# VI

# PENNSYLVANIAN INVERTEBRATE FAUNA

*By*

WILLIAM CLIFFORD MORSE

# THE PENNSYLVANIAN INVERTEBRATE FAUNA OF KENTUCKY

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## INTRODUCTION

Among the Pennsylvanian shales, sandstones, and coals in eastern Kentucky are a number of fossiliferous beds, containing invertebrate faunas, beautifully preserved and wonderfully interesting, though rather puzzling in their vertical and especially in their horizontal distribution. During 1919, when the months of July and August were spent in the field, these beds yielded 36 collections, 3 being from unknown beds and 33 forming the basis of the present report.

In the attempt to trace and correlate these fossiliferous beds, of which, with a single exception, not more than one is present in anyone section, the region, stretching from Tug Fork of Big Sandy River at Borderland on the east to North Fork of Kentucky River at Copeland on the west, was traversed. Inasmuch as this region includes parts of 7 counties, Martin, Pike, Johnson, Floyd, Magoffin, Knott, and Breathitt, or of 8 quadrangles, Williamson, Harold, Paintsville, Prestonsburg, Hindman, Salyersville, Troublesome, and Buckhorn, the work was, of necessity, largely reconnaissance. Moreover, as the region lies within the border limits of the Pennsylvanian basin, and streams do not anywhere completely penetrate the system, it is obviously not possible either to start at the base of the system or to begin at the margin of known beds. The region has, therefore, to be treated as an isolated area, and the beds given local names.

## PENNSYLVANIAN FORMATIONS

The names, positions, and relations of these beds are shown in the following table, and brief descriptions of them are given in the subsequent pages.

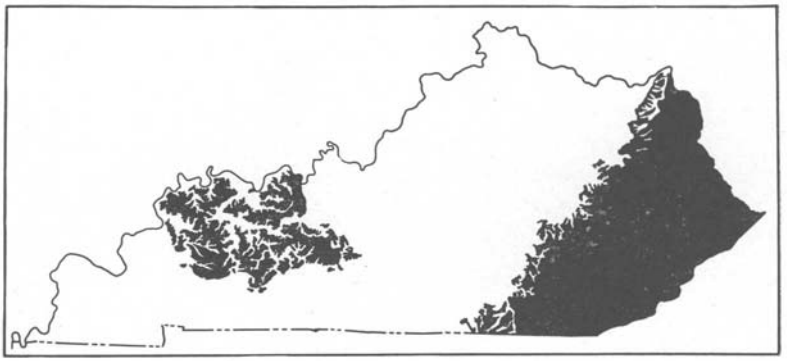


Fig. 29. Distribution of Pennsylvanian Sediments.

| | Feet |
|---|---|
| Flint Ridge flint | 3 |
| Interval | 370 |
| Lost Creek limestone | 3 |
| Interval | 127 |
| Saltlick beds | 7 |
| Interval | 35 |
| Magoffin beds | 6 |
| Middle coal, "Taylor", or Copeland coal | 4 |
| Interval | 221 |
| Kendrick shales—(Copland shales) | 20 |
| Lower coal, "Thacker", or Bevins coal | 5 |
| Interval | 45 |
| Elkins Fork shales | 10 |
| Interval | 45 |
| Dwale shales | — |
| Prestonsburg No. 1 coal | 3 |
| Interval | 49 |
| Total | 953 |

## DWALE SHALES

The lowest and oldest fossiliferous bed which was studied may be designated the Dwale shales, from the town of Dwale, where they are associated with the Prestonsburg coal. The fossil specimens (Coll. 4) came from the dump of the abandoned mine of the Dwale Coal Company, one-half mile northwest of Dwale in Floyd County (Prestonsburg quadrangle). They belong to *Lingula carbonaria,* and hence their shales may represent brackish water deposits rather than marine.

### ELKINS FORK SHALES

The name Elkins Fork is proposed far the shales which are exposed opposite the school of that name in northern Pike County (Williamson Quadrangle). The known fossiliferous portion of the shales is only 80 feet thick, is blue and argillaceous, and lies only three feet above the creek level. The fauna, although containing other forms, is represented almost exclusively by species of the single genus, Productus. By barometer, the shales lie 50 feet below the Kendrick shales. Nothing further is known concerning the geographic distribution of these lower shales.

The collection (No. 28) of fossils from the Elkins Fork shales at the type locality consists of the following forms:

BRACHIOPODA

Productus cora d'Orbigny
P. (Marginifera) missouriensis Girty
P. (Pustula) nebraskensis Owen
P. nodosus Newberry
P. (Pustula) symmetricus McChesney
P. (Marginifera) wabashensis (?) Norwood and Pratten

PELECYPODA

Aviculopecten herzeri Meek
Myalina swallovi McChesney

GASTROPODA

Worthenia tabulata Conrad

CEPHALOPODA

Orthoceras spc.

### BEVINS COAL

In accordance with his custom to call coals of unknown stratigraphic position by the name of the farm on which they were opened, Crandall referred to such a coal in eastern Pike County as the Bevins coal, inasmuch as it was opened an Mr. J. Bevins farm on Big Creek.[1] His section of the coal and associated beds is as follows:

| | Thickness (Inches) | Total (Inches) |
|---|---|---|
| Pennsylvanian, undifferentiated | | |
| Sandstone | | |
| Shale | 10 | |

[1] Crandall, A. R. The coals of Big Sandy Valley; Kentucky Geological Survey, Bull. 4, pp. 54-58, 1905.

| | Thickness (Inches) | Total (Inches) |
|---|---|---|
| Bevins coal | | 57 |
| Coal | 11 | |
| Clay | 1 | |
| Coal | 32 | |
| Shale | 1 | |
| Coal | 12 | |
| Pennsylvanian, undifferentiated | | |
| Under clay | | |

Because the overlying Kendrick shales have not been found to contain characteristic fossils, or any for that matter, east of the Bevins locality, it becomes necessary to refer repeatedly to the underlying coal. The term Bevins has been revived, therefore, but in order that the name may conform to the standards of geologic nomenclature and be a geographic one, the type locality has been shifted slightly from Couder Post Office on Fraley Branch to Bevins Branch where the coal is opened on the farm of Mrs. G. M. D. Bevins. At this place the coal is five feet thick, is 755 feet above sea level, and is overlain by a black carbonaceous shale filled with typical Kendrick fossils.

## KENDRICK SHALES

The Kendrick shales were so named by State Geologist Jillson[2] from exposures at the Dr. Kendrick homestead near the headwaters of Cow Creek in Floyd County, Kentucky. They are also well developed on Sugarloaf Branch the next creek to the north of Cow Creek where they are present in both the fossiliferous and nonfossiliferous phases in the upper and lower stretches of the branch.

The Kendrick shales are largely bluish and black carbonaceous shales which contain considerable calcareous material. They vary considerably in lithology from place to place as well as in invertebrate fossil content, being very fossiliferous in places and barren in others. Contemporaneous erosion or local unconformity erosion has removed part or all of them in places, so that their position in such places is occupied by younger beds, the unconformable relation thus represented not always being apparent in many of the poor exposures, unless the younger unconformable beds should be of marked lithologic

[2] Jillson, W. R. The Kendrick shale—A new calcareous fossil horizon in the Coal Measures of eastern Kentucky—The Mineral and Forest Resources of Kentucky, Ser. V, Vol. I. No. 2, pp. 96-104, 1919.

difference, as sandstones for example. At the type locality they have the composition shown in the next section. Their variation is shown in subsequent sections.

Section (No.7) of Cow Creek at the Second House below the Kendrick Homestead.

| | Thickness Feet | Total Feet |
|---|---|---|
| Pennsylvanian, undifferentiated | | 12.0 |
| Sandstone, coarse, gray, rather massive and irregular. Contains *Sigillaria* | 12.0 | |
| Kendrick shales | | 19.5 |
| Shales, soft, clayey, dove-colored or brown | 1.5 | |
| Shales, bluish-black, carbonaceous | 2.5 | |
| Siderite nodules, cone-in-cone | 0.5 | |
| Shales, dark bluish-black and black, carbonaceous. They are slightly fossiliferous at the top; more so in the middle; and slightly so at the base, the basal part containing Orbiculoidea, Productus, etc. | 12.5 | |
| Sandstone, bluish-black, micaceous. Contains Productus | 1.0 | |
| Shales, soft, clayey, or fire clay, dark bluish | 1.5 | |
| Pennsylvanian, undifferentiated | | 5.5 |
| Coal, bituminous | 0.5 | |
| Covered (said to be bluish fire clay) | 1.0 | |
| Clay, shaly, dark bluish-black, or fire clay | 1.0 | |
| Sandstone, cross-bedded | 3.0 | |

The complete list of fossils from the Kendrick shales at and near the type locality (Collections 1,2,8,20,21,22, and 23) is as follows:

ANTHOZOA

Lophophyllum profundum Milne-Edwards and Haime

CRINOIDEA

Basal plates and stems

Hydreionocrinus kansasensis Weller

BRYOZOA

Bryozoa undetermined

BRACHIOPODA

Ambocoelia planoconvexa Shumard
Chonetes glaber Geinitz

Cleiothyridina orbicularis McChesney
Lingula umbonata Cox

Lingulipora kentuckyensis Morse

L. nebraskensis Meek
Orbiculoidea (Roemerella) patula Girty
Orbiculoidea sp.

Productus cora d'Orbigny
P. (Marginifera) missouriensis Girty
P. nebraskensis Owen
P. nodosus Newberry
P. sp.
Reticularia perplexa McChesney
Spirifer rockymontanus Marcou

PELECYPODA
- Anthraconeilo taffiana Girty
- Astartella arcuata Morse
- A. compacta Girty
- A. concentrica Conrad
- A. kentuckyensis Morse
- Avicula acosta Cox
- Aviculopinna sp.
- A. americana Meek
- Deltopecten texanus Girty
- Edmondia glabra Meek
- Entolium aviculatum Swallow
- Leda bellistriata Stevens
- L. jillsoni Morse
- Lima retifera Shumard
- Modiola sp.
- Monopteria sp.
- Nucula sp.
- N. anodontoides Meek
- Nuculopsis ventricosa Hall
- Pinna sp.
- Pleurophorus subcostatus Meek and Worthen
- Posidonomya fracta Meek
- Prothyris elegans Meek
- Schizodus affinis Herrick
- S. alpinus Hall
- Solenomya sp.
- Yoldia glabra Beede and Rogers

GASTROPODA
- Aclisina stevensana Meek and Worthen
- Bellerophon sp. 1, sp. 2
- B. crassus Meek and Worthen
- B. (Patellostium) montfortanus Norwood and Pratten
- B. (Bucanopsis) meekianus Swallow
- Bulimorphia minuta Stevens
- Meekospira peracuta Meek and Worthen
- Pleurotomaria new sp.
- Schizostoma catilloides Conrad
- Sphaerodoma brevis White
- S. primigenia Conrad
- Trepospira depressa Cox
- Worthenia new sp. 1
- W. new sp. 2
- W. tabulata Conrad
- Zygopleura plebeia Herrick

SCAPHOPODA (Dentalium)
- Plagioglypta annulistriata Meek and Worthen

CEPHALOPODA
- Cyrtoceras sp.
- Gastrioceras new sp. 1. sp. 2, and sp. 3
- G. montgomeryense Miller and Gurley
- G. occidentale Miller and Faber
- Metacoceras scuptile Girty
- Orthoceras new sp. 1 and sp. 2
- O. colletti Miller
- O. (Pseudorthoceras) knoxense McChesney

CRUSTACEA
- Phillipsia trinucleata Herrick

The Kendrick shales lie 105 feet above the Prestonsburg coal. They form the roof shales of the lower coal (Thacker) of Tug Fork of Big Sandy River and of the tributaries of this fork, both in the vicinity of Borderland, W. Va.

The shales are exposed in the streams to the east of the type locality as far as Bevins Branch of Big Creek (Williamson quadrangle). From this point they have not been recognized, and their position was determined only by tracing the underlying coal from Bevins Branch down Big Creek and thence up Tug Fork to Hatfield and Borderland, where the coal proves to be the lower bed (Thacker). The shales are non-fossiliferous even as close to the type locality as the lower stretches of Sugarloaf Branch. Westward from this point they have not been recognized except at Copland on North Fork of Kentucky River (Buckhorn quadrangle), where they lie just above track level. A few hundred feet down stream the shales are largely or wholly replaced by sandstone, as a result of contemporaneous, or subsequent erosion and later deposition of younger beds.

## MAGOFFIN BEDS

The name Magoffin is proposed for the shales and limestones so extensively developed in southern Magoffin County (Salyersville and Prestonsburg quadrangles). These beds are not limited to this county, but probably they have their most typical development here.

The beds consist of two thin layers of limestone, separated by a thin bed of shales, and all three underlain and overlain by thin beds of shales. In places the upper shales are fossiliferous; in other places the lower shales; and in still others, neither one is fossiliferous. In spite of the fact that the two layers of limestone and included shales are fossiliferous, the variation in the fossil content of the underlying and overlying shales makes the drawing of the lower and upper lines of contact an arbitrary matter. The total thickness assigned to the beds is

likewise an arbitrary matter, but that shown in the following section is perhaps an average. The position of the beds above the thin coal is significant.

