VOL. XVII, SECOND SERIES

The Devonian *of* Missouri

By E. B. BRANSON

with chapters on

The Bailey Limestone

By V. O. TANSEY

and

The Little Saline Limestone

By GRACE ANNA STEWART

1922

MISSOURI BUREAU OF GEOLOGY AND MINES

H. A. Buehler, Director and State Geologist

ROLLA, MISSOURI

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TABLE OF CONTENTS.

ILLUSTRATIONS.

LETTER OF TRANSMITTAL.

Missouri Bureau of Geology and Mines,
Rolla, Mo., December 1, 1922.

To the President, Governor Arthur M. Hyde, and the Members of the Board of Managers of the Bureau of Geology and Mines:

Gentlemen: It is my pleasure to transmit herewith a report on the Devonian formations of Missouri by Doctor E. B. Branson, including chapters on the Bailey limestone by V. O. Tansey and the Little Saline limestone by Grace Anna Stewart.

The stratigraphy of the Devonian has not been studied heretofore in any considerable detail and the relation of this series of formations has not been clearly defined up to the present time.

The work is an important addition to the systematic geology of the State.

Respectfully submitted,
H. A. BUEHLER,
Director and State Geologist.

INTRODUCTION.

The data for the report contained in this bulletin were collected by the writer and his assistants during six field seasons. During June, July, and August of 1914, J. P. Connolly and Chester Longwell assisted in mapping and collecting; Mr. Connolly mapped during June of 1915; in June and July of 1917, several advanced students assisted in mapping and collecting; G. P. Moore and E. O. Markham were field assistants the summer of 1918; V. W. Vandiver collected during July and August of 1919; G. P. Moore and V. W. Vandiver mapped the Devonian of Ralls County in 1919; and Roy H. Hall mapped part of Moniteau County in 1921. Mr. D. K. Greger knew the Devonian of Callaway County very thoroughly before the field work for the report was begun and helped out the investigation from his information. He collected from the Devonian of Montgomery County during June and part of July, 1914.

The topographic maps of the United States Geological Survey for the region studied are old, half-inch scale, and fifty-foot contour interval, and are entirely unsatisfactory for accurate mapping. The base finally used for most of the work was a large scale county map with contour lines supplied from the United States Geological Survey contour maps. The contours were corrected to make them fit conditions as found in the field. A two-inch scale was used for all mapping in Boone, Callaway, Montgomery, Warren and Moniteau Counties, and the U. S. Geological Survey topographic maps were the base for the other areas.

Contacts were not walked out but valleys were sectioned every half-mile or mile and if irregularities were present the contacts were followed in more detail. Half of the work was intrusted to advanced students but all irregularities were checked by the writer and all pinching out or appearances of formations were also investigated by him.

G. P. Moore is responsible for the Ralls County map though the writer visited the area of outcrops twice to check up the stratigraphy. Marion County was visited once by D. K. Greger

and the writer. Most of the mapping in Cooper and Pettis Counties was accomplished in one week with the assistance of William Rubey. The work there is much less accurate than that in the counties north of the Missouri River. It can scarcely be considered as better than reconnaissance. The Sedalia and Boonville topographic sheets were used as bases for these maps.

South of Pettis County the writer with assistants followed near the contact of the Mississippian with the Ordovician, examining it in many places, nearly to the Arkansas line, but found no evidences of Devonian save near Warsaw, where some specimens of *Atrypa reticularis* (Linnaeus) were collected from the mantle rock.

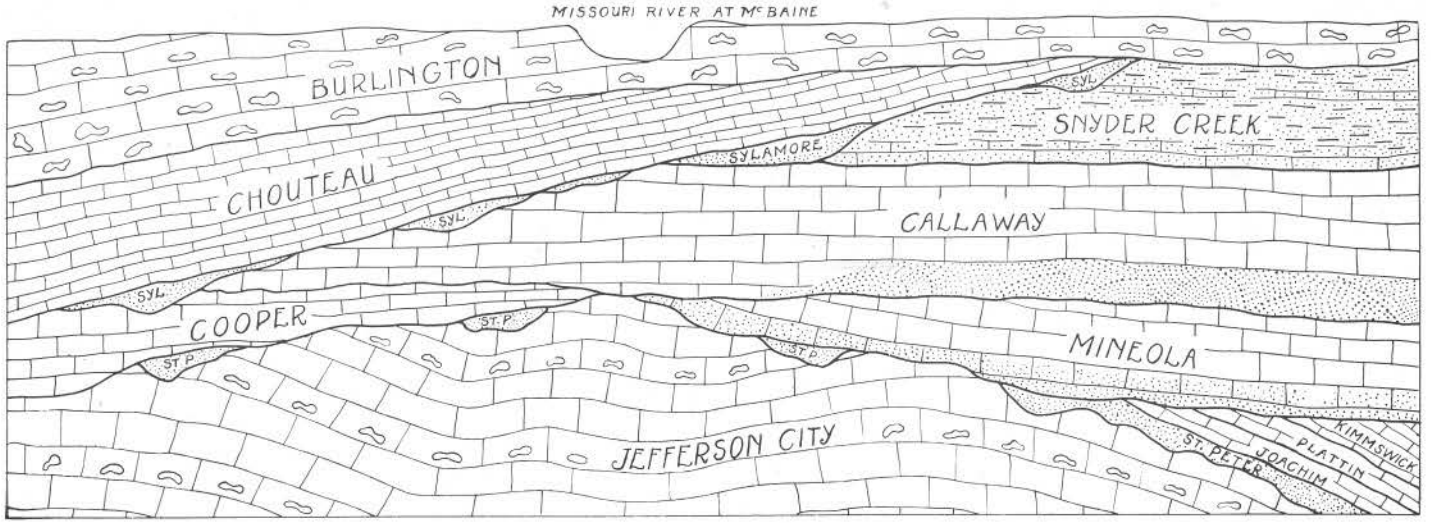
In the original plan of the work, Mr. D. K. Greger, then an assistant in the University of Missouri, was to write the paleontologic part of the report which deals with the Callaway and Snyder Creek, but he took on other work, and, as the writer had agreed with the state geologist, Mr. H. A. Buehler, to finish a report on the Devonian, he was forced to have collections made, and write the report. He feels that Mr. Greger's long experience with the Snyder Creek shale and Callaway limestone and his extensive collections from the formations would have enabled him to write a more complete paleontologic report on these two formations than is here presented.

The paleontology of the Cooper is not taken up extensively because Mr. Greger has prefaced a paper on the fauna, which has not been published. Though many species from each of the formations are not listed here the significant forms, from the point of view of stratigraphy, are discussed and the description of other forms will not alter the stratigraphic conclusions advanced.

Acknowledgments.

The writer is under obligations to Professor R. R. Rowley for loan of specimens from his collection; to Messrs. Stuart Weller, E. O. Hovey, John M. Clark and A. O. Thomas for loans of specimens from the museums of which they have charge; to the assistants and advanced students whose names have been mentioned in preceeding paragraphs, and particularly to Mr. D. K. Greger; to Mr. Klein for his painstaking care in making the drawings; to Dr. M. G. Mehl for various services which required much time; to Dr. E. M. Kindle for examining some doubtful forms; to Dr. J. E. Hyde for studying a species of

Syringothyris; particularly to Dr. Herrick E. Wilson for studying the crinoids from the Mineola and criticising the descriptions and figures, and James S. Williams who has read all of the manuscript, checked up all of the synonomy, and helped make many of the plates.



GENERALIZED SECTION OF THE DEVONIAN SERIES IN MISSOURI.

Drawn to show relationships of underlying and overlying formations in central Missouri. The thickness of formations is not shown to scale. The barrier between Mineola and Cooper is near the Missouri River at McBaine.

CHAPTER I.

GENERAL ACCOUNT OF MISSOURI DEVONIAN.

The Paleozoic in Missouri is represented by formations belonging to Cambrian, Ordovician, Silurian, Devonian, Mississippian, and Pennsylvanian periods. The generalized geological column on page 1 gives average thicknesses of the various formations in northeastern Missouri where all periods are represented. The Devonian is the subject of treatment in this volume.

From Marion County in the northeastern part of the State to Pettis County west of the center nearly all of the numerous Devonian outcrops were investigated and form the basis for the discussion in this chapter. Limited outcrops of Devonian rocks occur in the southeastern part of the State, chiefly in Ste. Genevieve County. In Chapter II the author has described the fauna of the middle Devonian of this region while Chapters on the Bailey limestone by V. O. Tansey and on the Little Saline limestone by Grace Anna Stewart describe the general fauna of the lower Devonian.

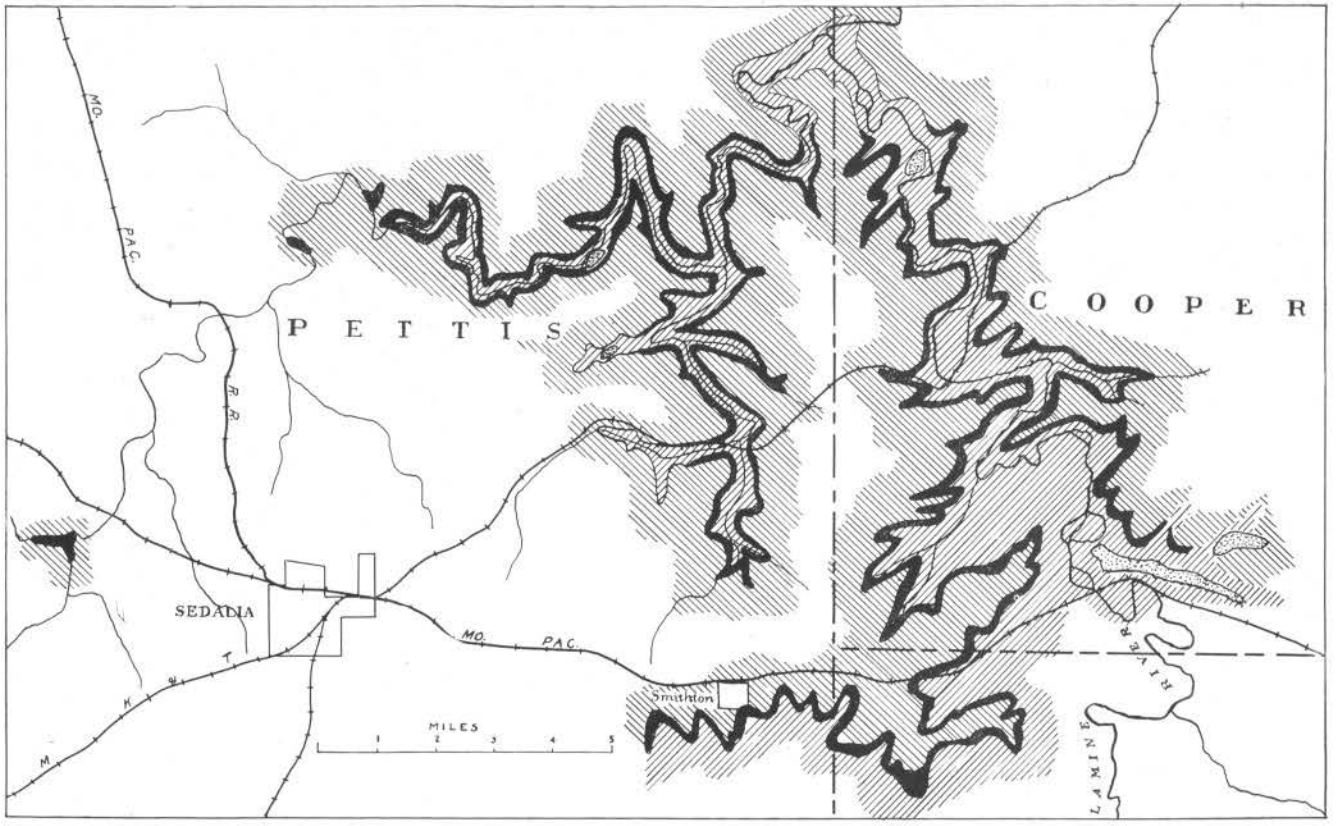
In Pennsylvania, Maryland, New York, and Virginia Devonian deposits are several thousand feet thick; in Ohio they reach a thickness of 2,000 feet or more; but they thin westward and no section in central Missouri is more than 100 feet thick. Moreover, in eastern United States the Devonian consists mainly of sandstones and shales, while in central Missouri it is mainly limestones.

In New York, the type region for Devonian in America, it consists of several formations grouped into Lower, Middle, and Upper, and all divisions are well represented, while in central Missouri the Lower Devonian is not represented, although present in the southeastern part of the State. The formations in other states are given in the following table with their equivalents in Missouri:

Correlation table of the Devonian formations of New York, Missouri, and Iowa

		New York	Central Missouri	Southeastern Missouri	Iowa
Upper	Seneca	Chemung f.	Snyder Creek sh.		State Quarry Lime Creek Sweetland Creek
		Portage f.			
		Genesee sh.			
		Tully ls.	Callaway ls.	St. Laurent ls.	Cedar Valley ls.
Middle	Erian	Hamilton sh.		Beauvais ss.	
		Marcellus sh.	Mineola ls.	Grand Tower ls.	Wapsipinicon
	Ulster	Onondaga ls.	Cooper ls.		
		Schoharie f.			
Lower	Oriskany	Esopus f.		Little Saline ls.	
		Glenerie f.			
		Connely f.			
		Port Ewen f.			
	Helderberg	Becraft f.		Bailey ls.	
		New Scotland f.			
		Coeymans ls.			
		Keyser ls.			

Vertical lines indicate absence.



DEVONIAN IN PETTIS & COOPER COUNTIES

MISSISSIPPIAN DEVONIAN ST. PETER JEFFERSON CITY

The Devonian of central Missouri has rarely been mentioned in geological literature and its extent and relationships are known to few people. This is due in part to the inaccessibility of the outcrops. The exposures most easily reached are near Providence and Easley in Boone County, Lupus in Moniteau County, and Sweeney in Cooper County. They are in the bluffs of the Missouri River along the Missouri, Kansas and Texas, and Missouri Pacific railroads in Boone and Moniteau Counties, and along the Missouri, Kansas and Texas at Sweeney, but at the places mentioned the rocks are thin and only sparsely fossiliferous and have attracted little attention.

Southward and eastward from Providence the Devonian outcrops retreat from the river bluffs and are only rarely within three miles of Missouri River. They occur in very rugged topography that is reached only with difficulty from the towns on the Missouri, Kansas and Texas Railroad. Furthermore, all of the towns are small, and the chance of geologists visiting in their vicinity is rare. The Wabash Railroad parallels roughly the Missouri River and the northern margin of Devonian outcrops, but it is in a nearly level country which rarely comes closer than five miles to the Devonian, and the country adjacent to it gives little promise to exploring geologists.

South of the Missouri River the exposures near Lupus are limited in extent, thin, and sparsely fossiliferous. At Sweeney, about fifteen miles northeast of Sedalia, a good outcrop of Cooper occurs in a large quarry, but the rock is nonfossiliferous, and though Sweeney is well-known as a collecting place for Chouteau fossils its Devonian exposures are little known and have never been mentioned in geologic literature.

The Central Missouri Devonian outcrops occur from Pettis County on the west to Marion County on the northeast. In Pettis, Cooper, and Moniteau Counties they are patchy and of small extent. In most cases they are in the bluffs of the larger streams and only rarely form the surface rocks over areas even a quarter of a mile in width. (The areas of outcrops shown on the small map (Plate F. a.) are greatly exaggerated.)

From Boone County through Callaway, Montgomery and western Warren counties the Devonian exposures are almost continuous, but the formations are so thin that they only rarely make up an important part of the valley sides and usually the part taken by them is negligible. In central Callaway County where the main valleys are about one hundred feet deep and the

Devonian averages sixty to seventy-five feet thick, the valley sides are in many cases largely made up of Devonian rocks. In central Warren County they are rarely present and where they occur form weathered slopes. From central Warren County to eastern Lincoln County Devonian rocks are absent and at the latter place they are only a few feet thick and occur in isolated patches. In Marion County, southwest of Palmyra, Salt River has cut down to the Devonian for a distance of a mile or two and the rocks do not occur more than twenty feet above the stream bed. In Ralls County near the town of Rensselaer, Devonian rocks outcrop over small areas.

The formations recognized in the region under discussion are:

Snyder Creek shale (Craghead Creek shale of Greger)
Callaway limestone
Mineola limestone
Cooper limestone

The most easily accessible important Devonian outcrops are on Smith's Branch, west of the Montgomery City-Danville road about four miles from Montgomery City, where for two or three miles down the creek the outcrops are good and both Callaway and Mineola are exposed. The most easily accessible outcrops of Snyder Creek shale are about six miles south of Fulton at the type locality of the formation, and Callaway limestone also occurs near the Snyder Creek outcrops. The outcrops of Cooper one mile south of Providence are better than occur in most places, those at Sweeney, mentioned in another paragraph, are good, and for two or three miles down stream from Sweeney they continue to be good. In northeastern Missouri the outcrops of Mineola near Rensselaer on the Wabash Railroad are good and are easily reached.

UPPER AND LOWER BOUNDARIES OF THE DEVONIAN

The upper and lower limits of the Devonian in Missouri have been placed at various horizons, but while the upper is still in dispute there is general agreement about the lower, owing to the large break between the oldest Devonian and youngest rocks beneath. In central Missouri the oldest Devonian rocks are Middle Devonian in age, and the youngest underlying rocks are older than the Niagaran of the Middle Silurian. The time interval between the youngest underlying rocks and the oldest Devonian probably ranges between three

million and ten million years in different sections. During this time some 5,000 feet of sediments were deposited in places in New York and Pennsylvania. Only in Pike County does the Devonian rest on rocks as young as Silurian and every place else it is on Ordovician formations. In most places the Ordovician rocks were thrown into small folds before they were eroded and the Devonian seas came over them. Commonly the Devonian limestones rest on dolomites or sandstones, but in some cases they are on limestones.

The unconformity between Devonian and older rocks is indicated in several ways. A clear-cut erosion surface of the older formations showing erosion channels and truncated folds is common. (See Plate D, a.) The overlap of Devonian formations on several older formations is the rule. In Callaway County The Callaway limestone rests on Jefferson City, St. Peter, Joachim, Plattin, and Mineola formations, all in a radius of ten miles. Any distance of ten miles would show Devonian rocks on two or three older formations. There is an almost complete break in life between the underlying formations and the Devonian.

The top of the Devonian is not as well defined as the bottom and is placed at the contact with the Grassy Creek shales in northeastern Missouri and at the contact with the Sylamore sandstone in the central part of the State.

GRASSY CREEK SHALE

The Grassy Creek shales have usually been classed with the Devonian, but seem to belong with the Mississippian. By this I do not mean to imply that they may not be of the same age as some of the formations east of the Cincinnati arch that have usually been classed as Devonian, but that they were formed in a sea that advanced widely following a widespread land emergence and considerable deformation, and their sedimentation was continuous with that of the Mississippian.

The Grassy Creek shales range from a few inches to more than 60 feet thick, and consist mainly of black and blue shales with which thin layers of sandstone are imbedded near the top. The shales are exposed only in Lincoln, Pike, Ralls, and Marion counties and lie unconformably on Mineola and Cooper of the Middle Devonian, Edgewood and Sexton Creek of the Silurian, Kimmswick and Flattin of the Ordovician. The unconformity

below the shales is profound, and above they grade into the Louisiana limestone of the Mississippian without any indication of unconformity.

The evidence from fossils indicates a Devonian age for the shales but the evidence is not strong. A group of fishes is present that has not been identified from rocks above the Devonian but in some cases the presence of these fishes was made the basis for identifying the rocks as Devonian. The species present in the Grassy Creek shales are, with two exceptions, different from those in other areas. The exceptions are *Ptyctodus calceolus* (Newberry and Worthen) and *Dipterus mordax* Eastman. But *Ptyctodus calceolus* (Newberry and Worthen) is widespread in the Sylamore sandstone of central Missouri which is without question of Mississippian age. The armored fishes present belong to the genera *Dinichthys* and *Mylostoma.* These genera lived usually in seas in which black muds were being deposited and do not occur in abundance anywhere. They are unlike the sharks, which are relatively independent of bottom conditions and leave their remains in all sorts of waters. The pavement toothed sharks were just coming in during Grassy Creek time and they are not distinguishable from those from the Chouteau. The invertebrates are mainly *Lingulas* belonging to new species and are of little value for correlation purposes. Greger[1] identifies the following species in the fauna.

Ptychostylus subtumidus Gurley
Lingula missouriensis Rowley
**Lingula pikensis* sp. nov.
Lingula tantilla sp. nov.
Lingula rowleyiana sp. nov.
Lingula insolata sp. nov.
Lingula yatsui sp. nov.
Lingula conklini sp. nov.
Athyris bransoni sp. nov.
Adolfia cf. amarus Swallow
Douvillina cf. mucronata Conrad
Palaeonila compressa sp. nov.
Pterochaenia longwelli sp. nov.

*The new species have not been described or figured.

[1]Bulletin, Geol. Soc. Am., vol. 29, p. 95

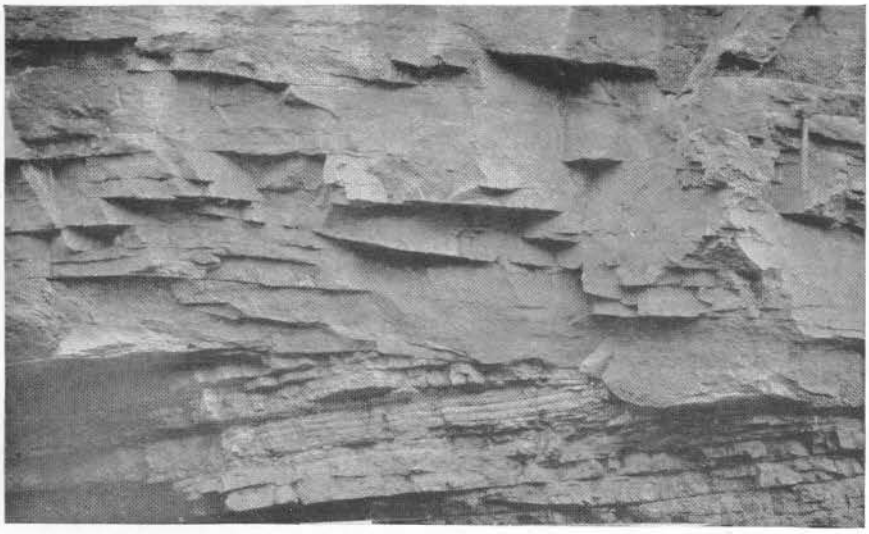


Fig. a. Mineola Overlying Tilted Jefferson City.

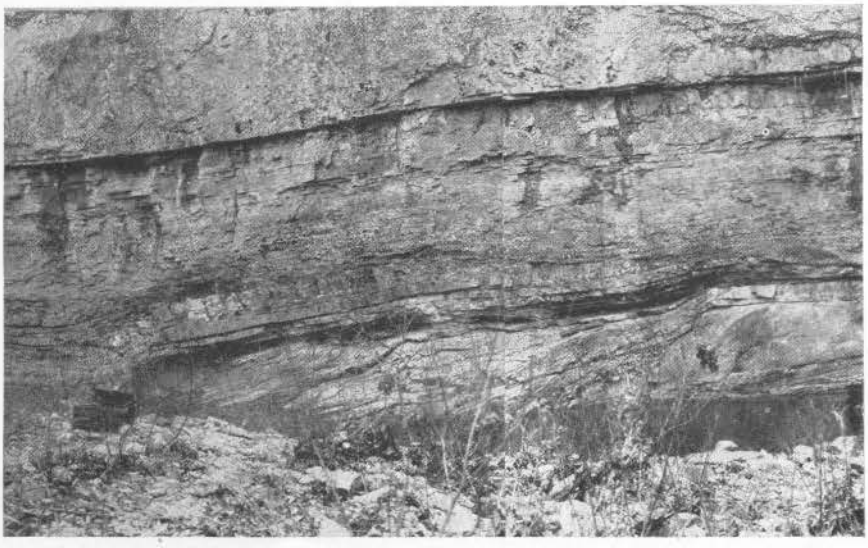


Fig. b. The lower contact of the Mineola on Cedar Creek, Ralls County.

SYLAMORE SANDSTONE

Southward the Grassy Creek shales thin and seem to disappear in northern Lincoln County. A few miles south of their southern margin the Sylamore sandstone occupies the same horizon and has the same relationships to the underlying and overlying strata. The Sylamore is less than one foot thick at most of its outcrops, though in narrow elongated areas it is 30 to 70 feet thick and in a few places it reaches a thickness of 40 feet over several square miles. It is composed of medium to fine-grained sand for the most part, but conglomerates are not rare and many lenses of shale have been found. It is usually gray to light brown in color but a light green phase is frequently met with. It lies with marked unconformity on the Snyder Creek shales, Callaway limestone, Mineola, Cooper, Plattin, Kimmswick, and Joachim formations. The evidences of unconformity are overlap on many formations, striking irregularity of the bottom, complete break in life, conglomerates at the bottom, complete change in sediments, Sylamore sand filling cracks in underlying rock, Sylamore sand filling old caves in underlying rock. The Sylamore shows positive evidences of having been deposited in a sea advancing over extensively eroded rocks, some of which were of very late Devonian age. There can be no question that the line between Devonian and Mississippian should be placed below the Sylamore in central Missouri, and that the Snyder Creek shale, the youngest underlying formation, is Upper Devonian in age.

Devonian seems to be absent from southwestern Missouri. The Phelps sandstone referred to the Devonian by Shepard and Ulrich on the basis of the *Ptyctodus* remains in it, is equivalent to the Sylamore in central Missouri. The shales associated with the Phelps seem to be only another phase of the same formation, as they are in central Missouri. The Eureka shale of southwestern Missouri should be referred to the Mississippian as the Grassy Creek shales are referred in the northeast.

The Eureka shales associated with the Sylamore are the deposits of an advancing sea. The underlying rocks are St. Peter sandstone or Ordovician dolomites in northern Arkansas and southern Missouri as they are from Pettis County southward and in many places in Cooper, Moniteau, Phelps, Boone, Callaway, Montgomery and Warren counties. In the above named group of counties, the Sylamore usually rests on the

Devonian, but Devonian formations are absent in many places and in such areas the Sylamore rests on Ordovician formations.

The Sylamore sandstone and its equivalent, the Phelps sandstone and the Eureka shales are the only formations south of Pettis County that have been referred to the Devonian and in this work they are considered as basal Mississippian.

Grabau[1] notes the similarity of conditions in the origin of the Grassy Creek shales and the Noel shales of southwestern Missouri, but considers the Noel much younger than the Grassy Creek. However, he reached that conclusion from incomplete data on the relationships of the shales and he was not aware of the wide extent of the Sylamore sandstone of the same age as the shales. He says: "Whatever the age of the Sylamore, the relationship of the Black shale (Eureka or Noel) to the overlying and underlying formations is clear. It represents a basal bed of an advancing sea, and progressively rises in the scale southward from middle Kinderhook to uppermost Kinderhook or lowest Burlington. That this basal bed is such a fine grained rock can only be explained by the assumption that the land was very low, and that the residual soil covering it was clay mixed with much carbonaceous material. In other words, the Noel shale can only represent the reworked residual soil of an old peneplain surface which was slowly submerged beneath the advancing Mississippian sea. Taken in connection with the position of the Black shale at the base of the Louisiana limestone in northeastern Missouri, we see that the transgression went on through the entire Kinderhook."

The Sylamore in central Missouri, in Warren, Montgomery and Callaway counties, is immediately below the Burlington limestone, but is overlapped by Chouteau in patches in the same general area, and the Chouteau comes in between the Burlington and Sylamore from Boone County to near the Arkansas line. In Arkansas the Chouteau is absent and the same relationships exist as in the central district. No general rise in horizon of the black shale is indicated as postulated by Grabau, and the age of Noel shale, Sylamore sandstone, and Grassy Creek shale seems to be practically the same.

COOPER LIMESTONE

Historical—The Cooper limestone was first described by Swallow[2] in 1855 under the name or Cooper marble, as follows:

[1]Bulletin, Geol. Soc. Am., 17, 1906, pp. 598 and 599.
[2]Geol. Surv. Mo., Reports I and II, p. 196.

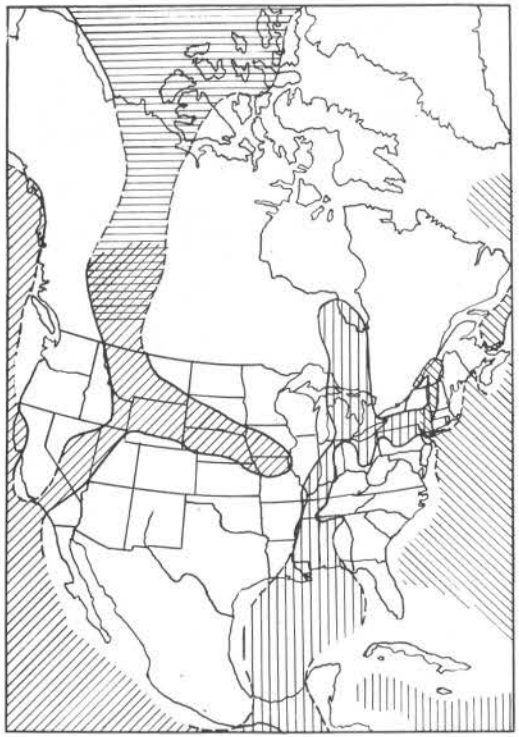


Fig. a. Early Onondaga seas, time of Cooper deposition.
(Modified from Schuchert.)

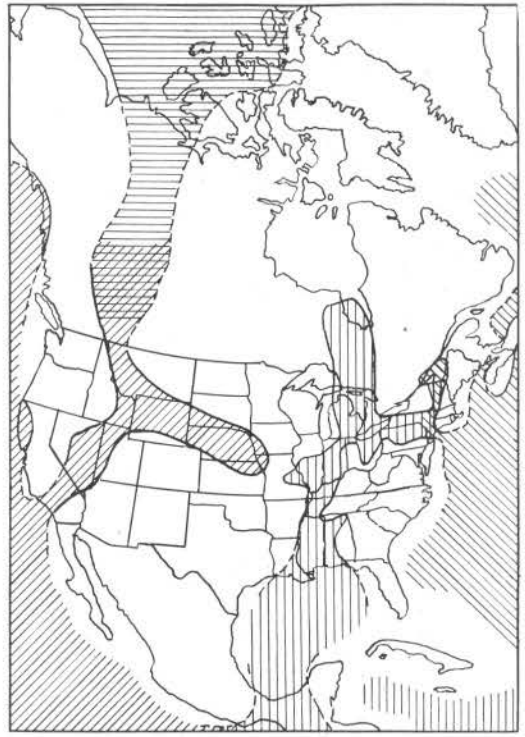


Fig. b. Late Onondaga seas, time of Mineola deposition.
(Modified from Schuchert.)

Fig. c. Early Upper Devonian seas, time of Snyder Creek deposition.
(Modified from Schuchert.)

"ONONDAGA LIMESTONE—COOPER MARBLE

The upper part is a bluish drab compact limestone, containing cavities filled with a yellowish green substance, which gives the rock a fine mottled appearance; but it passes down into bluish compact beds, which contain numerous small crystals of calcareous spar.

Range and Thickness—Its thickness varies from 20 to 60 feet, as may be seen in Sec. 17, and the one above from the La Mine, and the following from Clear Creek, some two miles above its mouth:

No. 1.—6 feet of Bluff.
No. 2.—20 feet of Ferruginous Sandstone.
No. 3.—100 feet of Encrinital Limestone.
No. 4.—30 feet of Chouteau Limestone.
No. 5.—50 feet of Vermicular Sandsone and Shale.
No. 6.—30 feet of Lithographic Limestone.
No. 7.—20 feet of Cooper Marble.

It is best developed on Clear Creek, and on the La Mine, between the mouths of Clear Creek and Otter Creek, and on little Saline, in Town. 47, R. 18, Sec. 34*. It becomes much thinner, and passes into dull bluish gray semi-crystalline beds, towards the southern and eastern part of the county, where it is often entirely wanting.

Organic Remains.—No organic remains have been found in the Cooper Marble proper, but the beds into which it passes to the south and east, contain the characteristic fossils of the Onondaga Limestone."

In the same report Meek[1] called attention to beds in Moniteau County that are in part Cooper. "Below the above-mentioned beds, we have at some places in Moniteau County, the lower member of the same group. This rock varies much in its composition, being at some places an arenaceous limestone, and at others a calcareous sandstone, and I even suspect it passes, in some instances, into a pure quartzose sandstone.

This formation was only met with at the following localities:—First, in a bluff on the Missouri, already referred to. At

*The writer visited this locality and found Chouteau limestone on St. Peter sandstone and Jefferson City dolomite.

[1]Geol. Surv. Mo., Reports I and II, pt. II, pp. 104-105.

this place it is a calcareous sandstone, whilst at another point, only a short distance along the same outcrop, it passes into layers of arenaceous limestone, containing its usual fossils, and alternating with beds of obliquely-laminated sandstone. It also occurs in the bed of a small branch of Little Splice creek, some mile and a quarter south of the above locality, where it is more calcareous, and contains many fossils, of a few species.

On the north side of the Moniteau, it was again seen at Mr. William Routon's place, in Sec. 27, Town. 46, R. 14. Here is only exposed about eight feet at the base of a hill, and it is made up of course, partly-rounded grains of quartz, cemented with calcareous matter.

The only organic remains seen in this part of the group were *Terebratula reticularis*, an *Orthis* like *O. resupinata*, a plicated *Spirifer* rather under medium size, and a small smooth *Spirifer*."

Meek failed to differentiate between Callaway and Cooper and nearly or quite all the arenaceous rock belongs to the former.

In his discussion of the geology of Marion County in the same report Swallow[1] says of the Cooper there: "This marble is easily distinguished by its lithological characters. It is a hard, compact, blue limestone, which has disseminated through it, numerous small angular masses of pellucid calcareous spar. These particles of spar often present the appearance of Arabic characters, like the quartz in graphic granite. The marble is hard and durable, and receives a fine polish.

It passes down into a light-colored, thin-bedded, argillaceous limestone which is, probably, the upper part of the *Hudson River Group*. A single filiform coral, *Acervularia Davidsoni?* is the only fossil found in the rock."

Acervularia Davidsoni Edwards and Haime was not found by the writer, but it occurs in the Callaway about ten miles south of Swallow's locality.

In Meek's report on Saline County, published in 1873,[2] he described the Cooper as follows: "The exact position of this rock in the series has not been determined as no organic remains have yet been found in it, and it has only been seen in connection with the Chouteau Limestone and the Saccharoidal Sandstone. That is to say, it has been seen immediately beneath the former and reposing upon the latter. In this county it was only observed associated with the Chouteau Limestone, as

[1]Geol. Surv. Mo., Reports I and II, p. 178.
[2]Geol. Surv. Mo., 1855-1871, p. 176.

represented in the section given on page 175, and it is not known to occur at any other locality excepting where that section was taken, and near there on the Blackwater.

In composition it is a rather pure Limestone, and resembles some of the more compact layers of the Chouteau above. It is generally, however, more compact and heavy-bedded, and differs in always having numerous small, irregular particles of calc-spar disseminated through it.

The fact that this rock occurs so frequently immediately beneath the Chouteau Limestone in Cooper county, leads me to place it provisionally in that position in the general section, though I am aware further investigations may prove it to belong even to some part of the Lower Silurian series. It is the only bed observed in this county in regard to the relative position of which there can be any doubt."

The name Cooper was not used in the literature from Meek's report in 1873 to 1916, when it appeared in an abstract of one of the writer's papers.

In 1905 F. B. Van Horn[1] mentioned middle Devonian deposits in Moniteau County and gave some details about distribution but no correlation data. He did not differentiate sharply between the Cooper and the overlying Callaway though he gave Ulrich's opinion that both middle and upper Devonian were present.

In 1908 Marbut mentioned the occurrence in Morgan County of rocks supposed to be Devonian and described them as follows: "The rock consists of very fine-grained massive compact bluish limestone weathering to a white color. It is so massive that the weathering takes the form of the erosion of basins and holes in the surface of the limestone rather than disintegration along the bedding planes of the rock. Crinoid stems, brachiopods, and other forms of fossil remains which are so abundant in the overlying Mississippian limestones are absent from this Devonian rock. The only fossil found in it, at least without a very close examination, is a loose growing compound coral which is very abundant.

The maximum thickness of this rock is probably not more than 10 feet. In places it disappears entirely. It seems to be merely a series of remnants of an originally very extended and thick limestone formation which was nearly eroded away before the deposition of the Mississippian limestone."[2]

[1]Mo. Bu. Geol. Mines, III, pp. 38-43.
[2]Mo. Bu. Geol. Mines, 2nd series, VII, p. 49.

Description.—The Cooper limestone is usually a bluish-gray, compact, very fine-grained rock that resembles the so-called lithographic limestone of northeastern Missouri. In places the lower beds are almost black and are not quite so compact and homogeneous.

In Pettis, Cooper, Moniteau and Morgan counties the upper 2 to 4 feet of the limestone contains cavities filled with calcite which give the rock a mottled appearance. It seems to have been honeycombed with borings like those of the vermicular sandstone and the holes were later filled by deposition from solution.

In Western Boone and eastern Moniteau counties the rock is all light colored but is much more irregular in both color and texture than that farther west. In Marion and Ralls counties the rock is not as homogeneous and fine-grained as in the outcrops in Pettis and Cooper counties.

In thickness the Cooper ranges up to 30 feet but is rarely more than 20 feet and averages less than 15 feet. On Clear Creek in Cooper County, Swallow lists 20 feet of Cooper marble, but the writer has not seen thicknesses greater than 16 feet. At Pinhook Bridge, in Pettis County, northeast of Sedalia, about 30 feet of blue limestone above and nearly black limestone below is exposed and the bottom is covered. In a quarry at Sweeney on the Missouri, Kansas and Texas tracks, about 15 miles east of Sedalia, the upper part of the Cooper, all light colored, is well exposed.

Relationships and Distribution.—Outcrops of Cooper limestone are known in Pettis, Cooper, Morgan, Moniteau, Saline, Boone, Ralls and Marion counties. Its thickest and most typical exposures are in Cooper and Pettis counties. The thickest section known to the writer is at Pinhook Bridge, northeast of Sedalia in Pettis County. The most extensive exposures are along the Lamine valley below Sweeney in Cooper County.

The formation is not continuous but represents erosion remnants. In the bluffs of the Missouri River in Boone County it outcrops intermittently for about ten miles ranging up to 15 feet in thickness. It was deposited on a greatly eroded surface and was extensively eroded before the Callaway limestone was deposited on it. For distances of a mile or more along the bluffs no Cooper is present. In eastern Moniteau County along the river bluffs the conditions are about the same as in Boone County. Along the Lamine River in Cooper and Pettis counties the forma-

tion outcrops intermittently for several miles but in places was entirely removed before the deposition of the Mississippian rocks.

The original extent of the Cooper is problematical. It did not reach far east of Boone County, as in that direction the Mineola occupies the same horizon and the two formations contain only two identified species in common. Southward from Boone, Moniteau, Morgan and Pettis counties, only older rocks are exposed. West of Morgan County and south of Pettis no indication of Cooper limestone occurs. It may extend westward from Pettis County under the younger rocks and as it is thickest in its westernmost outcrops it seems probable that it is present westward. The Cooper seas may have connected northward with the earliest middle Devonian seas of Iowa. They extended as far eastward as Spalding in Ralls County and probably to the Mississippi River. The paleontologic data are too meager for positive conclusions and the paleogeographic map in Plate F, figure a, is only a suggestion. If the sea in which the Cooper was deposited had been connected with the seas of eastern Missouri and Illinois the fossils should indicate it. The thickening of the Cooper westward suggests sea connection in that direction. As it does not occur in outcrops south of Pettis County and has not been found in Iowa, the western connection must have been narrow.

The Cooper is nonconformable on the Jefferson City over most of its extent in central Missouri though in several places it rests on St. Peter sandstone. In northeastern Missouri it is disconformable on the Kimmswick and Maquoketa.

In central Missouri the Callaway limestone is disconformable on it in small areas, the Sylamore sandstone is nonconformable on it over most of its extent, and the Chouteau limestone lies on it where the Sylamore is absent. In northeastern Missouri it is overlain disconformably by Louisiana limestone and Grassy Creek shale.

Paleontology.—The Cooper faunas are meager and the species are not diagnostic. Some places have given promise of furnishing abundant faunas from abundant fragments of fossils of various kinds but the fossils have not been found. *Pleurotomaria providencis* Broadhead seems to be the most widely distributed species in Missouri. It occurs in western Boone County and also in Ralls and Marion counties. Only *Favosites alpenensis* Winchell, *Streptelasma cooperensis* Branson, and *Atrypa reticularis*

(Linnnaeus) have been identified in other formations. The fauna has a Middle Devonian aspect but does not agree with any other Middle Devonian fauna. Its relationship to the Mineola places it in the very earliest Middle Devonian. It is probable that more extensive collecting will add many species to those known from the formation.

The following list contains all of the identifiable forms that the writer has collected from the Cooper limestone:

Coelenterata
Favosites alpenensis Winchell
Streptelasma cooperensis Branson

Brachiopoda
Atrypa reticularis (Linnaeus)
Gypidula marionensis Greger

Pelecypoda
Lunulicardium grande Miller and Gurley

Gastropoda
Pleurotomaria providencis Broadhead

In addition to the list there are two or three species of gastropods, two cephalopods, two or three bryozoans, and three or four brachiopods that are too fragmentary for description.

Greger[1] lists the following species, all but two undescribed, of which the writer has seen only fragmentary materials.

Bryozoa, 2 species, gen. et sp. indet.
Stromatopora sp.
Favosites sp.
Cyathophyllum sp.
Spirifer lupusensis sp. nov.
Schuchertella altirhynchus sp. nov.
Stropheodonta cooperensis sp. nov.
Camarotoechia splicensis sp. nov.
Gypidula marionensis sp. nov.
Cranaena marionensis sp. nov.
Martinia sp. cf. glanscerasi (White)
M. sp. cf. sublineata (Meek)
Conocardium cooperensis sp. nov.
Lunulicardium grande Miller and Gurley,
Turbonopsis providencis (Broadhead)

[1]Am. Jour. Sci. 50, p. 24.

Platyceras sp. nov.
Loxonema sp.
Gomphoceras sp.

All of Greger's species excepting *Gypidula marionensis*, *Cranaena marionensis*, *Turbinopsis* (*Pleurotomaria*) *providencis* Broadhead, and *Lunulicardium grande* Miller and Gurley were collected from number 3 of a section in Moniteau County which he describes as follows:[1]

	ft.
MISSISSIPPIAN.	
No. 7. Light gray, crinoidal, Burlington limestone	15
No. 6. Yellowish, shaly limestones and thin beds of shale, Chouteau	65
No. 5. Sandy shale, blue-green, soft in places	1
Unconformity.	
DEVONIAN, Callaway limestone.	
No. 4. Gray and brown, gritty limestones, fossiliferous	10
DEVONIAN, Cooper limestone.	
No. 3. Bluish, compact limestones, alternating thick and thin beds, fossiliferous	8
No. 2. Very sandy conglomerate, blue and black oolitic cherts	3
Unconformity.	
ORDOVICIAN, Jefferson City formation.	
No. 1. Brown and buff, dolomitic limestone	5

The fossiliferous part that Greger calls Cooper grades upward into the Callaway, without break save change in lithology, while there is a distinct unconformity below the fossiliferous part, and the rock below has the typical lithology of the Cooper. The fossiliferous bed is about one foot thick and should be classed with the Callaway. All of Greger's species belong with the Callaway excepting the four listed above. The writer is unable from fragmentary materials to distinguish Greger's species as different from those described from the Callaway. The *Martinia* cf. *glanscerasi* (White) is probably the one described in this bulletin as *Martinia halli*. The *Cyathophyllum* sp. is Branson's *Streptelasma cooperensis* which occurs in the Cooper as well as in the Callaway. *Pleurotomaria providencis* Broadhead is common along the river bluffs near Providence in Boone County and in the outcrops in Marion County. *Favositis alpenensis* Winchell is the most widely distributed species.

MINEOLA LIMESTONE

Historical.—The only reference in geoligical literature to a middle Devonian formation older than the Hamilton, other than the Cooper, in central Missouri, is in Broadhead's report on Warren County. He refers to it as follows:

[1]Op. cit., p. 23.

"HAMILTON GROUP

This formation is but sparingly developed in Warren, and is only important as a connecting link between the rocks above and those below.

A heavy bed of brown limestone at lower part of Sec. 54 may belong to this group. (*The Hamilton here referred to is the Callaway.*)

LOWER DEVONIAN

The exact Geological position of the beds below, we are not able to place with certainty. On waters of Massey's Creek we have:

SECTION 13.

No. 1. 50 feet chert slope.
No. 2. 12 feet coarse gray Encrinital Limestone.
No. 3. 10 feet brownish Limestone.

Chouteau Beds:

No. 4. 4 feet fine grained bluish-drab Limestone.
No. 5. 1-foot brittle, variegated, compact Limestone.

Devonian:

No. 6. Dark-blue Limestone, contains *Favosites reticulata.*
No. 7. 6 feet dark, coarse Limestone, contains *Spirifer euryteines, Orthis tulliensis,* and a large *Spirifer.*
No. 8. 8 feet coarse, Crinoidal Limestone.
No. 9. Trenton Limestone.

On Bear, Massey's, and Lost Creeks, beneath the Hamilton (?) beds as above described, we find about 20 feet, mostly of a coarse gray, and sometimes of a dark-bluish drab Limestone. In the upper part fossils are sometimes quite numerous, belong to the genus *Merista* and *Rhynchonella.* At some places a fine close-grained, bluish-drab Limestone occurs near the top, containing *Favosites reticularia, Alveolites Verneulana, Spirifer,* and an *Orthis* resembling *Tulliensis,* or *Iowensis,* near the base. *Cyathophyllum rugosum* (?) occurs in a brownish Limestone in N. E. part of T. 46, R. 2 W. The Geological position of the above described rocks is probably above ? that of the Coralline bed of the Callaway section. The Coralline beds were not seen in this county, but a specimen of *Zaphrentis gigantea* was found separated from its parent bed. These beds may probably belong near the Onondaga Limestone.

