

THE
DEVONIAN FOSSILS
AND
STRATIGRAPHY OF INDIANA.

BY EDWARD M. KINDLE.

INTRODUCTION.

The study of the Devonian faunas of Indiana was begun by the writer independently of the State Survey, and a preliminary report on the results accomplished was published* in the spring of 1899. The generous assistance of State Geologist Blatchley has made it possible to continue the work thus begun, and the field work has been extended to the northern Indiana Devonian, about which but little has heretofore been known. The work on the northern Devonian has about doubled the number of species previously known from the Devonian black shale of the State, and has brought to light a new fauna in the Devonian limestone.

In preparing the accompanying report, the writer has kept in mind the needs of Indiana students who may wish to become acquainted with the interesting faunas of our Devonian rocks. The specialist in paleontology will probably find little use for the artificial keys to species which have been prepared, but it is believed that they will be helpful to the beginner. Frequent quotations from other writers have been made for a similar reason, as it is expected that many of those who will use this report will not have access to an extensive reference library, and for their convenience the descriptions of Hall, Meek and others have been fully quoted wherever the material at hand did not permit of so full or complete a description as had been published elsewhere. It has also seemed desirable to quote Hall's original descriptions in many cases of species which were described from Indiana specimens. In all such cases any new observations or variations from the description quoted have been noted after it.

The publication of such papers as Schuchert's work on the Brachiopoda seems to render it unnecessary to give the synonymy of species in a paper of this kind. For the sake of convenient reference to other figures and descriptions, however, one or two citations are usually given after each species.

In addition to the collections of the State Museum and those made for the State survey, the writer has had access to the splendid private

* Bull. Am. Pal., No. 12, 1899, pp. 1-111.

collection of Mr. G. K. Greene during the preparation of this report. To Mr. Greene's generosity he is indebted for the use of many of the specimens here figured. Mr. Taylor, of Hanover, and Mr. John Powers, of Lexington, have also kindly loaned specimens for study. Special acknowledgment is due to Prof. H. S. Williams and to Dr. John M. Clarke, to whom a few specimens were referred for identification or comparison with types. To Dr. Geo. H. Girty, Prof. H. S. Williams and Dr. H. F. Cleland I am indebted for the privilege of examining specimens belonging to the United States Geological Survey. The drawings for the plates were made by Dr. J. C. McConnell of Washington, D. C.

PART I.—STRATIGRAPHY AND FAUNAS.

GEOGRAPHICAL DISTRIBUTION OF THE DEVONIAN.

A large part of the Devonian rocks of Indiana are deeply covered by the drift. With the exception of two somewhat widely separated districts, the Devonian formation throughout the northern two-thirds of the State are buried under a mantle of Drift which varies in thickness from 50 to 400 feet. The Devonian rocks which are not completely covered by the deposits of the Drift may, for convenience of discussion, be referred to three geographical areas. These districts in which Devonian rocks may be studied are separated from each other by considerable areas in which no outcrops of the Devonian occur. They will be designated as the Wabash area, the Pendleton area and the Southern Indiana area.

The attenuated character of the Drift in the southern part of the State permits of frequent outcrops of the Devonian rocks for a distance of 85 miles north of the Ohio. The portion of the Devonian belt outcropping from the Ohio River to the southern part of Johnson and Shelby counties comprises the Southern Indiana area.

The nearest Devonian outcrops to the north of the Southern Indiana area are those of the Pendleton area, about 45 miles to the north of the Johnson and Shelby county sections. About 75 miles to the northwest of Pendleton, Devonian rocks are again found outcropping through the Drift along the Wabash River. The outcrops of the Wabash area are not very numerous, and are confined to a narrow strip of country 10 or 15 miles wide on either side of the river, extending from near Peru to Delphi, a distance of 35 or 40 miles.

Drill records indicate that the Devonian rocks lie immediately below the Drift over a continuous belt of country corresponding in direction with the general strike of the rocks, and extending from

the Falls of the Ohio to Lake Michigan. The drill has also indicated the presence of a belt of Devonian rocks extending east and west across the northern end of the State. With the Sub-Quaternary Devonian, however, we are not concerned except to point out that the areas above referred to do not represent isolated Devonian deposits.

THE SOUTHERN INDIANA AREA.

STRATIGRAPHIC NOMENCLATURE.

Previous studies of the Devonian faunas and stratigraphy in Indiana have nearly all related to the southern Indiana area.* The stratigraphic names which have been used and the correlations which have been made apply directly, therefore, to the Devonian as developed in southern Indiana.

New Albany shale.—This formation is extensively exposed along the bank of the Ohio River in the vicinity of New Albany. It consists there of a fissile black shale, having a thickness of about 100 feet and showing but little variation from top to bottom. It rests upon the Devonian limestone and is terminated above by the Rockford limestone. The shale carries a considerable amount of bituminous matter, and occasionally thin sheets of pure bitumen are seen between the layers of shale. The shale shows a uniform black color on fresh surfaces and scarcely any variation in lithological characters in the southern Indiana area. This uniformity in lithological characters does not hold in the northern part of the State, however, as will be shown later.

Mr. Wm. B. Borden was the first to propose a local geographical name for the formation. In his report on Clark and Floyd counties in 1873† Mr. Borden designated this formation as the "New Albany black slate." In the same report the author states that "it outcrops on the Wabash River at Delphi," Carroll County, Ind. This formation is not a slate, and in the later reports of the State Geologist it has usually been called the New Albany black shale. It seems best to drop the qualifying term "black" in using this stratigraphic name because the formation in Indiana is not always black and is frequently composed in part of brown or drab colored shale in the northern part of the State. The following section taken near Delphi, one of the localities mentioned by Mr. Borden in proposing the term

* For a review of the literature relating to the Devonian in Indiana see Bull. Am. Pal. No. 12, 1899, pp. 88-97. and the paper by Mr. Siebenthal in another part of this report; also "Bibliography of Indiana Paleontology," by E. M. Kindle, 22d Ann. Rep. Dept. Geol. and Nat. Res. of Ind., 1897, pp. 488-514.

† Fifth Ann. Rep. Geol. Surv. of Ind., 1873, p. 158.

"New Albany black slate," illustrates the objection to the word black when applied to this formation:

	<i>Ft.</i>	<i>In.</i>
1. Drift	7	..
2. Bluish black shale, sheety and tough.....	45	..
3. Drab grayish colored slightly sandy shale.....	4	6
4. Band of gray colored concretions.....	6	14
5. Drab colored sandy shale.....	10	6
6. Bluish gray sandstone.....	4	10
7. Drab colored sandy shale.....	5	6
8. Covered	8(?)	..
Devonian limestone.		

The section of a well at South Bend shows 25 feet of brown shale* which corresponds stratigraphically to the drab shale of the above section.

In the southern Indiana area the New Albany shale is very frequently separated from the limestone below it by a band of red clay and limestone pebbles associated with iron ore. This ferruginous clay and conglomeritic band has usually a thickness of from one to four inches. Fish teeth are frequently abundant in the limestone just below the clay band.

The Rockford limestone is present at every point where the top of the New Albany shale has been observed in southern Indiana. It is a ferruginous limestone of brownish or greenish gray color, usually from one to three feet in thickness.

Sellersburg beds.—In a paper published by the writer in 1899† the Devonian limestones in the vicinity of the Falls of the Ohio were recognized as representing two distinct formations, which were named the Sellersburg beds and the Jeffersonville limestone.† The Sellersburg beds constitute the uppermost of these two formations and "include the beds from the New Albany shale down to the lowest beds worked at the cement quarries."‡ The Sellersburg beds comprise a bed of fine grained argillaceous drab grayish colored limestone which is extensively quarried in the vicinity of Sellersburg for cement, and a thin bed of light gray or bluish crystalline limestone above it. The lower drab colored "cement rock" has a thickness of from six to 20 feet in Clark and Scott counties, and does not vary greatly in lithological characters in the region between Lexington and Jeffersonville. The upper limestone, where it can be dis-

* Eleventh Ann. Rep. U. S. Geol. Surv., 1889-90, p. 738.

† Bull. Amer. Pal., No. 12, p. 8.

‡ Bull. Amer. Pal., No. 12, pp. 1-111.

tinguished from the "cement rock," usually has a thickness of from five to eight feet. It shows considerable variation in lithological characters, and in some localities is absent or can not be distinguished from the "cement." At the cement quarry, one and a half miles south of Charlestown, the two divisions of the Sellersburg beds are sharply differentiated as shown in the following section:

	<i>Ft.</i>	<i>In.</i>
1. Red clay with fragments of black shale.....	2	..
2. Crystalline white or light gray crinoidal limestone	6	..
3. Coarse-grained blue limestone, full of small black pebbles .....	..	8
4. Dray gray fine-grained limestone.....	9	..

Three miles to the north of the above quarry at the quarry of the Standard Cement Company we find the following section:

	<i>Ft.</i>	<i>In.</i>
1. Surface clay	4 to 5	..
2. Black shale	1	..
3. Gray to black conglomerate with black pebbles and chert .....	..	3 to 15
4. Hard bluish drab fine-grained arenaceous limestone with much chert.....	7	..
5. Drab colored arenaceous limestone without chert.	2	..
6. Drab colored arenaceous limestone with light colored concretions of chert.....	1	6
7. Drab colored arenaceous limestone free from chert	6	..

It will be seen from the above section that no very satisfactory stratigraphic division of the Sellersburg beds as here developed can be made. The same is true of the section exposed at the quarry of the Ohio River Cement Company.

The outcrop along a small stream about one mile west of Oregon shows the "cement rock" directly under the New Albany shale at some points, while at others a light gray crinoidal limestone separates them. Where typically developed this upper limestone often has a great abundance of crinoids. At the Falls of the Ohio it was distinguished by Lyon* as the "encrinital limestone." The local character of this limestone in its typical development, however, seemed to make it preferable to include it with the "cement rock" under the name of the Sellersburg beds. About 35 miles north of the Falls of the Ohio the Sellersburg beds lose their characteristic lithological features and can not be distinguished from the Jeffersonville lime-

*Trans. St. L. Acad. Sci., Vol. I, 1859-60, pp. 612-622.

stone. This blending of the physical features of the two formations is accompanied by a mingling of their two faunas, as will be pointed out in detail later.

Jeffersonville limestone.—The Jeffersonville limestone is the lowest formation of the Devonian as developed at the Falls of the Ohio. It is the "limestone lying between the Sellersburg beds and the *Catenipora* beds of the Niagara."* This formation has, perhaps, its most typical development at the Falls of the Ohio just below the city of Jeffersonville. It shows a continuous outcrop along the north bank of the river from the Pennsylvania Railway bridge at Jeffersonville to the upper end of the Government dyke below Whirlpool point. At the latter locality the Jeffersonville limestone is overlain by about eight or 10 inches of the bluish drab arenaceous limestone of the Sellersburg beds. The Jeffersonville limestone has a thickness of about 20 feet at the Falls of the Ohio. It is a gray or bluish gray crystalline or subcrystalline limestone, occurring both as a massive and a thinly stratified limestone.

The fossil coral reef for which the Falls of the Ohio have long been noted, occurs in the lower part of this formation. *Spirifer acuminatus* and *Spirifer gregarius* are abundant and characteristic fossils of the upper portion of the formation. The upper beds of the Niagara or the Louisville limestone of Foerste lie immediately below the Jeffersonville limestone. The lower part of the latter and the Louisville limestone are well exposed in the Bear Grass Creek quarries just east of Louisville, Ky. The section exposed at the west quarry shows:

1. White to light gray limestone (Jeffersonville limestone) 10 feet.
2. Light bluish gray argillaceous limestone (Louisville limestone)..... 35 feet.

Geneva limestone.—North of the Falls of the Ohio 10 or 15 miles, sections which include the Lower Devonian and Niagara rocks begin to show a thin bed of rather soft, dark buff to brownish fine grained magnesian limestone. This formation lies between the Jeffersonville limestone and the Niagara or Louisville limestone. It thickens gradually toward the north and reaches its maximum development along Flat Rock Creek.

The Geneva limestone is generally a massive light buff to chocolate brown saccharoidal magnesian limestone. It varies in lithological

*Bull. Amer. Pal., No. 12, 1899, p. 8.

characters, however. Along Wyloosing Creek, in Jennings County, it is in part a very hard siliceous limestone and was used at one time for mill stones.

The southernmost point at which I have recognized it is at the roadside one quarter of a mile east of Charlestown in the following section:

- | | |
|--|----------|
| 1. Bluish drab impure limestone..... | 4 feet. |
| 2. Gray subcrystalline limestone..... | 5 feet. |
| 3. Dark buff, rather soft magnesian limestone (Geneva limestone) | 3 feet. |
| 4. Buffish argillaceous hard limestone with <i>Halysites catenulatus</i> near the top..... | 25 feet. |

About 10 miles further north the dark buff magnesian limestone has a thickness of seven feet near the sulphur spring, northwest of New Washington. In the vicinity of Vernon it has attained a thickness of 20 feet or more. Along the banks of Flat Rock Creek, which is about eighty-five miles north of the Falls of the Ohio, it has a thickness of about 30 feet.

The name Geneva limestone was first used by Collett in his report on the geology of Shelby County.* The term as used by Collett included the buff or light chocolate colored magnesian limestones exposed along Flat Rock Creek in the vicinity of Geneva. Fossils are extremely rare at most localities in this formation and occur usually as casts when found. Collett referred the Geneva limestone to the Corniferous, but without presenting any paleontological evidence of its Devonian age. The "Rubble stone of Waldron" lying between it and the Waldron shale Collett referred doubtfully to the Corniferous. The fossils collected by the writer from the Geneva limestone leave no doubt as to its Devonian age. No fossils have been obtained from the limestone lying between the Waldron shale and the Geneva limestone, but the unconformity which exists between the latter and the six or eight feet of hard gray limestone below it makes it extremely probable that the latter belongs to the Niagara.

Mr. Foerster correlates the limestone immediately above the Waldron shale with the Louisville limestone. He proposed for the beds above the unconformity, which was first recognized by him, the name "Shelby bed." This term appears to be a synonym for Collett's Geneva limestone. The latter term was published sixteen years earlier than the name proposed by Foerster, and by the rule of priority the term "Shelby bed" must be referred to the synonymy of the Geneva limestone.

* Eleventh Ann. Rep. Ind. Dep. Geol. and Nat. Hist., pp. 63, 78, 81, 82.
 † 22d Ann. Rep. Ind. Dep. Geol. and Nat. Res., pp. 234-235.

Mr. Foerste expressed some doubt as to the age of the four or five feet of limestone immediately overlying the Waldron shale in the vicinity of Hartsville.† Mr. Price, in the area covered by his report, has used the local name "Hartsville bed"‡ or "Hartsville ledge"§ for this bed.

The observations of the writer lead him to correlate this bed in the vicinity of Hartsville on stratigraphic grounds with the Louisville limestone.

The strong development of the Geneva limestone in the northern part of the southern Indiana area is accompanied by a corresponding thinning of the Sellersburg beds and Jeffersonville limestone. These two formations can not be distinguished in Bartholomew County and their total thickness does not generally exceed ten feet. The rocks of these two formations do not outcrop along Flat Rock, and if present, they are buried under the Drift. Their greatly reduced thickness in the nearest sections to the south make it probable that the dolomitic Geneva limestone has entirely supplanted them in the Flat Rock Creek sections.

SECTIONS.

The Ohio Falls Section.—At low water the entire Devonian section is exposed in the bed and the north bank of the Ohio between Jeffersonville and the lower part of New Albany. The direction of the river here is normal to the strike of the rocks. The rapids known as the "Falls of the Ohio" occur where the river crosses the Devonian limestone.

The New Albany shale forms a continuous outcrop along the river from near the lower end of New Albany for about three-quarters of a mile. Between the waterworks pumping station and the mouth of Falling Run, the shale extends from 20 to 30 feet above low water and the exposure extends back from the water 80 to 190 feet. The shale here is cut by a very regular set of east and west joints, nine-tenths of which run within 5 or 6 degrees of due east and west. Occasionally a joint diverges from an east and west line as much as 20 degrees. The joints are usually from 6 to 18 feet apart. Sometimes they are much closer, and rarely they converge, cutting out a wedge-shaped section of shale. There is also a set of north and south joints, but they are not so regular and well-developed at this locality as the others.

†22d Ann. Rep. Ind. Dep. Geol. and Nat. Res., p. 241.

‡24th Ann. Rep. Ind. Dep. Geol. and Nat. Res., p. 111.

§24th Ann. Rep. Ind. Dep. Geol. and Nat. Res., p. 125.

Above the pumping station the New Albany shale is hidden by alluvium almost to the K. & I. bridge. The shale outcrop begins again just below the K. & I. bridge and continues almost to the mouth of Silver Creek. At the north end of the Government dam above Silver Creek an isolated outcrop of the shale occurs in the river bed which shows the lowest layer in the New Albany shale. Here certain layers of the tough black shale contain great numbers of *Schizobolus concentricus*.

At low water a considerable area of limestone is exposed on each side of the Government dam above the mouth of Silver Creek. Nearly all of the rock here exposed belongs to the highest division of the Sellersburg beds or the "Encrinital limestone" of Lyon. Crinoid heads occur in this limestone in great abundance, together with corals and a few brachiopods. The thickness of the bed is probably not more than four feet. This bed extends from the Indiana side to Sand Island. At the upper edge of the outcrop above Sand Island the "cement rock" is exposed, lying just below the gray crinoidal limestone.

The rise of the strata toward the east brings to view the lower part of the Sellersburg beds and the upper part of the Jeffersonville limestone at a point about 200 yards below the lower end of the Government jetty. The section exposed here shows:

1. Bluish drab arenaceous limestone—"cement rock,"
(Sellersburg beds)..... 3 feet.
2. Bluish gray, subcrystalline limestone (Jeffersonville
limestone) 7 feet.

At the upper end of the jetty the section exposed in the river bank shows:

	Ft.	In.
1. "Cement rock" (Sellersburg beds).....	7	8
2. Massive gray limestone.....	6	..
3. Blue to gray limestone in strata 10 inches to 3 feet thick.....	6	..

Spirifer acuminatus is a common fossil in No. 2 of this section, which belongs to the upper part of the Jeffersonville limestone.

In a previous paper* by the writer it was proposed to designate the fauna of the Jeffersonville limestone as the *Spirifer acuminatus* zone of the Eodevonian. Later studies of the geologic range and geographic distribution of the Devonian species of the State have seemed to fully justify the selection of this species for that purpose.

* Bull. Am. Pal., No. 12, p. 110.

In the section at the Falls of the Ohio, however, this species appears to be limited to the upper part of the Jeffersonville limestone. *Spirifer gregarius* is the most abundant species in the middle beds of the Jeffersonville limestone at the Falls of the Ohio, while the lower beds are, for the most part, a mass of corals. A band of limestone five or six inches in thickness is made up almost exclusively of the silicified shells of *Sp. gregarius*. It may be traced almost continuously for more than half a mile along the outcrop on the north bank of the river above the jetty. At Whirlpool point it is about 10 or 12 feet above low water.

Near the upper end of the Government jetty the following fossils were obtained from three feet of the lowest limestone exposed at low water:

Pentamerella arata r., *Spirifer gregarius* r., *Spirifer varicosus* r., *Stropheodonta demissa*, *Stropheodonta perplana* r., *Eunella lincklaeni*, *Modiomorpha myteloides* r., *Holopea* sp., *Pleurotomaria* sp., r., *Proetus crassimarginatus* c., *Proetus microgemma* r., *Conocardium cuneus* a., *Blothrophyllum* sp., c., *Favosites hemisphericus* c., *Zaphrentis giganteus* a.

The two feet of hard gray limestone immediately above the bed containing the above noted fossils shows the following association of species:

Actinopteria boydi r., *Atrypa reticularis* c., *Callonema bellatulum* c., *Callonema imitator* ? c., *Chonetes mucronatus* c., *Conocardium cuneus* a., *Cyathophyllum rugosum* c., *Cyrtina hamiltonensis* r., *Dalmanites anchiops* var. *sorbrinus* r., *Dalmanites selenurus* r., *Glyptodesma occidentale* r., *Modiomorpha affinis* a., *Modiomorpha myteloides* a., *Schizophoria striatula* ? r., *Proetus crassimarginatus* c., *Ptychodesma* sp. r., *Orthotheses chemungensis* *arctistriatus* r., *Stropheodonta demissa* c., *Stropheodonta perplana* r., *Turbo shumardi* c., *Zaphrentis giganteus* c.

About six feet above the last station the species obtained were:

Spirifer acuminatus c., *Atrypa reticularis* c., *Chonetes mucronatus* c., *Proetus crassimarginatus* ? c., *Stropheodonta hemispherica* c., *Stropheodonta demissa* c.

The Jeffersonville limestone shows a nearly continuous outcrop from 10 to 15 feet thick between the Government jetty and the J., M. & I. bridge. Above the bridge it continues to outcrop at low water as far up as the end of the upper bridge.

Near the head of the mill race above the J., M. & I. bridge the "cement rock" outcrops and the following section is exposed:

	Ft.	In.
Bluish drab argillaceous limestone with <i>Chonetes yandellanus</i> .....	..	8
Hard blue limestone with <i>Spirifer acuminatus</i>.....	..	6
Bluish gray limestone.....	6	..

Lime was formerly burned from the Jeffersonville limestone above the J., M. & I. bridge.

On the Kentucky side of the river the Sellersburg beds form the bed of the river in the vicinity of the J., M. & I. bridge, where they are worked for cement. A small amount of collecting here afforded the following species:

Atrypa reticularis a, *Chonetes yandellanus* a, *Leiorhynchus quadricostatum* c, *Proetus* sp., *Spirifer oweni* a, *Spirifer segmentus* c, *Spirifer* r, *Stropheodonta demissa*

Cement quarries.—The following lists of species from the Sellersburg beds represent the fauna of the *Spirifer granuliferus* zone:

The following section is exposed at the cement quarry just west of Watson:

	Ft.	In.
1. Surface clay	3	..
2. Black shale .....	..	18
3. Arenaceous cherty limestone.....	5	18
4. "Cement rock".....	9	..

The species obtained from the "cement rock" (4) of the above section are the following:

Athyris fultonensis a, *Atrypa reticularis* c, *Chonetes yandellanus* a, *Spirifer byrnesi* c, *Spirifer granuliferus* a, *Spirifer iowaensis* c, *Spirifer varicosus* a, *Stropheodonta demissa* a, *Stropheodonta hemispherica* c, *Fenestella* sp., *Lichenalia* sp. c, *Michelinia favistoidea* r.

The residual clay from the "cement rock" at the Watson quarry furnished the following species:

Athyris spiriferoides? *Athyris fultonensis*, *Atrypa reticularis* a, *Camarotoechia congregata*, *Chonetes yandellanus?* a, *Meristella haskinsi*, *Pentagonia unisulcata*, *Rhipidomella livia*, *Paracyclas elliptica*, *Phacops rana*, *Schizophoria striatula*, *Spirifer granulosis*, *Spirifer oweni*, *Spirifer segmentus*, *Spirifer varicosus*, *Zaphrentis* sp.

At Speed & Co.'s cement quarries near the center of lot 132 one

and three-quarter miles northeast of Speed Station the section exposed is given by Mr. Siebenthal as follows:

- | | |
|-----------------------------------|----------|
| 1. Soil | 2 feet. |
| 2. New Albany Black shale..... | 3 feet. |
| 3. Black buckshot clay..... | 1 foot. |
| 4. Soft buff arenaceous rock..... | 1 foot. |
| 5. Cement rock..... | 16 feet. |

The cement rock of this section afforded the following species:

Chonetes yandellanus a, *Atrypa reticularis* c, *Orthis* sp., *Camarotoechia tethys* r, *Spirifer granuliferus* r, *Spirifer segmentus* c, *Spirifer varicosus* r, *Stropheodonta demissa* r.

The surface clay of this quarry furnished the following:

Athyris fultonensis a, *Atrypa reticularis* a, *Chonetes yandellanus* a, Crinoid stems a, *Loxonema hydraulicum* r, *Proetus* ? r, *Spirifer byrnesi* r, *Spirifer euruteines* r, *Spirifer granulatus* a, *Spirifer varicosus* r, *Stropheodonta demissa* c.

The cement quarry one and one-half miles south of Charlestown shows the following section:

	Ft.	In.
1. Red clay with fragments of black shale.....	2 to 6	..
2. Crystalline white or light gray crinoidal limestone	6	..
3. Coarse-grained blue limestone full of black pebbles .....	..	8
4. Drab gray fine-grained limestone (cement rock)..	9	..

The fauna of the cement rock here does not vary from that listed in connection with the section described above.

Utica.—The Lower Devonian and Niagara limestones are well exposed along the river front above Utica. The Niagara limestone here has long been used for the manufacture of lime. The Utica lime works, owned by J. B. Speed & Co., manufacture from 5,000 to 8,000 barrels per annum.

Section at the lime quarry north of Utica:

- | | |
|---|----------|
| 1. Gray crystalline limestone with <i>Atrypa reticularis</i> , <i>Stropheodonta demissa</i> and crinoid stems abundant .. | 6 feet. |
| 2. Gray limestone with <i>Spirifer gregarius</i> abundant.. | 3 feet. |
| 3. Gray crystalline limestone with corals very abundant | 10 feet. |
| 4. Argillaceous buffish close-grained limestone with <i>Halysites catenulatus</i> at the top..... | 10 feet. |
| 5. Hard blue limestone..... | 20 feet. |

No. 5 of the above sections is used for lime. Nos. 1, 2 and 3 belong to the Jeffersonville limestone, while 4 and 5 represent the Louisville limestone (Niagara). The limestone here is said to make a good building stone as well as good lime. The piers of the J., M. & I. bridge were built in part of stone from the Utica quarries.

The Sellersburg beds are not exposed at the quarries. The old fields to the north and west of town, however, afford excellent collecting ground for the fossils of this formation.

Charlestown.—The Jeffersonville limestone forms the bed of the small stream flowing through the west part of Charlestown. The Sellersburg beds and the New Albany shale constitute the surface rocks of the higher land about Charlestown. The red clay resulting from the decay of the former is the source of the beautifully preserved fossils for which Charlestown has long been noted.

East of Charlestown about one-third of a mile at the roadside occurs the following section which is of interest because it is the southernmost section in which the Geneva limestone has been noted:

- | | |
|---|----------|
| 1. Bluish drab impure limestone..... | 4 feet. |
| 2. Gray subcrystalline limestone..... | 5 feet. |
| 3. Dark buff rather soft magnesian limestone (Geneva limestone) | 3 feet. |
| 4. Buff hard argillaceous limestone with <i>Halysites catenulatus</i> near the top..... | 25 feet. |

Oregon and New Washington sections.—Oregon lies about six miles northeast of Charlestown. The Sellersburg beds retain their characteristic lithological features in the vicinity of Oregon, but they are thinner than at Charlestown.

The following section is exposed in the road on the south side of Oregon:

	Ft.	In.
1. Black shale	?	..
2. Light gray crinoidal limestone.....	..	15?
3. "Cement"	7	..
4. Blue and gray limestone (Jeffersonville limestone) 15	..	..

The following section occurs three-quarters of a mile northeast of Oregon. With the exception of 1 and 2, which outcrops in the wagon road, the section was taken 150 yards below the wagon bridge:

	Ft.	In.
1. Black shale	1	..
2. Dark gray impure limestone (cement).....	5	..
3. Shelly bluish drab limestone.....	6	..
4. Gray limestone with <i>Spirifer acuminatus</i>	4	..

	Ft.	In.
5. Drab gray impure limestone with <i>Chonetes yandellanus</i> , etc.....	5	..
6. Gray limestone with corals.....	5	..
7. Hard, flinty limestone, conglomeritic in places with pebbles of chert, quartz and metamorphic rock and shell and coral fragments.....	4	..
8. Gray limestone with <i>Zaphrentis giganteus</i> and other corals.....	..	18
9. Light gray limestone with <i>Halysites catenulatus</i> <i>Pentamerus</i> sp., etc.....	10	..
	6	..

This section is of especial interest because of the bed of conglomerate which has not been noted in any other section at this horizon. The absence of the Geneva limestone from this section is another local peculiarity of interest.

About three miles southeast of the above section in tract 145 the Geneva limestone shows a thickness of eight or 10 feet at the big spring just north of the New Washington and Charlestown road.

In the vicinity of New Washington the drift shows a considerable thickness. The well on Miss Fannie Bowers' land one-half mile west of New Washington passed through:

Drift clay	25 feet.
Black muck.....	3 feet.

The limb of a tree was struck at a depth of 20 feet, and a boulder lower down.

Just east of New Washington the section exposed in the road shows:

1. Light buff sandy looking magnesian limestone with a few crinoid stems and corals (Geneva limestone) 3 feet.
2. Hard gray limestone 5 feet.

Two miles northwest of New Washington at the cave one-quarter of a mile above the sulphur spring is the following section:

1. Dark gray coralline limestone..... 5 feet.
2. Buff sandy looking magnesian limestone (Geneva limestone) 7 feet.
3. Hard gray limestone (Louisville limestone)..... 9 feet.
4. Bluish sandy shale (Waldron shale)..... 6 feet.

The small cave at this point is in the comparatively soft Geneva limestone, the Devonian and Niagara limestones forming its roof and floor.

Lexington and Hanover sections.—Hanover marks the extreme eastern limit of the Devonian along the Ohio and lies about 10 miles northeast of Lexington. Opposite the railroad station at Lexington the following section is exposed:

	Ft.	In.
1. Black shale	6	..
2. Ferruginous conglomerate .....	..	2 to 3
3. Bluish limestone with <i>Tropidoleptus carinatus</i> , etc. ..	..	20
4. Drab colored sandy limestone.....	2	..

The beds three and four of the above section afforded the following species:

Chonetes yandellanus a, *Tropidoleptus carinatus a*, *Spirifer granulosus c*, *Stropheodonta demissa c*, *Roemerella grandis r*, *Phacops rana r*, *Proetus canaliculatus?* *Stictopora sp.*, *Cystiphyllum sp.?*

At a small quarry at the side of the railroad and about 400 yards north of the station the Jeffersonville limestone is well exposed. From the upper beds here the following fossils were collected:

Schizophoria striatula a, *Rhipidomella vanuxemi a*, *Spirifer byrnesi c*, *Spirifer euruteines c*, *Stropheodonta hemispherica c*.

Just below the bed containing the above fauna occur the following typical Jeffersonville limestone species:

Spirifer acuminatus a, *Stropheodonta demissa c*, *Stropheodonta hemispherica a*, *Platyceras erectum r*, *Stictopora sp.*

South of Lexington one-half mile, the "cement rock" outcrops along the railroad five or six feet thick. This is the northernmost point at which the Sellersburg beds have their typical appearance. The following species were collected at this locality:

Atrypa reticularis c, *Athyris fultonensis r*, *Camaratoechia tethys?*, *Spirifer byrnesi a*, *Spirifer euruteines r*, *Spirifer segmentus? r*, *Spirifer varicosus a*, *Aulopora sp.*, *Chaetetes arbusculus r*, *Coleolus aciculum*, *Hyolithes sp.*, *Macrocheilus carinatus r*, *Microcyclus sp.*, *Modiomorpha concentrica r*, *Paracyclas ellipticus r*, *Proetus canaliculatus*.

About three-quarters of a mile east of Lexington the New Albany shale outcrops in the bed of a small branch on Dr. Davis's farm. The black shale here contains the following fauna. The fossils are abundant and occur in strata three or four feet above the Sellersburg beds:

Chonetes lepidus c, *Leiorhynchus quadricostatus a*, *Styliola fissurella a*.

Two miles west of Hanover, near Big Spring on the Lexington and Hanover road, about 20 feet of Devonian limestone outcrops on the west side of the creek. *Tropidoleptus carinatus* is the predominant species in the uppermost beds here, while *Spirifer acuminatus* is the most abundant fossil a little lower down. The limestone forming the bed of the creek at this point is a mass of corals comparable in abundance with those at the Falls of the Ohio. The Jeffersonville limestone outcrops in the road in the west part of Hanover near the residence of Mr. G. W. Taylor. Its thickness was not ascertained.

A buff magnesian limestone 10 or 15 feet thick outcrops at the top of the river bluff around the edge of Hanover College campus. No fossils were found in it but this bed is supposed to belong just below the horizon of the Jeffersonville limestone and to represent the Geneva limestone.

Northwest of Hanover about six miles and just west of Smyrna church is the following section:

1. Buff colored magnesian limestone showing a pitted and cavernous face on weathered surfaces (Geneva limestone)..... 5 feet.
2. Hard gray limestone..... 7 feet.

About one mile west of Smyrna church is the following section:

1. Thin bedded gray limestone full of fossils (Jeffersonville limestone)..... 6 feet.
2. Buff magnesian limestone (Geneva limestone)..... 4 feet.
3. Covered 8 feet.
4. Hard gray limestone..... 1 foot.

Loose fragments of coarse brownish sandstone containing Devonian fossils are scattered about the fields in the vicinity of Smyrna church. Careful search failed to discover this sandstone in position. Its fossils seem to indicate that it represents the remnants of a local bed belonging near the base of the Jeffersonville limestone.

The Muscatatuck and Big Creek sections.—The sections here described include representative sections occurring on or near the east fork of Muscatatuck River and Big Creek. The general direction of these streams is east and west, directly across the strike of the Devonian formations which they traverse.

The westerly dip of the New Albany shale brings the top of the formation nearly to drainage level at the wagon bridge over the

Muscatatuck one mile south of Crothersville. The section exposed here in the bank of the river is as follows:

1. Hard gray limestone with conchoidal fracture
(Rockford limestone) 5 feet.
2. Fissile black shale with *Lingula spatulata?* abundant.

On the north side of the Muscatatuck, just west of the B. & O. S. W. Railway, the Devonian limestone just below the New Albany shale was formerly extensively quarried for building stone. The quarry is now abandoned, the stone, like most of the other Devonian limestone in Indiana, having failed to stand the effects of frost action.

The Sellersburg beds have entirely lost the lithological features which characterize them in Clark and southern Scott counties. The beds which correspond in stratigraphic position to them are usually bluish gray heavy bedded limestones.

The face of the cliff along the creek three or four hundred yards southwest of the quarry shows the following section:

1. Black shale 1 to 3 feet.
2. Heavy bedded blue to gray limestone..... 50 feet.
3. Chocolate colored sandy looking magnesian limestone (Geneva limestone) 5 feet.

Just east of Deputy, at the old limestone quarry the section exposed is the following:

1. Blue to gray heavy bedded limestone, with the lower three or four feet very arenaceous in places 12 feet.
2. Gray limestone with *Spirifer acuminatus*..... 6 feet.
3. Covered 5 feet.
4. Bluish gray limestone full of corals..... 6 feet.
5. Chocolate colored sandy looking magnesian limestone (Geneva limestone)..... 5 feet.

The upper 12 feet was quarried for building and foundation work.

West of Paris crossing about one and one-half miles, the New Albany shale and a few feet of the underlying limestone are exposed at a small quarry on the south side of the road. The following fauna was found in the three and a half feet of black shale outcropping above the limestone:

Chonetes lepidus a, *Lingula spatulata a*, *Styliola fissurella a*.

The limestone immediately below the shale yielded the following species:

Atrypa reticularis r, *Chonetes arcuatus* a, *Cyrtina hamiltonensis*? r, *Productella subaculeata* var. *cataracta* c, *Schizophoria striatolata* c, *Spirifer byrnesi* c, *Spirifer granuliferus* r, *Spirifer grieri*?, *Spirifer iowensis* c, *Stropheodonta demissa*, *Stropheodonta hemispherica*, *Stropheodonta perplana* c, *Cladopora* sp. a, *Onychodus sigmoides* r.

The limestone here does not differ lithologically from the Jeffersonville limestone as it usually appears. We have, however, an essentially Hamilton fauna if we except *Chonetes arcuatus* which is a Corniferous species.

At the Graham Creek ford, one and one-half miles east of Paris Crossing, the Jeffersonville limestone constitutes the upper 20 or 25 feet of the bluffs. The lower parts of these beds contain an abundance of corals with but few other fossils. The limestone at the top of the bluff contains the *Spirifer acuminatus* fauna with the following species:

Spirifer acuminatus a, *Atrypa reticularis* c, *Chonetes arcuatus* a, *Chonetes pusillis* c, *Glyptodesma occidentale*, *Orthis iowensis* c, *Onychodus sigmoides* c, *Camarotoechia tethys* c, *Spirifer iowensis* c, *Stropheodonta demissa* c, *Tentaculites bellulus*? c.

On the west side of the middle fork of Big Creek at Lancaster the following section is exposed:

	Ft.	In.
1. Gray limestone with chert bands.....	..	10
2. Coralline limestone	15	..
3. Buff to brownish magnesian limestone (Geneva limestone)	18	..
4. Gray limestone	5	..

No. 1 of this section is the source of the loose masses of fossiliferous chert which are abundantly scattered about the surface here.

The Coralline limestone, No. 2, is composed almost entirely of fossil corals.

The following species were obtained from No. 1 on the bank of the creek just above the bridge:

Atrypa aspera r, *Atrypa reticularis* a, *Glyptodesma occidentale* r, *Onychodus sigmoides* c, *Schizophoria striatula* a, *Phacops rana*?, *Pleurodictum problematicum* c, *Pterinea flabellum*? r, *Camarotoechia tethys* r, *Spirifer acuminatus* a, *Spirifer davissi*, *Spirifer fornaculus* r, *Spirifer varicosus* c, *Strep. torhynchus* sp. r, *Stropheodonta concava* r, *Stropheodonta hemispherica*, *Tentaculites scalariformis* r.

The loose masses of chert on Mr. Geo. Ferris's land a short distance north of the last section afforded the following species:

Actinopteria boydi r, *Bucania devonica* r, *Clinopistha subnasuta* r, *Cyclonema cancellatum* r, *Glyptodesma erectum* r, *Glyptodesma occidentale* a, *Schizophoria propinqua?* r, *Platyceras erectum* r, *Platyostoma lineatum* r, *Pleurotomaria sulcomarginata* r, *Camarotoechia tethys* r, *Spirifer acuminatus* a, *Spirifer euruteines* a, *Spirifer varicosus* r, *Streptorhynchus arctostriata* r, *Stropheodonta concava* c, *Stropheodonta demissa* a, *Stropheodonta hemispherica* c, *Stropheodonta perplana* c.

About one mile west of Wirt loose blocks of very hard dark brown sandstone, resembling quartzite somewhat in texture and hardness are common. This sandstone has not been found in place in this locality. In its manner of occurrence and fossils it is similar to the sandstone blocks previously referred to which occur in the vicinity of Smyrna church in Jefferson County. They represent apparently the remnants of a bed of sandstone of local development like the buhrstone on Wyløosing Creek. The fossils indicate that the Jefferson County sandstone erratics come either from the Jeffersonville limestone or the Geneva limestone.

At Kent, near the head of one of the tributaries of Big Creek is the following section:

- | | |
|--|----------|
| 1. Clay and chert..... | 4 feet. |
| 2. Limestone full of brachiopods..... | 5 feet. |
| 3. Coralline limestone..... | 10 feet. |
| 4. Dark buff impure magnesian limestone..... | 6 feet. |

The masses of chert weathered out of the limestone, No. 2 of the above section, are very rich in fossils. The following species were collected from the chert northwest of town, near the old saw mill:

Bellerophon sp., *Bucania devonica* r, *Callonema bellatulum* r, *Crania doria* r, *Cyrtina hamiltonensis* c, *Glyptodesma occidentale* c, *Loxonema hydraulicum*, *Schizophoria striatula* a, *Rhipidomella vanuxemi* a, *Paleoneilo* sp., *Platyceras buculentum* r, *Platyceras erectum* c, *Platyostoma lineatum* var. *callosum* r, *Productella subaculeata* var. *cataracta* r, *Proetus crassimarginatus*, *Camarotoechia tethys* r, *Spirifer acuminatus* c, *Spirifer arctisegmentus*, *Spirifer varicosus* r, *Streptorhynchus arctistriatus* r, *Stropheodonta demissa* a, *Stropheodonta hemispherica* c, *Stropheodonta perplana* a.

At Dupont, just above the railroad bridge the Jeffersonville limestone outcrops, showing four or five feet of buffish gray fossiliferous rock. Loose chert fragments are extremely abundant along the stream above town.

At the railroad bridge over Big Creek south of Dupont the following section is seen on the south bank of the creek:

1. Surface clay	10 feet.
2. Gray limestone with numerous corals (Jeffersonville limestone)	4 feet.
3. Buff to chocolate colored magnesian limestone (Geneva limestone)	5 feet.
4. Bluish clay and partly covered (Waldron shale)....	5 feet.
5. Hard gray limestone in strata 8 to 15 inches thick (Niagara)	15 feet.

Vernon and North Vernon sections.—The deeply cut channel of Muscatatuck Creek affords good sections of the rocks from the New Albany shale down to the Niagara limestone in the vicinity of Vernon.

Northwest of the J., M. & I. station, about 50 yards, the following section is exposed in the bank of the creek:

	Ft.	In.
1. Surface clay	5	..
2. Black fissile shale	15	..
3. Gray to bluish shelly fossiliferous limestone.....	..	10
4. Gray to bluish crystalline limestone.....	5	..
5. Light gray to ash colored limestone full of calcite crystals (no fossils)	6	..
6. Dark buff to chocolate colored massive magnesian limestone	20	..
7. Covered	8	..
8. Blue clay shale (Waldron shale).....	..	10
9. Gray even bedded limestone.....	5	..

No. 2 of this section—the New Albany shale—contains an abundance of *Chonetes lepida* and *Styliola fissurella*.

The limestone, Nos. 1 and 2 of this section, contain the following fauna:

Productella spinulicosta a, *Delthyris sculptilis* c, *Spirifer macra*? r, *Stropheodonta cancava* r, *Stropheodonta perplana* c, *Atrypa reticularis* r, *Spirifer divaricata* r, *Centronella glansfagea* r, *Schizophora striatula* r, *Reticularia fimbriata* r, *Centronella ovata* ?, r, *Cyrtina hamiltonensis*, *Phacops bufo* a, *Platyceras dumosum* r, *Platyceras* sp., *Strophostylus varians* r, *Chonetes coronatus*? r,

It should be noted in connection with this fauna that *Spirifer acuminatus* and *Spirifer granulatus*, two species which, further south, are limited respectively to the Jeffersonville limestone and the Sellersburg beds, are absent. The species present are, for the most

part, species which occur in both the Hamilton and Corniferous faunas. The upper six feet of this section is apparently the only part of the Devonian limestone which is fossiliferous.

The 12 feet of limestone, Nos. 3, 4 and 5 of the section, represent here the Sellersburg beds and the Jeffersonville limestone. At the lower end of the tunnel Mr. Foerste has given in his report* a section in which he records "40 feet of Upper Niagara limestone, most of it dolomitic and of a light brown color,"† above the Waldron shale. I am not able to concur with Mr. Foerste in assigning 40 feet of limestone above the Waldron shale to the Niagara in the Vernon sections. The covered portion of the above section is well exposed in the vertical cliff at the north end of the tunnel leading to the Tunnel Mill. The section is as follows:

	Ft.	In.
1. Massive chocolate colored dolomitic limestone....	14	..
2. Hard gray limestone.....	10	..
3. Blue shelly calcareous sandstone.....	3	..
4. Blue sandy shale full of Niagara fossils.....	4	6
5. Blue to gray limestone.....	4	..

The abundance of characteristic fossils and the lithological features make 3 and 4 of this section typical representatives of the Waldron shale. As in the case of similar sections elsewhere, no fossils have been found in limestone immediately overlying the Waldron shale, No. 2 of the last section, but it is believed to belong to the Niagara, and to be the representative of the Louisville limestone. Fossils are extremely scarce in the buff or brownish dolomitic limestone, No. 1 of this section, but a few have been found in it just above the wagon bridge east of Vernon. Their poor condition does not permit of satisfactory specific determination. They have been referred to *Rhipidomella* sp. and *Proetus curvimarginatus*?. While the specific determination of the trilobite is doubtful, it appears pretty certain that it is a Devonian form. The principal reason, however, for considering the brownish buff dolomitic limestone about Vernon to be of Devonian age, is the stratigraphic evidence of its identity with the Geneva limestone. The following section taken above Geneva on Flat Rock Creek is introduced here for comparison with the sections just given:

	Ft.	In.
1. Massive buff to brownish dolomitic limestone (Geneva limestone)	5	6
2. Hard gray limestone in strata 3 to 8 inches thick.	6	..
3. Waldron shale.....	4	..

*21st Ann. Rep. Ind. Dep. Geol. and Nat. Res., 1897, pp. 213-298.

†21st Ann. Rep. Ind. Dept. Geol. and Nat. Res., 1897, p. 284.

A comparison of this section with the two Vernon sections which have been given, shows that the brownish buff dolomitic limestone in the latter corresponds entirely in stratigraphic position and lithological features with the Geneva limestone at the type locality which is known to be of Devonian age.

Mr. Foerste gives, in a paper published in 1897* an interpretation of the Tunnel Mill section at Vernon, differing from that expressed in his earlier report, and corresponding somewhat more closely with that of the writer. In this he refers to the Devonian everything in the Tunnel Mill section above the Waldron shale except 58 inches of limestone immediately above it, which he considers "of uncertain age."

On the north bank of the Muscatatuck, one and a quarter miles above North Vernon the following section was taken at a small quarry:

- | | |
|--|----------|
| 1. Black shale | 6 feet. |
| 2. Bluish limestone | 10 feet. |
| 3. Light buff closely banded limestone with thin black carbonaceous partings | 15 feet. |
| 4. Dark brownish massive saccharoidal magnesian limestone | 15 feet. |

The Waldron shale horizon is below drainage level at this point. Mr. Foerste recognizes it doubtfully in the section near the water works.

No. 4 of this section is the Geneva limestone. It is here nearly barren of fossils. One brachiopod is doubtfully referred to *Cyrtina hamiltonensis*.

As pointed out in other sections, the Devonian limestones above the Geneva limestone have lost the physical characteristics which distinguish them further south. No. 4 of the above section is probably in part the stratigraphic equivalent of the Jeffersonville limestone. The beds below No. 3, however, contain, with the exception of corals, almost no fossils. *Spirifer acuminatus*, which further south is not known above the Jeffersonville limestone, occurs here abundantly in the upper 10 feet of limestone, No. 2 of the section. Near the water works station, the same species has been found within two feet of the base of the New Albany shale. We find here a distinct mingling of the faunas of the *Spirifer acuminatus* and the *Sp. granulatus* zones.

The limestones Nos. 3 and 4 of this section were formerly extensively quarried at North Vernon. They are used at present only for crushed rock in road building.

*22d Ann. Rep. Ind. Dept. Geol. and Nat. Res., pp. 236-237.

The limestone in the quarry northeast of North Vernon shows locally bands of black shale one-quarter to three-quarters of an inch thick in the limestone six or eight feet below the base of the New Albany shale.

Sand Creek sections.—Sand Creek crosses the northwestern part of Jennings County, cutting the Devonian formations nearly at right angles to their strike. These sections are about 60 miles north of the Falls of the Ohio.

At Helt's mill, which is about three miles below Scipio, the lower beds of the New Albany shale are exposed in the mill race and in the south bank of the creek just above the dam. The latter outcrop contains an abundance of fossils which, however, are accessible only while the dam is out of repair. The following species occur here:

Chonetes lepida a, *Leiorhynchus limitaris* a, *Tentaculites fissurella* a, *Cardiopsis* sp.

Just below the dam a hard bluish black limestone outcrops below the black shale.

Above Helt's mill three-quarters of a mile, at an old quarry, the following fossils were obtained:

Spirifer acuminatus a, *Stropheodonta demissa*, *Stropheodonta perplana*, *Tentaculites bellulus*?, *Onychodus sigmoides*?, *Pleurodyctum problematicum*, *Polyphora* sp., *Proetus canaliculatus*?

At Scipio the New Albany shale outcrops just southwest of the Episcopal church, at the roadside. *Styliola fissurella* occurs here in great abundance. A few yards to the southwest from this outcrop the following fossils were collected from the limestone five or six feet below the black shale:

Spirifer acuminatus, *Chonetes yandellanus*, *Spirifer varicosus*, *Stropheodonta perplana*, *Stropheodonta demissa*, *Tentaculites bellulus*?, *Dalmanites* sp., *Glyptodesma erectum*.

We have here another interesting example of the mingling of the *Spirifer acuminatus* and the *Spirifer granulatus* faunas. *Chonetes yandellanus* is here associated with *Spirifer acuminatus*, while in Clark County it is one of the most characteristic species of the *Spirifer granulatus* fauna and is never found associated with *Sp. acuminatus*.

Above Scipio the Geneva limestone affords the principal outcrops along Sand Creek. About a mile and a quarter below Brewersville a small natural bridge has been developed in this limestone on the north bank of the creek across the mouth of a small ravine.

Just below the cemetery, on Wyloosing Creek, a small cave occurs in the same formation. The following section occurs at this locality:

	Ft.	In.
1. Light buff colored limestone.....	8	..
2. Very hard flinty gray limestone with numerous corals which locally pass into a nearly pure chert or buhrstone		26
3. Buff chocolate colored massive saccharoidal magnesian limestone	20	..
4. Hard blue thin bedded limestone.....	5	..

All of this section above 5 is referred to the Geneva limestones. No. 5 is the representative of the Niagara.

The following fauna was obtained from the Buhrstone, No. 3 of the section:

Conocardium trigonale c, *Schizodus* sp. r, *Megambonia* sp. c, *Panenca potens* c, *Pentamarella arata*? r, *Reticularia undifera*? c, *Martinia subumbona*? r, *Stropheodonta plicata* r, *Pleurotomaria* sp. c, *Strophostylus* sp. r, *Macrocheilus* sp. r, *Macrocheilus hebe*? r, *Bellerophon* sp. r, *Platystoma pleurotoma*? r, *Naticopsis* sp. r, *Loxonema* sp. r, *Murchisonia desiderata*? r, *Orthoceras* sp.

This bed contains, in addition to the above, a rich coral fauna. All of the fossils here are in the condition of casts and usually in a very poor state of preservation.

A considerable number of millstones were manufactured from this bed at one time. It has not been worked for this purpose for more than 50 years. During the early pioneer days, millstones are said to have been obtained from this locality for mills as far west as Vincennes.

Southeast of Westport, on Millstone Branch, the same bed is well developed and makes a good buhrstone. Millstones were also cut out at this locality 75 or 80 years ago.

Along the creek road west of Brewersville the dark colored Geneva limestone outcrops in numerous vertical ledges and isolated masses with vertical weatherworn faces.

At the Big Four bridge at Brewersville the Waldron shale is seen in the following section:

1. Blue sandy shale	5 feet.
2. Gray and blue limestone.....	18 feet.

Bartholomew County sections.—East of Burnsville one-quarter of a mile the following section is exposed at the side of the road and in the bank of the stream:

	Ft.	In.
1. Drift clay	4	..
2. Black shale	2	..
3. Red clay and limestone pebbles.....	..	3
4. Blue to gray limestone.....	3	6
5. Gray limestone	4	..
6. Dark blue magnesian limestone.....	6	..

Spirifer acuminatus is abundant here in No. 4, within three or four feet of the New Albany shale. The beds 3 and 4 together represent here the Sellersburg beds and the Jeffersonville limestone. No. 6 is the Geneva limestone.

West of Brewersville in the southwest quarter of section 6, at the J. M. Manley limekiln, the limestone above the Geneva limestone is thicker than in the above section and is burned for lime. On the north side of the creek at Burnsville the decay of the upper Devonian limestone has left an abundance of chert rich in fossils. The section exposed here is:

	Ft.	In.
Drift clay with chert	4	6
Grayish buff dolomitic limestone with numerous small calcite veins (Geneva limestone).....	10	..

The most important outcrops in Bartholomew County are along the banks of Clifty Creek and the streams entering it. The limestone is so lightly covered with drift between Duck and Clifty creeks that sinkholes are common in a part of this area to the northwest of Newbern.

In the southeast quarter of section 6 (9 north, 7 east), the New Albany shale outcrops at the roadside northeast of the schoolhouse. *Styliola fissurella* is present here in great abundance.

In the southwest quarter of section 5 (9 north, 7 east), is located the old Everrard quarry on John Burney's land. Four or five feet of bluish gray limestone are exposed here, containing an abundant brachiopod fauna. The limestone here represents the highest part of the Devonian limestone of this region.

One mile west of Newbern and about 200 yards north of the bridge, a bed of chert is exposed to the east of the road. The chert here contains an abundance of Devonian fossils.

The Geneva limestone outcrops in the bed of the creek near this point and dips below drainage a short distance below the bridge.

East of Newbern the Geneva limestone outcrops in bold ledges of massive buff to chocolate brown magnesian limestone. Fossils are extremely rare in this formation. The following were obtained from it east of Newbern about a mile and a half, from outcrops at the roadside:

Conocardium trigonale, *Proetus* sp., *Atrypa reticularis*, *Atrypa aspera* and *Streptorhynchus chemungensis arctostriatus*. The last is a distinctly Devonian species and is alone sufficient to establish the Devonian age of this formation.

At Anderson Falls, two miles south of Hartsville, the following section is exposed:

	Pt.	In.
1. Dark buff magnesian limestone with <i>Atrypa reticularis</i> and a few corals (Geneva limestone)	9	..
2. Hard arenaceous gray limestone without fossils (Louisville limestone?)	4	6
3. Blue calcareous and arenaceous shale with Waldron fossils (Waldron shale)	5	6

No. 2 of this section Mr. Foerste considered of uncertain age.*

Mr. Price in his report on the Waldron shale calls it the "Hartsville ledge."† It appears to the writer to be the stratigraphic equivalent of Foerste's Louisville limestone.

Between the forks of Clifty Creek and Hartsville the Geneva limestone shows many prominent outcrops, frequently presenting a ledge of dark brownish buff sandy looking limestone with vertical face 8 to 20 feet high. The Waldron shale outcrops from four to six feet below it at many points and affords an abundance of fossils (see Price's report).‡

Just north of Hope, in the bed of Haw Creek, a soft buff sandy looking dolomitic limestone outcrops. About 150 yards east of the road this stone has been quarried for local use. The outcrops in the quarry and creek together show about eight feet of stone.

Northwest of Hope, near the junction of Tough and Haw creeks, a small quarry has been worked for road metal. The rock is a shelly impure limestone and apparently belongs, together with the above mentioned outcrops, to the Geneva limestone.

Fossils are comparatively scarce in this limestone, and are limited mainly to *Conocardiums*, *Gasteropods* and a new species of *Martinia*.

Johnson County.—The northernmost outcrop of the New Albany shale in the southern Indiana area occurs in the bank of Sugar

* 22d Rep. Ind. Dep. Geol. and Nat. Res., p. 241.

† 24th Ann. Rep. Ind. Dep. Geol. and Nat. Res., p. 125.

‡ 24th Ann. Rep. Ind. Dep. Geol. and Nat. Res., pp. 81-143.

Creek about 100 yards below the Pennsylvania railroad bridge. Nine or 10 feet of fissile black shale is exposed in the bank of the creek overlaid by drift. Mr. Wm. Neal's well, which is a few rods from this outcrop, has penetrated the shale to a depth of 40 feet without passing through it, so that the shale at this point has a thickness of a least 45 feet.

Just below the mill-dam at Edinburg loose pieces of black shale are thrown up on a gravel bar but the outcrop is in the bed of the river and is not accessible. The Devonian limestone does not outcrop in the county.

Flat Rock sections.—The sections exposed along this stream are about 85 miles north of the Falls of the Ohio, and are the northernmost outcrops of the Devonian limestone in the southern Indiana area. Flat Rock Creek and its tributary, Conn's Creek, cut through the Devonian and Niagara limestones in the southeastern part of Shelby County, exposing beds as low as the Laurel limestone. The New Albany shale is not exposed in these sections, but outcrops nearly west of them at the Johnson County localities previously mentioned.