Section (No. 31) at the head of Sycamore Branch of Oakley Creek at the home of Mrs. Sarah Salyers (Salyersville quadrangle)

| | Thickness Feet | Total Feet |
|---|---|---|
| Pennsylvanian, undifferentiated | | 18.0 |
| Sandstone, massive, some iron ore nodules | 18.0 | |
| Magoffin beds | | 9.4 |
| Shales, blue and black, clayey and carbonaceous. Basal part fossiliferous | 3.5 | |
| Limestone, layer, dove-colored; fossiliferous | 1.0 | |
| Shales, upper part calcareous and very fossiliferous | 1.5 | |
| Limestone, layer, impure and sandy; fossiliferous | 0.4 | |
| Shales, soft, blue, clayey, filled with plant fossils | 3.0 | |
| Copland coal and fire clay | | 1.2 |
| Coal, bituminous | 0.2 | |
| Fire clay, shaly | 1.0 | |
| Pennsylvanian, undifferentiated | | 7.0 |
| Sandstone above and shales below | 7.0 | |

The collection (No. 31) of fossils from the Magoffin beds at the type locality contains the following forms:

CRINOIDEA
- Crinoid stems and plates

BRACHIOPODA
- Chonetes granulifer Owen
- Composita subtilita Hall
- Derbya crassa Meek and Hayden
- D. robusta (?) Hall
- Orbiculoidea spc.
- Productus (Marginifera) missouriensis Girty
- P. semireticulatus Martin
- Reticularia perplexa McChesney
- Spirifer opimus Hall
- S. rockymontanus Marcou

PELECYPODA
- Astartella concentrica (?) Conrad
- Edmondia ovata Meek and Worthen
- Leda sp.
- Nuculopsis ventricosa Hall

GASTROPODA
- Bellerophon (Euphemus) carbonarius Cox

The Magoffin beds lose their identity as limestone bearers east of the headwaters of Licking River. Their position is, therefore, difficult to determine, but they are computed to lie approximately 330 feet above the coal mined at Boscoe. This coal is said to be opened just above the railroad track at short

intervals down Beaver Creek and Levisa Fork to Prestonsburg, where it is correlated with the Prestonsburg No. 1 coal. The coal was not traced from Boscoe to Dwale, but the above universal correlation by the coal men is accepted as correct or as essentially so. The Magoffin beds, accordingly, lie about 220 or 230 feet above the Kendrick shales, and are, therefore, the representatives of the roof shales of the middle, Taylor, coal, so extremely fossiliferous in the Kentucky mines opposite Borderland, West Virginia. Southward and westward from the type locality, the Magoffin shales and limestones can be traced through Knott and Breathitt counties to North Fork of Kentucky River at Copland (Buckhorn quadrangle), where they form the roof of the coal mined at Copland. The middle, Taylor, coal at Borderland is, therefore, the same bed of coal as the one mined at Copland.

## SALTLICK BEDS

Just south of the gap between Grassy Creek and Raccoon Branch (Prestonsburg quadrangle) and just northeast of the one between Saltlick Creek and Quicksand Creek (Hindman quadrangle) are impure limestones, which might be mistaken easily for the Magoffin beds, because of their stratigraphic position so near the Magoffin beds and also because of their structure at the Saltlick-Quicksand gap, where the beds consist of two thin layers of limestone separated by a thin interval of shales. Careful measurements at this gap showed, however, that the beds under discussion lie 35 feet above the Magoffin beds, and careful study revealed that they are lithologically different from those beds. As the following section indicates, the beds are best exposed at the head of Saltlick Creek, after which stream it is proposed to name them.

Section (No. 36) in the highway at the head of Saltlick Creek.

| | Thickness | Total |
|---|---|---|
| | Feet | Feet |
| Pennsylvanian, undifferentiated | | 7.5 |
| Shales, sandy | 7.5 | |
| Saltlick beds | | 7.3 |
| Limestone, blue, impure, shaly at the top; fossiliferous | 1.3 | |
| Shales, blue, carbonaceous. and sandy; fossiliferous | 5.5 | |
| Limestone, impure, sandy and blue | 0.5 | |

The complete list of fossils from the Saltlick beds at the type locality (Collection 35) consists of the following:

BRACHIOPODA
- Ambocoelia planoconvexa Shumard
- Chonetes granulifer Owen
- Derbya crassa Meek and Hayden
- Productus cora d'Orbigny
- P. (Marginifera) missouriensis Girty
- Spirifer opimus Hall

GASTROPODA
- Schizostoma catilloides Conrad

The extent of the Saltlick beds is unknown. The loose blocks of limestone (Collection 19) in the gap between Mare Creek and Buffalo Creek (Harold quadrangle) may be Saltlick in age, because of their position and fossil content. Outside of the three gaps mentioned the Saltlick beds have not been recognized as such.

### LOST CREEK LIMESTONE

On the divide between Lost Creek and Big Branch of North Fork of Kentucky River (Buckhorn quadrangle), just north of the gap through which passes the road connecting these two streams, is a thin limestone which differs markedly from all the others of eastern Kentucky. Where exposed along the crest of the ridge, the limestone is rather badly broken, but large blocks show it to be at least three and one-half feet thick. The lower two-thirds is a fossiliferous dolomitic limestone, and the upper third is a blue shelly limestone. The limestone is very fossiliferous, Bryozoa being especially abundant. It lies, by barometric measurement, about 175 feet above the Magoffin beds and nearly 130 feet above the Saltlick beds. For more reasons than one, this dolomitic limestone is very appropriately named the Lost Creek limestone from the stream of that name.

The list of fossils (Collectian 37) from the Lost Creek limestone at the type locality is as follows:

BRYOZOA
- Fenestelloid specimen

BRACHIOPODA
- Chonetes granulifer Owen
- Composita subtilita Hall
- Derbya crassa Meek and Hayden
- Productus sp.
- Spirifer sp.
- Spiriferina kentuckyensis Shumard

### FLINT RIDGE FLINT

On Flint Ridge at the head of Leatherwood Branch of South Quicksand Creek (Troublesome quadrangle), 30 feet from the top of the ridge and near the 1,500-foot contour line, and also 550 feet, by barometer, above the Magoffin beds, is a three-foot bed of flint, which is yellow in color and contains no fossils. Loose dolomitic or leached limestone blocks associated with the flint are very fossiliferous, however. The Flint Ridge flint which lies so near the top of the high ridge has not been recognized outside of this area.

The collection (No. 14) of fossils from the Flint Ridge flint at the type locality contains the following forms:

CRINOIDEA
Crinoid stems
BRYOZOA
Fenestelloid specimen
BRACHIOPODA
Orbiculoidea convexa Shumard
Productus nebraskensis Owen
Spirifer rockymontanus Marcou
PELECYPODA
Allerisma terminale Hall
Lima retifera (?) Shumard
Pseudomonotis kansasensis (?) Beede
GASTROPODA
Bellerophon (Bucanopsis) meekianus ? Swallow

## DESCRIPTION OF SPECIES

# PHYLUM COELENTERATA

## CLASS ANTHOZOA

### LOPHOPHYLLUM PROFUNDUM MILNE-EDWARDS AND HAIME Plate XLV, figs, 1-3a

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

The coralla are typical rather abruptly expanding cones which are but slightly curved. The surface is marked by rather prominent longitudinal ridges and a few transverse wrinkles and depressions. One of the two specimens has the characteristic columella or pseudocolumella as the case may be.

*Distribution.* Kendrick shales: Collections 3, 8, 21, 22, 18, 15.

# PHYLUM MOLLUSCOIDEA

## Class BRACHIOPODA

### LINGULA CARBONARIA SHUMARD Plate XLV, figs. 4-7

*1858. Lingula carbonaria.* Shumard, Trans. St. Louis Acad. Sci., Vol. 1, p. 215.
Coal Measures: Clark County, Missouri.

*1922. Lingula carbonaria.* Morningstar, Geol. Surv. Ohio, Bull. 25, p. 166, pl. 7, figs. 1-3.
Pottsville formation: Ohio.

Most of the shells of this species are of medium size, measuring 6 by 11 millimeters. In outline, they are distinctly subrectangular. The umbonal and middle portions of the valves are moderately convex; the sides and front, flattened. The surfaces of both valves are marked by fine concentric striae, which are decidedly grouped along the lateral and anterior margins, and by less distinct radiating striae.

The shells agree rather closely with those figured by Dr. Hellen Morningstar, being, perhaps, a trifle more rectangular. They differ from *L. kanawhensis* Price in their smaller size and especially in their rectangular rather than more transverse outline

*Distribution.* Dwale shales: Collection 4.

### LINGULIPORA KENTUCKYENSIS N. Sp. Plate XLVI, figs. 1-4a

The shells are large, being twice the length of *L. nebraskensis.* Like that species they are subtrigonal in outline and almost as wide as long, the greatest breadth being near the anterior margin. The front and anterolateral margins are, perhaps, more uniformly rounded; the sides are nearly straight, converging toward the beak at an angle of about ninety-two degrees.

The surface is lustrous and is ornamented by minute prominent sharp abrupt concentric ridges, which are separated from one to another by flat interspaces but two to three times as wide as the ridges. Accordingly the concentric ridges are approximately twice as numerous as on *L. nebraskensis.*

Length 28 millimeters.

The species resembles *L. nebraskensis* in its lingulate shape and sharp concentric ridges and differs from that species in having twelve ridges instead of only seven or eight to five millimeters of space. The difference in number cannot be attributed to the difference in size of the shells of the two species, for the larger species has the more closely spaced ridges

*Distribution.* Kendrick shales: Collections 1, 8, 21, 22, 7.

LINGULIPORA NEBRASKENSIS MEEK.
Plate XLVI, figs. 5-6a

*1872. Lingula scotica* var. *nebrascensis.* Meek, U. S. Geol. Survey, Nebraska Final Rept., p. 158, pl. 8, figs. 3a, 3b.
Upper Coal Measures, Nebraska City, Neb.

The shells range from small to medium in size. They are subtrigonal in outline and about as wide as long, the greatest breadth being near the anterior margin. The front is broadly rounded; the antero-lateral margins abruptly so; the sides are nearly straight, converging toward the beak at an angle of eighty to ninety degrees.

The surface is brilliant and is marked by minute but prominent, sharp, abrupt concentric ridges, which are separated from one another by flat interspaces four or five times as wide as the ridges.

Length 12 to 14 millimeters.

The species is characterized by its lingulate shape and sharp concentric ridges.

*Distribution.* Kendrick shales: Collections 8, 22.

ORBICULOIDEA (ROEMERELLA) PATULA GIRTY
Plate XL VII, figs. 1-4,

*1911. Roemerella patula.* Girty, New York Acad. Sci. Annals, Vol. 21, p. 125.
Wewoka formation: Wewoka and Coalgate quadrangles, Okla.

The shells are of medium size, ranging from sixteen to eighteen millimeters in diameter.

The brachial valves are low and regularly convex. The apex or beak is small, eccentric, being about two-thirds of the distance from the posterior margin to the center.

The pedicle valve is not represented.

The surface is marked by fine, abruptly raised concentric ridges, which are separated by broader flattened interspaces. As in Girty's type, the exfoliated portion of the shell is marked most conspicuously by very fine radiating plications and striae, the plications being slightly more prominent.

The specimens seem to agree exactly with the species *patula*, which Girty referred to the subgenus *Roemerella* of Hall and Clarke, largely on the internal markings of the brachial (dorsal) valve, which markings those authors neither mention nor illustrate, though they do both with the subgenus *Lindstroemella.* In the absence of the pedicle valve, the concavity of which constitutes the subgeneric value of *Roemerella,* it is impossible to definitely refer the present forms to a subgenus of the genus *Orbiculoidea,* again illustrating the fact that it is often easier to identify a species than it is to identify a refined subgenus or genus, and illustrating the futility of such refinement in either practical paleontology or stratigraphy.

*Distribution.* Kendrick shales: Collections 2, 20, 1, 8, 21, 22, 23, 9, 18, 7, 29, 30, 15.

### DERBYA CRASSA MEEK AND HAYDEN Plate XLVII, figs. 5, 5a

*1858. Orthisina crassa.* Meek and Hayden, Proc. Acad. Nat. Sci. Phil., p. 261.
Coal Measures: Leavenworth, Kans.

Though largely or exclusively fragmental the specimens of this species can readily be identified by their Strophomenoid outline and crenulated growth lines, produced by the concentric lines crossing two or more series of radiating costae, separated by wider interspace. The shells are doubly convex and subcircular, the hinge line being, therefore, much shorter than the width of the shell. In addition to the ornamentation mentioned, both valves are somewhat contorted and undulating, the concentric wrinkles being rather prominent in some specimens.

*Distribution.* Kendrick shales: Collections 9, 7, 24, 15; Magoffin beds: Collections 27, 26, 25, 31, 12, 32, 33, 16; Saltlick beds: Collection 35; Lost Creek limestone: Collection 37.

CHONETES GLABER GEINITZ Plate XLVIII, figs. 1-10

*1866. Chonetes glabra.* Geinitz, Carb. und Dyas in Nebr., p. 60, Tab. 4, figs. 15-18. (Not *C. glaber* Hall, 1857).
Dyas, Nebraska City, Nebr.

The shells are small, thin, concavo-convex, and sub-semicircular in outline.

The pedicle valve is but moderately convex. Its most distinctive features are two broad undefined prominences which diverge from the beak toward the antero-lateral margins, thus forming a triangular sinus between them. The hinge line bears six diverging prominent spines on each side of the beak.

The concave brachial valve conforms rather closely to the convex pedicle valve.