CRINOIDAL LIMESTONE

The area occupied by this rock is small; it was recognized at a few localities on Massey's and Lost Creeks, and outcrops on nearly all the bluffs of Bear Creek. It is generally about 11 feet thick, and uniformly a coarse gray Limestone, often crumbly,

and generally containing many crinoid stems. Fossils are rare; *Atrypa reticularis* is sometimes found. Its total thickness in this county is probably about 15 feet. It is extensively used in Montgomery County (where it is better developed) for chimney fire-places. It probably belongs to a division of the Upper Silurian system."[1]

Number 8 given in the section and the crinoidal limestone are part of the Mineola.

Lithology.—The Mineola is rather heterogeneous in composition. One of its typical phases is a highly crystalline, crinoidal limestone, almost white in color, which weathers readily to a crumbly condition. This phase might easily be mistaken for ordinary Burlington limestone, though it weathers much more rapidly than Burlington. It contains large numbers of crinoid stems and in many places numerous crinoid heads from which the outer parts of the plates have been exfoliated. Near Rensselaer, in Ralls County, crinoid heads in good condition were found in this bed.

Another phase, about as common as the crinoidal, is made up of a yellowish to pinkish gray limestone, which contains large numbers of small irregular cavities produced by the solution of fossils. In most places the limestone is sandy. A fenestelloid bryozoan, *Cyclotrypa communis* Ulrich, is abundant, but other fossils are rare.

A brown limestone flecked with specks of white occurs rarely. It contains few impurities and the white specks are of calcite. The rock is abundantly fossiliferous.

In some places the lowest member is a very sandy, pinkish to yellowish limestone, that grades towards sandstone, and is abundantly fossiliferous. It ordinarily occurs in shallow erosion depressions in the older rocks.

The various phases are never present in one section and they seem to have been contemporaneous deposits, the lithologic differences being due to variations in sedimentation.

Distribution and Relationships.—The Mineola limestone occurs in Callaway, Montgomery, Warren, St. Charles, Lincoln, Ralls and Pike counties. It exists only as erosion remnants and though its east-west extent is more than 100 miles and its north-south extent 60 miles or more, it probably covers a total area of less than 500 square miles. Only rarely is any patch of the forma-

[1]Geol. Surv. Mo., 1855-71, pp. 47-48.

tion more than four or five miles in diameter and many patches are only a few hundred feet in extent. It was deposited on an eroded surface and was deeply eroded before the Callaway limestone was deposited on it, though the greater part of the removal by erosion was accomplished in post Devonian, pre-Mississippian time.

The Mineola rests on Jefferson City dolomite, St. Peter sandstone, Joachim dolomite, Plattin limestone, Kimmswick limestone and Maquoketa shale. The absence of Silurian and lower Devonian rocks in the area where it occurs indicates a long period of erosion. In the main the underlying rocks are only slightly folded though in some places the Jefferson City is crushed and crumpled into small folds. Wherever the Mineola rests on Jefferson City the nonconformity between the formations is easily made out but where it rests on Kimmswick or Joachim the structural relations are obscure.

At location 5 south of Montgomery City, on Smith's Branch, the Mineola rests on the Plattin on a slightly irregular surface. Here it is less than 5 feet thick and occurs in patches. At location 6, southeast of New Florence it also rests on Kimmswick.

At the mouth of Cow Creek in Callaway County, the Mineola rests on dipping Jefferson City. (See Plate D, figure a.) About one mile west of Mineola, Montgomery County, it also immediately overlies Jefferson City.

On Whetstone Creek about half way between Montgomery City and Williamsburg, St. Peter is the underlying rock in a few places. Both St. Peter and Mineola are very patchy in this district and come in contact in only a few places. At several places near the Callaway-Montgomery County line, St. Peter and Mineola are in contact.

Nearly everywhere in eastern Montgomery County, where the Mineola occurs, it rests on Joachim. At location 7, three miles northwest of Big Springs in Montgomery County, it rests on Joachim less than half a mile from an area where a good section of Plattin overlies the Joachim.

The Mineola is overlain by Callaway limestone, Sylamore sandstone, and Chouteau limestone, though the Callaway is the commonest overlying formation. The disconformity between the Mineola and Callaway is much less distinct than between the Cooper and Callaway and the final determination of unconformity rests on the thickening and thinning of the Mineola and the overlap of the Callaway. Next to the Callaway the Syla-

more is the commonest overlying formation and the Chouteau only rarely comes in contact with it. Very rarely Pennsylvanian formations come in contact with it where deep valleys were excavated in pre-Pennsylvanian time and filled during the Pennsylvanian.

The Callaway is in contact with Mineola at location 4, at the mouth of Cow Creek in Callaway County, at location 6, near New Florence in Montgomery County, and at numerous other places.

The Sylamore is the overlying formation in Sec. 6, T. 46 N., R. 5 W, 2 miles west of Big Springs in Montgomery County, Sec. 17, T. 47 N., R. 5 W, Montgomery County, and in many areas in western Warren County.

The westernmost outcrop of Mineola is at the mouth of Cow Creek in eastern Callaway County, locality 4. The granular crinoidal phase is present but is not indentified as Mineola without reservation. No diagnostic fossils have been recovered from it and it is not sharply differentiated from the Callaway above. In the Mineola region in western Montgomery County the second phase of the formation is well developed, reaching a thickness of more than 20 feet, and is continuous for four or five miles. Good outcrops occur in sections 11 and 12, T. 48 N., R. 6 W. The granular crinoidal phase is also present here, but is patchy. It outcrops near the tops of the hills about three-quarters of a mile west of Mineola, and is about five feet thick at a maximum.

In southeastern Montgomery County the crinoidal phase is widespread and often reaches a thickness of 10 to 15 feet, while the other phases are only rarely present. Patches of a yellowish-gray, sandy limestone which is highly fossiliferous, occur here and there. This phase, never more than two or three feet thick, always lies at the bottom of the formation, and was the first deposit of the advancing seas. The best place to examine outcrops is in Sec. 20, T. 47 N., R. 5 W., about 3 miles northwest of Big Springs, where it rests on the Joachim.

On the headwaters of Whippoorwill Creek, in Sec. 3, T. 47 N., R. 5 W., about five miles southeast of New Florence, the crinoidal phase, about five feet thick, occurs at the top and beneath it about two feet of the brown phase, resting on the Kimmswick. The brown phase bears great numbers of fossils, many of which are well preserved.

In Warren County the Mineola occurs only rarely and the only phase observed was the crinoidal. It outcrops in only a

few places in the western part of the county and occurs as float in several places, one of which is as far east as 10 miles south of Warrenton. As the horizon of the Mineola is usually weathered to slopes the formation may be present over larger areas, but outcrops showing Mississippian and Ordovician, or Callaway and Ordovician, in contact are not uncommon, and Mineola must be exceedingly limited.

The writer has not seen outcrops of the Mineola in St. Charles County, but a few fragments of rock from the formation have been sent to him from the western part of the county. It must occur only in patches of small extent and only a few of the patches.

In northeastern Lincoln County a few patches of small extent are known. In Ralls County, near Spalding, outcrops are numerous though they do not cover large areas. The greatest thickness examined, about 50 feet, occurs in this locality. Near Rensselaer the crinoidal phase is prominent and crinoid heads are fairly well preserved in considerable numbers. In the northern part of Ralls County the Mineola rests disconformably on the Cooper with a well-developed erosion surface between. Gilbert P. Moore measured and described the following section near Spalding.

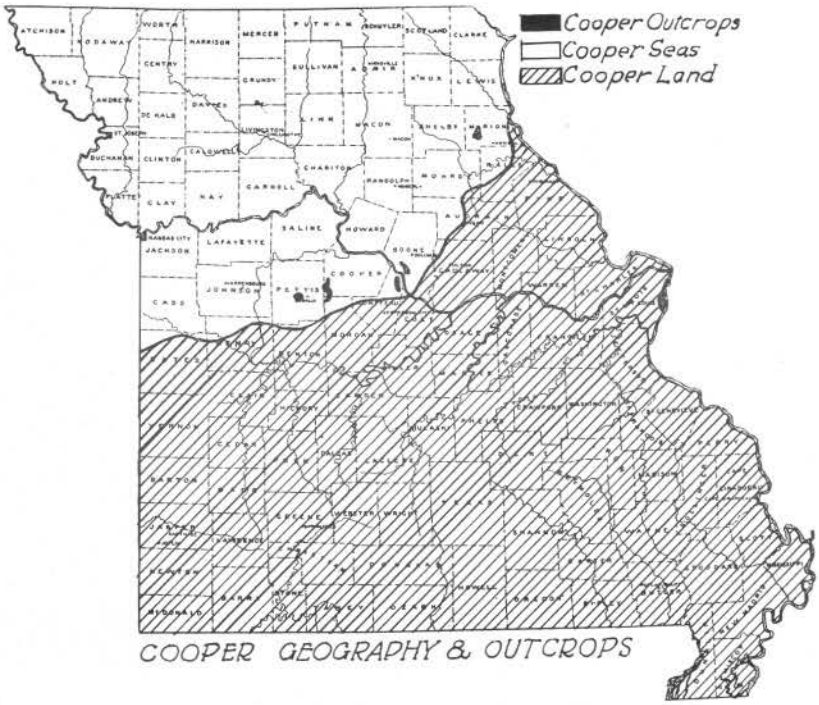
Mantle rock	2 to 10 feet
Mineola:	
Red fossiliferous sandstone	8 to 20 feet
Sandy yellow massive-bedded non-fossiliferous limestone	8 to 10 feet
Red sandstone	2 feet
White cross-bedded very fossiliferous limestone	2 feet
Hard blue dense limestone	20 feet

The sandstone is very patchy. In another section about 3 miles north of Spalding at the large outcrop near Rensselaer, Moore measured the following:

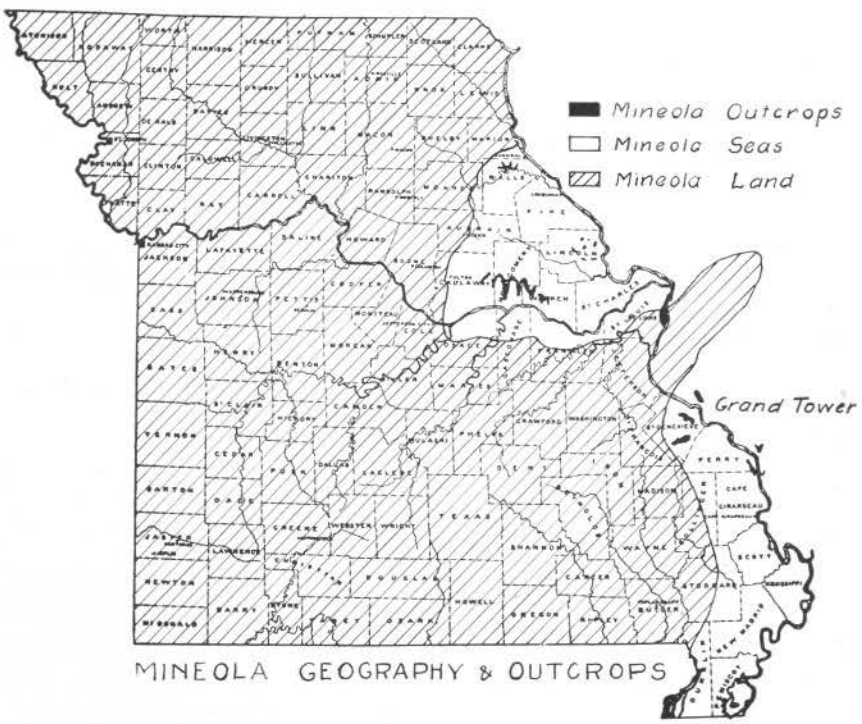
Mantle rock	2 feet
Mineola:	
White limestone composed dominantly of corals and bryozoans	10 feet
White limestone having a great many fossils other than corals	4 feet
Brown limestone carrying crinoids in abundance	2 feet
Very hard brown limestone with few fossils	4 feet
Hard blue limestone	30 feet

The thick sections of limestone, much the same from one township to another, indicate the original extent of the formation. The remnants covered by the Mississippian seas were of very limited extent and the upper Devonian seas did not extend into Ralls County.

In a bulletin of the Geology of Missouri the writer placed the southern boundary south of the Missouri River but later investi-



COOPER GEOGRAPHY & OUTCROPS



MINEOLA GEOGRAPHY & OUTCROPS

gations have shown the absence, or extreme patchiness, of the formation in the outcrops nearest the river on the north. These outcrops are as near the river as 5 miles in only a few places. There are few outcrops of rocks as young as the Mineola south of the river west of Franklin County and east of Moniteau County. Mineola may have been present south of the river, originally, but the distribution of the rocks north of the river renders this improbable. At the place where the outcrops of Devonian and younger rocks cross the river no Devonian occurs in the section and Devonian does not come in again for about eighty miles.

The small amount of clastic material at the base of the Mineola indicates weathering so complete as to reduce all residue to such fine particles that the advancing seas removed them to the deeper waters. The limestones and dolomites exposed to weathering contained few impurities and there were no shales and little sandstone exposed in central Missouri. The surface on which the limestone was deposited contained no deep valleys and no caves, indicating that it had been eroded to near sea level. The yellow sandy basal phase contains large numbers of crinoids and few corals indicating water of considerable depth.

Conditions under which the Mineola and Cooper were deposited seem to have been almost identical and the barrier between the two seas must have been a low divide between wide shallow bays. The Cooper bay must have extended to the west, north or northwest and the Mineola to the northeast, as otherwise the latter would have merged with the former and some of the fossils in the two formations would have been of the same species.

The withdrawal of the Cooper and Mineola seas may have been due either to lowering of the sea level or uplift of the land. It was probably the latter as the seas came together farther north very shortly after the close of Mineola time. Though the formations were widely eroded and completely removed over wide areas no deep valleys were produced by the post-Mineola—pre-Callaway erosion and the lands must have remained very low.

Paleontology.—The Mineola is irregular in the amount of fossil contents. Some of the members are practically made up of fossils while others are barren. The crinoidal phase mentioned in the description is the most fossiliferous.

The following is a list of all of the identifiable fossils known to the writer. Fragments indicate the presence of nearly as many more species. The crinoids and corals are represented by many more species but it is difficult to get satisfactory descriptive materials.

LIST OF SPECIES FROM THE MINEOLA LIMESTONE

Coelenterata
- *Acervularia davidsoni* Edwards and Haime (r)
- *Ceratopora grabaui* Branson (r)
- *Favosites alpenensis* Winchell (c)

Crinoidea
- *Megistocrinus broadheadi* Branson (r)
- *Megistocrinus mineolaensis* Branson (r)
- *Megistocrinus missouriensis* Branson (r)
- *Stereocrinus moori* Branson (c)
- *Stereocrinus springeri* Branson (c)
- *Stereocrinus vandiveri* Branson (c)

Blastoidea
- *Nucleocrinus verneuili* (Troost) (r)

Bryozoa
- *Coscinium missouriensis* Branson (r)
- *Cyclotrypa communis* Ulrich (c)
- *Cyclotrypa magna-monticulata* Branson (r)
- *Cystodictya mineolaensis* Branson (r)
- *Fenestella missouriensis* Branson (r)
- *Hemitrypa mineolaensis* Branson (c)

Brachiopoda
- *Athyris vittata* Hall (a)
- *Atrypa reticularis* (Linnaeus) (c)
- *Cranaena romingeri* (Hall) (c)
- *Cyrtina hamiltonensis* Hall (c)
- *Eunella lincklaeni* (Hall) (a)
- *Gypidula mineolaensis* Branson (r)
- *Pentamerella arata* (Conrad) (a)
- *Pholidostrophia iowaensis* (Owen) (r)
- *Productella spinulicosta* Hall (r)
- *Pugnoides swallovi* Branson (r)
- *Reticularia fimbriata* (Conrad) (r)
- *Schizophoria cf. propinqua* (Hall) (r)
- *Schuchertella cf. pandora* (Billings) (r)
- *Spirifer euryteines* Owen (r)
- *Spirifer subvaricosus* Hall and Whitfield (r)
- *Spirifer varicosus* Hall (c)
- *Stropheodonta demissa* (Conrad) (c)
- *Stropheodonta inequiradiata* Hall (r)
- *Stropheodonta mineolaensis* Branson (r)
- *Syringothyris* n. sp. Branson (r)

Pelecypoda
- *Conocardium ohioense* (Meek)

Gastropoda
- *Euryzone lucina* (Hall) (r)
- *Euryzone mineolaensis* Branson (r)
- *Platyceras cf. calantica* Hall (r)
- *Platyceras carinatum* Hall (r)
- *Platyceras conicum* Hall (r)
- *Platyceras cf. erectum* Hall (r)
- *Platyceras cf. nodosum* Conrad (r)
- *Pleurotomaria* sp. undet. (r)

Cephalopoda
- *Gomphoceras* sp. undet. (r)

Trilobita
- *Proetus crassimarginatus* Hall (r)

Pisces
- *Dinichthys pustulosus* Eastman (r)
- *Ptyctodus calceolus* (Newberry and Worthen) (c)
- Unidentified fish remains. (r)

The dominant species in Central Missouri are *Eunella lincklaeni* (Hall) and *Pentamerella arata* (Conrad). *Athyris vittata* (Hall), *Hemitrypa mineolaensis* Branson, *Cyrtina hamiltonensis* Hall, and *Spirifer varicosus* Hall are important members of the fauna but are far less abundant than the first two species listed. In the crinoidal member various species of *Megistocrinus* and *Stereocrinus* are abundant but nearly all of the heads are exfoliated and specific identifications are impossible. The crinoids are easily dominant in the crinoidal member.

In northeastern Missouri, Ralls County, the fauna is more varied. *Spirifer subvaricosus* Hall and Whitfield, *Cranaena romingeri* (Hall), three species of *Stereocrinus*, *Acervularia davidsoni* Edwards and Haime, *Favosites alpenensis* Winchell, and *Ptyctodus calceolus* (Newberry and Worthen) are common forms. An unidentified stromatoporoid is abundant in the Ralls County fauna. The corals are restricted to rather definite members of which the most important is the lowest member of the section near Spalding.

In Central Missouri several species of platyceras-like gastropods are present but they are not abundant. *Nucleocrinus verneuili* (Troost) was collected from only two localities, both of which are in Montgomery County, the New Florence locality and the Big Springs locality. The specimens came from near the bottom of the formation.

Correlation.—The fossil content and relationships of the Mineola indicate its correlation with the Onondaga of Illinois, Indiana and eastward.

The correlation with Onondaga is made mainly on the basis of the aspect of the fauna. Remains of *Eunella lincklaeni* (Hall), *Pentamerella arata* (Conrad), and *Athyris vittata* Hall, constitute the larger part of the fossils in Central Missouri. None of these species has very positive characters for identification purposes and the last two are of little value on account of their range. The species give general character to the fauna.

Associated with the abundant branchiopods is a large number of species of platyceras-like gastropods, recalling Onondaga faunas.

Nucleocrinus verneuili (Troost) is rare but it emphasizes the relationship to the Onondaga.

The number of species of bryozoans makes the fauna distinct from any other in Iowa and Missouri. The only species of value for correlation purposes is *Cyclotrypa communis* Ulrich, which is from the so-called Hamilton of Buffalo, Iowa, and Rock Island, Illinois.

The presence of such species as *Spirifer varicosus* Hall, *Productella spinulicosta* Hall, *Schizophoria propinqua* (Hall), and *Stropheodonta inequiradiata* Hall indicates Onondaga rather than later time but these species are rare and some of the identifications are uncertaion.

The absences are almost as significant as the fossils actually present. Not one of the standard list of Hamilton species as

given by Williams is present in the fauna, but this is also true of the overlying Callaway limestone which is supposed to be Hamilton in age. However all of the Mineola species were immigrants or developed from immigrants. If this immigration came in Hamilton time some of the standard list should have come with the others. At least 6 of the standard New York list came into southeastern Missouri in Hamilton time and with an eastern connection assured they should also have come to Central Missouri. The eastward connection must have come in Onondaga time but assuming that to be true there are some remarkable absences. *Spirifer acuminatus* (Conrad), *Spirifer gregarius* Clapp, and *Stropheodonta concava* Hall are some of the characteristic Onondaga species which are not present or have not been found.

Summary.—

1. Many species are common to the Onondaga of Indiana and eastward and the Mineola of Missouri.
2. The dominant species of the Mineola are Onondaga species.
3. The fauna contains none of the dominant Hamilton species.
4. Only two of the dominant species of the Mineola are present in other Devonian formations west of the Mississippi River.
5. The Mineola lies unconformably below the Callaway which is definitely correlated with the Hamilton.

CALLAWAY LIMESTONE

Historical.—Keyes[1] first used the term "Callaway limestone" but included two formations in his brief description which reads as follows: "In southeastern Missouri, rocks containing the typical fauna of the Western Hamilton are sparingly represented in Perry and Cape Girardeau counties, in connection with the limestones above mentioned (Grand Tower Limestone). In this region the limestones belonging to this group are dark colored shaly rocks, quite different from the associated strata.

North of the Ozark uplift the Devonian rocks referred to the Hamilton extend westward along the Missouri River as far as Jefferson City, having their most typical development in Calla-

[1]Geol. Surv. Mo., vol IV, 1894, p. 43.

way County. In several places abundant fossils of this formation have been obtained from strata having lithological characters not very unlike the beds of the eastern Ozark region referred to the same age."

Greger[1] called attention to Keyes' misuse of the term as follows: "If the writer (Keyes) means to apply the name Callaway limestone to the strata 'having their most typical development in Callaway county' he would likewise include beds in Perry and Cape Girardeau counties, which to our knowledge contain an entirely distinct assemblage of fossils, a fauna in fact intimately related to the southern Illinois Devonian."

The first mention of Devonian formations in Missouri was made by Owen[2] in 1852 as follows: "In Missouri this formation (Devonian of the same age as in Iowa) was traced, reappearing for a very limited space in the valley of the Auxvasse in Callaway County, skirting for a short distance one of the southern promontories of the Iowa and Missouri coal-field, in close proximity to the great uplift of magnesian limestone, of Silurian date, in the same vicinity. It has, probably, a considerably greater range in this locality than here ascertained and laid down by me."

In 1855 Swallow[3] mentioned the occurrence of rocks that are undoubtedly Callaway in Callaway County on Cedar Creek. He called these rocks Onondaga. In the same year Meek[4] identified rocks of the Callaway in Moniteau County and called them Onondaga, with no differentation from the Cooper limestone on which they rest.

In 1860 Swallow[5] described several species of fossils from the Callaway and Snyder Creek of Callaway County. No illustrations accompanied the descriptions and as the types were later destroyed by fire when the museum of the University of Missouri burned, many of Swallow's names cannot be used.

In 1873 Broadhead[6] described the Devonian of Warren County as quoted in the description of the Mineola on page 15. He recognized the presence of more than one formation but identified the Callaway as lower Devonian in some places and as Hamilton in others, and did not differentiate between Mineola

[1]Am. Jour. Sci., vol. XXVII, pp. 374-375, May, 1909.
[2]Geol. Surv. of Wis., Ia., and Minn., 1852, p. 81.
[3]Geol. Surv. Mo., I and II, Reports, p. 107.
[4]Ibid., pp. 103-105.
[5]St. Louis Acad. Sci., vol. I, pp. 635-660.
[6]Geol. Surv. Mo., 1855-71, pp. 46-48.

and Callaway in most places. He also included the Sylamore with the Devonian and called it "The old Red Sandstone." (The Sylamore is the basal formation of the Mississippian.)

Lithology.—The Callaway limestone presents various rather strongly contrasted phases but is much the same lithologically from place to place. Its thickest parts consist of light to dark blue compact fine-grained limestone, in many places highly fossiliferous. The limestone is relatively free from impurities.

A light to dark-brown compact limestone is usually present in from one to three or four thin beds, with a total thickness in most places of less than 6 feet. Some of these beds are highly fossiliferous.

A third phase of the Callaway consists of white to gray coarsely to finely crystalline limestone, in many places highly fossiliferous. The crystalline phase occurs in one to three or four lentils and the lentils range from 6 inches to three or four feet thick.

At many places a sandstone, ranging up to ten feet thick, and often highly cross-bedded, occurs at the bottom of the formation. The bottom limestones, where the sandstone is absent, are often sandy, and sandstone lenses are not uncommon near the bottom. In eastern Moniteau County more than twenty feet of cross-bedded sandstone makes up most of the formation.

Much of the Callaway is highly fossiliferous and the entire rock in some places is composed of fossils. One thousand specimens of *Atrypa reticularis* (Linnaeus) were counted in ten pounds of average weathered material.

The maximum thickness of the Callaway is about fifty feet and it averages 30 to 40 feet through Callaway and Montgomery counties. It is very irregular in thickness, owing to its having been deposited on an eroded surface and its upper surface having been deeply eroded in pre-Mississippian time. It is absent in many places short distances from where it is best developed.

Exposures in Moniteau County.—The westernmost outcrops of the Callaway are in the bluffs of the Missouri River near Lupus in Moniteau County, and it dips under northward about two miles north of Lupus. Westward it dips under, but its horizon reappears a few miles west with no Callaway present.

The most striking feature of the formation in Moniteau County is a thick sandstone that resembles the St. Peter. This

appears in the first bluff north of Lupus, about half a mile from the railway station. Overlying the sandstone the granular limestone phase, some 6 to 8 feet in thickness, caps the bluff.

Exposures in Boone County.—In the bluffs of the Missouri River in western Boone County the Callaway is extremely patchy and occurs in only a few isolated localities. One of these is about half way between the villages of Providence and Easley where a granular phase bearing large numbers of *Atrypa reticularis* (Linnaeus) fills an old valley in the Cooper. (See Plate 4, figure a.) Railway excavations have left the contact well exposed. At the eastern end of the exposure the Callaway is one inch thick and gradually thickens westward to three feet. Within fifty feet the outcrops are covered with talus and where the horizon reappears less than a quarter of a mile west, no Callaway is present. One mile west of this place the horizon dips under and does not reappear to the northward on the east side of the river.

South of the outcrop mentioned above the writer has not identified with certainty any outcrop of Callaway for about twenty miles. The Cooper occurs, a few feet thick, and it is impossible to differentiate positively between Cooper and Callaway owing to the absence of fossils. However, this absence of fossils indicates that the rocks are Cooper.

Cedar Creek forms the eastern boundary of Boone County and the Callaway is well developed and continuous for about fifteen miles along the creek, ranging up to forty feet in thickness. All of its various phases are present from top to bottom. It rests in most places on the Jefferson City with marked nonconformity but in a few places it lies on the St. Peter, where patches of the latter are present. It is succeeded by the Sylamore sandstone, though this cannot be observed in every outcrop, owing to its having a thickness of less than one foot and weathering very readily to a sandy soil. In some places the Chouteau limestone may rest directly on the Callaway.

Exposures in Callaway County.—From Cedar Creek eastward through Callaway County the Callaway has its best development and is ordinarily forty to fifty feet thick. The appended list of sections is of typical occurrences. It dips under northward about twenty miles north of the Missouri River in Callaway County, and its northward extent is unknown. A few scattered outcrops in northern Cole County demonstrate, its former extent southward. South of the Missouri River in

the longitude of the Callaway outcrops all strata younger than lower Ordovician have been removed by erosion, excepting the patches referred to in Cole County.

Section of the Callaway limestone, about 3 miles north of Williamsburg, Callaway County, N. W. ¼, Sec. 10, T. 48 N., R. 7 W.

		Feet.	inches.
	Pennsylvanian shales on Callaway limestone.		
1.	Dark blue limestone, finely crystalline	2	
2.	Dense, compact, fine-grained, dark gray limestone. Appears to be made up of light gray and dark bluish gray spots on freshly broken surfaces. Contains *Favosites limitaris* Rominger in great numbers. May well be called the *Favosites limitaris* zone	5	11
3.	Variegated red, yellow, blue compact thin-bedded limestone. Weathers yellow	2	9
4.	Dense dark-bluish-gray compact limestone bears *Diplophyllum callawayensis* Branson and a Stromatoporoid in abundance	3	3
5.	Dense dark-bluish-gray compact limestone bears *Diplophyllum callawayensis* Branson in abundance	2	3
6.	Dark bluish-gray compact limestone more coarsely crystalline than No. 7	2	10
7.	Dense dark bluish-gray limestone in beds 4″ to 6″ thick. About two feet from the top a gray crinoidal bed, about 6″ thick, that looks like concrete. Fossils rare	13	6
8.	Covered. Seems to be alternating one-inch to four-inch beds of shale and limestone, yellow in color	4	
9.	Yellow with red streaks, variegated limestone, very hard, compact, fine-grained		6
10.	Compact fine-grained bluish-gray nodular-looking limestone. Few fossils	1	11
11.	Medium gray, coarsely crystalline, crinoidal limestone. Contains numerous small, smooth *Atrypa reticularis* (Linnaeus). The color is somewhat darker than No. 15	8	
12.	Yellow with dark red streaks, compact shaly limestone. No fossils observed	3	
13.	Medium gray to dull reddish gray, coarsely crystalline, crinoidal limestone. No indentifiable fossils observed		10
14.	Yellow with dark red streaks compact shaly limestone. No fossils observed		3
15.	Medium gray, coarsely crystalline, crinoidal limestone. Numerous iron nodules 1/16 to 1/4-inch in diameter. No identifiable fossils collected	1	7
	Total	52	7

This is the thickest section of Callaway measured by the writer. The measurements are not exact as the rocks are somewhat irregular in their bedding and the places of measurement were not good. Several well marked Callaway beds are not present in the section or do not bear the usual fossils. The *Acervularia davidsoni* member is the best marked absentee. The section was made along a steep wagon road without examination along the strike to discover weathered sections and fossils.

The Callaway rests on the Plattin near this section. Along the road where the description was made the underlying rock is too much weathered for identification.

Fourteen miles southwest of the Williamsburg section, the Callaway is only 22 feet thick unless the two lower members should be included with the Callaway instead of with the Mineola. The only basis for calling this Mineola is a bryozoan which seems to be *Hemitrypa mineolaensis* Branson. The identification is uncertain.

Section of the Callaway Limestone on Cow Creek.

S. W. ¼ Sec. 22. T. 47 N., R. 8 W.

	Feet.	Inches.
Burlington limestone, brown at bottom.		
Sylamore sandstone	1 ±	
Snyder Creek shale	50 ±	
Callaway limestone.		
Dark-blue, dense fine-grained, hackly limestone. Almost non-fossiliferous. Thickness measured	22	
Practically uniform. The top may be five or six feet above the exposed top.		
Mineola formation.		
Massive sandy limestone, dark drab, a three-foot bed at top	5	5
Gray to dark-brown sandstone, in massive to thin beds	7	6

This lies nonconformably on Jefferson City dolomite.

Exposures in Montgomery County.—The Callaway is well developed through most of Montgomery County and is lacking in only a few places. In the western part of the county it ranges from 30 to 50 feet thick but gradually thins and becomes patchy towards the eastern part. Descriptions for Callaway County are applicable to Montgomery. In Sec. 31, T. 48 N., R. 5 W., about the middle of the county, Chouteau rests directly on the Callaway and the Callaway appears as follows.

	Thickness.
Gray granular crinoidal limestone bearing many bryozoans and corals	5′
Mainly bluish-gray limestone weathering to thin beds; often crossbedded	22′
Compact dark-bluish-gray limestone bearing *Cranaena iowensis* (Calvin) in abundance at the top	6′
Gray granular limestone weathering to brown. About 10 feet from the bottom it bears large numbers of *Cyrtina missouriensis* (Swallow). Beds more finely granular near the top, highly crinoidal	17′
Total thickness	50′

In eastern Montgomery County near the mouth of Whippoorwill Creek in Secs. 16, 17, 20 and 21, T. 47 N., R. 5 W., Callaway is absent and in most places Sylamore sandstone rests on Plattin limestone, though Mineola is present in patches.

Exposures in Warren County.—In western Warren County the Callaway is much the same as in Callaway County though it is absent in many places. The following section which occurs on South Bear Creek, in the NW. ¼ Sec. 29, T. 47 N., R. 4 W., is typical.

		Thickness	
1.	Compact, dirty-bluish-gray limestone bearing large *Atrypa reticularis* (Linnaeus)	2′	
2.	Crystalline bluish-gray limestone, non-fossiliferous	2′	
3 and 4.	Compact, very resistant light-bluish to pinkish gray limestone. Weathers into rounded knobs with deep holes between. Carries *Cranaena iowensis* (Calvin) and corals	15′	
5.	Compact light-blue limestone, weathering to yellowish-brown. Bears many simple corals	1′	6″
6.	Light-gray compact fine-grained limestone bearing many small *Atrypa reticularis* (Linnaeus)	2′	6″
7.	Compact dark-blue limestone weathering to yellow. Bears small *A. reticularis* (Linnaeus) in abundance	4′	
8.	White to light-gray to dark-gray finely crystalline limestone, highly crinoidal	5′	
9.	Grayish brown finely crystalline limestone; finer crystals than in 8	2′	
10.	Dark-gray granular limestone bearing abundant large *A. reticularis* (Linnaeus) and many *Stropheodonta demissa* (Conrad)	2′	
11.	White to light-gray coarsely crystalline limestone bearing large *A. reticularis* (Linnaeus)	1′	2″
12.	Like number 10	2′	
	Total thickness	39′	2″

In this section Chouteau lies unconformably on the Callaway and the Callaway is unconformable on the Plattin.

One mile east of last location the Devonian is 13½ feet thick. The following is a section in Sec. 27, T. 47 N., R. 4 W.

	Unconformable Callaway-Chouteau Contact.	Feet.
1.	Crystalline, crinoidal limestone, dark blue, coralline	3½
2.	Compact bluish-gray limestone bearing *Acervularia davidsoni* Edwards and Haime	1
3.	White, highly crinoidal limestone	7½
4.	Mottled brownish crystalline limestone	1
5.	Light brown compact partly crystalline limestone	½
	Unconformable contact with Plattin limestone.	

Two miles southeast of the above section no Devonian is present but four miles south the Callaway is more than ten feet thick.

The Callaway pinches out to the east and is absent west of Dry Fork of Charette Creek, excepting in sec. 8, T. 46 N., R. 2 W. where some float, identified as Callaway, occurs. Two miles west of this place, in sections 12 and 13 of range 3, are three Callaway outcrops, but the total thickness of the formation is not more than five feet.

The Callaway occurs only in patches in Warren County between Masses Creek and Charette Creek and it is not probable that many patches will be found east of Charette Creek. Owing to the variations in lithology and lack of fossils it is not always possible to determine whether an outcrop is of Callaway or Mineola.

Exposures in Ralls County.—In northwestern Ralls County, Secs. 10, 11, 14, 15, 20, 25, 26, 28, 29, 32 and 33, T. 56 N., R. 6

W., Callaway outcrops in patches. Its maximum thickness is about 40 feet, and occurs south of Shiel in section 20. In this section its contact with the Mineola is exposed on the roadside. It is a sandstone or a sandy limestone at the bottom and consists of alternating beds of sandstone and limestone. Twenty to thirty feet from the bottom a limestone bed is made up largely of *Acervularia davidsoni* Edwards and Haime and *Favosites* sp. undet. A sandy bed about ten feet from the bottom contains *Spirifer eurytеines* Owen, *Chonophyllum ellipticum* Hall and Whitfield, and *Atrypa reticularis* (Linnaeus) in abundance. The fossils are all silicified.

In the eastern part of section 29 about 80 feet of Devonian is exposed. The Callaway rests on the Mineola, and the two formations are of about equal thickness.

An unusual exposure occurs in section 33, about one mile south of the exposure in section 29. The Mineola consists of sharply truncated limestone and sandstone beds. The limestone seems to have been pushed over the sandstone when the folding took place. See Plate D, fig. b.

Exposures in Pike County.—In southeastern Pike County, near Paynesville, Rowley has mapped several patches of Devonian that seem to be Callaway though the identification is uncertain. They may be Mineola. *Spirifer eurytеines* Owen is common in the beds. The writer has not studied the outcrops.

Exposures in Lincoln County.—In a belt extending from Winfield northwestward to near Briscoe, Devonian occurs in small outliers and most of it seems to be Callaway. It outcrops in the bluffs of the Mississippi west of the railroad about one mile north of Winfield and its outcrops were examined in four other places between there and Briscoe. It is absent more frequently than present in this area. The rocks have a monoclinal dip ranging from 25 degrees to 80 degrees and a thick section is exposed along the belt which has been truncated by erosion. In most places basal Mississippian rests on the Maquoketa shale of the Upper Ordovician but here and there the Devonian, ranging up to 20 feet thick, comes in between.

The best section studied is in Sec. 34, T. 50 N., R. 1 E, on Bobs Creek. At this place it rests disconformably on the Maquoketa shale and is overlain disconformably by the Grassy Creek shale of basal Mississippian.

		Feet.	Inches.
	Grassy Creek shale	38	
1.	Light gray sandy limestone bearing *Spirifer eurytcines* Owen, *Schizophoria striatula* (Schlotheim), *Atrypa reticularis* (Linnaeus) and bryozoans in abundance	3	
2.	Brown sandy limestone in one prominent bed. Carries numerous *Chonophyllum ellipticum* Hall and Whitfield		9
3.	Brown sandy limestone, very cherty, weathers hackly and forms re-entrants. Highly fossiliferous	3	1
4.	Limestone like 3 but bears a great many *Chonophyllum ellipticum* Hall and Whitfield, which make it resistant	2	
5.	Like number 4 but not coralline		7
6.	Like number 4	1	3
7.	Like number 5	1	
8.	Like number 4	1	6
9.	Like number 5, but a bed at the bottom contains small black pebbles. Maquoketa shale.	2	3

Beds made up largely of *Chonophyllum ellipticum* Hall and Whitfield are characteristic of the Callaway in Lincoln County.

South of New Hope in Sec. 2, T. 50 N., R. 1 E., and in Sec. 7, T. 50 N., R. 2 E., patches of Callaway with silicified fossils like those at Shiel in Ralls County outcrop in the road but do not extend more than a quarter of a mile. Two miles northwest of Elsberry, in Sec. 18, T. 51 N., R. 2. E., an outcrop was found but in most places the Devonian is absent. *Atrypa reticularis* (Linnaeus) and *Spirifer eurytcines* Owen are abundant in this place.

The Callaway of Ralls, Pike, and Lincoln Counties is patchy and thin and its easternmost extent was near these outcrops.

Relationships to other Formations.—In western Callaway County the Callaway rests nonconformably on Jefferson City dolomite, and here and there on St. Peter, but in the easternmost five miles it rests in some places on Joachim of the Lower Ordovician, in others on Plattin of the Middle Ordovician, and in a few places on Mineola. The westernmost edges of the Plattin, Joachim, and Mineola are in the eastern part of the county. In Montgomery and Warren Counties it is nonconformable on Kimmswick limestone in a few places. In Lincoln County it is disconformable on Maquoketa shales, Kimmswick limestone, and Mineola limestone.

Though the Callaway rests on four formations ranging in age from Lower Ordovician to Devonian the surface on which it was deposited was a gently undulating plain. The bottom does not vary 200 feet in elevation in Boone, Callaway, Montgomery and Warren Counties. This seems the more remarkable on account of the Mineola representing lower Middle Devonian and the Callaway upper Middle Devonian. The Mineola also rested on a nearly level surface. It was probably not firmly

consolidated and on that account was easily eroded. The lack of muds in the botton of the Callaway indicates the erosion of a surface that was very completely weathered or consisted of unconsolidated limestones.

Over about one-third of its extent the Callaway is overlain unconformably by the Sylamore sandstone of the basal Mississippian. In most cases only a slight difference in dip between the Callaway and Sylamore is apparent, but in some cases the difference is as great as six degrees. In some places erosion had completely removed the Callaway before the Sylamore sea advanced, and the latter filled narrow valleys with their sides formed of Callaway and their bottoms of some older formation. On the whole, the surface over which the Sylamore sea advanced was a nearly level plain with shallow narrow young valleys dissecting it here and there.

Over perhaps one-fifth of its extent the Callaway is overlain conformably by the Snyder Creek shale. The amount of erosion suffered by the Upper Devonian before the advance of the Mississippian seas is indicated better by the Snyder Creek than by the Callaway.

In a few places Chouteau limestone is in contact, nonconformably, with the Callaway. In these places the Sylamore failed to be deposited. This relationship is exceedingly rare.

More common than the Chouteau-Callaway contact is the Burlington-Callaway contact. A considerable interval of erosion elapsed between Chouteau and Burlington time and in many places the Chouteau and Sylamore were completely removed and Burlington limestone was deposited on Callaway limestone.

In Sec. 21, T. 46 N., R. 10 W., on Little Murphy Creek, Pennsylvanian conglomerates of Cherokee age rest on Callaway, and this is not the only instance of the kind observed.

In Ralls County the Grassy Creek shales of the basal Mississippian are disconformable on the Callaway. In Lincoln County the Chouteau limestone rests on the Callaway where the Grassy Creek shales are absent.

The Callaway was slightly folded and subjected to erosion at the close of the Devonian; it was uplifted and those parts exposed subject to erosion in the interval between the Chouteau and Burlington; it again suffered erosion after the close of the Mississippian and before the advance of the Pennsylvanian seas; and parts of it have been undergoing erosion from the close of the Pennsylvanian to the present.

Paleontology.—So many members of the Callaway bear large numbers of fossils that the entire formation gives the impression of being fossiliferous, though some members are almost barren. The Callaway has decidedly different faunules in different members and at different localities though the assemblages have the same general aspects save where zones of corals appear.

Atrypa reticularis (Linnaeus) is responsible for the abundance of fossils in the Callaway. It is very abundant and highly varied in size and appearance.

Coelenterata.—Corals are abundant though only five species have been identified. *Acervularia davidsoni* Edwards and Haime is the most abundant. Some beds are almost completely composed of it. *Favosites limitaris* Rominger is as widely distributed as *A. davidsoni* Edwards and Haime but is by no means so abundant. *Favosites alpenensis* Winchell is common. An unidentified *Stromatopora* is common.

Crinoidea.—Crinoid stems and fragments of plates are abundant, but the writer has not seen an identifiable specimen of crinoid head. Greger[1] lists a species of *Megistocrinus* and one of *Melocrinus.*

Brachiopoda.—Brachiopods are the most important group and, as stated in an earlier paragraph, *Atrypa reticularis* (Linnaeus) is the most abundant species. · *Syringothyris occidentalis* (Swallow) is the most characteristic form as it is unknown in any other formation and is widely distributed though rare. It has long been known as the oldest of the genus and was the first described from the Devonian. An older form has been found in the Mineola. *Newberria missouriensis* Swallow is abundant in a member about six feet thick on Cedar Creek, about 20 miles southeast of Columbia. It has been collected, also, from near Lupus in Moniteau County, but the specimens are all badly broken in that locality. *Cyrtina missouriensis* (Swallow) is a characteristic form, readily distinguishable from *C. hamiltonensis* Hall by the plications on fold and sinus.

Pelecypoda and Gastropoda.—Pelecypods and gastropods are very rare. Only three species are known and *Paracyclas elliptica* Hall is the only species of which several specimens have been collected.

Pisces.—Fish remains are very rare and belong to only four or five species. Teeth of *Ptyctodus calceolus* Newberry and

[1]Am. Jour. Sci., vol. 27, p. 377.

Worthen are more numerous than other remains but in the best collecting localities one may collect for several days without finding a specimen.

The following is a list of all of the Callaway limestone species known to the writer.

Coelenterata
- *Acervularis davidsoni* Edwards and Haime (a)
- *Cyathophyllum halli* (Edwards and Haime) (r)
- *Diplophyllum callawayensis* Branson (r)
- *Favosites alpenensis* Winchell (c)
- *Favosities limitaris* Rominger (c)

Crinoidea
- Fragments of *Megistrocrinus ?* and *Stereocrinus ?* (c)

Brachiopoda
- *Athyris fultonensis* Swallow (a)
- *Atrypa reticularis* (Linnaeus) (a)
- *Cranaena iowensis* (Calvin) (a)
- *Crania famelica* Hall and Whitfield (r)
- *Cyrtina missouriensis* (Swallow) (c)
- *Leptaena rhomboidalis* (Wilckens) (r)
- *Martinia halli* Branson (r)
- *Newberria missouriensis* Swallow (r)
- *Pentamerella fultonensis* Branson (r)
- *Rhynchonella gregeri* Branson (r)
- *Schizophoria striatula* (Schlotheim) (c)
- *Spirifer aspèr* Hall (r)
- *Spirifer euryteines* Owen (c)
- *Stropheodonta demissa* (Conrad) (c)
- *Syringothyris occidentalis* (Swallow) (c)

Pelecypoda
- *Conocardium ohioense* Meek (r)
- *Paracyclas elliptica* Hall (c)

Gastropoda
- *Spiroraphe arata* (Hall) (r)

Pisces
- *Dipterus mordax* Eastman (r)
- *Ptyctodus calceolus* (Newberry and Worthen) (r)
- *Onychodus sigmoides* Newberry
- Unidentified fish remains (r)

Greger's[1] list includes *Pleurotomaria providensis* Broadhead which occurs only in the Cooper. At the time that Greger made his list the Cooper was supposed to be part of the Callaway. The *Stropheodonta costata* Owen of his list is the *S. demissa* (Conrad) of this paper, his *Spirifer iowaensis* Owen is *S. euryteines* Owen of this paper, his *Pentamerella dubia* Hall is *P. fultonensis* Branson of this paper. His *Pachyphyllum woodmani* White is not in the collections studied.