The following section, taken one and a quarter miles above Geneva on the west bank of Flat Rock Creek, indicates the relations of the beds exposed in the vicinity of Geneva:

	<i>Ft.</i>	<i>In.</i>
1. Brownish buff dolomitic limestone with saccharoidal texture	5	6
2. Hard gray limestone in 3 to 8 inch courses.....	6	..
3. Waldron clay partly covered.....	4	..

No. 1 represents the lower part of the limestone which Collett called the Geneva limestone. Prof. Collett's original section at Geneva is as follows:*

Slope and soil, buff magnesian limestone for calcining, Devonian	28 feet.
Stratified rubble stone, cap of fossiliferous blue shale to same in river.....	4 feet.
Total	32 feet.

Collett considered the Geneva limestone of Devonian age, but did not offer any proof of his opinion.

Fossils are generally very scarce and poorly preserved in this formation. One locality has been found, however, where gasteropods are fairly abundant. The following fauna was secured at this lo-

*11th Ann. Rep. Ind. Dep. Geol. and Nat. Hist., 1881, p. 82.

cality, which is located on the north bank of the creek about three-quarters of a mile above Cave Mills and below the Park a short distance:

Atrypa reticularis, *Orthothetes chemungensis arcostriatus*, *Cyrtina hamiltonensis*, *Stropheodonta perplana*, *Delthyris raricosta*, *Pentamarella arata*, *Ambocaelia umbonata*, *Martinia subumbona*, *Eunella* sp., *Stropheodonta demissa*?, *Spathella typica*?, *Conocardium trigonale*, *Proetus* sp., *Pleurotomaria filatecta*?, *Pleurotomaria* sp., *Polyphemopsis louisvillæ*, *Orthoceras crotalium*?, *Cyrtoceras morsum*?, *Gomphoceras raphanus*?, *Gomphoceras* sp., *Zaphrentis* sp.

This is a distinctly Devonian fauna and places the age of the Geneva limestone beyond question.

A slight unconformity exists between the Geneva limestone and the hard grayish limestone immediately below it. An outcrop on the east side of Flat Rock Creek at the ford about one and one-third miles above Geneva shows this unconformity. The section exposed at this point is:

	Ft.	In.
1. Brownish dolomitic saccharoidal limestone (Geneva limestone)	3	..
2. Hard light gray limestone.....	5	6
3. Blue fossiliferous clay with irregular masses of limestone (Waldron shale)	5	..
4. Hard gray limestone.....	..	15

The character of the unconformity between 1 and 2 is shown in the accompanying photographs. The bed on which the hammer rests is No. 2 of the above section.

This unconformity is also seen in the Wm. Avery quarry on the east side of Conn's Creek about one mile below Waldron, where the following section is exposed:

	Ft.	In.
1. Brownish buff sandy looking limestone.....	2	6
2. Clay .....	..	1
3. Blue limestone in 3 to 6 inch layers.....	5	6

The thin clay band marks the line of unconformity in this section. The bed No. 1 (Geneva limestone) lies horizontal, while the limestone No. 3 dips three or four degrees to the northwest. A hard sandy shale about 15 inches below the floor of the quarry represents the Waldron shale.

The specimens from which Prof. Hall's descriptions of the Waldron fossils were made were obtained nearly due west of this quarry along the creek. No fossils have been found in the limestone be-



(a) View of Jeffersonville limestone near Bunker Hill, Miami County, Indiana.
(b) View of Sellersburg beds near Delphi, Carroll County, Indiana.

tween the Waldron shale and the Geneva limestone. The lithological differences which everywhere distinguish the Geneva limestone from the beds below, together with the unconformity between the two in the Flat Rock sections, leads the writer to consider this limestone to belong to the Niagara, and to represent, as suggested by Mr. Foerste in his report,* the Louisville limestone.

The general westerly dip of the rocks carries the Louisville limestone below drainage level at Geneva. The Geneva limestone has been burned for lime at Geneva for a number of years. About 19 feet of limestone is exposed in the lime quarry. It is a dirty buff to brownish limestone in strata three inches to three feet thick.

Extensive outcrops of the Geneva limestone occur on both sides of the creek near Cave Mill. A small cave occurs in the limestone at the south end of the dam. About half a mile further up stream a larger cave is found on the north side of the stream. Just below the bridge at Cave Mill about 15 feet of the Geneva limestone is exposed which is here a dull buff to drab colored magnesian limestone. Frequent outcrops of this formation are seen as far down as the ford one mile west of Flat Rock P. O.

The Sellersburg beds and Jeffersonville limestone, if present, in the Flat Rock region, do not outcrop. Their absence in the sections exposed makes it probable that they have thinned out and are represented entirely by the Geneva limestone.

THE PENDLETON AREA.

The town of Pendleton is located about twenty-eight miles northeast of Indianapolis, and forty-two miles north of the northernmost sections of the southern Indiana area. The territory which is here designated as the Pendleton area includes a very limited district in the southern part of Madison County in the immediate vicinity of Pendleton. All of the Devonian outcrops occurring near the central part of the State are found, so far as known, in this limited area. Extensive outcrops of rocks of Niagara age or older occur to the north of it in the central part of Madison County along White River.

In Henry County, which lies east of Madison, the only Paleozoic outcrop known was found to contain Niagara fossils.

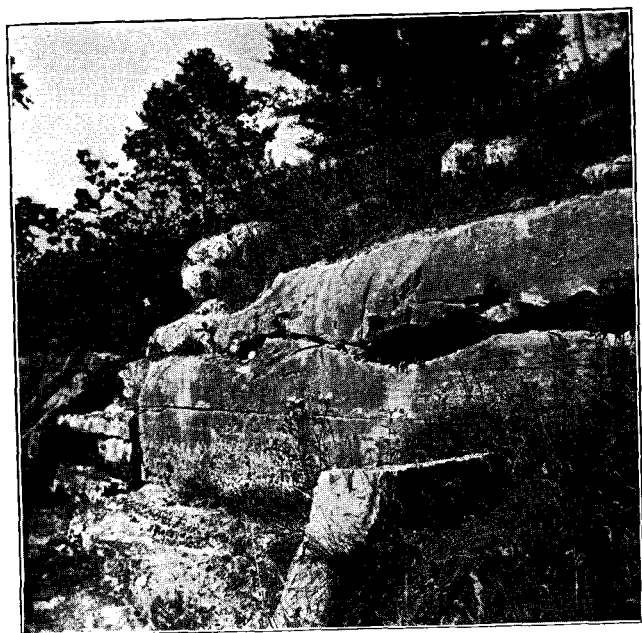
South of Pendleton no bed rock outcrops for more than forty miles.

West of Pendleton, in Hamilton County, outcrops of bed rock occur at a number of places, the most extensive being those at Con-

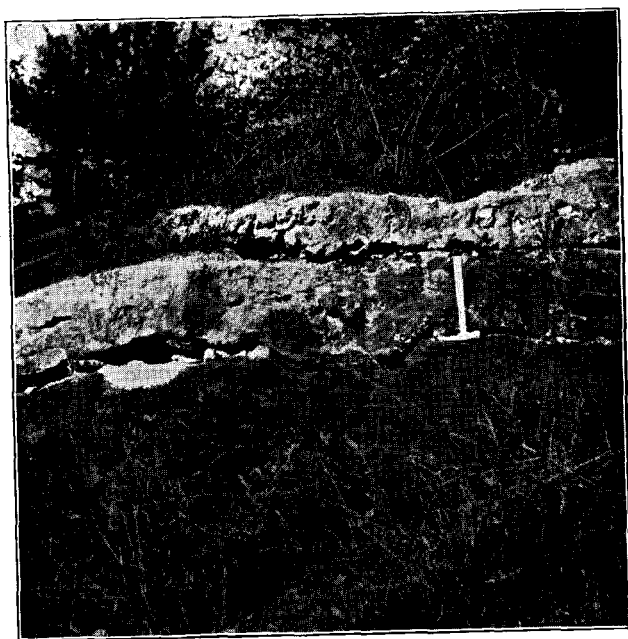
*22d Ann. Rep. Ind. Dep. Geol. and Nat. Res., pp. 234-235.

PLATE 16.

a



b



Views showing unconformity between Genesee limestone and Niagara limestone, Flat Rock Creek, Shelby County, Indiana.

nor's mill on White River. In Dr. R. T. Brown's report on Hamilton County, he states that "the outcrops of rock in Hamilton County are quite barren of fossils."* The outcrop at Connor's mill was considered by Dr. Brown to be of Devonian age. The writer has secured a rich Niagara fauna from this limestone which will be described in a future paper. The "Corniferous limestone" of Brown along Stony Creek in Hamilton County has also been found to contain a Niagara fauna. It overlies unconformably a sandstone in which no fossils were found.

The Pendleton section.—Prof. E. T. Cox published, in 1879, the following section of the rocks at Pendleton:†

1. Drift with large boulders of granite and other crystalline rocks strewed over the surface..... 50 feet.
2. Ash colored rough weathering, cherty magnesian limestone, alternating with soft sandy, greenish colored, pyritous layers, in all about..... 4 feet.
3. Buff sandy magnesian limestone, *Pleurotomaria* and coral bed 4 feet.
4. Heavy bedded and soft, white sandstone, upper part fossiliferous 15 feet.

The above is evidently a connected section since No. 2 has not been found anywhere resting directly on No. 3 at Pendleton. The magnesian limestone No. 2, however, occurs at a little greater absolute elevation than the sandstone in the outcrops of the two which are not very distant from each other, and this doubtless led Professor Cox into the error of supposing that No. 2 is a bed of later formation than No. 3. Both of these he referred to the Corniferous epoch on the evidence of fossils from the sandstone bed No. 3. The writer has found in the ash colored limestone No. 2 a Niagara fauna in which *Sphaerexochus romingeri* is one of the most common species. The fauna of the sandstone is of Devonian age, so that the order of the beds as given by Cox presents the strata in reverse order, the oldest at the top. Whether the apparent order of the beds which has led to their misinterpretation in Professor Cox's section is due to a fault, to unconformity or to some other cause, the few outcrops and the limited time spent on the stratigraphy of the region has not permitted the writer to decide. The ash or buff Niagara limestone referred to above has few outcrops and may be best seen in the cellar of a house standing on a small knoll 100 yards south of Fall Creek on Charles Clarke's lot.

*14th Ann. Rep. Ind. Dept. Geol. and Nat. Hist., 1884, p. 27.

†8th, 9th and 10th Ann. Repts. Geol. Surv. Ind., 1879, p. 60.

Both Cox and Brown, in their reports on the geology of this locality, appear to have overlooked an interesting conglomerate formation whose remnants are very abundant in some parts of the town of Pendleton. This conglomerate is a matrix of coarse sand and well rounded chert pebbles, which are frequently three or four inches in diameter. The pebbles often constitute nearly the whole of the rock. This bed, where observed, is from 4 to 12 inches thick. In the orchard lot of Mr. Chas. Clarke, near the Universalist church, the loose slabs of the conglomerate were so large and numerous as to interfere seriously with the planting of trees. The same formation is conspicuous in some open lots on the south side of town about 100 yards east of the railroad. At the top of a little knoll in that vicinity near an old limestone quarry the loose pieces of conglomerate are numerous. On the north side of Fall Creek, just east of Main Street, the conglomerate may be seen in place. It outcrops also on the opposite side of the street at the east end of a small knoll. The exposures here show the conglomerate to be a bed of local development in the upper part of the Pendleton sandstone. There is no trace of the bed in the sandstone quarry three or four hundred yards to the southeast of the above mentioned locality.

The best exposures of the rocks at Pendleton are found at the Fall just below the Big Four railroad bridge, and at the quarry southwest of the latter, where the formation named the Pendleton sandstone by Professor Cox* is quarried.

The following section was taken at the quarry and in the bank of the creek:

	Ft.	In.
1. Hard gray limestone	3	6
2. Massive white sandstone with 10 to 12 inch strata.	6	8
3. Bluish drab calcareous fine grained sandstone....		10+

The following fossils were found in bed No. 1: *Reticularia fimbriata* c, *Eunella* sp. r, *Martinia subumbona* r, *Pleurotomaria* sp. c

In the sandstone No 2 the following fauna occurs: *Reticularia fimbriata* var. a, *Martinia subumbona* c, *Eunella* sp r, *Pentamarella arata* r, *Atrypa reticularis* r, *Tentaculites dextithea* c, *Bellerophon curvilineatus* r, *Calionema bellatula*, *Schizodus contractus* (?) c, *Conocardium trigonale* c, *Conocardium cuneus* c, *Proetus curvimarginatus* c, *Proetus latimarginatus* c, *Cyrtoceras eugenium* r, *Zaphrentis giganteum* r, *Favosites limitaris* c.

The above list adds some species to those recognized by Hall from this section, but does not materially alter the evidence on which he

* Rept. Geol. Surv. of Ind., 1876-1878, pp. 60-62.

corellated the Pendleton sandstone with the Schoharie Grit of New York.*

The presence of Niagara fossils in the bed immediately below the Pendleton sandstone still further strengthens the view that the Pendleton sandstone fauna represents the Eodevonian fauna.

The following species occur below the sandstone in No. 3 of the section: *Dalmanites verrucosus*, *Leptaena rhomboidalis*, *Cornulites proprius?*, *Murchisonia* sp., *Schizotreta tenuilamellata?*, *Euomphalus* sp, *Orthoceras* sp, *Streptelasma(?)* sp.

Bed No. 1 of the section outcrops at a few points along the creek between Pendleton and Huntsville and is frequently a sandy dirty buff rock containing casts of a large gasteropod. This is the "*Pleurotomaria* and coral bed" of Cox's section.

The limestone outcrops near Fall Creek below Pendleton are all, so far as examined, of Niagara age. About four miles southwest of Pendleton the Niagara limestone is extensively quarried for lime.

THE WABASH AREA.

In many places along the Wabash River and the streams joining it in northern Indiana, the drift is thin, and outcrops of the Devonian and Niagara are correspondingly numerous. The outcrops of the Devonian, so far as known, are confined to that portion of the Wabash Valley between Peru and Delphi and to the Tippecanoe River near Monticello.

STRATIGRAPHY.

The New Albany shale outcrops extensively in the vicinity of Delphi, along Rock Creek, and above Monticello on the Tippecanoe.

The bulk of this formation is composed of fissile black shale identical in appearance with that of the same formation in southern Indiana. Interstratified with the black shale are beds of arenaceous or argillaceous drab gray colored shale of varying thickness which are unlike anything occurring in the southern Indiana sections. These drab colored beds carry a fauna which has not been recognized elsewhere, and which will be described in another section of this paper. None of the sections observed show the upper limit of the New Albany shale in this region. It appears from well sections, however, that the Rockford limestone is absent in this area.

The Devonian limestones of the Wabash area are differentiated both faunally and lithologically into two divisions, as in the southern

*8th to 10th Ann. Repts. Ind. Geol. Surv., 1879, p. 60.

part of the southern Indiana area. These two divisions are correlated respectively with the Sellersburg beds and the Jeffersonville limestone. The Sellersburg beds of the Wabash area contain a Hamilton fauna, but the predominant species in it are forms which are unknown in the Sellersburg beds of southern Indiana. *Spirifer pennatus* is the most abundant and generally distributed species, and the fauna may be called the *Spirifer pennatus* zone of the Wabash area. *Spirifer granulatus*, which is so characteristic of the Sellersburg beds where typically developed in the southern part of the State, has not been observed in the rocks of the Wabash area.

The beds lying immediately below the New Albany shale and holding the *Spirifer pennatus* fauna are composed of a limestone darker in color and more impure than the limestone below them. This limestone varies from a fairly pure bluish drab rock, breaking with sub-conchoidal fracture to a very dark arenaceous limestone. At the only place where the entire thickness of this bed could be observed it did not exceed 14 feet.

The formation corresponding to the Jeffersonville limestone at the Falls of the Ohio is a gray crystalline, thin to heavy bedded limestone. This limestone carries a fauna similar to that of the same formation in southern Indiana, and has, as one of its most characteristic species, *Spirifer acuminatus*. This limestone is unconformable with the Niagara on which it rests, over a part of the area at least. The Niagara rocks at many points are highly tilted, while the Devonian beds lie nearly horizontal.

SECTIONS.

White County.—The New Albany shale and the Sellersburg beds outcrop along the Tippecanoe River, about two miles above Monticello, near the old mill-dam. The New Albany shale outcrops on both sides of the river about a quarter of a mile above the dam. The following section occurs on the west side of the river about one-quarter of a mile above the dam:

	Ft.	In.
Surface clay	4	..
Black shale	5	..
Blue clay shale band .....	..	½
Black shale	5	..
Blue shale .....	..	1½
Black shale .....	..	8
Blue clay .....	..	2
Black shale	7	..

On the east bank of the river the shale shows a slight dip to the west and north.

The Sellersburg beds outcrop in the bed of the river at the dam and in the old mill race just east of the dam. About two feet of dark gray to almost black arenaceous limestone is exposed here. The cavities left in it by fossils often contain asphaltum. The following fauna was obtained here, and from the same beds at the side of a small branch entering the river from the northeast at this point:

Spirifer pennatus c, *Stropheodonta plicata* a, *Atrypa reticularis* c, *Cyrtina hamiltonensis* r, *Spirifer* sp, *Zaphrentis* sp., *Cyathophyllum* sp.

The above described outcrops comprise the only exposures of Devonian rocks known to occur in White County.

Delphi.—The New Albany shale outcrops extensively along Deer Creek near Delphi. From the Wabash railroad bridge over Deer Creek to its mouth the shale forms a nearly continuous outcrop, showing a thickness of about 30 feet in the section exposed.

About three-quarters of a mile east of Delphi and just west of the crossing of the Monon Railway and the Camden pike the New Albany shale outcrops at the side of the road. The section exposed is as follows:

1. Black shale 12 feet.
2. Blue clay shale..... 4 feet.

The clay shale No. 2 contains a rich fauna which has not been seen elsewhere. Nearly all of the fossils are partially or entirely pyritized. The position of this bed with reference to the base of the New Albany shale can not be stated precisely, since the nearest outcrops of the underlying Devonian limestone are some two or three hundred yards distant. They are, however, probably within twenty feet of the base of the shale. The following is a list of the species occurring here:

Palaeoneilo sp., *Goniatites wabashensis* n. sp., *Goniatites delphiensis* n. sp., *Orthoceras* sp, *Plethospira socialis?* *Pleurotomaria* sp., *Macrochilina?* sp.

On the opposite side of Deer Creek from this section and about 200 yards above the old mill-dam the following section is exposed:

	Ft.	In.
1. Drift	7	..
2. Bluish black shale, sheety and tough.....	45	..
3. Drab grayish colored slightly sandy shale.....	4	6
4. Band of gray colored concretions.....	..	6 to 14
5. Drab colored sandy shale.....	10	6
6. Bluish gray sandstone.....	4	10
7. Drab colored sandy shale.....	5	6
8. Covered	8?	..
9. Devonian limestone .....	..	..

The Devonian limestone (9) outcrops at the dam about 200 yards below the remainder of the section. The thickness of No. 8 is estimated, while the remainder represents a continuous section in the nearly vertical bank of the creek.

In the black shale No. 2 of the above section only one species was found—*Lingula spatulata*.

In the drab colored shale No. 3, the following species occur:

Stropheodonta sp., *Lingula* sp. and *Spathiocaris emersoni*. The bed containing these fossils lies at the same level as bed No. 2 of the preceding section, so that the species listed from beds 2 and 3 of these two sections constitute the same fauna.

The following section taken on the north side of Deer Creek at the south end of the old Deer Creek channel is representative of the Sellersburg limestone about Delphi:

	Ft.	In.
1. Drift	5	..
2. Gray clay shale.....	3	..
3. Black shale .....	..	1 to 4
4. Reddish brown ferruginous clay with some iron and concretions .....	..	1 to 3
5. Bluish gray limestone in regular courses 3 to 11 inches thick (Sellersburg beds).....	13	6
6. Light gray limestone (Niagara?)	8	..

Bed No. 5 dips two or three degrees toward the south. *Spirifer pennatus* occurs in it, and with the exception of a *Chonetes* is the only species found in it. The Jeffersonville limestone is absent from this section. This section is shown in the upper photograph, Plate 16.

The following sections occur at a small quarry on the east side of Delphi, in the southeast quarter of section 20:

	Ft.	In.
1. Black shale .....	..	10
2. Hard dark gray limestone in strata 8 to 10 inches thick	7	..

Spirifer pennatus is quite common here, and a single specimen of *Conularia* sp. was found in the limestone. This is the only locality where this genus has been found in the Indiana Devonian.

The Devonian limestone outcrops in the bank of Deer Creek, about 150 yards southwest of the standpipe, exposing about seven feet of siliceous dark gray limestone.

Rock Creek and Little Rock Creek.—These two streams enter the Wabash from the southeast, about midway between Delphi and Ken-

neth. The New Albany shale outcrops along Rock Creek northeast of Rockfield. The shale here forms the bed of the creek, and sections 15 to 30 feet thick are exposed in the bluffs along the stream.

Little Rock Creek enters the Wabash about one mile above Lockport. Immediately above where the road crosses the stream the Lower Devonian limestone outcrops in its bed. One hundred yards further up the stream the Upper Devonian shows in the banks, but a better exposure of it may be seen at an old quarry about a quarter of a mile above the mouth of the creek and about one hundred yards to the west of it. A connected section of these outcrops gives the following:

	Ft.	In.
1. Surface clay and soil.....	4	6
2. Drab colored fine textured limestone, breaking with conchoidal fracture	7	..
3. Gray crystalline limestone	1	..
4. Buff to brown sandy limestone, some layers al- most pure sandstone	2	..
5. Gray shelly limestone .....	..	6 to 8
6. Hard blue limestone.....	..	15
7. Gray Niagara limestone.....	1	..

No. 2 carries the *Spirifer pennatus* fauna and is correlated with the Sellersburg beds.

Beds 3 to 6 carry the *Spirifer acuminatus* fauna and are correlated with the Jeffersonville limestone. The composition of the *Sp. acuminatus* fauna as represented in the different beds from 3 to 6 does not vary materially, and the following list represents the fauna of these four beds:

Spirifer acuminatus a, *Stropheodonta demissa* a, *Rhipidomella vanuzemi* c, *Stropheodonta concava* r, *Stropheodonta preplana* c, *Cyclorhina nobilis* r, *Athyris fultonensis* c, *Atrypa reticularis* c, *Spirifer iowensis* r, *Reticularia fimbriata* c, *Pentamarella arata* c, *Camarotoechia telhys* r, *Camarotoechia congregata* r, *Trematospira hirsuta* r, *Tentaculites scalariformis* r, *Pholadistrophia iowensis* r, *Productella subaculeata* c, *Streptorhynchus chemungensis areostriatus*, *Eunella harmonia* r, *Stropheodonta inequistriata* a, *Cyrtina hamiltonensis* r, *Platyceras thetis* a, *Platyceras buculentum* a, *Platyceras ventricosum* r, *Platyceras fluctuosum* c, *Platyceras indianensis* c, *Platyceras blatchleyi* n. sp. r, *Dalmanites boothi* a, *Phacops rana* r, *Proetus folliceus* r, *Platyceras conicum* r, *Platyceras carinatum* c, *Turbo shumardi* r.

No. 2 furnished the following fauna:

Spirifer pennatus c, *Martinia subumbona* c, *Chonetes manitobiensis* c.

It is interesting to note that not one of these three species is known in the Devonian sections where the Sellersburg beds are typically developed near the Ohio River. They are all Upper Devonian species, however, and the beds containing them are for that reason correlated with the Sellersburg beds.

The fauna from the beds just below these is essentially the same as that which can be found in the Jeffersonville limestone at nearly any locality in southern Indiana.

Little Rock Creek, to Georgetown.—The Sellersburg limestone outcrops in the road on the south side of the river at the mouth of Keep's Creek. It is here a fine grained, dark gray limestone, with *Spirifer pennatus*.

The Niagara limestone outcrops in the river below the mouth of Crooked Creek, forming the bed of the river just above Keep's Creek.

Just below Georgetown both the Niagara and the Devonian are exposed on each side of the river. From five to eight feet of gray crystalline Devonian limestone rests unconformably on the Niagara. The line of contact between the two is an irregular one, frequently rising or sagging. On the east side of the river the Niagara dips from six to 18 degrees to the east, while the Devonian limestone lies horizontal above it. The Jeffersonville limestone is the only division of the Devonian present here. *Spirifer acuminatus* is the most abundant fossil in it. About one-half mile below the Georgetown bridge the Niagara limestone dips below the bed of the river and the Devonian then forms the river bed for a short distance.

Waverly—Logansport.—No outcrops of the Devonian have been observed between Logansport and Georgetown. The extensive quarries at Kenneth are in rocks older than the Devonian.

About one mile south of the Wabash at Logansport a lime quarry is operated in Devonian limestone. The limestone outcrops frequently over about 60 acres in the vicinity of the lime kilns, and over a considerable part of this tract it is covered by a very few inches of soil and clay. The exposures here belong to the Jeffersonville limestone.

A hard gray flaggy limestone outcrops in the bed of the Wabash River above the wagon bridge at Logansport. The loss of paleontological material collected here has prevented a positive determination of their age, but they are believed to be of Niagara age.

At Keysport, about three miles above Logansport, lime is extensively manufactured from the limestone outcropping on the north bank of the Wabash. The section in the quarry is as follows:

	<i>Ft.</i>	<i>In.</i>
1. Shelly buff limestone.....	4	6
2. Hard, blue limestone with calcareous concretions	10 to 13	..
3. Light buff limestone.....		15

No. 1 contains an abundance of Devonian fossils characteristic of the Jeffersonville limestone. Except corals, fossils are very scarce in 2 and 3 of the section. In the absence of satisfactory material for the correlation of these beds, they are provisionally referred to the Niagara.

The Devonian limestone shows frequent outcrops above Keysport, near the wagon road, as far as the upper end of Cedar Island. Cedar Island itself, however, appears to be composed entirely of Niagara rocks.

On the south side of the Wabash River, just above Cedar Island, an isolated mass of Devonian limestone forms a turret-like mass to the south of the road. Similar isolated outcrops of the Devonian occur on each side of the road about one mile west of the mouth of Pipe Creek.

South of Waverly a mile and a half, Devonian limestone outcrops in the river bluffs on the Casebeer farm. The section exposed at the roadside is as follows:

Dark gray limestone with rich Lamellibranch fauna and corals (Devonian)	4 feet.
Buff magnesian limestone (Niagara).....	14 feet.

Adamsborough is the only locality at which the Devonian is known to outcrop on Eel River. The section exposed on the east bank of the river below the mill shows:

White shelly limestone full of fossils.....	6 feet.
Hard bluish gray limestone with few fossils.....	3 feet.

Pipe Creek.—This stream enters the Wabash seven miles above Logansport. A waterfall about seven feet in height occurs two miles above its mouth. Below the fall for two or three hundred yards the channel is cut for the most part in Niagara limestone; above the falls the bed of the stream is Devonian limestone for several hundred yards. The section just below the bridge at Pipe Creek Falls is as follows:

	<i>Ft.</i>	<i>In.</i>
1. Gray limestone (Devonian)	4	6
2. Hard buff limestone (Niagara)	14	..

The fossils of the Devonian limestone here show it to be the representative of the Jeffersonville limestone. The following is a list of the Devonian fauna of Pipe Creek Falls:

Cryptonella ovalis a, *Cryptonella lens* c, *Rhynchonella tenuistriata* c, *Rhynchonella gainesi* c, *Trematospira hirsuta* c, *Eunella sullivanii* c, *Terrebratulina romingeri* a, *Productella spinulicosta* a, *Atrypa reticularis* c, *Centronella navicella* r, *Cyrtina hamiltonensis* r, *Spirifer angusta* r, *Eunella harmonia* r, *Spirifer divaricatus* a, *Eunella lincklaeni* c, *Spirifer byrnesi* var. a, *Cyclorhina nobilis* r, *Stropheodonta inequistriata* a, *Athyris fultonensis* r, *Stropheodonta demissa* r, *Reticularia fimbriata* a, *Aviculopecten terminalis* r, *Pentamarella arata* c, *Proetus crassimarginatus* r, *Proetus folliceus* r, *Proetus macrocephalus* c, *Actinopteria boydi* c, *Pterinopecten hermes* r, *Leptodesma* sp. r, *Platyceras erectum* c, *Platyceras crassum* r, *Platyceras indianensis* r, *Cyclonema* n. sp. r, *Euomphalus planodiscus* r, *Euomphalus deceui* r, *Camarotoechia sappho* r, *Camarotoechia tethys* c, *Spirifer fornaculus* a, *Orthothetes chemungensis arctostriatus* r, *Callonema bellatula* r, *Rhipidemella vanuzemi?* r, *Camarotoechia gregaria?* r, *Platyceras conicum* r, *Platyceras argo?* c, *Platyceras echinatum* r, *Platyostoma* sp. r, *Leptodesma rogersi* c, *Cypricardina indenta* c, *Paracyclas elliptica* c, *Aviculopecten invalidus* r, *Leiopteria* sp. r, *Aviculopecten terminalis* r, *Clinopistha exacutus* r.

About one mile above Pipe Creek Falls the Devonian limestone outcrops in the bed of the creek just below the ford. The limestone at this point is a dark blue, impure, somewhat shelly limestone, with an abundance of bryozoan corals, *Stropheodonta concava*, and *Rhipidemella vanuzem?*

Above Pipe Creek Falls no Devonian limestone outcrops until the vicinity of Bunker Hill is reached. Near the wagon bridge three-quarters of a mile northwest of Bunker Hill the Jeffersonville limestone outcrops along the creek both above and below the bridge. Above the bridge the Jeffersonville limestone is a rough bedded gray limestone, and forms the bed and sides of the creek. See Plate 15. Below the bridge 300 yards is the following section:

1. Shelly white limestone (Devonian) 5 feet.
2. Dull gray to buff magnesian limestone (Niagara)... 6 feet.

The following is a list of the fauna occurring in the Devonian limestone near Bunker Hill:

Spirifer divaricatus a, *Productella spinulicosta* c, *Camarotoechia congregata?* r, *Rhynchonella gainesi* c, *Stropheodonta inequistriata* a, *Reticularia fimbriata* a, *Pentamarella arata* c, *Spirifer manni* r, *Spirifer byrnesi* r, *Cyrtina hamiltonensis* r, *Orthothetes chemungensis arctostriatus* r, *Rhynchonella tenuistriata* r, *Atrypa reticularis*, *Pterinopecten hermes* r, *Pterinopecten*

undosus r, *Aviculopecten terminalis* r, *Modiomorpha* sp. r, *Platyceras indianensis* r, *Cyclonema crenulata*, *Euomphalus* sp, *Polyphemopsis louisvillae?*, *Proetus macrocephalus* r, *Proetus crassimarginatus* c, *Cryptonella ovalis* r, *Centronella navicella* r, *Terrebratula romingeri* c, *Cryptonella harmonia* c, *Aclisina* sp r, *Cyclonema* sp. r, *Platyostoma* sp. r, *Platyceras* sp. r, *Cryptonella lens* r, *Eunella lincklaeni* r, *Aviculopecten terminalis* r, *Pterinopecten hermes* c, *Cypricardinia indenta* r, *Discina* sp. r, *Camerotoechia tethys* r, *Cyclorhina nobilis* r, *Athyris fultonensis* r, *Trematospira hirsuta* r, *Euomphalus decewi* r, *Nucleocrinus* sp. r, *Orthoceras* sp. r, *Polyphemopsis louisvillae* r, *Callonema imitator* r, *Platyostoma* sp.

CORRELATION.

The following table indicates approximately the relations which the several Devonian formations described in the preceding pages sustain to each other:

Southern Indiana Area.	Pendleton Area.	Wabash Area.
New Albany shale	Drift covered	New Albany shale.
(S. part of area.) (N. part of area.)	?	Sellersburg beds.
Sellersburg beds }		
Jeffersonville } Geneva limestone.....	Pendleton sandstone.	Jeffersonville limestone.
limestone }		

When the first attempts were made to determine the age of the New Albany shale, its known fauna was limited to one or two species of *Lingula*. Since the discovery of the Lexington fossils by Borden in 1874* the formation has been correlated with the Genesee of the New York scale. The discovery by the writer of a new fauna in the New Albany shale at Delphi throws some additional light on the difficult problem of the true position of this formation in the time scale. Associated with several species which are new or undetermined, we find in this fauna *Spathiocaris emersoni*, a well known representative of the Naples fauna of New York.

This fossil is not known in the Genesee in the New York sections, but occurs in the Portage and even as high as the Lower Chemung.†

Of the species which have been previously known in the New Albany shale at least three are characteristic Genesee species; one is common to the Portage and the Genesee. The presence in the New Albany shale of a Genesee fauna and a Portage fauna seems to justify the conclusion that this formation is the western representative of both the Genesee and the Portage.

*Geol. Surv. of Ind., 1874, pp. 112-134.

†Bull. U. S. Geol. Surv., No. 16, p. 47.

The *Styliola fissurella* fauna does not bear any stronger evidence of the Genesee age of the New Albany shale than does the *Spathiocaris emersoni* fauna of its Portage age; these two faunas, however, are not intermingled in the New Albany shale. While there is no evidence that either one occupies a higher stratigraphic horizon than the other, they are found in unlike sediments. The *Styliola fissurella* fauna is confined to the fissile black shale, while the *Spathiocaris emersoni* fauna occurs in a soft drab shale which is interbedded with the black shale in northern Indiana. The New Albany shale of northern Indiana contains in its fissile black strata and its drab sandy beds the lithologic elements of both the Genesee and the Portage. But neither these beds nor the elements of the Genesee and Portage faunas which they contain are sharply differentiated as they are in the eastern Devonian province.

The problem of the correlation of the Devonian limestones with the New York scale is much more difficult for some parts of the Indiana province than for others. In the vicinity of the Falls of the Ohio, we find two quite distinct and well marked faunas. These are the *Spirifer granulosus* and the *Spirifer acuminatus* faunas, and represent respectively the Hamilton and Corniferous faunas of New York. Near the Falls of the Ohio the Sellersburg beds and the Jeffersonville limestone which carry these faunas are sharply differentiated lithologically, the Jeffersonville limestone being a nearly pure limestone, and representing clear water conditions during its deposition, while the Sellersburg beds are composed of an impure argillaceous limestone. In the northern part of the southern Indiana area these two formations cease to be sharply differentiated lithologically and merge into each other in a limestone which is neither so pure as the Jeffersonville limestone nor so argillaceous as the Sellersburg beds near the Falls. Associated with the loss of individuality of these two formations occurs a mingling of their two faunas which renders them indistinguishable as separate faunas.

In the Wabash area the faunas of the Devonian limestone are even more distinct than at the Falls of the Ohio. In the lower one *Spirifer acuminatus* is an abundant fossil and the fauna does not differ greatly from that in the Jeffersonville limestone at the Falls of the Ohio. The upper fauna is a distinctly Hamilton fauna, but entirely different from the Hamilton fauna of southern Indiana. Two of the most abundant fossils in it are *Spirifer pennatus* and *Chonetes manitobiensis*. Neither of these species is known in the southern Indiana area.

PART II.—PALEONTOLOGY.

DEVONIAN BLACK SHALE FOSSILS.

BRACHIOPODA.

LEIORHYNCHUS.

- A. Plications angular or subangular, nearly uniform in character, covering the entire surface of the shell. *L. limitaris.*
- AA. Plications rounded, not uniform; those on sides of shell obscure and frequently becoming obsolete toward the margin. *L. quadricostata.*

Leiorhynchus quadricostatum (Vanuxem).

Pl. I. figs. 5, 5a.

L. quadricostatum Hall, Pal. N. Y., 1867, Vol. IV, p. 356, Pl. 56, figs. 44-49.

Hall's description.—"Shell broadly ovate somewhat gibbous, with distinct mesial fold and sinus. Ventral valve a little gibbous towards the beak; sides nearly flat with a wide mesial fold and sinus. Dorsal valve more gibbous than the opposite, greatest convexity in the middle of the valve; mesial fold prominent. Surface of mesial fold marked by three, four or five rounded plications which bifurcate above. Sides of the valves obscurely marked by rounded plications, which become obsolete toward the margin, and sometimes this part of the shell is entirely free from any markings whatever."

A cast of the dorsal valve shows it to possess a thin, high median septum extending a little more than one-third the length of the valve, terminating under the umbo in a rounded subovate process. The specimens present considerable variation in the number and strength of the plications.

This shell is known only at a few localities where it is very abundant.

Formation and locality.

New Albany shale; Lexington, Falls of the Ohio and Helt's Mill, Jennings County.

Leiorhynchus limitare (Vanuxem).

This species was recognized by Whitfield in a collection from Lexington. He states that "only a few individuals in the collection can with certainty be referred to this species. They are flattened on

the surfaces of the shale and resemble very closely those so common in the Marcellus shale of New York.”*

Formation and locality.

New Albany shale; Lexington.

Chonetes lepidus Hall.

Pl. I, fig. 7.

C. lepidus Hall, Pal. N. Y., 1867, Vol. IV, p. 132, Pl. 21, fig. 5.

Shell very small, subhemispherical in outline. Ventral valve moderately gibbous with a well marked medial depression in which there are from one to four striae; curving abruptly to the sides and front, with cardinal angles scarcely flattened. Dorsal valve following the curvature of the opposite valve but less arched. Area of the ventral valve narrow, widest in the middle. Area of dorsal valve scarcely equal to the thickness of the shell. Surface marked by slender angular bifurcating striae, of which there are from twenty to thirty near the margin, and half as many near the umbo. One of the striae on each side of the sinus in the ventral valve is stronger and more prominent than the others near the beak. Two or three spines may usually be seen on the hinge line on each side of the beak. The interior of the dorsal valve shows a longitudinal depression and the course of the striae is well defined and strongly papillose.

This species is quite abundant in some localities occurring with *Styliola fissurella*.

Formation and locality.

New Albany shale; Helt's Mill and Scipio, Jennings County, New Albany, Lexington and Bartholomew County.

Lingula spatulata Vanuxem.

Pl. I, fig. 1.

L. spatulata Hall, Pal. N. Y., 1867, Vol. IV, p. 13, Pl. 1, fig. 1.

Hall's description. — “Shell small, subspatulate or subelliptical, moderately convex, attenuate toward the beak, the ventral valve being more acute; greatest width across the middle of the shell; length (which is scarcely three-tenths of an inch) about twice as great as the width. Surface marked by fine concentric striae, and in the exfoliated shells, by faint radiating striae.”

I have found this a common species at two localities.

Formation and locality.

New Albany shale; Crothersville, Lexington and Falls of the Ohio.

* Geol. Surv. of Ind., 1874, p. 180.

Barriosella subspatulata Meek & Worthen.

B. subspatulata Hall & C., Pal. N. Y., VIII, Pt. I, 1892, p. 63, Pl. 2, figs. 14-16.

Shell narrow, elliptical, sides regularly curving or sometimes nearly straight; length a little less than twice the width. Anterior end broadly rounded, posterior extremity more or less acute. The surface is marked by fine concentric striae. Near the front and sides in perfectly preserved shells, the surface shows under a good lens a delicately corrugated surface ornamentation. No radiating striae have been observed.

This species is abundant in many localities.

Formation and locality.

New Albany shale; Helt's Mill, Jennings County, Crothersville, Delphi and Rockford.

Schizobolus concentricus (Vanuxem).

Pl. I, figs. 2, 3.

Discina truncata Hall, Pal. N. Y., 1867, p. 23, Pl. 1, fig. 15; Pl. 2, figs. 36, 37.

Hall's description.—"Shell ovate, the anterior end broader; valves depressed-convex. Dorsal valve with the apex near the posterior margin, and directed backwards; posterior margin very abruptly rounded or truncate.

"Ventral valve with the apex submarginal; foramen extending nearly or quite to the posterior margin, which is indented. Surface marked by fine concentric striae and faint radiating undefined lines."

This is an abundant species in the black shale at the Falls of the Ohio. The posterior margin is often rounded and the shell nearly circular.

Formation and locality.

New Albany shale; Falls of the Ohio.

Orbiculoidea lodiensis (Vanuxem)?

Pl. I, fig. 4.

Discina lodiensis Hall, Pal. N. Y., 1867, Vol. IV, p. 22, Pl. 1, fig. 14; Pl. 2, fig. 35.

The specimen, which is referred with some doubt to this species, is the impression of a rather poorly preserved pedicle valve. The outline of the impression is very indistinct and it is not entirely

certain that the pedicle slit extends to the margin of the valve as indicated by the figure. The specimen measures three-twentieths of an inch in length.

Formation and locality.

New Albany shale; Falls of the Ohio.

Stropheodonta sp.

Pl. I, fig. 6.

Associated with *Spathiocaris emersoni* several specimens of a small species of *Stropheodonta* have been found in a drab colored band of shale in the Black shale. All of the specimens are exfoliated and too poorly preserved to permit of detailed description.

Formation and locality.

New Albany shale; Delphi.

PELECYPODA.

Paleoneilo sp.

Pl. I, figs. 8, 8a.

Shell small subovate, length nearly one-third greater than the height. Anterior end short and regularly rounded. Basal margin regularly rounded, hinge line straight posterior to the beaks; anterior to the beaks it descends to the anterior margin. Valves gibbous in the umbonal region; nearly uniformly convex, no umbonal slope. Beaks at about the anterior third, slightly elevated above the hinge line. Anterior and posterior muscular scars strongly marked. Six or seven small impressions near each of the beaks marks the position of the points of attachment of umbonal muscles. A distinct sharp ridge extends from the upper angle of the anterior and posterior muscular scars along the cardinal line almost to the beaks, indicating the position of corresponding grooves in the valves.

The specimen described is a cast and preserves no surface markings.

Formation and locality.

New Albany shale; Delphi.

Panenka radians (Hall).

Cardiola radians Whitfield, 6th Ann. Rep. Ind. Geol. Surv. 1875, p. 126.

Whitfield recognized this species or a species allied to it in a collection sent him from the New Albany shale of Scott County. The

poor state of preservation of specimens referred to this species and to *Panenka robusta* makes this specific determination doubtful.

Panenka sp.

Badly crushed shells which resemble *Panenka robusta* have been found in the Black shale. They are comparatively rare.

Horizon and locality.

New Albany shale; Lexington and Helt's Mill, Jennings County.

Lunulicardium fragile Hall.

L. Fragile Hall, Pal. N. Y., Vol. V, Pt. I, 1885, p. 434, Pl. 71, figs. 1-14.

This species is included here on the authority of Hall, who states that "It has likewise been noticed in the Genesee shale of Ohio, and Indiana." If Hall's statement is correct, *L. fragile* is certainly a very rare species in Indiana.

Horizon and locality.

New Albany shale; locality?

GASTEROPODA.

Plethospira socialis Girty?

Pl. I, fig. 9.

Shell rather small with three rapidly expanding volutions. Spire depressed and small. The body whorl comprising about seven-eighths of the bulk of the shell. Volutions regularly rounded, nearly circular in transverse section. Umbilicus open. Surface markings not preserved. Specimens varying in diameter from $6/25$ to $\frac{1}{2}$ inch in diameter. Diameter usually somewhat greater than the height.

Nearly all of my specimens are considerably larger than the species described by Mr. Girty but they agree with it pretty closely in form and proportions. The entire absence of surface markings from the specimens here described, however, makes their identification with *P. socialis* very uncertain.

Formation and locality.

New Albany shale; Delphi.

Pleurotomaria sp.

Pl. I, fig. 11.

Shell turbinate, spire rather slender, apex minute. The spire consists of three volutions, increasing gradually to the body whorl, which expands more rapidly and is a trifle ventricose. Aperture oval.

The specimens preserve only traces of the surface markings. The body whorl shows a revolving band limited by strong revolving lines. Transverse striae mark the volutions of the spire.

Formation and locality.

New Albany black shale; Delphi.

Macrochilina? sp.

Pl. I, fig. 10.

Shell conical; spire gradually tapering to the apex which is minute. Volutions four and a half or five; regularly rounded and nearly circular in transverse section. Aperture undetermined.

All of the specimens observed are interior casts, preserving none of the surface markings.

Formation and locality.

New Albany shale; Delphi.

Straparollus sp.

Pl. I, fig. 12.

Shell small; spire slightly elevated above the body whorl. Volutions three or four, expanding gradually to the outer whorl, which increases more rapidly. Umbilicus equals about one-third the diameter of the shell. Transverse section of volutions subquadrangular to rounded. Some of the specimens preserve traces of transverse striae.

The ridges on the outer whorl shown in the figure have developed during the pyritization of the shell.

The collections contain a number of specimens of this shell, all in a very poor state of preservation.

Formation and locality.

New Albany shale; Delphi.

Styliola fissurella Hall.

Pl. II, fig. 9.

S. fissurella Hall, Pal. N. Y., Vol. V, Pt. II, p. 178, Pl. 31A, figs. 1-30.

Hall's description.—"Form an extremely slender, elongate cone, like the point of a small needle. Apical portion of the tube solid. Apex extremely minute, often bulbiform, and very gradually enlarging to the mouth. Surface often smooth and without any visible ornamentation, so far as can be determined; or with fine striae of

growth which are unequally developed on different parts of the shell; and also with fine longitudinal striae, which may be present with or without transverse striae. Usual length from one to two, sometimes two and a half and rarely five millimeters."

This species occurs in the New Albany shale at some localities in great abundance; several thousand individuals often cover a few square inches of shale. The shells are nearly always crushed, a depressed line marking the place of fracture along the middle of the shell. Nearly all of the specimens seem to be without surface ornamentation. A few, however, have fine longitudinal striae.

Formation and locality.

It occurs in the New Albany shale associated with *Chonetes lepida* and *Leiorhynchus mesacostalis*, and in such abundance that I have designated the faunal zone in which it occurs as the *Styliola fissurella* zone (see Bull. Am. Pal. No. 12, p. 111); Falls of the Ohio, Lexington, Helt's Mill, Jennings County, Scipio, and Newbern.

CEPHALOPODA.

Goniatites wabashensis n. sp.

Pl. II, figs. 4, 4a.

Shell small, discoid, the thickness of the disc being about one-third of the diameter. Umbilicus large, exposing all the volutions, which are five or six in number. Outer volutions embracing the inner ones very slightly or not at all. The periphery of the outer volution is flattened or very slightly compressed and the sides rounded. The sutures of the septa in passing from the inner umbilical margin of the volution describe a gentle backward curve on the side of the volution, and then swing forward to the peripheral face where they make an abrupt retral curve describing a deep sinus in the middle of the periphery. The surface is marked by fine transverse striae which arch backward on the periphery of the volution. Chamber of habitation and siphuncle unknown.

This species is so unlike the other form here described as to require no comparison with it. Only two specimens have been found.

Formation and locality.

New Albany shale; Delphi.

Goniatites delphiensis n. sp.

Pl. II, figs. 1, 1a, 2, 3.

Shell small, flattened or slightly convex, periphery rounded. Volutions about four and a half. Inner volutions embraced in the dorsal

groove of the succeeding ones to the depth of from one-half to three-fourths of their dorso-ventral diameter. The ratio of the dorso-ventral to the transverse diameter of the outer volution about as three to four. The umbilicus is large and open, exposing the inner margin of all the volutions and the minute bulbous protoconch. The sutures in passing outward from the dorsal groove make a very slight forward curve; in crossing the umbilical angle, they curve gently backward, and then make a deep forward curve to the middle of the lateral face of the volution, whence they curve abruptly backward to the margin of the periphery, the septa bend forward from the margin of the periphery, describing a shallow saddle on each side of the middle of the periphery, with a short narrow backward pointing lobe between them. The chamber of habitation has not been observed.

The surface in the earlier or nepionic and neanic stages is marked by prominent transverse ridges, which bend backward slightly in crossing the periphery. These annulations are very prominent and well developed in the earlier volutions. In the later ones they decrease in strength and finally disappear, transverse, rather crowded striae taking their place. The later representatives of the annulations do not extend entirely across the volution but are confined to the umbilical margin.

The individuals vary in size from one-eighth to one and a quarter inches in diameter.

This species rather closely resembles *Goniatites simulator* Hall in the character of the sutures, but the peripheral lobes and saddles seem to be somewhat shallower than in that species.

Formation and locality.

New Albany shale; Delphi.

Orthoceras sp.

Pl. II, fig. 8.

Shell small, straight, and regularly expanding from the apex. Transverse section circular. Initial extremity and chamber of habitation unknown. Thickness of air chambers equal to two and a half or three times the width of the shell. Siphuncle unknown.

Formation and locality.

New Albany shale; Delphi.

CRUSTACEA.

Spathocharis emersoni Clark.

Pl. II, figs. 5, 6, 7.

Carapace elliptical or subquadrate in general outline. The cephalic or rostral cleft extends about one-third the length of the shield. The sides of the cleft diverge from 20 to 45 degrees. All of the specimens are flattened and the original elevation and character of the apex is not shown. Anterior extremities of the carapace rounded; posterior extremity rounded or subtruncate. Surface marked by fine striae following the outline of the margin of the carapace. These are very indistinct in some individuals. The radiating lines on the posterior extremity mentioned in Clark's description of *S. emersoni* have not been recognized. The test consists of a very thin, black chitinous substance.

This species has been found at one locality only, where it is rather common in a bed of drab colored shale occurring in the New Albany shale. Associated with it occurs a small species of *Stropheodonta* and *Barriosella subspatulata*.

Formation and locality.

New Albany shale; Delphi.

DEVONIAN LIMESTONE FOSSILS.

BRACHIOPODA.

Orbiculoidea doria Hall.

Pl. III, fig. 7.

Discina doria Hall, Pal. N. Y., 1867, Vol. IV, p. 19, Pl. 2, figs. 19-22, 31.

Hall's description.—"Shell subcircular or oblate, the transverse diameter usually the greater. Dorsal valve convex; apex elevated subterminal. Ventral valve flat or concave, the apex excentric; foramen comparatively large, oval, with margins depressed. Shell thin. Surface marked by fine concentric striae, and the cast by folds or wrinkles in the same direction."

Seven specimens in Mr. Green's collection are referred to this species with some doubt. The dorsal valve which is partially exfoliated, shows very faint traces of concentric striae near the margin. The apex is less elevated and more terminal than in Hall's figures. The pedicle valve is marked by ten or twelve strongly impressed con-

centric lines, and the spaces between them by very fine concentric striae. Six specimens are attached to *Spirifer granulosus*.

Formation and locality.

Sellersburg beds; Clark County.

Roemerella grandis (Vanuxem).

Discina grandis Hall, Pal. N. Y., 1867, Vol. IV, p. 17, Pl. 1, fig. 18; Pl. 2, figs. 32, 33. *Discina grandis* Hall and Whitfield, 27th Rep. N. Y. State Cab. Nat. Hist., 1875, Pl. 9, figs. 33-35.

Hall's description.—"General form broadly and transversely elliptical, plano-convex or concavo-convex. Dorsal valve sometimes extremely elevated; apex subcentral, a little on one side of the transverse axis. Ventral valve usually moderately concave; foramen reaching from the center or near the center towards one side but varying somewhat in different individuals. Surface marked by fine concentric striae, crowded near the center, and more distant and sharply elevated towards the margin."

This species is comparatively rare. The specimens at hand, numbering six, measure from one to one and two-fifths inches in their transverse diameter. The cast of the dorsal valve figured has a depth of three-sevenths of an inch, and a transverse diameter of one and one-tenth inches.

Formation and locality.

Sellersburg beds; Charlestown.

Pholidops sp.

Pl. III, fig. 4.

A few unattached valves have been found in the *Spirifer acuminatus* zone of northern Indiana which are referred to this genus.

The specimen figured is marked by strongly lamellose lines of growth. The apex is moderately elevated and slightly nearer the posterior than the anterior margin.

Formation and locality.

Jeffersonville limestone; Bunker Hill.

CRANIA.

- | | | |
|-----|-----------------------------------|---|
| A. | Surface with radiating striae. | |
| | b. | Dorsal valve depressed posterior to the beak. <i>C. greenei</i> . |
| | bb. | Dorsal valve not depressed posterior to the beak. |
| | c. | Striae very fine. <i>C. sheldoni</i> . |
| | cc. | Striae not very fine. <i>C. erenistria</i> . |
| AA. | Surface without radiating striae. | <i>C. granosa</i> . |

Crania sheldoni White.

Pl. III, fig. 2.

C. bordeni Hall, 24th Rep. N. Y. State Cab. Nat. Hist., 1872, p. 187.

Hall and Whitfield's original description.—"Shell depressed conical about half as high as wide; beak subcentral, slightly nearer the anterior end. Surface marked by fine radiating striae, and somewhat strong lines of growth, giving a rugose character to the surface, especially toward the margin."

The specimens at hand show from 12 to 15 striae near the margin in the space of one-tenth of an inch. The striae are sometimes irregular in character, swelling at intervals into node-like expansions.

This is a rare species.

Formation and locality.

Sellersburg beds; Charlestown.

Crania crenistria Hall.

Pl. III, fig. 1.

C. crenistria Hall, Pal. N. Y., 1867, Vol. IV, p. 28, Pl. 3, figs. 13-16.

Hall's description.—"Dorsal upper valve very depressed, conical, subcircular apex central or subcentral, a little inclined. Surface marked by sharp elevated crenulate striae reaching almost to the apex (which is quite smooth), and increasing by interstitial additions."

Mr. Green's collection contains four specimens of this species—the only specimens I have seen. Two of these are attached to Brachiopods and two of them to a *Platyceras*; one of these is attached inside the mouth of the shell.

Formation and locality.

Jeffersonville limestone; Falls of the Ohio.

Crania granosa Hall and Clarke.

Pl. III, fig. 3.

C. granosa Hall and Clarke, Pal. N. Y., VIII, Pt. I, 1892, p. 180, Pl. 4H, figs. 19-20.

Dorsal valve greatly depressed, shell subcircular, apex nearly central. Surface covered with fine granules and marked by a few concentric lines of growth.

I have seen but one specimen of this species which is attached to a *Stropheodonta*.

Formation and locality.

Jeffersonville limestone; Falls of the Ohio.

Crania greenei Miller.

C. greenei Miller, 18th Rep. Ind. Geol. Surv., 1894, p. 310, Pl. 9, fig. 7.

Miller's original description.—"Shell large, subcircular, broadly convex, depressed posterior to the beak, height about one-third the diameter. Apex subcentral, obtuse. Surface bears a few concentric imbricating lines of growth, and is marked by irregular transverse striae, some of which are deflected on the anterior side of the shell, and also by faint radiating lines that somewhat sculpture the surface especially towards the margin. Lower valve and muscular impressions unknown."

Formation and locality.

"Upper Helderburg;" Falls of the Ohio.

Crania sp.

Pl. III, fig. 8.

The specimen figured is a ventral valve which I have not been able to identify with any described species.

Valve transversely subovate. The margin of the interior is marked by a broad thickened ridge around the front and sides, and by a distinctly developed cardinal area at the posterior side of the shell. Muscular scars deeply impressed. Vascular sinuses covering the space at the sides and in front of the anterior adductors. The exterior of the valve shows no indication of having been attached. It is marked by coarse lammelose lines of growth, giving an irregular, roughly flattened surface. The dorsal valve has not been seen. The species is based on a specimen in Mr. Green's collection.

Formation and locality.

Sellersburg beds; Charlestown.

Craniella hamiltoniae Hall.

Pl. III, fig. 5.

Chaniae hamiltoniae Hall, Pal. N. Y., 1867, Vol. IV, p. 27, Pl. 3, figs. 17-23.

Hall's description.—"Shell broadly oval or subcircular. Dorsal valve subconical; apex subcentral or excentric, pointed in well preserved specimens, often worn or decorticated. Exterior surface of dorsal valve marked by concentric lammelose striae. Ventral or lower valve marked by four strong impressions of the adductor muscles, which are variable in form; the posterior ones are distant, the anterior ones approximate, diverging above and assuming a some-

what cordiform appearance, the pit for the protractor muscles occupying the space between. Vascular impressions strongly digitate."