Scarcely less distinctive than the converging prominences of the pedicle valve is the smooth surface of both valves, save for a few indistinct concentric lines of growth.

*Distribution.* Kendrick shales: Collections 3, 2, 20, 1, 8, 21,22,23,9,18,6,7,24,30,15.

CHONETES GRANULIFER OWEN Plate XLVIII, figs. 11-16a

*1852. Chonetes granulifera.* Owen, Rept. Geol. Survey Wisconsin, Iowa and Minnesota, p. 583, pl. 5, fig. 12.
Carboniferous limestone: Near mouth of Keg Creek, Mo.

For *Chonetes* the shells are rather large, though not nearly so much so as some of the Mississippian species. In outline they are roughly semi-circular. As presented the shells are nearly plano-convex or but slightly concavo-convex. The pedicle valves are moderately and rather uniformly convex. The brachial valves are almost flat. Both valves are covered by fairly uniform, beautiful fine radiating costae, which are crossed by concentric growth lines, more conspicuous on the brachial valve.

*Chonetes granulifer* is distinguished from other Pennsylvanian species by the uniform convexity of the pedicle valve and the radiating costae.

*Distribution.* Magoffin beds: Collections 27, 25, 31, 12, 32, 33, 36, 16; Saltlick beds: Collections 19, 35; Lost Creek limestone: Collection 37.

### PRODUCTUS (MARGINIFERA) MISSOURIENSIS GIRTY

Plate XL VII, figs. 6-11

*1915. Marginifera luricata var. missouriensis.* Girty, Missouri Bureau Geol. and Mines, Vol. 13, p. 350, pl. 30, figs. 2-5a. Cherokee shale: Mo.

The shells are small in size and typical productoid in form.

The pedicle valves are almost uniformly curved from the beak to the anterior edge and are approximately as broad as long. They are covered by small uniform ribs, which bear spine bases, especially in the umbonal region, and which in that region are crossed by a few less distant concentric wrinkles. Some of the specimens have a fairly well defined sinus.

The brachial valves are slightly concave. The interior surface of this valve has less regular ribs or costae than those of the pedicle valve, and in the visceral area these are crossed by more pronounced concentric wrinkles.

Although some of the specimens have a sinus on the pedicle valve, their shape otherwise and their fine regular costae agree very closely with the variety *missouriensis* of the species *muricata* which Girty doubtfully referred to the subgenus *Marginifera.* None of the present specimens show the internal ridge characteristic of *Marginifera.* It may be possible, therefore, to recognize this subgenus after the species has been definitely determined.

*Distribution.* Elkins Fork shales: Collection 28; Kendrick shales: Collections 3, 2, 20, 1, 8, 21, 22, 23, 9, 18, 7, 24, 29, 30, 15; Magoffin beds: Collections 27, 26, 25, 31, 12; Saltlick beds: Collections 19, 35.

### PRODUCTUS NEBRASKENSIS OWEN

Plate XLVII, figs. 12-16

*1852. Productus nebrascensis.* Owen, Rept. Geol. Survey Wisconsin, Iowa, and Minnesota, p. 584, Pl. 5, fig. 3.
Carboniferous limestone: Bellevue, Missouri River, Nebr.

This species is represented by a brachial valve which is medium in size and slightly concave in the visceral area, though the remainder of the valve conforms to the contour of the pedicle valve. Both the interior of the valve (brachial) and the impression of the exterior reveal the short discontinuous ribs and the concentric undulations or wrinkles so characteristic of

the species when the shell and the numerous spines are exfoliated.

*Distribution.* Elkins Fork shales: Collection 28; Kendrick shales: Collections 22, 24, 15; Magoffin beds: Collection 12; Flint Ridge flint: Collection 14.

PRODUCTUS NODOSUS NEWBERRY

Plate XLIX, figs. 1-4

*1861. Productns nodosus.* Newberry, Ives, Colorada Expl. Exped., p. 124, Pl. 1, figs. 7 -7b.
Carboniferous limestone: Santa Fe, New Mex.

The shells are of medium size and typically productoid in form, though all of them have been more or less compressed or crushed in the compacting of the shales.

The pedicle valve is, of course, the more gibbous of the two. Like P. *cora* it is covered by fine closely arranged costae, some of which, along the median line, on converging toward the anterior end unite to form, or at least to support, the few large spine bases.

The brachial valves are slightly concave in the visceral area. They are covered by the same kind of costae, some of which converge and unite to form a median row of a few large spine bases, as on the pedicle valve. In the visceral area the costae are crossed by rather numerous concentric wrinkles.

*P. nodosus* is easily recognized by its productoid form, *P. cora* type of costae, and particularly by the converging and uniting of some of the costae to form the median line of a few large spine bases.

*Distribution.* Elkins Fork shales: Collection 28; Kendrick shales: Collections 3, 8, 21, 22, 23, 15.

PRODUCTUS SEMIRETICULATUS MARTIN

Plate XLIX, figs. 5-8

*1847. Productus semireticulatus.* De Koninck, Mon. du Gen. Prod. et Chon., p. 83, Pl. 8, figs. 1a-h; Pl. 9, figs. 1a-m; Pl. 10, figs. la-d.
Carboniferous: Ohio, Mo., Ind., Ill., Ky., South America.

The shells are of medium size and wider than long. All the specimens are more or less crushed. The pedicle valve is convex, and, in most forms, it has a more or less definite sinus, which the crushing of the shells commonly accentuates. Though the surfaces of most specimens are covered with rather regular

medium costae, still the costae vary somewhat in size on some of the forms. In the posterior part, the radiating costae are crossed by concentric striae in such a manner as to develop distinct concentric costae, hence, the reticulate ornamentation so characteristic of this half or part of the shell. The brachial valve is flattened in the visceral region, but in the remaining portion conforms to the pedicle valve into which it fits. Its ornamentation is virtually the same as that of the pedicle.

Perchance some of these specimens are *P. costatus*-like forms similar to the ones Meek submitted long ago (before 1872) to Mr. Davidson, the English authority on Brachiopoda, who considered them small *P. semireticulatus* (U. S. G. S. of Nebraska, p. 160.)

*Distribution.* Kendrick shales: Collection 15; Magoffin beds: Collections 31, 12, 32, 33, 16.

SPIRIFER CAMERATUS MORTON
Plate XLIX, figs. 9-10

*1836. Spirifer cameratus.* Morton, Am. Jour. Sci., Vol. 29, pp. 32, 150, Pl. 2, fig. 3.
Coal Measures: Putnam Hill, Zanesville, Ohio.

The shells are large and transverse, incomplete pedicle valves measuring fifty-four millimeters in breadth at the hinge line and thirty-four millimeters in length. The pedicle valve is moderately convex. Its medium sinus is conspicuous, being an abrupt groove at the beak and broader and less abrupt at the anterior end. The cardinal area is arched and is bounded by two nearly parallel margins. The beak is small and incurved. The surface of the sides and of the sinus is covered with medium rounded costae separated from each other by grooves of smaller size. The costae are typically arranged in bundles so characteristic of the species. The brachial valve was not secured.

*Distribution.* Kendrick shales: Collection 18.

SPIRIFER ROCKYMONTANUS MARCOU
Plate L, figs. 1-3

*1858. Spirifer rocky-montana.* Marcou, Geol. North America, p. 50, pl. 7, figs. 4-4e.
Mountain limestone: Tigerus, New Mex.

The shells are small, slightly wider than long. Both valves are strongly and almost equally convex.

The pedicle valve is strongly convex and has an elevated pointed beak. The mesial sinus is well defined at the beak and gradually increases in depth and width toward the anterior. It contains distinct ribs which are not so stout as those on the sides of the valve which are about eight in number.

The brachial valve is slightly less convex. It is marked by a prominent mesial fold which originates as a sharp plication, the two branches of which anterior to the point of bifurcation are not so curved as the ribs on the side of the valve.

The surfaces of both valves are further ornamented by fine radiating striae and concentric growth lines of which the striae are the more prominent.

*Distribution.* Kendrick shales: Collections 8, 21, 22, 18; Magoffin beds: Collections 27, 31, 12, 32; Saltlick beds: Collection 19; Flint Ridge flint: Collection 14.

### RETICULARIA (SQUAMULARIA) PERPLEXA MCCHESNEY

Plate L, fig. 4

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. la.
Upper Coal Measures: McAlester quadrangle, Ind. Ter.

This species is represented by a brachial valve which is convex and has a slightly elevated beak. The surface bears evidence of the concentric rows of fine spines, which form the reticulate ornamentation so characteristic of the genus.

This species was long referred to the genus *Spirifer* and then in 1899 to *Reticularia* (McCoy 1844) by Girty. *Reticularia* has become a well established genus for a number of Mississippian species by virtue of its easily recognized reticulate surface. Though not considered distinctive by its creator, Gemmellaro, in 1899, the genus *Squamularia,* according to Girty in 1903 is a non-septate form of the reticulate type to which *perplexa* should be referred. Weller showed in 1914 that even in some of the specimens of true *Reticularia* the median septum of the brachial valve has become almost obsolete, though they are septate forms. As early as 1903 Girty found, "in practice", difficulty in distinguishing poorly preserved or imperfect forms of *Squamnlaria perplexa* from *Seminula sub-*

*tilita* and *Ambocoelia planoconvexa.* Now in 1927 it is possible to refer doubtfully to the genus *Squamularia* those specimens not preserving or showing the obsolescent median septum provided the paleonlotogist has determined them to belong to the species *perplexa* or the stratigrapher has shown them to come from Pennsylvanian or Permian beds, another striking example of the futulity of basing generic differentiation on minor concealed features or of establishing subgeneric differentiation on scarcely specific values.

*Distribution.* Kendrick shales: Collection 22; Magoffin beds: Collections 27, 31.

AMBOCOELIA PLANOCONVEXA SHUMARD

Plate L, fig. 5

1855. *Spirifer planoconvexa.* Shumard, Missouri Geol. Survey, Second Ann. Rept., p. 202.
Upper Coal Measures: On Missouri River, near mouth of Platte River.

The shells are small and plano-convex.

The convex pedicle valve has the stout beak projecting beyond the shoulders of the valve in typical *Ambocoelia* fashion. A small but distinct mesial sinus extends from the beak to the anterior end.

The brachial valve is nearly flat and decidedly transverse. In some specimens it is marked by an indistinct sinus.

The surface is practically smooth.

*Distribution.* Kendrick shales: Collections 3, 2, 1, 8, 22, 9, 18, 6, 24, 15; Magoffin beds: Collection 27; Saltlick beds: Collection 35.

COMPOSITA SUBTILITA HALL

Plate L, fig. 6

1852. *Terebratula subtilita.* Hall, Stansbury's Exped. Great Salt Lake of Utah, p. 409, Pl. 4, figs. 1, 2.
Carboniferous: Missouri River, near Weston.

The shells are medium in size and subovoid in shape. Both valves are nearly equal and convex. The pedicle valve is rather uniformly convex, save for the mesial sinus which begins as an indistinct line and gradually increases in depth and breadth to the anterior margin. The beak is small, incurved, and obliquely truncated to form the foramen. The brachial valve is slightly more convex along a median line, but it has no distinct mesial

fold, a curved notch in the margin accommodating the sinus of the pedicle valve. Both valves have their surface marked by distinct growth lines.

*Distribution.* Kendrick shales: Collection 15; Magoffin beds: Collections 27, 31, 12, 32, 16; Lost Creek limestone: Collection 37.

CLEIOTHYRIDINA ORBICULARIS MCCHESNEY

Plate L, fig. 7

1860. *Athyrus orbicularis.* McChesney, Desc. New Spec. Foss., p. 47.
Coal Measures: Western States.

The shells are medium to large in size. Although the specimens are crushed, they seem to agree with the usual descriptions. They are subcircular in outline; approximately as wide as long; their pedicle valve is convex and has but an indistinct mesial sinus; their brachial valve is less convex and may have a less distinct sinus. In those specimens having the numerous spines broken away, the shell is decidedly lamellose in appearance.

*Distribution.* Kendrick shales: Collections 8, 22; Magoffin beds: Collection 12.

## PHYLUM MOLLUSCA

## CLASS PELECYPODA

LEDA BELLISTRIATA STEVENS

Plate L, figs. 8-15

1858. *Leda bellistriata.* Stevens, Am. Jour. Sci., Vol. 25, p. 261.
Coal Measures: Danville, Ill.; Summit, Ohio.

For members of this species, the shells are rather large, ranging from eighteen to twenty-eight millimeters in length. The ventral margin can, perhaps, be likened to a slightly concave sled runner, a considerable portion of which bends upward in a graceful curve at the anterior end. Here the cardinal margin is a continuation in about the same curvature backward toward the beak, posterior of which it is a somewhat smaller replica of the ventral margin. The lunule is an extremely narrow arrow-like triangular area, bordered by umbonal ridge margins which diverge slightly toward the anterior and gradually fade away in this direction. The escutcheon is more distinct and lanceolate in outline.

The surface of this prim little shell, as the name suggested, is ornamented with beautiful concentric striae, which alternate with fine sharp concentric ridges.

The sculpture of the internal impression, the so-called cast, is distinctive. Two or more broad shallow grooves extend obliquely from the umbonal region toward the ventral margin. The dentition is represented by a zigzag line, not unlike the suture lines of the brain.