Correlation.—Of the 25 species identified from the Callaway, 11 occur in the Cedar Valley limestone of Iowa, and these are the most important forms. The following list is common to the two formations.

- *Acervularia davidsoni* Edwards and Haime
- *Cyathophyllum halli* (Edwards and Haime)
- *Favosities alpenensis* Winchell
- *Athyris fultonensis* Swallow
- *Atrypa reticularis* (Linnaeus)
- *Cranaena iowensis* (Calvin)
- *Schizophoria striatula* (Schlotheim)
- *Spirifer asper* Hall
- *Spirifer euryteines* Owen
- *Stropheodonta demissa* (Conrad)
- *Ptyctodus calceolus* (Newberry and Worthen)

[1]Am. Jour. Sci., vol. 27, p. 378.

Conocardium ohioense Meek and *Paracyclas elliptica* Hall lingered over from the Mineola and did not migrate to the Iowa seas during Callaway time. The western immigrants of the Cedar Valley fauna did not reach the Callaway area and the Callaway is more closely related to the eastern Devonian than the Cedar Valley is. The Callaway seas were, probably contemporaneous with the Cedar Valley seas and the two formations can be definitely correlated.

It is remarkable that the Callaway has none of the standard list of Hamilton species as given by Williams[1] while it contains many species that are present in eastern Hamilton formations. The central Missouri sea was connected with the eastern United States seas during Mineola and most of the Callaway species survived from the Mineola or developed from the Mineola species. The possible immigrants from the northwest by way of Iowa are *Spirifer asper* Hall, *Cranaena iowensis* (Calvin), and *Schizophoria striatula* (Schlotheim).

It seems probable that central Missouri was at the south end of a bay that extended southward from Iowa and that eastern Missouri was a land barrier which kept out eastern immigrants.

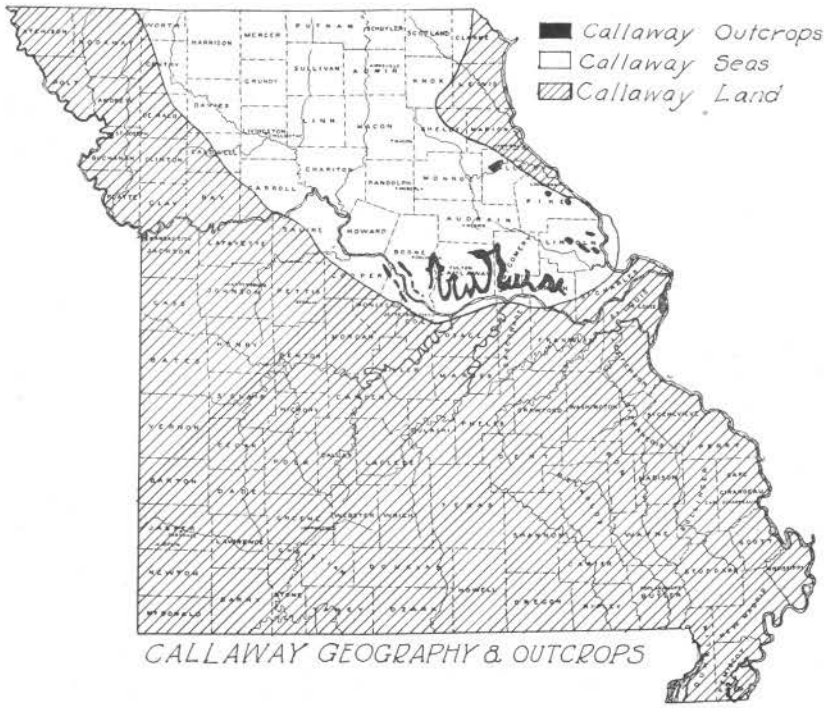
The Callaway is late Hamilton in age but may have been also, in part, contemporaneous with lower Tully.

THE SNYDER CREEK SHALE

Historical.—In Callaway and Montgomery counties the Callaway limestone is overlain by a shale and limestone formation ranging up to 63 feet in thickness. Gallaher first called attention to the formation in 1900 as follows: "Following immediately after the Hamilton limestone are the Snyder Creek Shales, another Devonian deposit which is limited almost exclusively to Callaway County. Plate 43 shows several important rocks, in their natural order of occurrence, but poorly developed."[2] The plate 43 is a photograph of the shales at their type locality on Craghead Creek.

Mr. D. K. Greger, who was Gallaher's assistant, probably called his attention to the shales. Keyes mentions the Snyder Creek shales in several places in his articles on Missouri geology, and in 1909 Greger[3] gave the following brief description of them: "Structurally the Craghead Creek shale is readily divisible into three members; the lower portion made up of dark blue and

[1] U. S. G. S., Bull. 210, p. 60.
[2] Missouri Geol. Surv., vol. 13, p. 153.
[3] Am. Jour. Sci., vol. 27, p. 375.



CALLAWAY GEOGRAPHY & OUTCROPS

SNYDER CREEK GEOGRAPHY & OUTCROPS

drab shale, with interbedded bands of shaly limestone, highly fossiliferous; the middle member consisting of a light drab, argillaceous limestone with few fossils, mostly remains of Crinoidea; the upper member consisting of a light gray, siliceous shale, this like the lower member being highly fossiliferous." South of Fulton about six miles the formation is about 25 feet thick. He lists 34 species of fossils and indicates the species that are common to the Craghead and the Lime Creek shale and Cedar Valley limestone of Iowa.

On account of the meagreness of Gallaher's description and the lack of a Snyder Creek on maps of Callaway County, the writer had used Craghead Creek in preference to Snyder Creek, but a communication from Mr. David White gives the opinion of the committee on nomenclature of the United States Geological Survey that Snyder Creek has the better standing. In the interest of harmony the writer is adopting the name Snyder Creek.

In 1860 Swallow[1] described several species of fossils from the Snyder Creek shale of Callaway County, but called the shales Hamilton.

Relationships and Distribution.—The Snyder Creek seems to be conformable on the Callaway and has not been found resting on any other formation. It varies greatly in thickness and its extent is decidedly patchy, the latter being due to erosion preceeding the advance of the Mississippian seas. Its entire extent is in Callaway and Montgomery counties and it probably is not greater than 200 square miles, while the area of outcrop probably does not exceed 50 square miles.

The Snyder Creek shale was deposited in a narrow bay which extended southward from Iowa but did not reach much south of the Missouri River and seems to have been less than 50 miles wide at the south end. Though the formation reaches a thickness of 63 feet or more it rarely exceeds 25 feet and in many places is less than 10 feet. The map of Callaway and Montgomery counties shows its extent as accurately as our methods of mapping allowed.

Greger called attention to the close relationship of the Snyder Creek fauna with those of the Lime Creek shale and Cedar Valley limestones of Iowa and the fossils listed and figured in this report emphasize the relationship with the Lime Creek

[1]St. Louis Acad. Sci., vol. 1, pp. 635-660.

shale; but close as it is, it does not warrant the reference of the formation to one of the Iowa formations. No rocks between Callaway County and the outcrops of the Lime Creek and Cedar Valley of Iowa are of the same age as the Snyder Creek and the gap is too large to bridge with present evidence.

The best outcrops of Snyder Creek shale are in Callaway County, but even in this region of best development the formation is absent over considerable areas. Its westernmost outcrops are near the Fulton branch of the Alton Railroad near New Bloomfield where the section is as follows.

Section along the road 1½ miles east of New Bloomfield:

	Feet.	Inches.
Burlington		
Brown limestone capped with weathered limestone.		
Unconformity		
Sylamore sandstone		
Blue and yellow shale		9
Green sandstone		6
Unconformity		
Snyder Creek shale		
1. White to buff, very fine-grained sandstone, in beds up to 8 inches thick which alternate with beds one to two inches thick of white sandy shale	5	
2. Brown to bluish-brown sandy shale which weathers to yellowish brown. Some limestone nodules. Shale not in thin layers. Exposure too imperfect for accurate description	15	
3. Nodular limestone interbedded with shale. All light gray weathering to light yellow. *Stromatopora solidula* Hall and Whitfield, *Athyris fultonensis* (Swallow), *Atrypa reticularis* (Linnaeus), *Spirifer annae* Swallow, *Cyrtina triquetra* Hall, *Stropheodonta demissa* (Conrad), *Stropheodonta boonensis* Swallow, *Zaphrentis* sp., *Paracyclas elliptica* Hall and *Pleurotomaria isaacsi* Hall and Whitfield are common fossils	15	
Total Snyder Creek	35	
Callaway limestone		
Dark-blue limestone	1	
Yellowish gray shaly limestone	12	

Snyder Creek shale at the type locality on Craghead Creek in SW¼ Sec. 17, T. 46 N., R. 9 W., six miles south of Fulton, Callaway County. The details were worked out by James S. Williams.

	Feet.	Inches.
Burlington limestone, gray crystalline limestone, which weathers to brown sandy texture, containing many crinoid stems; overlaid by brown sandy phase of Burlington	1	2
Sylamore sandstone:		
Greenish-brown friable sandstone		6
Hard dense light-gray to pink sandstone		3½
Snyder Creek shale:		
1. Yellowish-brown sandy shale, very light where not weathered	3	3
2. Drab to blue dense limy shale with several thin beds of shaly limestone, in part sandy, containing many large, coarsely plicated *Atrypa reticularis* (Linnaeus)	5	2
3. Covered	1	8
4. Blue to drab limy shale, somewhat sandy near top, containing several species of *Stropheodonta* in abundance	1	2

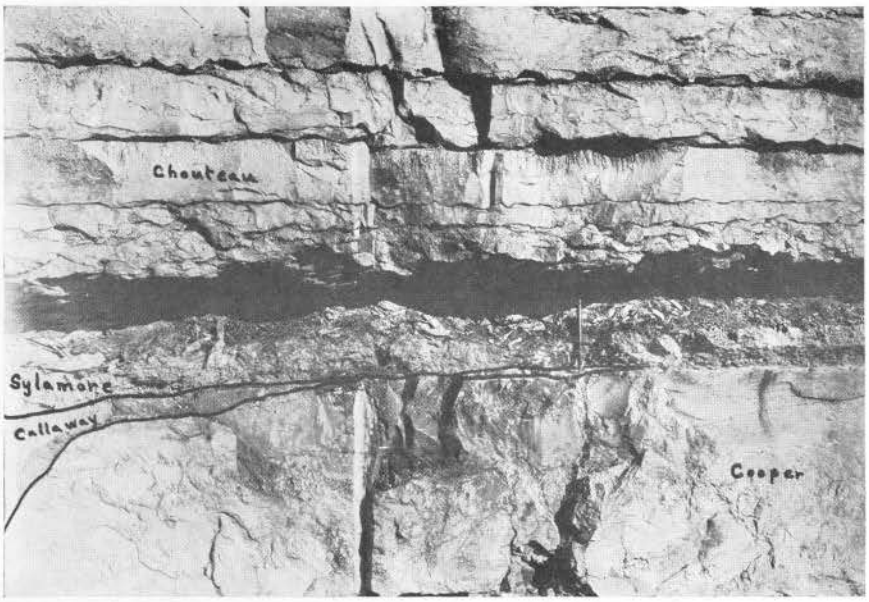


Fig. a. Devonian—Mississippian contact near Providence, Boone County.

Fig. b. Sylamore sandstone filling a cave in the Cooper limestone.

		Feet.	Inches.
5.	Dark blue to drab calcareous shale, abundantly fossiliferous, containing all Snyder Creek species of *Stropheodonta*	1	4
6.	Interval	3	
7.	Dark blue to drab calcareous shale, all of Snyder Creek *Stropheodonta* species abundant, *Lioclema occidens* (Hall and Whitfield) abundant	1	1
8.	Interval, covered	3	6
9.	Dark blue to drab calcareous shale, containing all of the Snyder Creek species of *Stropheodonta* in abundance and many large specimens of *Orthoceras*	2	7
	Total Snyder Creek measured	22	9

In this section it is impossible to determine the Snyder Creek-Callaway contact owing to the exposures being scattered for about one mile along the stream course. Below number 9 are thin beds of limestone and a sandstone which ranges up to five or six feet in thickness, but it was not determined whether the limestone and sandstone belong to the Callaway or Snyder Creek.

On Cow Creek, Sec. 23, T. 47 N., R. 8 W., the following section is exposed:

		Feet.	Inches.
Burlington			
	Brown limestone which grades above into weathered materials.		
Unconformity			
Sylamore sandstone			
	Green and brown sandstone	1	
Unconformity			
Snyder Creek shale			
1.	Brown sandy limestone	1	6
2.	Highly fossiliferous brown sandy limestone, containing a great many *Stropheodonta demissa* (Conrad)	1	
3.	Brown sandy, calcareous shale containing many *Spirifer euryteines* Owen near the bottom	4	
4.	Fossiliferous bluish-gray limestone, crowded with *Spirifer euryteines* Owen, *Stropheodontas* and *Schizophorias*		10
5.	Blue shale, not well bedded, yields many pelecypods	3	

The section is incomplete as number 5 ends in the bottom of the stream. About two miles down stream the shales are 50 feet thick, and the details of the shales at that place are given below:

COW CREEK SECTION OF THE SNYDER CREEK SHALE

The thickest section of Snyder Creek shale known to the writer is near the mouth of Cow Creek in Secs. 22 and 27, T. 47 N., R. 8 W. Owing to the nature of the shale the sections are not all exposed but almost complete sections were obtained by removing mantle rock from some surfaces.

	Feet.	Inches.
Burlington limestone, brown sandy phase	4	4
Sylamore, gray to brown and green sandstone	1	4
Snyder Creek shale.		
1. Brown sandstone grading to brown sandy limestone below. All very porous. Bears *Chonophyllum ellipticum* Hall and Whitfield, *Stropheodonta demissa* (Conrad), *Schizophoria striatula* (Schlotheim) and *Spirifer euryteines* Owen	1	10
2. Hackly thin-bedded, sandy limestone, drab, weathering to yellow.	1	3
3. Sandy limestone weathering into thin yellowish-brown layers. Original color brown. Crowded with *Schizophoria striatula* (Schlotheim)	1	4
(Almost 100 yards from the above the top 4′ 3″ is a rather homogeneous brown sandy limestone. In places crowded with *Chonophyllum ellipticum* Hall and Whitfield, *Stropheodonta demissa* (Conrad). At the top it grades without break into a green sandstone.)		
4. Mainly gray to brown shale, in some places greenish. A few very thin beds of sandstone	38	5
5. Limestone and shale interbedded, mainly limestone, drab to bluish-gray, 2 inches very compact fine-grained limestone at the top which weathers out in large slabs	4	6
6. Bluish-gray limey shale	2	6
Total Snyder Creek shale	49	10
Callaway, blue hackly limestone with very dark spots making up about half the mass.		

This section is about two miles west of the Cow Creek section given on page 39. Only the top of the Snyder Creek is exposed in the other section and the shales as described there are much like the number 4 of this section.

The New Bloomfield section as given on page 38 lacks the top part of this section.

The section on Craghead Creek as given on page 38 lacks all but the lower 23 feet of this section.

An isolated outcrop a few acres in extent is found north of Bluffton in Montgomery County. At this place the formation is about 20 feet thick and consists of purple limestone and shale. It rests on Callaway, which is only a few feet thick, and is overlain by the Burlington. Fossils occur in abundance, *Spirifer euryteines* Owen being particularly abundant.

On the Montgomery City-Danville road, four miles south of Montgomery City, a yellowish sandy shale, of which about 8 feet is exposed, outcrops west of the road on the south side of Smith's Branch, and this is the most easterly outcrop on the north margin of the Snyder Creek shale.

The most northerly outcrops are on Whetstone Creek, 7 miles northwest of Williamsburg, where the shales occur in only a few places and are not over 10 feet thick at any place.

The Snyder Creek shale is overlain unconformably by Sylamore sandstone over most of its extent, but Chouteau limestone, Burlington limestone, and Cherokee shale are occa-

sionally in contact with it. Its surface was deeply eroded before the earliest Mississippian seas advanced though the relief of the surface of the entire area over which it occurs was not greater than 150 feet. The Sylamore sandstone often fills valleys with sides of Snyder Creek shale and bottom of Callaway limestone or older rock. At the type locality, Sylamore, a few inches to 2 feet thick, is the overlying rock.

Paleontology.—Fossils are abundant in several members of the Snyder Creek shales but several members are not fossiliferous. The faunules are decidedly different at different localities and in different members at the same locality. *Stromatopora solidula* Hall and Whitfield seems to occur in only one member about 15 to 25 feet from the bottom. *Spirifer annae* Swallow is present in the same member and not below or above. *Lioclema occidens* (Hall and Whitfield) is abundant near the bottom and is rare above the middle. Pelecypods are abundant in the upper 15 feet. The following is a list of all of the indentifiable fossils from the Snyder Creek that the writer has seen. Greger's list[1], published in 1909, was preliminary. Several differences between that list and the present resulted from differences in identifications. Greger's species *Acervularia profunda* Hall, *Gypidula comis* Owen, and *Philhedra crenistriata* Hall, the writer has not seen.

LIST OF SPECIES FROM THE SNYDER CREEK SHALE

Coelenterata
- *Aulopora repens* Knorr and Walch (c)
- *Ceratopora snyderensis* Branson (r)
- *Chonophyllum ellipticum* Hall and Whitfield (a)

Hydrozoa
- *Stromatopora solidula* Hall and Whitfield (a)

Crinoidea
- *Dactylocrinus concavus* (Rowley) (r)
- *Melocrinus gregeri* Rowley (r)
- *Melocrinus lylii* Rowley (r)
- *Melocrinus tersus* Rowley (r)

Bryozoa
- *Lioclema occidens* (Hall and Whitfield) (a)
- *Rhombopora missouriensis* Branson (a)

Brachiopoda
- *Athyris fultonensis* (Swallow) (c)
- *Atrypa gregeri* Rowley (r)
- *Atrypa reticularis* (Linnaeus) (a)
- *Atrypa spinosa* Hall (a)
- *Camarotoechia depressa* Kindle (r)
- *Camarotoechia gregeri* Branson (r)
- *Cranaena calvini* (Hall and Whitfield (r)
- *Crania famelica* Hall and Whitfield (c)
- *Cyrtina triquetra* Hall (c)
- *Orbiculoidea* sp. (r)
- *Pentamerella missouriensis* Branson (r)
- *Productella callawayensis* (Swallow) (c)
- *Pugnoides altus* (Calvin) (r)
- *Schizophoria striatula* (Schlotheim) (a)
- *Schuchertella arctostriata* (Hall) (r)
- *Spirifer annae* Swallow (c)
- *Spirifer euryteines* Owen (a)
- *Stropheodonta boonensis* Swallow (a)
- *Stropheodonta callawayensis* Swallow (a)
- *Stropheodonta cymbiformis* Swallow (a)
- *Stropheodonta demissa* (Conrad) (a)
- *Stropheodonta equicostata* Swallow (a)

[1]Am. Jour. Sci., vol. 27, pp. 376-377.

Stropheodonta inflexa Swallow (c)
Stropheodonta navalis Swallow (c)
Strophonella crassa Rowley (r)
Vermes
Spirorbis omphaloides (Goldfuss) (c)
Pelecypoda
Clinopistha? rowleyi Branson (c)
Goniophora hamiltonensis (Hall) (r)
Grammysia elliptica Hall (r)
Modiomorpha missouriensis Branson (r)
Nucula cf. lirata (Conrad) (r)
Nucula snyderensis Branson (r)
Paracyclas elliptica Hall (a)
Paracyclas lirata (Conrad) (a)
Schizodus chemungensis (Conrad) (a)
Gastropoda
Bellerophon sp. (r)
Diaphorostoma snyderensis Branson (a)
Euomphalus cf. hecale Hall (r)
Pleurotomaria isaacsi Hall and Whitfield (c)
Cephalopoda
Cyrtoceras sp. undet. (r)
Nautilus lawsii Swallow (r)
Orthoceras atreus Hall (r)
Orthoceras sp. undet. (r)
Orthoceras sp. undet. (r)
Trilobita
Proetus crassimarginatus Hall (r)
Pisces
Glyptaspis sp. (r)
Ptyctodus calceolus (Newberry and Worthen) (c)
Ptyctodus ferox Eastman (r)

The most abundant species are: *Athyris fultonensis* (Swallow), *Lioclema occidens* (Hall and Whitfield), *Stropheodonta callawayensis* (Swallow), *Stropheodonta boonensis* (Swallow), *Stropheodonta equicostata* Swallow, *Stropheodonta demissa* (Conrad), *Schizophoria striatula* (Schlotheim), *Spirifer euryteines* Owen, *Stromatopora solidula* Hall and Whitfield, *Paracyclas elliptica* Hall, and *Chonophyllum ellipticum* Hall and Whitfield.

Four of the species came up from the Callaway and the others migrated into the Snyder Creek seas or originated there. The fauna is decidedly different from that of the Callaway though the Snyder Creek deposition was continuous with that of the Callaway. Several species, abundant in the Callaway, do not appear in the higher formation. Among these are *Acervularia davidsoni* Edwards and Haime, *Favosites alpenensis* Winchell, *Cyrtina missouriensis* (Swallow), *Craenena iowensis* (Calvin), and *Newberrya missouriensis* Swallow.

Anthozoa.—Two species of corals are abundant. *Aulopora repens* Knorr and Walch, an abundant form, is widespread in the Hamilton and Upper Devonian of eastern United States and is probably present in the Lime Creek of Iowa. *Chonophyllum ellipticum* Hall and Whitfield is very abundant. It occurs also in the Cedar Valley formation of Iowa and in the Upper Devonian of the Mackenzie Valley. *Ceratopora missouriensis* Branson, a rare species, is closely related to *Ceratoporas* of the eastern Hamilton and Onondaga.

Stromatoporoidea.—*Stromatopora solidula* Hall and Whitfield is a very abundant form, which occurs in no other formations save the Lime Creek of Iowa.

Crinoidea.—Crinoid remains are very rare. The species of *Melocrinus* are all distinctive, but they have been found in only one locality. No crinoid heads have been collected from the Callaway though the stems are abundant. *Melocrinus* may be present in the Callaway, though the stems and fragments suggest *Megistrocrinus* or *Dolatocrinus*. *Melocrinus gregeri* Rowley occurs in the Iowa Devonian and a thorough study of the crinoids from Iowa may show the presence of other Snyder Creek species.

Vermes.—*Spirorbis omphaloides* (Goldfuss) is the only worm identified in the faunas. It is found from bottom to top of the formation but is not abundant.

Bryozoa.—*Lioclema occidens* Hall and Whitfield is very abundant in one member in the lowest ten feet and ranges to the top of the formation. *Rhombopora missouriensis* Branson largely makes up one thin bed of limestone in the lowest ten feet of the formation.

Brachiopoda.—The brachiopod species are the most important in the faunas. Twenty-seven species have been identified. *Stropheodonta* is the most important genus. *Stropheodonta demissa* (Conrad) is present in the Mineola and Callaway and in the Snyder Creek it changes very rapidly, giving rise to six other species within ten feet of the bottom. The new species are abundant in 10 to 15 feet of strata, then dwindle in 10 to 15 feet of strata, and seem to be absent from the highest 20 feet. The variations are in the direction of longer hinge-line and shorter hinge-line; coarser plications and finer plications; great convexity and flatness; narrow umbo and broad umbo. Specimens are very abundant and show all phases of the variations.

After the stropheodonts *Spirifer euryteines* Owen is the most characteristic brachiopod. Near the top at the Cow Creek locality it is very abundant. *Schizophoria striatula* (Schlotheim) is as abundant as *Spirifer euryteines* Owen, but its wide distribution in other formations makes it less characteristic. *Cyrtina triquetra* Hall is common at the New Bloomfield locality in the bottom member but is rare in other places. *Spirifer annae* Hall is common in the same member as *C. triquetra* Hall. *Athyris fultonensis* Hall is common in many localities and abundant in some. *Atrypa reticularis* (Linnaeus) is one of the most abundant forms and has many varieties. *Spirifer asper* Hall is listed on the authority of D. K. Greger.[1]

[1]Am. Jour. Sci., vol. 27, p. 376.

Pelecypoda.—Pelecypods are abundant near the top of the formation, especially in the Cow Creek locality. *Paracyclas elliptica* Hall is the most abundant form. *Modiomorpha missouriensis* Branson and *Schizodus chemungensis* (Conrad) are also abundant. *Goniophora hamiltonensis* (Hall) is a significant form, though rare, on account of its occurrence in the Hamilton and Upper Devonian of the eastern part of the United States and Canada.

Below the upper fifteen feet of the formation pelecypods are rare.

Gastropoda.—*Diaphorostoma snyderensis* Branson is the only abundant gastropod and it is abundant in only two members of the lower half of the formation. *Pleurotomaria isaacsi* Hall and Whitfield is significant on account of its occurrence in both the Snyder Creek and Lime Creek formations.

Cephalopoda.—The cephalopods are too poorly preserved and rare to be a significant element in the funa.

Trilobita.—Only one specimen of trilobite, a pygidium, has been collected, and its identification is uncertain.

Pisces.—Fishes are generally rare. *Ptyctodus calceolus* Newberry and Worthen is a common form which ranges from Mineola to basal Mississippian in Missouri. Only two specimens of *Ptyctodus ferox* Eastman have been collected. *Glyptaspis* is too fragmentary to be identified specifically and only one specimen has been collected. Fragments of three or four other species of dinichthyids have been collected.

Correlation.—The Snyder Creek faunas indicate a more or less isolated sea during most of the epoch. One of the closest relationships of the fauna is with the Lime Creek faunas of Iowa. Fenton[1] lists about 100 identified species from the Lime Creek and only 12 of these occur in the Snyder Creek. 53 species have been identified from the Snyder Creek and 12 of these occur in the Lime Creek.

Lioclema occidens (Hall and Whitfield) and *Stromatopora solidula* Hall and Whitfield form the closest tie between the Lime Creek and Snyder Creek as both are abundant forms that occur in no other formations. *Chonophyllum ellipticum* Hall and Whitfield also is confined to the two formations.

The following is a complete list of the species common to the two formations:

[1]Am. Midland Naturalist, vol. 6, pp. 188-197.

Chonophyllum ellipticum Hall and Whitfield
Stromatopora solidula Hall and Whitfield
Spirorbis omphaloides (Goldfuss)
Lioclema occidens (Hall and Whitfield)
Crania famelica Hall and Whitfield
Schizophoria striatula (Schlotheim)
Pugnoides altus (Calvin)
Cranaena calvini (Hall and Whitfield)
Atrypa reticularis (Linnaeus)
Atrypa spinosa Hall
Paracyclas elliptica Hall
Ptyctodus calceolus Newberry and Worthen

The Iowa fauna is characterized by an abundance of significant spirifers and none of these is in the Snyder Creek shale. The Snyder Creek fauna is peculiar on account of its large variety of stropheodonts, none of the new species of which occurs in the Lime Creek. The Snyder Creek sea and Lime Creek sea were probably contemporaneous but were not directly or continuously connected.

Eleven of the Snyder Creek species are found in the Milwaukee formation of Wisconsin. The following are the species as listed by Cleland.[1]

Aulopora repens Knorr and Walch
Spirorbis omphaloides (Goldfuss)
Atrypa reticularis (Linnaeus)
Athyris fultonensis (Swallow)
Spirifer euryteines Owen
Spirifer asper Hall
Schizophoria striatula (Schlotheim)
Nucula lirata (Conrad)
Paracyclas elliptica Hall
Paracyclas lirata (Conrad)
Ptyctodus calceolus (Newberry and Worthen).

Cleland correlates the Milwaukee formation with the Hamilton of New York.

The seven Snyder Creek species in the following list are given by Whiteaves from the Devonian of the Mackenzie River.[2]

Atrypa reticularis (Linnaeus)
Aulopora repens Knorr and Walch
Chonophyllum ellipticum Hall and Witfield
Schizodus chemungensis (Conrad)
Schizophoria striatula (Schlotheim)
Spirorbis omphaloides (Goldfuss)
Stropheodonta demissa (Conrad)

Euomphalus inops Hall of the Mackenzie region may be the same as the Snyder Creek *Euomphalus hecale* Hall.

Thirteen of the Snyder Creek species are listed by Stauffer,[3] from the Hamilton of Ontario, but none of these is significant for correlation purposes.

Nine of the Snyder Creek species are listed from the Upper Devonian of Maryland[4], and a larger number occurs in the Upper Devonian of New York but the relationship of the Snyder Creek

[1]Wisconsin Geol. Nat. Hist. Surv., Bull. 21, pp. 12-21.
[2]Contributions to Canadian Paleontology, vol. 1, pt. 3, pp. 250-251.
[3]Canada Geol. Surv., Memoir 34, pp. 229-237.
[4]Maryland Geol. Surv., Devonian, Middle and Upper.

fauna to any one Upper Devonian fauna of Eastern United States is not close.

The Snyder Creek fauna is, largely, a development from the Callaway fauna which preceeded it and which lacked most of the Eastern Hamilton species. There is not an immigrant from the eastern seas in the fauna. The formation should probably be correlated with the Tully or Genessee of New York but the evidence of the fossils does not indicate one of these more than the other.

Geologic Column South of Fulton in Callaway County*

Pennsylvanian	Cherokee shales	100′
Mississippian	Burlington limestone	100′
	Sylamore sandstone	1′
Devonian	Snyder Creek shale	40′
	Callaway limestone	40′
Ordovician	Jefferson City dolomite	380′
	Not exposed below the middle of the Jefferson City.	
	Roubidoux sandstone	150′
	Gasconade dolomite	225′
	Proctor dolomite	75′
	Potosi dolomite	150′
Cambrian	Elvins	75′
	Bonneterre	150′
	Lamotte	150′

Pre-Cambrian granite and prophyry.

Geologic Column in Northwestern Ralls County, Missouri†

Pennsylvanian	Cherokee shales	100′
Mississippian	Salem limestone	20′
	Burlington limestone	120′
	Chouteau limestone	30′
	Hannibal shale	90′
	Louisiana limestone	50′
	Grassy Creek shale	20′
Devonian (Middle)	Callaway limestone	20′
	Mineola limestone	40′
Ordovician	Not exposed below the middle of the Kimmswick.	
	Kimmswick limestone, Plattin limestone	200′
(Middle)	Joachim dolomite	150′
	St. Peter sandstone	130′

*Thicknesses below Jefferson City generalized from well data and from exposures south of the Missouri River.

†Below the Kimmswick the data are generalized from St. Louis well logs. The total thickness to the top of the Lamotte is known at St. Louis, but the formation boundaries are arbitrarily placed.

(Lower)	Jefferson City dolomite	500′
	Roubidoux sandstone	200′
(Ozarkian)	Gasconade dolomite Proctor dolomite Potosi dolomite	600′
Cambrian	Elvins formation	75′
	Bonneterre dolomite	300′
	Lamotte sandstone	300′

DEVONIAN LOCALITIES

1. Craghead Creek, Callaway County, Mo. Sec. 17, T. 46 N., R. 9 W. Top of Snyder Creek shale.
2. Cow Creek, Callaway County, Mo. Sec. 25, T. 47 N., R. 8 W. Top of Snyder Creek shale.
3. New Bloomfield, Callaway County, Mo. Secs. 33 and 34, T. 46 N., R. 10 W. Snyder Creek shale.
4. Mouth of Cow Creek, Callaway County, Mo. S. E. ¼ sec. 22, T. 47 N., R. 8 W. Snyder Creek shale, Callaway limestone and Mineola limestone.
5. Near Montgomery City, Montgomery County, Mo. Sec. 11, T. 48 N., R. 6 W. Mineola limestone.
6. New Florence Region, 5 miles southwest of New Florence. Sec. 3, T. 47 N., R. 5 W. Mineola formation.
7. Big Springs location, 3 miles northwest of Big Springs, Montgomery County. Sec. 20, T. 47 N., R. 5 W.

DESCRIPTION OF SPECIES.

Several of the rarer forms from the Snyder Creek shale and Callaway limestone are not included in the following descriptions, a few forms from the Mineola are represented by specimens too imperfect for identification, and the Cooper material is too poorly represented to be satisfactorily treated.

The synonomy for the species of all groups excepting the brachiopods includes all descriptive articles. The brachiopod synonomy, for the most part, lists the article which contains the original description, articles giving important name changes, Schuchert's bulletin on the Brachiopoda, and the articles which have appeared since Schuchert's bulletin.

COELENTERATA

Class ANTHOZOA

Subclass Tetracoralla

Family Zaphrentidae

Genus Streptelasma Hall

Streptelasma cooperensis n. sp.

Plate 1, figures 6 and 7

Corallum simple, conical, slightly curved, pointed at the base Epitheca complete, showing longitudinal septal furrows. Largest specimen collected 8 cm. long, 34 mm. wide at the top: average size about 6 cm. long. Calyx with steep walls, depth about half the height of the corallum. Septae rather poorly developed in the calyx but well developed near the base of the corallite. 25 septae that reach nearly to the middle one centimeter from the base of an ordinary specimen; 33 septae 2 centimeters from the base with some indications of secondary septae; 41 primary septae 45 mm. from the base with a like number of short secondary septae. Dissepiments few and present only near the margin. Subcentral fossula 8 mm. wide and 10 mm. deep in specimens of ordinary size.

The calyx is completely filled with solid rock in all of our specimens and for that reason no figures of that part can be made. The species resembles *Streptelasma prolifica* Billings but the number of septae is much smaller and the secondary septae are not so well developed.

Occurrence—Abundant in the Callaway of Moniteau and Boone Counties; present in the Cooper of the same counties.

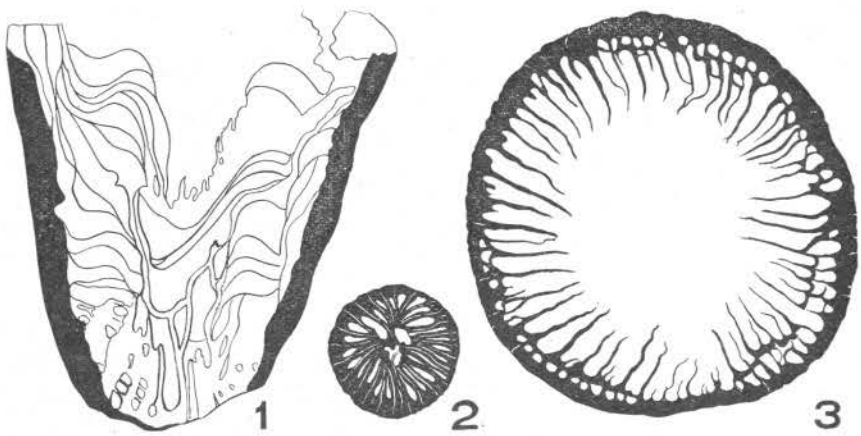


Fig. 1. Sections of *Streptelasma cooperensis* Branson.

1. A vertical section which retains only 1/3 of the cup. The basal part of the specimen is missing. (X3/2).
2. A cross section about two centimeters from the base. (X3/2)
3. A cross section about 6 centimeters from the base. (X3/2)

Family Cyathophyllidae

Genus Cyathophyllum Goldfuss

Cyathophyllum halli (Edwards and Haime)

Plate 1, figure 1.

1843. *Strombodes helianthoides?* Hall, Geol. of New York, pt. IV, p. 209, fig. 3.
1851. *Heliophyllum Halli* Milne-Edwards and Haime, Polyp. Foss. des Terr. Palaeoz., p. 408, pl. 7, figs. 6, 6a, 6b.
1853. *Heliophyllum Halli* Milne-Edwards and Haime, Brit. Foss. Corals, p. 235, pl. LI, fig. 3.
1859. *Heliophyllum Eriense, H. Cayugaense, H. Canadense, H. Halli* Billings, Canadian Journal, new series, vol. IV, pp. 124-126.
1873. *Heliophyllum Colbornense* Nicholson, Canadian Naturalist, new series, vol. VII, p. 143.
1874. *Heliophyllum Colbornense* Nicholson, Palaeon. of Ont., p. 25, pl. V, fig. 4.
1874. *Heliophyllum proliferum* Nicholson, Geological Magazine, new series, vol. I, p. 59.
1874. *Heliophyllum proliferum* Nicholson, Palaeon. of Ont., p. 27.
1876. *Cyathophyllum Halli* Rominger, Geol. Sur. Mich., Foss. Corals, p. 98, pl. XXXV.
1876. *Heliophyllum Halli, H. proliferum* Hall, Illus. Dev. Foss., pl. XXIII, figs. 1-5, 12, and pl. XXV, figs. 1-7, and pl. XXVI, figs. 1, 2, 5.
1883. *Heliophyllum halli* Hall, 12th. Ann. Rept., Indiana Dept. Geol. Nat. Hist., p. 259, pl. 6, fig. 1.
1885. *Cyathophyllum halli* Davis, Kentucky Fossil Corals, pl. 77, 92, figs. 2-3.
1899. *Cyathophyllum halli* Lambe, Cont. to Canadian Pal., vol. IV, pt. 1, p. 148.
1909. *Heliophyllum halli* Grabau and Shimer, North American Index Fossils, I, p. 68, fig. 102.
1911. *Heliophyllum halli* Cleland, Bull. 21, Wisconsin Geol. Nat. Hist. Surv., p. 28, pl. 1, fig. 5.

Lambe's description—"Corrallum simple or by prolific budding becoming aggregate, broadly or narrowly turbinate, conico-cylindrical or cylindrical, with many variations of these forms, straight, curved, twisted, or geniculated, frequently contracted above, generally exhibiting numerous annular constrictions and swellings, base small, pointed, the epitheca marked by numerous parallel rings of growth and striated longitudinally by distinct linear septal furrows or depressions; attaining a diameter of over 10 cent. and a length of about 30 cent. Increase by lateral calicinal gemmation, sometimes as many as eight or nine buds springing simultaneously in a circle from the sides of the calyx. Calyx with numerous modifications in shape, in the short coralla, generally rather shallow with broadly expanding, more or less reflexed margins, more inclined to become deep with steep sides in the elongate forms, the sides radially ribbed by the free denticulated edges of the septa that converge toward the bottom of the cup, where the longer ones either meet with straight or twisted ends, at times uniting to form a low boss, or falling short of the centre leave exposed a smooth surface formed by the upper tabulum. A narrow septal fossette is present in the cup. Septa of two orders, primaries and secondaries, the former passing to or almost to the centre, the latter reaching a little past half way, strongly carinated on their side faces, the carinae curving upward and inward from the wall, each corresponding pair forming, by their union on the free edges of the septa in the cup, a prominent tooth-like projection or short transverse rib: near the margin of the cup the difference in size between the primaries and secondaries is generally not recognizable. The distance apart of the carinae from each other is subject to considerable variation in different specimens and to a small extent in the same individuals, from four to twelve occurring in the space of 5 mm. The septa number from about sixty-eight to one hundred in specimens having a diameter of from 4 to 6

cent., in thicker specimens sometimes as many as one hundred and fifty can be counted. Tabulae small, flat in the centre, bent down at the edge, rendered vesiculose by the introduction of cystose plates and generally somewhat disturbed in their regularity by the inner ends of the septa, confined to a central zone varying in breadth from about one-fourth to one-third of the entire diameter of the corallum. Vesicles filling the septal interspaces outside the tabulate zone, small, strongly curved with their convex sides upward, resting on each other and against the sides of the septa, their general direction being upward and outward at right angels to that of the arched carinae of which they are independent in their disposition."

Remarks—This species is rare in the Callaway limestone and all of the specimens are imperfect. The carinae are badly weathered on the surface, and are difficult to distinguish. One specimen is 6 cm. wide at the top and 15 cm. long, with both ends practically complete. Another specimen of the same width is 18 cm. long, and the lower end is broken away. The longitudinal section shown in figure 4 is diagrammatic. It was impossible to get a section that was not highly complicated and the reticulate network was filled in from a small area. The right side of the central part which shows the tabulae was broken during the sectioning. The cross section shown in figure 1 was made from the smaller end of the specimen 18cm. long.

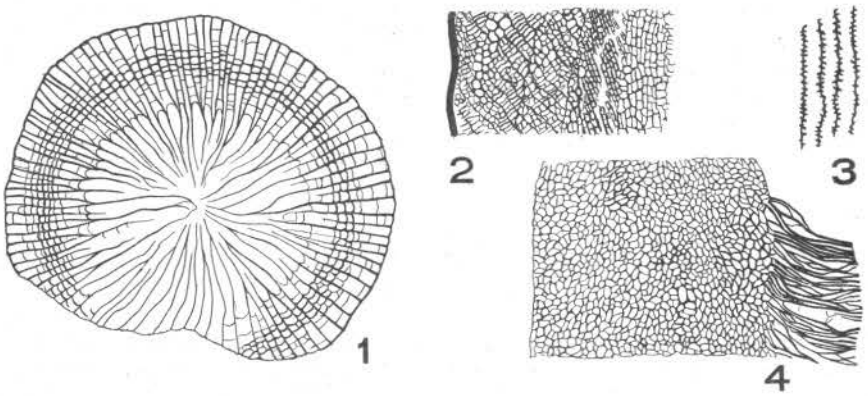


Fig. 2. Sections of *Cyathophyllum halli* (Edwards and Haime)

1. Cross section of a long specimen, 17 centimeters from the top. No evidence of spines on the septae appears. (X8/5).
2. A small area of a vertical section which shows the complexity of the structure. The right side is near the center of the specimen but is not cut to the center of the tabulate area. (X 8/5.)
3. A vertical section of a small part of a large specimen which shows the spines on the septae. (X2.)
4. Vertical section of part of the specimen shown on plate 1, figure 1. The reticulate part is somewhat diagramatic as no section was cut that did not cross several septae. About two-thirds of the tabulate area is shown in the drawing. (X2.)

Genus Diplophyllum Hall

Diplophyllum callawayensis n. sp.

Plate 3, figure 4.

Corallum composed of nearly upright, subparallel corallites, which range up to 3 cm. in diameter 10 cm. from the base. Corallites straight to slightly curved, in contact or separated by small interspace. Connections between corallites not observed. The

best specimens have no secondary septae. In some specimens the dissepiments unite in one row to form a sort of secondary wall and from this minute secondary septae develop. In some cases the inner ends of the spetae unite to form an inner wall but in many specimens the wall is imperfect as though disarranged. Near the outer ends of the corallites the septae become disarranged as shown in figure 3. Dissepiments are well developed but not numerous, usually 3 to 5 between adjoining septae, but more numerous outward. The outer surface has no pronounced annular constrictions but has well-developed septal furrows.

In some respects this species appears more like *Craspedophyllum* Dybowsky than *Diplophyllum* Hall. However, the septae are not carinate. It differs from most species of both genera in not having well-developed secondary septae.

Occurrence—Callaway limestone of Boone and Callaway Counties.

Genus Chonophyllum Edwards and Haime

Chonophyllum ellipticum Hall and Whitfield

Plate 1, figures 2-5; plate 2, figure 6.

1873. *Chonophyllum ellipticum* Hall and Whitfield, 23rd. Ann. Rept., N. Y. State Cab. Nat. Hist., p. 233, pl. 9, fig. 13.

1891. *Campophyllum ellipticum* Whiteaves, Contr. to Canadian Pal. I, pt. III, p. 202, pl. XXVII, figs. 5-6.

1892. *Chonophyllum ellipticum* Sherzer. A revision and monograph of the genus *Chonophyllum*, Geol. Soc. Am., vol. 3, pp. 269-270.

Hall and Whitfield's description—"Coral small, subturbinate, laterally compressed, and much distorted in growth; rays somewhat strongly developed and numerous very slightly twisted as they approach the center of the cup. Calyx shallow, with rapidly ascending sides in young specimens, and spreading nearly horizontally toward the margin in older forms. Exterior of the body covered by a continuous epithecal coating, increasing in strength from below upward. In a vertical section the infundibuliform cups are somewhat distant, broad at the base, with rapidly ascending sides; the spaces between them, and also between the rays, are filled with numerous irregular, cystose partitions.

The distinctive features of this species consist in its elliptical outline and distinctly marked rays. There may be some doubt as to its generic relations. The rays are very slightly twisted as they approach the center of the cup, but there is no appearance of a columella. The great development of the rays, and the continuous epithecal coating, are features which pertain more particularly to *Ptychophyllum* than to *Chonophyllum*."

Remarks—This species is abundant in some parts of the Snyder Creek shale and it also occurs in the Callaway limestone. The preservation is always imperfect. Figure 6 of plate 2 represents the septae imperfectly. They extend to the edge of the calyx but are much worn in the specimen figured. The septae are twisted near the center but do not form a columella. *Stromatopora solidula* Hall and Whitfield incrusts many of the Snyder Creek specimens.

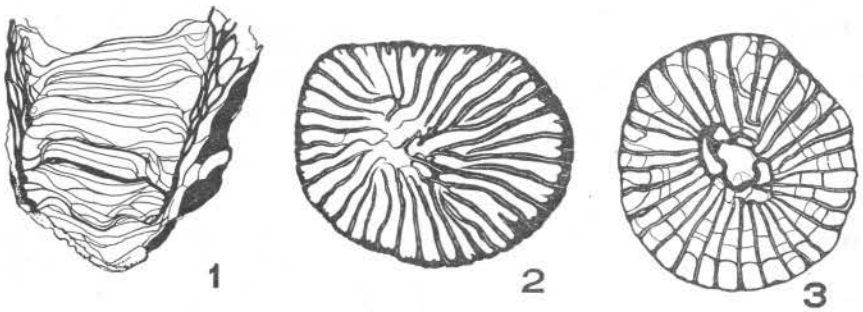


Fig. 3. Sections of *Chonophylum ellipticum* Hall.

1. A vertical section of a corallite from the bottom of the cup to two centimeters below the bottom. (X3/2.)
2. A cross section 4 centimeters below the margin of the cup of the specimen figured on plate 1, fig. 2. This section corresponds to a place about one-third the distance from the bottom of figure 1. (X3/2.)

Section of *Diplophyllum callawayensis* Branson

3. A cross section about 4 centimeters from the base. (X3/2.)

Genus Acervularis Schweigg

Acervularia davidsoni Edwards and Haime

Plate 4, figures 9 and 10.

