
5.	*Dark-blue limestone,* Upper Mercer	3	--
6.	Coal, thin, 4 to 6 in.	--	6
7.	Concealed	30	--
8.	*Blue limestone,* Lower Mercer	4	--
9.	Dark shale	2	--
10.	Coal, thin	--	--
11.	Dark shale	2	--
12.	Fire clay	6	--
13.	Concealed	20	--
14.	Blue limestone (occurs occasionally at this horizon), *Boggs*	1	6
15.	Concealed to canal	15	--

Summary

The Boggs member, although occurring in patches, has been traced from the Ohio River as far north as Tuscarawas County. In Muskingum County it is the second fossiliferous limestone in the Pottsville

[1]Orton, Edward, Geol. Surv. Ohio, Vol. V, p. 68, 1884. The word Boggs has been supplied by the writer.

formation, and where characteristically developed, is less than 2 feet in thickness, hard, blue, and fossiliferous, closely resembling the Lower Mercer limestone, from which it is separated by an interval of about 22 feet. It is notably variable in character, however, and may be interbedded with or replaced by flint, shale, sandstone, or iron ore. North of Frazeysburg it is entirely replaced by iron ore, while in Tuscarawas County, it is represented by limestone. In southern Ohio the Boggs member is an iron ore varying in thickness from 6 inches to 6 feet. It is of good quality, and was formerly mined for smelting in the old charcoal furnaces.

A list of the fossils collected from the Boggs member follows:

Plant leaves
Lepidodendron sp.

Crinoid segments
Eupachycrinus mooresi (Whitfield)

Tabulipora ohioensis (Foerste)
Fenestella shumardi Prout?
Septopora biserialis (Swallow)
Rhombopora lepidodendroidea Meek

Lingula carbonaria Shumard
Orbiculoidea missouriensis (Shumard)
Orbiculoidea capuliformis (McChesney)
Derbya crassa (Meek and Hayden)
Chonetes choteauensis Mather
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Productus semireticulatus (Martin) var.
Pustula nebraskensis (Owen)
Pustula punctatus (Martin)
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer boonensis Swallow?
Squamularia perplexa (McChesney)
Composita subtilita (Hall)
Composita sp.

Edmondia peroblonga Meek and Worthen
Edmondia sp.
Leda bellistriata Stevens
Leda prolongata n. sp.
Parallelodon carbonarius (Cox)
Parallelodon tenuistriatus (Meek and Worthen)
Aviculopinna americana Meek
Myalina pernaformis Cox
Naiadites elongata Dawson
Schizodus affinis Herrick
Schizodus amplus Meek and Worthen
Schizodus curtus Meek and Worthen

Schizodus wheeleri Swallow
Aviculopecten coxanus Meek and Worthen
Deltopecten scalaris (Herrick)
Deltopecten occidentalis (Shumard)
Acanthopecten carboniferous (Stevens)
Crenipecten foerstii Herrick
Astartella concentrica (Conrad)?

Euphemus carbonarius (Cox)
Pleurotomaria sp.
Schizostoma catilloides (Conrad)
Naticopsis altonensis (McChesney)

Pseudorthoceras knoxense (McChesney)
Temnocheilus forbesianus (McChesney)

Fish teeth and plates

LOWER MERCER LIMESTONE

Historical Review

The Lower Mercer limestone received its name from outcrops 2 feet in thickness in Mercer County, Pennsylvania, which were first described by H. D. Rogers in 1858.[1] In 1878 I. C. White and other workers of the Second Pennsylvania Geological Survey made constant use of the term. The stratum was also early recognized by the first geologists of Ohio, among whom was Professor E. B. Andrews, who referred to it simply as the *Blue limestone.* In 1878 Dr. Newberry gave the name *Zoar limestone* to exposures of hard, blue, fossiliferous limestone near the village of Zoar in the northern part of Tuscarawas County.[2] The term Zoar limestone was later employed by Dr. Edward Orton who described it in the Hanging Rock District,[3] and it was so used in some of the later reports of the Geological Survey of Ohio. However, in 1884 Dr. Orton correlated it with the Lower Mercer limestone of Pennsylvania, and at the present time the term *Lower Mercer* is universally accepted.[4]

Stratigraphy and Extent

The Lower Mercer is the third member of the series of marine limestones occurring in the Pennsylvanian system, and is the next fossiliferous horizon above the Boggs where the latter is present. It is the most persistent stratum and has the most extensive outcrop of any

[1]Rogers, H. D., Geol. of Pennsylvania, Vol. II, Pt. 1., p. 476, 1858.
[2]Newberry, J. S., Geol. Surv. Ohio, Vol. II, section opp. p. 81; pp. 81-180, 1874; Vol. III, p. 60, 1878.
[3]Orton, Edward, Geol. Surv. Ohio, Vol. III, pp. 891, 892, 1878.
[4]Orton, Edward, Geol. Surv. Ohio, Vol. V, pp. 13, 14, 1884.

of the members of the Pottsville formation, as it enters southern Ohio from Kentucky and extends northward across the state, being present in every county where the Pottsville occurs, and finally extends across the Ohio-Pennsylvania border line from Mahoning County. It is found in the following counties beginning at the Ohio River,—Lawrence, Scioto, Jackson, Vinton, Hocking, Perry, Muskingum, Licking, Coshocton, Tuscarawas, Holmes, Wayne, Stark, Summit, Portage, Mahoning, and Columbiana. On account of its wonderful persistence it forms an extremely valuable horizon for stratigraphic and correlative purposes.

The Lower Mercer limestone occurs above a thin but rather persistent bed of coal, known as the Middle Mercer coal, and is either directly overlain by an iron ore, designated as the Lower Mercer or Little Red Block, or is separated from it by an interval of only a few feet. The ore is fossiliferous but to a much less extent than the limestone; the faunas of the two horizons, however, are practically the same, indicating a marine origin for the ore and conditions of deposition similar to those under which the limestone was deposited.

Outcrop in Southern Ohio.—In southern Ohio the Lower Mercer member is a hard, tough, dark blue or almost black limestone, with thick or thin layers which are often shaly in character. In Scioto and Lawrence counties the limestone measures 1 foot in thickness; northward in Jackson County two benches are present, each 1 foot thick, separated by about 2 feet of black shale. In Vinton, Hocking, and Perry counties similar conditions exist, and the two benches together with the intervening shales attain a thickness of 5 feet. Dr. Edward Orton, in his description of the Hanging Rock District in Lawrence and Scioto counties, describes the member thus:[1] "The color of the limestone is dark-blue..... In thickness it occasionally rises to 10 feet, but it, as often, shrinks to 10 inches. The usual measure for it in the district is from 1 to 3 feet. It is generally shaly in structure, at least for a part of the stratum. It does not lie in massive or even beds, and does not endure weather well."

The limestone is everywhere fossiliferous, but at some localities fossils are present in extreme abundance. The soft black shales which occur between the benches or on top of the limestone are especially fossiliferous and afford excellent collecting. The fauna is everywhere characterized by a richness of large crinoid stems.

Outcrop in East-Central Ohio.—In east-central Ohio the Lower Mercer limestone also forms the most persistent and well marked stratigraphic unit of the Pottsville formation. It is particularly well developed in western Muskingum County as far east as Zanesville and in the adjoining parts of Licking County. Thence the deposit extends northward into Coshocton, Tuscarawas, Holmes, and Wayne counties. The average thickness in Muskingum County is 3 feet 7

[1]Orton, Edward, Geol. Surv. Ohio, Vol. III, p. 891, 1878.

inches, although the member may vary from 1 to 20 feet in different places; the same thickness is found in Licking County where the stratum is excellently developed along Flint Ridge, Hopewell Township.[1] In southern Coshocton County in Opossum Hollow 4 feet is present which is the same thickness found at Bolivar in the northern part of Tuscarawas County near the type locality for the "Zoar limestone." The stratum consists of very hard, blue to black limestone which may or may not be interbedded with or replaced by impure shaly limestone and black calcareous shale. At some localities the hard, blue limestone consists of only one layer about a foot in thickness, while at others two or more layers are present, separated by calcareous shale or impure shaly limestone. The hard, blue limestone varies in composition from place to place, often becoming ferruginous and siliceous in character; chert nodules are not an uncommon constituent. In a few localities, especially in Newton Township, Muskingum County, the member is entirely replaced by sandstone. The geologic sections from the counties in the central part of the Lower Mercer outcrop in Ohio, given later in the discussion, will show the relation of the hard, blue limestone to the impure, shaly limestone and the dark calcareous shales, as well as local variations in thickness.

As in southern Ohio the stratum is extremely fossiliferous, especially the dark shales and impure shaly limestones, which contain a profusion of species as well as of individuals. The fauna consists largely of brachiopods and pelecypods. The black calcareous shales overlying the limestone furnish easy and profitable collecting, as is also the case along weathered outcrops of the impure shaly limestone which splits up easily into thin layers upon exposure, revealing a wealth of fossils between the layers. The hard, blue limestone, although fairly fossiliferous, does not afford such good collecting on account of its extreme hardness; its fauna is largely one of brachiopods and large crinoid stems which often attain a diameter of almost an inch.

Outcrop in Northeastern Ohio.—In northeastern Ohio, including Stark, Summit, Portage, and Mahoning counties, the Lower Mercer member is present also with great persistence. Where characteristically developed it consists of two layers or benches of hard, tough, blue to black limestone generally without shaly partings between them. However, a layer of black shale is usally present beneath the limestone. In thickness the member varies from 1 to 3 feet in Stark County, but it becomes more massive in Mahoning County where it shows an average depth of 3 feet. The upper layer is as a rule much thicker than the lower and often becomes flinty toward the top; it is likewise sparingly fossiliferous. The thin lower layer possesses an abundance of animal remains, while the black shales below the limestone are also extremely rich in fossils. The faunal content is similar to that in the

[1]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 21, pp. 82-90, 1918.

other parts of the State, large crinoid stems everywhere characterizing the deposit.[1]

Description of Geologic Sections and Collecting Localities

Lawrence County.—The Lower Mercer limestone is present in the western part of Lawrence County where it is reported to be fossiliferous. No fossils, however, were collected from the county, but an excellent specimen of *Metacoceras pottsvillensis* n. sp.—in the Geological Museum of The Ohio State University—was obtained from the member near Hanging Rock in the southeastern part of Hamilton Township (Locality 30).

Scioto County.—About four miles south of Lyra in the extreme southeastern corner of Vernon Township, the Lower Mercer limestone is exposed on land of Edward Toffins in the field east of the road, about 100 feet above the base of the hill (Locality 31). The stratum at this locality is light buff in color and somewhat siliceous and ferruginous in composition. Fossils occur abundantly between the layers, and differ from the general type of Lower Mercer forms in being larger and more robust. The section measured at this point follows:

	Feet	Inches
Limestone, fossiliferous, *Ferriferous*	4	--
Covered	60	--
Sandstone, massive	55	--
Covered	10	--
Sandstone, massive	20	--
Shale	1	6
Coal, *Upper Mercer, No. 3a*	1	6
Covered	28	8
Limestone, ferruginous, very fossiliferous, *Lower Mercer*	1	--
Covered	4	--
Sandstone	2	--

The fossils listed below were collected from this locality:

Crinoid segments

Archaeocidaris spines

Fenestella shumardi Prout?
Fenestella, two or more species, undetermined
Septopora biserialis (Swallow)
Septopora biserialis var. gracilis (Meek)
Cystodictya carbonaria (Meek)

Orbiculoidea meekana (Whitfield)
Rhipidomella pecosi (Marcou)

[1]Lamb, G. F., Pennsylvanian Limestones of Northeastern Ohio below the Lower Kittanning Coal, Ohio Naturalist, Vol. 10, March, 1910, pp. 89-135.

Derbya crassa (Meek and Hayden)
Derbya robusta (Hall)
Chonetes choteauensis Mather
Aulacorhynchus millepunctatus (Meek and Worthen)
Productus cora d'Orbigny
Productus semireticulatus (Martin) var.
Pustula nebraskensis (Owen)
Spiriferina kentuckyensis (Shumard)
Spirifer boonensis Swallow?
Composita subtilita (Hall)

Pteria ohioense (Herrick)
Schizodus wheeleri Swallow
Aviculopecten coxanus Meek and Worthen
Deltopecten scalaris (Herrick)
Acanthopecten carboniferous (Stevens)
Entolium aviculatus (Swallow)
Lima retifera Shumard
Allerisma terminale Hall

Pharkidonotus percarinatus (Conrad)
Euphemus carbonarius (Cox)
Pleurotomaria carbonaria Norwood and Pratten
Schizostoma catilloides (Conrad)

Jackson County.—In the eastern part of Section 10, Coal Township, the Lower Mercer member outcrops in several places. The accompanying geologic section, which also includes the Lower Mercer or Little Red Block ore, was measured in the hollow east of Grace mine (Locality 11).

Section measured in the hollow east of Grace Mine, Coal Township, Jackson County

		Feet	Inches
Ore, *Upper Mercer*		--	4
Covered		10	--
Coal blossom		--	--
Clay shale		2	--
Shale and covered		11	--
Clay shale		2	--
Sandstone, shaly		7	--
Shale and covered		8	6
Coal		--	6
Clay		2	--
Shale		4	7
Ore, *Lower Mercer*		--	5
Shale		3	--
Covered		5	3
Shale, blue		5	--
Limestone, gray, fossiliferous	*Lower Mercer*	--	11
Shale, dark, fossiliferous	*Lower Mercer*	1	10
Limestone, blue, fossiliferous	*Lower Mercer*	1	--

	Feet	Inches
Covered	9	--
Coal, cannel	--	6
Covered	1	6
Shaft	97	--
Coal, *Quakertown or No. 2*	3	--

A small collection of fossils was made:

Crinoid segments

Rhombopora lepidodendroidea Meek

Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spirifer boonensis Swallow?
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Astartella concentrica (Conrad)

Fossils were collected in Section 18, Milton Township, from exposures of Lower Mercer limestone in the private lane near the level of the Baltimore & Ohio Southwestern Railroad, Portsmouth Branch, just north of Hoganville School (Locality 32). The geologic section here follows:[1]

	Feet	Inches
Allegheny formation:		
Limestone, flinty, *Vanport*	3	--
Shale, black, fissile	2	--
Coal and partings, *Clarion*	4	--
Clay and covered	13	--
Pottsville formation:		
Sandstone	9	--
Covered	10	--
Sandstone	12	--
Shale	1	6
Ore, *Upper Mercer*	--	3
Clay, light	1	3
Sandstone	1	--
Covered	5	--
Ore, *Sand Block*	--	4
Sandstone, ferruginous	--	8
Sandstone, soft	10	--
Covered	5	--
Sandstone	11	--
Clay, light	2	--

[1]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 20, p. 150, 1916.

Pottsville formation—Concluded.

	Feet	Inches
Sandstone, shaly	3	--
Sandstone, coarse grained	5	6
Shale	1	6
Limestone, dark, fossiliferous, *Lower Mercer*	1	--
Shale, dark	2	--
Shale and covered	11	--
Level of Baltimore & Ohio Railroad tracks.		

The fossils listed below were obtained from this locality:

Crinoid segments

Fenestella sp.
Septopora biserialis (Swallow)
Rhombopora lepidodendroidea Meek

Derbya crassa (Meek and Hayden)
Chonetes choteauensis Mather
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spirifer cameratus Morton
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Aviculopecten coxanus Meek and Worthen
Acanthopecten carboniferous (Stevens)

Pseudorthoceras knoxense (McChesney)

A collection of fossils was also obtained from outcrops in the road, Section 13, Washington Township, about one mile west of Hamden, where the member has a thickness of about 10 inches (Locality 33). The geologic section below shows the relation of the Lower Mercer limestone to the Boggs ore below and to the Lower Mercer or Little Red Block ore above:

		Feet	Inches
Ore		--	3
Shale	*Lower Mercer*	1	--
Ore		--	10
Shale, very fossiliferous		1	6
Shale		2	1
Limestone, *Lower Mercer*		--	10
Clay shale		2	--
Coal		--	2
Shaly sandstone and covered		14	--
Ore, *Boggs*		--	6

The following fossils were obtained here:

Crinoid segments

Rhombopora lepidodendroidea Meek

Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer opimus Hall
Composita subtilita (Hall)

Vinton County.—Excellent collecting is found in the dark, extremely fossiliferous shales which outcrop in Rock Hollow, western part of Section 33, Elk Township, where the following geologic section was measured (Locality 34):

		Feet	Inches
Limestone, gray		--	10
Shale, gray		2	6
Shale, dark, very fossiliferous	*Lower Mercer*	--	6
Limestone, gray, very fossiliferous		--	6

The following fossils were collected:

Plantae

Derbya crassa (Meek and Hayden)
Marginifera muricata var. missouriensis Girty

Posidonia girtyi n. sp. (abundant)
Posidonia vintonensis n. sp. (very abundant)
Aviculopecten coxanus Meek and Worthen
Pleurophorella sesquiplicata Price

Schizostoma catilloides (Conrad)

Pseudorthoceras knoxense (McChesney)

Hocking County.—The two benches of the Lower Mercer with its normal thickness are well shown near the plant of the Union Furnace Brick Co., Section 23, Starr Township, about three-fourths mile south of Union Furnace. No collections of fossils were made, but the geologic section below was measured:

		Feet	Inches
Limestone, blue, fossiliferous	*Lower Mercer*	1	5
Shale		--	1
Limestone, blue, fossiliferous		2	2

	Feet	Inches
Shale	--	2
Coal, bony, *Middle Mercer*	--	7
Clay, light	6	--
Sandstone, light, argillaceous	1	5
Coal, impure, *Flint Ridge*	--	3
Clay, light	5	6

Perry County.—The Lower Mercer limestone is well developed in Perry County, but varies greatly in thickness from place to place. The following geologic sections show the character of the member and its relation to the overlying and underlying deposits:

Section 11, Clayton Township:

	Feet	Inches
Limestone, flinty, ferruginous, *Upper Mercer*	2	6
Shale	1	6
Coal, bony, *Bedford*	--	8
Covered	5	--
Limestone, *Lower Mercer*	1	--
Coal blossom, *Middle Mercer*	1	--

Section 23, Hopewell Township:

	Feet	Inches
Limestone, shaly, very fossiliferous } *Lower Mercer*	6	--
Limestone, blue, hard, fossiliferous } *Lower Mercer*	1	2
Coal blossom, *Middle Mercer*	--	3
Clay, siliceous	10	--

Section 17, Monday Creek Township, west of Maxville:

	Feet	Inches
Limestone, very fossiliferous, *Lower Mercer*	--	7
Coal blossom, *Middle Mercer*	--	6
Clay	1	6
Shale, sandstone, and covered	69	--
Coal, shaly, *Bear Run*	--	4
Clay, light	2	8
Sandstone, shale, and covered	27	--
Clay, *Sciotoville*	3	2
Sandstone	2	--
Covered	3	--
Limestone, *Maxville*	4	--

The collection of fossils listed below was obtained in Section 10, Reading Township, from the very fossiliferous shales above the Lower Mercer limestone in the cut of the Baltimore & Ohio Railroad at Somerset, and from the roadbed about one-half mile south of Somerset (Locality 35):[1]

[1]These fossils are among the paleontological collections at Western Reserve University. They were collected by Mr. Eber Hyde, of Lancaster, and were made available to the writer for study through the kindness of his son, Professor Jesse E. Hyde, of Western Reserve University, Cleveland, Ohio.

Lophophyllum profundum (Milne-Edwards and Haime)

Eupachycrinus mooresi (Whitfield), plates and spines
Crinoid segments

Archaeocidaris spines

Tabulipora ohioensis (Foerste)
Fenestella limbata Foerste
Polypora fastuosa Foerste
Fenestellids undetermined
Septopora biserialis (Swallow)
Rhombopora lepidodendroidea Meek
Prismopora sereata (Meek)

Lingula kanawhensis Price
Orbiculoidea meekana (Whitfield)
Crania modesta White and St. John
Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Productus semireticulatus (Martin) var.
Pustula nebraskensis (Owen)
Pustula symmetricus (McChesney)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer boonensis Swallow?
Spirifer cameratus Morton
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Edmondia anodontoides (Meek)?
Edmondia aspinwallensis Meek
Edmondia ovata Meek and Worthen
Nucula parva McChesney
Nuculopsis vertricosa (Hall)
Leda bellistriata Stevens
Leda prolongata n. sp.
Parallelodon carbonarius (Cox)
Parallelodon obsoletus (Meek)
Parallelodon sangamonensis (Worthen)
Parallelodon tenuistriatus (Meek and Worthen)
Aviculopinna americana Meek
Pteria ohioense (Herrick)
Pseudomonotis sp.
Myalina pernaformis Cox
Myalina swallovi McChesney
Schizodus cuneatus Meek
Schizodus mooresi Miller?
Schizodus wheeleri Swallow
Aviculopecten coxanus Meek and Worthen
Aviculopecten herzeri Meek
Deltopecten scalaris (Herrick)

Acanthopecten carboniferous (Stevens)
Euchondria neglecta (Geinitz)
Entolium aviculatus (Swallow)
Lima retifera Shumard
Allerisma terminale Hall
Pleurophorus immaturus Herrick
Pleurophorus tropidophorus Meek
Astartella compacta Girty
Astartella concentrica (Conrad)
Astartella newberryi Meek
Astartella varica McChesney
Cypricardinia ? carbonaria Meek

Plagioglypta prosseri n. sp.

Bellerophon crassus Meek and Worthen
Pharkidonotus percarinatus (Conrad)
Pharkidonotus percarinatus var. tricarinatus (Shumard)
Euphemus carbonarius (Cox)
Euphemus nodocarinatus (Hall)
Bucanopsis meekiana (Swallow)
Patellostium montfortianum (Norwood and Pratten)
Phanerotrema grayvillense (Norwood and Pratten)
Schizostoma catilloides (Conrad)
Naticopsis altonensis (McChesney)
Zygopleura plenum (Herrick)?
Zygopleura plicata (Whitfield)
Bulimorpha inornata (Meek and Worthen)?
Sphaerodoma brevis (White)
Sphaerodoma fusiformis (Hall)?
Sphaerodoma klipparti (Meek)
Sphaerodoma newberryi (Stevens)
Sphaerodoma primigenia (Conrad)
Sphaerodoma regularis (Cox)

Orthoceras isogramma Meek
Pseudorthoceras knoxense (McChesney)

Phillipsia sangamonensis Meek and Worthen

Muskingum County.—The Lower Mercer member attains its maximum thickness in Licking and Muskingum counties. In Newton Township in the latter county the limestone is in places replaced by sandstone. Fossils were collected along a small tributary of Jonathan Creek, in the northeastern part of Section 20, about one mile south of White Cottage. Here the upper stratum of the member is a light, bluish-gray shale which contains small brachiopod shells, *Marginifera muricata var. missouriensis* Girty and *M. wabashensis* (Norwood and Pratten) in extreme abundance. Below the shale there occur two benches of hard, fossiliferous limestone. Collections were made from both the hard limestone and the overlying shale. The geologic section at this locality is given below (Locality 36):

Section along a small tributary of Jonathan Creek near White Cottage, Newton Township, Muskingum County

		Feet	Inches
Allegheny formation:			
Shale, rather fossiliferous		7	--
Limestone, blue, fossiliferous, *Putnam Hill*		--	6
Shale, siliceous, fossiliferous		5	--
Pottsville formation:			
Sandstone, thin bedded		20	--
Covered		30	--
Shale, siliceous		14	--
Clay shale, black		--	3
Clay shale, gray		--	11
Sandstone, nodular, very fossiliferous		--	3
Covered		--	9
Shale, dark, calcareous, very fossiliferous		2	2
Shale, bony		--	2
Coal		--	10
Sandstone and covered		12	--
Clay shale, bluish gray, very fossiliferous	*Lower Mercer*	1	--
Limestone, nodular, very fossiliferous	*Lower Mercer*	2	4
Clay shale, bluish gray	*Lower Mercer*	2	10
Limestone, fossiliferous	*Lower Mercer*	--	10
Shale, black		--	2
Coal, cannel, *Middle Mercer*		--	3
Clay		3	5

The following collections were made:

FOSSILS FROM THE HARD LIMESTONE

Crinoid segments

Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Pustula nebraskensis (Owen)
Marginifera muricata var. missouriensis Girty
Spiriferina kentuckyensis (Shumard)
Composita subtilita (Hall)

FOSSILS FROM THE SOFT SHALE ABOVE THE LIMESTONE

Lophophyllum profundum (Milne-Edwards and Haime)

Crinoid segments

Fenestella shumardi Prout?
Septopora biserialis (Swallow)
Rhombopora lepidodendroidea Meek

Crania modesta White and St. John
Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny

Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer cameratus Morton
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Nuculopsis ventricosa (Hall)
Parallelodon tenuistriatus (Meek and Worthen)
Myalina swallovi McChesney
Aviculopecten coxanus Meek and Worthen
Aviculopecten herzeri Meek
Acanthopecten carboniferous (Stevens)
Crenipecten foerstii Herrick
Lima retifera Shumard
Allerisma terminale Hall
Pleurophorus tropidophorus Meek
Astartella varica McChesney

Pharkidonotus percarinatus (Conrad)
Euphemus carbonarius (Cox)
Euphemus nodocarinatus (Hall)
Pleurotomaria newportensis White

In Washington Township, one mile east of Gilbert, the hard, blue Lower Mercer limestone is exposed in the bed of Blount Run. The extreme hardness of the limestone, however, renders collecting very difficult. The Blount Run section is given below (Locality 37):

Section along Blount Run, Washington Township, Muskingum County

		Feet	Inches
Sandstone, massive		30	--
Flint, black, fossiliferous	*Upper Mercer*	--	6
Limestone, fossiliferous	*Upper Mercer*	--	8
Shale		--	2
Coal	*Bedford*	--	3
Shale	*Bedford*	--	1
Coal, bony	*Bedford*	--	8
Clay		--	4
Covered		6	--
Sandstone, shaly		7	--
Limestone, shaly, fossiliferous	*Lower Mercer*	1	11
Limestone, hard, blue, fossiliferous	*Lower Mercer*	--	7
Shale	*Lower Mercer*	--	2
Limestone, hard, blue, fossiliferous	*Lower Mercer*	1	6
Shale, with coal bands		--	4
Coal, bony, *Middle Mercer*		--	8
Clay, siliceous		1	--
Sandstone, shaly		5	--

The fossils listed below were collected from the hard limestone:

Crinoid segments

Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera wabashensis (Norwood and Pratten)
Spirifer cameratus Morton
Spirifer opimus Hall
Composita subtilita (Hall)

Fossils were also obtained from outcrops of Lower Mercer limestone in a small ravine on the east side of the Muskingum River opposite Ellis where the following geologic section was measured (Locality 38):

		Feet	Inches
Coal, good, *Upper Mercer*		1	2
Clay		1	4
Shale, siliceous		10	6
Limestone, shaly	*Lower Mercer*	1	--
Limestone, hard		--	7
Shale		--	2
Limestone, hard		1	8

The collection of fossils from this locality includes the following forms:

Crinoid segments

Fenestella shumardi Prout?

Orbiculoidea meekana (Whitfield)
Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Pustula punctatus (Martin)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spirifer cameratus Morton
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Leda bellistriata Stevens
Leda meekana Mark
Aviculopecten herzeri Meek
Deltopecten occidentalis (Shumard)
Acanthopecten carboniferous (Stevens)
Entolium aviculatus (Swallow)

Lima retifera Shumard
Allerisma terminale Hall
Astartella concentrica (Conrad)

Pharkidonotus percarinatus var. tricarinatus (Shumard)
Euphemus nodocarinatus (Hall)
Trepospira depressa (Cox)
Trachydomia sp.

Pseudorthoceras knoxense (McChesney)

In the ravine of another small stream flowing from the east into the Muskingum River, about one mile north of the above locality, only a few forms were collected from the hard, blue limestone, although abundant remains were obtained from the soft, gray shale which overlies the limestone (Locality 39). The forms listed below were found:

FOSSILS FROM THE LOWER MERCER LIMESTONE

Crinoid segments

Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Pustula nebraskensis (Owen)
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Posidonia sp.
Entolium aviculatus (Swallow)
Euchondria neglecta (Geinitz)
Astartella concentrica (Conrad)

FOSSILS FROM THE SHALE ABOVE THE LIMESTONE

Lophophyllum profundum (Milne-Edwards and Haime)

Crinoid segments—very abundant

Rhombopora lepidodendroidea Meek

Orbiculoidea meekana (Whitfield)
Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Schizodus curtus Meek and Worthen
Aviculopecten herzeri Meek
Allerisma terminale Hall
Astartella concentrica (Conrad)
Cypricardinia ? carbonaria Meek

Euphemus nodocarinatus (Hall)

A small collection was made from loose blocks of limestone which had fallen from place in the walls of a small ravine by the side of the road just east of the Muskingum River and opposite Rock Cut (Locality 40).

Crinoid segments—very abundant

Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera wabashensis (Norwood and Pratten)
Composita subtilita (Hall)

About one-fourth mile north of Locality 40, an excellent outcrop occurs in the bed of a small stream flowing from the east into the Muskingum River, which affords one of the best collecting places for Lower Mercer fossils which was found. The stream forms a small waterfall over hard limestone, about 1 foot thick, above and below which occurs soft, black, extremely fossiliferous shale. These shales are composed of a mass of crushed and macerated animal remains among which a few species of brachiopods and crinoid stems predominate. Collections were made from both the limestone and shales (Locality 41).

FOSSILS FROM THE BLACK CARBONACEOUS SHALE BELOW THE LIMESTONE

Plantae—abundant

Crinoid segments

Orbiculoidea meekana (Whitfield)
Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer boonensis Swallow?
Composita subtilita (Hall)

Aviculopecten coxanus Meek and Worthen
Acanthopecten carboniferous (Stevens)
Entolium aviculatus (Swallow)
Astartella varica McChesney

FOSSILS FROM THE LOWER MERCER LIMESTONE

Crinoid segments

Septopora biserialis (Swallow)

Derbya crassa (Meek and Hayden)

Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer cameratus Morton
Spirifer opimus Hall
Composita subtilita (Hall)

Schizodus mooresi Miller?
Acanthopecten carboniferous (Stevens)
Entolium aviculatus (Swallow)
Allerisma terminale Hall

FOSSILS FROM THE BLACK CARBONACEOUS SHALE ABOVE THE LIMESTONE

Crinoid segments

Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer opimus Hall
Composita subtilita (Hall)

In Madison Township excellent outcrops of Lower Mercer limestone occur in the banks of Symmes Creek just east of the crossroads and two miles from the mouth of the stream. Large blocks of extremely fossiliferous, blue limestone have fallen from position in the valley walls into the stream bed, and on the weathered surface large brachiopods and crinoid stems protrude (Locality 29). The species found are listed below:

Fusulina secalica (Say)

Lophophyllum profundum (Milne-Edwards and Haime

Crinoid segments

Fenestella shumardi Prout?
Pinnatopora whitii Foerste
Septopora biserialis (Swallow)
Rhombopora lepidodendroidea Meek
Prismopora sereata (Meek)

Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Pustula punctatus (Martin)

Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer cameratus Morton
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Parallelodon carbonarius (Cox)
Entolium aviculatus (Swallow)
Allerisma terminale Hall
Pleurophorus immaturus Herrick

Pharkidonotus percarinatus (Conrad)
Patellostium montfortianum (Norwood and Pratten)
Naticopsis ventricosus (Norwood and Pratten)
Sphaerodoma ventricosa (Hall)

Pseudorthoceras knoxense (McChesney)
Endolobus (Temnocheilus ?) ortoni (Whitfield) ?
Epphipioceras sp.

A collection of fossils also from Madison Township in the vicinity of Adams Mills was borrowed for study from the Geological Museum of The Ohio State University, and includes the following forms (Locality 42):

Crinoid segments

Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera muricata var. missouriensis Girty
Spiriferina kentuckyensis (Shumard)
Spirifer opimus Hall
Composita subtilita (Hall)

Myalina recurvirostris var. sinuosa n. var.
Pleurophorella costata (Meek and Worthen)

Schizostoma catilloides (Conrad)

In Section 20, Muskingum Township, the Lower Mercer member outcrops in the bed of Blunt Run where it is represented by two layers of hard limestone separated by dark, shaly, very fossiliferous limestone. The locality is one of the best for collecting purposes as it is easily accessible and the fossils abundant and can be obtained without difficulty (Locality 27). The character of the deposit is shown in the following geologic section:

		Feet	Inches
Limestone, shaly, fossiliferous	*Lower Mercer*	1	--
Limestone, hard, fossiliferous		--	8
Limestone, shaly, fossiliferous		--	3
Limestone, hard, fossiliferous		1	8
Shale, with coal bands		--	6
Coal, bony, *Middle Mercer*		--	8

The collections listed below were made at Blunt Run:

FOSSILS FROM THE LOWER MERCER LIMESTONE

Fusulina secalica (Say)

Lophophyllum profundum (Milne-Edwards and Haime)

Crinoid segments

Fenestella shumardi Prout?
Polypora sp.
Septopora biserialis (Swallow)
Septopora biserialis var. gracilis (Meek)
Rhombopora lepidodendroidea Meek

Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer cameratus Morton
Spirifer boonensis Swallow?
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Schizodus wheeleri Swallow

Pharkidonotus percarinatus (Conrad)
Naticopsis nanus (Meek and Worthen)

Orthoceras sp.
Endolobus (Temnocheilus?) ortoni (Whitfield)

FOSSILS FROM THE SHALE ABOVE THE LIMESTONE

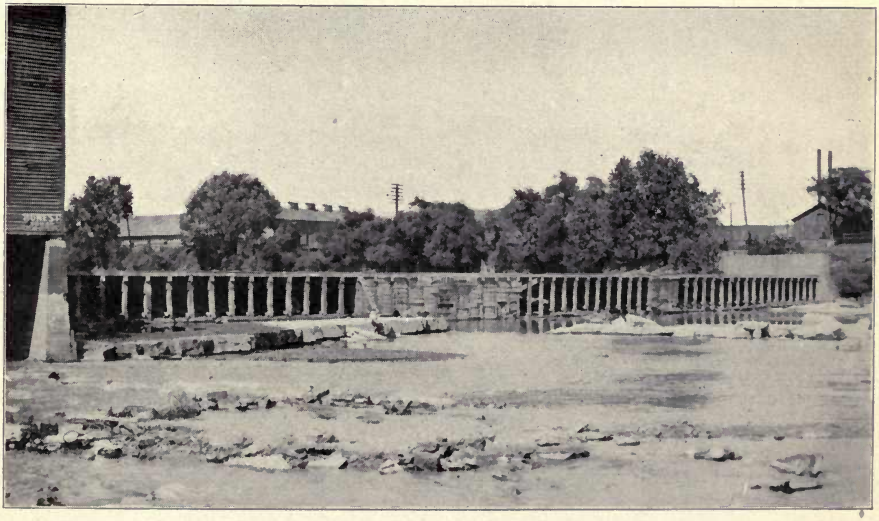
Lophopyllum profundum (Milne-Edwards and Haime)

Crinoid segments

Fenestella limbata Foerste
Fenestella shumardi Prout?
Septopora biserialis var. gracilis (Meek)
Rhombopora lepidodendroidea Meek

Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Rhipidomella pecosi (Marcou)
Spiriferina kentuckyensis (Shumard)
Spirifer cameratus Morton
Spirifer boonensis Swallow?
Spirifer opimus Hall

A—Lower Mercer limestone along Wheeling & Lake Erie Railroad near Rock Cut, Muskingum Township, Muskingum County (Locality 28)



B—Lower Mercer limestone in bed of Licking River at Zanesville, Muskingum County

Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Leda bellistriata Stevens
Schizodus wheeleri Swallow
Acanthopecten carboniferous (Stevens)
Allerisma terminale Hall
Astartella varica McChesney

Euphemus nodocarinatus (Hall)

Phillipsia trinucleata Herrick

Exposures, which also furnish excellent collecting, are found along the Wheeling & Lake Erie Railroad embankment north of Rock Cut. In the same locality the Boggs and Upper Mercer members both are present, and the relation between the three strata can be seen to the best advantage (Locality 28).[1] The fossils listed below were obtained:

Plantae

Fusulina secalica (Say)

Crinoid segments

Fenestella limbata Foerste
Fenestella shumardi Prout?
Polypora sp.
Rhombopora lepidodendroidea Meek

Orbiculoidea meekana (Whitfield)
Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Pustula pertenuis (Meek)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Edmondia aspinwallensis Meek
Posidonia sp.
Parallelodon tenuistriatus (Meek and Worthen)
Aviculopecten coxanus Meek and Worthen
Aviculopecten sorer Herrick
Deltopecten occidentalis (Shumard)
Acanthopecten carboniferous (Stevens)
Crenipecten foerstii Herrick
Euchondria neglecta (Geinitz)

[1]See geologic section under discussion of the Boggs member, p. 42.

Entolium aviculatus (Swallow)
Lima retifera Shumard
Allerisma terminale Hall
Pleurophorus immaturus Herrick
Astartella compacta Girty
Astartella concentrica (Conrad)
Astartella newberryi Meek
Cypricardinia ? carbonaria Meek

Pharkidonotus percarinatus (Conrad)
Pharkidonotus percarinatus var. tricarinatus (Shumard)
Bucanopsis meekiana (Swallow)
Patellostium montfortianum (Norwood and Pratten)

In the vicinity of Frazeysburg, Cass Township, the Lower Mercer member outcrops in many places. A particularly good locality for collecting occurs in the southeastern part of the township about three miles southeast of Frazeysburg in the road bed on land of J. F. Shaw. The deposit here is flinty in character with impure, shaly, extremely fossiliferous limestone overlying the flinty phase. The geologic section measured at this place follows (Locality 43):[1]

		Feet	Inches
Limestone, shaly, very fossiliferous	*Lower Mercer*	4	6
Limestone, flinty, very fossiliferous	*Lower Mercer*	6	6
Coal, *Middle Mercer*		--	8
Shale and covered		13	4
Limestone, dark gray, *Boggs*		1	10

A large number of species were collected and were identified as follows:

Lophophyllum profundum (Milne-Edwards and Haime)

Crinoid segments

Chainodictyon laxum Foerste
Fenestella limbata Foerste
Polypora fastuosa Foerste
Pinnatopora whitii Foerste
Septopora biserialis (Swallow)
Septopora biserialis var. gracilis (Meek)
Rhombopora lepidodendroidea Meek
Rhombopora multipora Foerste
Cystodictya carbonaria (Meek)
Prismopora sereata (Meek)

Glossina waverlyensis (Herrick)
Orbiculoidea meekana (Whitfield)
Crania modesta White and St. John
Rhipidomella pecosi (Marcou)
Derbya crassa (Meek and Hayden)

[1]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 21, p. 88, 1918.

Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer cameratus Morton
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Solenomya radiata Meek and Worthen
Edmondia anodontoides (Meek)?
Edmondia aspinwallensis Meek
Edmondia meekiana (Herrick)?
Edmondia gibbosa (McCoy)
Edmondia reflexa Meek
Nucula parva McChesney
Nuculopsis ventricosa (Hall)
Leda bellistriata Stevens
Leda meekana Mark
Yoldia stevensoni Meek
Parallelodon carbonarius (Cox)
Parallelodon obsoletus (Meek)
Parallelodon sangamonensis (Worthen)
Parallelodon tenuistriatus (Meek and Worthen)
Pteria ohioense (Herrick)
Pseudomonotis sp.
Myalina swallovi McChesney
Schizodus affinis Herrick
Schizodus curtus Meek and Worthen
Schizodus wheeleri Swallow
Aviculopecten coxanus Meek and Worthen
Aviculopecten herzeri Meek
Aviculopecten sorer Herrick
Deltopecten occidentalis (Shumard)
Acanthopecten carboniferous (Stevens)
Crenipecten foerstii Herrick
Euchondria neglecta (Geinitz)
Entolium attenuatum Herrick
Entolium aviculatus (Swallow)
Lima retifera Shumard
Posidonia ? acosta (Cox) ?
Allerisma terminale Hall
Pleurophorella costata (Meek and Worthen)
Pleurophorus immaturus Herrick
Pleurophorus oblongus Meek
Pleurophorus tropidophorus Meek
Astartella concentrica (Conrad)
Astartella newberryi Meek
Astartella varica McChesney
Cypricardinia ? carbonaria Meek

Plagioglypta meekana (Geinitz)

Bellerophon crassus Meek and Worthen

Pharkidonotus percarinatus (Conrad)
Bucanopsis meekiana (Swallow)
Patellostium montfortianum (Norwood and Pratten)
Euphemus carbonarius (Cox)
Euphemus nodocarinatus (Hall)
Trepospira depressa (Cox)
Pleurotomaria ornatiformis n. sp.?
Schizostoma catilloides (Conrad)
Naticopsis nanus (Meek and Worthen)
Sphaerodoma klipparti (Meek)

Pseudorthoceras knoxense (McChesney)

Phillipsia sangamonensis Meek and Worthen
Phillipsia trinucleata Herrick

In the northern part of Cass Township, Section 5, a small collection of fossils was made from outcrops in the ravine east of the north and south road about one mile south of the Muskingum County line (Locality 44):

Fusulina secalica (Say)

Crinoid segments

Fenestella limbata Foerste
Rhombopora lepidodendroidea Meek

Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer opimus Hall

Parallelodon tenuistriatus (Meek and Worthen)
Parallelodon carbonarius (Cox)
Aviculopecten coxanus Meek and Worthen
Deltopecten occidentalis (Shumard)
Acanthopecten carboniferous (Stevens)
Crenipecten foerstii Herrick
Entolium aviculatus (Swallow)
Lima retifera Shumard
Posidonia ? acosta (Cox) ?
Pleurophorus tropidophorus Meek
Astartella newberryi Meek
Astartella varica McChesney
Cypricardinia ? carbonaria Meek

Pharkidonotus percarinatus (Conrad)

In Jackson Township excellent exposures of Lower Mercer limestone are present in the vicinity of Fairview School, three miles north-

west of Frazeysburg. Fossils occur in great profusion in the shaly layers above the hard limestone, and good collecting is afforded at several localities. Fossils were obtained in Section 7, where the deposit is found in the roadbed, one-half mile southeast of the schoolhouse. The geologic section measured here follows (Locality 45):

		Feet	Inches
Limestone, shaly, very fossiliferous	*Lower Mercer*	4	6
Limestone, hard, fossiliferous	*Lower Mercer*	1	6
Clay, shale, and covered		20	--
Covered		13	--
Coal blossom, *Lower Mercer*		2	--

The fossils identified from this locality are as follows:

Fusulina secalica (Say)

Lophophyllum profundum (Milne-Edwards and Haime)

Crinoid segments

Tabulipora ohioensis (Foerste)
Chainodictyon laxum Foerste
Fenestella limbata Foerste
Fenestella remota Foerste
Polypora fastuosa Foerste
Pinnatopora whitii Foerste
Septopora biserialis (Swallow)
Septopora biserialis var. gracilis (Meek)
Rhombopora lepidodendroidea Meek
Rhombopora multipora Foerste
Cystodictya carbonaria (Meek)
Prismopora sereata (Meek)

Lingula carbonaria Shumard
Orbiculoidea meekana (Whitfield)
Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Pustula punctatus (Martin)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer cameratus Morton
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Solenomya radiata Meek and Worthen
Edmondia ovata Meek and Worthen
Edmondia aspinwallensis Meek
Nucula parva McChesney
Leda bellistriata Stevens

Leda meekana Mark
Leda prolongata n. sp.
Yoldia stevensoni Meek
Parallelodon carbonarius (Cox)
Parallelodon tenuistriatus (Meek and Worthen)
Pteria ohioense (Herrick)
Myalina pernaformis Cox
Schizodus affinis Herrick
Aviculopecten coxanus Meek and Worthen
Aviculopecten herzeri Meek
Aviculopecten sorer Herrick
Deltopecten occidentalis (Shumard)
Acanthopecten carboniferous (Stevens)
Crenipecten foerstii Herrick
Euchondria neglecta (Geinitz)
Entolium attenuatum Herrick
Entolium aviculatus (Swallow)
Lima retifera Shumard
Allerisma terminale Hall
Pleurophorella costata (Meek and Worthen)
Pleurophorella geinitzi (Meek)
Pleurophorus immaturus Herrick
Pleurophorus tropidophorus Meek
Astartella concentrica (Conrad)
Astartella newberryi Meek
Astartella varica McChesney

Plagioglypta prosseri n. sp.

Pharkidonotus percarinatus (Conrad)
Patellostium montfortianum (Norwood and Pratten)
Euphemus carbonarius (Cox)
Euphemus nodocarinatus (Hall)
Naticopsis nanus (Meek and Worthen)
Schizostoma catilloides (Conrad)
Zygopleura plenum (Herrick) ?
Sphaerodoma fusiformis (Hall) ?

Pseudorthoceras knoxense (McChesney)

Phillipsia trinucleata Herrick

Licking County.—The Lower Mercer member extends westward in Licking County, where at its extreme limit it is found on the top of Bald Knob, one of the highest hills of that vicinity, located about two miles southeast of Newark. The limestone is thus described by Miss Mark in her report on the Mercer limestone in the Newark-Zanesville region:[1] "The top of the hill is covered with broken blocks of dark blue, very fossiliferous limestone which weathers into somewhat shaly fragments. None of the limestone is in place, and the heaviest block measured eight inches in thickness. A small proportion of these fragments are less shaly and when weathered are buff in color and much

[1]Mark, C. G., Bull. Den. Univ., Vol. XVI, p. 271, 1911.

lighter in weight than the shaly dark blue limestone. They are extremely fossiliferous, but the fossils are, as a rule, not so well preserved as in the blue limestone." The species listed below were collected from loose blocks on the hilltop (Locality 46):

Lophophyllum profundum (Milne-Edwards and Haime)

Crinoid segments

Fenestella limbata Foerste
Polypora fastuosa Foerste
Septopora biserialis var. gracilis (Meek)
Rhombopora lepidodendroidea Meek
Streblotrypa merceri n. sp.
Cystodictya carbonaria (Meek)
Prismopora sereata (Meek)

Orbiculoidea meekana (Whitfield)
Orbiculoidea missouriensis (Shumard)
Rhipidomella pecosi (Marou)
Derbya crassa (Meek and Hayden)
Derbya robusta (Hall)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Pustula pertenuis (Meek) ?
Pustula punctatus (Martin)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer cameratus Morton
Spirifer boonensis Swallow ?
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Solenomya radiata Meek and Worthen
Edmondia aspinwallensis Meek
Edmondia meekiana (Herrick) ?
Edmondia ovata Meek and Worthen
Nucula beyrichi von Schauroth
Nucula elongata n. sp. ?
Leda bellistriata Stevens
Leda meekana Mark
Yoldia stevensoni Meek
Parallelodon carbonarius (Cox)
Parallelodon obsoletus (Meek)
Parallelodon sangamonensis (Worthen)
Parallelodon tenuistriatus (Meek and Worthen)
Pteria ohioense (Herrick)
Myalina pernaformis Cox
Myalina swallovi McChesney
Schizodus affinis Herrick

Schizodus cuneatus Meek
Schizodus curtus Meek and Worthen
Schizodus wheeleri Swallow
Aviculopecten coxanus Meek and Worthen
Aviculopecten herzeri Meek
Aviculopecten sorer Herrick
Deltopecten occidentalis (Shumard)
Deltopecten scalaris (Herrick)
Acanthopecten carboniferous (Stevens)
Crenipecten foerstii Herrick
Euchondria neglecta (Geinitz)
Entolium attenuatum Herrick
Entolium aviculatus (Swallow)
Lima retifera Shumard
Allerisma terminale Hall
Pleurophorella geinitzi (Meek)
Pleurophorus immaturus Herrick
Pleurophorus spinulosa n. sp.
Pleurophorus tropidophorus Meek
Astartella concentrica (Conrad)
Astartella compacta Girty
Astartella newberryi Meek
Astartella varica McChesney
Cypricardinia ? carbonaria Meek

Plagioglypta prosseri n. sp.

Bellerophon crassus Meek and Worthen
Pharkidonotus percarinatus (Conrad)
Bucanopsis meekiana (Swallow)
Patellostium montfortianum (Norwood and Pratten)
Euphemus nodocarinatus (Hall)
Naticopsis altonensis (McChesney)
Schizostoma catilloides (Conrad)
Hemizyga sp. undescribed
Sphaerodoma klipparti (Meek)
Sphaerodoma regularis (Cox) ?

Pseudorthoceras knoxense (McChesney)

Phillipsia sangamonensis Meek and Worthen
Phillipsia trinucleata Herrick

The Lower Mercer limestone is exposed along Flint Ridge which is located for the most part in Hopewell Township, Licking County, although it also extends eastward into Muskingum County. Fossils, which occur in great abundance wherever the member is present, were collected at several localities. A large number of species were found at the old cannel coal mine, about one-half mile north of the Flint Ridge road and just west of the north and south road passing parallel to the township line (Locality 47). The geologic section measured at the cannel coal mine follows:

Section at Cannel Coal Mine, Hopewell Township, Licking County

		Feet	Inches
Flint, *Vanport*		5	--
Sandstone and covered		124	--
Limestone, shaly, fossiliferous	*Lower Mercer*	8	9
Shale, calcareous		--	3
Limestone, hard, fossiliferous		1	4
Limestone, shaly		--	6
Coal, bituminous, *Middle Mercer*		--	8
Shale, black		--	10
Clay shale		4	--
Coal, bony	*Flint Ridge*	--	10
Clay, dark		--	8
Coal, cannel		3	9
Shale		1	4
Coal, cannel		--	10
Clay shale		4	--

The species collected at this locality are listed below:

Lophophyllum profundum (Milne-Edwards and Haime)

Crinoid segments and plates

Tabulipora ohioensis (Foerste)
Fenestella limbata Foerste
Fenestella remota Foerste
Fenestella shumardi Prout ?
Polypora fastuosa Foerste
Pinnatopora whitii Foerste
Septopora biserialis (Swallow)
Rhombopora lepidodendroidea Meek
Cystodictya carbonaria (Meek)
Prismopora sereata (Meek)

Lingula carbonaria Shumard
Orbiculoidea meekana (Whitfield)
Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Dielasma bovidens Morton ?
Spiriferina kentuckyensis (Shumard)
Spirifer cameratus Morton
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Solenomya radiata Meek and Worthen
Prothyris elegans Meek
Edmondia anodontoides (Meek)

Edmondia aspinwallensis Meek
Edmondia meekiana (Herrick)
Edmondia ovata Meek and Worthen
Edmondia gibbosa (McCoy)
Edmondia reflexa Meek
Nucula parva McChesney
Leda bellistriata Stevens
Yoldia stevensoni Meek
Parallelodon carbonarius (Cox)
Parallelodon obsoletus (Meek)
Parallelodon sangamonensis (Worthen)
Parallelodon tenuistriatus (Meek and Worthen)
Pteria ohioense (Herrick)
Posidonia sp.
Myalina swallovi McChesney
Schizodus affinis Herrick
Schizodus cuneatus Meek
Schizodus curtus Meek and Worthen
Schizodus wheeleri Swallow
Aviculopecten coxanus Meek and Worthen
Aviculopecten herzeri Meek
Deltopecten occidentalis (Shumard)
Deltopecten scalaris (Herrick)
Acanthopecten carboniferous (Stevens)
Crenipecten foerstii Herrick
Euchondria neglecta (Geinitz)
Entolium attenuatum Herrick
Entolium aviculatus (Swallow)
Lima retifera Shumard
Placunopsis ? recticardinalis Meek
Allerisma terminale Hall
Pleurophorus immaturus Herrick
Pleurophorus tropidophorus Meek
Astartella concentrica (Conrad)
Astartella newberryi Meek
Astartella varica McChesney
Cypricardinia ? carbonaria Meek

Bellerophon crassus Meek and Worthen
Pharkidonotus percarinatus (Conrad)
Bucanopsis meekiana (Swallow)
Patellostium montfortianum (Norwood and Pratten)
Euphemus carbonarius (Cox)
Euphemus nodocarinatus (Hall)
Pleurotomaria broadheadi White
Pleurotomaria coxanus Meek and Worthen
Pleurotomaria carbonaria Norwood and Pratten
Schizostoma catilloides (Conrad)
Zygopleura plicata (Whitfield) ?
Sphaerodoma klipparti (Meek)

Conularia crustula White

Orthoceras isogramma Meek
Pseudorthoceras knoxense (McChesney)

Phillipsia sangamonensis Meek and Worthen
Phillipsia trinucleata Herrick

Another collection was made on Flint Ridge from outcrops of Lower Mercer limestone in the north and south road near the township line, about three-fourths mile north of the Fairview School. The deposit at this place attains the unusual thickness of 15 feet and contains a great profusion of fossils. The geologic section below shows the succession of strata in this vicinity (Locality 48):

Section about three-fourths mile north of Fairview School, Hopewell Township, Licking County

		Feet	Inches
Allegheny formation			
Flint, fossiliferous	*Vanport*	2	--
Limestone, shaly, part covered	*Vanport*	15	--
Covered		23	--
Limestone, fossiliferous, *Putnam Hill*		--	6
Coal blossom, *Brookville*		1	--
Pottsville formation			
Clay and covered		14	--
Sandstone, shaly		7	--
Clay and covered		11	--
Flint, black, fossiliferous, with shale, *Upper Mercer*		1	--
Coal blossom, *Bedford*		1	--
Shale and covered		8	--
Limestone, shaly, fossiliferous	*Lower Mercer*	13	--
Limestone, hard, fossiliferous	*Lower Mercer*	2	--

The fossils listed below were collected from Fairview School locality:

Plantae

Fusulina secalica (Say)

Crinoid segments and plates
Eupachycrinus mooresi (Whitfield) ?

Chainodictyon laxum Foerste
Fenestella limbata Foerste
Polypora fastuosa Foerste
Pinnatopora whitii Foerste
Septopora biserialis (Swallow)
Septopora biserialis var. gracilis (Meek)
Rhombopora lepidodendroidea Meek
Cystodictya carbonaria (Meek)
Prismopora sereata (Meek)

Orbiculoidea meekana (Whitfield)
Crania modesta White and St. John
Schizophoria altirostris (Mather)
Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten

Productus cora d'Orbigny
Pustula nebraskensis (Owen)
Pustula punctatus (Martin)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer cameratus Morton
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Solenomya radiata Meek and Worthen
Edmondia meekiana (Herrick) ?
Nuculopsis ventricosa (Hall)
Leda bellistriata Stevens
Leda meekana Meek
Yoldia stevensoni Meek
Parallelodon carbonarius (Cox)
Parallelodon sangamonensis (Worthen)
Parallelodon tenuistriatus (Meek and Worthen)
Aviculopinna americana Meek
Pteria ohioense (Herrick)
Posidonia sp.
Myalina swallovi McChesney
Schizodus affinis Herrick
Schizodus curtus Meek and Worthen
Aviculopecten coxanus Meek and Worthen
Aviculopecten herzeri Meek
Acanthopecten carboniferous (Stevens)
Crenipecten foerstii Herrick
Euchondria neglecta (Geinitz)
Entolium attenuatum Herrick
Entolium aviculatus (Swallow)
Lima retifera Shumard
Allerisma terminale Hall
Pleurophorus immaturus Herrick
Pleurophorus tropidophorus Meek
Pleurophorus oblongus Meek
Pleurophorella geinitzi (Meek)
Astartella concentrica (Conrad)
Astartella newberryi Meek
Astartella varica McChesney
Cypricardinia ? carbonaria Meek

Pharkidonotus percarinatus (Conrad)
Bucanopsis meekiana (Swallow)
Patellostium montfortianum (Norwood and Pratten)
Euphemus carbonarius (Cox)
Schizostoma catilloides (Conrad)
Bulimorpha inornata (Meek and Worthen) ?

Conularia newberryi Winchell ?

Pseudorthoceras knoxense (McChesney)

Phillipsia trinucleata Herrick

A third collection of fossils from Flint Ridge was obtained from the sandy shale on the Flint Ridge road just east of the north and south crossroads and north of Locality 48 (Locality 49). The species found are as follows:

Lophophyllum profundum (Milne-Edwards and Haime)

Crinoid segments

Fenestella limbata Foerste
Polypora fastuosa Foerste
Septopora biserialis (Swallow)
Septopora biserialis var. gracilis (Meek)
Rhombopora lepidodendroidea Meek
Rhombopora multipora Foerste
Cystodictya carbonaria (Meek)
Prismopora sereata (Meek)

Lingula carbonaria Shumard
Glossina waverlyensis (Herrick)
Orbiculoidea meekana (Whitfield)
Orbiculoidea missouriensis (Shumard)
Rhipidomella pecosi (Marcou)
Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Pustula punctatus (Martin)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer cameratus Morton
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Edmondia ovata Meek and Worthen
Edmondia gibbosa (McCoy)
Nucula parva McChesney
Parallelodon carbonarius (Cox)
Parallelodon tenuistriatus (Meek and Worthen)
Schizodus curtus Meek and Worthen
Schizodus wheeleri Swallow
Aviculopecten coxanus Meek and Worthen
Aviculopecten herzeri Meek
Deltopecten occidentalis (Shumard)
Acanthopecten carboniferous (Stevens)
Crenipecten foerstii Herrick
Euchondria neglecta (Geinitz)
Entolium attenuatum Herrick
Entolium aviculatus (Swallow)
Lima retifera Shumard
Allerisma terminale Hall
Pleurophorus immaturus Herrick

Pleurophorus oblongus Meek
Pleurophorus tropidophorus Meek
Astartella concentrica (Conrad)
Astartella newberryi Meek
Astartella varica McChesney
Cypricardinia ? carbonaria Meek

Pharkidonotus percarinatus (Conrad)
Patellostium montfortianum (Norwood and Pratten)
Euphemus carbonarius (Cox)
Euphemus nodocarinatus (Hall)
Pleurotomaria newportensis White ?
Schizostoma catilloides (Conrad)

Orthoceras isogramma Meek
Pseudorthoceras knoxense (McChesney)

Phillipsia sangamonensis Meek and Worthen
Phillipsia trinucleata Herrick

Coshocton County.—The Lower Mercer limestone was observed in Opossum Hollow in the southwestern part of Washington Township, where it consists of hard blue, moderately fossiliferous limestone, four feet in thickness (Locality 50).[1] The forms collected are listed below:

Crinoid segments

Rhombopora lepidodendroidea Meek

Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula punctatus (Martin)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)

Entolium attenuatum Herrick
Entolium aviculatus (Swallow)
Astartella concentrica (Conrad)

Tuscarawas County.—In Tuscarawas County the Lower Mercer member outcrops in various places but no collections of fossils were made. It consists for the most part of hard, blue limestone, 3 to 6 feet in thickness. The geologic section showing the member with its associated rocks, measured on the farm of Joseph Hair two miles northwest of Bolivar, is given in the review of the Boggs horizon. About three miles to the southeast of this point is the village Zoar, from which the stratum was named by Newberry in 1874, on account of the excellent outcrops in the vicinity.

[1]See geologic section measured in Opossum Hollow under discussion of Lowellville member, p. 34.

Holmes County.—The following fossils, which are among the collections in the Geologic Museum at The Ohio State University, were obtained from the Lower Mercer shales near Millersburg in Hardy Township (Locality 51):

Crinoid segments

Orbiculoidea meekana (Whitfield)
Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny

Parallelodon obsoletus (Meek)
Myalina swallovi McChesney
Entolium aviculatus (Swallow)

Wayne County.—The geologic section below was measured near the road corners in the northern part of Section 17, Paint Township, where the exposure of Lower Mercer limestone is fairly characteristic for the county. No collections of fossils were made.

	Feet	Inches
Allegheny formation		
Limestone, fossiliferous, *Putnam Hill*	3	8
Coal, *Brookville*	2	4
Pottsville formation		
Clay, gray	7	6
Coal, smut	--	1
Clay	3	--
Covered	36	8
Shale, gray	7	--
Ore, *Lower Mercer*	--	4
Shale, gray	--	5
Limestone, blue, fossiliferous, *Lower Mercer*	1	9
Coal, bony } *Middle Mercer*	1	3
Shale, bony } *Middle Mercer*	--	2

Stark County.—In Stark County the Lower Mercer member is exposed at various places, although fossils were obtained from only one locality. The limestone is hard and fossiliferous, varying in thickness from 1 to 3 feet. The following forms were obtained from the Lower Mercer limestone and the black carbonaceous shale overlying the limestone near East Greenfield at the shaft mine, two and one-half miles east of Dalton (Locality 52):

FOSSILS FROM THE LOWER MERCER LIMESTONE

Lophophyllum profundum (Milne-Edwards and Haime)

Crinoid segments

Fenestella limbata Foerste

Orbiculoidea meekana (Whitfield)
Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spirifer cameratus Morton
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Crenipecten foerstii Herrick

FOSSILS FROM THE BLACK, CARBONACEOUS SHALE ABOVE THE LIMESTONE

Crinoid segments

Orbiculoidea meekana (Whitfield)
Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Rhipidomella pecosi (Marcou)
Spiriferina kentuckyensis (Shumard)
Spirifer cameratus Morton
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Parallelodon carbonarius (Cox)
Parallelodon obsoletus (Meek)
Parallelodon tenuistriatus (Meek and Worthen)
Aviculopecten coxanus Meek and Worthen
Acanthopecten carboniferous (Stevens)
Entolium aviculatus (Swallow)
Allerisma terminale Hall
Pleurophorella costata (Meek and Worthen)
Pleurophorus tropidophorus Meek
Astartella varica McChesney
Astartella concentrica (Conrad)

Plagioglypta meekana (Geinitz)

Pharkidonotus percarinatus (Conrad)
Euphemus nodocarinatus (Hall)
Phanerotrema grayvillense (Norwood and Pratten)
Pleurotomaria carbonaria Norwood and Pratten
Pleurotomaria newportensis White
Schizostoma catilloides (Conrad)
Naticopsis nanus (Meek and Worthen)
Naticopsis pulchella n. sp.

Bulimorpha inornata (Meek and Worthen) ?
Sphaerodoma brevis (White)
Sphaerodoma regularis (Cox) ?

Pseudorthoceras knoxense (McChesney)

An excellent outcrop of Lower Mercer limestone occurs in Section 2, Pike Township, in the valley of Nimishillen Creek just north of Howenstein, where the geologic section below was measured:

Section in valley of Nimishillen Creek, Pike Township, Stark County

	Feet	Inches
Allegheny formation		
Limestone, fossiliferous, *Putnam Hill*	3	7
Shale	--	1
Coal, *Brookville*	1	6
Pottsville formation		
Clay, gray	6	--
Shale and covered	19	3
Shale	30	--
Ore, *Upper Mercer*	--	2
Limestone, dark, fossiliferous, *Upper Mercer*	2	--
Coal, bony, *Bedford*	1	4
Clay, dark	1	4
Ganister, light	1	6
Shale and ganister	1	6
Shale, gray	19	4
Limestone, ferruginous, fossiliferous } *Lower Mercer*	1	--
Limestone, gray, fossiliferous } *Lower Mercer*	1	3

In the northern and eastern parts of the county the member has been penetrated in mines and well drillings. To the east the limestone is sometimes replaced by shale, but where present, it often reaches a thickness of about 3 feet. The geologic section below was taken at Aultman, in Section 30, Lake Township, at the mine of the National Fire Proofing Co.

	Feet	Inches
Shale	20	--
Limestone, blue, fossiliferous, *Lower Mercer*	1	8
Shale	--	4
Coal, bony, *Middle Mercer*	--	10

Summit and Portage Counties.—In Summit and Portage counties the Lower Mercer member, where exposed, is similar to the deposits elsewhere in northeastern Ohio.

Mahoning County.—The member is well developed in Mahoning County and consists characteristically of two benches of hard blue limestone, generally without shaly partings between them. Black, ex-

tremely fossiliferous shale often occurs below the limestone. The average thickness is about 3 feet, the lower bench being thinner and more fossiliferous than the upper. One of the best outcrops occurs in the western part of the county along Little Mill Creek, about two and one-half miles northeast of North Benton and one-fourth mile west of the junction of Turkeybroth Creek with Little Mill Creek. Here the stream has formed a waterfall over a projecting ledge of hard Lower Mercer limestone. The deposit consists of two benches of tough, almost black limestone, without partings, the upper one of which is flinty at the top. The lower bench is very fossiliferous and affords excellent collecting. The section measured here follows (Locality 53):

Section along Little Mill Creek, Berlin Township, Mahoning County

	Feet	Inches
Limestone, *Upper Mercer*	3	4
Covered	5	3
Shale, black	2	--
Coal, *Upper Mercer or No. 3b*	--	10
Shale, black	--	7
Clay	5	--
Shale, gray	1	--
Sandstone, shaly	5	4
Shale, sandy, gray	7	6
Limestone, hard, flinty near top, fossiliferous } *Lower Mercer*	2	--
Limestone, very fossiliferous } *Lower Mercer*	--	6
Shale, clay	--	1
Coal, *Middle Mercer*	--	2
Shale, clay, gray	1	--
Covered	2	--
Shale, clay, bluish-gray	1	--
Sandstone, shaly, micaceous	2	--

The fossils collected at this locality include the following forms:

Crinoid segments

Septopora biserialis var. gracilis (Meek)
Cystodictya carbonaria (Meek)
Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer cameratus Morton
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Orthoceras n. sp.