Specimens of this beautiful and characteristic Pennsylvanian Pelecyod form a perfect series, ranging from typical normal-sized *Leda bellistriata* without a beak to typical L. *bellistriata* var *attenuata* Meek, approximately twice the normal size.

*Distribution.* Kendrick shales: Collections 1, 8, 22, 18, 6; Magoffin beds: Collections 27, 12.

LEDA JILLSONI N. SP.

Plate L, figs. 16, 16a

Externally this beautiful little shell differs from the more attenuate *L. bellistriata,* elsewhere described in this report, only by its smaller size and the greater coarseness of its configuration. The specimen is small, attaining, perhaps, in its unbroken condition a length of fifteen millimeters. The surface is marked by narrow sharp abruptly raised concentric ridges separated by flat interspaces six to eight times as broad as the ridges. The ridges are 0.5 millimeter apart and total approximately fifteen on each valve, a number surpassed on the beak itself of *L. bellistriata.* In outline and sharpness of concentric ridges *L. jillsoni* resembles *L. arata* Hall, but Hall's form must have been almost twice as large and must have had less sharp and more numerous concentric ridges.

This species is named after the Director and State Geologist of Kentucky, Dr. Willard Rouse Jillson, who has shown a keen interest in these fossiliferous beds. The species can be distinguished at a glance by its ornamentation.

*Distribution.* Kendrick shales: Collections 1, 8, 22, 23, 6, 7, 30.

AVICULOPINNA AMERICANA MEEK

Plate L, fig. 18

1867. *Aviculopinna americana.* Meek, Am. Jour. Sci., Vol. 44, p. 282.

The shells are small, ranging from twenty-five millimeters to thirty-five millimeters in length. The dorsal and ventral

margins are nearly straight and gradually converge toward the anterior end. Although both specimens are imperfect they seem to agree further with Meek's description.

The surface is ornamented by numerous sharp regularly disposed concentric ridges which are much narrower than the nearly flat interspaces. In curvature they conform to the posterior margin of the shell.

*Distribution.* Kendrick shales: Collections 22, 7, 15; Magoffin beds: Collection 25.

SCHIZODUS ALPINUS HALL

Plate LII, fig. 1

*1858, Dolabra? alpina*, Hall Rept. Geol. Survey Iowa, Vol. 1, Pt. 2, p. 716, Pl. 29, fig. 2.
Lower Coal Measures: Alpine Dam, Iowa.

The shells are of medium size and are slightly higher than long. They are commonly described as having curved anterior and ventral margins and an obliquely truncated posterior margin and subcentral beaks. Once gained the conception of the outline of the shell suffices to identify it at once.

*Distribution.* Kendrick shales: Collections 2, 1, 8, 21, 22, 9, 18, 7, 29, 30, 15; Magoffin beds: Collection 16.

DELTOPECTEN TEXANUS GIRTY

Plate LI, fig. 1

*1904. Limipecten texanus.* Girty, U. S. Nat. Mus. Proc., Vol. 27, p. 722. Pl. 45, figs. 1, 2, 3; Pl. 46, figs. 4?; Pl. 47, figs. 1, 2, 3.
Pennsylvanian (Cisco): Graham, Young County, Texas.

The shell is large, being at least ninety by ninety millimeters and therefore about as long as high.

The left valve is moderately and rather uniformly convex. Both the anterior and the posterior wings are large; the anterior wing is set off from the shell proper by an abrupt change in slope. The surface is covered with rather widely spaced radiating ribs, "which are more or less regularly unequal in size" (Girty). Crossing the ribs on well preserved forms are irregular concentric scalloped lamellae.

Though imperfectly preserved the right valve is much flatter than the left. The surface has the same radial and concentric ornamentation as the left valve, but the radiating ribs are so much smaller and so much more closely spaced as to suggest another species were the valve not attached to the left one.

As observed by Girty, the shell consists of two conspicuous layers, but in the Kendrick form the outer layer is dark and earthy, whereas the inner is light and pearly.

*Distribution.* Kendrick shales: Collections 8, 23.

ALLERISMA TERMINALE HALL

Plate LI, fig. 2

1852. *Allorisma terminalis.* Hall, Stansbury's Exped. to Great Salt Lake, p. 413, Pl. 2, figs. 4a, b.
Carboniferous: Big Blue River.

The shells are large and elongate, from two to three times as long as high. The dorsal and ventral margins are nearly parallel, being nearly straight or respectively slightly concave and convex. The beaks are near the anterior end. The surface is marked by strong concentric rounded ridges which are separated by narrower grooves. Though commonly compressed and represented only by external and internal impressions, this splendid Pennsylvanian form can be readily recognized by its large size, subcuneate shape, and prominent concentric ridges.

*Distribution.* Magoffin beds: Collections 12, 16; Flint Ridge flint: Collection 14.

PROTHYRIS ELEGANS MEEK

Plate LII, fig. 2

1871. *Prothyris elegans.* Meek, Am. Jour. Conch., Vol. 7, p. 8, Pl. 1, fig. 3.
Coal Measures: Nebraska City, Nebraska; Ohio; Illinois, Michigan.

The shell is subrectangular in outline and about four times as long as high. The ventral and dorsal margins are nearly straight and parallel. The beaks are not distinct and are located near the antero-dorsal angle at which is the well defined notch. The surface is marked by fine concentric growth lines or striae which are more conspicuous along the ventral and posterior portions.

*Distribution.* Kendrick shales: Collection 22.

ASTARTELLA ARCUATA N. SP.

Plate LII, figs. 4-5a

Associated with other *Astartella,* particularly with *A. kentuckyensis,* are some rare specimens which, from the "swing"' of the shell and the nature of the sculpture, obviously belong to a species not yet described. The shells are medium in size. In profile the dorsal concave line is parallel with the ventral

convex line in such a manner as always to suggest the Hollander's wooden shoe. Though imperfect specimens, the ventral line seems to be very convex, bending abruptly upward into the rather straight anterior line and likewise into the curved posterior margin. There is no well delimited umbonal ridge, but the greatest convexity of the shell passes downward and backward in a curve somewhat parallel with the concave dorsal and convex ventral margins thus accentuating this peculiar outline or "swing" of the shell.

The surface is covered with rather fine concentric ridges and furrows, of about equal size, which have the characteristic curvature or "swing" of the shell. The species can be thus be differentiated at a glance from the other species of the genus.

*Distribution.* Kendrick shale: Collections 8, 22.

ASTARTELLA CONCENTRICA CONRAD

Plate LII, fig. 3

1842. *Nuculites concentricus.* Conrad, Acad. Nat. Sci. Phil. Jour. Vol. 8, Pt. 2, p. 248.
Coal Measures: Pennsylvania.

The shell is small in size and subquadrilateral in outline. The dorsal border is nearly straight. The ventral border is likewise nearly straight or but slightly convex, curving strongly toward the front and more so toward the rear. The rear slope makes an obtuse angle with the dorsal border.

The valves are fairly convex, being most so in the umbonal region. The umbonal ridge is broad and is not sharply differentiated.

The surface is marked by sharp angular concentric ridges and broad shallow interspaces, resembling respectively the crests and troughs of waves.

*Distribution.* Kendrick shales: Collections 3, 8, 22, 9; Magoffin beds: Collections 31?, 12.

ASTARTELLA KENTUCKYENSIS N. SP.

Plate LII, figs. 6-9a

The shells are stout and medium in size; they commonly attain a length of twenty-five millimeters. The ventral margin and the hinge line are nearly parallel, though the umbos rise above the upper line. The ventral margin is but slightly convex, except in those specimens which have been compressed with the induration of the inclosing shale. Anteriorly it bends

abruptly upward in a pronounced curve; posteriorly, in a sharp angular curve. The lunule is heart-shaped; the escutcheon, an elongated oval; both are but slightly differentiated, the escutcheon the more so by an indistinct groove parallel to the posterior margin of the umbonal ridge.

In most specimens the umbonal ridge as such is not conspicious, being so embracing. It includes the whole triangular area between the antero-ventral and the postero-ventral angles and the beak, thus constituting almost the whole of each valve. Longitudinally the triangle is nearly a plane surface, but vertically it is a gently curved surface, becoming progressively more curved towards the beaks. Few specimens show even a trace of sinus.

The internal structure has not been observed.

The whole surface is marked by pronounced concentric ridges and grooves, which are approximately the reverse complements of each other. Near the line extending from the beak to the antero-ventral angle, the concentric ridges increase by division or implantation, thus giving a saucy tilt to the sculpture, perhaps the most distinctive feature of the shell.

This species seems to be confiined to the Kendrick shales, and it is, therefore, one of the most diagnostic in the Pennsylvanian system of Kentucky.

*Distribution.* Kendrick shales: Collections 3, 2, 20, 1, 8, 21, 22, 23, 9, 18, 6, 7, 24, 29, 30.

## CLASS SCAPHOPODA

### PLAGIOGLYPTA ANNULISTRIATA. MEEK AND WORTHEN

Plate LIII, fig. 1

1870. *Dentalium annulostriatum.* Meek and Worthen, Acad. Nat. Sci. Philadelphia Proc., p. 45.
Coal Measures: Danville, Ill.

The collection contains one imperfect specimen which seems to belong to this species which Meek and Worthen described in the following terms: "Shell very small, rather distinctly tapering, and slightly arched; aperture and section circular; surface ornamented by regular, distinct, annular costae, which pass around a little obliquely, and are separated by rounded furrows of the same breadth as the costae themselves" (1873).

*Distribution.* Kendrick shales: Collection 22.

## CLASS GASTROPODA

### WORTHENIA TABULATA CONRAD

Plate LIII, fig. 2

1835. *Turbo tabulatus.* Conrad, Pennsylvania Geol. Soc. Trans. Vol. 1, Pt. 2, p. 267, Pl. 12, fig. 1.

The specimens range in size from minute shells to large ones more than twenty millimeters in length. The prominent nodose carina, bounded by two lesser carinae, divides the volutions into subequal halves. The flattened sloping upper half of each whorl is conical in profile whereas the exposed portion of the lower half is cylindrical.

The surface is marked by revolving and transverse striae, which give to the shell a reticulate sculpture.

Perhaps the most characteristic feature of the shell is the resemblance of the profile of the spire to a graded series of cylinders. Into the truncated conical cap of each larger form almost the whole cylinder of the next size has been thrust.

*Distribution.* Elkins Fork shales: Collection 28; Kendrick shales: Collections 22, 18; Magoffin beds: Collections 27, 25.

### TREPOSPIRA DEPRESSA COX

Plate LIII, figs. 14.-21

1857. *Pleurotomaria depressa.* Cox, Kentucky Geol. Survey Rept., Vol. 3, p. 569, Pl. 8, figs. 10, l0a. (Not *P. depressa* Phillips, 1836).
Coal Measures: Bonharbour, Davies County and Airdrie, Muhlenberg County, Ky.

The shells of this species range in size from small to medium, the largest shells attaining a diameter of only nineteen millimeters. They are discoidal or rather lens-shaped. Accordingly, the spire is low, and, save for the sculpture, each volution joins without a break the preceding one in such a way as to maintain the lens shape of the entire shell. The peripheral portion of the whorl consists of a sharp edge above which is a slight groove into which fits the inner portion of the succeeding whorl. The inner edge of the whorl is marked by a slightly elevated belt on which are developed the single spiral row of nodes, which, with the lens shape of the shell, form such a characteristic feature of the species. The slit band lies just above the carina. The umbilicus is broad and shallow.

The lower surface is beautifully marked by fine growth lines, each of which bends forward in a graceful curve. The upper surface is similarly marked, but it is not so commonly preserved.

As previously stated, the characteristic features of the shell are the lens shape and spiral row of nodes.

*Distribution.* Kendrick shales: Collections 3, 2, 1, 8, 21, 22,9,18,7,24,29,30; Magoffin beds: Collections 27, 25, 12.

### BELLEROPHON (EUPHEMUS) CARBONARIUS COX

Plate LIII, fig. 3

1857. *Bellerophon carbonarius.* Cox, Kentucky Geo. Survey Rept., Vol. 3, p. 562.
Coal Measures: Kentucky.

The shells are small, the larger of them attaining a diameter of only ten millimeters. In outline they are subspherical. The whorls are embracing. There is no umbilicus. The anterior or apertural portion of the shell is smooth; the posterior portion, in the preserved forms, is marked by the characteristic revolving ridges, which are narrow and sharp and which project abruptly from the flat interspaces.

*Distribution.* Kendrick shales: Collections 18, 30, 15; Magoffin beds: Collections 27, 25, 31, 12.

### BELLEROPHON CRASSUS MEEK AND WORTHEN

Plate LIII, figs. 4-10

1860. *Bellerophon crassus.* Meek and Worthen, Proc. Acad. Nat. Sci. Philadelphia, p. 458.
Lower Coal Measures: Pittsburg, St. Clair County, Ill.

The shells are mostly small, a few, however, attain a diameter of fifteen millimeters. In shape they are typical Bellerophons, being subspherical in outline. The outer whorl is all embracing. Transversely the aperture is almost a perfect oval. In most specimens there is but a faint suggestion of an umbilicus. The columnella is both prominent and stout. The surface is faintly marked by somewhat imbricating growth lines which bend gently forward except in the median portion where they bend abruptly backwards to cross the slit band.

The shell is characterized by its Bellerophon shape and its plainness, most specimens scarcely showing the fine lines of growth.

*Distribution.* Kendrick shales: Collections 3, 2, 20, 1, 8, 21, 22, 23, 9, 18, 7; Magoffin beds: Collections 27, 36.