1851. *Acervularia davidsoni*, Edwards and Haime, Polyp. Foss. des. Terr. Palaeoz, p. 418, pl. 9, figs. 4, 4a and 4b.
1858. *Acervularia profunda* Hall, Geol. Surv. Iowa, I, pt. 2, pp. 477-478, pl. 1, figs. 7, a, b, c.
1858. *Acervularia davidsoni?* Hall, Geol. Surv. Iowa, I, pt. 2, pp. 476-477, pl. 1, figs. 8, a, b.
1876. *Cyathophyllum davidsoni* Rominger, Geol. Surv. Michigan, III, pt. 2, p. 107, pl. 37, fig. 4.
1885. *Cyathophyllum davidsoni* Davis, Kentucky Fossil Corals, pt. 2, pl. 93, fig. 2; pl. 113, fig. 3.
1892. *Acervularia davidsoni* Calvin, Am. Geologist, vol. 9, pp. 355-358.
1894. *Acervularia davidsoni* Keyes, Pal. Missouri, pt. 1, Mo. Geol. Surv. IV, pp. 104-105.
1900. *Acervularia davidsoni* Lambe, Cont. to Canadian Pal. IV, pt. 2, pp. 164-165, pl. 14, fig. 3.
1909. *Acervularia davidsoni* Grabau and Shimer, North American Index Fossils, I, p. 69, fig. 106.
1911. *Acervularia davidsoni* Cleland, Wisconsin Geol. Nat. Hist. Surv. Bull. 21, p. 30, pl. 1, figs. 3 and 4.
1918. *Acervularia davidsoni* Branson, Geology of Missouri, pp. 100-101, pl. 3, fig. 8.

Hall's description—"Coral astraeiform, subhemispheric; cells irregularly polygonal, unequal in size, often somewhat circular in the young and half-grown conditions; walls thin, scarcely undulating; inner wall undefined, cup abruptly and deeply depressed from a little within the outer wall; centre marked by a papilliform mode."

Calvin's description—"The calyces have a sharply defined central pit with explanate margins. In typical specimens the floor of the calyx, except in the central pit, is almost

on a level with the margin; the septa are thick, scarcely denticulated, with but a small portion of their edges free; the carinae are few and clumsy and chiefly developed in the region immediately surrounding the central area. Around the edge of the central area both primary and secondary septa are conspicuously thickened, the carinae are also developed there better than elsewhere, the effect being to produce in polished sections the appearance of a bi-areal coral with a central area bounded by a definite inner wall. Under the magnifier this wall is never complete. The thickened septa and strongly developed carinae never quite coalesce, so that the outer area is never, as in true bi-areal corals, perfectly shut off from the central space. At the margin of this central space the secondary septa all end more or less abruptly, and only the primary septa are continued as thin non-carinated lamellae into the central area."

Remarks—The species is abundant at one horizon in the Callaway limestone and is common in the Mineola limestone. The range in form seems to be as large as between *Acervularia profunda* and *Acervularia davidsoni* from the Iowa Devonian.

Subclass Hexacoralla

Order Madreporaria

Suborder Tabulata

Family Favositidae

Genus Favosites Lamarck

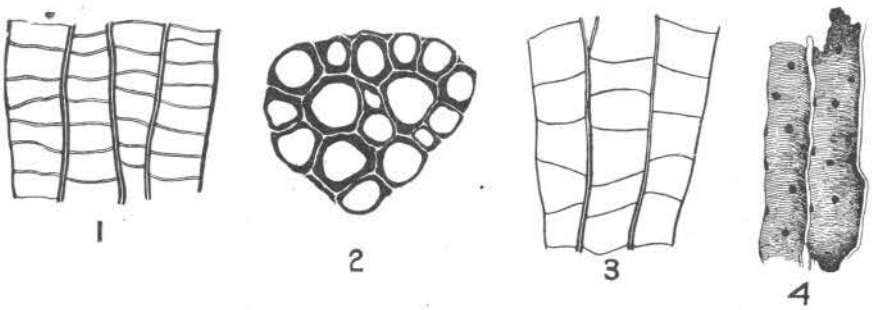


Fig. 4. Sections of *Favosites alpenensis* Winchell

2. Cross section near the base where the walls are thick. (X5.)
3. Vertical section where the walls are thin. (X5.)
(Mineola limestone of Ralls County)

Sections of *Favosites* sp. undet.

1. Vertical section (X5)
4. Section to show arrangement and size of pores. (X5.)
(Devonian of Callaway County, formation uncertain)

Favosites alpenensis Winchell

Plate 2, figures 1-3.

1866. *Favosites alpenensis* Winchell, Rep. Lower Pen. of Michigan, p. 88.
1876. *Favosites hamiltonensis* Rominger, Geol. Sur. Mich., Foss. Corals, p. 28, pl. VII, figs. 3 and 4.
1892. *Favosites gothlandica* Whiteaves, Contr. to Can. Paleon., vol. I, pt. IV, p. 272.

1899. *Favosites alpenensis* Lambe, Contr. to Can. Paleon., vol. IV, pt. I, p. 18.
1909. *Favosites alpenensis* Grabau and Shimer, North American Index Fossils, I, p. 87.
1911. *Favosites alpenensis ?* Cleland, Wisconsin Geol. Surv., Bull. 21, p. 31, pl. I, fig. 8.

Lambe's description—"Corallum massive, irregular in shape, attaining sometimes a diameter of about 1 foot with a height or thickness of 4 or 5 inches. Corallites prismatic, unequal in the same specimen, varying from 1 to 2.5 mm. in width. Pores of moderate size, about .25 mm. in diameter, occurring generally in one row, though sometimes in two rows in the sides of the corallites. A slightly raised margin is seen round many of the pores but this is evidently not a constant character as very frequently the edges of the pores are quite plain or even slightly depressed when weathering would not account for the change. Tabulae complete, horizontal, at times slightly concave or convex; frequently exhibiting marginal depressions. Squamulae few in number, rather small, narrow and rather short, extending only a short distance into the corallites. Inner surface of corallites faintly striated longitudinally.

This species is distinguishable from other Devonian *Favosites* principally by the size of the corallites whose sides have most frequently only one row of pores and by the fewness and small size of the squamulae as well as the large number of well developed tabulae."

Remarks—Modal corallites of the Missouri specimens are about 1.3 mm. in diameter. The tabulae average about .5 mm. apart but some are more than a millimeter apart. The ordinary size of Missouri specimens is 8 to 12 cm. in diameter.

Occurrence—The species is abundant at one horizon in the Callaway and it also occurs in the Mineola and Cooper.

Favosites limitaris Rominger

Plate 3, figure 1.

1876. *Favosites limitaris* Rominger, Fossil Corals, Geol. Surv. Michigan, vol. III, pt. 2, p. 36, pl. 13.
1883. *Favosites limitaris* Hall, Indiana Dept. Geol. Nat Hist., 12th Ann. Rept., pp. 256-257, pl. 4, figs. 5, 6.
1885. *Favosites limitaris* Davis, Kentucky Fossil Corals, pl. 30; pl. 31, fig. 1.
1909. *Favosites limitaris* Grabau and Shimer, North American Index Fossils, I, p. 88, fig. 142.

Rominger's description—"Ramified and reticulated stems, from five to fifteen millimeters in thickness, forming horizontally explanate expansions or erect fruticose ramifications. Tubes very thick-walled, opening nearly rectangularly to the surface, with circular orifices, the walls forming either a solid, undefined interstitial mass, or in another state of preservation, the polygonal outlines of each tube are visible on the surface of the interstices as delicate engraved lines. Several varieties are observed in regard to the mode of growth and the size of tubes. The tube orifices rarely exceed the diameter of one millimeter; often they are smaller, and in some forms they are all equal in a specimen; others have smaller and larger orifices intermingled. A part of the orifices on the side faces of the stems are often found closed by opercula, situated below the outer edge of the channels; in the interior parts of the tube channels diaphragms are not regularly developed, and are of rare occurrence. Pores, large, distant, and irregularly dispersed. In older stems the tube channels not unfrequently become considerably narrowed by excessive incrassation of the tube walls, while the pore channels gain in length and width, and appear on the surface as vermicular, transverse channels connecting the tube channels, which later are, in their narrowed condition, hardly larger than the connecting pore channels."

Remarks—This species is common in the Callaway limestone associated with *Acervularis davidsoni* Edwards and Haime. It occurs also in the St. Laurent of Ste.

Genevieve County. As with many Devonian corals the figures and specific descriptions are incomplete and without comparison with the types specific identification is somewhat uncertain. Figures 3 and 4 show the structures inside the tubes of a Callaway limestone specimen. Rarely tabulae cross the tubes. About 12 spines appear in some cross sections.

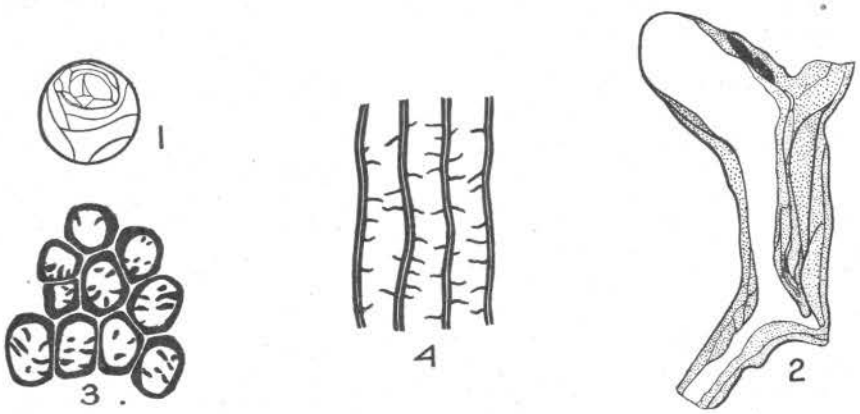


Fig. 5. Sections of *Ceratopora snyderensis* n. sp.

1. Cross section (X2½).
2. Vertical section (X2½). (Snyder Creek shale of Callaway County.)

Sections of *Favosites Limitaris* Rominger.

4. Vertical section of an ordinary specimen showing spines (X10).
3. Cross-section of ordinary corralites showing spines. Some of the spines are cut diagonally so that they do not show connection with the walls. (X10.)

Family Auloporidae

Genus Aulopora Goldfuss

Aulopora repens Knorr and Walch

Plate 4, figure 4.

1775. *Melliporites repens* Knorr et Walch, Rec. des mon. catastr. t. III, p. 157, sup. pl. 6, fig. 1.
1829. *Aulopora serpens* Goldfuss, Petref. Germ., vol. I, p. 82, pl. 29, fig. 1.
1857. *Aulopora repens* Milne-Edwards and Haime, Polyp. Foss. des Terr. Pal., p. 312.
1876. *Aulopora serpens* Rominger, Geol. Surv. Mich., III, pt. II, pp. 87-88, pl. 33, fig. 2.
1911. *Aulopora serpens* Cleland, Bull. 21, Wisconsin Geol. Nat. Hist. Surv., p. 34, pl. 2, fig. 4.
1913. *Aulopora repens* Clarke and Swartz, Maryland Geol. Surv., Middle and Upper Devonian, p. 542, pl. 45, figs. 10, 11.

Clarke and Swartz's description—"Corallum tubular, prostrate; branching from buds which originate below calyx; dichotomous, or branches anastomosing to produce a loose meshwork. Branches funnel-shaped, attached throughout their length to other organisms, especially to brachiopods. Calyx funnel-shaped, directed upwards. Tabulae and septa absent.

Diameter of branches at calyx 2 mm.; at base 1 mm.; length of branches 3-5 mm."

Remarks—Aulopora repens is of common occurrence in the Snyder Creek shale and is nearly always on *Stropheodonta demissa* or *Stropheodonta callawayensis*.

Genus Ceratopora Grabau

Ceratopora grabaui n. sp.

Plate 4, figures 2 and 3; plate 3, figure 5.

Corallum maintaining about the same width with upward growth; tubules closely aggregated, spreading in various directions so that the outer points of a cross-section of a corallum lie in a rude circle. Corallites closely connected through their entire length, maintaining about the same diameter. The diameter of the tubes is 1½ to 2 mm. No pores have been observed in the walls and no spines in the tubes. In some cases the entire corallum bifurcates several tubes going with each branch, branches of about the same size. Figure 3 of plate 4 shows such a branching. Figure 5 of plate 3 shows the central mass with the tubes broken away.

Occurrence—Mineola limestone of Montgomery and Ralls Counties.

Ceratopora snyderensis n. sp.

Plate 3, figure 2

Corallum simple, unattached excepting at the base. Corallites slightly curved and gradually enlarging toward the circular aperture. In the two specimens on which the description is based the first bud is given off 8 mm. from the base. The second bud is 12 mm. higher than the first. The buds are almost at right angles to the main corallite. Interior with circumferential cysts. Cysts few but of large size. Septal spines few, of medium size.

This species differs from *Ceratopora jacksoni* Grabau in its smaller size and lack of longitudinal striations.

Occurrence—Snyder Creek shale of Callaway County.

Class HYDROZOA

Subclass Hydromedusae

Family Stromatoporoidea

Genus Stromatopora Goldfuss

Stromatopora solidula Hall and Whitfield

Plate 4, figure 1; plate 5, figures 1-6.

1873. *Stromatopora solidula* Hall and Whitfield, 23d Ann. Rept. N. Y. State Cabinet of Nat. History, p. 227, pl. 9, fig. 4.

Hall and Whitfield's description—"Specimens in irregular masses, or incrusting foreign substances, the form of which they frequently retain. Surface extremely irregular and more or less thickly covered with small conical or rounded irregularly disposed pustules, giving origin to minute, indistinct, flexuous, ramifying channels, which traverse their sides and the intervening spaces, seldom extending to any great distance. Vertical section showing closely arranged horizontal layers of varying density, giving a strongly lamellose appearance: the individual plates or vertical columns scarcely or not at all distinguishable, but showing the ramifying tubes of different sizes very distinctly."

Remarks—This is an exceedingly variable form frequently occurring in nodules of various sizes and not uncommonly incrusting other forms. Over large surfaces there may be no pustules while other surfaces may have pustules closely crowded. The substance is so dense that structure has not been satisfactorily determined in microscopic sections. The peculiar ornamentation shown in the drawing is a conspicuous feature of all good specimens. The slightly weathered specimens show no trace of them.

Occurrence—Abundant near the bottom of the Snyder Creek shale in Callaway County. Locations 1 and 2 are good collecting grounds.

VERMES

Class ANNELIDA

Subclass Chaetopoda

Order Polychaeta

Suborder Tubicola

Genus Spirorbis Lamarck

Spirorbis omphaloides (Goldfuss)

Plate 6, figures 9 and 10.

1833. *Serpula omphalodes* Goldfuss, Petref. Germ., vol. 1, p. 225, pl. 68, fig. 3.
1874. *Spirorbis omphalodes* Nicholson, Rep. Paleont. Prov. Ont., p. 121, fig. 54a.
1891. *Spirorbis omphalodes* Whiteaves, Cont. to Canadian Pal. I, pt. 3, p. 209, pl. 28, figs. 3, 4, 4a, 5 and 5a.
1911. *Spirorbis omphalodes* Cleland, Wisconsin Geol. Nat. Hist. Surv., Bull. 21, p. 46, pl. 4, figs. 3, 3a.
1913. *Spirorbis omphalodes* Hinde Zittel's Textbook of Paleontology (Engl. ed.), vol. 1, 2nd ed., fig. 219.

Whiteaves' description—"In small specimens the outer volution is rounded and somewhat depressed and the umbilicus usually, though not always, comparatively wide. In large individuals the outer volution is elevated and subangular and the umbilicus narrow. The surface is usually smooth or nearly so, but in some specimens which seem to be nearly intermediate between this species and the next, the umbilical margin is seen to be distinctly plicated, when examined under a lens."

Remarks—Specimens are common in the Snyder Creek shale, but they are usually in poor condition. The sub-angular condition of the outer volution is not apparent.

ECHINODERMATA

Class BLASTOIDEA

Order Eublastoidea

Family Nucleocrinidae

Genus Nucleocrinus Conrad

Nucleocrinus verneuili (Troost)

Plate 8, figures 3 and 4.

1841. *Pentremites verneuili* Troost, 6th Report Geol. State Tenn., p. 14.
1849. *Pentremites verneuilii* D'Orb., Prod. Pal. Strat, I, p. 102.
1849. *Olivanites verneuili* Troost, Am. Jour. Sci., VIII, p. 419.
1850. *Olivanites verneuilii* Troost, Proc. Am. Assoc. Adv. Sci., for 1849, p. 62.
1851. *Elaeacrinus verneuilii* Roemer, Archiv f. Naturgesch, Jahrg. XVII, Bd. i, p. 379, pl. 8, fig. 1, *a-d*.
1857. *Olivanites verneuilii* Lyon in Owen's 3rd Report Geol. Survey Kentucky, pp. 487-492, t. 5, f. 1, *a-e*.
1857. *Pentremites verneuilii* Shumard, Trans. St. Louis Acad. Sci., I, p. 247.

1852-54. *Elaeacrinus verneuilii* Roemer in Bronn's Lethaea Geogn., Dritte Aufl· Theil II, p. 284, 4. f. 10, *a and b.*

1859. *Nucleocrinus verneuili* Lyon and Casseday, Proc. Am. Acad., IV, p. 295.

1859. *Elaeacrinus verneuili* Bronn, Klassen und Ordn. Thier-Reichs, Bd. i, t. 23, f. 5, A-E.

1862. *Elaeacrinus verneuilli* Dujardin and Hupe, Hist. Nat. Zooph. Echinod., p. 100.

1865. *Elaeacrinus verneuili* Shumard, Trans. St. Louis Acad. Sci., II, p. 369.

1870. *Nucleocrinus verneuilii* Billings, Am. Jour. Sci., vol. 50, p. 229, figs. 3-6.

1883. *Elaeacrinus verneuili* E. & C., Ann. & Mag. Nat. Hist., IX, p. 231.

1886. *Elaeacrinus verneuili* E. & C., Cat. Blastoidea Brit. Mus., pp. 216-218, pl. 2, fig. 45; pl. 17, fig. 19; pl. 18, figs. 16-18; pl. 19, fig. 7.

1889. *Nucleocrinus verneuili* Miller, North American Geology and Paleontology, p, 263.

1889. *Nucleocrinus verneuili* Bather, List Blastoidea British Museum (Nat. Hist.). p. 22.

1902-03. *Nucleocrinus verneuili* Rowley, Contributions to Indiana Paleontology, I, pp. 79-81 and 128-129, pl. 26, figs. 9-15, 18-22; pl. 27, figs. 17-23; pl. 36, figs. 52-56.

1900. *Nucleocrinus verneuili* Bather, A Treatise on Zoology, III, The Echinoderma, p. 88, text fig. 10.

1909. *Nucleocrinus verneuili* Wood, U. S. Nat. Mus. Bull. 64, pp. 18-19, pl. 3, figs. 7-13.

1910. *Elaeacrinus verneuili* Grabau and Shimer, North American Index Fossils, II p. 484, fig. 1796.

1918. *Nucleocrinus verneuili* Branson, Geology of Missouri, pp. 100-101, fig. 11.

Troost's description—"Pelvis—or the base of the body—is very complicated in the Olivanites. It is composed of five plates of an irregular form—each has a very elevated ridge running longitudinally over them, this elevated ridge is hollow at the superior margin, in the aperture of which it receives the lower extremity of the double rows of pores or what is generally called ambulacrum, these five plates, joined together have a subpentagonal form, each of the five angles being elevated and somewhat rounded to receive the five double rows of pores. Five such plates joined together have a pentagonal vacuum in its center, and this open place, which I at first considered as a cavity in which a column was inserted, is closed up with numerous small plates forming a kind of mosaic placed at the bottom of the cavity.

Here the general arrangement of costals, and scapulars as in the generality of crinoids, terminates. The whole is now composed of a shell on which no suture of junction is perceptible. Consequently it does not belong to the *Prentremites* in which these divisions are found, and in which the pelvis is divisible into three parts.

Five double rows of pores, originating at the summit near two small elongated apertures, descending longitudinally terminate in the above-mentioned cavity under the elevations of the pelvic plates. These two rows of pores are separated by a narrow strip, or septum having a longitudinal depression in the middle, and must have answered for the same purpose as the ambulacra in the Pentremites which are also composed of double rows of pores.

The apertures near the origin of the ambulacra—or double rows of pores—form in the interior a short conical tube, descending a short distance and it is not closed—the place where the ambulacra terminate is also open in the interior.

The intermediate spaces between the ambulacra are superficially divided by longitudinal lines into five parts—the middle part is slightly elevated above the two others, and is more or less longitudinally grooved, while the two following are transversely striated. Four of these parts are of equal size—but the fifth is broader and its central part is much more elevated and wider than in the four other divisions, it reaches not the same height and has on its summit a large lanceolate aperture with an elevated border. Its summit is covered with numerous microscopic plates."

Remarks—Specimens from the Mineola are abundant but are never well preserved. None of them retains the surface markings, and identifications must be made largely on the basis of shape. Even in this there is considerable variation but the smaller specimens are all elongate, nearly symmetrical, and flat to convex between the ambulacra. The only large specimen collected is much less elongate compared with the width and is somewhat larger near the ventral end as is common with *N. verneuili* (Troost).

Occurrence—Mineola limestone of Montgomery County.

Class CRINOIDEA

Order Camerata

Family Melocrinidae

Genus Melocrinus Goldfuss

Melocrinus gregeri Rowley

Plate 7, figures 11 and 12.

1893. *Melocrinus gregeri* Rowley, Am. Geologist, XII, pp. 303-304, pl. 14, fig. 1.
1897. *Melocrinus calvini* W. and Sp., Harv. Mus. Comp. Zool. Mem., XX, p. 300, pl. 22, fig. 6.
1909. *Melocrinus gregeri* Greger, Am. Jour. Sci., XXVII, p. 376.

Description—Calyx subpyriform; sides nearly straight from the top of the basals to near the bases of the arms; top of the tegmen nearly flat, with a small, short eccentric anal tube. Each of the radials, fixed brachials, and interbrachials to the third row, usually crowned by a pointed node. The lowest distichals in some cases bear nodes.

Basals projecting downward around the column and often forming nodes at the lowest part of the plates; in large specimens the radials and costals are wider than long but in small specimens they may be nearly equidimensional or longer than wide. Interbrachial spaces large, somewhat irregular, the plates arranged 1, 2, 3, 3, or 1, 2, 2, 2, or 1, 2, 3, 4. Four distichals are present but no interdistichals. The lower distichals are much smaller than the axillary. Anal area widest, with plates arranged 1, 3, 4, 5, or 4. Plates on the ventral disk small and subequal in size.

Occurrence—Snyder Creek shale of Callaway County, location 1. The writer knows of only six specimens of the species from the Snyder Creek shale.

Melocrinus lylii Rowley

Plate 6, figures 7 and 8

1894. *Melocrinus lylii* Rowley, Am. Geologist, XIII, p. 152, fig. 2.
1909. *Melocrinus lylii* Greger, Am. Jour. Sci., XXVII, p. 376.

Rowley's description—"This is the smallest crinoid yet discovered at the Callaway locality. Three of the basal plates are quadrangular and the fourth pentagonal, slightly projecting outward. Three of the first radials are heptagonal and two hexagonal; width and length about equal. Second radials hexagonal. Third radials heptagonal, supporting above two series of two small plates each. Interradial series twelve to thirteen, arranged as usual in this genus. First interradial about as large as the second radial piece and hexagonal. Anal interradius composed of twelve pieces, all being small with the exception of the lowest piece.

All the plates of the calyx of this little crinoid bear a central short spine and strong radiating ridges connecting the centers of all the plates, giving the specimen a very handsome appearance.

Vault plates numerous, almost spinose and having the radiating ridges. Proboscis slender, excentric. Free rays, arms and column unknown."

Remarks—The most remarkable thing about this crinoid are deep pits at the angles of the plates. From these pits the surface rises to the middle of the plates, forming low broad cones. Each plate is surrounded by 5 or usually 6 of the pits. Ridges cross from plate to plate between the pits, and sutures are rarely apparent. The ridges, pits, and cones distinguish the species from *Melocrinus gregeri* which has the same arrangement of plates though it is a much larger form.

Occurrence—Snyder Creek shale of Callaway County. The specimen figured is the holotype from the collection of Professor R. R. Rowley.

Melocrinus tersus Rowley

Plate 7, figures 9 and 10

1894. *Melocrinus tersus* Rowley, Am. Geologist, XIII, pp. 151-152, fig. 1.
1909. *Melocrinus tersus* Greger, Am. Jour. Sci., XXVII, p. 376.

Rowley's description—"Calyx obconical; dome almost flat, basal plates four, three of which are quadrangular, the fourth and largest pentagonal. Breadth nearly twice the length, but slightly expanded; excavated for the reception of the column.

Of the first radials, three are heptagonal and two are hexagonal; width a little greater than length. Of the second radials two are heptagonal, two hexagonal, another? octagonal. In the ray to the left of the anal area, the second radial? is entirely separated from the first radial (a malformation) by the abutment of the lower lateral edges of the large piece of the anal area and the large interradial to the left of the anal area. Third radials heptagonal, supporting, on the upper sloping sides, two small secondary radials.

Interradial areas filled by from 12 to 14 pieces, the lowest one of which is almost as large as the first radial and hexagonal. In two of the areas two plates rest on the upper sides of the first interradial and first radial, while in one area three such plates are above the first. There seem to be about ten plates in the anal interradius, but this can not be well made out from the disordered condition of the radial series to the left. All of the calyx as well as the vault plates are slightly convex but without spines and radiating ridges, except at the edges where short connecting ridges give a pitted character to the lines of union.

Vault pieces numerous. Base of proboscis medium, excentric. Base of the free rays prominent, giving an actinocrinoid look to this beautiful species. Top stem joint rather large."

Remarks—Rowley's type is abnormal in the anal and adjoining rays. Another specimen, collected from the type locality, has the following arrangement of the plates: In the anal area 1, 3, 4, 5, 5; in other interrays 1, 2, 3, 4, 4; 1, 2, 3, 3, 4; 1, 2, 2, 2, 3; 1, 2, 3, 3, 3. Arrangement of plates in the type: Anal area 1, 2, 2, 3, 4; other interrays 1, 2, 2, 3, 4; 1, 2, 2, 3, 4; 1, 3, 3, 3, 4; 1, 2, 3, 4, 5. The second specimen is slightly longer compared to the width than the type and the plates are strongly convex, while in the type they are slightly convex. At nearly every angle between the plates a pore is present in the type, but only a few pores are present in the other specimen. The ridges between the basals and radials are less prominent and fewer than in the type.

A large series might show *Melocrinus tersus* and *M. gregeri* to be conspecific, though spines are absent on the known specimens of the former and are prominent on the latter, and the former is much smaller and less expanded at the top. Measurements of two specimens of *M. gregeri* show height 30 and 31 mm., greatest width 31 and 34 mm., of two specimens of *M. tersus*, height 20 and 22 mm., width 18 mm.

Occurrence—Known only from location 1, Snyder Creek shale, Callaway County.

Megistocrinus and Stereocrinus

E. B. Branson H. E. Wilson

Branson wrote the descriptions of the new species of *Megistocrinus* and *Stereocrinus* in 1918. In February 1922 he sent all of the materials and manuscript to Wilson. Wilson revised all specific descriptions and wrote the generic descriptions. All morphological discussion in the footnotes should be credited entirely to Wilson.

All of the drawings of plates 6, 7, and 8, were made by Mr. G. T. Kline under the directions of Branson.

Genus Stereocrinus Barris

Calyx an oblate spheroid; convex or flattened orally; convex, flattened or depressed aborally: Height to width as 1:1 to 1:2.5. Tegmen 1/3 to 1/5 height of calyx. Basal cycle discoidal; surface convex, flattened, or depressed to funnel-shape, nearly concealed by columnals; exposed margin narrow; axial canal large, quinquelobate, from 1/4 to 1/2 the diameter of the basal cycle. Basals (B) 3, subequal; 2 compound, reduced laterally, 1 simple, laterally enlarged, basal formula usually *ab-c-de-*, with complete ankylosis the formula becomes *abcde*. Radials (R), in contact laterally, subequal; 2 supported by compound basals only, hexagonal, 3 supported by two basals each heptagonal; all hexagonal when all basals are ankylosed[1] forming a basal disk. Primibrachs (I Br) separated laterally, about equal in area to radials but higher and narrower; pentagonal, axillary, and homologous to I Ax only.[2] Secundibrachs (II Br) all pinnulate; II Br_1 pentagonal with subtriangular outline supporting II Br_2 on the outer side of the dichotome and one pinnule on the inner. II Br_2 subtriangular; II Br_3 et seq., biserially arranged and incorporated to at least II Br_6 in larger specimens; the number of incorporated brachials varying with the size and age of the individual. Pinnules[3] (P) of lower II Br partially incorporated, those above, free; incorporated pinnules (II nP) free above second pinnular (II nPr_2); upper half of incorporated pinnulars II nP_1r_2 to II nP_4r_2 inflexed forming a portion of the tegmenal margin; neuroambulacral canals of II nP present in immature specimens but absent in many larger, mature forms showing that the free portion of the pinnule was lost and the canal permanently closed, during ontogenetic development. Interbrachials (iBr) 2, 3, or 4, uniserially arranged; iBr_1 the largest plate in the calyx; iBr_2 et seq., consecutively reduced in area. Incorporated interpinnulars inP rare; present only in large specimens.

Arms bifurcating but once, biserial and pinnulate; size and length unknown; arm bases horizontally directed; enlarging by spreading rather than by growth, thus bringing more brachials and their pinnules into the cup wall.

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[1]The term basal disk has been loosely applied to any group of ankylosed, or unankylosed basals having discoidal proportions and as this usage tends to confusion I believe the term should be applied only where complete ankylosis has taken place.

[2]I Ax in all forms having but one primibrach has usually been considered a compound plate but the tendencies in *Dolatocrinus*, from which *Stereocrinus* originated, show clearly that elimination by suppression and not ankylosis caused the loss of the I Br.

[3]Pinnules, especially incorporated pinnules, form an important as well as a conspicuous portion of the skeleton in many genera of crinoids and the following terms and symbols are suggested for their technical description: Pinnules P; on secundibrachs II P, on tertibrachs III P, etc. Pinnules incorporated, nP; on secundibrachs II nP, etc. Pinnulars Pr; on pinnules of secundibrachs II Pr, etc. Pinnulars incorporated nPr.

Interpinnulars iPr.

Interpinnulars incorporated inPr.

Following Dr. Bather's system of symbolism a step further we may designate any incorporated pinnular in the following manner:
ex. II nP_1r_3 meaning the second, incorporated pinnular of the pinnule arising from the first secundibrach.

Tegmen low, convex or flattened; 1/3 to 1/5 the height of the calyx. Ambulacral areas distinct; ambulacrals with regular uniserial arrangement. Primary interambulacrals (iI amb) 2 x 5, subequal, elongate, narrow, mirror twins, meeting incorporated pinnulars and occasionally iBr_3 or iBr_4. iIIAmb, 1 x 5, narrow, elongate, meeting incorporated pinnulars. Orals (O), if present,[1] slightly modified in form, grouped in front of the anal opening, with the anterior and lateral orals resting against iIAmb and surrounding pO. Anal interambulacrals (An iAmb), 5 or more grouped between the orals, I Amb and iI Amb. Anal tube if formed, small.

Stem unknown; proximal columnals circular, conforming to unexposed outer surface of basals; discoidal if the base is flattened, or convex; funnel-shaped if the base is a re-entrant funnel.

Plate surfaces smooth or ornamented, conforming to the general curvature of the cup or pronouncedly convex. Ornamentation consisting of ridges on the cup plates and papilli on tegmenal plates. Basically the ridges fall into three systems, the neural, transverse, and oblique ridges, which may be laterally duplicated by parallel secondary ridges forming groups of concentric triangles centering at the plate angles. Both primary and secondary ridges may be smooth or rugose, broken up into bars and nodes, suppressed even to extinction or greatly exaggerated. Spines too, altho not discovered, may be found on both cup and tegmenal plates as this type of ornamentation often becomes spinose. This great diversification of ornamentation and the differences in calyx form furnish the diagnostic characters for specific differentiation.

All sutures closed; contact surfaces of plates with low relief consisting of minute vermiform ridges.

Nervous system indicated by 5, unequal,[2] lobed depressions on the visceral side of the basals, and narrow, shallow grooves following the mid-line of the radials and brachials.

Stereocrinus, derived directly as it was from *Dolatocrinus*, differs from it in the following characters: In the absence of I Br_1, in having but one bifurcation of the arms, at least but one incorporated in the calyx and in the general absence of the free portion of the incorporated pinnules as well as closure of the pinnular neuro-ambulacral canals during ontogenetic development, after the loss of the pinnules.

Stereocrinus moori n. sp.

Plate 6, figures 5 and 6; plate 8, figure 8.

Calyx of medium size, 1.5 times as wide as high; orally flattened, aborally depressed; aboral depression including BB and RR. IAx convex, curving smoothly from RR to IIBr; 11Br nearly vertical. Arm bases conical, laterally protuberant. Tegmen flattened, convexity low; depressed interambulacral areas curving smoothly to less depressed iIBrs. Cup ornamented by ridges; three primary and one secondary; neural ridge not accentuated; all ridges rugose: Tegmen papilose. Sutures not incised between ridges.

Basal 3, forming a deep re-entrant funnel, mostly concealed; exposed rim narrow, rounded. Axial canal quinquelobate, ½ diameter of base. Proximal columnals funnel-shaped.

Radials and primibrachs subequal in size; IAx higher and narrower than RR. $IIBr_1$ and $IIBr_2$ uniserially arranged, those following, smaller, biserial. Arms biserial, pinnulate from $IIBr_1$ up, bifurcating but once; brachials incorporated to $IIBr_4$: Free portion of incorporated pinnules lost; incorporated pinnular canals closed.

[1]Whether these plates are true orals is not known as a sufficient number of young specimens has not yet been found to satisfactorily trace the ontogenetic development of these plates, but until satisfactory evidence to the contrary is obtained I shall not abandon Wachsmuth and Springers' terminology.

[2]The inequality in size of the lobes approaches the trilobed condition but as no calcareous neural capsule was formed the triangularity of the central area is not as well marked as in the Flexibilia and some of the other Camerata.

Interbrachials in lateral areas three, uniserially arranged; in anal area six, irregularly arranged.

Tegmen low, slightly convex, all plates conforming in outline to generic plan; surface papilose, conforming to general curvature.

In form and ornamentation this species resembles *Stereocrinus triangulatus* Barris, but differs from it in having but one secondary system of ridges, rugose ornamentation, less pronounced neural ridge, low curvature of tegmen and tegmenals, deeper interambulacral, interbrachial, and aboral depressions, and in the much smaller size of the basals, and proximal columnals.

Occurrence—Mineola limestone of Ralls County.

Collection—Geological Department of the University of Missouri. Specimen No. 3207.

Stereocrinus springeri n. sp.

Plate 7, figures 1-3.

Calyx of medium size, from less than 1.5 to nearly 2 times as wide as high; orally elevated, aborally flattened; aboral flattening including RR. IAx at angle of 40 with sides above it nearly vertical. Arm bases directed laterally, not markedly protuberant. Tegmen elevated, convex, ambulacral areas elevated gradually on approaching arms; interambulacrals relatively depressed only; separated from interbrachials by a sharp horizontal ridge formed at the bend of the inflexed II nPr_2; interbrachials not depressed. Cup ornamented by ridges; three primary and one secondary; neural ridge not accentuated; all ridges rugose and broken up into bold, angular bars and nodes, uniting in various ways to form "graphic" figures. Sutures indistinct and not incised between ridges. Tegmenals nodose, barred or tumid depending upon general outline of the plates.

Basals 3, forming a very shallow funnel, partially concealed by columnals. Axial canal small, quinquelobate, about 1/4 the diameter of the base. Proximal columnals unknown.

Primaxials as large or larger than radials. $IIBr_2$ cuneiform, $IIBr_3$ et seq., biserially arranged. Arms bifurcating once, all IIBr pinnulate and incorporated to $IIBr_5$. Free portion of nP lost, incorporated pinnular canals closed.

Interbrachials in lateral areas 4, in anal interray 3 or 4, all uniserially arranged; $iIBr_4$ inflexed forming rim of tegmen.

Tegmen high, convex, all plates conforming in outline to generic plan, surface of plates nodose, ridged, or tumid depending upon the plate form. Surface of paired iIAmb granulose.

This species resembles *S. triangulatus* Barris in general form but differs markedly from it in ornamentation and number of iIBr. From *S. moori* Branson and Wilson it differs in the bold angularity of its broken ridges, in a general lack of depressions and in surface sculpture of the tegmenal plates.

Occurrence—Abundant at one horizon of the Mineola near Spalding in Ralls County. Exfoliated specimens, seeming to belong to this species, are abundant in the Mineola of Montgomery County.

Stereocrinus vandiveri n. sp.

Plate 7, figures 6-8.

Calyx of medium size, 1.5 times as wide as high, greatest width at apices of I Axs, curving inward toward arm bases; orally flattened, aborally depressed. Arm bases directed obliquely upward, not markedly protuberant. Tegmen very low, 1/3 height of calyx, ambulacral areas not elevated, interambulacrals but slightly depressed, meeting slightly depressed interbrachials. Cup ornamented by ridges, three primary and one incomplete secondary; neural ridge accentuated; all ridges low, rounded, and

slightly wavy. Plates below $IIBr_2$ concave, with elevated rims and centers; sutures deeply incised between ridges. Tegmen papilose.

Basals 3; funnel deep, rim broad and rounded; axial canal 1/4 diameter of base, quinquelobate; proximal columnals circular, funnel-shaped.

Primaxials larger than radials. $IIBr_2$ variable, pentagonal to cuneiform, $IIBr_3$ et seq., biserially arranged. Arms bifurcating once; all IIBr pinnulate and incorporated to $IIBr_5$. Free portion of nP lost, nP canals closed.

Interbrachials 2, perhaps 3, in larger specimens, not meeting iIAmb.

Tegmen very low, flattened; all plates conforming in outline to generic plan; surface of plates papilose. Anal opening slightly excentric, small.

Column unknown.

Stereocrinus vandiveri differs from the other species herein cited in the concavity of all plates below $IIBr_2$, flatness of the tegmen and bulging of the sides below the arm bases.

Occurrence—This is a common species in the Mineola limestone of Ralls County, and is probably abundant in the Mineola of Montgomery and Warren Counties, although, as all specimens from there are exfoliated, it is impossible to identify them.

The species is named for Mr. V. W. Vandiver, a student in the University of Missouri, who collected the best specimen.

A small specimen is probably an immature *S. vandiveri* as it has the tendency to concavity in the plate surfaces, the same general style of ornamentation, and the deep marginal incisions between the ridges. In this specimen several interesting points in the development of incorporated pinnules are demonstrated.

The pinnules of $IIBr_1$ and $IIBr_2$, incorporated as described in the generic plan, are elevated slightly above the general surface of the tegmen, and several of the better preserved ones bear a small pinnule facet, showing that the free portion of the pinnule was very slender. The neuro-ambulacral canals, which are usually in contact with the facet, are here slightly above it. This fact coupled with the small size of the facet apparently means that atrophy of the pinnule had already begun. A larger specimen shows complete absence of the canals and closer conformity of the incorporated with the body curvature.

Family Batocrinidae

Genus Megistocrinus Owen and Shumard

The North American species of Megistocrinus form two reasonably distinct groups well separated stratigraphically but not differing to any great extent morphologically. The first group, the Devonian species, has in general 16 arm openings in the calyx, a strong anal tube, and few if any biserially arranged brachials incorporated. The second group, the Mississippian species, has 20 arm openings in the calyx, a weak anal tube, and many biserial brachials incorporated. This difference is evidently due to increasing enlargement of the calyx which incorporates both tube and brachials in much the same manner as incorporation takes place in the ontogenetic development of many recent crinoids, and is not of sufficient importance to warrant separating the Devonian from the Mississippian forms.

Megistocrinus (Devonian)

Calyx large, generally wider than high; convex, flattened, depressed, or excavated aborally; convex to conical, or sometimes flattened orally. Plate surfaces generally smooth, either conforming to the cup curvature, convex to nodose, or ornamented with ridges radiating to the plate angles.

Base hexagonal, with shallow depression for columnals; axial canal quinquelobate, 1/4 to 1/3 the diameter of the base. BB 3, hexagonal, sometimes completely ankylosed.

Radials separated posteriorly by anal x; RR hexagonal in general outline. Primibrachs 2 x 5, laterally separated by iIBr. IAx often slightly out of vertical alignment. Arrangement[1] of brachials above IAx ant. and post. lats. 2IIAx, 4IIIBr$_1$, 4IIIBr$_2$, free biserials. Antero-laterals. . .2IIBr$_1$, 2IIBr$_2$, 2IIBr$_3$, free biserials.

"Arms biserial, branching and gradually diminishing in size upwards;"[2] biserials usually not incorporated, "Pinnules small and rarely preserved." "Ambulacral covering plates biserially arranged and bordered by a series of side plates."

Interbrachials numerous iIBr, regular in arrangement but not constant in number, the mean being approximately 1, 3, 3, 2, 2, 3, and the size growing progressively smaller from below upwards; iIIBr regularly arranged, but with slight variation in number, as for example 1, 2, 1 and 1, 2, 2, I IIIBr few or none, large or small. All interbrachials meeting the interambulacrals.

Anal x narrower than the radials but of equal height; secondary anals one, rarely more; anal interbrachials of varying number but growing progressively smaller from below upwards and meeting the interambulacrals; anal interray usually broader than the others.

Tegmen wider than high, convex to conical, or, rarely flattened; anal tube large, excentric; tegmenals numerous not regularly arranged, but growing progressively smaller from center to margin of calyx. "Orals" and radial dome plates often accentuated in size or ornamentation, being larger than the other plates and occasionally spinose or with greater convexity. Ambulacral areas slightly elevated; interambulacrals depressed and meeting interbrachials: ambulacral cover plates often distinct marginally and with the "side plates" entering the tegmen.

"Column circular, large, with strong cirri at distal end; axial canal quinquelobate."

Range: Devonian.

To this group the following species may be assigned without question: *M. rugosus* Lyon and Casseday (Corniferous); *M. farnsworthi* (White), *M. depressus* (Hall), *M. multidecoratus* (Barris), *M. nodosus* (Barris), and the three species to be described later.

The following species offer some variations: *M. latus* (Hall) has apparently no anal tube, *M. spinosulus* Lyon has 8 arm openings to each ray, *M. concavus* Wachsmuth has very few iIBr, and no iIIBr or iIIIBr, while *M. abnormis* (Lyon) is evidently a collection of abnormal individuals of doubtful generic and specific standing.

Megistrocrinus broadheadii n. sp.

Plate 8, figures 5-7.

Species large. Calyx nearly as high as wide; deeply invaginated aborally, highly convex orally; basals, radials and lower 1/3 of IBr$_1$ curving upwards, sides of cup sloping but slightly outward from IBr$_1$ to arm bases. Radial areas elevated, interradial areas depressed; anal tube slightly excentric, large.

Basals and radials included in aboral invagination not distinct owing to the peculiar preservation which foils successful cleaning. Primibrachs 2 x 5; IBr$_1$ slightly larger than iIBr$_1$, IAx offset in the anterior and post-lateral rays, symmetrically placed in the antero-lateral rays. Brachials above IAx arranged as described in the generic diagnosis.

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[1]The bifid and trifid arrangement of the arms, so well expressed in the Devonian forms of this genus, is not of rare occurrence, being found in varying degrees of expression in many widely separated genera. In *Botryocrinus* it is shown by the angle of the radial facets in reference to the vertical axis of the calyx; in *Mysticocrinus* in the lack of IBr$_1$ and distal radial spines in the ant.-laterals; and in *Pisocrinus* in the peculiar subequal size of the anterior, and left posterior radials and the right-post. inferradial.

I have mentioned but three examples of this phenomenon, yet its occurrence is so widespread and so clearly delineated that there can be no doubt that there is some fundamental principle governing it, but just what it is I am not ready to state.

[2]Statements in quotation marks after Wachsmuth and Springer, in N. Am. Cam. Crinoidea. p. 532.

iIBr irregular, 1, 1, 2, 2, 1, 1; 1, 2, 3, 2, 2, 2, etc.; iIIBr absent in antero-lateral rays, and irregular in the others; iIIIBr few or none.

Tegmen high, convex; "orals," and plates covering ambulacral areas larger than interambulacrals.

Anal tube excentric, large.

Column and arms unknown.

Measurements of the type specimen are: Height of cup 23mm., of tegmen 17 mm., width of base 33 mm., at arm bases 52 mm.

The holotype of this species is not complete, as the left lateral rays have been broken away but these we have restored in the description.

Megistocrinus broadheadii closely resembles *M. concavus* W. & S., (N. Am. Cam. Crin. p. 543, pl. 48, figs. 5a-c), in general configuration, and lack of secondary and tertiary interbrachials, but differs from it the greater divergence and flattening of the cup walls, greater prominence of the arm bases, wider interradial depressions, larger size of the marginal tegemenals, lower convexity of the calyx plates, and lack of nodes on the "orals" and radial dome plates.*

Occurrence—Mineola limestone, 4 miles south of Montgomery City. The formation may be Callaway. Only a small patch of the rock is exposed, and it contains no diagnostic fossils.

Megistocrinus mineolaensis n. sp.

Plate 6, figures 2-4.

Species large. Calyx globose, wider than high; cup bowl shaped, with basals and radials nearly horizontal; tegmen as high as cup, convexity high; plates conforming to curvature of walls, unornamented (?), sutures scarcely visible. Measurements of type specimen, height 43 mm., width at arm bases 56 mm., width of aboral area of flattening 30 mm.