The upper valve from which the interior is here figured is very much depressed, having an elevation of about one-seventh of an inch. The exterior is entirely covered by a bryozoan growth. This is a rather rare species.

Formation and locality.

Jeffersonville limestone; Falls of the Ohio, Pipe Creek Falls and Bunker Hill.

Glossina triangulata Nettleroth.

Lingulae triangulata Nett., Ky. Foss. Shells, 1889, p. 34, Pl. 26, fig. 1.

Nettleroth's description.—"Shell of medium size; subtriangular or broadly subovate. The lateral margins form at the apex an angle of about sixty degrees; the sides slope from apex to two-thirds the length of the shell in a straight line; from there they curve gently to basal margin, which is broadly rounded. Shell is moderately convex from beak down to front, but depressed almost flat at the margins. The greatest width is about one-third of length of shell from the front; width is smaller than length. The specimen before me measures twelve lines in length by ten lines in width. Shell itself is thick. The surface is marked by fine concentric lines of growth, and also by fine radiating striae, both of which are somewhat obscure on account of exfoliated condition of fossils, which are mostly internal casts. It appears to have some resemblance to *Lingula paliformis* of the Hamilton group, but differs from it by its shape and surface markings."

I have not seen this fossil.

Formation and locality.

Sellersburg beds; Falls of the Ohio, Ky.

Cyclorhina nobilis Hall.

Pl. VII, fig. 3.

C. nobilis Hall and Clarke, Pal. N. Y., VIII, Pt. II, 1893, p. 207, Pl. 61, figs. 1-12.

Shell large, subtriangular biconvex; the dorsal valve being the more convex. Beak of ventral valve large and obtuse. Surface covered by very sharply angular plications of which there are from 26 to 33 on each valve. Plications crossed by fine sharp striae which

crenulate the tops of the plications. These striae are seldom preserved, only two of the fourteen specimens at hand showing them. Fold and sinus well developed, moderately broad with from six to eleven plications on each.

The large obtuse beak of the ventral valve serves to distinguish this species from some of the *Camarotoechias* which it somewhat resembles as ordinarily preserved.

Formation and locality.

Jeffersonville limestone; Charlestown, Falls of the Ohio, Bunker Hill, Pipe Creek Falls and Little Rock Creek, Cass County.

CAMAROTOECHIA.

- A. Shell gibbous or subglobose.
 - b. Gibbous and transversely subelliptical. Plications grooved toward the front in old shells. *C. sappho.*
 - bb. Rotund or subglobose in outline. Plications not grooved, but distinctly rounded. *C. congregata.*
- AA. Shell not gibbous or subglobose.
 - c. Plications angular, fold well developed. *C. nitida.*

Camarotoechia sappho Hall.

Pl. VII, fig. 4.

Rhynchonella (*Stenocisma*) *sappho* Hall, Pal. N. Y., 1867, p. 340, Pl. 54, figs. 33-43; Var. Pl. 55, figs. 47-52.

Shell gibbous and transversely subelliptical in mature specimens to broadly subtrigonal in young shells. Beak of ventral valve acute and moderately incurved; cardinal slopes concave. Surface covered with rounded to subangular plications which in old shells are marked in the center with a fine thread-like line toward the front of the shell.

Fine, closely arranged concentric striae cross the plications in well preserved specimens. The plications vary in number from 15 to 18 in young shells and from 20 to 28 in mature specimens; from five to eight of these occupy the fold and sinus. Those on the sides of the dorsal valve curve abruptly to the margin of the shell. The sinus begins about the middle of the ventral valve; the fold becomes conspicuous only toward the front of the shell. The specimen figured is the largest in the collection.

Formation and locality.

Jeffersonville limestone and Sellersburg beds; Charlestown and Pipe Creek Falls.

Camartoechia carolina Hall.

Rhynchonella (*Stenocisma*) *carolina* Hall, Pal. N. Y., IV, 1867, p. 337, Pl. 54, figs. 14-19.

Hall's description.—"Shell ovate, moderately gibbous, a little produced in front and broadly sinuate; length and breadth about equal.

"Ventral valve convex on the upper part, curving gently to the margins and a little convex along the cardinal slope, sometimes nearly flat below; beak a little incurved or nearly straight; sinus beginning at about one-third the length of the shell from the apex, very gradually depressed and not abruptly incurved in front, making a broad shallow sinus with curving sides, the limits of which are strongly defined. Dorsal valve moderately gibbous and regularly arcuate from summit to base, the sides more abruptly curved; mesial fold becoming defined below the middle of the shell, its summit convex and the sides not abruptly limited.

"Surface marked by about 20 to 25 obtusely angular plications; those of the margins becoming obsolete and about four or five depressed in the sinus, with a corresponding number on the dorsal fold, which are stronger than the rest; a single one on each side of the sinus and fold, partially depressed or elevated and smaller than the others. The shell has been marked by elevated thread-like striae."

This species has been figured by Nettleroth (Ky. Foss. Shells, Pl. 13, figs. 1-3, 34, 35). Three of his figures, however, 1-3, appear to belong to *Cychlorhina nobilis* instead of *C. carolina*.

Formation and locality.

"Corniferous" (Jeffersonville limestone); Falls of the Ohio (Nett.).

Camartoechia congregata (Conrad).

Rhynchonella contracta Hall, Pal. N. Y., IV, 1867, p. 351, Pl. 55, figs. 26-39.

Shell subglobose, length and width nearly equal, thickness to length as five to six. Dorsal and ventral valves slightly convex or nearly flat toward the beaks. Sides and front of shell curving abruptly to margin of valves. Surface marked by from 14 to 17 strong rounded plications of which from five to six in each valve occupy the sinus and fold. Mature specimens, according to Hall, have from 18 to 22 plications on each valve. I am able to refer but three rather small specimens in my collection to this species.

Formation and Locality.

Jeffersonville limestone; Pipe Creek Falls.

Camarotoechia nitida n. sp.

Pl. VII, figs. 8, 8a.

Shell small, subtrigonal, length and breadth nearly equal, thickness equal to two-thirds of the width; front straight, cardinal area slightly concave. Dorsal valve flat; mesial fold perceptible only at the front of the shell. Ventral valve slightly convex toward the beak; the sinus is wide and shallow, beginning between the middle and front of the shell.

Surface covered by from 15 to 17 rounded to subangular plications, of which there are from six to seven on the dorsal fold and from five to six in the sinus. The plications curve abruptly at the front and sides to the margins of the valves.

Formation and locality.

Jeffersonville limestone; Pipe Creek Falls.

Camarotoechia tethys (Billings).

Rhynchonella (Stenocisma) tethys Hall, Pal. N. Y., IV, 1867, Pl. 54, figs. 1-8.

Shell subtrigonal, usually wider than long, but length and breadth sometimes equal. Dorsal valve depressed convex in young and medium sized shells, more gibbous in larger individuals. Ventral valve slightly convex toward the beak. The fold and sinus are well developed and originate about two-thirds of the distance from the front to the beak. Surface covered by from 14 to 18 angular plications, of which from four to six occupy the fold and sinus. Fine striae which are seldom preserved cross the plications.

Some specimens show one or more strong lines of growth. A specimen in Green's collection which appears to be a variety of this species has 29 plications on each valve, five of which occupy the sinus and six the fold.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Charlestown, Bunker Hill and Pipe Creek Falls.

RHYNCHONELLA.

A. Plications few, developed only near the front and sides.

b. Fold and sinus prominent and well developed.

R. gainesi.

bb. Fold and sinus not well developed.

R. gainesi var. cassensis.

AA. Plications numerous and well developed.

c. Shell much flattened; fold and sinus obscure or wanting.

R. depressa.

cc. Shell moderately convex, fold and sinus prominent toward the front.

d. Greatest width at the middle of shell, sinus produced at the front.

R. louisvillensis.

dd. Greatest width near the front, sinus not produced.

R. tenuistriata.

Rhynchonella louisvillensis Nettleroth.

Pl. VII, fig. 6.

R. louisvillensis Nett., Ky. Foss. Shells, 1889, p. 77, Pl. 31, figs. 1-4.

Nettleroth's original description.—"Shell of less than medium size among the Rhynchonellidae; longitudinally suboval or subtriangular; length and width about equal, the latter rarely exceeding the former slightly; both valves about equally convex. Ventral valve moderately convex; mesial sinus beginning in front of the umbo, is broad and flat, deepens at the base and has a considerable quadrilateral extension fitting a corresponding indentation of the other valve; it contains five plications; beak small and pointed and only slightly arched. Dorsal valve somewhat more convex than the other; mesial fold starting below the umbo, becomes prominent at the front, and contains, like the sinus, five plications; beak small, narrow and incurving into the other valve beneath the ventral beak.

"Surface ornamented by four or five rounded ribs on each side of the mesial depression or elevation; those on the lateral slopes of the dorsal valve are abruptly curving outwards and downwards."

Mr. Green's collection contains two specimens which appear to belong to this species, although they differ somewhat from Nettleroth's description. They have two and three plications respectively in the sinus, four on the sinus and three or four on each side of the fold and sinus. All of the plications become obsolete in the umbonal region.

Nettleroth reports having seen but three specimens of this shell.

Formation and locality.

Sellersburg beds; Charlestown and Falls of the Ohio.

Rhynchonella gainesi Nettleroth.

Pl. VII, figs. 9, 9a, 9b.

R. gainesi Nett., Ky. Foss. Shells, Mem. Ky. Geol. Surv., 1889, p. 76, Pl. 31, figs. 6-9.

Shell small; the species shows great variation in its characters; subtriangular in its outline, front nearly straight to broadly rounded.

Dorsal valve moderately convex marked by a variable number of rounded indistinct plications, seldom exceeding eight, which are usually developed only near the margin of the valves, but sometimes extending half way to the beaks. The fold is usually well marked, extending about half way to the beak and bearing from two to four plications. Ventral valve convex toward the beak with a deep flat sinus toward the front; the surface is flat or slightly concave on either side of the sinus toward the front; sinus with from one to three faint plications toward the front; two or three plications are usually developed on either side the sinus but these are sometimes wanting. The beak is sharp and slightly incurved. Surface marked by numerous fine lines of growth.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Charlestown, Bunker Hill and Pipe Creek Falls. This shell is more common in northern than in southern Indiana.

Rhynchonella gainesi var. *cassensis*, nov. var.

Pl. VII, figs. 10, 10a.

The specimens included under the name of this variety differ from typical specimens of *R. gainesi* in being much depressed and in having a poorly developed fold and shallow sinus, which are often entirely free from plications. Some specimens, however, possess from three to five faintly developed plications near the front of the fold and sinus, and are intermediate in appearance between this variety and *R. gainesi*.

Formation and locality.

Jeffersonville limestone; Bunker Hill.

Rhynchonella tenuistriata Nettleroth.

Pl. VII, fig. 7.

R. tenuistriata Nett., Ky. Foss. Shells, 1888, p. 82, Pl. 17, figs. 27-29.

Nettleroth's original description.—"Shell rather small, subtriangular or subpentagonal; cardinal line forms a right angle at the beak; its two sides, which are somewhat concave or incurved, slope down below the middle of the shell; here they meet the lateral margins with which they form again an almost right angle; lateral margins short, about one-third the length of the shell, almost straight or very slightly convex; basal margin straight with a slight concavity.

Ventral valve less convex than the dorsal, with its greatest convexity at the umbo, from which it slopes in almost straight lines to the lateral margins; the cardinal margins deflect abruptly to meet the margin of the dorsal valve in one and the same plane; below the umbo the central portion becomes depressed, which depression increases in depth and width towards the front, where it occupies the valve to the full extent of the basal margin. This mesial sinus is rounded, its margins are not well defined, and its depth becomes only somewhat prominent at or near the front; the umbo is small, the beak elevated above that of the other valve, and very little arched. The dorsal valve is very little convex, almost flat in the umbonal region and below it to the basal margin, where a part of the front is elevated into a mesial fold. On each side of this mesial fold the valve slopes down very abruptly to the baso-lateral margins. The mesial fold is only observable at or near the front; the umbo is inflated, and the beak small and incurved into the opposite valve. The surface of both valves is covered by slender, subangular or rounded radii, of which there are five or six on each side of the mesial fold and sinus; the fold is occupied by about seven while the sinus only contains about six. These striae increase by intercallation, but not by bifurcation. Other markings of the surface are not observed."

This species is rare. I have with some doubt identified one specimen in Mr. Green's collection with it, which is here figured. This specimen has fewer striae than those described by Nettleroth, there being five in both the fold and sinus, and about the same number on each side of fold and sinus.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Charlestown and Falls of the Ohio.

Rhynchonella depressa nov. sp.

Pl. VII, figs. 5, 5a, 5b.

Shell small, flattened, trigonoid-subovate in outline; cardinal lines forming nearly a right angle at the beak, the front uniformly rounded; length and breadth about equal. Ventral valve most convex at the umbo from which it slopes regularly to the front and sides; sinus wide and very shallow or entirely obsolete, marked by five or six plications; beak acute extended and slightly incurved. Dorsal valve very slightly convex, beak incurved beneath the umbo of the opposite valve. Mesial fold obsolete or represented by a very low

broad elevation near the front, marked by five or six plications. Surface covered by from 16 to 25 plications on each valve. These are crossed by numerous fine concentric striae.

This species is rather common in northern Indiana.

Formation and locality.

Jeffersonville limestone; Pipe Creek Falls, Bunker Hill and Charlestown.

Pholidostrophia iowaensis (Owen).

Pl. VI, figs. 7, 8.

Stropheodonta (*Pholidostrophia*) *nacrea* H. & C., Pal. N. Y., VIII, Pt. I, 1892, p. 287, Pl. 15, figs. 20-24.

Shell small, semielliptical or subquadrate, broader than long; ventral valve moderately convex, the convexity approaching rather closely the inner contour of the dorsal valve; dorsal valve concave, sometimes curving abruptly toward the ventral valve near the front. Interior of dorsal valve marked by large flabelliform muscular impressions; outside the muscular impressions the interior of the valves is strongly papillose; hinge line crenulated. Surface smooth except for occasional lines of growth. The radiating lines and nacreous lustre mentioned by Hall have not been noticed on the specimens at hand.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Little Rock Creek, Cass County, Charlestown and Falls of the Ohio.

Ambocoelia umbonata (Conrad).

Pl. X, figs. 7, 7a.

A. umbonata Hall, Pal. N. Y., IV, 1867, p. 259, Pl. 44, figs. 7-18.

Shell small, plano-convex, semiorbicular in outline; width of shell slightly greater than length of dorsal valve; hinge line equal to or a little less than the greatest width of shell; cardinal extremities rounded, subangular. Ventral valve gibbous with the umbo extremely elevated and a large incurved beak; mesial sinus with a shallow but distinct linear depression, extending from the beak to the front of the shell. Area large, arched, having about one-third the height of the ventral valve and extending to the cardinal extremities. Dorsal valve slightly convex in the upper central portion, flat or convex near the sides and front. Apex inconspicuous, barely elevated above the hinge line; area equaling the thickness of the shell.

The radiating and concentric striae occurring in the New York specimens of this species are not noticeable on the Indiana shells. Average specimens of the Indiana shells measure about one-fourth of an inch in width. This is a rare shell in Indiana.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Bunker Hill, Charlestown and Louisville.

CYRTINA.

- A. Plications coarse, about four on each side of the fold and sinus. *C. crassa*.
 AA. Plications fine, six or eight each side of the fold and sinus.
 b. Beak more or less curved or twisted, plications rounded. *C. hamiltonensis*.
 bb. Beak straight, plications angular. *C. hamiltonensis* var. *recta*.

Cyrtina crassa Hall.

C. crassa Hall, Pal. N. Y., IV, 1867, Pl. 27, figs. 11, 12.

Hall's original description.—"Shell depressed, pyramidal (semielliptical in a dorsal view); length and breadth about at three to four; hinge line equal to the greatest width of the shell, with the extremities slightly rounded.

"Ventral valve depressed, semi-semipyramidal, convex, regularly arching from the beak and cardinal area to the front; sinus broad and rounded in the bottom; beak extended and slightly incurved over the area which has a height equal to half the length of the valve.

"Dorsal valve moderately convex, a little inflected or concave toward the extremities; mesial fold broad, moderately elevated, rounded above and strongly defined; area linear. Surface marked on each side the mesial fold and sinus by about four strong, low rounded plications, which are crossed by fine thread-like concentric striae and a few imbricating folds. Shell structure punctate."

This species has not been seen by the writer. Nettleroth reports having seen but three specimens. Hall figures a specimen from the Falls of the Ohio.

Formation and locality.

"Corniferous limestone" (Jeffersonville limestone); Falls of the Ohio and Utica.

Cyrtina hamiltonensis Hall.

C. hamiltonensis Hall, Pal. N. Y., IV, p. 268, Pl. 27, figs. 1-4; Pl. 44, figs. 26-33, 38-52.

Hall's description.—"Shell more or less triangular-subpyramidal; hinge line equal to the greatest width of the shell; proportions of

length, breadth and height variable, but frequently the width is equal to the length of the ventral valve, and the height of area is equal to the length of the dorsal valve. Surface plicate. Ventral valve quadrilateral in outline, obliquely subpyramidal, most prominent at the beak, which is very variable in elevation and straight or a little arched over the area, and not unfrequently attenuate and distorted or turned to one side; mesial sinus wide and strongly defined, rounded or subangular in the bottom; area variable, large and elevated, plane or arcuate in different degrees with the lateral margins angular, distinctly striate in both directions; fissure narrow, closed by a convex pseudo-deltidium, which is perforated above by an oval or narrowly ovate foramen. Dorsal valve depressed-convex, with a broad, more or less prominent mesial fold, which is bounded by broader furrows than those between the plications, and is sometimes extremely elevated in front; beak scarcely rising above the hinge line; area narrow linear, but quite distinct. Surface marked by about six to eight (rarely one or two more) simple rounded plications on either side of the mesial fold and sinus, and these are crossed by very fine concentric lines of growth, which at intervals become crowded and subimbricate, especially toward the margins of older shells. The finer surface marking is minutely granulose or papillose and the shell structure distinctly punctate. In some of the larger individuals there is an obscure elevation on each slope of the sinus resembling an obsolete plication. The longitudinal median septum extends for more than half the length of the ventral valve, and is continued into the cavity beneath the pseudo-deltidium. These features are shown in the casts and in transverse sections of the valve. The dorsal valve shows a double or bilobed cardinal process with the strong crural bases supporting spiral arms which are directed into the two compartments of the ventral valve, and, making numerous turns, terminate in the rostral part of the shell."

This species is not abundant but occurs at many localities in both the northern and southern Indiana Devonian.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Little Rock Creek, Cass County; Pipe Creek Falls, Newbern, Charlestown, Scipio, Paris Crossing, Kent, Clark County, and Falls of the Ohio.

Cyrtina hamiltonensis var. *recta* Hall.

Cyrtina hamiltonensis var. *recta* Hall, Pal. N. Y., Vol. IV, p. 270, Pl. 44, figs. 34-37.

The only specimen in the collection has a very high perfectly flat

area, dorsal valve short and rather narrow; ventral valve very steeply pyramidal, and subangular plications.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Little Rock Creek, Cass County and Falls of the Ohio.

Leptaena rhomboidalis (Wilckens).

Pl. IV, fig. 5.

Strophomena rhomboidalis Hall, Pal. N. Y., Vol. IV, p. 76, Pl. 12, figs. 16-18.

Hall's description.—"The shell is more or less semielliptical or subquadrate, varying greatly in its proportions of length and breadth; hinge line straight; cardinal extremities sometimes rounded, sometimes acute and slightly produced. The valves are geniculated and the proportions of the flattened part or disc and the recurved part of the shell are very variable, insomuch that the geniculation is sometimes little more than one of the strong concentric wrinkles. The surface of the flattened portion is marked by concentric (and sometimes interrupted) wrinkles, which, following the curve of the outline, are bent outwards, and often become obsolete on the cardinal angles. These concentric wrinkles are very variable in number, being from six to 15 or 16 upon the specimens from the same rock. The entire surface is covered by radiating, thread-like striae. In young specimens there is usually a round foramen in the apex of the dorsal valve, which becomes closed at a later period. The triangular foramen of the ventral area is partially closed by a deltidium and the apex of the ventral valve."

This specimen is abundant in some localities.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Deputy, Sellersburg and Charlestown.

Orthothes chemungensis arctostriatus Hall.

Pl. VI, fig. 3.

Streptorhynchus chemungensis var. *arctostriata* Hall, Pal. N. Y., Vol. IV, 1867, p. 71, Pl. 9, figs. 1-12.

Hall's description.—"Shell semicircular or semielliptical, frequently unsymmetrical, the proportions of length and breadth varying in different individuals; hinge line straight, nearly or quite equal to or greater than the greatest width of the shell; sides nearly rectan-

gular to the hinge line or curving inwards. Ventral valve more or less convex toward the umbo and sometimes in the middle, curving downwards or flattened toward the front and sides of the shell; beak often distorted; area vertical or inclined forwards or backwards, usually unequal on the two sides of the foramen, which is closed by a strong convex deltidial plate. Dorsal valve depressed convex, sometimes nearly flat and sometimes very convex, with a narrow linear area; socket plates strong and supporting the cardinal process, which is double and has sometimes a faint ridge between the two divisions, which are themselves very short. Surface marked by sharp close radiating crenulated striae, which increase mainly by interstitial additions."

This extremely variable species is rather rare. In the specimens studied the radiating striae increase by bifurcation instead of by interstitial addition as described by Hall.

Formation and locality.

Jeffersonville limestone; Falls of the Ohio, Lancaster, Scipio, Kent and Newbern.

Parazyga hirsuta Hall.

Pl. XI, figs. 4, 4a.

Trematospira hirsuta Hall, Pal. N. Y., Vol. IV, 1867, p. 274, Pl. 45, figs. 16-32.

Hall's description.—"Shell depressed orbicular in the young state; becoming subtrilobate by the gradual development of the mesial fold and sinus and often gibbous in the older specimens; valves subequally convex; hinge line extending about two-thirds the width of the shell. Ventral valve usually a little more gibbous than the opposite; greatest convexity above the middle of the shell, whence it curves regularly to the apex which is terminated by a circular foramen or more often truncated below by the summit of the opposite valve; contour regularly curving to the cardinal and lateral margins. The mesial sinus becomes gradually developed above the middle in full grown shells, and is very conspicuous toward the front, having the sides curving and rarely strongly defined. The false area is not visible beneath the beak. Dorsal valve regularly convex in young shells; becoming elevated in the center, and a mesial fold gradually developing itself, till in older shells it becomes very conspicuous toward the front, having the sides curving and rarely strongly defined. The false area is not visible beneath the beak. Dorsal valve regularly convex in young shells; becoming elevated in the center and a mesial fold gradually developing itself, till in old shells it becomes very conspicuous towards

the front. The sides are pretty regularly convex, and curving towards the margins. Surface marked by from 30 to 40 low rounded striae which are obscure toward the beaks, but become larger and more conspicuous towards the margin; these are crossed by fine close concentric lines of growth, and more distant imbricating lamellae. The surface ordinarily preserved is granulose, but when perfect it is covered by minute seta or spinules, the bases of which remaining give the papillose character. Entire shell structure punctate. The interior of the ventral valve shows two strong teeth, which are extended in low plates along the sides of the rostral cavity to the margins of the muscular area, which is broad, flabelliform, and scarcely defined on the front and lower lateral margins. The interior of the dorsal valve shows a strong deeply bilobed cardinal process, with the bases of slender crura; the teeth sockets are large and deep; there is a low median crest or septum, which is somewhat strong above, but dies out towards the middle of the shell. In specimens which have been cut to show the spires, these appendages are slender with about 10 or 11 turns on each side. The proportions of length and breadth are about as three to four. The largest specimen observed is a little more than three-fourths of an inch in length, by an inch and one-sixteenth in width; while many of the specimens are less than half these dimensions. A well formed specimen of about three-fourths of an inch in length by one inch, has a depth of nine-sixteenths of an inch. A very gibbous specimen measures three-eighths of an inch in length, nine-sixteenths in width and half an inch in depth."

A specimen from Charlestown slightly above the average size measures five-eighths of an inch in length, nine-sixteenths of an inch in width and three-eighths in thickness. The Indiana specimens do not preserve the fine concentric lines and minute striae described on the New York specimens. This is a rather rare fossil.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Charlestown, Falls of the Ohio and Bunker Hill.

Tropidoleptus carinatus (Conrad).

Pl. VI, figs. 4, 5.

T. carinatus Hall, Pal. N. Y., Vol. IV, 1867, p. 407, Pl. 62, figs. 2, 3.

Hall's description.—"Shell concavo-convex, semielliptical, the length sometimes equaling the width; hinge line equaling, greater or

less than the width of the shell, and the cardinal extremities sometimes rounded so as to give the shell a broadly oval form; the sides are sometimes nearly straight and the front broadly rounded. Ventral valve convex, broadly subcarinate along the middle, and sloping in a flattened curve to the lateral margins and front, which is sometimes slightly truncate or emarginate; cardinal extremities deflected, abruptly incurved at the umbo, and the apex often imperfect from the encroachment of the foramen. Area about half a line to about one line in width; its margins parallel to near the extremities, where it slopes suddenly down from the outer margin. The area is longitudinally striate, and indented by a very wide foramen. Dorsal valve moderately concave, sometimes nearly flat, often with a median depression or sinus which becomes conspicuous below the middle of the valve; apex small, projecting a little beyond the hinge line. There is a narrow area interrupted in the middle by a wide pseudo-deltidium which covers the extremity of the cardinal process. Surface marked by about 18 to 20 broad simple rounded plications which are wider than the spaces between them; the central one on the ventral valve is broader and more elevated than the others, while there is a corresponding wider and deeper depression in the middle of the dorsal valve. In rare instances the plications are bifurcated. Fine undulating concentric striae cover the surface and five stronger imbricating lamellae mark the form of the shell in its stages of growth."

This is a common fossil in the Upper Devonian of northern and southern Indiana.

Formation and locality.

Sellersburg beds; Norway, Scott County, North Vernon, Deputy, Charlestown and Lexington.

ATHYRIS.*

- | | | |
|-----|--|--------------------------|
| A. | Shell usually more than an inch in width. | <i>A. spiriferoides.</i> |
| AA. | Shell usually less than one inch in width. | <i>A. fultonensis.</i> |

Athyris spiriferoides (Eaton).

Pl. XI, fig. 6.

A. spiriferoides Hall, Pal. N. Y., Vol. IV, 1867, p. 285, Pl. 46, figs. 5-31.

Hall's description.—"Shell varying from transversely oval to sub-orbicular and sometimes subquadrate, depressed or subglobose, more or less deeply sinuate on the ventral side, with a corresponding

*The separation of *A. spiriferoides* and *A. vitata* as distinct species is based chiefly on the difference in the structure of the spires of the two forms.

elevation on the dorsal side; hinge line short, the cardinal extremities rounded. Ventral valve moderately gibbous, often regularly convex above the middle, and becoming deeply sinuate toward the front, which is frequently abruptly elevated, flattened or a little concave toward the cardinal extremities in the wider specimens; umbo gibbous, the beak incurved, and often directed in a line nearly rectangular to the plane of the longitudinal axis and covering the umbo of the opposite valve; apex perforate. Dorsal valve gibbous, much more convex than the opposite valve; umbo prominent, outline regularly convex above the middle and curving abruptly to the sides; the usually defined mesial fold becomes visible below the middle of the valve and usually very conspicuous toward the front, which is abruptly elevated. Surface marked by concentric lines of growth, and the lamellae often extended and closely imbricated; fine interrupted and scarcely distinct radiating striae, which appear like ducts within the substance of the shell, marking the surface in many specimens. The upper part of the shell is sometimes nearly free from imbricating lamellae, but they become crowded toward the front."

Athyris spiriferoides is much rarer than *A. fultonensis*, which differs from it externally only in its smaller and more gibbous form.

Formation and locality.

Sellersburg beds; Charlestown.

Athyris fultonensis (Swallow).

A. vitata Hall, Pal. N. Y., Vol. IV, 1867, p. 289, Pl. 46, figs. 1-4.

Hall's description.—"Shell ovate, subquadrate, gibbous with the mesial fold and sinus distinct; front conspicuously sinuate; hinge line short; cardinal extremities rounded. Ventral valve gibbous above, more convex than the dorsal; umbo prominent; the beak incurved and truncated in the plane of the longitudinal axis by a rounded foramen, curving very abruptly to the cardinal and cardino-lateral margins; the center marked by a well defined mesial sinus, which is continued nearly or quite to the beak and becoming much deeper and subangularly margined towards the front. Dorsal valve a little less gibbous than the ventral, sides regularly curving; the middle of the upper part distinctly prominent, and developed below in a strong mesial fold which is abruptly elevated in front. Surface marked by regularly imbricating lamellose lines of growth, which, on the better preserved surfaces are finely crenulated on their edges and the intermediate spaces striate. Interiorly the spires of this form, in their first volution and in the accessory lamellae are quite distinct from those of *A. spiriferoides*."

This species is abundant at many localities.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Little Rock Creek, Cass County, Bunker Hill, Falls of the Ohio, Charlestown, Watson, Kent, Sellersburg and Lexington.

ATRYPA.

- A. Plications very coarse, about seven or eight in a half inch, cancellated by strong concentric lamellae. *A. spinosa.*
- AA. Plications not very coarse, about 12 or 16 in a half inch, usually without concentric lamellae.
- b. Shell longitudinally subelliptical in outline. *A. reticularis* var. *ellipsoidea.*
- bb. Shell not longitudinally subelliptical in outline. *A. reticularis.*

Atrypa reticularis (Linnaeus).

Pl. VI, fig. 10.

A. reticularis Hall, Pal. Iowa, Vol. I, Pt. 2, 1858, p. 515, Pl. 6, figs. 4, 5.

Hall's description.—"Shell depressed, suborbicular in its young state, becoming gibbous and sinuate in its mature condition; hinge line often nearly straight and almost equaling the width of the shell; valves nearly equally convex in the young state, the dorsal valve becoming more gibbous as the shell advances in age, and sometimes acquiring an undefined mesial lobe down the center. The ventral valve in the young state has the beak nearly straight and perforate at the apex, becoming incurved and finally closely bent over the beak of the opposite valve; a narrow false area is sometimes observable. Shell broadly and deeply sinuate in front."

This is one of the most abundant species of the Devonian limestones. It is subject to great variation in shape, size and surface markings. The specimens found in the arenaceous "cement rock" of the Sellersburg beds reach a considerably larger average size than those in the more pure limestones.

A specimen in Mr. G. K. Green's collection is almost entirely covered by a series of closely arranged imbricating lamellae or lines of growth, giving the shell a very roughly imbricated surface.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; throughout the Devonian.

Atrypa spinosa Hall.

Pl. VI, fig. 11.

A. spinosa; vel *aspera* Hall, Pal. N. Y., 1867, Vol. IV, p. 322, Pl. 53A, figs. 1-14.

Hall's description.—"Shell robust suborbicular or ovoid; width greater or less than the length; radiatingly costate and concentrically lamellose or spinose; hinge line often nearly straight, a little less than the width of the shell. Ventral valve depressed convex, becoming more convex in the upper part; nearly flat and often a little concave toward the lateral margins, and cardinal extremities depressed or broadly sinuate in part; beak abruptly rounded; apex truncate and perforate, closely appressed and overlapping the umbo of the opposite valve. Dorsal valve convex, becoming gibbous in old shells, flattened or slightly concave toward the cardinal angles, regularly curving to the sides and baso-lateral margins, and a little elevated in front but without any distinct mesial fold. Surface marked by strong rounded radiating costae bifurcating at unequal intervals, which are much stronger in the middle of the valve and become obsolete or appear as gentle undulations towards the cardinal angles. In the middle of the valves there are about seven or eight of these costae in the space of half an inch. The shell is also marked by strong concentric lamellae which are often about a line apart. In perfect shells these lamellae at the crossings of the costae are often produced into tubular spines, which, when worn off, leave the ordinary lamellose surface. The spaces between these projecting lamellae are marked by fine thread-like striae. In the separated valves the hinge line is often nearly straight, the muscular area of the ventral valve is short and broad, the length from the apex being about equal to the width. There is a slight thickening of the shell at the base of the rostral cavity. The surface around the muscular area is papillose, and limited by a thickened border except in part, where it is discontinued. Fine vascular markings are sometimes visible near the margin. In the dorsal valve there is a thickened septum in the upper part of the muscular area. The spires of full grown individuals have about fifteen turns in each."

This is a rare species as compared with *A. reticularis*.

Formation and locality.

Sellersburg beds; Falls of the Ohio and Charlestown.

Atrypa reticularis var. *ellipsoidea* (Nettleroth).

A. *ellipsoidea* Nett., Ky. Foss. Shells, 1889, p. 90.

Nettleroth says of this shell that "it resembles in every feature except the form" *Atrypa reticularis*. But Nettleroth considered the elliptical form a specific character and based the species *A. ellipsoidea* upon it.

Specimens of *Atrypa reticularis* which are longer than wide and approach somewhat the elliptical form, are not uncommon. The variation in shape is so great in *Atrypa reticularis* that it seems preferable to regard *A. ellipsoidea* as a variety of *A. reticularis*.

Formation and locality.

Jeffersonville limestone; Falls of the Ohio (Nettleroth).

CHONETES.

- A. Cardinal extremities produced. *C. acutiradiata.*
- AA. Cardinal extremities not produced.
 - b. Shell large.
 - c. Nine to fifteen radiating striae in the space of two-tenths of an inch.
 - d. Ventral valve extremely gibbous, striae rounded, dorsal valve profoundly concave, striae rounded. *C. arcuatus.*
 - dd. Ventral valve usually moderately convex, striae slender and rather sharply angular, dorsal valve not profoundly concave.
 - e. Five to seven spines on each side the beak (frequently not visible). *C. coronatus.*
 - ee. Two spines on each side the beak? **C. subquadrata.*
 - cc. Twenty to twenty-four radiating striae in the space of two-tenths of an inch. *C. manitobiensis.*
 - f. Radiating striae about sixty. *C. yandellanus.*
 - ff. Radiating striae twenty-six to thirty-four. *C. vicinus.*
 - fff. Radiating striae eight to twenty-six. *C. mucronatus.*

Chonetes manitobiensis Whiteaves.

Pl. IV, fig. 10.

C. manitobiensis Whiteaves, Contr. to Can. Pal., 1892, Vol. I, p. 281, Pl. 37, figs. 1, 2.

*The synopsis may be inaccurate with reference to the number of striae in this species. It was described without figures and the description is not very full.

Whiteaves's original description.—"Shell small, concavo-convex, strongly compressed, transversely semielliptical, about twice as broad as long and broadest at the hinge line; cardinal extremities angular and very slightly produced; sides rounded in front; anterior margin nearly straight or but faintly convex in the center. Ventral valve compressed convex, its cardinal border armed on each side of the beak with three or four slender and widely divaricating spines, which increase in length outward; its beak inconspicuous, minute and not projecting, its hinge area narrow with a small triangular fissure. Dorsal valve shallowly convex, its beak minute and its hinge area narrower than that of the ventral. Surface marked with very minute radiating raised lines, which increase in number at variable distances from the beaks by bifurcation or intercalation, so that around the outer margin as many as from seventy to a hundred can be counted under a lens. In addition to these, the exterior of well preserved specimens is marked with exceedingly fine and close-set concentric raised lines. Interior of the valve minutely papillose. Muscular impressions unknown. The dimensions of two average specimens are as follows: Of one, maximum length nearly ten millimeters, greatest breadth nineteen; of another, length ten millimeters and a quarter, breadth twenty."

The shells referred to this species do not differ from the above description except in the number of radiating striae. Specimens on which the striae were counted have from 120 to 150 near the margin and 23 to 25 were counted on the space of two-tenths of an inch. Well preserved shells show from two to three slender spines pointing outward on each side the beak. Many specimens show a wide but indistinct mesial depression on the ventral valve. A rather large specimen measures nine-tenths of an inch in width, five-tenths of an inch in length and one-tenth of an inch in thickness in the thickest part of the shell.

This species is extremely abundant at a single locality in northern Indiana, where it is associated with *Sp. mucronatus*.

Formation and locality.

Sellersburg beds; Little Rock Creek, Cass County.

Chonetes arcuatus Hall.

Pl. IV, figs. 6, 6a.

C. arcuatus Hall, Pal. N. Y., Vol. IV, 1867, p. 119, Pl. 25, fig. 7.

Hall's description.—"Shell semielliptical or approaching to semi-circular; the cardinal extremities often extended and auriculate.

Ventral valve arcuate, extremely gibbous or ventricose, with usually a shallow undefined longitudinal sinus extending from the umbo to below the middle or near the front of the shell, often constricted near the cardinal extremities; umbo more or less gibbous or raised in a gentle elevation above the hinge line with the beak incurved. Hinge line in casts apparently crenulate; and on the exterior margin are ten or twelve tubular spines directed obliquely outward. Dorsal valve profoundly concave, following nearly the convexity of the opposite valve, and having the center a little elevated corresponding to the mesial depression. Surface marked by fine even rounded striae, which increase both by bifurcation and intercallation, crossed by extremely fine concentric striae with sometimes stronger sub-imblicating lines of growth. The surface of the cast in the ventral valve is marked by closely disposed oblong pits or pores, from the papillose inner surface of the shell. There is a concentric line extending from the apex gently receding from the hinge margin and curving inwards at the same distance from the cardinal extremities, and thence to the front of the shell, leaving the portion outside of this a little more elevated. The muscular impressions consist of a narrow central scar just below the apex of the beak, for the oclucosor muscles; while there are two elongate ovate or pyriform scars, one on each side of the apex and spreading laterally just within the limits of the constricted line."

Prof. J. M. Clarke says of specimens submitted to him "that there is no important difference in specific characters, although there is a notable difference in size, our corniferous limestone species generally being larger than those from Indiana, and the type specimens quite notably so." The surface is marked by from sixty to seventy rounded striae.

This species has been found at but one locality where it is abundant.

Formation and locality.

Jeffersonville limestone; Paris Crossing.

Chonetes coronatus (Conrad).

Pl. IV, fig. 7.

C. coronatus Hall, Pal. N. Y., 1867, Vol. IV, p. 133, Pl. 21, figs. 9-12.

Hall's description in part.—"Shell transverse, somewhat broadly elliptical, the hinge line being sometimes shorter than the width of the shell and the cardinal angles rounded; in others it is often equal

to the greatest width of the shell, and its form is semioval, with the lateral margins nearly rectangular to the hinge line, the width being about once and a half as great as the length. The cardinal angles are sometimes produced in short acute ariculate extensions. Ventral valve varying from moderately convex in the younger shells to very gibbous in the older ones; often a little flattened below the umbo, and this plane space gradually widening to the front. Sometimes there is a shallow undefined depression along the middle of the valve. The outline of the valve presents a very regular convexity, while it is abruptly depressed towards the cardinal extremities, which are flattened and a little deflected to the ventral side. The dorsal valve is variably concave, sometimes following nearly the contour of the ventral valve, but often very moderately concave or nearly flat in the middle and upper part, and more suddenly deflected toward the front and lateral margins, flattened at the cardinal extremities, and a little concave just below the hinge line. The surface is marked by numerous closely arranged slender subequal striae which are bifurcated or increased by intercallation, and are continued on the cardinal extremities to within a little distance of the hinge line, beyond which the surface is marked by lamellose concentric striae. In well preserved surfaces the radiating striae are crossed by undulating concentric striae; but in the greater number of specimens these are not preserved and the radiating striae have a fibrous appearance. The cardinal margin of the ventral valve is furnished with five, six or seven oblique tubular spines on each side of the apex, though usually only three or four are visible. The ventral area is usually narrow, sublinear, though often perceptibly triangular; the foramen is of moderate size, partially closed by a convex pseudo-deltidium, and the lower part occupied by the cardinal process. The dorsal area is linear, often more than half as wide as the ventral area, with a triangular space in the middle occupied by the cardinal process. * * *

An average specimen of this shell shows 12 striae in the space of two-tenths of an inch, and about 70 around the margin of the shell. This is a rather rare species.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Lexington, Charlestown and Deputy.

Chonetes acutiradiatus Hall.

C. acutiradiatus Hall, Pal. N. Y., 1867, Vol. IV, p. 120, Pl. 20, fig. 5.

Hall's description.—"Shell nearly semicircular, sometimes a little more than twice as wide as long; the cardinal extremities produced.

Ventral valve moderately convex, sometimes a little gibbous in the upper part and frequently flattened or depressed at or below the middle; umbo little elevated above the hinge line; greatest convexity above the middle, from whence it curves gently to the front, somewhat abruptly depressed toward the cardinal extremities, which are subauriculate and nearly flat. In two individuals there is a distinct longitudinal sinus in the middle of the valve. Dorsal valve unknown. Surface marked by regular subequal rounded or subangular striae, which are often irregularly bifurcated toward the margin or increased by intercalations, and sometimes are nearly simple throughout their length below the umbo, those of the cardinal extremities being very irregular or nearly obsolete. Hinge line marked on each side of the center by four or five strong tubular spines, which are directed obliquely outward. The sinus in the ventral valve is not uniform, and though evidently a normal character where it occurs, it can not be relied upon as characterizing the species."

This fossil is reported to be rare by Nettleroth.

Formation and locality.

Jeffersonville limestone; Falls of the Ohio (Nettleroth, Hall).

Chonetes subquadratus Nettleroth.

C. subquadratus Nett., Ky. Foss. Shells, 1889, p. 67.

Nettleroth's original description.—"Shell as (a?) chonetes of medium size; subquadrate, hinge line somewhat shorter than the greatest width of shell; cardinal extremities rounded; lateral margins slightly curved, almost straight except in their basal part which is regularly curved into the basal margin; central half of the front is straight or only slightly curved. Ventral valve only moderately convex in the central portion, which curves regularly from its middle to apex and base; the slope toward the lateral and cardinal margins is more abrupt, causing a flattening of the valve along the lateral borders and producing between the cardinal extremities, which are little deflected, and the umbo a shallow concavity; umbo sharply defined and moderately elevated; the beak small, pointed and incurved over the hinge area; the area is small forming a low triangle which is divided by a small triangular fissure; the foramen is partly closed by the cardinal process of the opposite valve. The margins of the cardinal area are provided with two round tubular spines on each side of the beak, which appear from their stumps to have an outward direction. The dorsal valve is concave, corresponding in its depression with the convexity of the ventral valve; its hinge line is narrow or linear. The surface of both valves is covered by fine

rounded or subangular radiating striae which increase partly by intercalation but mostly by bifurcation on the ventral valve, while it is the reverse on the dorsal valve, where very few of the striae dichotomize, but a great many short ones are implanted. The specimen before me, the only one so far known, measures seven and one-half lines in length and two lines in depth. It differs from the other shallow *Chonetes* by its greater size and from the larger species by its shallowness."

A rare species.

Formation and locality.

Jeffersonville limestone; Falls of the Ohio (Nettleroth).

Chonetes yandellanus Hall.

Pl. IV, figs. 8, 8a.

C. yandellana Hall, Pal. N. Y., Vol. IV, 1867, p. 123, Pl. 20, fig. 4.

Hall's description.—"Shell semioval, more or less gibbous; hinge line equaling the greatest width of the shell. Ventral valve regularly convex, abruptly depressed toward the cardinal angles, which are nearly flat and very slightly deflected toward the ventral side. Dorsal valve with the concavity a little less than the convexity of the opposite valve. Area of the ventral valve parallel with the longitudinal axis of the shell nearly twice as wide in the middle as near the extremities; foramen comparatively large, with margins projecting and the opening filled by the cardinal process of the opposite valve. Dorsal area extremely narrow, being barely a defined line. Surface marked by fine somewhat equal striae which increase by bifurcation and intercalation till there are from sixty to seventy on the margin of the shell. The cardinal margin of the ventral valve bears three or four short oblique spines on each side of the center. The interior of the ventral valve shows strong dental lamellae and the muscular impressions are pretty well defined. The dorsal muscular impressions are well defined and between them there is a strong mesial ridge which is extended in a bidentate cardinal process. The lower half of the surface is strongly papillose."

This species is very abundant in the "cement rock" in southern Indiana.

Formation and locality.

Sellersburg beds; Charlestown, Watson, Falls of the Ohio.

Chonetes mucronatus Hall.

Pl. IV, fig. 11.

C. mucronata Hall, Pal. N. Y., 1867, Vol. IV, p. 124, Pl. 20, fig. 1; Pl. 21, fig. 1.

Hall's description.—"Shell small, semioval, moderately convex, nearly flat, (often flattened in the shale and gibbous in the limestone); cardinal line equaling or a little greater than the middle of the shell below; the extremities sometimes salient. In the original specimens of this species from the Marcellus shale, the ventral valve is slightly convex or nearly flat, one-fourth to one-third wider than long; the hinge extremities are rarely a little produced, but the spines being in the direction of the hinge line often give it the appearance of extreme extension. The dorsal valve is very moderately concave or nearly flat. The surface is marked by twenty to twenty-four or twenty-six nearly simple subangular striae, which are not so wide as the spaces between them. Sometimes one, two or three of these striae are bifurcated toward the margin. The radiating striae are crossed by extremely fine concentric elevated striae. The cardinal margin shows two and rarely three spines on each side of the center, which are abruptly bent outward so as to lie nearly parallel to the hinge line, and the outer one extending much beyond the cardinal extremity. The area is very narrow."

A well preserved specimen in Mr. Green's collection has 20 plications on the ventral valve with two strong spines on each side the beak and a third slightly developed nearer the beak. A sharp low median septum extends not quite one-third the distance from the area to the front of the shell. The dorsal valve of another specimen shows the cardinal process to be trilobed at the extremity.

Another specimen representing the variety originally described by Hall as *C. latticosta* is very gibbous and has only eight simple rounded plications on each valve.

This is rather a rare shell.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Charlestown, Falls of the Ohio and Sellersburg.

Chonetes vicinus (Castelnau).

C. deflecta Hall, Pal. N. Y., 1867, Vol. IV, p. 126, Pl. 21, figs. 7, 8.

Hall's description.—"Shell semielliptical; length and width as four to five or eight to nine, but rarely proportionally wider. Ventral

valve extremely gibbous regularly arched, the greatest elevation being above the middle of the length; abruptly depressed towards the cardinal angles, which are flattened with the extremities deflected toward the ventral side. The umbo is a little elevated above the cardinal margin, and the minute apex (in perfect specimens) projects a little over the area. Dorsal valve deeply concave, but not equaling the convexity of the ventral valve. Area of the ventral valve narrow, with the margin declining in a gentle curve to the extremities; the triangular foramen is partially closed by a pseudo-deltidium, and the aperture occupied by the cardinal process of the upper valve. Dorsal area more than half as wide as the ventral and marked in the middle by a wide triangular callosity. Surface of the ventral valve marked by from twenty-six to thirty or thirty-four subangular or sometimes rounded striae, which are often increased by bifurcation or intercalation toward the margin. In those with fewer striae they are sharp, more abruptly elevated, and only half as wide as the interspaces, while in those with a larger number, the striae and interspaces are equal, but sometimes the striae become fuller and more rounded, and the interspaces proportionally less in width. The striae on the dorsal valve correspond essentially with those on the ventral valve, and there is a considerable space at the cardinal angles of each valve destitute of striae. Fine, closely arranged concentric striae are visible on the surface of well preserved specimens. The interior of the dorsal valve shows a slender elongate cardinal process which is scarcely bifid at the extremity, and has on each side a little below the apex, a minute lateral process for muscular attachment. The dental sockets are limited on the upper side by a narrow ridge, and on the lower side by a stronger oblique ridge which supports the base of the cardinal process. The two pairs of oclusor muscular imprints are pretty well defined. Beyond the muscular impressions the surface is covered by elongate papillae, the marks of the striae being scarcely distinct. The interior of the ventral valve shows strong dental lamellae; a somewhat broad and angular median ridge terminates above the middle of the valve. The oclusor muscular imprints are distinctly marked; and outside of these, the muscular impressions are pretty well defined. Beyond the muscular impressions the surface is covered by elongate papillae, the marks of the striae being scarcely distinct. The interior of the ventral valve shows strong dental lamellae; a somewhat broad and angular median ridge terminates above the middle of the valve. The oclusor muscular impressions have not been observed; and those of the divaricator muscles are wide and spreading, but not distinctly defined. The

cavity of the shell is abruptly rounded below and the shell abruptly deflected at the sides, leaving the cardino-lateral margins nearly flat. The surface is finely pustulose in the middle, a little more coarsely pustulose along the deflected line, and nearly or quite smooth towards the margins."

A few specimens occurring in the Devonian chert are referred to this species.

Formation and locality.

Jeffersonville limestone; Newbern.

Conchidium knighti (Nettleroth)?.

Pentamerus knighti Nett., Ky. Foss. Shells, 1889, p. 57, Pl. 29, figs. 1, 2, 17.

Nettleroth figures two specimens of this fossil in the Fossil Shells of Kentucky, and states that they are from the Corniferous rocks near Louisville. No other specimens have been reported from the Devonian. Since this shell is known only in the Niagara elsewhere, it may be that its reported occurrence in the Corniferous is an error.

DELTHYRIS.

A. Cardinal extremities rounded, surface marked by two to four, rarely five, rounded or subangular ribs on each side the fold and sinus.

D. varicosta.

AA. Cardinal extremities mucronate, surface marked by from three to six prominent angular plications on each side the fold and sinus.

D. sculptilis.

Delthyris sculptilis Hall.

Pl. X, fig. 2.

D. sculptilis Hall, Pal. N. Y., 1867, Vol. IV, p. 221, Pl. 35, figs. 10-14.

Hall's description.—"Shell gibbous; valves subequally convex, semielliptical or subtriangular; hinge line longer than the width of the shell and prolonged into mucronate extensions, length about half the width of the hinge line. Surface coarsely plicated. Ventral valve regularly convex, arcuate; beak arcuate over a sublinear area of moderate height, extending to the limits of the cardinal line; mesial sinus strongly defined, subangular. Dorsal valve regularly convex, the greatest convexity in the middle and regularly arcuate from beak to base; mesial fold abruptly and strongly elevated, with the summit flattened or grooved; beak incurved, area very narrow. Surface strongly marked by three, four or five abruptly elevated

angular plications on each side of the mesial fold and sinus, leaving a somewhat wide corrugated space at the cardinal angles. The plications bordering the sinus are stronger, more elevated, and continuing distinct quite to the apex. The shell is concentrically marked by strong imbricating lamellose striae, which are abruptly bent backward and much elevated in crossing the plications, giving them a sub-nodose character. In the bottom of the sinus, these lamellose striae have often a distinct retral bend, with a slight elevation indicating an incipient plication which corresponds with the depression in the mesial fold."

In all of the specimens under observation a distinct retral bend in the striae in the bottom of the sinus is noticeable; two or three of the larger ones have a well developed plication in the bottom of the sinus. The plications on each side of the fold and sinus vary from five to six. The plications sometimes extend almost or quite to the cardinal angles. The specimens vary from eleven-sixteenths of an inch to one and one-third inches in width. The lamellose striae vary from fifteen in the smaller specimens to twenty in the larger.

This shell is very rare in Indiana.

Delthyris consobrina, which is closely related to this species, was included in my list, published in 1899* on the authority of the catalogue of the State Museum. Examination of the specimens labeled *D. consobrina* shows them to belong to another species.

Formation and locality.

Sellersburg beds; Charlestown, Falls of the Ohio.

Delthyris raricosta Conrad.

Pl. IX, fig. 9.

Spirifer raricosta Hall, Pal. N. Y., Vol. IV, p. 192, Pl. 27, figs. 30-34; Pl. 30, figs. 1-9.

Hall's description.—"Shell subquadrate, semicircular or ovate, gibbous; hinge line equaling the width of the shell or often less; cardinal extremities rounded. Surface strongly plicated. Ventral valve most gibbous in the upper half and sloping abruptly to the cardinal angles, which are rarely a little extended and subauriculate; beak much elevated and much incurved over the area which is variable in elevation, sometimes being barely perceptible, while in others it has a width of from one to two lines and is marked longitudinally by a few strong striae. The mesial sinus is a broad rounded depression and reaches with the adjacent plications quite to the apex.

* Bull. Am. Pal., No. 12, p. 60.

Dorsal valve gibbous most convex in the middle, flattened or a little concave toward the cardinal angles. The mesial fold is very prominent and rounded or a little flattened in the middle, regularly arcuate and forming the small beak which is arched over the linear area. Surface marked by from two to four strongly elevated rounded or subangular ribs on each side of the mesial fold and sinus. In one specimen I have seen a fifth plication toward the cardinal angle. The entire shell is covered by strong lamellose or imbricating concentric striae, which are undulated upon the ribs and intermediate depressions. These concentric lines are sometimes quite regularly equidistant, but often crowded and irregular in their distribution and more or less prominent at their edges. There are a series of fine closely arranged radiating striae crossed by the concentric lamellae and in very perfect shells a fimbriate aspect. The surface is usually more or less worn, and only the stronger concentric lamellae are visible; and even these are often partially or entirely obliterated. In some specimens where the shell is well preserved the plications are rounded and not very prominent; while they become more distinct with a subnodose character, on the exfoliation of the shell. The mesial sinus is usually very wide at its base, sometimes equal to half the length of the shell. The proportions of the shell are extremely variable, the length being sometimes greater than the width, while usually the width is somewhat greater than the length; and in some individuals the length and breadth are as two to three. The casts of the ventral valve show a small rostral cavity with short strong dental plates; the muscular area being small, quadrangular and divided through the middle by a distinct septum. The interior of the shell of the ventral valve shows short strong hinge teeth and very short incurving plates below, while the bottom of the cavity is divided by a distinct elevated septum. The dorsal cast shows marks of dental sockets, with strong muscular markings at the apex of the fissure."

This is a very rare species.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Charlestown and Falls of the Ohio.

Pentagonia unisulcata (Conrad).

Pl. X, figs. 6, 6a, 6b, 6c, 6d.

Meristella (*Pentagonia*) *unisulcata* Hall, Pal. N. Y., 1867, Vol. IV, p. 309, Pl. 50, figs. 18-35.

Hall's description.—"Shell subtrigonal, quadrilateral or sometimes subhexagonal in outline, wider in front with the sides sometimes

sloping from the beak; and in others the hinge line extended nearly straight, and the sides nearly rectangular to it. A wide mesial depression on one side, with prominent elevation on the other. Ventral valve with a broad deep mesial sinus which occupies nearly the whole width of the valve, and is bounded on either side by an angular elevation which extends from the beak to the baso-lateral angles. The portion of the valve outside of the limitation by the sinus is abruptly inflected upwards and often nearly at right angles; the umbo is prominent and the beak is incurved over the umbo of the dorsal valve. Dorsal valve gibbous in the middle; the centre occupied by a prominent mesial fold, from which the surface slopes abruptly to the lateral angles, becoming more or less concave within the lateral and cardino-lateral margins. The mesial fold is marked along the center by a single deep groove, which extends to the beak of the valve. Surface marked by fine concentric striae, and sometimes by strong imbricating folds. In well preserved surfaces the striae and undulations are bent backwards in the middle of the mesial sinus indicating a mode of growth in the shell corresponding to the sinus in the mesial fold of the opposite valve. There are also slight indications of interrupted radiating striae. In the specimens from the Hamilton group there are appearances of faint undefined continuous striae. The specimens from the limestone are for the most part exfoliated, or have the shells silicified, by which the finer markings are obliterated. The interior of the ventral valve shows a perforation in the beak opening below into an angular space which has been occupied by the beak of the dorsal valve and thence communicating with the main cavity of the valve. The base of the fissure is margined on each side by a strong tooth on each side, which extends in strong dental plates to the bottom of the cavity, and these are often continued in a thickened ridge bordering the muscular impression. The imprints of the adductor muscles are opposite the bases of the dental plates, and below and on either side are the imprints of the broad divaricator muscles. In the dorsal valve the cardinal process is broad and strong, the crural bases somewhat widely diverging and the center abruptly depressed; the teeth sockets are long and supported by strong lamellar callosities which extend along the inner side of the valve nearly parallel to the exterior margin. The muscular imprints are divided by a low distinct septum."