BELLEROPHON (BUCANOPSIS) MEEKIANUS SWALLOW

Plate LIII, figs. ll-lla

1858. *Bellerphon Meekianus.* Swallow, St. Louis Acad. Sci. Trans., Vol. 1, p. 204.

Middle Coal Measures: Lexington, Mo.
Lower Coal Measures: Howard County, Mo.

The shell is small and subglobose. The body whorl expands gently, giving the shell a very prim appearance. The slit band is not well differentiated from the rest of the shell. In fact it does not rise above the general surface of the shell, but is set off on each side by a groove which is slightly larger than the other revolving striae.

Under the magnifying glass, the conspicuous surface features are not the longitudinal striae but the longitudinal plications which alternate in size. The transverse striae are so grouped as to give the surface a somewhat wrinkled appearance.

Besides its Bellerophon outline, the other characteristic feature of the shell is its cancellate surface by means of which alone Ulrich separated the genus *Bucanopsis* from the genus *Bellerophon*, although he was in doubt that *B. meekianus* belonged to *Bucanopsis* (Op. cit. pp. 853, 854). Obviously an exfoliated specimen could be referred either to *Bellerophon* or *Bucanopsis;* hence the writer's serious objection to generic classification so refined as to be practically useless to the stratigrapher. Furthermore it may well be questioned whether
or not the revolving striae are of generic value.

*Distribution.* Kendrick shales: Collections 22, 9, 18; Magoffin beds: Collection 27; Flint Ridge flint: Collection 14.

SCHIZOSTOMA CATILLOIDES CONRAD

Plate LIII, figs. 12-13

1842. *Inachus catilloides.* Conrad, Acad. Nat. Sci. Philadelphia Jour., Vol. 8, Pt. 2, p. 273, Pl. 15, fig. 3,

Carboniferous: Inclined plane of the Alleghany Mountain, Pa.

The shells are small and discoidal in outline. Both sides of the disk are either flat or concave. In the concave specimens the upper side is commonly the more so. Sections of the volutions are more or less quadrate, though the concavity of the two sides of the disk causes somewhat of a departure from this feature. Inasmuch as the volutions are not indented by their contact, the internal surface of the volutions are not affected,

being practically circular in cross section. Two pairs of grooves accentuate the two carinae, one of which is situated along the top edge of the periphery and the other along the bottom edge.

The surface is crossed by fine transverse striae, the arrangement of which in some specimens produced transverse or oblique ridges and in others node-like protuberances.

The most characteristic features are the discoidal shape and the flat or concave sides.

*Distribution.* Kendrick shales: Collections 3, 1, 8, 21, 22, 6, 15; Magoffin beds: Collection 12; Saltlick beds: Collection 35.

### ZYGOPLEURA PLEBEIA HERRICK

Plate LIII, fig. 22

1887. *Loxonema sp.* Herrick, Denison Univ. Sci. Lab. Bull. Vol. 2. p. 147, Pl. 14, fig. 8. *(L. plebium* in explanation of plate). Coal Measures: Flint Ridge, Ohio.

The shell is a small gently tapering cone. In spite of the flattened sides of the volutions, the suture is rather prominent. The ornamentation of the shell consists of small transverse plications, those of the successive whorls opposing each other in such a manner as to form a series of nearly straight but broken ridges extending from the apex to the base of the shell.

The shell is readily recognized by its gently tapering cone and the prominent plications already described.

*Distribution.* Kendrick shales: Collection 22.

### SPHAERODOMA BREVIS WHITE

Plate LIII, fig. 23

1881. *Soleniscus brevis.* White, U. S. Geog. Survey, W. 100 Mer. Rept., Vol. 3, Supp., Appendix p. 28, Pl. 4, figs. 5a-c.
Carboniferous: Coyote Creek; north of Black Lake; and near Taos, N. Mex.

The shell is small and subglobose in outline. Perhaps the most distinctive feature of the species is the concave profile of the spire, due to the abrupt and unequal increase of the volutions. As a result of this manner of growth, the subglobose body whorl is surmounted by a minute sharply pointed spire.

*Distribution.* Kendrick shales: Collections 8, 22, 15.

SPHAERODOMA PRIMIGENIA CONRAD

Plate LIII, fig. 24,

1835. *Stylifer primogenia.* Conrad, Geol. Soc. Pennsylvania Trans., Vol. 1, Pt. 2, p. 267, Pl. 12, fig. 2.

The shell is subglobose in outline. Like *S. brevis,* it has a small low spire, but the well rounded volutions give to the spire an altogether different aspect. Due to the rounded volutions, the suture is, of course, well defined.

*Distribution.* Kendrick shales: Collections 8, 21, 22, 18.

BULIMORPHA MINUTA STEVENS

Plate LIII, figs. 25-26

1858. *Loxonema minuta.* Stevens, Am. Jour. Sci., Vol. 25, p. 260.
Coal Measures: Sangamon County and Danville,. Ill.

The shells are small. They are best described as subfusiform. Though incomplete they are perhaps four times as long as wide. All have a long slender tapering conical spire. The upper edge of each whorl laps over the lower edge of the preceding whorl in such a manner as to produce a nearly vertical suture. In spite of this well developed suture the whorls are so nearly flat as scarcely to break the continuity of the general conical slope.

In addition to its small size the most characteristic feature of the shell is the continuity of the conical slope of the spire.

*Distribution.* Kendrick shales: Collections 1, 22, 18.

## CLASS CEPHALOPODA

ORTHOCERAS COLLETTI MILLER

Plate LIV, figs. 1-2

1892. *0rthoceras colletti.* Miller, Adv. Sheets, 18th Rept. Geol. Survey Indiana, p. 67, Pl. 10, fig. 1.
Upper Coal Measures: Kansas City, Mo.

The shells are very thick and, for Pennsylvanian forms, they are very large. The septa are abruptly and deeply concave, the concavity exceeding the depth of the chamber. Though the specimens are crushed, the septa seem to agree with the original description in being circular in outline and distant from each other about one-fourth their diameter. Extending from septum to septum along one side of the shell, where completely exfoliated, is the small narrow longitudinal ridge, so characteristic of this Pennsylvanian species and the representative, perhaps, of the siphuncle.

The surface seems to lack ornamentation.

*Distribution.* Kendrick shales: Collections 2, 1, 8, 22, 23?

ORTHOCERAS (PSEUDORTHOCERAS) KNOXENSE MCCHESNEY

Plate LIV, figs. 3-6a

1860. *Orthoceras knoxensis.* McChesney, Des. New Spec. Foss, p. 69.
Coal Measures: Danville, Springfield, Peoria and Dr. E. Hall's mill, Knox County, Ill.

The shells are small and but slightly tapering. The septa are circular, regularly and moderately concave, distant from each other about one-third of their diameter. The siphuncle is small and approximately circular in cross section and central in position.

The surface is without ornamentation.

Without questioning the validity of the genus *Pseudorthoceras,* based, however, on the internal secondary deposit, the present forms are retained in the *Orthoceras* for the convenience of the stratigrapher.

*Distribution.* Kendrick shales: Collections 3, 2, 20, 8, 21, 22, 23, 9, 18, 30; Magoffin beds: Collections 27, 26?, 25, 12, 13, 33, 36?

GASTRIOCERAS MONTGOMERYENSE MILLER AND GURLEY

Plate LIV, figs. 7-9a

1896. *Goniatites montgomeryensis.* Miller and Gurley, Bull. No. 11, Illinois State Mus. Nat. Hist., p. 38, Pl. 4, figs. 12-14.
Coal Measures: Montgomery County, Ill.

Though small the shell is robust in that the breadth nearly equals the greatest diameter. In spite of the fact that the whorls are deeply embracing, the shoulders of the inner whorls are exposed in the deep funnel-shaped umbilici. The angular nodose shoulders of the successive whorls form step-like descents into the umbilici, which are deep and wide, being one-half of the total diameter of the shell.

"There are six constrictions to a revolution, beginning at the umbilical border, curving abruptly forward on the sides and then backward on the abdomen in a broad, gentle series.

"Septa consisting of a pair of narrow tongue-shaped ventral lobes, separated by a short siphonal saddle, deeply

incised by a secondary notch or lobe; a broad, short, lateral lobe on the sides halfway between the siphon and the umbilical shoulders." (Smith, 1903).

*Distribution.* Kendrick shales: Collections 3, 2, 20, 1, 8, 22, 18, 6, 7, 29; Magoffin beds: Collection 27.

Register of Localities

DWALE SHALES
Harold quadrangle
4. Dwale

ELKINS FORK SHALES
Williamson quadrangle
28. Elkins Fork School

KENDRICK SHALES
Harold quadrangle
3. Head of Goebel Branch of Cow Creek 2. Tom Sellers Branch of Cow Creek
20. Branch of Cow Creek below School No. 23
1, 8, 21, 22, 23, Kendrick homestead at head of Cow Creek
9. Head of Sugarloaf Branch of Levisa Fork
18. Forks of Home Branch of Buffalo Creek
6. Daves Branch of Buffalo Creek
7. Head of Missouri Branch of Johns Creek
Williamson quadrangle
24. Jarad
29. Burris Mine on Rockhouse Fork one mile above Elkins Fork School
30. Bevins Mine at head of Bevins Branch
Buckhorn quadrangle
15. Shale near L. & N. Ry. track level at Copland

MAGOFFIN BEDS
Williamson quadrangle
27. Middle coal roof opposite Borderland 26.? Caney Fork of Pigeonroost Fork
25.? Fall Branch (edge of sheet) of Pigeon roost Creek
Salyersville quadrangle
31. Sycamore Branch of Oakley Creek
12. Head of Right Fork of Middle Fork of Licking River
13. Leatherwood Creek two miles above its confluence with South Quicksand Creek
Prestonsburg quadrangle
32. Long Branch one mile above its confluence with Licking River
33. Bate Lick Branch of Jake Wireman Fork of Licking River
34. Grassy Creek one mile above its confluence with Straight Fork of Licking River
Hindman quadrangle
36. Mouth of small tributary of Quicksand Creek one-half mile above Lick Branch
Buckhorn quadrangle
16. Roof shales of abandoned mine at Copland

SALTLICK BEDS

Harold quadrangle

19.? Limestone gap between Mare and Buffalo Creeks

Hindman quadrangle

35. Highway gap between Saltlick and Quicksand Creeks

LOST CREEK LIMESTONE

Buckhorn quadrangle

37. One-half mile north of byway across divide between Lost Creek and Big Branch of North Fork of Kentucky River

FLINT RIDGE FLINT

Troublesome quadrangle

14. One-fourth mile north of byway across divide between Leatherwood Branch and Fugate Fork

# PENNSYLVANIAN INVERTEBRATE FOSSILS

**Explanation of Plate XLV**

Figures

1-3a. *Lophophyllum profundum.*

1. Side view of a nearly perfect specimen.
la. The same specimen enlarged twice.
2. Side view of a specimen showing part of the calice.
2a. The same specimen enlarged twice.
3. View of a smaller specimen.
3a. The same specimen enlarged twice.

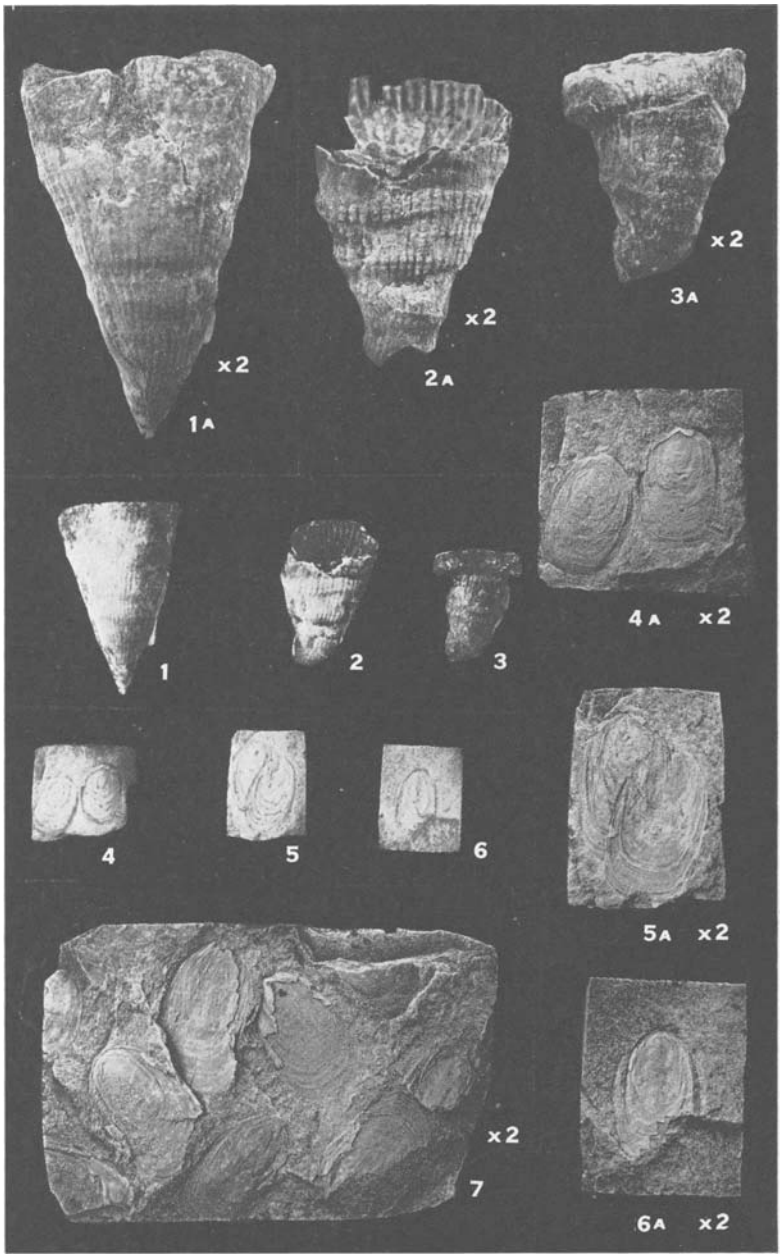
Kendrick shales: Collection 18.