Base hexagonal projecting beyond column; basals ankylosed; width of column facet unknown; axial canal quinquelobate, about 3/8 diameter of basal hexagon.

All plates in radial cycle hexagonal; radials slightly larger than anal x, 2/3 as high as wide. Primibrachs 2 x5, IBr_1 larger then IAx. Arrangement of intrebrachials above IAx according to the group plan (see generic description). Primary interbrachials irregular in arrangement; 1, 3, 3, 2, 2, 3; 1, 3, 4, 3, 3, 3; 1, 2, 3, 3, 3, and variable in size but growing progressively smaller from the base up. iIIBr, irregular, 1, 2, 2, or 1, 2, 1 iIIIBr also irregular, all interbrachials meeting interambulacrals in slight interradial depression.

Tegmen high, sloping upward from all sides to base of anal tube; ambulacrals preserved near margin, biserial; ambulacral areas slightly elevated, interambulacrals slightly depressed. Anal tube excentric, 1/3 the diameter in from the back margin, Tegmenals numerous, about 200, irregular in size and form; orals undifferentiated.

Megistocrinus mineolaensis resembles *M. multidecoratus* (Barris) in general configuration but differs markedly from it in an entire lack of ornamentation, and in having a lower tegmen.

Occurrence—Mineola of Ralls County.

Megistocrinus missouriensis n. sp.

Plate 6, figure 1; plate 8, figures 1-2.

A large species. Calyx shallow, about three times as wide as high; tegmen flattened, basals and radials deeply and abruptly depressed; sides expanding rapidly upwards; arm bases elevated; plates strongly convex, margins depressed, sutures inconspicuous. Measurements of type specimen: Height 26 mm., width 66 mm., width of basal concavity 20 mm., depth 8 mm.

Base hexagonal, convex, basals ankylosed; size of column facet unknown; axial canal quinquelobate, 1/3 diameter of base.

All plates of the radial cycle hexagonal, almost perpendicular; radials slightly larger than anal x. Primibrachs 2 x 5, IBr_1 smaller than IAx. Arrangement of brachials above IAx as given in the generic description. Primary interbrachials arranged 1, 2, 2, or 3, 2; iIIBr in the bivium 1, in the trivium 2; anal interray X, 3, 2, 2. iIIIBr 1 or more. All interbrachials meeting interambulacrals.

Tegmen slightly elevated centrally, flattened marginally; plates convex, numerous, of irregular form and size, sutures indistinct. Anal tube about 1/7 diameter of tegmen, excentric, about 1/3 the diameter in from the back margin.

Column and arms unknown.

Remarks—The species as represented by a single specimen is characterized by great width, low dome, shallow cup, and deep aboral depression. The type is somewhat misshapen on account of crushing and the cup may have been slightly deeper than shown in the figure.

Megistocrinus missouriensis differs from all species herein cited in the great width at the arm bases and flatness of its tegmen.

Occurrence—Mineola limestone, 4 miles south of Montgomery City.

Order Flexibilia

Family Ichthyocrinidae

Genus Dactylocrinus Quenst.

Dactylocrinus concavus (Rowley)

Plate 7, figures 4 and 5

1893. *Taxocrinus concavus* Rowley, Am. Geologist, XII, pp. 304-305, pl. 14, fig. 2.
1894. *Taxocrinus concavus* Rowley, Am. Geologist, XIII, pp. 153-154, figs. 3 and 9.
1895. *Aristocrinus concavus* Rowley, Am. Geologist, XVI, pp. 217-219, figs 1 and 2.
1902. *Aristocrinus concavus* Keyes, Bull. Geol. Soc. America XIII, p. 285.
1909. *Aristocrinus concavus* Greger, Am. Jour, Sci., XXVII, p. 376.
1920. *Dactylocrinus concavus* Springer, The Crinoidea Flexibilia, Smithsonian Institution, pp. 309-310 plate 41, figs. 7a, b, c, 8a, b, c, 9.

Springer's description—"A rather small species. Crown short, rotund, with broad base; contracting above the inter-axial, where height to width is 1 to 2.2; spread of calyx from outside of basal rim, 1 to 2; cross-section obtusely pentagonal, side outline curved. Base broadly and shallowly concave, resting on basals and lower incurved points of radials. Surface smooth. Crown of mature specimen, 25 mm. high by 22 mm. wide; base at line of curavture of rim, 11 mm., column facet, 5 mm.

Infrabasals small, wholly covered by the column. Basals curving from basal cavity to outside of rim; their points visible in side view; post-basal truncate, not rising to top of radials, followed by small anal, and this by two series of 3 or 4 plates tapering to an apex between posterior rays. Interbrachials one very large plate, rising to top of distichals, with a wide, rounded, distal face, probably for attachment of perisome. Interdistichals present in large specimens. Radials unusually large for the genus—the largest plates in the calyx. Costals much shorter and narrower. Rays and their divisions deeply rounded, tapering but little; the inner branch the smaller; distichals usually 3, occasionally 2 or 4. Ramules small, 4 to 6 visible below point of infolding; intervals usually of 3 or 4 brachials, shorter in the distal portions. Column small, with thin ossicles next to calyx.

A well-marked and constant species, nearer to *D. excavatus* than to any other, but without its deep basal cavity; otherwise distinguished by its longer, more rounded, and less tapering ray divisions. In that species the ramules become equal to the main

branches at about the third division, whereas here they are well differentiated to at least the sixth."

Occurrence—Springer figures 3 specimens. Probably all are from the Snyder Creek shale type locality on Craghead Creek. The figures on plate seven are all from Mr. Rowley's original type, from the same locality.

MOLLUSCOIDEA

Class BRYOZOA

Order Cyclostomata

Family Fistuliporidae

Genus Cyclotrypa Ulrich

Cyclotrypa communis Ulrich

Plate 9, figures 7-9.

1890. *Fistulipora communis* Ulrich, Geol. Surv. Illinois, VIII, p. 476, pl. 47, figs 1 and 1a; pl. 48, figs. 1 and 1a.
1896. *Cyclotrypa communis* Ulrich, Zittel's Textbooks of Paleontology (Engl. ed.), vol. I, p. 269, fig. 443.
1913. *Cyclotrypa communis* Bassler, Zittel's Textbook of Paleontology (Engl. ed.), vol. I, 2nd ed., p. 329, fig. 470.

Ulrich's description—"Zoarium explanate, commonly attached to foreign bodies, at other times free and provided with an epitheca, often composed of layers, each a mm. or two in thickness. The surface is raised into low, broad, rounded monticules two or three mm. wide, and their summits three or four mm. apart. Apertures circular with a very thin but distinctly elevated peristome, generally about 0.16 mm. in diameter, but attaining a diameter of 0.25 mm. near the summits of the monticules; distances apart rather variable, those in the monticules more separated than the other. In the intermediate spaces five or six occur in two mm. When the surface is worn the apertures appear quite small and the interspaces very wide. Zooecia thin walled, circular or oval, provided with two or three distant diaphragms. Lunarium obsolete. Vesicles thin-walled, generally wide and shallow, about two-thirds as wide as the zooecia, surrounding them in two or more series and forming large clusters under the monticules. In good tangential sections the vesicle spaces exhibit one or more subcentral minute spots, which probably represent perforations in their covers."

Remarks—This is a common form in the Mineola. It is often attached to foreign bodies, the coral *Ceratopora grabaui* Branson being one of its favorites. The specimens show very few zooecial openings at the top of the monticules, and no subcentral spots have been observed in the vesicle spaces.

Occurrence—Mineola of Montgomery and Warren Counties.

Cyclotrypa magna-monticulata n. sp.

Plate 9, figures 4, 5, 16; plate 10, figures 1, 3, 6.

Though several specimens of this species have been collected, the description is based mainly on a well-preserved impression and on part of a well-preserved zoarium. The zoarium impression is nearly semicircular with a radius of about 3 cm. The original was strongly concave, the center being depressed about 2 cm. below the edges.

The most striking characteristics of the specimen are the large size of the monticules and their large distance apart. They range from 1 to 2 millimeters in height, from

3 to 5 millimeters across, and from 6 to 8 millimeters from crest to crest. The zooecia are arranged in fairly definite rows, about .23 mm. apart, and about the same distance apart in the rows, giving a reticulate pattern to the surface. They average .25 mm. in diameter. The margins of the peristomes are strong, and the posterior part of the margin is the more distinctly elevated.

Occurrence—Mineola of Montgomery County.

Order Trepostomata

Family Batostomellidae

Genus Lioclema Ulrich

Lioclema occidens (Hall and Whitfield)

Plate 4, figures 7 and 8; plate 9, figure 15; plate 10, figures 4 and 7.

1873. *Fistulipora occidens* Hall and Whitfield, Twenty-third Ann. Rept. New York State Cab. Nat. Hist., pp. 228-229, pl. 10, figs 9 and 10.
1878. *Callopora cincinnatiensis* Ulrich, Jour. Cincinnati Soc. Nat. Hist. I, p. 93, pl. 4, figs. 8, 8a.
1882. *Callopora cincinnatiensis* Ulrich, Jour. Cincinnati Soc. Nat. Hist., V, p. 142, pl. 6, figs. 18, 18a.
1890. *Leioclema occidens* Ulrich, Geol. Sur. Illinois, VIII, pp. 426-427.
1900. *Lioclema occidens* Nickles and Bassler, American Fossil Bryozoa, Bull. U. S. Geol. Surv., 173, p. 305.
1909. *Leioclema occidens* Greger, Am. Jour. Sci., XXVII, p. 376.

Ulrich's description—"Zoarium exceedingly variable in form, commonly irregularly ramose or lobate. Surface smooth, occasionally (in exceptionally well preserved specimens) minutely spinulose, but this is never a conspicuous feature. Walls of zooecia thin, somewhat flexuous in the axial region, slightly thickened in the peripheral region. Apertures of zooecia circular from 0.15 to 0.20 mm. in diameter, seven or eight in the space of two mm.; encircled by a single series of large angular or subcircular mesopores, on an average about two-thirds the size of the true zooecia. Diaphragms rather few and remote in the zooecial tubes, in the mesopores more numerous, and about their diameter or more apart. Acanthopores small, present in moderate numbers, and at times encroaching a little upon the zooecia."

Remarks—Of the Missouri specimens none shows acanthopores; the diaphragms are about as numerous in the mesopores as in the zooecia; in some places more than one row of mesopores separates the zooecia. In the original description mention is made of "low, rounded tubercles" irregularly spaced on the surface of the zoarium, and such tubercles are present on most of the Missouri specimens, though they are widely spaced and often absent over large surfaces. *Lioclema occidens* (Hall and Whitfield) is abundant near the bottom of the Snyder Creek shale, at many places in Callaway and Montgomery Counties. In the same bed *Stropheodonta boonensis* Swallow is abundant.

Order Cryptostomata

Family Fenestellidae

Genus Fenestella Lonsdale

Fenestella missouriensis n. sp.

Plate 9, figures 13 and 14.

Description—Species known from one fair specimen and several fragments. Zoarium growing into large flabellate expansions. Branches averaging about 5 in 10 milli-

meters. Fenestrules varying slightly in size, but averaging 4 to 5 in 10 millimeters, measured longitudinally. Branches subcarinate and following zigzag courses on the non-celluliferous face. Zooecial openings about 7 to 2 millimeters, 2 to 4 rows between the fenestrules.

This species resembles *Fenestella perundata* Hall, but the fenestrules are much smaller than in that form and are more regularly arranged.

Occurrence—Mineola of Montgomery County.

Genus Hemitrypa Phillips

Hemitrypa mineolaensis n. sp.

Plate 9, figures 10, 11, 12; plate 10, figure 5.

Zoarium known from numerous fragments and from one fairly complete specimen. On the reverse side many of the branches are nearly straight while others are slightly zigzag, 9 to 11 in 5 millimeters, rounded, and with considerable variation in width. Dissepiments short, slenderer than the branches, ranging from opposite to alternate in adjoining rows, generally rising above the branches and forming interrupted zigzag ridges. Fenestrules oval to nearly circular, about .4 mm. by .2 mm., with about 14 in 1 centimeter.

On the obverse side the branches appear narrower than on the reverse and are not so broadly rounded at the top. Zooecial pores in two parallel ranges, opening obliquely toward the fenestrules, 3 or 4 to each fenestrule, 23 in 5 millimeters.

The network on the obverse side is very delicate. The principal bars are easily distinguishable from the secondary on account of their greater width and height; the lateral bars are like the secondary, and there are about 23 in 5 millimeters.

This species differs from *Hemitrypa tenera* Ulrich, in the circular shape of the openings in the network on the obverse side, the larger size of the principal bars on this side, in the larger size of the branches of the zoarium, comparatively slenderer dissepiments, and higher dissepiments uniting to form ridges.

Remarks—This is the most abundant fossil in the Mineola limestone.

Occurrence—Mineola limestone of Montgomery and Warren Counties.

Family Rhabdomesontidae

Genus Rhombopora Meek

Rhombopora missouriensis n. sp.

Plate 9, figure 6; plate 10, figure 2.

Description—Zoarium branching dichotomously at intervals of 5 to 10 mm. usually spreading in one plane but sometimes in various directions. Branches from 0.5 to 3 mm. in diameter. Zooecia proceeding out from the axis of the branch at an angle of about 80°. Zooecial apertures small, oval, 0.2 mm. long, arranged in longitudinal and diagonal intersecting series, 7 in 2 mm. in the first, and 9 to 10 in 2 mm. in the second. In some specimens the rows are very irregular. Interspace generally ridge-shaped, the summits rather sharp, enclosing oval depressions which are steep sided at the lower side and gently sloping from the upper.

Rhombopora subannulata Ulrich, from the Devonian of Iowa, has a similar external appearance but has tubercles at each angle of intersection of the surface ridges and the zooecia branch out at a much smaller angle.

Occurrence—Abundant near the top of the Snyder Creek, in the Stromatoporoid zone in Callaway County.

Family Cystodictyonidae

Genus Cystodictya Ulrich

Cystodictya mineolaensis n. sp.

Plate 9, figures 1 and 3

Zoarium a parallel-edged, bifurcating stipe with narrow non-poriferous margins, elliptical in cross-section, 2 to 3 mm. in average width, greatest thickness about .4 mm. Zooecial apertures in 7 or 8 longitudinal, parallel rows, separated by well-developed parallel ridges; averaging 3 zooecia per millimeter lengthwise of the rows; apertures about .2 mm. in their longer diameter and .14 mm. in their shorter, separated longitudinally by a space about equal to their own width, not alternating so as to give a zigzag appearance to the interspace but most often opposite. The zoarium varies widely in shape, the branches coming off at infrequent intervals in some specimens and being much closer together in others.

Remarks—The species is represented by only a few specimens.

Occurrence—Mineola formation of Montgomery and Warren Counties.

Genus Coscinium Keyserling

Coscinium missouriensis n. sp.

Plate 9, figure 2

Zoarium consisting of an explanate frond with oval or circular perforations or fenestrules at somewhat regular distances; length of fenestrules 1½ to 2 mm., width 1 to 1½ mm.; generally distant transversely about 2½ mm., longitudinally about 3½ mm. Cell apertures subcircular, diameter about .12 mm., irregularly spaced, generally separated by one or two apertural diameters. A non-cellular band ranging from ½ mm. to 1½ mm. wide borders each fenestrule. The cell apertures are in grooves and low sinuous ridges occupy the intercellular space. The zoarium is ½ mm. thick or less.

Remarks—This species resembles *Coscinium striatum* Hall but the pores are smaller and more numerous and the sinuous ridges are much larger and only one occurs between the rows of pores. The surface of our only specimen is somewhat macerated and it is impossible to determine whether the pores originally had denticles.

Occurrence—Mineola of Montgomery County.

Class BRACHIOPODA

Order Neotremata

Superfamily Discinacea

Family Discinidae

Genus Orbiculoidea d'Orbigny

Orbiculoidea sp. undet.

One fragmentary brachial valve of an *Orbiculoidea* from the Snyder Creek shale is in the collections of the University of Missouri. The fragment represents an individual about 25 mm. wide and of only moderate height. Greger[1], identifies this form as *O. telleri* Cleland, but the identification is, at best, doubtful.

[1]Am. Jour. Sci., Vol. 49, 4th Series, p. 266.

Superfamily Craniacea

Family Craniidae

Genus Crania Retzius

Crania famelica Hall and Whitfield

Plate 11, figures 1 and 2

1872. *Crania famelica* Hall and Whitfield, Descriptions n. sp. Fossils, p. 17, pl. 11, figs. 6, 7.
1873. *Crania famelica* Hall and Whitfield, Twenty-third Rep. New York State Cab. Nat. Hist., p. 236, pl. 11, figs. 6, 7.
1897. *Crania famelica* Schuchert, U. S. Geol. Surv., Bull. 87, p. 190.
1909. *Philhedra famelica* Greger, Am. Jour. Sci., XXVII, p. 376.

Hall and Whitfield's description—"Shell small and thin, seldom exceeding one-third of an inch in diameter, ——the largest seen measuring about four-tenths of an inch; usually flattened, discoid, the apex subcentral and scarcely elevated. Surface marked by distinct lamellose lines of growth, which are often partly obliterated by conforming to the surface of the bodies to which they are attached, as Spirifera and Orthis.

The only convex example seen, is about half as high as wide, but it is attached to a very convex surface, which must occupy about half the convexity; usually they are entirely compressed, with the exception of a small area surrounding the apex."

Remarks—Crania famelica Hall and Whitfield is common in the Snyder Creek shale and has been reported by Greger from the Callaway limestone. It is only rarely well preserved, being represented most commonly by subcircular rings on other fossils.

Order Protremata

Superfamily Orthacea

Family Rhipidomellidae

Genus Schizophoria King

Schizophoria striatula (Schlotheim)

Plate 15, figures 1-7.

1813. *Anomia Terebratulites striatulus* Schlotheim, Min. Taschenbuch, VIII, pl. 1, fig. 6.
1843. *Orthis impressa* Hall, Geol. N. Y.; Rep. Fourth Dist., p. 267-268, fig. 2.
1852. *Orthis lentiformis* Owen (non Hall), Geol. Survey Wisconsin, Iowa, Minnesota, pl. 3, figs. 10, 10a.
1858. *Orthis iowensis* Hall, Geol. Survey Iowa, I, pt. 2, p. 488-489, pl. 2, fig. 4.
1858. *Orthis iowensis var. furnarius* Hall, Geol. Survey Iowa, I, pt. 2, pp. 489-490, pl. 2, fig. 5.
1859. *Orthis iowensis* Billings, Hind's Rep. Expl. Assiniboine and Saskatch., p. 187, fig. 1.
1865. *Orthis striatula* Davidson, Brit. Devonian Brach., Pal. Soc., p. 87, pl. 17, figs. 4-7.
1867. *Orthis impressa* Hall, Pal. New York. IV, pt. 1, p. 60, pl. 8, figs. 11-19.
1867. *Orthis iowensis* Meek, Trans. Chicago Acad. Sci., I, pt. I, p. 90, pl. 12, fig. 2.
1868. *Orthis Iowensis var. furnarius* Meek and Worthen, Geol. Survey Illinois, III, p. 424, pl. 13, fig. 9.

1880. *Orthis iowensis* White, Second Ann. Rep. Indiana Bureau of Statistics and Geol., pp. 501-502, pl. 5, figs. 10-12.
1882. *Orthis impressa* Whitfield, Geol. Wisconsin, IV, p. 326, pl. 25, figs. 13-15.
1884. *Orthis impressa* Walcott, Mon. U. S. Geol. Survey, VIII, p. 115, pl. 13, fig. 13.
1889. *Orthis propingua* Nettelroth (non Hall), Kentucky Fossil Shells, Monograph Kentucky Geol. Survey, p. 43, pl. 16, figs. 1-3, 7-11.
1891. *Orthis striatula* Whiteaves (non Schlotheim), Cont. Canadian Pal., I, pp. 218, 283.
1892. *Schizophoria Iowensis* Hall and Clarke, Pal. New York, VIII, pt. 1, pp 212-216, pl. 6a, fig. 29.
1892. *Schizophoria impressa* Hall and Clarke, Ibid, pp. 212-216, pl. 6, fig. 31; pl. 6a, figs. 26, 27.
1895. *Orthis iowensis* Keyes, Geol. Survey Missouri, V, pt. 2, p. 62, pl. 38, fig. 6.
1896. *Orthis impressa* Kindle, Bull. American Pal., 6, p. 36.
1897. *Schizophoria striatula* Schuchert, U. S. Geol. Surv., Bull. 87, p. 375.
1901. *Schizophoria striatula* Kindle, Indiana Dept. Geol. Nat. Res., 25th Ann. Rept., p. 626, pl. 3, figs. 11, 11a.
1909. *Schizophoria iowensis* and *Schizophoria macfarlani* Greger, Am. Jour. Sci., XXVII, pp. 376-377.
1911. *Schizophoria striatula* Cleland, Bull. 21, Wisconsin Geol. Surv., pp. 93-94, pl. 19, figs. 1-6.
1913. *Schizophoria striatula* Clarke and Swartz, Maryland Geol. Surv., Middle and Upper Devonian, pp. 572-574, pl. 52, figs. 14-18; pl. 53, figs 1 and 10.
1913. *Schizophoria striatula* Prosser and Kindle, Maryland Geol. Surv., Middle and Upper Devonian, pp. 170-171, pl. 14, figs 13, 14.

Hall's description—"Shell rotund. Dorsal valve very gibbose 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 towards the front, the margin of the shell being somewhat abruptly incurved; area of moderate height, a little incurved at the beak.

The surface is very finely and evenly striated, and the texture of the shell is minutely punctate.

The cast of the dorsal valve shows a strong, somewhat quadrilobate muscular impression, 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."

Remarks—The *Schizophorias* from Iowa have usually been identified as *S. iowensis* Hall and Clarke. According to Clark and Swartz,[1] the main differences between *S. iowensis* Hall and Clarke and *S. striatula* are that the former is smaller, has finer striations, more gibbous dorsal valve, narrow median depression on ventral valve, and more sharply sinuous anterior margin. In the Snyder Creek shale of Missouri this is a very abundant form and specimens may be selected that agree with *S. striatula* while others agree with *S. iowensis* Hall and Clarke, or two of the distinguishing characteristics of one and two of the other may be present on the same shell.

A large specimen of *S. striatula* from Maryland is 30 mm. in length by 40 mm. in width. The largest specimen from the Snyder Creek, in the collections of the University of Missouri, is 39 mm. in length by 50 mm. in width. Average specimens are about 25 mm. in length by 30 mm. in width. The striations show considerable variation, the larger specimens having the coarser, and they range from the *S. iowensis* Hall and Clarke size to that of *S. striatula*. The extremely gibbous brachial valve is

[1]Upper Devonian of Maryland, p. 573.

exceptional in Missouri specimens as it is in Iowa specimens; normal individuals are no more gibbous than normal individuals from New York or Maryland. The depression on the ventral valve is broader and shallower than in average specimens from Iowa though many Iowa specimens are similar to those from Missouri; the average Missouri specimens are normal for *S. striatula*. The emargination of average Missouri specimens is about the same as for average *S. striatula* and not as deep as in the Iowa specimens.

The Snyder Creek specimens are typical *S. striatula* though one extreme is like the typical *S. iowensis* Hall and Clarke.

Occurrence—Abundant in the Snyder Creek shale of Callaway and Montgomery Counties; rarely found in the Callaway limestone of the same counties.

Schizophoria cf. propinqua (Hall)

Plate 11, figure 4

1857. *Orthis propinqua* Hall, Tenth Rep. N. Y. State Cab. Nat. Hist., p. 110.
1867. *Orthis propinqua* Hall, Pal. New York, IV, pt. 1, p. 43, pl. 5, fig. 3.
1883. *Orthis propinqua* Hall, Second Ann. Rep. N. Y. State Geol., pl. 36, figs 30 and 31.
1892. *Schizophoria propinqua* Hall and Clarke, Pal. New York, VIII, pt. 1, pp. 212, 226, pl. 6, fig. 30.
1897. *Schizophoria propinqua* Schuchert, U. S. G. S. Bull. 87, p. 574.
1909. *Schizophoria propinqua* Grabau and Shimer, North American Index Fossils, I, p. 268.

Hall's description—"Shell somewhat transversely elliptical or subquadrate, the front truncate or emarginate, and the sides little curved, varying from moderately to extremely gibbous; hinge-line equaling or a little greater than half the width of the shell. Dorsal valve the larger and much the more gibbous; the greatest convexity a little above the middle of the length curving abruptly to the sides and beak, and a little more gently to the front; sometimes a little concave just within the cardinal angles; area inclined to the area of the opposite valve, and about one-half or two-thirds as wide; dorsal beak full, broad and rounded or obtusely pointed, extending a little beyond and slightly incurved over the area. Ventral valve less gibbous than the dorsal, very prominent on the umbo, sloping very abruptly to the cardinal angles and more gently towards the lateral and basolateral margins, flattened in the centre; the lower half marked by a gradually increasing, broad and undefined sinus, which gives a strongly curved outline to the front margin; beak more acutely pointed and incurved; area elevated and incurved, its length equalling or greater than half the width of the shell. The beaks of the two valves are approximate.

Surface marked by fine unequal striae which increase by interstitial additions, and are crossed by fine concentric striae, and, at unequal intervals, by stronger imbricating lamellose lines of growth. In certain conditions of the surface, the striae show tubular openings at the concentric lamellose lines. There are from eight to ten of the larger striae in the space of two lines; and by counting the finer intermediate striae, there are sometimes from thirteen to eighteen in the same space. The cast of the dorsal valve shows a subquadrate or quadrate-ovate muscular scar, with a deeply marked border and longitudinal median groove; a groove passes from the centre of the median line obliquely to the lower lateral angles, dividing the adductor muscular scar. The vascular impressions radiate from the muscular impression in broad bands, dividing several times before reaching the margin of the shell."

Remarks—Only two specimens are in our collections and as only the exteriors are exposed the identification is uncertain. One of the specimens has a more pronounced sinus than any specimens examined from Iowa and Michigan.

Occurrence—Mineola of Montgomery and Warren Counties.

Superfamily Strophomenacea

Family Strophomenidae

Genus Stropheodonta Hall

Stropheodonta boonensis Swallow

Plate 11, figure 11; plate 13, figures 6-12; plate 14, figure 9.

1860. *Strophodonta boonensis* Swallow, Trans. St. Louis, Acad. Sci., I, p. 638.
1897. *Stropheodonta navalis boonensis* Schuchert, Bull. U. S. Geol. Surv. 87, p. 425.
1918. *Stropheodonta boonensis* Branson, Geology of Missouri, p. 101, fig. 1.

Swallow's description—"Shell hemispheroidal. Ventral valve regularly convex, slightly raised along the mesial line; umbo depressed, scarcely modifying the curvature of the valve; beak small, slightly incurved over the area; area straight, narrow, impressed, striated vertically, about as long as the width of the shell; ears small, indistinct. Dorsal valve less convex, semielliptical, depressed in front; lateral margins recurved to meet the cardinal border. Surface marked with large rounded, radiating plications, (which are sometimes angular, irregular and unequal), increased by subdivisions and implantations.

Length, 1.12; breadth, 1.20; depth of ventral valve, .65."

Additional description—The hemispheroidal shape is prominent but is often modified by the small ears when they are present, by increased or decreased length of hingeline, by decrease of convexity of the pedicle valve, and by the greater convexity coming nearer the hingeline than the anterior margin. Average specimens are not slightly raised along the mesial line. In some specimens that grade toward *S. inflexa* Swallow the umbo modifies the shape of the valve. Measurements of three specimens give the following dimensions: Length 30, 24½, 22 mm., breadth 37, 35½, 24 mm., height 22, 18, 15 mm. The plications present a considerable amount of variation though they are all coarse; the extremes are an average of 6 to the centimeter and 12 to the centimeter. In plications the specimen with 10 to the centimeter is about like *S. inflexa* Swallow but in other respects it is quite distinct. The entire shell is punctate.

In one direction this species grades toward *S. inflexa* Swallow, from which it differs in having coarser plications, length compared to breadth being much less, averaging about 3:4 compared to 9:10 in *inflexa* and in the umbo not projecting back of the hingeline. In another direction it grades toward *S. callawayensis* Swallow from which it differs in its greater convexity, shorter hingeline, less prominent ears, and coarser plications.

Remarks—Schuchert refers *S. boonensis* and *S. inflexa* to *S. navalis boonensis*. Swallow's descriptions clearly differentiate these forms and though some specimens intergrade it is an easy matter to refer almost all specimens to their species. *S. navalis* is defined by Swallow as having "ears distinctly defined and strongly arched towards the area" while both of these species have the ears poorly defined and not arched toward the area. Both of these species have coarse plications while *S. navalis* Swallow is defined as having "numerous plications."

Occurrence—Snyder Creek shales Callaway and Montgomery Counties.

Stropheodonta callawayensis Swallow

Plate 13, figures 1-5

1860. *Stropheodonta callawayensis* Swallow, Trans. Acad. Sci. St. Louis I p. 638.
1897. *Stropheodonta callawayensis* Schuchert, Bull. U. S. Geol. Survey, 87, p. 420.

Swallow's description—"Shell semi-elliptical, margin regularly curved from the anterior margin to the cardinal extremities. Ventral valve very convex from middle towards the beak; somewhat flattened towards the anterior and lateral margins; the

convex or raised portion broadly ovate; ears large, well defined, and arched towards the cardinal borde.; extremities recurved towards the center of the valve; area common to both valves, wider in the middle, as long or shorter than the width of the shell; umbo large, prominent. Dorsal valve concave following the curvatures of the opposite valve; lateral portions, towards the cardinal line, curved down and arched to form the concave surface of the ears; cardinal border crenulated. Surface marked with numerous small, rounded, granulated radiating costae, and by fine concentric striae and lamellar imbricating bands, which are most abundant near the margins.

"Length 1.30; breadth 1.35; depty of ventral valve .52.

"This fossil most resembles *S. demissa* of Conrad; but it is more convex, its ears are better defined and less prolonged on the cardinal line. It may be distinguished from *S. aequicostata* Swallow by its larger and better defined ears, and by the ovate form of the convex portion of the ventral valve."

Revised description—Shell semicircular to semielliptical, margin regularly curved to near the cardinal extremities where, in most cases, it turns sharply outward. Pedicle valve moderately convex with the greatest convexity in or posterior to the middle; the convex portion sloping rather uniformly toward the sides but interrupted at the base of the ears; ears large, acute, arched toward the cardinal border; umbo of moderate to small size. Brachial valve concave, following closely the curvature of the opposite valve, curving downward near the cardinal line to form the concave surface of the ears. Surface of both valves marked with moderately large plications which increase by implantation and occasionally by bifurcation, generally 8 to 10 plications to the centimeter, occasionally 12 or 6. Some specimens grade towards *S. boonensis* Swallow, differing in the smallness of the umbo, greater length of the hingeline, and much more numerous plications.

Three average specimens measure, width 47mm., 58 mm., 46 mm.; length 35 mm., 32 mm., 31 mm.; height 16 mm., 15 mm., 15 mm. The width of the cardinal area in six average specimens is 2½ to 3½ mm., in an unusually thick shell the area is 6 mm. wide.

The species grades toward *S. demissa* (Conrad) from which it differs in its greater convexity, greater length of hingeline, coarser plications, thicker shell, wider cardinal area, and greater width compared to length. It also grades toward *S. boonensis* Swallow from which it differs in lesser convexity, longer hingeline, greater width compared to length, and less prominent umbo.

Remarks—Swallow's description of *S. callawayensis* does not agree in several respects with the specimens which are here referred to that species. The greatest discrepancies are in the extremities of cardinal border usually not being recurved towards the middle of the valve, the umbo not being large, and the plications being of medium to large size.

As this is an abundant form in the fauna, it seems unlikely that Swallow would not have described it with the rest and the description of *S. callawayensis* is the only one that agrees in even a general way. For these reasons our specimens are referred to this species and the description modified to agree. Specimens may be selected that would fit Swallow's description but they are rare in the fauna and seem to be merely variations from the general type.

Occurrence—Snyder Creek shale, Callaway and Montgomery Counties.

Stropheodonta cymbiformis Swallow

Plate 12, figures 1, 2, 3.

1860. *Strophodonta cymbiformis* Swallow, Trans. St. Louis, Acad. Sci., I, pp. 635-636.
1860. *Strophodonta subcymbiformis* Swallow, Ibid., p. 636.
1860. *Strophodonta kemperi* Swallow, Ibid., pp. 636-637.
1860. *Strophodonta altidorsata* Swallow, Ibid., pp. 637-638.
1897. *Stropheodonta navalis, cymbiformis, subcymbiformis* and *altidorsata* Schuchert, Bull. U. S. Geol. Surv., 87, pp. 424-425.

Swallow's description—"Shell semiellipsoidal, auriculate and costate. Ventral valve very convex, subcarinate, highest near the center; curvature increased regularly from the anterior margin to the beak; flattened towards the lateral margins and sharply rounded along the middle; umbo large, projecting beyond the cardinal line about one-fourth the length of the shell; beak small, strongly recurved; scarcely modifying the area; area straight, narrow, and much impressed; cardinal line as long as the width of the shell. Dorsal valve semielliptical, very concave, with a deep rounded sinus in front to fill the corresponding elevation in the opposite valve; the lateral edges recurved and arched to meet the impressed cardinal border, and form the sinuses leading from the central cavity into the small arched ears. Surface marked by small, rounded, granulated irregular, radiating plications, whose number is increased by subdivisions and implantations.

Length, 1.45; breadth, 1.11; depth of ventral valve, .94."

Supplementary description—Shell thin; outline of valves, resting with the margins flat, semi-ellipsoidal in many specimens, in others much constricted toward the hinge-line: Ears small but rather distinctly set off from the rest of the shell by the upturning of the extremities or by a deep groove. Pedicle valve very convex, sharply rounded to subcarinate, highest near the center; curvature increased regularly from the anterior margin to the beak. Umbo large, projecting beyond the hingeline one-third to one-fourth the length of the shell; beak very small, projecting slightly over the cardinal area. Hingeline usually shorter than the width of the shell but occasionally as long. The length of hingeline in 7 average specimens varies from 17 mm. to 23 mm., the mode being 20 mm.; length of hingeline compared to greatest width 3:4 to 4:4; length of shell compared to greatest breadth 10:8 to 10:9. The curvature of the brachial valve is about half to two-thirds that of the pedicle; at the highest and narrowest part the shell is almost flat; the lateral edges are recurved and arched to meet the cardinal border. Surface marked by small, rounded to subangular, irregular, radiating plications, which increase in number by bifurcation and implantation; 12 to 18 plications to the centimeter. Size given by Swallow about one-tenth above average. Only one of our specimens has a ventral valve depth as great as listed by Swallow. Surface of shell punctate.

Remarks—The species is readily recognized by the extreme projection back of the hingeline, small plications, and narrow hingeline. No other species of *Stropheodonta* in the fauna has an average length of hingeline compared to length of shell less than 50 per cent greater than this.

Schuchert uses the specific name "*navalis*" for this form, but the most characteristic feature, the projecting umbones, is not present in *navalis*. The ears are not strongly arched towards the area as in *navalis* and the cardinal line is generally shorter than the width of the shell while it is longer in *navalis*.

Occurrence—Snyder Creek shale, Callaway and Montgomery Counties.

Stropheodonta demissa (Conrad)

Plate 11, figures 3 and 8; plate 14, figures 1-8.

1842. *Strophomena demissa* Conrad, Jour. Acad. Nat. Sci., Phila., VIII, p. 258, pl. 14, fig. 14.
1852. *Strophodonta dimosa* (?) Owen, Geol. Survey Wisconsin, Iowa and Minnesota, tab. 3a, fig. 14.
1857. *Strophomena* (*Strophodonta*) *demissa* Hall, Tenth Rep. N. Y. State Cab. Nat. Hist., pp. 137-139, figs. 1-2.
1858. *Strophomena demissa* Rogers, Geol. Penna., II, p. 827, fig. 666.
1858. *Strophodonta demissa* Hall, Geol. Surv. Iowa, I, pt. 2, p. 495, pl. 3, fig. 5.
1860. *Strophodonta quadrata* Swallow, Trans. Acad. Sci., St. Louis, I, p. 639.
1867. *Strophodonta demissa* Hall, Pal. N. Y., IV, pp. 81 and 101, pl. 11, figs. 14-17; pl. 12, figs. 1-5; pl. 17, figs. 2a-2s.

1880. *Strophodonta demissa* White, Second Ann. Rep. Indiana Bureau of Statistics and Geol., p. 500, pl. 4, figs. 6, 7.
1881. *Strophodonta demissa* White, Tenth Rep. Indiana State Geol., p. 132, pl. 4, figs. 6, 7.
1882. *Strophodonta demissa* Whitfield, Geol. Wisconsin, IV, p. 327, pl. 25, fig. 18.
1889. *Strophodonta demissa* Nettleroth, Kentucky Fossil Shells, Mem. Kentucky Geol. Survey, p. 143, pl. 18, figs. 10-16; pl. 33, fig. 22.
1892. *Strophodonta demissa* Hall and Clarke, Pal. N. Y., VIII, pt. 1, pl. 14, figs. 7-12.
1895. *Strophodonta demissa* Keyes, Geol. Survey Missouri, V, p. 70, pl. 39, fig. 7.
1897. *Strophodonta demissa* Schuchert, Bull. U. S. Geol. Surv., 87, p. 421.
1907. *Strophodonta demissa* Grabau and Shimer, North American Index Fossils, I, p. 217, fig. 263.
1913. *Strophodonta demissa* Prosser and Kindle, Maryland Geol. Survey, Middle and Upper Devonian, pp. 136-137, pl. 10, fig. 1; Clarke and Swartz, p. 551, pl. 47, fig. 14.

Hall's description—Somewhat modified in accordance with the specimens from the Missouri Devonian—Shell commonly semielliptical, usually wider than long, length and breadth often nearly equal, hingeline usually greater than the width of the shell in front, extremities often auriculate; in some specimens the sides are nearly straight, and parallel for more than half the length of the shell.

Pedicle valve nearly flat to regularly convex, greatest elevation nearly central; umbo small, with the apex slightly incurved and extending beyond the area; surface a little concave towards the cardinal angles, which are slightly deflected. Dorsal valve moderately concave, closely following the convexity of the opposite valve; in some specimens an ill-defined median depression extends from beneath the apex to the front of the shell.

Area of pedicle valve variable, usually of moderate width, varying from 1 mm. to 2 mm. wide in the centre in average specimens, and narrowing toward the extremities. Inner margin crenulated for nearly its entire length. There is no open delthyrium but a triangular space below the beak of many specimens marks its location. 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 sometimes to give less than a right angle between them, but generally a 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 pedicle valve, with finer ones coming in between and on either side; striae frequently increasing by intercalation and bifurcation until they become very numerous.

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 occlusor muscular impressions occupy a semielliptical space on each side of the 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 minutely pustulose, the points being more prominent just without their limits; beyond which, the course of the vascular impressions can be distinctly traced.

In the brachial valve, the anterior and posterior occlusor muscular impressions are very conspicuous and deeply marked, and often limited by an elevated ridge, a narrow longitudinal ridge dividing the two parts. On each side, and below the muscular impressions, the surface is minutely pustulose, the vascular impressions becoming distinct towards the margin. The cardinal process is divided from the base, the divisions strongly diverging.

Remarks—This is a rare form in the Mineola and the individuals are always small, the maximum size collected measuring less than an inch along the hingeline. In the Callaway it is common and a tendency toward variation in several directions has appeared. In the Snyder Creek it is very abundant and *S. boonensis* Swallow, *S. callawayensis* Swallow, *S. cymbiformis* Swallow, *S. navalis* Swallow, *S. inflexa* Swallow and *S. equicostata* Swallow developed from it in a short time. None of the new species lived beyond Snyder Creek time. More than 1,000 specimens of these stropheodonts are in the collections of the University of Missouri and the variations present are remarkable as they all took place while 25 feet of shales and limestones were being deposited.

Occurrence—Mineola of Warren, Montgomery, Ralls and Callaway Counties; Callaway of Warren, Montgomery, Callaway, Boone and Moniteau Counties; Snyder Creek of Montgomery and Callaway Counties.

Stropheodonta equicostata Swallow

Plate 11, figure 6; plate 12, figures 9-17.

1860. *Strophodonta aequicostata* Swallow, Trans. St. Louis Acad. Sci., I, p. 639.
1860. *Strophodonta quadrata* Swallow, Ibid., p. 639.
1897. *Stropheodonta callawayensis, quadrata* and *aequicostata* Schuchert, Bull. U. S. Geol. Surv., 87, pp. 420 and 425.

Swallow's description—"Shell suborbicular, auriculate, with a sinus on each lateral margin anterior to the ears. Ventral valve subsemihemispherical, regularly convex, but most arched between the beak and the center; ears defined by a depression on this valve and the sinuses on the lateral margins; they are arched and but slightly change the regular contour of the valve; area straight, narrow, vertically striated, and common to both valves; umbo depressed; beak small, depressed. Dorsal valve very concave, following closely the curvature of the opposite valve, much flattened towards the cardinal border; lateral edges depressed and arched to form the concave surface of the ears; cardinal border slightly arched and finely crenulated. Surface marked by numerous small, rounded, granulated, radiating plications, and by very fine concentric striae, and imbricating plications of growth.

Length, 1.18; breadth, 1.45; depth, .53; cardinal line, 1.20."

Supplementary description—The specimens which come nearest to other parts of Swallow's description do not have projecting auriculations and as his measurements show the hingeline about 1/6 shorter than the maximum width of the shell, he probably meant only that the auriculations are distinct. The sinus anterior to the ear is not present on the most typical specimens of the group but occurs on a variety which grades towards *S. cymbiformis* Swallow. The most typical examples have the hingeline about the same width as the shell but the variations seem to be towards shorter hingelines in every case. Three typical examples give the following measurements: Length, 24, 24, 26 mm.; length of hingeline 26, 28, 26 mm.; convexity 12, 12, 14½ mm. The greatest width of specimen 3 is 2 mm. more than the width of the hingeline. One specimen of the *cymbiformis* type has a hingeline length of 17 mm. and a greatest width of 21 mm. A specimen with a hinge length of 13 mm., and a maximum width of 19 mm. is intermediate between *S. cymbiformis* Swallow and *S. equicostata* Swallow. The fine plications are rounded to subangular and vary from 14 to 20 to the centimeter. None of the specimens has fine concentric striae though a few lines of growth are present. The plications appear granulated on account of numerous very small pores.

The varieties of this species grade toward *S. cymbiformis* Swallow but the typical forms are quite distinct and none of them has the umbo projecting prominently back of the hingeline. In another direction it grades toward *S. demissa* (Conrad) but differs from it in the much more strongly arched valves and shorter hingeline.

Remarks—Schuchert uses the name *S. callawayensis* Swallow for this species, but *callawayensis* can not be positively identified among the Snyder Creek specimens from Swallow's description and *equicostata* is easily identified. No specimens among our 1,000

has a very convex valve flattened near the anterior and lateral margins as described by Swallow for *callawayensis*. Swallow describes *callawayensis* as having "ears large, well defined, and arched towards the cardinal border" and as having "numerous small, rounded, granulated, radiating costae." The specimens having ears of this description do not have fine plications but the plications run 8 to 14 to the centimeter with an average of about 10.

Occurrence—Snyder Creek shale, Callaway and Montgomery Counties.

Strophеodonta inequiradiata Hall

Plate 11, figure 15; plate 14, figures 10 and 11.

1857. *Strophomena (Strophodonta) inaequiradiata* Hall, Tenth Rep. N. Y. State Cab. Nat. Hist., pp. 113-114, figs. 1-3.
1861. *Strophomena inaequistriata* Billings, Canadian Jour. Sci., Arts, VI, p. 338, fig. 113.
1863. *Strophomena inaequistriata* Billings, Geol. Canada, p. 367, fig. 375.
1867. *Strophodonta inequiradiata* Hall, Pal. New York, IV, p. 87, pl. 11, figs. 24-31 pl. 12, fig. 12; pl. 13, figs. 6-11.
1874. *Strophomena inaequiradiata* Billings, Pal. Fossils, II, p. 24, fig. 13; pl. 2, figs. 4 and 4a.
1883. *Strophodonta inaequiradiata* Hall, Second Ann. Rep. New York State Geol., pl. 45, figs. 13 and 14.
1884. *Strophodonta inaequiradiata* Walcott, Mon. U. S. Geol. Survey, VIII, p. 120, pl. 11, fig. 11.
1892. *Stropheodonta inaequiradiata* Hall and Clarke, Pal. New York VIII, pt. 1, pl. 14, figs. 13 and 14.
1897. *Stropheodonta inaequiradiata* Schuchert, Bull. U. S. Geol. Survey, 87, p. 422.
1909. *Stropheodonta inaequiradiata* Grabau and Shimer, North American Index Fossils, I, p. 216, fig. 259.

Hall's description—"Shell semielliptical or semicircular, more or less gibbous, approaching a hemispheric form; cardinal extremities sometimes salient, but often rounded, and the cardinal line less than the width of the shell below. The ventral valve varies from moderately convex to gibbous, often forming a somewhat regular arch from beak to front, usually with the greatest convexity above the middle, depressed and often concave between the umbo and the cardinal extremities, which (in perfect shells) are somewhat salient; beak a little elevated above the hingeline, and incurved; area very narrow, linear, and finely crenulate. The dorsal valve is concave, often in a less degree than the convexity of the ventral valve; the disc sometimes very slightly concave, and abruptly deflected or almost geniculate towards the front.

The surface presents much variety of character and aspect, both in the original shell and in its partial or entire exfoliation. The striae on the ventral valve are often coarse and uneven, somewhat fasciculate, and often rising in ridges which in the exfoliated shell do not show the divisions. Some specimens have the striae sharp and slender, and nearly equal, with wider plain intermediate spaces. On the dorsal valve the striae are pretty uniform; the stronger ones being distant, sharp and elevated, with wide intermediate spaces marked by extremely fine regular striae, from the midst of which, as the shell increases, the elevated striae arise, dividing the space in which the smaller striae are constantly increasing by intercalation."