Variation in this species occurs chiefly in connection with three characters,—the mesial fold, the short oblique folds near the beak on the dorsal valve and the angular ridges bounding the mesial sinus. The latter are always well developed and either obtusely or sharply

angular near the beak; when these ridges are obtusely angular near the beak they usually fade out before reaching half way to the front into the gently rounded sides of the ventral valve; in some specimens, however, they continue from the beak to the front as sharply angular elevations. The groove marking the center of the mesial fold varies from a well marked depression which extends from the beak to the front of the shell, to a shallow groove noticeable only at the beak. A series of shells from Mr. Green's collection shows this groove extending from beak to front in some specimens, and gradually retreating toward the beak in others until only a trace of it is preserved at the beak, the remainder of the fold being rounded on the top. In some specimens there is a short well marked oblique fold on each side the beak on the dorsal valve. In one specimen there is a second fold slightly developed. A series of shells arranged with reference to the development of this fold shows it growing gradually less distinct until it is entirely absent or barely noticeable.

A study of a series of these shells shows that the variations of the three characters above described are closely correlated. The cardinal folds, the angular ridges of the ventral valve, and the groove on the mesial fold have about the same relative development on each individual.

This is a rather rare species.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Charlestown and Falls of the Ohio and Newbern.

PENTAMERELLA.

- | | | |
|-----|--|--------------------------|
| A. | Length exceeding the width considerably. | <i>P. thusneldia.</i> |
| AA. | Length less than the width or exceeding it but slightly. | |
| | b. Plications numerous and usually bifurcated. | <i>P. arata.</i> |
| | bb. Plications few and simple. | <i>P. pavilionensis.</i> |

Pentamerella pavilionensis Hall.

Pl. VII, figs. 1, 1a.

P. pavilionensis Hall, Pal. N. Y., 1867, Vol. IV, p. 377, Pl. 58, figs. 28-39.

Hall's description.—"Shell ventricose broadly ovate, often wider than long, more or less gibbous and arcuate in old shells. Ventral valve gibbous or ventricose above, becoming depressed in the middle into a broad shallow undefined sinus, which scarcely reaches to the beak, and sometimes not much above the middle, and is produced in front; sides abruptly curving to the margin; beak incurved, obtuse,

arching from the broad fissure; cardinal line extending for more than half the width of the shell. The space above on each side of the fissure is concave and wrinkled. Dorsal valve gibbous in the middle, somewhat regularly curving to the sides and front; sides abruptly curving to the margin; beak incurved, obtuse, arching from the broad fissure; cardinal line extending more than half the width of the shell. The space above on each side the fissure is concave and wrinkled. Dorsal valve gibbous in the middle, somewhat regularly curving to the sides and front; mesial fold defined below the middle of the valve. Surface plicated, the plications rounded or subangular, becoming obsolete towards the beak, and prominent below the middle; of these there are two or three in the mesial sinus, and usually about four on the mesial fold, with three, four or five on either side. The plications are crossed by fine concentric striae of growth, which, at irregular intervals, are crowded into squamose imbricating lines. The entire surface is finely papillose or punctate and when well preserved might be mistaken for a punctate shell. The substance of the shell is lamellose-prismatic and brittle. The interior of the ventral valve shows a broad short and deep spoon-shaped pit, the extremity of which is bent abruptly to the dorsal side. The septum supporting the conjoined lamellae extends from one-third to one-half the length of the valve, and in some examples may extend still farther toward the anterior margin. The interior of the dorsal valve is not fully known."

The specimens in Mr. Green's collection from the Falls of the Ohio show considerable variation. One specimen has nine or ten plications on each valve, while in some specimens only the three or four plications occupying the fold and sinus are developed. All of the plications fade out entirely or become very indistinct before reaching the cardinal line. In one shell the umbo is twisted to one side giving the distorted appearance so common in *Cyrtina hamiltonensis*. This species is common.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Charlestown and Falls of the Ohio, Bunker Hill, Pipe Creek Falls, and Little Rock Creek, Cass County.

Pentamerella thusnelda Nettleroth.

P. thusnelda Nett., Ky. Foss. Shells, p. 51, Pl. 31, figs. 26, 27, 28.

Nettleroth's original description.—"Shell of medium size, ovoid or subquadrate; cardinal extremities rounded, forming in the beak of the dorsal valve an angle of a little more than sixty degrees; length exceeding the width considerably, giving to the shell an elongate somewhat slender appearance. Ventral valve ventricose, even gibbous; convexity regular from beak to front, and also transversely; greatest convexity a little above the middle of the valve; mesial sinus indicated by two very strong plications, and by a wide and deep groove on each side of them; the summit of these plications drops not at all, or at least very slightly, at the very front of the valve, below the regular surface; the two prominent grooves extend almost to the beak forming on the umbo only one rib, which separates into two plications in front of the beak; these mesial ribs are considerably prolonged in front, producing a subquadrilateral extension, beak is prominent and incurved, cardinal area large, extending to the extremities and bounded by a well marked regularly curved line of demarcation; fissure of moderate size but partly closed by the beaks of both valves. Dorsal valve depressed convex, curved slightly in the upper half of the valve; lateral partitions of lower half almost flat, mesial fold formed by three strong plications, which are united into one simple elevation on the umbo, where it is only faintly visible; below the umbo the three mesial ribs separate and extend to a little beyond the front, where they are considerably elevated; beak moderate and incurved into the foramen of the other valve, cardinal area only linear. Surface marked by about twelve subangular plications, of which those of the mesial depression and elevation are considerably stronger than those on the lateral slopes; the lateral ribs on the dorsal valve are single and of equal size; those on the ventral valve increase by bifurcation, and those nearest to the mesial furrows appear to be stronger than the more lateral ones."

Nettleroth reports this species to be rare, only two specimens being known.

Formation and locality.

Jeffersonville limestone ("Corniferous"); Falls of the Ohio.

Pentamerella arata (Conrad).

Pl. VII, fig. 2.

P. arata Hall, Pal. N. Y., 1867, Vol. IV, p. 375, Pl. 58, figs. 1-21.

Hall's description.—"Shell ovate, more or less convex or gibbous, becoming arcuate ovoid in old shells; the width greater or less than the length; hinge line variable. Ventral valve gibbous and somewhat regularly convex in the young shells, becoming ventricose in old shells, with a mesial sinus which is more or less developed. In old shells the form is extremely arcuate and the beak strongly incurved; in shells of medium size the beak is obtuse, limiting the apex of the triangular fissure. There is a narrow area bordering the fissure and the space on either side between the hinge line and its apex is often flattened and sometimes distinctly limited by a faint elevation; fissure large and nearly covered by the beak of the opposite valve. Dorsal valve in young shells more or less convex, and sometimes gibbous in the upper part, and often moderately convex in older shells; mesial fold usually well defined in the lower half of the valve, sometimes reaching nearly to the apex; in young shells there is rarely a short sinus in place of the mesial elevation. Surface plicated by rounded or angular plications, which sometimes reach nearly or quite to the beak but are often only developed below the first third of the length; plications usually bifurcated; the bifurcations irregular or unequal. The interior of the ventral valve has an elongate spoon-shaped pit, the inner extremity of which is free for a considerable extent and the upper part supported on the central septum which usually extends less than half the length of the shell from the apex. In the dorsal valve the crura or lamellae are joined at their bases, making a V-shaped trough or pit, which is attached to the valve in its upper part and continues sessile for about one-half the length of the shell."

Hall states that this species may be distinguished from *P. pavilionensis* by its greater number of plications which are more or less angular and usually bifurcate.

Only three or four specimens in a collection of about eighty *Pentamerellas* show any bifurcating striae. A few specimens clearly correspond to the *P. arata* type in their abundant and angular plications, but the *pavilionensis* type generally predominates in numbers.

Formation and locality.

Jeffersonville limestone; Bunker Hill, Cass County and Falls of the Ohio.

STROPHEODONTA.

- A. Shell nearly flat, striae rather fine. *S. perplana.*
- AA. Shell arched with some or all of the striae coarse.
- b. Shell very large, frequently two inches or more in width. *S. concava.*
- bb. Shell small or of moderate size.
- c. Surface marked by distant elevated striae and the interspaces occupied by very fine striae.
- d. Shell usually more than an inch in width, striae less regular on the ventral than on the dorsal valve. *S. inequiradiata.*
- dd. Shell usually less than one inch in width. Striae on the ventral and dorsal valves similar. *S. inequistriata.*
- cc. Surface marked by bifurcating coarse striae.
- e. Shell small, striae few and very coarse. *S. plicata.*
- ee. Shell of moderate size, striae numerous, and usually rather fine toward the margin. *S. demissa.*

Stropheodonta demissa (Conrad).

S. demissa Hall, Pal. N. Y., 1867, Vol. IV, p. 101, Pl. 11, figs. 14-17.

Hall's description.—"Shell semielliptical, usually wider than high, length and breadth often nearly equal; hinge line equaling or greater than the width of the shell below, abruptly contracted beneath the extremities, which are often auriculate; in some specimens the sides are nearly straight, and parallel for more than half the length of the shell. Ventral valve regularly convex, often gibbous; greatest elevation nearly central, and sometimes subangulated along the middle; umbo small and prominent with the apex slightly incurved and extending beyond the plane of the area. Surface a little concave toward the cardinal angles which are slightly deflected. Dorsal valve moderately concave, rarely following the convexity of the opposite valve; sometimes an undefined median depression extends from beneath the apex to the front of the shell. Area of ventral valve variable, usually of moderate width, from 8/100 to 12/100 of an inch wide in the center, having a low triangular outline, concave in the middle, and for a considerable distance on each side of the beak, strongly striated transversely and more faintly longitudinally, sometimes marked along the middle by a subangular elevation; inner margin crenulated for nearly its entire length. There is no foramen but sometimes a smooth triangular space beneath the beak. Dorsal area narrow and usually linear, sometimes wider and

sometimes narrower in the middle, and the margin for a short space free from crenulations. The planes of the two areas are inclined so as to sometimes give less than a right angle between them, but generally a greater angle, and along the middle the two are often nearly in the same plane. Surface marked by numerous crowded striae, about nine or ten of which are much stronger and more elevated on the umbo of the ventral valve, with finer ones coming in between and on either side; striae frequently increasing by intercalation and bifurcation, until they become very numerous and much finer at the margin. On the dorsal valve the striae are similar to those on the ventral valve. In well preserved specimens fine concentric striae cover the entire surface, but the greater number of specimens do not preserve these markings. The coarser striae are sometimes seen separated on the middle of the shell, each one presenting the appearance of a fascicle of striae, which spreading, cover the lower part of the shell with extremely crowded striae. The interior of the ventral valve and casts of the same show a large flabelliform divaricator muscular impression, which is somewhat widely separated in front, and each division distinctly lobed. The ocluser muscular impressions occupy a semielliptical space on each side of a narrow central depression, the marking on either side being double in well preserved specimens. The upper extremities of this impression are close under the arch of the umbo, and separated by a smooth space from the divaricator impressions. Beyond the muscular impressions the interior surface is pustulose, the points being more prominent just without their limits; beyond which the course of the vascular impressions can be distinctly traced. In the dorsal valve the anterior and posterior ocluser muscular impressions are very conspicuous and deeply marked and often limited by an elevated ridge, a narrow longitudinal ridge dividing the two pairs. On each side and below the muscular impressions the surface is marked by small pustules or tubercles; and beyond these the surface is minutely pustulose, the muscular impressions becoming distinct toward the margin. The cardinal process is divided from the base, the divisions strongly diverging."

The specimens at hand vary considerably in the convexity of the dorsal valve; in some specimens it is deeply arched while in others it is nearly flat. Three types of surface markings which merge into each other in a large collection are distinguishable in this species; shells with not very coarse striae which are of uniform size from the beaks to the margin; shells with very coarse striae near the beaks, each of which splits into a bundle of fine striae toward the middle

of the shell; and shells with a few coarse and sometimes very indistinct striae near the beaks which fade out before reaching the middle of the shell, leaving the greater part of the shell entirely bare of striae, or marked by very faint striae.

This is one of the most abundant species in the Indiana Devonian.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; throughout the Devonian area.

Stropheodonta plicata Hall.

Pl. VI, fig. 2.

S. plicata Hall, 13th Rep. N. Y. State Cab. Nat. Hist., 1860, p. 90.

The character of this shell is sufficiently indicated by the figures. It seems to differ from *S. dimissa* only in the stronger plications. It should probably be considered a well marked variety of that species.

Formation and locality.

Jeffersonville limestone; Falls of the Ohio.

Stropheodonta perplana (Conrad).

Pl. V, figs. 3-7.

S. perplana Hall, Pal. N. Y., 1867, Vol. IV, pp. 92-98, Pl. 11, fig. 22; Pl. 12, figs. 13-15; Pl. 17, fig. 1.

Hall's description, in part.—"Shell semielliptical; the length varying from two-thirds to three-fourths the width, which is from half an inch to two inches; slightly concavo-convex, and often nearly flat; hinge line equaling or often a little greater than the width of the shell below; but the sides are frequently nearly straight for half their length, and the front broadly rounded with the margin attenuate. Ventral valve very little convex, the greatest convexity above the middle of its length, with frequently a few obscure concentric wrinkles near the apex and sometimes upon the body of the shell; apex scarcely rising above the hinge line, and slightly incurved. Dorsal valve gently concave and often nearly flat. Area of the ventral valve usually less than a line in width, inclined to an angle of 40 degrees to 50 degrees to the plane of the margins and curved in the upper part, vertically striated in its whole extent and crenulate on the inner margin; sometimes a flat triangular space in place of a foramen, with a narrow callosity in the middle, but this feature is not always observable. Area of the dorsal valve about half as wide as that of the ventral, gently curved outward, leaving an angle between the two of more than 90 degrees; the center is marked by a

narrow callosity or an impressed space. Surface covered by fine subequal striae, those of the ventral valve being the finer, extremely sharp and often gently undulating, increasing both by bifurcation and intercalation and crossed by fine even concentric striae. In some specimens the longitudinal striae rise at frequent intervals into minute granules, evidently the bases of minute spines, which have covered the surface of the ventral valve. Very rarely there is some interruption in the regularity of the striae, apparently owing to an injury which has caused the concentric striae to curve toward that point, and the radiating striae to converge, making a kind of seam or cicatrix."

The common form of this species corresponds to the above description. There is a variety of the species, however, which has the striae arranged in fascicles of from three to six fine ones between stronger and more elevated striae.

This is a common species in northern and southern Indiana.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Little Rock Creek, Cass County and from Shelby County to the Ohio in southern Indiana.

Stropheodonta concava Hall.

Pl. V, figs. 1, 1a, 2; Pl. VI, fig. 1.

S. concava Hall, Pal. N. Y., Vol. IV, 1867, p. 96, Pl. 16, figs. 1a-1h.

Hall's description.—"Shell large, from two to three and a half inches wide on the hinge line, concavo-convex or subhemispheric, broadly semielliptical or subcircular, sometimes subtriangular from becoming narrowed in front. The proportions vary from nearly equal length and breadth to a width one-fourth to one-third greater. The hinge extremities salient, but often rounded. Ventral valve varying from moderately to extremely convex, and becoming gibbous in the middle, rounded upon the umbo and little elevated above the hinge line, with beak small and scarcely incurved in some specimens, the centre of the valve is elevated in a median ridge. Dorsal valve usually almost flat or slightly concave in the upper and central portions, becoming suddenly deflected toward the margin; in some specimens regularly concave. Area of the ventral valve nearly on a plane with the axis of the shell about a line in width, narrowing toward the extremities, vertically striated with the margin crenulated for more than half the distance from the center to the extremities. Area of the dorsal valve almost rectangular to that of the ventral valve, very narrow and nearly linear throughout; sometimes narrower

in the middle striate and crenulate in the opposite valve; with a small smooth triangular space beneath the apex. The surface of the ventral valve is marked by sharply elevated, strongly crenulated striae, between which are sometimes one or two less elevated striae similarly crenulated and still finer striae between the latter. In other specimens there are wider spaces of finer equal striae between the stronger ones; and in still other examples, the striae are nearly all strong and sharply elevated, with few finer ones, which soon rise to the strength of the others. Close undulating concentric striae cover the whole surface. The dorsal valve is marked by distant sharp elevated striae, between which there are from three to six and rarely ten finer striae, which are very finely crenulated by concentric striae. In some specimens the ventral valve is marked by an irregular fold or ridge down the middle, and there are sometimes a few incipient plications on one or both sides towards the margin of the shell. These plications likewise affect the dorsal valve. The interior of the valves is finely pustulose. The divaricator muscular impressions of the ventral valve are large and spreading, about as wide as long, extending nearly half the length of the valve and deeply striate; while the ocluser impressions are elongate-ovate or cordiform and strongly marked. The muscular impressions of the dorsal valve are strong and divided above by a rounded ridge which supports the strong bifurcate cardinal process, each division of which is bilobed, and the surface roughened for the muscular attachment."

The large size of this shell readily distinguishes mature specimens from any other species of the genus. Each of the three specimens from near Pipe Creek Falls exceeds three inches in width. One of these measures in the widest part $3\frac{3}{4}$ inches and $2\frac{1}{8}$ inches in length. Many mature shells, however, do not reach this size.

This species is rather common.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Pipe Creek Falls, Little Rock Creek, Cass County, Charlestown, Sellersburg and Falls of the Ohio.

Stropheodonta hemispherica Hall.

There seems to be no clearly defined difference between *S. concava* and *S. hemispherica* as defined by Hall. The specimens heretofore referred by the writer* to the latter species are probably varieties of *S. concava*.

*Bull. Am. Pal., No. 12, p. 68.

Stropheodonta inequistriata (Conrad).

Pl. IV, figs. 12, 13.

S. inequistriata Hall, Pal. N. Y., 1867, Vol. IV, p. 106, Pl. 12, figs. 6-8; Pl. 18, fig. 2.

Hall's description.—"Shell semioval or semicircular in outline; hinge line extended beyond the width of the shell below; extremities acute, sometimes auriculate. Rarely the sides are nearly straight below the auriculate extremities, and the basal curve rather straightened on each side and produced in a subnasute extension in the middle. Ventral valve usually convex and often gibbous in the middle and abruptly arched toward the hinge line, depressed-convex on the disc the margin toward the front more abruptly curving; sometimes gently sloping towards the front and abruptly constricted on the sides below the cardinal extremities, which are deflected toward the ventral side; the beak is small scarcely prominent on the hinge line. Dorsal valve moderately concave, often more deeply concave; sometimes moderately concave in the upper and middle part, and suddenly deflected toward the front. Area of the ventral valve narrow linear, extending to the extremities of the hinge line, striate vertically, with the inner margins crenulate from one-half to two-thirds the length from the beak to the extremities; foramen none; a slight linear elevation extends across the area. Dorsal area scarcely more than half as wide as the ventral area, and, in every perfect specimen having a narrow elevated ridge crossing it in continuation of that of the opposite valve. Surface of the entire shell marked by slender elevated striae, which are increased by interstitial additions; the interspaces occupied by much finer closely arranged striae, which are scarcely visible to the naked eye, and crossed by fine concentric striae. In the interior of the ventral valve, the ocluser muscular impressions occupy a narrow subquadrangular elevated space just beneath the apex; while the divaricator muscular imprints occupy a short broad space on each side and are limited by nearly vertical or slightly converging ridges which have in some degree the appearance of dental lamellae; within the limits of these ridges the muscular imprints are not strongly marked. In the dorsal valve the posterior ocluser imprints are broad and extending far toward the cardinal line and often limited by a low pustulose ridge; the anterior impressions are small and narrow, separated by a narrow mesial ridge and margined by diverging elevated ridges, which above the impression are united in the mesial ridge from which proceeds the bifurcating cardinal process; the divisions of this process are broad and some-

what flattened vertically or a little obliquely and sometimes grooved on the inner side and distinctly bilobate at the cardinal extremities. The condition of the muscular imprints is subject to considerable variation; for in some specimens those of the interior oclusors are raised in two prominent processes to a height greater than the enclosing ridges, and sometimes the imprints remain depressed, and the enclosing ridges are extremely elevated, arching over and nearly enclosing the muscular area. Just without the muscular areas, in both valves, the interior surface is rather strongly pustulose and beyond this it is finely pustulose in lines corresponding to the external striae; while the dorsal valve more often than the ventral, is marked by strong vascular impressions."

Most of the specimens of this species have the ventral valve highly arched. Those from northern Indiana seldom exceed three-quarters of an inch in width. Sharp elevated striae with interspaces containing from six to fifteen very fine striae mark the surface of both valves.

This is a common species in northern Indiana but less common in southern Indiana.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Bunker Hill, Pipe Creek Falls, Charlestown and Falls of the Ohio.

RHIPIDOMELLA.

- A. Beak of ventral valve extending beyond the beak of dorsal valve; dorsal valve usually without sinus. *R. livia.*
- AA. Beak of ventral valve not extending beyond the beak of dorsal valve, or but slightly.
 - b. Shell narrow toward the beaks, sides sloping from them in nearly straight lines to near the middle of shell; dorsal valve very gibbous. *R. leucosia.*
 - bb. Shell wide toward the front sides near the beaks rounded, dorsal valve slightly gibbous. *R. vanuxemi.*

Rhipidomella vanuxemi Hall.

Pl. III, fig. 14; Pl. IV, figs. 1, 1a, 2, 3, 3a.

O. vanuxemi Hall, Pal. N. Y., 1867, Vol. IV, p. 47, Pl. 5, fig. 6; Pl. 6, fig. 3.

Hall's description.—"Shell subcircular or transversely suboval compressed; hinge line very short; margins of the valves crenulated within from the external striae; interior minutely punctate. Dorsal valve convex; beak scarcely distinct from the cardinal border, not incurved; cardinal process prominent; area flat or slightly inclined

to the ventral area and about two-thirds as wide. Ventral valve nearly flat or a little concave toward the front, moderately convex in the umbonal region; beak small, extending little beyond the opposite beak, arched and rarely incurved over the area; area very small, less than half the greatest breadth of the shell, arcuate; foramen comparatively large, triangular, and partly filled by the cardinal process of the other valve; teeth prominent. Surface marked by fine, closely arranged radiating tubular striae, which are perforate at intervals, increasing both by implantation and bifurcation, and are crossed by very fine indistinct concentric striae, and, at greater intervals, by more distinct concentric imbricating lines of growth; entire surface granulate or punctate, under a magnifier. Striae from twelve to sixteen in the space of two lines near the beak, and from seven to nine in the same interval near the margin. The interior of the dorsal valve shows a strong cardinal process, which is continued in a prominent rounded median ridge for half the length of the shell, where it sometimes divides, or gradually becomes obsolete; there are sometimes visible low transverse ridges which divide the muscular impression. The crural processes are prominent and sustained below by strong oblique ridges. In the interior of young specimens, the marks of the external striae visible nearly or quite to the muscular impressions; while in older specimens these marks extend little beyond the margin. The interior of the ventral valve is marked by a large flabelliform muscular impression which reaches from one-half to two-thirds the length of the shell. The central or adductor impression is sometimes simple and sometimes longitudinally divided by a slight median ridge which is stronger below. In the older shells the ovarian spaces are pustulose. The dental lamellae are strong and divergent, supported below by the ridge which margins the muscular impression. Vascular impressions are rarely seen extending beyond the muscular area. Under a lens the interior surface is distinctly punctate. In all well preserved specimens the exterior shows minute tubular openings in the striae; and when the striae are much worn, these also are seen to be tubular; while a farther wearing of the surface shows more distinctly the minutely punctate character of the shell."

This species is very abundant at many localities. The specimens correspond closely to the above description.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Bunker Hill, Little Rock Creek, Cass County, North Vernon, Charlestown, Lexington and Falls of the Ohio.

Rhipidomella leucosia Hall.

Pl. III, figs. 12, 13, 13a.

Orthis leucosia Hall, Pal. N. Y., IV, 1867, pp. 48, 63, Pl. 7, fig. 4; Pl. 8, figs. 9, 10.

This species is so closely related to *R. vanuxemi* that it is, as suggested by Hall, probably only a variety of that species. A few specimens in Mr. Green's collection correspond to the description and figure of *R. leucosia*. They differ from *R. vanuxemi* in their more ovate form, more gibbous dorsal valve and in the less rounded extremities of the cardinal line; the margin of the shell from the beak to near the middle forms a nearly straight line. In two specimens the length and greatest breadth of the shell are equal; in the others the width exceeds the length very slightly. This species is rare.

Formation and locality.

Sellersburg beds; Charlestown.

Rhipidomella livia (Billings?).

Pl. IV, fig. 4.

Orthis livia Billings, Can. Journ. of Industry, Sci. and Art, No. 27, p. 269, 1860.

Billings' original description.—"Shell suborbicular or subquadrate, length about eight-ninths of the width; greatest width usually a little in front of the middle; length of hinge line one-half to two-thirds the width of the shell; cardinal extremities rounded; sides in most specimens somewhat straight, often sufficiently curved to give a circular aspect to the shell; front angles obtusely rounded, front margin in general broadly convex, sometimes, in a small central portion nearly straight. Dorsal valve of medium convexity, most elevated about the middle; the outline forming an uniform arch from depressed beak to front margin; slope from umbo to cardinal angles gently concave; sometimes a barely perceptible mesial depression, commencing on a point at the beak, and becoming obsolete at one-half or two-thirds the length; area small, lying in the plane of the lateral margins; beak minute, forming a small triangular projection rising scarcely one-fourth of a line above the edge of the area. Ventral valve moderately convex, most elevated at between one-fourth and one-third the length from the beak, thence descending with a flat or gently concave slope to the lateral margins, with a somewhat concave one to the front, and also to the hinge line and cardinal angles. The concavity toward the front is not found in all speci-

mens; some shells have basal portions either flat or slightly convex. The ventral umbo is small and neatly defined; beak small pointed and somewhat incurved, but scarcely overhanging edge of the area; area triangular and somewhat larger than the dorsal one. Foramen not observed. Surface covered with small subangular radiating ridges or striae of nearly uniform size, from eight to ten in the width of three lines, increasing by bifurcation, strongly curved outward on the lateral part of shell; the interspaces subangular and equal in size with the striae. In perfect specimens very fine concentric sublamellose striae are visible, seven or eight to one line. In certain conditions of preservation, also, the radiating striae are seen to be subtubular, and exhibit numerous small oval or circular openings on their edges, each about the eighth or tenth of a line in width and from one-fourth to two-thirds of a line distant from each other."

A specimen in the State Museum which is here figured, is doubtfully referred to this species.

Formation and locality.

Sellersburg beds; Clark County.

Rhipidomella goodwini Nettleroth.

R. goodwini Nett., Ky. Foss. Shells, 1889, p. 39, Pl. 17, figs. 30-31.

Nettleroth's original description.—"Shell small, subcircular or subquadrate; moderately convex in both valves; hinge line short, equal or less than half the width of the shell; cardinal extremities rounded; lateral margins almost straight or very slightly curved; they diverge toward the base in consequence of which greatest width of shell is close to base or front; the basal margin is broadly curved, with its central portion either straight or slightly inflected. Ventral valve is somewhat more convex in its umbonal region than dorsal, but in its basal half it is the reverse. Its greatest convexity is just below the umbo, from where it slopes in a very gentle curve to lateral and basal margins, but more rapidly, even almost abruptly to the cardinal lines; umbo moderate, beak a little elevated above opposite valve, sharp pointed and slightly arched, but not incurved. Cardinal area short but comparatively high, limited by sharp margins and divided by an open triangular foramen, which is partly closed at its base by the cardinal process of the dorsal valve. Dorsal valve moderately convex; point of greatest convexity a little above middle of valve, from where it slopes to all the margins and to the beak, giving the valve over its whole surface an even convexity, with the exception of a narrow strip in the middle, which extends from beak to base, and

which is slightly depressed. This mesial depression is deepest in its middle portion; it is only faintly marked upon the umbo, and it becomes shallower but wider toward the base. The surface of both valves is ornamented by fine thread-like radiating striae which increase in number, partly by bifurcation, but mostly by intercalation; these radii are crossed by several concentric lines of growth, which become more numerous toward the basal margin. In regard to size the specimen illustrated on plate 17, figures 30, 31 and 32, is of about the average size, though a few specimens have been found which are considerably larger."

The specimen figured by Nettleroth is a half inch in width.

The above description agrees perfectly with shells which the writer considers to be immature specimens of *R. vanuxemi*. It seems probable that Mr. Nettleroth's species is based on young specimens of *R. vanuxemi*.

Formation and locality.

"Hamilton"; Falls of the Ohio.

Schizophoria striatula (Schlotheim).

Pl. III, figs. 11, 11a.

Orthis impressa Hall, Pal. N. Y., 1867, Vol. IV, p. 60, Pl. 8, figs. 11-19.

Hall's description.—"Shell rotund. Dorsal valve very gibbous, wider than long; sinuate in front; hinge line about two-thirds the width of the shell. Ventral valve moderately convex at the sides, somewhat flattened on the umbo, with a broad undefined sinus which becomes deeper toward the front, the margin of the shell being sometimes abruptly incurved at the beak. The surface is finely and evenly striated and the texture of the shell is minutely punctate. The cast of the dorsal valve shows strong, somewhat quadrilobate, muscular impressions, limited by strong and widely diverging socket plates, with the vascular impressions somewhat narrow and extending below it to the margin of the shell. The surface of the cast preserves fine even striae. The cast of the ventral valve is broadly sinuate in the middle below with a triangular or subovate deeply bilobed muscular impression, which is subject to considerable variation in form and proportions."

This shell is frequently found associated with *Rhipidomella vanuxemi* but is very much less common than that species.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Lexington, Paris Crossing, Lancaster, Sellersburg, Charlestown and Falls of the Ohio.

MARTINIA. -

- A. Anterior margin of shell crenulated by weak plications. *M. williamsi* n. sp.
AA. Anterior margin not crenulated, surface without plications. *M. subumbona*.

Martinia williamsi n. sp.

Pl. XI, figs. 5, 5a, 5b.

Shell small; length greater than width, cardinal angles rounded, rather ventricose toward the middle; hinge line very short, length of cardinal area exceeding its height about one-half. Ventral valve more gibbous than dorsal, beak slightly incurved over the high fissure; marked toward the front by a very shallow sinus which is barely perceptible in most specimens. Two or three weak plications crenulate the margin of the shell on each side of the sinus; surface marked by fine concentric striae. Dorsal valve marked by a broad, poorly defined fold towards the front, with two or three faint plications on each side near the anterior margin. Fine concentric striae cover the surface. A slight linguiform projection usually characterizes the anterior margin of the shell.

This species is rather common where discovered but it has not been found at any other locality.

Formation and locality.

Geneva limestone; Hope.

Martinia subumbona (Hall).

Pl. XI, figs. 3, 3a.

Spirifer subumbona Hall, Pal. N. Y., 1867, Vol. IV, p. 234, Pl. 23, figs. 22-30.

Hall's description.—"Shell small, more or less gibbous or ventricose; cardinal extremities rounded; surface smooth or finely striated concentrically. Ventral valve ventricose in the middle, regularly curving toward the basal and lateral margins; umbo much elevated above the opposite valve, and beak abruptly incurved over the high area, which has its lateral margins rounded or rarely defined, and sloping toward but not reaching the cardinal extremities; more or less arcuate, and the elevation apparently variable. The foramen is higher than wide and open to the apex in all the specimens observed. There is usually a narrow but not always distinct mesial sinus reaching from the apex to the base of the valve, where it becomes wider but without defined limits. Dorsal valve less gibbous than the ventral, somewhat regularly convex in the middle, and curving toward the front and baso-lateral margins, a little depressed or flattened

towards the abruptly rounded cardinal extremities; umbo slightly elevated above the hinge line; area linear. There is often a faint impressed line extending from the beak to the base of the valve. Surface marked by fine concentric lines of growth which are sometimes crowded into imbricating folds toward the front of the shell. In partially exfoliated specimens the surface is finely and distinctly punctated, as if in its original condition it had been covered by closely arranged spinules. The texture of the shell is fibrous yet differing from the fibrous texture of ordinary Spirifers."

All of the specimens referred to this species are from a single locality where they are very abundant. They differ from Hall's figures in having the beak of the ventral valve more sharply incurved over the area. In some specimens it almost or quite touches the beak of the dorsal valve, and the area is very narrow. The ventral sinus mentioned by Hall is noticeable only on one or two specimens, where it is represented by the faintest kind of a depression. Average specimens measure $\frac{3}{8}$ of an inch in width; one specimen has a width of $\frac{1}{2}$ inch. The shells have the length and the greatest width equal.

This shell resembles in some respects *Ambocaelia umbonata*. It is, however, about twice the size ordinarily attained by *A. umbonata* in southern Indiana; the dorsal valve is much more concave than in that species, and the beak of the ventral valve less elevated; it is usually incurved until it lies in the plane marking the contact of the two valves.

Formation and locality.

Sellersburg beds; Little Rock Creek, Cass County.

Nucleospira concinna Hall.

Pl. XI, fig. 7.

N. concinna Hall, Pal. N. Y., 1867, Vol. IV, p. 279, Pl. 45, figs. 33-57.

Hall's description.—"Shell depressed, subspheroidal, nearly circular in outline, the width being usually a little greater than the length; valves subequal. Ventral valve regularly convex, the greatest convexity a little above the middle, and curving regularly to the sides and front; umbo prominent, the beak neatly pointed and incurved over the apex of the dorsal valve, leaving a space between, which sometimes exposes a narrow area. There is usually a narrow depressed line from the beak to the base of the valve; but this is sometimes partially absent, or so faint as not to be readily observed. Dorsal valve regularly convex sometimes gibbous, becoming a little

depressed towards the base, the greatest convexity being a little above the center; there is usually a depressed line along the middle of the valve. The hinge line is about one-third, and sometimes half as long as the width of the shell. Surface usually smooth or very finely papillose; but in its perfect condition it is covered by numerous fine setae which are matted together and the interstices being filled with clay, it has a rough appearance; while under a lens, these setae give a finely striate aspect. Beneath the fine papillose surface the texture of the shell is minutely punctate. The interior of the ventral valve presents beneath the beak a low depressed area, or false area which is bordered on each side by a strong tooth. The muscular area is somewhat broad, flabelliform, with the margin lobed; the occlusor imprints in the center are strongly marked elongate oval spots, and there is a low median crest which often extends to near the front of the shell. In the dorsal valve there is a strong wide cardinal process, the inner surface of which is mainly occupied by a broad oval pad for the muscular attachment extending in a narrow callosity into the cavity below. The teeth sockets are deep and margined by a strong callosity which forms the base of the process; and from thence proceed the crura and the slender spiral arms, which make about eleven or twelve turns in the larger individuals. The muscular area is narrow, well defined and lobed below; while the inner portions marked by the occlusor muscles are two sublinear spots. A slender crest extends along the middle of the impression. The interior of the shell is somewhat pustulose."

The fine setae which belong to perfect specimens are seldom preserved. The shell is frequently marked by two or more strong lines of growth. This species is not very common.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Charlestown and Falls of the Ohio.

PRODUCTELLA.

- A. Surface of ventral valve marked by numerous spines or spine bases, frequently sixty or more. *P. spinulicosta.*
 AA. Surface of ventral valve marked by a few isolated spines. *P. semiglobosa.*

Productella spinulicosta Hall.

Pl. VI, figs. 9, 9a.

P. subaculeata Hall, Pal. N. Y., 1867, Vol. IV, pp. 54-160, Pl. 23, figs. 4-5, 25-34.

Hall's description.—"Ventral valve gibbous, length and breadth about as seven to eight; hinge extremities angulated, and the margins

being contracted a little below from small ears, while below this contraction the sides are regularly curved and the front is broadly rounded. The umbo is considerably elevated above the hinge line and the apex incurved. Surface marked by closely arranged concentric striae and studded with slender rounded spines. On the upper part of the shell and on the ears these spines are round at the base, and rise directly from the surface. On the middle and lower part of the valve there is a slight elevation of the surface a little above the base of the spine, but not a defined ridge. The number of spines on the individual figured has been sixty or more."

The dorsal valve appears to have been almost if not entirely destitute of spines. Some of the specimens in Mr. Green's collection which have spines $\frac{3}{8}$ of an inch in length on the ventral valve show no traces of spines on the dorsal valve.

Some of the specimens from the lower Devonian of northern Indiana have pretty well defined plications on the ventral valve. A small variety of this shell which does not usually exceed one-fourth of an inch in width was found abundant at one locality in the upper Devonian of northern Indiana.

This shell is very abundant at many localities in northern Indiana but less common in southern Indiana.

Formation and locality.

Jeffersonville limestone and Sellersburg beds; Bunker Hill, Pipe Creek Falls, Little Roek Creek, Cass County, Shelby County, North Vernon, Paris Crossing, Kent and Falls of the Ohio.

Productella semiglobosa Nettleroth.

P. semiglobosa Nett., Ky. Foss. Shells, 1887, p. 70, Pl. 26, fig. 7.

Nettleroth's original description.—"Shell of medium size, semiglobose or subcircular; hinge line somewhat shorter than greatest width of shell; cardinal extremities rounded. Ventral valve very gibbous, regularly curved from the umbo to the front, and also transversely; umbo only moderately elevated above surrounding surface; beak incurved upon the hinge line, not overlapping it into dorsal valve. Width and length of shell about equal but sometimes the width exceeding the length. Dorsal valve apparently deeply concave but its other characters are not known. Surface does not show any markings except the stumps of a few isolated spines placed at irregular intervals; the figure 7 on plate 26 shows about twice as many as in reality exist. I am unable to identify it with any of the species of Devonian *Productella* known to me, and I therefore place it

in the above named new species. This shell has some similarity with some middle-sized, but very ventricose forms of *Stropheodonta demissa*, from which it is, however, easily distinguished by its smooth surface, which shows only a few spine-bases, while *Stropheodonta demissa* is covered by radiating striae, and never becomes fully as ventricose as our shell. The specimen illustrated is of about average size."

Rare, not seen by the writer.

Formation and locality.

Jeffersonville limestone; Falls of the Ohio.

Centronella glansfagea (Hall).

Pl. XI, figs. 1, 1a, 1b.

C. glansfagea Hall, Pal. N. Y., 1867, Vol. IV, p. 399, Pl. 61A, figs. 1-21, 25, 26.

Hall's description.—"Shell small, broad ovate, or subquadrate; the sides often sloping from near the middle to the apex at an angle of about 85 degrees; the front rounded; the valves very unequal. Ventral valve much larger than the dorsal, very prominent, often subcarinate along the middle and curving very abruptly to the lateral margins, regularly arcuate from beak to base. Beak much extended beyond that of the opposite valve, strongly incurved, bringing the apex above the plane of the margin of the dorsal valve. Dorsal valve usually convex in the upper part, concave in the middle by a broad and undefined sinus, which toward the front often involves the entire width of the valve; beak not incurved. Surface smooth or with faint concentric lines of growth; shell compact and very finely punctate. The shell varies from three-fourths to four-tenths of an inch in length; the width usually more than three-fourths as much, and sometimes nearly equal to the length. The interior of the ventral valve shows two strong teeth, at some distance below the apex with strong dental lamellae. The interior of the dorsal valve shows the bases of the crura to be very thick and strong, entirely dividing at the center and each supporting a thin filament which becomes broader below and sends off a spur into the ventral cavity; and thence curving inwards the outer margins are united and produced along the line of junction in a slender elevated carina, which extends forward in a slender free point. The muscular imprint is oval, and divided along the center. The casts of the interior preserve the impression of the features described, and are readily recognized by the slender incurved filling of the rostral cavity."

The extremely ventricose type shown in some of Hall's figures is not represented in the collections at hand, the sinus being developed the entire length of the dorsal valve. The largest specimen measures five-eighths of an inch in length and one-half inch in width. The shell figured is of the average size.

This is one of the rare species.

Formation and locality.

Sellersburg beds; Charlestown and Falls of the Ohio.

Vitulina pustulosa Hall.

Pl. XI, figs. 2, 2a, 2b.

V. pustulosa Hall, Pal. N. Y., 1867, Vol. IV, p. 410, Pl. 62, fig. 1.

Hall's description.—"Shell subplano-convex, semielliptical; hinge line equaling or a little less than the length of the shell; surface marked by a few strong plications, and covered by minute papillae, which appear like the bases of setae. Substance of the shell finely punctate. Ventral valve very convex; the apex a little acute, subangular in the middle above, and the elevation continued in a broad fold, which is at first flattened and then becomes grooved or duplicate below, with four or five rounded or subangular plications on each side; the area much elevated and the margin rapidly sloping from the apex to the cardinal extremities; foramen large and wide, being half the length of the area, and reaching to the apex; deltidial pieces or pseudodeltidium unknown. Dorsal valve flat or slightly convex with a wide mesial depression which is nearly flat in the bottom, and in larger specimens has a shallow groove in the middle toward the front. The plications on the side correspond with those of the ventral valve. There is a narrow scarcely perceptible area. Surface covered by minute papillae. Substance finely punctate. In the interior of the ventral valve, the margins of the foramen are extended in two strong teeth, which are supported on the lower and lateral margins by a callosity of the shell. Beneath the apex a strong callosity or false area extends across the valve and reaches to the base of the teeth. This callosity is visible in the foramen, and from its lower margin proceeds a slender median septum. On each side of this septum, at its junction with the transverse callosity, there is a small pit for the ocluser muscle; and beyond that a broad flabelliform area for the divaricator muscular attachments. These features are shown in the cast, fig. 1i."

In the dorsal valve there is a strong median ridge or septum which terminates in a slightly lobed cardinal process; on each side of this

are the crural processes, and between these and the margin are the teeth sockets:

This is a rare shell. The collection of Mr. G. K. Green, however, contains 25 or 30 specimens, including single valves.

Formation and locality.

Sellersburg beds; Charlestown.

SPIRIFER.

- A. Ventral valve with very high area and beak incurved but slightly or not at all.
 - b. Plications angular, not more than twelve or fifteen on each side of fold and sinus.
 - c. Ventral valve with distinct linear ridge along margin of area. *Spirifer arctisegmentum.*
 - cc. Ventral valve without linear ridge along margin of area.
 - d. Shell large with ten or twelve plications each side of fold and sinus. *Spirifer manni.*
 - dd. Shell small with eight or ten plications on each side of fold and sinus.
 - d¹. Sinus rounded in bottom. *Spirifer varicosus.*
 - d². Sinus angular in the bottom. *Sp. hobbsi.*
 - bb. Plications rounded or very slightly angular, 16 or more on each side of fold and sinus.
 - e. Shell large, area not inclined forward.
 - f. Surface with 20 to 30 plications which frequently have a thread-like groove in the middle, on each side of the fold and sinus. *Sp. audaculus.*
 - ff. Surface with 16 to 20 plications without a thread-like groove on each side the fold and sinus.
 - g. Area concave. *Sp. macconathii.*
 - gg. Area straight. *S. fornacula.*
 - ee. Shell large, area inclined forward. *Sp. segmenta.*
- AA. Ventral valve with low or only moderately high area, beak incurved.
 - f. Plications on fold and sinus.
 - g. Plications few, about ten on each side of fold and sinus, smaller in sinus than elsewhere. *Sp. grieri.*
 - gg. Plications numerous, usually about 20 or more on each side of fold and sinus, those in sinus equally developed with the others. *Sp. divaricatus.*
 - ff. No plications on fold or sinus.
 - h. Hinge line greatly extended.
 - i. Area of ventral valve high and incurved.
 - i¹. Surface marked by fine radiating striae. *Sp. iovenensis.*
 - i². Surface not marked by radiating striae. *Sp. macrus.*
 - ii. Area of ventral valve narrow, not incurved. *Sp. pennatus.*
 - hh. Hinge line not greatly extended.
 - j. Shell large.

- k. Mesial fold and sinus rounded.
 - . *Sp. granulosus*.
- kk. Mesial fold and sinus sharply angular.
 - Sp. acuminatus*.
- jj. Shell small.
 - l. Plications sharply angular, sinus angular at the bottom. *Sp. byrnei*.
 - ll. Plications rounded, sinus rounded in the bottom.
 - m. Mesial fold narrow, area of ventral valve sublinear.
 - Sp. duodenarius*.
 - mm. Mesial fold wide, area of ventral valve rather high.
 - n. Surface of shell covered with concentric striae which are strongest toward the front.
 - o. Shell very gibbous, length usually equal to or greater than width. *Sp. gregarius*.
 - oo. Shell not very gibbous, length usually much less than width.
 - Sp. gregarius* var. *greeni*.
 - nn. Surface smooth except near the front where there are from five to seven strong imbricating lines of growth. *Sp. davisii*.

Spirifer divaricatus Hall.

Pl. VIII, figs. 5, 5a.

S. divaricata Hall, Pal. N. Y., 1867, Vol. IV, p. 213, Pl. 32, figs. 1-6.

Hall's description.—"Shell ventricose, somewhat rhomboidal or quadrilateral (looking upon the ventral valve). Dorsal valve semi-elliptical; hinge line less than the width of the shell; cardinal extremities obtuse or rounded; area large. Ventral valve most convex above the middle, extremely arcuate from the umbo to the base, abruptly curving to the sides; beak abruptly arching over the area; sinus plicated, shallow above and becoming rapidly expanded below with the margins undefined and terminating in a broad triangular extension in front. Area high, flat below, abruptly arcuate above and reaching to the cardinal extremities; foramen large. Dorsal valve regularly and strongly convex, with an angular mesial fold,

which is narrow above and expands toward the front with bifurcating plications; sides regularly curving and sometimes a little flattened toward the cardinal extremities. Area rather wide with the beak and central portions of the valve arching over it. The surface is marked by numerous fine bifurcating rounded or subangular plications; the mesial sinus having on either side a stronger plication which bifurcates on one or on both sides. At the beak there is a single plication in the bottom of the sinus, which sometimes continues simple nearly or quite to the base; while the accessions take place mainly from those on the sides of the depression, till they reach the number of ten, eleven or twelve within the limits of the sinus near the base. In a specimen of ordinary size, where the surface is well preserved, there can be seen sixty or more plications with their divisions at the margin of the shell. In some specimens from the Corniferous limestones where the surface is partially or entirely exfoliated the bifurcating character of the striae is not observed; and in one specimen they appear to have been nearly simple throughout. The plications are crossed by fine imbricating lamellose striae which are abruptly arched backwards. A cast of a ventral valve shows a long oval muscular area which is deeply divided by a rounded median crest, and strongly striated on the lateral portions."

In perfectly preserved specimens the transverse striae have a fimbriate character. One shell in Mr. Green's collection has a width of three inches but the shells are usually much smaller than this.

This species appears to be more common in northern than southern Indiana. It is rather common, however, in the bed of limestone frequently found just over the "Cement rock" in southern Indiana.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Pipe Creek Falls, Bunker Hill and Clark County.

Spirifer acuminatus (Conrad).

PL. IX, fig. 1.

Sp. acuminata Hall, Pal. N. Y., 1867, Vol. IV, pp. 198, 234, Pl. 29, figs. 9-18; Pl. 35, fig. 24.

Hall's description in part.—"Shell large ventricose, transverse, with the hinge line usually less than the width of the shell; cardinal extremities rounded or truncate, having a subelliptical or subquadrate outline; mesial fold and sinus extreme. Surface plicated. Ven-

tral valve variably convex on the two sides, with a wide mesial sinus which is well defined in the upper part, becomes wider and deeper and less distinctly defined in the middle of the shell, and is produced in part in a long triangular extension; gently or more abruptly curving from the greatest convexity to the sides and cardinal angles, with the margin rounded except towards the extremities. Dorsal valve gibbous slightly elevated in the middle into a strong angular mesial fold, and curving from the sides of the fold to the margins of the shell, except at the cardinal angles, where it is a little flattened and projecting, so as to give a minute auriculate appearance; summit of mesial fold regularly arcuate from beak to base; apex slightly incurved over the narrow nearly vertical area. Surface on either side of the mesial fold and sinus marked by from sixteen to twenty plications, about four or five of which nearest the center are dichotomous from below the middle of their length; ribs low and rounded above, flattened below the middle, those near the margin very slender; the first ten or twelve ribs on each side occupy the greater part of the valve. The entire surface is marked by delicate concentric striae, which are often crowded into imbricating lamellose lines towards the front of the shell. In very perfect specimens these concentric striae are papillose or fimbriated by fine radiating striae. These fine surface markings, however, are usually nearly or quite obliterated."

This is one of the most abundant and characteristic fossils of the Indiana Devonian. In southern Indiana, where the Sellersburg beds have their typical development, I have not seen this species above their base, but at North Vernon and other points where there is no very evident lithological distinction between this formation and the Jeffersonville limestone, *Sp. acuminatus* occurs abundantly immediately below the Black shale. In northern Indiana this fossil has not been found in the highest fauna of the Devonian limestone, but occurs in the lower one.

Formation and locality.

Jeffersonville limestone; throughout the Devonian area.

Spirifer gregarius Clapp.

Pl. X, fig. 3.

Sp. gregaria Hall, Pal. N. Y., 1867, Vol. IV, p. 195, Pl. 28, figs. 1-11.

Hall's description.—"Shell ventricose, subglobose, semioval or subquadrate in outline; hinge line equaling or less than the width of

the shell; cardinal extremities truncate or rounded. Surface plicated. Ventral valve the more gibbous, regularly arcuate from beak to front, the greatest convexity at or a little above the middle, and curving somewhat abruptly to the sides and more gently to the front; beak much elevated and the apex closely incurved over the fissure; area high concave and extending to the cardinal angles where it is sometimes more than half a line high, often distinctly striated; mesial sinus rounded or subangular and much produced in front. Dorsal valve very convex, with a strong mesial fold, either angular or somewhat flattened along the summit, and sometimes marked by an indistinct groove; beak often considerably elevated and slightly inclined over the hinge line; area narrow except in the center where it perceptibly widens. Surface marked by from six to ten strong rounded ribs on each side of the mesial fold and sinus; the entire surface with undulating concentric striae, which towards the front become strong zigzag imbricating lines. The interior of the ventral valve presents a well defined oval muscular impression with a low crest in the centre. The dental plates are often much thickened, filling the entire rostral cavity and encroaching upon the muscular area. The width of the species ranges from one-half to seven-eighths of an inch, and the length is sometimes a little greater but usually a little less than the width. In the more gibbous specimens the beak of the ventral valve is so extremely elevated that one-half the length of the valve is above the cardinal line. In the majority of specimens there are about six or seven plications on each side of the valve. The variable gibbosity gives an apparent variation in the height of the area, the beaks of the two valves sometimes approaching close to each other."

This shell is extremely abundant at the Falls of the Ohio and elsewhere in Clark County, but I have not seen it in northern Indiana.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Falls of the Ohio, Charlestown and Scott County.

Spirifer gregarius var. *greeni* n. var.

Pl. X, figs. 4, 4a.

The collection of Mr. Green contains several specimens which differ considerably from the ordinary type of *Sp. gregarius*. They are very much less gibbous, comparatively wider, the width always exceeding the length, and do not have the strong imbricating striae toward the front which characterize *Sp. gregarius*.

This variety was illustrated by White (Rept. Ind. Geol. Surv. 1880, Pl. 4, figs. 10-11) but no attention was called to the difference between it and the ordinary form.

Formation and locality.

Jeffersonville limestone; Falls of the Ohio.

Spirifer grieri Hall.

Pl. VIII, fig. 6.

Sp. grieri Hall, Pal. N. Y., 1867, Vol. IV, p. 194, Pl. 27, fig. 29; Pl. 28, figs. 17-23.

Hall's description.—"Shell gibbous, transversely oval or subquadri-lateral, sometimes longitudinally ovate, the proportions of length and breadth being variable; hinge line usually shorter than the width of the shell, with the cardinal extremities rounded; valves subequally convex. Ventral valve gibbous or ventricose, most convex above the middle and nearly opposite the center of the hinge line and sloping very abruptly to the lateral margins; sometimes regularly arcuate in the entire length and often arched in the upper part and nearly straight below. Umbo prominent and much elevated above the hinge line; beak more or less extremely incurved over the high arcuate area which has a length of from one-half to two-thirds the width of the shell; mesial sinus wide and deep, subangular in the lower part. Dorsal valve regularly arcuate, the greatest convexity near the middle and regularly curving to the lateral margins; mesial fold prominent sometimes rounded but usually more or less distinctly angular; beak small, slightly incurved over a nearly vertical narrow area. Surface marked by six, eight or ten more or less rounded simple plications on each side of the mesial fold and sinus; while there are three or four distinct bifurcating or dichotomous plications upon the fold or sinus, giving six or seven at the margin of the shell. In perfect specimens, the surface is covered by fine concentric lamellose striae which are crossed by delicate radiating striae. This species is distinguished from most of the allied forms by its simple strong plications on each side the mesial fold and sinus, while those occupying the latter are smaller and bifurcating. Sometimes the middle plication on the mesial fold is simple, in which case the fold is quite angular; while in other instances it bifurcates, leaving a longitudinal depressed line in the middle, giving it a more rounded outline. It is only in specimens which have suffered no injury by wearing or exfoliation, that the fimbriate appearance of the concentric markings is visible. In some of the larger or older individuals

the plications are low and gently rounded. In other specimens they are prominent, while from exfoliation they often become angular and more conspicuous; and the same appears to be true of the dichotomous plications of the mesial fold and sinus. In two or three instances I have noticed in the casts a partial bifurcation of one or two of the lateral plications. In some of the casts or partial casts, the plications on the fold or sinus appear to be partly or entirely obsolete. The interior of the valve is unknown."

This is a rare species.

Formation and locality.

Jeffersonville limestone; Paris Crossing and Falls of the Ohio.

Spirifer davis Nettleroth.

Pl. IX, figs. 8, 8a.

Sp. davis Nett., Ky. Foss. Shells, 1889, p. 112, Pl. 12, figs. 1-4.

Nettleroth's original description.—"The shell is semicircular or subquadrate and gibbous. Hinge line equal or longer than the greatest width of the shell. Cardinal extremities acute and mostly somewhat acuminate. Surface strongly plicated. Ventral valve considerably more gibbous than the dorsal valve, regularly arcuate from beak to front; greatest convexity at or a little above middle, and curving gently to the sides and front except at the cardinal angles, which are somewhat flattened; beak much elevated above that of the opposite valve, and arching over the fissure, but scarcely incurved. Cardinal area high and concave, and reaching to the cardinal extremities. Mesial sinus is broad and rounded and reaches quite to the apex. Dorsal valve gibbous, most convex in the middle, flattened or a little concave towards the cardinal extremities. The mesial fold is very prominent, rounded and regularly arcuate; it has a faint impression extending from beak to middle of valve. The beak is small and arched over the linear area. Surface is marked by six to eight rounded or subangular plications on each side of the mesial fold and sinus. The shell is smooth with the exception of the front part which is marked by from five to seven strong concentric imbricating lines of growth, which reach to the cardinal angles and which give to the shell its peculiar beautiful front view. Such imbricated front is only noted in *Sp. gregaria* and *Sp. mucronata*, in both of which it is less regular and less prominent. Interior of shell is unknown.

"The specimens so far found show great similarity in form, also in size; they measure from one inch to one inch and a quarter in

width, by from three-fourths to seven-eighths of an inch in length. This species is related to *Sp. raricosta* and *Sp. gregaria*. From the former it differs in its greater number of plications; its somewhat acuminate cardinal extremities; its longer and more elevated hinge area, and by its peculiar imbricated front. From *Sp. gregaria* it is distinguished by its larger size, by its smooth shell, by its greater width, and by its less prominent umbo, and also by its more marked imbricated front."

This species is rare.

Formation and locality.

Jeffersonville limestone; Lancaster and Falls of the Ohio.

Spirifer granulosis (Con.).

Pl. IX, figs. 2, 2a, 2b.

Sp. oweni Hall, Pal. N. Y., 1867, Vol. IV, p. 197, Pl. 29, figs. 1-8.