4- 7. *Lingula carbonaria.*

4. A slab showing the impressions of two specimens.
4a. The slab enlarged twice.
5. A slab showing the impressions of two overlapping specimens.
5a. The slab enlarged twice.
6. A slab showing the impression of one specimen.
6a. The slab enlarged twice.
7. An excellent slab, enlarged twice, showing abundance of forms.

Dwale shales: Collection 4.

## PLATE XLV




Fossils from the Kendrick and Dwale shales—Pennsylvanian

**Explanation of Plate XLVI**

Figures

1- 4a. *Lingulipora kentuckyensis.*

1. View of a nearly perfect specimen.
Kendrick shales: Collection 22.

2, 3,4. Views of three nearly perfect specimens.

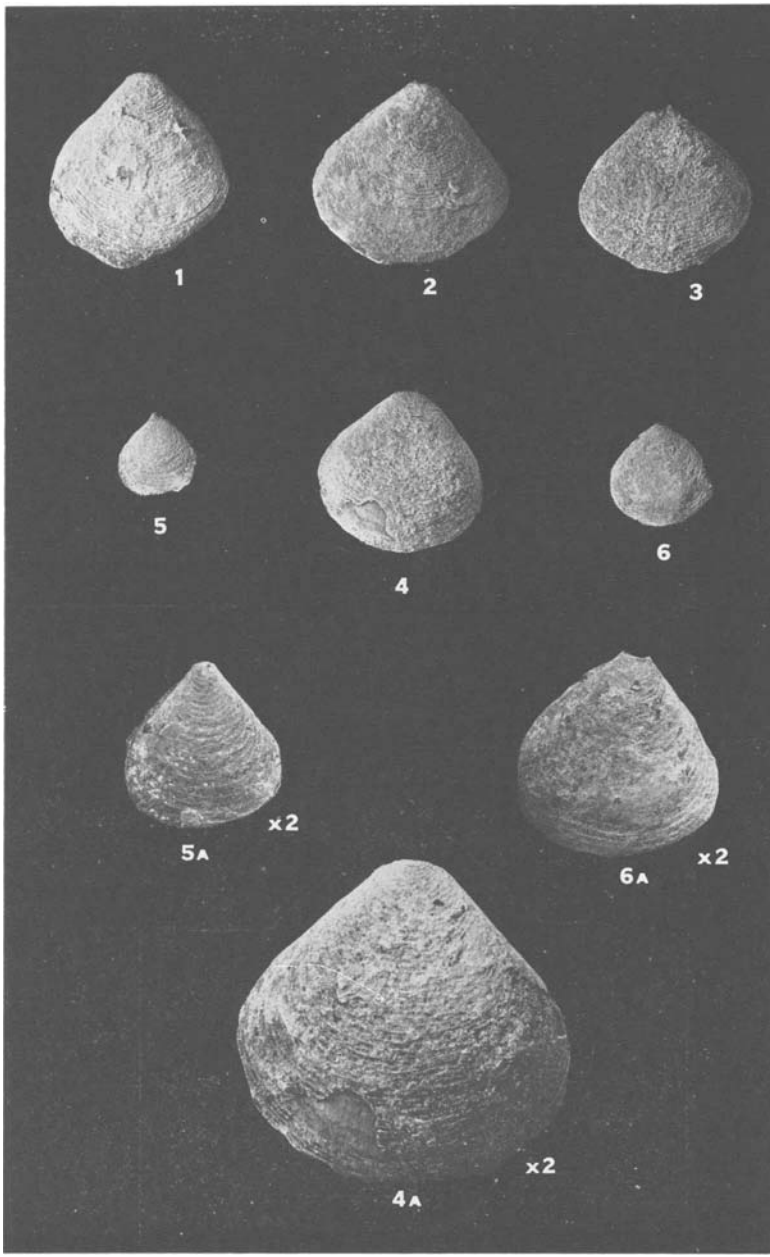
4a. Specimen 4 enlarged twice to show the closely spaced concentric ridges.
Kendrick shales: Collection 8.

5- 6a. *Lingulipora nebraskensis.*

5, 5a. A nearly perfect specimen and a double enlargement of it.
Note the widely spaced concentric ridges.
Kendrick shale: Collection 22.

6, 6a. A specimen having a slightly broken beak and a double enlargement of it.
Kendrick shales: Collection 8.

**PLATE XLVI**




Fossils from the Kendrick shales—Pennsylvanian

**Explanation of Plate XLVII**

Figures

1- 4. *Orbiculoidea (Roemerella) patula.*

Views of four nearly perfect brachial valves.
Kendrick shales: Collection 22.

5- 5a. *Derbya crassa.*

Dorsal view of a nearly perfect and characteristic specimen, and a double enlargement of it.

Magoffin beds?: Collection 25.

6-11. *Productus (Marginifera) missouriensis.*

Views of the pedicle valves of six specimens showing the regular medium costae.

Kendrick shales: Collection 22.

12-16. *Productus nebraskensis.*

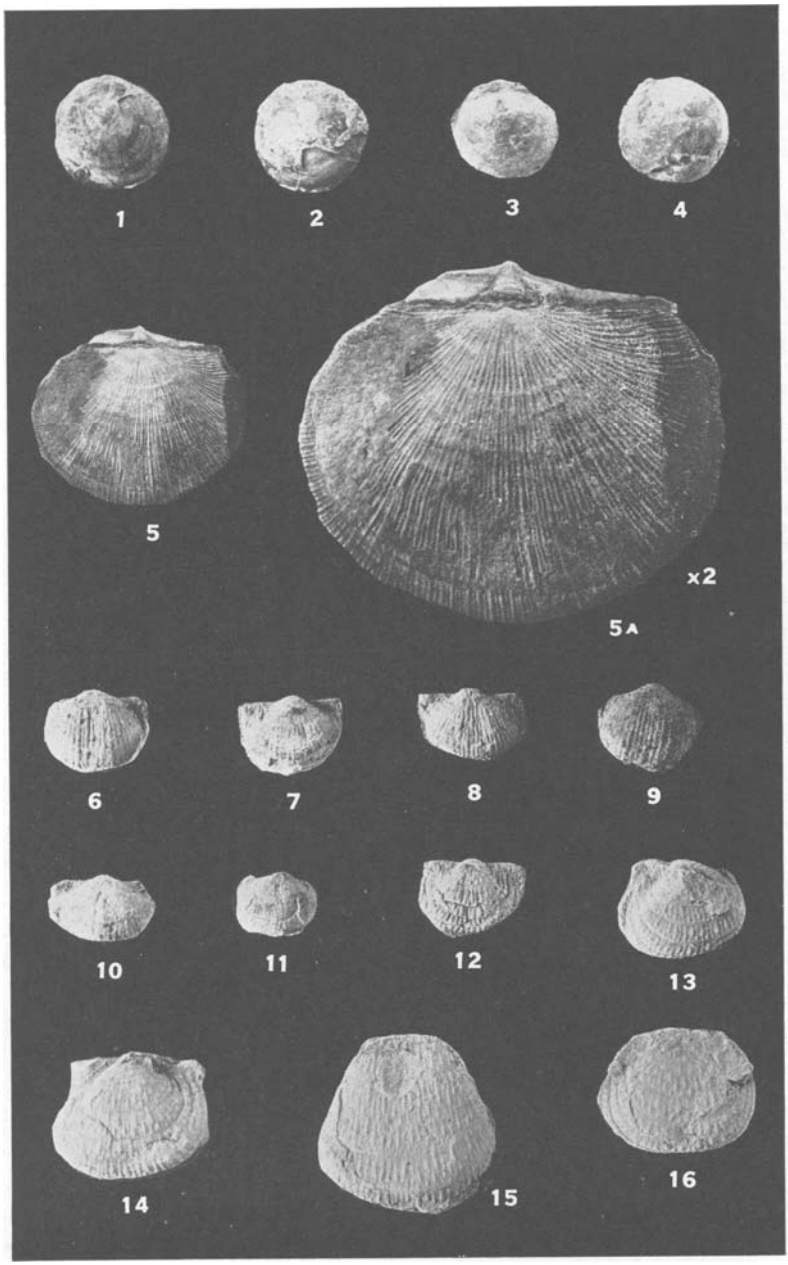
12. Ventral view of the external impression of the brachial valve.

Kendrick shales: Collection 22.

13-16. Views of four specimens, showing the short discontinuous radiating ribs.

Elkins Fork shales: Collection 28.

## PLATE XLVII




Fossils from the Kendrick shales, Magoffin beds, and Elkins Fork shales—Pennsylvanian

## Explanation of Plate XLVIII

Figures

1-10. *Chonetes glaber.*

1, 1a. View of pedicle valve of a specimen and a double enlargement of it.

2, 2a. Internal view of a brachial valve of a specimen and a double enlargement of it.

3, 3a. View of a pedicle valve of a specimen and a double enlargement of it, showing the two diverging folds, and the shell free from radial ribs and striae.

4. Dorsal view of brachial valve and cardinal area of a pedicle valve of a complete specimen.

5. Pedicle valve of a specimen.

6. Dorsal view of a complete specimen.

7. Pedicle valve of a specimen.
Kendrick shales: Collection 8.

8, 9. Pedicle valves of two typical specimens.
Kendrick shales: Collection 22.

10. Pedicle valve of a small specimen.
Kendrick shales: Collection 9.

11-16a. *Chonetes granulifer.*

11, 11a. Pedicle valve of a typical specimen and a double enlargement of it.

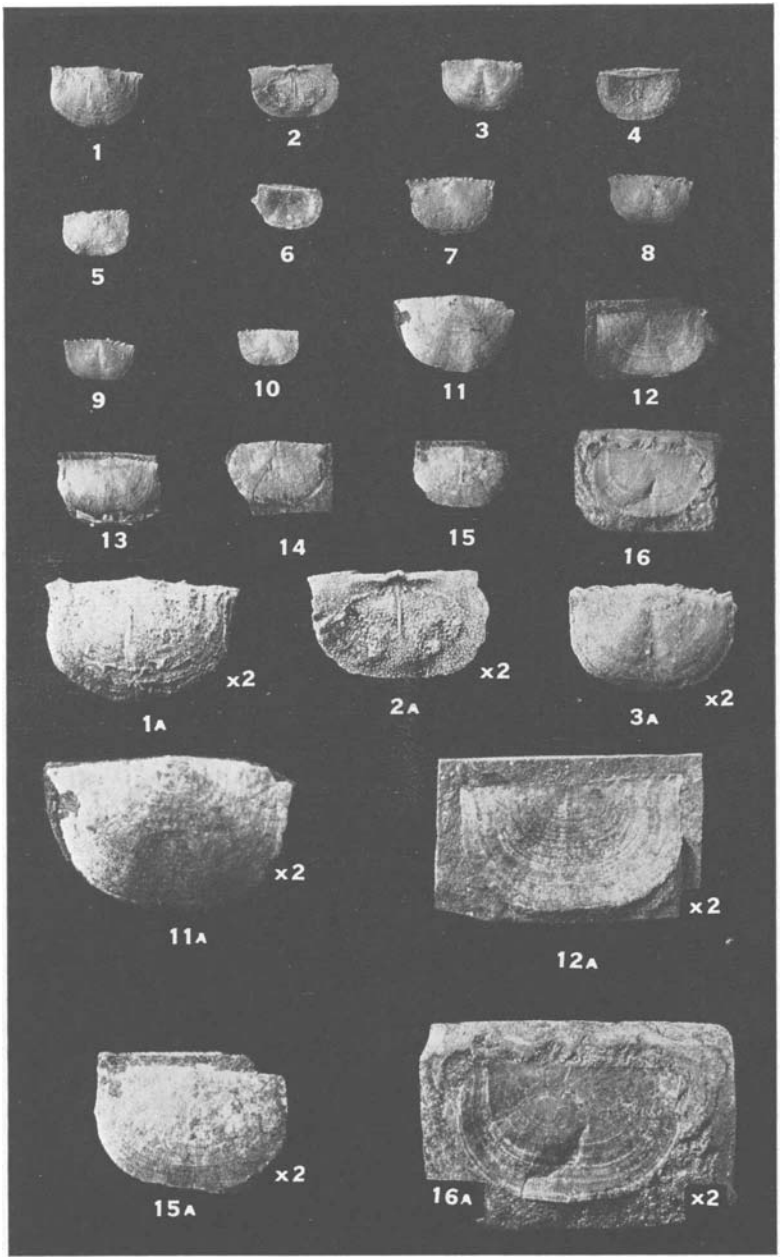
12, 12a. Brachial valve of a specimen and a double enlargement of it.

13,14. Views of the pedicle valves of two specimens.
Magoffin beds: Collection 16.