Near the central part of the county a collection was made from exposures of Lower Mercer limestone in the bed of West Branch of Meander Creek, one-fourth mile east of Club Lake and one-half mile south of Ellsworth. The stratum is very hard and flinty toward the top where the fauna is small and stunted. A thin, extremely fossiliferous zone occurs about 3 inches above the base of the horizon. The geologic section here follows (Locality 54):

	Feet	Inches
Sandstone, massive, base very irregular, coarse-grained, ferruginous, rich in plant fossils	26	--
Coal, *Upper Mercer or No. 3b*	1	4
Sandstone, irregular base	--	2
Clay, plastic	4	4
Shale, gray, siliceous, micaceous, rich in plant fossils	11	--
Limestone, hard, flinty, *Lower Mercer*	2	6

The following fossils were collected:

Crinoid segments

Fenestella shumardi Prout ?
Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spirifer boonensis Swallow ?
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

In eastern Mahoning County the member outcrops in the bed of Yellow Creek, one-half mile east of Poland, forming a projecting ledge over which the water falls. Lamb describes the deposit thus:[1] "The stratum presents here that peculiarity of 2 layers noted elsewhere. The upper layer measured 2 feet 3 inches and the lower 7 inches. Resting directly on the heavy bed is a 2 inch very impure layer of limestone of cone-in-cone structure which breaks easily and shows this peculiar structure quite admirably. The heavy bed is bluish gray, tough, fossiliferous, and sparkles with crinoid stems and calcite crystals. The limestone is directly underlain by black carbonaceous shale which is extremely fossiliferous." The lower bench, however, is much more fossiliferous than the upper. The section here follows (Locality 55):

[1]Lamb, G. F., Pennsylvanian Limestones of Northeastern Ohio below the Lower Kittanning Coal, Ohio Naturalist, Vol. 10, p. 122, March, 1910.

		Feet	Inches
Sandstone, coarse, thin-bedded, cross-bedded		15	--
Ore, nodular,	*Lower Mercer*	--	4
Limestone, hard, blue, sparingly fossiliferous		2	9
Limestone, very fossiliferous		--	7
Shale, extremely fossiliferous		--	6

Collections were made from both the hard limestone and the extremely fossiliferous black shale which underlies it:

FOSSILS FROM THE LOWER MERCER LIMESTONE

Crinoid segments

Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Acanthopecten carboniferous (Stevens)

FOSSILS FROM THE BLACK SHALE BELOW THE LIMESTONE

Crinoid segments

Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Aviculopecten herzeri Meek
Aviculopecten coxanus Meek and Worthen
Deltopecten occidentalis (Shumard)
Deltopecten scalaris (Herrick)
Acanthopecten carboniferous (Stevens)
Entolium attenuatum Herrick
Entolium aviculatus (Swallow)

Naticopsis altonensis (McChesney)?

In the extreme eastern part of Mahoning County near the Ohio-Pennsylvania line, Lower Mercer fossils were collected from exposures

at Lowellville. The characteristic two benches are present, the lower containing abundant fossils. Dr. Newberry in his section measured on Grindstone Run in 1878 records a thickness of one foot for the limestone.[1] The section below was measured at the same locality in 1919 (Locality 22):

Section on Grindstone Run at Lowellville, Mahoning County

	Feet	Inches
Limestone, *Upper Mercer*	2	--
Covered	3	--
Clay, exposed along railroad	1	--
Covered	9	--
Sandstone and shale, sandy	5	--
Shale	5	--
Ore, nodular, *Lower Mercer*	--	4
Limestone	2	1
Limestone, very fossiliferous } *Lower Mercer*	--	5
Shale, black	--	4
Shale, gray, clay	2	8
Coal, bony	--	2
Clay, bluish-gray, flinty	4	--
Shale, gray, siliceous	3	6
Covered	5	--
Shale, gray, siliceous	6	--
Shale, bluish-gray	3	6
Covered	30	--
Sandstone, thin-bedded	6	--
Shale, arenaceous, ferruginous	28	6
Shale, black, fissile, calcareous	2	4
Limestone, *Lowellville*	2	--
Covered	19	--
Sandstone, massive, coarse-grained	10	--

The fossils listed below were found:

Crinoid segments

Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera wabashensis (Norwood and Pratten)
Spirifer cameratus Morton
Spirifer boonensis Swallow ?
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

[1]See section at Grindstone Run included under discussion of the Lowellville member, p. 34.

Summary

The Lower Mercer limestone, which forms the next faunal horizon above the Boggs member, is the most widespread and persistent member of the Pottsville formation and is found in every county where the Pottsville outcrops. It consists of hard, blue to black, fossiliferous limestone which occurs characteristically in two benches either with or without shaly partings. The hard limestone is generally associated with or replaced by extremely fossiliferous, black calcareous shales or impure shaly limestones. In thickness the member varies from less than 1 foot to as much as 20 feet, with an average of about 3 feet. The fauna is always abundant and is composed largely of pelecypods and brachiopods, although it is characterized everywhere by a profusion of large crinoid stems.

The complete list of fossils from the Lower Mercer member follows:

Plantae

Fusulina secalica (Say)

Lophophyllum profundum (Milne-Edwards and Haime)

Eupachycrinus mooresi (Whitfield)
Crinoid segments

Archaeocidaris spines

Tabulipora ohioensis (Foerste)
Chainodictyon laxum Foerste
Fenestellidae undetermined
Fenestella limbata Foerste
Fenestella remota Foerste
Fenestella shumardi Prout ?
Fenestella sp.
Polypora fastuosa Foerste
Polypora sp.
Fenestellae undetermined
Pinnatopora whitii Foerste
Septopora biserialis (Swallow)
Septopora biserialis var. gracilis (Meek)
Rhombopora lepidodendroidea Meek
Rhombopora multipora Foerste
Streblotrypa merceri n. sp.
Cystodictya carbonaria (Meek)
Prismopora sereata (Meek)

Lingula carbonaria Shumard
Lingula kanawhensis Price
Glossina waverlyensis (Herrick)
Orbiculoidea meekana (Whitfield)
Orbiculoidea missouriensis (Shumard)
Crania modesta White and St. John
Rhipidomella pecosi (Marcou)
Schizophoria altirostris (Mather)

Derbya crassa (Meek and Hayden)
Derbya robusta (Hall)
Chonetes choteauensis Mather
Chonetes mesolobus Norwood and Pratten
Aulacorhynchus millepunctatus (Meek and Worthen)
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Productus semireticulatus (Martin) var.
Pustula nebraskensis (Owen)
Pustula pertenuis (Meek)
Pustula punctatus (Martin)
Pustula symmetricus (McChesney)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Dielasma bovidens Morton ?
Spiriferina kentuckyensis (Shumard)
Spirifer cameratus Morton
Spirifer opimus Hall
Spirifer boonensis Swallow ?
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Solenomya radiata Meek and Worthen
Prothyris elegans Meek
Edmondia anodontoides (Meek) ?
Edmondia aspinwallensis Meek
Edmondia meekiana (Herrick)
Edmondia gibbosa (McCoy)
Edmondia ovata Meek and Worthen
Edmondia reflexa Meek
Nucula beyrichi von Schauroth
Nucula elongata n. sp. ?
Nucula parva McChesney
Nuculopsis ventricosa (Hall)
Leda bellistriata Stevens
Leda meekana Mark
Leda prolongata n. sp.
Yoldia stevensoni Meek
Parallelodon carbonarius (Cox)
Parallelodon obsoletus (Meek)
Parallelodon sangamonensis (Worthen)
Parallelodon tenuistriatus (Meek and Worthen)
Aviculopinna americana Meek
Pteria ohioense (Herrick)
Pseudomonotis sp.
Posidonia ? acosta (Cox) ?
Posidonia girtyi n. sp.
Posidonia vintonensis n. sp.
Posidonia sp.
Myalina pernaformis Cox
Myalina recurvirostris var. sinuosa n. var.
Myalina swallovi McChesney
Schizodus affinis Herrick
Schizodus cuneatus Meek
Schizodus curtus Meek and Worthen

Schizodus mooresi Miller ?
Schizodus wheeleri Swallow
Aviculopecten coxanus Meek and Worthen
Aviculopecten herzeri Meek
Aviculopecten sorer Herrick
Deltopecten occidentalis (Shumard)
Deltopecten scalaris (Herrick)
Acanthopecten carboniferous (Stevens)
Crenipecten foerstii Herrick
Euchondria neglecta (Geinitz)
Entolium attenuatum Herrick
Entolium aviculatus (Swallow)
Lima retifera Shumard
Placunopsis ? recticardinalis Meek
Allerisma terminale Hall
Pleurophorella costata (Meek and Worthen)
Pleurophorella geinitzi (Meek)
Pleurophorella sesquiplicata Price
Pleurophorus immaturus Herrick
Pleurophorus oblongus Meek
Pleurophorus spinulosa n. sp.
Pleurophorus tropidophorus Meek
Astartella compacta Girty
Astartella concentrica (Conrad)
Astartella newberryi Meek
Astartella varica McChesney
Cypricardinia ? carbonaria Meek

Plagioglypta meekana (Geinitz)
Plagioglypta prosseri n. sp.

Bellerophon crassus Meek and Worthen
Pharkidonotus percarinatus (Conrad)
Pharkidonotus percarinatus var. tricarinatus (Shumard)
Euphemus carbonarius (Cox)
Euphemus nodocarinatus (Hall)
Bucanopsis meekiana (Swallow)
Patellostium montfortianum (Norwood and Pratten)
Phanerotrema grayvillense (Norwood and Pratten)
Trepospira depressa (Cox)
Pleurotomaria broadheadi White
Pleurotomaria carbonaria Norwood and Pratten
Pleurotomaria coxanus Meek and Worthen
Pleurotomaria newportensis White
Pleurotomaria ornatiformis n. sp. ?
Schizostoma catilloides (Conrad)
Naticopsis altonensis (McChesney)
Naticopsis nanus (Meek and Worthen)
Naticopsis pulchella n. sp.
Naticopsis ventricosus (Norwood and Pratten)
Trachydomia sp.
Zygopleura plenum (Herrick) ?
Zygopleura plicata (Whitfield)
Hemizyga n. sp.
Bulimorpha inornata (Meek and Worthen) ?

Sphaerodoma brevis (White)
Sphaerodoma fusiformis (Hall) ?
Spaerodoma klipparti (Meek)
Sphaerodoma newberryi (Stevens)
Spaerodoma primigenia (Conrad)
Sphaerodoma regularis (Cox)
Sphaerodoma ventricosa (Hall)

Conularia crustula White
Conularia newberryi Winchell ?

Orthoceras isogramma Meek
Orthoceras n. sp.
Orthoceras sp
Pseudorthoceras knoxense (McChesney)
Endolobus (Temnocheilus ?) ortoni (Whitfield)
Metacoceras pottsvillensis n. sp.
Epphipioceras sp.

Phillipsia sangamonensis Meek and Worthen
Phillipsia trinucleata Herrick

LOWER MERCER ORE

Stratigraphy and Extent

The Lower Mercer limestone is associated everywhere with an iron ore, known as the Lower Mercer or Little Red Block ore, which either lies directly over the limestone or is separated from it by a few feet of shale. Where the ore is best developed in southern Ohio, it is remarkably persistent and is present even where the limestone member is wanting. In thickness it measures from 4 to 6 inches with a maximum of 10 inches.[1] In Lawrence County the ore is found directly on the limestone; in Scioto County an interval of a few feet intervenes, while in Jackson County the average distance between the two members is 8 feet, with a maximum of 18 feet. In Vinton and Perry counties they are again in contact. Northward in Muskingum and Licking counties the Lower Mercer ore is present only locally in a few places and is separated from the underlying limestone by about one foot of shale.[2] Elsewhere in central and northeastern Ohio the member is less well represented. Formerly this ore was mined extensively for use in the charcoal furnaces of Scioto, Lawrence, and Jackson counties.

Although the Lower Mercer ore contains fossils, they are not abundant and represent the same forms as are present in the limestone member. In general, they are smaller showing the effects of impoverished living conditions which existed in the Pottsville sea during the period of iron ore deposition.

[1]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 20, pp. 142, 297, 570, 1916.
[2]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 21, p. 60, 1918.

Description of Geologic Sections and Collecting Localities

Jackson County.—Fossils were collected from the Lower Mercer ore at only one locality,—from outcrops along the road in the eastern part of Section 10, Coal Township, just east of Grace mine. The stratum is dark red in color, coarse and siliceous in character, and sparingly fossiliferous. The section measured here follows (Locality 56):

		Feet	Inches
Coal		6	--
Clay		2	--
Shale		4	7
Ore, *Lower Mercer*		--	5
Shale		3	--
Covered		5	3
Shale, blue		5	--
Limestone, gray, fossiliferous		--	11
Shale, dark, fossiliferous	*Lower Mercer*	1	10
Limestone, blue, fossiliferous		1	--

The fossils collected here are as follows:

Derbya crassa (Meek and Hayden)
Productus cora d'Orbigny
Spiriferina kentuckyensis (Shumard)
Spirifer opimus Hall
Composita subtilita (Hall)

Parallelodon sangamonensis (Worthen)
Allerisma terminale Hall

Euphemus carbonarius (Cox)
Pleurotomaria sp. (fragment)

SAND BLOCK ORE

Stratigraphy and Extent

In ascending order the Sand Block ore is the next faunal horizon above the Lower Mercer ore. It is of limited stratigraphic extent and has been found only in Lawrence, Scioto, and Jackson counties. Its position with reference to the Upper Mercer or No. 3a coal varies much from place to place; sometimes it is found directly above the coal, while sometimes the two horizons are separated by an interval of 30 feet, as in parts of Scioto County. In Lawrence County the distance varies from 1 to 15 feet, and in southern Jackson County 10 to 20 feet is generally found. In the northern part of the latter county the ore lies just above the Upper Mercer coal. In Scioto County it is also found 10 to 20 feet below the Upper Mercer ore.[1]

[1]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 20, pp. 160, 297, 580, 1916.

The Sand Block ore appears locally in patches, and in Lawrence County is found only in a few localities. It is nodular, highly siliceous in composition, and generally very thin, varying in thickness from 1 inch to slightly more than 1 foot, with an average of 5 inches. It is poor in fossils, and the forms which are present are microscopic in size. As the iron content in the ore is low, it is not used commercially at the present time, although formerly it was utilized to some extent for smelting in the old charcoal furnaces of Jackson County.

Description of Geologic Sections and Collecting Localities

Scioto County.—In the following section, measured on the land of Smith Hayward, Section 35, Bloom Township, the general relations of the Sand Block ore to the Upper Mercer or No. 3a coal below, and to the Upper Mercer ore above, are well shown.[1] No collections of fossils were made.

	Feet	Inches
Coal, *Tionesta or No. 3b*	2	--
Covered	18	--
Ore, *Upper Mercer*	1	6
Covered	16	--
Ore, sparingly fossiliferous, *Sand Block*	1	--
Shale	10	--
Coal, *Upper Mercer or No. 3a*	1	6

Jackson County.—The ore outcrops in the Dever Valley on the land of Joseph Woods, Section 24, Hamilton Township. It is moderately fossiliferous, the remains consisting mostly of small fragments of very diminutive shells which have for the most part been decomposed to a white, chalky substance. The white color of the shells presents a striking contrast to the coarse-grained, dark red matrix. The geologic section here follows (Locality 57):[2]

	Feet	Inches
Ore, *Upper Mercer*	--	4
Covered	13	--
Ore, very fossiliferous, *Sand Block*	--	4
Shale and covered	27	--
Ore, *Lower Mercer*	--	1
Clay, light	1	--

The fossils found in the Sand Block ore from this locality are listed below:

Orbiculoidea sp.

Minute Pelecypoda (three or more species)

Minute Gastropoda (three or more species)

[1]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 20, p. 579, 1916.
[2]Idem., p. 162.

UPPER MERCER MEMBER

Historical Review

The name Upper Mercer was first given to the marine limestone, which occurs above the Lower Mercer, by I. C. White in 1878 in his report on Mercer County, Pennsylvania,[1] although the same stratum had been previously recognized by H. D. Rogers along the Mahoning River and had been named the Mahoning limestone.[2] In Mercer County, Pennsylvania, the two Mercer limestones are reported to be seldom exposed in the same locality. In Ohio the stratum was referred to by Read, Andrews, Newberry, and Orton in the State Survey reports of various counties.[3] However, in 1878 the term Gore limestone was applied by Dr. Edward Orton in his description of the Hanging Rock District, probably from the town, Gore, in the northeastern part of Hocking County. He describes the deposit thus:[4] "The Gore limestone which is found from thirty to forty feet above the Zoar, resembles the latter in some of its phases, and can easily be mistaken for it. Like the latter, too, it is underlain with a coal seam and overlain with an iron ore. As a limestone it is chiefly found in Hocking and Vinton counties. It is often replaced by flint, though seldom by as heavy deposits as the Zoar horizon shows. Like that limestone, it is dark blue in color, but it is not as heavily charged with fossils as the Zoar." In 1884 Dr. Edward Orton adopted the name Upper Mercer for the Gore limestone from the equivalent stratum in Pennsylvania,[5] and this term has been used in all later reports.

Stratigraphy and Extent

The Upper Mercer member forms the next fossiliferous horizon of the Pottsville formation above the Sand Block ore, and is the fourth marine limestone of the Pennsylvanian system. In Ohio its area of outcrop is as great as that of the Lower Mercer limestone although it is by no means as persistent or as uniform in lithologic character. It is found at intervals along the entire outcrop of the Pottsville formation, including the following counties,—Lawrence, Scioto, Jackson, Vinton, Athens, Hocking, Perry, Muskingum, Licking, Coshocton, Tuscarawas, Wayne, Holmes, Stark, Portage, Summit, Mahoning, and Columbiana.

[1]White, I. C., Second Geol. Surv. Pa., Rept. Prog., Geol. Mercer Co., p. 36, 1878.

[2]Rogers, H. D., Geol. Pa., Vol. II, Pt. 1, p. 489, 1858.

[3]Read, M. C., Geol. Surv. Ohio, Vol. III, p. 567, Rept. on Coshocton County, 1878.
Andrews, E. B., Idem., pp. 823-825, Repts. on Perry and Muskingum counties.
Newberry, J. S., Idem., p. 795, Rept. on Mahoning County.
Orton, Edward, Idem., pp. 898-903, Rept. on the Hanging Rock District.

[4]Orton, Edward, Idem., p. 898.

[5]Orton, Edward, Geol. Surv. Ohio, Vol. V, pp. 13, 14, 1884.

The interval between the Upper and Lower Mercer members varies greatly from place to place. At its southern extension in Scioto County the average distance is 52 feet, while to the northward this interval gradually thins. In Jackson County it averages 44 feet;[1] in Perry, Muskingum, and Coshocton counties about 23 feet 5 inches, with a minimum of 15 feet.[2] In northeastern Ohio, including Stark and Mahoning counties, the same interval reaches 21 to 23 feet.[3] Between the Upper Mercer member and the overlying Tionesta coal the intervening distance averages 35 feet in Scioto County and 28 feet in Jackson.[4]

The Upper Mercer consists of a bluish-gray to almost black limestone, often siliceous or markedly flinty in character, which resembles the Lower Mercer both in lithologic character and composition so closely that it is sometimes difficult to distinguish the two. In the central part of the outcrop, including Perry, Muskingum, and Coshocton counties, the horizon is characterized by massive, generally black flint which to a large extent replaces the limestone; occasionally the limestone is also replaced by massive sandstone in its central and southern exposures. Dr. Edward Orton describes the member as follows:[5] "It everywhere lacks the remarkable steadiness and continuity of the Lower Mercer limestone, but in all other respects it is almost the exact counterpart of that well-marked stratum. It has, in the main, the same chemical composition, the same color, and the other physical properties, and also the same fossils. In many instances the limestones can be distinguished only by their stratigraphical relations. But though generally agreeing with the lower limestone, it has some local peculiarities which serve to mark it for particular districts. In central Ohio it is quite often a flint, constituting one of the main flint horizons of the series."

In southern Ohio, including Scioto, Lawrence, and Jackson counties,[6] the limestone is seldom present, but the horizon is represented by the Lower Mercer iron ore, or Big Red Block ore, as it is called in Scioto County. The ore is very persistent, and where both facies are present, it lies directly over the limestone. Where the limestone is found, it is hard, nodular, flinty, and dark in color; it is sparingly fossiliferous and the forms present are similar to those of the Lower Mercer. The ore, which resembles the limestone in fossil content, is of good quality and of sufficient thickness to be of economic value. It was

[1]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 20, pp. 581, 161, 1916.

[2]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 21, p. 103, 1918.

[3]Lamb, G. F., Pennsylvanian Limestones of Northeastern Ohio below the Lower Kittanning Coal, Ohio Naturalist, Vol. 10, pp. 89-135, March, 1910.

[4]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 20, pp. 581, 161, 1916.

[5]Orton, Edward, Geol. Surv. Ohio, Vol. V, p. 15, 1884.

[6]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 20, pp. 160-171, 297-305, 580-584, 1916.

formerly used extensively for smelting in the old charcoal furnaces of Lawrence, Scioto, and Jackson counties, and next to the Ferriferous ore (Allegheny formation), it was at one time more extensively worked than any other of the ores of the Pennsylvanian system. Northward in Vinton and Hocking counties the limestone phase is much better developed and is more persistent than to the south.

In the central part of the Upper Mercer outcrop in Ohio the member is either represented by only one bench or layer (Muskingum and Tuscarawas counties) or by as many as six layers, each separated by shaly partings (Perry and Coshocton counties).[1] The characteristic type of deposit is flint which entirely replaces the limestone or is present with it. Where the limestone phase is found, it is dark in color, flinty, ferruginous, and sparingly fossiliferous. The flint is extremely hard, breaks with a conchoidal fracture, and is dark gray to black in color due to inclusions of carbonaceous matter; it is characterized by small cavities lined or completely filled with quartz crystals. Although fossils are present, they are by no means abundant and are essentially the same as found in the Lower Mercer limestone. However, *Fusulina secalica* (*Say*), which is so abundant in the higher Pennsylvanian formations, is present here for the first time in sufficient numbers to be conspicuous, although it is found very sparingly also in the Lower Mercer member. The flinty phase is everywhere characterized by large branching tubes, ranging from one-half to almost an inch in diameter, which although sometimes hollow are generally filled with hard impure iron ore. This filling is either wholly or partially decomposed to a soft, limonitic material, the decomposition taking place first around the edges of the tube and progressing inward. The branching tubes have the appearance of plant stems, but a microscopic study of the filling from various localities showed no evidence of organic structure. It seems probable, therefore, that they originated as concretionary formations of impure hematite, similar to those often found in the Lowellville limestone, which have later undergone partial or complete decomposition.

In northeastern Ohio the horizon is characterized by hard, dark blue, somewhat siliceous limestone which is fairly persistent and moderately fossiliferous. Lamb states that in Mahoning County it is present equally as often as the Lower Mercer limestone[2] which it resembles closely in lithologic character, composition, and fossil content.

The thickness of the Upper Mercer deposit varies from a few inches in southern Ohio to about 3½ feet in the northeastern part of the State. In the south where the horizon is represented mostly by an iron ore, 5 inches to 1 foot 6 inches, with a maximum of 2 feet, is present.

[1]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 21, pp. 102-103, 1918.

[2]Lamb, G. F., Pennsylvanian Limestones of Northeastern Ohio below the Lower Kittanning Coal, Ohio Naturalist, Vol. 10, p. 130, March, 1910.

When the limestone is found it measures only a few inches in thickness. In the central part of the outcrop, where the flinty phase is developed, the stratum is about 1 foot 6 inches thick, while in northeastern Ohio the heavy limestones reach a maximum thickness of 3 feet 6 inches with an average of over 2 feet. Locally in a few places in Ohio the member attains 15 feet in thickness.

Conditions of Deposition

The Upper Mercer limestone is of marine origin and was deposited in relatively shallow waters. The fossils, although not abundant, are all marine. The ore of southern Ohio, and the flints of the central part of the outcrop are likewise of marine origin as is shown by the fauna which is practically identical with that of the limestone. The origin of the flint is discussed by Stout in his report on the Geology of Muskingum County in which three views are given as tenable for the origin of the flints associated with the limestones of the Pennsylvanian system:[1]

(a) "That the flint was formed by direct precipitation of the siliceous matter by silica-secreting organisms.

(b) That the flint was the resultant of chemical action of soluble silica and other components in the sea water upon the calcium carbonate of the newly formed limestone. In this case the change took place while the limestone was forming or while it was yet under the direct influence of the salt brines.

(c) That circulating ground waters, charged with silica and organic components which acted upon the limestone deposited under normal conditions and buried by later sediments, slowly removed the calcium carbonate and deposited silica in its place. This action began as soon as the beds were covered by other material and is still effective. Under this condition the flint is entirely of secondary origin."

After a discussion of these three views, the following conclusions are reached:[2] "It appears that these flint beds were original deposits laid down in shallow water under conditions similar to those where limestones were deposited, but where siliceous material from organic life was present in considerable quantities, and was either deposited directly or was substituted for calcium carbonate of newly formed limestone. The action of ground waters in the silicification of limestones appears, therefore, relatively small; and this view is further strengthened by evidence afforded by the higher beds of this (Muskingum) county."

[1]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 21, p. 109, 1918.
[2]Idem., p. 113.

Description of Geologic Sections and Collecting Localities

Scioto County.—The Upper Mercer ore is well developed in the abandoned mine of Hanging Rock Iron Co., one and one-half miles north of Ohio Furnace, Green Township. The lower layer is calcareous enough to be called a ferruginous limestone. The ore is very sparingly fossiliferous. The section measured in the mine follows (Locality 58):[1]

		Feet	Inches
Shale		2	--
Ore, upper block	*Upper Mercer*	--	7
Parting	*Upper Mercer*	--	--
Ore, lower block	*Upper Mercer*	--	11
Coal, dense, hard, *Bedford*		--	2

The fossils collected at this locality include the following forms:

Crinoid segments

Derbya crassa (Meek and Hayden)
Productus semireticulatus (Martin)
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer boonensis Swallow ?
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

A few fossils were also found in the ore outcropping on the land of Smith Hayward, Section 35, Bloom Township, where the geologic section below was measured (Locality 59):[2]

	Feet	Inches
Shale and sandstone	10	--
Ore, *Upper Mercer*	1	6
Shale and covered	16	--
Ore, *Sand Block*	1	--

The forms listed below were collected here:

Crinoid segments

Archaeocidaris spines

Septopora biserialis (Swallow)

Derbya crassa (Meek and Hayden)
Spirifer opimus Hall
Spiriferina kentuckyensis (Shumard)

Astartella concentrica (Conrad)

Conularia crustula White

[1]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 20, p. 581, 1916.
[2]Idem.

Jackson and Vinton Counties.—The Upper Mercer ore is also found in Jackson County and geologic sections showing its relation to other members of the Pottsville formation are given under the discussion of the Lower Mercer member. In Vinton County the ore is likewise present, although the limestone phase below is well developed and becomes of more stratigraphic importance than in the counties to the south. In Elk Township, three miles southwest of McArthur, black shaly limestone from the Upper Mercer horizon contains specimens of *Lingula carbonaria* Shumard in great profusion, but no other fossils were discovered (Locality 60).

Perry County.—Fossils were obtained from the limestone in the shaft of the Straitsville Impervious Brick Co. near New Straitsville in the extreme southwestern part of the county. The deposit at this locality is hard, dark blue, and moderately fossiliferous. There is considerable doubt, however, whether the limestone belongs to the Upper Mercer or the McArthur horizon (Locality 61). The following fossils were identified:

Crinoid segments

Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Productus semireticulatus (Martin) var.
Pustula nebraskensis (Owen)
Marginifera wabashensis (Norwood and Pratten)
Spirifer opimus Hall
Composita subtilita (Hall)

In Perry County as in Muskingum and Coshocton counties, the Upper Mercer limestone is generally partially or wholly replaced by massive beds of flint, dark to black in color. In the eastern part of Section 3, Clayton Township, where the geologic section below was measured, the flint is partly light gray in color and very sparingly fossiliferous. Samples were collected from the ravine near the road (Locality 62).

		Feet	Inches
Shale and covered		50	--
Flint, light gray, fossiliferous	*Upper Mercer*	3	4
Limestone, very ferruginous	*Upper Mercer*	--	4
Covered	*Upper Mercer*	1	4
Flint, black, fossiliferous	*Upper Mercer*	3	--
Covered		3	--
Coal blossom, *Bedford*		1	--
Clay and shale		16	--
Limestone, blue, fossiliferous, *Lower Mercer*		1	--

The fossils listed below were identified:

Fusulina secalica (Say)
Girtyina ventricosa (Meek and Hayden)

Lophophyllum profundum (Milne-Edwards and Haime)

Crinoid segments

Fenestella shumardi Prout ?
Rhombopora lepidodendroidea Meek

Derbya crassa (Meek and Hayden)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spirifer opimus Hall
Composita subtilita (Hall)

Parallelodon tenuistriatus (Meek and Worthen)
Euchondria neglecta (Geinitz)

The collection of fossils listed below was made in the northern part of Section 10, Reading Township, from outcrops of Upper Mercer limestone in the roadbed about one-half mile east of the north end of the Baltimore & Ohio Railroad cut at Somerset (Locality 63):[1]

Lophophyllum profundum (Milne-Edwards and Haime)

Crinoid segments

Fenestella limbata Foerste
Fenestellids undetermined
Septopora biserialis (Swallow)
Rhombopora lepidodendroidea Meek
Prismopora sereata (Meek)

Orbiculoidea meekana (Whitfield)
Crania modesta White and St. John
Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin) var.
Pustula nebraskensis (Owen)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer boonensis Swallow ?
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Edmondia ovata Meek and Worthen
Parallelodon tenuistriatus (Meek and Worthen)

[1]These fossils are among the paleontological collection at Western Reserve University, Cleveland, Ohio. The collection was made by Mr. Eber Hydé of Lancaster, and was made available to the writer for study through the kindness of his son, Professor Jesse E. Hyde, of Western Reserve University.

Deltopecten scalaris (Herrick)
Acanthopecten carboniferous (Stevens)
Astartella concentrica (Conrad)
Astartella varica McChesney

Muskingum County.—In Section 32, Newton Township, along the diagonal road one and one-half miles northwest of Roseville, the Upper Mercer member is exposed (Locality 64). It measures ten inches in thickness, and consists of a lower layer of dark gray limestone containing flint nodules and an upper layer of black flint in which large, branching tubes, either hollow or filled with a soft limonitic decomposition product, are abundant. The filling of the tubes seems to have originated as concretionary structures of iron ore, although the resemblance to plant stems is very marked. The flint is extremely poor in fossils both in number of species and individuals, and the following represent the only species which were discovered:

Fusulina secalica (Say)

Cystodictya carbonaria (Meek)

Marginifera wabashensis (Norwood and Pratten)

In Hopewell Township the member is rarely present as a limestone but is represented by black flint. The following geologic section was measured along the Flint Ridge Road in Section 8, about one mile northwest of Poverty Run School. Although fossils are scarce, good collecting is afforded as the locality is easy of access (Locality 65):

	Feet	Inches
Shale and covered	15	--
Flint, black, *Upper Mercer*	2	--
Clay and covered	5	--

The fossils below were collected:

Fusulina secalica (Say)
Girtyina ventricosa (Meek and Hayden)

Crinoid segments

Productus semireticulatus (Martin)
Squamularia perplexa (McChesney)

Pleurotomaria sp. ?

Along Flint Ridge, both in Hopewell Township, Licking County, and in Hopewell Township, Muskingum County, the black flint is well developed, and was used to some extent by primitive man in Ohio for the manufacture of weapons, arrowheads, and implements of various sorts, for which purpose the flint seems especially well adapted. Some

of the holes which can still be seen along the ridge mark the sites of excavations made for obtaining the flint. The following section was measured at the east end of Flint Ridge along the ravine in the western part of Section 14, and shows excellently the relation of the various members on Flint Ridge:

Section at the east end of Flint Ridge along the ravine in the western part of Section 14, Hopewell Township, Licking County

		Feet	Inches
Allegheny formation			
Flint, light, fossiliferous	*Vanport*	2	--
Covered		1	--
Limestone, siliceous, sparingly fossiliferous		--	10
Covered		1	--
Limestone, argillaceous, thin bedded, fossiliferous		15	--
Covered		6	--
Shale		19	--
Limestone, blue, fossiliferous, *Putnam Hill*		1	2
Shale		--	2
Coal, *Brookville*		--	1
Pottsville formation			
Clay, light, siliceous		3	--
Sandstone, light, argillaceous		5	--
Clay, flint, dark	*Tionesta*	1	--
Clay, light		2	--
Covered		5	--
Shale		2	--
Covered		4	--
Flint, black, fossiliferous, *Upper Mercer*		1	--
Shale		--	4
Coal, semi-cannel, *Bedford*		1	--

Other geologic sections along Flint Ridge and elsewhere in Hopewell Township, Muskingum County, which include the Upper Mercer, have been given in the discussions of the Lowellville, Boggs, and Lower Mercer members. Fossils were collected from the black flint outcropping in the roadbed in the extreme northeastern part of the township, east of the Licking River and about one-fourth mile northwest of Sodon School (Locality 66):

Fusulina secalica (Say)
Girtyina ventricosa (Meek and Hayden)

Crinoid segments

Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus semireticulatus (Martin)

Pustula nebraskensis (Owen)
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer opimus Hall
Composita subtilita (Hall)

In Washington Township the Upper Mercer member consists of black flint and flinty limestone and is well exposed in the ravine of a small stream which flows from the east into the Muskingum River opposite Ellis. Collections of both Lower and Upper Mercer fossils were made at this locality (Locality 38). The geologic section follows:[1]

		Feet	Inches
Allegheny formation			
Limestone, *Putnam Hill*		4	6
Pottsville formation			
Covered		50	--
Flint, black, ferruginous	*Upper Mercer*	1	10
Limestone, dark, flinty	*Upper Mercer*	--	9
Coal blossom, *Bedford*		--	3
Clay and clay shale		8	--
Coal, good, *Upper Mercer*		1	2
Clay		1	4
Shale, siliceous		10	6
Limestone, shaly	*Lower Mercer*	1	--
Limestone, hard	*Lower Mercer*	--	7
Shale	*Lower Mercer*	--	2
Limestone, hard	*Lower Mercer*	1	8

The species identified from the Upper Mercer flint and flinty limestone are as follows:

Fusulina secalica (Say)
Girtyina ventricosa (Meek and Hayden)

Crinoid segments

Fenestella limbata Foerste
Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin) var.
Pustula nebraskensis (Owen)
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer cameratus Morton
Spirifer boonensis Swallow ?
Spirifer opimus Hall
Composita subtilita (Hall)

Good exposures are found also at several other localities in Washington Township. Good collecting is afforded from both the Lower

[1]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 21, p. 106, 1918.

and Upper Mercer members in the ravine on the east side of the Muskingum River, one mile north of Ellis (Locality 39). The fossils listed below were found in the Upper Mercer limestone and flint:

Fusulina secalica (Say)

Crinoid segments

Chonetes mesolobus Norwood and Pratten
Marginifera wabashensis (Norwood and Pratten)
Spirifer cameratus Morton

Fossils were obtained together with Lower Mercer forms from blocks of flint fallen from place in the walls of a small ravine by the roadside east of the Muskingum River and opposite Rock Cut. (Locality 40). The collection includes the following Upper Mercer forms:

Fusulina secalica (Say)

Crinoid segments

Chonetes mesolobus Norwood and Pratten
Productus semireticulatus (Martin)
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer opimus Hall

In Muskingum Township fossils were collected from the dark flinty limestone which underlies a layer of black flint in the roadbed about one mile north of the Sandy Ridge School, where the entire member measures 1½ feet in thickness (Locality 67). The collection includes the following forms:

Girtyina ventricosa (Meek and Hayden)

Crinoid segments

Fenestella limbata Foerste
Cystodictya carbonaria (Meek)

Derbya crassa (Meek and Hayden)
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Marginifera wabashensis (Norwood and Pratten)
Spirifer cameratus Morton
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

In the exposure along the Wheeling & Lake Erie Railroad north of Rock Cut, the flint is unusually well developed and reaches a thickness of 2 feet. It is more fossiliferous than is generally the case, especially in number of individuals, and forms one of the best collecting

localities in the flint which was found. A portion of the Rock Cut section is repeated below (Locality 28):

		Feet	Inches
Shale		5	---
Flint, black, fossiliferous, *Upper Mercer*		2	--
Coal, with shale bands	*Bedford*	--	8
Coal, somewhat bony	*Bedford*	2	4
Clay, siliceous		1	6

The following fossils were collected:

Textularia sp.
Nodosaria sp.
Fusulina secalica (Say)
Girtyina ventricosa (Meek and Hayden)

Crinoid segments

Derbya crassa (Meek and Hayden)
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spirifer cameratus Morton
Squamularia perplexa (McChesney)

Myalina pernaformis Cox

Bulimorpha inornata (Meek and Worthen) ?

In Madison Township outcrops of the member are numerous. A few fossils were collected from the hard, flinty black limestone, 2½ feet in thickness, which outcrops near the top of the cliff on the east bank of the Muskingum River north of Symmes Ford. The lower part of the exposure consists of hard, fossiliferous limestone while the upper part is composed of black flint. The geologic section at Symmes Ford shows especially well the relation of the marine limestones of Muskingum County to each other[1] (Locality 21). The fossils obtained include the following species:

Textularia sp.
Nodosaria sp.
Fusulina secalica (Say)
Girtyina ventricosa (Meek and Hayden)

Crinoid segments

Fenestella limbata Foerste

Derbya crassa (Meek and Hayden)

[1]See geologic section at Symmes Ford, given under the discussion of the Lowellville member, p. 33.

Pustula nebraskensis (Owen)
Pustula punctatus (Martin)
Marginifera wabashensis (Norwood and Pratten)
Spirifer cameratus Morton
Spirifer opimus Hall

Collections were made from the Upper Mercer black flint which is exposed in the bed of Symmes Creek, east of the crossroads; fossils from the Boggs and Lower Mercer members were also obtained from Symmes Creek (Locality 29). The fauna from the flint includes the forms listed below:

Fusulina secalica (Say)
Girtyina ventricosa (Meek and Hayden)

Crinoid segments

Fenestella limbata Foerste
Prismopora sereata (Meek)

Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin) var.
Pustula nebraskensis (Owen)
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer cameratus Morton
Spirifer opimus Hall
Squamularia perplexa (McChesney)

Probably the best locality for collecting fossils which was found in the Upper Mercer member, is located along the small eastern tributary of the North Branch of Symmes Creek about one-fourth mile north of the crossroads. Here the member reaches the exceptional thickness of 5 feet 3 inches and is composed of two layers,—the upper of flint and the lower of hard, very fossiliferous limestone in which large crinoid stems are abundant. This limestone resembles the Lower Mercer very closely not only in appearance but also in character and abundance of fossils. The stream forms a small waterfall over a projecting ledge of Upper Mercer limestone. Below the limestone there occurs a layer of extremely fossiliferous black shale associated with the Bedford coal, from which a collection of fossils was also made. The geologic section here follows (Locality 68):[1]

[1]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 21, p. 106, 1918.

A—Upper Mercer limestone and black flint with Bedford coal below. West of Warsaw, Coshocton County

B—Upper Mercer limestone represented largely by black flint along a small stream south of Symmes Ford, Madison Township, Muskingum County

Section along the small eastern tributary of the North Branch of Symmes Creek, Madison Township, Muskingum County

		Feet	Inches
Allegheny formation			
Limestone, blue, fossiliferous	*Putnam Hill*	1	1
Shale, with ore nodules		4	--
Limestone, gray, fossiliferous		3	10
Shale		--	2
Coal	*Brookville*	1	--
Shale		--	1
Coal		--	10
Pottsville formation			
Clay, light		2	--
Covered		13	--
Sandstone, shaly		18	--
Shale and covered		3	--
Flint, black, irregular, fossiliferous	*Upper Mercer*	3	--
Limestone, flinty, very fossiliferous		2	3
Shale		--	1
Coal, bony	*Bedford*	--	5
Shale		--	2
Coal, bony		1	2
Clay, siliceous		5	--

The lists of fossils below include the species collected from this locality:

FOSSILS FROM THE UPPER MERCER LIMESTONE AND FLINT

Fusulina secalica (Say)
Girtyina ventricosa (Meek and Hayden)

Crinoid segments

Fenestella limbata Foerste
Fenestella sp.
Septopora biserialis (Swallow)
Septopora biserialis var. gracilis (Meek)
Rhombopora lepidodendroidea Meek
Prismopora sereata (Meek)

Lingula carbonaria Shumard
Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer cameratus Morton
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Parallelodon carbonarius (Cox)
Parallelodon sangamonensis (Worthen)
Parallelodon tenuistriatus (Meek and Worthen)
Myalina pernaformis Cox
Aviculopecten coxanus Meek and Worthen
Deltopecten scalaris (Herrick)
Acanthopecten carboniferous (Stevens)
Entolium aviculatus (Swallow)
Pleurophorus tropidophorus Meek

Sphaerodoma sp.

Phillipsia trinucleata Herrick

FOSSILS FROM THE BLACK CARBONACEOUS SHALE BELOW THE LIMESTONE

Crinoid segments and plates

Rhombopora lepidodendroidea Meek

Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Spirifer opimus Hall

In the southeastern part of Cass Township, flinty limestone outcrops in the roadbed on land of J. F. Shaw, three miles southeast of Frazeysburg, from which the following fossils were obtained (Locality 43):

Fusulina secalica (Say)

Crinoid segments

Fenestella limbata Foerste
Cystodictya carbonaria (Meek)
Prismopora sereata (Meek)

Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Samples of flinty limestone containing fossils were collected from a small ravine on the southwest side of the road, about one-half mile south of Locality 43 (Locality 69). The following species were found:

Textularia sp.

Fusulina secalica (Say)

Crinoid segments

Cystodictya carbonaria (Meek)
Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Pustula nebraskensis (Owen)
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer cameratus Morton
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Coshocton County.—The Upper Mercer limestone is exceptionally well developed in the southern part of Jefferson Township, southwest of Warsaw, where it attains the unusual average thickness of 8 feet. Fossiliferous limestone is everywhere associated with the flinty phase. About one mile east of Mohawk village the deposit is exposed in the roadbed and also near the mouth of the coal mine of Lee Moore, a few hundred yards north of the road (Locality 70). The character of the member at the mine is shown in the following geologic section:

		Feet	Inches
Allegheny formation			
Limestone, *Putnam Hill*		5	--
Pottsville formation			
Covered		42±	--
Flint, gray, calcareous, fossiliferous	*Upper Mercer*	1	3
Shale		--	2
Limestone, gray, shaly, fossiliferous		2	2
Shale, gray		2	8
Flint, black, with gray limestone		1	9
Coal, bituminous	*Bedford*	2	2
Coal, cannel		5	6

The limestone and flint here are unusually fossiliferous for the member and yielded the following forms:

Fusulina secalica (Say)

Crinoid segments

Fenestella limbata Foerste
Fenestellidae undetermined
Pinnatopora sp.
Septopora biserialis var. gracilis (Meek)
Rhombopora lepidodendroidea Meek

Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)

Pustula nebraskensis (Owen)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Parallelodon tenuistriatus (Meek and Worthen)
Schizodus wheeleri Swallow

About one mile southeast of Locality 70 the Upper Mercer member outcrops in the same roadbed. Here it attains a maximum thickness of 15 feet and is composed of both limestone and black flint (Locality 71). The character of the stratum may be seen in the section below:

		Feet	Inches
Allegheny formation			
Limestone, gray, fossiliferous, *Putnam Hill*		6	--
Pottsville formation			
Shale and covered		26	--
Flint, light gray, fossiliferous	*Upper Mercer*	--	8
Flint, black, fossiliferous		2	--
Limestone, shaly		8	2
Limestone, shaly, parts covered, fossiliferous		3	--
Flint, black, with gray limestone, fossiliferous		1	4

The collection below was made only from the flinty phase:

Fusulina secalica (Say)

Lophophyllum profundum (Milne-Edwards and Haime)

Crinoid segments

Rhombopora lepidodendroidea Meek
Septopora biserialis (Swallow)
Septopora biserialis var. gracilis (Meek)
Prismopora sereata (Meek)

Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Astartella concentrica (Conrad)

One mile north of Locality 71 the member is exposed on the Wheeler farm along the slope of the ridge east of the north-and-south road.

The black flint in this vicinity was formerly used by the Indians for making arrowheads, tools, and implements of various sorts; the color, durability, and hardness made it very desirable for this purpose. Large blocks of black, somewhat fossiliferous flint are scattered everywhere over the fields along the outcrop. The geologic section on the Wheeler farm is given below (Locality 72):

Section on the Wheeler Farm, Jefferson Township, Coshocton County

		Feet	Inches
Allegheny formation			
Limestone, *Putnam Hill*		3	--
Pottsville formation			
Shale and covered		27	6
Flint, gray, with shaly limestone, fossiliferous	*Lower Mercer*	5	--
Flint, black, with gray limestone, fossiliferous	*Lower Mercer*	2	6
Shale		--	5
Coal, weathered	*Bedford*	--	3
Shale	*Bedford*	--	4
Coal, cannel, weathered	*Bedford*	2	1
Clay		5	--
Shale and covered		8	--
Limestone, blue, fossiliferous	*Lower Mercer*	1	2
Limestone, blue, fossiliferous	*Lower Mercer*	2	9
Clay and covered		3	--

The species listed below were collected:

Nodosaria sp.
Textularia sp.
Fusulina secalica (Say)

Rhombopora lepidodendroidea Meek

Crania modesta White and St. John
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera wabashensis (Norwood and Pratten)
Spirifer opimus Hall
Composita subtilita (Hall)

Orthoceras isogramma Meek

Holmes County.—In northeastern Ohio, including Holmes, Stark, Mahoning, and Columbiana counties, the Upper Mercer flint is entirely replaced by limestone which resembles markedly the Lower Mercer member. In Holmes County fossils were obtained from only one locality,—from a mine in the northeastern part of Section 33, Salt Creek Township, one mile south of the county line (Locality 73). The species found are listed below:

Crinoid segments

Fenestella shumardi Prout ?

Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Pustula symmetricus (McChesney)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spirifer boonensis Swallow ?
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Prothyris elegans Meek
Crenipecten foerstii Herrick

Sphaerodoma brevis (White)
Sphaerodoma ventricosa (Hall)

Stark County.—In the central part of Stark County the limestone is well exposed in the valley of Nimishillen Creek and a good collecting place is afforded in the central part of Section 34, Canton Township, south of the village of North Industry. The limestone here is hard, dark, fossiliferous, and about 2 feet in thickness. The following geologic section shows the succession of strata in this vicinity (Locality 74):

	Feet	Inches
Allegheny formation		
Coal, *Brookville*	1	6
Pottsville formation		
Clay, gray	6	--
Shale and covered	19	3
Shale	30	--
Ore, *Upper Mercer*	--	2
Limestone, dark, fossiliferous, *Upper Mercer*	2	--
Coal, bony, *Bedford*	1	4

The following fossils were collected here:

Fusulina secalica (Say)

Crinoid segments

Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera wabashensis (Norwood and Pratten)
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Mahoning County.—Excellent exposures of limestone occur at many localities in Mahoning County. In the northern part of Section 2, Smith Township, one-half mile northwest of North Benton and almost on the county line, the stratum measures 3 feet in thickness and is moderately fossiliferous (Locality 75). The species listed below were obtained:

Fusulina secalica (Say)

Lophophyllum profundum (Milne-Edwards and Haime)

Crinoid segments

Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spirifer cameratus Morton
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

The forms below were collected in Little Mill Creek, about two and three-fourths miles northeast of North Benton and just east of the junction of Turkeybroth Creek with Little Mill Creek (Locality 53). The dark fossiliferous limestone measures $3\frac{1}{3}$ feet in thickness.

Crinoid segments

Cystodictya carbonaria (Meek)

Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer cameratus Morton
Spirifer opimus Hall
Spirifer boonensis Swallow ?
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

In the eastern part of the county, in Canfield Township, a collection of fossils was made from outcrops occurring along Indian Run at a point one and one-fourth miles southeast of Wind School. The limestone measures 3 feet in thickness and is moderately fossiliferous (Locality 76). The species identified are listed below:

Crinoid segments

Chonetes mesolobus Norwood and Pratten
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)
Composita sp.

Acanthopecten carboniferous (Stevens)

Naticopsis nanus (Meek and Worthen)

Outcrops 2 feet in thickness occur also in the vicinity of Lowellville but no fossils were collected.

Columbiana County.—The Upper Mercer member comprises the oldest rocks in Columbiana County and is found only in Section 12, St. Clair Township. The geologic section below was measured near the mouth of Bieler Run, in the northern part of Section 12, St. Clair Township, and shows the character of the Upper Mercer limestone in that vicinity.

Strata exposed near the mouth of Bieler Run, Section 12, St. Clair Township, Columbiana County

		Feet	Inches
Coal, *Lower Kittanning*		1	10
Clay, gray, plastic		7	2
Clay, shaly		1	--
Clay, dark		--	10
Clay, gray, plastic		5	5
Sandstone, shaly, and shale, siliceous		25	--
Shale and covered		23	8
Shale, black, fossiliferous	*Vanport*	1	4
Shale, gray, siliceous	*Vanport*	8	2
Ore, nodular, fossiliferous	*Vanport*	--	2
Shale and shaly sandstone		8	2
Clay, plastic, siliceous, *Clarion*		6	--
Sandstone, thin-bedded to shaly		28	6
Clay shale, dark, with thin layers of shaly coal		--	8
Sandstone, hard, blue		--	11
Shale with parts covered		14	--
Limestone, ferruginous, fossiliferous	*Upper Mercer*	--	5
Shale, calcareous, very fossiliferous	*Upper Mercer*	--	2
Clay, shaly		3	--
Shale		10	--

Fossils were collected at two places in Section 12, St. Clair Township; those listed below were obtained along Little Beaver Creek, about one-fourth mile south of Bieler Run (Locality 77):

Plantae

Lophophyllum profundum (Milne-Edwards and Haime)

Crinoid segments

Orbiculoidea missouriensis (Shumard)
Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus semireticulatus (Martin)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spirifer cameratus Morton
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

The following collection was made along Bieler Run (Locality 78):

FOSSILS FROM THE UPPER MERCER LIMESTONE

Lophophyllum profundum (Milne-Edwards and Haime)

Crinoid segments

Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Pustula nebraskensis (Owen)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

FOSSILS FROM THE SOFT SHALE ABOVE THE LIMESTONE

Plantae

Lophophyllum profundum (Milne-Edwards and Haime)

Crinoid segments

Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spirifer cameratus Morton
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Parallelodon tenuistriatus (Meek and Worthen)
Aviculopecten coxanus Meek and Worthen
Acanthopecten carboniferous (Stevens)
Astartella concentrica (Conrad)

Summary

In conclusion, the Upper Mercer deposit or the fourth member in the series of marine fossiliferous limestones of Pennsylvanian age, is composed of dark blue limestone which closely resembles the Lower Mercer both in lithologic character, fossil content, and composition, and also of dark to black flint which to a large extent replaces the limestone in the central counties of the outcrop. The limestone phase is best developed in the northeastern part of the State including Stark and Mahoning counties, where it reaches a thickness of 3½ feet and is equally as fossiliferous and persistent as the Lower Mercer limestone. It is also represented by a flinty limestone in Hocking and Vinton counties, while at various other localities in the southern counties it is generally wanting or where present measures only a few inches in thickness. In the central counties, including Perry, Muskingum, and Coshocton, the stratum measures 1 to 15 feet in thickness and is composed to a large extent of flint although limestone may be present with the flint. In southern Ohio the horizon is marked by very persistent iron ore with an average thickness of 1 to 1½ feet, which lies directly over the limestone where the latter is present. The Upper Mercer limestone is as a rule sparingly fossiliferous, while the flint and ore contain a still more meager fauna, but of the same type as the limestone.

A complete list of fossils from the Upper Mercer member follows:

Plantae

Textularia sp.
Nodosaria sp.
Fusulina secalica (Say)
Girtyina ventricosa (Meek and Hayden)

Lophophyllum profundum (Milne-Edwards and Haime)

Crinoid segments and plates

Archaeocidaris spines

Fenestellids undetermined
Fenestella limbata Foerste
Fenestella shumardi Prout ?
Fenestella sp.
Pinnatopora sp.
Septopora biserialis (Swallow)
Septopora biserialis var. gracilis (Meek)
Rhombopora lepidodendroidea Meek
Cystodictya carbonaria (Meek)
Prismopora sereata (Meek)

Lingula carbonaria Shumard
Orbiculoidea meekana (Whitfield)

Orbiculoidea missouriensis (Shumard)
Crania modesta White and St. John
Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Productus semireticulatus (Martin) var.
Pustula nebraskensis (Owen)
Pustula punctatus (Martin)
Pustula symmetricus (McChesney)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer boonensis Swallow ?
Spirifer cameratus Morton
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)
Composita sp.

Prothyris elegans Meek
Edmondia ovata Meek and Worthen
Parallelodon carbonarius (Cox)
Parallelodon sangamonensis (Worthen)
Parallelodon tenuistriatus (Meek and Worthen)
Myalina pernaformis Cox
Schizodus wheeleri Swallow
Aviculopecten coxanus Meek and Worthen
Deltopecten scalaris (Herrick)
Acanthopecten carboniferous (Stevens)
Crenipecten foerstii Herrick
Euchondria neglecta (Geinitz)
Entolium aviculatus (Swallow)
Pleurophorus tropidophorus Meek
Astartella concentrica (Conrad)
Astartella varica McChesney

Pleurotomaria sp.
Naticopsis nanus (Meek and Worthen)
Bulimorpha inornata (Meek and Worthen) ?
Sphaerodoma brevis (White)
Sphaerodoma ventricosa (Hall)
Sphaerodoma sp.

Conularia crustula White ?

Orthoceras isogramma Meek

Phillipsia trinucleata Herrick

McARTHUR MEMBER

Stratigraphy and Extent

The next fossiliferous horizon above the Upper Mercer limestone and flint with its accompanying ore is the McArthur member which in ascending order forms the fifth marine limestone of the Pennsylvanian system in Ohio. The horizon includes the impure fossiliferous limestones, the calcareous shales, and the shaly sandstones which occur directly above the Tionesta or No. 3b coal. The name McArthur limestone was given to the stratum by Stout in 1919 from typical exposures in the vicinity of the town of that name in the central part of Vinton County, where the member consists of massive, bluish gray, extremely fossiliferous limestone.[1] It is best developed in Vinton and Jackson counties, but pinches out and disappears south of Monroe Furnace, in the southern part of the latter county. In Lawrence and Scioto counties a dark, tough, sparingly fossiliferous shale wedges in from the south across the Ohio River and occupies the position of the McArthur member above the Tionesta coal. North of Vinton County the member is well developed in Hocking and Perry counties, and has been found in a few places in Muskingum and Coshocton; however, in the latter counties a massive sandstone, the Homewood or Tionesta, and clays occupy the position of the McArthur member and sometimes fill the entire interval between the Tionesta and Brookville coals. In places even the two coals as well as many feet of rock above and below them are replaced by the Homewood sandstone which sometimes reaches a thickness of 70 feet and bridges the dividing line between the Pottsville and Allegheny formations.

The McArthur member is found just above the Tionesta coal which forms a fairly persistent and well-marked horizon in southern and south-central Ohio, and measures 1 to 6 feet in thickness. The coal occurs midway between the Upper Mercer ore and the Brookville coal, the basal member of the Allegheny formation. The interval between the Upper Mercer ore and the Tionesta coal in Lawrence County measures about 32 feet; northward in Jackson and Vinton counties the same interval averages 25 feet, while 22 feet intervenes between the Tionesta coal and the Black Flint horizon which occurs just below the Brookville coal.[2] These intervals are about the same in Hocking and Perry counties, but they thin gradually as they are followed into Muskingum County where the distance between the Tionesta and Brookville coals measures 8 to 20 feet, while that between the Tionesta and Brookville is about 8 feet.[3]

[1]Stout, W., Geol. Surv. Ohio, Manuscript on Clays of Ohio.

[2]Stout, W., Geol Surv. Ohio, Fourth Ser., Bull. 20, pp. 171-179, 305-309, 584-588, 1916.

[3]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 21, pp. 115-118, 1918.

The McArthur member consists of impure, bluish-gray, argillaceous limestone, gray to black calcareous shales, and shaly, calcareous sandstones. Where typically developed in Jackson and Vinton counties, shales occupy the entire interval between the Tionesta coal and the Black Flint, as the Homewood sandstone is often lacking or interbedded in thin layers with the shale. The lower portion of these shales is calcareous and remarkably fossiliferous, and constitutes the McArthur horizon. At the southern limit near Monroe Furnace in southern Jackson County, 6 feet is present, while northward in Jackson, Vinton, Hocking, and Perry counties, the member measures 2 to 14 feet, with an average thickness of 4 feet. In the vicinity of McArthur the deposit consists of 6 feet of massive limestone which is extremely rich in fossils and forms by far the most fossiliferous horizon of the Pottsville formation with the possible exception of the black shales and impure shaly limestones associated with the Lower Mercer member. The fauna is of marine origin and is composed largely of brachiopods and pelecypods, although gastropods are much more abundant individually than in any of the older members. Collecting is excellent as the fossils are well preserved often showing even the most delicate markings, and can be easily obtained from the soft limestones and shales. It is common for the substance of the shell to be decomposed to a soft, chalky, white material which rapidly disintegrates on exposure.

Conditions of Deposition

At the close of the swamp conditions under which the Tionesta coal was deposited, shallow waters prevailed over southern and east-central Ohio which were favorable for the deposition of limestone such as was deposited during Lower and Upper Mercer times. The sea supported an abundant life as is testified by the richness of marine fossils found in the stratum. However, sediments of various sorts, such as sand and mud, were constantly carried to the sea, so that as a result impure argillaceous limestones, calcareous shales, and shaly, calcareous sandstones were formed. Similar conditions existed in the southern part of the outcrop until the bottom of the sea was built up to a height sufficient for the swamp conditions necessary for the deposition of the Brookville coal to again prevail.

Description of Geologic Sections and Collecting Localities

Lawrence and Scioto Counties.—In southern Ohio the horizon of the McArthur member is occupied by hard, tough shales which enter Ohio as a wedge from the south. Sandstone at some localities replaces the shale or is interbedded with it. The shale measures 5 to 10 feet in thickness and is reported to be sparingly fossiliferous. The section

below, measured on Cooney Branch of Brady Creek, Lawrence County, near the Lawrence-Scioto County line, is given to show the relation of the Tionesta coal to the overlying shale:[1]

		Feet	Inches
Shale, hard, dark, tough		12	--
Coal	*Tionesta*	--	9
Bone coal		--	1
Coal		1	--
Clay		--	6
Coal		--	6
Clay shale		2	--

The following section was measured in the eastern part of Section 21, Vernon Township, Scioto County, on Cadot Hill. A few fragments of fossils were obtained from the soft, clay shales overlying the Tionesta coal, which were identified as *Orbiculoidea meekana* (Whitfield) (Locality 79).

		Feet	Inches
Shale, dark, lower part sparingly fossiliferous, *McArthur*		4	--
Coal, good	*Tionesta*	1	2
Clay		1	5
Coal, good		--	6

Jackson County.—In the southern part of Jackson County near the head of Monroe Hollow, Jefferson Township, the fossiliferous, calcareous shales of the McArthur horizon can be found at any of the numerous old coal mines of the region. Fossils, which occur in extreme abundance, were collected at Monroe Furnace in the northern part of Section 29 (Locality 80). The following geologic section was measured on the farm of John Jaycox, in the western part of Section 30, and is typical of the member in that vicinity:

		Feet	Inches
Shale, gray, calcareous, parts very fossiliferous, *McArthur*		6	--
Shale, black, tough		11	--
Coal, good	*Tionesta*	1	3
Coal, bony		--	6
Coal, good		2	2
Coal, cannel		--	3
Clay and covered		21	--

The fossils collected at Monroe Furnace are listed below:

Crinoid segments

Bascomella gigantea n. gen. and n. sp.

Orbiculoidea meekana (Whitfield)

[1]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 20, p. 306, 1916.

Rhipidomella pecosi (Marcou)
Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Pustula nebraskensis (Owen)
Pustula pertenuis (Meek)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer boonensis Swallow ?
Spirifer opimus Hall
Ambocoelia planoconvexa (Shumard)
Composita subtilita (Hall)
Composita sp.

Edmondia reflexa Meek
Leda bellistriata Stevens
Yoldia glabra Beede and Rogers ?
Parallelodon carbonarius (Cox)
Parallelodon obsoletus (Meek)
Parallelodon sangamonensis (Worthen)
Parallelodon tenuistriatus (Meek and Worthen)
Pteria ohioense (Herrick)
Myalina pernaformis Cox
Myalina swallovi McChesney
Schizodus affinis Herrick
Schizodus curtus Meek and Worthen
Schizodus subcircularis Herrick
Schizodus wheeleri Swallow
Aviculopecten coxanus Meek and Worthen
Aviculopecten herzeri Meek
Deltopecten occidentalis (Shumard)
Deltopecten scalaris (Herrick)
Acanthopecten carboniferous (Stevens)
Entolium aviculatus (Swallow)
Allerisma terminale Hall
Pleurophorus immaturus Herrick
Pleurophorus oblongus Meek
Pleurophorus tropidophorus Meek
Astartella compacta Girty
Astartella concentrica (Conrad)
Astartella varica McChesney
Cypricardinia ? carbonaria Meek

Plagioglypta prosseri n. sp.

Bellerophon crassus Meek and Worthen
Pharkidonotus percarinatus (Conrad)
Bucanopsis meekiana (Swallow)
Phanerotrema grayvillense (Norwood and Pratten) ?
Pleurotomaria sp.

Pseudorthoceras knoxense (McChesney)
Coloceras sp.

On the property of Harriet A. and W. L. Burris, northwestern part of Section 8, Bloomfield Township, the McArthur horizon is marked by 4 feet of siliceous, very fossiliferous shale. The following geologic section shows excellently the relation of the stratum to the Tionesta coal, as well as to the other members above and below.[1]

Strata exposed on the Burris land, Section 8, Bloomfield Township, Jackson County

		Feet	Inches
Allegheny formation			
Limestone, *Vanport*		4	--
Covered		49	--
Pottsville formation			
Ore, *Black Flint horizon*		--	10
Covered		8	--
Shale, gray		3	--
Shale, siliceous, very fossiliferous, *McArthur*		4	--
Shale, dark		4	--
Sandstone, carbonaceous		--	4
Shale, black, bony		2	--
Coal, good		--	10
Clay	*Tionesta*	--	10
Coal, good		1	2
Covered		8	2
Shale, siliceous		9	--
Shale, "dram slate"		--	4
Coal, *Upper Mercer, No. 3a*		1	11

In Milton Township, just south of Glenroy, samples of black shale which forms the roof of the Tionesta coal were obtained. Specimens of *Lingula carbonaria* Shumard were present in great abundance, but no other fossils were found (Locality 81).

Excellent collecting is afforded in the eastern part of Section 3, Coal Township, from the light, bluish-gray, calcareous, extremely fossiliferous shales which outcrop at the mouth of the old abandoned Tom Corwin mine. The geologic section at this locality follows (Locality 82):[2]

Rocks measured at the old Tom Corwin mine, Section 3, Coal Township, Jackson County

		Feet	Inches
Ore, calcareous, *Black Flint horizon*		—	8
Covered		25	--
Sandstone, shaly, calcareous, very fossiliferous	*McArthur*	4	--
Limestone, shaly, very fossiliferous		1	3
Shale, dark, very fossiliferous		--	4

[1]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 20, p. 186, 1916.
[2]Idem., p. 174.

		Feet	Inches
Coal		1	2
Clay, slate with thin coal bands		--	6
Coal	*Tionesta*	--	5
Clay, dark		--	11
Coal		--	10
Clay shale, dark		1	6
Covered		14	--
Ore, *Upper Mercer*		--	4

The fossils listed below were collected at the old Tom Corwin mine:

Lophophyllum profundum (Milne-Edwards and Haimé)

Crinoid segments

Fenestella shumardi Prout? ?
Rhombopora lepidodendroidea Meek

Orbiculoidea meekana (Whitfield)
Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer opimus Hall
Composita subtilita (Hall)

Parallelodon carbonarius (Cox)
Parallelodon tenuistriatus (Meek and Worthen)
Myalina pernaformis Cox
Myalina swallovi McChesney
Aviculopecten coxanus Meek and Worthen
Aviculopecten herzeri Meek
Acanthopecten carboniferous (Stevens)
Entolium aviculatus (Swallow)
Pleurophorus immaturus Herrick
Pleurophorus tropidophorus Meek
Astartella concentrica (Conrad)
Astartella varica McChesney

Pharkidonotus percarinatus (Conrad)
Schizostoma catilloides (Conrad)

Pseudorthoceras knoxense (McChesney)

Vinton County.—The McArthur member is extremely well developed in Vinton County. In the southern portion, northwestern part of Section 34, Richland Township, very fossiliferous shales outcrop south of Jackman School and afford excellent collecting. The section below, measured at this locality, shows the relation of the various members of the upper Pottsville formation to each other (Locality 83):[1]

[1]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 20, p. 175, 1916.