Hall's description.—"Shell more or less ventricose in its different stages of growth, somewhat transversely oval, semielliptical or subquadrate; hinge line about equal to the width of shell; cardinal extremities rounded or subangular. Surface plicated.

"Ventral valve scarcely so gibbous as the dorsal valve, its greatest convexity about the middle of its length, and curving regularly to the margins; beak much elevated above that of the opposite valve and arching over the fissure but scarcely incurved; mesial sinus shallow concave, usually well defined and reaching distinctly to the apex. Area high concave elevated and continuing to the hinge extremities; foramen large, reaching to the apex and sometimes partially filled by the thickening of the dental plates. Dorsal valve the more gibbous, the greatest convexity in the middle and curving regularly to the front and lateral margins and usually a little flattened or concave towards the cardinal extremities; mesial fold prominent, rounded, with a longitudinally depressed line along the middle. Area narrow, vertical or in the plane of the longitudinal axis. The surface is marked by from fifteen to seventeen rounded or subangular plications on each side of the mesial fold and sinus; and these are crossed by distinct concentric striae, which become strongly imbricating, or are marked in strong imbricating lines of growth toward the margin. In well preserved specimens there are distinct radiating striae. In many of the silicified specimens, however, both the radiating and concentric striae are partially or entirely obliterated. The interior of the ventral valve shows two short and rather strong teeth, with the ventral portion quite solid. The dental plates reaching to the

bottom of the cavity of the shell, curve slightly outwards and partially enclose an oval muscular area which, in its upper part is divided by a short prominent median crest. In some silicified specimens the conical spires are partially preserved. The crura are widely separated at their bases and converging somewhat abruptly, curve into the dorsal valve, making twelve or more turns, and producing a short, strong spire. In well preserved specimens the mesial fold and sinus are usually sharply defined, but in some of the more gibbous forms the sinus is very broad and one or two of the plications on each side are involved in the sides of the depression; at the same time the mesial fold is very prominent, rounded, and sloping almost imperceptibly into the general contour of the convexity of the valve."

This species frequently has as many as twenty plications on each side of the fold and sinus. The spires are pointed toward the cardinal extremities at an angle of about 45 degrees to each other. In six specimens in Mr. Green's collection, the number of coils in the spire varies from 18 to 21. This is one of the most abundant species in the "Cement rock" of southern Indiana.

Formation and locality.

Sellersburg beds; Sellersburg, Watson, Charlestown, Utica, Falls of the Ohio, Lexington and Paris Crossing.

Spirifer fornacula Hall.

S. euruteines Hall, Pal. N. Y., 1867, Vol. IV, p. 209, Pl. 31, figs. 14-19.

Hall's description.—"Shell semielliptical; length and breadth about as six to ten; hinge line equal to the greatest width of the shell. Surface plicate. Ventral valve subpyramidal, the elevation being equal to nearly half the width, curving abruptly and equally to the front and lateral margins; the distance from the apex to the cardinal extremity and to the front of the shell being about equal. Apex sometimes projecting slightly over the area; mesial sinus shallow, well defined, and reaching to the apex, sometimes a little flattened in the bottom. Area extremely elevated, nearly flat or slightly concave above; fissure large and open to the apex, the length of the sides being about once and a half the width of the base. Dorsal valve moderately and evenly convex with a well defined low rounded mesial fold; beak and margins of the valve in the middle slightly arched. Area narrow at the sides, but having the width of a line in the middle. Surface marked by from sixteen to twenty plications on each side of the mesial fold and sinus; these plications are rounded

and well defined; about eight of them reach the apex on the ventral valve, and the remainder coalesce with the angular border of the area. In perfect specimens the entire surface has been covered by fine concentric undulating striae, which are crossed by fine radiating striae. The remains of these upon some silicified specimens give a granulose surface. The length of full grown individuals is a little more than three-fourths of an inch with a width of about an inch and three-eighths; the height varies from three-fourths of an inch to a little less."

Hall described, under the name of *S. euruteines* var. *fornacula*, a variety of this species from the Bake Oven, Illinois, which is characterized by the incurving of the upper part of the area. This variety is very common in Indiana.

The height of the area varies considerably; in some of the higher forms it is contained in the length of the ventral valve one and two-third times, while in the flat lower types the length of the ventral valve is equal to two and a half times the height of the area. *S. euruteines* is always associated with *Sp. granulosus* in southern Indiana and is nearly as abundant.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Falls of the Ohio, Charlestown, Lexington, Lancaster, Watson, Sellersburg, Kent, Pipe Creek Falls.

Spirifer manni Hall.

Pl. X, figs. 1, 1a.

Sp. manni Hall, Pal. N. Y., 1867, Vol. IV, p. 211, Pl. 31, figs. 20-30.

Hall's description.—"Shell semielliptical or subquadrate; valves very unequally convex; hinge line equal to the greatest width of the shell; cardinal extremities angular, and sometimes produced in acute extensions. Ventral valve subpyramidal, the height often nearly equal to two-thirds the length; greatest elevation at the apex and thence curving to the front and lateral margins; mesial sinus angular above, and rounded or flattened toward the front; margins angular and sharply defined. Area large and high, flat and inclined a little backwards or slightly concave; foramen large and open to the apex. Dorsal valve more or less gibbous and sometimes only moderately convex, curving to the front and lateral margins, and a little flattened at the cardinal extremities; mesial fold moderately elevated, strongly defined and flattened or concave on the summit; the beak

and adjacent portion of the margin is more or less arcuate, and the area is concave for more than half its length on each side of the center. The surface is marked by ten or twelve plications on each side of the mesial fold and sinus; the plications rounded or subangular and sometimes subnodose on exfoliation. Portions of the shell preserved on some of the specimens, show strong lamellose concentric striae, with faint radiating striae."

This shell is very closely related to *Sp. fornacula*. It has a more angular sinus and fewer striae than that species. It is a rare fossil.

Formation and locality.

Jeffersonville limestone; Falls of the Ohio.

Spirifer segmentum Hall.

Pl. IX, figs. 7, 7a.

Sp. segmenta Hall, Pal. N. Y., 1867, Vol. IV, p. 207, Pl. 31, figs. 14-19.

Hall's description.—"Shell transverse semioval; length less than half the width; hinge line equaling the greater width of the shell, and terminating in salient angles. Surface plicate. Ventral valve much elevated, subpyramidal, most prominent at the beak, which is not incurved; sinus strongly defined, shallow and nearly flat in the bottom, with the sides straight, giving a triangular form in which the sides are about once and a half as long as the base. Area very large with sharply angular margins a little inclined forward, and nearly of the same size as the exterior; the fissure is high and large, being nearly of the same dimensions as the mesial sinus. Dorsal valve depressed convex and flattened toward the cardinal extremities, larger than the ventral valve, semielliptical in form with a low but sharply defined mesial fold which is barely flattened upon the summit. The proportions in height of area, length of dorsal and length of ventral valves is about as five, six and seven. Surface marked by twenty or more simple rounded (or subangular) plications on each side of the mesial fold and sinus, the lateral ones of which do not reach the beak, but run out along the margin of the valve. In its perfect condition the shell has been marked by fine concentric striae, traces of which are still preserved, together with stronger imbricating lines of growth."

This is a very common shell in southern Indiana.

In specimens which have been studied from southern Indiana the inclination of the area to the plane passing through the margins of the two valves varies between 60 degrees and 75 degrees. A specimen

from northern Indiana shows an angle of 58 degrees, the lowest noted.

This species is very closely related to *Sp. angustus* if not identical with it; but I have seen no specimens in Indiana with the extremely mucronate hinge extremities shown in Hall's figures of *Sp. angustus*.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Falls of the Ohio, Charlestown, Sellersburg, Kent, Lexington and Pipe Creek Falls.

Spirifer varicosus Hall

Pl. IX, fig. 3.

Sp. varicosa Hall, Pal. N. Y., 1867, Vol. IV, p. 205, Pl. 31, figs. 1-4.

Hall's description.—"Shell somewhat semicircular or semielliptical; length equaling or less than half the width; hinge line equal to the greatest width of the shell, and terminating in salient angles or mucronate extensions. Surface plicated. Ventral valve much the more convex; greatest elevation at the umbo, and regularly curving to the front and lateral margins; mesial sinus strongly defined, rather flat in the bottom; beak slightly arcuate. Area high, nearly flat below and slightly concave towards the apex. Dorsal valve moderately convex with a prominent abruptly elevated mesial fold, which is flattened on the summit and sometimes slightly depressed along the center; the beak projecting a little above the hinge line, and with a narrow area gently incurved. The surface is marked by from eight to ten simple and somewhat abruptly elevated plications on each side of the mesial fold and sinus; these are crossed by strong lamellose imbricating lines of growth, which give a varicose character to the surface, and where the shell is exfoliated the plications are nodose. In some specimens distinct fine radiating striae can be observed. There is often a retral curving of the striae in the centre of the mesial sinus, and sometimes a slight elevation along that line."

This is a very common little shell.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; throughout the Devonian area.

Spirifer bynesi Nettleroth.

Pl. IX, figs. 6, 6a.

Sp. bynesi Nett., Ky. Foss. Shells, 1889, p. 109, Pl. 10, figs. 1-5, 31-34, 36-39.

Nettleroth's original description.—"Shell subquadrate, semicircular and gibbous in outline; hinge line equaling greatest width of shell

and terminating in salient angles. Surface plicate. Ventral valve ventricose and only a little more gibbous than the other valve; regularly arcuate from beak to front; greatest convexity in the upper part a little above the middle from where it curves regularly to the front and sides; beak much elevated above the hinge line and slightly arcuate. Cardinal area high concave and extending to the cardinal angles where it never forms an acute angle, but shows always a height of from one-quarter to one-half a line, a feature which is not sufficiently expressed in the figures on plate 10. Mesial sinus sharply defined, forming a deep triangular groove, with an acute angle at the bottom, much produced in front; fissure of medium size. Dorsal valve gibbous with a greatly elevated mesial fold, which is edged in its upper part and rounded below; beak little elevated and slightly inclined over a narrow hinge area. Surface marked by from eight to ten very prominent and angular plications on each side of the mesial fold and sinus which are crossed by strong imbricating concentric lines of growth, showing more prominently in front than in upper portion of shell. Of the plications the lateral ones do not reach to the beak, but run out on the margins of the cardinal area. The dimensions of this species are as follows: It measures from one-half to three-fourths of an inch in length and from three-fourths to seven-eighths of an inch in width; its width always exceeds its length. This species takes an intermediate position between *Sp. gregaria* and *Sp. varicosa*; it is more transverse than the former and less so than the latter; its umbo is less elevated and curved than that of *gregaria* and more so than that of *varicosa*; its deeper and sharply angular sinus and its more elevated fold, distinguish it from both of its relations. It is a well marked and easily recognized species."

This is a very abundant shell.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; throughout the Devonian area.

Spirifer varicosa var. *hobbsi* (Nettleroth).

Sp. hobbsi Nettleroth, Ky. Foss. Shells, 1889, p. 121, Pl. 10, figs. 21, 22, 26-30, 35-40.

An examination of the type specimens of Nettleroth's *Sp. hobbsi* indicates that the only difference between it and *Sp. varicosa* is in the character of the sinus; the sinus in *hobbsi* is rather sharply angular, while in *varicosa* it is usually rounded or flattish. This character is variable in *Sp. varicosa*; sometimes the sinus approaches the

angular type and sometimes a partially developed plication occupies the bottom of it.

This variety is not very common.

Formation and locality.

Sellersburg beds; Falls of the Ohio.

Spirifer arctisegmentum Hall.

Sp. arctisegmenta Hall, Pal. N. Y., 1867, Vol. IV, p. 208, Pl. 31, figs. 9, 10.

Hall's description.—"Shell transversely semioval; length less than one-third the width; hinge line equal to the greatest width of the shell, and terminating in mucronate points. Ventral valve the more convex, most prominent at the umbo from which it slopes regularly to the anterior and lateral margins; mesial sinus angular, and distinctly defined quite to the apex of the shell; beak not incurved. Area flat, a little inclined forwards, striated longitudinally, fissure narrow and open to the apex. Dorsal valve depressed convex, scarcely flattened towards the cardinal extremities; the beak and central portion of the shell, together with the linear area, slightly incurved. The surface of the ventral valve is marked by eight or nine angular plications, which are slightly curved towards the front and about three of them only reaching the apex; the remainder coalesce with an elevated ridge which borders the area. The plications on the dorsal valve are pretty direct, the greater part of them terminating in the margin at a distance from the beak. Fine close concentric striae mark the entire surface."

This is a rare species.

Formation and locality.

Sellersburg beds; Kent and Falls of the Ohio.

Spirifer audaculus (Conrad).

Pl. VIII, fig. 4.

This species is closely allied to *Sp. fornacula*.

Only a few well preserved specimens have been seen; these have the fold and sinus and plications marked by fine closely arranged striae, with a thread-like groove along the middle of each plication.

Formation and locality.

Sellersburg beds; Watson.

Spirifer duodenarius (Hall).

Pl. IX, fig. 10.

Sp. duodenaria Hall, Pal. N. Y., 1867, Vol. IV, p. 189, Pl. 27, figs. 13-16; Pl. 28, figs. 21-23.

Hall's description.—"Shell transverse semicircular; hinge line equaling the greatest width of the shell; cardinal extremities obtuse or acute, rarely acuminate. Valves subequally convex; area very narrow. Surface plicated. Ventral valve moderately gibbous, arcuate, compressed towards the cardinal extremities. Mesial sinus of moderate width and depth, rounded or slightly flattened on the bottom; umbo prominent, the beak small neatly curved over a wide triangular fissure, and reaching to within half a line of the umbo of the opposite valve; area concave, sublinear, a little wider on each side near center. Dorsal valve regularly convex, a little gibbous in the middle, and flattened or sometimes slightly concave at the cardinal extremities. Mesial fold rather narrow, rounded prominent, and strongly defined, sometimes a little flattened on the middle. The surface is marked by six and rarely seven strongly rounded ribs on each side of the mesial fold and sinus. The ribs gradually decrease in size and prominence from the center, and the outer ones are often scarcely elevated in young or medium sized individuals. The entire surface is marked by lamellose concentric striae giving a papillose or subfimbriate aspect at their junction. It usually happens however that the surface is smooth from partial exfoliation. In the Schoharie grit, the cast of the ventral valve shows a somewhat narrow muscular area, with the sides subparallel for half their length and contracting below. There are faint indications of a median crest. In the interior of a ventral valve from the Corniferous limestone, Pl. 28, fig. 23, the muscular area is broad and rounded, with a distinct median crest. A cast of the dorsal valve shows rather shallow teeth sockets, with a strong callosity between them and the fissure, while the apex is marked by muscular impressions."

This species is very rare.

Formation and locality.

Sellersburg beds; Charlestown and Falls of the Ohio.

Spirifer iowensis Owen.

Sp. pennata Hall, Geol. Surv. of Iowa, I, Pt. II, 1858, pp. 5-10, Pl. 5, fig. 1.

Hall's description.—"Shell variable in form from subglobose to transverse and broadly triangular, often inequilateral; hinge line ex-

tremely extended in wing-like expansions; valves often nearly equally convex. Ventral valve very gibbous in the middle and on the umbo; beak much elevated above the hinge line, more or less pointed and slightly incurved; mesial sinus strongly defined at the margins, widely spreading towards the base, and produced in an angular extension in front; area concave and very large, extending to the extremities of the hinge line, striated vertically and longitudinally; foramen large and open to the apex, and forming an equilateral triangle. Dorsal valve very gibbous in the middle and upon the umbo which is abruptly incurved; regularly curved towards the baso-lateral margins, and more or less compressed towards the lateral extremities; mesial fold strongly elevated, sometimes a little flattened on the top, and often subangular towards the front and slightly depressed on each side. Surface marked by fourteen to twenty-six or more rounded plications on each side of the mesial fold and sinus; those near the center to the number of ten or twelve being much stronger than those upon the extremities, which become finally very slender. Plications crossed by closely arranged concentric undulating lamellae of growth; and the entire surface in perfect specimens ornamented by slender radiating striae which become granulose at their junction with the concentric striae."

I have not seen any perfect specimens of this shell.

Formation and locality.

Sellersburg beds; Paris Crossing, Watson, Falls of the Ohio.

Spirifer maceonatheii Nettleroth.

Sp. maceonatheii Nett., Ky. Foss. Shells, 1889, p. 123, Pl. 11, figs. 1-5.

Nettleroth's description.—"Shell transverse, triangular or semielliptical; hinge line much extended, extremities often mucronate; valves unequal in depth; area large surface plicate. Ventral valve elevated at the beak; abruptly sloping to the front and lateral margins, but with little convexity. Area one-third as high as long, and only slightly concave; fissure about twice as high as wide, and reaching to apex of valve; beak minute. Mesial sinus well defined but shallow and flattened at the bottom, with subangular margins rapidly widening toward the front, where it is somewhat produced. Dorsal valve depressed convex, most convex in the middle; cardinal extremities often inflected; beak not prominent, incurving over the linear area. Mesial fold well defined and rounded, but flattened on top toward the front. Surface marked by from eighteen to twenty simple

rounded plications on each side of the mesial fold and sinus; only a few of these ribs reach to the beak, the others run out on the margins of the cardinal area. This species agrees in many points with Prof. Hall's description of *Sp. macronata*, in Pal. N. Y., Vol. IV, p. 231, but it differs by its smaller number of ribs which in this species never exceed twenty while *macronata* has from twenty-five to thirty-five. The area of *macronata* is straight while that of *macconathei* is always concave, and the surface of the last species is generally smooth, while the surface of the former is covered by several lamellose imbricating lines of growth."

I have not seen this species. Nettleroth reports it to be rare.

Formation and locality.

Sellersburg beds; Falls of the Ohio.

Spirifer pennatus (Atwater).

Pl. VIII, figs. 1, 2, 2a.

Sp. mucronata Hall, Pal. N. Y., Vol. IV, 1867, p. 216, Pl. 34, figs. 1-32.

Hall's description in part.—"Shell more or less gibbous, semicircular, semioval or triangular in outline; cardinal angles sometimes truncate but usually extended and often extremely prolonged into mucronate points, giving a length of hinge line two, three or four times as great as the shell; sides straight or curving, the front straight or concave. Ventral valve often scarcely more convex than the dorsal, but in very gibbous forms becoming more unequal, gently curving to the lateral margins. The beak is small and incurved over the narrow linear area; the mesial sinus is sharply defined quite to the apex, and limited by angular plications which are stronger than the adjacent ones. The prevailing form of the sinus is shallow and rounded in the bottom; it is sometimes flat and sometimes with a fold in the center. Dorsal valve moderately convex, sometimes becoming gibbous. The sides are gently curving, and usually flattened towards the cardinal margin; the mesial fold usually prominent and well defined, flat or rounded above, sometimes with a median groove and again angulated in the middle. The beak is incurved and the area extremely narrow, about one-third as high as that of the ventral valve. Surface marked by from eight or ten to twenty or more subangular plications on either side of the mesial fold and sinus; the plications are not very prominent but usually well defined, flat or rounded above, sometimes with a median groove and again angulated in the middle. The beak is incurved and the area extremely narrow,

about one-third as high as that of the ventral valve. Surface marked by from eight or ten to twenty or more subangular plications on either side of the mesial fold and sinus; the plications are not very prominent but usually well defined, the outer half of the number not reaching the beak, but terminating in the callosity along the area margin. The plications are crossed by numerous fine lamellose striae which become crowded together and closely imbricating towards the front of the shell and sometimes presenting several interrupted lines of growth."

This fossil is one of the most abundant species in the upper Devonian limestone fauna in northern Indiana. The specimens do not differ in any respect from the New York specimens. This species is unknown in southern Indiana.

The appearance of the specimens of this fossil in the State Museum credited to Charlestown would indicate that they came from some locality outside the State. They have a very different appearance from that of fossils coming from that locality. No collector so far as I am aware claims to have found this species in southern Indiana.

Formation and locality.

Sellersburg beds; Norway, Delphi, and Little Rock Creek, Cass County.

Spirifer macrus Hall.

Pl. VIII, figs. 3, 3a, 3b, 3c.

Sp. Macra Hall, Pal. N. Y., 1867, Vol. IV, p. 190, Pl. 27, figs. 17-28.

Shell transversely elongate, the hinge line extending somewhat beyond sides of shell and the cardinal angles usually extended in mucronate points; valves about equally convex. Ventral valve regularly convex except near the cardinal extremities where it is somewhat flattened. Beak small and slightly incurved over the large triangular fissure. Area rather high and slightly concave. The sinus is broad and well defined, usually rather deep and angular or subangular in the bottom; in some specimens it is comparatively shallow and somewhat rounded in the bottom. Dorsal valve moderately convex or somewhat gibbous in the middle, becoming flattened or concave toward the cardinal extremities. Mesial fold well developed, rounded or flattened on the summit. One specimen shows a slightly depressed line along the middle of the flattened fold. Area linear, beak very small. Surface marked by from ten to 16 slender angular plications on each side of the fold and sinus. Strong concentric lamellose striae cover the entire surface.

The interior of the ventral valve shows short strong dental plates partially enclosing a deep rather narrow muscular area; in the middle of this area are two long narrow occlusor impressions separated by a low and narrow median ridge.

The interior of the dorsal valve shows two teeth projecting into the cavity of the shell nearly at right angles to each other, and separated from the cardinal area by a shallow groove on the outside of each; the outer surface of each tooth is also marked by a shallow groove. A low linear ridge extends along the middle of the shell half way to the front.

The specimens figured are from Mr. G. K. Green's collection. This seems to be a rare species.

Formation and locality.

Sellersburg beds; Charlestown.

RETICULARIA.

- A. Shell subcircular, surface without tubercles.
 - b. Mesial sinus with two plications. *R. knappiana.*
 - bb. Mesial sinus without plications. *R. wabashensis.*
- AA. Shell transversely subelliptical, surface curved, with tubercles. *R. fimbriata.*

Reticularia fimbriata (Conrad).

Pl. VII, fig. 11.

Spirifer fimbriata Hall, Pal. N. Y., Vol. IV, 1867, p. 214, Pl. 33, figs. 1-11.

Hall's description.—"Shell transversely subelliptical, gibbous; hinge line less than the width of the shell; cardinal extremities rounded. Ventral valve gibbous in the upper half, regularly curving to the front and sides; sinus well defined, usually shallow and rounded, sometimes deep and angular, and much produced in front; beak small and incurved over the area, which is high and concave, extending about half the entire width of the shell; foramen often limited by a sharp elevated border which appears to be a projection of the dental plates. Dorsal valve gibbous regularly convex on the sides, a little flattened at the cardinal extremities; mesial fold abruptly elevated in the lower part, often but little elevated or scarcely defined in the upper part; beak small, slightly arched over the sub-linear area, which is somewhat concave. Surface marked by from three or four to eight or nine plications on each side; these are crossed by imbricating lamellose striae, which are sometimes wide or distant, and often crowded. The concentric striae are studded

with elongated nodes or tubercles, which are thus arranged in parallel bands more or less contiguous, according to the distance of the concentric striae. The elongate tubercles may perhaps more properly be regarded as interrupted radiating striae, which in the perfect condition of the shell have doubtless extended in slender spines or setae. (They are termed by Mr. Conrad longitudinal striae.) The area is strongly striated vertically."

The interior of the ventral valve shows a well marked subovate muscular area with thin dental plates at the sides and a low median septum extending the length of the muscular area. The interior of the dorsal valve shows well developed teeth sockets projecting obliquely into the cavity of the valve.

This is a rather common species in northern Indiana, less common in southern Indiana.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Bunker Hill, Little Rock Creek and Charlestown.

Reticularia knappianum Nettleroth.

Spirifer knappianum Nett., Ky. Foss. Shells, 1889, p. 122, Pl. 7, fig. 14.

Nettleroth's original description.—"Shell subcircular, gibbous; hinge line shorter than the width of the shell; cardinal extremities rounded. Ventral valve gibbous in the upper part, and regularly curving to the front and sides. Mesial sinus well defined from front to apex of beak, somewhat shallow and rounded; it contains two faintly marked plications. Beak of medium size and curved over the area, which is high and concave, extending over about two-thirds of the entire width of the shell; fissure of medium size. Dorsal valve gibbous regularly convex on the sides, a little flattened at the cardinal extremity; mesial fold prominent and well defined to apex of beak, containing on its middle a well marked depression. Beak small, slightly arched over the sublinear area, which is somewhat concave. Surface marked by from six to eight rounded plications on each side of the fold or sinus; they are crossed by imbricating lines or striae which have irregular distances in the upper part but become regular and close set in the front part. The whole surface is covered with very fine closely set radiating striae, but there are no elongated nodes or tubercles as in *conradana*.

"The cardinal area is densely covered with fine closely set radiating striae."

I have not seen this shell. Nettleroth reports it to be rare.

Formation and locality.

"Corniferous"; Falls of the Ohio.

Reticularia wabashensis n. sp.

Pl. X, figs. 5, 5a, 5b.

Shell subcircular in outline, hinge line less than width of shell; cardinal extremities rounded. Ventral valve slightly more convex than dorsal, most gibbous at the umbo from which it slopes regularly to the front and sides; beak elevated and incurved over a rather high short area which scarcely reaches to the extremities of the hinge line; sinus broad and shallow reaching to the apex of the beak, somewhat extended in front. Dorsal valve regularly convex; mesial fold prominent, rounded or rarely with a depressed line in the middle; beak small, slightly arched over the sublinear area.

Surface marked by from three to five low rounded plications on each side the fold and sinus. Entire surface covered by fine radiating striae. A few specimens have traces of concentric striae.

This shell differs from *R. fimbriata* in the absence of surface tubercles, and in the comparatively shorter transverse diameter.

Common in northern Indiana.

Formation and locality.

Jeffersonville limestone; Pipe Creek Falls and Bunker Hill.

Gypidula romingeri var. *indianensis* nov. var.

Pl. VI, figs. 12, 12a.

Shell gibbous, inequivalve, width greater than the length. Ventral valve very gibbous, arching very regularly to the front and sides; a distinct mesial fold towards the front is marked by four strong plications. Dorsal valve convex near the umbo, and becoming nearly flat near the sides of the shell. A well developed sinus marks the anterior half of the valve which is marked by four plications of unequal strength extending rather more than half the length of the valve.

Surface marked by two or three obscure plications on each side of the fold and sinus near the front which become obsolete before reaching the middle of the shell.

Mr. John M. Clarke who kindly compared this shell with the types of *G. romingeri*, observes that it "resembles in many respects the

Gypidula romingeri, especially in the general character of its exterior, its form, proportions, etc., although it is much smaller in size than the prevailing shell in the Hamilton group of Michigan. There is also a marked difference in the degree of surface plication. This is generally much more pronounced in the Michigan form than in your specimen and extends from shoulder to shoulder of the shell."

While the surface plication of this variety is less pronounced than in *G. romingeri* it appears to be much more strongly developed than *G. comis* and in this respect at least it seems to be intermediate between these two types.

Only one specimen is known, which was found by the author and now belongs to the U. S. Geol. Survey.

Formation and locality.

Jeffersonville limestone; Falls of the Ohio.

MERISTELLA.

- | | | |
|-----|---|--------------------|
| A. | Beak of ventral valve closely incurved. | <i>M. nasuta.</i> |
| AA. | Beak of ventral valve not closely incurved. | <i>M. barrisi.</i> |

Meristella nasuta (Conrad).

Pl. XII, fig. 7.

M. nasuta Hall, Pal. N. Y., 1867, Vol. IV, p. 299, Pl. 48, figs. 1-25.

Hall's description in part.—"Shell suboval, ovate or subrhomboidal, the greatest width near or a little below the middle; length equaling or greater than the width. Valves convex, the ventral valve gibbous. A nasute or linguiform extension of the front in old shells. Ventral valve much the more convex, the greatest convexity being above the middle, becoming gibbous or extremely arcuate in old individuals, curving abruptly to the sides and cardinal margins, and more gradually to the front; umbo extremely prominent; beak neatly rounded and closely incurved, standing at a right angle with the plane of the axis, or in old shells directed forwards. The anterior portion is produced into a nasute or linguiform extension, usually without a sinus or any depression of the surface. In the young or half-grown individuals this feature does not appear. Dorsal valve less convex than the opposite, moderately and regularly convex in the young shell, becoming in the old shells gibbous above, curving regularly to the sides and often a little flattened at the baso-lateral margins; at about the middle of the length or sometimes above, the central portion of the valve becomes more gibbous and towards the front is abruptly elevated into a short rounded prominent fold, corresponding

to the linguiform extension of the opposite valve. The beak is moderately incurved, lying close beneath that of the opposite valve. The general aspect of the surface is that of a smooth shell with a few concentric lamellose lines. In perfect specimens, however, the entire surface is marked by close concentric striae, and usually by indistinct radiating striae, which are often more conspicuous in the partially exfoliated shell, and still more distinct in some of the casts."

This shell reaches a large size; one specimen in Mr. Green's collection measures one and a half inches in width. A well developed sinus is present in some shells but it is usually represented only by the extension at the front; one specimen shows a low fold in place of a sinus on the ventral valve.

Formation and locality.

Jeffersonville limestone; Falls of the Ohio.

Meristella barrisi Hall.

Pl. XII, fig. 6.

M. barrisi Hall, Pal. N. Y., Vol. IV, 1867, p. 304, Pl. 49, figs. 5-22.

Hall's description.—"Shell ovoid, more or less elongate and sometimes broadly ovate, gibbous; valves subequally convex, sinuate in front. Ventral valve gibbous in the middle, the greatest convexity a little above the middle of its length, and abruptly sloping to its sides, flattened below the middle, becoming depressed towards the front, which in old shells is produced into a short linguiform extension; umbo gibbous, the beak arching over the umbo of the opposite valve and not closely appressed. Dorsal valve little longer than wide, varying from moderately convex to gibbous, the greatest convexity being about the middle of its length; without distinct mesial fold, but abruptly elevated near the anterior margin, corresponding to the depression on the opposite side. Surface smooth or marked by regular concentric striae, which are sometimes crowded into wrinkles near the margin of the valves. The exfoliated shells sometimes show indistinct radiating striae. The muscular impression in the ventral valve is triangular and usually not deeply marked. The dorsal valve has a distinct median suture which extends nearly half the length of the valve, muscular area narrow elongate. This species presents considerable variety of form, from almost symmetrically oval to broadly ovate, with the greatest width below. The older shells are for the most part gibbous but some specimens are compressed in the lower half of the length. The mesial sinus is not

usually a very distinctive feature in half-grown shells; but in some individuals it begins about the upper third of the shell and affects the lower half and anterior part of the valve. The largest individuals have a length of about one inch and a quarter, with a width of one inch; in other specimens a length of one inch and an eighth gives a width of one inch and a depth of three-fourths of an inch. In a gibbous and somewhat elongate form the depth and width are as 5 to 6 and the length $8\frac{1}{2}$."

Mr. Green's collection contains four specimens which seem to belong to this species, the only ones which I have seen.

Formation and locality.

Jeffersonville limestone; Falls of the Ohio.

EUNELLA.

- | | | |
|-----|--|------------------------|
| A. | Shell sinuate or emarginate in front. | <i>E. sullivanii</i> . |
| AA. | Shell not sinuate or emarginate in front. | |
| | b. Beak of ventral valve extended, not closely incurved. | <i>E. harmonia</i> . |
| | bb. Beak of ventral valve rather abruptly incurved. | <i>E. lincklaeni</i> . |

Eunella sullivanii Hall.

Pl. XII, fig. 1.

Terebratula sullivanii Hall, Pal. N. Y., 1867, Vol. IV, p. 387, Pl. 60, figs. 5-10.

Hall's description.—"Shell elongate-ovate or subspatulate, truncate or emarginate in front, of moderate convexity; width and length about as four to six or seven to nine. Ventral valve a little less convex than the opposite; the beak much extended, neatly attenuate and perforate at the apex; the cardinal slopes rounded and a little concave near the hinge margin, usually depressed towards the front and sometimes a shallow sinus which reaches one-third or one-half the length of the valve. Dorsal valve a little more convex and considerably shorter than the ventral valve, usually flattened and sometimes depressed along the center of the lower part of the valve. Surface marked by fine close concentric striae which are neatly rounded on well preserved specimens and at intervals are crowded into more prominent ridges. Shell structure punctate. On cutting down a specimen of this species it has been found to possess a short simple loop, without appendage as in *Terebratula*. The larger specimens are about three-fourths of an inch in length."

This is a common species in northern Indiana, but has not been found in southern Indiana. The shells are seldom more than half

an inch in length. They seem to be less convex than the specimens figured by Hall. The greatly extended, nearly straight and attenuate beak is a constant feature but the outline of the shell is extremely variable. Some specimens are deeply emarginate at the front while others are rounded or truncate. The emarginate shells have a sinus in both valves; in the others it is wanting or but slightly developed.

Formation and locality.

Jeffersonville limestone; Pipe Creek Falls, Bunker Hill and Little Rock Creek, Cass County.

Eunella harmonia Hall.

Pl. XII, fig. 2.

Terebratula harmonia Hall, Pal. N. Y., 1867, Vol. IV, p. 388, Pl. 60, figs. 11-16.

Hall's description.—"Shell ovate or subspatulate, tapering somewhat abruptly to the beak, convex in the middle and compressed at the margins. Ventral valve regularly ovate from beak to front, moderately convex in the middle, a little gibbous above and depressed-convex or slightly concave towards the front, the upper part narrowing; the beak much extended, attenuate and arcuate, but not closely incurved; apex perforate, the slope to the cardinal margin scarcely concave; deltidial plates large. Dorsal valve moderately convex, sometimes a little more prominent along the middle in the upper part and depressed towards the front and sides. Surface marked by fine concentric lines of growth; the substance of the shell finely punctate. A well marked specimen of this species has been cut down on the dorsal side, revealing the loop, the divisions of which extend for more than one-third the length of the dorsal valve; the angle of return being visible, but not the connecting portion. Young specimens which I refer to this species are more gibbous than the older ones. The larger specimens are from six-eighths to seven-eighths of an inch wide."

This species is rather common in northern Indiana.

Formation and locality.

Jeffersonville limestone; Bunker Hill, Pipe Creek Falls and Falls of the Ohio.

Eumella lincklaeni Hall.

Pl. XII, figs. 3, 3a.

Cryptonella lincklaeni Hall, Pal. N. Y., 1867, Vol. IV, p. 397, Pl. 60, figs. 49-65.

Hall's description.—"Shell ovate or subelliptical, usually broader below the middle, varying from moderately convex to very gibbous and sometimes subcylindrical; front rounded subtruncate or a little depressed. Ventral valve varying from moderately convex to gibbous, somewhat regularly arcuate in longitudinal outline, sometimes a little flattened towards the front or marked by a narrow mesial depression. Beak more or less abruptly incurved and truncate by a foramen of moderate size; umbonal slope rounded or subangular, and concave towards the cardinal margin. Dorsal valve varying from moderately convex to gibbous; the greatest convexity about the middle of the length, and thence curving regularly to the sides and base. Surface marked by fine concentric striae of growth, which are sometimes crowded together towards the front, causing a thickening of the shell. Shell structure distinctly punctate. This species presents some variety of form from subelliptical to broad ovate. The length of a large individual is a little more than three-fourths of an inch, with a width of five-eighths of an inch and a depth of three-eighths; while another form which I refer to the same has a length and width of half an inch with a depth of a little more than a quarter of an inch. Some of the smaller individuals are a little more than a quarter of an inch in length."

This is a very common species.

Formation and locality.

Jeffersonville limestone; Pipe Creek Falls, Bunker Hill and Falls of the Ohio.

CRYPTONELLA.

- A. Shell very gibbous, length of dorsal valve greater than the width. *C. oval's.*
 AA. Shell moderately gibbous, length and breadth of dorsal valve about equal. *C. lens.*

Cryptonella lens Hall.

Pl. XI, fig. 9.

Terebratula lens Hall, Pal. N. Y., 1867, Vol. IV, p. 386, Pl. 60, figs. 1-4.

Hall's description.—"Shell ovate broadly elliptical or lenticular below the beak, which is abruptly tapering; moderately gibbous, the valves subequally convex, the greatest width a little below the mid-

dle, the width about four-fifths as great as the length, and the depth nearly equal to half the length. Ventral valve a little less convex than the dorsal, the beak moderately incurved and broadly truncated by the foramen; no visible sinus or elevation in the middle of the valve. Dorsal valve broadly elliptical or subcircular, somewhat regularly convex; the beak closely appressed below that of the opposite valve. Surface marked by concentric lines of growth; the shell structure distinctly punctate. The length of an ordinary specimen is seven-tenths of an inch, the width six-tenths of an inch."

This is a rather common fossil in northern Indiana but rare in southern Indiana.

Formation and locality.

Jeffersonville limestone; Bunker Hill, Pipe Creek Falls and Falls of the Ohio.

Cryptonella ovalis Miller.

Pl. XI, figs. 8, 8a.

C. ovalis Mill., advance sheets 17th Rep. Geol. Surv. Ind., 1891, p. 76, Pl. 13, figs. 1-2.

Miller's original description.—"Shell subovate, gibbous rounded in front, greatest width slightly above the middle. Surface concentrically banded, the bands apparently imbricating. Shell structure punctate. Ventral valve more gibbous than the dorsal; arcuate from the beak to the front; greatest convexity above the middle. Beak prominent incurved inflected along the umbonal slopes, truncated by a small foramen, no hinge area. Dorsal valve shorter than the ventral, less gibbous, greatest convexity above the middle. Beak incurved beneath the beak of the ventral valve. No hinge area. This species resembles *Cryptonella planirostra*, but is much more gibbous, and the ventral valve is much more convex than the dorsal, while in that species the dorsal valve is most convex. Our specimens vary greatly in length from three to seven-tenths of an inch."

This species closely resembles those specimens of *Cranaena romingeri* which are not sinuate in front and may prove to be a variety of that species. It is not very common.

Formation and locality.

Jeffersonville limestone; Bunker Hill and Falls of the Ohio.

Terebratula jucunda Hall.

Pl. XI, figs 10, 10a.

T. jucunda Hall, Pal. N. Y., 1867, Vol. IV, p. 390, Pl. 60, figs. 29-31.

Hall's description.—"Shell subcircular or very broadly ovate, the length and width about equal, regularly rounded below and abruptly narrowing above the middle. Ventral valve gibbous in the middle, curving abruptly to the base and baso-lateral margins; beak obtuse, and incurved over the umbo of the opposite valve; apex truncated by a rounded foramen. Dorsal valve rather regularly convex, the greatest convexity a little above the middle, curving to the base and baso-lateral margins. Length of specimens a little more than three-eighths of an inch. On cutting down the dorsal side, the loop is visible, showing the terebratuloid character."

This species resembles closely in external features some of the shorter forms of *Cryptonella lens*, from which it is difficult to distinguish it. The outline of the shells referred to this species is more nearly circular than Hall's figure, resembling in this respect *Terebratula ontario*. It is not very abundant.

Formation and locality.

Jeffersonville limestone; Pipe Creek Falls, Bunker Hill and Falls of the Ohio.

Cranaena romingeri Hall.

Pl. XII, fig. 4, 4a.

Terebratula romingeri Hall, Pal. N. Y., 1867, Vol. IV, p. 389, Pl. 60, figs. 17-25, 66, 67.

Hall's description.—"Shell ovate, more or less gibbous, truncate or slightly sinuate in front. Ventral valve gibbous above the middle; umbo gibbous, inflated; beak prominent, incurved over the opposite beak, and truncated by a round foramen which is often mainly anterior to the apex and completed on the lower side by two deltidial plates; cardinal slopes rounded, often depressed in the middle toward the front. Dorsal valve extremely gibbous, little longer than wide, the greatest convexity at the middle or above. Surface marked by fine concentric striae which are often crowded into prominent wrinkles toward the front. Shell structure finely punctate. The interior shows a short terebratuliform loop, which is abruptly recurved at its lower extremities."

The sinus in the ventral valve is more distinctly developed in the specimen figured than in any other specimen which has been ob-

served. In some of the shells referred to this species it is entirely wanting. This is a rather rare species.

Formation and locality.

Jeffersonville limestone; Bunker Hill, Pipe Creek Falls and Falls of the Ohio.

Camarospira eucharis Hall.

Pl. XII, fig. 5.

Camarophoria eucharis Hall, Pal. N. Y., 1867, Vol. IV, p. 368, Pl. 57, figs. 40-45.

Hall's original description.—"Shell broadly ovate, length a little greater than the width. Ventral valve ovate with the beak extended and arcuate, gibbous above the middle, curving gently to the sides, broadly flattened or a little depressed toward the front and terminating upwards in a broad short linguiform extension, giving the anterior margin an abruptly rounded or truncate aspect. Dorsal valve gibbous in the upper part, more abruptly elevated along the middle and towards the front, slightly concave on each side of the broad undefined elevation; anterior margin sinuate. Beak closely incurved into the cavity beneath the apex of the ventral valve. Surface marked by fine concentric striae which at intervals are crowded into lamelliform ridges. Shell apparently impunctate."

Two of my specimens show traces of fine radiating striae near the margin of the shell. This species is not very common.

Formation and locality.

Jeffersonville limestone; Bunker Hill, Pipe Creek Falls, Charles-town and Falls of the Ohio.

PELECYPODA.

AVICULOPECTEN.

- | | |
|--|--|
| <p>A. Ears not well defined.</p> <p>AA. Ears well defined.</p> <p> b. Radiating striae fasciculate.</p> <p> bb. Radiating striae not fasciculate.</p> <p> c. Test marked by coarse angular ribs, which are crossed by strong distant lamellose concentric ridges.</p> <p> cc. Test marked by moderately strong radiating striae which are crossed by fine concentric striae.</p> <p> d. Test marked by strong sharp rays, anterior ear small, posterior ear marked by rays.</p> <p> dd. Test marked by rather fine radiating striae, anterior ear large, posterior ear usually without rays.</p> | <p><i>A. (Pterinopecten?) terminalis.</i></p> <p><i>A. fasciculatus.</i></p> <p><i>A. crassicostata.</i></p> <p><i>A. exacutus.</i></p> <p><i>A. princeps.</i></p> |
|--|--|

Aviculopecten princeps (Conrad) Hall.

Pl. XII, fig. 10.

A. princeps Hall, Pal. N. Y., Vol. V, Pt. I, 1884, p. 1, Pl. 1, figs. 10, 11; Pl. 5, figs. 18, 19, 23, 24; Pl. 6, figs. 1-9; Pl. 24, fig. 7; Pl. 81, figs. 13-17.

Hall's description in part.—"Shell large, obliquely broad, ovate; axis inclined more than 60 degrees to the hinge line; length and height nearly equal, varying within moderate limits; anterior margin convex; the convexity increasing to the middle of the postero-lateral side, thence truncated and extending in a straight line to the beak, making an angle of from 30 degrees to 40 degrees with the hinge line. Valves depressed; left valve regularly convex; right valve nearly flat or very moderately convex. Hinge line straight, having a length of from two-thirds to more than three-fourths the length of the shell, and extending anteriorly as far as the antero-lateral margin with little variation. Beaks obtuse, rounded anterior to the middle of the hinge. Umbo subtending an angle of about 130 degrees. Ears large, triangular; posterior one the larger and defined by the abrupt slope of the side of the umbo, while the anterior ear is separated by a distinct sulcus; lateral margins concave, becoming convex at the hinge line. Byssal sinus broad, rounded, well defined and indicated on the ear by a sulcus extending to the extremity of the beak. The right valve is flatter and proportionally broader than the left. The limits of the ears are clearly indicated by the rapid slope of the umbo, and the absence of strong radiating lines of ornamentation. Test thin, marked by numerous regular alternating rays, which increase in number by interstitial additions, and become broader and stronger toward the margins. These radiating ribs are crossed by very fine sharp striae of growth. On the ears the rays are nearly obsolete, and the lines of growth are sharper and stronger than on the body of the shell."

This is not a common species. *A. pecteniformis* and *A. parilis* have been recognized by Hall as synonyms of *Aviculopecten princeps*.

Formation and locality.

Jeffersonville limestone; Keesport, Cass County and Falls of the Ohio.

Aviculopecten exacutus Hall.

Pl. XII, fig. 11.

A. exacutus Hall, Pal. N. Y., Vol. 5, Pt. I, 1884, p. 8, Pl. 3, figs. 18-22.

Hall's description.—"Shell of medium size, obliquely broad ovate; greatest longitudinal diameter below the middle; height nearly equal

to the length, transverse axis oblique to the hinge line; basal margin full and regularly rounded; posterior margin extended beyond the ear and more convex than the anterior. Valves equally convex; the byssal sinus larger in the right valve and the umbo less ample. Hinge line straight; length four-fifths of the longitudinal diameter, extending nearly as far as the anterior margin. Beaks obtuse, oblique, anterior to the middle of the hinge and of the valve; umbo ample. In some specimens of the left valve the beak arches over the hinge line, while in the right valve the beak rises from the hinge. Ears triangular; posterior one somewhat the larger, margin concave, extremely acute; defined from the umbo by a broad, shallow sulcus, an obscure carination, and an abrupt change in the surface characters to subdued striae. The anterior ear is well defined by the sulcus extending from the angular byssal sinus. Test ornamented by about forty strong, sharp continuous rays, alternating in size with broader and concave interspaces crossed by fine sharp crenulating concentric striae. The ears show finer concentric striae and a few rays. Pallial line impressed continuous, extending parallel to the margin of the shell about half way from the beak, terminating near the center of the posterior side, in a subcircular muscular impression, marked with regular concentric striae. The cast preserves traces of the exterior markings, but presents no definite characters of the hinge. The largest specimen has a height of 35mm. A medium sized specimen has a height of 26mm; length 27mm; hinge line 24mm."

Formation and locality.

Jeffersonville limestone; Pipe Creek Falls.

Aviculopecten fasciculatus Hall.

A. fasciculatus Hall, Pal. N. Y., Vol. V, Pt. I, 1884, p. 11, Pl. 5, figs. 7-19; Pl. 81, figs. 1-4.

A. fasciculatus Nettleroth, Ky. Foss. Shells, 1889, p. 224, Pl. 3, fig. 4.

I have not seen this species. Nettleroth reports it to occur in the "Corniferous limestone" around the Falls of the Ohio.

Aviculopecten (Pterinopecten?) terminalis Hall.

Pl. XII, figs. 12, 13; XIII, fig. 1.

A. (Pterinopecten?) terminalis Hall, Pal. N. Y., Vol. V, Pt. I, 1884, p. 32, Pl. 1, fig. 3.

Hall's description.—"Shell small, rhomboidal body of the shell obliquely ovate; length a little greater than the height, margins

regularly rounded, somewhat extended behind. Left valve very convex. Right valve unknown. Hinge line straight central, equal to the length of the shell. Beak acute, prominent, directed a little forward, arching over the hinge line. Umbo elevated, subtending a right angle. Ears triangular; margins concave; extremities acute. Posterior ear larger undefined. Anterior ear limited by a shallow sulcus. Byssal sinus moderate. Test thin marked by fine sharp radii, with wider interspaces, which show one, two or three finer rays, crossed by fine crenulating lines of growth. The same characters of marking extend over the ears. Internal characters not known. The specimen is 14mm in length, 12mm in height, with hinge line 15mm."

The specimens which I have referred to this species are considerably smaller than the specimen described by Hall, but in other respects there appears to be no important differences.

Formation and locality.

Jeffersonville limestone; Bunker Hill and Pipe Creek Falls.

Aviculopecten crassicosata H. and W.

A. crassicosata Hall and Whitfield, 24th Rept. N. Y. State Mus. Nat. Hist., p. 188.

Hall and Whitfield's original description.—"Shell below medium size, left valve depressed, convex; body of shell oblique, hinge line straight, equal to three-fourths the length of the shell; anterior wing very small, separated from the body of the shell by an abrupt deep sinus; posterior wing narrow, obtusely pointed and extending nearly as far as the posterior extremity. Surface marked by strong coarse angular ribs, of which there are about thirteen or fourteen on the body of the shell, with intermediate smaller ones; about five obscure rays on the posterior wing; the radiating costae crossed by coarse distant lamellose concentric ridges."

This species was described from specimens obtained in "limestone of the age of the Upper Helderburg group" at the Falls of the Ohio. I have not seen it. Nettleroth reports it from the "Hydraulic limestone" (Sellersburg beds).

Limoptera cancellata Hall.

Pl. XIII, fig. 6.

L. cancellata Hall, Pal. N. Y., Vol. V, Pt. I, p. 244, Pl. 26, figs. 1-4; Pl. 92, figs. 1-3.

Hall's description.—"Shell large; body suberect, broadly ovate; axis nearly vertical to the hinge line; wing expanded; height and

length nearly equal; ventral margin very broadly rounded; anterior margin expanded below and contracted above; postbasal side expanded, recurved somewhat abruptly and extending in a subarcuate line to the beak. Valves very unequal. Left valve moderately convex below, gradually becoming gibbous and arcuate above. Right valve concave below, flat in the middle and depressed convex in the umbonal region. Hinge line straight, less than the length of the valve. Beak of left valve prominent, anterior to the middle of the valve, acute, inclined forward and arching over the hinge line. Umbonal region prominent gibbous; abruptly limited on either side. In the right valve the beak does not rise above the cardinal line. Umbonal region defined on the anterior side by a distinct oblique fold or ridge, and on the posterior side by a well-marked depression limiting the wing, subtending an acute angle. Ear small, limited by a shallow sinus below. Wing large, triangular, extending more than half the height of the shell toward the base; margin gently concave and slightly recurving toward the hinge line; extremity angular. Test of moderate thickness, marked by somewhat distant rounded, abruptly elevated radii, with wider intermediate flat spaces, which are sometimes marked by one or more smaller rays. In the partial cast these rays are crossed and the intermediate spaces cancelled by fine concentric striae. Toward the ventral and basolateral margins the shell is lamellose and the radii become obsolete. The concentric striae are crowded upon the wing and the radii are less conspicuous than on the body of the shell. Ligamental area in left valve large; smaller in the right valve. The pallial line in the left valve forms a distinct nodose ridge which extends from the rostral cavity in a slightly arcuate line to below the middle of the valve. In the right valve the pallial line in the cast extends along the ridge, limiting the body of the shell from the anterior alation. In the cast of the left valve the umbonal cavity is marked by numerous nodes indicating pits in the shell for muscular attachment. The posterior muscular impression is large, occupying the post-umbonal slope at a point half-way from the beak to the base of the shell.

"A cast of the interior has a length of about 78mm, height of 77mm and hinge line less than the length of the shell."

This is not a common species.

Formation and locality.

Jeffersonville limestone; Falls of the Ohio, and Watson.

PTERINOPECTEN.

- A. Surface with concentric undulations.
- b. Concentric undulations numerous, elevated into strong nodes in crossing the rays. *P. nodosus.*
- bb. Concentric undulations about six to ten, not elevated into nodes in crossing the rays. *P. undosus.*
- AA. Surface without concentric undulations. *P. reflexus.*

Pterinopecten reflexus Hall.

Pl. XII, fig. 8.

P. reflexus Hall, Pal. N. Y., Vol. V, Pt. I, 1884, p. 58, Pl. 82, fig. 8.

Hall's original description.—"Shell of medium size, rhomboidal, moderately oblique; length one-sixth greater than the height; outline regularly curved to the postero-basal margin, thence extending posteriorly. Left valve depressed convex; margin reflexed. Right valve unknown. Hinge line straight, extended posteriorly, exceeding the greatest length of the shell. Beak obtuse, low rounded, directed forward. Umbonal region convex subtending an obtuse angle. Posterior ear large flat, triangular, scarcely defined from the umbo; margin slightly convex; extremity obtuse. Anterior ear small, triangular, convex, limited by an undefined sulcus and a shallow byssal sinus; margin nearly straight; extremity obtuse. Test marked by fine rounded striae, alternating with finer lines; intermediate spaces flat. The same surface marking continued in a subdued degree upon the posterior ear, and somewhat more strongly on the anterior slope and anterior ear. Internal characters unknown."

In some specimens the surface is marked by numerous concentric lines of growth. This is a common species at the Pipe Creek localities.

Formation and locality.

Jeffersonville limestone; Bunker Hill, Pipe Creek Falls and Falls of the Ohio.

Pterinopecten undosus Hall.

Pl. XII, fig. 9.

The only specimen of this species which I have found is very poorly preserved. It is marked by six strong concentric undulations, which are crossed by closely arranged rounded striae.

Formation and locality.

Jeffersonville limestone; Bunker Hill.

Pterinopecten nodosus Hall.

P. nodosus Hall, Pal. N. Y., Vol. V, Pt. I, Pl. 82, fig. 13.

Hall's original description.—"Shell small, subrhomboidal, slightly oblique, form not fully known. Left valve very convex. Beak prominent, nearly erect. Umbonal region very prominent; the limits distinct on the anterior and obscure on the posterior side; subtending an acute angle. Posterior ear large, triangular; margin very slightly concave; extremity angular.

"Anterior ear not preserved in the specimen. Test thin marked (in a partially exfoliated specimen) by strong rounded rays with intermediate finer ones, and fine concentric undulating, elevated striae, with numerous concentric undulations which increase in frequency from the beak to the margin, and on crossing the larger rays, are elevated into strong nodes. On the posterior ear the rays are fine, equal and continuous. Interior characters unknown.

"This species is described from an imperfect specimen of the left valve, but it is so remarkable in its nodose undulations that it is readily distinguished from every other form."

This species is known only by the type specimen.

Formation and locality.

"Corniferous limestone"; Falls of the Ohio.

Actinopteria boydi (Conrad).

Pl. XIII, fig. 2.

A. boydi Hall, Pal. N. Y., Vol. V, Pt. I, p. 113, Pl. 19, figs. 2-24, 26-30; Pl. 84, figs. 16, 17.

Hall's description.—"Shell of medium size, rhomboidal; barely ovate, varying in proportions, the longitudinal axis at an angle with the hinge line of from 45 degrees to 60 degrees; length varying from nearly equal to one-fourth greater than the height; margins regularly rounded below, straight and nearly vertical for a short distance in front; post-basal side extended. Valves convex, the right valve a little less convex than the left. Hinge straight from the anterior side of the beak to the posterior extremity. Beak anterior, acute, prominent, inclined forward, rising above the hinge in the left valve. Umbonal regions prominent, subtending an acute angle. Ear short, oblique, limited by a deep but not sharply defined sulcus. Wing large, triangular not distinctly separated from the body of the shell. Margin concave; extremity acute. In the right valve the ear is somewhat more extended, the sulcus is not strong, but the byssal sinus is

marked; the wing is proportionally larger and usually more acute at the extremity. Test thick; the left valve in well preserved specimens, is marked by numerous strong simple, sharp rays, which are continuous from the umbo to the margin with rarely intercalated finer rays, crossed by regular sharp, elevated concentric lamellae. On the wing the rays are more subdued while the concentric lamellae are strong. The ear is marked only by the crowded concentric striae. On the right valve the radii are obsolete on the body and well marked on the wing, and the lamellose expansions are conspicuous. In some cases they appear as undulating elevated lamellae. Pallial line extending parallel to the margin of the shell and terminating in a muscular impression on the posterior slope. A small muscular impression is also seen just in front of the beak, and obscure indications of one or two cardinal teeth. Ligamental area narrow, striated, marked by two or three slender grooves which are slightly divergent from the hinge line. One of the original specimens of *A. quadrula* (= *A. boydi*) has a length of 30mm, height and hinge line each 28mm. A similar specimen has length of 25mm, height and hinge line each 23mm."

This species occurs abundantly in certain layers at a few localities. Usually, however, it is entirely absent.

Horizon and locality.

Jeffersonville limestone; Pipe Creek Falls, Lancaster and Falls of the Ohio.

PTERINEA.

- | | |
|--|----------------------|
| A. Shell very large, wing not strongly defined. | <i>P. grandis.</i> |
| AA. Shell not very large, wing strongly defined. | <i>P. flabellum.</i> |

Pterinea flabella (Cov.) Hall.