Remarks—The Mineola specimens are all internal casts of pedicle valves and are not well preserved. Only one shows the fine striations between plications as shown in figure 15 of plate 11. The most characteristic features of this shell are the increase of plications near the middle of the pedicle valve by implantation, and the fine striae that mark the spaces between the plications. Muscular impressions are preserved on all of the specimens but they are of little aid in identification.

Occurrence—Mineola of Montgomery County.

Stropheodonta inflexa Swallow

Plate 13, figures 13-17

1860. *Strophodonta inflexa* Swallow, Trans. St. Louis Acad. Sci., I, p. 637.
1897. *Stropheodonta navalis boonensis* Schuchert, Bull. U. S. Geol. Surv. 87, p. 425.

Swallow's description—"Shell semiellipsoidal, but a little wider in front, regularly arched and coarsely costated. Ventral valve very convex, semiellipsoidal, wider in front, highest near the center—regularly arched to the anterior margin, more abruptly at the posterior extremity, and somewhat flattened near the beak—very regularly arched transversely, but most abruptly on the obsolete mesial fold; ears very small, or obsolete; beak small, depressed; area straight, narrow, impressed, and common to both valves; umbo large and prominent. Dorsal valve semielliptical, less convex, slightly depressed in front; lateral edges recurved and slightly arched where they meet the cardinal line; cardinal line as long or shorter than the width of the shell, situated about one-third of the length of the shell from the posterior extremity. Surface marked with large subangular, unequal, irregular, granulated costae, increased by implantations and subdivisions; structure punctate.

Length, 1.41; breadth, 1.21; depth of ventral valve, .83."

Supplementary description—The specimens show the cardinal line about 1/5 the length of the shell from the posterior extremity rather than 1/3 as stated by Swallow but in other respects Swallow's description is good. The species seems good and is easily distinguished from *S. cymbiformis* Swallow by its coarser plications, much broader arching, and broader form (length compared to breadth 9:10 to 10:10), and from *S. boonensis* Swallow by its smaller plications, projecting umbo, shorter hingeline, and greater convexity. The plications run 8 to 12 to the centimeter as compared with 12 to 18 in *S. cymbiformis* Swallow and 6 to 12 in *S. boonensis* Swallow. It differs from *S. equicostata* Swallow in having a much thicker shell, coarser plications, less prominent auriculations, and greatest convexity directly below the hingeline.

Occurrence—Snyder Creek shale, Montgomery and Callaway Counties.

Stropheodonta mineolaensis n. sp.

Plate 12, figures 18-21

Shell of medium size, plano-convex to strongly concavo-convex, cardinal extremities blunt, hingeline little longer than the greatest width of the shell. Pedicle valve with point of greatest convexity near the umbo, surface concave toward cardinal extremities, area narrow. Brachial valve flat to strongly concave, area very narrow.

The plications constitute the distinctive feature of the species. Three or four plications originate at the beak, and these form the dominant plications across the shell. By bifurcation these give rise to about 8 or 9 each and they remain in distinct groups. Outside these groups, on the cardinal extremities, the plications are faint or obsolete. The shells of greater convexity have stronger plications nearer the cardinal extremities than the less convex shells.

The largest specimen in our collection measures 38 mm. in width, 24 mm. in length and 6 mm. in height. A convex specimen measures 22 mm. wide, 20 mm. long and 8 mm. in height.

Hall described *S. plicata* from Iowa and this species resembles it very closely. In the Snyder Creek shale are young specimens that would be referred to *S. plicata* Hall without question but the mature forms are *S. callawayensis* Swallow.

Figures 2, 4 and 5 of plate 14 are of immature forms of *S. demissa* (Conrad), while figure 6 of plate 13 seems to be an immature specimen of *S. boonensis* Swallow. However, it is always difficult and in many cases impossible to refer the immature specimens from the Snyder Creek shale to their proper species. In *S. plicata* Hall, 6 to 8 plications originate at the beak and as they pass outward and bifurcate they do not form

bundles as in *S. mineolaensis*. The major plications are subequal in size in *S. plicata* Hall, while about three plications are much the largest in *S. mineolaensis*.

The specimen figured by Kindle in the 25th Annual Report of the Indiana Department of Geology and Natural Resources, figure 2, of plate 6, may belong to the Mineola species rather than to *S. plicata* Hall.

Occurrence—Mineola of Ralls County. The variation toward coarse plications was common with *S. demissa* (Conrad) but seems to have gone so far as to produce well-marked species with distinguishing features other than coarse plications in only a few cases. Three of these were in the Snyder Creek shale and one in the Mineola limestone.

Stropheodonta navalis Swallow

Plate 11, figure 7; plate 12, figures 4-8; plate 14, figure 12.

1860 *Strophodonta navalis* and *subnavalis* Swallow, Trans. St. Louis Acad. Sci., I, pp. 635.

1897. *Stropheodonta navalis* Schuchert, Bull. U. S. Geol. Surv. 87, pp. 424-425.

Swallow's description—"Shell rather large, thick semielliptical, carinate, punctate, costate. Ventral valve very convex, obtusely carinated, somewhat flattened towards the lateral margins; strongly arched from the beak to the middle, with a more gentle curve towards the anterior margin, where the carina is somewhat depressed and rounded; beak small, incurved slightly beyond the cardinal border; umbo large, projecting slightly beyond the cardinal border; ears distinctly defined and strongly arched towards the area; area straight, linear, common to both valves and vertically striate. Dorsal valve very concave, closely following the curvatures of the ventral, recurved along the cardinal margin, forming the concave surface of the ears; cardinal line as long or longer than the width of the shell. Surface marked by numerous subirregular, rounded, granular, radiating plications; but few originate at the beak of the ventral valve; the number is increased by subdivisions and implantations. The punctate structure is very obvious where the shell is worn or exfoliated.

Length, 1.40; breadth, 1.44; depth of ventral valve, .61."

Supplementary description—The shell is rather thin in small specimens. The flattening toward the anterior margin is indistinct to obsolete. The umbo is small in comparison with *S. inflexa* Swallow and *S. cymbiformis* Swallow. The plications are intermediate in size between *S. boonensis* Swallow and *S. equistriata* Swallow averaging fewer than 10 to the centimeter. Some are rounded and some subangular. The dimensions of one average and one large specimen are: Length 28 and 39 mm.; breadth 32 and 42 mm.; height 15 and 18 mm. The width in each case is along the hingeline, both ends of which are missing. The probable width exceeds the measurements by about 5 millimeters.

This species resembles *S. callawayensis* Swallow, from which it differs in greater convexity, carinate pedicle valve, greater length compared to width, and more prominent umbo.

Occurrence—Snyder Creek shale, Montgomery and Callaway Counties.

Genus Pholidostrophia Hall and Clarke

Pholidostrophia iowaensis (Owen)

Plate 11, figure 9

1852 *Chonetes* (?) *iowensis* Owen, Geol Survey Wisconsin, Iowa, Minnesota, p. 584, pl. 3a, fig. 7.

1867. *Strophodonta nacrea* Hall, Pal. New York, IV, pt. 1, p. 104, pl. 18, fig. 1.

1897. *Pholidostrophia iowaensis* Schuchert, U. S. G. S. Bull. 87, p. 308.

Hall's description—"Shell small, semielliptical, having a brilliant nacreous lustre; hingeline crenulated, equalling or a little less than the greatest width of the shell below, and sometimes terminating in more or less distinct angles. Dorsal valve concave. Ventral valve sometimes regularly convex, flattened at the margins, often depressed-convex in the umbonal region and abruptly arched towards the front; beak very small and depressed; area very narrow, linear, without foramen. The area of the dorsal valve is often nearly as wide as that of the ventral valve.

Surface apparently smooth, but under a lens showing very faint concentric lines of growth, with sometimes obscure traces of radiating lines.

The muscular impressions in the ventral valve extend more than half the length of the shell. The divaricator muscular imprints are deeply depressed, elongate-ovates narrowing above and somewhat widely separated below; while the occlusor impressions are narrow-ovate spots on the thickened portion of the shell, and below these extends a narrow elevated band separating the other impressions. In the dorsal valve, the anterior and posterior occlusor muscular impressions are small and not strongly defined. The cardinal process is slender, bifurcating, with a narrow rounded ridge extending from its base down the middle of the valve. The interior of the shell, excepting the muscular impressions, is studded with prominent scattered granules or papillae. The crenulations on the hingeline are rather distant, but conspicuous."

Occurrence—Specimens of this species are rare in the Mineola limestone of Montgomery County.

Genus Strophonella Hall

Strophonella crassa Rowley

Plate 11, figures 12, 13 and 14.

1894. *Strophonella crassa* Rowley, Am. Geologist, XIII, p. 153, figs. 4-6.
1897. *Strophonella crassa* Schuchert, U. S. G. S. Bull. 87, p. 438.
1909. *Strophonella crassa* Greger, Am. Jour. Sci., XXVII, p. 377.

Rowley's description—"Shell semicircular, slightly eared at the cardinal extremities. Heavy and thick for a species of this genus. Dorsal valve slightly concave from the obsolete beak to the middle, convex beyond. Striae numerous, rather small and indistinct on both valves, probably due in part to the state of preservation of the type. Ventral valve low-convex behind the beak, flat toward the circumference. Beak not incurved, slightly elevated, giving a wide, low, triangular cardinal area. Both valves have areas but there is no deltidium.

This species is apparently nearly related to *S. reversa* Hall, but is much larger form, with less concavity to the dorsal valve and less convexity to the ventral valve."

Remarks—The writer has examined only one specimen of this species, one of Mr. Rowley's paratypes. The pedicle opening is about twice as high in the pedicle valve as in the brachial and is completely closed by stony matter in both.

Occurrence—Snyder Creek shale, localtity 1, Callaway County.

Genus Schuchertella Girty

Schuchertella arctostriata (Hall)

Plate 15, figures 8, 9, 12; plate 24, figures 18-23.

1843. *Strophomena arctostriata* Hall, Geol. N. Y., Rept. Fourth Dist., p. 266, fig. 3.
1897. *Orthothetes chemungensis arctistriatus* Schuchert, Bull. U. S. Geol. Surv., 87, pl. 296.
1909. *Schuchertella arctostriata* Grabau and Shimer, North American Index Fossils, I, pp. 229-230, figs. 280 a and b.
1911. *Schuchertella chemungensis arctistriata* Cleland, Bull. 21, Wisconsin Geol. Surv., p. 91, pl. 16, fig. 15.

Hall's description—"Shell semicircular or semielliptical, frequently unsymmetrical, the proportions of length and breadth varying in different individuals; hingeline straight, nearly or quite equal to or greater than the greatest width of the shell; sides nearly rectangular to the hingeline, or curving inwards. Ventral valve more or less convex towards the umbo and sometimes in the middle, curving downwards or flattened towards 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."

Remarks—The interiors are not preserved in any of the specimens from Missouri. The outstanding features of the shells are the crenulated striae which increase by interstitial additions, the shape of the valves, and the strong convex deltidium. It differs from *Schuchertella parva* from the Iowa Devonian in having a low area with the shell not distorted. Specimens of a *Schuchertella* from the Lime Creek shale of Iowa agree in every respect with the Missouri specimens but not with Hall's description of *S. parva*. It is possible that a large series of specimens from the Lime Creek would show that *S. parva* (Hall) is a synonym of *S. arctostriata* (Hall). Hall used only one specimen for illustration and description.

Occurrence—Snyder Creek shale of Callaway County.

Schuchertella cf. pandora (Billings)

Plate 11, figures 5 and 14.

1860. *Streptorhynchus pandora* Billings, Canadian Jour., V, p. 226, figs. 12, 13.
1863. *Streptorhynchus Pandora* Billings, Geol. Canada, p. 369, fig. 384.
1867. *Streptorhynchus pandora* Hall, Pal. New York, IV, pp. 68-70, pl. 4, figs. 11-19; pl. 9, figs. 18-25, 27.
1874. *Streptorhynchus pandora* Nicholson, Pal. Prov. Ontario, p. 70.
1883. *Streptorhynchus chemungensis var. pandora* Hall, Second Ann. Rep. N. Y. State Geol., pl. 40, figs. 1-6.
1892. *Orthothetes chemungensis var. pandora* Hall and Clark, Pal. New York, VIII, pt. 1, p. 255, pl. 9, fig. 30; pl. 10, figs. 1-6.
1897. *Orthothetes pandora* Schuchert, U. S. Geol. Surv., Bull. 87, p. 298.
1909. *Schuchertella pandora* Grabau and Shimer, North American Index Fossils, I, p. 229, fig. 279.
1912. *Schuchertella pandora* Kindle, Bull. U. S. Geol. Surv., 508, p. 76, pl. 3, figs. 7 and 8.

Hall's description—"This shell, in its symmetrical form is somewhat semioval, the length and width being about as four to five. A well-formed specimen, of one inch in length, measures one and a quarter inches in width; hingeline equal to the greatest width of the shell, and forming right angles with the sides, which are usually nearly straight; the front broadly rounded; cardinal extremities sometimes a little salient, and sometimes rounded. Ventral valve convex on the umbo, the greatest convexity being at the apex, from which the surface slopes in a regular plane to the sides and middle of the shell, becoming slightly concave below the middle of the shell, becoming slightly concave below the middle and along the front; area large triangular, extending the entire length of the hingeline, and inclining over the dorsal valve at an angle of about 110°. The foramen has been large, about twice as wide at the base as the height, and is closed by a convex deltidium. Dorsal valve moderately convex, a little flattened towards the cardinal extremities, and curving towards the sides and front; area narrow and linear.

Surface striated by numerous fine strongly elevated striae, which are increased by bifurcation and interstitial additions, and crenulated by fine closely arranged concentric striae.

The interior of the ventral valve is marked by strong dental lamellae and a broad flabellate muscular impression, which, in well-preserved specimens, shows the cordiform imprint of the adductors, and a short low mesial septum in the upper part.

The interior of the dorsal valve preserved deep dental sockets, with thick socket-plates which support the duplicate cardinal process, each division of which is grooved at the extremity. There is likewise a small process between the two branches of the cardinal process; and below the hingeline, the flabelliform muscular impression is divided by a low rounded mesial longitudinal ridge or obsolete septum.

Remarks—The specimens identified with *S. pandora* are so rare, and imperfectly preserved that a comparison is more nearly the correct word than identification.

Occurrence—Rare in the Mineola of Warren and Montgomery Counties.

Family Productidae

Genus Productella Hall

Productella callawayensis (Swallow)

Plate 11, figures 10 and 16; plate 15, figures 10, 11, 13 and 14

1860. *Productus Callawayensis* (Swallow), Trans. St. Louis Acad. Sci., I, p. 640.
1894. *Productella marquessi* Rowley, Am. Geologist, XIII, p. 153, figs. 7 and 8.
1894. *Productella subalata* Keyes. Geol. Survey Missouri, V, p. 52.
1897. *Productella marquessi* Schuchert, Bull. U. S. Geol. Surv., 87, p. 316.
1909. *Productella marquessi* Greger, Am. Jour. Sci., XXVII, p. 376.
1909. *Productella callawayensis* Greger, Am. Jour. Sci., XXVII, p. 376.

Swallow's description of P. callawayensis—"Shell small, thin, depressed, spinose, varying from semiorbicular to suborbicular. Ventral valve very regularly convex, but most so on the umbo, flattened towards the ears; break small, incurved to or slightly over the cardinal line; umbo small, prominent, projecting a little back of the cardinal line; ears large flattened triangular, slightly arched towards the cardinal line, rounded on the outer angle; mesial sinus obsolete, or entirely wanting. Dorsal valve regularly concave, most depressed in the middle in adult specimens, but nearer the beak in the young; ears well defined, triangular, slightly arched; cardinal line as long or shorter than the width of the shell; curved at the extremities towards the lateral margins and down towards the center of the ventral valve. Surface marked with small, irregular, iterrupted corrugations and striae; both valves thickly set with depressed spines, whose bases are more or less prolonged into longitudinal plications; spines on the dorsal valve, smaller.

Length, .85; breadth, 1.12; thickness, .40."

Rowley's description of P. marquessi—"This small shell is subcircular in outline. Cardinal line of a little less length than the greatest width of the shell. Ventral valve without striae but provided with a few slender spines, convex. Beak incurved. Cardinal area very narrow, scarcely appearing more than a line. Dorsal valve deeply concave, apparently without striae or spines. Lines of growth cross both valves.

This little *Productella* resembles *P. pyxidata* Hall from the Lithographic limestone, but is much smaller and from a lower horizon. Length of type 5/16, width 6/16 of an inch."

Description—Shell usually small but ranging to large, the small shells about equidimensional but the large ones wider than long, the hingeline a little shorter than the greatest width. Average specimens are about 7 mm. wide by 7 mm. long with a convexity of the pedicle valve of about 3 mm. The largest specimen in the collection of

the University of Missouri if 40 mm. wide, 28 mm. long, with a convexity of the pedicle valve of 13 mm.

Pedicle valve strongly convex in small specimens, moderately convex in large, greatest convexity posterior to the middle; the umbonal region projecting considerably beyond the hingeline; cardinal extremities well differentiated in large specimens, not differentiated in small; no mesial sinus; beak small and strongly incurved.

Brachial valve moderately concave, with the surface slighly deflected towards the cardinal extremities. The cardinal process is small, bifid, each division excavated longitudinally on its outer surface. From the base of the cardinal process a pair of shallow furrows extends outward at an angle of about 80° from the median line of the shell to near the cardinal extremities and back of the furrow a low ridge forms its boundary. From the base of the cardinal process an illdefined furrow runs forward for about one-fourth the length of the shell, where it is replaced by a sharp-topped narrow low median septum which extends about one-third the length of the shell. The brachial impressions are weak and extend about three-fourths the width and length of the shell. The inner surface is covered by radiating papillae.

Surface of both valves marked by a few lines of growth. Spines slender, numerous, arranged in irregularly concentric and radiating lines. A specimen 19 mm. wide has one spine 1/8 mm. in diameter and 2½ mm. long preserved. The spines are recumbent and often against the shell for one or two millimeters. The brachial valve spines are not infrequently missing, but all well preserved specimens have them.

Remarks—This species differs from *P. subalata* Hall of the Cedar Valley limestone in the abundance of spines, slenderness of spines, recumbency of spines, much less convexity, and greater comparative width of large specimens. Rowley's *P. marquessi* seems to belong with Swallow's species. The absence of spines on the brachial valve would be sufficient to differentiate it, but many of the specimens of *P. callawayensis* Swallow show only very faint spines owing to poor preservation. This is shown in figure 13 of plate 15.

Occurrence—Snyder Creek shale of Callaway County.

Productella spinulicosta Hall

1854. *Productus subaculeatus* Norwood and Pratten (non Murchison), Jour. Acad. Nat. Sci., Philadelphia, III, p. 21.
1857. *Productus spinulicosta* Hall, Tenth Rep. N. Y. State Cab. Nat. Hist., p. 173.
1867. *Productella spinulciosta* Hall, Pal. New York, IV., pt. I, p. 160, pl. 23, figs. 6-8, 25-34.
1897. *Productella spinulicosta* Schuchert, U. S. Geol. Surv., 87, p 318.
1901. *Productella spinulicosta* Kindle, Indiana Dept. Geol. Nat Res., 25th Ann. Rept., pp. 629-630, pl. 6, figs. 9 and 9a.
1903. *Productella spinulicosta* Clarke, N. Y. State Mus., Bull. 65, p. 292.
1909. *Productella spinulicosta* Grabau and Shimer, North American Index Fossils, I, p. 241, figs. 293c, d.
1913. *Productella cf. spinulicosta* Prosser and Kindle, Maryland Geol. Survey, Middle and Upper Devonian, ppl. 162-163, pl. 13, figs. 17-20.

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 form 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."

Remarks—The specimens identified as *P. spinulicosta* Hall are rare and in most cases not well preserved. They are all small.

Occurrence—Mineola of Montgomery and Warren Counties.

Superfamily Pentameracea

Family Pentameridae

Genus Pentamerella Hall

Pentamerella arata (Conrad)

Plate 16, figure 16; plate 17, figures 17-23

1841. *Atrypa arata* Conrad, Fifth Ann. Rep. Geol. Survey N. Y., p. 55.
1867. *Pentamerella arata* Hall, Pal. New York, IV, pt. 1, p. 375, pl. 58, figs. 1-21.
1897. *Pentamerella arata* Schuchert, U. S. G. S. Bull. 87, p. 302.
1901. *Pentamerella arata* Kindle, Indiana Dept. Geol. Nat. Res., 25th Ann. Rept., p. 615, pl. 7, fig. 2.
1909. *Pentamerella arata* Grabau and Shimer, North American Index Fossils, I, pl. 277, fig. 337.

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; hingeline 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 hingeline 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."

Remarks—This species is abundant in the Mineola. It is extremely variable in size, shape and plications. The largest specimen is 28 mm. long by 35 mm. wide, while average specimens are about 14 mm. long by 14 mm. wide. Some specimens have no more than 8 plications to a valve while others have 25; in some the plications are very strong (see figure 18) while in others they are scarcely visible (see figure 22). In some the plications extend two-thirds the length of the shell while in others they are confined to the margin.

Occurrence—Abundant in the Mineola of Montgomery and Ralls Counties.

Pentamerella missouriensis n. sp.

Plate 24, figures 1-4; plate 23, figure 5.

Description—General outline of the shell ovate, narrower at the pedicle end, width 16 mm., length 16 mm. Pedicle valve moderately convex with the greatest convexity directly above the hingeline. A shallow sinus originates about the middle and occupies a little less than half the width of the shell at the front margin. The back two-fifths of the valve is narrow and projects more than one-third the length of the shell back of the hingeline. The beak is strongly incurved but not over the hingeline. Two faint plications extend back from the margin in the sinus for about one-fourth the length of the shell. Strong plications form the margins of the sinus for about one-fourth the length of the valve. On one side of the sinus there are two strong plications and on the other side three that are not so strong. The plications bounding the sinus are the strongest. The sinus part projects 6 mm., or three-eights the length of the valve in front of the rest of the valve. The hingeline is 6 mm. long, three-eights the width of the shell

The brachial valve is elliptical in outline. Along the top of the fold it is nearly straight. The fold originates about the middle of the valve and in a distance of 6 mm. rises to a height of 5 mm. The sides are very abrupt and the top is rounded. Outside the fold the valve slopes gently to the margins. The right half of the valve is missing. On the left there is one plication 3 mm. long and another very faint one of about the same length.

Holotype, one imperfect specimen.

Snyder Creek shale of Callaway County.

Pentamerella fultonensis n. sp.

Plate 16, figures 21-23; plate 24, figures 10-12

Description—General outline of the shell subovate, narrower toward the pedicle end, gibbous, width and length subequal. Pedicle valve strongly convex, with the greatest convexity slightly in front of the hingeline. A shallow sinus originates near the middle and occupies more than one-third the width of the shell at the front margin. The beak is strongly incurved but not over the hingeline. A very short median septum is present. The brachial valve is much less convex than the pedicle. The beak projects beyond the hingeline and the greatest convexity is a short distance in front of the hingeline. A fold that is inconspicuous in some specimens, and strong in others, appears near the front of the valve. Faint indications of rather small plications appear on both valves but are not apparent to the naked eye. The interior of the pedicle valve has a spoon-shaped pit that extends about one-half the length of the shell. In the brachial valve the crura are united at their bases, making a V-shaped or U-shaped trough which is attached to the valve at the upper part and extends for about one-half the length of the shell.

The most striking peculiarity of the shell is the lack of plications visible to the naked eye, and it should, perhaps, be referred to the genus *Clorinda*.

Occurrence—Callaway limestone, Callaway County.

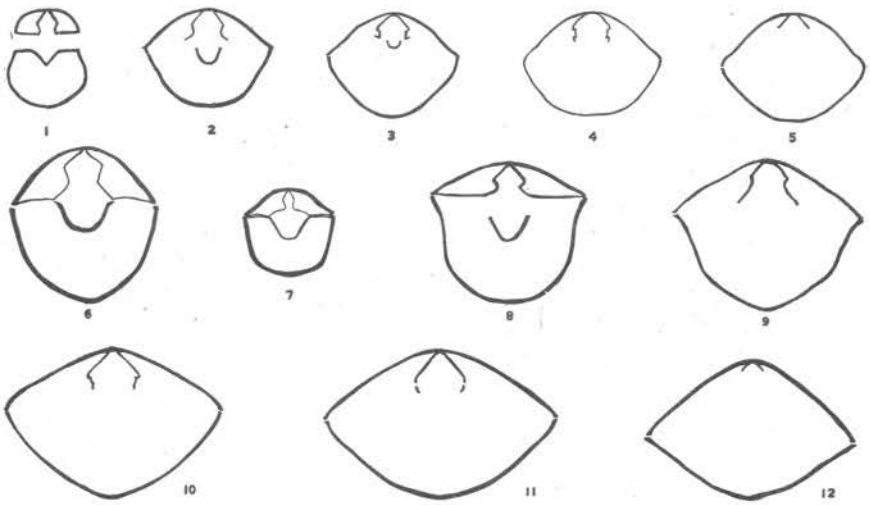

Fig. 6. Sections of *Pentamerellas*.

1-5. *Pentamerella arata* (Conrad). Sections of a small specimen from the Mineola. The brachial valve was 11½ mm. long and the sections were made 1 mm., 3½ mm., 4.5 mm., 4 6 mm. and 5.2 mm. from the beak. The septae continue for less than one millimeter in front of the last section.

6. *Pentamerella arata* (Conrad). Section near the beak of a specimen from the Jeffersonville beds of Indiana.

7-12. *Pentamerella fultonensis* Branson. Sections of a specimen with a brachial valve 14 mm. long. The sections were made 1.5 mm., 2.1 mm., 3.2 mm., 5 mm., 5.7 mm. and 6.3 mm. from the beak.

All sections are arranged in series with the smaller numbers nearer the beak.

Genus Gypidula Hall

Gypidula marionensis Greger

Plate 16, figures 17-20.

1920. *Gypidula marionensis* Greger, Am. Jour. Sci., vol. 50, p 24.

Description—Shell small subglobose, the pedicle valve much more convex than the brachial. In old specimens the convexity of the pedicle valve is proportionately much greater than in young specimens. The beak of the pedicle valve is strongly incurved but ordinarily not overlapping the beak of the brachial valve. A very short median septum. The shell is smooth and has no indication of fold or sinus. The brachial valve is much less convex than the pedicle. It is smooth and has no fold or sinus. The crural plates and septae extend about half the length of the valve and are nearly parallel, though the septae converge to form a point at their anterior end.

The dimensions of an average specimen are: Length 10 mm., width 9 mm., thickness 9.5 mm. A specimen with an unusually large pedicle valve measures: Length 9 mm., width 10 mm., thickness 12 mm.; in this specimen the height of the pedicle valve is 9 mm.

The distinguishing feature of this species are its smoothness, small size, and unusual height of the pedicle valve.

Greger published no description or figure.

Occurrence—Abundant in the Cooper of Monroe County.

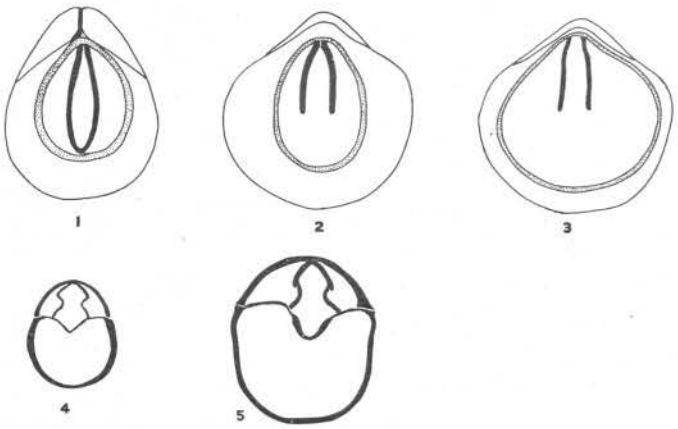

Fig. 7. Sections of *Gypidula marionensis* Greger.

1-3. *Gypidula marionensis* Greger. Sections of the brachial valve showing the extent of the loop. Fig. 1 is of a different specimen than figs. 2 and 3, and is cut near the top of the valve. The dotted areas represent the cut edge of the shell.

4 and 5. *Gypidula marionensis* Greger. Transverse sections in front of the short median septum of the pedicle valve, showing the spondylia.

Gypidula mineolaensis n. sp.

Plate 23, figures 6, 10, 11

Description—Pedicle valve moderately convex, the summit of the convexity directly above the hingeline, from which the sides slope abruptly to the beak and cardinal margins and gently to the other margins. The umbo projects strongly beyond the hingeline. The beak is small and only slightly incurved. A very short median septum is present. The cardinal area is small and rounds imperceptably to the rest of the shell. The delthyrium is wide and low. There is no fold or sinus on the specimens collected. The valve is marked by about 30 low angular plications which extend more than half way to the beak in the middle of the shell but a much shorter distance near the margins.

Only two brachial valves are in our collection, and they are imperfect. The shell is much less convex than the pedicle valve. It is marked by similar plications and has no fold or sinus.

Remarks—The species resembles *Gypidula multicostata* Dunbar but the plications extend only a short distance on the shell; fold and sinus are not present; the plications extend to the cardinal margins, and the shell is much wider compared to the length.

Occurrence—Mineola of Ralls County.

Order Telotremata

Superfamily Rhynchonellacea

Family Rhynchonellidae

Genus Camarotoechia Hall and Clarke

Camarotoechia depressa (Kindle)

Plate 24, figure 16.

1901. *Rhynchonella depressa* Kindle, Ind. Dept. Geol. Nat. Res., 25th Ann. Rept., pp. 589-590, pl. 7, figs. 5, 5a, 5b.

Kindle's description—"Shell small, flattened, trigonoid-subovate in outline; cardinal lines forming nearly a right angles 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."

Remarks—Only one specimen of this species has been collected during the present investigation. It is slightly crushed but seems to differ in no respect from Kindle's species though its occurrence so much higher in the geologic column is remarkable.

Occurrence—Snyder Creek shale of Callaway County.

Camarotoechia gregeri n. sp.

Plate 24, figures 5-9

Description—Shell of medium size, subquadrate in outline, usually wider than long; proportions of width to length 6-5 to 5-5. The dimensions of three specimens are: Length 16 mm., 15 mm., 12 mm., breadth, 17 mm., 17 mm., 12 mm.; height 10 mm., 9 mm., 8 mm.

Pedicle valve slightly convex; beak pointed and incurved; sinus of moderate depth, originating slightly back of the middle and projecting prominently in front of the rest of the valve. Three or four rounded plications occur in the sinus in most specimens, one on each slope, and 6 or 7 on either side of the sinus. The total number of plications ranges from 17 to 20.

Brachial valve regularly convex from beak to front. The fold originates about the middle and is sharply set off from the rest of the shell near the front. It forms part of the regularly convex surface. There are four plications which occur on the top of the fold, and usually, one on each flank. The usual number of plications on the valve is 18 and none of our specimens vary more than 2 from that number.

This species resembles *Camarotoechia contracta* Hall but differs from it in the projecting fold, in having plications on the sides of the fold and sinus, and in the quadrate shape with the top of the beak forming one angle of a rectangle.

Greger[1] seems to identify the Snyder Creek specimens with *Camarotoechia scitulus* Cleland, but that species has 24 plications, not including those on the fold and sinus, while this species has only 14 or 16 at the most.

Occurrence—Rare in the Snyder Creek shale of Callaway County.

Genus Hypothyris King

Hypothyris gregeri n. sp.

Plate 17, figures 5-7, 11-14

Description—Shell small, subglobose; width equal to the length in young forms, greater than the length in old. Four specimens give the following measurements in millimeters; 1 width, 2 length, 3 thickness. 11-9.5-8.7; 12.2-11, 9.5; 9-9-7; 9-9-7.3.

In the pedicle valve the sinus affects only the front margin of the shell. It is shallow, occupies more than half the width of the shell and is flat on the bottom. Beak projecting slightly back of the hingeline, not incurved. Plications rounded, simple, fairly strong on the margin but become faint and obsolete about the middle of the shell; four are present in the sinus and four on each lateral slope. The dental plates are short and the median septum extends about 1/3 the length of the valve, as shown in figure 7 of plate 17.

[1]Am. Jour. Sci., 49, p. 266.

In the brachial valve the fold originates about the middle of the shell in young specimens and is low and inconspicuous. The beak is short and incurved against the opposite valve. The plications are similar to those on the opposite valve—five plications on the fold. The median septum extends forward about 1/3 the length of the shell.

Occurrence—Rare in the Callaway limestone of Callaway County.

Genus Pugnoides Weller

Pugnoides altus (Calvin)

Plate 16, figures 10-12

1875. *Ryhnchonella alta* Calvin, paper read before the Iowa Acad. Sci., and a named photographic plate distributed.
1890. *Rhynchonella pugnus, var. alta* Williams, Bull. Geo. Soc. Am., I, pl. 12, figs. 5-7.
1894. *Pugnax altus* Hall and Clarke, Pal. New York, VIII, pt. 2, p. 203, pl. 60, figs. 1-5.
1897. *Pugnax pugnus alta* Schuchert, Bull. U. S. Geol. Surv. 87, p. 335.
1909. *Pugnax altus* Greger, Am. Jour. Sci., 27, p. 376.
1913. *Pugnax pugnus* var. *altus* Clarke and Swartz, Maryland Geol. Survey, Middle and Upper Devonian, pp. 583-584, pl. 54, figs. 17-22.

Description—Shell subelliptical to subcircular; length and breadth subequal; greatest width near the middle. Pedicle valve slightly convex near the hinge, with a sinus beginning near the middle and becoming deep at the front. Beak prominent, slightly incurved, projecting slightly beyond that of the opposite valve. Brachial valve more convex than the pedicle; fold beginning near the front and only slightly elevated. Plications coarse, usually 2 in the sinus, 3 on the fold and 2 or 3 on each lateral slope. In most specimens the plications are marginal but in some they extend to the middle of the valve.

Remarks—This is a rare form and during the investigation it has been collected only from the Craghead Creek locality from a thin bed of shale near the top of the Snyder Creek shale. As it has a median septum in the pedicle valve, it belongs to Weller's genus *Pugnoides*.

Pugnoides swallovi n. sp.

Plate 16, figures 13-15

Description—Shell small, subtriangular in outline, usually slightly longer than wide, the greatest width anterior to the middle, usually thin but in some cases thick. The dimensions of three specimens are: Length 8 mm., 7mm., 6 mm.; width, 8 mm., 6 mm., 7 mm.; thickness, 7 mm., 5 mm., 3 mm.

Pedicle valve slightly convex; beak pointed and slightly incurved; sinus shallow and present only on the anterior margin; a projection of the front of the sinus reaching far into the brachial valve; median septum about one-third the length of the valve.

Brachial valve slightly convex, highest at the front margin; beak small, incurved below that of the pedicle valve; mesial fold low and present only near the front margin; a well developed median septum for about half the length of the valve.

Plications on the smaller shells inconspicuous, on the larger 2 to 3 in the sinus, 3 on the fold, and 3 to 5 each side of the fold and sinus. The best developed plications extend less than half the length of the shell. No other surface markings appear on the specimens studied.

Remarks—This is a rare form, only 5 specimens having been collected. It does not resemble closely any other species from the Devonian of America.

Occurrence—Mineola of Montgomery and Ralls Counties.

Superfamily Terebratulacea

Family Centronellidae

Genus Newberria Hall

Newberria missouriensis Swallow

Plate 18, figures 1-4

1891. *Newberria missouriensis* (Swallow MS.) Hall, Tenth Ann. Rep. N. Y. State Geol., p. 7, extract, pl. 5, figs. 10-12.

1894. *Newberria Missouriensis* Hall and Clark, Pal. New York, VIII, pt. 2, p. 263, pl. 78, figs. 21-23.

1897. *Newberrya missouriensis* Schuchert, Bull. U. S. Geol. Surv., 87, p. 272.

Swallow's description—"Shell elongate oval; valves convex, usually gibbous in the umbonal region, sometimes depressed. Brachial valve equaling if not exceeding in convexity the opposite valve.

The convexity of both valves is greatest in the median axis, the slopes to the lateral margins being quite abrupt; over the pallial region there may be a slight median flattening on both valves.

Umbo of the pedicle-valve quite pronounced, more so than in the other species.

Surface of both valves smooth, without evidence of concentric wrinkles.

Interior markings, muscular scars and vascular ridges and furrows having about the same degree of development as in *N. Johannis.*

This species is a larger, more robust and rotund shell than *N. Johannis* and is less elongate and more turgid than *R. laevis.*"

Supplementary description—Shell a little longer than wide; greatest width about one-third the length of the shell from the back; narrowing slightly towards the hinge-line from the widest part. The convexity of the pedicle valve varies considerably, the highest part usually appearing about one-third the length of the shell from the back but in some cases being in front of the middle; large specimens measure 10 cm. long, 10 cm. wide, and 7 cm. thick. The smaller specimens are more easily collected than the larger and those figured by Hall were small. The specimens figured in this report are of medium size.

Remarks—Specimens of this species have been found, during the present investigation, only along Cedar Creek from about 7 miles southeast of Ashland up creek for about 6 miles. It occurs near the bottom of the Callaway and is abundant enough to make up the larger part of a limestone about 10 feet thick. Specimens are so abundant and so badly crushed together that few good ones have been found. This is the largest of the Devonian brachiopods of Missouri.

Occurrence—Lower part of Callaway limestone, eastern Moniteau, western Callaway and eastern Boone Counties.

Family Terebratulidae

Genus Eunella Hall and Clarke

Eunella lincklaeni (Hall)

Plate 20, figures 12-16

1860. *Terebratula lincklaeni* Hall, Thirteenth Rep. N. Y. State Cab. Nat. Hist., p. 88.

1861. *Cryptonella lincklaeni* Hall, Fourteenth Rep. N. Y. State Cab. Nat. Hist., p. 101.

1867. *Cryptonella (?) lincklaeni* Hall, Pal. N. Y., IV, pt. 1, p. 397, pl. 60, figs. 49-65.

1867. *Terebratula lincklaeni* Hall, Pal. N. Y., IV, Corrigenda.

1894. *Eunella Lincklaeni* Hall and Clarke, Pal. N. Y., VIII, pt. 2, p. 290, pl. 80, figs. 28-32.

1897. *Eunella lincklaeni* Schuchert, Bull. U. S. Geol. Surv., 87, p. 223.
1901. *Eunella lincklaeni* Kindle, Ind. Dept. of Geol. and Nat. Res. 25th Ann. Rept., p. 658, pl. 12, figs. 3, 3a.
1909. *Eunella lincklaeni* Grabau and Shimer, North American Index Fossils, I, p. 303, fig. 378.
1911. *Eunella licnklaeni* Cleland, Wisconsin Geol. and Nat. Hist. Survey, Bull. No. 21, p. 72.
1913. *Eunella lincklaeni* Prosser and Kindle, Maryland Geol. Survey, Middle and Upper Devonian, pp. 179-181, pl. 15, figs. 18-23.

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 truncated 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."

Remarks—Eunella lincklaeni is abundant in the Mineola of Callaway and Montgomery Counties. Most of the specimens are small, averaging less than 13 mm. in length, though the largest specimens are as large as Hall's largest. Many specimens were ground so as to show the loop and other internal structures. No specimens were preserved in such a way as to show such structures without grinding.

Occurrence—Mineola of Montgomery, Callaway and Ralls Counties.

Genus Cranaena Hall and Clarke

Cranaena calvini (Hall and Whitfield)

Plate 16, figures 3-5; plate 18, figure 5

1873. *Cryptonella Eudora* Hall and Whitfield (non Hall, 1867), 23rd Rep. New York State Cab. Nat. Hist., p. 225.
1873. *Cryptonella Calvini* Hall and Whitfield, Ibidem, p. 239.
1891. *Cryptonella Calvini* Whiteaves, Cont. Canadian Pal., I, pp. 235-236.
1894. *Dielasma Calvini* Hall and Clarke, Pal. New York, VIII, pt. II, pp. 294-296, pl. 80, figs. 20-22.
1897. *Dielasma calvini* Schuchert, U. S. G. S. Bull. 87, p. 212.
1908. *Cranaena morsii* Greger, Am. Jour. Sci., XXV, pp. 313-314, figs. 1-7.
1909. *Cranaena morsii* Greger, Am. Jour. Sci., XXVII, p. 376.

Greger's description of Cranaena morsii—"Shell large for the genus, subcircular, valves nearly equally and uniformly convex. Marginal line along the lateral and anterior juncture of the valves, forming a sharp, thin edge. No defined fold or sinus. Surface covered with very faint, even, concentric lines of growth; otherwise the surface is smooth. Shell structure abundantly punctate, the punctae very minute and arranged as in the related *Cranaena iowensis* (Calvin).

Brachial valve similar in degree of convexity to the opposite valve, slightly ridged from beak to near the center. Beak obtuse and but slightly incurved.

Pedicle valve regularly convex, most prominent near the center sloping gently to the front and sides. Beak elevated, slightly incurved and truncated by a circular foramen. Deltidial plates conspicuous. A slight auriculation in the posterio-lateral region gives a shouldered appearance to some individuals, but it is not a constant character.

Brachial valve similar in degree of convexity to the opposite valve, slightly ridged from beak to near the center. Beak obtuse and but slighly incurved.

Measurements: The average of a number of mature individuals give the following: Length, 42 millimeters; breadth, 40 millimeters; thickness, 17 millimeters."

Remarks—The material from Missouri is fragmentary, but there seem to be no well-marked differences between Greger's *Cranaena morsii* and Hall and Whitfield's *Dielasma calvini*. Greger's figures show a wider hingeline and a brachial valve less tapering near the hingeline, but some of the Missouri specimens have this valve of the same shape as the Iowa species. The most characteristic feature of the species is the slight convexity of the valves.

The retention of the color pattern was mentioned by Greger, and the pattern is shown in figure 5 of plate 18

Occurrence—Snyder Creek shale of Callaway County.

Cranaena iowensis (Calvin)

Plate 20, figures 20-22

1890. *Terebratula (Cryptonella) iowensis* Calvin, Bull. Lab. Nat. Hist. Univ. Iowa, I, p. 174, pl. 3, fig. 4.
1894. *Cranaena Iowensis* Hall and Clarke, Pal. New York, VIII, pt. II, p. 297, pl. 80, figs. 36-39; pl. 83, fig. 4.
1897. *Cranaena iowensis* Schuchert, U. S. G. S. Bull. 87, pl. 188.
1911. *Cranaena iowensis* Cleland, Wisconsin Geol. Nat. Hist. Surv. Bull. 21, pl. 72, pl. 13, figs. 8-11.
1914. *Cranaena iowensis* Weller, Mississippian Brachiopoda, p. 249, figs. a.-j.

Calvin's description—"Shell large, ovate, widest at or below the middle, adult specimens very convex, greatest convexity a short distance in front of the umbo; front margin regularly rounded, truncate or slightly sinuate. Dorsal valve convex, curving gradually in all directions from a point situated at a variable distance behind the middle of the valve. Ventral valve, like the dorsal, sloping from a point behind the middle line, the curvature increasing most rapidly toward the beak; beak only moderately incurved, perforated by a relatively small foramen; cardino-lateral slopes rounding gradually, without the usual subangular ridge toward the deltidial plate; deltidial plate wide, its sides meeting beneath the foramen in an obtuse angle; muscular scars of ventral valve elongated and bounded by sharp ridges that leave three grooves extending beyond the middle of the shell in the exfoliated cast, middle groove deeper than the other two and extending in some instances almost to the front margin; sometimes the middle groove widens from the beak to about the middle of the valve, then narrows abruptly and is continued toward the front as a slender furrow. Muscular markings on the dorsal valve very variable; in general, the scars were long and separated by a narrow carina. The other details, however, are far from being constant. Dental laminae forming two short septa in the umbonal cavity of ventral valve, nearly parallel or slightly diverging where their lower margins join the shell, but curving at their upper margins so as to conform nearly in direction to the lateral margins of the deltidial plate. Surface smooth, marked only by obscure lines of growth. Shell very finely punctate. Internal loop unknown.

Large specimens are an inch and a quarter in length, more than an inch in width, and three-fourths of an inch in thickness. Immature forms are very common."

Remarks—Many of the Missouri specimens of *Cranaena iowensis* are large. The largest is 36 mm. long, 31 mm. wide, and 22 mm. thick. Sections of the interior differ from those published by Weller, but sections of some specimens from Iowa are similar to those from Missouri. The main difference between the sections is the greater strength of the curual ridges on the hingeplate of the Missouri specimens.

Occurrence—Callaway limestone, Callaway County.

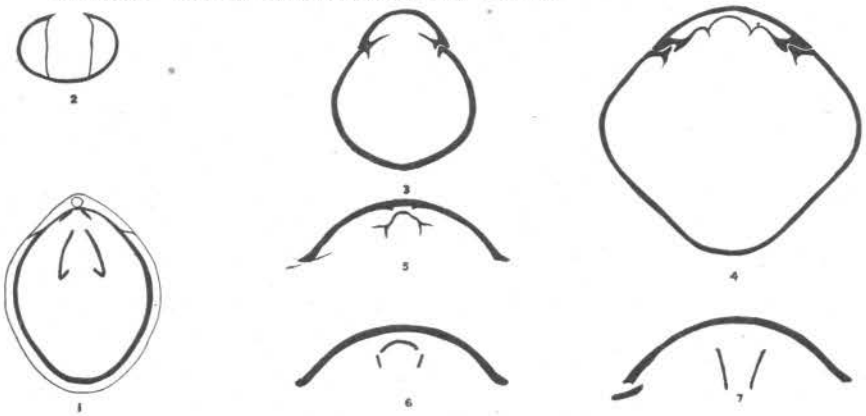

Fig. 8. Sections of *Cranaena iowensis* Hall.