	Feet	Inches
Shale, dark blue	4	--
Ore, kidney, *Black Flint horizon*	--	8
Shale	5	--
Shale and covered	19	--
Shale, very fossiliferous, *McArthur*	4	--
Coal, *Tionesta*	5	1

The following fossils were identified:

Crinoid segments

Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)
Composita sp.

Parallelodon carbonarius (Cox)
Parallelodon tenuistriatus (Meek and Worthen)
Myalina pernaformis Cox
Schizodus curtus Meek and Worthen
Schizodus affinis Herrick
Entolium aviculatus (Swallow)
Lima retifera Shumard
Pleurophorus immaturus Herrick
Pleurophorus tropidophorus Meek

Bellerophon crassus Meek and Worthen
Pharkidonotus percarinatus (Conrad)
Euphemus carbonarius (Cox)
Schizostoma catilloides (Conrad)
Naticopsis nanus (Meek and Worthen)
Sphaerodoma newberryi (Stevens)

Pseudorthoceras knoxense (McChesney)

The type locality for the stratum is found in the central part of the county, Elk Township, in the vicinity of the town of McArthur where it is represented by massive, bluish-gray argillaceous limestone about 6 feet in thickness, which abounds in fossils. It is found on many hills of the vicinity, but probably the best exposure of the limestone occurs at Moore mine in the northern part of Section 17, about two miles northwest of McArthur where it lies directly above the Tionesta coal and forms the roof of the mine. From the piles of limestone blocks lying around the mouth of the mine easy and profitable collecting is furnished, for the limestone possesses a great wealth of fossils

both in species and individuals which are generally in an excellent state of preservation (Locality 84). The forms listed below were collected from this locality:

Crinoid segments

Lophophyllum profundum (Milne-Edwards and Haime)

Fenestella shumardi Prout ??
Fenestellids undetermined
Rhombopora lepidodendroidea Meek

Orbiculoidea meekana (Whitfield)
Orbiculoidea missouriensis (Shumard)
Crania modesta White and St. John
Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer opimus Hall
Composita subtilita (Hall)

Edmondia aspinwallensis Meek
Edmondia gibbosa (McCoy)
Edmondia meekiana (Herrick)
Edmondia ovata Meek and Worthen
Edmondia reflexa Meek
Nucula parva McChesney
Nuculopsis ventricosa (Hall)
Leda bellistriata Stevens
Leda meekana Mark
Yoldia glabra Beede and Rogers
Parallelodon carbonarius (Cox)
Parallelodon sangamonensis (Worthen)
Parallelodon tenuistriatus (Meek and Worthen)
Myalina pernaformis Cox
Myalina swallovi McChesney
Schizodus affinis Herrick
Schizodus curtus Meek and Worthen
Schizodus mooresi Miller ?
Schizodus subcircularis Herrick
Aviculopecten coxanus Meek and Worthen
Aviculopecten herzeri Meek
Deltopecten occidentalis (Shumard)
Deltopecten scalaris (Herrick)
Acanthopecten carboniferous (Stevens)
Entolium attenuatum Herrick
Entolium aviculatus (Swallow)
Pleurophorus immaturus Herrick
Pleurophorus oblongus Meek
Pleurophorus tropidophorus Meek

Astartella compacta Girty
Astartella concentrica (Conrad)
Astartella newberryi Meek
Astartella varica McChesney
Cypricardinia ? carbonaria Meek

Plagioglypta prosseri n. sp.

Bellerophon crassus Meek and Worthen
Pharkidonotus percarinatus (Conrad)
Pharkidonotus percarinatus var. tricarinatus (Shumard)
Euphemus carbonarius (Cox)
Euphemus nodocarinatus (Hall)
Bucanopsis meekiana (Swallow)
Patellostium montfortianum (Norwood and Pratten)
Phanerotrema grayvillense (Norwood and Pratten)
Pleurotomaria newportensis White?
Schizostoma catilloides (Conrad)
Naticopsis tortum (Meek)
Zygopleura plenum (Herrick)
Bulimorpha inornata (Meek and Worthen)?
Sphaerodoma brevis (White)
Sphaerodoma fusiformis (Hall)?
Sphaerodoma klipparti (Meek)
Sphaerodoma newberryi (Stevens)
Sphaerodoma primigenia (Conrad)

Pseudorthoceras knoxense (McChesney)

Another good collecting place is found in the northwestern part of Section 32, Madison Township, about two miles west of Prattsville, at the mouth of an old coal mine located a few hundred yards south of the McArthur pike. The stratum here consists of dark gray, calcareous shales which are very soft and friable, but extremely rich in fossils. The geologic section below was measured at the mouth of the old mine (Locality 85):

		Feet	Inches
Shale, gray		6	--
Shale, dark gray, very fossiliferous, *McArthur*		4	--
Coal	*Tionesta*	1	1
Shale		--	7
Coal		2	6

The following species were identified:

Crinoid segments

Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus semireticulatus (Martin)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)

Spirifer opimus Hall
Composita subtilita (Hall)

Edmondia gibbosa (McCoy)
Parallelodon carbonarius (Cox)
Parallelodon obsoletus (Meek)
Parallelodon tenuistriatus (Meek and Worthen)
Schizodus curtus Meek and Worthen
Schizodus subcircularis Herrick
Schizodus mooresi Miller ?
Aviculopecten coxanus Meek and Worthen
Acanthopecten carboniferous (Stevens)
Crenipecten foerstii Herrick
Entolium aviculatus (Swallow)
Lima retifera Shumard
Allerisma terminale Hall
Pleurophorella costata (Meek and Worthen)
Pleurophorus immaturus Herrick
Pleurophorus tropidophorus Meek
Astartella concentrica (Conrad)
Astartella varica McChesney

Pharkidonotus percarinatus (Conrad)
Schizostoma catilloides (Conrad)
Naticopsis nanus (Meek and Worthen)

Pseudorthoceras knoxense (McChesney)

Hocking County.—In Hocking County the member consists of both fossiliferous limestone and shale interbedded with each other. The following geologic section measured near the plant of the National Fire Proofing Co. at Haydenville, Green Township, in the southeastern part of the county, shows the character and relations of the stratum:

	Feet	Inches
Sandstone, shaly	10	8
Shale, dark, calcareous, fossiliferous, *McArthur*	1	--
Coal, *Tionesta*	--	5
Sandstone, hard	--	9
Shale, bony, hard	1	7
Coal, hard	--	2
Shale, fossiliferous — *Bedford*	--	5
Coal, hard	--	5
Clay, light, siliceous	11	6

In Section 36, Green Township, at the mine of the Logan Clay Products Co., one mile east of Logan, excellent collections can be obtained from the limestone and shale. The following geologic section was measured at this locality (Locality 86):

		Feet	Inches
Sandstone, yellow		20	--
Shale, gray		18	--
Shale, blue, fossiliferous	*McArthur*	4	8
Limestone, argillaceous, very fossiliferous	*McArthur*	--	11
Coal, *Tionesta*		--	6
Clay		14	--

The forms listed below were identified:

Crinoid segments and plates

Fenestella shumardi Prout ?
Polypora fastuosa Foerste
Fenestellidae undetermined
Rhombopora lepidodendroidea Meek
Prismopora sereata (Meek)

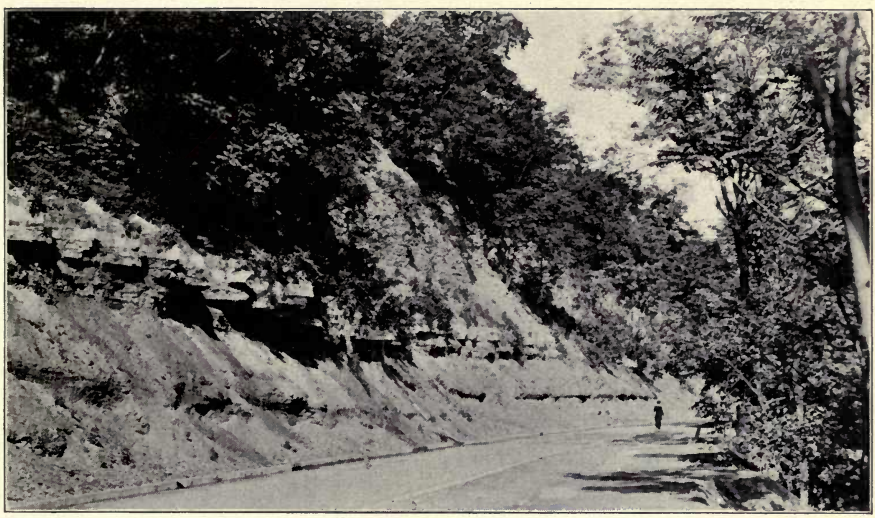
Orbiculoidea meekana (Whitfield)
Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Spiriferina kentuckyensis (Shumard)
Spirifer cameratus Morton
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Ambocoelia planoconvexa (Shumard)
Composita subtilita (Hall)

Parallelodon tenuistriatus (Meek and Worthen)
Entolium aviculatus (Swallow)
Pleurophorella costata (Meek and Worthen)
Astartella compacta Girty
Astartella concentrica (Conrad)
Astartella varica McChesney

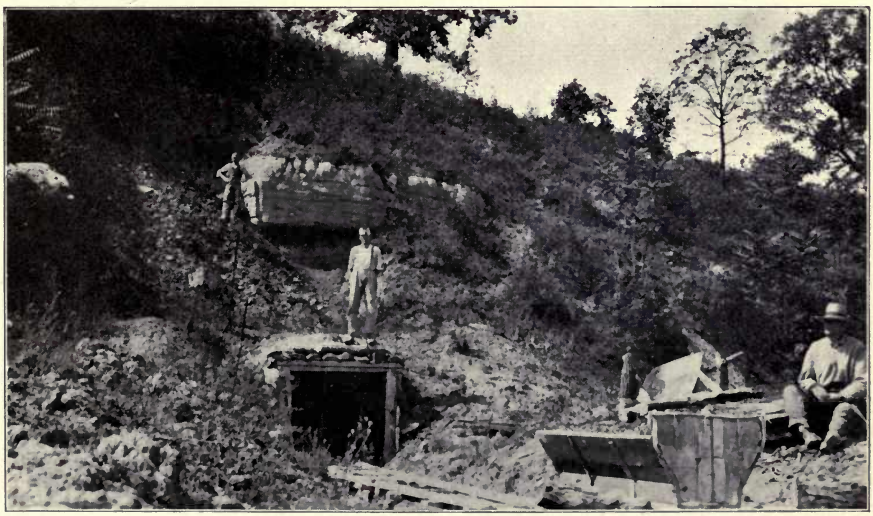
Pharkidonotus percarinatus (Conrad)
Patellostium montfortianum (Norwood and Pratten)
Pleurotomaria carbonaria Norwood aud Pratten
Naticopsis nanus (Meek and Worthen)

Pseudorthoceras knoxense (McChesney)
Coloceras sp.
Metacoceras sp.

Perry County.—In Perry County the stratum is generally notably thick. It consists of limestones and calcareous shales, both of which are fossiliferous. No collections were made in the county but the following sections will show the lithologic character of the member and its relations to the strata below:



A—Projecting ledge of Putnam Hill limestone with Brookville coal below; Tionesta coal, shown by dark streak, a few feet above road. Dugway at Putnam Hill, Zanesville, Muskingum County



B—The Carl Crabtree mine in which Tionesta clay is mined for the general market. Putnam Hill limestone exposed about 15 feet above the mine. Blunt Run, Muskingum County (Locality 27)

Section measured in pit of Central Refractories Co., Lexington, Perry County

		Feet	Inches
Shale, gray		20	--
Shale, blue, concretionary, sparingly fossiliferous	*McArthur*	8	--
Limestone, ferruginous, fossiliferous	*McArthur*	--	5
Shale, calcareous, fossiliferous	*McArthur*	--	5
Coal, *Tionesta*		1	--
Clay, part siliceous		11	8

Strata measured at mine of Ludowici Celadon Co., Section 7, Pike Township, Perry County

		Feet	Inches
Shale, blue		20	--
Shale, blue, concretionary, sparingly fossiliferous	*McArthur*	8	--
Limestone, impure, very fossiliferous	*McArthur*	--	4
Coal	*Tionesta*	--	9
Shale	*Tionesta*	--	1
Coal	*Tionesta*	1	4
Clay		3	--
Flint, black, irregular, *Upper Mercer*		1	--
Coal, *Bedford*		1	--

Muskingum and Coshocton Counties.—North of Perry County the McArthur member has been found in a number of places, but the deposit is thin and sparingly fossiliferous. In most cases, however, if it is present, it forms a part of the mass of shales which occupy the entire interval between the Tionesta horizon and the Putnam Hill limestone of the Allegheny formation.

Summary

The McArthur member is generally represented by calcareous shale, although impure limestone and sandy shale may mark the horizon or may be interbedded with the calcareous shale. At the type locality near McArthur in Vinton County, the limestone phase is well developed. The stratum is bluish-gray to almost black in color and is everywhere extremely rich in fossil remains. The member is also well developed in Jackson County as far south as Monroe Furnace, and extends northward into Hocking, Perry, Muskingum, and Coshocton counties. In thickness it varies from 1 to 15 feet, and it forms the fifth member of the series of marine limestones of the Pennsylvanian system in Ohio.

The complete list of fossils collected from the McArthur member follows:

Lophophyllum profundum (Milne-Edwards and Haime)

Crinoid segments

Bascomella gigantea n. gen. and n. sp.
Fenestella shumardi Prout ?
Polypora fastuosa Foerste
Fenestellids undetermined
Rhombopora lepidodendroidea Meek
Prismopora sereata (Meek)

Lingula carbonaria Shumard
Orbiculoidea meekana (Whitfield)
Orbiculoidea missouriensis (Shumard)
Crania modesta White and St. John
Rhipidomella pecosi (Marcou)
Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Pustula pertenuis (Meek)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer boonensis Swallow ?
Spirifer cameratus Morton
Spirifer opimus Hall
Ambocoelia planoconvexa (Shumard)
Squamularia perplexa (McChesney)
Composita subtilita (Hall)
Composita sp.

Edmondia aspinwallensis Meek
Edmondia gibbosa (McCoy)
Edmondia meekiana (Herrick)
Edmondia ovata Meek and Worthen
Edmondia reflexa Meek
Nucula parva McChesney
Nuculopsis ventricosa (Hall)
Leda bellistriata Stevens
Leda meekana Mark
Yoldia glabra Beede and Rogers ?
Parallelodon carbonarius (Cox)
Parallelodon obsoletus (Meek)
Parallelodon sangamonensis (Worthen)
Parallelodon tenuistriatus (Meek and Worthen)
Pteria ohioense (Herrick)
Myalina pernaformis Cox
Myalina swallovi McChesney
Schizodus affinis Herrick
Schizodus curtus Meek and Worthen
Schizodus mooresi Miller ?
Schizodus subcircularis Herrick
Schizodus wheeleri Swallow
Aviculopecten coxanus Meek and Worthen
Aviculopecten herzeri Meek

Deltopecten occidentalis (Shumard)
Deltopecten scalaris (Herrick)
Acanthopecten carboniferous (Stevens)
Crenipecten foerstii Herrick
Entolium attenuatum Herrick
Entolium aviculatus (Swallow)
Lima retifera Shumard
Allerisma terminale Hall
Pleurophorella costata (Meek and Worthen)
Pleurophorus immaturus Herrick
Pleurophorus oblongus Meek
Pleurophorus tropidophorus Meek
Astartella compacta Girty
Astartella concentrica (Conrad)
Astartella newberryi Meek
Astartella varica McChesney
Cypricardinia ? carbonaria Meek

Plagioglypta prosseri n. sp.

Bellerophon crassus Meek and Worthen
Pharkidonotus percarinatus (Conrad)
Pharkidonotus percarinatus var. tricarinatus (Shumard)
Euphemus carbonarius (Cox)
Euphemus nodocarinatus (Hall)
Bucanopsis meekiana (Swallow)
Patellostium montfortianum (Norwood and Pratten)
Phanerotrema grayvillense (Norwood and Pratten)
Pleurotomaria carbonaria Norwood and Pratten
Pleurotomaria newportensis White
Pleurotomaria sp.
Schizostoma catilloides (Conrad)
Naticopsis nanus (Meek and Worthen)
Naticopsis tortum (Meek)
Zygopleura plenum (Herrick)
Bulimorpha inornata (Meek and Worthen) ?
Sphaerodoma brevis (White)
Sphaerodoma fusiformis (Hall) ?
Sphaerodoma klipparti (Meek)
Sphaerodoma newberryi (Stevens)
Sphaerodoma primigenia (Conrad)

Pseudorthoceras knoxense (McChesney)
Coloceras sp.
Metacoceras sp.

BLACK FLINT MEMBER

Stratigraphy and Extent

The Black Flint member, which forms the next fossiliferous horizon above the McArthur limestone, is near the top of the Pottsville formation. It is a very local deposit and its outcrop is confined to Jackson and southwestern Vinton counties.[1] The member is associated with the basal member of the Allegheny formation, namely the Brookville coal, which it either directly underlies or from which it is separated by a few feet of clay and shale; however, the coal is much more persistent than the flint. The interval between the Black Flint and the Tionesta coal with its accompanying McArthur member varies from 10 to 35 feet with an average of 21 feet. In Jackson County, Washington Township, the entire thickness of the Pottsville formation from the Sharon conglomerate at the base to the Black Flint was measured in Section 21 from the old Glen Nell mine to the hill just west of the Town House and was found to be 273 feet.[2]

The Black Flint horizon is marked by deposits of extremely hard, lustrous, black flint; impure, very fossiliferous limestone; and nodular iron ore. In the southern part of Jackson County heavy beds of sandstone mark the top of the Pottsville formation; northward in Lick Township, east of Jackson, the member is represented by fairly persistent iron ore, 5 to 15 feet below the Brookville coal. When only one bench is represented, the thickness is about 6 to 8 inches, although three benches, each 4 to 6 inches thick, may be present. Fossils are absent or are found very sparingly. The ore was formerly used for smelting in the old charcoal furnaces of the vicinity.

In the northeastern part of Jackson County, including Coal and northern Milton townships, the flint and ore are both present in patches although they are seldom found together. The flint is deep black, lustrous, and about a foot in thickness; in the latter township it is underlain by shaly, gray limestone which contains a great abundance of fossils in an excellent state of preservation. The ore on the horizon measures 8 inches in thickness. In Washington Township only flint and gray limestone are present.

As the flint passes northward into Vinton County it thickens somewhat and is found in Richland, Clinton, and Elk townships where both ore and flint are present. The thickness of the ore is about 8 inches while that of the flint varies from 1 to 2 feet. In central Richland Township the flint and gray limestones are exposed on the high knobs, while in western Clinton Township, east of Hamden, they are found at the tops of some of the hills. The northern limit of the deposit is in

[1]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 20, pp. 179-187, 1916.
[2]Idem., p. 183.

Elk Township, where it consists of very patchy, shaly limestone and flint.

Faunally the Black Flint member resembles the Lower Mercer limestone, although it is much less fossiliferous both in number of individuals and in species; gastropods are likewise very rare. Bryozoans, mostly Fenestellidae, are the most abundant class of fossils represented, and are more numerous individually than in any other member of the Pottsville formation of this State. The greater part are, however, not sufficiently well preserved to make satisfactory identification possible.

Conditions of Deposition

The black flint and shaly limestone were deposited during the closing shallow water stage of Pottsville time, and mark a continuation of the same conditions which had existed during the deposition of the McArthur limestone. During the entire interval which elapsed between the formation of the Tionesta and Brookville coals, shallow waters favorable for the deposition of limestone prevailed over the region; sediments, however, were carried to the sea and deposited at varying rates, resulting in the formation of calcareous shales and sandstones, and shaly limestones. While the Black Flint member was deposited, the sea supported fairly abundant life, whose remains are excellently preserved in the shaly limestones. The formation of the flint on the horizon was similar to that of the Upper Mercer member. At the close of the shallow water period, swamp conditions again prevailed during which the basal member of the Allegheny formation, the Brookville coal, was laid down.

Description of Geologic Sections and Collecting Localities

Jackson County.—One of the best exposures of Black Flint is located in Washington Township in the road just north of the Town House in Section 22, and it is also found capping the hill to the west. The calcareous, shaly limestone outcrops on top of the hill about one-fourth of a mile south of the above locality where blocks of limestone are scattered over the field to the east of the road. The deposit is extremely fossiliferous and affords excellent collecting. The geologic section measured from the old Glen Nell mine in the western part of Section 21, to the hill capped with Black Flint west of the Town House shows the entire thickness of the Pottsville formation, as well as the relation of the Black Flint to the underlying members (Locality 87):[1]

[1]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 20, p. 183, 1916.

Strata measured from old Glen Nell mine to hill west of Town House, Sections 21 and 22, Washington Township, Jackson County

	Feet	Inches
Flint, black, *Black Flint*	1	--
Shale and covered	18	--
Shale	3	--
Coal blossom, *Tionesta*	1	--
Clay, sandy	2	--
Sandstone	37	--
Covered	14	--
Shale, dark	6	--
Coal, *Upper Mercer*	1	--
Shale and covered	3	--
Shale, sandy	8	--
Covered	4	--
Sandstone	12	--
Ore, *Lower Mercer*	--	2
Covered	75	--
Sandstone	5	--
Coal, irregular	--	6
Sandstone	3	2
Sandstone and shale, irregular	3	6
Coal, *Quakertown*	2	6
Covered	61	--
Sandstone, coarse-grained	12	--
Ore, *Sharon*	--	7
Shale	--	4
Coal, *Sharon*	3	1
Covered	3	--
Conglomerate, *Sharon*	15	--

The following fossils were collected at this locality:

Lophophyllum profundum (Milne-Edwards and Haime)

Crinoid segments

Archaeocidaris spines

Fenestella remota Foerste
Fenestella shumardi Prout ?
Fenestella venusta Mather ?
Fenestellids undetermined
Septopora biserialis (Swallow)
Prismopora sereata (Meek)

Rhipidomella pecosi (Marcou)
Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)

Spiriferina kentuckyensis (Shumard)
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Pteria ohioense (Herrick)
Myalina pernaformis Cox
Myalina swallovi McChesney
Schizodus curtus Meek and Worthen
Aviculopecten coxanus Meek and Worthen
Aviculopecten herzeri Meek
Deltopecten scalaris (Herrick)
Acanthopecten carboniferous (Stevens)
Euchondria neglecta (Geinitz)
Entolium aviculatus (Swallow)
Pleurophorus immaturus Herrick
Pleurophorus tropidophorus Meek
Astartella concentrica (Conrad)

Schizostoma catilloides (Conrad)

Phillipsia trinucleata Herrick

Hard, black flint outcrops near the top of the hill in the central part of Section 3, Coal Township, west of the northeast-southwest road, one mile northeast of Davisville. The flint is very fossiliferous and is especially rich in bryozoans which are, for the most part, too poorly preserved for identification (Locality 88). The forms listed below were identified:

Fusulina secalica (Say)

Lophophyllum profundum (Milne-Edwards and Haime)

Crinoid segments

Fenestella shumardi Prout ?
Fenestellids undetermined
Septopora biserialis (Swallow)
Rhombopora lepidodendroidea Meek
Prismopora sereata (Meek)

Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer boonensis Swallow ?
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Patellostium montfortianum (Norwood and Pratten)

A few specimens of *Orbiculoidea meekana* (Whitfield), which probably belong to the Black Fint horizon, were also obtained in Coal Township just west of Wellston from the impure shaly limestone 30 feet above the Tionesta coal (Locality 89).

Vinton County.—In Section 34, Richland Township, near the Jackman School, the Black Flint member is represented by an iron ore. The following section shows the relation of the member to the Tionesta coal and to the extremely fossiliferous, calcareous shales which mark the McArthur horizon:[1]

	Feet	Inches
Ore, *Black Flint horizon*	--	8
Shale	5	--
Shale and covered	19	--
Shale, very fossiliferous (*McArthur*)	4	--
Coal, *Tionesta*	5	1

The forms below were obtained from the extremely hard, unfossiliferous black flint which is exposed in the roadbed near Mt. Zion School, in Section 24, Richland Township (Locality 90). The flint measures 1 foot 6 inches at this locality.

Fusulina secalica (Say)

Lophophyllum profundum (Milne-Edwards and Haime)

Crinoid segments

Productus semireticulatus (Martin)

Excellent exposures of Black Flint are present in many localities in Elk Township, where the member is exceptionally thick and everywhere fossiliferous. Fossils are, however, present very sparingly in the black flint phase, but are abundant in the impure shaly limestone. The following strata were measured in the southeastern part of Section 11, along the northeast-southwest road (Locality 91):

Rock succession in the southeastern part of Section 11, Elk Township, Vinton County

	Feet	Inches
Allegheny formation		
Coal blossom, *Clarion*	2	--
Clay	5	--
Shale with scattered ore nodules	17	--
Coal blosson, *Brookville*	4	--
Pottsville formation		
Clay	1	--
Flint, gray to black and impure limestone, *Black Flint*	2	6
Coal blossom	2	--

[1]Stout, W., Geol. Surv. Ohio, Fourth Ser., Bull. 20, p. 185, 1916.

Pottsville formation—Concluded.	Feet	Inches
Clay and covered	4	--
Shale and covered	11	--
Shale, very fossiliferous, *McArthur*	4	--
Coal blossom, *Tionesta*	3	6
Clay	7	--

The following fossils were collected from the impure shaly limestone at this locality:

Lophophyllum profundum (Milne-Edwards and Haime)

Crinoid segments

Archaeocidaris spines

Spirorbis sp.

Fenestella shumardi Prout ?
Fenestella venusta Mather ?
Fenestellids undetermined
Septopora biserialis var. gracilis (Meek)
Prismopora sereata (Meek)

Orbiculoidea meekana (Whitfield)
Rhipidomella pecosi (Marcou)
Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Pteria ohioense (Herrick)
Myalina pernaformis Cox
Myalina swallovi McChesney
Posidonia ? acosta (Cox) ?
Aviculopecten coxanus Meek and Worthen
Aviculopecten herzeri Meek
Acanthopecten carboniferous (Stevens)

Schizostoma catilloides (Conrad)

Phillipsia trinucleata Herrick

Samples of black flint were obtained from the Ogan farm in the southeastern part of Section 14, same township, four miles northeast of McArthur. Here the member is composed entirely of extremely hard, unusually fossiliferous flint and reaches the exceptional thickness of 6 feet as shown below (Locality 92):

	Feet	Inches
Coal, *Brookville*	1	6
Clay	1	--
Flint, gray to black; *Black Flint*	6	--
Coal	2	6

The species listed below were obtained:

Lophophyllum profundum (Milne-Edwards and Haime)

Crinoid segments

Archaeocidaris spines

Spirorbis sp.

Fenestella delicatula Ulrich
Fenestella shumardi Prout ?
Fenestella venusta Mather ?
Fenestellids undetermined
Septopora biserialis (Swallow)
Prismopora sereata (Meek)

Orbiculoidea meekana (Whitfield)
Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d'Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)
Spirifer boonensis Swallow?
Spirifer cameratus Morton
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Parallelodon tenuistriatus (Meek and Worthen)
Myalina swallovi McChesney
Myalina pernaformis Cox
Schizodus wheeleri Swallow
Aviculopecten coxanus Meek and Worthen
Aviculopecten herzeri Meek
Deltopecten scalaris (Herrick)
Acanthopecten carboniferous (Stevens)

Trachydomia sp. with Spirorbis sp.

The Black Flint in Spook Hollow, southwestern part of Section 23, one and one-half miles east of McArthur, was also examined for fossils, but a few fragments of *Lepidodendron sp.* constituted the only form which was obtained. The following section was measured here (Locality 93):

	Feet	Inches
Clay, *Brookville*, formerly mined	--	--
Clay	1	--
Flint, gray to black, *Black Flint*	1	8
Covered	52	--
Sandstone and covered	40	--

Summary

The Black Flint member forms the uppermost stratum of the Pottsville formation and, in ascending order, the sixth marine limestone of this formation. The deposit is a very local one and occurs only in parts of Jackson and Vinton counties. It consists of iron ore, black flint, and shaly limestone, the latter of which is extremely fossiliferous and is directly associated with the flint. The flinty phase is confined largely to northern Jackson County including Coal and Washington townships, and to southwestern Vinton County including Richland, Clinton, and Elk townships. The flint and limestone vary from 1 to 2 feet in thickness, while the ore generally measures from 4 to 8 inches. The complete list of fossils obtained from the Black Flint member is given below:

Lepidodendron sp.

Fusulina secalica (Say)

Lophophyllum profundum (Milne-Edwards and Haime)

Crinoid segments

Archaeocidaris plates and spines

Spirorbis sp.

Fenestella delicatula Ulrich
Fenestella remota Foerste
Fenestella shumardi Prout ?
Fenestella venusta Mather ?
Fenestellids undetermined
Septopora biserialis (Swallow)
Septopora biserialis var. gracilis (Meek)
Rhombopora lepidodendroidea Meek
Prismopora sereata (Meek)

Orbiculoidea meekana (Whitfield)
Rhipidomella pecosi (Marcou)
Derbya crassa (Meek and Hayden)
Chonetes mesolobus Norwood and Pratten
Productus cora d' Orbigny
Productus semireticulatus (Martin)
Pustula nebraskensis (Owen)
Marginifera muricata var. missouriensis Girty
Marginifera wabashensis (Norwood and Pratten)
Spiriferina kentuckyensis (Shumard)

Spirifer boonensis Swallow ?
Spirifer cameratus Morton
Spirifer opimus Hall
Squamularia perplexa (McChesney)
Composita subtilita (Hall)

Parallelodon tenuistriatus (Meek and Worthen)
Pteria ohioense (Herrick)
Myalina pernaformis Cox
Myalina swallovi McChesney
Posidonia ? acosta (Cox) ?
Schizodus curtus Meek and Worthen
Schizodus wheeleri Swallow
Aviculopecten coxanus Meek and Worthen
Aviculopecten herzeri Meek
Deltopecten scalaris (Herrick)
Acanthopecten carboniferous (Stevens)
Euchondria neglecta (Geinitz)
Entolium aviculatus (Swallow)
Pleurophorus immaturus Herrick
Pleurophorus tropidophorus Meek
Astartella concentrica (Conrad)

Patellostium montfortianum (Norwood and Pratten)
Schizostoma catilloides (Conrad)
Trachydomia sp.

Phillipsia trinucleata Herrick

RANGE OF POTTSVILLE FOSSILS IN OHIO

Complete list of fossils from the Pottsville formation	Members												
	Harrison	Sharon	Anthony	Quakertown	Bear Run	Lowellville	Boggs	Lower Mercer	Lower Mercer Ore	Sand Block Ore	Upper Mercer	McArthur	Black Flint
Plantae	---	---	X	---	---	---	X	X	---	---	X	---	---
Cordaites sp.	---	---	---	---	---	X	---	---	---	---	---	---	---
Calamites sp.	---	---	---	---	---	X	---	---	---	---	---	---	---
Lepidodendron sp.	---	---	---	---	---	---	X	---	---	---	---	---	X
Textularia sp.	---	---	---	---	---	---	---	---	---	---	X	---	---
Nodosaria sp.	---	---	---	---	---	---	---	---	---	---	X	---	---
Fusulina secalica (Say)	---	---	---	---	---	---	---	X	---	---	X	---	X
Girtyina ventricosa (Meek and Hayden)	---	---	---	---	---	---	---	---	---	---	X	---	---
Lophophyllum profundum (Milne-Edwards and Haime)	---	---	---	---	---	---	---	X	---	---	X	X	X
Eupachycrinus mooresi (Whitfield)	---	---	---	---	---	---	X	X	---	---	---	---	---
Crinoid segments	X	X	---	---	---	X	X	X	---	---	X	X	X
Archaeocidaris plates and spines	---	---	---	---	---	---	---	X	---	---	X	---	X
Spirorbis sp.	---	---	---	---	---	---	---	---	---	---	---	---	X
Bascomella gigantea n. gen. and n. sp.	---	---	---	---	---	---	---	---	---	---	---	X	---
Tabulipora ohioensis (Foerste)	---	---	---	---	---	X	X	X	---	---	---	---	---
Chainodictyon laxum Foerste	---	---	---	---	---	---	---	X	---	---	---	---	---
Fenestellids undetermined	---	---	---	---	---	---	---	---	---	---	X	X	X
Fenestella delicatula Ulrich	---	---	---	---	---	---	---	---	---	---	---	---	X
Fenestella limbata Foerste	---	---	---	---	---	---	---	X	---	---	X	---	---
Fenestella remota Foerste	---	---	---	---	---	---	---	X	---	---	---	---	X
Fenestella shumardi Prout ?	---	---	---	---	---	X	X	X	---	---	X	X	X
Fenestella venusta Mather ?	---	---	---	---	---	---	---	---	---	---	---	---	X
Fenestella sp.	---	---	---	---	---	---	X	X	---	---	X	---	---
Polypora fastuosa Foerste	---	---	---	---	---	---	---	X	---	---	---	X	---
Polypora sp.	---	---	---	---	---	---	---	X	---	---	---	---	---
Pinnatopora whitii Foerste	---	---	---	---	---	---	---	X	---	---	---	---	---
Pinnatopora sp.	---	---	---	---	---	---	---	---	---	---	X	---	---
Septopora biserialis (Swallow)	---	---	---	---	---	---	X	X	---	---	X	---	X
Septopora biserialis var. gracilis (Meek)	---	---	---	---	---	---	---	X	---	---	X	---	X
Rhombopora lepidodendroidea Meek	---	---	---	---	---	---	X	X	---	---	X	X	X
Rhombopora multipora Foerste	---	---	---	---	---	---	---	X	---	---	---	---	---
Streblotrypa merceri n. sp.	---	---	---	---	---	---	---	X	---	---	---	---	---
Cystodictya carbonaria (Meek)	---	---	---	---	---	---	---	X	---	---	X	---	---
Prismopora sereata (Meek)	---	---	---	---	---	---	---	X	---	---	X	X	X

RANGE OF POTTSVILLE FOSSILS IN OHIO—Continued

Complete list of fossils from the Pottsville formation	Members												
	Harrison	Sharon	Anthony	Quakertown	Bear Run	Lowellville	Boggs	Lower Mercer	Lower Mercer Ore	Sand Block Ore	Upper Mercer	McArthur	Black Flint
Lingula carbonaria Shumard	---	X	X	X	---	X	X	X	---	---	X	X	---
Lingula kanawhensis Price	---	---	---	---	---	---	---	X	---	---	---	---	---
Lingula sp.	---	---	X	---	---	---	---	---	---	---	---	---	---
Glossina waverlyensis (Herrick)	---	---	---	---	---	---	---	X	---	---	---	---	---
Orbiculoidea capuliformis (McChesney)	X?	X?	---	---	---	---	X	---	---	---	---	---	---
Orbiculoidea meekana (Whitfield)	---	---	---	---	---	---	---	X	---	---	X	X	X
Orbiculoidea missouriensis (Shumard)	---	---	---	---	---	X	X	X	---	---	X	X	---
Orbiculoidea stoutella n. sp.	X	X	---	---	---	---	---	---	---	---	---	---	---
Orbiculoidea sp.	---	---	---	---	---	---	---	---	---	X	---	---	---
Crania modesta White and St. John	---	---	---	---	---	---	---	X	---	---	X	X	---
Rhipidomella pecosi (Marcou)	---	---	---	---	---	X	---	X	---	---	---	X	X
Schizophoria altirostris (Mather)	---	---	---	---	---	---	---	X	---	---	---	---	---
Schizophoria sp.	X	---	---	---	---	---	---	---	---	---	---	---	---
Derbya crassa (Meek and Hayden)	---	---	---	---	---	X	X	X	X	---	X	X	X
Derbya robusta (Hall)	---	---	---	---	---	---	---	X	---	---	---	---	---
Chonetes choteauensis Mather	---	---	---	---	---	X	X	X	---	---	---	---	---
Chonetes mesolobus Norwood and Pratten	---	---	---	---	---	---	X	X	---	---	X	X	X
Aulacorhynchus millepunctatus (Meek and Worthen)	---	---	---	---	---	---	---	X	---	---	---	---	---
Productus cora d'Orbigny	---	---	---	---	---	X	X	X	X	---	X	X	X
Productus semireticulatus (Martin)	---	---	---	---	---	X	X	X	---	---	X	X	X
Productus semireticulatus (Martin) var.	---	---	---	---	---	---	X	X	---	---	X	---	---
Pustula nebraskensis (Owen)	---	---	---	---	---	X	X	X	---	---	X	X	X
Pustula pertenuis (Meek)	---	X	---	---	---	---	---	X	---	---	---	X	---
Pustula punctatus (Martin)	---	---	---	---	---	X	X	X	---	---	X	---	---
Pustula symmetricus (McChesney)	---	---	---	---	---	---	---	X	---	---	X	---	---
Marginifera muricata var. missouriensis Girty	---	X	---	---	---	X	---	X	---	---	X	X	X
Marginifera wabashensis (Norwood and Pratten)	---	---	---	---	---	X	X	X	---	---	X	X	X
Dielasma bovidens Morton ?	---	---	---	---	---	---	---	X	---	---	---	---	---
Spiriferina kentuckyensis (Shumard)	X?	X?	---	---	---	X	X	X	X	---	X	X	X
Spirifer boonensis Swallow ?	---	---	---	---	---	---	X	X	---	---	X	---	X
Spirifer cameratus Morton	---	---	---	---	---	---	---	X	---	---	X	X	X
Spirifer opimus Hall	---	---	---	---	---	X	---	X	X	---	X	X	X
Ambocoelia planoconvexa (Shumard)	---	---	---	---	---	---	---	---	---	---	---	X	---

RANGE OF POTTSVILLE FOSSILS IN OHIO—Continued

Complete list of fossils from the Pottsville formation	Members												
	Harrison	Sharon	Anthony	Quakertown	Bear Run	Lowellville	Boggs	Lower Mercer	Lower Mercer Ore	Sand Block Ore	Upper Mercer	McArthur	Black Flint
Ambocoelia planoconvexa (Shumard) var.						X							
Squamularia perplexa (McChesney)							X	X			X	X	X
Hustedia mormoni (Marcou)	X												
Composita subtilita (Hall)	X	X				X	X	X	X		X	X	X
Composita sp.							X				X	X	
Minute Pelecypoda, three or more species										X			
Solenomya radiata Meek and Worthen								X					
Solenomya ?? sharonensis n. sp.		X											
Solenomorpha lamborni n. sp.		X											
Prothyris elegans Meek								X			X		
Edmondia anodontoides (Meek) ?								X					
Edmondia aspinwallensis Meek								X				X	
Edmondia gibbosa (McCoy)								X				X	
Edmondia meekiana (Herrick) ?								X				X	
Edmondia ovata Meek and Worthen								X			X	X	
Edmondia ? peroblonga Meek and Worthen ?							X						
Edmondia reflexa Meek								X				X	
Edmondia sp.						X	X						
Nucula beyrichi von Schauroth	X							X					
Nucula elongata n. sp.		X						X?					
Nucula lunulata Girty mss.		X											
Nucula parva McChesney								X				X	
Nucula subrotundata Girty mss.	X	X											
Nuculopsis ventricosa (Hall)	X	X						X				X	
Leda bellistriata Stevens						X	X	X				X	
Leda inflata Girty mss.		X											
Leda meekana Mark								X				X	
Leda prolongata n. sp.							X	X					
Yoldia glabra Beede and Rogers ?												X	
Yoldia stevensoni Meek								X					
Anthraconeilo bownockeri n. sp.		X											
Parallelodon carbonarius (Cox)							X	X			X	X	
Parallelodon obsoletus (Meek)						X?		X				X	
Parallelodon sangamonensis (Worthen)						X		X	X		X	X	

RANGE OF POTTSVILLE FOSSILS IN OHIO—Continued

Complete list of fossils from the Pottsville formation	Members												
	Harrison	Sharon	Anthony	Quakertown	Bear Run	Lowellville	Boggs	Lower Mercer	Lower Mercer Ore	Sand Block Ore	Upper Mercer	McArthur	Black Flint
Parallelodon tenuistriatus (Meek and Worthen)	X	---	---	---	---	---	X	X	---	---	X	X	X
Aviculopinna americana Meek	---	---	---	---	---	---	X	---	---	---	---	---	---
Pteria ohioense (Herrick)	---	---	---	---	---	---	---	X	---	---	---	X	X?
Pseudomonotis sp.	---	---	---	---	---	---	---	X	---	---	---	---	---
Posidonia ? acosta (Cox) ?	---	---	---	---	---	---	---	X	---	---	---	---	X
Posidonia girtyi n. sp.	---	---	---	---	---	X	---	X	---	---	---	---	---
Posidonia vintonensis n. sp.	---	---	---	---	---	---	---	X	---	---	---	---	---
Posidonia sp. ?	---	---	---	---	---	---	---	X	---	---	---	---	X
Myalina pernaformis Cox	---	---	---	---	---	---	X	X	---	---	X	X	X
Myalina pernaformis Cox var.	X	---	---	---	---	---	---	---	---	---	---	---	---
Myalina recurvirostris var. sinuosa n. var.	---	---	---	---	---	---	---	X	---	---	---	---	---
Myalina swallovi McChesney	---	---	---	---	---	---	---	X	---	---	---	X	X
Naiadites elongata Dawson	---	X	---	X	X	---	X	---	---	---	---	---	---
Naiadites ohioense n. sp.	---	X	---	---	---	---	---	---	---	---	---	---	---
Naiadites sp.	---	---	X	---	---	---	---	---	---	---	---	---	---
Schizodus affinis Herrick	X	---	---	---	---	---	X	X	---	---	---	X	---
Schizodus amplus Meek and Worthen	---	---	---	---	---	---	X	---	---	---	---	---	---
Schizodus cuneatus Meek	---	---	---	---	---	---	---	X	---	---	---	---	---
Schizodus curtus Meek and Worthen	---	---	---	---	---	---	X	X	---	---	---	X	X
Schizodus mooresi Miller ?	---	---	---	---	---	---	---	X	---	---	---	X	---
Schizodus subcircularis Herrick	X	---	---	---	---	---	---	---	---	---	---	X	---
Schizodus wheeleri Swallow	---	---	---	---	---	---	X	X	---	---	X	X	X
Aviculopecten coxanus Meek and Worthen	X	X	---	---	---	X	X	X	---	---	X	X	X
Aviculopecten herzeri Meek	---	---	---	---	---	---	---	X	---	---	---	X	X
Aviculopecten pellucidus Meek and Worthen	---	---	---	---	---	X	---	---	---	---	---	---	---
Aviculopecten sorer Herrick	---	---	---	---	---	---	---	X	---	---	---	---	---
Deltopecten occidentalis (Shumard)	---	---	---	---	---	---	X	X	---	---	---	X	---
Deltopecten scalaris (Herrick)	---	---	---	---	---	---	X	X	---	---	X	X	X
Acanthopecten carboniferous (Stevens)	---	---	---	---	---	---	X	X	---	---	X	X	X
Crenipecten foerstii Herrick	---	---	---	---	---	---	X	X	---	---	X	X	---
Euchondria neglecta (Geinitz)	---	---	---	---	---	X	---	X	---	---	X	---	X
Entolium attenuatum Herrick	---	---	---	---	---	---	---	X	---	---	---	X	---
Entolium aviculatus (Swallow)	---	---	---	---	---	---	---	X	---	---	X	X	X
Lima retifera Shumard	---	---	---	---	---	---	---	X	---	---	---	X	---

RANGE OF POTTSVILLE FOSSILS IN OHIO—Continued

Complete list of fossils from the Pottsville formation	Members												
	Harrison	Sharon	Anthony	Quakertown	Bear Run	Lowellville	Boggs	Lower Mercer	Lower Mercer Ore	Sand Block Ore	Upper Mercer	McArthur	Black Flint
Placunopsis ? recticardinalis Meek								X					
Allerisma terminale Hall								X				X	
Pleurophorella costata (Meek and Worthen)								X	X			X	
Pleurophorella geinitzi (Meek)								X					
Pleurophorella sesquiplicata Price								X					
Pleurophorus immaturus Herrick								X				X	X
Pleurophorus oblongus Meek		X						X				X	X
Pleurophorus spinulosa n. sp.								X					
Pleurophorus tropidophorus Meek						X		X			X	X	X
Astartella compacta Girty								X				X	
Astartella concentrica (Conrad)						X	X	X			X	X	X
Astartella newberryi Meek								X				X	
Astartella varica McChesney								X			X	X	
Astartella sp.						X							
Cypricardinia ? carbonaria Meek								X				X	
Plagioglypta meekana (Geinitz)								X					
Plagioglypta prosseri n. sp.								X				X	
Minute Gastropoda, three or more species										X			
Bellerophon crassus Meek and Worthen	X	X						X				X	
Pharkidonotus percarinatus (Conrad)								X				X	
Pharkidonotus percarinatus var. tricarinatus (Shumard)								X				X	
Euphemus carbonarius (Cox)	X	X					X	X	X			X	
Euphemus nodocarinatus (Hall)								X				X	
Bucanopsis meekiana (Swallow)								X				X	
Patellostium montfortianum (Norwood and Pratten)								X				X	X
Phanerotrema grayvillense (Norwood and Pratten)								X				X	
Trepospira depressa (Cox)								X					
Pleurotomaria broadheadi White								X					
Pleurotomaria carbonaria Norwood and Pratten								X				X	
Pleurotomaria coxanus Meek and Worthen								X					
Pleurotomaria newportensis White								X				X	
Pleurotomaria ornatiformis n. sp.	X	X						X					
Pleurotomaria, several species	X	X					X		X		X	X	
Schizostoma catilloides (Conrad)	X	X				X	X	X				X	X
Naticopsis altonensis (McChesney)							X	X					

RANGE OF POTTSVILLE FOSSILS IN OHIO—Concluded

Complete list of fossils from the Pottsville formation	Members												
	Harrison	Sharon	Anthony	Quakertown	Bear Run	Lowellville	Boggs	Lower Mercer	Lower Mercer Ore	Sand Block Ore	Upper Mercer	McArthur	Black Flint
Naticopsis nanus (Meek and Worthen)								X			X	X	
Naticopsis pulchella n. sp.								X					
Naticopsis tortum (Meek)												X	
Naticopsis ventricosus (Norwood and Pratten)								X					
Trachydomia sp.								X					X
Zygopleura plenum (Herrick)								X?				X	
Zygopleura plicata (Whitfield)								X					
Hemizyga n. sp.								X					
Bulimorpha inornata (Meek and Worthen)								X			X	X	
Sphaerodoma brevis (White)								X			X	X	
Sphaerodoma fusiformis (Hall) ?								X				X	
Sphaerodoma humilis (Keyes) ?	X												
Sphaerodoma klipparti (Meek)								X				X	
Sphaerodoma newberryi (Stevens)												X	
Sphaerodoma primigenia (Conrad)		X						X				X	
Sphaerodoma regularis (Cox) ?								X					
Sphaerodoma ventricosa (Hall)								X			X		
Sphaerodoma sp.											X		
Conularia crustula White								X			X?		
Conularia newberryi Winchell ?								X					
Orthoceras isogramma Meek								X			X		
Orthoceras n. sp.		X											
Orthoceras n. sp.						X		X					
Orthoceras sp.								X					
Pseudorthoceras knoxense (McChesney)						X	X	X				X	
Coloceras sp.	X											X	
Metacoceras pottsvillensis n. sp.								X					
Metacoceras sp.												X	
Temnocheilus forbesianus (McChesney)							X						
Endolobus (Temnocheilus ?) ortoni (Whitfield)								X					
Epphipioceras sp.								X					
Phillipsia sangamonensis Meek and Worthen								X					
Phillipsia trinucleata Herrick		X						X			X		X
Estheria		X											
Fish teeth and plates					X	X	X						

REGISTER OF LOCALITIES

HARRISON ORE

1. Jackson County: Section 22, Hamilton Tp., Harrison ore in stream bed of tributary of Little Scioto River, below house of Philip Meldick. Mr. W. Stout

SHARON ORE

2. Scioto County: Section 14, Porter Tp.; Sharon ore near mouth of Lick Run, on farm of Joseph Jenkins. Mr. W. Stout
3. Scioto County: northern part of Section 15, Madison Tp.; shale above Sharon coal from roof of mine on farm of John Alexander near head of Higgins Run. Mr. W. Stout
4. Scioto County: western part of Section 15, Madison Tp.; shale above Sharon coal from Harry Odle mine in creek bed. Mr. W. Stout
5. Jackson County: Section 21, Washington Tp.; Sharon ore from coal dump at mouth of Glen Nell mine. Mr. W. Stout
6. Jackson County: central part of Section 34, Hamilton Tp.; bone shales on Sharon ore horizon from road just east of Tattle Creek.

ANTHONY SHALE

7. Scioto County: near Scioto Furnace, shale on Anthony coal horizon from mine of Wm. E. Dee Clay Product Co. Mr. W. Stout
8. Scioto County: Scioto Furnace, bone shale above Anthony coal from mine of Buckeye Fire & Clay Co. Mr. W. Stout

QUAKERTOWN SHALE

9. Jackson County: northeastern part of Section 32, Coal Tp.; shale on Quakertown coal horizon from Wilson mine. Mr. W. Stout
10. Jackson County: central part of Section 35, Coal Tp.; shale on Quakertown coal horizon from Twin-Ada mine, at Glenroy. Mr. W. Stout
11. Jackson County: northeastern part of Section 10, Coal Tp.; shale on Quakertown coal horizon from Grace mine, just east of Davisville. (Fossils from Lower Mercer limestone and ore also collected in vicinity of Grace mine.) Mr. W. Stout
12. Summit County: eastern county line, shale from Quakertown coal horizon near Magadore Station, five miles east of Akron. Mr. W. Stout

BEAR RUN ORE AND SHALE

13. Scioto County: Section 3, Bloom Tp.; shale above Bear Run coal on land of H. H. Stevenson. Mr. W. Stout
14. Jackson County: southern part of Section 25, Hamilton Tp.; shale above Bear Run coal on land of Edward Toffin, in Dever Valley.
15. Jackson County: western part of Section 21, Lick Tp.; fissile shale interbedded with black band ore on Bear Run coal horizon, at mouth of old coal mine on land of D. D. Evans.
16. Jackson County: central part of Section 5, Lick Tp.; black band ore on Bear Run coal horizon in stream bed on property of Mrs. John Butts.
17. Vinton County: western part of Section 6, Elk Tp.; shale on Bear Run coal horizon in bed of Elk Fork. Mr. W. Stout
18. Vinton County: northern part of Section 14, Jackson Tp.; shale on Bear Run coal horizon, three-fourths mile south of Stella. Mr. W. Stout

LOWELLVILLE LIMESTONE

19. Muskingum County: Section 18, Hopewell Tp.; Lowellville limestone and shale on Poverty Run, two miles northwest of Hopewell P. O., on land of Della Wise. (Type locality for Poverty Run limestone.)
20. Muskingum County: Fall Tp.; Lowellville limestone and shale (?) in bed of small stream flowing into Licking River at Holbein, on land of E. G. Marshall.
21. Muskingum County: Madison Tp.; Lowellville limestone on east bank of Muskingum River, one-half mile north of Symmes Ford. (Fossils from Upper Mercer flint also collected here.) Mr. R. E. Lamborn
22. Mahoning County: Poland Tp.; Lowellville limestone and shale from Grindstone Run, at Lowellville.(Type locality for Lowellville limestone.) Mr. R. E. Lamborn

BOGGS LIMESTONE

23. Scioto County: Southwestern part of Section 24, Bloom Tp.; shale associated with Boggs ore on William M. Galliger farm. Mr. W. Stout
24. Scioto County: Vernon Tp.; shale on Boggs ore horizon along road east of Pine Creek, one and one-half miles southeast of Lyra. Mr. W. Stout
25. Vinton County: southeastern part of Section 23, Elk Tp.; Boggs ore from Spook Hollow in Elk Creek bed, one and one-half miles east of McArthur. Mr. W. Stout
26. Muskingum County: northeastern part of Section 18, Hopewell Tp.; Boggs limestone in bed of small stream on land of O. J. Riggle, one mile north of Hopewell P. O. Mr. W. Stout and writer
27. Muskingum County: Muskingum Tp.; Boggs limestone in bed of Blunt Run on land of Carl Crabtree. (Fossils from Lower Mercer limestone and shale also collected on Blunt Run.)
28. Muskingum County: Muskingum Tp.; Boggs limestone along Wheeling & Lake Erie Railroad cut, just north of Rock Cut. (Fossils from Lower and Upper Mercer members also collected here.)
29. Muskingum County: Madison Tp.; Boggs limestone from bed of Symmes Creek at the crossroads near mouth of North Branch. (Fossils from Lower and Upper Mercer members also collected along Symmes Creek.)

LOWER MERCER MEMBER

30. Lawrence County: southeastern part of Hamilton Tp.; Lower Mercer limestone near Hanging Rock. Geological Museum of The Ohio State University.
31. Scioto County: southeastern part of Vernon Tp.; Lower Mercer limestone in pasture east of road and about 100 feet above base of the hill, four miles south of Lyra. Mr. W. Stout
11. Jackson County: northwestern part of Section 10, Coal Tp.; Lower Mercer limestone from hollow just east of Grace mine. (Fossils from Quakertown horizon collected in Grace mine and from Lower Mercer ore in road above hollow.)
32. Jackson County: Section 18, Milton Tp.; Lower Mercer limestone in private lane near level of Baltimore & Ohio Railroad, north of Hoganville School.
33. Jackson County: Section 13, Washington Tp.; Lower Mercer limestone in roadbed, one mile west of Hamden.
34. Vinton County: western part of Section 33, Elk Tp.; Lower Mercer black shale in stream bed at Rock Hollow, one and one-half miles south of McArthur. Mr. W. Stout

35. Perry County: Section 10, Reading Tp.; Lower Mercer shale above limestone in cut of Baltimore & Ohio Railroad, at Somerset, and Lower Mercer limestone in bed of north-and-south road, one-half mile south of Somerset. Mr. Eber Hyde
36. Muskingum County: northeastern part of Section 20, Newton Tp.; Lower Mercer limestone and soft shale in bed of small tributary of Jonathan Creek, one mile south of White Cottage.
37. Muskingum County: Washington Tp.; Lower Mercer limestone in bed of Blount Run, one mile east of Gilbert.
38. Muskingum County: Washington Tp.; Lower Mercer limestone in ravine on east side of Muskingum River, opposite Ellis. (Fossils from Upper Mercer member also collected here.)
39. Muskingum County: Washington Tp.; Lower Mercer limestone and soft shale in ravine on east side of Muskingum River, one mile north of Ellis. (Fossils from Upper Mercer member also collected here.)
40. Muskingum County: Washington Tp.; blocks of Lower Mercer limestone at road side, fallen from position in walls of small ravine, on east side of Muskingum River opposite Rock Cut. (Fossils from Upper Mercer member also collected here.)
41. Muskingum County: Washington Tp.; Lower Mercer limestone with shale above and below in bed of small stream about one-fourth mile north of Locality 40.
29. Muskingum County: Washington Tp.; Lower Mercer limestone from bed of Symmes Creek, east of crossroads. (Fossils from Boggs and Upper Mercer members also collected along Symmes Creek.)
42. Muskingum County: northern part of Madison Tp.; Lower Mercer limestone and black shale, near Adams Mills, one-fourth mile south of the county line. Geological Museum of The Ohio State University
27. Muskingum County: Muskingum Tp.; Lower Mercer limestone and shale from bed of Blunt Run. (Fossils from Boggs member also collected along Blunt Run.)
28. Muskingum County: Muskingum Tp.; Lower Mercer limestone along Wheeling & Lake Erie Railroad cut, north of Rock Cut. (Fossils from Boggs and Upper Mercer members also collected here.)
43. Muskingum County: southeastern part of Cass Tp.; Lower Mercer limestone in roadbed on land of J. F. Shaw, three miles southeast of Frazeysburg. (Fossils from Upper Mercer member also collected here.)
44. Muskingum County: Cass Tp.; Lower Mercer limestone in ravine east of north-and-south road, one mile south of county line.
45. Muskingum County: Section 7, Jackson Tp.; Lower Mercer limestone from roadbed, one-half mile southeast of Fairview School.
46. Licking County: Newark Tp.; loose pieces of Lower Mercer limestone on top of Bald Knob, two miles southeast of Newark. Mr. W. Stout
47. Licking County: Hopewell Tp.; Lower Mercer limestone at mouth of old cannel coal mine on Flint Ridge, one-half mile north of Flint Ridge road and just west of north-and-south road parallel to township line. Mr. W. Stout
48. Licking County: Hopewell Tp.; Lower Mercer limestone on Flint Ridge, from bed of north-and-south road parallel to township line and three-fourths mile north of Fairview School. Mr. W. Stout
49. Licking County: Hopewell Tp.; Lower Mercer limestone in bed of Flint Ridge Road, just east of the crossing of Flint Ridge and north-and-south roads, and north of Locality 47. Mr. W. Stout
50. Coshocton County: southwestern part of Washington Tp.; Lower Mercer limestone from Opossum Hollow.
51. Holmes County: Hardy Tp.; Lower Mercer black shale at Millersburg. Geological Museum of The Ohio State University

52. Stark County: Tuscarawas Tp.; Lower Mercer limestone and black shale at shaft of mine, two and one-half miles east of Dalton near East Greenfield. Mr. G. W. Conrey
53. Mahoning County: Berlin Tp.; Lower Mercer limestone in bed of Little Mill Creek, two and one-half miles northeast of North Benton and one-fourth mile west of junction of Turkeybroth Creek with Little Mill Creek. Mr. R. E. Lamborn
54. Mahoning County: Ellsworth Tp.; Lower Mercer limestone in bed of West Branch of Meander Creek, one-fourth mile east of Club Lake and one-half mile south of Ellsworth. Mr. R. E. Lamborn
55. Mahoning County: Poland Tp.; Lower Mercer limestone and black shale in bed of Yellow Creek, one-half mile east of Poland. Mr. R. E. Lamborn
22. Mahoning County: Poland Tp.; Lower Mercer limestone from Grindstone Run at Lowellville. (Fossils of Lowellville member also collected from Grindstone Run.)

LOWER MERCER ORE

56. Jackson County: northeastern part of Section 10, Coal Tp.; Lower Mercer ore in road above hollow just east of Grace mine. (Fossils from Quakertown horizon collected in mine and from Lower Mercer limestone in hollow below road.) Mr. W. Stout

SAND BLOCK ORE

57. Jackson County: eastern part of Section 24, Hamilton Tp.; Sand Block ore from pit in pasture, near head of Dever Valley. Mr. W. Stout

UPPER MERCER MEMBER

58. Scioto County: Green Tp.; Upper Mercer ore from abandoned mine of Hanging Rock Iron Co., one and one-half miles north of Ohio Furnace. Mr. W. Stout
59. Scioto County: southern part of Section 35, Bloom Tp.; Upper Mercer ore on land of Smith Hayward. Mr. W. Stout
60. Vinton County: Elk Tp.; Upper Mercer black shale three miles south of McArthur. Geological Museum of The Ohio State University
61. Perry County: Section 30, Coal Tp.; Upper Mercer (or McArthur ?) limestone from shaft of Straitsville Impervious Brick Co., New Straitsville. Mr. W. Stout
62. Perry County: eastern part of Section 3, Clayton Tp.; Upper Mercer flint in ravine near road. Mr. W. Stout
63. Perry County: northern part of Section 10, Reading Tp.; Upper Mercer limestone in roadbed about one-fourth mile east of north end of Baltimore & Ohio Railroad cut, at Somerset. Mr. Eber Hyde
64. Muskingum County: Section 32, Newton Tp.; Upper Mercer flint in bed of diagonal road, one and one-half miles northwest of Roseville. Mr. W. Stout
65. Muskingum County: Section 8, Hopewell Tp.; Upper Mercer flint in bed of Flint Ridge road, one mile northwest of Poverty Run School.
66. Muskingum County: northeastern part of Hopewell Tp.; Upper Mercer flint in roadbed, one-fourth mile northwest of Sodon School.
38. Muskingum County: Washington Tp.; Upper Mercer flint in ravine on east side of the Muskingum River opposite Ellis. (Fossils from Lower Mercer member also collected here.)
39. Muskingum County: Washington Tp.; Upper Mercer flint in ravine on east side of Muskingum River, one mile north of Ellis. (Fossils from Lower Mercer member also collected here.)

40. Muskingum County: Washington Tp.; pieces of Upper Mercer flint on roadside fallen from place in walls of small ravine, on east side of Muskingum River opposite Rock Cut. (Fossils from Lower Mercer member also collected here.)
67. Muskingum County: Muskingum Tp.; Upper Mercer flint in roadbed, one mile north of Sandy Ridge School.
28. Muskingum County: Muskingum Tp.; Upper Mercer flint along Wheeling & Lake Erie Railroad cut, just north of Rock Cut. (Fossils from Boggs and Lower Mercer members also collected here.)
21. Muskingum County: Madison Tp.; Upper Mercer flint near top of east bank of the Muskingum River, north of Symmes Ford. (Fossils from Lowellville limestone also collected in vicinity of Symmes Ford.)
29. Muskingum County: Madison Tp.; Upper Mercer flint from bed of Symmes Creek, east of crossroads. (Fossils from Boggs and Lower Mercer members also collected along Symmes Creek.)
68. Muskingum County: Madison Tp.; Upper Mercer flint in bed of small tributary of North Branch of Symmes Creek, one mile north of crossroads.
43. Muskingum County: southeastern part of Cass Tp.; Upper Mercer flint from roadbed on land of J. F. Shaw, three miles southeast of Frazeysburg. (Fossils from Lower Mercer member also collected.)
69. Muskingum County: southeastern part of Cass Tp.; Upper Mercer flint in small ravine on southwest side of road, one-half mile south of Locality 43.
70. Coshocton County: southern part of Jefferson Tp.; Upper Mercer limestone and flint in roadbed and at mouth of Lee Moore coal mine just north of road, one mile east of Mohawk village.
71. Coshocton County: southern part of Jefferson Tp.; Upper Mercer flint in roadbed, two miles southeast of Mohawk village.
72. Coshocton County: southern part of Jefferson Tp.; Upper Mercer limestone on Wheeler farm, along slope of ridge east of north-and-south road, one mile north of Locality 70.
73. Holmes County: northeastern part of Section 33, Salt Creek Tp.; Upper Mercer limestone, one mile south of county line. Mr. G. W. Conrey
74. Stark County: central part of Section 34, Canton Tp.; Upper Mercer limestone in valley of Nimishillen Creek, just south of North Industry. Mr. R. E. Lamborn
75. Mahoning County: northern part of Section 2, Smith Tp.; Upper Mercer limestone, one mile northwest of North Benton. Mr. R. E. Lamborn
53. Mahoning County: Berlin Tp.; Upper Mercer limestone in bed of Little Mill Creek, two and one-half miles northeast of North Benton and one-fourth mile west of junction of Turkeybroth Creek with Little Mill Creek. (Fossils from Lower Mercer member also collected here.) Mr. R. E. Lamborn
76. Mahoning County: eastern part of Canfield Tp.; Upper Mercer limestone from Indian Run, one and one-fourth miles southeast of Wind School. (Possibly Putnam Hill limestone.) Mr. R. E. Lamborn
77. Columbiana County: Section 12, St. Clair Tp.; Upper Mercer limestone from Little Beaver Creek, one-fourth mile south of Bieler Run. Mr. C. F. Moses
78. Columbiana County: Section 12, St. Clair Tp.; Upper Mercer limestone from Bieler Run. Mr. C. F. Moses

McARTHUR MEMBER

79. Scioto County: eastern part of Section 21, Vernon Tp.; soft clay shale on McArthur horizon from Cadot Hill. Mr. W. Stout
80. Jackson County: northern part of Section 29, Jefferson Tp.; McArthur limestone from Monroe Furnace. Mr. W. Stout

81. Jackson County: Milton Tp.; black shales forming roof of Tionesta coal, just south of Glenroy. Mr. W. Stout
82. Jackson County: eastern part of Section 3, Coal Tp.; shaly McArthur limestone at mouth of old Tom Corwin mine. Mr. W. Stout
83. Vinton County: northwestern part of Section 34, Richland Tp.; McArthur limestone on Jackman Ridge just south of Jackman School. Mr. W. Stout
84. Vinton County: northern part of Section 17, Elk Tp.; McArthur limestone at mouth and forming roof of Moore mine, two miles northwest of McArthur. (Type locality for McArthur limestone.)
85. Vinton County: northwestern part of Section 32, Madison Tp.; shaly McArthur limestone at mouth of old coal mine, two miles west of Prattsville.
86. Hocking County: Section 36, Green Tp.; McArthur limestone from mine of Logan Clay Products Co., one mile east of Logan. Mr. W. Stout

BLACK FLINT MEMBER

87. Jackson County: western part of Section 22, Washington Tp.; Black Flint in pasture east of north-and-south road, one-fourth mile south of Town House.
88. Jackson County: central part of Section 3, Coal Tp.; Black Flint near top of hill west of northeast-southwest road, one mile northeast of Davisville. Mr. W. Stout
89. Jackson County: Coal Tp.; shale 30 feet above Tionesta coal (Black Flint horizon), just west of Wellston. Mr. W. Stout
90. Vinton County: northwestern part of Section 24, Richland Tp.; Black Flint in roadbed north of Mt. Zion School. Mr. W. Stout
91. Vinton County: southeastern part of Section 11, Elk Tp.; impure limestone on Black Flint horizon along northeast-southwest road. Mr. W. Stout
92. Vinton County: southeastern part of Section 14, Elk Tp.; impure limestone on Black Flint horizon from Ogan farm, four miles northeast of McArthur. Mr. W. Stout
93. Vinton County: southwestern part of Section 23, Elk Tp.; Black Flint from Spook Hollow, one and one-half miles east of McArthur. Mr. W. Stout

PART II

POTTSVILLE FAUNA AND DESCRIPTION OF SPECIES[1]

PLANT KINGDOM

Plant remains

Remarks.—Plant remains are present in the fossiliferous horizons of the Pottsville formation which are described in this bulletin, although they are by no means common. A considerable variety of forms are represented, but they are, for the most part, too poorly preserved for identification. The scope of the present work does not include a study of the Pottsville flora.