This species differs from *P. grandis* in its smaller size, more strongly defined wing and shorter form.

It is a rare species.

Horizon and locality.

Sellersburg beds; Lancaster and Falls of the Ohio.

Pterinea grandis Hall.

P. grandis Hall, Pal. N. Y., Vol. V, Pt. I, 1884, p. 91, Pl. 83, fig. 14.

Hall's original description.—"Shell very large, capacious, oblique, subrhomboidal, body broadly ovate; length about one-fifth greater than the height; margins regularly rounded, broad along the base,

and a little produced on the posterior side. Left valve convex. Right valve unknown. Hinge line straight, apparently somewhat less than the length of the valve, (imperfect in the specimen). Beak obtuse, prominent, directed forward. Umbonal region gibbous, subtending an angle of about 90 degrees. Wing large, triangular, not distinctly defined, margin rounded with a gentle concavity near the junction of the valve. Ear not observed. Test thick, marked by distant strong radii from the umbo to the base; the interspaces having alternate larger and smaller rays; crossed by concentric undulating lamellose striae of growth. Interior unknown.

"The specimen has a length of 120mm, height 100mm and the hinge line from the beak to the extremity of the wing, 95mm."

No other specimens besides the types have been found.

Formation and locality.

"Upper Helderburg limestone"; Scott County.

GLYPTODESMA.

- A. Surface with strong radiating striae. *G. cancellatum.*
 AA. Surface without radiating striae.
 b. Limitation between the body and posterior wing strongly defined; shell not very robust and surface not strongly marked by the fascicles of striae. *G. erectum.*
 bb. Limitation between the body and the posterior wing not strongly defined; shell robust and surface strongly marked by the fascicles of striae. *G. occidentale.*

Glyptodesma occidentale Hall.

Pl. XIII, figs. 4, 5; Pl. XIV, fig. 1.

G. Occidentale Hall, Pal. N. Y., Vol. V, Pt. I, 1884, p. 157, Pl. 15, fig. 12; Pl. 86, fig. 9.

Hall's description.—"Shell large, broadly ovate; body nearly erect; height and length about equal; margins regularly curved. Left valve very convex, gibbous on the umbo. Right valve unknown. Hinge line straight, equaling or greater than the length of the shell. Beaks anterior to the shell directed slightly forward, acute and prominent. Umbonal region gibbous, defined anteriorly by the broad sulcus and on the anterior side sloping abruptly to the wing. Anterior wing short, defined by a deep sulcus and a marked byssal sinus. Posterior wing large, depressed convex, much extended, joining the body of the shell below the middle, and defined only by the recurving of the striae; margin concave; extremity acute. Test thick marked by numerous fine striae of growth, which at intervals are

crowded into fascicles, producing an undulating surface. The striae are more closely arranged and become lamellose on the anterior part of the shell. On the posterior wing the striae are regular, and at distant intervals a single striae becomes sharply elevated. Interior unknown. The specimen of this species described has a length of 60mm; height 66mm, and hinge line equal to or greater than the length of the shell."

The right valve of this species is much less convex than the left; the umbonal region is moderately convex, while the lower half of the valve is nearly flat. The surface is somewhat rugose from the fascicles of striae, but less so than that of the left valve.

A cast of the interior shows a large posterior muscular impression near the middle of the posterior slope. From the lower anterior side of this impression the pallial line curves downward and forward, and then upward, terminating in the rostral cavity.

This is a very abundant species in the chert of the Sellersburg beds.

Formation and locality.

Sellersburg beds; Falls of the Ohio, Scipio, Paris Crossing, Lancaster, Charlestown, Hanover, and Bartholomew County.

Glyptodesma erectum Hall.

G. erectum Hall, Pal. N. Y., Vol. V, Pt. I, p. 153, Pl. 11, figs. 1-10; Pl. 12, figs. 1-3, 5-9; Pl. 13, figs. 1-4, 12-15; Pl. 25, figs. 14-17; Pl. 86, figs. 1-8; Pl. 87, figs. 1-3.

This species is most closely related to *G. occidentale*, and a study of a large series of specimens would probably show that the latter is a variety of *G. erectum*. *Glyptodesma erectum* differs from *G. occidentale*, according to Hall, in its less robust form, in being less orbicular, and less gibbous in the umbonal region; the surface is less rugose from the undulations of the fascicles of striae and the limitation between the body and the posterior wing is less strongly defined.

Horizon and locality.

Jeffersonville limestone; Scipio, Lancaster, and Falls of the Ohio.

Glyptodesma cancellata Nettleroth.

G. cancellata Nett., Ky. Foss. Shells, 1889, p. 227, Pl. 5, fig. 1.

Nettleroth described this species from a specimen found in the "Corniferous limestone" at the Falls of the Ohio. No other specimens have been found so far as I know.

Leptodesma rogersi Hall.

Pl. XIII, figs. 3, 3a, 3b.

L. rogersi Hall, Pal. N. Y., Vol. V, Pt. I, p. 176, Pl. 21, figs. 1-9.

Hall's description.—"Shell of small or medium size, subrhomboidal; body ovate, very oblique; length greater than the height, anterior and basal margins broadly rounded; posterior margin extended and abruptly recurved. Valves equally convex above. Right valve somewhat depressed below, comparatively higher than the left. Hinge line straight, longer than the length of the shell. Beak subanterior, obtuse, nearly erect, prominent. Umbonal region gibbous, oblique. The anterior extremity is scarcely alate or auriculate, consisting of a rounded extension, straight above and highly sinuate at the base. Wing comparatively large, triangular, joining the body of the valve near the posterior extremity, defined by the crowding and curving of the concentric striae; margin nearly straight for five-sixths of its extent, then acutely recurving; extremity prolonged into a mucronate spine which extends beyond the posterior limit of the valve. In the right valve the wing is less deeply sinuate. Test thin, marked by closely arranged concentric striae, which at irregular intervals are crowded into fascicles, producing a gently undulating surface. On the wing the striae are closely arranged and just below the hinge line are turned backward along the spiniform extension of the wing. Interior unknown. Ligamental area narrow, several fine grooves parallel to the hinge."

All of my specimens are small; the largest measures 30/50 of an inch from the beak to the base, 24/50 of an inch in height and 30/50 along the hinge line to the base of the mucronate extension. The mucronate extension of the hinge line seen in the New York specimens has not been observed. This may be due to the imperfection of the specimens secured. This species has been found at but one locality, where it occurs abundantly in a limestone.

Formation and locality.

Jeffersonville limestone; Pipe Creek Falls.

Ptychodesma knappianum H. and W.

Pl. XV, figs. 2, 2a, 2b, 2c.

P. knappianum Hall & Whitfield, 24th Rep. N. Y. State Mus. Nat. Hist., 1872, p. 192.

Hall and Whitfield's original description.—"Shell obliquely ovate, compressed posteriorly, and more or less ventricose in the middle

and toward the front; hinge line short, beaks subterminal; anterior end truncated at right angles to the hinge line. Surface marked by fine concentric striae with more distinct laminae of growth. Ligamental area well developed, sublinear, deeply grooved on the sides, the grooves and intermediate ridges slightly inclined toward the hinge line on both sides of the apex. The area shows seven grooves and eight ridges on each valve; but these increase in number with the growth of the shell, and are therefore not of specific value. This shell bears much resemblance externally to some forms of *Modiomorpha* and *Nyassa*; but the deeply grooved ligamental area is a distinctive feature."

The hinge has about three short oblique hinge teeth just below the beaks, and two long teeth near the posterior end of the hinge, having a direction parallel with it. In the larger specimens the upper margins of the hinge area are usually distant, showing the deeply grooved area; the smaller specimens have the margins of the hinge area closely appressed and the area is not exposed.

Formation and locality.

Sellersburg beds; Charlestown and the Falls of the Ohio.

Schizodus contractus Hall.

Pl. XV, fig. 9.

S. contractus Hall, Pal. N. Y., Vol. V, Pt. I, 1885, p. 451, Pl. 75, figs. 27, 28.

Hall's original description.—"Shell small, ovate, cuneate; length one-third greater than the height; basal margins regularly curving. Posterior extremity pointed, nasute below, obliquely truncate above. Cardinal line more than half the length of the shell. Anterior end short, regularly rounded. Valves regularly convex below, gibbous in the middle and above. Beaks at about the anterior third prominent, incurved, flattened. Umbonal slope distinctly angular, extending to the post-inferior extremity. Post-cardinal slope concave, marked by a narrow depression near the cardinal line. Surface marked by fine elevated sharp filiform concentric striae, which become fasciculate towards the margin; also sometimes marked by very fine radiating striae. Anterior muscular impressions strongly limited posteriorly. Two specimens measure respectively 14 and 15mm in length and 10mm in height."

This species is very rare. My collection contains only one specimen. It is much smaller than the specimens figured by Hall, measuring in length $32/50$ of an inch and in height $34/50$ of an inch.

In other respects it agrees with Hall's figures and description. The muscular impressions are situated near the beak, the anterior impression being slightly nearer the beak than the posterior.

Formation and locality.

Jeffersonville limestone; Newbern, Bartholomew County, and Lancaster.

PARACYCLAS.

- A. Anterior end of shell produced and flattened, posterior slope marked by an oblique sulcus. *P. ohioensis.*
- AA. Anterior end of shell not flattened, posterior slope without an oblique sulcus.
 - b. Beaks anterior, elliptical in shape. *P. elongata.*
 - bb. Beaks central or subcentral, circular or subcircular in shape.
 - c. Shell medium size, marked by strong subangular concentric ridges. *P. lirata.*
 - cc. Shell large, marked by fine concentric striae, aggregated into fascicles at irregular distances. *P. elliptica.*

Paracyclas elliptica Hall.

P. elliptica var. *occidentalis*, Hall and Whitfield, 24th Ann. Rep. N. Y. State Mus. Nat. Hist., p. 189, 1872.

Hall and Whitfield's description.—"Shell orbicular, of medium size, nearly circular in outline, with regularly curving valves and small, closely appressed and approximate beaks, centrally situated. Cardinal border very slightly excavated just anterior to the beaks, but rounded and full behind. The sinus just within the posterior cardinal margin (so characteristic of the group) is but slightly developed. Surface marked by strong, sharp striae which are often developed into irregular concentric ridges."

This species is rather common in some localities.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Falls of the Ohio, Watson, Charlestown, Lexington, Pipe Creek Falls and Keysport.

Paracyclas lirata (Conrad).

Pl. XV, fig. 10.

P. lirata Hall, Pal. N. Y., Vol. V, Pt. I, 1885, p. 441, Pl. 72, figs. 2-19; Pl. 95, fig. 19.

Hall's description.—"Shell of medium size, subcircular or broadly elliptical; length a little greater than the height; margins regularly rounded. Cardinal line short, less than half the length of the shell.

Valves moderately convex below, becoming gibbous on the middle and above. Beaks anterior to the center, small, appressed, rising but little above the hinge line. Post-cardinal slope not defined. Surface marked by fine concentric striae, and by strong subangular concentric ridges, which are more or less sharply defined, depending upon the condition of the specimen and the nature of the matrix in which the fossil is imbedded. Ligamental grooves distinctly marked and only moderately divergent from the cardinal margin.

"Four specimens measure respectively 15, 19, 25, and 29mm in length and 13, 18 and 25.5mm in height."

This is a common species in the "Cement rock" of southern Indiana.

Horizon and locality.

Sellersburg beds; Falls of the Ohio, Lexington and Charlestown.

Paracyclas elongata Nettleroth.

P. elongata Nett., Ky. Foss. Shells, 1889, p. 210, Pl. 2, fig. 8.

Nettleroth's original description.—"This shell resembles very closely *P. lirata* of Conrad, but differs from it greatly in form, so much so, that any one must distinguish the two species at the first glance. While *P. lirata* has almost the shape of a regular circle, this shell has the form of an ellipse, in which the larger axis exceeds the smaller one considerably. In this shell the width is only about three-fourths of the length. It is covered with strong concentric striae which are sharply marked, almost all parallel to each other and equidistant. The depression of the dorsal margin in front of the beaks is very conspicuous; the illustration does not show this at all or very faintly. The beaks are close to the anterior margin; the anterior slope is steep, while the posterior one has little fall. The size of this shell varies in different specimens; it agrees generally with that of *P. lirata*. Both valves are moderately convex. It differs from *P. lirata* by its elongate shape, and by the position of its beaks, which is subanterior, while the position of the beaks in *P. lirata* is almost central."

This species is known only from Nettleroth's description.

Formation and locality.

Sellersburg beds; Clark County.

Paracyclas ohioensis (Meek).

Pl. XV, figs. 1, 1a, 1b.

Lucina (*Paracyclas*) *ohioensis* Meek, Pal. Ohio, Vol. I, 1873, p. 199, Pl. 18, fig. 7.

Meek's description.—"Shell apparently not attaining a medium size, compressed, more or less nearly circular; beaks small, central, depressed nearly to the dorsal line, and contiguous; anterior margin rather abruptly compressed above, just in front of the beaks; hinge margin short and rounding into the posterior dorsal outline; surface ornamented with small more or less regular, concentric undulations, most strongly defined on the umbones and very fine lines of growth; posterior dorsal slopes of each valve marked by a strongly oblique sulcus, extending from the back part of the beaks to the upper part of the posterior margin, to which it imparts a slightly sinuous outline at its termination. Length, 0.46 inch; height, 0.42 inch; convexity, 0.18 inch."

This is one of our rarest species. I have seen but four specimens, which differ considerably from each other and also from Meek's figures in outline, but which probably belong to the same species.

Formation and locality.

Sellersburg beds; Falls of the Ohio and Burnsville, Bartholomew County.

Paracyclas oeterlonii Nettleroth.

After examining the types of this species I am inclined to regard them as distorted specimens of *Paracyclas elliptica*.

Cardiopsis crassicotata Hall and Whitfield.

C. crassicotata Hall and Whitfield, 24th Rep. N. Y. State Mus. Nat. Hist., p. 188; 27th Rep. N. Y. State Mus. Nat. Hist., 1875, Pl. 12, fig. 9.

This species was described from specimens found in the "upper limestone" at Louisville, Ky. It doubtless occurs in southern Indiana, but I have not seen it.

NUCULA.

- A. Beaks subcentral.
- b. Shell small, less than $\frac{1}{2}$ of an inch in length. *N. lamellosa.*
 - bb. Shell large, more than one inch in length. *N. hanoverensis.*
- AA. Beaks anterior.
- c. Surface marked by radiating striae which cross the strong concentric undulations. *N. tirata.*
 - cc. Surface without radiating striae, marked by concentric striae.
 - d. Anterior margin almost vertically truncate. *N. notica.*
 - dd. Anterior margin not vertically truncate.
 - e. Anterior and posterior extremities pointed, height and depth of shell equal. *N. herzeri.*
 - ee. Anterior and posterior extremities rounded, height greater than the depth.
 - f. Shell subequilateral, triangular in form. *N. corbuliformis.*
 - ff. Shell rhomboid, ovate in form. *N. neda.*

Nucula hanoverensis n. sp.

Pl. XIV, fig. 3.

Size and form as indicated by the figure. Valves not very gibbous. Beaks subcentral; the internal cast shows a broad depressed belt extending around the margin from the anterior end of the hinge line to the posterior extremity of the shell. Above this band the valves are moderately and uniformly convex. Strongly marked anterior and posterior muscular scars are located just inside the hinge line near each end of the shell. A small retractor scar occurs on the posterior side of the large anterior scar. The hinge line between the anterior and posterior muscular scars is crenulated by transverse teeth. The surface markings are unknown.

The specimen described was found by Mr. Taylor, of Hanover, in the Upper Devonian chert.

Formation and locality.

Jeffersonville limestone; Jefferson County.

Nucula herzeri Nettleroth.

N. herzeri Nett., Ky. Foss. Shells, 1889, p. 221.

Nettleroth's original description.—"Shell small, subtrigonal; very gibbous; length one and one-half the height; both terminal extremities very narrow, almost pointed; beaks prominent and closely in-

curved; situated about one-fourth of the whole length from the anterior end; basal margin in its main portion only slightly convex, even at its anterior end, where it joins the anterior margin, which is most prominent close to the basal line; at the posterior end the basal margin turns in a light regular curve upwards to the very narrow, often pointed posterior margin. The cardinal margin slopes in a straight line down to the posterior extremity, and with an inflected curve very abruptly to the anterior extremity; umbones very ventricose, making the thickness of the shell equal to its height.

"This species is associated with *Nuc. notica* and *neda*, which it resembles in some points, but is easily distinguished from them by its elongate form, its pointed terminal extremities, and the equality between its depth and height. An average sized specimen of this species has the following dimensions: Length, one-half inch; height and depth, one-third of an inch."

This species was described by Nettleroth without figures from the "cherty layers of the hydraulic cement rock." I have not seen it.

Formation and locality.

Sellersburg limestone; Falls of the Ohio.

Nucula corbuliformis Hall?

Pl. XIV, fig. 5.

N. corbuliformis Hall, Pal. N. Y., Vol. V, Pt. I, 1885, p. 319, Pl. 46, figs. (10, 11?), 24-34 (35-36-37?).

Shell subtriangular, moderately gibbous; cardinal line slightly arcuate, basal margin broadly rounded; anterior end gently rounded. Beaks not very prominent, incurved; a wide faintly marked depression extends from the umbones to the basal margin. A subangular arcuate umbonal ridge extends to the post-basal margin. Surface marked by fine concentric striae with varices of growth. The specimen measures in length $\frac{7}{10}$ of an inch, in height $\frac{5}{10}$ of an inch, and in thickness $\frac{3}{10}$ of an inch.

This specimen differs from Hall's description and figures of this species in possessing a rather distinctly defined umbonal slope and a faint depression across the middle of the valves. It is therefore with some doubt that I refer it to *N. corbuliformis*.

Formation and locality.

Sellersburg limestone; Charlestown.

Nucula lirata Conrad.

This species is reported from the "Corniferous group" in Shelby County by John Collett.* I have not seen it.

Nucula neda Hall.

Pl. XIV, fig. 4.

N. neda Hall, Pal. N. Y., Vol. V, Pt. I, 1885, p. 314, Pl. 45, figs. 3, 4.

Hall's description.—"Shell of medium size, rhomboid-ovate cuneate; length about one-fifth greater than the height; basal margin broadly rounded; cardinal margin sloping to the anterior and posterior extremities, which are abruptly rounded. Valves gibbous, with the umbones ventricose. Beaks a little more than one-third the length of the shell from the anterior end, prominent and incurved. The surface has been marked by fine, concentric striae. The cast shows strong anterior and posterior muscular impressions, with three or four umbonal muscular scars and a narrow protractor scar just within the cardinal line, and anterior to the posterior muscular area, as usual in the genus. The number of teeth can not be determined, but there are as many as six or eight on the posterior side, with a distinct ligamental cavity in the cast beneath the beak. The specimen described has a length of 21mm and a height of 17mm."

This is a rather common species.

Formation and locality.

Sellersburg beds; Charlestown, Falls of the Ohio.

Nucula niotica Hall.

Pl. XIV, figs. 6, 7.

N. niotica Hall, Pal. N. Y., Vol. V, Pt. I, 1885, p. 313, Pl. 45, figs. 1, 2.

Hall's description.—"Shell small, obtusely subcuneiform; length a little greater than the height; basal margin regularly curving, rounded posteriorly; cardinal margin very oblique; anterior margin vertically truncate. Valves very gibbous. Beaks anterior incurved. Umbo prominent, umbonal slope very gibbous. Test very thick in the upper part, marked by fine even concentric striae, which are aggregated into fascicles of growth.

*11th Ann. Rep Ind. Dept. Geol. and Nat. Hist., p. 71.

"The interior cast shows strong anterior and posterior muscular impressions and three distinct umbonal muscles; there are seven or more posterior and five anterior teeth in a specimen of medium size. An internal mould has a length of 17mm, and a height of 13mm. A specimen preserving the test has a length of 18mm, and a height of 16mm."

The specimen figured measures in length $\frac{3}{8}$ of an inch; in thickness $\frac{6}{25}$ of an inch.

This is not an uncommon fossil.

Formation and locality.

Sellersburg beds; Clark County.

Nucula lamellata Hall.

Pl. XIV, fig. 2.

N. lamellata Hall, Pal. N. Y., Vol. V, Pt. I, 1885, p. 320, Pl. 51, figs. 18-21; Pl. 45, fig. 13 (?); Pl. 93, fig. 7.

Hall's description.—"Shell small, elongate ovate, truncate behind; length twice the height; basal margin broadly curving, straight or slightly arcuate in the middle; posterior margin short, obliquely truncate. Cardinal line straight, directed somewhat upward toward the anterior. Anterior end large and regularly rounded. Valves gibbous with a broad flattened depression extending from the beaks to the base and sometimes slightly constricting the margin. Beaks subcentral or posterior to the middle of the shell, incurved, rising a little above the hinge line. Umbo gibbous. Umbonal slope obtusely subangular, extending from the beak to the post-basal extremity, declining abruptly to the cardinal line. Surface marked by regular strong, lamellose, concentric striae which appear to be made up of aggregations of extremely fine striae. Six or eight strong transverse teeth are preserved on each side of the beak. Three specimens measure respectively 9, 8 and 7mm in length, and 4.5, 4 and 3.5mm in height."

The only specimen which I have found agrees perfectly with the above description of the New York specimens, except in size. It is much larger, measuring $\frac{17}{25}$ inches in length and $\frac{8}{25}$ inches in height. The surface is marked by about 25 lamellose striae. Their indistinctness near the middle of the shell appears to be due to the state of preservation. The cast shows a strong anterior and posterior muscular scar.

Formation and locality.

Jeffersonville limestone; in chert beds at Burnsville.

MODIOMORPHA.

- A. Concentric striae prominent and regular. *M. concentrica.*
- AA. Concentric striae not prominent, more or less irregular.
- b. Shell medium size, cardinal line straight or almost straight.
- c. Posterior end abruptly rounded, surface without strong varices of growth. Anterior end limited by a flattening of the valves extending from the beak to the margin. *M. recta.*
- cc. Posterior end greatly rounded, surface marked by strong varices or concentric zones, anterior end not limited by a flattening of the valves. *M. charlestownensis.*
- bb. Shell large, cardinal line usually arcuate.
- d. Anterior end extended, umbonal ridge not defined, shell rather elongate. *M. myteloides.*
- dd. Anterior end slightly extended, umbonal ridge gibbous and arcuate, shell rather broad.
- e. Cardinal margin nearly straight, anterior end rather wide below the beaks. *M. alta.*
- ee. Cardinal margin distinctly arcuate, anterior end narrow below the beaks. *M. affinis.*

Modiomorpha concentrica Hall.

Pl. XIV, figs. 10, 11.

M. concentrica Hall, Pal. N. Y., Vol. V, Pt. I, 1885, p. 275, Pl. 34, figs. 9, 10; Pl. 35, figs. 1-5; Pl. 36, figs. 1-16 (17, 18?).

Hall's description.—"Shell of medium size, ovate, extremely variable in its proportions; length less than twice the height; basal margin often nearly straight, usually a little concave on the anterior third; posterior margin abruptly rounded below and more gently curving above; cardinal margin oblique in the prevailing forms, moderately arcuate, often nearly straight, subulate in many specimens. Anterior end produced beyond the beaks, abruptly rounded, sometimes nasute, limited by a broad depression extending from the beak to about the anterior third of the basal margin. Valves moderately convex, gibbous along the umbonal slope; the point of greatest convexity is about the anterior third of the length of the shell. Hinge line extending half or sometimes more than half the length of the shell. Beaks subanterior, small, sharply angular, appressed, directed forward. Umbonal region a prominent subangular elevation, extending obliquely from the beak toward the post-basal margin, usually dying out before the middle of the length of the shell. Test comparatively thick, strongly ornamented by regular concentric rounded or subangular striae, which become lamellose and coalescing on the anterior end of the valves, where they are less prominent. Anterior

muscular impression strong striated, situated just within the anterior margin, with a small retractor scar above it. Posterior impression large and shallow. Pallial line moderately impressed. Hinge furnished with a strong cardinal tooth just posterior to the beak in the left valve, and a corresponding depression in the right valve. No proper lateral teeth have been observed, but the cardinal margin is thickened and grooved from the beak backward about half the length of the cardinal line."

This species is rare. I have seen no perfect specimens of it.

Formation and locality.

Sellersburg beds; Watson, Charlestown, Lexington and Falls of the Ohio.

Modiomorpha charlestownensis Nettleroth.

M. charlestownensis Nett., Ky. Foss. Shells, 1889, p. 218, Pl. 5, figs. 7, 8 and 9.

This shell was described by Nettleroth from the "Hydraulic limestone" (Sellersburg beds) in Clark County. I have not seen it. It is closely related to *M. concentrica*, according to Nettleroth, from which it differs in its elongate form, greater gibbosity, its linguiform posterior end and the marked concentric zones on its surface.

Modiomorpha myteloides Con.

M. myteloides Hall, Pal. N. Y., 1885, Vol. V, Pt. I, p. 277, Pl. 37, fig. 2; Pl. 38, figs. 1-16.

I have not recognized this species in my collection, but Nettleroth reports it from Watson's Station, Clark County, associated with *M. concentrica* and *M. affinis*.

Modiomorpha affinis Hall.

Pl. XIV, fig. 9.

Shell large, gibbous, cardinal line arcuate, basal margin straight; beaks closely incurved, not prominent; anterior end short and regularly rounded. Umbonal ridge rounded, curved slightly upwards. Valves gibbous in the middle and upper part, nearly flat between the middle and basal margin anterior to the umbonal ridge.

The only specimen which I have seen measures in length $2\frac{1}{2}$ inches, height $1\frac{1}{2}$ inches; thickness $1\frac{1}{16}$ inches.

Formation and locality.

Sellersburg beds; Clark County.

Modiomorphora alta Hall.

Pl. XIV, fig. 8.

M. alta Hall, Pal. N. Y., 1885, Vol. V, Pt. I, p. 278, Pl. 37, figs. 1, 2 (4-6?), 7-12, 15, 16; Pl. 80, fig. 7.

Hall's description.—"Shell larger than the medium size, broad rhomboid ovate; length one-third greater than the height; the basal margin for two-thirds of its length from the anterior curve is nearly straight, varying from slightly concave to nearly straight, abruptly curving at the post-basal extremity, and continuing to the post-cardinal margin in an oblique, gently curved outline. In some examples the posterior margin is regularly curved, cardinal margins sometimes forming a nearly straight line, usually gently arcuate. In some examples the posterior margin is regularly curved, cardinal margin sometimes forming a nearly straight line, usually gently arcuate. Anterior end produced beyond the beak from one-sixth to one-fourth the length of the shell, obliquely truncated, obtuse, rounded below; its greatest extension is below the middle of the shell. Valves convex gibbous on the umbonal and medial portions of the shell; the umbonal ridge is gibbous and arched upward; the point of greatest convexity is about the middle of the shell or a little posterior. The depth of both valves is equal to two-thirds of the height of the shell. Hinge line straight, oblique, extending for less than half the length of the shell. Beaks rounded, somewhat appressed directed forward. Umbonal region not strongly defined, depressed anteriorly, becoming gibbous in the middle of the shell, gradually merging into the general contour in the posterior portion. Test of moderate thickness, marked by irregular concentric striae which become fasciculate and produce strong concentric ridges at irregular intervals. The surface is marked by fine vascular lines similar to those referred to in *M. myteloides*. The anterior muscular impression is situated close to the anterior margin of the shell, with a small retractor scar above it. Other characters of the interior are unknown. The type specimen has a length of 68mm, and a height of 46mm."

This species is rare. The specimen figured measures in length $2 \frac{1}{10}$ inches, height $1 \frac{1}{2}$ inches, thickness $\frac{3}{8}$ of an inch. Two of these have the shell of *Crania sheldoni* attached.

Formation and locality.

Sellersburg beds; Watson, Charlestown and Falls of the Ohio.

Modiomorphora recta Hall.

M. recta Hall, Pal. N. Y., Vol. V, Pt. I, 1885, p. 286, Pl. 35, fig. 9.

I have not seen this species. It was described by Hall from specimens found in the "cherty layers of the Hamilton group," (Sellersburg beds), in Clark County.

Sanguinolites? sanduskyensis Meek.

Pl. XVI, figs. 6, 6a.

S. sanduskyensis Meek, Pal. Ohio, Vol. I, 1873, p. 209, Pl. 18, fig. 3.

Meek's description.—"Shell approaching longitudinal-oblong or trapezohedral outline, moderately convex, a little more than twice as long as high, and slightly narrower anteriorly than behind; cardinal margin straight, equaling about three-fifths the entire length; basal margin nearly straight or a little sinuous towards the front, and subparallel to the hinge, or slightly ascending anteriorly along its entire length and rounding up a little more gradually into the front than behind; posterior extremity compressed, obliquely truncated above and rather narrowly rounded to the base below; anterior side very short, sloping rather abruptly from the beaks above, and narrowly rounded at the middle; beaks depressed nearly or quite to the hinge line, compressed and placed near the middle of the anterior third; posterior umbonal slopes not regular or even prominently rounded, surface only showing a few regular furrows and slight undulations of growth, most distinct below the middle of the valves. Length 2.70 inches; height at the posterior end of the hinge, 1.20 inches; do under the umbones, 1.04 inches; convexity about 0.52 inch."

The specimens which I have referred to this species are much smaller than the specimens figured by Meek; the largest has a length of $1\frac{1}{2}$ inches. They occur as casts in the chert. A very faint cincture extends from the beak diagonally to the basal margin; there is a muscular scar below the beak, just inside the anterior margin. This shell is rather rare.

Formation and locality.

Jeffersonville limestone; Burnsville and Newbern, Bartholomew County.

GRAMMYSIA.

A. Cincture extending from the beaks to basal margin strongly marked.

G. subarcuata.

AA. Cincture extending from beaks to basal margin not well defined or obsolete.

b. Posterior slope with fine radiating striae.

G. arcuata.

bb. Posterior slope without radiating striae.

G. secunda var. *gibbosa.*

Grammysia subarcuata Hall?

Pl. XV, fig. 3.

A single imperfect specimen is referred to this species with some doubt. The shell is gibbous, width to height as two to three, beaks prominent; a faint cincture extends from the beaks to margin of shell; surface marked by strong concentric undulations.

Formation and locality.

Sellersburg beds; Charlestown.

Grammysia arcuata Hall.

G. arcuata Hall, Pal. N. Y., Vol. V, Pt. I, 1885, p. 373, Pl. 61, figs. 1-9; Pl. 63, fig. 6; Pl. 93, fig. 27.

This species has been recognized by Hall "in the cherty layers above the Corniferous limestone at the Falls of the Ohio." I have not seen it.

Grammysia secunda var. *gibbosa* H. and W.

G. secunda var. *gibbosa* H. & W., 24th Rep. N. Y. State Mus. Nat. Hist., 1872, p. 199; 27th Rep. N. Y. State Mus. Nat. Hist., 1875, Pl. 12, figs. 7, 8.

I have not been able to secure specimens of this shell. It has been described by Hall and Whitfield from "the Hydraulic limestone at the Falls of the Ohio."

GONIOPHORA.

- A. Shell marked by radiating striae.
AA. Shell without radiating striae.

G. truncata.
G. hamiltonensis.

Goniophora hamiltonensis Hall.

Pl. XVI, figs. 4, 5.

G. hamiltonensis Hall, Pal. N. Y., Vol. V, Pt. I, p. 296, Pl. 43, figs. 8-15, 17-21.

Shell of medium size, trapezoidal, length a little more than twice the height; basal margin nearly straight, sometimes sinuate at the terminus of the sinus. Posterior margin obliquely truncate. Cardinal line usually parallel with the basal margin, sometimes slightly arcuate. Valves convex below the umbonal ridge, and concave above it. Umbonal ridge strongly defined and angular, extending from the beaks to the post-basal extremity in a nearly direct line. A broad undefined sinus which is sometimes obsolete extends from the beak

to the anterior basal margin. Surface marked by strong concentric striae. Cast shows a deeply impressed muscular scar near the anterior margin.

This species is not uncommon in the condition of casts in the chert near the top of the Devonian limestone.

Formation and locality.

Jeffersonville limestone; Newbern and Burnsville, Bartholomew County.

Goniophora truncata Hall.

G. truncata Hall, Pal. N. Y., Vol. V, Pt. I, 1885, p. 298, Pl. 42, figs. 9-10; Pl. 44, figs. 1-5.

I have not seen this shell. Nettleroth reports it to occur very rarely in the "Corniferous limestone" at the Falls of the Ohio.

CYPRICARDINIA.

- A. Shell with concentric lines of growth. *C. cataracta.*
- AA. Shell with lamellose concentric striae.
 - b. Concentric lamellose undulations very prominent with faint radiating striae crossing them. *C. indenta.*
 - bb. Concentric lamellose striae faint, not marked by radiating striae. *C. cylindrica.*

Cypricardinia indenta Conrad.

Pl. XV, figs. 8, 8a.

C. indenta Hall, Pal. N. Y., Vol. V, Pt. I, 1885, p. 485, Pl. 79, figs. 6-16, 23; Pl. 96, fig. 2.

Hall's description.—"Shell of medium size, subrhomboid-ovate; length more than one-third greater than the height; basal margin nearly straight, slightly sinuate anterior to the middle. Posterior extremity abruptly rounded below and obliquely truncate above. Cardinal line straight oblique. Anterior end very short, rounded below. Right valve convex, often extremely gibbous. Left valve usually depressed-convex below and posteriorly, becoming moderately gibbous in the umbonal region. Beaks nearly anterior small and appressed, rising but little above the hinge line. Cincture distinct upon the right valve, less marked upon the left valve. Surface marked by extremely fine concentric striae, and by unequally distant but somewhat regular, lamellose, imbricating, concentric undulations; and in well preserved specimens the entire surface is marked by fine striae which radiate from the apex of the shell, and in some conditions of preservation the surface shows a second set of striae vertical to the direction of the lamellae."

This is a common species in northern Indiana. The specimens appear to be smaller than the New York representatives of the species, seldom exceeding a half inch in length. Nearly all of the shells are exfoliated and do not show the finer surface markings; a few, however, show traces of the radiating striae.

Formation and locality.

Jeffersonville limestone; Pipe Creek Falls, Bunker Hill and Falls of the Ohio.

Cypricardinia cataracta Conrad.

This species is reported by Nettleroth to occur in the "Corniferous limestone at the Falls of the Ohio."

Cypricardinia? cylindrica H. and W.

C. cylindrica H. W., 24th Reg. Rep. N. Y., 1870, p. 190.

C. cylindrica H. W., 27th Reg. Rep. N. Y., 1875, Pl. 2, figs. 5, 6.

Hall and Whitfield's original description.—"Shell cylindrical, extremities rounded, height little more than the depth, and rather more than twice as long as high; beaks nearly terminal, rounded and incurved; left valve scarcely less convex than the opposite; umbonal slope slightly angular. Surface marked by faint distant concentric lamellose lines.

"The specimen described is essentially a cast preserving a portion of the shell on one side. This species is more elongate and cylindrical, less arcuate, and more equivalve than *C. inflata*. The lamellose striae have never been so strong and are more distant."

. I have not seen this species.

Formation and locality.

Sellersburg beds; Clark County.

CONOCARDIUM.

- A. Umbonal slope angular, shell not distinctly constricted in front, radiating plications on ventricose portion of shell numerous. *C. cuneus.*
- AA Umbonal slope rounded, shell distinctly constricted in front, about six radiating plications on the ventricose portion of the valve. *C. ohioense.*

Conocardium ohioense Meek.

Pl. XV, fig. 7.

C. ohioense Hall, Pal. N. Y., Vol. V, Pt. I, 1885, p. 411; Pl. 68, figs. 2, 3.

Hall's description.—"Shell small, ovate, subtrigonal, ventricose behind the middle of its length; length one-third greater than the

height. Posterior end prominent, produced in the middle and sloping abruptly to the post-cardinal angle. Anterior end abruptly contracted in front of the middle and prolonged, nasute, with the extremity narrowly rounded. The body of the shell is marked by about six strong radiating plications on the ventricose portion of the valve, and on each side more numerous and smaller plications. The interspaces between the ribs are marked by lamellose concentric striae. A specimen of this species has a length of 15mm and a height of 10mm. This species differs from *C. cuneus* in being more narrowly ventricose, and the body of the shell marked by fewer plications, with a distinct constriction in front; the umbonal slope is more rounded and less oblique, while the posterior extremity is more produced than in the usual forms of *C. cuneus* and *C. trigonale*."

Miller described a new species in the 17th Indiana Geological Report, p. 94, under the name of *C. exigum*. The descriptions and figures together with a study of material from Bunker Hill indicate that the specimens described belong to *Conocardium ohioense*.

Conocardium cuneus Hall.

Pl. XV, Figs. 4, 5.

C. cuneus Hall, Pal. N. Y., Vol. V, Pt. I, 1885, p. 409, Pl. 67, figs. 1-32; Pl. 68, figs. 1, 4-16; Pl. 94, figs. 11-12.

Hall's description.—"Shell large angularly subovate, or trigonal in outline; length less than twice the height; basal margin greatly curving from the post-inferior extremity to the anterior end. Posterior extremity abruptly truncate, produced into a tubular extension along the cardinal line. Cardinal line straight, margins inflected towards the anterior end. Anterior end more or less attenuate, with the margins gaping before reaching the extremity. Valves gibbous. Beaks subcentral prominent and closely incurved over the hinge line. Umbonal slope angular, usually strongly defined, extending to the post-inferior extremity. Post-cardinal slope flat or concave. Test thick, composed of two distinct layers. Surface marked by numerous radiating plications and intermediate arching lamellose concentric striae on the body of the shell. The posterior slope is ornamented by curving radii extending from the beak to the posterior margin, with the interspaces marked by transverse lamellose striae. From the entire periphery of the umbonal ridge there extends a finely striated expansion of the shell, which increases in extent from the beaks downward and in old shells is supported anteriorly by a thickening of the shell along the basal margins, which often obliterates

the radii. At the junction of these thickened portions, along the base of the valves, the shell is excavated, leaving a tubular opening extending backward from the post-inferior extremity. Valves crenulated along their margins. Anterior muscular impression elongate, deeply impressed, narrower behind. Four specimens measure respectively 60, 47, 43 and 21mm in length and 30, 33, 26 and 13mm in height."

Hall recognizes the following three varieties of this species:

Var. attenuatum Conrad. In this variety the surface is marked by numerous uniform fine radii, and the posterior extremity is not abruptly truncated. This is probably the young of *C. cuneus*.

Var. trigonale Hall. The specimens from the Corniferous limestone were originally described under this name as a distinct species.

Var. nasutum Hall. This variety is characterized by fewer radii than the characteristic forms of *C. cuneus*; it is short and triangular in form, broad and abruptly truncated behind, abruptly truncated in front with the anterior end nasute.

The interior of this shell is marked by strong flat or rounded ribs which are continued slightly beyond the edge of the shell, giving the crenulated margin.

Miller has described a Conocardium from Bunker Hill under the name of *C. parvulum*. It appears from the description and figure to be a variety of *C. cuneus*. The umbonal slope in this variety is nearly at right angles to the cardinal line instead of making an oblique angle to it as in typical specimens of *C. cuneus*.

Formation and locality.

Jeffersonville limestone; Falls of the Ohio, Hanover, Bartholomew County and Bunker Hill.

CLINOPISTHA.

- A. Shell with radiating striae running from the dorsal to the basal margin. *C. striata.*
- AA. Shell without radiating striae running from the dorsal to the basal margin.
 - b. Length about twice the height; no radiating striae. *C. subnasuta.*
 - bb. Length less than twice the height, with obscure radiating striae toward the basal margin. *C. antiqua.*

Clinopistha subnasuta Hall and Whitfield.

C. subnasuta Hall, Pal. N. Y., Vol. V, Pt. I, 1885, p. 512, Pl. 51, figs. 32, 33; Pl. 95, fig. 31.

Hall's description.—"Shell small, narrowly subelliptical, nearly straight on the basal side; length about twice the height. Basal margin nearly straight, curving abruptly to the anterior and more

gently to the posterior end. Posterior extremity rounded. Cardinal line gently arcuate. Anterior end short, subnasute, declining from the beaks and narrowly rounded below. The place of the lunule is occupied by a fold or callosity which is distinctly limited by the margins of the valves. Valves moderately convex below and posteriorly gibbous in the umbonal region. Beaks at about the anterior third, small, closely appressed. Umbonal slope convex, not defined. Test thin. Surface marked by somewhat regular fine thread-like striae of growth, which, in the perfect condition of the shell, may have been lamellose, and are fasciculate on some individuals. The hinge shows some appearance of having been crenulated, but the condition of the specimens is such as not to admit of positive determination. Muscular impressions distinct. Pallial line entire, marked in the cast by a series of radiating pustules. Three specimens measure respectively 21, 26 and 27mm in length and 12, 13 and 13mm in height."

This is not a common species.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Watson, Lancaster and Pipe Creek Falls.

Clinopistha antiqua Meek.

Pl. XVI, fig. 3.

C. antiqua Meek, Pal. of Ohio, Vol. I, p. 208, Pl. 18, fig. 5a, b.

Meek's description.—"Shell very thin, transversely suboval gibbous, with flanks along the middle near the lower margin somewhat flattened or slightly concave; more than half as high as long; anterior or longer side regularly rounded in outline; posterior sloping above from the beaks to the narrowly rounded extremity, which is most prominent below the middle; basal margin straightened or broadly sinuous along the central region and rather abruptly rounded up at the extremities; beaks depressed nearly or quite to the dorsal outline, and placed about half way between the middle and the posterior extremity; dorsal outline nearly horizontal and parallel to the base in front of the beaks, but rounding regularly into the anterior margin. Surface merely showing moderately distinct lines of growth, with some obscure traces of radiating striae, where a little worn near the base; these last mentioned markings being more distinct on the internal cast. Length 0.22 inch; height 0.51 inch; convexity 0.39 inch."

I have seen but one specimen of this species, which differs from Meek's description only in being less gibbous.

Formation and locality.

Sellersburg beds; Clark County.

Clinopistha striata Nettleroth.

C. striata Nett., Ky. Foss. Shells, 1889, p. 200, Pl. 4, figs. 1-2.

Nettleroth's original description.—"Shell of medium size, transversely subelliptical; length not quite twice the width or height, and thickness about one-half the height; beaks small and closely appressed in the level of the dorsal margin and situated about two-thirds of the whole length from the anterior extremity; basal margin slightly convex in the central half but curving regularly but rapidly into the terminal margins. Dorsal margin straight and almost parallel with the central portion of the basal one; at its anterior end it curves down into the anterior margin, which appears to be regularly rounded; posterior end slopes down from the beaks to a somewhat pointed posterior extremity, which is most prominent a little below the middle height of the shell. Both valves are moderately convex. The surface is marked by very peculiar radii, which apparently run from the basal margin to the dorsal one, across the valves, but which make near the dorsal line a rapid deflection into the direction of the beaks. These radii are low and flat and have a faint but plainly observable depressed line in their middle, a feature which I have never noticed in any other shell. Their interspaces are large, from three to four times their own width; in some of these interspaces there is a smaller intermediate line. This species has the general features of *Clinopistha subnasuta* and *antiqua* except its peculiar surface markings and its greater size."

I have not seen this species.

Formation and locality.

Sellersburg beds; Clark County.

Solemya (Janeia) vetusta Meek.

Pl. XVI, figs. 1, 1a, 1b, 2.

S. (Janeia) vetusta Hall, Pal. N. Y., Vol. V, Pt. I, 1885, p. 46, Pl. 47, figs. 53-55; Pl. 94, fig. 10.

Hall's description.—"Shell of medium size, elongate elliptical; length more than twice the height; basal margin very gently curved. Posterior extremity very gently rounded. Cardinal line nearly straight or gently arcuate. Anterior end large, narrower than the posterior,

rather abruptly rounded at the extremity, carrying on its upper margin a distinct fold. Valves moderately convex below, scarcely gibbous in the upper portion. Beaks inconspicuous, situated anterior to the middle. Surface marked by regular distant lamellose, undulating concentric striae, which are crossed by distant radiating lines; between which the concentric striae curve downward."

Exfoliated shells show their interior to be marked by radiating striae which are most distinct towards the posterior end. The faint radiating lines which cross the concentric striae where the undulations bend upwards are sometimes indistinctly developed or wanting. They are usually confined to the middle portion of the shell where the undulations are most pronounced. This species is rare.

Formation and locality.

Sellersburg beds; Watson and Falls of the Ohio.

GASTROPODA.

BELLEROPHON.

- A. Dorsum sharply carinate. *B. curvilineatus.*
- AA. Dorsum not sharply carinate.
 - b. Shell with strong revolving striae.
 - c. Transverse striae distinct, strongly ventricose, width greatly exceeding the length. *B. leda.*
 - cc. Transverse striae obsolete or indistinct, not strongly ventricose, width not greatly exceeding the length. *B. lyra.*
 - bb. Shell without revolving striae.
 - d. Outer volution greatly expanded at the aperture, prominent part marked by strong costae with fine striae between. *B. patulus.*
 - dd. Outer volution not greatly expanded at the aperture; surface marked by subregular transverse striae. *B. pelops.*

Bellerophon leda Hall.

Pl. XXI, figs. 4, 5.

B. leda Hall, Pal. N. Y., Vol. V, Pt. II, p. 110, Pl. 23, figs. 2-16.

Hall's description.—"Shell subglobose, often a little flattened upon the dorsum; body whorl ventricose, very rapidly expanding. Aperture abruptly spreading, broadly sinuate in front and sometimes with a deeper notch in the middle, the margin gently recurved, joining the volution a little on the ventral side, where it is thickened, somewhat abruptly curving over and partially enclosing the small umbilicus, and extends in a callus over the columellar lip, which is sometimes distinctly striato-pustulose.

"Surface marked by strong longitudinal or revolving striae, which alternate in size, are sometimes fasciculate, and often finer and more numerous on each side of the dorsal band than on the lateral portions of the shell. The revolving striae are cancellated by finer, subequal, thread-like transverse striae. The dorsal band is narrow, rarely elevated or sometimes scarcely raised above the surface, and usually flat or slightly concave, the concentric striae making an abrupt retral curve upon it in crossing. The band is likewise usually marked by one, two, three or more revolving striae finer than those on the sides of the shell, and sometimes quite obscure." This shell is usually found in an exfoliated condition. It is rather common in the chert of the Upper Devonian at some localities.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Falls of the Ohio and Newbern.

Bellerophon pelops Hall.

Pl. XXI, fig. 7.

B. pelops Hall, Pal. N. Y., 1879, Vol. V, Pt. II, p. 95, Pl. 22, figs. 7-13.

Only a few imperfect specimens of this species have been seen. They show the slender dorsal band and subregular transverse striae which characterize this species. Hall regards this species as identical with Meek's *B. propinquus*.

Formation and locality.

Jeffersonville limestone; Pipe Creek Falls, Charlestown, and Newbern.

Bellerophon patulus Hall.

Pl. XXI, fig. 7.

B. patulus Hall, Pal. N. Y., 1879, Vol. V, Pt. II, p. 100, Pl. 22, figs. 17-30; Pl. 24, figs. 3-6.

This species has been observed only in the form of the interior casts. The great expansion of the outer volution of this species is its chief distinguishing characteristic. In a specimen in Mr. Taylor's collection the outer lip has a transverse width of one and four-tenths inches and a longitudinal width of one inch. The height of the shell measured from the plane of the margin of the outer lip is five-tenths of an inch. According to Hall, "The surface on the expanded part of the outer volution is marked by fine close concentric striae, which are sometimes crowded in fascicles, giving an undulating surface; the posterior prominent part of the volution is marked on the back, and

partially on the sides, by strong even arching costae, which are more abruptly and sometimes subangularly curved on the dorsal line. These costae sometimes continue for half the length of the volution anteriorly, gradually becoming obsolete on the middle and sides, and are never seen upon the broad expansion of the shell. The spaces between these costae are marked by fine close concentric striae, and in well preserved specimens, extremely fine revolving striae are sometimes visible. The costae become finer or obsolete as they approach the umbilicus, and the surface is marked only by the fine striae of growth."

Formation and locality.

Jeffersonville limestone; Hanover, Charlestown and Shelby County and Falls of the Ohio.

Bellerophon lyra Hall.

B. lyra Hall, Pal. N. Y., 1879, Vol. V; Pt. II, Pl. 23, figs. 1, 17-20.

This species has not been seen by the writer. Hall reports having seen only one specimen, which he figured (fig. 1, Pl. 23).

Formation and locality.

"Hamilton; Falls of the Ohio."

Bellerophon curvilineatus Con.

Pl. XXI, figs. 1, 1a.

B. curvilineatus Hall, Pal. N. Y., 1879, Vol. V, Pt. II, pp. 94-95, Pl. 22, figs. 1-6.

Hall's description.—"Shell discoidal. Volutions four or five compressed and sharply carinated on the back, each one embracing about half the width of the preceding one, the last scarcely more ventricose than the preceding, and bending almost rectangularly at the umbilical edge. Aperture triangular, acute at the anterior margin, which is deeply sinuate; the curvature of the peristome from the umbilical side receding about one-quarter of a volution to the dorsal line. The inner margins of all the volutions are exposed in the cavity of the umbilicus.

"Surface marked by fine striae of growth, which follow the curvature of the peristome, making a retral curve of about a quarter of a volution; often slightly fasciculate, but sometimes the striae are in regular fascicles of about six or seven finer ones, with a fine sharply elevated finer one supporting them. The dorsum is sharply carinate."

I have seen but two or three specimens of this species. The smallest has a diameter of $\frac{2}{10}$ of an inch. They are covered by fine striae which vary somewhat in strength. In crossing the dorsal carina the striae become extremely fine.

Formation and locality.

Jeffersonville limestone; Newbern and Hope, Bartholomew County.

Bellerophon sp.

Pl. XXI, fig. 3.

The specimen here figured is from Mr. Green's collection. I have not been able to identify it with any of the species described.

The anterior part of the outer volution, which is not shown in the figure, has a rugose appearance, due to coarse transverse, somewhat wavy or interrupted striae. These are separated by rather wide interspaces, and arch backward from the umbilicus to the dorsal band which is imbricated by them.

Formation and locality.

Sellersburg beds; Charlestown.

PLATYOSTOMA.

- A. Form distinctly subturbinate or cone-shaped.
 - b. Spire elevated. *P. turbinata.*
 - bb. Spire depressed. *P. turbinata* var. *cochleata.*
- AA. Form not distinctly turbinate or cone-shaped.
 - c. Spire depressed, nearly flat on top. *P. lineata* var. *callosa.*
 - cc. Spire moderately elevated.
 - d. Volutions enlarging rapidly to the outer volution which is very ventricose. *P. lineata.*
 - dd. Volutions enlarging gradually to the outer volution which is not very ventricose. *P. pleurotoma.*

Platyostoma pleurotoma Hall.

Pl. XX, fig. 6.

P. pleurotoma Hall, Pal. N. Y., Vol. V, Pt. II, 1879, p. 30, Pl. 9, figs. 31-35.

Hall's description.—"Shell rotund, subturbinate. Spire depressed; volutions rounded, gradually enlarging, and the last one much expanded. Aperture broadly oval, and extended below; peristome more or less sinuous, and on the columellar side, extended below in a thickened and slightly contorted callosity.

"Surface finely striated with concentric and revolving striae, the latter conspicuous and the former scarcely perceptible. In one speci-

men a distinct narrow band marks the suture line; and in another, a narrow carina marks the periphery, giving the aspect of *Pleurotomaria*."

One specimen in the collection of Mr. G. K. Green is referred to this species. The striae on the lower two-thirds of the body whorl arch sharply from the umbilicus to a line extending nearly around the body whorl, which is very slightly elevated only near the aperture; above this line the striae bend gently backward and then forward to the suture. The revolving striae on the upper volutions are very fine and close and have a slightly wavy appearance. They are crossed by concentric striae.

Formation and locality.

Sellersburg beds; Charlestown.

Platystoma sp.

PL. XX, fig. 8.

Spire consisting of about two loosely coiled volutions; gradually enlarging from the apex. Body whorl disconnected from the apical whorl for about one-third of a volution. The periphery of body whorl rather sharply angular. Aperture subovate.

Surface marked by fine transverse striae and by very indistinct revolving striae.

This specimen differs from any species known to me in its disunited and angular body whorl. I am inclined to regard it, however, as an abnormal specimen and have not for that reason proposed a specific name for it.

Formation and locality.

Sellersburg beds; Charlestown.

Platystoma lineata Conrad.

PL. XX, figs. 1, 2, 2a, 3, 7.

P. lineata Hall, Pal. N. Y., Vol. V, Pt. II, p. 21, Pl. 10, figs. 1-21.

Hall's description.—"Shell subovate, approaching to subglobose. Spire elevated above the body whorl, though varying in degree; in some extreme varieties, on the same plane or below the outer volution.

"The shell with four or five volutions when entire, but seldom preserving more than three, the apex being usually imperfect. The outer volution usually very ventricose and regularly convex, a little depressed below the suture line (but not caniculate). Aperture sub-

orbicular in perfect specimens, sometimes subrhomboidal; outer lip thin, with a sharp entire margin; columellar lip thickened, folded, and reflexed over the umbilicus, which in adult specimens is entirely closed.

“Surface marked by fine, equidistant thread-like revolving striae, which are cancellated by fine concentric striae of about the same strength, but unequally distant; the latter sometimes bend abruptly backwards upon the back of the shell, indicating a sinus in the lip at some period of growth, and are frequently crowded in fascicles, giving a rugose character to the surface.”

Mr. G. K. Green's collection contains several specimens of this species. They show considerable variation in the height of the spire, and in the character of the striae on the body whorl. In one specimen the transverse striae bend abruptly backward, producing a sharply defined ridge which extends half-way around the periphery of the body whorl. In others the striae arch sharply backward near the suture without producing a band or ridge.

Formation and locality.

Sellersburg beds; Charlestown.

Platystoma lineatum var. *callosum* Hall.

Pl. XX, figs. 4, 4a.

P. lineatum var. *callosum* Hall, Pal. N. Y., 1879, Vol. V, Pt. II, p. 23, Pl. 10, figs. 22, 23.

This variety is based upon the depressed spire, slightly sinuate upper margin of the peristome and the thickened callus of the inner lip which characterize some specimens. It appears to be less common than the preceding type.

Formation and locality.

Sellersburg beds; Charlestown.

Platystoma turbinata Hall.

P. turbinata Hall, Pal. N. Y., 1879, Vol. V, Pt. II, p. 27, Pl. 9, figs. 12-24.

Hall's description.—“Shell subturbinate, sometimes approaching a subglobose form. Spire depressed, or more or less elevated above the outer volution, sometimes nearly on the same plane; volutions three or four, rapidly expanding, the last extremely ventricose, with the lower part projected in the direction of the columella, which is much extended. Aperture subovate, broader above, narrowing and often extended below.

"Surface marked by fine subequal concentric striae, crossed by finer revolving striae; the former variously undulated upon the surface, indicating sinuosities in the aperture at different stages of growth. In older shells the striae become lamellose and often crowded in fascicles."

This species is included on the authority of Nettleroth.

Formation and locality.

"Corniferous limestone;" Falls of the Ohio.

Platystoma turbinata var. *cochleata*.

P. turbinata var. *cochleata* Hall, Pal. N. Y., 1879, Vol. V, Pt. II, p. 28, Pl. 9, figs. 1-11.

Hall's description.—"Shell turbinate. Spire elevated conical, volutions about four or five; periphery of the last volution obtusely rounded or distinctly subangular, with a sinus in the margin of the aperture; the last volution sometimes becoming free near the aperture, as shown in figs. 5, 6 and 7. Aperture obliquely subovate or ovate; peristome sinuous, often with a deep notch in the upper margin, and sometimes continued in a columellar extension below.