15, 15a. Pedicle valve and double enlargement of it.

16, 16a. Brachial valve and a double enlargement of it.
Magoffin beds: Collection 12.

## PLATE XLVIII




Fossils from the Kendrick shales and Magoffin beds—Pennsylvanian

**Explanation of Plate XLIX**

Figures

1- 4. *Productus nodosus.*

1. Pedicle valve of an excellent specimen showing the converging costae along the medium line of nodes or spine bases.
2. Pedicle valve of a smaller specimen. Kendrick shales: Collection 8.
3. Pedicle valve of a specimen showing the typical median line of nodes.
4. Ventral view of the external impression of a brachial valve. Kendrick shales: Collection 22.

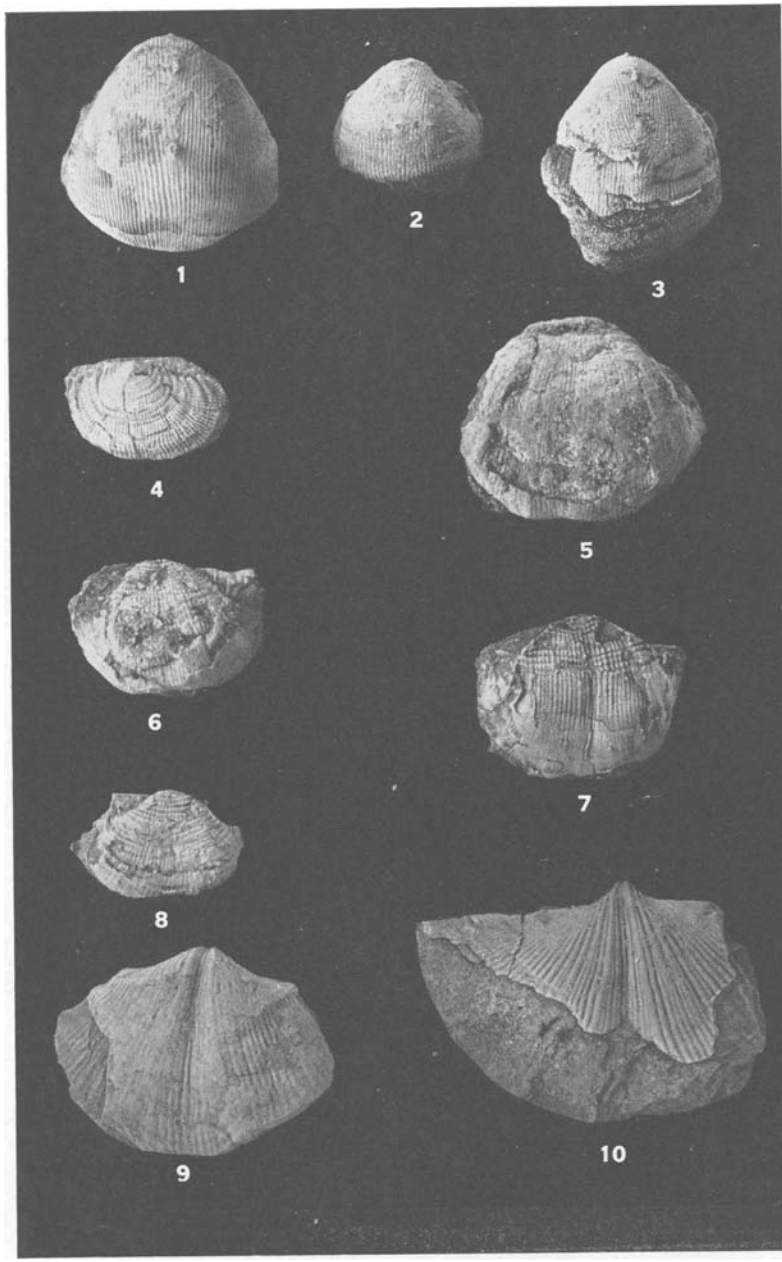
5- 8. *Productus semireticulatus.*

5. Pedicle valve of a large specimen.
6. Pedicle valve of a medium specimen.
7. Pedicle valve of a medium specimen, showing the abrupt change from the reticulate to the non-reticulate parts.
8. Another specimen. Magoffin beds: Collection 12.

9-10. *Spirifer cameratus.*

Pedicle valves of two specimens, one of which shows the extended hinge line. Kendrick shales: Collection 18.

## PLATE XLIX




Fossils from the Kendrick shales and Magoffin beds—Pennsylvanian

## Explanation of **Plate L**

Figures

1- 3. *Spirifer rockymontanus.*

1-3. Two pedicle valves and one brachial valve of three typical specimens.
Kendrick shales: Collection 22.

4. *Reticulcuria (Squamularia) perplexa.*

A poorly preserved specimen.
Magoffin beds: Collection 31.

5. *Ambocoelia planoconvexa.*

Dorsal view of a complete specimen.
Magoffin beds: Collection 27.

6. *Composita subtilita.*

Dorsal view of a complete specimen.
Magoffin beds: Collection 12.

7. *Cleiothyridina orbicularis.*

A rather badly crushed specimen.
Kendrick shales: Collection 22.

8-15. *Leda bellistriata.*

8-8a. Right valve of a beautiful specimen and a double enlargement of it.
9, 10. Right valves of two specimens.
11,12. Left valves of two specimens.
13, 14. Internal impressions of left and right valves of two specimens.
15. Dorsal view of internal impressions of both valves of a specimen.
Kendrick shales: Collection 22.

16-16a. *Leda jillsoni.*

16. Left valve of type specimen.
16a. The same valve enlarged twice to show the widely spaced concentric ridges.
Kendrick shales: Collection 22.

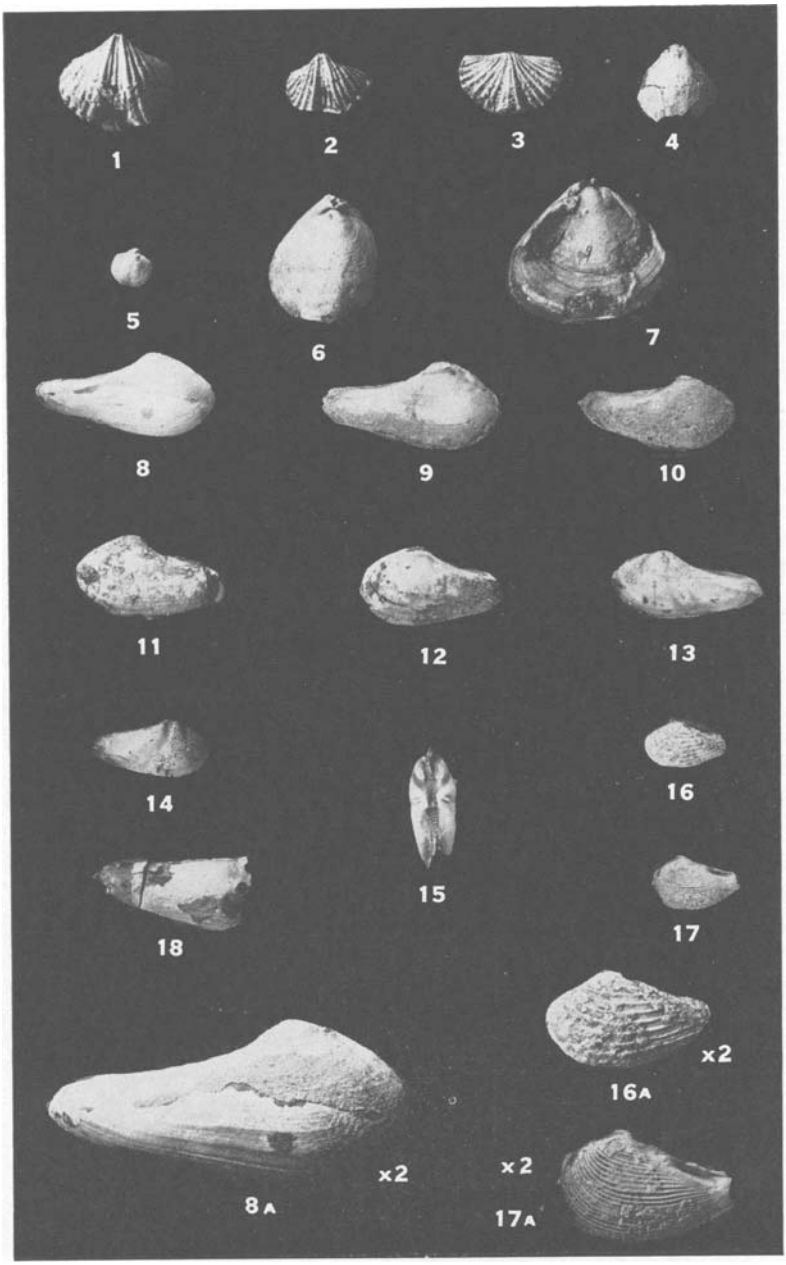
17-17a. *Leda arata.*

17. Left valve of a specimen.
17a. The same valve enlarged twice. Introduced to show its concentric ridges intermediate between the fine ones of *L. bellistriata* and the widely spaced ones of *L. jillsoni.*
Kendrick shales: Collection 7.

18. *Aviculopinna americana.*

A left valve of an imperfect specimen.
Kendrick shales: Collection 22.

**PLATE L**




Fossils from the Kendrick shales and Magoffin beds—Pennsylvanian

**Explanation of Plate LI**

Figures

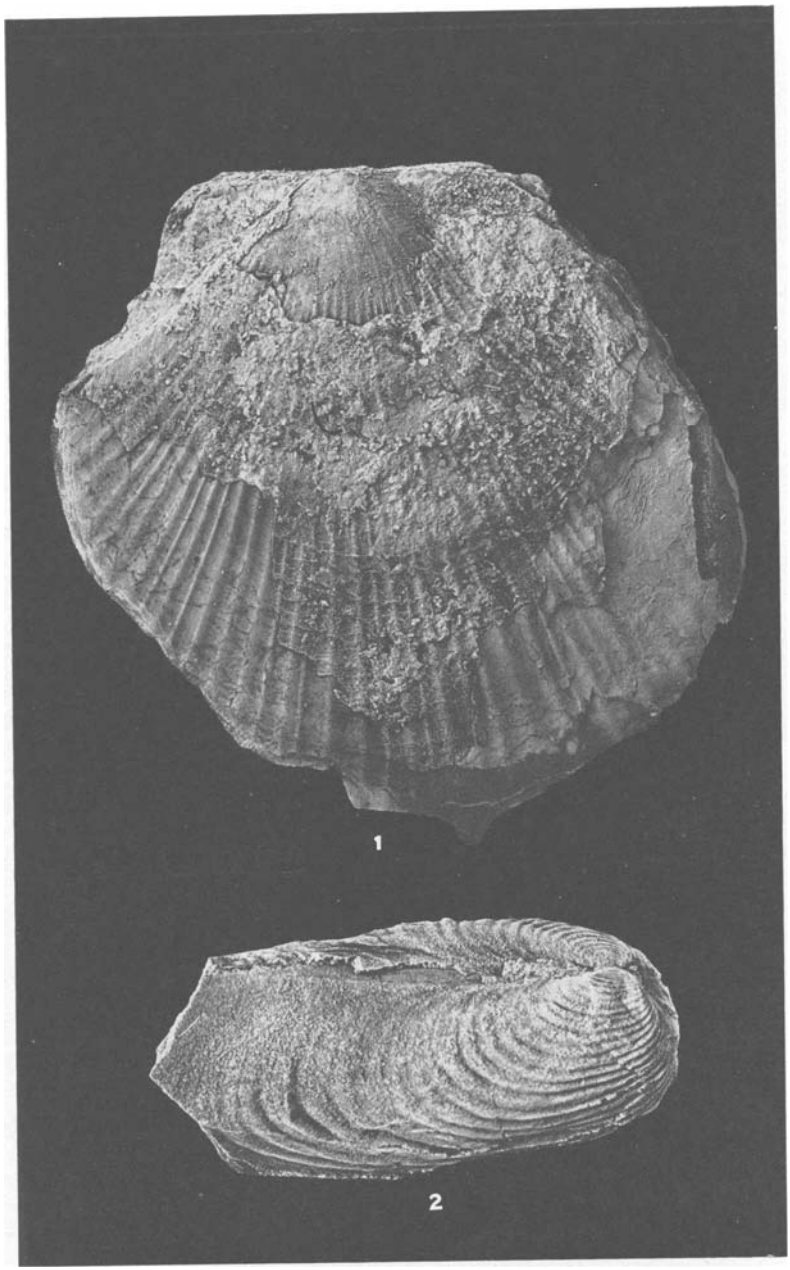
1. *Deltopecten texanus.*

   Left valve of a large handsome specimen.
   Kendrick shales: Collection 8.

2. *Allerisma terminale.*

   Dorsal-lateral view of a slightly distorted specimen of this excellent species.
   Flint Ridge flint: Collection 14.

## PLATE LI




Fossils from the Kendrick shales and Flint Ridge Flint—Pennsylvanian

**Explanation of Plate LII**

Figures

1. *Schizodus alpinus.*
   An imperfect left valve. Kendrick shale: Collection 22.