Horizon and locality.—Present at various localities in the Anthony, Boggs, Lower Mercer, and Upper Mercer members, r.

ANIMAL KINGDOM

PHYLUM PROTOZOA

Class Rhizopoda

ORDER FORAMINIFERA

Foraminifera of the genus *Fusulina* occur in the Pottsville rocks of Ohio although they are not present in the extreme abundance which characterizes their presence in the higher formations of the Pennsylvanian system of this State. *Fusulina secalica* (Say) is found in considerable numbers in the flinty phases of the Upper Mercer member where it forms the most characteristic fossil of the horizon. It is found as low as the Lower Mercer limestone and extends throughout the middle and upper parts of the formation, although with the exception of the Upper Mercer member, it is of rare occurrence. Other Foraminifera were observed in the Upper Mercer flint, but they are for the most part fragmentary and poorly preserved. *Textularia* and *Nodosaria* have been identified with comparative certainty, and judging from the fragmentary material at hand, other forms are in all probability present.

[1]In the descriptions of Pottsville species the following symbols are used: aa, very abundant; a, abundant; c, common; r, rare.

Genus Textularia Defrance

Textularia sp.

Pl. VI, figs. 1, 2

Description.—Test elongate, tapering, in widest portion the width equal to about two-thirds the length, regular in outline. Segments numerous, broad, much compressed longitudinally, convex on outer edge, nine to eleven present on the specimens examined, last segment apparently smaller than those immediately preceding; sutures deeply impressed.

Dimensions.—Length 1.5 mm.; width 1 mm.

Remarks.—The form described above is associated with *Fusulina secalica* (Say) and *Girtyina ventricosa* (Meek and Hayden) in the Upper Mercer flint of Perry, Muskingum, and Coshocton counties. The remains, however, are universally very fragmentary and are seen only as longitudinal sections at various angles when the flint is examined under the microscope. Probably several species of *Textularia* are present, but the poorly preserved material renders specific determination impossible. Representatives of the genus are rare.

The forms here referred to resemble *T. eximia* d'Eichwald from the Carboniferous rocks of England, Scotland, and Russia, and may possibly represent a variety of that species. The outline of *T. eximia* is more irregular and the width in proportion to the height is somewhat less. The apparently smaller size of the last segment of the Ohio forms also presents a notable difference, but this character may be due to a large extent to the position of the sections. The general form more closely resembles that of *T. gibbosa* d'Orbigny, but the segments are less gibbous and more numerous than in the latter species.

Horizon and locality.—Upper Mercer flint: Muskingum County, Localities 28, 21, 43, r; Coshocton County, Locality 72, r.

Genus Nodosaria Lamarck

Nodosaria sp.

Remarks.—Fragments of Protozoa with straight, slightly tapering, rod-like outline which have the segments uniserially arranged have been referred to the genus *Nodosaria*. These forms are very minute, measuring less than one millimeter in length. Several species may be present, although on account of the imperfect condition of the material at hand no attempt at identification beyond a generic determination was made.

Horizon and locality.—Upper Mercer flint: Muskingum County, Localities 28, 29, r.

Genus Fusulina Fischer

Fusulina secalica (Say)

Pl. VI, fig. 3

1837 *Miolites secalicus.* Say, Long's Exped., p. 151 (Footnote).
1837 *Fusulina cylindrica.* Fischer, Oryct. du Gouv. Mascou, p. 126, Pl. 18, Figs. 1–5.
1900 *Fusulina secalica.* Beede, Geol. Surv. Kansas, Vol. IV, p. 10, Pl. 1, Fig. 1.
Coal Measures: Kansas.

Remarks.—This wide-spread Pennsylvanian Foraminifera is common in the flinty phase of the Upper Mercer member of east-central Ohio. Although entire specimens are sometimes obtained, the form is seen most often on freshly chipped fragments of flint as sections broken at various angles. These sections show remarkably well the coiled, chambered condition of the interior. The form ranges from the Lower Mercer limestone in the middle part of the Pottsville formation to the Black Flint member at the top, where it is present in the flinty phase. In both the Lower Mercer and Black Flint members, however, it is of rare occurrence.

Dimensions.—A specimen of average size measures: length 3.5 mm., width 1.2 mm.

Horizon and locality.—Lower Mercer limestone: Muskingum County, Localities 27, 28, 44, r; Licking County, Locality 48, r. Of wide distribution in the Upper Mercer flint of east-central Ohio, c. Black Flint member: Jackson County, Locality 88, c; Vinton County, Locality 90, r.

Girtyina ventricosa (Meek and Hayden)

Pl. VI, fig. 4

1858 *Fusulina cylindrica var. ventricosa.* Meek and Hayden, Proc. Acad. Nat. Sci. Phil., p. 261.
Carboniferous: Juniata and Manhattan, Kansas.
1900 *Fusulina secalica var. ventricosa.* Beede, Geol. Surv. Kansas, Vol. VI, p. 10. (See notes on *Fusulina secalica* [Say]).

Remarks.—*Girtyina ventricosa* is found associated with *Fusulina secalica* (Say) in the flinty phase of the Upper Mercer member. Longitudinal and transverse sections show excellently on freshly broken fragments of flint. The short, extremely convex external form presents a striking contrast to the more slender outline of *F. secalica.* All the specimens examined are unusually small.

Dimensions.—Length 3 mm., width about 2 mm.

Horizon and locality.—Widely distributed throughout the flinty phase of the Upper Mercer member in east-central Ohio.

PHYLUM COELENTERATA

Class Anthozoa

Genus Lophophyllum Milne-Edwards and Haime

Lophophyllum profundum (Milne-Edwards and Haime)

Pl. VI, figs. 5, 6

1851 *Cyathaxonia profunda.* Milne-Edwards and Haime, Monog. des Polyp. Foss., p. 323.
Carboniferous: Flint Ridge, Ohio.

Description.—*Lophophyllum profundum* is the only coral found among the collections of Pottsville fauna of this State. It is common and widely distributed in the Pottsville formation above and including the Lower Mercer limestone and extends upward in its stratigraphic range to the top of the Conemaugh formation. Specimens are always small in size, an individual of average size from the Lower Mercer limestone measuring: length 16 mm.; width at mouth of calyx 10.5 mm.

Horizon and locality.—Widely distributed throughout the Lower Mercer, McArthur, and Black Flint members, c. Upper Mercer member: Perry County, Locality 62, r; Coshocton County, Locality 71, c; Mahoning County, Locality 75, r.

PHYLUM ECHINODERMATA

Class Crinoidea

Genus Eupachycrinus Meek and Worthen

Eupachycrinus mooresi (Whitfield)

Pl. VI, figs. 7, 8

1882 *Zeacrinus mooresi.* Whitfield, Ann. N. Y. Acad. Sci., Vol. 2, p. 227.
Coal Measures: Carbon Hill, Hocking Co., Ohio.
1895 *Zeacrinus mooresi.* Whitfield, Geol. Surv. Ohio, Vol. VII, p. 483, Pl. 11, Figs. 6–10.
Coal Measures: Carbon Hill, Hocking Co., Ohio.

Description.—Spines of a crinoid closely resembling those described by Whitfield on the second radial plates of *Zeacrinus mooresi* are not uncommon in the Boggs and Lower Mercer members. Whitfield's description of these spines, which he obtained from Carbon Hill, Hocking County, is quoted below:[1]

[1]Whitfield, R. T., Geol. Surv. Ohio, Vol. VII, p. 483, 1895.

"The second radial plates present the strong specific features of the species, and are large and spine-bearing, as in *Zeacrinus mucrospinus* McChesney. The spines are long, much thickened, and bulbous in the lower part, presenting in this respect a strong contrast with those of that species. The cicatrix for the attachment of the arm plates is very large, showing that the plates above were of large size.

"The species has been quite abundant, as the spines are found in great numbers, and vary considerably in size, according to the width of the first radial plates upon which they have rested. But all are thickened and bulbous, and many of them are more than an inch in length. They are seldom found attached to the calyx, but are scattered through the shale in the bed where found."

Remarks.—At no locality in the Pottsville formation from which collections were made for the present paper, do these spines occur as abundantly as they are found at the Carbon Hill locality.[1] The close resemblance of the spines in question to those described above, combined with stratigraphic and geographic evidence, points to identification with the Carbon Hill species, although with the exception of a few fragments of plates no other portions of the calyx have been discovered. The figured specimen of a calyx of *E. mooresi* from Carbon Hill is included to show the attachment of the second radial plates and spines to the first radial plates.

Horizon and locality.—Boggs limestone: Muskingum County, Locality 27, c; of general distribution in the Lower Mercer limestone, c.

Crinoid Segments

Pl. VI, figs. 9-13

Description.—That crinoids were very abundant during the deposition of Pottsville strata is evinced by the abundance of stems which characterize the marine limestones. In the Lower Mercer and in the limestone phase of the Upper Mercer members they are particularly abundant and characteristic. They vary in diameter from only a few millimeters to over one-half inch. The specimens figured form the most abundant types.

Horizon and locality.—Widely distributed in the marine limestones of the Pottsville formation, aa.

[1]The exact stratigraphic position of the horizon from which the Carbon Hill fauna described by Whitfield came, has not been determined definitely, although it is known to be either upper Pottsville (probably McArthur) or basal Allegheny

Class Echinoidea

Genus Archaeocidaris McCoy

Archaeocidaris spines

Pl. VI, figs. 14, 15

Description.—Spines of an unknown species of *Archaeocidaris* are present in the Lower and Upper Mercer members, but are particularly common in the Lower Mercer limestone of Scioto County. All the specimens examined are imperfect, the longest fragment measuring about 6 cm. and having a diameter of 4.5 mm. The spines are very slender and, judging from their very gradual taper, must have been at least from 12 to 15 cm. in length. The surface is ornamented by four vertical rows of stout spinules about 2 mm. in length and about 4 to 6 mm. apart in a vertical direction; the spinules of the vertical rows alternate irregularly with each other. The basal ring and other characters of the spine are unknown.

Horizon and locality.—Lower Mercer limestone: Scioto County, Vernon Township, Locality 31, c; Perry County, Somerset, Locality 35, c. Upper Mercer member: Scioto County, Bloom Township, Locality 59, r.

PHYLUM VERMES

Class Chaetopoda

Genus Spirorbis Daudin

Spirorbis sp.

Description.—Several specimens belonging to this genus, measuring about .5 mm. in diameter, have been found adhering to other shells in the Black Flint member. Specific determination, however, is impossible from the imperfect condition of the material.

Horizon and locality.—Black Flint member: Vinton County, Localities 91, 92, r.

PHYLUM MOLLUSCOIDEA

Class Bryozoa

Genus Bascomella n. gen.

Description.—A parasitic, boring bryozoan which has been assigned to the family *Rhopalonariidae* of the Order *Ctenostomata.* Zoarium

creeping, branching, partially or entirely embedded in the host; composed, as far as is known, of relatively large ovoid, pear-shaped, or fusiform bodies or internodes, without regular arrangement, connected by minute, branching tubular filaments or stolens. Internodes marked by a few rather large pores scattered irregularly over the surface. Zooecia unknown, but probably deciduous and developed by budding from the surface pores as in the genus Rhopalonaria.[1]

In its generic relationships this genus apparently lies midway between *Rhopalonaria* and *Allonema* of the Family *Vinellidae*, and is characterized by its ability to excavate and disintegrate the host, by the large size and irregular arrangement of the excavations which have been filled with foreign material so that they appear on the inside of the host as ovate bodies. It differs from the genus *Rhopalonaria* in the larger size, ovate shape, and irregular arrangement of the internodes, which in the latter genus have a pinnate arrangement. It can be distinguished from both *Allonema* and *Ascodictyon* by its ability to excavate the host. It resembles *Allonema* in the ovate form and irregular arrangement of the internodes but lacks the finely punctate surface of that genus; it may also be distinguished by the minute filament connecting the internodes. *Ascodictyon* may be distinguished likewise not only in the minute surface punctae on the vesicles, but also in the stellate or more regular arrangement of the vesicles.

Genotype.—Bascomella gigantea n. sp. Found in the McArthur limestone, of the upper Pottsville formation of Ohio. This genus is named in honor of Dr. Florence Bascom, Professor of Geology at Bryn Mawr College.

Bascomella gigantea n. sp.

Pl. VI. figs. 18-20

Description.—Zoarium creeping, partially, or as is generally the case, entirely embedded in the host, sometimes covering the entire inner surface of the shell on which it is parasitic. Ovoid bodies typically pear-shaped but often fusiform or irregular in outline; arrangement irregular; narrow pointed end depressed, broad blunt end constricted near base; formed by the filling of the excavation with sediment; an ovoid body of average size measuring: length 2 mm., width .8 mm., height 1 mm.; surface apparently pierced by rather large, distant, irregularly arranged pores. Minute, tubular filaments or stolens connected with any portion of the ovoid bodies, but generally with the base; one or several growing from each excavation; branching frequently and forming an irregular network.

Remarks.—This species of boring bryozoan is extremely abundant in the McArthur limestone at Monroe Furnace, Jackson County, but

[1]Ulrich, E. O., and Bassler, R. S., Smithsonian Miscell. Coll., Vol. 45, p. 267, 1904.

has not yet been found elsewhere. The ovoid bodies are seen on the inside of external molds of brachiopods and pelecypods, but in especial abundance on the large *Spirifer boonensis,* which is the most characteristic fossil from the locality. The minute filaments associated and connected with the ovoid bodies are seen entirely within the external impression or on the external cast when only partially embedded.

Horizon and locality.—McArthur limestone: Jackson County, Monroe Furnace, Locality 80, aa.

Genus Tabulipora Young

Tabulipora ohioensis (Foerste)

1887 *Stenopora ohioensis.* Foerste, Bull. Den. Univ., Vol. 2, p. 85, Pl. 7, Figs. 12 a–e.
Coal Measures: Flint Ridge, Ohio.

Remarks.—*Tabulipora ohioensis* occurs in the Boggs member, where it is represented in the collections studied by only a few specimens, and also in the Lower Mercer of Perry, Muskingum, and Licking counties where it is more common and characteristic.

Horizon and locality.—Boggs limestone: Muskingum County, Locality 26, r. Lower Mercer limestone: Perry County, Locality 35, r; Muskingum County, Locality 45, c; Licking County, Locality 47, c.

Genus Chainodictyon Foerste

Chainodictyon laxum Foerste

1887 *Chainodictyon laxum.* Foerste, Bull. Den. Univ., Vol. 2, pp. 81, 87, Pl. 7, Figs. 8a–c.
Coal Measures: Flint Ridge, Ohio; Seville, Illinois.
1888 *Chainodictyon laxum.* Foerste, Bull. Den. Univ., Vol. 3, p. 135.

Foerste's description.—"Meshes elongate, rhomboid, elliptical, oval, ovate, and obovate in the same zoarium, typically elliptical, about 2.5 mm. long and 1.3 mm. wide. Branches narrow, about .3 to .38 mm. wide; the cells are arranged in diagonal rows; longitudinally about 5 cells may be measured along the sides of the branches in a length of 2 mm. The cells arise near the nonporiferous side, are quite elongate, and reach the surface at a very oblique angle. Longitudinal arrangement of cells is incidental rather than typical and often obscured, whereas the oblique series remain distinct."

Remarks.—This rare species is represented in the collections studied by about a half-dozen specimens from the Lower Mercer limestone of Muskingum and Licking counties which for the most part are a little smaller than those which were regarded typical by Foerste.

Horizon and locality.—Lower Mercer limestone: Muskingum County, Localities 43, 45, r; Licking County, Locality 48, r.

Fenestellidae undetermined

Remarks.—Bryozoans belonging to the family Fenestellidae are present in the middle and upper Pottsville formation, but are too poorly preserved even for generic identification.

Horizon and locality.—Lower Mercer limestone: Perry County, Locality 35, c. Upper Mercer member: Perry County, Locality 63, c; Coshocton County: Locality 70, c. McArthur member: Vinton County, Locality 84, c; Hocking County, Locality 86, c. Widely distributed throughout the Black Flint, c.

Genus Fenestella Lonsdale

Fenestella delicatula Ulrich

1890 *Fenestella delicatula.* Ulrich, Geol. Surv. Ill., Vol. 8, p. 549, Pl. 52, Fig. 2.
Base of Coal Measures: Seville, Illinois.

Remarks.—A few specimens in very close agreement with Ulrich's species, *Fenestella delicatula*, were obtained from the Black Flint member at a single locality in Vinton County. The state of preservation is somewhat imperfect, but as nearly as can be observed no important differences exist between the two forms.

Horizon and locality.—Black Flint: Vinton County, Locality 92, r.

Fenestella limbata Foerste

1887 *Fenestella limbatus.* Foerste, Bull. Den. Univ., Vol. 2, pp. 83, 87, Pl. 7, Figs. 10 a-d.
Coal Measures: Flint Ridge and Bald Hill, Ohio.

Description.—This species is common in the Lower and Upper Mercer limestones, especially of Muskingum and Licking counties, but has not been obtained from any of the other members of the Pottsville formation. The size varies within wide limits, and the species includes fine, delicate forms as well as those which are considerably coarser. It is characterized by small, rather closely arranged nodes on the median keel, and by unusually large, regularly arranged pores on either side, so situated that one generally occurs opposite each dissepiment, and another half-way between each dissepiment. On account of their large size, these pores project laterally into the fenestrule, thus imparting to it a slightly sereated outline. The length of the fenestrule is about one and one-half times the width. "Branches from 10 to 13 in a width of 5 mm.; dissepiments 9.3 to 13 in the same length."

Horizon and locality.—Lower Mercer limestone: Perry County, Locality 35, c; Muskingum County, Localities 43, 45, c; Licking County, Localities 46, Flint Ridge, 47, 48, 49, c; Stark County, Locality 52, c. Upper Mercer member: Muskingum County, Localities 21, 38, 43, 67, 68, c; Coshocton County, Locality 70, c.

Fenestella remota Foerste

1887 *Fenestella limbatus var. remotus.* Foerste, Bull. Den. Univ., Vol. 2, p. 84.
Coal Measures: Flint Ridge and Bald Hill, Ohio.
1887 *Fenestella remota.* Foerste, Bull. Den. Univ., Vol. 2, p. 87, Pl. 7, Fig. 5.

Foerste's description.—"Four cells to each fenestrule, a comparatively broad median keel occupied by a closely arranged series of nodes. The reverse is occupied by distinct longitudinal striae." The species closely resembles *F. limbata*, but is distinguished by the greater distance between the dissepiments and by the greater number of pores opposite each fenestrule.

Horizon and locality.—Lower Mercer limestone: Muskingum County, Locality 45, c; Licking County, Locality 47, c. Black Flint: Jackson County, Locality 87, r.

Fenestella shumardi Prout?

1858 *Fenestella shumardi.* Prout, Trans. St. Louis Acad. Sci., Vol. 1, p. 232.
Carboniferous Ls.: Organ Mts., New Mexico.
1872 *Fenestella shumardi?* Meek, U. S. Geol. Surv. Nebr., p. 153, Pl. 7, Figs. 3 a–c.
Upper Coal Measures: Nebraska City, Nebraska.
Lower Coal Measures: Ohio.

Remarks.—A very small, delicate species of Fenestella is common in the marine limestones of the Pottsville formation which has been referred with some doubt to *Fenestella shumardi*, a form originally described from a far distant locality. However, this form agrees very closely with Meek's interpretation of Prout's species, which is also reported by him to be present in the Lower Coal Measures of Ohio. If Meek's form is really identical with *F. shumardi* there seems little doubt that the Ohio specimens likewise belong to that species.

Horizon and locality.—Lowellville limestone: Muskingum County, Locality 20, r. Boggs limestone: Muskingum County, Localities 27 (r), 28 (c), 29 (r). Lower Mercer limestone: Scioto County, Locality 31, r; Muskingum County, Localities 36 (r), 38 (r), 27 (c), 28 (c), 29 (r); Licking County, Locality 47, r; Mahoning County, Locality 54, r. Upper Mercer member: Perry County, Locality 63, r; Holmes County, Locality 73, r. McArthur member: Jackson County, Locality 82, r; Vinton County, Locality 84, c; Hocking County, Locality 86, c. Generally distributed in the Black Flint member, c.

Fenestella venusta Mather?

1915 *Fenestella venusta.* Mather, Bull. Den. Univ., Vol. XVIII, p. 114, Pl. IV, Figs. 9–10a.
Morrow Group: Arkansas and Oklahoma.

Remarks.—A species of *Fenestella* very closely related to *F. venusta*, is common in the Black Flint member. Unfortunately all the specimens observed were too poorly preserved to be identified with confidence.

Horizon and locality.—Black Flint member: Jackson County, Locality 87, c; Vinton County, Localities 91, 92, c.

Fenestella, several species

Remarks.—Specimens belonging to the genus *Fenestella*, which are too poorly preserved to be identified specifically, were found in the Lower and Upper Mercer members at the localities listed below. Probably several species are represented.

Horizon and locality.—Lower Mercer limestone: Scioto County, Locality 31, c; Jackson County, Locality 32, r. Upper Mercer member: Muskingum County, Locality 68, r.

Genus Polypora McCoy

Polypora fastuosa Foerste

1887 *Polypora fastuosa.* Foerste, Bull. Den. Univ., Vol. 2, p. 82, Pl. 7, Figs. 9 a–d.
Coal Measures: Flint Ridge and Bald Knob, Ohio.

Remarks.—Specimens agreeing with the form described by Foerste as *Polypora fastuosa* are common in the Lower Mercer limestone of Muskingum and Licking counties and occur less abundantly in the McArthur member. Considerable variation exists in the size of individuals, and Foerste suggests that two distinct species, differing principally in size, may be included in the term; however, as the material at hand is for the most part rather poor, a subdivision is at present unjustifiable.

Horizon and locality.—Lower Mercer limestone: Perry County, Locality 35, c; Muskingum County, Localities 43, 45, c; Licking County, Localities 46, Flint Ridge, 47, 48, 49, c. McArthur limestone: Hocking County, Locality 86, r.

Polypora, several species

Remarks.—A few specimens of bryozoans belonging to the genus *Polypora* were obtained from the Lower Mercer limestone, but no

specific identification could be made owing to the poorly preserved condition of the material. Probably several species are present.

Horizon and locality.—Lower Mercer member: Muskingum County, Localities 27, 28, r.

Genus Pinnatopora Vine

Pinnatopora whitii Foerste

1887 *Glauconome whitii.* Foerste, Bull. Den. Univ., Vol. 2, p. 78, Pl. 7, Figs. 4 a–c.
Coal Measures: Flint Ridge, Ohio.
1887 *Pinnatopora whitii.* Foerste, Bull. Den. Univ., Vol. 2, p. 87.

Remarks.—*Pinnatopora whitii* has been found only in the Lower Mercer limestone of Muskingum and Licking counties where it is of fairly common occurrence. The longest specimen obtained measures 13.5 mm. A number of excellently preserved individuals are among the collections studied which differ in no way from the description and figures of Foerste's species.

Horizon and locality.—Lower Mercer limestone: Muskingum County, Localities 29, 43, 45, r; Licking County, Localities 47, 48, c.

Pinnatopora sp.

Remarks.—A specimen belonging to the genus *Pinnatopora* was obtained from the Upper Mercer member and probably represents a different species than *P. whiii*. The state of preservation, however, is too poor to permit specific identification.

Horizon and locality.—Upper Mercer member: Coshocton County, Locality 70, r.

Genus Septopora Prout

Septopora biserialis (Swallow)

1858 *Synocladia virgulacea* ? Swallow, Trans. St. Louis Acad. Sci., Vol. 1, p. 179.
(Not *S. virgulacea* Phillips)
Lower Permian: Valley of the Cottonwood, Kansas.

Remarks.—*Septopora biserialis* is an abundant and widely distributed bryozoan in the Pottsville formation of this State. It appears in the Boggs limestone and continues throughout the middle and upper parts of the formation, but occurs most abundantly in the Lower Mercer and Black Flint members.

Horizon and locality.—Boggs limestone: Muskingum County, Locality 28, r. Widely distributed throughout the Lower Mercer, Upper Mercer, and Black Flint members, a.

Septopora biserialis var. gracilis (Meek)

1875 *Synocladia biserialis* (*gracilis*, suggested). Meek, Pal. Ohio, Vol. II, p. 326, Pl. 20, Figs. 5a, b.
Lower Coal Measures: Near Newark, Ohio.

1887 *Septopora biserialis var. gracilis.* Foerste, Bull. Den. Univ., Vol. 2, p. 80, Pl. 7, Figs. 7a–c.
Coal Measures: Flint Ridge, Ohio.

Description.—This variety of *Septopora biserialis* occurs throughout the middle and upper Pottsville formation of this State. It can be distinguished from typical *S. biserialis* by its more slender branches, by the more regular arrangement of the dimorphic cells on the non-poriferous side, one cell being located at the union of each dissepiment with the branches, and by the presence of a faintly developed median ridge on the non-poriferous side. As the representatives of the species are often found in a poorly preserved condition, it is not always possible to distinguish the variety *gracilis*, which is probably much more common in occurrence than is indicated in the list of localities below.

Horizon and locality.—Lower Mercer limestone: Scioto County, Locality 31, r; Muskingum County, Localities 27, 43, 45, c; Licking County, Localities 46, 48, 49, c; Mahoning County, Locality 53, r. Upper Mercer member: Muskingum County, Locality 68, r; Coshocton County, Locality 70, r. Black Flint member: Vinton County, Locality 91, r.

Genus Rhombopora Meek

Rhombopora lepidodendroidea Meek

1866 *Stenopora columnaris* (pars). Geinitz, Die Carb. und Dyas in Nebraska, p. 66. (Non Schloth, 1813)
Coal Measures: Wyoming and Nebraska.

1872 *Rhombopora lepidendroides.* Meek, U. S. Geol. Surv. Nebraska, p. 141, Pl. 7, Figs. 2a–f.
Upper Coal Measures: Wyoming, Nebraska, Kansas, Iowa, Missouri, Illinois.

Description.—This small, delicate, branching bryozoan with its wide geographic and stratigraphic range in the Pennsylvanian rocks of North America is common in the Pottsville formation of this State above and including the Boggs member. It occurs most abundantly, however, in the Lower Mercer and McArthur limestones. The diameter of the largest fragment studied is 2 mm., but the average width varies from 1 to 1.5 mm. Only one bifurcation was observed on any of the fragments examined, the longest of which measures 18 mm.

Horizon and locality.—Boggs limestone: Muskingum County,

Localities 27, 29, c. Widely distributed throughout the Lower Mercer, Upper Mercer, and McArthur members, c. Black Flint member, Jackson County, Locality 88, c.

Rhombopora multipora Foerste

1887 *Rhombopora multipora.* Foerste, Bull. Den. Univ. ,Vol. 2, p. 72, Pl. 7, Figs. 1a–c. Coal Measures: Flint Ridge, Ohio.
1887 *Rhombopora multipora.* Foerste, Bull. Den. Univ., Vol. 2, p. 78. Coal Measures: Seville, Illinois.

Description.—Several individuals of *Rhombopora multipora* were obtained from the Lower Mercer limestones of Muskingum and Licking counties, but the species has been found at no other horizon of the Pottsville formation. It resembles *R. lepidendroidea,* but differs in the larger size of the branches and the greater number of pores. Foerste points out the following distinguishing features, "The mature region of the cells appears more abruptly inclined to the immature region of the cells; the ridges between the cells are covered with smaller and more numerous granules, these are also present on the slopes of the vestibules, and are not arranged in such well defined rows as in the other species."

Horizon and locality.—Lower Mercer limestone: Muskingum County, Localities 43, 45, r; Licking County, Locality 49, r.

Genus Streblotrypa Ulrich

Streblotrypa merceri n. sp.

Pl. VI, figs. 16, 17

Description.—Zoarium consisting of very slender, dicotomously dividing stems, about .6 mm. in diameter. Zooecia apertures oval in outline, about .15 mm. long and .1 mm. wide; surrounded by a narrow area sloping abruptly down to the aperture; arranged in regular longitudinal rows, with those of successive rows alternating with each other; rows separated by prominent, rounded, longitudinal ridges which equal about one-half the width of the aperture; slopes of ridges forming the lateral portions of the area surrounding the apertures. Zooecial interspaces with about the same length as the apertures, occupied by the equally-sized mouths of four mesopores arranged in two rows. This number and arrangement of the pores is generally very uniform, although where a division of the stem occurs, and occasionally elsewhere, variations are found so that three to six mesopores may be present. Longitudinally about 13 zooecia apertures occupy the space of 5 mm.

Remarks.—This species resembles most closely the Mississippian form *Streblotrypa major* Ulrich from the Keokuk group of Kentucky,

Iowa, and Illinois, and also from the Cuyahoga shale of Ohio, but it can be distinguished from that species by its much smaller size and slender form, as well as by the more regular arrangement and more uniform number and size of the pores between the zooecia apertures, which are generally four and occur in two rows. In *S. major* these pores vary considerably in size and are usually four to six in number, but may range from three to twelve.

Horizon and locality.—Lower Mercer limestone: Licking County, Bald Knob, Locality 46, r.

Genus Cystodictya Ulrich

Cystodictya carbonaria (Meek)

1871 *Ptilodictya (Stictopora) carbonaria.* Meek, Proc. Nat. Sci. Phil., p. 160.
Lower Coal Measures: Newark, Ohio.

1875 *Ptilodictya (Stictopora) carbonaria.* Meek, Pal. Ohio, Vol. II, p. 328, Pl. 20, Figs. 3a, b.
Coal Measures: Newark, Ohio.

1887 *Cystodictya carbonaria.* Foerste, Bull. Den. Univ., Vol. 2, p. 74, Pl. 7, Figs. 2a–c.
Coal Measures: Bald Hill, Ohio.

Remarks.—*Cystodictya carbonaria* is one of the most characteristic and widely distributed bryozoans of the middle Pottsville formation. It is most common in the Lower Mercer member, especially in Muskingum and Licking counties along Flint Ridge; it is also present in the Upper Mercer member. As far as present knowledge goes, the species is confined to the Pottsville formation, as its presence in the higher formations of the Pennsylvanian system of this State has not been recorded.

Horizon and locality.—Lower Mercer limestone: Scioto County, Locality 31, c; Muskingum County, Localities 43, 45, c; Licking County, Localities 46, 47, 48, 49, c; Mahoning County, Locality 53, c. Upper Mercer member, widely distributed, c.

Genus Prismopora Hall

Prismopora sereata (Meek)

Pl. VI, fig. 21

1875 *Ptilodictya (Stictopora) sereata.* Meek, Pal. Ohio, Vol. II, p. 327, Pl. 20, Fig. 4.
Lower Coal Measures: Flint Ridge, Ohio.

1887 *Prismopora sereata.* Foerste, Bull. Den. Univ., Vol. 2, p. 75, Pl. 7, Figs. 6 a–c.
Coal Measures: Bald Hill and Flint Ridge, Ohio.

Description.—As stated by Foerste, "the general features of the species . . . . . consist in regularly scalloped margins; the serrations are

not rounded typically, but are more or less accurately truncated, sometimes even slightly concave, the serrations decrease in prominence with the size of the specimens; the indentations are bordered by crescentic non-poriferous spaces; these spaces are large and conspicuous in the large forms, decreasing to narrow, but distinct proportions in the smaller specimens." The zooecia are small and regular although not close in their arrangement.

The form is common and widely distributed in the middle and upper Pottsville formation, but is especially numerous and characteristic in the Lower and Upper Mercer and Black Flint members. It has not been recorded from any of the higher Pennsylvanian formations of this State.

Horizon and locality.—Lower Mercer member: widely distributed, c. Upper Mercer member: Muskingum County, Localities 29, 43, 68, c; Coshocton County, Locality 70, c. McArthur member: Hocking County, Locality 86, c. Black Flint member: widely distributed, c.

Class Brachiopoda

Genus Lingula Bruguiere

Lingula carbonaria Shumard

Pl. VII, figs. 1-3

1858 Lingula carbonaria. Shumard, Trans. St. Louis Acad. Sci., Vol. 1, p. 215.
Coal Measures: Clark County, Missouri.
1873 *Lingula mytiloides* ? Meek and Worthen, Geol. Surv. Ill., Vol. 5, p. 572, Pl. 25, Fig. 2.
Coal Measures: Illinois.

Description.—Shell varying in size from small to almost medium; subquadrangular-ovate in outline; ratio of length to width about 3 : 5. Beak minute, elevated; umbonal region and middle portion of valves moderately convex, becoming flattened toward the sides and front; posterior margin somewhat pointed, curving regularly into the sides, which are subparallel or slightly rounded; anterior margin sometimes slightly flattened, giving a quadrangular appearance to the shell. Outer covering usually preserved, thin, polished, and marked by fine concentric lines of growth which are crossed by fainter radiating striae, those extending from the beak to the anterior margin being most prominent.

Dimensions.—The great variation in the size of the species can be noted by the following measurements: a specimen of large size from the Upper Mercer member, length 12 mm., width 8 mm.; a large specimen from the Anthony coal horizon, length 11 mm., width 6.7 mm., a small

specimen from the same horizon, length 7 mm., width 4.5; an individual of average size from the Quakertown coal horizon, length 6.5 mm., width 4.2 mm.

Remarks.—*Lingula carbonaria* is an important fossil of the Pottsville formation in Ohio as it is found on nearly every horizon, and on some in the greatest profusion. In the bone shales associated with the Anthony coal it is extremely abundant and forms the characteristic fossil of that member. It also occurs in similar numbers in the shales at various localities on other horizons, among which are the Quakertown, Boggs, Upper Mercer, and McArthur. *L. umbonata* Cox differs in having the greatest width about one-third the length of the shell from the posterior margin, from which point the shell contracts toward the front. *L. kanawhensis* Price is a much larger and relatively broader form.

Horizon and locality.—Sharon ore horizon: Jackson County, Locality 6, c. Anthony coal horizon: Scioto County, Locality 7, aa. Quakertown coal horizon: Summit County, Locality 12, aa. Lowellville member: Muskingum County, Locality 20, aa. Boggs member: Scioto County, Locality 24, a; Vinton County, Locality 25, a. Lower Mercer member: Muskingum County, Locality 45, r; Licking County, Localities 47, 49, r. Upper Mercer member: Vinton County, Locality 60, aa; Muskingum County, Locality 68, r. McArthur member: Jackson County, Locality 81, a.

Lingula kanawhensis Price

1914 *Lingula kanawhensis.* Price, W. Va. Geol. Surv., Kanawha Co. Rept., p. 647, Pl. I, Figs. 5, 6.
Kanawha Series, Kanawha Black Flint, Queen Shoals, Kanawha County, West Virginia.

Price's description.—"Shell small, oval, subquadrate, thin; beak terminating at hinge line; from which the posterior margin slopes gently away on both sides, forming a broad, flat curve; posterior margins rounding rapidly but smoothly into the lateral margins, which are nearly straight, parallel, and rounding more gradually anteriorly than posteriorly; posterior margin broadly rounded, greatest width at center; beak and umbonal regions apparently only slightly elevated above the remainder of the shell; greatest convexity apparently in the center, from which the surface falls away gradually and evenly toward the anterior and antero-lateral margins; toward the postero-lateral margins it descends more abruptly and is continued as a triangular raised area narrowing toward the beak. Postero-lateral areas flat.

Exterior surface ornamented with numerous, fine, raised, concentric lines of alternating coarseness, the finer being the more numerous, crowded closely toward the posterior margin, more distantly

separated anteriorly, those upon the anterior fourth terminating at the lateral margins, the remainder continuing to the posterior margin; between these are extremely fine, closely-placed, concentric striae which may be seen only with the aid of a 12-power magnifier. Interior of the shell very imperfectly known, but not so highly ornamented as the exterior."

A single specimen from the Lower Mercer limestone is the only representative of this species found among the collections of Pottsville fauna studied for the present bulletin. Although by no means perfect, the shell presents the large size and subquadrate form which characterizes *L. kanawhensis*, so that the identification is made with a considerable degree of confidence.

Dimensions.—Length 19 + mm.; width 14 mm.; convexity cannot be determined on account of compression.

Horizon and locality.—Lower Mercer limestone: Perry County, Somerset, Locality 35, r.

Lingula sp.

Description.—Large *Lingulas* of uncertain affinities are common in the black bone shales of the Anthony coal horizon, at mine of the Buckeye Fire Brick & Clay Co., in Scioto County. Considerable variation exists in the form of the individuals, some being elongate and narrow enough to resemble *L. tighti* Herrick, while others are broader and suggest a possible identification with *L. kanawhensis* Price. The lateral margins are subparallel and the front, especially on the broader forms, flattened; the surface is apparently smooth. The material at hand, however, is too poor to permit satisfactory conclusions to be reached. Two distinct species may be present, or the differences in form may be due to compression, as the specimens are all much flattened, so that the original shape may possibly have been intermediate between the long slender form and the broader one. The size is much greater than that of *L. carbonaria* Shumard, and although common, it does not occur in the extreme profusion of the latter species. It is of interest to note that the form under discussion was found within one mile of the Wm. E. Dee mine where *L. carbonaria* characterized the Anthony shales.

Dimensions.—An elongated, narrow form measures: length 16 mm., width 9.5 mm.; a broad variety: length 13 mm., width 8.5 mm.

Horizon and locality.—Anthony shales: Scioto County, Scioto Furnace, Locality 8, a.

Genus Glossina Phillips

Glossina waverlyensis (Herrick)

Pl. VII, fig. 4

1875 *Lingula scotica*? Meek, Pal. Ohio, Vol. II, p. 276, Pl. 14, Fig. 9. (Non *L. scotica* Davidson)
Berea Grit: Berea, Ohio.
1887 *Lingula scotica* (var. ?). Herrick, Bull. Den. Univ., Vol. 2, p. 144, Pl. XIV, Fig. 15.
Coal Measures (Lower Mercer limestone): Flint Ridge, Ohio.
1888 *Lingula waverlyensis*. Herrick, Bull. Den. Univ., Vol. 4, p. 18, Pl. 3, Fig. 1.
Waverly Group: Newark, Ohio.

Description.—A form either identical with or closely related to *Glossina waverlyensis* is represented in the collections studied by the external molds of two individuals in a fair state of preservation, and by several less perfect specimens,—all from the Lower Mercer limestone of Muskingum and Licking counties. Assuming that Meek's restoration of *Lingula scotica*? from the Waverly group, and Herrick's drawings of *Lingula scotica* (var.) from the Lower Mercer limestone,—both of which are based upon very fragmentary remains—are accurate, our form differs only in being a little broader in comparison to the length of the shell. Typical *G. waverlyensis*, however, as later described by Herrick, has the length and width of the shell almost equal, so that the form under discussion seems to be intermediate between the former and latter species. From the scanty material at hand and from the lack of specimens of *G. waverlyensis* for comparison, it is not known whether these differences in the shape of the shell are constant or whether they can be accounted for by individual variation. For the present, therefore, it seems unjustifiable to separate our form as a distinct species, although after more material is examined, it is not unexpected that the Pennsylvanian form will prove distinct from the Mississippian. Miss Mark also figures *G. waverlyensis* and cites its occurrence in the Lower Mercer limestone at several localities along Flint Ridge.[1]

The shell is cuneate in form, the ratio of the length to the width being about 5:4, with the greatest width close to the anterior margin. The lateral margins are almost straight or very slightly convex, the anterior-lateral angles narrowly rounded, and the front broadly convex. The surface is marked by about thirty-six sharply elevated, closely arranged, concentric lirae, separated by broad flat interspaces which are likewise marked by extremely minute concentric lines. Where small portions of the shell still adhere to the molds the structure is apparently punctate, although this character can by no means be determined accurately.

[1]Mark, C. G., Bull. Den. Univ., Vol. 16, pp. 281, 284, 291, Pl. VIII, Fig. 1, 1911.

Dimensions.—The measurements of the two most perfect specimens obtained are respectively: length 22 + mm., 25 + mm.; maximum width 18 mm., 20 mm.

Remarks.—Another Pennsylvanian species which is closely related to the Pottsville form from Ohio was originally described by Meek as *Lingula scotica var. nebraskensis* and later by Girty as *Lingulipora nebraskensis,* which can be distinguished from our form by its much smaller size and fewer concentric lirae. *Lingulipora nebraskensis* as described by Girty is also a broader form with the length and width of the shell approximately equal; however this character may not be of specific importance inasmuch as Herrick's typical *G. waverlyensis* has similar proportions. Generically, our form is assigned to *Glossina* on account of its characteristic cuneate shape, rather than to *Lingulipora,* as the punctate structure which characterized the latter genus is by no means definitely established on our shell. It is of rare occurrence in rocks of Pennsylvanian age and has been found only from the Lower Mercer limestone.

Horizon and locality.—Lower Mercer limestone: Muskingum County, Locality 43, r; Licking County, Flint Ridge, Locality 49, r.

Genus Orbiculoidea d'Orbigny

Orbiculoidea capuliformis (McChesney)

1860 *Discina capuliforma.* McChesney, Desc. New Pal. Fossils, p. 72.
1861 *Discina capuliformis.* McChesney, Trans. Chicago Acad. Sci., Vol. 1, p. 23, Pl. 2, Fig. 20.
Coal Measures: Springfield, Illinois; 12 miles nw. of Springfield, Missouri.

Description.—Specimens of an *Orbiculoidea* are abundant in the black bone shale on the Sharon ore horizon and have been referred with some doubt to *Orbiculoidea capuliformis.* They show considerable variation in size, ranging from those 6 mm. in diameter to forms which are relatively large; the outline of both valves is circular. The beak of the dorsal valve is slightly posterior to the center; as the specimens are greatly flattened, it is possible only to make conjectures concerning the convexity, which seems to have been moderate. The ventral valve is also compressed, some specimens showing a slightly convex region surrounding the almost centrally located beak, the valve becoming concave toward the margins; a deep, broad slit extends from the beak posteriorly to a point about two-thirds the distance from the beak to the margin; slit widest in the central portion. The surface is marked by numerous fine, concentric striae which are regularly arranged; on a few forms very faint radiating markings are visible. Crushed specimens from the Harrison ore, similar to those just described, have been referred tentatively to the same species, while more

perfect forms from the Boggs member agree closely with McChesney's description and were identified with *O. capuliformis* with more confidence.

Dimensions.—The diameter of a small specimen is 7.5 mm.; of a large specimen 18 mm.

Remarks.—The doubtful forms from the Harrison and Sharon horizons may possibly be identical with *O. meekana* Whitfield, which is common and widely distributed in the higher Pottsville members of this State, but the material at hand is too crushed to show specific characters adequately. However, *O. meekana* has the beak of the dorsal valve eccentric, located about one-third of the length of the shell from the posterior margin, while that of the specimens under discussion is more central. *O. missouriensis* Shumard is in general a much smaller form, and also has the beak eccentric.

Horizon and locality.—Harrison ore: Jackson County, Locality 1, r. Sharon horizon: Jackson County, Locality 6, a. Boggs member: Muskingum County, Locality 26, r.

Orbiculoidea meekana (Whitfield)

1882 *Discina meekana.* Whitfield, Ann. N. Y. Acad. Sci., Vol 2, p. 228.
Coal Measures: Carbon Hill and Flint Ridge, Ohio; Illinois, Iowa.

Whitfield's description.—"Shell of moderate size or larger, circular to subcircular in outline. Dorsal valve convex, with an elevated beak which is directed backward and situated at about one-third of the length of the shell from the posterior margin. Posterior slope slightly concave just below the apex; anterior slope convex. Surface of shell, when preserved, marked by fine, even, but elevated and regular concentric lines, with flattened interspaces; about ten or eleven of the elevated lines occupy the space of an eighth of an inch on the middle of the shell, being finer within and coarser beyond that point. On the partially exfoliated shell fine vascular lines are perceptible. Ventral valve flat, discoidal, circular in outline, or perceptibly elongated in some cases; the apex a little more than one-third the length from the posterior margin. Foramen small, elongate-elliptical, narrow, not extending more than one-fourth of the distance from the apex toward the margin, and the depression somewhat further. Surface marked as in the other valve."

Dimensions.—A specimen of average size measures: diameter 18 mm., height 8.5 mm.

Remarks.—*Orbiculoidea meekana* is a common fossil in the middle and upper Pottsville formation above and including the Lower Mercer limestone. The shell belongs to the same general type as *O. missouriensis*, with which it is commonly considered a synonym, but a number

of points of difference can be noted which are believed by the writer to be of specific importance and which seems to render Whitfield's species a valid one. Both have the beak eccentric, situated about one-third the diameter of the shell from the posterior margin, but *O. meekana* is a much larger form, adult specimens being at least twice the size of those of the other species. The convexity of the dorsal valve is much greater in *O. meekana* than in *O. missouriensis*, being in the former at least one-half the diameter of the shell, and in the latter only one-third the diameter of the shell. The surface sculpture of *O. missouriensis* is arranged in parabolic curves, while that of *O. meekana* is circular. *O. convexa* is also a considerably smaller form described from a far-distant locality and from the Upper Pennsylvanian rocks, so that on geographic and stratigraphic grounds, the identification with the Ohio Pottsville form is unlikely. *O. meekana* has been found rather commonly at Carbon Hill[1] and in the collections from Flint Ridge used for this bulletin—the type localities of Whitfield.

Horizon and locality.—Widely distributed throughout the Lower Mercer and McArthur members, c. Upper Mercer member: Perry County, Locality 63, c. Black Flint: Jackson County, Locality 89, c; Vinton County, Localities 91, 92, c.

Orbiculoidea missouriensis (Shumard)

1858 *Discina missouriensis.* Shumard, Trans. St. Louis Acad. Sci., Vol. 1, p. 221.
Middle Coal Measures: Lexington and Charbonnier, Missouri.

Shumard's description.—"Shell circular; small; upper valve depressed, conic, sloping gradually from the beak to the front, and rather abruptly to the cardinal edge; beak rounded at tip, not curved, situated about one-third the diameter from the posterior edge, its elevation equal to about one-third the diameter of the shell. Surface marked by fine, close striae, which are arranged in concentric, nearly parabolic curves, the extremities of which are directed to the front. Lower valve circular, flat or slightly concave, having a large, deep, elliptical depression at the bottom of which is an elliptical aperture. The surface is marked with rather strong, concentric lines of increase. Length of average specimen, .33 (inches); height, .10."

Remarks.—Small *Orbiculoideas* from the Lowellville and Boggs members are entirely comparable with Shumard's species in respect to size, form, surface sculpture, and position of the beak, but differ in having the beak slightly less depressed. A few individuals from the Lower Mercer and McArthur members have also been referred to the same species, although they differ in having the beak of the dorsal valve depressed so that the greatest convexity occurs a little anterior

[1]For the stratigraphic position of Whitfield's fauna from Carbon Hill see footnote on p. 155.

to the beak. However, as pointed out by Girty, individuals vary considerably in regard to the elevation and position of the beak.[1]

Dimensions.—A specimen of average size measures: diameter 6.5 mm., convexity 2.5 mm.

Horizon and locality.—Lowellville member: Muskingum County, Locality 19, c. Boggs member: Muskingum County, Locality 27, r. Lower Mercer member: Licking County, Localities 46, 49, r. Upper Mercer member: Columbiana County, Locality 78, r. McArthur member: Vinton County, Locality 84, r.

Orbiculoidea stoutella n. sp.

Pl. VII, figs. 5-8

Description.—Shell large for specimens of this genus, subcircular in outline, gibbous, width slightly greater than length. Ventral valve unknown. Dorsal valve with widest portion a little anterior to middle of shell; anterior margin broadly rounded, posterior margin more narrowly rounded; greatest convexity about the middle of the valve; beak small, very inconspicuous and depressed, situated almost at the posterior margin of the shell; area posterior to the beak sloping to the margin with a concave outline. Epidermis of shell where preserved, thick, with surface marked by fine, closely arranged, irregular, concentric lines of growth.

On the specimens at hand, which are for the most part casts of the interior, not only are internal markings of especial interest retained, but they are preserved in an unusual manner. A well-marked rhombohedral or lozenge-shaped visceral area is present in the posterior portion, extending anteriorly about one-third or more of the length of the shell. The posterior margin of this area includes the beak and is sharply marked, but is less well defined laterally and anteriorly. The anterior edge of the lozenge-shaped area is bordered by two shallow rather faintly defined grooves,—one on either side of a low median septum,—which extend diagonally upward toward the lateral angles of the area. These grooves were formed by ridges on the inside of the shell, which doubtlessly served for the attachment of muscles, and apparently correspond to the anterior muscular ridge of *Lindstroemella aspidium* as figured by Hall and Clarke.[2] On either side of the median septum and just above the muscular ridge is a sharply defined, large, elevated (therefore deeply impressed on the interior of the shell) muscular scar; while closer to the septum and on either side of it, is an irregular, less well defined area of muscular attachments which probably represent the anterior adductor muscular scars. The writer has been unable to work out the function of the muscles which produced the

[1]Girty, G. H., U. S. Geol. Surv., Bull. 436, pp. 22-24, Pl. 1, Figs. 6-10, 1910.
[2]Hall and Clarke, Pal. New York, Vol. 8, Pt. 1, Pl. 4E, Figs. 25, 26, 1892.

more laterally placed pair of scars, although the possibility exists that they may represent the lateral scars shown in the figure of *Lindstroemella aspidium* cited above. The median septum is short, extending anteriorly one-half the length of the visceral area, but dying out a little posterior to it. From the two lateral angles a prominent, elevated (on the internal cast) vascular sinus extends obliquely forward to the anterior-lateral margins of the valve; the sides and front of the shell, as well as the region posterior to the beak, are marked by numerous fine, threadlike, radiating, vascular lines, the coarser ones of which branch from the pair of main sinuses and are subjected to frequent subdivisions.

Dimensions.—The figured specimen of the cotype, preserved as an internal cast upon which the internal structure is imprinted, was obtained from the Harrison ore and shows the following measurements: length 23 mm., width 24 mm., convexity of dorsal valve 5 mm. (much flattened). The measurements of another cotype, which shows the external characters of the shell and the normal convexity are: length 22.5 mm., width 23 mm., convexity of dorsal valve 9 mm. This species of *Orbiculoidea* was also found at one locality in the Sharon ore where it was the only fossil discovered. The size of the Sharon specimens is on the average considerably smaller than that of the forms from the Harrison ore. A large specimen from the Sharon ore measures: length 17 mm., width 18 mm., convexity of dorsal valve 4 mm. (somewhat compressed).

Remarks.—The distinctive features of this species are its circular form, its inconspicuous, depressed beak which overhangs the posterior margin, and its great convexity in the central part of the valve. It resembles *O. meekana* Whitfield in form, but the latter species has the beak elevated, forming the point of greatest convexity of the valve; it is also situated farther from the posterior margin,—about one-third the length of the shell. *O. munda* (Miller and Gurley) and *O. planidisca* Raymond are forms which have the beak almost marginal in position. The former is distinctly elliptical in form and has a much less depressed and inconspicuous beak than the species under consideration; the greatest convexity also occurs in the posterior third of the shell. *O. planidisca* is also elliptical, the width being only three-fourths as great as the length.

Horizon and locality.—Harrison ore: Jackson County, Locality 1, c. Sharon ore: Jackson County, Glen Nell mine, Locality 5, r. The specific name has been given in honor of Mr. Wilber Stout, of the Geological Survey of Ohio.

Orbiculoidea sp.

Description.—A single minute dorsal valve belonging to the genus *Orbiculoidea*, which measures 1.3 mm. in diameter, was obtained from

the Sand Block ore. The convexity is moderate, and the beak is situated about two-fifths the length of the valve from the posterior margin. Small portions of the external shell which remain show a surface sculpture of extremely fine concentric lines.

Horizon and locality.—Sand Block ore: Jackson County, Locality 57, r.

Genus Crania Retzius

Crania modesta White and St. John

1868 *Crania modesta.* White and St. John, Trans. Chicago Acad. Sci., Vol. 1, p. 118.
Upper Coal Measures: Fremont County, Iowa.
1882 *Crania carbonaria.* Whitfield, Ann. N. Y. Acad. Sci., Vol. 2, p. 229.
Coal Measures: Carbon Hill, Hocking County, Ohio.

Remarks.—A species of *Crania* is common in the middle and upper Pottsville of this State which probably represents the same form as that described by White and St. John, although judging from the description, the latter was free while the Ohio form is always found attached to other shells by the pedicle valve. It is likewise identical with Whitfield's species, *C. carbonaria*, described from Carbon Hill, Hocking County, a form which is always found attached to foreign objects.

Horizon and locality.—Lower Mercer limestone: Perry County, Locality 35, c; Muskingum County, Locality 36, c; Licking County, Flint Ridge, Locality 48, r. Upper Mercer limestone: Perry County, Locality 63, r; Coshocton County, Locality 72, c. McArthur limestone: Vinton County, Locality 84, c.

Genus Rhipidomella Oehlert

Rhipidomella pecosi (Marcou)

Pl. VII, fig. 13

1859 *Orthis pecosi.* Marcou, Geol. N. Am., p. 48, Pl. 6, Fig. 14.
Mountain limestone: Pecos Village, New Mexico.

Remarks.—This small shell with its almost circular form and its fine radiating lines is rather rare in rocks of Pottsville age in this State, but it is most frequent in occurrence in the Lower Mercer limestone. In the collections of Lowellville limestone it is represented only by a single ventral valve which measures: length 6.5 mm., width 7.7 mm., convexity 2 mm.

Horizon and locality.—Lowellville member: Muskingum County, Locality 19, r. Lower Mercer limestone: Scioto County, Locality 31,

r; Muskingum County, Locality 27, r; Licking County, Localities 46, 49, r; Stark County, Locality 52, r. McArthur limestone: Jackson County, Locality 80, r.

Genus Schizophoria King

Schizophoria altirostris (Mather)

1916 *Rhipidomella altirostris.* Mather, Bull. Den. Univ., Vol. XVIII, p. 143, Pl. VIII, Figs. 5–7c.
Hale formation: East Mountain, Fayetteville, Arkansas.

Description.—This species is represented in the collections studied by a single well-preserved individual. The shell is partially exfoliated, but where present shows a surface sculpture of extremely fine radiating lines. *Schizophoria resupinoides* is a very closely related, but much larger form; as pointed out by Price[1] the two species differ chiefly in size. In lieu of characters in the specimen studied which will definitely assign it to one or the other species, it is deemed best to refer it to *S. altirostris* on the basis of size, although it is slightly larger than average individuals of this species.

Dimensions.—Length 22 mm., width 26 mm., convexity 17 mm.

Horizon and locality.—Lower Mercer limestone: Licking County, Flint Ridge, Locality 48, r.

Schizophoria sp.

Remarks.—A few small brachiopods belonging to the genus *Schizophoria* are present in the Harrison ore, but are too poor for specific identification. They occur as internal molds on which faint traces of very fine surface sculpture are visible.

Horizon and locality.—Harrison ore: Jackson County, Locality 1, r.

Genus Derbya Waagen

Derbya crassa (Meek and Hayden)

Pl. VII, figs. 9, 10

1852 *Orthis umbraculum* ? Hall, Stansb. Exped. Gt. Salt Lake, p. 412, Pl. 3, Fig. 6. Carboniferous: Missouri River, above Fort Leavenworth.
1852 *Orthis umbraculum* ? Owen, Geol. Rep. Wis., Iowa, and Minn., Pl. 5, Fig. 11. Carboniferous: Missouri River, near mouth of Keg Creek, and at Council Bluffs.

[1]Price, W. A., Geol. Surv. W. Va., Raleigh, Wyoming, McDowell and Adjacent Co. Rept., pp. 694-698, 1916.

1852 *Orthis arachnoidea.* Roemer, Kreid. von Texas, p. 89, Taf. 1, Figs. 9a, b.
Carboniferous: San Saba Valley, Texas.
1858 *Orthisina crassa.* Meek and Hayden, Proc. Acad. Nat. Sci. Phil., p. 261.
Coal Measures: Leavenworth, Kansas.
1892 *Derbya crassa.* Hall and Clarke, Pal. N. Y., Vol. 8, Pt. 1, Pl. 10, Figs. 10, 11; Pl. 11A, Figs. 28–33; Pl. 11B, Figs. 23, 24; Pl. 20, Figs. 12, 13.
Upper Coal Measures: Near Kansas City, Missouri, and Winterset, Iowa.

Description.—Among the Pottsville fossils at hand are large collections of *Derbya crassa*, which is one of the most abundant, if not the most abundant, fossil of the entire formation. Although it has not been found below the Lowellville member, it is present in all of the marine limestones, and it occurs with very few exceptions at every locality from which fossils were collected. The size is somewhat variable, but the measurements of an individual of average size from the Lowellville black shale on Poverty Run are: length 20.5 mm., length of hinge line 20 mm., maximum width 23.5 mm. Dorsal valves, when uncrushed, are quite convex, while ventral valves are slightly convex in the umbonal region, becoming flattened toward the margins. The surface is characteristically covered with radiating lines, a coarse one alternating with one, two, or three finer ones; crossed by fine, closely arranged, concentric lines which give a crenulated appearance to the shell, and also by a few coarse lines of growth.

Horizon and locality.—Very abundant and widely distributed in the middle and upper Pottsville formation including the following members: Lowellville, Boggs, Lower Mercer limestone, Lower Mercer ore, Upper Mercer, McArthur, and Black Flint, aa.

Derbya robusta (Hall)

Pl. VII, fig. 11

1858 *Orthis robusta.* Hall, Geol. Iowa, Vol. I, Pt. 2, p. 713, Pl. 28, Figs. 5a–c.
Lower Coal Measures: St. Clair County, Illinois.

Description.—This large brachiopod is confined to the Lower Mercer horizon in its occurrence in the Pottsville formation of this State; it is by no means a common or characteristic fossil except at a single locality in Vernon Township, Scioto County. A considerable number of well-preserved specimens of both dorsal and ventral valves which agree rather closely with Hall's species, have been examined. However, our shell differs from Hall's figures in having the hinge line considerably shorter, so that its length is less than the greatest width of the shell below. As this group of brachiopods, however, is a very variable one, the difference in the length of the hinge line is not thought to be of specific value. In Vernon Township, Scioto County, it is associated with *Chonetes choteauensis, Aulacorhynchus millepunctatus*, and

Deltopecten scalaris, all of which are common and represent a peculiar local fauna, distinct from the Lower Mercer fauna found elsewhere in the State.

Dimensions.—The dimensions of a dorsal and a ventral valve of average size are:

	Dorsal	Ventral
Length	53 mm.	58 +mm.
Width	66 mm.	69 mm.
Length of hinge line	52 mm.	52 mm.
Convexity	13 mm. (Crushed)	8 mm. (Crushed)

Horizon and locality.—Lower Mercer limestone: Scioto County, Vernon Township, Locality 31, c; Licking County, Bald Knob, Locality 46, r.

Genus Chonetes Fischer

Chonetes choteauensis Mather

Pl. VII, figs. 16-18

1915 *Chonetes choteauensis*. Mather, Bull. Den. Univ., Vol. XVIII, p. 150, Pl. 8, Figs. 9–10a.
Morrow formation: Near Choteau and Fort Gibson, Oklahoma.

Description.—Shell small, subcircular to subquadrangular in outline; ratio of length to width about 3:5; hinge-line equal to or slightly greater than the greatest width of the shell below. Ventral valve moderately convex, the greatest convexity being anterior to the middle of the valve and on either side of the shallow mesial sinus; ears flattened; extremities of the hinge line on some specimens slightly mucronate, on others just equal to the greatest width anteriorly; lateral margins forming an angle of 90 degrees with the hinge line, subparallel to a point below the middle of the valve, broadly rounded into the front; front flattened or very slightly concave; beak inconspicuous, not extending beyond the cardinal margin; cardinal area narrow with upper margin marked by four or five long, slender oblique spines on either side of the beak; a poorly defined, shallow mesial sinus, or rather a mere flattening becoming evident in the posterior half of the valve, widening toward the front. Dorsal valve concave, following the curvature of the opposite valve. Surface marked by very fine, rounded, radiating striae, crossed by concentric lines of growth which are fairly prominent near the anterior and lateral margins; finely punctate with spine bases arranged at regular intervals along the striae imparting to them a nodose appearance when examined microscopically.

Dimensions.—A specimen of average size from the Lowellville

member measures: length 6.2 mm., width 10.2 mm., convexity 1 mm. The measurements of another specimen from the Boggs limestone where the form is on the average larger than those of the Lowellville limestone are: length 8.5 mm., width 12 mm., convexity 2 mm.

Remarks.—In the Boggs member this species occurs most commonly as internal casts on which the muscular impressions and other internal markings are often well preserved. The Ohio forms differ from the typical *C. choteauensis* from Oklahoma in being less convex, with the mesial sinus or flattening correspondingly less pronounced. These variations, however, may be attributed largely to compression. It is abundant in the Lowellville and Boggs members, and has been found at a few localities in the Lower Mercer limestone; in the first-mentioned member it constitutes the most characteristic fossil.

Horizon and locality.—Lowellville member: Muskingum County, Localities 19 (a), 20 (c), 21 (c); Mahoning County: Locality 22, a. Boggs limestone: Muskingum County, Localities 26 (a), 27 (a), 28 (c), 29 (c). Lower Mercer limestone: Scioto County, Locality 31, c; Jackson County, Locality 32, r.

Chonetes mesolobus Norwood and Pratten

Pl. VII, figs. 14, 15

1855 *Chonetes mesoloba.* Norwood and Pratten, Jour. Acad. Nat. Sci. Phil., 2nd Ser., Vol 3, p. 27, Pl. 2, Figs. 7a–c.
Coal Measures: Belleville, Illinois; Charboniere, Missouri.

Remarks.—This common and characteristic fossil of wide distribution throughout the Pennsylvanian rocks of the United States, is not found in the lower Pottsville formation of Ohio, but is common and universally distributed in the members including and above the Lower Mercer limestone. It is, however, particularly characteristic of the Lower Mercer horizon in which it occurs in extreme abundance. *Chonetes choteauensis* characterizes the Lowellville and Boggs members, while *C. mesolobus* has not been found on either horizon, with the exception of a few individuals from the Boggs limestone at a single locality. The former species seems to have disappeared almost entirely from the Pottsville sea by the advent of Lower Mercer time, for it has been discovered practically at only one locality in Scioto County. In its place *C. mesolobus* appears abundant and wide-spread, persisting throughout the remainder of the Pottsville and the Allegheny formations. This little shell is unusually interesting because it often retains color markings. The colors occur in rather broad, concentric bands which become narrower and more closely arranged toward the sides and front.

Horizon and locality.—Boggs member: Muskingum County, Locality 27, r. Widely distributed throughout the Lower Mercer, Upper Mercer, McArthur, and Black Flint members, aa.

Genus Aulacorhynchus Dittmar

Aulacorhynchus millepunctatus (Meek and Worthen)

Pl. VII, fig. 12

1870 *Chonetes ?? millepunctatus.* Meek and Worthen, Proc. Acad. Nat. Sci. Phil., p. 35.
Upper Coal Measures: Marion County, Illinois.

1873 *Chonetes ?? millepunctata.* Meek and Worthen, Geol. Surv. Ill., Vol. 5, p. 566, Pl. 25, Fig. 3.
Upper Coal Measures: Marion County, Illinois.

Description.—The occurrence of this large brachiopod in the Pottsville formation of Ohio is confined, so far as is known, to the Lower Mercer member of a single locality in Vernon Township, Scioto County. A dozen or more specimens of dorsal valves, some of which are fairly well preserved, were observed and were found to agree with the Illinois form so closely that the identification was made with considerable confidence. The presence of *Aulacorhynchus millepunctatus* in the middle Pottsville of this State is of especial interest as the species belongs distinctly to the Upper Pennsylvanian; its occurrence in any of the higher formations of the Pennsylvanian system of Ohio has not been recorded.