"The specimens referred to this variety all agree in having an elevated spire, with rounded volutions above the last one, which is almost invariably subangular."

This variety is recorded by Nettleroth. It has not been seen by the writer.

Formation and locality.

"In the rotten hornstone" (Jeffersonville limestone?); Louisville, Ky.

Strophostylus varians Hall.

Pl. XX, figs. 5, 5a.

S. varians Hall, Pal. N. Y., 1879, Vol. V, Pt. II, figs. 16-31.

Hall's description.—"Shell obliquely subconical, or depressed subglobose. Spire moderately elevated; volutions about three or four symmetrically rounded above, and somewhat gradually enlarging to the last one, which is ventricose extending downward and forward. Aperture oval or suborbicular; peristome entire; the columellar lip usually expanded and spreading over the umbilicus, sometimes free and leaving the umbilicus exposed. Surface finely striate, with the peculiar thread-like striae visible on well preserved surfaces, while on the weathered portions they become lamellose; and on some specimens the surface is marked by peculiar waved and interrupted striae."

I have seen but two specimens of this shell, both in Mr. Green's collection. The smaller of these two is about one-third the size of the specimen figured. Over a part of the body whorl the striae are arched sharply backward, indicating a notch in the lip at one stage of growth. The columellar lip is attached to the umbilicus. In the specimen figured the umbilicus is exposed.

Formation and locality.

"Corniferous," (Nettleroth) and Sellersburg beds; Charlestown and Falls of the Ohio.

CALLONEMA.

- A. Spire elevated.
 - b. Periphery of whorls flat. *C. conus.*
 - bb. Periphery of whorls concave.
 - c. Shell large, usually more than an inch in height. *C. lichas.*
 - cc. Shell small, usually less than an inch in height. *C. bellatulum.*
- AA. Spire depressed or moderately elevated.
 - d. Surface marked by strong elevated striae. *C. imitator.*
 - dd. Surface marked by very fine transverse striae. *C. clarki.*

Callonema bellatula Hall.

C. bellatula Hall, Pal. N. Y., Vol. V, Pt. II, 1879, p. 51, Pl. 14, figs. 10-15.

Hall's description.—"Shell subovoid conical; spire elevated and rapidly expanding below. Volutions about six or seven, the upper ones minute and somewhat gradually expanding to the third or fourth and more rapidly below, the last one being very ventricose, regularly rounded or obtusely subangular towards the base. Aperture apparently transverse, its extension below not fully known; columellar lip thickened, spreading above and extended anteriorly. Surface marked by regular elevated striae with about equal interspaces, which are slightly turned backwards from the suture and gently curved to the base of the volution, and on the last one curving over the periphery with equal strength, a portion becoming obsolete, and others coalescing and becoming stronger as they enter the umbilical depression."

The above description is based upon specimens from the Falls of the Ohio and Columbus, Ohio. The species is rare.

Formation and locality.

Jeffersonville limestone; Falls of the Ohio and Hope.

Callonema conus n. sp.

Pl. XXIII, figs. 1, 1a.

Shell forming a nearly perfect cone, spire elevated. Volutions six or seven, perfectly flat between the sutures, the last one being sharply angular toward the base. Aperture subrhomboidal, character of the lip not well known, umbilicus exposed. Surface marked by fine regular striae which bend backward in passing from upper to lower sutures. Striae on the body whorl, crossing the angular base and continuing with equal strength to the umbilicus.

Only two specimens of this species have been found. The flat peripheries of the whorls and the angular base of the body whorl seem to characterize this as a type distinct from *C. bellatula*, to which it is most closely related.

Formation and locality.

Geneva limestone; Hope.

Callonema lichas Hall.

Pl. XX, fig. 11.

C. lichas Hall, Pal. N. Y., 1879, Vol. V, Pt. II, p. 52.

Hall's description.—"Shell obliquely conical ovate; spire elevated. Volutions about four or more, rounded upon the exterior, the earlier ones moderately expanding and the last ones becoming very ventricose. Aperture subovate extended below. Surface marked by fine even striae of growth which on the last volution continue over the periphery and disappear in the umbilicus."

This is not a common species.

Formation and locality.

Jeffersonville limestone?; Jefferson County.

Callonema imitator (Hall and Whitf.).

Pl. XXIII, fig. 5.

C. imitator Hall, Pal. N. Y., Vol. V, Pt. II, 1879, p. 53, Pl. 14, figs. 16, 17.

Hall's description.—"Shell depressed hemispherical; spire moderately elevated, consisting of five or more rounded volutions, regularly increasing from the apex to the aperture, which is subcircular, its lower extension unknown, round below and broadly umbilicate; suture slightly depressed, not canaliculate and making the periphery of the preceding volutions. Surface marked by strong elevated

simple striae, which have a slight bend just below the suture and curve gently backward to the periphery, gradually increasing in strength from the apex to the outer volution, on the middle of which there are about twenty in the space of an inch. In one specimen, on the outer half of the volution, they become gradually obsolete or merge into the ordinary striae of growth."

Specimens of this shell which are well preserved are rare; interior casts which probably belong to this species are rather common at some localities.

Formation and locality.

Jeffersonville limestone; Falls of the Ohio and Bunker Hill.

Callonema clarki Nettleroth.

C. clarki Nett., Ky. Foss. Shells, 1889, p. 175, Pl. 24, figs. 2, 4, 5.

Nettleroth's original description.—"Shell above medium size; sub-hemispherical; spire moderately elevated, more or less so in different shells, as shown by the two specimens illustrated, consisting of from three to five volutions. The volutions are regularly increasing from apex to aperture, which is subcircular or subquadrate; they are depressed convex on their upper side. The columella is much extended below. Suture small and shallow, between the upper volutions scarcely noticeable. The surface appears to the naked eye entirely smooth, but under a magnifier shows fine transverse striae, closely set between some stronger marked lines of growth. These striae and lines of growth extend from the suture down and backwards to the umbilical depression. The last volution or the body whorl, as it is also called, curves very abruptly at its middle, and slopes from there in a straight or slightly curved line to the inner lip of the aperture, making the lower half of the last volution either flat or only very little convex. The apex appears to be very minute in perfect specimens."

Formation and locality.

The types of this species were found in the Devonian chert east of Louisville. It has not been recognized in Indiana.

Isomena humilis Meek ?.

Naticopsis? (*Isonema*) *humilis* Meek, Pal. Ohio, Vol. I, 1873, p. 214, Pl. 19, figs. 1a, b, c.

Two or three imperfect specimens are referred with some doubt to this species.

Height of spire equals about two-thirds the width of shell. Volutions four, increasing rather rapidly in size. Surface marked by distinct lines of growth which are slightly arched. These are occasionally interrupted by strong wrinkles of growth. Aperture not preserved. Width of shell one and one-tenth inches.

Formation and locality.

Sellersburg beds; Charlestown and Lexington.

Bucania devonica Hall and Whitf.

B. devonica Hall & Whitf., 24th Rep. N. Y. State Mus. Nat. Hist., 1870, p. 191.

Hall and Whitfield's original description.—"Shell discoid, widely and equally umbilicate on the two sides; remaining volutions about four slightly embracing, vertically compressed, giving the transverse diameter a little more than twice the vertical diameter, lateral margins of the volutions obtusely angular toward the dorsal side. The surface has apparently been marked by several (three or four) revolving ridges or carinae on each side of the center or dorsum, which is gently concave; finer surface markings and aperture unknown."

This is not a common species. No specimens satisfactory for figuring have been found.

Formation and locality.

Kent, Charlestown, Falls of the Ohio and Bunker Hill.

LOXONEMA.

- A. Surface smooth or indistinctly marked by striae.
 - b. Shell rather slender, spire tapering gently to the apex.
 - L. laeviusculum.*
 - bb. Shell rather robust, tapering rather abruptly near the apex.
 - L. teres.*
- AA. Surface with strong transverse striae.
 - c. Striae fine, scarcely curved in crossing the whorl; whorl slightly constricted near the suture. *L. rectistriatum.*
 - cc. Striae coarse, strongly curved in crossing the whorl; the whorls not constricted near the suture.
 - d. Strongly constricted at the suture; whorls very convex. *L. hydraulica.*
 - dd. Not strongly constricted at the suture; volutions moderately convex. *L. hamiltoniae.*

Loxonema laeviusculum Hall.

L. laeviusculum Hall, Pal. N. Y., 1879, Vol. V., Pt. II, p. 131, Pl. 28, figs. 10-11.

Hall's original description.—"Shell elongate, subulate. Volutions about 12 in the entire shell, rounded and somewhat rapidly expanding to the last one, which is moderately ventricose. Suture close and simple. Aperture ovate, the columellar lip much extended below. Surface nearly smooth or marked by faint obsolescent striae, which are moderately curved over the convexity of the volution and become fasciculate on the lower side of the last one as they approach the columellar lip."

I have not seen this species. It was described from specimens obtained in the "limestone above the hydraulic beds." Nettleroth reports it to be associated with *L. hydraulicum* in the "cherty layers above the hydraulic limestone."

Formation and locality.

Sellersburg beds; Falls of the Ohio.

Loxonema sp.

A single broken cast of *Loxonema* in my collection differs specifically from any of these described from the Devonian and resembles rather closely *L. teres* from the Chemung. The lower whorls are marked by very strong angular plications, of which there are six or eight on the space of half the circumference of the shell. The upper whorls have more numerous and very much finer striae. The specimen is too imperfect to admit of a satisfactory specific description.

Formation and locality.

Devonian chert (Jeffersonville limestone?); Newbern.

Loxonema hydraulica Hall.

Pl. XVI, fig. 12.

L. hydraulica Hall, Pal. N. Y., Vol. V, Pt. II, 1879, p. 44, Pl. 13, fig. 14.

Hall's description.—"Shell turreted. Volutions rounded, six in the length of one inch and a quarter from the base; greatest convexity about the middle of each; upper ones unknown. Suture deep, giving a constricted aspect at the junction of the volutions. Surface marked with distinct angular striae, bending gently backward from the suture to the periphery, and with a long forward curve to the base

of each volution; those of the last volution bending more abruptly backward and making a second abrupt retral curve to the columellar lip."

This species is very closely related, if not identical with *L. hamiltonae*. Not very common.

Formation and locality.

Sellersburg beds; Charlestown, Kent, Lexington and Falls of the Ohio.

Loxonema hamiltoniae Hall.

L. hamiltoniae Hall, Pal. N. Y., Vol. V, Pt. II, 1879, p. 45, Pl. 13, figs. 15-17.

Hall's description.—"Shell elongate, subulate. Volutions moderately convex, about thirteen in the largest specimens known, very gradually increasing in size from the minute apex, the last one ventricose. Aperture ovate, narrowing below; columella extended. Surface marked by longitudinal, sharp, curving striae, which bend gently backward from the suture, and forwards toward the base of the volution, having the greatest curve near the middle, those of the last volution curving abruptly backward to the columellar lip. Striae separated by distinctly defined grooves which are a little wider than the ridges; the striae increasing in distance as the shell grows older."

A few specimens having a shallow suture and moderately convex volutions have been referred to this species.

Formation and locality.

Sellersburg beds and Jeffersonville limestone?; Watson, Burnsville, and Falls of the Ohio.

Loxonema rectistriatum Hall.

L. rectistriatum Hall, Pal. N. Y., Vol. V, Pt. II, 1879, p. 130, Pl. 28, fig. 9.

Hall's original description.—"Shell elongate terete. Volutions probably twelve or more in number, moderately convex, very gradually increasing in size, the last one being scarcely more convex than the preceding; each volution is distinctly contracted a little below the close suture, and then expanding gives the greatest convexity near the lower third. Suture line close. Aperture ovate, with the columella extending below. Surface marked by slender, gently curving longitudinal striae, which bend backward from the suture to the bottom of the constriction, and then continue to the base of the volution—those of the last one curving gently forward to the col-

umellar lip. The spaces between the striae are from once and a half to twice the width of the ridges."

The specimens which I have referred to this species are all very much smaller than the type figured by Hall. They agree with his description, however, in the nearly straight transverse striae, and the constriction of the whorls just below the suture line. It is not uncommon in the chert in some localities.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Burnsville and the Falls of the Ohio.

Loxonema? teres Hall.

L.? *teres* Hall, Pal. N. Y., Vol. V, Pt. II, 1879, p. 42, Pl. 13, fig. 10.

Hall's description.—"Shell turretiform. Volutions seven or more, gradually enlarging from the apex, the last one moderately ventricose, and all gently rounded on the periphery."

The specimens referred to this species are like the type, casts which do not show any surface markings. The largest of these has a length of one and three-fifths inches. None of them show the entire spire."

Formation and locality.

Jeffersonville limestone; Newbern.

MACROCHEILINA.

- A. Last volution marked by a carina.
AA. Last volution without a carina.

M. carinatus.
M. hebe.

Macrocheilina hebe Hall.

Pl. XXIII, fig. 2.

Macrocheilina hebe Hall, Pal. N. Y., Vol. V, Pt. II, 1879, p. 32, Pl. 12, figs. 4-7.

Hall's description.—"Shell turreted subfusiform, length less than twice the diameter. Volutions five or six, upper ones minute, the last two ventricose; one-half the height of each volution showing above the suture. Shell thick on all parts, especially near the aperture. Aperture longitudinally suboval, somewhat pointed below. Surface marked by extremely fine lines of growth. Height of the longest individual seen, a little more than three-fourths of an inch.

The specimens which I have seen are not well enough preserved to show whether the fine lines of growth mentioned by Hall have

been present. In other respects, however, they agree closely with Hall's figures and descriptions of this species. This is a rare species.

Formation and locality.

Jeffersonville limestone; Bunker Hill and Newbern.

Macrocheilina carinatus Nettleroth.

Macrocheilus carinatus Nett., Ky. Foss. Shells, 1889, p. 180, Pl. 20, figs. 20-23.

Nettleroth's original description.—"Shell of medium size, turreted, subfusiform; length less than twice the diameter; volutions four or five, gradually increasing from the apex, last two ventricose, and the last one occupying one-half the length of the shell. Aperture not known; indications point to its being elongate. No surface markings are visible; they have been obliterated by the process of silification, to which our specimens were subjected. A peculiarity of this shell is the carina on the periphery of the last volution, as plainly shown in figures 20 and 23. It is in fact not a real carina but produced by the elevation of the lower half of the volution above the surface of the upper half. This species has some resemblance to *M. hebe*, but differs from it by the peculiar feature of its lower volution."

Formation and locality.

Sellersburg beds and "Corniferous limestone;" Falls of the Ohio and Lexington.

Murchisonia desiderata Hall.

Pl. XVI, fig. 8.

M. desiderata Hall, Pal. N. Y., Vol. V, Pt. II, 1879, p. 89, Pl. 2y, figs. 1-3.

Hall's description.—"Shell elongate turretiform; spire somewhat rapidly ascending. Volutions ten or more, obtusely angular, flattened on their upper sides, and a little more convex below the spiral bend, the lower ones gradually enlarging; the greatest width of the last volutions about equal to the height of the two above, and scarcely more ventricose than the preceding one, except toward the aperture. Aperture somewhat elongate; the columellar lip thickened and bounded by a marked callosity.

"Surface marked by distinct concentric striae, which are sometimes raised in fascicles above the general surface of the shell, and bending gently back from the suture reach the spiral band, crossing which they bend forward more abruptly, making a gentle curve to the

suture below. The spiral band at about three-fourths of the width of the volution below the suture is simple, flattened or slightly concave, limited by narrow moderately elevated revolving lines, and marked by the retrally curving striae, which are less prominent upon it and the adjacent parts than near the suture. Suture close."

The specimen here figured is considerably larger than those figured by Hall. I have seen only one specimen in which any of the striae are well preserved (Pl. XVI, fig. 8). In this they bend abruptly backward on reaching the spiral band before crossing it.

One of my specimens from the chert agrees closely with that figured and described by Hall as *Murchisonia desiderata* var. except in the character of the upper part of the spire, which has the volutions distinctly rotund instead of angular. Spire gradually and regularly tapering with the volutions; striae indistinct; revolving band well marked only in the lower four volutions; those in the upper part of the spire are distinctly rotund. Apparently considerable variation obtains within the limits of this species. Good specimens are very rare.

Formation and locality.

Jeffersonville limestone; Burnsville and Falls of the Ohio.

Naticopsis sp.

Pl. XVI, fig. 10.

Shell small, form as indicated by figure; spire low; volutions three or four, the last very large, and regularly rounded. Surface apparently smooth; suture well defined. Aperture unknown. This shell is less globose and more depressed than most of the forms referred to *Naticopsis* and is placed provisionally in this genus:

Formation and locality.

Jeffersonville limestone; Pipe Creek Falls.

Naticopsis levis Meek.

N. levis Meek, Pal. Ohio, Vol. I, 1873, p. 215, Pl. 19, figs. 4a, b.

Meek's description.—"Shell apparently attaining a medium size; subovate in general form at maturity, but proportionally shorter in the young; spire moderately prominent; volutions four to four and a half, convex, increasing rather rapidly in size; last one large, or forming near nine-tenths of the entire bulk of the shell, rounded on the sides, and a little extended below; suture well defined; aperture ovate, being regularly rounded below and more or less angular above; col-

umella arcuate and distinctly flattened, or a little concave below the non-perforate umbilical region, above which the inner lip is thickened. Surface only showing obscure lines of growth.

"Length of the largest specimen seen, 0.60 inch; breadth, 0.48 inch; height of aperture, 0.38 inch; breadth of aperture, 0.27 inch."

I have not seen this species, but it is recorded in Hall's list of species from the Falls of the Ohio, 24th Rep. N. Y. State Mus. Nat. Hist., p. 200.

Formation and locality.

Jeffersonville limestone(?); Falls of the Ohio.

Straporollus cyclostomus (Hall).

Pl. XXI, fig. 9.

Euomphalus cyclostomus Hall, Geol. Surv. Iowa, Vol. I, Pt. II, 1858, p. 516.

This species is listed in the State Museum catalogue (16th Ann. Rep., p. 409). The specimen there referred to, however, is a cast which belongs to another species. *S. cyclostomus* has not yet been recognized in Indiana. The specimen of this species which is here figured is from Lime Creek, Iowa.

Pleuronotus decewi (Billings).

Euomphalus decewi Meek, Pal. Ohio, Vol. I, 1873, p. 220, Pl. 19, figs. 3a, b; Pl. 20, fig. 1.

Euomphalus decewi Hall, Pal. N. Y., Vol. V, Pt. II, 1879, p. 55, Pl. 15, figs. 1-8.

Meek's description.—"Shell attaining a large size, discoid in form, the upper side being moderately concave or nearly or quite flat, and the lower broadly and deeply concave; periphery flattened convex, and nearly vertical to the plane of the shell, or somewhat oblique. Volutions about three; irregularly subquadrangular, increasing regularly and gradually in size from the apex, and coiled more or less nearly (but never exactly) in the same plane, obtusely angular around the upper outer side, and thence flattened, with a more or less inward slope above, to the inner side; lower side of volutions prominent and obtusely angular at its connection with the periphery, from which point it slopes strongly inward, usually with a concave face, into the large umbilicus; aperture like the section of the volutions, irregularly quadrangular, the inner side being much narrower, and the oblique lower side wider, than any of the others. Surface ornamented by distinct lines of growth, and sometimes, on the upper and outer sides of the volutions, by little regular ridges, both of which curve

strongly backward to the angle formed at the meeting of the upper and outer sides, where they make a short backward arch in crossing a slightly concave, undefined band, somewhat like that seen in *Pleurotomaria*; thus indicating a wide, deep notch in the lip at the termination of the upper angle of the volutions. A similar but less strongly defined backward curve of these markings also occurs on the outer surface of the whorls, at the lower angle. Greatest transverse diameter of a large specimen, about 4.30 inches; height of same near the aperture, 1.66 inches."

Internal casts of this species are not uncommon. They may be recognized by the angular character of the volutions, a transverse section of the outer volution being subquadrilateral or triangular. I have seen no specimens preserving the outer surface of the shell.

Formation and locality.

Jeffersonville limestone; Pipe Creek Falls, Jefferson County and Falls of the Ohio.

Polyphemopsis louisvillae Hall and Whitf.

P. louisvillae Hall and Whitfield, 24th Rep. N. Y., State Mus. Nat. Hist., 1870, p. 193.

P. louisvillae Nettleroth, Ky. Foss. Shells, 1889, p. 180, Pl. 20, figs. 16-19.

Hall and Whitfield's original description.—"Shell small, ventricose, consisting of about six rapidly tapering volutions, the last of which comprises about two-thirds the entire length of the shell. Aperture large ovate, widest below the middle, and pointed at the upper angle; a little more than half as long as the shell. Columella slight; suture scarcely impressed. Surface smooth."

The specimen here figured is apparently a young individual of this species.

This is a rather rare shell.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Burnsville, Falls of the Ohio.

Turbo shumardi DeVerneuil.

Pl. XXII, fig. 1.

T. shumardi Hall, Pal. N. Y., Vol. V, Pt. II, 1879, p. 135, Pl. 29, figs. 1-4.

Hall's description.—"Shell gibbous, subglobose. Spire moderately elevated, apex minute; volutions about five or six, gradually enlarging in the earlier stages of growth, and the last one becoming ex-

tremely ventricose, with a broadly expanded aperture; the earlier volutions are smooth and regularly rounded upon the exposed surfaces, gradually becoming nodose and flattened or somewhat concave upon the upper side, the nodes increasing in size and strength with the increase of the volutions. Suture close in the earlier volutions, and becoming somewhat canaliculate in the later ones. Lower side of the outer volution very convex even in the umbilical region, and much extended in the direction of the columella. Aperture broadly rounded or somewhat obscurely pentahedral; columellar lip obtuse, thickened, having a distinct, broad opercular groove; callus covering the umbilicus and spreading outwardly; external margin of the aperture thin. Surface marked by fine comparatively even striae of growth, which are often crowded in fascicles, and in old shells are somewhat imbricated at irregular intervals. Periphery of the outer volution with a strongly elevated obtusely angular carina, which is continued from the suture line at the inner posterior angle of the aperture. The outer one or two of the volutions (depending on the size of the shell) marked by strong curving nodes, which, commencing just below the suture, are nearly vertical for a short distance, and thence curving forward are finally directed toward the aperture, and gradually become merged in the general surface. The striae originating at the suture, are first directed backward, and thence gently curving over the nodes, become nearly vertical and thus continue to near the peripheral carina, where they are turned a little backward and, passing this elevation, they are directed with a slight curve toward the columella."

The above description is based upon specimens from the Falls of the Ohio. This species occurs also in the northern Indiana Devonian. A specimen from the latter region shows the strong folds or nodes which extend entirely across the upper side of the outer volution from the suture and are directed backward. This is a rare fossil.

Formation and locality.

Little Rock Creek, Cass County, and Falls of the Ohio.

PLEUROTOMARIA.

- A. Surface cancellated by regular revolving striae.
 - b. Shell large with rotund form and convex volutions.
 - P. lucina* and var. *perfasciata*.
- AA. Surface without revolving striae.
 - c. Peripheral band divided by a central carina. *P. procteri*.
 - cc. Peripheral band without a central carina.
 - d. Shell with two carinae below the peripheral band.
 - P. arbella*.
 - dd. Shell without two carinae below the peripheral band.
 - P. sulcomarginata*.

Pleurotomaria sulcomarginata Conrad.

Pl. XX, figs. 9, 10.

P. sulcomarginata Hall, Pal. N. Y., Vol. V, Pt. II, 1879, p. 69, Pl. 19, figs. 8-17.

Hall's description.—"Shell depressed trochiform; spire moderately elevated; apex minute. Volutions four or five, very depressed convex on the upper side, gradually enlarging to the last one, which becomes somewhat ventricose. Aperture subquadrate, somewhat wider than high, the columella much extended below.

"Surface marked by two distinct narrow revolving carinae on each volution, one just below the suture, and the other near the periphery, with finer intermediate striae which are rarely visible; the entire surface marked by strong regular and even concentric striae which crenulate the revolving carinae, and, passing over the lower one, bend backward to the concave peripheral band. Suture sometimes sharply canaliculate.

"In entire specimens the apex is very minute, and, when the outer carination is crenulated by the strong concentric striae, the shell has a coronate aspect. This carination, however, is often obsolete on the outer volution, and more rarely on the next above, and the striae then continue uninterruptedly bending backward to the peripheral band, and continuing on the lower side often very nearly of the same strength as above. There is frequently a narrow depressed band just below the peripheral band on the last volution, causing a slight deflection of the striae. The striae are usually finer, and sometimes become nearly obsolete below the outer carination, and more rarely on other parts of the shell, especially near the aperture."

This is a rather common species at some localities in southern Indiana.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Lexington, Charles-town, Lancaster and Falls of the Ohio.

Pleurotomaria lucina Hall.

P. lucina Hall, Pal. N. Y., Vol. V, Pt. II, 1879, p. 67, Pl. 18, figs. 1-11.

Hall's description.—"Shell subglobose, or obliquely ovoid-conical. Spire moderately elevated; apex minute. Volutions about four, gradually expanding to the last one, which becomes very regularly ventri-

case, with the aperture expanded and nearly rounded, extended over the lower side, with a shallow notch on the anterior margin; upper side of the volutions very symmetrically convex; suture neatly defined, slightly canaliculate; lower side of the body volution convex in the middle and abruptly curving into the umbilical depression. Surface beautifully cancellated by concentric and revolving striae, which, in many specimens, are of equal strength. Periphery marked by a moderately wide band, on which the striae are turned abruptly backward. This band is limited by stronger striae or narrow ridges on each side, sometimes with one or two slender revolving striae within the limits of the band, marking a narrow space which is often crenulated by the concentric striae.

"This species is well marked by its symmetrically rotund form with moderate elevation of the spire, and the regular convexity of the volutions, even in casts of the interior when not compressed. There is some variety in the surface markings of the specimens apparently belonging to this species. The concentric striae are sometimes much coarser than the revolving ones; and finer striae are implanted between the stronger ones, and do not reach the suture line. In old individuals the revolving band is sometimes nearly a quarter of an inch in width. A very symmetrical specimen has a diameter of a little more than two inches, and is nearly an inch and three-fourths in height. Another specimen, which has suffered some compression, has a breadth of about three inches, with nearly the same height of spire."

The State Museum contains one specimen of this species, the only one I have seen.

Formation and locality.

Sellersburg beds (?) and Jeffersonville limestone; Falls of the Ohio and Charlestown.

Pleurotomaria lucina var. *perfasciata* Hall.

P. lucina var. *perfasciata* Hall, Pal. N. Y., Vol. V, Pt. II, 1879, p. 83, Pl. 21, figs. 19, 20.

This variety differs from *P. lucina* according to Hall in having somewhat stronger striae, and in the character of the concentric and revolving striae on the last volution; the latter where crossing the transverse striae produce a nodose surface, "giving the shell a coarse rude aspect quite unlike the ordinary forms of this species."

Formation and locality.

Nettleroth reports this variety from the "Corniferous limestone;" Falls of the Ohio.

Pleurotomaria arbella Nettleroth.

P. arbella Nett., Ky. Foss. Shells, 1889, p. 171, Pl. 26, fig. 12.

Nettleroth's original description.—"Shell rather large, turbinate, spire elevated; apex minute, aperture subquadrate, apparently somewhat wider than high. Volutions five or six, prominently convex, rapidly enlarging, last one or body whorl very ventricose. Shell wider than high. Surface marked by three revolving carinae, of which one is above and the other two below the peripheral band; the band itself is flat and narrow, and not limited by elevated carinae; the upper part of the volution at least in the two last ones, is gently sloping from suture to the first or upper carinae; from this it curves to the spiral band, forming a moderately deep rounded furrow.

"The interspaces between band and second carina, and between this and the third or last carination, are also rounded depressions, of which only the one next to the band is of about equal depth with the furrow in the upper half; the second depression in the lower half is shallow. In consequence of the great convexity of the volutions the suture is deep. The character of the transverse striae is only indicated but not fully known."

This species is known only from the type in the Nettleroth collection.

Formation and locality.

"Corniferous limestone;" Clark County.

Pleurotomaria procteri Nettleroth.

P. procteri Nett., Ky. Foss. Shells, 1889, p. 173, Pl. 21, figs. 9, 10, 13.

Nettleroth's original description.—"Shell trochiform; height exceeding width about one-fourth or more. Volutions from five to six, somewhat rapidly increasing in size, the last one ventricose; there is only one carina above and one below the peripheral band; the carina above the band gives to the upper portion of the volution a sub-angular appearance, while the lower part is regularly rounded. The peripheral band is divided by a somewhat finer central carina, which is crossed rectangularly by strong striae, which only extend from margin to margin of the peripheral band with interspaces of about four times their own size. These rectangular striae are entirely separated from the striae of the upper or lower half of the volution; they give the dividing carina a beautifully crenulated appearance. On both sides of the peripheral band the surface is ornamented by

strong transverse striae; in the upper half they start from the suture, and run in an almost straight line, with a backward deflection of about ten degrees, to the first carina, from which they curve slightly backward to the upper marginal carina of the peripheral band. This system of striae, interrupted by the band, continues at the lower marginal carina of the latter, from where the striae extend in slightly curved or nearly straight lines with a forward deflection, either to the sutures of the upper volutions, or to the lower carina of the body whorl. From this lower carina, which forms the suture line of the upper whorls, and which is therefore only visible on the last volution, the striae curve gently to the umbilicus and to the columellar lip; but a great number of them die out or become extinguished at different distances from the lower carina. All the volutions are, in their transverse sections, extremely convex, which gives them very deep sutures, and separates them from each other in a very decided manner. The aperture of this shell is not known, inasmuch as in all the specimens in my collection the outer lip is missing."

Formation and locality.

Nettleroth reports this species from the "Corniferous limestone of Clark County."

TROCHONEMA.

- | | | |
|-----|--|------------------------|
| A. | Surface marked by nodes. | <i>T. yandellanum.</i> |
| AA. | Surface not marked by nodes. | |
| | b. Body volution bicarinate. | |
| | c. The lower carina of the whorls of the spire separated from the suture by an interspace. | <i>T. emacerata.</i> |
| | cc. The lower carina of the whorl of the spire coincident with the suture. | <i>T. rectilatera.</i> |
| | bb. Body volution with three or more carinae. | <i>T. meekanum.</i> |

Trochonema meekanum (Meek).

Pl. XVI, fig. 9.

Trochonema tricarinatum Meek, Pal. Ohio, Vol. I, 1873, p. 218, Pl. 19, figs. 4a, b.

Meek's description.—"Shell turbinate, thin, a little wider than high; spire depressed. Volutions about five, strongly shouldered, or nearly rectangular above, the upper surface being flat or a little concave, and extended out almost horizontally to the rectangular and carinate shoulder; below this the outer side is nearly vertically flattened to a second carina, passing on around near the middle of the body whorl, exactly coincident with the suture between that and the

succeeding turn, so as not to be exposed on the spire; below this second carina the under side of the body volution is flattened with a strong inward slope, to a third well defined carina, passing around the middle of the under side, and forming the margin of the umbilicus. Aperture oval-subpentagonal, being a little higher than wide, and somewhat angular above at the connection of its outer lip with the return of the spire, and at the termination of each of the three revolving carina, as well as very obscurely so, a little below the middle of the inner side; under lip thin below its connection with the carina, passing around the umbilicus, at which point it is very slightly thickened, while above this it seems to be nearly or quite obsolete. Umbilicus rather wide, but shallow, or very rapidly contracting within.

"Suture well defined without being in the slightest degree furrowed. Surface only showing very fine lines of growth, which, on the upper flattened space of the volutions, pass obliquely outward and backward, with a very slight curve from the suture to the upper angle or shoulder, below which they pass nearly straight down the outer flattened area to the second carina, which is as far as they can be traced in the specimen studied.

"Height, 0.81 inch; breadth, 0.90 inch; height of aperture, 0.54 inch; breadth of aperture, 0.46 inch."

The specimen here figured is a guttapercha cast. It differs from Meek's description in some respects, the height slightly exceeding the width, and the surface striae being stronger than his figure would indicate. The specimen also shows below the carina limiting the lower side of the flat peripheral band of the body whorl two other revolving carina and a third indistinct one. It seems best, however, in the absence of material for studying the variation of the species, to regard this as a variation of Meek's species.

Formation and locality.

Jeffersonville limestone; Newbern.

Trochonema yandellana Hall and Whitf.

T. yandellana Hall & Whitfield, 24th Rep. N. Y. State Mus. Nat. Hist., 1872, p. 194.

T. yandellana Hall & Whitfield, 27th Rep. N. Y., State Mus. Nat. Hist., 1875, Pl. 13, fig. 3.

Hall and Whitfield's original description.—"Shell turbinate volutions about five, (three of which are preserved in the specimen), rapidly increasing, carinated; the last volution becoming ventricose

and marked by seven revolving carinae, including the one bordering the somewhat channeled suture; four of the carinae are distinctly marked by thin lanceolate nodes, which become more prominent with the increased growth of the shell, while the other three—one bordering the suture and two on the lower middle portion of the volution—are destitute of nodes (in the specimen described), but may possibly assume this character in more advanced stages of growth. The carinae are situated one at the suture and one bordering the moderately large umbilicus, with five on the body of the volution, of which two are above the middle and three below; the spaces separating those bordering the suture and umbilicus from those on the body of the volution, are considerably wider than the spaces between the intermediate carinae. Aperture rounded, slight, modified by the carinae. Surface marked by fine transverse striae of growth, which turn backward as they cross the volution, to the umbilicus.”

I have not seen this species.

Formation and locality.

“Cherty layers of the Corniferous limestone,” Falls of the Ohio.

Trochonema emacerata Hall and Whitf.

T. emacerata Hall & Whitfield, 24th Rep. N. Y. State Mus. Nat. Hist., 1872, p. 193.

T. emacerata H. & W., 27th Rep. N. Y. State Mus. Nat. Hist., 1875, Pl. 13, fig. 11.

Hall and Whitfield's original description.—“Shell turbinate, consisting of four or five volutions, the upper ones moderately convex and bicarinate; the suture line commences a little below the second carina. The last volution is very ventricose, with a rounded aperture; umbilicus small.

“Surface marked apparently only by lines of growth.

“This species differs from *T. tricarinata* Meek, in the more elevated spire, the sloping side of the volutions between the suture and the first carina, and in having two carinae with an interspace equal to that above and below, while there is no evidence of a carina bordering the narrow umbilicus.”

This species is rare.

Formation and locality.

“In limestone above the ‘Hydraulic beds’;” Sellersburg beds; Louisville.

Trochonema rectilatera Hall and Whitfield.

T. rectilatera H. & W., 24th Rep. N. Y. State Mus. Nat. Hist., 1872, p. 193.

T. rectilatera H. & W., 27th Rep. N. Y. State Mus. Nat. Hist., 1875, Pl. 13, figs. 4-5.

Hall and Whitfield's original description.—"Shell turbinate, breadth and height almost equal; volutions about five, carinated above with straight nearly vertical sides; outer one ventricose with two distinct carinae having a wide, vertical, slightly concave space between, which occupies more than one-third of the height of the volution. Upper side of the volution convex for half the distance to the carina, and below this they are concave, giving the form of an ogee.

"In another specimen, apparently identical, the upper side of the volutions are slightly concave and regularly sloping downward from the suture to the carina. Lower side of the volution not carinate; umbilicus small, or closed with a callosity.

"Surface marked by fine striae of growth, which are turned backward from the suture, and are vertical on the sides of the volution, and on the lower side curve backward to the umbilical area."

Formation and locality.

"Upper limestones" (Sellersburg beds?); Falls of the Ohio.

Cyclonema crenulata Meek.

Pl. XXI, figs. 10, 11.

C. crenulata Meek, Pal. Ohio, Vol. I, 1873, p. 213, Pl. 19, figs. 2a, b, c, d.

Meek's description.—"Shell turbinate, subtrochiform, thin; spire depressed conical, volutions four, increasing rather rapidly in size, those of the spire convex, but not rounded; last one not large, convex on the upper slope of the periphery, which is rather narrowly rounded; suture well defined between the upper volutions, and somewhat canaliculate further down; aperture ovate. Surface ornamented by sharply elevated revolving lines or small ridges, which are beautifully and intimately crenulated by the crossing of the very fine, very oblique lines of growth. Of these revolving lines from sixteen to eighteen may be counted on the body volution and sixteen on the next above, while those farther up appear to be quite smooth.

"Length, 0.34 inch; breadth, 0.32 inch."

I have several specimens of this species, all from the northern Indiana Devonian. The revolving striae are not noticeable on the third volution, as indicated by one of the figures.

Formation and locality.

Jeffersonville limestone; Bunker Hill and Pipe Creek Falls.

Cyclonema cancellata.

C. cancellata Hall, 27th Ann. Rep., N. Y. State Museum Nat. Hist., 1875, Pl. 13, figs. 6-7.

This species was figured by Hall, but not described. I have not been able to recognize it in my collections.

Formation and locality.

Jeffersonville limestone(?); Falls of the Ohio.

Aclisina barnetti n. sp.

Pl. XXIII, fig. 3.

Shell elongate conical; volutions seven or eight in mature specimens, compressed convex, the lower third descending to the suture with a distinctly convex outline, while the upper portion is flat; volutions regularly increasing from the apex. Suture well defined and rather deeply impressed. The volutions of the spire have the surface marked by from six to eight strong revolving lines; the body volution has about twice this number, half of which are on the lower side of the volution.

The smallest specimen observed has a length of $\frac{7}{50}$ of an inch and only five volutions. In four specimens examined the length is about one and a half times the width.

Formation and locality.

Jeffersonville limestone; Pipe Creek Falls and Bunker Hill.

Aclisina barnetti var. *elongata* n. var.

Pl. XXIII, fig. 4.

The elongate form of one specimen seems to justify its separation from the others as a well marked variety. Its length equals the width.

Formation and locality.

Jeffersonville limestone; Keesport, Cass County.

These plications increase in strength from apex to the aperture; their interspaces are also gradually widening in their course toward the front; they are of unequal width; some are of four times and others of double the size of the adjacent ribs. My specimens being internal casts completely silicified into hornstone, no other surface markings are retained.

"Form and size of the aperture unknown."

This species is known only by the types.

Formation and locality.

Sellersburg beds; Watson.

Capulus cassensis n. sp.

Pl. XVI, fig. 11.

Shell small, subconical, nearly erect, the apex inclined slightly backwards; aperture ovate, its length and the height of the shell are in the ratio of three to four. The surface is marked by very fine concentric striae and by distinct regular lamellae which lap upwards, the exposed margin of each being on the upper side instead of the lower, as in ordinary lamellae. The lamellae and striae bend very slightly upward in crossing the front side of the shell and arch rather abruptly downwards in crossing the posterior side. There appear to be faint traces of radiating striae over a part of the surface.

The peculiar regular lamellae seem to distinguish the shell from any other species. The specimen figured measures in height 21/50 of an inch; the diameters of the aperture are 15/50 and 12/50 of an inch respectively. Two other specimens measure respectively 11/50 and 13/50 of an inch in height.

Only three specimens have been observed.

Formation and locality.

Jeffersonville limestone; Pipe Creek Falls, Cass County.

PLATYCERAS.

A. Shell with spines.

b. Spines in a single line along the dorsum.

P. blatchleyi.

bb. Spines not confined to the dorsum.

c. Shell large.

d. Shell elongate with loosely coiled spire.

P. milleri.

dd. Shell not elongate without loosely coiled spire.

d¹. Form erect.

P. dumosum var. *pileum.*

dd¹. Form usually depressed.

- e. Having few spines.
 - f. Body volutions greatly expanded.
 - P. fornicatum.*
 - ff. Body volution not greatly expanded.
 - P. dumosum* var. *rarispinum.*
- ee. Having numerous spines.
 - g. Shell very large, greatly depressed, expanding rapidly. Spines very numerous.
 - P. multispinosum.*
 - gg. Shell of moderate size, not greatly depressed, with from 15 to 100 spines. *P. dumosum.*
- cc. Shell small or of medium size.
 - h. Posterior margin of peristome contiguous to the preceding volution.
 - P. rictum* var. *spinosa.*
 - hh. Posterior margin of peristome distant from preceding volution. *P. echinatum.*
- AA. Shell without spines.
 - i. Dorsum serrated. *P. indianensis.*
 - ii. Dorsum not serrated.
 - j. Body volution entirely straight, shell nearly perfectly conical. *P. conicum.*
 - jj. Body volution not entirely straight, shell not perfectly conical.
 - k. Dorsum sharply angular or with a carina. *P. carinatum.*
 - kk. Dorsum without a carina, not sharply angular.
 - l. Body volution greatly compressed laterally.
 - m. Apex apparently incurved. *P. fluctuosum.*
 - mm. Apex closely enrolled.
 - n. Peristome strongly serrated *P. serratum.*
 - nn. Peristome not serrated. *P. arctiostoma.*
 - ll. Body volution not greatly depressed laterally.
 - o. Shell above the body whorl abruptly contracted, apical whorl very slender. *P. attenuatum.*
 - oo. Shell not abruptly contracted above the body whorl, apical whorl not very slender.
 - p. Shell bilaterally symmetrical or nearly so. *P. symmetricum.*
 - pp. Shell bilaterally symmetrical.
 - q. Body whorl very ventricose or aperture greatly expanded.
 - r. Body volution generally contiguous to preceding volution.
 - s. Surface of body whorl with two or three rounded plications. *P. bucculentum.*
 - ss. Surface of body whorl usually without plications. *P. ventricosum.*

- rr. Body volution not contiguous to preceding volution.
 - t. Body volution with an oblique angular ridge on the left side. *P. rictum.*
 - tt. Body volution with several strong longitudinal folds. *P. crassum.*
- qq. Body whorl not very ventricose, aperture not greatly expanded.
 - u. Peristome deeply sinuous. *P. quinquisinuatum.*
 - uu. Peristome deeply sinuous.
 - v. Shell arcuate from the base, usually with folds or plications on the right. *P. thetis.*
 - vv. Shell erect and subarcuate, usually without folds or plications on the right side. *P. erectum.*

Platycerus conicum Hall.

Pl. XVIII, figs. 2, 2a, 2b.

P. (Orthonychia) conicum Hall, Pal. N. Y., Vol. V, Pt. II, 1879, p. 3, Pl. 1, figs. 13-23.

Hall's description.—"Shell erect, conical, the minute apex closely incurved. Body volution entirely straight, with broad undefined longitudinal ridges and depressions, which become more distinct toward the aperture; height of the shell a little greater than the width of the aperture, which is a little longer than wide. Surface marked by concentric undulating striae which become sublamellose toward the aperture and are sometimes closely crowded and wrinkled with numerous knots and nodes. Peristome deeply sinuous; the width from the anterior to the posterior side a little greater than the transverse diameter. The length of the shell is one inch and a half or more, with the aperture a little less."

This is a common species in both northern and southern Indiana. The figures illustrate the principal types of this shell as it is found in the Indiana Devonian.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Pipe Creek Falls, Little Rock Creek, Cass County, Charlestown and Falls of the Ohio.

Platyceras carinatum Hall.

Pl. XVIII, figs 5, 6, 7.

P. carinatum Hall, Pal. N. Y., Vol. V, Pt. II, 1879, p. 5, Pl. 2, figs. 12-29.

Hall's description.—"Shell obliquely subconical or subpyramidal; the nucleus or apex minute, and making from one to one and a half volutions which are vertically compressed, and below which the body

volution is abruptly expanded; the dorsum angular or marked by an angular carina which often becomes double in old shells, or is rounded on the summit. This angularity or carina indicates, by direction of the striae, the existence of a sinus in the peristome from an early period of growth; and sometimes there may have been two of such sinuosities close together, giving the double carina. There is usually a depression along one or both sides of the carina, with longitudinal folds (obscure plications) on one or both sides, which become more strongly developed toward the aperture, and are very conspicuous in old shells; the right side is more expanded than the left, and in some well preserved specimens is nearly twice as wide. Aperture very oblique, rhomboidal or subtriangular, and the peristome sinuous.

"Surface marked by fine, closely arranged, undulating striae of growth, which are not lamellose."

The figures illustrate the two principal types of shells which are referred to this species, those with a carina and those with an angular dorsum.

This is not a very common species.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Pipe Creek Falls and Charlestown.

Platyceras dumosum Conrad.

Pl. XVII. fig 1.

P. dumosum Hall, Pal. N. Y., Vol. V, Pt. II, 1879, p. 14, Pl. 5, figs. 11-16; Pl. 6, fig. 1.

Hall's description.—"Shell subovoid, arcuate, extremely ventricose when full grown; the length from the apex to the anterior margin of the aperture greater than the height. Apex minute, closely enrolled for a single volution or more, when the body volution becomes free and rapidly expanded, spreading more upon the right side, which is sometimes depressed-convex, while the left side is more abruptly rounded. The aperture is subrhomboid-ovate, with the peristome making a sinus on the left side, the posterior margin widely separated from the preceding volution.

"Surface marked by strong concentric striae which are interrupted and irregular from the numerous nodes projecting from the shell, and extended into long tubular spines."

This is not a common species.

Formation and locality.

Sellersburg beds; Falls of the Ohio and Charlestown.

Platyceras dumosum var. *pileum* n. var.

Pl. XVII, fig. 2.

Shell large, erect, body volution very ventricose, aperture circular, lip not sinuous. Surface marked by strong concentric striae, and thickly covered by tubular spines, somewhat regularly arranged in diagonal rows.

The spines are very much smaller and more numerous than in average specimens of *P. dumosum*; in this respect it resembles *P. multispinosum*, but it is much more erect than either of these species and seems to be a well marked variety.

Formation and locality.

Jeffersonville limestone; Falls of the Ohio.

Platyceras multispinosum Meek.

Pl. XVII, fig. 3.

P. multispinosum Meek, Pal. Ohio, Vol. I, 1873, p. 210, Pl. 20, fig. 7a, b.

This species differs from *P. dumosum* according to Meek "not only in its much larger size, more oblique, depressed, and more rapidly expanding form, but in having much more numerous spines."

I have seen but one specimen of this species, which is here figured.

Formation and locality.

Jeffersonville limestone; Falls of the Ohio.

Platyceras dumosum var. *rarispinum* Hall.

Pl. XVII, fig. 4.

P. dumosum var. *rarispinum* Hall, Pal. N. Y., Vol. V, Pt. II, 1873, p. 16, Pl. 5, figs. 5-7, 10.

This variety is characterized by having a smaller size, less ventricose shell and fewer spines than *P. dumosum*.

Mr. Green's collection contains two specimens which I refer to this variety. The largest of these has a height of $1\frac{3}{8}$ inches; the diameter of the aperture about equals the height; the aperture is nearly circular in outline and is somewhat sinuous in front. The surface is covered by coarse wrinkled striae and appears to have had only about four or five spines.

Formation and locality.

Sellersburg beds(?); Charlestown and Falls of the Ohio.

Platyceras milleri Nettleroth.

P. milleri Nett., Ky. Foss. Shells, 1889, p. 165, Pl. 25, fig. 1.

One specimen in Mr. Green's collection is referred to this species.

The apical volution is broken away. Upper portion of the shell spirally twisted to the left; shell enlarging gradually. Surface marked by fine concentric striae which are crowded into wrinkles on the anterior side; tubular spines are distributed over the surface, but not so abundantly as in the specimen figured by Nettleroth. The greater part of these are confined to the dorsal part. Aperture somewhat compressed laterally.

Formation and locality.

Sellersburg beds; Charlestown.

Platyceras thetis Hall.

Pl. XIX, figs. 1, 1a; XVIII, figs. 8, 8a, 9.

P. thetis Hall, Pal. N. Y., Vol. V, Pt. II, 1879, Pl. 3, figs. 11-16.

Hall's description.—"Shell obliquely arcuate from the base, with the apex incurved, the nucleus making barely more than a single minute volution; gradually expanding from the apex to near the aperture, which is sometimes more abruptly spreading. The back of the body whorl is prominent, and a little flattened on the left side; while the right side from one-third to one-half the length is sometimes marked by two or three longitudinal folds, and often by more numerous, finer plications. Aperture a little oblique, nearly round or subquadrangular, with the peristome sinuous.

"Surface marked by fine, closely arranged lamellose striae, which are abruptly undulated on all parts of the body of the shell."

Two of the specimens here figured represent extreme types of the shell; one is long, slender and gently arcuate; the second is short and abruptly curved; in the latter specimen the apex is incurved in the same plane as the body whorl, and resembles in this respect *P. symmetricum*, but has not the extended body whorl of this species.

The third specimen is referred with considerable doubt to this species. A slight fold marked by the upward arching striae occupies the dorsum and terminates in a well marked sinus in the peristome.

Formation and locality.

Sellersburg beds; Charlestown.

Platyceras sp.

Pl. XIX, fig. 8.

Shell arcuate from the base. Apex closely incurved for about one revolution, twisted a little to the right, gradually enlarging to the aperture. Below the apical whorl, which is gently convex, the shell is marked by four strong longitudinal plications, which give the body revolution a roughly quadrilateral shape. These longitudinal folds are separated by wide, shallow depressions.

Surface marked by lamellose striae.

I have not been able to identify this shell with any of the described forms. It may be compared with *P. thetis* and may possibly be a variety of that species.

Formation and locality.

Jeffersonville limestone; Charlestown.

Platyceras fornicatum Hall.

P. fornicatum Hall, Pal. N. Y., Vol. V, Pt. II, 1879, p. 11, Pl. 4, figs. 1-5, 7-8, 18-20; Pl. 5, figs. 8, 9, (?).

Hall's description.—"Shell obliquely subhemispherical, or very depressed, obliquely subconical. Apex minute, distinct, spirally enrolled for about one turn and a half, below which it expands, so that in the extent of an inch and a half along the dorsum to the front it has acquired an aperture of about an inch and a half in diameter in both directions. The upper side of the spire for the first revolution and the following half is flattened; the angle continuing into the broad expansion of the body whorl, and dying out before reaching the margin, as shown in figs. 1-5. Aperture nearly round or round ovate; peristome scarcely sinuous, except at the postero-lateral margin.

"Surface marked by fine concentric striae, with a few strong spines upon the body revolution."

Hall includes this species in his list* of Devonian fossils from the Falls of the Ohio. I have not seen it.

Platyceras bucculentum Hall.

Pl. XIX, figs. 3, 3a, 3b, 4, 4a.

P. bucculentum Hall, Pal. N. Y., Vol. V, Pt. II, 1879, p. 10, Pl. 3, figs. 7, 26-29.

Hall's description.—"Shell ventricose, obliquely subovoid. Apex extremely attenuate, the spire making one or two closely enrolled

*24th Ann. Rep. N. Y. State Mus. Nat. Hist., 1870. p. 200.

volutions, with a gently enlarging diameter, and below this abruptly expanding and becoming very ventricose in the middle and lower part; spreading more upon the right side than on the left; the shell near the posterior side swells out into a distinct pouch-like projection with two or three rounded folds or semiplications, which give a deeply sinuous outline to the margin. Aperture subovate, and sinuate on the right posterior side. Peristome sinuous, and on the posterior side spreading partially over the preceding volution.

"Surface marked by fine, closely arranged concentric striae which are undulated toward the margin of the aperture, and sometimes over the greater part of the surface, the irregularity having commenced during the earlier stages of growth. In well preserved specimens there are revolving striae or fascicles, rising in little bands of obsolescent striae, giving a waved aspect to the surface."

Some of the specimens which I have referred to this species are greatly depressed, and with their lateral expansion present a sub-triangular outline viewed from above. In each of the specimens figured the shell has been more or less broken away about the aperture. Other specimens which preserve this part of the shell show a strongly sinuous peristome. The "two or three rounded folds" on the posterior side mentioned by Hall are generally wanting in my specimens, but the greatly expanded and ventricose body volution seems to place them with this species. One or two specimens show traces of revolving striae.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Charlestown and Kent.

Platyceras symmetricum Hall.

P. symmetricum Hall, Pal. N. Y., Vol. V, Pt. II, 1879, p. 9, Pl. 3, figs. 17-25.

Hall's description.—"Shell elongate, subovoid, arcuate, incurved nearly in the same plane; nucleus minute, the spire making about one volution or one and a half, when the body whorl becomes free and rapidly, or somewhat abruptly, expanded; spreading about equally on the two sides of the dorsum, which is more prominent and sometimes marked by a ridge. Aperture oblique, subquadrate or rhomboidal, margin of the peristome sinuate, and on the posterior side distant from the spire.

"Surface marked by concentric undulating striae, and longitudinally by obscure interrupted ridges, which on some parts of the older

shells become regular and uniform, with a narrow groove between."

The specimens which I have referred to this species show very slight traces of longitudinal ridges and have the surface nearly smooth except for concentric striae. They are characterized by their bilateral symmetry, having the apex in nearly the same vertical plane as the dorsum.

Formation and locality.

Sellersburg beds; Charlestown.

Platyceras indianensis Miller and Gurley.

Pl. XIX, figs 9, 9a.

P. indianensis M. & G., Bull. Ill. State Mus. Nat. Hist. No. 12, 1897, p. 48, Pl. 4, figs. 7-10.

Miller and Gurley's original description.—"Species rather large. The back of the body whorl from the apex to the aperture is sharply angular and strongly serrated. Toward the apex the shell is laterally compressed, but it expands laterally toward the aperture. The apex is sharply pointed. The shell makes about one volution, in nearly the same plane, when the apex comes in contact with the rapidly spreading body whorl. The aperture is compressed subelliptical, in outline, in the specimen illustrated by figure 9, with a moderately deep sinus at the angular back of the body whorl. And the shell substance is thin, which indicates, probably, a young shell, or, it may be, the apical end of a mature specimen.

"Figure 10 represents a mature specimen. It is much extended upon the back of the body whorl and the shell gradually becomes thicker, but the aperture below the beak remains in the same position that it is in the specimen shown in figure 8. The aperture increases its length, and by reason of the lateral expansion of the shell with the growth, it retains a compressed subelliptical outline, but acquires a deep, sharply angular sinus at the back of the shell.

"The surface is marked by concentric undulating striae, that become more and more pronounced toward the aperture. They are not shown in the illustrations."

The specimen here figured is referred to this species with some doubt.

The angular back is surmounted by a small, sharp carina which appears to be somewhat serrated. The removal of the specimen from the limestone has left this feature indistinct. The figures fail to show the somewhat distinct serration which is noticeable near the aperture. This shell has certainly not been as strongly serrated along

the dorsum as the typical specimens of *P. indianensis* and is regarded as a variety of that species.

P. indianensis is not uncommon in southern Indiana. Mr. Green's collections from Charlestown contain five or six typical specimens.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Little Rock Creek, Cass County, and Charlestown.

Platyceras (Orthonychia) attenuatum Hall.

Pl. XIX, fig. 6.

P. (Orthonychia) attenuatum Hall, Pal. N. Y., Vol. V, Pt. II, 1879, p. 6, Pl. 3, figs. 1-6.

Hall's description.—"Shell elongate-ovate or conically subovate with a slender apex, the nucleus making about one revolution or one and a half, below which the body whorl becomes rather abruptly inflated, and thence gradually expands to the aperture, which is very oblique—the anterior side of the peristome being much more extended.

"Surface marked by crowded, undulating concentric striae and longitudinal, irregular and undefined folds, which vary greatly in different specimens; the latter becoming more distinctly marked as plications near the aperture. Peristome sinuous, with numerous indentations corresponding to the folds upon the surface."

The specimen here figured does not preserve any of the original surface markings. The small circular spots shown by the figure indicate a peculiar structure developed during the silicification of the specimen. Two or three faint undefined plications are noticeable on the sides. A rather deep sinus marks the posterior side of the peristome.

Formation and locality.

Sellersburg beds; Charlestown.

Platyceras erectum Hall?

Pl. XIX, fig. 7.

P. erectum Hall, Pal. N. Y., Vol. V, Pt. II, 1879, p. 5, Pl. 11, figs. 4-11.

Shell obliquely arcuate, apex minute, closely enrolled for one revolution, beyond which the shell rapidly expands to the middle of the body revolution, where it attains its maximum diameter. Surface

marked by concentric striae which are somewhat lamellose near the aperture. A faintly defined fold marks the dorsum.