1. *Cranaena iowensis* Hall. Section of a brachial valve showing the extent of the loop.
2. *Cranaena iowensis* Hall. Cross-section of the pedicle valve in front of the median septum and behind the beak of the brachial valve.

3-7. *Cranaena iowensis* Hall. Cross-sections of a brachial valve 33 mm. long 3 mm., 4 mm., 5.5 mm., 7 mm. and 8 mm. from the beak.

Cranaena romingeri (Hall)

Plate 20, figures 17-19

1863. *Terebratula romingeri* Hall, 16th Rep. New York State Cab. Nat. Hist., p. 48, figs. 22 and 23.
1867. *Terebratula romingeri* Hall, Pal. New York, IV, pt. 1, p. 389, pl. 60, figs. 17-25, 66, 67.
1889. *Terebratula romingeri* Nettleroth, Kentucky Fossil Shells Monograph, Kentucky Geol. Survey, pp. 155-156, pl. 16, figs. 20-22.
1894. *Cranaena romingeri* Hall and Clarke, Pal. New York, VIII, pt. 2, p. 297, fig. 215; pl. 80, figs. 13-19.
1897. *Cranaena romingeri* Schuchert, U. S. G. S. Bull. 87, p. 188.
1901. *Cranaena romingeri* Kindle, Indiana Dept. Geol. Nat. Res., 25th Ann. Rept., pp. 660-661, pl. 12, figs. 4 and 4a.
1909. *Dielasma romingeri* Grabau and Shimer, North American Index Fossils, I, p. 302, figs. 376a-c.

Hall's description—"Shells 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 towards 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 towards the front. Shell-structure finely punctate. The interior shows a short terebratuliform loop, which is abruptly recurved at its lower extremities."

Remarks—The *Cranaena romingeri* from Missouri are somewhat more ventricose than average and most of them have no indication of a sinus. The preservation is not such as to retain the loop so that it can be definitely determined.

Occurrence—Mineola of Montgomery and Ralls Counties.

Superfamily Spiriferacea

Family Atrypidae

Genus Atrypa Dalman

Atrypa gregeri Rowley

Plate 18, figures 7-9

1900. *Atrypa gregeri* Rowley, Am. Geologist, XXV, p. 264, pl. 5, figs. 9-11.
1909. *Atrypa gregeri* Greger, Am. Jour. Sci., XXVII, p. 376.

Rowley's description—"Shell ovoid, gibbous, length and breadth nearly equal. Brachial valve almost circular, convex. Pedicle valve convex, with an extended, slightly incurved, perforate beak. Neither mesial elevation nor sinus is apparent on any of the five specimens examined.

Surface marked by numerous, fine radiating striae crossed by rather strong concentric lines of growth.

It may be possible that an examination of the inside of the valves of this shell will place it in some other genus, but externally it is apparently very close to Atrypa."

Remarks—*Atrypa gregeri* has about four plications per millimeter, while small specimens of *A. reticularis* (Linnaeus) have about two. The fineness of plications is about the only distinguishing character of the species. In lacking fold and sinus it agrees with many specimens of *A. reticularis* (Linnaeus).

Occurrence—Rare in the Snyder Creek shale of Callaway County.

Atrypa reticularis (Linnaeus)

Plate 21, figures 6 and 7; plate 23, figures 12, 13

1767. *Anomia reticularis* Linne, Systema Nature, ed. XII, 1, p. 1132.
1842. *Atrypa chemungensis* Conrad, Jour. Acad. Nat. Sci., Philadelphia, VIII, p. 265.
1842. *Atrypa chemungensis* Vanuxem, Geol. New York, Rep. Third Dist., p. 182, fig. 4.
1858. *Atrypa reticularis* Hall, Geol. Survey Iowa, vol. I, part II, p. 515.
1867. *Atrypa reticularis* Hall, Pal. New York, IV, pp. 316-321, pl. 52, figs. 1-3, 7-12; pl. 53, figs. 3-19; pl. 53a, figs. 22, 23.
1894. *Atrypa missouriensis* Miller, Indiana Dept. Geol. Nat. Res., 18th Ann. Rept., p. 315, pl. 9, figs. 19-21.
1897. *Atrypa reticularis* Schuchert, Bull. U. S. Geol. Surv., 87, pp. 154-155.
1901. *Atrypa reticularis* Kindle, Indiana Dept. Geol. Nat. Res., 25th Ann. Rept., p. 598, pl. 6, fig. 10.
1909. *Atrypa reticularis* Greger, Am. Jour. Sci., XXVII, pp. 376, 377.
1909. *Atrypa reticularis* Grabau and Shimer, North American Index Fossils, I, p. 310, figs. 389a, b.
1911. *Atrypa reticularis* Cleland, Wisconsin Geol. and Nat. Hist. Surv., Bull. 21, p. 74, pl. 13, figs. 12, 13.
1913. *Atrypa reticularis* Prosser and Kindle, Maryland Geol. Survey, Middle and Upper Devonian, pp. 183-185, pl. 16, figs. 4-6; and Clarke and Swartz, pp. 586-587, pl. 55, figs. 6-11.

1915. *Atrypa reticularis* Butts, Kentucky Geol. Survey, ser. 4, III, pt. 2, p. 115, pl. 39, figs. 1-3.

Hall's description—"Shell depressed, suborbicular in its young state, becoming gibbous and sinuate in its mature condition; hingeline 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 advanced 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."

Remarks—Atrypa reticularis is the most abundant form in the Callaway and Snyder Creek, and is highly varied, ranging from a small form with fine plications which Rowley has called *A. gregeri* Rowley, to large forms with coarse plications. The *A. gregeri* Rowley have about 4 plications to the millimeter, while the large forms may measure more than one millimeter per plication. Specimens 45 mm. wide are not unusual, though at some horizons specimens as large as 25 mm. wide are rarely found. Near the top of the Snyder Creek shale large specimens are about the only ones found and these have seven or more concentric ridges which are strongly spinose, giving to the individuals a very rough appearance.

Near the top of the Callaway one member is largely made up of medium sized *A. reticularis* and more than 1,000 fairly good specimens have been counted from 1/100 of a cubic yard of weathered limestone of this member.

Occurrence—Abundant in Callaway and Snyder Creek, common in Mineola, rare in Cooper.

Atrypa spinosa Hall

Plate 20, figures 8-11; plate 23, figures 8-9.

1897. *Atrypa spinosa* Schuchert, Bull. U. S. Geol. Surv., 87, p. 156.
1901. *Atrypa spinosa* Kindle, Indiana Dept. Geol. Nat. Res., 25th Annual Report, p. 599, pl. 6, fig. 11.
1909. *Atrypa hystrix occidentalis* Greger, Am. Jour. Sci., XXVII, p. 376.
1909. *Atrypa spinosa* Grabau and Shimer, North American Index Fossils, I, p. 311, fig. 392d.
1913. *Atrypa spinosa* Clarke and Swartz, Maryland Geol. Surv., Middle and Upper Devonian, pp. 587-589, pl. 55, figs. 12, 13.

Hall's description—"Shell robust, suborbicular or ovoid; width greater or less than the length; radiatingly costate and concentrically lamellose or spinose; hingeline 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 towards the lateral margins, and cardinal extremities depressed or broadly sinuate in front; 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 towards the cardinal angles, regularly curving to the sides and basolateral 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 toward 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 hingeline 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 front, 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 show about fifteen turns in each."

Remarks—Specimens from the Snyder Creek have usually been identified as *A. hystrix* var. *occidentalis* Hall by Missouri collectors. They differ from that species in their larger number of plications, 17 to 25 as compared to 8 to 14, in the plications remaining distinct to the margin, and in the brachial valve being less gibbous. No specimens with spines are in the collections examined. On plate 23, figure 7, the *Atrypa* is inserted for comparison with typical *A. spinosa* from the Snyder Creek shale.

Occurrence—Rare in the Snyder Creek shale of Montgomery County.

Family Spiriferidae

Genus Spirifer Sowerby

Spirifer annae Swallow

Plate 19, figures 13, 15-17; plate 24, figure 17

1860. *Spirifer annae* Swallow, Trans. St. Louis Acad. Sci., I, p. 641.
1860. *Spirifer amarus* Swallow, Trans. St. Louis Acad. Sci., I, p. 642.
1897. *Spirifer annae* Schuchert, Bull. U. S. Geol. Surv., 87, p. 381.
1897. *Spirifer amarus* Schuchert, Bull. U. S. Geol. Surv., 87, p. 381.
1909. *Spirifer amarus* Greger, Am. Jour. Sci., XXVII, p. 377.

Swallow's description—"Shell very small, sub-semipyramidal. Ventral valve semi-pyramidal; slightly arched from the beak to the anterior and lateral margins; area high, arched, triangular; sides shorter than the base on the cardinal line; beak small, pointed, and slightly incurved; mesial sinus simple, well defined, concave, or flattened at the bottom, foramen narrow. Dorsal valve semicircular, slightly convex, flattened towards the cardinal extremities; mesial fold sharply defined, depressed, simple beak small, slightly incurved over the cardinal line; cardinal line as long or shorter than the width of the shell. Surface marked with from six to ten plications on each side of the mesial sinus and fold, and by numerous concentric imbricating lamellae.

Length, .25; breadth, .33; thickness, .20."

Revised description—Shell very small for the genus, angular, semiconical, wider than long, the greatest width usually along the hingeline. Resembles *Cyrtina* in shape and dimensions. Usual dimensions: Length 5 to 6 mm., breadth 6 to 7 mm., thickness 3 to 4 mm. The largest specimen observed measured: Length 11 mm., width 15 mm., height, 9 mm. Shells 2/3 as large as the largest given are not uncommon.

Pedicle valve very convex and Cyrtina-like in shape; beak small, pointed, slightly to strongly incurved; cardinal area very high, slightly to quite strongly arched, lateral margins sharply defined; lateral slopes each marked by 5 to 8 simple rounded plications; mesial sinus shallow, rounded at the bottom, originating at the beak and increasing gradually in width to the front margin.

Brachial valve slightly convex, with the greatest convexity near the back; mesial fold low, not rising above the rest of the shell, separated from the lateral plications by a slightly deeper furrow than those between the other plications, an incipient groove near the front on the larger specimen; plications similar in number and shape to those on the other valve.

The surface is marked by numerous imbricating lines of growth. Very fine radiating striae are the most striking peculiarity of the shell surface.

Remarks—Swallow's *S. annae* and *S. amarus* are, without question, the same. Specimens are abundant in some places and the differences displayed are in size, number of plications, and height of cardinal area. All have the radiating striae and the variations in other respects are not striking. The resemblance in shape to *Cyrtina triquetra* Hall which occur with *Spirifer annae* is so close that in most cases one must look for the striae to distinguish them.

Occurrence—Snyder Creek shale of Montgomery and Callaway Counties.

Spirifer asper Hall

Plate 19, figures 19-23; plate 23, figure 4.

1858. *Spirifer aspera* Hall, Geol. Survey Iowa, I, pt. 2, pp. 508-509, pl. 4, fig. 7.
1882. *Spirifer (Cyrtina) aspera* Whitfield, Geol. Wisconsin, IV, p. 331-332, pl. 26, figs. 1, 2.
1894. *Spirifer asper* Hall and Clarke, Pal. New York, VIII, pt. 2, pp. 29, 31, 32, 39, pl. 25, figs. 20-25.
1897. *Spirifer asper* Schuchert, Bull. U. S. Geol. Survey, 87, p. 382.
1909. *Spirifer asper* Grabau and Shimer, North American Index Fossils, I, p. 331.
1909. *Spirifer asper* Greger, Am. Jour. Sci., XXVII, p. 377.
1911. *Spirifer asper* Cleland, Wis. Geol. and Nat. Hist. Surv., Bull. 21, pp. 76-77, pl. 16, figs. 1-5.

Hall's description—"Shell semielliptical, width about twice the length; hingeline equaling the greatest width of the shell, and abruptly angular at the extremities. Ventral valve triangular pyramidal, extremely elevated at the umbo, and sloping abruptly to the lateral and anterior margins; mesial sinus shallow, strongly defined at its margins, equal or less in height than the length of the valve, transversely and vertically striate; foramen proportionally narrow, extending to the beak, and partially closed within by a pseudo-deltidium; beak not incurved. Dorsal valve nearly flat or moderately convex; mesial fold strongly defined at the margins, and rounded above.

Surface, in full-grown specimens, marked by twenty or more simple rounded and moderately elevated plications on each side of the mesial fold and sinus. Plications often fifteen to eighteen in ordinary specimens, four or five only of which reach the beak, the others running out along the hingeline and margins of the area; concentrically marked by fine imbricating lines of growth, which are sometimes very conspicuous. Entire surface granulose; granules closely arranged, sometimes visibly following the concentric striae, and in other parts apparently scattered without order."

Remarks—Specimens from Missouri are not as large as average specimens from Iowa and the number of plications on either side of the fold and sinus is usually 15 or 16 rather than more than 20.

Occurrence—Rare in Snyder Creek shale and Callaway limestone of Callaway County.

Spirifer euryteines Owen

Plate 22, figures 1-12; plate 23, figures 2 and 3

1844. *Delthyris euruteines* Owen, Rep. Geol. Expl. Iowa, Wis. and Ill., p. 69, pl. 12, fig. 9.
1852. *Spirifer euruteines* Owen, Geol. Survey, Wisconsin, Iowa and Minnesota, p. 586, pl. 3, figs. 2-6.
1858. *Spirifer parryanus* Hall, Geol. Survey Iowa, I, pt. 2, p. 509, pl. 4, fig. 8.
1858. *Spirifer capax* Hall, Geol. Survey Iowa, I, pt. 2, pp. 520-521, pl. 7, fig. 7.
1861. *Spirifera Parryana* Billings, Canadian Jour., VI, p. 261, figs. 77, 78.
1863. *Spirifera Parryana* Billings, Geol. Canada, p. 386, fig. 422.
1868. *Spirifer fornacula* Meek and Worthen (non Hall), Geol. Survey Illinois, III, p. 433, pl. 13, fig. 8.

1883. *Spirifer parryana* Hall, Second Ann. Rep. N. Y. State Geol., pl. 52, figs. 8, 9.
1883. *Spirifera capax* Hall, Second Ann. Rep. N. Y. State Geol., pl. 52, figs. 15-17.
1884. *Spirifera Parryana* Walcott, Mon. U. S. Geol. Surv. VIII, p. 137, pl. 14, fig. 10.
1888. *Spirifera parryana* Calvin, Bull. Lab. State Univ. Iowa, p. 19.
1894. *Spirifer Parryanus* Hall and Clarke, Pal. New York, VIII, pt. 2, pp. 29, 31, 39, pl. 22, figs. 8, 9, 15-17.
1894. *Spirifera parryana* Keyes, Geol. Surv. Missouri, V, p. 77, pl. 40, fig. 4.
1897. *Spirifer euryteines* Schuchert, Bull. U. S. Geol. Surv., 87, p. 389.
1909. *Spirifer euryteines* Greger, Am. Jour. Sci., XXVII, p. 377.
1909. *Spirifer euryteines* Grabau and Shimer, North American Index Fossils, I, pp. 326-327.
1911. *Spirifer euryteines* var. *milwaukeensis* Cleland, Wisconsin Geol. and Nat. Hist. Surv., Bull. 21, pp. 77-78, pl. XV, figs. 1-6.

Owen's description—"Shell nearly semi-elliptical; cardinal area very wide, slightly concave and finely striated; narrow perforation; beaks sometimes more than half an inch apart, smooth, with eighteen to twenty ribs on either side of the bourrelet, finely striated longitudinally, sometimes studded with small granulae, bourrelet rather narrow with a shallow sinus in the median line, finely striated, and crossed by fine concentric lines of growth, and sometimes by fine granulae. Sinus of the dorsal valve also sometimes finely granulated. Length, one inch, breadth one and a half inches."

Revised description—Shell large, nearly twice as wide as long, greatest width along the hingeline; dimension of an average sized pedicle valve, length 25 mm., width 40 mm., convexity 14 mm. Dimensions of average brachial valve, length 21 mm., breadth 40 mm., convexity 10 mm. Thirty-one specimens of 220 measured were more than 50 mm. along the hingeline. The largest specimen in a collection of more than 300 is 70 mm. along the hingeline, the longest pedicle valve is 43 mm., the longest brachial valve is 35 mm.

Pedicle valve with greatest convexity near the middle; beak acute, projecting slightly beyond the hingeline; cardinal area high and wide, average height about 8 mm., greatest height observed 35 mm. Each lateral slope marked by about 15 to 25 rounded plications. Mesial sinus shallow, broad near the front.

Brachial valve about half as convex as the pedicle; greatest convexity near the front. Fold low, well defined, broad near the front.

The most characteristic structure of this Spirifer is fine radial lines which cover plications, fold, sinus, and cardinal area. On perfectly preserved specimens minute granules appear along the lines.

Occurrence—Abundant near the top of the Snyder Creek shale in Callaway and Montgomery Counties, rare in the Callaway limestone of Montgomery, Callaway and Boone Counties, rare in the Mineola of Ralls and Warren Counties.

Spirifer subvaricosus Hall and Whitfield

Plate 20, figures 6 and 7; plate 24, figure 13

1873. *Spirifera subvaricosa* Hall and Whitfield, 23rd Ann. Rept. New York State Cabinet of Nat. Hist., p. 237, pl. 11, figs. 12-15.
1897. *Spirifer subvaricosus* Schuchert, U. S. G. S. Bull. 87, p. 406.
1911. *Spirifer subvaricosus* Cleland, Bull. 21, Wis. Geol. Nat. Hist., pp. 81-82, pl. 16 figs. 6-11.

Hall and Whitfield's description—"Shell small, seldom more than five-eighths of an inch on the hingeline. Valves highly convex, the ventral somewhat gibbous, with an incurved cardinal area of moderate height, divided by a triangular foramen which is higher than wide; cardinal angles slightly rounded, plications subangular, eight to ten on each side of the ventral valve, with one moderately strong in the bottom of the sinus not always extending to the apex; on the dorsal valve this mesial fold consists of two strong equal plications with a deep angular groove between. Surface marked by

somewhat strong, rugose, zigzag lines of growth, which are sharply bent backwards as they cross the plications."

Remarks—This species occurs in the Mineola of Ralls County associated with *S. varicosus* Hall. None of the specimens is perfect. The distinguishing features are: Plications more angular on *subvaricosus* than on *S. varicosus* Hall, cardinal area higher and narrower, entire shell narrower, a well defined angular plication in the bottom of the sinus. A larger series might show all gradations between the forms.

Occurrence—Mineola of Ralls County.

Spirifer varicosus Hall

Plate 19, figure 18; plate 21, figures 4 and 5; plate 24, figures 14 and 15.

1857. *Spirifer varicosa* Hall, Tenth Rep. N. Y. State Cab. Nat. Hist., p. 130.
1861. *Spirifera varicosa* Billings, Canadian Jour., VI, p. 255, figs. 63, 64.
1863. *Spirifera varicosa* Billings, Geol. Canada, p. 960, fig. 467.
1867. *Spirifera varicosa* Hall, Pal. New York, IV, pt. 1, pp. 205-206, pl. 31, figs. 1-4.
1883. *Spirifera varicosa* Hall, Second Rep. N. Y. State Geol., pl. 59, figs. 4-8.
1884. *Spirifera varicosa* Walcott, Mon. U. S. Geol. Survey, VIII, p. 136.
1889. *Spirifera varicosa* Nettleroth, Kentucky Fossil Shells, Monograph Kentucky Geol. Survey, p. 134, pl. 10, figs. 11-20, 23-25.
1894. *Spirifer varicosus* Hall and Clarke, Pal. New York, VIII, pt. 2, pp. 17, 36, pl. 34, figs. 4-8.
1897. *Spirifer varicosus* Schuchert, U. S. Geol. Survey, 87, p. 408.
1901. *Spirifer varicosus* Kindle, Ind. Dept. Geol. and Nat. Res., 25th Ann. Rept., p. 644, pl. 9, fig. 3.
1909. *Spirifer varicosus* Grabau and Shimer, North American Index Fossils, I, p. 325, figs. 413, a-c.
1912. *Spirifer varicosus* Kindle, U. S. Geol. Surv., Bull. 508, p. 82, pl. 6, fig. 16.

Hall's description—"Shell somewhat semi-circular or semi-elliptical; length equaling or less than half the width; hingeline 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 centre; the beak projecting a little above the hingeline, 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 concentric striae in the centre of the mesial sinus, and sometimes a slight elevation along that line."

Remarks—This is one of the common species in the Mineola fauna though few good specimens have been collected. All of the specimens are small, the largest measuring 24 mm. along the hingeline. The average width is 13 to 15 mm. along the hingeline. The number of plications on either side of the fold and sinus ranges from 8 to 11, most specimens having 8, 9 or 10. The median fold in some cases has a well defined groove that forms two plications, while in some specimens the groove is scarcely distinguishable. Only one specimen is well enough preserved to retain the concentric lines that gave the species its name. The beak of the pedicle valve projects slightly farther back of the hingeline than in ordinary *S. varicosus*.

Occurrence—Mineola of Montgomery and Warren Counties.

Genus Syringothyris Winchell

Syringothyris occidentalis (Swallow)

Plate 20, figures 3-5; plate 21, figures 1-3; plate 23, figure 1

1860. *Cyrtia occidentalis* Swallow, Trans. St. Louis Acad. Sci., I, pp. 648-649.
1889. *Cyrtina occidentalis* Miller, North American Geology and Pal., p. 343.
1894. *Syringothyris occidentalis* Keyes, Missouri Geol. Surv., V, p. 86.
1897. *Cyrtina ? occidentalis* Schuchert, U. S. G. S. Bull. 87, p. 199.
1909. *Cyrtia occidentalis* Greger, Am. Jour. Sci., XXVII, p. 378.
1910. *Syringothyris occidentalis* Schuchert, Am. Jour. Sci., XXX, pp. 223-224.
1918. *Syringothyris occidentalis* Branson, Geology of Missouri, pp. 100-101, fig. 7.
1920. *Syringothyris occidentalis* Greger, Am. Jour. Sci., L, p. 23.

Swallow's description—"Shell of medium size, semi-conical. Ventral valve high, semi-conical, slightly curved from the beak to the anterior and lateral margins; sinus well defined, very wide and flattened in front; area slightly concave, high and triangular—base but little longer than the slightly curved sides; foramen extending from the beak to the cardinal line, much wider at the base, and not closed in the specimens observed; beak pointed and slightly incurved; dorsal valve convex, somewhat quadrangular, much broader than long; lateral edges rounded towards the cardinal extremities; mesial fold broad and convex in front; cardinal line shorter than the greatest width of the shell. Surface marked with some fifteen or twenty rounded plications on each side of the mesial fold and sinus, and numerous concentric lamellose lines, which often become very conspicuous towards the margins; shell punctate."

Revised description—Shell wider than long, the greatest width along the hingeline or a little in front of it, height about the same as the length. An average specimen measures 30 mm. wide, 23 mm. long and 24 mm. high, cardinal area 17 mm. high, greatest width of cardinal area 20 mm., width of delthyrium at hingeline 8 mm.

Pedicle valve high, sinus wide and shallow; cardinal area gently arched, margin angular to subangular, meeting the sides in almost a right angle; each lateral slope of the valve marked by about 16 rather faint plications. The dental lamellae extend about 1/3 the length of the valve. They diverge considerably in passing outward along the sinus and their outer ends are against the third plication from the sinus margin. The delthyrial plate extends about half way down the delthyrium and the syrinx extends only a short distance below. No syrinx is developed excepting at the lowest part of the plate, as shown in figures 12 and 14. The upper part is much like a long delthyrial plate in a *Spirifer*. *Spirifer euryteines* Owen, in some cases, has a plate comparable to the upper part of this. The syrinx part is not in contact with the edge of the delthyrium and it seems to be solid. Muscular scars well developed, subovate in outline. The adductor scars narrow and elongate and not sharply distinguished from the diductor.

Brachial valve moderately convex; fold originating at the beak and widening rapidly toward the margin; cardinal area narrow, practically at right angles to the area of the pedicle valve; beak extending sharply beyond the cardinal margin; plications similar to those on the pedicle valve. The muscle scars are of medium size. They extend about 3 times the width of the fold near the hingeline but are confined to the fold at their anterior ends. The scars are not deeply impressed.

Remarks—This is the oldest species of the genus that has been described, but *S.* n. sp. of this volume is from an older formation. During Middle and Upper Devonian the *Spirifers* evolved toward high areaed forms and the syrinx was one of the results.

Occurrence—Generally rare in the Callaway but abundant in some places in Boone and Callaway Counties.

Syringothyris n. sp.

Plate 20, figures 1 and 2

One specimen of *Syringothyris* has been collected from the Mineola. It is an internal mould and imperfectly preserved. The following notes on the specimen are from a letter of Prof. J. E. Hyde:

"Specimen is an interior mould of a new species of *Syringothyris*, properly a *Pseudosyrinx* if that genus proves of permanent value. It is a pedicle valve with high, flat cardinal area standing at between 80 degrees and 87 degrees to the plane of the valve. Length of pedicle valve, 22.7 mm., brachial valve about 14.5 mm. Ratio $\frac{\text{L. Br.}}{\text{L. Pd.}}$ .64. Height of cardinal area 17.3 mm., breadth of cardinal area, 23 mm. Greatest breadth of pedicle valve 28 to 29 mm. Width of delthyrial opening at hinge about 8 mm. From this it would be seen that the hinge line is narrower than the greatest width of the valve. Greatest width of valve about half way between cardinal area and anterior margin. Width of sinus at anterior margin 13 mm., or nearly half the greatest width of the valve. Sinus broadly concave, its margins rather abruptly bent into the strongly convex sides of the valve which are rounded to meet the cardinal area at an obtuse angle. Dental lamellae, where attached to the cardinal area but moderately divergent to form a high, narrow delthyrial opening, the whole essentially flat, and parallel to the plane of the cardinal area or but slightly pointing into the valve, but slightly sunken below the plane of area. The free end is a flat, or very slightly concave, triangular point, one-third the total length of plate, with no upturned edges, exactly the stage of the syrnix made by Weller characteristic of his genus *Pseudosyrinx*. As in many other species examined, the triangular tip shows what appears to be a clearly defined muscle scar. This *Pseudosyrinx* or flat-plate stage is commonly found in the older species of *Syringothyris*, is clearly primitive, and this mid-Devonian species runs true to form in its possession.

Some years ago I examined a suite of authentic *Syringothyria occidentalis* Swallow from the Callaway limestone of Missouri. This Devonian form, as I now recall it, is wholly distinct from the one you present. That species is possessed of a high, flat area bending by sharp angles into the flattened sides of the valve, and these in turn rather abruptly into the shallow, broad sinus; there is very little curvature along any line from the beak to the free margin, and the result is a high, pointed, rigid, subpyramidal aspect that is characteristic.

Syringothyris chemungensis Cushing, from the Ohio Chagrin, which is Upper Devonian, has its greatest width at the hinge and acute or 90-degree cardinal angles, transverse plate much larger, occupying half the length of the delthyrial opening or more, syrinx on whole a little more advanced in type, with recurved edges suggesting beginning of a tube, though occasional individuals show same stage as yours.

Your specimen with its delicate transverse plate, sunken but slightly below the cardinal area, has almost nothing in common with those early Syringothyri from Warren, Pa., described by Simpson as *S. randalli* and *angulata*, with their narrow arched areas and thick, massive, spine-like, highly-inclined, transverse plate, sunken far below the plane of the area."

Remarks—Schuchert's[1] earlier supposition that *Syringothyris* originated in the Atlantic province rather than the Cordilleran is supported by the presence of this specimen in the Mineola. However, the two provinces were not as distinct as was supposed.

[1]Am. Jour. Sci. XXX. p. 223.

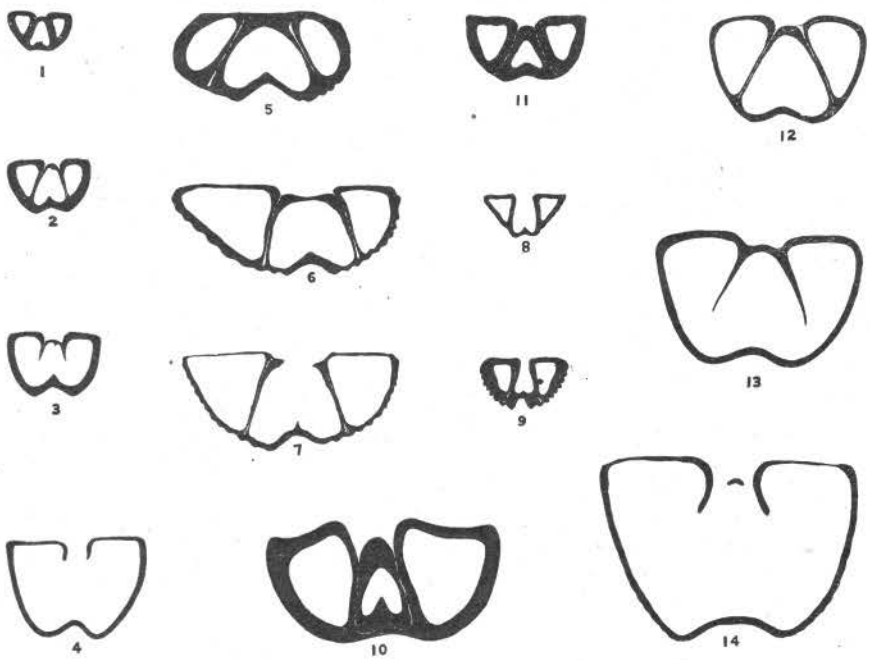

Fig. 9. Sections of *Spirifers*.

1-4. *Spirifer asper* (Hall). Sections 3 mm., 4 mm., 4½ mm., and 5.3 mm. from the beak.
5-7. *Spirifer euryteines* Hall. Sections 1½ mm., 4 mm., and 7.3 mm. from the beak.
10. *Syringothyris hannibalensis* (Swallow). Section 9 mm. from the beak.
11-14. *Syringothyris occidentalis* (Swallow). Sections 3 mm., 4 mm., 5 mm. and 6 mm. from the beak.
Spirifer annae Swallow. Section 1 mm. from the beak.
Spirifer subvaricosus Hall and Whitfield. Section 2 mm. from the beak.

Genus Reticularia McCoy

Reticularia fimbriata (Conrad)

Plate 16, figures 1 and 2.

1842. *Delthyris fimbriatus* Conrad, Jour. Acad. Nat. Sci., Phila., VIII, p. 263.
1897. *Reticularia fimbriata* Schuchert, Bull. U. S. Geol. Surv., 87, p. 342.
1901. *Reticularia fimbriata* Kindle, Ind. Dept. Geol. Nat. Res., 25th Ann. Rept., p. 651-652, pl. 7, fig. 11.
1903. *Spirifer fimbriatus* Clarke, N. Y. State Mus., Bull. 65, p. 316.
1909. *Reticularia fimbriata* Grabau and Shimer, North American Index Fossils, I, p. 338, figs. 431a, b.
1911. *Reticularia fimbriata* Cleland, Wisconsin Geol. and Nat. Hist. Surv., Bull. 21, p. 82, pl. 17, figs. 1-2.
1912. *Reticularia* (cf.) *fimbriata* Kindle, Bull. U. S. Geol. Surv., 508, p. 82.
1913. *Spirifer* (*Reticularia*) *fimbriatus* Prosser and Kindle, Maryland Geol. Surv., Middle and Upper Devonian, pp. 197-198, pl. 19, figs. 10-12.

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 and 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 sublinear area. which is somewhat concave.

Surface marked by from three or four to eight or nine low, rounded, often obscure 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 short longitudinal striae.)

The area is strongly striated vertically."

Remarks—This is a rare species in the Mineola faunas of Missouri and most of the specimens are imperfectly preserved. On one specimen the fine undulating lamellose striae are well preserved and two specimens show the radiating lines which represent the elongated nodes or tubercles.

Occurrence—Mineola of Montgomery and Warren Counties.

Genus Martinia McCoy

Martinia halli n. sp.

Plate 16, figures 6-8

Description—Shell small, subcircular in outline, cardinal extremities rounded. The dimensions of two nearly perfect specimens are: Length of pedicle valve 7.7 mm., 6 mm.; width 8 mm., 6.7 mm.; thickness 6 mm., 4 mm.; length of brachial valve, 7 mm., 5.4 mm.

Pedicle valve strongly and uniformly convex, the greatest convexity a little in front of the hinge line; umbo prominent and projecting beyond the hinge line; curve to the beak a little stronger than that toward the front of the shell; a faint indication of a mesial sinus on the anterior half of the shell. Cardinal area small, strongly arched, the lateral margins rounded; delthyrium small.

Brachial valve about two-thirds as convex as the pedicle, the greatest convexity near the hinge line, the surface sloping almost uniformly in all directions. No indication of a mesial fold. Beak small, cardinal area very narrow.

Both valves seem to be smooth. The description is based on six specimens, three of which are excellently preserved and show no markings.

Occurrence—Callaway limestone of Moniteau County. The species is named for Mr. Roy H. Hall, who mapped the Devonian of Moniteau County and collected the first specimens of the species.

Family Suessiidae

Genus Cyrtina Davidson

Cyrtina hamiltonensis (Hall)

Plate 19, figures 5-8

1857. *Cyrtia hamiltonensis* Hall, Tenth Rep. N. Y. State Cab. Nat. Hist., p. 166.
1861. *Cyrtia Hamiltonensis* Billings, Canadian Jour., VI, p. 262, figs. 80-82.
1863. *Cyrtina Hamiltonensis* Billings, Geol. Canada, p. 384, fig. 415.

1867. *Cyrtina hamiltonensis* Hall, Pal. N. Y., IV, pt. 1, p. 268, pl. 27, figs. 1-4; pl. 44, figs. 26-33, 38-52.
1868. *Cyrtina hamiltonensis* Meek, Trans. Chicago Acad. Sci., I, pt. 1, pp. 99-100, pl. 14, figs. 5, 7?, 10.
1889. *Cyrtina hamiltoniae* Nettleroth, Kentucky Fossil Shells, Mon. Kentucky Geol. Survey, p. 96, pl. 13, figs. 4-12.
1889. *Cyrtina hamiltonensis* Miller, North American Geol. Pal., p. 343, fig. 558.
1891. *Cyrtina hamiltonensis* Keyes, Johns Hopkins Univ. Circ., XI, p. 29.
1891, 1892. *Cyrtina Hamiltonensis* Whiteaves, Cont. to Canadian Pal., I, pt. 3, pp. 226-227, pt. 4, p. 288.
1894. *Cyrtina Hamiltonensis* Hall and Clarke, Pal. N. Y. VIII, pt. 2, p. 46, pl. 28, figs. 23-33, 43, 45, 46, 53.
1896. *Cyrtina hamiltonensis* Kindle, Bull. American Pal., 6, p. 35.
1897. *Cyrtina hamiltonensis* Schuchert, Bull. U. S. Geol. Surv. 87, p. 198.
1903. *Cyrtina hamiltonensis* Clarke, N. Y. State Mus., Bull. 65, p. 224.
1909. *Cyrtina hamiltonensis* Grabau and Shimer, North American Index Fossils, I, p. 313, figs. 393 a-c.
1911. *Cyrtina hamiltonensis* Cleland, Wisconsin Geol. Nat. Hist. Surv., Bull. 21, p. 75, pl. 15, figs. 7-10.
1912. *Cyrtina hamiltonensis* Kindle, Bull. U. S. Geol. Surv., 508, p. 81, pl. 5, fig. 4.
1913. *Cyrtina hamiltonensis* Prosser and Kindle, Maryland Geol. Survey, Middle and Upper Devonian, pp. 185-187, pl. 17, figs. 1-9; Clarke and Swartz, pp. 591-592, pl. 56, figs. 1-3.

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 break, which is very variable in elevation and straight or a little arched over the area, and not infrequently 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 towards 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."

Remarks—The species is common in the Mineola and, though good specimens are rare, a few beautifully preserved ones have been collected. Most of the specimens are

smaller than average *C. hamiltonensis* but some are large. Many of the small specimens have only 5 plications on each side of the fold and sinus.

Occurrence—Mineola of Callaway, Montgomery and Warren Counties.

Cyrtina missouriensis (Swallow)

Plate 16, figure 9; plate 19, figures 1-4

1860. *Cyrtia Missouriensis* Swallow, Trans. St. Louis Acad. Sci., I, pp. 647-648.
1889. *Cyrtina missouriensis* Miller, North American Geol. Pal., p. 343.
1894. *Cyrtina umbonata* Keyes, Missouri Geol. Surv., V, p. 90.
1897. *Cyrtina missouriensis* Schuchert, Bull. U. S. Geol. Surv. 87, p. 198.
1909. *Cyrtina missouriensis* Greger, American Jour. Sci., XXVII, p. 378.

Swallow's description—"Shell small, angular, beak and cardinal extremities salient. Ventral valve very prominent, regularly arched from the beak to the front and anterior portions of the lateral margins; beak pointed and incurved; sinus well defined, becoming deep and broad in front where it projects into the fold of the dorsal valve; area somewhat regularly concave, triangular; the hinge line but little longer than the sides, and about equal to the greatest width of the shell; foramen rather large, widening regularly from the beak to the hinge-line, closed by a convex pseudo-deltidium, which is perforated above the middle. Dorsal valve semi-elliptical, convex, flattened towards the cardinal extremities, which are somewhat produced; mesial fold convex, well defined and bounded by grooves larger and deeper than those separating the plication; beak incurved against the lower extremity of the deltidium. Surface marked with rounded plications, seven to nine on each side of the mesial fold, and eight to ten on each side of the mesial sinus. There is also one plication, somewhat smaller than the others, on each slope of the mesial fold and sinus. The plications bounding the mesial sinus are larger than the others; the internal casts of the shell show all the plications less distinctly. The shell is also marked with fine imbricating concentric lamellae and numerous small punctures.

This species is more nearly allied to the *Cyrtia umbonata* of Prof. Hall than to any other. It differs, however, from that in having plications on the mesial fold and in the sinus of the ventral valve; the plications are more numerous and extend to the beak; the foramen is wider at the base."

Supplementary description—Shell usually small but some as large as large specimens of *C. hamiltonensis* Hall. Pedicle valve regularly arched or straight from the beak to the front. Beak pointed and straight or incurved. Area plane or concave. Delthyrium of about the same proportions as in *C. hamiltonensis* Hall, wider near the hinge line in some specimens. Brachial valve moderately convex to almost flat; mesial fold usually well-defined but in some specimens indistinct. Surface marked by 7 to 11 rounded plications on each side of the fold and sinus. The plications bounding the fold and sinus are usually slightly larger than those on the sides of the shell.

Remarks—Swallow's description seems to have been based on a selected group of specimens that omitted the variations. The supplementary description is based on specimens from the type region. The species differs from *C. hamiltonensis* Hall in the presence of plications on the fold and sinus; in the fold and sinus being less distinct; and in the plications being more numerous and uniform.

Occurrence—Abundant in the Callaway of Callaway, Montgomery and Warren Counties.

Cyrtina triquetra (Hall)

Plate 19, figures 9-12

1858. *Cyrtia triquetra* Hall, Geol. Survey Iowa, I, pt. 2, pp. 513-514.
1868. *Cyrtina triquetra* Meek, Trans. Chicago Acad. Sci., I, p. 99.
1868. *Cyrtina triquetra* Meek and Worthen, Geol. Survey Illinois, III, p. 436, pl. 13, fig. 4.

1894. *Cyrtina triquetra* Hall and Clarke, Pal. New York, VIII, pt. 2, pl. 28, figs. 34, 35.
1897. *Cyrtina triquetra* Schuchert, Bull. U. S. Geol. Surv., 87, p. 199.
1909. *Cyrtina triquetra* Greger, Am. Jour. Sci., XXVII, p. 376.

Hall's description—"Shell small, pyramidal; cardinal extremities somewhat salient. Ventral valve extremely elevated, the beak slightly incurved; sinus deep, angular or subangular, bounded on either side by strong plications; area large, forming a nearly equilateral triangle, the base being scarcely longer than the sloping sides; foramen narrow, slightly open at base, and closed for half its length by a pseudo-deltidium. Dorsal valve depressed convex, semi-circular or semi-oval, with a strongly elevated mesial fold which is bounded by a deeper groove than those separating the plications.

Surface marked by seven or eight plications on either side of the mesial fold, and by nine on either side of the mesial sinus, and these are crossed by fine imbricating lamellose striae; the entire surface granulose or punctate."

Remarks—Specimens identified as *Cyrtina triquetra* are rare in the Snyder Creek shale. The area is somewhat higher than in the type of *C. triquetra*, the number of plications is 6 to 8, and occasionally 9 on either side of the fold and sinus, the outer ones usually poorly defined. On the type of *C. triquetra* the outer plications on the brachial valve are poorly defined. In most of the Snyder Creek specimens the pseudo-deltidium extends about half the height of the delthyrium, but in the one shown in figure 12, it nearly closes it.

Family Athyridae

Genus Athyris McCoy

Athyris fultonensis (Swallow)

Plate 17, figures 1-4.

1860. *Spirigera Fultonensis* Swallow, Trans. St. Louis Acad. Sci., I, p. 650.
1860. *Spirigera minima* Swallow, Ibid. p. 649.
1894. *Athyris vittata* Keyes, Geol. Survey Missouri, V, pt. 2, p. 90, pl. 41, fig. 1.
1897. *Athyris fultonensis* Schuchert, Bull. U. S. Geol. Surv., 87, p. 147.
1909. *Athyris fultonensis* and *Athyris minima* Greger, Am. Jour. Sci., XXVII, pp. 376-377.

Swallow's description—"Shell small, lenticular, flattened towards the anterior and lateral margins, forming there a thin sharp edge at the junction of the valves. Ventral valve suborbicular, moderately convex, highest near the beak; mesial sinus obsolete or entirely wanting; beak short, incurved; perforation small, orbicular. Dorsal valve smaller, orbicular, most convex near the beak; beak small, incurved, breaking the periphery of the perforation of the opposite beak. Surface regularly marked with numerous, concentric, lamellose, granular plications and fine concentric striae; the striae are observed on well preserved specimens only.

Length, .50; breadth, .53; thickness, .28.

This fossil is most like *Sp. hirsuta* of Prof. Hall; but it may be distinguished by its greater thickness near the beaks, and by the sharp thin edge found at the junction of the valves.

Abundant in some beds of the Hamilton rocks of Callaway County."

Remarks—Most paleontologists use *Athyris vittata* Hall as a synonym for *A. fultonensis* (Swallow) and the writer followed that precedent until he had collected hundreds of specimens of both species. Swallow described two species of *Athyris* from Callaway County, Missouri. *A. fultonensis* and *A. minima*. Both are listed from the Hamilton rocks of Callaway County. As the types were burned it is impossible to compare with them, but there can be no question about the species. The writer has examined more than 500 good specimens of *Athyris* from Callaway County. The small specimens grade into the large with no perceptible differences save in size, and *A. minima* becomes a synonym of *A. fultonensis*.

A. fultonensis (Swallow) shows decided and constant differences from *A. vittata* Hall. An average specimen of *A. vittata* Hall from the Cedar Valley of Iowa gives the following measurements: Length, 11 mm.; breadth, 12 mm.; thickness, 7.5 mm. An average *A. fultonensis* (Swallow) from Callaway County gives: Length, 7.5 mm.; breadth, 6.5 mm.; thickness, 4.5 mm.

The ratio of length to breadth of the Iowa form is 11:12, of the Missouri form 15-13. The greater width compared to length is constant with the Iowa form while the reverse is true of the Missouri form. The largest specimen examined by the writer is 9 mm. wide by 8.8 mm. long, and measurements have been made of only two specimens that are wider than long. Swallow must have selected unusually large specimens for his description. Some of the largest specimens have fairly well defined fold and sinus which are much narrower than in Iowa specimens of *A. vittata* Hall. The beak of the pedicle valve is much narrower and projects farther behind the hinge line than in *A. vittata* Hall.

Callaway limestone specimens of *A. fultonensis* may be distinguished from Snyder Creek specimens on account of being thinner and broader, but this seems to be due to flattening from pressure. The average size is larger in the Callaway.

Occurrence—Abundant in the Snyder Creek shale of Callaway County, particularly near New Bloomfield. Most of the Snyder Creek specimens are less than 8 mm. in length. Rare in the Callaway limestone of Callaway, Montgomery and Boone Counties.

Athyris vittata (Hall)

Plate 17, figures 8-10, 15, 16.

1860. *Athyris vittata* Hall, Thirteenth Rep. New York State Cab. Nat. Hist., pp. 89-90.
1897. *Athyris fultonensis* Schuchert, Bull. U. S. Geol. Surv., 87, p. 147.
1901. *Athyris fultonensis* Kindle, Indiana Dept. Geol. Nat. Res., 25th Ann. Rept., pp. 597-598.
1909. *Athyris fultonensis* Grabau and Shimer, North American Index Fossils, I, pp. 352-353, fig. 460.
1911. *Athyris fultonensis* Cleland, Wisconsin Geol. Nat. Hist. Surv., Bull. 21, pp. 83-84, pl. 14, figs. 1-4.
1915. *Athyris fultonensis* Butts, Geol. Surv. Kentucky, ser. 4, III, pt. 2, pl. 45, figs. 3, 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 round 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 intermediate spaces striate."

Remarks—Specimens from the Mineola of Missouri show several variations from the Iowa specimens though the differences are not important. The greatest convexity of the pedicle valve is nearer the front margin in the Mineola specimens. The beak of the pedicle valve does not project as far back of the hinge line in the Missouri specimens as in the Iowa specimens. In most cases the fold and sinus are somewhat broader in the Iowa specimens than in the Missouri. The Missouri specimens are thicker compared to length than the Iowa specimens.

Occurrence—Mineola of Ralls and Montgomery Counties. Abundant in Ralls County.

MOLLUSCA

Class PELECYPODA

Order Prionodesmacea

Family Solemyacidae

Genus Clinopistha Meek and Worthen

Clinopistha? rowleyi n. sp.