Dimensions.—Length of the largest specimen found 20 mm.; width 58 mm.

Horizon and locality.—Lower Mercer member: Scioto County, Locality 31, c.

Genus Productus Sowerby

Productus cora d'Orbigny

Pl. VIII, figs. 1-3

1847 *Productus cora.* De Koninck, Monog. du Gen. Prod. et Chon., p. 50, Pl. 4, Figs. 4a, b; Pl. 5, Figs. 2a–d.
Carboniferous: Guernsey County, Flint Ridge, and Zanesville, Ohio; Indiana; Nova Scotia; Bolivia, etc., South America.

Description.—This species is a common one in the marine limestones of the Pottsville formation, but does not become abundant below the Lower Mercer member. Although it varies much in size, it is generally very large; a representative specimen from the Lower

Mercer limestone has the following measurements: length 47 + mm., length of hinge line 40 mm., width 50 + mm. The hinge line is commonly shorter than the greatest width of the valves, which are marked with fine, sinuous lines. Coarse, concentric wrinkles cover the visceral regions, but become more deeply impressed on the ears. The ventral valve is not marked by a sinus, but sometimes a slight flattening occurs in the mesial region. A few large spines are scattered over the surface.

Horizon and locality.—Universally distributed throughout the middle and upper Pottsville formation: Lowellville, c; Boggs, a; Lower Mercer, aa; Lower Mercer ore, c; Upper Mercer, aa; McArthur, aa; Black Flint, c.

Productus semireticulatus (Martin)

Pl. VIII, fig. 6

1847 *Productus semireticulatus.* De Koninck, Monog. du Gen. Prod. et Chon., p. 83, Pl. 8, Figs. 1 a–h; Pl. 9, Figs. 1a–m; Pl. 10, Figs. 1a–d.
Carboniferous: Harrisville, Bagdad, Cuyahoga, Zanesville, Flint Ridge, Greensburg, and Antrim, Ohio; Missouri, Indiana, Illinois, Kentucky; Bolivia, South America.

Remarks.—This common and widely distributed *Productus* is one of the most abundant and characteristic fossils of the Pottsville formation of this State, especially in the middle and upper members. In size, however, it is considerably smaller than is generally the rule with representatives of the species.

Dimensions.—A typical specimen measures: length 35 mm., width at hinge line 46 mm., convexity 23 mm.

Horizon and locality.—Lowellville limestone: Muskingum County, Localities 20, 21, c. Widely distributed in the Boggs, c, Lower Mercer, Upper Mercer, McArthur, and Black Flint members, aa.

Productus semireticulatus (Martin) var.

Pl. VIII, figs. 4, 5

Compare 1915 *Productus morrowensis.* Mather, Bull. Den. Univ., Vol. XVIII, p. 152, Pl. 10, Figs. 1–4a.
Hale formation: Arkansas and Oklahoma; Morrow formation: Oklahoma.

Description.—Associated with *Productus semireticulatus* there is another less abundant *Productus* of the semireticulatus type, which may either represent a distinct species or may be only a variety of the above form. The contour is in no way different, although the size is generally less, and the radiating costae are finer and more regular. Careful comparisons have been made by the writer with the type speci-

mens of *P. morrowensis* Mather, borrowed for this purpose from the Walker Museum at the University of Chicago, and with one exception no essential differences could be noted between the two forms. However, indications of the double row of spines on the cardinal slopes and the main flanks which characterizes the Morrow species, was noted on only one of the Ohio specimens although a considerable amount of material was examined. It seems probable that this form represents an individual variation, rather than that the spines were originally present on all of the specimens but failed to be preserved. There appears to be a gradual gradation between this form and *P. semireticulatus* and for the present it seems advisable to refer to it as a variety of the latter species.

Horizon and locality.—Boggs member: Muskingum County, Localities 26, 27, 28, c. Lower Mercer member: Scioto County, Locality 31, c. Upper Mercer member: Perry County, Locality 63, c; Muskingum County, Localities 29, 38, c.

Genus Pustula Thomas

Pustula nebraskensis (Owen)

1852 *Productus nebraskensis.* Owen, Geol. Rep. Wisconsin, Iowa, and Minnesota, p. 594, Tab. 5, Fig. 3.
Carboniferous limestone: Bellevue, Missouri River, Nebraska.

Remarks.—This common Pennsylvanian fossil occurs abundantly in rocks of Pottsville age in Ohio, and is one of the most widely distributed forms. Although it characterizes the marine limestone horizons, it has not been found below the Lowellville member. Much of the material in the collections studied is in an excellent state of preservation.

Horizon and locality.—Lowellville limestone: Muskingum County, Locality 19, r; Mahoning County, Locality 22, r. Widely distributed in the Boggs, c, Lower Mercer, Upper Mercer, McArthur, aa, and Black Flint, a, members.

Pustula pertenuis (Meek)

Pl. VIII, fig. 8

1866 *Productus cancrini.* Geinitz (non de Verneuil), Die Carb. und Dyas in Nebraska, p. 54, Pl. 4, Fig. 6.
Nebraska City, Nebraska.

1872 *Productus pertenuis.* Meek, U. S. Geol. Surv. Nebr., p. 164, Pl. 1, Fig. 14; Pl. 8, Fig. 9.
Upper Coal Measures: Nebraska City and Brownville, Nebraska; Grasshopper Creek, Kansas.

Description.—Specimens of *Pustula pertenuis* have been obtained from the Sharon ore and the Lower Mercer and McArthur limestones, although they are of rare occurrence in the Pottsville rocks of this State. The small size, the fine radiating lines, and the numerous concentric wrinkles which cover the entire shell, together with a few scattered spine bases make the form easily recognizable.

Dimensions.—A specimen from the Harrison ore measures: length 8 mm., width 11 mm., convexity 4 mm.

Horizon and locality.—Sharon ore: Scioto County, Locality 2, r. Lower Mercer member: Muskingum County, Locality 28, r; Licking County, Locality 46, r. McArthur member: Jackson County, Locality 80, r.

Pustula punctatus (Martin)

Pl. VIII, fig. 9

1836 *Productus punctatus*? Morton, Am. Jour. Sci., 1st Ser., Vol. 29, p. 153, Pl. 26, Fig. 38.
Coal Measures: Ohio Valley.
1838 *Producta semipunctata.* Shepard, Am. Jour. Sci., 1st Ser., Vol. 34, p. 153, Fig. 9.
Limestone: Peru, Illinois.

Description.—*Pustula punctatus* is common in the Pottsville formation of this State in and above the Boggs member. It is generally well preserved and can be distinguished by its large size and by the numerous regular, concentric ridges covered with small spines which mark the surface. An almost perfect specimen from the Boggs limestone has the following measurements: length 40 mm., length of hinge line 30 ± mm., width 38 mm., convexity 22 mm.

Horizon and locality.—Boggs member: Muskingum County, Localities 27, 28, r. Lower Mercer member: Muskingum County, Localities 44, 45, r; Licking County, Localities 46, 48, 49, c. Upper Mercer member: Muskingum County, Locality 21, r.

Pustula symmetricus (McChesney)

Pl. VIII, fig. 7

1860 *Productus symmetricus.* McChesney, Desc. New Pal. Foss., p. 35.
Upper Coal Measures: LaSalle and Springfield, Illinois.
1865 *Productus symmetricus.* McChesney, Ill. New Spec. Foss., Pl. 1, Figs. 9a–b.

Description.—Representatives of *Pustula symmetricus* are rare in the collections of Pottsville fossils at hand and consist of a few dorsal valves from the Lower and Upper Mercer members. These differ from the dorsal valves of *P. nebraskensis* principally in their larger size and in their trifid cardinal process, which in the latter species is bifid.

P. symmetricus is of rare occurrence, while *P. nebraskensis* is extremely abundant and widely distributed throughout the Pottsville formation.

Horizon and locality.—Lower Mercer limestone: Perry County, Somerset, Locality 35, r. Upper Mercer limestone: Holmes County, Salt Creek Township, Locality 73, r.

Genus Marginifera Waagen

Marginifera muricata var. missouriensis Girty

Pl. IX, figs. 1-5

1915 *Marginifera muricata var. missouriensis.* Girty, Missouri Bureau Geol. and Mines, Vol. XIII, 2nd Ser., p. 350, Pl. XXX, Figs. 2–5a.
Cherokee shale: Missouri.

Description.—*Marginifera muricata var. missouriensis* is one of the most abundant and widely distributed fossils of the Pottsville formation in Ohio; it occurs in all of the marine limestones with the exception of the Boggs member, and is present in great profusion at some localities in the Lower Mercer limestone. It is small in size and the gibbous ventral valve imparts a globular appearance to the shell. The surface is marked by rather fine, regular costae, crossed by concentric wrinkles which on some specimens reach anteriorly two-thirds the length of the shell; spines are numerous on all parts of the valves. The slight, ill-defined fold near the anterior margin of the ventral valve, mentioned by Girty on the Missouri forms, is absent on specimens from Ohio; this character, however, is not a constant one.

Dimensions.—The measurements of a ventral valve of average size are: length 11 mm., width 13.5 mm., convexity 3.2 mm.; of a dorsal valve: length 10.5 mm., width 12.5 mm., convexity 3.2 mm.

Horizon and locality.—Widely distributed throughout the Lowellville, c, Lower Mercer, aa, Upper Mercer, c, McArthur, aa, and Black Flint, c, members.

Marginifera wabashensis (Norwood and Pratten)

Pl. IX, figs. 6-10

1854 *Productus wabashensis.* Norwood and Pratten, Acad. Nat. Sci. Phil. Jour., 2nd Ser., Vol. 3, p. 13, Pl. 1, Figs. 6 a–d.
Coal Measures: near New Harmony, Indiana.
1903 *Marginifera wabashensis* var. Girty, Prof. Paper. U. S. Geol. Surv., No. 16, p. 375, Pl. 5, Figs. 8, 8a.
Carboniferous: Colorado.

Description.—This common and characteristic fossil is found everywhere in the marine limestones of the Pottsville formation, al-

though it is especially abundant in the Lower Mercer and McArthur members. It is generally found in an excellent state of preservation. The ventral valve is very gibbous or even globular, having the greatest curvature in the posterior third of the shell. The hinge line is extended forming the greatest width of the valve; the beak is small, depressed, and slightly incurved, while the visceral region is flattened. The valve is divided into two prominent lobes by a deep, narrow sinus, and the entire surface is covered with fine, often obscure, radiating striae, with small, indistinct concentric wrinkles covering the visceral region and ears; a few spines are scattered over the surface, two of which are generally located near the center of the valve, one on either side of the sinus.

Dimensions.—Length 12.7 mm., length of hinge line 14 mm., greatest width of valve below hinge line 13.5 mm., convexity 9 mm.

Remarks.—*Marginifera wabashensis* is the common Pennsylvanian fossil which has been described and figured in various Ohio reports as *Productus longispinus*.[1] It likewise agrees very closely with the geniculate forms from Colorado described and figured by Girty as *M. wabashensis* var.[2]

Horizon and locality.—Lowellville limestone: Muskingum County, Locality 20, r; Mahoning County, Locality 22, r. Widely distributed throughout the Boggs, Lower Mercer, Upper Mercer, McArthur, and Black Flint members, aa.

Genus Dielasma King

Dielasma bovidens Morton?

1836 *Terebratula bovidens.* Morton, Am. Jour. Sci., 1st Ser., Vol. 29, p. 150, Pl. 2, Fig. 4.
Coal Measures: Ohio Valley.

Remarks.—A few specimens of a small brachiopod apparently closely resembling *Dielasma bovidens* were obtained from the Lower Mercer limestone on Flint Ridge. Their condition of preservation, however, is too poor to permit the identification to be made with much confidence, especially as no other specimens were found elsewhere in the Pottsville formation of this State.

Horizon and locality.—Lower Mercer limestone: Licking County, Flint Ridge, Locality 47, r.

[1]Herrick, C. L., Bull. Den. Univ., Vol. 2, p. 48, Pl. 2, Figs. 25, 27, 28, 1887.
Mark, C. G., Bull. Den. Univ., Vol. XVI, Pl. 8, Fig. 7, 1911.
Mark, C. G., Geol. Surv. Ohio, Fourth Ser., Bull. 17, p. 302, Pl. 13, Fig. 8, 1912.
[2]Girty, G. H., U. S. Geol. Surv., Prof. Paper No. 16, p. 385, Pl. 5, Figs. 8, 8a, 1903.

Genus Spiriferina D'Orbigny

Spiriferina kentuckyensis (Shumard)

1852 *Spirifer octoplicata* ? Hall, Stansb. Exped. to Gt. Salt Lake, p. 409, Pl. 4, Figs. 4 a, b.
Carboniferous: Missouri River, near Weston.
1855 *Spirifer Kentuckyensis.* Shumard, Geol. Rep. Mo., p. 203.
Coal Measures: On the Missouri River near Weston, and Grayson County, Kentucky.

Description.—This species is common in the Lower Mercer limestone and also in the higher members of the Pottsville formation but is rare in the lower horizons. It shows considerable variation in size and shape as well as in the length of the hinge line and the number of plications present. A number of small individuals from the Harrison and Sharon ores, all of which are in an imperfect state of preservation, have been referred rather doubtfully to this species. The surface is finely punctate and is covered with concentric lamellae, while five plications are present on either side of the fold and sinus. The forms from the marine limestones can easily be recognized by the long, extended hinge line, by the prominent fold and sinus, marked centrally by a small furrow and plication respectively, and by the numerous regular concentric lines covering the surface. Eight to ten plications mark the area on either side of the fold and sinus.

Dimensions.—A specimen of average size from the Harrison ore measures: length 7 mm., width 11 mm., convexity of the ventral valve 4 mm.; one of average size from the Lower Mercer limestone: length 9 mm., width 18.5 mm., convexity of the ventral valve 6 mm.

Horizon and locality.—Harrison ore: Jackson County, Locality 1, c. Sharon ore: Scioto County, Locality 2, c. Lowellville member: widely distributed, c. Generally distributed in the Lower Mercer, Upper Mercer, and McArthur members, c. Lower Mercer ore: Jackson County, Locality 56, r.

Genus Spirifer Sowerby

Spirifer boonensis Swallow?

Pl. IX, figs. 21-25

1860 *Spirifer boonensis.* Swallow, Trans. St. Louis Acad. Sci., Vol. 1, p. 646.
Lower Coal Measures: Boone, Randolph, and Monroe Counties, Missouri.
1903 *Spirifer boonensis* ? Girty, Prof. Paper, U. S. Geol. Surv., No. 16, p. 381, Pl. 6, Figs. 1–3.
Carboniferous: Colorado.

Description.—Shell large, subquadrate in outline, convex, ratio of length to width about 2:3; hinge line produced, always forming the greatest width of the shell. Ventral valve strongly convex, beak highly elevated and incurved over the hinge line; cardinal area, broad, transversely striated; delthyrium large; mesial sinus well defined, becoming broad and deep toward the front, always marked by at least three strong, rounded ribs, but sometimes by five ribs, the lateral one on each side in the latter case being smaller and formed by the bifurcation of the ribs bounding the sinus. Dorsal valve less convex than ventral, beak incurved and slightly elevated above the hinge line; mesial fold strongly elevated, consisting of four to six ribs, the two middle ones extending to the beak but bifurcating posterior to the middle of the valve, so that four plications always reach the front; two smaller, lateral plications sometimes originating by further bifurcation of the outer ribs. Surface on either side of the fold and sinus marked by ten to twelve simple, rounded ribs which are covered with fine, radiating lines; crossed by a few faint concentric lines of growth near the front and lateral margins.

Dimensions.—The following measurements were made of four large specimens, two of which are ventral valves, and two, dorsal valves:

	Ventral Valves		Dorsal Valves	
Length of hinge line (maximum width)	37 mm.	33 mm.	41 mm.	35 mm.
Length of shell	20 mm.	19 mm.	28 mm.	23 mm.
Convexity	4.5 mm.	4.5 mm.	7 mm.	5.5 mm.

Remarks.—This species is common throughout the marine limestones of the Pottsville formation of this State in and above the Boggs member, but is especially abundant in the Boggs, Lower Mercer, and McArthur limestones. It appears identical with the form from the Humerosa formation of Colorado, described and figured by Girty as *S. boonensis*? Both are characterized by their long hinge lines which form the greatest width of the shell, and by their coarse ribs of which three to five occupy the sinus and four to six the fold. In the Colorado form there are twelve to thirteen lateral plications, while the form from Ohio has ten to twelve on either side of the fold and sinus. There can be little doubt that the forms under consideration belong to *S. boonensis* as interpreted by Girty.

Horizon and locality.—Boggs member: Localities 26, 27, 28, 29, a. Lower Mercer member: Scioto County, Locality 31, a; Jackson County Localities 11, 33, c; Muskingum County, Locality 27, c; Licking County, Locality 46, r; Mahoning County, Localities 54, 22, c. Upper Mercer member: Scioto County, Locality 58, c; Muskingum County, Locality 38, c; Mahoning County, Locality 53, r. McArthur member: Jackson County, Locality 80, c. Black Flint member: Jackson County, Locality 87, c; Vinton County, Locality 92, r.

Spirifer cameratus Morton

Pl. IX, figs. 11, 12

1836 *Spirifer cameratus.* Morton, Am. Jour. Sci., 1st Ser., Vol. 29, p. 150, Pl. 2, Fig. 3.
Coal Measures: Ohio Valley.

Description.—Large *Spirifers* of the cameratus type constitute one of the most common and characteristic forms not only of the middle and upper Pottsville, but of almost the entire Pennsylvanian system of Ohio. It has not been found to occur, however, below the Lower Mercer limestone. The type is distinguished by its long hinge line, and by its strong, numerous, freely bifurcating plications which are arranged in bundles of three, five, or occasionally seven. The forms in the collections studied show considerable variation in the length of the hinge line, the number and size of the plications, and the tendency toward bifurcation, and it is believed that several varieties doubtlessly are present. As all gradations exist in the above-mentioned respects between opposite extremes, no plausible basis for further subdivision of the species was discovered. The more coarsely plicate type, however, greatly predominates in Pottsville rocks of this State.

Dimensions.—A specimen of average size from the Lower Mercer limestone measures: length 30 mm., width at hinge line 38 mm., convexity of ventral valve 10 mm.

Horizon and locality.—Widely distributed throughout the Lower Mercer, Upper Mercer, McArthur, and Black Flint members, a.

Spirifer opimus Hall

Pl. IX, figs 13-20

1858 *Spirifer opimus.* Hall, Geol. Iowa, Vol. 1, Pt. 2, p. 711, Pl. 28, Figs. 1a, b.
Coal Measures: Ohio, Maryland, Iowa, etc.
1915 *Spirifer opimus.* Mather, Bull. Den. Univ., Vol. XVIII, p. 185, Pl. 12, Figs. 7-7c.
Morrow formation: Arkansas and Oklahoma.

Hall's description.—"Shell rotund, gibbous, length and width nearly equal; hinge line equaling or sometimes a little greater or less than the width of the shell below: valves nearly equally gibbous in their greatest convexity. Dorsal valve regularly convex, with a strong well-defined mesial fold which is simple at the apex, dividing a little below, and each division again dicotomizing, the two middle divisions stronger than the lateral ones, and separated by a well-defined groove; in some of the smaller shells, the lateral plications of the mesial fold are feebly or not at all developed: beak elevated a little above the hinge-line, and incurving over a narrow defined area. Ventral valve most

gibbous above the middle, and abruptly rounding toward the sides and front; mesial sinus well defined, simple above, and becoming marked by three small plications in the middle and lower part; beak much elevated and strongly incurved, covering the upper part of the large foramen; area high in the middle, slightly concave, continued to the extremities of the hinge line, vertically striated: foramen large, forming an equilateral triangle.

"Surface marked by from eight to ten simple abruptly elevated plications (on either side of the fold and sinus)[1] which are equal to the spaces between, concentrically marked by strong imbricating lamellose lines of growth, and, on well-preserved specimens, by finer radiating and concentric striae."

The Ohio forms are uniformly small with the hinge line equal to or less than the greatest width of the shell below. The sinus of the ventral valve is marked by three to five bifurcating plications, of which the middle one is generally larger than the lateral ones; the fold of the dorsal valve by four to six bifurcating plications, the two middle being most prominent. The plications on either side of the fold and sinus are invariably simple, and although generally ten in number, variations from eight to twelve were noted.

Dimensions.—The following measurements were taken of three specimens of typical size:

	1	2	3
Length	18 mm.	16 mm.	18 mm.
Length of hinge line	19.5 mm.	16 mm.	19 mm.
Maximum width below hinge line	20 mm.	19 mm.	20 mm.

Remarks.—As compared with *S. boonensis*, *S. opimus* is much smaller, and less transverse, with the length and width nearly equal; the hinge line is never extended as in the former species. Each, however, has the lateral plications simple and those of the fold and sinus bifurcated.

S. opimus has generally been regarded as a synonym of Marcou's species, *S. rockymontanus*, from the Mountain limestone of New Mexico. According to Mather's interpretation of Marcou's species from his study of certain forms from the Morrow formation of Arkansas and Oklahoma, *S. opimus* is really distinct from the latter species. He compares the two forms thus:[2] "This shell (Spirifer rockymontanus) one of the most abundant in the Morrow collections, is characterized by occasional bifurcations of the lateral plications in which it agrees with the larger specimen figured by Marcou. *S. opimus* Hall is apparently a form

[1]The words in parentheses have been supplied by the writer.

[2]Mather, K. F., Bull. Den. Univ., Vol. XVIII, p. 184, 1915.

Dr. Mather has kindly examined some specimens of the form in question from Ohio, and states that they are identical with those which he identified as *S. opimus* from the Morrow fauna of Arkansas.

ordinarily smaller than adult members of this species and its lateral plications are invariably simple, as inferred from figures and descriptions. It is not synonymous with *S. rockymontanus.*"

An examination of Marcou's figures of *S. rockymontanus* shows that his species is marked with numerous, rather fine plications, freely bifurcating on the sides as well as in the sinus and on the fold. On the right side of the fold on the large figure of the dorsal valve, there are four bifurcated plications, while on the large ventral valve one of the plications is apparently three-forked and at least sixteen lateral plications seem to be present. The hinge line as stated in the description is shorter than the greatest width of the shell. Compared with *S. opimus*, the contour is very similar as in both the length and width are nearly equal, but the plications are finer, more numerous and freely bifurcating. It is of significance also that Hall cites his species as occurring in Ohio, while that of Marcou was described from a distant locality.

Horizon and locality.—Widely distributed throughout the middle and upper Pottsville formation excluding the Boggs and Sand Block ore members: Lowellville, a; Lower Mercer, aa; Lower Mercer ore, a; Upper Mercer, aa; McArthur, aa; Black Flint, a.

Genus Ambocoelia Hall

Ambocoelia planoconvexa (Shumard)

1855 *Ambocoelia planoconvexa.* Shumard, Geol. Rep. Mo., p. 202.
Upper Coal Measures: On Missouri River, near mouth of Platte River.

Description.—This common and widely distributed Pennsylvanian species has been found only in the McArthur limestone from two localities. Although it is rare in the Pottsville formation of this State, a number of well-preserved specimens have been obtained. The individuals are all small, one of average size measuring: length 5.5 mm., width 5 mm., convexity 2.5 ± mm.

Horizon and locality.—McArthur limestone: Jackson County, Locality 80, r; Hocking County, Locality 86, r.

Ambocoelia planoconvexa (Shumard) var.

Description.—A small brachiopod belonging to the genus *Ambocoelia* is common in the black shales on the Lowellville horizon along Poverty Run, Muskingum County. The form suggests identification with *Ambocoelia planoconvexa* (Shumard), but fairly constant differ-

ences render such identification doubtful. The Lowellville form is small, about one-half the size of *A. planoconvexa*, narrower, with a shorter hinge line which equals only about one-half the greatest width of the shell. The beak of the ventral valve is somewhat broader and less elevated; it is marked by a faint, narrow sinus which becomes evident near the beak. However, occasionally specimens of *A. planoconvexa* are found on which the differences mentioned above are not very evident, so that a new specific or even a new variety name for the Lowellville form may not be justifiable, especially as the material at hand is not in first-class condition.

Dimensions.—A large ventral valve measures: length 4.5 mm., width 5.5 mm., convexity 2.2 mm. A dorsal valve of average size measures: length 2.2 mm., width 2.7 mm.

Horizon and locality.—Lowellville member: Poverty Run, Muskingum County, Locality 19, c.

Genus Squamularia Gemmellaro

Squamularia perplexa (McChesney)

Pl. IX, figs. 26, 27

1856 *Spirifer lineatus.* Hall, Pac. R. R. Rep., Vol. 3, p. 101, Pl. 2, Figs. 6–8.
(Non *S. lineatus* Martin, 1809.)
Carboniferous: Pecos Village, New Mexico.

1860 *Spirifer perplexa.* McChesney, Desc. New Pal. Foss., p. 43.
Upper Coal Measures: Almost every part of the country where rocks of that age occur.

1899 *Reticularia perplexa.* Girty, U. S. Geol. Surv., Nineteenth Ann. Rept., Pt. 3, p. 577, Pl. 72, Fig. 1a.
Upper Coal Measures: McAlester quadrangle, Indian Territory.

1903 *Squamularia perplexa.* Girty, Prof. Paper, U. S. Geol. Surv., No. 16, p. 392, Pl. 6, Figs. 8–11c.
Humerosa, Weber, and Maroon formations: Colorado.

Description.—This is an abundant and widely distributed fossil in the marine limestones of the Pottsville formation above the Boggs member, although it is rare in the latter horizon. It occurs as a rule as internal casts on which fine concentric bands of spines or traces of them are usually visible. The Ohio specimens are somewhat larger than those described by McChesney which seldom attain a width of more than five-eighths of an inch.

Dimensions.—A specimen of average size from the Lower Mercer limestone measures: length 16 mm., width 19.5 mm., convexity 5 mm.

Horizon and locality.—Boggs limestone: Symmes Creek, Muskingum County, Locality 29, r. Widely distributed throughout the Lower Mercer, Upper Mercer, McArthur, and Black Flint members, a.

Genus Hustedia Hall and Clarke

Hustedia mormoni (Marcou)

Pl. IX, figs. 28, 29

1858 *Terebratula mormoni*, Marcou, Geol. North America, p. 51, Pl. 6, Fig. 11.
Mountain L. S.: Salt Lake City, Utah.
1894 *Hustedia mormoni*. Hall and Clarke, Int. to Study of Brach., Pt. 2, Pl. 37, Figs. 13–20.
Coal Measures: Near Kansas City, Missouri.

Remarks.—Although this little species is abundant and widely distributed in rocks of Pennsylvanian age, it is particularly characteristic of the upper part of the system, so that its appearance in the basal member of the Pottsville formation in Ohio is of interest,—especially as it has not been found in any of the higher members of that formation. The form is common in the Harrison ore, and with the exception of a few cases where the entire shell has been replaced by calcite, it occurs only as internal and external molds. Occasionally the spiralia and crura are preserved.

Dimensions.—A specimen of average size measures: length 7 mm., width 4.5 mm., convexity 4 mm.

Horizon and locality.—Harrison ore: Jackson County, Locality 1, c.

Genus Composita Brown

Composita subtilita (Hall)

Pl. VIII, figs. 10–13

1838 *Terebratula argentea*. Shepard, Am. Jour. Sci., 1st Ser., Vol. 34, p. 152, Fig. 8.
Limestone: Western bluff of Little Vermilion River, Illinois.
1852 *Terebratula subtilita*. Hall, Stansbury's Exped. Great Salt Lake of Utah, p. 409, Pl. 2, Figs. 1, 2.
Carboniferous: Missouri River, near Weston.

Remarks.—*Composita subtilita* constitutes without doubt the most widely distributed and one of the most abundant fossils of the Pottsville formation of Ohio. It is common in the Harrison and Sharon ores at the base, and is found in almost every other fossiliferous horizon to the Black Flint member at the top, although it occurs in great profusion in the Lower Mercer and McArthur members. Specimens from the Harrison ore often have the spiralia and even the jugum preserved in an unusual manner.

Dimensions.—The measurements of a large specimen from the Harrison ore are: length 18 mm., width 16 mm., convexity of ventral

valve 5 mm.; an individual of average size from the Lower Mercer limestone has the following dimensions: length 24 mm., width 22 mm., convexity 12 mm.

Horizon and locality.—Harrison ore: Jackson County, Locality 1, c. Sharon ore: Scioto County, Locality 2, c. Of general distribution in the Lowellville, Boggs, Lower Mercer limestone, Lower Mercer ore, Upper Mercer, McArthur, and Black Flint members, aa.

Composita sp.

Description.—A species of *Composita*, closely related to *C. subtilita*, occurs at several localities in the Boggs, Upper Mercer, and McArthur members. The form is relatively shorter and broader than is characteristic of *C. subtilita*, with the fold and sinus much less strongly marked. However, the specimens at hand are for the most part too poorly preserved for specific identification.

Horizon and locality.—Boggs member: Muskingum County, Locality 26, r. Upper Mercer member: Mahoning County, Locality 76, r. McArthur member: Jackson County, Locality 80, c; Vinton County, Locality 83, r.

PHYLUM MOLLUSCA

Class Pelecypoda

Minute Pelecypoda (Three or more species)

Description.—Several species of minute pelecypods are common in the Sand Block ore. They are pleurophoroid in form and occur as internal molds measuring from .5 to 1.5 mm. in length; none of the surface markings are preserved.

Horizon and locality.—Sand Block ore: Jackson County, Locality 57, c.

Genus Solenomya Lamarck

Solenomya radiata Meek and Worthen

1860 *Solenomya radiata.* Meek and Worthen, Proc. Acad. Nat. Sci. Phil., p. 547.
Coal Measures: Grayville, Illinois.
1866 *Solenomya radiata.* Meek and Worthen, Geol. Surv. Ill., Vol. 2, p. 349, Pl. 26, Figs. 10a, b.
Coal Measures: Schuyler County, Illinois.

Description.—This species is rare in the Pottsville formation of Ohio, but occurs most commonly in the Lower Mercer limestone of Muskingum and Licking counties, especially along Flint Ridge. Most

of the specimens are internal molds on which the fine radiating lines characteristic of the species are clearly marked. The Ohio forms show no variations which distinguish them in any way from Meek and Worthen's species.

Dimensions.—The largest specimen in the collections at hand measures: length 30 mm., height 14.5 mm.

Horizon and locality. — Lower Mercer limestone: Muskingum County, Localities 43, 45, r; Licking County, Locality 46, r; Flint Ridge, Localities 47, 48, r.

Solenomya?? sharonens s n. sp.

Pl. X, figs. 1, 2

Description.—Shell small, transversely subovate, length about twice the height; convex, point of greatest convexity being about two-fifths the height of the shell from the beak to the inferior margin; beak pointing obliquely forward, incurved, slightly elevated over the cardinal margin, situated about one-third the length of the shell from the anterior extremity; cardinal margin equal to one-half the length of the shell, sloping slightly downwards; ventral or inferior margin long, almost straight, rounding abruptly into the posterior extremity which is obliquely truncated above and forms an angle of 145 degrees with the hinge line, posterior extremity most extended below the middle of the shell; anterior extremity broadly rounded, slightly concave in outline anterior to the beak, most prominent about the middle of the valve or a little below; a prominent umbonal ridge extending from the beak to the posterior-inferior angle. Surface smooth except for a few obscure, concentric lines of growth.

Dimensions.—The measurements of the holotype are: length 13.5 mm., length of hinge line 6.2 mm., height 6.8 mm., convexity of right valve 2.4 mm.

Remarks.—There is much doubt concerning the generic identification of this shell, for it is not very closely allied to any Pennsylvanian genus. It is very possible that it does not belong to the genus *Solenomya* which lacks the prominent beak and umbonal development of the form under discussion; however, as our specimens appear most closely related to *Solenomya*, it seems best to place them provisionally with that genus. One would scarcely be justified in establishing a new genus from the material at hand which does not show the characters of the hinge and interior adequately. The form is confined to one locality of the Sharon ore and has been found only as internal casts.

Horizon and locality.—Sharon ore: Lick Run, Scioto County, Locality 2, r.

Genus Solenomorpha Cockerell

Solenomorpha lamborni n. sp.

Pl. X, fig. 3

Description.—Shell small, elongate, length about four times the height; convex, with maximum convexity in the anterior half of the shell behind the beak; beak small, inconspicuous, depressed, directed anteriorly, scarcely distinct from the cardinal margin, situated about one-eighth the length of the shell from the anterior margin, separated from the anterior portion by a short, oblique groove; cardinal margin long, straight, extending posteriorly from the beak two-thirds the length of the shell; anterior margin broadly rounded dorsally, but narrowly rounded or slightly truncated ventrally, joining the ventral margin at a point one-third the length of the shell from the anterior end; ventral margin straight, parallel to the hinge line, forming an angle of about 80 degrees with the posterior extremity; posterior margin straight below, sharply truncated above, forming an angle of 155 degrees with the hinge line; a prominent umbonal ridge extending obliquely backward from the beak to the posterior inferior angle. Surface smooth except for a few faint concentric lines of growth near the margins.

Dimensions.—The holotype measures: length 22 mm., length of hinge line 13 mm., height 5.5 mm., convexity of right valve 1.5 mm.

Remarks.—This species has been found only as internal casts from the Sharon ore of a single locality in Scioto County, where it is of comparatively common occurrence. It is characterized by its elongate form, its small, inconspicuous, depressed beak, and its parallel dorsal and ventral margins. In the latter respect it differs from *Solenomorpha solenoides* (Geinitz), a species which has the shell tapering posteriorly and becoming bluntly pointed at the posterior extremity. The form is extremely fragile, although with care specimens in good condition can be obtained.

Horizon and locality.—Sharon ore: Lick Run, Scioto County, Locality 2, c. The specific name is given in honor of Mr. Raymond E. Lamborn of the Geological Survey of Ohio, by whom the collections of Pottsville fossils from Stark and Mahoning counties were made.

Genus Prothyris Meek

Prothyris elegans Meek

Pl. XIV, fig. 12

1871 *Prothyris elegans.* Meek, Am. Jour. Conch., Vol. 7, p. 8, Pl. 1, Fig. 3.
Coal Measures: Nebraska City, Nebraska; Ohio; Illinois; Michigan.

1872 *Prothyris elegans.* Meek, U. S. Geol. Surv. Nebr., p. 223, Pl. 10, Figs. 9 a, b. Upper Coal Measures: Nebraska City, Nebraska.

Meek's description: "Shell compressed, elongate-oblong, the width being about three and a half times the height; ventral and dorsal margins straight or a little arched; the latter with a faintly defined marginal furrow, below which there is usually an obscure ridge also parallel to the dorsal margin; posterior extremity obliquely subtruncate, the most prominent part being below the middle; beaks compressed, depressed, not distinct from the dorsal margin, and placed about one-eighth or one-ninth the length of the valves behind the anterior extremity; notch of the anterior margin well defined, and extending about half way up from the base, and nearly half the distance back from the front to the beaks; ridge from the inner angle of the notch narrow, flat, and widening slightly from above; anterior margin above the notch rounded, and having the appearance of a flattened ear; surface striae nearly obsolete on the upper half of the valves, and more distinct on the ventral and antero-ventral regions."

Dimensions.—The dimensions of the most perfect of the only two specimens in the collections studied are: length 12.5 mm., height 3.5 mm., convexity .7 mm.

Remarks.—This species is represented in the collections of Pottsville fossils at hand by two individuals,—one in almost perfect condition from the Lower Mercer limestone on Flint Ridge, with the valves open but still connected at the hinge line; the other in a less perfect state of preservation from the Upper Mercer limestone. Practically no differences between our species and Meek's can be noted except that the size is only about one-half as great as that of his figured specimen. A form identified by Herrick as *P. elegans* was likewise obtained on Flint Ridge,[1] but it is also larger than our form.

Horizon and locality.—Lower Mercer limestone: Licking County, Flint Ridge, Locality 47, r. Upper Mercer limestone: Holmes County, Locality 73, r.

Genus Edmondia De Koninck

Edmondia anodontoides (Meek)?

1875 *Solenomya ?? anodontoides.* Meek, Pal. Ohio, Vol. II, p. 339, Pl. 19, Fig. 11. Coal Measures: Newark, Ohio.

1887 *Solenomya ? anodontoides.* Herrick, Bull. Den. Univ., Vol. 2, p. 29, Pl. 4, Fig. 10. Coal Measures: Flint Ridge.

Description.—A few individual valves from the Lower Mercer member are apparently identical with the Flint Ridge form which Herrick referred to Meek's species *Solenomya?? anodontoides.* However,

[1]Herrick, C. L., Bull. Den. Univ , Vol. 2, p. 32, Pl. 4, Fig. 3, 1887.

even after due allowance is made for natural variation in shape, the differences noted between Meek's and Herrick's specimens appear too great for individuals of the same species. Typical *S. anodontoides* has the cardinal and basal margins strongly converging anteriorly, with the anterior extremity acutely and prominently projecting. In Herrick's form, on the other hand, the cardinal and basal margins are subparallel, and the anterior extremity is broadly rounded and less prominent. No specimens comparable to typical *S. anodontoides* have been found even in Meek's type locality on Flint Ridge, so that in the absence of material for comparison Herrick's identification is provisionally retained, although it is the opinion of the writer that the form here referred to *S. anodontoides* really constitutes a distinct species.

Horizon and locality.—Lower Mercer limestone: Perry County, Locality 35, r; Muskingum County, Locality 43, r.

Edmondia aspinwallensis Meek

Pl. X, fig. 7

1871 *Edmondia aspinwallensis.* Meek, Prelim. Rept. U. S. Geol. Surv. Wyoming p. 299.
Upper Coal Measures: Aspinwall, Nebraska.

Description.—*Edmondia aspinwallensis* is present in the middle and upper Pottsville formation. It resembles most closely the form here referred to *E. ovata,* but differs in being shorter in comparison to the height with a shorter dorsal margin, and in having a narrower posterior extremity, and slightly more elevated beaks. The concentric surface markings are likewise finer and more regular and faint traces of radial sculpture are sometimes retained.

Horizon and locality. — Lower Mercer limestone: Muskingum County, Localities 43 (r), 45 (c); Licking County, Localities 46 (c), Flint Ridge, 47 (c). McArthur limestone: Vinton County, Locality 84,c.

Edmondia gibbosa (McCoy)

Pl. X, figs. 4, 5

1844 *Astarte gibbosa.* McCoy, Syn. Carb. Foss. Ireland, p. 55, Pl. VIII, Fig. 11.
Carboniferous: Ireland.
1866 *Astarte gibbosa.* Geinitz, Die Carb. und Dyas in Nebr., p. 16, Tab. 1, Figs. 23, 24.
Carboniferous: Plattsmouth, Nebraska.

Description.—A form of *Edmondia* which is in very close agreement with the species from Nebraska figured and described by Geinitz as *Astarte gibbosa,* is rather common in the Lower Mercer and McArthur limestones. It is small, subcircular or slightly transversely ovate in

outline, and strongly convex; the beaks are situated about one-third the length of the shell from the anterior margin. The front is rounded with the posterior-inferior portion slightly produced; the posterior extremity is broadly rounded and slightly truncated above, while the anterior extremity is more narrowly rounded. The surface is marked by numerous prominent and regularly arranged concentric ridges separated by broad deep furrows. There is, however, much variation among individuals in the number, regularity, and prominence of the surface markings.

Dimensions.—The measurements of separate right and left valves of average size are respectively: height 13 mm., 14 mm., length 17 mm., 18 mm., convexity 3.5 mm., 4 mm.

Horizon and locality. — Lower Mercer limestone: Muskingum County, Locality 43, c; Licking County: Flint Ridge, Localities 47, 49, c. McArthur limestone: Vinton County, Localities 84, 85, c.

Edmondia meekiana (Herrick)?

Pl. X, fig. 6

1887 *Solenomya ? meekiana.* Herrick, Bull. Den. Univ., Vol. 2, p. 30, Pl. 4, Fig. 9. Coal Measures: Flint Ridge, Ohio.

Herrick's description: "Nearly quadrate, elongate, more than twice as long as wide; sides parallel, straight; posterior outline gently curved; anterior outline somewhat truncate, not produced; convexity somewhat greatest near the beak, but entire valve nearly equally convex, sloping gently and almost equally to the entire margin. Length 1.05 (inches), width .50." Surface marked by rather coarse, regular, concentric undulations and covered entirely with fine, concentric lines.

Dimensions.—The measurements of a large specimen are: length 28 mm., height 16 mm., convexity of single valve 3.5 mm.; a smaller individual measures: length 14 mm., height 8.5 mm., convexity of single valve 2 mm.

Remarks.—About six separate valves of this species from the Lower Mercer limestone of Flint Ridge and also a few specimens from the McArthur limestone are among the collections studied. Our form differs from Herrick's species *Solenomya ? meekiana* only in its slightly less elongate outline, the length being a little less than twice the height. Another similar species is referred to by Herrick as *Solenomya ? anodontoides,*[1] but this form is less elongate than ours which seems to lie between *S. ? anodontoides* and *S. ? meekiana,* although it resembles the latter more closely. Herrick states that the two species mentioned above are practically identical except that the latter is much more elongate.

[1]Herrick, C. L., Bull. Den. Univ., Vol. 2, p. 29, Pl. 4, Fig. 11, 1887.

However, his specimen of *S.* ? *anodontoides* differs notably from typical *S.* ? *anodontoides* of Meek in lacking the anteriorly converging margins and the acute, prominently projecting anterior extremity, and probably represents a different species.

Horizon and locality.—Lower Mercer limestone: Muskingum County, Locality 43, r; Licking County, Localities 46, Flint Ridge, 47, 48, r.

Edmondia ovata Meek and Worthen

Pl. X, figs. 8, 9

1873 *Edmondia ovata.* Meek and Worthen, Geol. Surv. Ill., Vol. 5, Pl. 26, Fig. 13. Coal Measures.
1874 *Edmondia ovata.* Meek, Am. Jour. Sci., 3d Ser., Vol. 7, p. 580.

Description.—Shells resembling both *Edmondia ovata* and *E. subtruncata* are common in the Lower Mercer limestone, especially in Muskingum and Licking counties, and also in the McArthur member. The figured specimen is typical of this group of fossils. From *E. ovata,* to which it seems most closely related, it differs in being slightly less elongate with the beak a little more anterior; from *E. subtruncata* in having the posterior outline a little less truncated. However, the differences between *E. ovata* and *E. subtruncata* are so slight that, as intimated by Meek, the two species may be identical. The surface of our form is marked by coarse, irregular, concentric wrinkles with the entire shell covered with very fine concentric lines.

Dimensions.—Figure 9 on Plate X measures: length 29 mm., height 20 mm., convexity of right valve 5.5 mm.

Horizon and locality.—Lower Mercer member: Perry County, Locality 35, r; Muskingum County, Locality 45, c; Licking County, Localities 46, r, Flint Ridge, 47 (c), 49 (r). Upper Mercer member: Perry County, Locality 63, r. McArthur member: Vinton County, Locality 84, c.

Edmondia reflexa Meek

1872 *Edmondia reflexa.* Meek, U. S. Geol. Surv. Nebraska, p. 213, Pl. 10, Figs. 6a, b; Pl. 4, Fig. 7.
Upper Coal Measures: Nebraska City, Nebraska.

Description.—This species of *Edmondia* is present in the Pottsville formation of this State in and above the Lower Mercer limestone, and is fairly common in the latter member and in the McArthur limestone. The shell is marked by very fine concentric undulations on which faint traces of radiating lirae are sometimes visible.

Dimensions.—A specimen of average size measures: length 15 mm., height at beaks 8.5 mm., convexity of right valve 2 mm.

Horizon and locality. — Lower Mercer limestone: Muskingum County, Locality 43, r; Licking County, Locality 47, c. McArthur member: Jackson County, Locality 80, c; Vinton County, Locality 84, c.

Edmondia ? peroblonga Meek and Worthen?

1865 *Edmondia ? peroblonga.* Meek and Worthen, Proc. Acad. Nat. Sci. Phil., p. 249.
Upper Coal Measures: LaSalle, Illinois.
1873 *Edmondia ? peroblonga.* Meek and Worthen, Geol. Surv. Ill., Vol. 5, p. 583, Pl. 27, Fig. 4.
Upper Coal Measures: LaSalle, Illinois.

Remarks.—A form closely related to *Edmondia ? peroblonga* occurs in the Boggs limestone of Muskingum County; it is represented by a single specimen somewhat imperfect at the posterior extremity. The size is about two-thirds that of the specimen described and figured by Meek and Worthen, although the resemblance between the two forms is so close, that they represent in all probability the same species. However, as *E. ? peroblonga* occurs much higher in the Pennsylvanian system, and as the Boggs specimen is imperfect, identification of the Ohio form with this species is not at all conclusive.

Dimensions.—The measurements of the Boggs specimen are: length 43 + mm., height 20 mm., convexity of the right valve 5 mm.

Horizon and locality. — Boggs limestone: Muskingum County, Locality 26, r.

Edmondia sp.

Remarks.—Specimens belonging to the genus *Edmondia* occur in the Lowellville and Boggs members, but are too crushed and imperfect to permit specific identification.

Horizon and locality.—Lowellville limestone: Muskingum County, Locality 19, r. Boggs limestone: Muskingum County, Localities 26, 27, r.

Genus Nucula Lamarck

Nucula beyrichi von Schauroth

1866 *Nucula beyrichi.* Geinitz, Die Carb. und Dyas in Nebr., p. 21, Tab. 1, Figs. 36, 37.
Nebraska City, Nebraska.

Remarks.—This species of *Nucula* is rare in rocks of Pottsville age in Ohio and is represented in the collections studied by only a few in-

dividuals from the Harrison ore and the Lower Mercer limestone. The single specimen obtained from the Harrison ore occurs in the form of an internal cast, which, however, is sufficiently well preserved to be referred with considerable confidence to *N. beyrichi*.

Horizon and locality.—Harrison ore: Jackson County, Locality 1, r. Lower Mercer limestone: Licking County, Locality 46, r.

Nucula elongata n. sp.

Pl. X, figs. 10–13

Description.—Shell small, subtriangular, much produced anteriorly, length almost twice the height, greatest width slightly below the middle of the shell, gibbous in posterior portion, the greatest convexity occurring midway between the beaks and the ventral margin, shell flattened anteriorly. Umbonal region prominent, beak small, elevated and incurved over the hinge line, directed posteriorly, situated about one-fourth the length of the shell from the posterior margin; cardinal margin sloping from the beak to the extended anterior extremity; posterior extremity regularly rounded forming a continuous curve with the rounded ventral margin which anteriorly extends slightly upward; anterior extremity produced and pointed. Surface of internal mold smooth except for a few faint lines of growth; occasionally indications of fine concentric lines.

Dimensions.—Considerable variation exists in the size of the individuals as may be seen by the following measurements, the first of which is the holotype:

Maximum length	11 mm.	9 mm.	7 mm.	6 mm.
Height from beak to opposite margin	6.2 mm.	5.5 mm.	4.5 mm.	3.5 mm.
Thickness of single valve	2 mm.	1.5 mm.	1.2 mm.	1 mm.

Remarks.—This species is common in the Sharon ore at a single locality in Scioto County where it occurs in an excellent state of preservation in the form of internal casts. It is closely related to *N. parva* McChesney and to *N. beyrichi* von Schauroth, but can be easily distinguished from either species by its much more produced anterior end. It is associated with two other species, common in the Sharon ore—*N. subrotundata* Girty mss. and *N. lunulata* Girty mss. A single, somewhat imperfect individual from the Lower Mercer limestone at Bald Knob, also in the form of an internal cast, agrees closely with the species as it occurs in the Sharon ore, although its otherwise apparent total absence from any horizon above the Sharon tends to throw much doubt upon the identification.

Horizon and locality.—Sharon ore: Scioto county, Locality 2, c. Lower Mercer limestone: Licking County, Locality 46, r.

Nucula lunulata Girty mss.

Pl. X, figs. 17–19

Description.—Another species of *Nucula* from the Sharon ore is the same as Girty's manuscript form from the Morrow formation of Arkansas, the description of which is quoted below:

"Shell small and conspicuously triangular in shape. The width and height are about equal. The convexity is great and the umbones are very prominent. The cardinal and posterior parts of the shell are strongly inflected long lines that are straight or slightly concave, and that make with one another an angle of considerably less than 90 degrees. The inflected parts are so directed that they are concealed when the shell is viewed from either side. The inferior outline is gently convex and is directed to the two other sides in such a way that the height of the shell is nearly equal to the width and the posterior outline is distinctly shorter than the anterior outline. Owing to the high convexity and strong inflection of the margins a broad flattened surface is formed on the cardinal and posterior ends. This surface on the posterior side is somewhat depressed and set off by angles, thus forming a large 'lunule' which is very sharply defined. Nothing at all comparable to this is developed on the cardinal plane.

"The surface is marked by very fine, regular, concentric striae.

"This species resembles several that occur in such different stratigraphic and geologic relations that I would hesitate to regard them as the same without conclusive evidence of very close agreement. It is similar to the Mississippian *N. shumardana*, but it is rather less elongated transversely, and it is readily distinguished by its higher convexity and more prominent umbones. *N. wewokana*, *N. levatiformis var. obliqua*, and *N. pulchella* are related but distinct species."

Remarks.—*N. lunulata* is common in the Sharon ore at one locality in Scioto County where it is associated with *N. subrotundata* Girty mss. and *N. elongata* n. sp. It occurs only as internal casts.

Horizon and locality.—Sharon ore: Scioto County, Lick Run, Locality 2, c.

Nucula parva McChesney

1860 *Nucula parva*. McChesney, Desc. New Pal. Foss., p. 54.
Coal Measures: Danville, Illinois.
1865 *Nucula parva*. McChesney, Ill. New Spec. Foss., Pl. II, Figs. 8a–c.

Remarks.—*Nucula parva* is of rare occurrence in rocks of Pottsville age in Ohio, but has been found to be sparingly present in the Lower Mercer limestone of Perry, Muskingum, and Licking counties, and also in the McArthur limestone. Several fairly well preserved specimens

and a number of less perfect individuals are among the collections studied; no essential divergences from the form as it ordinarily occurs were noted.

Horizon and locality.—Lower Mercer limestone: Perry County, Locality 35, r; Muskingum County, Localities 43, 45, r; Licking County, 47, 49, r. McArthur limestone: Vinton County, Locality 84, r.

Nucula subrotundata Girty mss.

Pl. X, figs. 14–16

Description.—A species of *Nucula* from the Sharon ore is identical with one described and figured in manuscript by Girty from the Morrow formation of Arkansas. Girty's manuscript description is quoted below:

"Shell small, subtriangular to subcircular in outline. In shape all three sides are gently convex, the anterior side most and the posterior side least. In length the inferior side is greatest and the posterior side is considerably the shortest. The inferior-posterior angle is rather narrowly, the inferior-anterior angle rather broadly, rounded. In a genus in which so many of the species are strongly convex the convexity of *N. subrotundata* is generally rather low, though it varies greatly in different specimens (partly due to the degree of maturity), and it may be rather high. The chief flexures occur near the anterior and posterior margins along lines that make with each other an angle rather less than a right angle. A projection of the inflected parts beyond these angles gives the sides their curved outlines. The oblique anterior outline is thus rather regularly curved; the posterior outline may be essentially straight. On the posterior side a 'lunule' is more or less faintly outlined by a sulcus which tends to produce a slight emargination in the outline. A few specimens referred under this species have the 'lunule' rather strongly defined in this way. The beaks are not very prominent. They are rather attenuated and are conspicuously turned backward.

"The shell is, for its size, very thick and massive, and it is marked superficially by rather coarse, strong and regular concentric striae."

Remarks.—This species of *Nucula* is very abundant in the Sharon and less so in the Harrison ore, but as far as is known it is confined in its occurrence in this State to these two horizons. It has, moreover, been found only at a single locality in each member, and only in the form of internal casts. The Ohio forms differ from those of the Morrow formation of Arkansas in being on the average a little more gibbous. In the Sharon ore this species of Nucula is associated with *N. lunulata* Girty mss. as in the Morrow formation, and also with *N. elongata* n. sp.

Horizon and locality.—Harrison ore: Jackson County, Locality 1, c. Sharon ore: Scioto County, Lick Run, Locality 2, a.

Genus Nuculopsis Girty

Nuculopsis ventricosa (Hall)

Pl. X, fig. 20

1858 *Nucula ventricosa.* Hall, Geol. Iowa, Vol. 1, Pt. 2, p. 716, Pl. 29, Figs. 4, 5a, b.
Coal Measures: Iowa.
1915 *Nuculopsis ventricosa.* Girty, U. S. Geol. Surv., Bull. 544, p. 117, Pl. XV, Figs. 1–8.
Wewoka formation: Oklahoma.

Remarks.—*Nuculopsis ventricosa* occurs in the basal member of the Pottsville and ranges throughout the entire formation, although individuals are by no means common. It is most common in occurrence in the Lower Mercer and McArthur members. In the Harrison ore it is associated with *N. subrotundata* Girty mss., and in the Sharon ore with *N. subrotundata*, *N. lunulata* Girty mss., and *N. elongata* n. sp.

Dimensions.—A considerable variation exists in the size of individuals; a specimen of average size from the Sharon ore measures: length 9.2 mm., height 7 mm., thickness of a single valve 3.5 mm.; from the Lower Mercer limestone: length 11 mm., height 8 mm., thickness of a single valve 2.5 mm.

Horizon and locality.—Harrison ore: Jackson County, Locality 1, r. Sharon ore: Scioto County, Locality 2, r. Lower Mercer limestone: Perry County, Locality 35, r; Muskingum County, Localities 36, 43, r; Licking County, Locality 48, r. McArthur limestone: Vinton County, Locality 84, r.

Genus Leda Shumacker

Leda bellistriata Stevens

Pl. X, fig. 27

1858 *Leda bellistriata.* Stevens, Am. Jour. Sci., 2nd Ser., Vol. 25, p. 261.
Coal Measures: Danville, Illinois; Summit, Ohio.
1915 *Leda bellistriata.* Girty, U. S. Geol. Surv., Bull. 544, p. 122, Pl. XIV, Figs. 1–9a.
Wewoka formation: Oklahoma.

Remarks.—*Leda bellistriata* appears in the Lowellville limestone and continues throughout the middle and upper Pottsville, but it has nowhere been found in considerable numbers; it is most common, however, in the Lower Mercer member on Flint Ridge. Specimens from Ohio compare closely with those figured by Girty from the Wewoka formation of Oklahoma but are, on the average, smaller.

Dimensions.—A large specimen from the Lowellville limestone measures: length 10.5 mm., height 5.5 mm. An individual of unusually

large size for the Pottsville formation of this State, obtained from the Lower Mercer member in Baltimore & Ohio Railroad cut at Somerset, has the following measurements: length 33.5 mm., height at beaks 18 mm.

Horizon and locality.—Lowellville limestone: Muskingum County, Locality 19, r. Boggs limestone: Muskingum County, Locality 26, r. Widely distributed throughout the Lower Mercer limestone, c. McArthur limestone: Jackson County, Locality 80, c; Vinton County, Locality 84, c.

Leda inflata Girty mss.

Pl. X, figs. 22-24

Description.—Girty's manuscript description is quoted below: "Shell small, rarely exceeding 8 mm. in width, transversely subovate. Basal margin gently convex, slightly sinuate behind, more rapidly curving in front. Anterior extremity rather regularly rounded below the prominent and backwardly turned beaks. Behind the beaks the outline is concave, strongly contracting with the base to form a pointed posterior extremity. Beaks slightly anterior to median line. Convexity high, declining rapidly behind the beaks where a sort of constriction occurs which produces more or less of a sinus in the basal outline and gives the posterior extremities a compressed appearance in contrast with the subglobose shape of the major part of the shell. Umbonal ridge high, forming the posterior-superior outline, the post-umbonal slopes being directed almost horizontally, though projecting somewhat at their juncture.

"Surface finely and evenly striated.

"It cannot be said that we know precisely what form the name *Leda bellistriata* was intended to cover, but from the shells commonly passing as that species *L. inflata* differs in its smaller size, its more rapidly tapering shape, and its more inflated anterior portion."

Remarks.—A small species of *Leda* from the Sharon ore of Ohio is in all probability the same form as that described above by Girty from the Morrow formation of Arkansas. Its association in this State with *N. subrotundata* and *N. lunulata*, with which it is also associated in the Morrow formation, helps to strengthen this conclusion. *L. inflata* is characterized by its small size, its short depressed posterior end, and its inflated anterior end. The Ohio form differs in having a slightly less rapidly tapering posterior end, with less contrast between the compressed posterior and the inflated anterior ends. These differences, however, may be due to the fact that the Sharon specimens occur as internal casts, while the shell is preserved on the Morrow forms.

Horizon and locality.—Sharon ore: Lick Run, Scioto County, Locality 2, c.

Leda meekana Mark

Pl. X, figs. 25, 26

1866 *Nucula kazanensis.* Geinitz, Die Carb. und Dyas in Nebraska, p. 20, Tab. 1, Figs. 33, 34. (Non *N. kazanensis* de Verneuil, 1845.)
Nebraska City, Nebraska.

1872 *Nucula bellistriata var. attenuata.* Meek, U. S. Geol. Surv. Nebraska, p. 206, Pl. 10, Figs. 11a, b.
Upper Coal Measures: Nebraska City, Nebraska; Leavenworth, Kansas; Iowa; Illinois.

1913 *Leda meekana.* Mark, Geol. Surv. Ohio, Fourth Ser., Bull. 17, p. 307, Pl. XV, Fig. 1.
Portersville limestone: Muskingum and Perry counties.

Remarks.—*Leda meekana* is associated in the middle and upper Pottsville formation with *L. bellistriata* which it resembles in general appearance, but differs in being more slender with the posterior portion more attenuated. The species is rare.

Dimensions.—A specimen of average size measures: length 9.5 mm., height 4.7 mm., thickness 2 mm.

Horizon and locality. — Lower Mercer limestone: Muskingum County, Localities 38 (r), 43 (c), 45 (c); Licking County, Localities 46, 48, r. McArthur member: Vinton County, Locality 84, r.

Leda prolongata n. sp.

Pl. X, figs. 28, 29

Description.—Shell large for specimens of this genus, elongate-ovate in outline with the posterior end greatly produced; depressed convex, the greatest convexity being in the anterior part below the umbones but becoming gradually and regularly less to the posterior tip. Beaks prominent and incurved, situated from one-third to one-fourth the length of the valve from the anterior margin; cardinal margin posterior to beaks strongly concave; anterior margin rounded and curving regularly into the rounded base; posterior portion slender, tapering to a sharp point, and greatly extended; umbonal ridge prominent and elevated. Surface of shell marked by very fine, regular, rounded concentric lines.

Dimensions.—The holotype from the Lower Mercer limestone measures: length 39 mm., height 16 mm., convexity of right valve 2.5 mm. (compressed); a single small individual from the Boggs limestone measures: length 22.5 + mm., height 9.5 mm., convexity 2.5 mm.

Remarks.—This species is characterized by its large size, its slender form, and its greatly extended posterior portion. It is very rare and is represented in the Pottsville collections by only two indi-

viduals,—one from the Lower Mercer limestone, and another smaller specimen from the Boggs which is imperfect in lacking the posterior tip.[1] Considerable doubt exists as to the advisability of creating a new species on the basis of the scanty material at hand which is none too well preserved. The holotype from the Lower Mercer member is evidently compressed and probably not entirely uncovered; both specimens are in the form of internal casts although a small portion of the shell is retained on the smaller. The form is more closely related to *L. arata* (Hall) than to any other described species. Comparisons have been made with specimens of the latter species from Missouri with the result that the Ohio species was found to be much larger, probably less convex, more slender, with the posterior portion more extended and the beaks less centrally located. The surface markings are also considerably finer. It can be distinguished from *L. bellistriata* Stevens by its much larger size, more slender produced posterior extremity, and less centrally placed beaks; from *L. meekana* Mark by its larger size and still more attenuated form.

Horizon and locality.—Boggs limestone: Muskingum County, Locality 26, r. Lower Mercer limestone: Perry County, Locality 35, r; Muskingum County, Locality 45, r.

Genus Yoldia Muller

Yoldia glabra Beede and Rogers?

1899 *Yoldia glabra.* Beede and Rogers, Kansas Univ. Quart., Vol. 8, No. 3, p. 133, Pl. 34, Figs. 4 a, 4 b.
Coal Measures: Camerons Bluff, near Lawrence, Kansas.

Description.—A few internal molds as well as several specimens on which the external shell is partially preserved which were obtained from the McArthur limestone have been somewhat doubtfully referred to *Yoldia glabra.* The size is considerably greater than that of the type specimen, but agrees closely both in size and contour with the form from the Wewoka formation of Oklahoma, which Girty assigned to the same species.[2] The beak of our form, however, is a little higher and more prominent than his figures seem to indicate. The surface sculpture consists of extremely fine, rounded lirae separated by interspaces of about the same width.

Dimensions.—Height 11 mm., width 20 mm., convexity of left valve 3.5 mm.

[1]Since the above description was completed a third, more perfect specimen from the railroad cut at Somerset, Perry County, has come to the attention of the writer. The left valve is greatly crushed, while the almost perfect right valve probably shows very nearly the original convexity of the species. The escutcheon is broad and well marked. The dimensions of the specimen are: Length 37 mm., height at beaks 16 mm., thickness of right valve 6 mm.

[2]Girty, G. H., U. S. Geol. Surv., Bull. 544, p. 126, Pl. III, Figs. 9-15, 1915.

Horizon and locality. — McArthur limestone: Jackson County, Monroe Furnace, Locality 80, r; Vinton County, Moore mine, Locality 84, r.

Yoldia stevensoni Meek

1871 *Yoldia stevensoni.* Meek, Rep. Regents Univ., W. Va.
Coal Measures: Monongahela County, West Virginia.
1875 *Yoldia stevensoni.* Meek, Pal. Ohio, Vol. II, p. 335, Pl. 19, Figs. 4a, 4b.
Coal Measures: Monongahela County, West Virginia.

Remarks.—This little pelecypod is rare in the Pottsville fauna of Ohio and has been found only in the Lower Mercer member of Muskingum and Licking counties. Two fairly perfect valves and several less well preserved individuals are among the collections studied. The form agrees so closely with Meek's figures and description of *Yoldia stevensoni* that identification with that species is made with confidence.

Dimensions.—Length 13.5 mm., height at umbones 7.5 mm., convexity of single valve 1 mm. (crushed).

Horizon and locality. — Lower Mercer member: Muskingum County, Localities 43, 45, r; Licking County, Localities 46, 47, 48, r.

Genus Anthraconeilo Girty

Anthraconeilo bownockeri n. sp.

Pl. X, fig. 21

Description.—Shell small to almost median in size, transversely, ovate in outline, ratio of height to length about 2 : 3, maximum height about one-third the length of the shell from the posterior margin; moderately convex in umbonal region, becoming compressed anteriorly and slightly so at the posterior margin; beak directed posteriorly, prominent, elevated above hinge line and slightly incurved, situated about one-third the length of the shell from the posterior margin; anterior-dorsal margin long, sloping downward from the beak to the anterior extremity which is bluntly pointed and considerably produced; posterior margin broadly rounded; ventral margin rounded, sloping strongly upward anteriorly to meet the pointed anterior extremity. Surface of internal cast smooth.

Dimensions.—The measurements of the holotype are: length 18 mm., height 11 mm., convexity of left valve 3.5 mm.

Remarks.—This species of *Anthraconeilo* is of rare occurrence and has been found only in the Sharon ore from which internal casts of single valves of only three individuals have been discovered. It differs from *A. taffiana* Girty principally in its smaller size and more pointed

anterior extremity, which in the latter species is blunt and somewhat truncated. It is very similar to *A. kessleriana* (Mather), but may be distinguished by its less centrally located beaks and its more produced anterior end (the long pointed one), which give to the shell a decidedly more transversely-elongate form.

Horizon and locality.—Sharon ore: Lick Run, Scioto County, Locality 2, r. The specific name is given in honor of Dr. J. A. Bownocker, State Geologist of Ohio.

Genus Parallelodon Meek

Four species of *Parallelodon* are among the collections of Pottsville fossils studied,—*P. carbonarius*, *P. obsoletus*, *P. sangamonensis*, and *P. tenuistriatus*, all of which are of common occurrence except *P. sangamonensis*. The genus extends from the Harrison ore at the base throughout the entire formation, but occurs most abundantly in the Lower Mercer and McArthur members.

Parallelodon carbonarius (Cox)

1857 *Arca carbonaria.* Cox, Geol. Surv. Ky., Vol. 3, p. 567, Pl. 8, Fig. 5.
Coal Measures: Kentucky.
1887 *Macrodon carbonaria.* Herrick, Bull. Den. Univ., Vol. 2, p. 32, Pl. 4, Figs. 14, 21.
Coal Measures: Flint Ridge, Ohio.