One specimen is referred to this species with some doubt.

Formation and locality.

Sellersburg beds; Charlestown.

Platyceras rictum Hall.

P. rictum Hall, Pal. N. Y., Vol. V, Pt. II, 1879, p. 13, Pl. 4, figs. 6, 12-17.

P. rictum Nettleroth, Ky. Foss. Shells, 1889, p. 166.

Nettleroth records this species. I have not seen any specimens that could be referred with certainty to it.

Formation and locality.

"Corniferous limestone" (Jeffersonville limestone?); Clark County.

Platyceras rictum var. *spinosa* n. var.

Pl. XVII, figs. 5, 5a, 5b 5c.

Shell much depressed, strongly arcuate; apex minute; spire closely and obliquely enrolled about one and a half turns, when it abruptly expands, forming the large ventricose, closely enrolled body volution. Shell either sharply or gently rounded along the dorsal line of the body volution, with an oblique form inclining to the left. Peristome reflected in front, almost in contact with the spire. Surface marked by undulating concentric striae and irregularly arranged tubular spines; the spines vary in number from three or four up to fifteen or twenty. This form differs from *P. rictum* in its less angular or rounded dorsum, and in having the surface marked by spines. Mr. Green's collection contains several specimens of this shell; all of them have the aperture partially broken away so that they do not permit of a perfectly satisfactory comparison with *P. rictum*.

Formation and locality.

Sellersburg beds; Charlestown.

Platyceras ammon Hall.

P. ammon Hall, Pal. N. Y., Vol. V, Pt. II, 1879, p. 20, Pl. 8, figs. 7-10.

This species is listed in the State Museum catalogue of Fossils (16th Ann. Rep. Ind. Dept. Geol. and Nat. Hist., p. 409). The specimen there referred to is too poorly preserved to admit of a satisfactory identification. I have not recognized this species in my collection.

Platyceras crassum Hall?

P. crassum Hall, Pal. N. Y., Vol. V, Pt. II, 1879, p. 18, Pl. 7, figs. 6-10.

I have seen no specimens that can be certainly referred to this species. A few specimens which are not now accessible, were doubtfully referred to this species in a previous paper.*

Platyceras compressum Nettleroth.

P. compressum Nettleroth, Ky. Foss. Shells, 1889, p. 162, Pl. 25, figs. 8-10.

Nettleroth's original description.—"Shell of medium size or below it; very compressed in a lateral direction. Apex closely enrolled for one and a half volutions, which increase in size very gently; after this the body whorl, measuring a little more than a half volution, expands rapidly in the post-anterior direction, while its lateral extension remains almost the same throughout the whole length of the body volution. The right side of the shell is moderately convex in the apical half, but becomes concave in the lower half, the center line of the concavity running at right angles to the peristome. The left side is throughout concave, but the center line of the concavity is parallel to the peristome, or at least nearly so. The aperture is very elongate and narrow, and expands more or less at the posterior end of its right side. The surface is marked by five concentric lamellose striae, which are closely arranged, especially in the lower half, and by somewhat obscure, shallow, radiating plications, only noticed in the lower part.

"A smaller specimen, of about half the size of the one illustrated, does not show any indication of those plications."

Formation and locality.

"Corniferous limestone;" (Jeffersonville limestone?); Falls of the Ohio.

Platyceras compressum var.

Pl. XIX. figs. 2, 2a.

Shell obliquely arcuate, and laterally compressed. Apex minute, closely enrolled for one and a half volutions, which gradually increase in size. The body volution expands rapidly in the anterior and posterior direction, but beyond the apical whorls, which are moderately convex on the sides, the shell develops a wide sinus on

* Bull. Amer. Pal. No. 12, 1899 p. 75.

the right side which deepens gradually toward the aperture; the left side is slightly convex or nearly flat to within a short distance of the aperture, where a shallow sinus is developed corresponding in position to the one on the opposite side. The dorsum is sharply rounded. Aperture contracted anterior to the lateral sinus and expanded at the posterior end. The peristome on the left side near the posterior margin is bent in; but this probably is abnormal. Surface marked by fine concentric somewhat wrinkled striae.

This shell appears to be closely related to *P. compressum* Nettleroth, but does not have the left side concave throughout as in that species; the post-anterior width of the body whorl is proportionally much less in this form than it is in *P. compressum*. The enormous variation to which shells of this genus are subject, however, serves scarcely to justify recognizing a new species in this form without direct comparison with the type of *P. compressum*, so that it is here regarded only as a variety of that species.

Formation and locality.

Sellersburg beds; Charlestown.

Platyceras ventricosum Conrad.

P. ventricosum Meek, Ill. Geol. Rep., Vol. III, 1898, p. 441, Pl. 2, figs. 4a, b.

P. ventricosum Nettleroth, Ky. Foss. Shells, 1889, p. 168, Pl. 25, fig. 10.

This species has been reported from the Indiana Devonian by Nettleroth. I have not seen it.

Formation and locality.

"Corniferous limestone" (Jeffersonville limestone); Clark County.

Platyceras echinatum Hall.

P. echinatum Hall, Pal. N. Y., Vol. V, Pt. II, 1879, Pl. 5, figs. 1-4.

P. echinatum Nettleroth, Ky. Foss. Shells, 1889, p. 164, Pl. 33, fig. 21.

Hall's description.—"Shell small, obliquely subovoid. Apex closely incurved for about one volution or one and a half; the body whorl from one half to one volution is ventricose, rapidly expanding from the first, giving an obliquely conical form. Aperture nearly circular or broad oval; peristome sinuate, the lines of growth and fine striae conforming in direction to the outline of the margin. Remains of revolving striae are sometimes traceable, when the shell is not exfoliated.

ated. Besides the concentric and less conspicuous revolving striae, the surface is studded with numerous nodes and small spines, the latter preserved only where the shell has been embedded in the soft shale, and quite separable from the rock; when embedded in limestone, the spines and exterior shell are removed with the matrix."

Nettleroth has figured a specimen of this species from the Falls. I have not seen it.

Formation and locality.

"Corniferous limestone" (Jeffersonville limestone?); Falls of the Ohio.

Platyceras (Orthonychia) fluctuosum Ulrich.

P. fluctuosum Ulrich, Contrib. Am. Pal. 1886, p. 31, Pl. 3, figs. 6-6b.

Ulrich's original description.—"Shell obliquely conical, laterally compressed, gradually expanding; dorsum straight or arcuate; apex obtusely pointed, apparently not incurved. Surface or apical half of shell with irregular undulations or protuberances; lower half plicated longitudinally, the plications unequal, and crossed by irregular undulating lines of growth. Aperture narrowly ovate, with the margin sinuate, or rather irregularly serrated."

Formation and locality.

"Middle Devonian (Up. Helderberg?); Falls of the Ohio."

Platyceras (?) arctiostoma Ulrich.

P. arctiostoma Ulrich, Contrib. Am. Pal., Vol. I, 1886, p. 30, Pl. 3, figs. 7-7b.

Ulrich's original description.—"Shell semirhomboidal, obliquely enrolled, and consisting of about two volutions; apex minute, depressed; outer volution compressed laterally, rapidly increasing in height, but slowly in width, with the sides, which diverge at an angle of 45 degrees, flat at the aperture, and slightly convex near the nucleus whorl; the upper side is longitudinally concave and narrowly rounded toward the depressed apex; the periphery is subangular, and the lower side rather flat and abruptly rounded into the large umbilicus. Aperture oblique, extremely elongate, with the sides subparallel.

"Surface marked by fine, well developed, and somewhat undulating striae of growth. These are crossed by faint revolving lines. Where the external layer of the shell is preserved the surface is polished."

This species is known only by the type specimen.

Formation and locality.

"Lower Devonian" (Jeffersonville limestone); Falls of the Ohio.

Platyceras (Orthonychia) fluctuosum Ulrich.

P. (Orthonychia) fluctuosum Ulrich, Contrib. Am. Pal., Vol. I, p. 31, Pl. 3, figs. 6-6b.

Ulrich's original description.—"Shell obliquely conical, laterally compressed, gradually expanding; dorsum straight or arcuate; apex obtusely pointed, apparently not incurved. Surface of apical half of shell with irregular undulations or protuberances; lower half plicated longitudinally, the plications unequal, and crossed by irregular undulating lines of growth. Aperture narrowly ovate, with the margin sinuate, or rather, irregularly serrated. This shell differs from all the species belonging to the genus or subgenus *Orthonychia* Hall in the compressed form and the irregular surface undulations. It may be compared with *P. (O.) perplexum* Hall from the Upper Helderberg of New York."

The only specimens which have been found are in the collections of Mr. Green.

Formation and locality.

"Middle Devonian" (Jeffersonville limestone); Falls of the Ohio.

Platyceras blatchleyi n. sp.

Pl. XVII, fig. 6.

Shell arcuate, depressed; apex minute, closely enrolled for about three-fourths of a volution, when it abruptly widens into the greatly expanded body volution. The shell is compressed along the dorsal line from the apex to the posterior margin, giving it a sharply angular dorsum; the angular dorsum supports seven strong and somewhat compressed spines which are directed backwards. There may have been and probably were two or three other spines, anterior to those shown in the figure, which are not preserved. The right side is rather more expanded than the left. Shell in front descending almost vertically from the incurved apex to the aperture; on the sides it is slightly rounded below the dorsum and then slopes regularly to the aperture; length and width of aperture nearly equal. Peristome sinuous.

Surface marked by fine, even striae.

P. indianensis resembles this shell in its angular dorsum, but does not have the row of dorsal spines which clearly distinguishes this shell from any *Platyceras* with which I am acquainted.

Formation and locality.

Jeffersonville limestone; Little Rock Creek, Cass County.

Platyceras lineare n. sp.

Pl. XVIII, figs. 3, 3a.

Shell small, depressed arcuate along the dorsal axis; apex minute, closely enroled for one and a half volutions, beyond which the shell abruptly expands, spreading more upon the right than upon the left side. Dorsum gently rounded toward the aperture, abruptly rounded near the apex. Aperture oblique. Posterior half of the peristome deeply sinuate.

Surface marked by very fine concentric striae which are somewhat wrinkled on the upper part of the shell. The body whorl is marked by two distinct longitudinal color bands, one on each side of the dorsum; these do not extend quite to the closely enroled part of the shell. These bands have a sepia brown color and show as distinctly on the creamy white surface of the shell as if the specimen were still living.

This species is probably more closely related to the *P. buculentum* type than any other. Its much smaller size and comparatively larger aperture distinguish it from that species. The peristome does not spread over the preceding volution as in *P. buculentum*. The color bands are unique, but may not be preserved in other specimens. Mr. Green's collection contains the only specimen I have seen.

Formation and locality.

"Middle Devonian" (Jeffersonville limestone); Falls of the Ohio.

Platyceras subcirculare n. sp.

Pl. XIX, fig 5.

Shell arched, the dorsal line of the body whorl forming a nearly perfect half circle. Apex minute, closely coiled against the apical whorls, shell gradually enlarging from the apex, sharply rounded on the dorsum. The aperture is characterized by a peculiar auriculate expansion near the posterior margin on each side of the shell, which appears to be most strongly developed on the right side, giving a heart-shaped outline. The peristome is turned backwards at the margin, spreading partially over the preceding volution.

Surface marked by fine arched striae. On the body whorl the shell is marked by a color band on each side of the dorsum; the band on the right side on nearing the apex approaches the axis of the shell and on the apical whorl follows the dorsum. A third less distinct

color band marks the right side of the shell just above the auriculate expansion, and extends from the aperture about half way to the apex.

The specimen figured belongs to the collection of Mr. C. K. Green. It is the only one which I have seen.

Formation and locality.

"Middle Devonian" (Jeffersonville limestone); Falls of the Ohio.

PTEROPODA.*

Coteolus tenuicinctum Hall.

Pl. XXIII, figs. 6, 7.

C. tenuicinctum Hall, Pal. N. Y., Vol. V, Pt. II, 1879, Pl. 32, figs. 5-9; Pl. 32A, figs. 6-10.

Hall's description.—"Shell an extremely elongate, gradually and regularly tapering cone, having in the largest individuals a diameter of six millimeters at the largest extremity, with a length of seventy-five millimeters. Surface marked by fine closely arranged striae, or frequently with more distant oblique annulations, receding from the aperture or sinuate on the ventral side—the degree of obliquity depending upon the position of the fossil or the relation of the parts exposed to view. Interrupted longitudinal striae are visible in well preserved specimens."

This species is not uncommon, but well preserved specimens are rare. The specimens which I have are marked by fine regular concentric striae; there are no oblique annulations.

One specimen in Mr. Green's collection has a length of 2 9-10 inches and a width at the larger end of 3-10 of an inch. The specimens listed as *C. aciculum* on p. 80, Bull. Ann. Pal. No. 12, probably belong to this species.

Formation and locality.

Jeffersonville limestone and Sellersburg beds; Falls of the Ohio, Charlestown and Lexington.

TENTACULITES.

- A. Annulations prominent, angular or subangular, form moderately elongate and slender. *T. scalariformis.*
- AA. Annulations not very prominent, rounded, sides sloping, and form very elongate and slender. *T. derithea.*

* This group is treated as a division of the *Gastropoda* in the English edition of Zittel's Paleontology.

Tentaculites dexithea Hall.

T. dexithea Hall, Pal. N. Y., Vol. V, Pt. II, 1888, Supplement, p. 6, Pl. 114, figs. 18, 19.

Hall's original description.—"This species is distinguished from the *T. scalariformis* occurring in the Upper Helderburg limestone by its more elongate and slender form, and more sloping annuli."

The differences between the form occurring in the Pendleton sandstone and that found in the Devonian limestone are very slight and are due doubtless to the different conditions of sedimentation under which the two existed. The separation of the Pendleton form from *T. scalariformis* as a distinct species seems to be a distinction of doubtful value.

Formation and locality.

Pendleton sandstone; Pendleton.

Tentaculites scalariformis Hall.

Pl. XXIII, fig. 9.

T. scalariformis Hall, Pal. N. Y. Vol. V, Pt. II, p. 167, Pl. 31, figs. 3-11.

Hall's description.—"Form elongate conical, straight, somewhat more cylindrical in approaching the aperture; with the apex in well preserved specimens extremely attenuate and quite solid from one-fourth to one-third the entire length of the shell. Annulations prominent, subangular, sometimes rounded on the larger part of the cone, closely arranged and sharply angular near the apex, gradually increasing their distance, becoming less angular with the increase in the size of the shell, and obtuse and rounded towards the aperture; usually but little variation in character on the outer half of the length, where the spaces between are greater than the annulations. Interspaces and annulations, when well preserved, marked by fine, even transverse striae, of which nine or ten may be counted in the furrows, and half as many on the summit and sides of the annulations."

This species is rather common at some localities.

Formation and locality.

Sellersburg beds and Jeffersonville limestone; Clark County, Scipio, Lancaster, North Vernon, Bartholomew County, and Pipe Creek Falls.

Conularia sp.

Pl. XXIII, fig. 8.

Form of shell unknown; surface marked by numerous fine transverse ridges, of which there are from ten to fifteen in the space of one-fifth of an inch; the summit of each ridge is marked by from eight to ten minute pores in the space of one-tenth of an inch. The interspaces between the ridges are marked by extremely fine longitudinal lines.

Only one specimen, which is badly crushed, has been found. It occurs in the *Spirifer mucronatus* fauna of northern Indiana.

Formation and locality.

Sellersburg beds; Delphi.

CEPHALOPODA.

GYROCERAS.

- A. Surface marked by transverse foliate expansions rising above the test. *G. jason.*
- AA. Surface not marked by foliate expansions.
- b. Septa curving strongly backward in crossing the sides; volutions subquadrangular in transverse section. *G. indianensis.*
- bb. Septae curving very slightly backward in crossing the sides; volutions suboval in transverse section. *G. inelegans.*

Gyroceras jason Hall.

Pl. XXVII, fig. 1.

G. jason Hall, Pal. N. Y., Vol. V, Pt. II, 1879, p. 381, Pl. 50, figs. 1-2.

Shell very large curved, making about one-third of a volution; robust and nearly circular in transverse section. Conch rather gradually enlarging.

Chamber of habitation and siphuncle not observed. Test has a thickness of about $\frac{8}{50}$ of an inch. Surface covered by irregular lamellose lines of growth. Prominent transverse foliate expansions on the test mark the surface at regular intervals. These are usually distant from each other on the ventral side from one-half to one inch; they are directed toward the aperture, rising sometimes as much as an inch above the surface, and are somewhat crinkled. Traces of a low, sharp ridge a little to the left of the median line are preserved.

The specimen figured has a length of $10\frac{1}{2}$ inches, and a diameter in the widest part of $3\frac{1}{2}$ inches. This specimen does not show the "somewhat hexagonal" transverse section mentioned by Hall nor the

deep sinus ascribed to *C. jason*, but I am inclined to regard it as a representative of that type.

The specimen figured was collected by Mr. John Powers; it is the only one known to me.

Formation and locality.

Jeffersonville limestone; Lexington.

Gyroceras indianense n. sp.

Pl. XXIV, fig. 1; XXV, figs. 1, 1a.

Shell large, subvoid, discoid, making about two and a half or three volutions, which enlarge rather rapidly and are closely contiguous. Volutions rounded, subquadrangular, the transverse diameter somewhat greater than the dorso-ventral diameter; sides flattened, periphery and inner surface very gently convex. Septa separated on the periphery by a space equal to about one-third the dorso-ventral diameter; the width of the interseptal spaces on the periphery at any point is equal to about three times the width of the same spaces on the opposite surface. The septa describe graceful backward curves in crossing the sides, bending forward to the peripheral surface, which they cross in straight or slightly backward curving lines; the backward curve on the periphery, if developed, is much less marked than on the sides. Body chamber large, occupying about half the outer volution.

Siphuncle small, about midway between the center and the peripheral margin of the volution. The inner volution shows a line of small nodes marking each of the obtuse angles formed by the union of the sides with the dorsal and ventral surfaces of the volution. Surface markings elsewhere not preserved.

This shell agrees very closely with Meek's description of *Gyroceratites ohioensis* except in the direction of the septa, which he describes as curving backward more strongly on the peripheral surface than on the sides. In the specimens here described the reverse is true.

I have seen but two specimens of this fossil, both found by Mr. Taylor, of Hanover, Ind.

Formation and locality.

Jeffersonville limestone(?); Jefferson County.

Gyroceras inelegans Meek?

Pl. XXVIII, fig. 1.

G. (Nautilus) inelegans Meek, Ohio Pal. Vol. I, 1873, p. 232, Pl. 21.

The specimen here figured is referred doubtfully to *G. inelegans*. It represents apparently about half of the body volution of an individual of that species.

Dorso-ventral diameter somewhat greater than the transverse diameter; broadly rounded on the periphery and rather sharply rounded on the dorsal side. Septa crossing the sides with a very slight posterior curve, their anterior faces very concave. Body chamber very large, forming about three-fourths of the length of the specimen.

Formation and locality.

Jeffersonville limestone; Falls of the Ohio.

Nautilus maximus (Conrad).

N. maximus Nettleroth, Ky. Foss. Shells, 1889, p. 196, Pl. 24, fig. 1.

Nettleroth figures this species from the Indiana Devonian. I have not seen it.

Formation and locality.

Sellersburg beds; Falls of the Ohio.

GOMPHOCERAS.

- A. Surface marked by longitudinal ridges or striae.
 - b. Shell gibbous or subglobose. *G. oviforme.*
 - bb. Shell slender. *G. raphanus.*
- AA. Surface not marked by longitudinal striae.
 - c. Chamber of habitation abruptly rounded at the front. *G. turbiniforme.*
 - cc. Chamber of habitation gently rounded at the front. *G. minus.*

Gomphoceras turbiniforme M. and W.

G. turbiniforme Meek and Worthen, Geol. Surv. Ill., Vol. III, 1868, p. 444, Pl. 12, figs. 2a, b.

Meek and Worthen's description.—"Shell rather small, turbinate or subovate, very slightly unsymmetrical; section circular or nearly so; chambered part rapidly expanding, with sides slightly convex above. Nonseptate part very short, or three times as wide as long, rounding in abruptly above; aperture contracted, but exact form un-

known. Septa only moderately concave; nearly equidistant at all points, excepting near the center and the apex, where they are more crowded; at about the widest part of the shell, separated by spaces equaling one-eighth of its greatest diameter.

"Siphon small and marginal. Surface nearly smooth, or with only fine lines of growth."

The collections at hand contain three specimens of this species. In one of these specimens the aperture, the width of the nonseptate part, is equal to twice its length. The front of the shell rounds off abruptly to the aperture, which is margined by a process which projects slightly above the surface. The aperture is a transverse slit rounded at the ends with a straight upper margin; the lower lip has in the middle a deep rounded sinus whose width equals one-third the length of the aperture.

Formation and locality.

Sellersburg beds; Charlestown and Lexington.

Gomphoceras minum Hall.

Pl. XXV, fig. 3.

G. minum Hall, Pal. N. Y., Vol. VII, 1888, p. 34, Pl. 122, fig. 4.

Hall's description.—"Shell small, oviform; point of greatest transverse section on the anterior third of the tube. Chamber of habitation comparatively large and gibbous. Aperture small, trilobate. Air chambers two mm. in depth. Test marked by lines of growth. Length of specimen 30mm, greatest diameter 22mm. The shell of the individual described is silicified and many of the features are obscure."

The collections at hand contain four specimens of this species. They are characterized by their pear-shaped outlines, regularly rounded anterior extremities and trilobate apertures. One of the specimens shows the siphuncle to be submarginal. In some specimens the septa are more closely crowded at one side than at the other, giving them an unsymmetrical appearance, as in the specimen figured.

Formation and locality.

Sellersburg beds; Charlestown and Falls of the Ohio.

Gomphoceras oviforme Hall.

G. oviforme Hall, Pal. N. Y., Vol. V, Pt. II, 1879, p. 344, Pl. 45, figs. 1-4; Pl. 46, figs. 6, 7; Pl. 94, figs. 6, 7.

One specimen in Mr. Green's collection is referred to this species with some doubt.

Shell straight, rather gibbous, oval in transverse section. Chamber of habitation long, the length equal to three-fourths of the width. Greatest width near the base of the chamber of habitation, which is slightly contracted posterior to the aperture. The four or five camerae next the chamber of habitation are of uniform size except the last, which is slightly smaller than the others. Sides of shell tapering very gradually toward the apex, which is not preserved.

Surface markings not preserved. The length of the shell is 2 9/10 inches; the chamber of habitation has a length of 1 1/2 inches.

Formation and locality.

Sellersburg beds; Falls of the Ohio.

Gomphoceras raphanus Hall?.

G. raphanus Hall, Pal. N. Y., Vol. V, Pt. II, 1879, p. 347, Pl. 94, figs. 2-5, 10.

Some very poor specimens in the State Museum were listed under this species in the State Museum catalogue.* Their state of preservation will not permit of positive determination, and they may or may not belong to this species.

Formation and locality.

Sellersburg beds; Charlestown and Lexington.

Gomphoceras sp.

Pl. XXIX, fig. 1.

The specimen figured is a limestone cast, unsatisfactory for specific determination. It may be compared with *Gomphoceras eximum* Hall. The shell is vertically compressed, elliptical in cross section. Toward the apex the shell is slightly curved upward. The septa are moderately convex on their posterior faces.

Formation and locality.

Jeffersonville limestone; Falls of the Ohio.

ORTHO CERAS.

- A. Transverse ridges with nodes in longitudinal ridges. *O. caldwellsis*.
 AA. Transverse ridges without nodes. *O. thoas*.

Orthoceras thoas Hall.

O. thoas Hall, Pal. N. Y., Vol. V, Pt. II, 1879, p. 261, Pl. 41, figs. 1-9; Pl. 78B, fig. 5; Pl. 79, fig. 13; Pl. 80, figs. 7, 8, 10, 11; Pl. 112, figs. 7-8.

*16th Ann. Rep. Ind. Dept. Geol. and Nat. Hist.

The collections from northern Indiana contain a section of a tube of this species measuring two inches in length and one and one-tenth inches in width at the widest part. Shell straight, very gradually expanding, circular in transverse section. Septa rather deeply concave. Surface marked by transverse annulations separated by flat or slightly concave interspaces one-tenth of an inch in width. The annulations are rather low rounded or obtusely angular ridges. Indistinct longitudinal striae mark the surface. The specimen is poorly preserved and if transverse striae have been present they are not preserved.

Formation and locality.

Jeffersonville limestone; Bunker Hill.

Orthoceras caldwellensis Miller and Gurley.

O. caldwellensis M. & G., Bull. Ill. State Mus. Nat. Hist. No. 11, p. 31, Pl. 4, figs. 1-2.

Miller and Gurley's original description.—"Shell straight, large, long, very slowly and regularly enlarging from the apex toward the mouth of the chamber of habitation. Only the middle part of the shell is preserved in our specimens. Chamber of habitation unknown. Transverse section subelliptical. Siphuncle subcentral. The shell is preserved on our specimen and the air chambers are not, therefore, exposed. The shell is widely and deeply annulated or transversely furrowed. The dividing ridges are nodose. The nodes are arranged in longitudinal rows. There are fourteen nodes on each transverse ridge, in the specimen, and hence there are fourteen longitudinal rows of nodes. A longitudinal line crosses each furrow from node to node, but it is nearly obsolete at the bottom of the furrows. The width of a furrow or distance between two nodes, at the larger end, is equal to one-third of the shorter diameter of the shell, but, at the smaller end of the specimen, the distance between two nodes is more than one-third of the greater diameter. The width of the annulations, therefore, does not bear a regular proportion to the diameter of the shell. There is an obscure node between the regular nodes, at the larger end, but none near the smaller end. The septum shown at the smaller end is highly arched, and it appears as if there is only one septum to correspond with each annulation. The shell is thick and the outer surface of the furrows shows no lamellose lines of growth, but, possibly, a better preserved specimen would show such lines."

This species is known only from the types.

Formation and locality.

"Upper Helderburg group;" Clark County.

Cyrtoceras expansum n. sp.

Pl. XXVI, fig. 1.

Shell rather large, moderately curved. Transverse section elliptical, the dorso-ventral and transverse diameters in the ratio of 8 to 11. Shell rapidly enlarging from the apex. Apex not preserved. Chamber of habitation large and gibbous, having a length equal to or greater than the width. Septa rather strongly concave on their posterior faces. Sutures regularly transverse. Siphuncle dorsal, about midway between the center and dorsal margins.

Surface marked by transverse closely arranged striae, and by somewhat stronger and more distant longitudinal striae. The latter are separated by spaces four or five times their own width.

This form does not seem to be very closely related to any other species with which I am acquainted. The position of the siphuncle near the dorsal margin distinguishes it sharply from most species of this genus.

Formation and locality.

Jeffersonville limestone; Bunker Hill.

Cyrtoceras sp.

Pl. XXV, fig. 2.

Shell arcuate, very rapidly expanding. Somewhat compressed, subovate in transverse section, the ventral surface strongly convex and the dorsal very slightly convex or nearly flat. Chamber of habitation not preserved. Septa thin, with a concavity in the posterior portion equal to their thickness; in the anterior portion the concavity is greater. Siphuncle on the ventral side, submarginal.

Surface marked by fine transverse striae which arch slightly backward in crossing the middle of the ventral side.

The specimen here figured is believed to represent a new species, but since the absence of the chamber of habitation prevents a full description, no specific designation will be proposed.

Formation and locality.

Sellersburg beds(?); Jefferson County.

Goniatites discoideus var. *ohioensis* Hall.

G. discoideus var. *ohioensis* Hall, 27th Rep. N. Y. State Mus. Nat. Hist., 1874, Pl. 13, figs. 18, 19.

I have seen but one fragmentary specimen of this gonatite.

Formation and locality.

Sellersburg beds; Lexington and Falls of the Ohio.

CRUSTACEA.

PHACOPS

- A. Pleural annulations of the pygidium dichotomous.
 b. Axis of the thorax with row of spines. *P. cristata.*
 bb. Axis of the thorax without row of spines. *P. cristata* var. *pipa.*
 AA. Pleural annulations of the pygidium not dichotomous. *P. rana.*

Phacops rana (Green).

Pl. XXXI, figs. 1, 1a, 1b.

Phacops rana (Hall and Clarke), Pal. N. Y., Vol. VII, 1888, p. 19, Pl. 7, figs. 1-11; Pl. 8, figs. 1-18; Pl. 8A, figs. 21-33.

This well known species is perhaps more common than any other trilobite in the Indiana Devonian. Complete individuals, however, are rare. The largest specimen observed has the following dimensions: Length of cephalon, $7/10$ of an inch; thorax, $17/50$ inches; pygidium, $5/10$ of an inch; total length, $217/50$ inches. The lenses in the eyes of the specimens figured here, which are from Mr. Green's collection, number respectively 69 and 82.

Formation and locality.

Jeffersonville limestone; Charlestown, North Vernon, Bartholomew County, Falls of the Ohio, Watson, Lexington, Lancaster and Little Rock Creek, Cass County.

Phacops cristata Hall.

P. cristata Hall and Clarke, Pal. N. Y., Vol. VII, 1888, p. 14, Pl. 6, figs. 1-13, 16-29; Pl. 8A, figs. 1-4.

The collection of Mr. G. K. Green contains a segment of the thorax of this species. It is flattened and dichotomous on the pleurae and bears the short, strong spine on the axis which is characteristic of this species. No other specimens of the species have been observed.

Formation and locality.

Jeffersonville limestone; Falls of the Ohio.

Phacops cristata var. *pipa* H. and C.

Pl. XXX, fig. 4.

P. cristata var. *pipa* H. & C., Pal. N. Y., Vol. VII, 1888, p. 18, Pl. 8A, figs. 5-18.

This variety is distinguished from *P. cristata* according to Hall and Clarke by the following characters: (a) Greatly inferior size; (b) absence of the axial row of spines; (c) smaller spines at the genal angles; (d) fewer annulations upon the pygidium; (e) smaller number of corneal lenses, varying from 23 to 45 for each eye.

Hall and Clarke record this variety from the Falls of the Ohio. A few pygidia from this locality in Mr. Green's collection are referred with some doubt to this species. These have from nine to ten annulations on the axis and six to seven on the pleurae; the anterior two or three of the latter are distinctly grooved near their distal extremities and near their junction with the axis, while their medial partition is marked by a very faintly impressed line or not at all.

Formation and locality.

Jeffersonville limestone; Falls of the Ohio.

PROETUS.

- A. Pygidium very small, with minute tubercles arranged in two or more rows on each annulation. *P. microgemma.*
- AA. Pygidium not very small, with regularly arranged tubercles on the annulations.
 - b. Lateral furrows on the glabella deep and prominent, glabella tapering anteriorly. *P. curvimarginatus.*
 - bb. Lateral furrows on the glabella shallow and inconspicuous or obsolete, glabella not tapering anteriorly.
 - c. Posterior portion of the pygidium smooth. *P. crassimarginatus.*
 - cc. Posterior portion of pygidium with annulations similar to those on the anterior portion.
 - d. Cephalon very short without spines at the genal angles. *P. folliceus.*
 - dd. Cephalon not very short with long spines at the genal angles.
 - e. Annulations of the pygidium arching backward in crossing the summit of the axis. *P. macrocephalus.*
 - ee. Annulations of the pygidium not arching backward in crossing the axis.
 - f. Border of cephalon grooved by two furrows. *P. canaliculatus.*
 - ff. Border of cephalon not grooved by two furrows.
 - g. Glabella rather strongly convex. *P. clarus.*
 - gg. Glabella depressed. *P. latimarginatus.*

Proetus latimarginatus Hall and Clarke.

P. latimarginatus H. & C., Pal. N. Y., Vol. VII, p. 97, Pl. 22, figs. 7-12.

Hall and Clarke's original description.—"General form and proportions: Outline elliptical, length to width as two to one. Surface conspicuously trilobate, convex, deflected on the marginal area. Cephalon semielliptical in outline; border broad, flat, thickened by doublure and produced into stout spines at the angles of the cheeks. Length to width as 5 to 7.

"Facial sutures taking their origin close within the genal angles, passing forward very obliquely over the occipital ring to the eye lobe, cutting the anterior margin at points relatively distant, and approximating upon the doublure.

"Glabella depressed convex, slightly flattened above and posteriorly elevated on the axial line; long, conate extending to the frontal border. Width at the base greater than one-third the width of the shield. Lateral furrows obscure, but indications of three pairs may be observed. Occipital lobes comparatively large; occipital furrows narrow, bifurcating near the axial furrow to include the occipital lobes, and becoming very deep upon the cheeks; occipital ring broad and flat.

"Cheeks convex, depressed about the base of the eyes, thence somewhat abruptly deflected to the marginal sulcus and occipital furrow.

"Eyes comparatively small, approximate, attaining the elevation of the glabella. Palpebrum small; palpebral lobes depressed, obscure; palpebral sulcus shallow.

"Thorax subquadrate, length to width as two to three; margins nearly parallel; surface equally trilobate.

"Axis evenly arched, widest at the fourth segment and tapering thence regularly backward. Segments flattened, transverse.

"Pleurae flat for one-half their width and thence deflected in a moderately sharp curve to the margin. Each segment grooved for two-thirds its length, and beveled upon the outer third by the articulating plane.

"Pygidium parabolic in outline, length to width as three to five; evenly convex; border broad, flat or slightly sloping.

"Axis prominent and evenly tapering to an abrupt and somewhat elevated termination just within the posterior border, with which it is connected by a low ridge. Indications of seven or eight transverse annulations appear on the axis, exclusively of the articulating ring, which is more conspicuous than any of the others.

"Pleura evenly sloping to the lateral and posterior margins. Articulating ring very conspicuous; annulations obscure, almost obsolete. Four are visible in favorably preserved specimens; and all are depressed above and faintly grooved."

This species is not uncommon in the Pendleton sandstone from which the types were obtained, but I have not recognized it elsewhere.

Formation and locality.

Pendleton sandstone; Pendleton.

Proetus canaliculatus Hall.

P. canaliculatus H. & C., Pal. N. Y., Vol. VII, 1888, p. 107, Pl. 20, figs. 10, 11; Pl. 23, figs. 10, 11.

Hall and Clarke's description.—"The species is characterized by its violin-shaped glabella (genus *Aeonia*, Burmeister), constricted at the anterior angle of the eye, and broadly rounded on the anterior extremity. Its length would be more than two-thirds the length of the cephalon, and its width apparently somewhat less than one-third that of the cephalon. The transverse furrows are indistinct upon the crust, but appear to consist of three pairs and the accessory pair. The first pair visible is transverse, and the posterior pairs are inclined backward. All the glabellar lobes are faint. The occipital lobes are conspicuous; the occipital furrow narrow and deep; the occipital ring moderately broad and flattened. The border is very broad and flat, and is grooved along the anterior limbus by two furrows, the anterior of which is narrow and close upon the edge, the other is broad and is separated from the frontal margin of the glabella by a rounded ridge. Upon the cheeks these grooves become shallower and reduced to two planes, the interior and broader one horizontal, the anterior narrower and beveling. At the genal angles the border is produced into moderately long and stout spines which are ridged upon the surface, and minutely curved at the tip. The eyes and palpebral lobes are comparatively large, the orbital ridge elevated, the cheeks flattened at their summit below this ridge, abruptly curving to the marginal and occipital furrows. The surface is smooth upon the border, finely granulose upon the glabella and pustulose upon the flattened summits of the cheeks. The doublure is strongly rounded and incurved, somewhat excavate at the genal angles, sharply convex and ridged upon the genal spines. Its surface is marked by longitudinally parallel, lamellose lines."

Formation and locality.

Hall and Clarke record the species from the "Corniferous limestone" at the Falls of the Ohio.

Proetus curvmarginatus Hall and Clarke.

P. curvmarginatus H. & C., Pal. N. Y., Vol. VII, 1888, p. 94, Pl. 22, figs. 13-19.

This species is readily distinguished from *Proetus macrocephalus*, to which it is most closely related, by its deeply furrowed and rapidly tapering glabella.

The types were found in the Pendleton sandstone at Pendleton.

Proetus microgemma Hall and Clarke.

P. microgemma H. & C., Pal. N. Y., Vol. VII, 1888, p. 109, Pl. 22, figs. 33-34.

Hall and Clarke's original description.—"Several detached pygidia afford certain characteristic features in which they differ from described species. The shield is small and transversely semielliptical in outline, convex, longitudinally arched, distinctly and equally trilobate. The axis is elevated, tapering with slightly rounded margins to a blunt and somewhat elevated termination just within the border. It is somewhat appressed at the sides just above the axial furrows, bears eleven annulations which are angulated at the sides, and posteriorly recurved over the median line. Upon the axial line each bears a strong tubercle. The pleurae are depressed below the axis, slightly flattened above and equally deflected to the lateral and posterior margins. Each bears seven or eight annulations which are grooved by fine impressed lines. The border is thickened, moderately and equally broad throughout its extent; it is encroached upon by the articulating ring and slightly by the first two or three annulations. The surface is covered with minute and distinct tubercles, which are irregularly disposed upon the annulations of the axis, but are arranged in two or more rows on each annulation. A very young example, measuring 2mm in length and 3mm in width, shows nine annulations on the axis and ten on the pleurae; the margin is less thickened than in the later stages of growth, all the pleural annulations encroaching upon it. The annulation is also more distinct than in larger specimens. An average specimen measures 6mm in length and 9mm in width."

Formation and locality.

"Corniferous limestone;" Falls of the Ohio.

Proetus folliceus Hall and Clarke.

Pl. XXX, figs. 10, 10a.

P. folliceus H. & C., Pal. N. Y., Vol. VII, 1888, p. 101; Pl. 29, figs. 3-8.

Hall and Clarke's original description.—"General form and proportions: Body elongate, outline elliptical, lateral margins nearly parallel. Length to width as eight to five. Surface convex, anteriorly gibbous, conspicuously and subequally trilobate. Cephalon short, semicircular, border flat, moderately broad, horizontal anteriorly, becoming deflected toward the genal extremities, which are broadly rounded and not produced. Surface very convex, equally trilobate, length to width as one to two. The facial sutures take their origin just within the genal angles, run very obliquely across the occipital ring to the outer angle of the occipital lobes, thence rise abruptly to the eye lobes, and pass with slight divergence down the steep frontal slope, curving and approaching each other at the edge of the frontal border and uniting upon the doublure.

"Glabella subpyriform, very convex, longitudinally arched, rising abruptly on all sides from the lateral furrows, which are not deeply impressed; gibbous on the anterior slope, slightly flattened at the summit. Length equal to four-fifths the length of the cephalon; width at the base more than one-third that of the cephalon. Four pairs of lateral furrows and one pair of accessory furrows are discernible upon the cast of the lower surface, but upon the crust only the stronger of them can be seen, as faint lines interrupting the ornamentation. The first pair is situated at about one-third the length of the glabella from the anterior margin, and appear as faint elongate pits not distant from the marginal furrow. The other three pairs are longer and inclined backward, none except the fourth pair extending to the marginal furrow. The accessory furrows take their origin just in front of the proximal ends of the fourth furrow and are strongly inclined backward. The occipital lobes are moderately strong in the cast, but are inconspicuous where the crust is retained. Occipital furrows narrow, the anterior side nearly vertical and the posterior side almost horizontal, widening on the cheeks and continuous with the marginal sulcus. Occipital ring broad, flat, narrowing to the axial furrows and widening again to the genal angles, bearing a small pointed tubercle upon the axial line. Cheeks grooved and depressed about the orbital lobe, thence abruptly deflected to the broad margin. Eyes approximate, prominent, elevated to almost the height of the glabella; orbital ring conspicuous; palpebral lobe small;

palpebral furrow elevated and moderately deep. Thorax subrectangular, margins nearly parallel. Length to width as one to one and three-tenths.

“Axis arched.

“Pleurae flattened above for one-half their width, and thence somewhat abruptly deflected. The segments are transverse, somewhat flattened, grooved upon the pleurae and beveled for one-half their length. Pygidium subsemicircular, border broad, thickened and rounded. Surface convex, sloping more abruptly at the sides than posteriorly. Axis having less than one-third the width of the shield, tapering to a broad and blunt termination, considerably within the posterior margin. It bears seven or eight annulations, which bend forward for a short distance within the axial furrows, are there sharply angulated and cross the axial line in a broad curve.

“Pleurae with seven or eight annulations, each of which is broad, low, often indistinct, and very faintly grooved, all becoming obsolete upon the border. Length to width as one to one and eight-tenths.

“*Dimensions*.—An average adult affords the following measurements:

| | <i>Body.</i> | <i>Cephalon.</i> | <i>Thorax.</i> | <i>Pygidium.</i> |
|--------------|--------------|------------------|----------------|------------------|
| Length | 43 mm. | 12 mm. | 18 mm. | 13 mm. |
| Width..... | 27 mm. | 27 mm. | 23 mm. | 20 mm. |

“The smallest individual observed measures 24mm in length and 14mm in width.”

This species occurs rarely at Pipe Creek Falls.

Formation and locality.

Jeffersonville limestone; Pipe Creek Falls.

Proetus crassimarginatus Hall.

Pl. XXX, figs. 1, 1a, 2, 5, 6.

P. crassimarginatus H. & C., Pal. N. Y., Vol. VII, 1888, p. 99, Pl. 20, figs. 6-8, 20-31; Pl. 22, figs. 20-26; Pl. 15, fig. 8.

Glabella large, subquadrate; surface convex, slightly flattened on top, marginal furrows shallow; three to four pairs of lateral furrows, directed obliquely backward; these are developed on the lower surface of the glabella and reveal themselves in specimens which are not exfoliated only by their darker color showing through the semitransparent crust. Occipital lobes are relatively small but well defined; occipital furrow narrow and shallow. The border of the cephalon is usually narrow and much thickened in front.

Thorax composed of ten segments; axis broad and strongly arched; pleurae flattened for half their width, then sloping abruptly to the margin; the segments are flattened and grooved upon the pleura.

Pygidium semiovate, convex, sloping regularly to the lateral and posterior margin; axis strongly arched both transversely and longitudinally, tapering to an obtuse termination. The anterior end is marked by from four to ten annulations, the posterior lateral area being smooth. In exfoliated pygidia a larger number of indistinct annulations may be counted. In crossing the summit of the axis the annulations arch backward slightly.

The pygidia and glabella of this trilobite are abundant at Pipe Creek Falls, but I have seen no complete individuals.

Horizon and locality.

Jeffersonville limestone and Sellersburg beds; Pipe Creek Falls, Charlestown, Falls of the Ohio.

Proetus clarus Hall.

Pl. XXX, figs. 8, 9, 12.

P. clarus H. & C., Pal. N. Y., Vol. VII, 1888, p. 104, Pl. 20, figs. 12-14; Pl. 22, figs. 28-30.

The collections at hand contain several specimens of the glabella and free cheeks of this species. Partially exfoliated specimens show three pairs of transverse furrows on the glabella which are directed obliquely backwards. Other specimens show only the posterior pair, which are bent abruptly backwards about the middle of their length. The anterior border is very broad, flat or with a shallow groove toward the front. Occipital furrow narrow and deep; occipital lobes rather large.

Formation and locality.

Jeffersonville limestone; Falls of the Ohio, Burnsville, Bartholomew County, Lexington, Bunker Hill and Pipe Creek Falls.

Proetus macrocephalus Hall.

Pl. XXX, figs. 7, 11.

P. macrocephalus H. & C., Pal. N. Y., Vol. VII, 1888, p. 116, Pl. 21, figs. 10-21; Pl. 23, figs. 30-31.

Hall and Clarke's original description.—"General form and proportions: Outline elliptical. Surface depressed convex, distinctly and subequally trilobate. Length and width as one and five-tenths to one.

"Cephalon semicircular or lunate, margin slightly thickened and deflexed, produced at the genal angles into acute spines. Surface very convex in normally preserved specimens; depressed in the usual state of preservation. Length to width as one to two.

"Facial sutures normal. Glabella subconate, sides broadly tapering to the anterior extremity, where it is closely appressed upon the narrow reflexed margin. Width three-fourths the length. Surface convex, anterior slope normally abrupt or vertical, curving posteriorly and becoming horizontal at the occipital furrow. Under normal preservation only a single pair of lateral furrows is visible. These are the fourth or basal furrows and are very strong and deep, taking their origin nearly opposite the anterior angle of the eye and extending to the occipital furrow, thus forming two strong conspicuous lobes. Upon casts of the lower surface and in extremely rare instances upon the dorsal surface, there is evidence of the first, second and third pair of furrows, with faint indications of the accessory furrows. Occipital lobes prominent; occipital furrow narrow, broadly bifurcating about the occipital lobes, and becoming deeply impressed and broadened upon the cheeks; occipital ring broad and posteriorly convex, narrowing upon the cheeks. Eyes not large, lunate; palpebral lobe inconspicuous; palpebral sulcus narrow and deep.

"Cheeks deeply grooved about the orbit of the eye, and abruptly depressed to the broad marginal sulcus.

"Thorax subrectangular; surface convex and equally trilobate; length to width as one to one and eight-tenths; composed of ten segments which are arched upon the axis and considerably elevated above the pleurae, obliquely flattened and transverse. The pleurae are flattened for less than one-half their width and abruptly deflected to the margin; segments sulcate anterior and posterior limbs nearly equal, the former becoming abruptly obsolete at the fulcrum.

"Pygidium large, semielliptical convex; length to width as two to three.

"Axis having less than one-third the width of the shield upon the anterior margin, and tapering to a blunt termination within the border. Annulations thirteen or fourteen with an anterior bend near the margins, and a broad curve near the median line; in most individuals the annulations are slightly angulated along the axial line, each sometimes bearing a strong tubercle.

"Pleurae depressed in a more or less abrupt curve to the margin, bearing eleven or twelve flattened annulations, which are separated by moderately strong sulci. Each annulation is faintly grooved by a fine impressed line, which is sometimes almost or quite obsolete.

Border broad, becoming excavate and slightly reflexed posteriorly; all the annulations except two becoming obsolete upon reaching it. Doublure broad, reaching to the termination of the axis.

“Surface ornamentation.—The cephalon is covered with low tubercles which become obsolete upon the anterior portion of the glabella and the depressed areas of the cheeks. Upon the thorax and pygidium each segment and annulation is ornamented with granules; these upon the latter sometimes appear to be arranged in two rows, one upon each limb of the pleural annulations. In rare examples a row of small tubercles is noticeable along the axial line on both thorax and pygidium, beginning with a faint tubercle upon the occipital ring, the next being at the third or fourth segment thence backward, becoming stronger toward the apex of the axis.”

The glabella and pygidium of this species occurs rather abundantly in the limestone at Pipe Creek Falls. The specimens seem to agree perfectly with Hall's figures and descriptions of the New York specimens.

Horizon and locality.

Jeffersonville limestone; Pipe Creek Falls and Bunker Hill.

DALMANITES.

- A. Pygidium having two or more spines projecting from the border.
 - b. Spines on border of pygidium two in number. Frontal border of the cephalon with tooth-like denticulations.
 - c. Denticulations eleven, each of the pleurae of the pygidium with ten annulations, genal angles produced into spines extending to fourth or fifth thoracic segment.
 - D. (Odontocephalus) aegeria.*
 - cc. Denticulations nine, each of the pleura of pygidium with eight to nine annulations, genal angles obtuse, or produced into minute spines. *D. (Odontocephalus) selenurus.*
 - bb. Spines on border of pygidium more than two. Frontal border of cephalon without tooth-like denticulations. Pygidium with ten or more spines on each of its lateral margins.
 - D. (Coronura) aspectans.*
 - dd. Pygidium with five spines on each of its lateral margins.
 - e. Annulations of the pleurae not sulcate, spines of pygidium long and rounded.
 - D. (Cryphaeus) pleione.*
 - ee. Annulations of the pleurae sulcate, spines of pygidium not very long and somewhat flattened.
 - D. (Cryphaeus) boothi* var. *calliteles.*
- AA. Pygidium not having two or more spines projecting from the border.
 - f. Pygidium with a row of short spines along summit of the axis. *D. calypsa.*

- ff. Pygidium without a row of spines along the summit of the axis.
- g. Annulations on the pleurae grooved from end to end.
D. (Hausmannia) pleuroptyx.
- gg. Annulations on the pleurae grooved only near their distal extremities.
D. (Chasmops) onchiops.

Dalmanites (Cryphaeus) pleione Hall and Clarke.

Dalmanites (Cryphaeus) pleione H. & C., Pal. N. Y., Vol. VII, 1888, p. 41, Pl. 16A, fig. 2.

This species is at present known only by the type specimen, a pygidium, which, according to Hall and Clarke, closely resembles the pygidia of the young of *D. boothi* var. *calliteles*.

Horizon and locality.

Sellersburg beds ("Hydraulic limestone"); Falls of the Ohio.

Dalmanites (Cryphaeus) boothi var. *calliteles* Green (H. and C.).

Pl. XXXI, figs. 3, 4.

D. (Cryphaeus) calliteles H. & C., Pal. N. Y., Vol. VII, 1888, p. 45, Pl. 16, figs. 5-22; Pl. 16A, figs. 9-17.

Only three or four imperfect cephalae of this species have been seen. The accompanying figure indicates the character of one of those fairly well except that the axis is indicated rather wider than it should be.

My collections contain about twenty-five pygidia. The pygidium is subtriangular, depressed, with elevate axis. Axis with about twelve to fourteen annulations, tapering regularly and ending abruptly just within the posterior border.

Pleurae having each five strongly sulcate annulations; the posterior limb of each becomes obsolete near the margin while the anterior limb is produced beyond the margin in a slightly flattened spine. A spine somewhat shorter and broader than the others is produced from the posterior extremity.

The thorax has not been observed.

This trilobite has been found at only one locality, where it is abundant.

Formation and locality.

Jeffersonville limestone; Little Rock Creek, Cass County.

Dalmanites (Chasmops) anchiops (Green).

• Pl. XXXI, figs. 2, 2a, 2b.

D. (*Chasmops*) *anchiops* Hall, Pal. N. Y., Vol. VII, 1888, p. 59, Pl. 9, figs. 1-6, 10, 12, 13; Pl. 10, figs. 1-14.

Pygidium subtriangular, rather depressed. Posterior extremity produced, curving slightly upward, terminating in a sharp spine. Axis having less than one-half the width of one of the pleurae at the anterior extremity, tapering regularly to the low rounded posterior extremity; the axis is composed of fourteen broad transverse annulations. Pleurae divided into ten broad flattened annulations which extend nearly to the margins; the annulations are finely grooved for about one-third their length near the margin of the pleurae. The annulations are separated by interspaces having less than one-half their own width. The surface of the annulations of the pygidium are rather coarsely granular.

The above is a description of a pygidium in Mr. Green's collection. This species is comparatively rare; it has not been observed in northern Indiana.

Formation and locality.

Jeffersonville limestone; Falls of the Ohio and Utica.

Dalmanites (Chasmops) calypso H. and C.

Pl. XXX, fig. 3.

D. (*Chasmops*) *calypso* H. & C., Pal. N. Y., Vol. VII, 1888, p. 64, Pl. 11a, figs. 19-22.

Pygidium wide, subtriangular, axis much elevated above the pleurae.

Axis sharply angulated upon the median line, sides appressed; composed of thirteen closely set transverse annulations, each with a short spine or spinose node at the summit.

Pleurae rather broad, moderately convex toward the anterior end, sloping abruptly from the axis to the margin posteriorly; annulations flattened, twelve in number and distinctly grooved; border wide.

The pygidium here figured and described is the only representative of this species which I have seen; it belongs to Mr. G. K. Green.

Formation and locality.

Sellersburg beds; Charlestown.

Dalmanites (Odontocephalus) selenurus (Hall and Clarke).

D. (*Odontocephalus*) *selenurus* H. & C., Pal. N. Y., Vol. VII, 1888, p. 49, Pl. 11B, figs. 15-21; Pl. 12, figs. 1-13.

This species is represented in collections belonging to the U. S. Geol. Surv. which were made by the writer but which are not now accessible.

Formation and locality.

Jeffersonville limestone; Falls of the Ohio.

Dalmanites (Coronura) aspectans Conrad (Hall and Clarke).

Asaphus aspectans Con., Fifth Ann. Rep. Pal. N. Y., 1841, p. 49, fig. 9.

Dalmanites ohioensis Meek, Proc. Acad'y Nat. Sci. Phil., 1871, p. 91.

D. (*Coronura*) *aspectans* (H. & C.), Pal. N. Y., Vol. VII, 1888, p. 33, Pl. 13, figs. 1-11, 13.

Conrad's original description.—"A small portion of the buckler and one eye only is visible, but the eye is of extraordinary height, the margins parallel, and the lenses arranged in parallel longitudinal lines, small and very numerous."

This species is recorded by Hall and Clarke from the "Corniferous limestone" at the Falls of the Ohio. I have not observed it.

Dalmanites (Hausmannia) pleuroptyx Green (Hall?).

D. (*Hausmannia*) *pleuroptyx* Hall, Pal. N. Y., Vol. VII, 1888, p. 28, Pl. 11a, figs. 1-3.

Two pygidia are referred with some doubt to this species.

Form subtriangular, flattened or slightly convex.

Axis regularly tapering to a low rounded termination, and composed of from 16 to 19 transverse annulations. The pleurae are broad, rather flat on top and rounding somewhat abruptly to the margins. The annulations are thirteen in number, grooved from the axis to the margin, and rather strongly curved near their distal extremities towards the posterior end of the pygidium. The interspaces separating the annulations usually equal and sometimes exceed the width of the latter. The last five or six annulations are directed very strongly backwards. The surface of the pygidium is rather finely granulose.

Formation and locality.

Jeffersonville limestone; Falls of the Ohio.

Dalmanites (Odontocephalus) aegeria Hall.

Pl. XXXI, fig. 5.

Cephalon.—Outline as shown in the drawing. Border rather broad, nearly horizontal in front, sloping rather steeply downwards at the sides. The portion between the ends of the facial sutures is composed of eleven tooth-like processes which gradually decrease in size away from the median process; these processes are constricted at their bases, but widen towards the front so that their outer margins are in contact; partial exfoliation shows the walls of these finger-like processes to be double.

The glabella is subpentagonal, gently convex, sloping rapidly downwards toward the front. Surface minutely punctate. First lateral furrow oblique. First and second lateral lobes large and elevated. Axial portion of the glabella between anterior lateral lobes rounded and depressed. Occipital furrow narrow, moderately deep.

Eyes elevated above any other portion of the head; from the genal angles they present the outline of a nearly perfect truncated cone; the visual surface covers about three-fourths of the lateral surface of the cone. Palpebral lobe greatly depressed; palpebrum not prominent; lenses arranged in regular vertical lines and numbering about 110.

Cheeks flattened, separated from the eyes by a flat narrow terrace at the top. A shallow furrow extends from the anterior angle of the eye to the anterior lateral angle of the glabella, thence round the front of the glabella.

This species is represented in Mr. Green's collection by a single cephalon which is the only specimen which I have seen. It is referred to *D. aegeria* rather than to *D. selenurus* because the frontal denticulations agree in number with those in the former species. The parts which should show the other points of difference between these two closely related species are not preserved.

Formation and locality.

Jeffersonville limestone; Falls of the Ohio.

Calymene platys Green.

C. platys Hall, Pal. N. Y., Vol. VII, 1888, p. 1, Pl. 1, figs. 1-9; Pl. 25, fig. 1.

This species has not been observed by me. It is reported by Hall and Clarke from the "Upper Helderburg" at the Falls of the Ohio.

Lichas sp.

Pl. XXXI, fig. 6.

The collection of Mr. Green contains fragments of the cephalon and genal spines of a *Lichas* which may belong to *L. (Conolichas) eriopis*. The genal spine is closely studded on the upper surface and posterior with short strong spines, and on the anterior margin with numerous small tubercles.

Formation and locality.

Jeffersonville limestone; Falls of the Ohio.