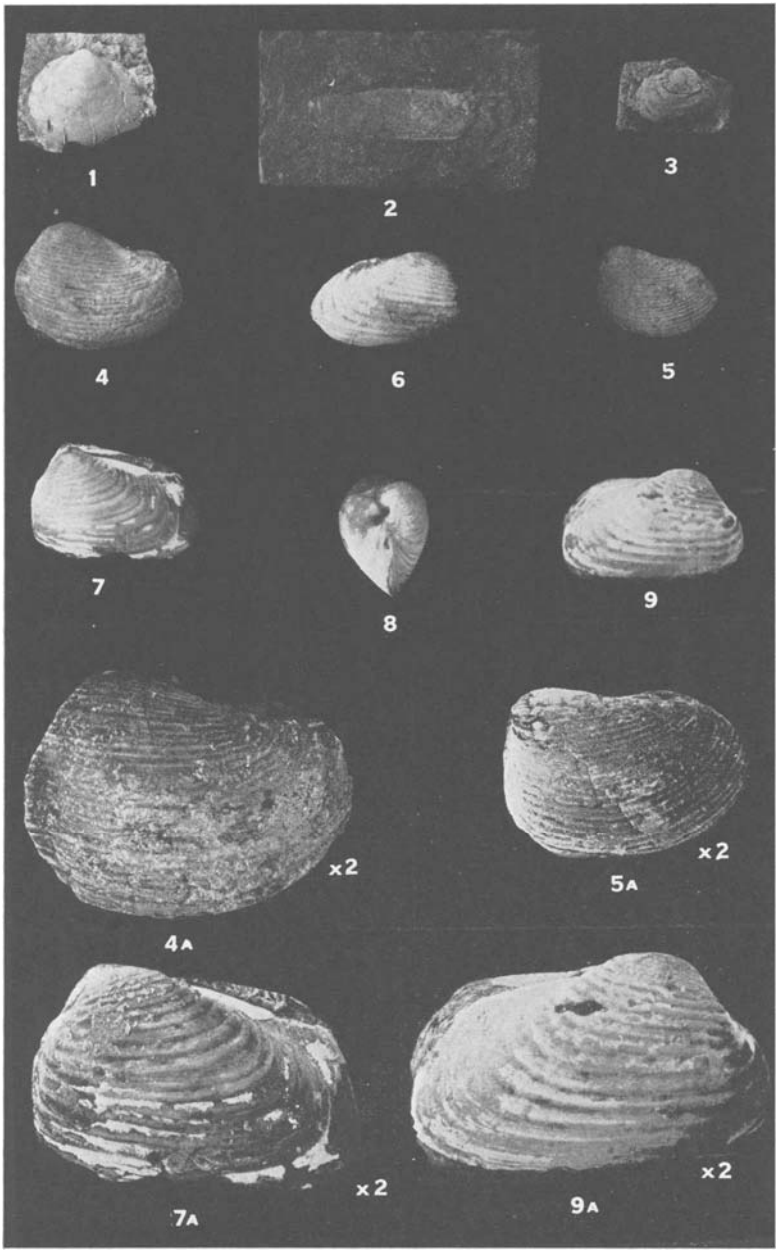
2. *Prothyris elegans.*
   A faintly defined valve of this delicate shell. Kendrick shales: Collection 22.

3. *Astartella concentrica.*
   A right valve.
   Kendrick shales: Collection 22.

4- 5a. *Astartella arcuata.*
   4, 5. Left valves of two slightly distorted specimens.
   4a, 5a. Double enlargements of specimens 4 and 5 respectively.
   Kendrick shales: Collections 22 and 8 respectively.

6- 9a. *Astartella kentuckyensis.*
   6. Right valve.
   7. 7a. Left valve and double enlargement of it.
   8. Anterior view of a distorted specimen.
   9, 9a. Right valve of a slightly distorted specimen and a double enlargement of it.
   Kendrick shales: Specimens 6 and 8 from Collection 8; Specimens 7 and 9 from Collection 22.

## PLATE LII




Fossils from the Kendrick shales—Pennsylvanian

## Explanation of Plate LIII

Figures

1. *Plagioglypta annulistriata.*
   An imperfect specimen referred to this species.
   Kendrick shales: Collection 22.
2. *Worthenia tabulata.*
   View of a broken specimen.
   Kendrick shales: Collection 22.
3. *Bellerophon (Euphemus) carbonarius.*
   Specimen having partly preserved sculpture.
   Magoffin beds: Collection 12.

4-10. *Bellerophon crassus.*

4, 5, 6, 7. Views of four characteristic specimens.
8. Apertural view of a specimen.
9. View of still another specimen.
   Kendrick shales: Collection 22.
10. View of a characteristic specimen.
    Kendrick shales: Collection 7.

ll-lla. *Bellerophon (Bucanopsis) meekianus.*

11. lla. An imperfect specimen having the revolving and transverse sculpture faintly preserved and a double enlargement of it.
Kendrick shales: Collection 22.

12-13. *Schizostoma catilloides.*

Opposite views of two specimens represented largely by internal impressions ("casts").
Kendrick shales: Collection 22.

14-21. *Trepospira depressa.*

14, 14a, 15, 15a. Dorsal and ventral views of two specimens and enlargements of them. Unfortunately the revolving sutural band of nodes has been destroyed by exfoliation.
16, 17, 18. Dorsal views of three specimens having the nodose band better preserved.
19. Ventral view of a specimen.
20. Internal impression ("cast").
21. Dorsal view of a small specimen.
Fragments of the dark shaly matrix impart to all the photographs an ornamentation not inherent in these shells, which are perfectly plain except for the nodose band.
Kendrick shales: Collection 22.

22. *Zygopleura plebeia.*
An imperfect specimen having only a few of the vertical (longitudinal) ridges preserved.
Kendrick shales: Collection 22.

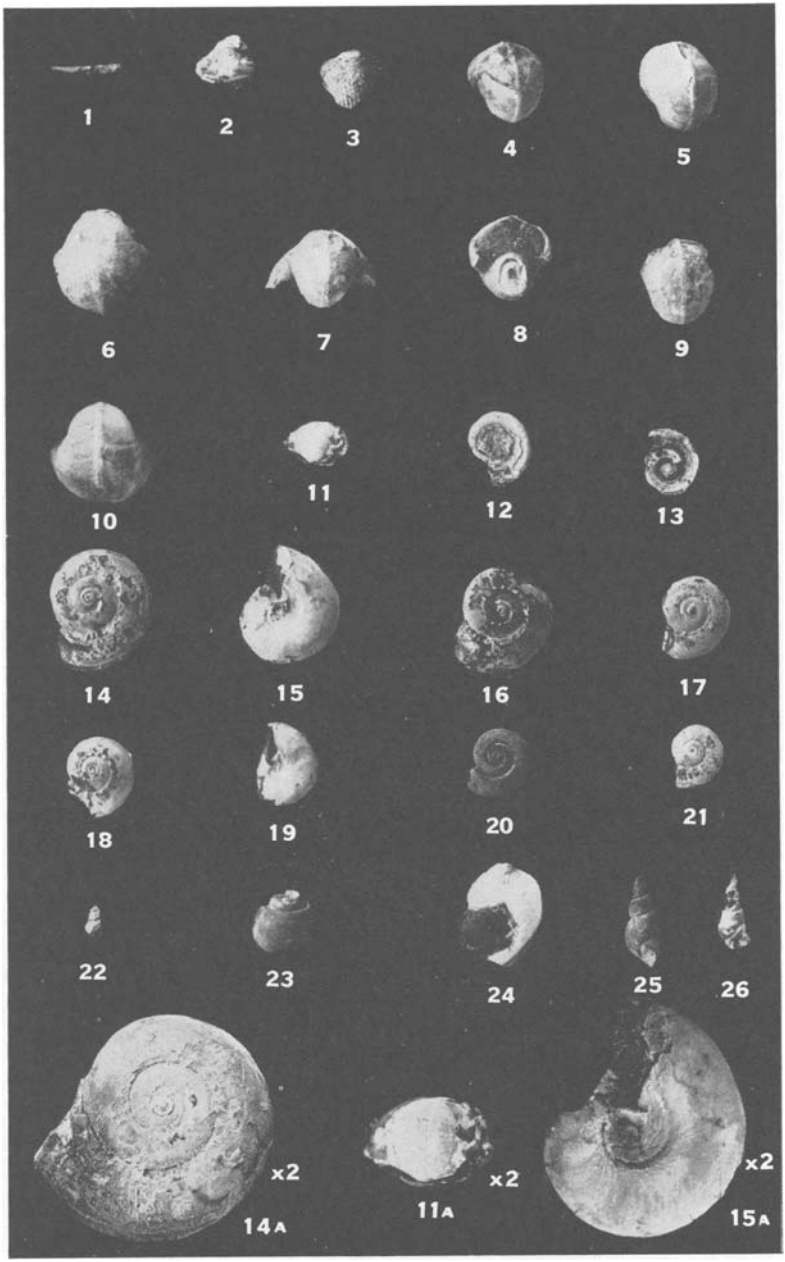
*23.* *Sphaerodoma brevis.*
An internal impression ("cast").
Kendrick shales: Collection 22.

*24.* *Sphaerodoma primigenia.*
A partly exfoliated chalky-white shell of this species.
Kendrick shales: Collection 22.

*25-26. Bulimorpha minuta.*

25. An internal impression ("cast").
26. A slightly exfoliated shell.
Kendrick shales: Collection 22.

## PLATE LIII




Fossils from the Kendrick shales and Magoffin beds—Pennsylvanian

**Explanation of Plate LIV**

Figures

1- 2. *Orthoceras colletti.*

1. Fragment of a specimen.
2. Fragment of another specimen faintly showing the longitudinal ridge so characteristic of this species.

Kendrick shales: Collection 22.

3- 6a. *Orthoceras (Pseudorthoceras) knoxense.*

3, 4. Fragments of two specimens.
5, 5a. Segment of another specimen and a double enlargement, showing the septa.
6, 6a. End view of specimen and a double enlargement of it, showing the central position of the siphuncle.

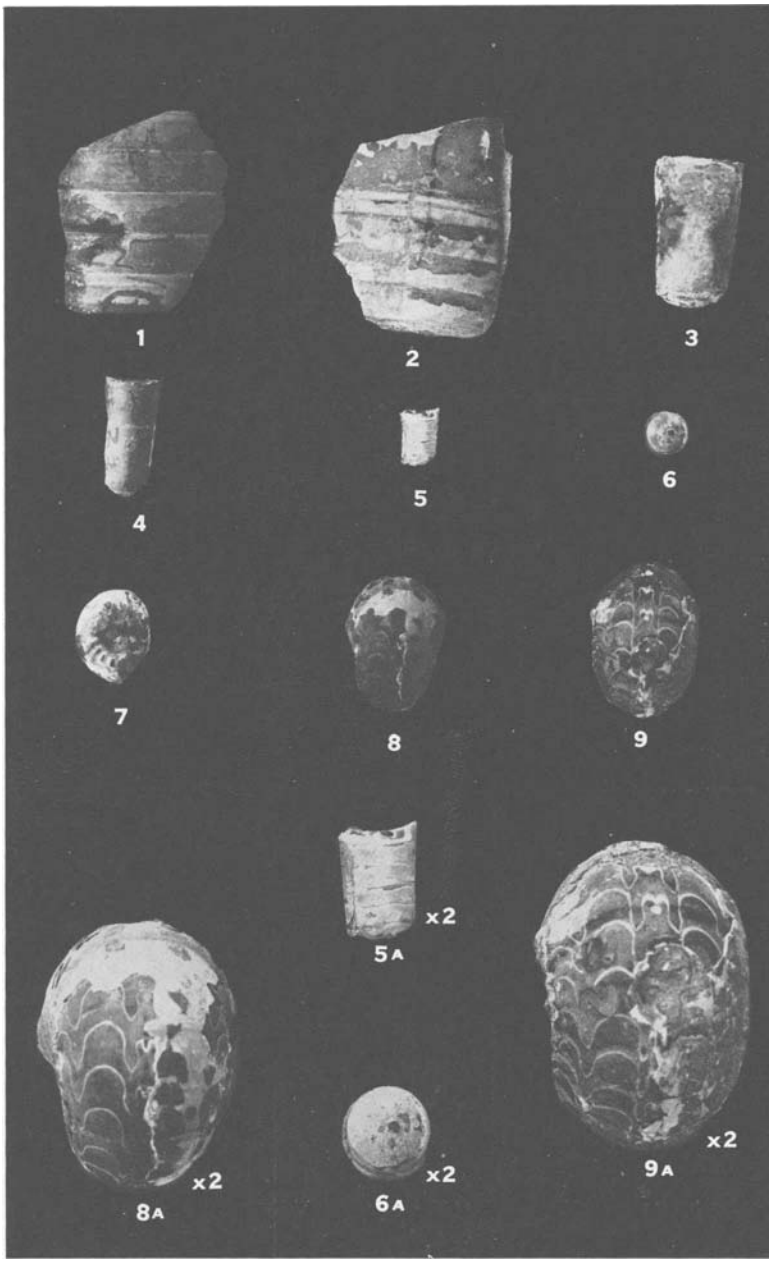
Kendrick shales: Collection 22.

7- 9a. *Gastrioceras montgomeryense.*

7. Side view of a specimen, showing the characteristic nodose shoulder about the umbilicus.
8, 8a. Ventral view of a specimen and a double enlargement of it, showing the characteristic septal configuration.
9, 9a. The same view and an enlargement, of a larger specimen.

Kendrick shales: Collection 22.

**PLATE LIV**




Fossils from the Kendrick shales—Pennsylvanian