Description.—*Parallelodon carbonarius* is particularly common in the Lower Mercer limestone although it occurs as low as the Boggs; it is also present in the higher members. It is characterized by surface sculpture of prominent, regular, radiating plications which become considerably larger and stronger on the flattened posterior portion below the hinge line.

Dimensions.—The dimensions of a specimen of average size from the Boggs member are: length 20 mm., height from beak to opposite margin 9 mm.

Horizon and locality.—Boggs member: Muskingum County, Locality 26, c. Widely distributed in the Lower Mercer limestone, c. Upper Mercer member: Muskingum County, Locality 68, r. Widely distributed in the McArthur member, c.

Parallelodon obsoletus (Meek)

Pl. XI, figs. 1, 2

1871 *Macrodon obsoletus.* Meek, Rep. Regents Univ., W. Va.
Lower Coal Measures: Monongahela County, West Virginia.
1875 *Macrodon obsoletus.* Meek, Pal. Ohio, Vol. II, p. 334, Pl. 19, Fig. 9.
Coal Measures: Newark, Ohio.

Description.—This species of *Parallelodon* appears in the Lowellville limestone but is most characteristic and abundant in the Lower Mercer. It is distinguished from the other species of *Parallelodon* occurring in this State by the apparent absence of all surface markings. The obscure, fine, radiating lines of the posterior-dorsal region, referred to by Meek[1] do not appear on the specimens examined. The individuals from the Lowellville limestone are all imperfectly preserved, so that their identification is not accompanied by a great degree of certainty. A specimen of average size from the Lower Mercer limestone measures: length 27.5 mm., maximum height 11.5 mm., convexity of right valve 5.5 mm.

Horizon and locality.—Lowellville limestone: Muskingum County, Locality 19, r. Widely distributed in the Lower Mercer member, c. McArthur member: Jackson County, Locality 80, r; Vinton County, Locality 85, c.

Parallelodon sangamonensis (Worthen)

Pl. XI, figs. 3, 4

1890 *Macrodon sangamonensis.* Worthen, Geol. Surv. Ill., Vol. 8, p. 123, Pl. 21, Figs. 3, 3a.
Coal Measures: Sangamon County, Illinois.

Description.—This form is rare in the Pottsville formation of Ohio, and where present is only about one-half the size of the Illinois specimens; an individual of average size measures: length 24 mm., height from beak to ventral margin 13 mm. Extending from the beak to the posterior margin there are generally six strong, rounded ribs; the remainder of the shell is smooth or marked by fine, radiating lines. The general contour resembles Worthen's species so closely the identification is made with considerable confidence.

Horizon and locality.—Lowellville limestone: Mahoning County, Locality 22, r. Widely distributed in the Lower Mercer limestone of Perry, Muskingum, and Licking counties, r. Lower Mercer ore: Jackson County, Locality 56, r. Upper Mercer member: Muskingum County, Locality 68, r. McArthur member: Jackson County, Locality 80, r; Vinton County, Locality 84, r.

Parallelodon tenuistriatus (Meek and Worthen)

Pl. X, figs. 30, 31

1866 *Arca striata.* Geinitz, Die Carb. und Dyas in Nebraska, p. 20, Tab. 1, Fig. 32. (Non *Mytilites striatus* Schloth., 1817.)
Nebraska City, Nebraska.
1867 *Macrodon tenuistriata.* Meek and Worthen, Proc. Chicago Acad. Sci., Vol. 1, p. 17.
Upper Coal Measures: Springfield, Illinois.

[1]Meek, F. B., Pal. Ohio, Vol. II, p. 334, 1875.

Description.—*Parallelodon tenuistriatus* is a common fossil throughout the Pottsville formation of this State, but it occurs in especial abundance in the Harrison ore and in the Lower Mercer and McArthur members. Forms from the Harrison ore and the McArthur limestone are unusually small and diminutive, while in the Lower Mercer and other horizons a much larger size is attained as may be seen by the following measurements:

Specimens of average size	Harrison	Lower Mercer	McArthur
Length	14.5 mm.	29 mm.	17 mm.
Height	6 mm.	13.5 mm.	8 mm.
Thickness of single valves	3 mm.	6 mm.	4 mm.

Horizon and locality.—Harrison ore: Jackson County, Locality 1, a. Boggs member: Muskingum County, Locality 27, r. Widely distributed throughout the Lower Mercer and McArthur members, a. Upper Mercer member: Perry County, Locality 62, r; Muskingum County, Locality 68, r; Coshocton County, Locality 70, r. Black Flint member: Vinton County, Locality 92, r.

Genus Aviculopinna Meek

Aviculopinna americana Meek

1866 *Aviculopinna pinnaeformis.* Geinitz, Die Carb. und Dyas in Nebr., p. 31, Tab. 2, Fig. 13. (Non *Solen pinnaeformis* Geinitz, 1848.) Nebraska City, Nebraska.
1867 *Aviculopinna americana.* Meek, Am. Jour. Sci., 2nd Ser., Vol. 44, p. 282.
1872 *Aviculopinna americana.* Meek, U. S. Geol. Surv. Nebr., p. 197, Pl. 9, Figs. 12a–d. Upper Coal Measures: Nebraska City, Nebraska; Iowa.

Description.—Internal casts of *Aviculopinna americana* are fairly common in the Boggs member of Muskingum County, and have also been found in the Lower Mercer limestone along Flint Ridge, Licking County. Specimens are on the average very similar in size and contour to the one figured by Meek from the Lower Coal Measures of this State.[1] However, some of the forms from the Boggs limestone are much larger, the largest individual measuring, if restored, about 3.25 inches (or 82 mm.). As nearly as can be judged from the crushed condition of the shells, the original convexity was great and the valves were flattened just below the cardinal margin. The beak is minute and not quite terminal, with the anterior margin extending beyond it in a small pointed lobe; a well defined marginal ridge marks the straight

[1]Meek, F. B., Pal. Ohio, Vol. II, p. 337, Pl. 20, Fig. 2, 1875.

cardinal margin. The surface is smooth except for a few thin, elevated lines parallel to the ventral and posterior margins.

Remarks.—This species is rare in the Pennsylvanian rocks of Ohio, and there is no record of its occurrence at any horizon as commonly as in the Boggs member. The type specimen was obtained from the upper Coal Measures of Nebraska, at which horizon it also occurs in Iowa and Missouri. Meek, however, described and figured the same species from the lower Coal Measures of Ohio, but he does not state the exact horizon or locality from which the figured specimen came. Herrick also figures a specimen from Flint Ridge (Lower Mercer member) which he provisionally refers to the same species.[1]

Horizon and locality.—Boggs member: Muskingum County, Locality 26, c. Lower Mercer limestone: Perry County, Locality 35, r; Licking County, Locality 48, r.

Genus Pteria Scopoli

Pteria ohioense (Herrick)

1887 *Gervillia ? ohioensis.* Herrick, Bull. Den. Univ., Vol. 2, p. 36, Pl. 4, Fig. 3; Pl. 3, Fig. 12.
Coal Measures: Flint Ridge, Ohio.

1887 *Avicula (Gervillia) ohioensis.* Herrick, Bull. Den. Univ., Vol. 2, p. 145, Pl. 14, Fig. 22.
Coal Measures: Flint Ridge, Ohio.

Herrick's description.—"The upper outline is nearly straight; beak distant nearly one-third the length from the anterior margin; posterior wing greatly produced, posterior margin deeply sinuous; posterior, produced part of shell keeled; anterior wing acute, its margin very oblique and slightly curved to its junction with the lower margin, with which it forms a continuous symmetrical curve. Hinge line, .65 (inches); height .45, greatest length .85. The surface is marked by rather obvious concentric lines. The postero-inferior projection is greater than that of the hinge line. From *A. longa,* which it most resembles, it differs in being not only larger, but less produced posteriorly, the posterior sinus is much less and the anterior part of the shell does not appear to have the oblique sulcus described for that species."

Remarks.—This species is of relatively wide distribution in the Lower Mercer and McArthur limestones; although the number of individuals obtained from any one locality is small; the specimens studied are all imperfect in one way or another, probably due to the thin, fragile character of the shell. No important differences were noted between our form and Herrick's species.

A few specimens from the Black Flint member have likewise been

[1]Herrick, C. L., Bull. Den. Univ., Vol. 2. p. 38, Pl. 1, Fig. 20, 1887.

referred to the same species with some doubt. The individuals are considerably distorted and apparently resemble *P. longa* more closely than Herrick's species. The posterior outline below the hinge line is more sinuous and the posterior portion of the body more produced than in *P. ohioense*, yet on a stratigraphic basis identification with the latter species is much more plausible than with *P. longa*. The imperfect condition of the material renders any specific identification uncertain.

Horizon and locality.—Lower Mercer limestone: Scioto County, Locality 31, r; Perry County, Locality 35, r; Muskingum County, Localities 43 (c), 45 (r); Licking County, Localities 46 (r), Flint Ridge, 47 (c), 48 (r). McArthur limestone: Jackson County, Locality 80, c. Black Flint: Jackson County, Locality 87, r; Vinton County, Locality 91, r.

Genus Pseudomonotis Beyrich

Pseudomonotis sp.

Description.—Fossils belonging to the genus Pseudomonotis occur in the Lower Mercer limestone but are too poorly preserved to be determined specifically. They are small in size and although the complete outline cannot be observed, they show a surface sculpture of flexuous costae with vaulted scale-like projections which alternate with smaller costae; still smaller radiating lines cover the interspaces. Herrick cites as cf. *Pseudomonotis radialis* an apparently closely related form from the Lower Mercer limestone on Flint Ridge which resembles the form under discussion in surface sculpture although exact comparisons of the contour are impossible.[1]

Horizon and locality.—Lower Mercer limestone: Perry County, Locality 35, r; Muskingum County, Locality 43, r.

Genus Posidonia Bronn

Posidonia ? acosta (Cox) ?

1857 *Avicula acosta.* Cox, Geol. Rep. Ky., Vol. 3, p. 572, Pl. 9, Fig. 3.
Coal Measures: Union County, Kentucky; Gallatin County, Illinois.

Description.—A single valve of a small pelecypod with the outline of *Placunopsis recticardinalis* was obtained from the Lower Mercer limestone of Coshocton County. However, all traces of the radial sculpture, characteristic of the genus *Placunopsis*, as well as the usual superimposed markings, are entirely wanting. But the absence of the peculiar superimposed markings is perhaps of little importance on a single specimen as the shell may have been attached to a smooth or

[1]Herrick, C. L., Bull. Den. Univ., Vol. 2, p. 145, Pl. 14, Fig. 26, 1887.

unornamented object. The surface of the valve in question is marked by fine concentric lines and by very faint concentric wrinkles. In view of the surface sculpture, the most plausible specific reference seems to be Cox's *Avicula acosta*, although our form has the hinge line slightly less produced and the lateral margins just below less concave. If the species is the same as that described as *A. acosta*, the valve must be the opposite (right ?) to Cox's figured specimen, which therefore is apparently equivalve and lacks a byssal sinus in either valve. If it is not the same as *A. acosta*, the presence of a byssal notch on the opposite valve of either specimen cannot be determined.

Assuming a specific identity with *A. acosta*, our form seems generically most closely allied with *Posidonia*, although it might almost as well be placed with *Plagiostoma* which also lacks a byssal notch in either valve, especially as the concentric wrinkles are very faint and poorly expressed,—markings of generic importance in the genus *Posidonia*. Two other specimens of the same valve and probably representing the same form, one also from the Lower Mercer and the other from the Black Flint member, resemble Cox's species more closely in outline, but have a surface sculpture similar to the previously described individual.

Dimensions.—Height 10 mm., length of hinge line 9 mm., maximum width below hinge line 10.5 mm.

Horizon and locality. — Lower Mercer limestone: Muskingum County, Localities 43, 44, r. Black Flint: Vinton County, Locality 91, r.

Posidonia girtyi n. sp.

Pl. XII, figs. 1–4

Description.—Shell large, ovate, compressed, slightly oblique; beaks prominent, almost anterior, slightly elevated above and incurved over the hinge line; greatest convexity in umbonal region, posterior and ventral portions flattened; hinge line straight, about three-fifths the length of the shell below; anterior margin almost straight or slightly convex, with small anterior auricle; ventral and posterior margins continuously rounded, with the latter truncated above and forming an angle of about 70 degrees with the hinge line; posterior auricle large, flattened. Surface marked by numerous strong, regular, concentric folds, separated by broad, rounded furrows. Shell very thin and fragile.

Dimensions.—The dimensions of two cotypes are:

	1	2
Length	40 mm.?	32 mm.
Height	45 mm.	38 mm.?
Length of hinge line	20 mm.?	18 mm.
Convexity	3.5 mm.	3 mm.

Remarks.—This species of *Posidonia* has been found at only two localities, one in Vinton and the other in Muskingum County, and although it is fairly abundant, no entirely perfect specimens have been obtained, probably on account of the thin, fragile character of the shell. The small, depressed anterior auricle is very seldom preserved. The species is characterized by its almost erect form, by its small anterior ear, and by its strong, regular concentric wrinkles. On large mature specimens these wrinkles are coarser and more irregular in arrangement in the umbonal region, becoming finer and more regular in the basal half toward the posterior margin of the shell; young, immature shells, on the other hand, exhibit only the coarser concentric wrinkles of the umbonal region of mature specimens. On a few of the larger forms very faint indications of coarse, radiating plications were noted in the furrows between the folds. There is no American species of *Posidonia* with which our form can be compared except *P.* (*Posidonomya*) *pertenuis* Beede; although very similar to the latter in contour, the Ohio species can be distinguished by its stronger, more numerous and more regular concentric wrinkles, and possibly by its smaller anterior auricle. It seems probable that the short auricle of *P. pertenuis* as well as that of the species under discussion is anterior, while the longer is posterior.[1]

In determining the generic position of this form three genera deserve serious consideration: *Posidonia* (=*Posidonomya*), *Posidoniella*, and *Caneyella*, all of which are characterized surficially by coarse concentric folds. *Posidonia*, rather than *Posidoniella*, seems correct on account of the presence of the small anterior auricle which is present on the former, but which is absent on the latter species; likewise, the beaks are anterior but not terminal as is generally the case in *Posidoniella*. It differs from *Posidonomya beecheri* Bronn, the type of the genus, principally in its more erect form and smaller anterior auricle. The form under discussion also seems very close to *Caneyella*, which may show an anterior auricle, and it strongly resembles *C. vaughani* Girty in its generic relationships. However, as the Ohio specimens are too poorly preserved to determine with any degree of certainty the presence of the large conspicuous byssal aperture between the valves which characterizes the genus *Caneyella*, it is deemed advisable to place our form under the genus *Posidonia* rather than under *Caneyella*.

Horizon and locality.—Black shale on Lowellville horizon ?: ravine near Holbein, Muskingum County, Locality 20, c. Black Shale on Lower Mercer horizon: Rock Hollow, Elk Township, Vinton County, Locality 34, a. Named in honor of the distinguished paleontologist of the United States Geological Survey, Dr. George H. Girty.

[1]Beede, J. W., Geol. Surv. Kansas, Vol. VI, p. 136, Pl. XIX, Fig. 5, 1900. Dr. Beede orients his species so that the longer auricle is anterior in position.

Posidonia vintonensis n. sp.

Pl. XII, figs. 5, 6

Description.—Shell small, obliquely semicircular to semiovate, moderately convex in umbonal region and along umbonal slope, but depressed along basal and posterior margins and also on large posterior auricle; axis of shell forming an angle of about 45 degrees with the hinge line; beak small and inconspicuous, scarcely elevated above the hinge line, located about one-fourth the length of the shell from the anterior extremity. Hinge line straight, long; basal and posterior margins forming a continuous curve, the latter meeting the hinge line at an obtuse, rounded angle; anterior margin oblique, almost straight, with small but conspicuous anterior auricle. Surface marked by rather coarse, sharply defined, concentric wrinkles which become obsolete or nearly so on the large, flattened posterior auricle. Shell extremely thin and fragile.

Dimensions.—The dimensions of two cotypes, the first of average size and the second of unusually large size, are:

	1	2
Length at hinge line	9 mm.	15 mm.
Maximum height perpendicular to hinge line	7 mm.	12 mm.
Length along oblique axis	9 mm.	14 mm.

Remarks.—This small species occurs abundantly in the black shales on the Lower Mercer horizon in Rock Hollow, one and one-half miles south of McArthur, Vinton County. It is here associated with the large species of *Posidonia*, described in the present report as *P. girtyi*, although no specimens were discovered in association with the latter species in the ravine near Holbein, Muskingum County. The known occurrence is confined to the single locality in Vinton County. The species is characterized by its small size, very oblique form, small although prominent anterior auricle, and strong concentric undulations. The extremely fragile, depressed posterior auricle and posterior margin are very seldom found in a perfect state of preservation.

Generically this form has been placed with *Posidonia* rather than with *Posidoniella* on account of its less anterior beak and its conspicuous anterior auricle. *Pteria* is another closely related genus, which, however, lacks the strongly wrinkled concentric surface sculpture of *Posidonia*. Although our form is also similar to *Naiadites*, its surface markings and its association with marine fauna serve to separate it from that genus.

Horizon and locality.—Black shale on Lower Mercer horizon: Rock Hollow, Elk Township, Vinton County, Locality 34, a.

Posidonia sp.

Description.—Shell of median size, subcircular or a little ovate in outline, slightly oblique, ratio of height to length about 13:12; slightly convex in umbonal region, becoming flattened toward the margins; beaks almost centrally located, very small and inconspicuous, depressed below hinge line; dorsal margin straight, about one-half as long as the maximum diameter of the shell below, extremities rounded; anterior and posterior margins broadly rounded and very slightly flattened at the middle of the shell, forming a continuous curve with the ventral margin which is more narrowly rounded; anterior and posterior auricles about equal in size. Surface marked by broad, ill-defined, concentric wrinkles and by fine concentric lirae which cover the entire shell. Shell, where preserved, thick.

Dimensions.—Height normal to dorsal margin 26 ± mm., length normal to height 24 mm., convexity of single valve 1.5 mm.

Remarks.—This rare form has been found only in the Lower Mercer member of Muskingum and Licking counties, and is represented in the collections studied by about six specimens, all more or less imperfect. It seems identical with the species identified and figured by Miss Clara G. Mark as *Placunopsis carbonaria* from the Lower Mercer limestone in the Flint Ridge region; however, none of the specimens at hand show the concentric wrinkles as strongly marked as the figured specimen, Fig. 9, Pl. X, Bull. Den. Univ., Vol. XVI, 1911. *Posidonia* seems a closer generic reference than the group of forms placed by Meek and Worthen under *Placunopsis*. Concentric undulations of the surface are of generic significance in *Posidonia* but do not ordinarily belong to the other genus. Likewise, the total absence of radiating striae, even though they are more or less evanescent, and of less importance the lack of accessory superimposed markings, due to attachment to foreign objects, which are characteristic of *Placunopsis*, but do not belong to *Posidonia*, point to identification with the latter genus. The form seems unlike any Pennsylvanian *Posidonia* in its specific relationships, and probably represents an undescribed species.

Horizon and locality.—Lower Mercer limestone: Muskingum County, Localities 28, 39, r; Licking County, Localities 47, 48, r.

Genus Myalina DeKoninck

Myalina pernaformis Cox

Pl. XI, figs. 7–9

1857 *Myalina pernaformis.* Cox, Geol. Rept. Ky., Vol. 3, p. 569, Pl. 8, Fig. 8. Coal Measures: Providence, Hopkins County, Kentucky.

Description.—This form is not rare in Pottsville rocks of Ohio, but is particularly common and characteristic of the Boggs and Black Flint members. In size it varies within wide limits from very large specimens to immature ones which are about one-half the size of that figured by Cox. The following measurements of individuals selected from the Boggs and Black Fint members will illustrate this variation in size:

	Boggs			Black Flint
Length of greatest diameter, from beak to posterior-inferior margin	22 mm.	48 mm.	60 mm.	69 mm.
Width, normal to umbonal ridge	10 mm.	21 mm.	30.5 mm.	35.5 mm.
Length of hinge line	12 mm.	21 mm.	28+ mm.	44 mm.
Convexity of left valve	3 mm.	6 mm.	10 mm.	crushed

Anterior margin straight, forming an angle of 60 to 65 degrees with the hinge line, subparallel to posterior margin; posterior margin slightly convex in outline, rounding broadly into the front below the middle of the shell. Sometimes the posterior end of the hinge line is somewhat produced with the posterior-lateral margin directly below slightly constricted, so that the posterior-superior angle forms a small wing-like extension; sometimes the posterior margin meets the hinge line at right angles, while more commonly the hinge line is short and the posterior-superior angle is truncated and slightly rounded. The surface is marked by strong, regular, concentric lines of growth.

Remarks.—The form resembles that of *M. kansasensis* Shumard, but lacks the fluted lamellae of that species. It differs from *M. recurvirostris* Meek and Worthen in its more oblique form and in lacking the prominent, strongly recurved beak which characterizes that species.

Horizon and locality.—Boggs member: Muskingum County, Localities 26, 27, 28, c. Lower Mercer limestone: Perry County, Locality 35, r; Muskingum County, Locality 45, c; Licking County, Locality 46, c. Upper Mercer member: Muskingum County, Localities 28, 68, r. McArthur limestone: widely distributed, c. Black Flint: Vinton County, Localities 91, 92, r.

Myalina pernaformis Cox var.

Pl. XI, figs. 5, 6

Description.—Two small specimens of *Myalina* from the Harrison ore of Jackson County have been classed as a variety of *Myalina pernaformis*. The axis is somewhat more oblique and the size much less than that of mature specimens of *M. pernaformis* from the higher Pottsville horizons. The angle between the cardinal and anterior margins measures about 52 degrees. It can be compared to *M. cunei-*

formis Gurley, but that form is still more oblique and more triangular in outline.

Dimensions.—Length of greatest diameter from beak to posterior-inferior margin 31 mm., width normal to umbonal ridge 16 mm., thickness of left valve 7 mm.

Horizon and locality.—Harrison ore: Jackson County, Locality 1, r.

Myalina recurvirostris var. sinuosa n. var.

Pl. XI, figs. 10–12

Description.—A variety of *Myalina recurvirostris* is of common occurrence in the Lower Mercer limestone from a single locality in Coshocton County. It possesses the strongly recurved beak of Meek and Worthen's species but differs in having a much longer hinge line which forms the widest portion of the shell and produces a prominent wing-like extension in the posterior-dorsal part of the shell. Below the hinge line the strong, concentric, rather regular laminae which cover the surface are curved abruptly, following the contour of the posterior wing. Just below the hinge line the posterior margin becomes sinuous, and a broad, shallow, faintly defined depression extends from the beak to this portion of the shell. Meek and Worthen describe the posterior part of *M. recurvirostris* thus, : "Posterior side compressed; its margin a little convex in outline, ranging nearly at right angles to the hinge above. . . . ."[1] It differs from the variety at hand in its shorter hinge line and in its rounded posterior-dorsal angle.

Dimensions.—The average size of the individuals is approximately the same as that of typical *M. recurvirostris.* An extremely large individual measures: length normal to hinge line 62 ± mm., width normal to length 47 mm., length of hinge line 61 ± mm.

Horizon and locality.—Lower Mercer limestone: Holmes County, Millersburg, Locality 51, c.

Myalina swallovi McChesney

Pl. XI, fig. 13

1860 *Myalina swallovi.* McChesney, Desc. New Pal. Foss., p. 57.
Coal Measures: Charbonier and 12 miles northwest of Richmond, Missouri.
1865 *Myalina swallovi.* McChesney, Ill. New Spec. Foss., Pl. 2, Fig. 6a–d.

Remarks.—This well known fossil with its wide stratigraphic and geographic range is a rather common member of the middle and upper Pottsville fauna of Ohio. It is generally well preserved and differs in no way from the species as it ordinarily occurs.

[1]Meek and Worthen, Geol. Surv. Ill., Vol. 2, p. 344, Pl. 26, Figs. 9a-c, 1866.

Dimensions.—A specimen of average size from the Lower Mercer limestone measures: maximum length parallel to hinge line 16 mm., length of hinge line 12 mm., height perpendicular to hinge line, near posterior end 12 mm., height at beak 5 mm., length of umbonal ridge 19 mm.

Horizon and locality.—Of general distribution throughout the Lower Mercer, McArthur, and Black Flint members, c.

Genus Naiadites Dawson

Naiadites elongata Dawson

Pl. XII, figs. 7–9

1860 *Naiadites elongata.* Dawson, Supp. Acad. Geol., p. 43.
Coal Measures: Nova Scotia.
1868 *Naiadites elongata.* Dawson, Acad. Geol., p. 204, Fig. 43.
Middle Coal Measures: Joggins and Sidney, Nova Scotia.

Description.—This fresh or brackish water pelecypod is characterized by its elongate, oblique form, its small inconspicuous beak, its short hinge line, and its fine, regular, concentric surface markings. Its great variability of form is conspicuous, and it is possible that more than one species may here be included under the name *N. elongata.* However, it is generally found greatly crushed and distorted by pressure so that a considerable variation in form is to be expected. It occurs abundantly in the lower horizons of the Pottsville formation, especially in the fissile shale and black band ore on the Bear Run coal horizon in which it is the only fossil found with the exception of plants and fish scales. A form of *Naiadites* which has been provisionally referred to the same species, occurs very sparingly in the shales associated with the Quakertown or No. 2 coal. The Quakertown specimens differ considerably in contour from those of the Bear Run horizon, but again a possible explanation for these differences is distortion due to pressure. Forms similar to those of the Bear Run member have also been found abundantly on the Sharon horizon,—in the black shales overlying the coal and in the ore,—and also at one locality in the Boggs member.

Dimensions.—Average sized individuals from the various horizons in which they occur have the following measurements:

	Sharon	Quakertown	Bear Run	Boggs
Length	15 mm., 9 mm.	15.5 mm.	16.2 mm.	18.5 mm.
Height	8.5 mm., 5.5 mm.	9.5 mm.	9.7 mm.	9.5 mm.
Thickness	- ------ 3.8 mm.	--------	--------	--------

Remarks.—Members of this genus, as they are found in Ohio, occur either wholly by themselves, or associated with plant remains and

fish plates. However, a few poorly preserved specimens of a large obscure species of *Naiadites* were found with large numbers of *Lingula carbonaria* on the Anthony coal horizon. Often *N. elongata* is so abundant that freshly broken surfaces of shale present a mass of crushed and macerated individuals.

Horizon and locality.—Sharon horizon: Scioto County, Harry Odle mine, Locality 4, r; John Alexander mine, Locality 3, c. Quakertown or No. 2 coal horizon: Muskingum County, Grace mine, Twin-Ada mine, and Wilson mine, Localities 11, 10, 9, r. Bear Run horizon: abundant in Scioto, Jackson, and Vinton counties in all localities from which collections were made, Localities 13, 14, 15, 16, 17, 18, aa. Boggs member: Scioto County, Bloom Township, Locality 23, a.

Naiadites ohioense n. sp.

Pl. XII, figs. 10–13

Description.—Shell small, obliquely elongate, gibbous, the greatest thickness being a little anterior to the middle, right valve a little more compressed than the left, shell gaping along ventral and posterior margins; hinge line almost or entirely as long as the greatest length of the shell; beaks minute, anterior but not quite terminal, incurved, slightly elevated above the hinge line; anterior lobe small, prominent, gibbous, projecting a little beyond the beak, rounding into the ventral or inferior margin; ventral margin concave or sinuous in middle, bluntly rounded posteriorly; posterior portion forming the greatest height of the shell, margin straight or very slightly rounded, meeting the hinge line at an angle which is either a little greater than or equal to a right angle; a prominent, gibbous umbonal ridge extending obliquely backward from the beak to the posterior-inferior angle, broadening posteriorly, but preserving its distinctive character throughout its extent; a deep, oblique sinus anterior to the ridge, separating the anterior lobe from the remainder of the shell; region below hinge line depressed. Surface marked by fine, regular, concentric lines of growth.

Dimensions.—A cotype measures: Maximum length 12 mm., maximum height near posterior margin 8 mm., length of hinge line 9.5 mm., convexity 6.5 mm.

Remarks.—This species of *Naiadites* has been found at one locality in Scioto County where it is not only extremely abundant, but specimens are often in a remarkable state of preservation,—a condition very unusual for representatives of this genus; the general occurrence of *Naiadites* in Pottsville rocks of Ohio is crushed, distorted, or macerated. The species under discussion occurs in nodules of iron ore and is associated with *N. elongata*, but no other fossils are present. *N. elongata* differs in having a shorter hinge line which is equal to less than one-

half the length of the shell; also in its rounded posterior margins and its less prominent umbonal ridge. *N. ohioense*, however, is very variable and differences exist in the size and prominences of the anterior lobe, the length of the hinge line, and the outline of the posterior portion. Whether these points of difference are due to slight distortion or natural variation among individuals, or whether more than one species is really present, is a matter of question. But on account of the variable nature of the genus itself, such differences are to be expected and are therefore particularly difficult to evaluate. After a careful study of the material at hand, it seems best to the writer to group under one species these forms with the long hinge line, as no tangible basis for further subdivision is evident.[1]

Horizon and locality.—Sharon ore: Scioto County, occurs in nodules of iron ore in the John Alexander mine, Locality 3, aa.

Naiadites sp.

Remarks.—Several crushed, poorly preserved specimens of a very large species of *Naiadites* were found associated with large numbers of *Lingula carbonaria* in the black shales of the Anthony coal horizon. They are, however, too poor for identification.

Horizon and locality.—Anthony coal horizon: Scioto County, Wm. E. Dee mine, Locality 7, r.

Genus Schizodus King

Schizodus amplus Meek and Worthen

Pl. XII, fig. 18

1870 *Schizodus amplus.* Meek and Worthen, Proc. Acad. Nat. Sci. Phil., p. 41.
Coal Measures: Seville, Fulton County, Illinois.

1873 *Schizodus amplus.* Meek and Worthen, Geol. Surv. Ill., Vol. 5., p. 579, Pl. 27, Fig. 6.
Coal Measures: Seville, Fulton County, Illinois.

[1]Since the above discussion was completed there has come to the attention of the writer figures and a description of a species of *Naiadites*, designated by Price as *N. carbonaria* Dawson, from the Pottsville series of West Virginia. (See W. Va. Geol. Surv., Webster Co. Rept., p. 602, Pl. XXXV, Figs. 1, 2.) Price states that these fossils may represent immature forms of either *N. elongata* or *N. carbonaria*. The writer is unable to find any essential differences between the Ohio and West Virginia species, unless perhaps *N. ohioense* has a greater posterior extension as well as a typically longer hinge line which equals the greatest diameter of the shell; but these characters are very variable. The umbonal ridge and the sinus below are more prominent on our specimens than the figures of the West Virginia form seem to indicate, which may, however, be accounted for by the fact that the former is unusual in being practically unaffected by pressure. Considering, then, the variable character of the group it does not seem at all improbable that the Ohio and West Virginia forms may belong to the same species. However, our form differs from typical *N. carbonaria*, as described and figured by Dawson, in the smaller size of mature individuals and in the longer hinge line, and seems to constitute a distinct species.

Description.—An excellent cast of the left valve of *Schizodus amplus* is among the collections of Boggs fossils at hand. The species is characterized by its large size, quadrangular form, anteriorly placed beak, and long, straight cardinal margin posterior to the beak. In the specimen studied the pallial line, the large oval adductor scar, and the anterior pedal muscular impression are distinctly marked.

Dimensions.—The figured specimen from the Boggs limestone measures: length about 70 + mm., height 56.5 mm., thickness of left valve 14 mm. (somewhat crushed).

Horizon and locality.—Boggs limestone: Muskingum County, near Hopewell P. O., Locality 26, r.

Schizodus affinis Herrick

Pl. XII, fig. 17

1887 *Schizodus affinis.* Herrick, Bull. Den. Univ., Vol. 2, p. 41, Pl. 4, Figs. 22, 22a.
Coal Measures: Flint Ridge, Ohio.

Remarks.—*Schizodus affinis* is a common fossil of wide stratigraphic range in the Pottsville rocks of this State; it is found from the Harrison ore at the base to the McArthur member near the top. The species exhibits considerable variation in size; an individual of average size from the Harrison ore measures: length 17.5 mm., height 14.2 mm., thickness of left valve 4.8 mm.

Horizon and locality.—Harrison ore: Jackson County, Locality 1, r. Boggs member: Muskingum County, Localities 26, 28, c. Lower Mercer member: Muskingum County, Localities 43, 45, r; Licking County, Localities 46, 47, r. McArthur member: Jackson County, Locality 80, c; Vinton County, Localities 84, 85, c.

Schizodus cuneatus Meek

Pl. XIII, figs. 1, 2

1875 *Schizodus cuneatus.* Meek, Pal. Ohio, Vol. II, p. 336, Pl. 20, Fig. 7.
Lower Coal Measures: Putnam Hill and Flint Ridge, Ohio.

Description.—Although this large species of *Schizodus* has been found only in the Lower Mercer member where it is of rather rare occurrence, nevertheless some excellently preserved specimens have been obtained. It is easily distinguished by its large size, its high pointed beaks, its short anterior end, and its extremely produced posterior-inferior angle.

Dimensions.—The largest specimen found measures: length 50 mm., height at beaks 41 mm., convexity of right valve 14 mm.

Horizon and locality.—Lower Mercer limestone: Licking County, Bald Knob, Locality 46, r; Flint Ridge, Locality 47, r.

Schizodus curtus Meek and Worthen

1866 *Schizodus curtus.* Meek and Worthen, Proc. Chicago Acad. Sci., Vol. 1, p. 18.
1887 *Schizodus curtus.* Herrick, Bull. Den. Univ., Vol. 2, pp. 42, 145, Pl. 14, Fig. 20.
Coal Measures: Flint Ridge, Ohio.

Remarks.—*Schizodus curtus* appears in the Boggs member, and although relatively rare, it continues throughout the middle and upper Pottsville formation. It is most common in the Lower Mercer and McArthur limestones, but even in the latter members the number of individuals found at any one locality is small.

Horizon and locality.—Boggs member: Muskingum County, Localities 26, 27, r. Lower Mercer member: Muskingum County, Localities 39, 43, r; Licking County, Flint Ridge, Localities 47, 48, 49, r. McArthur member: Jackson County, Locality 80, r; Vinton County, Localities 82, 84, r.

Schizodus mooresi Miller ?

1889 *Schizodus mooresi.* Miller, N. Am. Geol. and Pal., p. 511, Figs. 918, 919.
Coal Measures: Carbon Hill, Hocking County, Ohio.

Description.—Specimens of a very large, thick shelled *Schizodus* were obtained from the Lower Mercer and McArthur limestones, well preserved except in the posterior portions, which are in every case wanting or so badly crushed that no clue to the outline and to the degree of extension in that portion of the valve can be obtained. As these characters are of primary importance in separating the different species of Schizodus, any identification of these forms with described species must necessarily be extremely uncertain. They can, however, be best compared with *S. spellmani* Herrick and with *S. mooresi* Miller, the species in the latter case having been based upon imperfect specimens in which the posterior end is unknown; the McArthur forms may be referred equally as well to one species as to the other. The first mentioned form was described from the Lower Mercer horizon at Flint Ridge, while Miller's species came from a horizon a little above or possibly the same as the McArthur and from a relatively near-by locality. Comparisons with specimens from Carbon Hill, which are probably identical with Miller's *S. mooresi*, have been made, and very little difference could be noted. *S. mooresi* seems the closer specific reference for the Lower Mercer individuals also, although identification with this species is necessarily doubtful as the character of the posterior end is unknown.

Horizon and locality.—Lower Mercer member: Perry County, Locality 35, r; Muskingum County, Locality 40, r. McArthur member: Vinton County, Localities 84, 85, r.

Schizodus subcircularis Herrick

Pl. XII, figs. 14–16

1887 *Schizodus subcircularis.* Herrick, Bull. Den. Univ., Vol. 2, p. 41, Pl. 4, Fig. 24; p. 145, Pl. 14, Fig. 18.
Coal Measures: Flint Ridge, Ohio.

Description.—A single, well preserved individual of *Schizodus* from the Harrison ore has been referred to this species, the form of which is slightly more elongate than Herrick's figured specimens indicate. However, allowances must be made for the variable character of the Schizodus group and for some distortion resulting from compression. The collections studied contain excellent examples from the McArthur member which retain the almost circular form which characterizes the species. The beaks in these specimens are almost median in position.

Dimensions.—A specimen of average size measures: length 14.5 mm., height 14 mm., convexity of left valve 4.5 mm.

Horizon and locality.—Harrison ore: Jackson County, Locality 1, r. McArthur member: Jackson County, Locality 80, c; Vinton County, Locality 84, c.

Schizodus wheeleri Swallow

1858 *Schizodus obscurus.* Swallow, Trans. St. Louis Acad. Sci., Vol. 1, p. 193.
(Non *Axinus obscurus* Sowerby, 1823.)
Lower Permian, Kansas.
1872 *Schizodus wheeleri.* Meek, U. S. Geol. Surv. Nebraska, p. 209, Pl. 10, Figs. 1a-f.
Upper Coal Measures: Missouri, Nebraska, Iowa.

Remarks.—*Schizodus wheeleri*, with its wide geographic distribution throughout the Pennsylvanian and Lower Permian systems of this country, is present in the middle and upper Pottsville formation of Ohio, above and including the Boggs member. Specimens are often in a good state of preservation and many of them retain, partially at least, the fine, regular, concentric surface sculpture of the species. The form is of fairly common occurrence.

Horizon and locality.—Boggs member: Muskingum County, Locality 26 c. Widely distributed in the Lower Mercer, Upper Mercer, McArthur, and Black Flint members, c.

Genus Aviculopecten McCoy

Aviculopecten coxanus Meek and Worthen

1860 *Aviculopecten coxanus.* Meek and Worthen, Proc. Acad. Nat. Sci. Phil., p. 453.
Coal Measures: Adams County, Illinois.

Description.—*Aviculopecten coxanus* is common throughout the Pottsville formation of Ohio, but occurs abundantly in the Lower Mercer limestone. The radiating ribs, which alternate in size, are on the whole finer with wider interspaces than indicated on Herrick's figured specimen from the Lower Mercer limestone of Flint Ridge.[1] The form is slightly oblique with large ears which are also marked by radiating ribs. The entire surface is covered with fine, closely arranged, concentric lines.

Dimensions.—A large specimen from the Sharon ore measures: length 13.5 mm., length of hinge line 10 mm., maximum width below hinge line 13 mm.

Horizon and locality.—Harrison ore: Jackson County, Locality 1, r. Sharon ore: Scioto County, Locality 2, c. Lowellville limestone: Muskingum County, Locality 19, c. Boggs member: Muskingum County, Locality 27, c. Widely distributed throughout the Lower Mercer member, a. Upper Mercer member: Muskingum County, Locality 68, r. Widely distributed throughout the McArthur member, c. Black Flint member: Jackson County, Locality 87, c; Vinton County, Localities 91, 92, r.

Aviculopecten herzeri Meek

Pl. XIII, figs. 3, 4

1871 *Aviculopecten (Streblopteria ?) herzeri.* Meek, Proc. Acad. Nat. Sci. Phil., p. 61.
Lower Coal Measures: Newark, Ohio.
1875 *Aviculopecten (Streblopteria ?) herzeri.* Meek, Pal. Ohio, Vol. II, p. 330, Pl. 19, Figs. 13 a-c.
Lower Coal Measures: Newark, Ohio.

Description.—*Aviculopecten herzeri* is one of the most common and characteristic pelecypods in the collections of middle and upper Pottsville fossils. It occurs most abundantly in the Lower Mercer and McArthur members, but has not been found at any of the lower horizons. The surface sculpture of fine subequal radiating and concentric markings, which produce a beautifully cancellated appearance, distinguish it from all other forms in the Pottsville formation, except possibly from *A. pellucidus.* The latter species, however, may be distinguished by its difference in outline and by its smaller size.

[1]Herrick, C. L., Bull. Den. Univ., Vol. 2, p. 26, Pl. 1, Figs. 4, 17, 1887.

Dimensions.—Individuals vary greatly in size. The largest specimen examined was obtained from the McArthur limestone and measures: height 40.5 mm., length 35 mm. A large individual from the Lower Mercer limestone measures: height 26 mm., length 23 mm., while the dimensions of a specimen of average size are: height 17 mm., length 14 mm.

Horizon and locality.—Widely distributed throughout the Lower Mercer and McArthur members, c.

Aviculopecten pellucidus Meek and Worthen

1860 *Aviculopecten pellucidus.* Meek and Worthen, Proc. Acad. Nat. Sci. Phil., p. 455.
Coal Measures: Adams County, Illinois.

1866 *Aviculopecten pellucidus.* Meek and Worthen, Geol. Surv. Ill., Vol. 2, p. 327, Pl. 26, Figs. 5 a, b.
Lower Coal Measures: Adams County, Illinois.

Description.—A single specimen of this small, delicately sculptured *Aviculopecten* was found in the black shale associated with the Lowellville limestone. Its surface is ornamented by slender ribs, a little more than their own diameter apart, which are crossed by rather strong, more closely arranged concentric lines. Where the radiating and concentric markings cross each other, little nodes or scales are formed. The ornamentation of the ears is similar to that of the body of the shell.

Dimensions.—Height 6.5 mm., length about 6 mm.

Horizon and locality.—Lowellville member: Muskingum County, Poverty Run, Locality 19, r.

Aviculopecten sorer Herrick

1887 *Aviculopecten sorer.* Herrick, Bull. Den. Univ., Vol. 2, p. 27, Pl. 1, Fig. 7; Pl. 3, Fig. 16.
Coal Measures: Flint Ridge, Ohio.

Description.—Rather small aviculoid shells occur in the collections of Lower Mercer fossils from Muskingum and Licking counties, which in all probability represent the same form which Herrick referred to as *Aviculopecten sorer*, although a number of points of divergence were noted. However, the fact that the specimens under discussion came from the same locality and horizon as Herrick's species lends additional weight to the identification. It is of rather rare occurrence and all of the individuals studied are more or less imperfect. The size is considerably less than Herrick's figures indicate, the largest individual observed being about two-thirds as large as the one found on Plate III, Fig. 16. The ears are subequal with the anterior one convex and

marked by strong radiating ribs crossed by fine concentric lines of growth; posterior ear strongly concave and acutely pointed above, externally marked by coarse, concentric lines of growth with faint traces of radiating ribs visible on a few specimens. The contour of the ears differs from the figured specimens of *A. sorer*, but resembles closely that of *D. scalaris*; the radiating markings are likewise represented as equally strong on both ears. The surface sculpture of the body of the shell consists of about seventeen strong, radiating ribs, slightly nodose in character, separated by two to four finer nodose lirae of varying size, with the interspaces between them wider than the lirae themselves. The entire surface is covered by extremely fine, concentric lines.

Horizon and locality. — Lower Mercer limestone: Muskingum County, Localities 28, 43, 45, r; Licking County, Locality 46, r.

Genus Deltopecten Etheridge

Deltopecten occidentalis (Shumard)

1855 *Pecten occidentalis.* Shumard, Geol. Rep. Mo., p. 207, Pl. C, Fig. 18.
Coal Measures: Near Plattsburg, Clinton County, Missouri.

Description.—This common and widely distributed Pennsylvanian pelecypod makes its appearance in this State in the Boggs limestone and continues throughout the remainder of the Pottsville formation; it is especially common in the Lower Mercer limestone. It is recognized by its subequal ears and its rounded radiating ribs of unequal size which die out at various intervals between the beak and margins; only a comparatively few extend as far as the beak. The Ohio specimens are all small, an individual of average size from the Boggs limestone measuring: length 20 mm., width 18 mm., length of hinge line 15 mm.

Horizon and locality.—Boggs limestone: Muskingum County, Locality 27, r. Widely distributed throughout the Lower Mercer limestone, c. McArthur member: Jackson County, Locality 80, r; Vinton County, Locality 84, c.

Deltopecten scalaris (Herrick)

Pl. XIII, figs. 5, 6

1887 *Aviculopecten scalaris.* Herrick, Bull. Den. Univ., Vol. 2, p. 26, Pl. 1, Fig. 8.
Coal Measures: Flint Ridge, Ohio.

Description.—Shell of median size, almost equivalve, moderately convex, length and width about equal, maximum length below middle of shell; hinge straight or nearly so, equal to about three-fourths the

maximum width of the shell below; cardinal area broad with large, triangular ligamental pit beneath the beaks. Ventral and anterior margins broadly rounded, posterior margin slightly produced below the middle of the shell; ears subequal, sharply defined on either side of the beaks by a sinus which is deeper on the anterior ear than on the posterior; anterior ear slightly convex in outline, posterior ear mucronate at hinge line, strongly concave in outline. Surface marked by fascicles of strongly elevated ribs, three to five in each bundle (generally four) which increase by bifurcation; ears also marked by strong radiating ribs; entire surface including the ears crossed by fine, regular, closely arranged, concentric lines, which form minute scales where they cross the radiating ribs.

Dimensions.—An individual of average size measures: length 34 mm., height 33 mm., length of hinge line 22.5 mm., convexity of left valve 5 mm.

Remarks.—*Aviculopecten fasciculatus* Keyes and *A. providencesis* Cox are Pennsylvanian species which also have the fasciculate grouping of the ribs and to which the Ohio Pottsville form can be compared. The former is a much larger species,—almost three times the size of our form,—and comes from a much higher horizon in the Pennsylvanian system. *A. providencesis* is likewise a much larger form. If these species could be reduced to the size of *D. scalaris*, the ribs would probably be larger and less numerous.

Horizon and locality.—Boggs member: Muskingum County, Locality 26, c. Lower Mercer member: Scioto County, Locality 31, c; Licking County, Localities 46, 47, c; Mahoning County, Locality 55, c. Upper Mercer member: Muskingum County, 68, r. McArthur member: Jackson County, Locality 80, r; Vinton County, Locality 84, c.

Genus Acanthopecten Girty

Acanthopecten carboniferous (Stevens)

1858 *Pecten carboniferous.* Stevens, Am. Jour. Sci. and Arts, Vol. XXV, p. 261.
Coal Measures: Crooked Creek, Marion County, Illinois.

Description.—*Acanthopecten carboniferous* is an abundant and widely distributed fossil in the Pottsville formation of this State above and including the Boggs member. It is recognized by its large ears, and by its distinctive surface sculpture of fifteen to eighteen large, regular, plications which are marked at regular, somewhat distant intervals by spine-like projections where concentric lines cross the plications. The size is comparatively constant; an individual of average size measures: height 16 mm., length of hinge line 13 mm., greatest width below hinge line 18 mm. A specimen of unusual size from the

Lower Mercer limestone has the following measurements: height 27 mm , length of hinge line 23 ± mm., greatest width below hinge line 29 mm.

Horizon and locality.—Boggs limestone: Muskingum County, Locality 26, c. Widely distributed in the Lower Mercer member, a. Upper Mercer member: Muskingum County, Locality 68, r; Mahoning County, Locality 76, r. Widely distributed throughout the McArthur member, c.

Genus Crenipecten Hall

Crenipecten foerstii Herrick

Pl. XIII, figs. 7, 8

1887 *Crenipecten foerstii.* Herrick, Bull. Den. Univ., Vol. 2, p. 28, Pl. 3, Figs. 9, 9a. Coal Measures: Flint Ridge, Ohio.

Herrick's description.—"Shell below the ears subcircular, but moderately convex, equivalve. Right valve with anterior ear produced, rounded in front, separated from the valve by a deeply impressed, concave auricular sinus; posterior ear nearly rectangular, slightly concave in posterior outline, separated from the valve by an impressed line; hinge line one-half the height of the valves. Left valve of same form, but the ears less distinctly separated; hinge line less than one-half the height, anterior ear with concave front outline. The beaks are acute and moderately prominent. Surface marked by numerous close, minute, concentric lines, and numerous irregular, concentric wrinkles which give a peculiar appearance to the shell, not shared by other species. These wrinkles are less marked on young shells. There are also, in most cases, indications of radiating lines, which in the larger shells are strong striae or ribs, at a distance from each other."

This species appears in the Boggs limestone where it is rare; but in the Lower Mercer horizon it constitutes an abundant and characteristic fossil, especially in the Flint Ridge region. Herrick states that next to *Entolium aviculatus* Swallow it is the most common bivalve at Flint Ridge, which statement in the experience of the writer is true. A specimen a little above average size measures: length 20 mm., height 20.5 mm., length of hinge line of right valve 11 mm.

Horizon and locality.—Boggs limestone: Muskingum County, Locality 27, r. Widely distributed in the Lower Mercer limestone, a. Upper Mercer: Holmes County, Locality 73, r. McArthur limestone: Vinton County, Locality 85, r.

Genus Euchondria Meek

Euchondria neglecta (Geinitz)

1866 *Pecten neglectus.* Geinitz, Die Carb. und Dyas in Nebr., p. 33, Tab. 2, Fig. 17. Nebraska City, Nebraska.

1872 *Aviculopecten neglectus.* Meek, U. S. Geol. Surv. Nebr., p. 193, Pl. 9, Figs. 1 a, b. Upper Coal Measures: Nebraska City, Nebraska. Coal Measures: Illinois.

Meek's description.—"Shell very small, broad subovate exclusive of ears, even thin, rather compressed; sides and base more or less regularly rounded; cardinal margin shorter than breadth of the valves. Left valve (according to Professor Geinitz' figure) with ears nearly equal, the anterior one separated from the margin below by a broad, very shallow sinus, and forming less than a right angle at its extremity; posterior ear extending farther down the margin than the other, very faintly sinuous behind, and forming an angle of about 100 degrees at the extremity. Right valve with anterior ear narrow and rather acutely angular, defined by a deep, narrow sinus, extending back about half its length; posterior ear of about the same length, but of greater vertical breadth than the other, rather pointed at the extremity and defined by a moderately deep, broadly rounded sinus, and a subangular umbonal slope. Surface of the body part of both valves apparently only marked by fine concentric striae; ears with a few radiating costae, crossed by fine striae and a few coarser marks of growth.

"Height and breadth each, 0.26 inch; length of hinge, 0.21 inch."

Remarks.—A single, well preserved specimen was found in the Lowellville limestone, but the species occurs rather commonly in the Lower Mercer and McArthur members. The Ohio specimens are on the average larger than those figured by Meek but in other respects the forms are identical. The measurements of the individual from the Lowellville limestone, which is among the largest found, are: length 9.7 mm., height 9.5 mm., length of hinge line 7 mm. One from the Lower Mercer limestone measures: length and height 5 mm., length of hinge line 4.2 mm.

Horizon and locality.—Lowellville member: Muskingum County, Locality 19, r. Lower Mercer limestone: Muskingum County, Localities 39 (r), 28 (c), 43 (c), 45 (c); Licking County, Localities 46 (r), 47 (c), 48 (r), 49 (r). Upper Mercer: Perry County, Locality 62, r. Black Flint: Jackson County, Locality 87, r.

Genus Entolium Meek

Entolium attenuatum Herrick

1887 *Entolium attenuatum.* Herrick, Bull. Den. Univ., Vol. 2, p. 24, Fig. 11.
Coal Measures: Flint Ridge, Ohio.

Description.—*Entolium attenuatum* is not at all common among the Pottsville fauna of this State and its known occurrence is confined to the Lower Mercer and McArthur members. It is smooth-shelled, similar in appearance and closely related to *E. aviculatus.* It differs from the latter species principally in its narrow elongate form which has the height equal to one and one-fourth times the width, while in *E. aviculatus* the height and width are almost equal. Individuals are most common in occurrence along Flint Ridge, Licking County.

Dimensions.—Length 18 mm., width 13 mm., convexity of single valve 1.5 mm.

Horizon and locality. — Lower Mercer limestone: Muskingum County, Locality 45, r; Licking County, Localities 46, Flint Ridge, 47, 48, 49, r; Mahoning County, Locality 55, r. McArthur limestone: Vinton County, Locality 84, r.

Entolium aviculatus (Swallow)

Pl. XIII, fig. 9

1858 *Pecten aviculatus.* Swallow, Trans. St. Louis Acad. Sci., Vol. 1, p. 213.
Coal Measures: Valley of Verdigris, Kansas.

Description.—This species with its wide stratigraphic and geographic range is the most abundant and characteristic pelecypod of the Lower Mercer limestone. It is present throughout the middle and upper Pottsville, but is nowhere found in such extreme profusion as in the Lower Mercer member; it is also common and widely distributed in the McArthur limestone. It is characterized by its subcircular, compressed form with the anterior and posterior parts flattened and separated from the body of the shell by two furrows extending from the beak to the anterior- and posterior-inferior margins respectively, and also by its smooth, prominent ears. The delicate, concentric markings are generally not preserved so that the surface appears smooth. It is associated with *Entolium attenuatum* and *Crenipecten foerstii,* the former being of rare occurrence and the latter very abundant, especially in the Lower Mercer limestone of Muskingum and Licking counties.

Horizon and locality.—Widely distributed throughout the Lower Mercer and McArthur members, aa. Upper Mercer member: Muskingum County, Locality 68, r. Black Flint: Jackson County, Locality 87, r.

Genus Lima Brugueire

Lima retifera Shumard

Pl. XIII, fig. 10

1858 *Lima retifera.* Shumard, Trans. St. Louis Acad. Sci., Vol. 1, p. 214.
Coal Measures: Valley of Verdigris, Kansas.

Remarks.—*Lima retifer* is another form of wide geographic and stratigraphic distribution which is common in the middle and upper Pottsville formation of Ohio, especially in the Lower Mercer and McArthur members. A considerable number of individuals have been examined, many in an excellent state of preservation, and no marked variations from the species as ordinarily interpreted have been noted. The species is recorded as high as the upper Conemaugh formation in this State.

Horizon and locality.—Widely distributed throughout the Lower Mercer and McArthur members, c.

Genus Placunopsis Morris and Lycett

Placunopsis ? recticardinalis Meek

Pl. XII, fig. 19

1875 *Placunopsis recticardinalis.* Meek, Pal. Ohio, Vol. II, p. 331, Pl. 19, Fig. 12.
Coal Measures: Flint Ridge and Putnam Hill, Ohio.
1887 *Placunopsis recticardinalis.* Herrick, Bull. Den. Univ., Vol. 2, p. 43, Pl. 4, Fig. 11.
Coal Measures: Flint Ridge, Ohio.

Meek's description.—"Shell truncato-suboval or subquadrilateral, slightly oblique, with length and breadth nearly equal; cardinal margin straight, not quite equaling the greatest breadth of the valves; lateral margins almost straight and parallel, meeting the hinge at nearly right angles, and rounding regularly to the rounded ventral edge; upper valve depressed, most convex between the beak and central region; beak small, depressed, and but slightly projecting beyond the cardinal margin, near the middle of which it is placed with scarcely perceptible obliquity; surface showing fine, obscure lines, and a few stronger marks of growth, with faint traces of radiating striae, and an entirely distinct set of regular, transverse, waved or arched, parallel, little linear ridges or costae, which appear to have resulted from the markings of the surface of the object upon which the shell had grown; lower (right ?) valve unknown."

Dimensions.—The figured specimen measures: height 25 mm., length of hinge line 20 mm., maximum width below hinge line 24 mm.

Remarks.—As stated by Meek this species may be only an extreme variety of *P. carbonaria* which, according to the figured specimens, show great diversity of form.[1] However, none of these figures, even 2a and 2d, which are imperfect in the hinge area, indicate a hinge line as long or as straight or with such angular lateral extremities as *P.* ? *recticardinalis*. These differences together with the lower, less prominent, and more central beak seem of sufficient importance to justify a distinct species.

Horizon and locality.—Lower Mercer limestone: Licking County, Flint Ridge, Locality 47, r.

Genus Allerisma King

Allerisma terminale Hall

Pl. XIII, fig. 15

1852 *Allerisma terminalis.* Hall, Stansbury's Exped. to Great Salt Lake, p. 413, Pl. 2, Figs. 4a, b.
Carboniferous: Big Blue River.

Remarks.—*Allerisma terminale* is another Pennsylvanian species of very wide stratigraphic and geographic distribution which is common and widespread in the Pottsville formation of Ohio above and including the Lower Mercer limestone. Individuals usually occur in a greatly crushed condition, but are readily recognized by their large size, elongate form, and coarse concentric wrinkles. Spinulose surface sculpture is characteristic and usually well preserved.

Horizon and locality.—Widely distributed throughout the Lower Mercer and McArthur limestones, c. Lower Mercer ore: Jackson County, Locality 56, r.

Genus Pleurophorella Girty

Pleurophorella costata (Meek and Worthen)

1869 *Allorisma costata.* Meek and Worthen, Proc. Acad. Nat. Sci. Phil., p. 171.
Lower Coal Measures: Warren County, Illinois.
1873 *Allorisma costata.* Meek and Worthen, Geol. Surv. Ill., Vol. 5, p. 585, Pl. 26, Fig. 15.
Coal Measures: Warren County, Illinois.

Description.—This species with its distinctive surface markings is rare in the Pottsville formation of this State and is represented in

[1]Meek, F. B., Geol. Surv. Ill., Vol. 5, Pl. 27, Figs. 2a, b, c, d, 1873.

the collections studied by about six more or less perfect individuals from the Lower Mercer and McArthur members. The size and contour are about the same as those of Meek's specimen figured on Pl. 19, Vol. II, Paleontology of Ohio, but the ridges extending from the beak to the posterior margin are more sharply defined.

Horizon and locality. — Lower Mercer limestone: Muskingum County, Localities 42, 43, 45, r; Stark County, Locality 52, r. McArthur member: Vinton County, Locality 85, r; Hocking County, Locality 86, r.

Pleurophorella geinitzi (Meek)

Pl. XIII, figs. 18, 19

1866 *Allorisma elegans.* Geinitz, Die Carb. und Dyas in Nebraska, p. 13, Pl. 1, Fig. 31. (Non *A. elegans* King, 1844.)
Coal Measures: Nebraska City, Nebraska.

1872 *Allorisma (Sedgwickia) geinitzi.* Meek, U. S. Geol. Surv. Nebr., Final Rept., p. 219, Pl. X, Figs. 16 a, b.
Upper Coal Measures: Nebraska City, Nebraska.
Upper, Middle, and Lower Coal Measures: Illinois.

Description.—Although *Pleurophorella geinitzi* is abundant in the higher formations of the Pennsylvanian system of this State, it is rare in rocks of Pottsville age and has been found only in the Lower Mercer limestone. In size and general aspect it resembles very closely those of the Conemaugh formation figured by Miss Mark.[1]

Dimensions.—Length 5 mm., height at posterior end 1.3 mm., height at umbones 2.5 mm.

Horizon and locality. — Lower Mercer limestone: Muskingum County, Locality 45, r; Licking County, Localities 46, 48, r.

Pleurophorella sesquiplicata Price

Pl. XIII, figs. 16, 17

1919 *Pleurophorella sesquiplicata.* Price, W. Va. Geol. Surv., Fayette County Rept., p. 290.
Kanawha Group: Mingo County, West Virginia.

1920 *Pleurophorella sesquiplicata.* Price, W. Va. Geol. Surv., Webster County Rept., p. 606, Pl. XXXV, Figs. 7–12.
Kanawha Group, upper portion: Mingo County, West Virginia.

Description.—Representatives of this species are fairly common in the black shales on the Lower Mercer horizon in Rock Hollow, Vinton County, but have not been found elsewhere in rocks of Pottsville age in Ohio. The species occurs in the form of internal and external molds which are usually greatly compressed. On most of the specimens ex-

[1]Mark, C. G., Geol. Surv. Ohio, Fourth Ser., Bull. 17, p. 310, Pl. XV, Fig. 11, 1912.

amined faint traces of a plication are visible on the flattened area between the umbonal ridge and the ridge bordering the escutcheon, which, however, becomes obsolete toward the posterior margin. The very faint radiating lines in the same region, mentioned by Price on the West Virginia forms, are apparently absent, although they may not have been preserved or may have been later destroyed. In other respects the Ohio form agrees closely with the description and figures of Price's species.

Dimensions.—The measurements of single valves of two individuals are respectively: length 10.5 mm., 13.5 mm.; height 7 mm., 8.5 mm.; convexity unknown.

Horizon and locality.—Lower Mercer black shale: Vinton County, Rock Hollow, Locality 34, c.

Genus Pleurophorus King

Pleurophorus immaturus Herrick

Pl. XIV, figs. 5–8

1887 *Pleurophorus immaturus.* Herrick, Bull. Den. Univ., Vol. 2 ,p. 145, Pl. 14, Fig. 17. (Also *Pleurophorus subcostatus*? Herrick, Idem., p. 35, Pl. 4, Figs. 16, 16a.)
Coal Measures: Flint Ridge, Ohio.

Description.—Shell small, elongate-oblong in outline, with the length slightly greater than twice the height; moderately convex in umbonal region and along umbonal slope which extends obliquely backward from the beak to the posterior-inferior margin of the shell, becoming somewhat depressed below the hinge line and along the posterior extremity; cardinal and basal margins straight, converging a little anteriorly, so that the anterior extremity is slightly but conspicuously narrower than the posterior; beaks almost anterior in position, small, not elevated above the cardinal margin; hinge line long, extending from the beak about three-fourths the length of the shell; posterior extremity obliquely truncated above and narrowly rounded below; anterior extremity inconspicuous, slightly concave in outline below beaks, then rounding abruptly into the basal margin. Surface marked (1) by six to nine delicate but sharply defined lines or costae which radiate posteriorly from the beak and which, when fully developed, cover about four-fifths of the entire surface of the shell; (2) by very fine, regular, subequal, concentric lines; and (3) by innumerable, minute spinules which are larger and more conspicuous anteriorly than posteriorly where they are extremely small and crowded. These spinules are both concentric and radial in arrangement and where most conspicuous form tiny squares, each spinule marking the corner of a square. In

the anterior part where they are larger and less crowded, the concentric arrangement is most prominent, while posteriorly where they are extremely minute, the radial arrangement is most prominent, giving the appearance of very fine radiating lines.

Dimensions.—A well preserved right valve of large size from the Lower Mercer limestone at Flint Ridge measures: length 25 mm., height just behind beak 10 mm., convexity 2.5 mm. Two right valves of average size from the McArthur limestone of Vinton County measure: length 22 mm., 17 mm.; height 9.5 mm., 7 mm.; convexity 2 mm., 2 mm.

Remarks.—The most important characters of this form are the peculiar surface markings which are excellently shown on external molds,—the large number of radiating costae, the fine regular concentric lines, and especially the numerous, fine spinules covering the entire surface. In general contour and dentition, as far as can be determined, these shells belong to the genus *Pleurophorus*, although the spinulose sculpture has not been credited to the genus. It has, however, been commonly observed on representatives of *Sedgwickia* and *Allerisma* as well as on certain forms of *Pleurophorella*.

Among the described species of *Pleurophorus*, *P. subcostatus*, *P. immaturus*, and *P. occidentalis* approach this form most closely in general contour and appearance, although the surface markings described above have apparently not been heretofore observed. The species under discussion is abundant in the Lower Mercer and McArthur limestones, and is probably the same form which Herrick referred to as *P. subcostatus* ? in his study of the Lower Mercer fossils of Flint Ridge. Another smaller, more compact form from the same locality has been given the name *P. immaturus* by the same author with the suggestion that it may be the young of *P. subcostatus*?. Specimens intermediate between the small compact form and the large one have been observed in the collections studied, and as the differences between the two forms are those which one would naturally expect to find between the mature and young of a given species, it is the conclusion of the writer that *P. immaturus* actually represents the same form as that cited by Herrick as *P. subcostatus*?.

However, whether Herrick's *P. subcostatus* ? is really the same species as that described by Meek and Worthen as *P. subcostatus* may be questioned. Typical *P. subcostatus* is described as having the cardinal and basal margins subparallel, with the basal margin sinuous, and judging from the figures,[1] the anterior extremity is comparatively prominent. *P. occidentalis* Meek and Hayden, another species very closely related to *P. subcostatus*, is described as having the cardinal and basal margins either subparallel or converging, although as figured

[1]Meek and Worthen, Geol. Surv. Ill., Vol. 2, Pl. 27, Figs. 2, 2a, 1866.

the margins contract strongly toward the anterior extremity.[1] The basal margin is not sinuous, but very slightly convex, and the anterior extremity is much less conspicuous than that of *P. subcostatus*. On the latter species about three radiating costae are mentioned, while on *P. occidentalis* five or six are present. As the figured specimens are internal casts, more costae could probably have been observed on the external shell; also other surface markings similar to those described above may be assumed to have been present.

Obviously the forms under discussion, which belong to the same species cited by Herrick as *P. subcostatus*?, resemble *P. occidentalis* more closely than typical *P. subcostatus*; in fact there seems to be no essential difference between the two forms. However, identification with *P. occidentalis* seems rather doubtful as that species occurs in the upper Pennsylvanian and Permian systems of a distant locality; so it is considered best for the present to retain a distinct species name for these Pottsville forms from Ohio, especially in want of specimens of *P. occidentalis* to confirm the identification.

Since Herrick's *P. subcostatus*? and *P. immaturus* are probably the same species, and since that species is not *P. subcostatus* as originally described, the name *P. immaturus* is here provisionally retained, but in a larger sense than originally intended; however it is not unexpected that this name will prove to be a synonym of *P. occidentalis*.

Considerable variation exists in regard to the number and strength of costae on the umbonal slope. Nine is the greatest number observed, while some specimens, even from Herrick's type locality on Flint Ridge, have the costae evanescent with only one clearly marked, although indications of others can generally be observed. Likewise the spinulose structure is not evident on all specimens and is apparently lacking most often on those which have the costae reduced in number. Allowance must be made for variations in the development of costae and the simultaneous loss of the costae with the spinules may be accounted for by adverse conditions of preservation. After an examination of a comparatively large number of these specimens, there is little doubt in the mind of the writer that even those which show the number of costae greatly reduced belong to the same species.

Horizon and locality.—Widely distributed throughout the Lower Mercer and McArthur limestones, c. Black Flint: Jackson County, Locality 87, r.

Pleurophorus oblongus Meek

1866 *Clidophorus pallasi.* Geinitz, Die Carb. und Dyas in Nebraska., p. 23, Tab. 2, Fig. 4. (Non *Modiola Pallasi* de Vern., 1845.)
Nebraska City and Wyoming, Nebraska.

[1]Meek, F. B., U. S. Geol. Surv. Nebraska, Final Rept., Pl. X, Fig. 12, 1872. This figure is used instead of the original one which Meek states is inaccurate.

1872 *Pleurophorus oblongus.* Meek, U. S. Geol. Surv. Nebraska, p. 212, Pl. 10, Figs. 4 a–c.
Upper Coal Measures: Nebraska City, Nebraska.

Remarks.—*Pleurophorus oblongus* is represented in the lower Pottsville formation by the internal mold of a single specimen from the Sharon ore, and very sparingly in the middle and upper Pottsville formation. The individuals are for the most part well preserved so that the identification could be made with considerable confidence. The form from the Sharon ore is smaller than indicated by Meek's description and figures; its dimensions are: length 8 mm., length of hinge line 6 mm., maximum height near posterior end 4.5 mm., thickness of right valve 1.2 mm.

Horizon and locality.—Sharon ore: Scioto County, Locality 2, r. Lower Mercer member: Muskingum County, Locality 43, r; Licking County, Localities 48, 49, r. McArthur member: Jackson County, Locality 80, r; Vinton County, Locality 84, r.

Pleurophorus spinulosa n. sp.

Pl. XIV, figs. 9–11

Description.—This shell belongs to the same general type as the one here described as *Pleurophorus immaturus* (*P. subcostatus* of Herrick) and in outline appears identical with that species as nearly as can be observed from the somewhat imperfect specimens at hand. However the form under discussion differs from *P. immaturus* in the following ways: (1) The shell is large, equaling almost twice the size of the largest mature specimen of *P. immaturus* in the collections examined; (2) only four radiating costae which are confined to the umbonal slope were observed and these are more faintly expressed than those of *P. immaturus*, (3) the spinulose sculpture is coarser than is characteristic of *P. immaturus*.

Dimensions.—The most perfect of the two known specimens of this species measures: length 42 + mm., height 19 mm., convexity of left valve 4.5 mm.

Remarks.—Some doubt exists as to whether this form is not identical with *P. immaturus*, especially as it has been found at Bald Knob, at the same horizon and comparatively close to Herrick's type locality at Flint Ridge. However, the large size and the apparent absence of a series of forms intergrading in size between them seems to point to a distinct species. The coarser spinulose structure ought naturally to accompany so great an increase in size, but the radiating costae should also be correspondingly more numerous and more strongly marked. Even after allowances are made for natural variations in the strength and number of costae, the discrepancies between shells of such

different sizes seem too great to be found in the same species, and therefore these differences assume specific importance. The species, on the other hand, is known from two not entirely perfect specimens, so that later investigation may prove that the two forms are more closely related than is at present apparent. Both of the known specimens consist of external molds, one of a right and the other of a left valve.

Horizon and locality.—Lower Mercer limestone: Licking County, Bald Knob, Locality 46, r.

Pleurophorus tropidophorus Meek

Pl. XIII, figs. 20, 21

1875 *Pleurophorus tropidophorus.* Meek, Pal. Ohio, Vol. II, p. 338, Pl. 19, Figs. 10 a, b. Coal Measures: Newark, Ohio.

Meek's description.—"Shell transversely oblong, much compressed, with length a little greater than twice the height; posterior margin flattened and bifurcated, the lower truncation being nearly vertical, and the upper sloping obliquely downward and backward from the hinder end of the hinge; cardinal margin straight, equaling about two-thirds the length of the valves; anterior rounded below and sloping abruptly forward from the beaks above; basal margin long, parallel to the hinge, nearly straight for most of its length, or faintly sinuous near the middle, rounding up anteriorly, and forming a more or less defined angle at its connection with the lower part of the posterior margin behind; posterior umbonal slope distinctly angular from the beaks to the angular posterior basal extremity, while a second carina passes obliquely backwards and downwards along the middle of the posterior dorsal space above the umbonal ridge of each valve; beaks depressed to the line of the cardinal margin, very little projecting, and placed one-fifth to one-fourth the length of the valves from the anterior margin. Surface marked by distinct concentric lines of growth, that become strongly defined on the flanks and anterior parts of the valve, but are less distinct on the space above and behind the umbonal angles."

Dimensions.—A specimen of typical size from the cannel coal mine on Flint Ridge, Licking County, measures: length 29.5 mm.; maximum height posterior to the beak 15 mm., convexity of a single valve 4 mm.

Remarks.—This species is rare below the Lower Mercer limestone but is fairly common and widely distributed in the latter and higher members, especially in the McArthur limestone. The species shows very little variation from place to place, and differs from Meek's figured specimen only in having the beaks slightly more depressed. In his study of the fauna of Flint Ridge, Herrick[1] mentions that possibly

[1]Herrick, C. L., Bull. Den. Univ., Vol. 2, p. 35, 1887.

two related species differing chiefly in size may exist; and if the characters exhibited in his figure prove constant in a number of specimens, a different species rather than an abnormal development of *P. tropidophorus* is represented. This form differs not only in its larger size, but in its less angular posterior outline and its convex ventral margin. Collections were made from a number of localities along Flint Ridge, but no specimens comparable to Herrick's large form were discovered.

Horizon and locality.—Lowellville member: Muskingum County, Locality 19, r. Common and widely distributed in the Lower Mercer and McArthur members. Upper Mercer limestone: Muskingum County, Locality 68, r. Black Flint member: Jackson County, Locality 87, r.

Astartella compacta Girty

1915 *Astartella compacta.* Girty, Missouri Bureau Geol. and Mines, Ser. 2, Vol. XIII, p. 354, Pl. XXVIII, Figs. 4, 4a, 5, 5a.
Cherokee formation: Missouri.

Description.—This species is represented in the collections studied by a number of specimens from the Lower Mercer and McArthur members in a fairly good state of preservation; they exhibit no essential differences from the Missouri forms. The species is distinguished by its small compact form with the height a little greater than the length, by its high, slightly flaring posterior end, and by its surface sculpture of fine, very closely arranged concentric lines.

Horizon and locality.—Lower Mercer limestone: Perry County, Locality 35, r; Muskingum County, Locality 28, c; Licking County, 46, r. McArthur limestone: Jackson County, Locality 80, r; Vinton County, Locality 84, c; Hocking County, Locality 86, r.

Astartella concentrica (Conrad)

Pl. XIII, figs. 11–13

1842 *Nuculites concentrica.* Conrad, Acad. Nat. Sci. Phil. Jour., 1st Ser., Vol. 8, Pt. 2, p. 248.
Coal Measures: Pennsylvania.
1915 *Astartella concentrica.* Girty, U. S. Geol. Surv., Bull. 544, p. 142, Vol. XVIII, Figs. 2–9.
Wewoka formation: Oklahoma.

Description.—Two closely related representatives of the genus *Astartella* are common in the middle and upper Pottsville formation, one of which has been referred to *A. concentrica* and the other to the form which Meek called *A. newberryi*. Conrad's original description of *A. concentrica* is quoted below: "Subtriangular, slightly ventricose, with rather distant sharp concentric striae; umbonal slope obtusely angu-

lated; posterior dorsal margin rectilinear, very oblique; posterior extremity truncated, the margin nearly direct; beaks near anterior extremity; basal margin nearly straight in middle."

This form is obviously very similar to *A. vera* and is probably identical with the one which has previously been referred to the latter species in various reports on the Pennsylvanian fauna of Ohio. However, the specimens examined by the writer are narrower, with the posterior-inferior angle less produced than is shown on Hall's figure. These slight differences in outline together with more regular concentric markings than are accredited to *A. vera*, seem to render identification with *A. concentrica* more apt, although it does not seem improbable that these species are the same and that the differences in outline and surface markings are of varietal rather than of specific importance. The form is convex and the beak is close to the anterior end, while the surface is marked by about seventeen to twenty regular, sharply angular, concentric laminae, separated by broad furrows. The entire surface is covered by very fine concentric lines. Faint radial striations, such as are characteristic of the middle layer of shell substance of *A. varica*, are often visible near the basal margin and are clearly marked where the outer layer has been exfoliated.

Several small, imperfect specimens from the Lowellville and Boggs members have likewise been referred to this species, but the poorly preserved condition of the material renders the identification more doubtful.

Dimensions.—An individual of average size has the following measurements: length 12 mm., height 11 mm., convexity of a left valve 5.5 mm.

Horizon and locality.—Lowellville member: Muskingum County, Locality 19, r. Boggs member: Muskingum County, Locality 26, r. Widely distributed throughout the Lower Mercer and McArthur members, a. Upper Mercer member: Scioto County, Locality 59, c. Black Flint member: Jackson County, Locality 87, r.

Astartella newberryi Meek

Pl. XIII, fig. 14

1875 *Astartella newberryi.* Meek, Pal. Ohio, Vol. II, p. 340, Pl. 19, Fig. 3.
Coal Measures: Newark, Ohio.

Description.—This fossil is present in the middle and upper Pottsville formation, but is especially common in the Lower Mercer limestone of Muskingum and Licking counties. Although the species was originally founded on a single specimen, the characters attributed to it by Meek have been found to hold constant in adult forms; it is almost impossible, however, to distinguish immature individuals from those

forms identified in this bulletin as *A. concentrica.* The species resembles closely both *A. vera* and especially *A. concentrica.* It differs from Hall's figured specimens of the former species in having the beaks less anterior and slightly less prominent, and the surface sculpture more regular. The resemblance to *A. concentrica* is so close that it has been suggested both by Meek[1] and by Girty[2] that it may represent a variety of the latter rather than a distinct species. Comparisons with *A. concentrica* as interpreted by Girty show that *A. newberryi* is less convex, a little narrower, with the dorsal margin more oblique, and with the posterior-inferior angle more produced; the concentric ridges are also more numerous, about twenty-five to twenty-eight being present on an adult individual. The entire surface is covered by extremely fine concentric lines, and the posterior and basal margins are generally crenulated with radial markings which characterize the middle layer of shell substance. In view of the differences cited above it seems advisable for the present to retain the rank of a distinct species for this form, rather than to include it as a variety of *A. concentrica.*

Dimensions.—Adult individuals attain a considerably larger size than those here referred to *A. concentrica.* A typical form measures: length 16.5 mm., height at beak 12 mm., convexity of left valve 3.5 mm., length of umbonal ridge 15.5 mm.

Horizon and locality.—Lower Mercer limestone: widely distributed in Muskingum and Licking counties, c. McArthur limestone: Vinton County, Locality 84, c.

Astartella varica McChesney

Pl. XIV, figs. 1-4

1860 *Astartella varica.* McChesney, Desc. New Pal. Foss., p. 55.
Coal Measures: Springfield, Illinois.

Description.—This species is common in the middle and upper Pottsville formation, particularly in the Lower Mercer and McArthur members. Eight to ten sharply elevated concentric ridges, separated by broad, rounded furrows, are present. The convexity is moderate and the umbonal slope on uncrushed specimens prominent. A number of individuals from the McArthur limestone show the same interesting shell structure described by Miss Mark on *A. vera.*[3] Three layers are present: an inner lamellose layer on which the coarse concentric ridges which characterize the species are absent or only faintly visible; an outer layer marked by eight to ten elevated ridges separated

[1]Meek, F. B., Pal. Ohio, Vol. II, p. 340, 1875.

[2]Girty, G. H., U. S. Geol. Surv., Bull. 544, p. 144, 1915.

[3]Mark, C. G., Geol. Surv. Ohio, Fourth Ser., Bull. 17, p. 311, Pl. XV, Figs, 13, 14, 1912.

by broad furrows; and a middle layer on which the ridges are almost as sharply marked as on the outer layer, and which is covered by extremely fine but distinct radiating lines. Fig. 3, Pl. XIV, shows the middle layer of an individual with a portion of the outer layer remaining around the beak.

Dimensions.—A specimen of average size from the Lower Mercer limestone measures: length 19 mm., height 15 mm., convexity of left valve 7 mm.

Horizon and locality.—Of general distribution throughout the Lower Mercer and McArthur members, c. Upper Mercer member: Perry County, near Somerset, Locality 63, r.

Astartella sp.

Description.—A small, crushed pelecypod, probably belonging to the genus *Astartella*, occurs in great abundance at two localities,—one in the Lowellville limestone ? and the other in the Lower Mercer,—distant from each other, yet faunally very similar and unique. A somewhat square posterior outline, long cardinal margin, prominent beaks, and fine, regular, concentric lines characterize the form. It is, however, too poorly preserved to be identified specifically. The measurements of a specimen of average size are: length 9.5 mm., height 6.5 mm., length of cardinal margin 6 mm.

Horizon and locality.—Lowellville member ?: near Holbein, Muskingum County, Locality 20, a. Lower Mercer limestone: Rock Hollow, Vinton County, Locality 34, a.

Genus Cypricardinia Hall

Cypricardinia ? carbonaria Meek

Pl. XI, fig. 14

1871 *Cypricardinia ? carbonaria.* Meek, Proc. Acad. Nat. Sci. Phil., p. 163.
Lower Coal Measures: Newark, Ohio.
1875 *Cypricardinia ? carbonaria.* Meek, Pal. Ohio, Vol. II, p. 432, Pl. 19, Figs. 8 a, b.
Lower Coal Measures: Newark, Ohio.

Meek's description.—"Shell small, longitudinally oval, less than twice as long as high, the widest (highest) part being under the posterior extremity of the hinge; rather gibbous, with usually a broad impression extending from the beaks obliquely backward and downward to the middle of the base of each valve; anterior side extremely short or nearly obsolete, convex, and rounded; posterior side broader, more compressed or cuneate, with its upper edge straight and sloping obliquely backward to the regularly rounded posterior margin; base

broadly and slightly sinuous in the middle, and rounding upward at the extremities; hinge line straight, between one-half and two-thirds as long as the valves, ranging at an angle of about 25 degrees with the oblique, longer axis of the shell, so as to meet the sloping upper edge of the posterior margin at a very obtuse but moderately well-defined angle, thus imparting to the somewhat compressed posterior dorsal region a very faintly alate appearance; beaks extremely oblique, depressed nearly to the dorsal margin, very nearly terminal, and scarcely projecting beyond the rounded outline of the anterior extremity. Surface ornamented by about fifteen to twenty exceedingly regular, well-defined, subimbricating, flattened, concentric ridges or undulations that gradually become smaller and more closely approximating to the umbones."

The specimens of this species in the collections examined show no departures from Meek's description. The species has been obtained only from the Lower Mercer and McArthur limestones.

Dimensions.—Length 10 mm., height at beaks 4.2 mm., height near posterior extremity 6 mm.

Horizon and locality.—Widely distributed in the Lower Mercer member of Muskingum and Licking counties, c. McArthur member: Jackson County, Locality 80, c; Vinton County, Locality 84, r.

Class Scaphopoda

Genus Plagioglypta Pilsbry and Sharp

Plagioglypta meekana (Geinitz)

1866 *Dentalium meekianum.* Geinitz, Die Carb. und Dyas in Nebr., p. 13, Tab. 1, Fig. 20.
Coal Measures: Nebraska City, Nebraska.

Description.—*Plagioglypta meekiana* is represented in the Lower Mercer limestone by a few scattered specimens. The form is moderately curved, is marked by very fine revolving lines which are slightly oblique in position, and ranges in length from about 12 to 22 mm.

Horizon and locality.—Lower Mercer limestone: Muskingum County, Locality 43, r; Stark County, Locality 52, r.

Plagioglypta prosseri n. sp.

Pl. XVI, figs. 3, 4

Description.—Shell of median size, slightly curved, the greatest curvature occurring in the smaller half of the shell; increasing in size rather gradually toward the large end; form of aperture unknown.

Surface ornamented by very fine, closely arranged lines of growth, passing a little obliquely around the shell, with a faint, barely noticeable revolving groove occurring at more or less regular intervals, about 3 to 3.5 mm. apart near the larger end but gradually becoming closer together near the smaller extremity.

Dimensions.—Length of a cotype which probably represents almost a complete individual 78 mm., diameter of the much flattened larger end 11.5 mm.; diameter near the small end which is also flattened 2.5 mm.

Remarks.—*Plagioglypta prosseri* is of rare occurrence and has been found at only a few localities in the Lower Mercer and McArthur limestones. The specimens studied include many imperfect specimens as well as two almost complete individuals,—an external mold and an internal cast.[1] Both are crushed so that the true diameter and the shape of the aperture cannot be determined. The species is characterized by its median size, its slightly curved form, and its fine oblique surface markings. It resembles *P. canna* (White) very closely, but the latter species can be distinguished by its straighter, still more tapering form, and larger size. The fact that *P. canna* occurs in a much higher portion of the Coal Measures from a far distant locality (common in the Permian of Arizona and New Mexico) lends additional weight to the differences cited above. From *P. meekiana* (Geinitz) it differs principally in its less curved form and much larger size, the length of the latter species according to Professor Geinitz' measurements being .60 to .70 inch.

Horizon and locality.—Lower Mercer limestone: Perry County, Somerset, Locality 35, r; Muskingum County, near Fairview School, Locality 45, r; Licking County, Bald Knob, Locality 46, r. McArthur limestone: Jackson County, Monroe Furnace, Locality 80, r; Vinton County, Moore mine near McArthur, Locality 84, r. The specific name is given in honor of Dr. Charles S. Prosser.

Class Gastropoda

Minute Gastropoda (Three or more species)

Description.—Extremely minute gastropods are abundant in the Sand Block ore, but they occur in a much decomposed, macerated condition. Three species were distinguished although more are probably present; all are internal casts showing none of the surface markings. One species has a spire of median height with three or four rapidly enlarging volutions; the body whorl is large and greatly expanded,

[1]The internal cast belongs to the collections of Dr. George H. Girty, by whom it was loaned for the purpose of studying the internal characters which are not shown on the writer's specimen.

constituting almost two-thirds of the entire spire. The height of the shell measures .75 mm. The second species is a high-spired, slender, gradually tapering form, about .5 mm. in height, while the third belongs to the *Bellerophontidae* and measures less than 1 mm. in diameter.

Horizon and locality.—Sand Block ore: Jackson County, Locality 57, a.

Family Bellerophontidae McCoy

Shells belonging to the Family Bellerophontidae are the best represented group of gastropods in the Pottsville formation in Ohio. The following genera are present,—*Bellerophon, Euphemus, Pharkidonotus, Patellostium,* and *Bucanopsis;* among these the genus *Pharkidonotus* is the most abundant while *Bellerophon* and *Euphemus* are most widely distributed. No fossils are more numerous in the Harrison and Sharon ores than the Bellerophon-like shells which can be obtained in an almost perfect condition. They are diminutive in size and occur as internal casts so that in most cases even the generic position is undeterminable. In only a few instances, however, is surface sculpture sufficiently well shown to disclose the generic and specific relations. Representatives of this family constitute the most common group of gastropods in the marine limestones, and hold an especially important position in the Lower Mercer and McArthur members.

Genus Bellerophon Montfort

Bellerophon crassus Meek and Worthen

1860 *Bellerophon crassus.* Meek and Worthen, Proc. Acad. Nat. Sci. Phil., p. 458. Lower Coal Measures: Pittsburgh, St. Clair County, Illinois.

Remarks.—Several of the numerous small Bellerophon-like forms from the Harrison and Sharon ores show a narrow slit band with faint transverse lines marking the surface, and have been referred provisionally to *B. crassus.* The species has not been found in any other Pottsville horizon below the Lower Mercer member; it is, however, relatively common in the middle and upper Pottsville formation, especially in the Lower Mercer limestone of Muskingum and Licking counties.

Horizon and locality.—Harrison ore: Jackson County, Locality 1, a. Sharon ore: Scioto County, Locality 2, a. Widely distributed in the Lower Mercer member, especially in Muskingum and Licking counties, c. McArthur member: Jackson County, Locality 80, c; Vinton County, Localities 83, 84, c.

Genus Pharkidonotus Girty

Pharkidonotus percarinatus (Conrad)

Pl. XV, fig. 6

1842 *Bellerophon percarinatus.* Conrad, Jour. Acad. Nat. Sci. Phil., 1st Ser., Vol. VIII, p. 268, Pl. XVI, Fig. 5.
Carboniferous: Inclined plane of the Allegheny Mts., in black shale overlying the stratum of Coal No. 7.

1915 *Pharkidonotus percarinatus.* Girty, U. S. Geol. Surv., Bull. 544, p. 165, Pl. XIX, Figs. 4–9c.
Wewoka formation: Oklahoma.

Description.—This is undoubtedly the most common and widely distributed gastropod of the Lower Mercer and McArthur limestones, but has not been found below the former horizon. It is easily distinguished by the coarsely nodose carina which occupies the median line of the dorsum, and by the large angular transverse plications on either side of the carina. As the form grades toward the variety *tricarinatus* a row of lateral nodes becomes more or less well developed on both sides of the median nodose carina. Many of the specimens here assigned to *P. percarinatus* show the lateral nodes somewhat developed and are really intermediate between *P. percarinatus* and the variety *tricarinatus.*

Horizon and locality.—Widely distributed throughout the Lower Mercer and McArthur members, c.

Pharkidonotus percarinatus var. tricarinatus (Shumard)

1855 *Bellerophon percarinatus.* Norwood and Pratten, Jour. Acad. Nat. Sci. Phil., 2nd Ser., Vol. III, p. 74, Pl. IX, Figs. 4 a–c.
Coal Measures: Grayville, Illinois; Posey County, Indiana; and 5 miles below New Harmony, Indiana.

1858 *Bellerophon tricarinatus.* Shumard, Trans. St. Louis Acad. Sci., Vol. 1, p. 204.
Upper Coal Measures: Kansas.

Description.—*Pharkidonotus percarinatus var. tricarinatus* differs from *P. percarinatus* in having a row of well developed, prominent nodes occupying the transverse wrinkles on either side of the median nodose carina, so that three rows of nodes are present on the dorsum. The development of the lateral nodes is a very variable character, and differs markedly between young and old specimens, as well as between individuals of the same age so that there is a series of forms grading gradually from one variety to the other. Only those forms with prominently developed lateral nodes are here assigned to the variety *tricarinatus,* although some of the intermediate forms may possibly belong

with it also; however, it is often difficult to determine just where the dividing line should be drawn. As thus interpreted the variety *tricarinatus* is much less common than *P. percarinatus*.

Horizon and locality.—Of general distribution throughout the Lower Mercer limestone, c. McArthur member: Vinton County, Moore mine, Locality 84, c.

Genus Euphemus McCoy

Euphemus carbonarius (Cox)

Pl. XV, figs. 4, 5

1855 *Bellerophon urii.* Norwood and Pratten, Jour. Acad. Nat. Sci. Phil., 2nd Ser., Vol. 3, p. 75, Pl. 9, Figs. 65 a–c. (Non *B. urii* Fleming, 1828)
Coal Measures: Galatia and Grayville, Illinois; 5 miles below New Harmony, Indiana.

1857 *Bellerophon carbonarius.* Cox, Geol. Surv. Ky., Vol. 3, p. 562.
Coal Measures: Indiana.

Remarks.—Among the Bellerophon-like forms from the Harrison and Sharon ores, several individuals retain indications of numerous strong, revolving lines and have been identified as *Euphemus carbonarius*, at least according to the general usage of the term which may in reality include several distinct species or varieties. It is also present in the Boggs member, although rare, but is common in the Lower Mercer and higher Pottsville horizons where it attains a much larger size than in the basal members.

Horizon and locality.—Harrison ore: Jackson County, Locality 1, a. Sharon ore: Scioto County, Locality 2, a. Boggs limestone: Muskingum County, Locality 26, r. Widely distributed in the Lower Mercer limestone, c. Lower Mercer ore: Jackson County, Locality 56, r. McArthur member: Vinton County, Localities 83, 84, c.

Euphemus nodocarinatus (Hall)

Pl. XV, figs. 1–3

1858 *Bellerophon nodocarinatus.* Hall, Geol. Iowa, Vol. 1, Pt. 2, p. 723, Pl. 29, Figs 15 a–c.
Coal Measures: Illinois and Iowa.

Hall's description.—"Shell subglobose, expanded at the sides, without umbilicus. Back and sides of the shell, near the aperture, marked by longitudinal or revolving ridges or carinae, about seven or eight on each side of the centre; the two central ones of which, in their extension forward, become more prominent, and form a kind of double

carina which becomes nodose towards the aperture; a broadly concave depression on each side of the carina where the shell is thinner, becoming convex and extremely thickened towards the margins."

Remarks.—Individuals of this species vary considerably in size although they are generally large and robust. The revolving lines on the inner lip are sharply marked and the double row of slightly nodose carinae are highly elevated near the aperture. The form is common in the middle and upper Pottsville formation but has not been found below the Lower Mercer limestone.

Horizon and locality.—Widely distributed in the Lower Mercer limestone, c. McArthur limestone: Vinton County, Locality 84, c.

Genus Bucanopsis Ulrich

Bucanopsis meekiana (Swallow)

1858 *Bellerophon Meekianus.* Swallow, St. Louis Acad. Sci. Trans., Vol. 1, p. 204. (Date of Imprint, 1860)
Middle Coal Measures: Lexington, Missouri.
Lower Coal Measures: Howard County, Missouri.

1915 *Bucanopsis meekiana.* Girty, U. S. Geol. Surv., Bull. 544, p. 169, Pl. XX, Figs. 4–6.
Wewoka formation: Oklahoma.

Description.—Specimens referred to this species are present in the middle and upper Pottsville formation and are relatively common in the Lower Mercer limestone. Individuals are generally crushed and fragmentary with very little of the outer lip preserved. The surface is marked by numerous fine, subequal revolving lirae crossed transversely by lines of a similar character. The slit band is only slightly elevated.

There appears to be very little real difference between the form here referred to *B. meekiana* and the one which Meek identified with Geinitz' species *Bellerophon marcouanus*,[1] and it does not seem at all unlikely that the two forms are identical. However Meek's species differs from typical *B. marcouanus* as figured by Geinitz in its less highly elevated slit band which is to a much less extent affected by the transverse markings than Geinitz' form. Otherwise *B. meekiana* and Geinitz' species are so similar that future investigation may prove that they are one and the same species. At present *B. meekiana* seems the more apt specific reference for our form.

Horizon and locality.—Widely distributed throughout the Lower Mercer limestone of Muskingum and Licking counties, c. McArthur member: Jackson County, Locality 80, c; Vinton County, Locality 84, c.

[1]Meek, F. B., U. S. Geol. Surv. Nebr., p. 226 ,Pl. 4, Fig. 17, 1872.

Genus Patellostium Waagen

Patellostium montfortianum (Norwood and Pratten)

Pl. XIV, figs. 13, 14

1855 *Bellerophon Montfortianum.* Norwood and Pratten, Jour. Acad. Nat. Sci. Phil., 2nd Ser., Vol. III, p. 74, Pl. IX, Figs. 5a–c.
Coal Measures: Galatia, Illinois, and 5 miles below New Harmony, Indiana.

Description.—*Patellostium montfortianum* is common in the Lower Mercer limestone but is found less frequently in the higher horizons of the Pottsville formation. It generally occurs in a crushed condition with little or none of the greatly expanded outer lip preserved. However, it can be readily recognized by its distinctive surface sculpture of large, rounded, revolving lirae, separated by about three to five smaller lirae of varying size, and by coarse, angular, transverse folds which only slightly affect the slit band.

Horizon and locality.—Widely distributed in the Lower Mercer limestone, c (especially common and characteristic in Muskingum and Licking counties). McArthur member: Vinton County, Locality 84, c; Hocking County, Locality 86, c. Black Flint member: Jackson County, Locality 88, r.

Family Pleurotomariidae d'Orbigny

Representatives of this family are very abundant in the Harrison and Sharon ores, and at least four forms, possibly more, are thought to be present. They occur, like the entire assemblage of fossils from these horizons, as internal casts or molds, which show the form but give little clue to the external characters. These Pleurotomaria-like forms, which are all very small, may prove to be new species, although no definite conclusions can be reached concerning them, unless the examination of more material may reveal something concerning the external markings of the group. In only one species is the surface sculpture preserved in the molds. The family ranges throughout the Pottsville formation, but is nowhere above the Sharon ore a common or characteristic group.

Genus Pleurotomaria Sowerby

Pleurotomaria broadheadi White

1880 *Pleurotomaria broadheadi.* White, Cont. to Inv. Pal., No. 8, p. 169, Pl. 42, Figs. 1a, b.
Coal Measures: Kansas City, Missouri.

Remarks.—A fragment of a very large gastropod from the Lower

Mercer limestone agrees closely with White's description and figures of *Pleurotomaria broadheadi*. The specimen consists of the two lower volutions on which a portion of the external shell is preserved, showing the slit band and the rather coarse revolving surface markings.

Horizon and locality.—Lower Mercer limestone: Licking County, Flint Ridge, Locality 47, r.

Pleurotomaria carbonaria Norwood and Pratten

Pl. XV, fig. 14

1855 *Pleurotomaria carbonaria*. Norwood and Pratten, Jour. Acad. Nat. Sci. Phil., 2nd Ser., Vol. 3, p. 75, Pl. 9, Fig. 8.
Coal Measures: Rock Creek, Williamson County, Illinois.

Remarks.—A number of shells, some in an excellent state of preservation, belong to the general type of *Pleurotomaria* referred to as *P. carbonaria*. It seems probable that several closely related varieties or perhaps species may be included under this term. The specimens from the Pottsville formation of Ohio show the slit band deeply depressed as in *P. harii*, so that it belongs to one of the varieties or phases of *P. carbonaria*, broadly interpreted, which has the deeply impressed slit band.

Horizon and locality.—Lower Mercer limestone: Scioto County, Locality 31, r; Licking County, Flint Ridge, Locality 47, r; Stark County, Locality 52, r. McArthur member: Hocking County, Locality 86, r.

Pleurotomaria coxana Meek and Worthen ?

1866 *Pleurotomaria coxana*. Meek and Worthen, Proc. Acad. Nat. Sci. Phil., p. 272.
Lower Coal Measures: Nolan's Furnace, Edmonson County, Kentucky.
1873 *Pleurotomaria coxana*. Meek and Worthen, Geol. Surv. Ill., Vol. 5, p. 600, Pl. 28, Fig. 15.
Coal Measures: Nolan's Furnace, Edmonson County, Kentucky.

Description.—A single vertically compressed, internal cast of a *Pleurotomaria* from the Lower limestone of Flint Ridge shows the fine, thread-like, transverse markings and general form of *P. coxana*, although slight differences may be ascribed to compression. However, until better specimens are obtained with which to verify the identification, the exact agreement of the two forms must remain somewhat uncertain.

Horizon and locality.—Lower Mercer limestone: Licking County, Flint Ridge, Locality 47, r.

Pleurotomaria newportensis White

1880 *Pleurotomaria newportensis.* White, Cont. to Pal., No. 8, p. 169, Pl. 42, Figs. 2a, b.
Coal Measures: Newport, Indiana.
1887 *Pleurotomaria newportensis* ? Herrick, Bull. Den. Univ., Vol. 2, p. 21, Pl. 2, Fig. 18.
Coal Measures: Flint Ridge, Ohio.

Remarks.—A few crushed specimens of evidently the same form which Herrick referred to as *Pleurotomaria newportensis* ? were found among the collections of Lower Mercer and McArthur fossils. The somewhat macerated condition of the shells, however, renders the identification with White's species uncertain. The form undoubtedly belongs to the same general type of shell as *P. carbonaria* but differs in having the slit band raised as in White's species. It seems probable that *P. newportensis* represents one of the various phases of *P. carbonaria* and constitutes a variety of that form rather than a distinct species.

Horizon and locality. — Lower Mercer limestone: Muskingum County, Locality 36, r; Licking County, Flint Ridge, Locality 49, r; Stark County, Locality 53, r. McArthur limestone: Vinton County, Locality 84, r.

Pleurotomaria ornatiformis n. sp.

Pl. XV, figs. 7–13

Description.—Shell small, height a little less than width; volutions five or six in number, the last forming about two-thirds the height of the shell. Volutions moderately convex, angular, and shouldered, marked centrally by a relatively broad, flat zone bounded by two prominent revolving carinae; slit-band situated on the central zone between two smaller carinae; region between the shoulder and the central flattened area slightly concave, marked by three or four revolving carinae; region below the slit-band on the last volution convex, marked by numerous closely arranged carinae; surface also marked by fine, transverse, thread-like lines which turn backward above and forward below the slit-band. Aperture unknown.

Dimensions.—As these specimens occur as external impressions, most of them very fragmental, exact measurements cannot be given. However, judging from the material studied, the dimensions of a typical individual are approximately: height of shell 7 mm., height of body whorl 4.5 mm., width of last volution 9 mm.

Remarks.—This species is very similar to *P. gurleyi* Meek and Worthen, but can be distinguished by the difference in the position of the slit-band. In *P. gurleyi* it is situated upon or just above the mesial

angle, while in the species under consideration it is on the flat vertical zone between the carinae. The form is common in both the Harrison and Sharon ores. A few external casts from the Lower Mercer limestone of Muskingum County have also been referred with considerable doubt to the same species.

Horizon and locality.—Harrison ore: Jackson County, Locality 1, c. Sharon ore: Scioto County, Locality 2, c. Lower Mercer limestone: Muskingum County, Locality 43, r.

Pleurotomaria, several species

Remarks.—Internal casts of small gastropods, evidently of the genus *Pleurotomaria*, are common in the Boggs limestone, but in the absence of all surface markings specific determination is impossible. Other small gastropods apparently belonging to the same genus and in a similar condition of preservation are present in the Upper Mercer member. Larger individuals, too poorly preserved for identification, occur in the McArthur limestone.

Horizon and locality.—Boggs limestone: Muskingum County, Locality 26, c. Upper Mercer member: Muskingum County, Locality 65, r. McArthur member: Jackson County, Locality 80, r.

Genus Phanerotrema Fischer de Waldheim

Phanerotrema grayvillense (Norwood and Pratten)

1855 *Pleurotomaria grayvillense.* Norwood and Pratten, Jour. Acad. Nat. Sci. Phil., 2nd Ser., Vol. 3, p. 75, Pl. 9, Figs. 7a, b.
Coal Measures: Grayville, Illinois; near mouth of Rush Creek, Posey County, Indiana; Shawneetown and Galatia, Illinois.

Remarks.—*Pleurotomaria grayvillense* is of rare occurrence in the middle and upper Pottsville formation of this State. It is represented in the collections studied by a few specimens in a fair state of preservation, on which the delicate surface markings are distinctly visible.

Horizon and locality.—Lower Mercer limestone: Perry County, Locality 25, r; Stark County, Locality 52, r. McArthur limestone: Jackson County, Locality 80, r; Vinton County, Locality 84, r.

Trepospira depressa (Cox)

1857 *Pleurotomaria depressa.* Cox, Geol. Rep. Ky., Vol. 3, p. 569, Pl. 8, Figs. 10, 10a. (Non *P. depressa* Phillips, 1836)
Coal Measures: Bonharbour, Daviess County, and Andrie, Muhlenberg County, Kentucky.

1884 *Pleurotomaria illinoisensis.* Worthen, Bull. No. 2, Illinois State Mus. Nat. Hist., p. 4.
Coal Measures: Mercer County, Illinois.

Description.—This form resembles very closely the one described by Worthen from the Coal Measures of Illinois as *Pleurotomaria illinoisensis*, with the exception that the tubercles at the inner angle of the volutions are somewhat smaller and more irregularly spaced. It also appears identical with the Kentucky form described by Cox as *P. depressa*. The species is characterized by its low depressed spire and the sharp outer angle of the last volution. The slightly depressed slit-band just above the outer angle of the body whorl is distinctly marked. The species has been found only in the Lower Mercer member where it is rare.

Dimensions.—Width 14 mm., height 6 mm., apical angle about 125 degrees.

Horizon and locality. — Lower Mercer limestone: Muskingum County, Localities 39, 43, r.

Genus Schizostoma Bronn

Schizostoma catilloides (Conrad)

Pl. XV, figs. 19, 20

1842 *Inachus catilloides*. Conrad, Jour. Acad. Nat. Sci. Phil., 1st Ser., Vol. 8, Pt. 2, p. 273, Pl. 15, Fig. 3.
Carboniferous: Inclined plane of the Allegheny Mountains, Pa.

Remarks.—*Schizostoma catilloides* is common and widely distributed throughout the Pottsville formation of Ohio. It is present in almost every member in which marine fauna occur from the Harrison ore at the base to the Black Flint at the top.

Horizon and locality.—Harrison ore: Jackson County, Locality 1, a. Sharon ore: Scioto County, Locality 2, c. Lowellville member: Muskingum County, Locality 19, r. Boggs member: Muskingum County, Locality 26, c. Widely distributed in the Lower Mercer and McArthur members, c. Black Flint member: Jackson County, Locality 87, c; Vinton County, Locality 91, r.

Genus Naticopsis McCoy

Naticopsis altonensis (McChesney)

Pl. XV, fig. 15

1865 *Natica altonensis*. McChesney, Ill. New Spec. Foss., P. O., Pl. 2, Figs. 14 a, b.
Coal Measures: Alton, Illinois.

1868 *Naticopsis altonensis*. McChesney, Trans. Chicago Acad. Sci., Vol. 1, p. 50, Pl. 2, Figs. 14a–c.
Coal Measures: Alton, Illinois.

1873 *Naticopsis altonensis* ? Meek and Worthen, Geol. Surv. Ill., Vol. 5, p. 595, Pl. 28, Figs. 11a, b.
Coal Measures: Macoupin County, Illinois.

Description.—A few individuals from the Boggs member agree closely with the form figured and described by Meek and Worthen as *Naticopsis altonensis* ?. They are characterized by the large body whorl which occupies almost the entire length of the shell, the high shoulder and prominent depression above the middle of the volution, together with the surface markings of fine, regular, transverse lines which are present on that species. The figured specimen which is compressed from above, is the most perfect individual obtained. Several, somewhat crushed forms from the Lower Mercer limestone have also been referred to the same species.

Horizon and locality.—Boggs member: Muskingum County, Locality 26, r. Lower Mercer limestone: Perry County, Locality 35, r; Muskingum County, Locality 27, r; Mahoning County, Locality 55, r.

Naticopsis nanus (Meek and Worthen)

1860 *Platyostoma nana.* Meek and Worthen, Proc. Acad. Nat. Sci. Phil., p. 463.
Upper Coal Measures: Springfield, Illinois.

Remarks.—A few well preserved specimens have been referred to *Naticopsis nanus* with considerable confidence. The species is rare although it has been obtained from a number of localities in the Lower Mercer, Upper Mercer, and McArthur members.

Horizon and locality. — Lower Mercer limestone: Muskingum County, Localities 27, 43, 45, r; Stark County, Locality 52, r. Upper Mercer limestone (?): Mahoning County, Locality 76, r. McArthur limestone: Vinton County, Localities 83, 85, r; Hocking County, Locality 86, r.

Naticopsis pulchella n. sp.

Pl. XV, fig. 16

Description.—Shell small, transversely ovate and explanate in outline, width about two-thirds the height; spire small, much depressed, scarcely elevated above the body whorl; volutions three, enlarging very rapidly in size; body whorl large, ventricose, composing almost the entire shell, rounded with greatest curvature just below middle; sutures well defined; aperture apparently large, inflated, subcircular to subovate in outline. Surface marked by very fine transverse lines of growth which curve slightly forward, then backward above the middle of the volution; also by two broad, dark revolving color stripes on the

upper half of the body whorl which show excellently on the light color substance of the shell; indications of color markings on the lower half of the whorl which, however, is much discolored by the dark, carbonaceous shale in which the shell was embedded. Shell thick.

Dimensions.—Height 9.5 mm. (slightly crushed); width 14 mm.; height of body whorl 8.5 mm.

Remarks.—In spite of its imperfect condition, this interesting little shell differs so markedly from any described species, and shows so excellently the color markings which are sometimes retained on representatives of the genus *Naticopsis*, that it seems justifiable to use it as the type of a new species. The single specimen which has been found is slightly crushed with a portion of the lower half and the end of the last volution missing. The species is characterized by its low spire and explanate shape (with allowances made for compression). It is closely related to *Platyceras? peoriense*, *N. nanus*, and *N. splendens*, but differs from all of these forms, especially from the two latter ones, in the above-mentioned ways. The shell is thick, while that of *P.? peoriense* which it resembles closely is said to be thin.

Horizon and locality.—Lower Mercer black shale: Stark County, near East Greenville, Locality 52, r.

Naticopsis tortum (Meek)

Pl. XV, figs. 17, 18

1871 *Platyceras tortum.* Meek, Proc. Acad. Nat. Sci. Phil., p. 171.
Coal Measures: Greentown, Summit County, Ohio.
1875 *Platyceras tortum.* Meek, Pal. Ohio, Vol. II, p. 345, Pl. 20, Figs. 1a–c.
Coal Measures: Greentown, Stark County, Ohio.

Meek's description.—"Shell very thin, dextral, attaining about a medium size, in young specimens composed of about one and a half to two volutions, subglobose, these first turns being contiguous, rounded, and rapidly increasing in size, after which the next turn, which composes the larger part of the shell, becomes free, very oblique, and increases more gradually in size, thus making the entire outline very obliquely elongate-rhombic; body volution a little flattened on the upper slope, subangular above, and somewhat prominently rounded near or below the middle; aperture apparently oval-suborbicular; lip without sinuses. Surface non-plicate, and with only moderately distinct lines of growth."

Dimensions.—The dimensions of the figured specimen are: length 32 mm., width 24 mm., length and width of aperture about 21 mm.

Remarks.—This species is represented in the collections of Pottsville fossils studied by about six specimens from the McArthur limestone which have been for the most part distorted vertically by press-

ure. They are preserved as internal casts to which small portions of the shell still adhere. The body whorl appears to be much less flattened above than is indicated by Meek's figures.

Horizon and locality.—McArthur limestone: Vinton County, Moore mine, Locality 84, r.

Naticopsis ventricosus (Norwood and Pratten)

1855 *Natica ventricosa.* Norwood and Pratten, Jour. Acad. Nat. Sci. Phil., 2nd Ser., Vol. 3, p. 76, Pl. 9, Figs. 10a, b.
Coal Measures: one mile south of New Harmony, Indiana.

Remarks.—A single, fairly well preserved specimen from the Lower Mercer limestone of Muskingum County has the form and surface markings of Meek and Worthen's figure 13a,[1]—a form which these writers believed to be the same as that which Norwood and Pratten designated as *Natica ventrica* in spite of somewhat marked differences, real or supposed, which apparently existed. The characters of the aperture are not shown on the specimen examined.

Dimensions.—Height of shell 14 mm., height of body whorl 11 mm., maximum width 13 mm. The specimen examined is slightly distorted by pressure.

Horizon and locality. — Lower Mercer limestone: Muskingum County, Symmes Creek, Locality 29, r.

Genus Trachydomia Meek and Worthen

Trachydomia sp.

Remarks.—Two crushed specimens of a gastropod from the Lower Mercer and Black Flint members have been referred to the genus *Trachydomia,* but due to the imperfect condition of the shell no specific determination is possible. The aperture and the lip are obscured. However, in its specific relationship it seems most closely related to T. *nodulosa* in size and in number and character of surface nodes.

Horizon and locality. — Lower Mercer limestone: Muskingum County, Locality 38, r. Black Flint member: Vinton County, Locality 92, r.

Genus Zygopleura Koken

Zygopleura plenum (Herrick)?

Pl. XVI, figs. 1, 2

1887 *Loxonema sp.* Herrick, Bull. Den. Univ., Vol. 2, p. 22, Pl. 3, Fig. 2. (The specific name *L. plenum* is suggested on p. 147.)
Coal Measures: Flint Ridge.

[1]Meek and Worthen, Geol. Surv. Ill., Vol. 5, p. 592, Pl. 28, Fig. 13a, 1873.

Description.—Three fragments of *Zygopleura* are among the collections at hand, two from the Lower Mercer and one from the McArthur limestone. The latter has approximately the same number of costae on the whorls and probably an equal number of whorls as Herrick's species, *Loxonema plenum*, although accurate comparisons cannot be made owing to the imperfect condition of the specimen. The Lower Mercer specimens which occur in the form of external molds, are referred to the same species with much less confidence. The costae are coarser than those of Herrick's species, which judging from his figure has about twenty to a volution, while the specimens under discussion are estimated to have only about sixteen to eighteen to a volution. The whorls are somewhat less convex, and the number of volutions considerably more than Herrick's in comparison to the size of the shells. Although these differences may be overestimated as our specimens are imperfect, nevertheless it does not seem at all unlikely that our forms constitute an undescribed species, but for want of more and better specimens, they are for the present provisionally placed with *Z. plenum*.

Horizon and locality.—Lower Mercer limestone: Perry County, Somerset, Locality 35, r; Muskingum County, near Fairview School, Locality 45, r. McArthur limestone: Vinton County, Moore mine near McArthur, Locality 84, r.

Zygopleura plicata (Whitfield)

1882 *Loxonema plicatum.* Whitfield, Ann. N. Y. Acad. Sci., Vol. 2, p. 231.
Coal Measures: Carbon Hill, Hocking County, Ohio.

1891 *Loxonema plicatum.* Whitfield, Ann. N. Y. Acad. Sci., Vol. 5, p. 601, Pl. 15, Figs. 14, 15.
Coal Measures: Carbon Hill, Hocking County, Ohio.

Description.—An external mold of a small, very slender, high-spired gastropod from the Lower Mercer limestone belonging to the genus *Zygopleura* has been referred with some doubt to the above species. The apical angle and the width of the volutions are similar to those of *Z. plicata*, while the surface is marked by fourteen to sixteen vertical plications. The spire is high and consists of about twelve volutions. An external cast also from the Lower Mercer limestone has been referred to the same species with more confidence, although in size it is less than two-thirds that of Whitfield's form. However, no other essential differences could be noted.

Horizon and locality.—Lower Mercer limestone: Perry County, Somerset, Locality 35, r; Licking County, Flint Ridge, Locality 47, r.

Subgenus Hemizyga Girty

Hemizyga n. sp.

Pl. XV, fig. 25

Description.—A small gastropod from the Lower Mercer limestone at Bald Knob, Licking County, represents in all probability a new species of *Hemizyga*, but unfortunately an adequate description or figure cannot be made on account of the imperfection of the only known specimen. The form is preserved as an external mold with the three lower volutions almost complete and the remainder of the spire so indicated that the height can be fairly accurately observed. The following description, although incomplete, shows the features of the shell which can be noted:

Shell small, robust, conical, composed probably of about seven volutions; spire median in height; volutions enlarging rapidly in size, convex, and apparently regularly rounded; body whorl forming almost one-half the length of the spire; sutures well defined. Surface marked by numerous sharply elevated, longitudinal ridges about twenty-four of which occupy a single volution, crossed by fine, regular, closely arranged revolving lines which are sharply defined on the lower half of the whorls, but become less distinct on the upper half.

Dimensions.—Length of shell 10 mm., height of body whorl 4.5 mm., width 6 mm. (not the width of the entire shell, but only of the portion preserved).

Horizon and locality.—Lower Mercer limestone: Licking County, Bald Knob, Locality 46, r.

Genus Bulimorpha Whitfield

Bulimorpha inornata (Meek and Worthen) ?

1860 *Loxonema inornata.* Meek and Worthen, Proc. Acad. Nat. Sci. Phil., p. 465. Upper Coal Measures: Springfield, Illinois.

Remarks.—Several small specimens from the Lower Mercer and McArthur limestones have been doubtfully referred to *Bulimorpha inornata* to which they seem closely related. However, as their condition of preservation is poor and as *B. inornata* has been described from a much higher horizon in the Coal Measures, our form may not represent the same species. A single individual from the Upper Mercer member, only 5 mm. in height, also seems closely related to *B. inornata* although its size is much less.

Horizon and locality.—Lower Mercer limestone: Perry County, Locality 35, r; Licking County, Locality 48, r; Stark County, Locality

52, r. Upper Mercer: Muskingum County, Locality 28, r. McArthur limestone: Vinton County, Locality 84, r.

Genus Sphaerodoma Keyes

Sphaerodoma brevis (White)

Pl. XV, figs. 22–24

1881 *Soleniscus brevis.* White, U. S. Geog. Surveys west 100 Mer. Rept., Vol. 3, Supp. Appendix, p. XXVIII, Pl. 4, Figs. 5a–c.
Carboniferous: Coyote Creek; north of Black Lake; and near Taos, New Mexico.

1813 *Sphaerodoma brevis.* Girty, U. S. Geol. Surv., Bull. 544, p. 201, Pl. XXIV, Figs. 8–12a.
Wewoka formation: Oklahoma.

Description.—This species appears in the Lower Mercer limestone where it is of rare occurrence, but becomes common in the McArthur limestone. The shell is small, having the low spire with concave sides and the inflated body whorl of White's species. The single fold on the columnella is well shown on some specimens. No essential difference can be noted between this form and Figures 25, 26, and 28 of the West Virginia form designated by Price as *Sphaerodoma ? primigenia* var. *intermedia,*[1] which, it seems possible, may prove to be a synonym of White's *S. brevis.*

Horizon and locality.—Lower Mercer limestone: Perry County, Locality 35, r; Stark County, Locality 52, c. Upper Mercer limestone: Holmes County, Locality 73, r. McArthur limestone: Vinton County, Locality 84, c.

Sphaerodoma fusiformis (Hall) ?

1858 *Macrocheilus fusiformis.* Hall, Geol. Iowa, Vol. 1, Pt. 2, p. 718, Pl. 29, Fig. 7.
Coal Measures: Alpine Dam, Iowa.

Remarks.—An internal cast of a high-spired gastropod of median size from the Lower Mercer limestone is evidently closely related to this species. On the fragment studied five volutions are present which show the same form and spiral slope as *Sphaerodoma fusiformis,* but the shell presents insufficient data for satisfactory identification. Several imperfect specimens from the McArthur limestone are apparently closely related to this species, to which they have been provisionally referred.

Horizon and locality.—Lower Mercer limestone: Perry County, Locality 35, r; Muskingum County, Locality 45, r. McArthur limestone: Locality 84, r.

[1]Price, W. A., W. Va. Geol. Surv., Preston Co. Report, p. 541, Pl. XLIII.

Sphaerodoma klipparti (Meek)

Pl. XV, fig. 21

1872 *Macrocheilus Klipparti.* Meek, Proc. Acad. Nat. Sci. Phil. for 1871, Pl. 328. Lower Coal Measures: near Somerset, Perry County, Ohio.
1875 *Macrocheilus Klipparti.* Meek, Pal. Ohio, Vol. II, p. 346, Pl. 20, Figs. 6a–c. Lower Coal Measures: near Somerset, Perry County, Ohio.

Meek's description.—"Shell attaining a large size, elongate-subfusiform, the length being sometimes from two and a half to three times the breadth; spire pointed at the apex, forming about half the entire length with its lateral slopes concave above and convex below; volutions six to eight or nine, the upper five or six being very compactly coiled, and forming comparatively but a small part of the entire shell, while those below suddenly increase in size much more rapidly than the others, particularly in the direction of the longer axis of the shell, and form most of its bulk, these larger turns in large adult examples sometimes assuming together a subcylindrical outline; last or body whorl comparatively long, cylindrical, or more or less oval, and somewhat produced below; suture moderately distinct, almost transverse between the smaller turns, but becoming decidedly more oblique below; aperture comparatively small and narrow, apparently subrhombic in form and effuse below; inner lip much thickened all the way up; columnella twisted, so as to form a single prominent fold below the middle of the aperture. Surface nearly smooth, or only showing very obscure lines of growth. Outer lip unknown.

"Length of one of the largest, most elongate specimens, 2.23 inches; breadth 0.87 inch; length of aperture, about 1 inch."

Remarks.—Our specimens agree quite closely with Meek's description and figures. The species is somewhat common in the Lower Mercer and McArthur members, although the individuals found at any one locality are few. The outer lip is not preserved on any of the specimens examined, most of them occurring as internal casts.

Horizon and locality.—Widely distributed in the Lower Mercer limestone, c (especially common in Muskingum and Licking counties). McArthur limestone: Vinton County, Moore mine, Locality 84, c.

Sphaerodoma humilis (Keyes) ?

1888 *Macrocheilus humilis.* Keyes, Proc. Acad. Nat. Sci. Phil., p. 239, Pl. 12, Fig. 1. Lower Coal Measures: Des Moines, Iowa.

Description.—Internal casts of small high-spired gastropods from the Harrison ore, with a fold on the columnella and apparently no

anterior canal on the outer lip, have been placed under the genus *Sphaerodoma*. Specifically they have been referred rather doubtfully to *S. humilis*, which they seem to resemble closely in contour. Height 5.5 mm., height of body whorl 3 mm., width of body whorl 3 mm.

Horizon and locality.—Harrison ore: Jackson County, Locality 1, c.

Sphaerodoma newberryi (Stevens)

1858 *Loxonema newberryi.* Stevens, Am. Jour. Sci., 2nd Ser., Vol. 25, p. 259.
Coal Measures: Danville, Illinois.

Remarks.—About six specimens from the Lower Mercer and McArthur limestones in a fairly good state of preservation are in very close agreement with *Sphaerodoma newberryi* in size, number and shape of volutions, and in the height and slope of the spire. The fold on the columnella is distinctly shown.

Dimensions.—A specimen of average size measures: height of shell 31 mm., height of body whorl 19 mm., width of body whorl 13.5 mm.

Horizon and locality.—Lower Mercer limestone: Perry County, Locality 35, r. McArthur limestone: Vinton County, Localities 83 (r), 84 (c).

Sphaerodoma primigenia (Conrad)

1835 *Stylifer primigenia.* Conrad, Trans. Geol. Soc. Penn., Vol. 1, p. 267, Pl. 12, Fig. 2.
1915 *Sphaerodoma primigenia.* Girty, U. S. Geol. Surv., Bull. 544, p. 208, Pl. XXIV, Figs. 13–17a.
Wewoka formation: Oklahoma.

Remarks.—A single internal cast of a small gastropod from the Sharon ore has been placed with the above species. As may be seen from the following measurements, the form from the Sharon ore is much smaller than even small specimens of *Sphaerodoma primigenia:* height 12 mm., height of body whorl 7 mm., width of body whorl 10 mm.

A few rather well preserved specimens from the Lower Mercer and McArthur limestones have been assigned to the same species more confidently. They are about twice the size of the individual from the Sharon ore and resemble *S. brevis* somewhat closely, but may be distinguished by their larger size and broader spire, the sides of which are straight, not concave as in the latter species.

Horizon and locality.—Sharon ore: Scioto County, Locality 2, r. Lower Mercer limestone: Perry County, Locality 35, r. McArthur limestone: Vinton County, Locality 84, c.

Sphaerodoma regularis (Cox)

1857 *Loxonema regularis.* Cox, Geol. Surv. Ky., Vol. 3, p. 566, Pl. 8, Fig. 2.
Coal Measures: Daviess County, Kentucky.

Description.—Completely flattened remains and impressions of a high-spired gastropod of median size resembling *Sphaerodoma regularis* are somewhat common in the black shale above the Lower Mercer limestone near East Greenville, Stark County. The lower volution is wanting on the specimens examined, so that the characters of the aperture and columnella are unknown. Twelve volutions which increase gradually and regularly in size are generally present. The form is here tentatively referred to *S. regularis* in the absence of data which would render the identification unlikely. A number of complete forms from the railroad cut at Somerset and from Flint Ridge, also from the Lower Mercer limestone, are preserved sufficiently well to be identified with more confidence.

Horizon and locality.—Lower Mercer limestone: Perry County, Locality 35, c; Licking County, Bald Knob, Locality 46, r; Stark County, Locality 52, c.

Sphaerodoma ventricosa (Hall)

1858 *Macrocheilus ventricosus.* Hall, Rept. Iowa Geol. Surv., Vol. 1, Pt. 2, Pl. 29, Fig. 8. (Non *Phasianella ventricosa* Goldfuss, 1841.)
Lower Coal Measures: Des Moines Valley, Iowa.
1913 *Sphaerodoma ventricosa.* Girty, U. S. Geol. Surv., Bull. 544, p. 213, Pl. XXIV, Figs. 4, 4a.
Wewoka formation: Oklahoma.

Remarks.—A single small individual from the Upper Mercer limestone has been referred to *Sphaerodoma ventricosa* although the aperture and columnella could not be observed. However, the height of the spire and the number and shape of the volutions appear identical with that species. About half a dozen specimens from the Lower Mercer limestone in a fairly good condition of preservation have been identified with *S. ventricosa* with more confidence.

Dimensions.—A specimen from the Lower Mercer limestone measures: height of shell 13 mm., height of last volution 7 mm., width 7 mm.

Horizon and locality.—Lower Mercer limestone: Muskingum County, Locality 29, r. Upper Mercer limestone: Holmes County, Locality 73, r.

Class Conularida

Genus Conularia Miller

Conularia crustula White

1880 *Conularia crustula.* White, Cont. to Pal., No. 8, p. 170, Pl. 42, Fig. 4a.
Coal Measures: Kansas City, Missouri; near Taos, New Mexico.
See also *Conularia crustula*? Price, W. Va. Geol. Surv., Kanawha County Rept., p. 15, Pl. II, Figs. 4–6.
Kanawha Series, Kanawha Black Flint: Queen Shoals, Kanawha County, W. Va.

Description.—A single fragment of a large *Conularia* from the Upper Mercer ore undoubtedly represents the same species as the West Virginia form to which Price referred as *C. crustula* ?, although the species may not be the same as White's. In surface sculpture and apparently in size the Upper Mercer form agrees closely with the West Virginia species; a portion of Price's discussion of the latter form is quoted below:

"Our shell shows the following differences from White's description: size somewhat larger,—in the middle of each side, instead of a furrow, a faint line is seen caused by the slight thickening, the interruption—the ends not meeting but passing each other slightly—or both the thickening and interruption of the transverse, raised striae; this thickening of the striae is due in most cases to a division of the ribs into two, as may be seen under a magnifier; where the rib is not interrupted the division is represented by a shallow groove in the center of the rib; one specimen has its ribs interrupted twice on one side for a portion of its length; thickening without interruption, interruption and division of the interrupted ends of the striae may all occur on different portions of the same side of the shell; no crenulations are observable on the striae, but the imperfect state of preservation of the material may account for their absence; irregular longitudinal wrinkles are seen on some specimens between the ribs. The shell is thin. It is not thought that the above points of difference between our shell and White's are of specific value."

Another fragment of a small *Conularia* from the Lower Mercer limestone agrees closely with the published figures of White's species, especially in size, so that the identification is made with considerably more confidence.

Horizon and locality.—Lower Mercer limestone: Licking County, Flint Ridge, Locality 47, r. Upper Mercer ore: Scioto County, Locality 59, r.

Conularia newberryi Winchell ?

1865 *Conularia newberryi.* Winchell, Proc. Acad. Nat. Sci. Phil., p. 130.
Marshall Group: Cuyahoga Falls, Ohio.
See also 1888 *Conularia newberryi* ? Herrick, Bull. Den. Univ., Vol. 2, p. 146, Pl. 14, Fig. 14.
Coal Measures: Flint Ridge, Ohio.

Description.—Among the collection of Lower Mercer fossils at hand are several fragments of a large species of *Conularia.* The resemblance to *C. newberryi* of the Waverly formation of Ohio is so close that identification with that species might be made with considerable confidence were it not for the different stratigraphic position of the forms and the fragmentary condition of the material at hand. The size is approximately the same as that of *C. newberryi* and the surface is marked by sharply elevated, finely crenulated, transverse costae separated by wide furrows. The costae are arched forward and are either continuous across the median line or terminate abruptly so that the ends alternate in position; about ten to twelve costae occupy a space of 10 mm. A similar form was figured by Herrick from the Lower Mercer limestone at Flint Ridge. Our forms do not show the thickening at the inner ends or in the middle of the costae which characterizes the form from the Kanawha Black Flint of West Virginia referred to by Price as *C. crustula* ?.[1]

Horizon and locality.—Lower Mercer limestone: Licking County, Flint Ridge, Locality 48, r.

Class Cephalopoda

Genus Orthoceras Breynius

Orthoceras isogramma Meek

Pl. XVI, figs. 5, 6

1871 *Orthoceras ? isogramma.* Meek, Proc. Acad. Nat. Sci. Phil., p. 172.

Meek's description.—"The only specimens of this shell that I have seen are flattened by accidental pressure. The most nearly perfect specimen in the collection is 2.80 inches in length, with a breadth (as seen flattened in the matrix), at the larger broken end, of about 0.95 inch, and with sides diverging from the smaller, rather bluntly pointed extremity, at an angle of about 18 degrees. At and near the smaller end the surface is marked by very minute, crowded, transverse, or annular striae. About three-fourths of an inch farther up, these striae gradually

[1]Price, W. A., W. Va. Geol. Surv., Kanawha County Report, p. 15, Pl. II, Figs. 4-6, 1914.

increase in size, and become more irregular in their arrangement, but soon pass above into very regular larger transverse lines, separated by spaces about twice as wide as the lines themselves. These spaces gradually increase in breadth, until they become five or six times as wide as the lines, above which they continue very regular in their arrangement, about four of the lines and three of the intervening spaces occupying a space of 0.10 inch. Near the smaller end, the flattened spaces show what appear to be impressions of septa made visible through the thin shell by pressure. Two of these occupy a space of 0.10 inch.

"As it is seen in the matrix, the very regular transverse lines on the fossil give it somewhat the appearance of an attenuated *Conularia;* but as it shows no indications whatever of longitudinal angles or furrows, it cannot belong to that genus, from which it also differs in texture, though I am not quite sure that it is an *Orthoceras.* It will be readily distinguished by its surface markings alone, from any species of the latter genus hitherto described from our Coal-measures. In its surface markings it bears some resemblance to *Dentalium cinctum* de Koninck (Am. Foss. Belg., Pl. XXII, Fig. 3), which Prof. de Koninck afterwards refers to the genus *Orthoceras.* Our shell, however, is much more rapidly tapering, and straight instead of arched.

"**Locality and position.**—Newark, Ohio. Lower Coal-measures."

Remarks.—This species is represented in the collections at hand by three crushed specimens, the most perfect measuring 60 mm. in length and 24 mm. in width at the larger end; the others are fragments evidently from the broad end of much larger specimens. On the most perfect specimen both extremities are incomplete with about three-fourths of an inch missing from the pointed end, so that the minute, crowded, transverse, or annular striae mentioned by Meek cannot be observed. However, with the exception of a few details of surface sculpture at this end, the agreement with Meek's description, in the absence of figures, is so exact that there is little doubt that this is the form to which his description refers. For a distance of one-half inch below the pointed extremity of the specimen at hand, the entire surface, including both the striae and the flattened interspaces, is covered by very minute transverse lines which are visible only by close observation under a microscope; on the remainder of the shell these delicate markings have been obliterated.

Horizon and locality.—Lower Mercer limestone: Perry County, Somerset, Locality 35, r; Licking County, Flint Ridge, Localities 47 and 49, r. Upper Mercer limestone: Coshocton County, near Warsaw, Locality 72, r. It is probable that Meek's specimen was obtained from Bald Knob, two miles southeast of Newark, Locality 46.

Orthoceras n. sp.

Description. — A small, gradually tapering *Orthoceras* from the Sharon ore represents in all probability a new species, but the material at hand is too poor for descriptive purposes. The siphuncle is conspicuously eccentric, and the septa strongly convex, being situated from each other about one-fourth of their diameter.

Horizon and locality.—Sharon ore: Scioto County, Lick Run, Locality 2, c.

Orthoceras n. sp.

Description.—Several crushed specimens of a large Orthoceras from the Lowellville and Lower Mercer members apparently belong to the same species which is undescribed. The material at hand, however, is too poor and fragmentary for description and figuring. The form appears to be gradually tapering, but other characters, such as the position of the siphuncle and the ratio of the height of the chambers to their diameter cannot be determined. The species can be most readily compared with *O. fanslerensis* Keyes and *O. colletti* Miller, but they can be distinguished from the Ohio form by the greater height of the chambers.

Horizon and locality.—Lowellville member ?: Muskingum County, Holbein, Locality 20, r. Lower Mercer: Mahoning County, Little Mill Creek, r.

Genus Pseudorthoceras Girty

Pseudorthoceras knoxense (McChesney)

1860 *Orthoceras knoxensis.* McChesney, Desc. New Spec. Foss., p. 69.
(Date of imprint, 1859.)
Coal Measures: Knox County, Missouri.

1860 *Orthoceras cribrosum.* Geinitz, Die Carb. und Dyas in Nebr., p. 4, Tab. 1, Fig. 5.
Dyas: Nebraska City, Nebraska.

Pseudorthoceras knoxense. Girty, U. S. Geol. Surv., Bull. 544, p. 227, Pl. XXVII, Figs. 1–6.
Wewoka formation: Oklahoma.

Also most or all of the citations, included under *Orthoceras rushense,* should be included under *Pseudorthoceras knoxense.*

Description.—*Pseudorthoceras knoxense* is common in the marine limestones of the Pottsville formation, but has not been found below the Lowellville member. Although small, representatives vary considerably in size; the form is gradually tapering and the siphuncle is central or subcentral in position. The septa are moderately convex with about three equaling the diameter of the shell at any point. The

peculiar pitted surface on the Nebraska form, described by Professor Geinitz as *O. cribrosum*, is not apparent on the Ohio specimens, but this difference is in no way significant as the pitted character was probably produced by minute parasites and therefore is not of specific importance.[1]

Horizon and locality.—Lowellville member: Muskingum County, Localities 19, 21, c. Boggs member: Muskingum County, Localities 26, 28, c. Widely distributed throughout the Lower Mercer and McArthur members, c.

Genus Coloceras Hyatt

Coloceras sp.

Remarks.—A small imperfect specimen from the Sharon ore has been referred to the genus *Coloceras*, although the generic relationships are very doubtful. Several larger, more perfect specimens from the McArthur limestone have been assigned to the same genus with more confidence, although specific determination seems impossible. However, the forms from the Sharon and McArthur horizons seem closely related.

Horizon and locality.—Sharon ore: Scioto County, Locality 2, r. McArthur limestone: Jackson County, Locality 80, r; Hocking County, Locality 86, r.

Genus Metacoceras Hyatt

Metacoceras pottsvillensis n. sp.

Pl. XVI, figs. 7, 8

Description.—Shell about median in size, consisting of a little more than two closely coiled volutions which increase rather gradually in size. Whorl section subquadrate, a little wider than high, the dimensions near the living chamber being: width 26 mm., height 21.5 mm. Ventral surface very slightly convex; sides flattened and converging a little toward the ventrilateral shoulders; impressed zone of dorsum about 15 mm. in width, deeply concave, forming a sharply acute angle along the median line; sides of dorsum between impressed zone and umbilical shoulders broad, slightly convex; umbilical shoulders sharply angular, forming widest portion of volutions, situated about one-third the distance from the dorsal edge to the ventrum; ventrilateral shoulders angular, marked by prominent highly elevated nodes which are situated opposite each other on either side of the ventrum, 15 to 17 mm.

[1]Meek, F. B., U. S. Geol. Surv. Nebr., p. 234, 1872.

intervening from crest to crest on the last volution. Sutures about 7 mm. apart near the living chamber but gradually becoming closer together, about 5 mm. intervening at the beginning of the second whorl; ventral lobe deep but regularly convex; lateral lobe rather narrow, not so deeply convex as ventral lobe; lobe on impressed zone deeply convex and angular along the median line; dorsal lobe flattened and scarcely perceptible; saddles abruptly curved on ventrilateral angles, less so on umbilical shoulders and almost imperceptible on the angles on either side of the impressed zone. Siphuncle centridorsal. Shell thin and where preserved marked by extremely fine revolving lines.

Dimensions.—Greatest diameter of shell exclusive of living chamber which is incomplete, 72 mm.

Remarks.—This species of *Metacoceras* seems most closely related to *M. cornutum* and *M. dubium*. From the former it differs principally in having the whorls narrower in comparison to the height, the impressed zone narrower and more angular, and the nodes farther apart and situated opposite each other on either side of the ventrum, while in *M. cornutum* they occupy alternate positions. From *M. dubium* it can be distinguished by the narrower outline of the whorls, and by the form of the venter, which in *M. dubium* is marked by longitudinal swellings on either side of a depressed central zone . The Ohio form is represented in the collections studied by a single specimen from the Lower Mercer limestone.

Horizon and locality.—Lower Mercer member: Lawrence County, near Hanging Rock, Locality 30, r.

Metacoceras sp.

Description.—The fragments of the outer whorl of two individuals probably belonging to the genus *Metacoceras* and apparently representing two distinct species are present in the McArthur limestone. The nodes on the ventrilateral shoulders are highly elevated and are more closely arranged on one specimen than on the other. The material at hand, however, is too crushed and imperfect to render specific determination possible.

Horizon and locality. — McArthur limestone: Hocking County, mine of Logan Clay Products Co., Locality 86, r.

Genus Endolobus Meek and Worthen

Endolobus (Temnocheilus ?) ortoni (Whitfield)

1882 *Nautilus ortoni.* Whitfield, Ann. N. Y. Acad. Sci., Vol. 2, p. 231.
Coal Measures: Springfield, Summit County, Ohio.

1891 *Nautilus ortoni.* Whitfield, Ann. N. Y. Acad. Sci., Vol. 5, p. 601, Pl. 16, Fig. 20.
Coal Measures: Springfield, Summit County, Ohio.

Whitfield's description.—"Shell of median size, and consisting of about two and a half or three closely coiled volutions, but which are not at all embracing; the outer one being simply in close contact with the medio-dorsal portion of the next within, and exposing nearly the entire dorso-ventral diameter of the shell. Volutions transversely subpentangular, being angularly convex on the back, strongly subangular on the sides and concave on the abrupt umbilical slope, which forms a somewhat sigmoidal curve resembling an ogee molding, while the slightly concave ventral surface is quite narrow, and forms a fifth surface. Lateral angles obtuse or round subangular, and ornamented by a series of nodes which are strong and very distinct on the inner coil, broad and rounded on the first part of the last volution and become obsolete on the outer third. The substance of the shell has been very thick and strong, and the surface shows no evidence of growth markings or striae. Septa and other internal features unknown."

Remarks.—Two specimens from the Lower Mercer limestone of Muskingum County have been referred to this species; although the better specimen is imperfect, nevertheless characters similar to those of Whitfield's species are preserved with sufficient distinctness, so that the identification can be made with a considerable degree of confidence. This specimen was found projecting from a loose block of limestone in the bed of Blunt Run, and the surface has consequently suffered somewhat from weathering. However, the nodes on the lateral angles are retained with sufficient distinctness to indicate their similarity in form, proximity, and position to Whitfield's species. From a small portion near the end of the last volution they are apparently wanting, while on the inner coil they are strongly marked and closely arranged. Septa not shown.

The second specimen is referred to the same species much less confidently. It consists of a fragment of one and one-half volutions in a poor state of preservation. Apparently it could be referred almost equally as well to *Temnocheilus forbesianus* although the lateral nodose angles are situated too close to the impressed zone and the intervening area is too abruptly sloping. However, these differences may have been produced by lateral compression.

Horizon and locality. — Lower Mercer limestone: Muskingum County, Blunt Run, Locality 27, r; Symmes Creek, Locality 29, r.

Genus Temnocheilus McCoy

Temnocheilus forbesianus (McChesney)

1860 *Nautilus forbesianus.* McChesney, Desc. New Pal. Foss., p. 63.
Coal Measures: Mercer County, Illinois.
1865 *Nautilus forbesianus.* McChesney, New Spec. Foss.. Pl. 3, Figs. 4a–b.

Remarks.—*Temnocheilus forbesianus* is represented in the collections studied by several fragments of the outer volution which preserve fairly well the characters of the surface and show the outline of the cross section of the volution.

Horizon and locality.—Boggs member: Muskingum County, Locality 26, r.

Genus Ephippioceras Hyatt

Ephippioceras sp.

Description.—A crushed fragment near the living chamber of an individual belonging to the genus *Ephippioceras* was obtained from the Lower Mercer limestone of Muskingum County. The species is much larger in size than *E. ferratus,* and is probably comparable in this respect to *E. divisus.* The sutures, which are sharply marked, are similar to those of the latter species. Specific determination, however, is impossible from the scanty material at hand.

Dimensions.—Width of volution near living chamber (almost complete) 90 mm., length of fragment 80 mm.

Horizon and locality.—Lower Mercer: Muskingum County, Symmes Creek, Locality 29, r.

PHYLUM ARTHROPODA

Class Crustacea

SUBCLASS TRILOBITA

Genus Phillipsia Portlock

Phillipsia sangamonensis Meek and Worthen

1865 *Phillipsia (Griffithides?) Sangamonensis.* Meek and Worthen, Proc. Acad. Nat. Sci. Phil., p. 271.
Upper Coal Measures: Springfield, Illinois.

1873 *Phillipsia (Griffithides?) Sangamonensis.* Meek and Worthen, Geol. Surv. Ill., Vol. 5, p. 615, Pl. 32, Fig. 4.
Upper Coal Measures: Springfield, Illinois.

1915 *Phillipsia sangamonensis.* Girty, U. S. Geol. Surv., Bull. 544, p. 265, Pl. XVIII, Figs. 10–13a.
Wewoka formation: Oklahoma.

Description.—Pygidia are present in the Lower Mercer limestone of Muskingum and Licking counties and also in the McArthur limestone which have been referred to *Phillipsia sangamonensis.* No remains of the cephalon or thorax have been found. Eighteen segments are present on the mesial lobe and eleven or twelve on the lateral lobes;

the surface is either smooth or marked by faint traces of fine granules. The pygidium of *P. sangamonensis* is described by Meek and Worthen as follows:

"Pygidium semi-elliptic, slightly wider than long, and rather convex, distinctly narrower and a little longer than the cephalic shield, narrowing backwards, and narrowly rounded at the posterior extremity. Mesial lobe prominent, a little flattened on each side, and narrower than the lateral lobes, from which it is distinctly separated by broad strong furrows; tapering gradually backwards, and terminating rather abruptly near one-third its own length from the posterior margin, so as to leave a broad, nearly flat, or more or less sloping, smooth border, which extends along each side the whole length of the pygidium, but becomes narrower anteriorly; segments of mesial lobe seventeen or eighteen, well defined, rounded, and very nearly or quite straight. Lateral lobes more depressed, and about one-third or one-fourth wider than the mesial lobe, rounding down rather abruptly to the lateral margins; segments nine or ten, rounded, simple, and separated by distinct furrows; all terminating abruptly at the inner edge of the broad, smooth marginal zone.

"Entire surface apparently very nearly smooth."

Dimensions.—Length of pygidium 14 mm., width 17.5 mm.

Remarks.—Two other closely related forms are *P. missouriensis* and *P. major*, which, as suggested by Girty, may represent the same species as *P. sangamonensis*, especially the first-mentioned form. *P. missouriensis* is described as having eighteen segments on the mesial lobe and eleven on the lateral lobes, which agrees exactly with the Ohio form; no other essential differences can be noted although Shumard gave no figures of his species. *P. major* is a considerably larger form with twenty-two or twenty-three segments on the mesial lobe and twelve or thirteen on the lateral lobes, but these are differences which can be accounted for by age; likewise, no illustrations are given of the species. The form under discussion is, however, practically identical, with the exception of size, with the specimen which Meek identified with some doubt as *P. major*,[1] and which he states is smaller and somewhat narrower than Shumard's species. As neither *P. missouriensis* or *P. major* was figured, and as the latter is described as typically larger with a greater number of segments, it seems best for the present to refer the Ohio form to *P. sangamonensis* although it is not unexpected that that species is the same as *P. missouriensis* and possibly as *P. major*.

Horizon and locality.—Lower Mercer limestone: Perry County, Locality 35, r; Muskingum County, Locality 43, c; Licking County, Localities 46 (r), Flint Ridge, 47, 49 , (c).

[1]Meek, F. B., U. S. Geol. Surv. Nebr., p. 238, Pl. 3, Figs. 2a, c, 1872.

Phillipsia trinucleata Herrick

Pl. XVI, fig. 9

1887 *Phillipsia trinucleata.* Herrick, Bull. Den. Univ., Vol. 2, p. 64, Pl. 1, Fig. 23; Pl. 2, Fig. 32; Pl. 3, Fig. 21.
Coal Measures: Flint Ridge, Ohio.

Remarks.—Several small pygidia from the Sharon ore are here referred to *Phillipsia trinucleata,* but they differ from Herrick's species in the absence of the minute granules on the surface. These granules, however, are so minute that they may easily have been destroyed. The form is relatively common in the middle and upper Pottsville formation, especially in the Lower Mercer and Black Flint members where some specimens show distinct traces of a finely granulose surface.

Horizon and locality.—Sharon ore: Scioto County, Localities 2 (r), 6 (c). Lower Mercer member: Muskingum County, Localities 27, 43, c; Licking County, Localities 46 (r), Flint Ridge, 47 (r), 48 (c). Upper Mercer member: Muskingum County, Locality 68, r. Black Flint: Jackson County, Locality 87, c; Vinton County, Locality 91, r.

PHYLUM VERTEBRATA

Class Pisces

Fish Remains

Remarks.—Fish remains were found at several horizons in the Pottsville formation,—in the Sharon, Bear Run, Lowellville, and Boggs members. They are, however, rare, and are represented by isolated teeth and a few plates.

Horizon and locality.—Sharon ore: Scioto County, Locality 2, r. Bear Run member: Vinton County, Locality 17, r. Lowellville member ?: Muskingum County, Locality 20, r; Mahoning County, Locality 22, r. Boggs member: Vinton County, Locality 25, r.

END

DESCRIPTION OF FOSSILS

PLATE VI

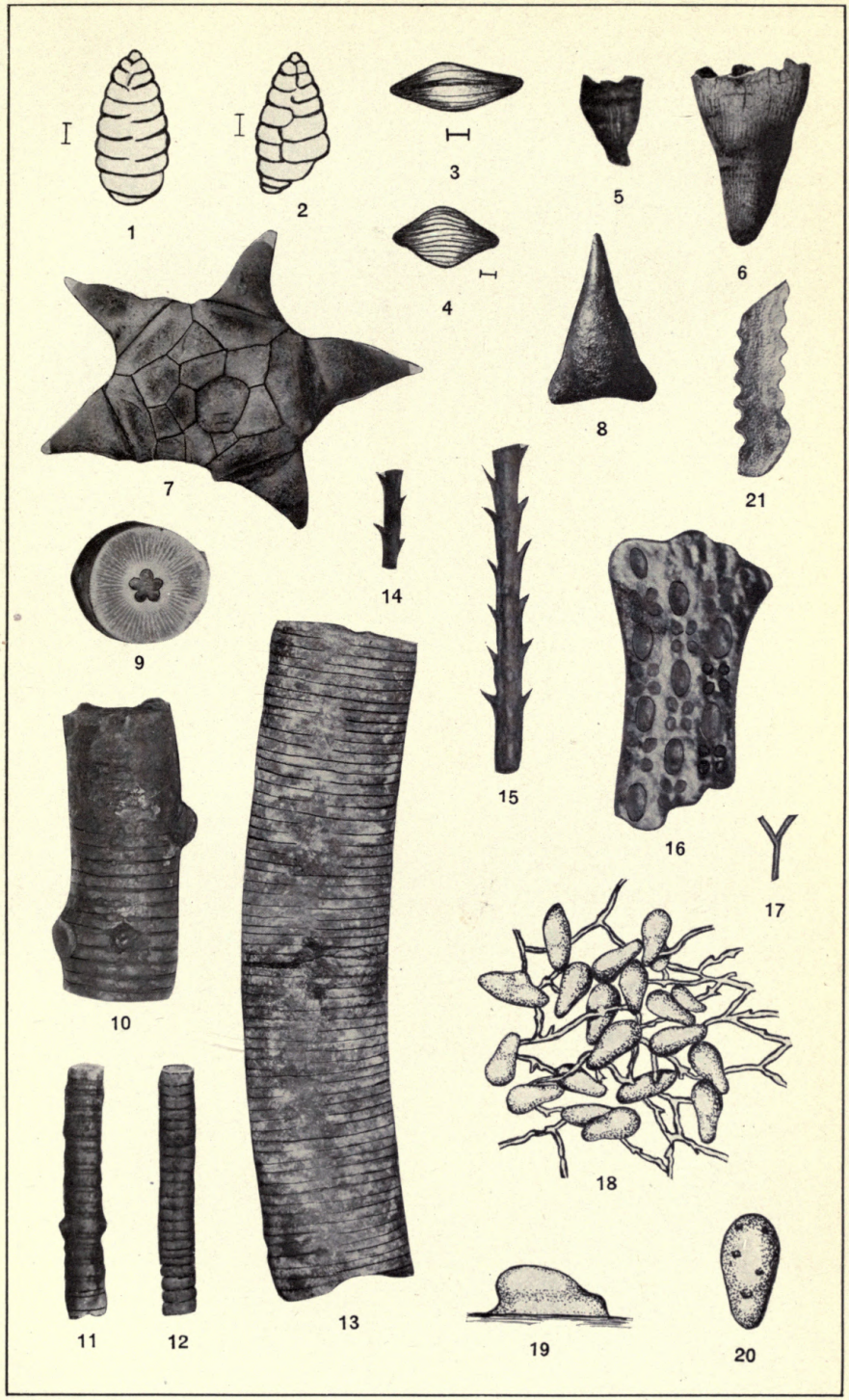

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PLATE VII

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Figs. 1 to 3. *Lingula carbonaria* Shumard 166
Fig. 1. Anthony coal horizon: Scioto County, near Scioto Furnace, Locality 7. x2
Figs. 2, 3. Upper Mercer member: Vinton County, Elk Township, Locality 60. x2

Fig. 4. *Glossina waverlyensis* (Herrick) 169
Lower Mercer limestone: Muskingum County, southeast of Frazeysburg, Locality 43.
"Squeeze" of external mold.

Figs. 5 to 8. *Orbiculoidea stoutella* n. sp. 173
Harrison ore: Jackson County, Hamilton Township, Locality 1.
Fig. 5. Internal cast of dorsal valve of a cotype showing internal markings. x2
Fig. 6. Internal cast of another cotype.
Fig. 7. Another cotype on which portions of the shell are preserved.
Fig. 8. Lateral view of a cotype showing the normal convexity of the species.

Figs. 9, 10. *Derbya crassa* (Meek and Hayden) 176
Fig. 9. Ventral valve showing average size of specimens from the Lowellville member.
Lowellville member: Muskingum County, Poverty Run, Locality 19.
Fig. 10. Dorsal valve showing average size of specimens from the Lower Mercer limestone.
Lower Mercer limestone: Licking County, Bald Knob, Locality 46.

Fig. 11. *Derbya robusta* (Hall) 177
Internal cast of dorsal valve.
Lower Mercer member: Scioto County, Vernon Township, Locality 31.

Fig. 12. *Aulacorhynchus millepunctatus* Meek and Worthen 180
Internal mold.
Lower Mercer member: Scioto County, Vernon Township, Locality 31.

Fig. 13. *Rhipidomella pecosi* (Marcou) 175
After Mark. Conemaugh formation: Ames limestone, Deersville, Ohio. x2
Ventral valve.

Figs. 14, 15. *Chonetes mesolobus* Norwood and Pratten 179
Lower Mercer limestone: Muskingum County, southeast of Frazeysburg, Locality 43.
Fig. 14. Ventral valve.
Fig. 15. Dorsal valve.

Figs. 16 to 18. *Chonetes choteauensis* Mather 178
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Figs. 16, 17. Ventral valves of two specimens with shell partly preserved showing punctate structure. x2
Fig. 18. Ventral valve, showing character of spines on the hinge line. x2

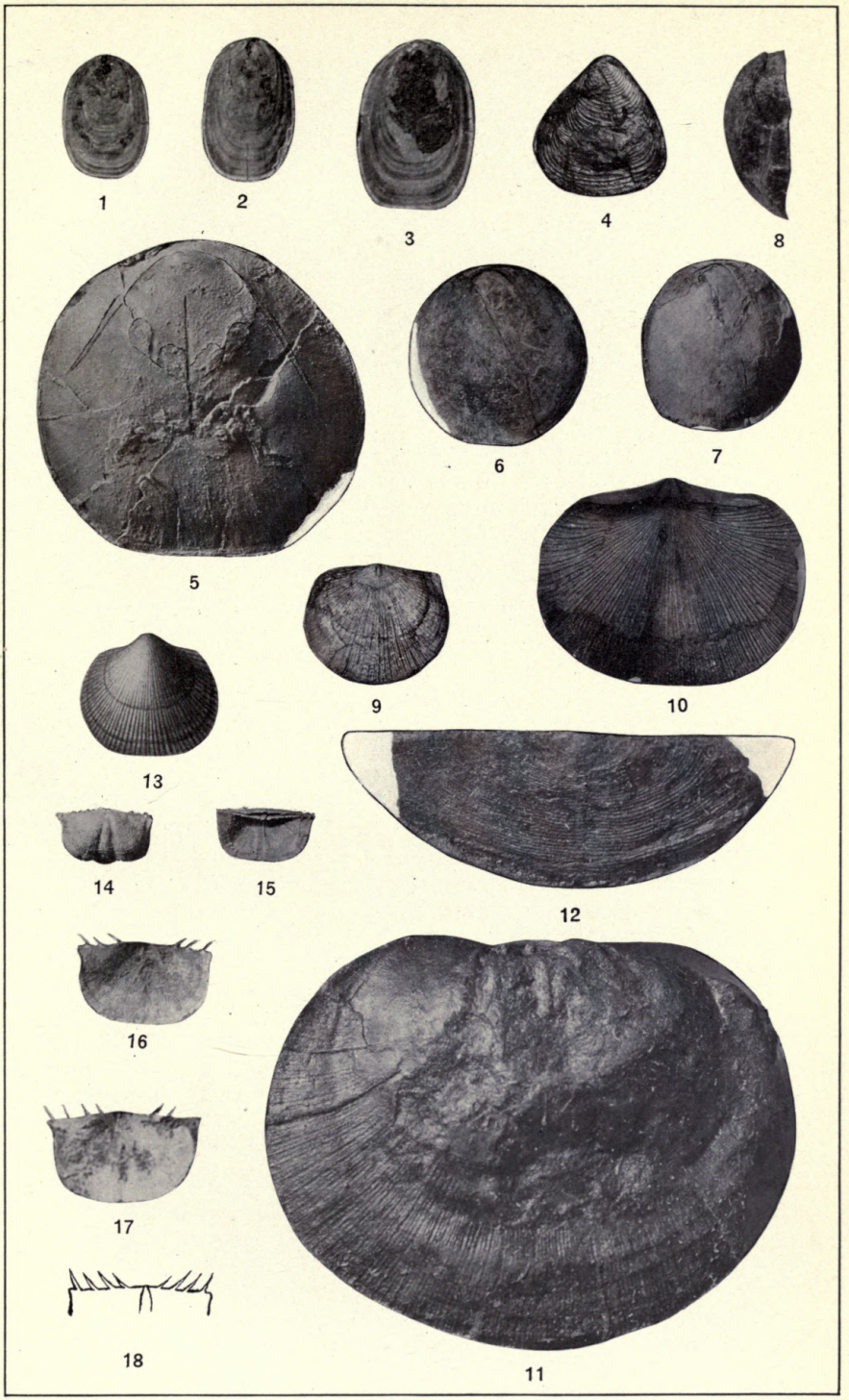
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PLATE VIII

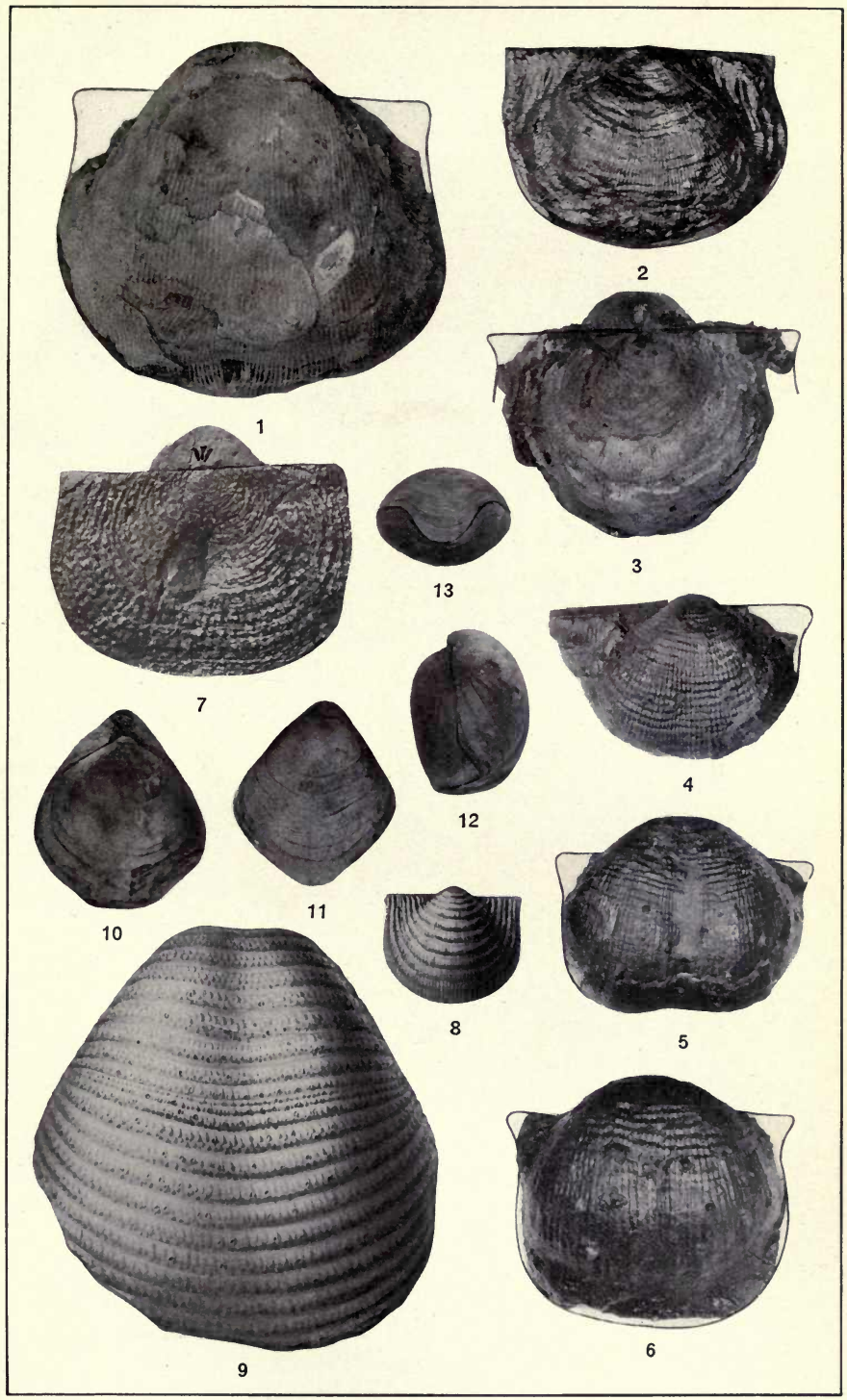
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PLATE IX

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Figs. 1 to 5. *Marginifera muricata var. missouriensis* Girty 184
Upper Pottsville (McArthur)?: Hocking County, Carbon Hill.
Fig. 1. Dorsal valve. x1½
Figs. 2, 3. Ventral valves. x1½
Lower Mercer limestone: Muskingum County, near White Cottage, Locality 36.
Fig. 4. Ventral valve.
Fig. 5. Dorsal valve.

Figs. 6 to 10. *Marginifera wabashensis* (Norwood and Pratten) 185
Lower Mercer limestone: Muskingum County, near White Cottage, Locality 36.
Figs. 6, 7, 8. Ventral valves of three specimens. x1½
Fig. 9. Lateral view of Fig. 6 showing the normal convexity of the species.
Fig. 10. After Mark. Ventral valve. Conemaugh formation: Cambridge limestone, Norwich, Ohio.

Figs. 11, 12. *Spirifer cameratus* Morton 188
After Mark. Conemaugh formation: Cambridge limestone, Langsville, Ohio.
Fig. 11. Dorsal valve.
Fig. 12. Ventral valve.

Figs. 13 to 20. *Spirifer opimus* Hall 188
Upper Pottsville (McArthur)?: Hocking County, Carbon Hill.
Figs. 13, 14, 15. Dorsal valves of three specimens.
Figs. 16, 17, 18, 19, 20. Ventral valves of five specimens showing variations in form.

Figs. 21 to 25. *Spirifer boonensis* Swallow? 186
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Figs. 21, 22. Ventral valves.
Fig. 23. Internal cast of ventral valve.
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Figs. 26, 27. *Squamularia perplexa* (McChesney) 191
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Fig. 26. Ventral valve.
Fig. 27. Dorsal valve of same specimen.

Figs. 28, 29. *Hustedia mormoni* (Marcou) 192
After Mark. Conemaugh formation: Ames limestone, Steubenville, Ohio.
Fig. 28. Dorsal valve. x2
Fig. 29. Lateral view. x2

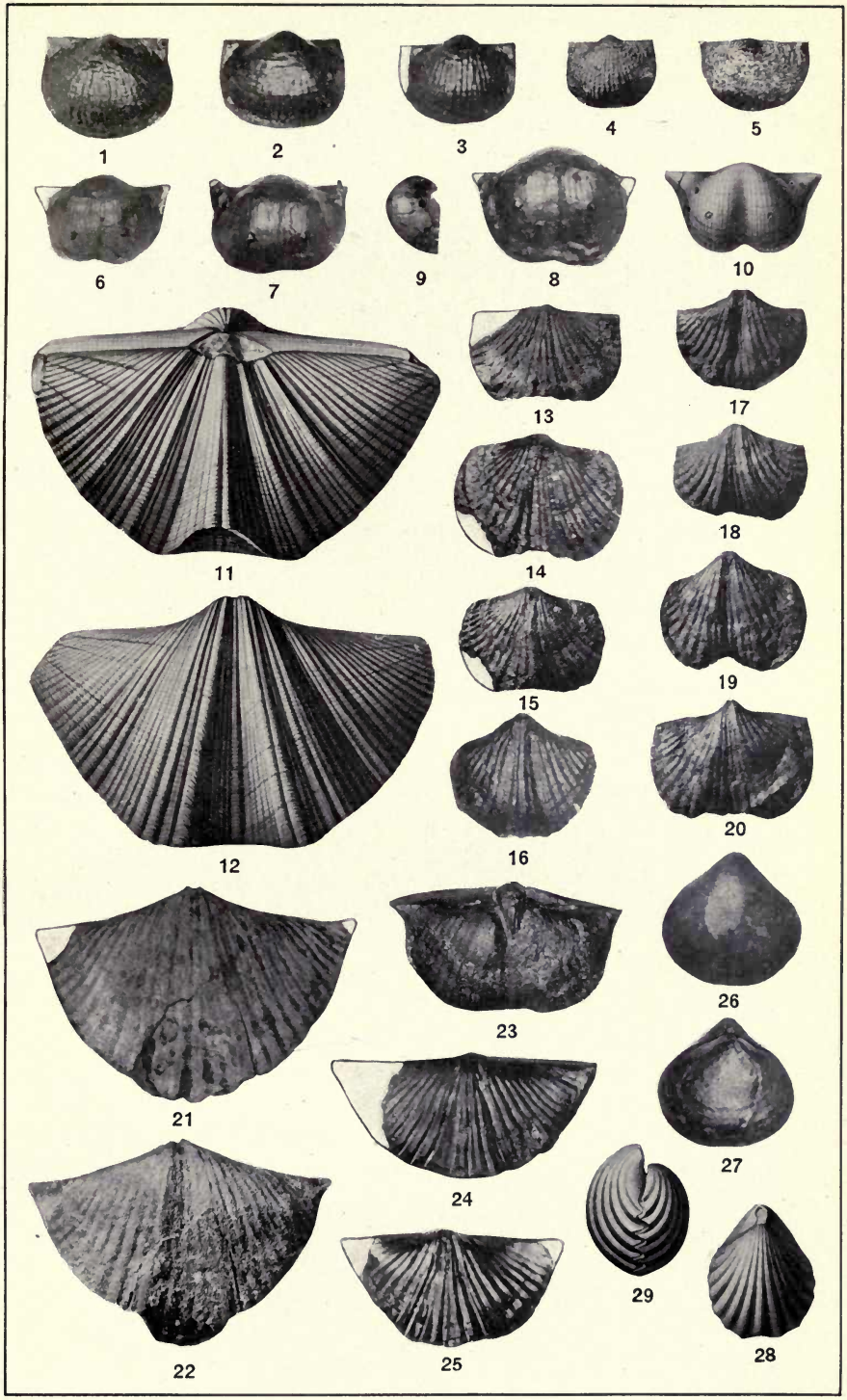
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PLATE X

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Figs. 1, 2. *Solenomya* ? ? *sharonensis* n. sp. ---- 194
Sharon ore: Scioto County, near mouth of Lick Run, Locality 2.
Fig. 1. Internal cast of right valve of holotype. x2
Fig. 2. Same, natural size.

Fig. 3. *Solenomorpha lamborni* n. sp. ---- 195
Sharon ore: Scioto County, near mouth of Lick Run, Locality 2.
Right valve of a cotype. x2

Figs. 4, 5. *Edmondia gibbosa* (McCoy) ---- 197
Lower Mercer limestone: Muskingum County, southeast of Fairview School, Locality 45.
Fig. 4. Right valve.
Fig. 5. "Squeeze" of right valve of another specimen.

Fig. 6. *Edmondia meekiana* (Herrick)? ---- 198
Lower Mercer limestone: Licking County, Flint Ridge, Locality 47.
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Fig. 7. *Edmondia aspinwallensis* Meek ---- 197
After Mark. Conemaugh formation: Portersville limestone, Portersville, Ohio.
Left valve.

Figs. 8, 9. *Edmondia ovata* Meek and Worthen ---- 199
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Fig. 9. Left valve. Lower Mercer: Muskingum County, southeast of Fairview School, Locality 45.

Figs. 10 to 13. *Nucula elongata* n. sp. ---- 201
Sharon ore: Scioto County, near mouth of Lick Run, Locality 2.
Fig. 10. Internal cast of left valve of a cotype. x2
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Fig. 13. Side view in outline. x2

Figs. 14 to 16. *Nucula subrotundata* Girty mss. ---- 203
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Fig. 14. Left valve of a cotype. x3
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Fig. 16. Side view of same cotype in outline. x3

Figs. 17 to 19. *Nucula lunulata* Girty mss. ---- 202
After Girty. Morrow formation: Arkansas.
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Fig. 18. Posterior view of same cotype showing the well defined lunule. x3
Fig. 19. Anterior view of same cotype. x3

Fig. 20. *Nuculopsis ventricosa* (Hall) ---- 204
Lower Mercer limestone: Muskingum County, near White Cottage, Locality 36.
Specimen showing both valves.

Fig. 21. *Anthraconeilo bownockeri* n. sp. ---- 208
Sharon ore: Scioto County, near mouth of Lick Run, Locality 2.
Internal cast of left valve of holotype. x2

(Continued on page 285)

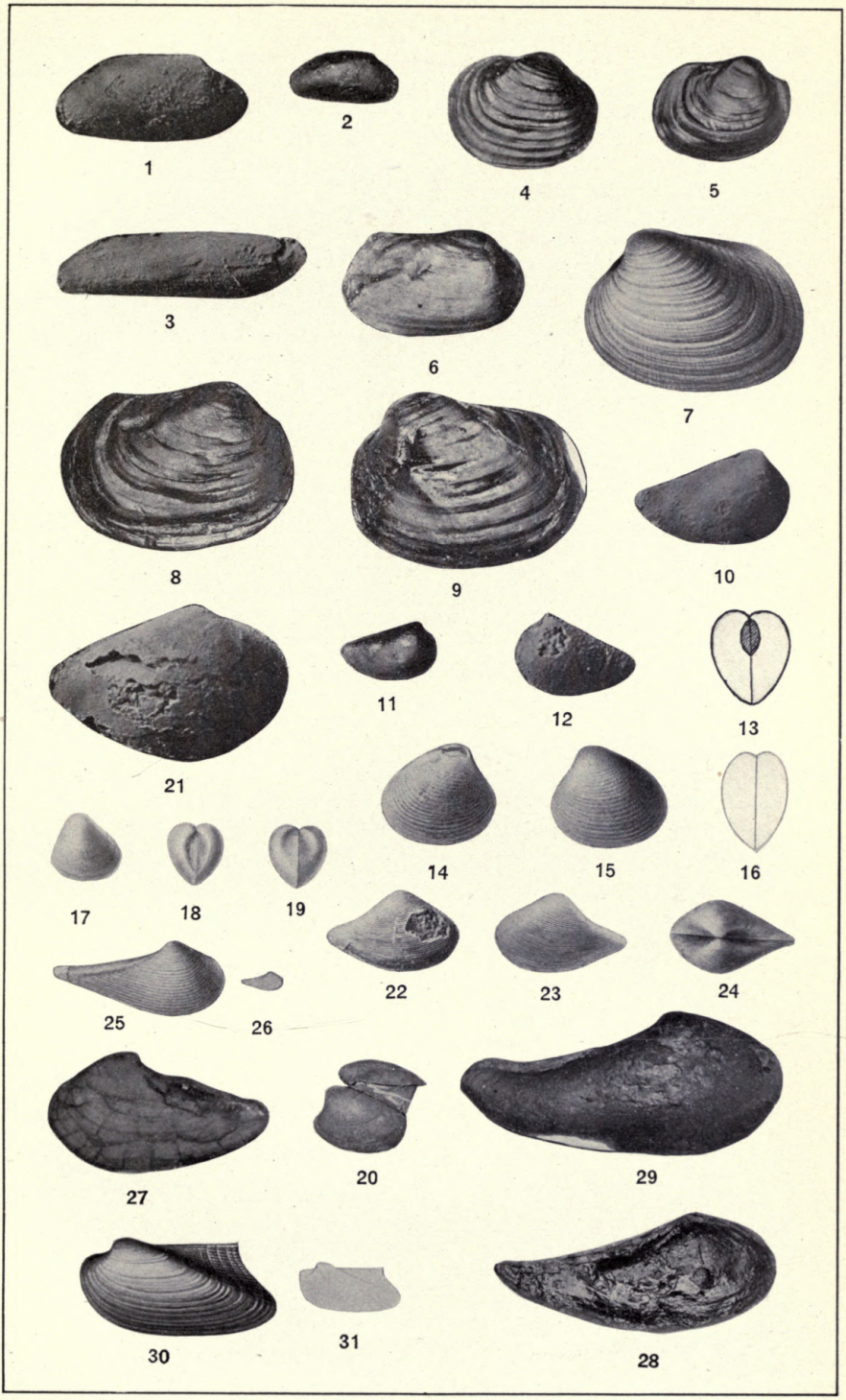
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PLATE X—Continued.

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Figs. 22 to 24. *Leda inflata* Girty mss. 205
After Girty. Morrow formation: Oklahoma.
Fig. 22. Right valve of a cotype. x2
Fig. 23. Left valve of same cotype. x2
Fig. 24. Dorsal view of same cotype. x2

Figs. 25, 26. *Leda meekana* Mark 206
After Mark. Conemaugh formation: Portersville limestone, Portersville, Ohio.
Fig. 25. Right valve. x4
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Fig. 27. *Leda bellistriata* Stevens 204
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Left valve. Hyde collection 819.

Figs. 28, 29. *Leda prolongata* n. sp. 206
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Fig. 29. Right valve of another more perfect specimen, showing more closely the real outline and convexity of the species, slightly enlarged. Lower Mercer member: Perry County, Somerset, Locality 35. Hyde collection 818.

Figs. 30, 31. *Parallelodon tenuistriatus* (Meek and Worthen) 210
After Mark. Conemaugh formation: Portersville limestone, Portersville, Ohio.
Fig. 30. Left valve showing the average size of specimens from the Lower and Upper Mercer members.
Fig. 31. Same showing average size of specimens from the Harrison and McArthur members.

PLATE XI

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Figs. 1, 2. *Parallelodon obsoletus* (Meek and Worthen)---- 209
Upper Pottsville (McArthur)?: Hocking County, Carbon Hill.
Fig. 1. Right valve, slightly enlarged.
Fig. 2. Left valve, slightly enlarged.

Figs. 3, 4. *Parallelodon sangamonensis* (Meek and Worthen)---- 210
Lower Mercer limestone: Perry County, Somerset, Locality 35.
Fig. 3. Right valve. Hyde collection 824.
Fig. 4. Left valve. Hyde collection 825.

Figs. 5, 6. *Myalina pernaformis* (Cox) var.---- 218
Harrison ore: Jackson County, Hamilton Township, Locality 1.
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Figs. 7 to 9. *Myalina pernaformis* (Cox)---- 217
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Figs. 10 to 12. *Myalina recurvirostris var. sinuosa* n. var.---- 219
Lower Mercer limestone: Muskingum County, near Adams Mills, Locality 42.
Fig. 10. Left valve of a large specimen showing the extended hinge line.
Fig. 11. Left valve of a smaller individual.
Fig. 12. Interior of left valve showing the recurved beak.

Fig. 13. *Myalina swallovi* McChesney---- 219
Lower Mercer member: Holmes County, Millersburg, Locality 57.
Left valve.

Fig. 14. *Cypricardinia ? carbonaria* Meek---- 244
Lower Mercer limestone: Licking County, Bald Knob, Locality 46.
Right valve.

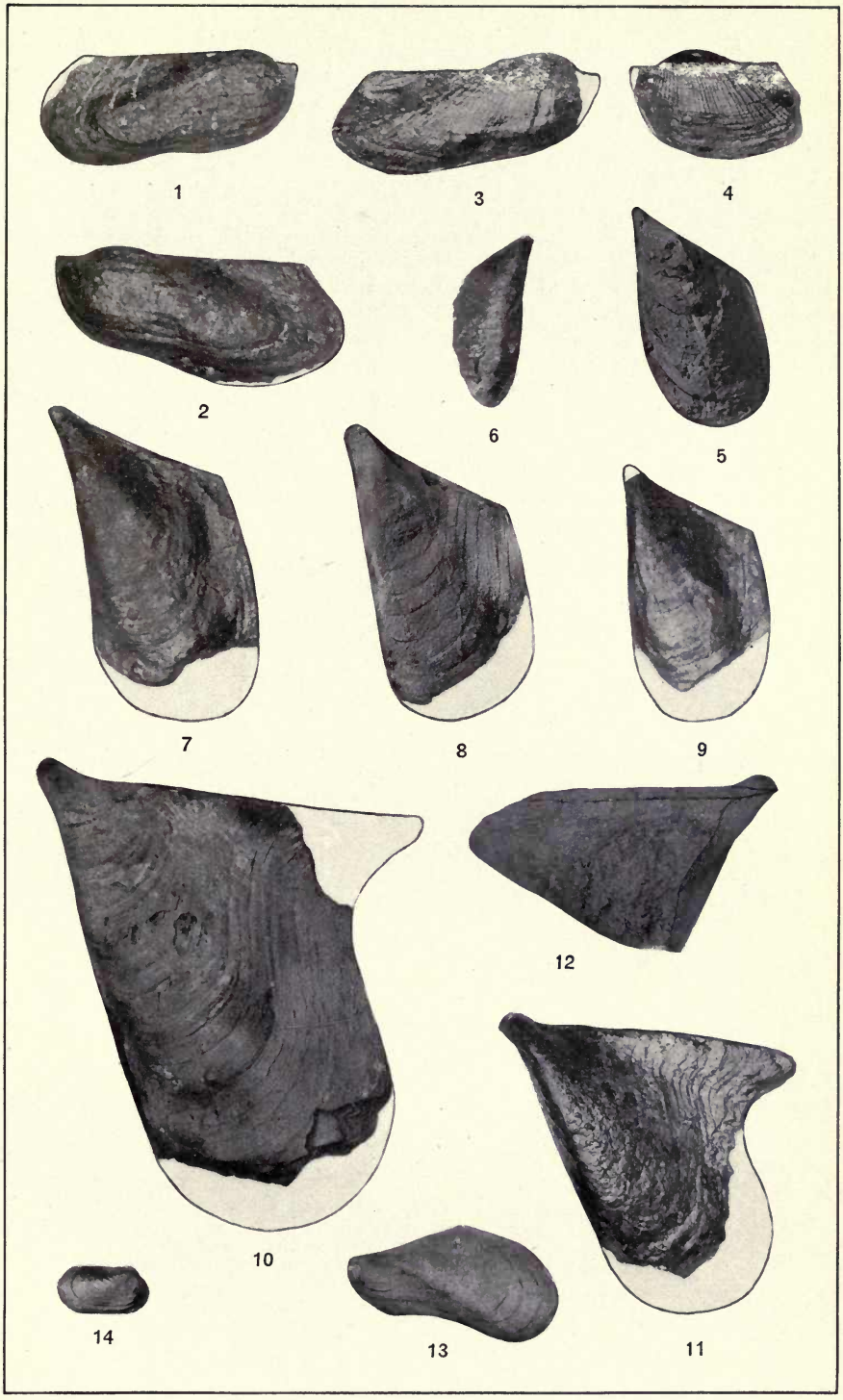
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PLATE XII

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Figs. 1 to 4. *Posidonia girtyi* n. sp. 214
Lower Mercer member: Vinton County, Rock Hollow, Locality 34.
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"Squeeze" of left valve showing superimposed markings.

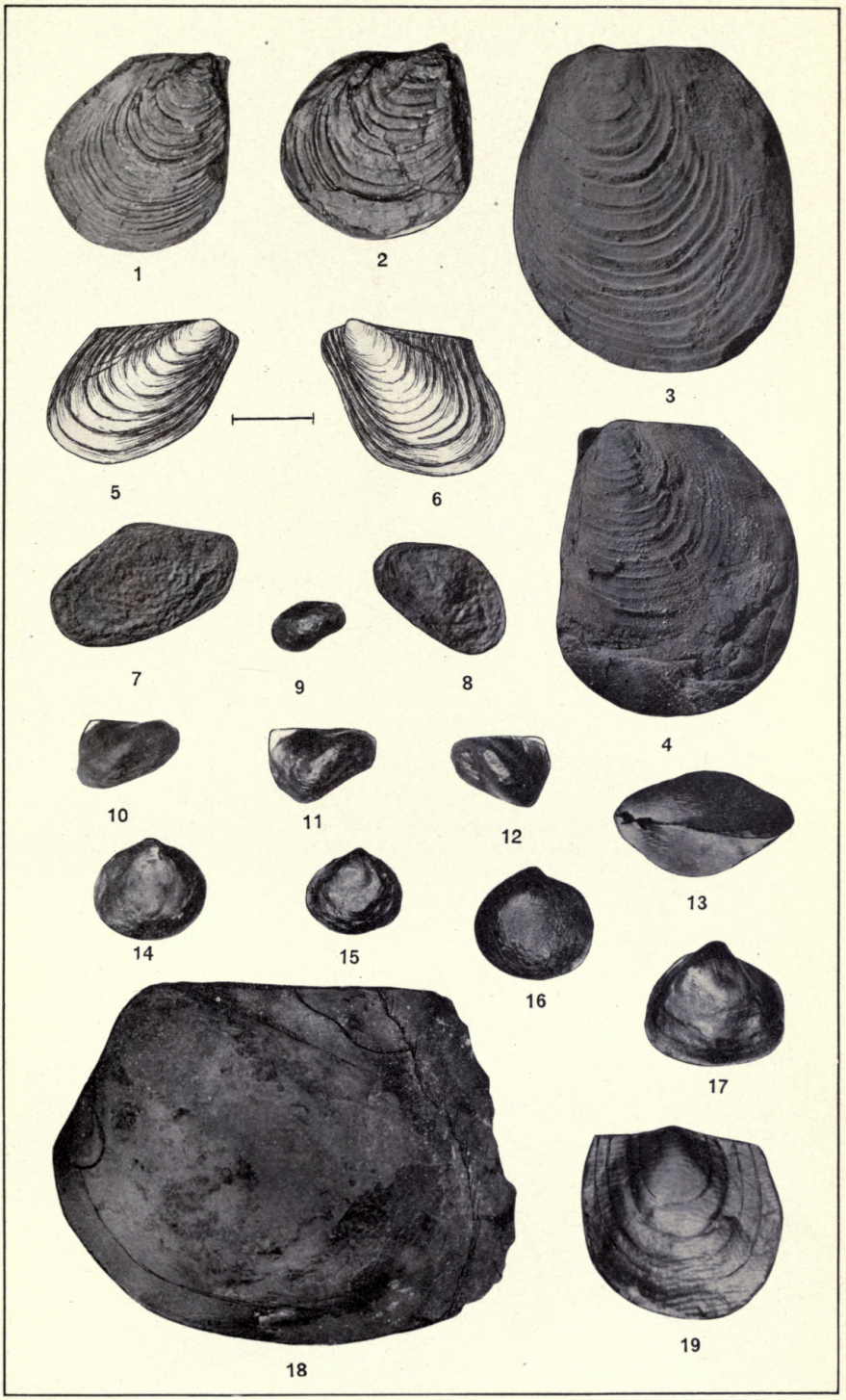
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Fig. 16. "Squeeze" of right valve of average size.
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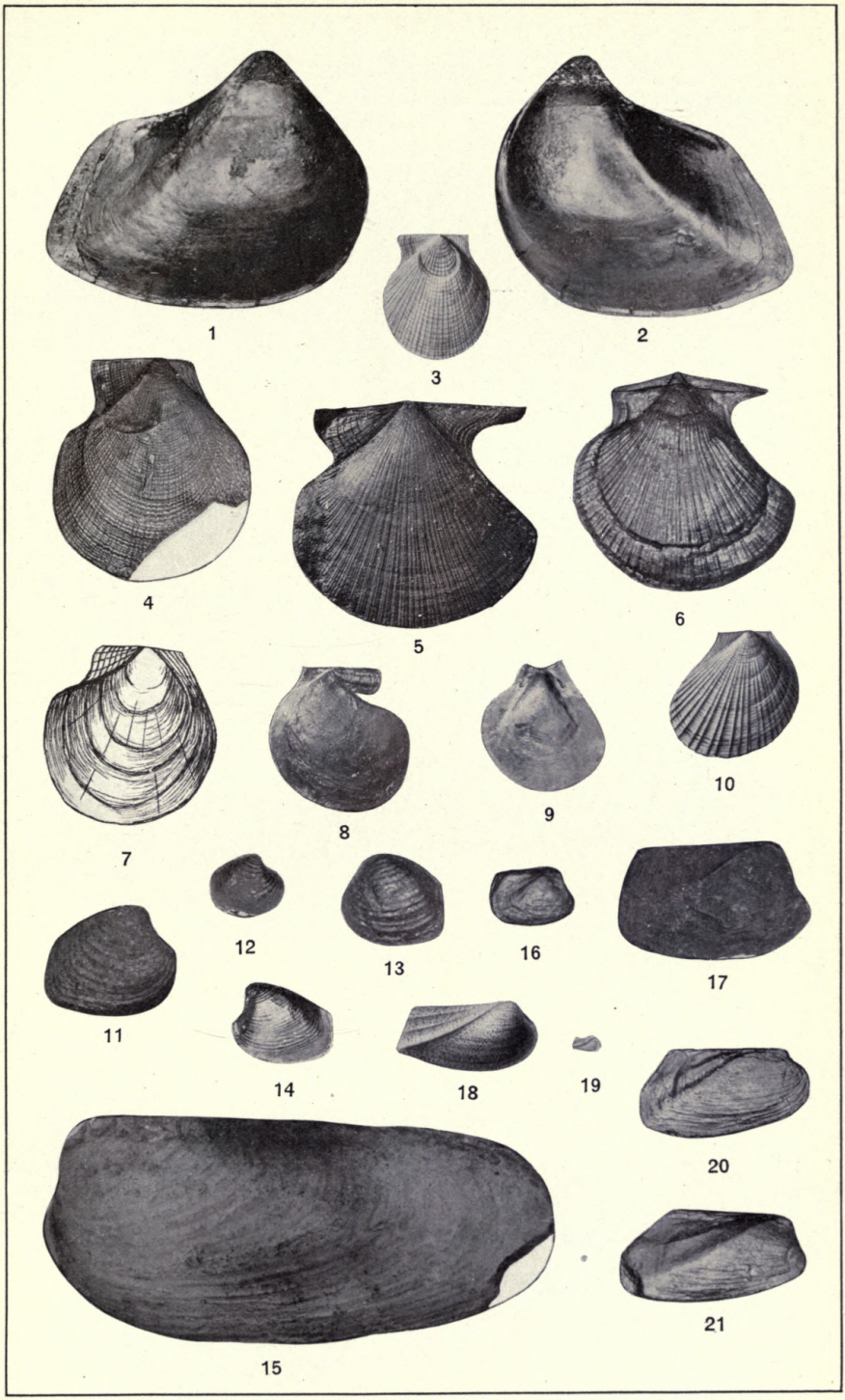
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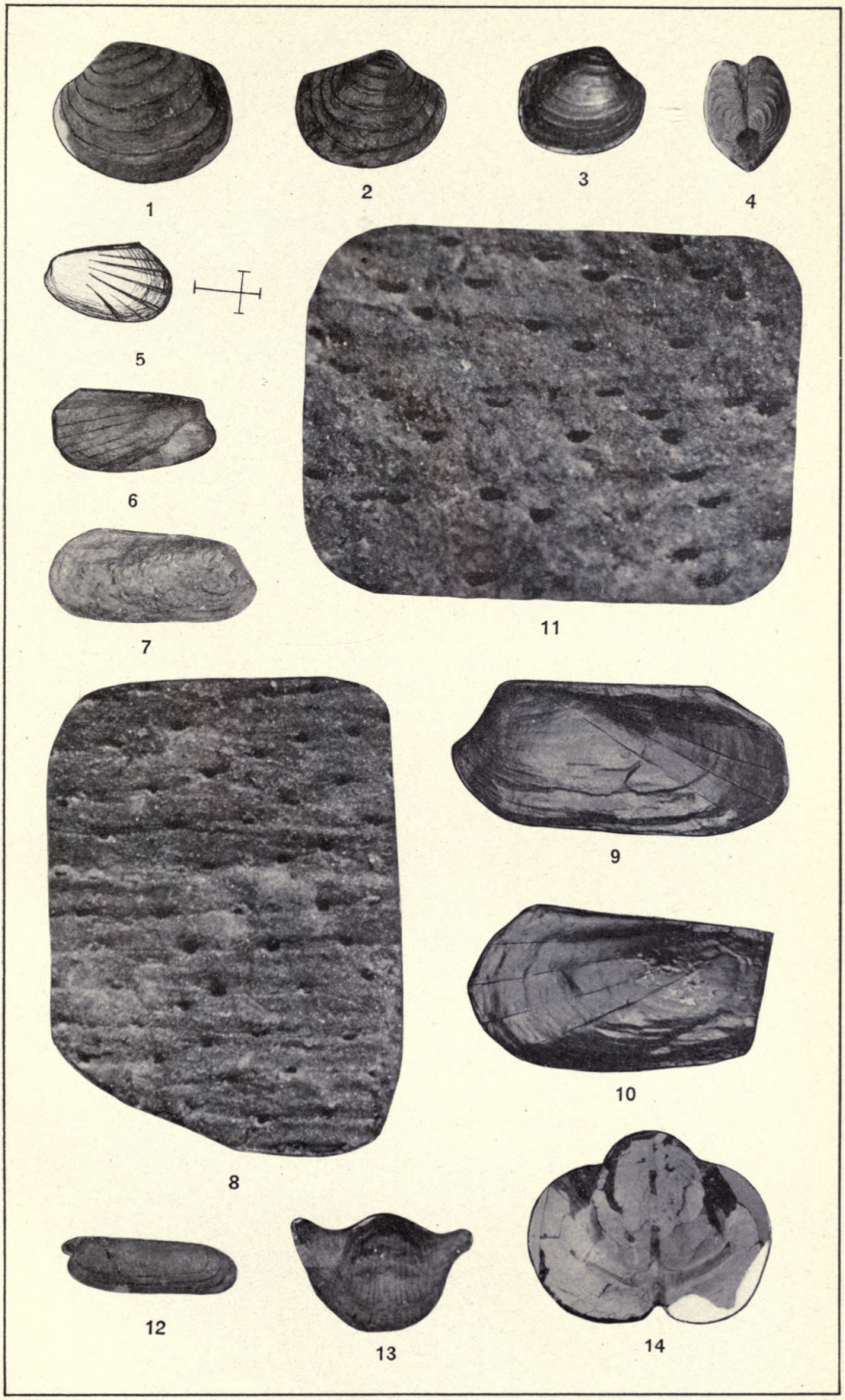
Fig. 14. Larger specimen with outer lip partly preserved. McArthur member: Vinton County, Elk Township, Moore mine, Locality 84.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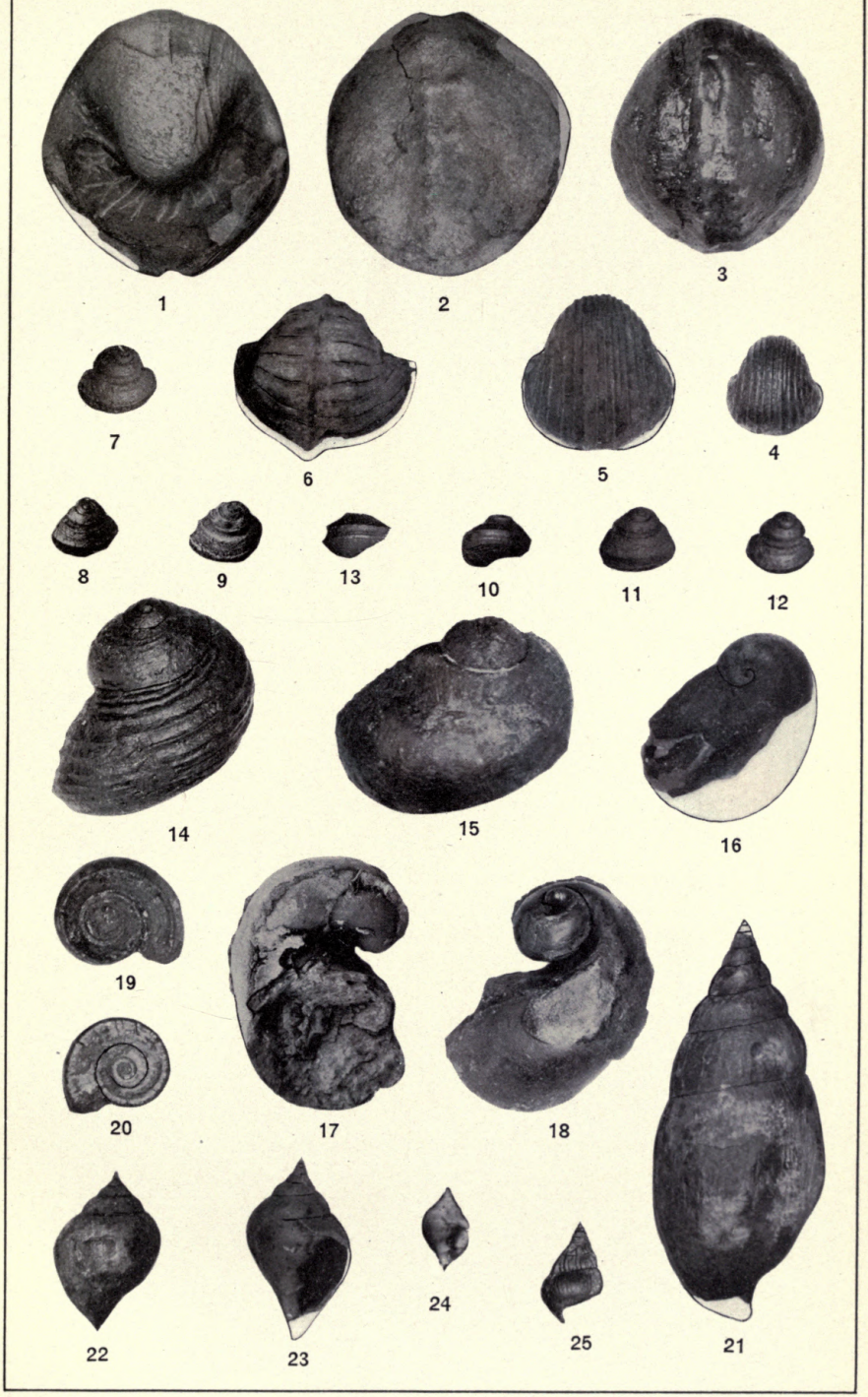
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Fig. 1. "Squeeze" of internal cast. Lower Mercer limestone: Muskingum County, near Fairview school, Locality 45.

Fig. 2. Lower volutions of another specimen. McArthur limestone: Vinton County, Elk Township, Moore mine, Locality 84. x1½

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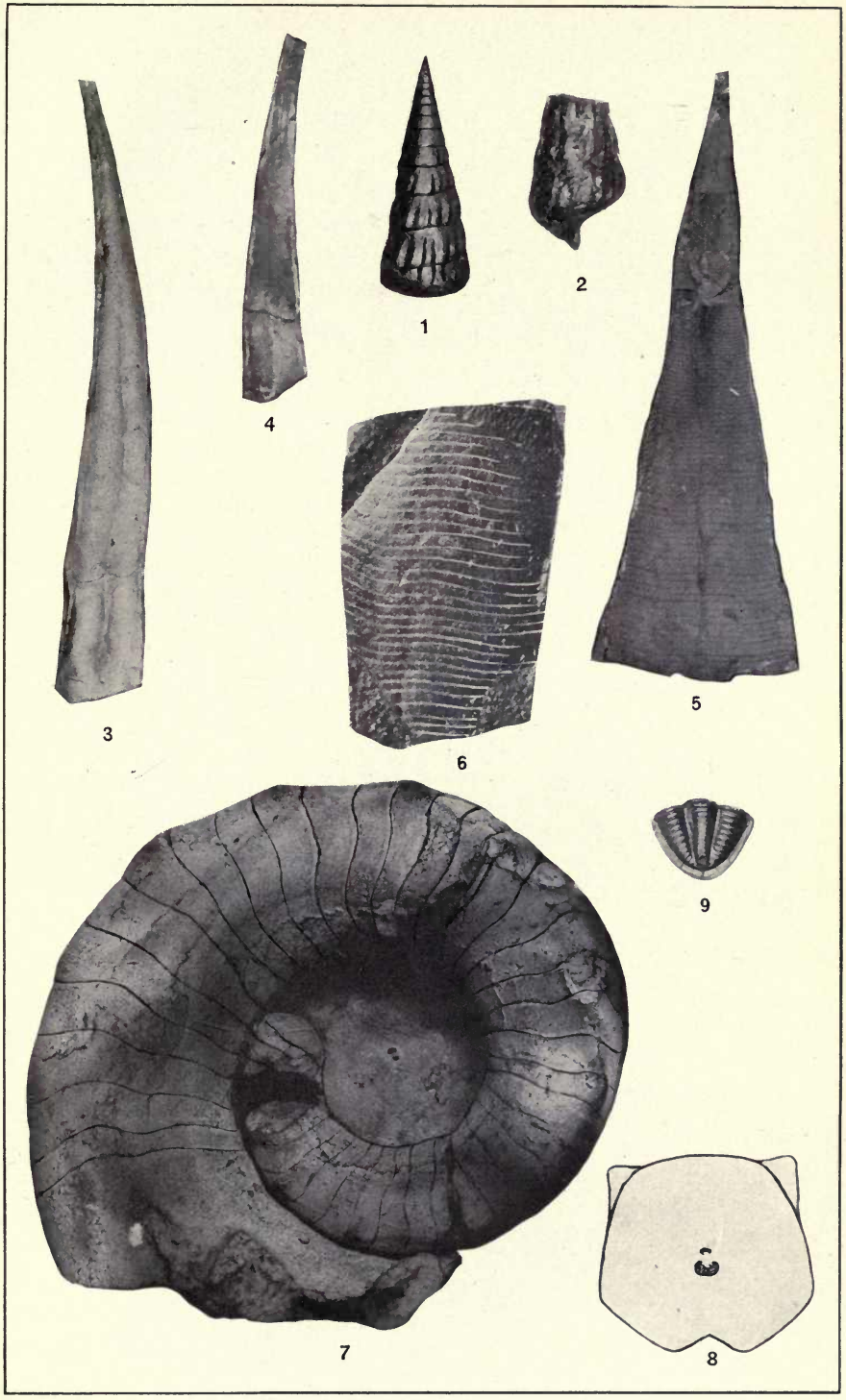
Lower Mercer limestone: Licking County, Flint Ridge, Locality 48.

Pygidium of typical size.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