Plate 25, figures 7 and 8

Description—Shell of medium size, suboval; height about two-thirds the length; basal margin gently and almost uniformly curving; posterior end rounded to truncate; anterior end rounded to pointed; part in front of the beaks about half as long as the part behind the beaks. Valves moderately to strongly convex. Surface marked with moderately coarse concentric lines of growth.

No specimen has the hinge well preserved and the generic reference is, of course, uncertain. The species differs from *Clinopistha antiqua* Meek, in the greater length anterior to the beaks and shorter length posterior.

Occurrence—Near the top of the Snyder Creek shale of Callaway County.

Family Grammysiidae

Genus Grammysia Verneuil

Grammysia elliptica Hall

Plate 25, figures 15 and 16

1870. *Grammysia elliptica* Hall, Notice Lamellibranchiata, II, p. 53.
1885. *Grammysia elliptica* Hall, Pal. of N. Y., V, pt. 1, pp. 365-366, pl. 58, figs. 1-12.
1913. *Grammysia elliptica* Clarke and Swartz, Maryland Geol. Survey, Middle and Upper Devonian, p. 606, pl. 59, figs. 11-12.

Hall's description—"Shell of medium or large size, transversely elliptical; length varying from one-sixth to one-third greater than the height; basal margin broadly curving, slightly sinuate about the middle; posterior margin abruptly rounded below and curving into the cardinal line above, sometimes more or less truncate. Cardinal line arcuate. Anterior end narrow and abruptly rounded below the lunule.

Valves regularly convex below, becoming more or less gibbous above the middle and in the umbonal region.

Beaks sub-anterior, very prominent, strongly incurved, rising considerably above the hinge line. Umbonal slope rounded, arcuate. Cincture consisting of a fold and furrow, extending downward in a curving direction to the base of the shell, producing a gentle sinuosity in the basal margin. The fold is more strongly developed in the left valve and the furrow in the right one.

Test thick, marked on the posterior and middle portions of the shell by fine, irregular, concentric striae, which become aggregated into fascicles on the middle of the shell; and on the anterior part marked by strong concentric undulations. No radiating striae have been observed.

The hinge of the right valve shows a thickened plate bearing a single angular fold just beneath the beak. Nothing is satisfactorily known about the muscular impressions.

Four specimens measure respectively 31, 57, 65 and 93 mm. in length, and 23, 36, 46 and 63 mm. in height."

Remarks—This form is rare and all specimens in the collections are imperfect. The identification, however, is fairly certain.

Occurrence—Snyder Creek shales of Callaway County, location 2.

Superfamily Nuculacea

Family Nuculidae

Genus Nucula Lamarck

Nucula cf. lirata (Conrad)

Plate 25, figures 13 and 14

1842. *Nuculites lirata* Conrad, Jour. Acad. Nat. Sci., Phila., vol. VIII, p. 250, pl. XV, fig. 7.
1870. *Nucula lirata* Hall, Prelim. Notice Lamellibranchiata, 2, p. 3.
1885. *Nucula lirata* Hall, Pal. N. Y., vol. V, pt. I, Lamellibranchiata II, p. 316, pl. XLV, figs. 5, 11, 15, 17-22, 24, 25; pl. XCIII, fig. 5.
1903. *Nucula lirata* Clarke, N. Y. State Mus. Bull. 65, p. 462.
1909. *Nucula lirata* Grabau and Shimer, N. Am. Index Fossils, vol. I, p. 395, fig. 503d.
1913. *Nucula lirata* Prosser and Kindle, Maryland Geol. Surv., Middle and Upper Devonian, pp. 229-30, pl. 25, figs. 6-8 and 9, 10 (?).

Description—"Shell of medium size, ovate-triangular; length from one-third to one-fourth greater than the height; basal margin regularly curving, more abruptly rounded at the posterior extremity; cardinal margin slightly arcuate, gradually sloping toward the posterior; anterior end short, subtruncate, usually abruptly rounded. Valves very gibbous, ventricose in the umbonal region; beaks, at the anterior third or fourth of the length of the shell, distant, elevated, rising considerably above the hinge-line; umbo very prominent. Test thick, marked by regular, strong, subangular concentric undulations, which are crossed by extremely fine radiating striae." Hall, 1885.

Remarks—One internal mould from the top of the Snyder Creek shale agrees with *N. lirata* in shape and muscular impressions. The dentition is not preserved. It is much smaller than ordinary specimens of *N. lirata*. No exteriors have been collected. The identification is uncertain at the best.

Occurrence—Snyder Creek shale, Cow Creek, Callaway County.

Nucula snyderensis n. sp.

Plate 25, figures 17 and 18

Description—Shell small, ovate; length about one-third greater than breadth; basal margin regularly curving, more abruptly rounded at posterior and anterior extremities. Cardinal margin nearly straight, sloping gently toward the posterior; anterior end short, symmetrically rounded; part behind beaks about twice as long as in front. Valves thin; beaks only slightly elevated. Muscular scars small, deep; palial line distinct.

All of the specimens in the collections are internal moulds, and the surface markings are not preserved. The dentition is not preserved.

The specimens differ from those identified as *Nucula lirata* (Conrad) in being much longer compared to the height, much less ventricose, and beaks less prominent.

Occurrence—Snyder Creek shale, Cow Creek, Callaway County.

Superfamily Pteriacea

Family Conocardiidae

Genus Conocardium Bronn

Conocardium ohioense Meek

Plate 26, figures 1-7

1873. *Conocardium Ohioense* Meek, Geol. Surv. Ohio, I, pt. II, Paleontology, pp. 203-206, pl. 18, fig. 9.
1885. *Conocardium Ohioense* Hall, Pal. N. Y., V, pt. I, Lamellibranchiata II, p. 411, pl. 68, figs. 2-3.

1901. *Conocardium ohioense* Kindle, 25th Ann. Report Indiana Dept. Geol. Nat. Res., pp. 686-687, pl. 15, fig. 7.
1909. *Conocardium ohioense* Grabau and Shimer, North American Index Fossils, I, p. 438, fig. 575.
1911. *Conocardium ohioensis?* Cleland, Wisconsin Geol. Nat. Hist. Surv., Bull. 21, p. 109, pl. 21, figs. 7, 8.

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 value, 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 15 mm. and a height of 10 mm. 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*."

Remarks—This species is abundant in the Mineola of Montgomery and Ralls Counties, and has been collected from the Callaway of Moniteau County. The specimens are small and display considerable variations. Most of the specimens show about six strong plications and all others much smaller but in some specimens the plications are nearly equal in size. Ordinarily the plications on the anterior slope of the ventricose part are the stronger but on some specimens those on the posterior slope are larger than on the anterior. Commonly a longitudinal groove marks or divides each plication but some specimens have simple plications. Commonly the anterior end projects to form a dorso-ventral ridge with both sides of the ridge convex, but some specimens are produced to a point and the front is concave in all directions from the point.

The writer attempted to describe the most ventricose form, the one with the most pointed ends, as a new species, but the descriptions all led back to *C. ohioense*.

Occurrence—Abundant in the Mineola of Montgomery and Ralls Counties. Two specimens have been collected from the Callaway of Moniteau County.

Superfamily Trigoniacea

Family Trigoniidae

Genus Schizodus King

Schizodus chemungensis (Conrad)

Plate 27, figures 4-7

1842. *Nuculites Chemungensis* Conrad, Jour. Acad. Nat. Sci., Phila., VIII, p. 247, pl. 13, fig. 13.
1885. *Schizodus Chemungensis* Hall, Pal. N. Y., V, pt. 1, Lamellibranchiata sec. 2, pp. 453-454, pl. 75, figs. 37-40, 41, 45.
1891. *Schizodus Chemungensis* Whiteaves, Cont. to Canadian Pal., p. 241, pl. 30, figs. 5, 5a.
1909. *Schizodus chemungensis* Grabau and Shimer, North American Index Fossils, I, p. 482, fig. 642b.
1913. *Schizodus chemungensis* Clarke and Swartz, Maryland Geol. Survey, Middle and Upper Devonian, pp. 644-645, pl. 64, figs. 3-5.

Hall's description—"Shell large, rhomboid-ovate; length one-fourth greater than the height. Anterior margin broadly rounded, curving into the basal margin, which is sometimes nearly straight posteriorly. Post-inferior extremity angular. Posterior margin obliquely truncate. Cardinal line straight, less than half the length of the shell.

Valves depressed-convex below, becoming gibbous in the middle and above. In its usual condition of preservation the shell is very much depressed.

Beaks at about the anterior third, prominent. Umbonal slope sub-angular, defined above, less prominent below.

Surface marked by fine concentric striae of growth, which are partially preserved in the cast.

Three specimens measure respectively 33, 35 and 43 mm. in length, and 25, 29 and 30 mm. in height."

Remarks—This species is abundant on Cow Creek, near the top of the Snyder Creek shales, but is rare at other places. It exhibits considerable variation. The posterior margin varies from obliquely truncate to a nearly regular curve; in some specimens the length is one-half greater than the height. In the longer shells the beaks are proportionately nearer the anterior end. All of the specimens are interior moulds and do not retain the surface markings. The series seem to include forms described by Clarke and Swartz as *Schizodus trigonalis*.

Superfamily Mytilacea

Family Modiolopsidae

Genus Modiomorpha Hall

Modiomorpha missouriensis n. sp.

Plate 25, figures 3-6, 10 and 11

Description—Shell small; length little greater than the height; basal margin gently curved; posterior margin rounded in about the same way above and below, narrow at the extremity; cardinal margin oblique; nearly straight though diverging slightly from a straight line at the beaks. Anterior end projecting in front of the beaks, rounded much like the posterior end. Valves moderately and regularly convex. Hinge line extending little more than one-third the length of the shell though its length is about half that of the shell. Beaks small, pointed, directed forward. Umbonal region not sharply set off from the rest of the shell. Test marked by strong, irregularly spaced concentric striae.

This form differs from *M. concentrica* (Conrad) in the termination of the hinge line a short distance in front of the beaks and the regular downward curve from this point to the anterior end of the shell. The concentric ridges are much coarser than in *M. concentrica* (Conrad); the shell is comparatively shorter and thicker.

Occurrence—Snyder Creek shale of Callaway County.

Genus Goniophora Phillips

Goniophora hamiltonensis (Hall)

Plate 25, figures 1 and 2

1870. *Sanguinolites hamiltonensis* Hall, Prelim. Notice Lamellibranchiata, 2, p. 36.
1877. *Goniophora hamiltonensis* Miller, Cat. Amer. Pal. Fossils, p. 192.
1885. *Goniophora Hamiltonensis* Hall, Pal. N. Y., V, pt. 1, Lammellibranchiata 2, pp. 296-297, pl. 43, figs. 8-15, 17-21.
1901. *Goniophora hamiltonensis* Kindle, Indiana Dept. Geol. Nat. Res., 25th Ann. Rept., pp. 684-685, pl. 16, figs. 4 and 5.
1903. *Goniophora hamiltonensis* Clarke, N. Y. State Mus., Bull. 65, p. 390.
1909. *Goniophora hamiltonensis* Grabau and Shimer, North American Index Fossils, I, p. 519, fig. 699c.

1913. *Goniophora hamiltonensis* Prosser and Kindle, Maryland Geol. Survey, Middle and Upper Devonian, pp. 271-272, pl. 33, figs. 11-13; Clarke and Swartz, p. 651, pl. 65, fig. 3.

Hall's description—"Shell large, trapezoidal; length more than twice the height; basal margin gently curving, sometimes nearly straight and slightly affected by the sinus. Posterior margin obliquely truncate. Anterior margin concave below the beak and abruptly rounded below. Cardinal line very slightly arcuate, extending for two-thirds the length of the shell; margins inflected, forming a long, deep escutcheon. Valves moderately convex below the umbonal ridge, and concave above it to the cardinal line. Beaks sub-anterior, small, closely incurved, situated from one-fourth to one-sixth the length of the shell from the anterior margin. Umbonal ridge angular, strongly defined, arching over the beaks and extending in nearly a direct line to the post-basal extremity. Umbonal region scarcely gibbous, separated from the anterior end by a broad undefined sinus, which becomes obsolete in some specimens, owing to compression. Test of moderate thickness, marked by regular, prominent, lamellose striae."

Remarks—This is a rare form in the Snyder Creek shale and only eight specimens are in the University of Missouri Collections. The specimens differ in no essential details from those from other localities. A small part of the posterior end is missing from each specimen.

Occurrence—Snyder Creek shale of Callaway County.

Order TELEODESMACEA

Superfamily Lucinacea

Family Lucinidae

Genus Paracyclas Hall

Paracyclas elliptica Hall

Plate 36, figure 1.

1843. *Paracyclas elliptica* Hall, Geol. N. Y., pt. IV, Rep. Fourth Dist., p. 171, t. 67, fig. 2.

1872. *Lucina* (*Paracyclas*) *elliptica*, var. *occidentalis*, Hall and Whitfield, Twenty-fourth Ann. Rep. N. Y. State Mus. Nat. Hist., p. 189.

1883. *Paracyclas elliptica* Hall, Pal. N. Y. vol. V, pt. I, pl. 72, figs. 23-30.

1885. *Paracyclas elliptica* Hall, Pal. N. Y., vol. V, pt. 1, Lamellibranchiata 2, p. 440, pl. 72, figs. 23-33, pl. 95, fig. 18.

1889. *Paracyclas elliptica* Nettleroth, Kentucky Fossil Shells, pp. 209-210, pl. 2, figs. 1-3.

1909. *Paracyclas elliptica* Grabau and Shimer, North American Index Fossils, 1, pp. 554-555, fig. 760d.

1911. *Paracyclas elliptica* Cleland, Wisconsin Geol. Nat. Hist. Surv., Bull. 21, p. 117, pl. 25, figs. 3-5.

Hall's description—"Shell large, sub-circular or broadly sub-elliptical (subject to great variation in form from compression); length and height about equal. Pallial margin regularly curving from the extremities of the hinge. Cardinal line short, more than one-third the length of the shell, slightly arcuate. Valves regularly convex, somewhat regularly gibbous in the middle. Beaks a little anterior to the middle, small, appressed and closely incurved, rising but little above the hinge line. Umbonal slope defined above by a depression extending from the beaks to about the middle of the posterior extremity, distinctly limiting the post-cardinal slope of the valves. Test thin, Surface marked by fine concentric striae, which are aggregated into fascicles at irregular distances. Ligamental groove narrow and elongate. Posterior musclar impression just within the post cardinal margin and below the ligamental groove. Pallial line parallel with the basal margin, marked in the cast by a row of elongate nodes, which are the

terminations of low ridges from above. Interpallial area pustulose on the cast. Five specimens measure respectively 30, 32, 40, 44 and 48 mm. in length, and 29, 33, 37, 40 and 44 mm. in height."

Remarks—This species is abundant in some places in the Snyder Creek shale, and especially so on Cow Creek at locality 2. The variety in size and shape is remarkable and if the varieties were collected from several localities they might be referred to two or more species. Some specimens are 1 ½ times as long as wide, while others are nearly as wide as long. Some are 2/3 as thick as wide, while others appear thin and are less than half as thick as wide.

Occurrence—Callaway limestone and Snyder Creek shale.

Paracycles lirata (Conrad)

Plate 25, figures 9 and 12

1838. *Posidonia lirata* Conrad, Geol. Surv. N. Y., Ann. Rept., p. 116, pl. (unnumbered), fig. 12.

1872. *Posodonia* (*Paracyclas*) *lirata* Hall and Whitfield, Twenty-fourth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 200.

1885. *Paracyclas lirata* Hall, Pal. N. Y., V, pt. 1, Lamellibranchiata 2, pp. 441-442, pl. 72, figs. 2-19; pl. 95, fig. 19.

1901. *Paracyclas lirata* Kindle, Indiana Dept. Geol. Nat. Res., 25th Ann. Rept., pp. 673-674, pl. 15, fig. 10.

1903. *Paracyclas lirata* Clarke, N. Y. State Mus., Bull. 65, p. 483.

1909. *Paracyclas lirata* Grabau and Shimer, North American Index Fossils, I, p. 555, fig. 760b.

1911. *Paracyclas lirata* Cleland, Wisconsin Geol. Nat. Hist. Survey, Bull. 21, p. 118, pl. 25, figs. 6 and 7.

1913. *Paracycles lirata* Prosser and Kindle, Maryland Geol. Survey, Middle and Upper Devonian, pp. 277-278, pl. 34, figs. 11-14.

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."

Remarks—The specimens from central Missouri, though numerous, are all somewhat worn and specific reference is somewhat uncertain. The surface markings are not as prominent as on Indiana and New York specimens but this may be due entirely to wear. A well-marked difference between this species and *P. elliptica* Hall is the much greater proportional thickness of *P. elliptica* Hall. *P. lirata* is a much smaller form.

Occurrence—Abundant near the top of the Snyder Creek shale in Callaway County.

Class GASTROPODA

SUBCLASS STREPTONEURA

Order Aspidobranchia

Suborder Docoglossa

Family Bellerophontidae

Genus Bellerophon Montfort

Bellerophon sp.

Plate 27, figures 2 and 3; plate 30, figure 9

Bellerophon is represented by only one mould from the Mineola and by several small specimens from the Snyder Creek. The specimens are too imperfect to warrant specific identification. Savage identifies specimens from the Grand Tower of Illinois as *B. pelops* Hall. The specimen from the Mineola agrees with *B. pelops* in shape.

Suborder Rhipidoglossa

Family Pleurotomariidae

Genus Pleurotomaria Sowerby

Pleurotomaria sp. undet.

Plate 28, figure 2

A large gastropod too imperfect for specific determination. The shell is preserved only on a small part of the outer side of the body whorl. It is not possible to determine whether a slit was present. The figure on plate 28 does not show clearly the flatness of the tops of the whorls or the nodes on the margins of the flat places. Only one specimen has been collected.

Occurrence—Mineola of Ralls County.

Pleurotomaria isaacsi Hall and Whitfield

Plate 28, figures 1, 10, 11

1873. *Pleurotomaria Isaacsi* Hall and Whitfield, New York State Cab. Nat. Hist. 23d Ann. Rept., p. 238, pl. 12, figs. 6 and 7.

Hall and Whitfield's description—"Shell depressed, suborbicular, with moderately elevated spire and rapidly increasing volutions, three to four in number, flattened or slightly convex on the upper surface, rounded below, obliquely truncate on the periphery. Umbilicus very broad and open. Surface of shell apparently destitute of ornamentation.

This species bears much resemblance to the *P. arata* Hall, from the Schoharie grit of New York and may be considered as a western representative species appearing to hold a very similar geologic position. It differs in the absence of the transverse furrows, crossing the upper side of the volutions, which characterize *P. arata* Hall."

Remarks—This is a common form in the Snyder Creek shale, but most of the specimens are misshapen, and the shape of the shell is the only means of identification.

Pleurotomaria providencis Broadhead

Plate 26, figures 19 and 20

1896. *Pleurotomaria Providencis* Broadhead, Am. Jour. Sci., 4th Ser. II, pp. 237-239, figs. 1-7.

1918. *Pleurotomaria providencis* Branson, Geology of Missouri, pp. 100-101, pl. 3, fig. 12.

Broadhead's description—"Shell subglobose, depressed, spire moderately elevated. Volutions three or four, the last whorl much expanded. Aperture circular. Surface marked by numerous striae or lines of growth which are occasionally imbricated, strongly marked and unevenly fasciculated.

A sulcus one-tenth of an inch broad and about one-half as deep divides the upper and lower part of each whorl. The striae as they pass from the suture curve backwards increasing in curvature as they approach the median sulcus, where they are so much crowded as to form a low border to the sulcus. In crossing the sulcus they are concave in front. On the lower side of the sulcus they also curve backward and form a sharp border to the sulcus similar to that formed above.

In average-sized specimens there is a row of prominent nodes about half way between the sulcus and the suture. These nodes at their upper and lower portions are elongated into a low ridge which follows the direction of the lines of growth of the shell, but in soon blended into the body whorl. There is also another range of nodes below the sulcus and sometimes a faint appearance of a second row. The shell also presents a somewhat nodular appearance just below the suture. The suture is well defined.

The lower side of the last volution is regularly curved, the upper side more often rough-looking from the presence of nodes and the occasional prominence of the lines of growth.

On the last volution of old shells the nodes almost disappear but the sulcus continues to be well marked. Columellar lip thick, flattened, making an angle of about 80 degrees with the outer surface of the shell.

Height of an average specimen.....2 inches.

Breadth of an average specimen.....2 inches.

Some shells are one-half larger."

Remarks—Superficially this form resembles *Turbo shumardi* De Verneuil, but it has a well marked slit which distinguishes it generically from *Turbo*. The nodes emphasized by Broadhead are really high parts of swollen ridges. The slit is peculiar in narrowness and the sulcus in depth. Broadhead's cotypes are in the museum of the University of Missouri. His figure 6 is of a badly crushed specimen and the specimen from which figure 1 was drawn is crushed and broken. The specimen figured in the Geology of Missouri was carefully prepared by D. K. Greger. It was formerly in the collection of the University of Missouri, but has disappeared. The University collection contains more than 40 specimens collected from the Cooper near Providence, Missouri. Specimens are abundant at one locality in the Cooper of Marion County.

Genus Euryzone Koken

Euryzone mineolaensis n. sp.

Plate 26, figure 18; plate 28, figures 8 and 9

Description—Shell turreted, slightly higher than wide; volutions about four, somewhat rapidly increasing in size, regularly convex, gradually expanding to the body whorl, which is ventricose; no umbilicus; aperature oval, somewhat wider than high, surface marked by numerous concentric striae which are directed gently backward from the suture and curve backward strongly over the peripheral band. The band is five times the width of the whorl, simple and slightly depressed at the margins.

Remarks—This form resembles *Euryzone itys* Hall, but lacks revolving striae. It is common in the Mineola of Ralls County, but good specimens are not easily secured. The best in our collection is shown in figure 9 of plate 28.

Euryzone lucina (Hall)

Plate 26, figure 14

1843. *Euomphalus? rotundus* Hall, Geology of N. Y., pt. 4, Surv. Fourth Geol. Dist., p. 172, f. 4.
1861. *Pleurotomaria Lucina* Hall, Descriptions of New Species of Fossils, etc., p. 14.
1862. *Pleurotomaria lucina* Hall, Fifteenth Rep. N. Y. State Cab. Nat. Hist., p. 42, pl. 5, fig. 12.
1876. *Pleurotomaria rotunda* and *P. Lucina* Hall, Illustrations of Devonian Fossils; Gastropoda, pl. 18.
1879. *Pleurotomaria Lucina* Hall, Nat. Hist. New York, Paleontology V, pt. 2, pp. 67-68, pl. 18, figs. 1-11.
1909. *Euryzone lucina* Grabau and Shimer, North American Index Fossils, I, p. 645, fig. 879c.

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 ventricose, with the aperture expanded and nearly round, extended on 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 backwards; 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 narrower space, which is often crenulated by the concentric striae."

Remarks—Only one good specimen is in our collections, and the surface markings are not present on it though the shell is preserved. Owing to an incrustation on the shell it is not possible to determine whether a band is present. All specimens from Missouri are from the Mineola of Ralls County.

Genus Spiroraphe Perner

Spiroraphe arata (Hall)

Plate 30, figures 1 and 2

1861. *Pleurotomaria arata* Hall, Descriptions of New Species of Fossils, etc., p. 14.
1862. *Pleurotomaria arata* Hall, Fifteenth Rep. N. Y. State Cab. Nat. Hist , p. 42, Pl. 5, fig. 13.
1876. *Pleurotomaria arata* Hall, Illustrations of Devonian Fossils; Gasteropoda, pl. 17.
1879. *Pleurotomaria arata* Hall, Pal. N. Y., V, pt. 2, p. 64, pl. 17, figs. 1-8.
1909. *Spiroraphe arata* Grabau and Shimer, North American Index Fossils, I, p. 645, fig. 880.

Hall's description—"Shell depressed-suborbicular or obliquely hemispheric. Spire moderately elevated; volutions four or more in the entire shell, depressed-convex or flattened upon the upper side, and rounded below, gradually enlarging from the apex—the outer half of the body-volution being ventricose. Aperture somewhat transverse.

Surface, on the upper side of the volutions, usually marked by strong, regular, distinct striae, which often rise in sharp elevated ridges; occasionally finer and more subdued. These striae are parallel to the lines of growth, and sometimes appear to have been crenulated by finer revolving striae. A well-defined revolving band marks the periphery of the shell, but usually (owing to compression of the specimens) this cannot be traced in the higher volutions. The lower side of the outer volution is marked by fine, equal, revolving striae."

Remarks—The identification is uncertain as the Missouri specimens are all interior moulds and none is perfect. The one figured is the most complete.

Specimens from the Cedar Valley of Iowa have been referred to this species.

Occurrence—Callaway limestone of Callaway and Montgomery Counties.

Family Euomphalidae

Genus Euomphalus Sowerby

Euomphalus cf. hecale Hall

Plate 28, figures 6, 7

1876. *Euomphalus Hecale* Hall, Illustrations of Devonian Fossils; Gasteropoda, pl. 16, figs. 10-14.

1879. *Euomphalus Hecale* Hall, Nat. Hist. New York, Paleontology V, pt. 2, p. 59, pl. 16, figs. 10-14.

Hall's description—"Shell discoid, spire depressed. Volutions about three or four, contiguous, rounded, the inner ones slightly elevated above the plane of the outer one, gradually enlarging from the apex, very slightly expanding at the aperture and flattened on the lower side. Umbilicus broad, descending abruptly from the inner basal margin of the volution, which is rounded on that side.

Surface concentrically striated—the striae often crowded in fascicles or ridges towards the aperture."

Remarks—A rare form in the Snyder Creek shale. It is preserved only as internal moulds and the identification is uncertain. The resemblance to *E. inops* Hall is very close.

Order Ctenobranchiata

Suborder Platypoda

Superfamily Taenioglossa

Family Capulidae

Genus Platyceras Conrad

Platyceras cf. calantica Hall

Plate 26, figures 9 and 17

1859. *Platyceras calantica* Hall, Nat. Hist. N. Y., Pal. vol. III, pp. 328-329, pl. 62, figs. 1-5.

Hall's description—"Shell obliquely or arcuately subconical; apex consisting of one and a half to two minute volutions, from which the body of the shell expands very abruptly, becoming extremely ventricose below and broadly campanulate at the aperture; peristome scarcely sinuous.

Surface marked by fine transverse striae and a few broad shallow wrinkles."

Remarks—We have only one well-preserved specimen in our collections. The reference to a Lower Devonian species seems questionable but its agreement in shape is

complete. The characters by which the species of *Platyceras* are differentiated are so uncertain, at the best, that a close reference is preferable to a new species. Ulrich found an Oriskany *Platyceras* in the Upper Devonian of Iowa.[1]

Occurrence—Mineola of Montgomery County.

Platyceras carinatum Hall

Plate 26, figures 10 and 11.

1879. *Platyceras carinatum* Hall, Pal. N. Y., V, pt. 2, p. 5, pl. 2, figs. 12-29.
1901. *Platyceras carinatum* Kindle, Indiana Dept. Geol. Nat. Res., 25th Ann. Rept. pp. 721-722, pl. 18, figs. 5-7.
1909. *Platyceras carinatum* Grabau and Shimer, North American Index Fossils, I, pp. 683-684, fig. 963b.

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, 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."

Remarks—Specimens from the Mineola agree with Hall's species in shape and dimensions but as only interior moulds are preserved the identification is somewhat uncertain.

Occurrence—Mineola limestone of Montgomery and Warren Counties.

Platyceras conicum Hall

Plate 26, figures 15 and 16.

1879. *Platyceras (Orthonychia) conicum* Hall, Pal. N. Y., V, pt. 2, p. 3, pl. 1, figs. 13-23.
1901. *Platyceras conicum* Kindle, Indiana Dept. Geol. Nat. Res., 25th Ann. Rept., pl 721, pl. 18, figs. 2, 2a and 2b.

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 and a half inches or more, with the aperture a little less."

Remarks—At locality number 4 of the Mineola, this species is abundant but it has not been collected from other localities. The apex is missing from all specimens. The specimens agree in detail with some of Hall's and Kindle's figures of the species. The specimen shown in figures 12 and 13 of plate 20 may belong to a different species but part of Hall's description would seem to include this variety.

[1]Geol. Surv. Ill., III, p. 442.

Platyceras cf. erectum Hall

Plate 26, figure 8; plate 28, figure 3.

1843. *Acroculia erecta* Hall, Geol. N. Y., Pt. IV, p. 174, fig. 6 on p. 172.
1861. *Platyceras erectum* Hall, Descriptions of New Species of Fossils, p. 4.
1862. *Platyceras erectum* Hall, 15th Rep. N. Y. State Cab. Nat. Hist., p. 32.
1876. *Platyceras erectum* Hall, Illustrations of Devonian Fossils; Gasteropoda, pl. 2.
1879. *Platyceras erectum* Hall, Pal. N. Y., vol. V, pt. 2, p. 5, pl. 2, figs. 4-11.
1901. *Platyceras erectum* Kindle, Indiana Dept. Geol. Nat. Res., 25th Ann Rept., p. 728, pl. 19, fig. 7.
1909. *Platyceras erectum* Grabau and Shimer, N. Am. Index Fossils, vol. I, p. 683, fig. 963a.
1913. *Platyceras erectum* Prosser and Kindle, Maryland Geol. Survey, Middle and Upper Devonian, pp. 296-297, pl. 37, figs. 1-3.

Prosser and Kindle's description—"Shell regularly arcuate to the inrolled spire; nearly two volutions; the spire at the apex closely inrolled for about one and one-half volutions beyond which the body volution expands somewhat rapidly; the aperture often spreading, not infrequently oblique with a sinuate peristome. Surface marked by closely arranged, revolving, lamellose striae, which, upon the lower half of the body volution, are abruptly arched along narrow bands, corresponding with former sinuosities of the aperture."

Remarks—Small specimens of the form referred to *P. erectum* are abundant but large specimens are rare.

Occurrence—Mineola of Montgomery and Callaway Counties.

Platyceras cf. nodosum Conrad

Plate 28, figures 4 and 5.

1841. *Platyceras nodosus* Conrad, Fifth Ann. Rep. Pal. N. Y., p. 56.
1859. *Platyceras nodosum* Hall, Nat. Hist. N. Y., Pal. III, p. 473, pl. 115, figs. 1-6. pl. 116, figs. 1-4.
1876. *Platyceras dumosum* and *P. dumosum* var. *rarispinum* Hall, Illustrations of Devonian Fossils; Gasteropoda, pl. 5 and 7.
1879. *Platyceras nodosum* Hall, Nat. Hist. N. Y. Pal. V, pt. II, p. 17, pl. 7, figs. 4 and 5.
1913. *Platyceras nodosum* Ohern, Maryland Geol. Survey, Lower Devonian, pp. 469-470, pl. 79, figs. 13 and 14.

Hall's description—"Subfalcate, with numerous thick obtuse nodes. This is a cast in sandstone, and the shell was probably covered with spines. Length two inches.

Shell obliquely subovate; volutions contiguous, about two or three, very rapidly expanding from the apex; summit of the spire on a plane with, or a little above, the outer volution; aperture round.

Surface marked by round obtuse nodes and strong interrupted or tortuous lamellose striae."

Remarks—Most of our specimens are fragmentary and all are internal moulds. The nodes are larger, lower and less numerous than in most specimens figured by Hall. The shape seems to be very near to that of Hall's specimens.

Occurrence—Mineola limestone of Montgomery County.

Platyceras annulatum n. sp.

Plate 26, figures 12 and 13.

Shell subconical. Aperture nearly circular. Apex slightly incurved; body volution expanding rapidly from near the apex. Margins incomplete. Surface ornamented with six or seven concentric ridges on the top of which are many nodes or bases of spines. Length 16 mm., breadth 14 mm. The complete diameter was probably greater.

Only one fairly complete specimen has been collected but it differs so much from other forms that it is used as the holotype of a new species. Fragments of other specimens have been collected.

Occurrence—Crinoidal bed of the Mineola limestone, Montgomery County.

Genus Diaphorostoma Fisher

Diaphorostoma snyderensis n. sp.

Plate 27, figures 1, 8 and 9.

Description—Spire generally slightly elevated above the body whorl; usually one and one-half to two and one-half volutions preserved. Young shells indicate the earlier presence of one or two more volutions. The body whorl expands rather rapidly and in an occasional specimen is not in contact with the rest of the shell. Aperture suborbicular in outline, inclined about 45 degrees from a vertical plane, with a regular margin.

Remarks—This is the most abundant gastropod in the Snyder Creek shales. There is little variation among the specimens, the largest being the divergence of the body whorl from the rest of the volutions. The specimens showing this variation most markedly would be classed as *Platyceras* if they were not associated with the other shells.

CLASS CEPHALOPODA,

Subclass Tetrabranchiata

Order Nautiloidea

Suborder Orthochoanites

Family Orthoceratidae

Genus Orthoceras Breynius

Orthoceras sp. undet.

Plate 30, figures 4 and 5

Only fragments of this species have been collected. By projecting the side lines an angle of about 20 degrees is obtained from the apex. The air chambers are 9 to 12 millimeters deep. Two specimens are about 7 centimeters in width. Six segments are preserved in each specimen. A much flattened specimen 13 centimeters in diameter probably belongs to the same species.

Occurrence—Snyder Creek shale, Callaway County.

Orthoceras sp. undet.

Plate 29, figures 1, 2, 3, 5 and 7

Several fragments of an *Orthoceras* of nearly circular cross-section and with a very small siphuncle are in our collections. The diameter of the preserved parts is about 4 centimeters and of the siphuncle 3 millimeters. Some of the specimens are not cylindrical but they seem to have been flattened.

Occurrence—Snyder Creek shale, Callaway County.

Orthoceras cf. atreus Hall

Plate 30, figure 3

1879. *Orthoceras Atreus* Hall, Pal. New York, vol. V, pt. 2, p. 305, pl. 88, fig. 1; pl. 89, figs. 10 and 11.

Hall's description—"Shell large, straight, robust, very regularly and gradually enlarging to the chamber of habitation. Transverse section circular. Apical angle about 6 degrees. Initial extremity unknown.

Chamber of habitation sub-cylindrical, well developed; length about three times the diameter of the tube at the last septum. Tube with a very broad and gentle constriction anterior to the middle of the outer chamber, and the indication of a contraction at the aperture.

Air-chambers regular, deep, having a depth of fourteen mm. where the tube has a diameter of fifty-five mm. The external walls are smooth in the cast, with a slight longitudinal carina indicating the ventral side.

Septa smooth, so far as observed, with a concavity equal to an arc of 120 degrees. Sutures straight and horizontal.

The siphuncle, as determined from a small fragment referred to this species with some doubt, is large and excentric, having a diameter at the septa of five mm., where the tube has a diameter of fifty mm., and distant from the nearest margin of the septa about one-third the diameter of the tube. It is expanded in the interseptal spaces, as indicated in a longitudinal section."

Remarks—Fragments of the species are not uncommon but no good specimen has been collected. The best specimen is 25 centimeters long and 12 centimeters in diameter at the base of the living chamber. The part of the living chamber preserved is 10 centimeters long. The air chambers are 18 millimeters deep. By projecting the side lines an angle of 12 degrees for the apex is obtained.

Occurrence—Snyder Creek shale, Callaway County.

Family Nautilidae

Genus Nautilus Linneaus

Nautilus? lawsii? Swallow

1860. *Nautilus? Lawsii* Swallow, Trans. St. Louis Acad. Sci., 1, p. 658.

Swallow's description—"Shell very large; septa very numerous and very convex; volutions depressed on the dorsal surface, somewhat flattened on the sides, and flattened or concave on the inner surface; taper gradual; aperture elliptical.

Diameter of the shell, 10.75 inches; length of aperture, 4 inches; width, 3.25."

Remarks—The writer has not seen a closely coiled specimen in the Missouri faunas and is listing this on Swallow's authority.

Occurrence—Probably from the Snyder Creek, Callaway County.

Suborder Cyrtochoanites

Family Ooceratidae

Genus Cyrtoceras Goldfuss

Cyrtoceras? sp. undet.

Plate 29, figure 4

Description—The only specimen of *Cyrtoceras* in our collections consists of 19 septae and three inches of the living chamber. The 19 septae occupy a distance of about 13 centimeters. The specimen is only a slab, less than an inch in thickness, flaked off from a large specimen.

Occurrence—Snyder Creek shale of Callaway County.

Family Phragmoceratidae

Genus Gomphoceras Sowerby

Gomphoceras sp. undet.

Plate 29, figure 7

Only one specimen of *Gomphoceras* from the Missouri Devonian was collected by the writer and his assistants. It came from the Mineola of Ralls County. It resembles closely *Gomphoceras solidum* Hall from the Goniatite limestone of New York. Both ends of the specimen are missing. The sides of the part preserved diverge at an angle of about 20 degrees. The air chambers are five millimeters deep. The living chamber is so badly broken that little can be made out concerning it.

ARTHROPODA

Class CRUSTACEA

Subclass Trilobita

Order Opisthoparia

Family Proetidae

Genus Proetus Steininger

Proetus crassimarginatus Hall and Clarke

Plate 21, figures 8, 9, 10; plate 30, figures 6, 7, 8

1888. *Proetus crassimarginatus* Hall and Clarke, Pal. New York, vol. VII, p. 99, pl. 20, figs. 6-8, 20-31; pl. 22, figs. 20-26; pl. 15, fig. 8.

1901. *Proetus crassimarginatus* Kindle, 25th, Ann. Rept., Indiana Dept. Geol. Nat. Res., p. 750, pl. 30, figs. 1, 1a, 2, 5, 6.

1910. *Proetus crassimarginatus* Grabau and Shimer, North American Index Fossils, II, p. 300, fig. 1611.

Kindle's description—"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 pygidiae a larger number of indistinct annulations may be counted. In crossing the summit of the axis the annulations arch backward slightly."

Remarks—Fragments of one species of trilobite are common in the highly crinoidal phase of the Mineola near Montgomery City. Most of the remains are of pygidia. Only two parts of cephala are in our collections. All of the specimens are small. The largest pygidium is 16 mm. wide and 12 mm. long. Another is 7 mm. wide and 6 mm.

long. One specimen of cephalon is exfoliated enough to show one groove on the glabella. The identification of the Mineola specimens is fairly satisfactory but one poorly preserved pygidium from the Snyder Creek shale is much less certain and it is even probable that it belongs to another genus. The only specimen collected from the Snyder Creek is from the locality near the mouth of Cow Creek about seven miles east of Fulton.

VERTEBRATA

Class PISCES

Subclass Holocephali

Order Chimaeroidei

Family Ptyctodontidae

Genus Ptyctodus Pander

Ptyctodus calceolus (Newberry and Worthen)

Plate 31, figures 1 and 2

1866. *Rinodus calceolus* Newberry and Worthen, Rept. Geol Surv. Illinois, 2, pp. 106-107, pl. 10, fig. 10.
1870. *Ptyctodus calceolus* Newberry and Worthen, Rept. Geol. Surv. Illinois, 4, p. 274.
1875. *Ptyctodus calceolus* Newberry, Rept. Geol Surv. Ohio, II, Pal. pt. 2, p. 59, pl. 59, figs. 13 and 13a.
1897. *Ptyctodus calceolus* Calvin' Proc. Iowa Acad. Sci., 4, p. 18.
1898. *Ptyctodus calceolus* Eastman, Rept. Geol. Surv. Iowa, VII, p. 115, text-fig. 10a.
1898. *Ptyctodus calceolus* Eastman, Amer. Nat. 32. pp. 476-479, figs. 1-17.
1899. *Ptyctodus calceolus* Weller, Jour. Geol., 7, pp. 484-485.
1906. *Ptyctodus* sp., Dean, Carnegie Inst. Wash. Pub. No. 32, p. 137, text-fig. 115.
1906. *Ptychtodus calceolus* Norton, Rept. Geol. Surv. Iowa (1905), XVI, p. 356.
1907. *Ptyctodus calceolus* Eastman, Mem. N. Y. State Mus. 10, pp. 71-72.
1908. *Ptyctodus calceolus* Eastman, Iowa Geol. Survey, vol. XVIII, pp. 133-135, Pl. V, figs. 1-17.
1911. *Ptyctodus calceolus* Cleland, Wisconsin Geol. Surv. Bull. 21, p. 150, pl. 48, figs. 1-17.
1914. *Ptyctodus calceolus* Branson, Devonian Fishes of Mo., Univ. Mo. Bull., Science Series, vol. 2, pp. 64-65, pl. 3, figs. 3 and 4.
1918. *Ptyctodys calceolus* Branson, Geology of Missouri, pl. IV, fig. 16.

Eastman's description—"Dental plates compressed into a thin cutting edge shortly behind the symphysis, but widening gradually, becoming more or less outwardly curved, and the functional surface occupied for nearly its entire width by the tritorial area, the inner margin of which is more strongly curved than the external. Laminar structure of the tritors indicated superficially by fine punctae arranged in parallel rows which are directed obliquely across the triturating surface. The compressed edge in advance of the tritor in the lower dental plate slopes rapidly upward and terminates in a strong anterior beak, beneath which the front margin is continued downwards in a short, blunt process. Upper dental plates similar in a general way to the lower, except that the symphysial margin is rounded and not produced into a beak."

Remarks—This species is so highly variable that it has the appearance of a scrap heap for specimens that cannot be referred elsewhere. The specimens from the Missouri Devonian accentuate this aspect. The varieties are so pronounced that some should probably be described as new species. However, the material is so fragmentary

that it does not justify specific description. The extremes of variety are illustrated in the following measurements of three adult specimens: Length 94 mm., 24 mm., 22 mm., height 23 mm., 6 mm., 4 mm.; thickness 18 mm., 7 mm., 4 mm. The greater number of specimens consist of only the worn tritoral parts. All of the large specimens are from the Mineola of Ralls County. Specimens are found, rarely, in the Callaway and Snyder Creek. The species is most abundant in the basal Mississippian.

Ptyctodus ferox Eastman

Plate 21, figure 12

1898. *Ptyctodus ferox* Eastman, Amer. Nat. 32, pp. 480-484, text-figs. 35-40.
1899. *Ptyctodus ferox* Eastman, Jour. Geol., 7, p. 282.
1906. *Ptyctodus* sp., Dean, Carnegie Inst. Wash. Pub. No. 32, p. 139, text-fig. 126.
1907. *Ptyctodus ferox* Eastman, Mem. N. Y. State Mus. 10, pp. 72-73.
1908. *Ptyctodus ferox* Eastman, Iowa Geol. Surv., vol. XVIII, pp. 135-137, text-figs. 20-22.
1911. *Ptyctodus ferox* Cleland, Wisconsin Geol. Surv. Bull. 21, p. 151, pl. 49, figs. 35-40.
1914. *Ptyctodus ferox* Branson, Devonian Fishes of Missouri, Missouri Univ. Bull., Science Series, vol. 2, pp. 63-64, pl. 4, figs. 3 and 4.

Description—A large species of the genus. The tritoral area of the upper jaw terminates anteriorly in a slight prominence or tubercle situated somewhat nearer the outside than the inside of the face and from this point outward as far as the crest of the symphasis there is a beveling along the outer face where the beak of the lower jaw played against it. Anteriorly, the upper dental plates project forward and upward in a gently curved line, and they are bent inwardly toward the front.

The lower dental plate is remarkable chiefly for its great height along the anterior margin, general straightness, and strong prehensile beak. Superficially, it is marked by fine concentric striae similar to those in Palaeomylus.

Remarks—The different species of *Ptyctodus* are so variable and grade into each other so remarkably that specific identification is uncertain.

Occurrence—Snyder Creek shale of Callaway County. Only one specimen from Missouri is known to the writer.

Subclass Dipneusti

Order Arthrodira

Family Coccosteidae

Genus Dinichthys Newberry

Dinichthys pustulosus Eastman

Plate 31, figures 7 and 8

1897. *Dinichthys pustulosus* Eastman, Bull. Mus. Comp. Zool., 31, No. 2, p. 38, pl. 3 fig. 4.
1898. *Dinichthys pustulosus* Eastman, Amer. Nat. 32, pp. 748-755, text-figs. 1 and 2.
1900. *Dinichthys pustulosus* Eastman, Jour. Geol. 8, pp. 32-34, text-fig. 1.
1901. *Dinichthys pustulosus* Dean, Mem. N. Y. Acad. Aci. 2, pt. 3, p. 122.
1902. *Dinichthys pustulosus* Eastman, Amer. Nat. 36, p. 657, text-figs. 1 and 2.
1906. *Dinichthys pustulosus* Hussakof, Mem. Amer. Mus. Nat. Hist. 9, pt. 3, pp. 142-148, text-fig. 22d.
1907. *Dinichthys pustulosus* Eastman, Mem. N. Y. State Mus. 10, pp. 130-133, pl. 2, fig. 6; pl. 5, figs. 2 and 3; pl. 12, text-fig. 25.

1908. *Dinichthys pustulosus* Eastman, Iowa Geol. Surv., vol. XVIII, pp. 194-198, pl. 1, fig. 10; pl. 4, text-fig. 28.

Eastman's description—"A primitive species seldom exceeding and usually somewhat smaller in size than *D. intermedius*, distinguished from it and its contemporaries in the Ohio Upper Devonian by its fine tuberculation, undulating suture lines, and decidedly Coccosteus-like aspect. Lower dental plates with a simple trenchant margin terminating behind in an abrupt downward declivity bearing a series of few, regularly spaced rudimentary denticles. Palatopterygoid dental plates ("shear-teeth") with convex functional margin, simply trenchant, and not denticulated along the posterior border, so far as known. Vomerine teeth resemble those of *D. intermedius*. Visceral surface of occipital region without prominent ridges, and posterior pit on under side of the median occipital scarcely divided. Pineal plate apparently in contact with the centrals, and with inconspicuous foramen."

Remarks—Only fragments have been collected from the Devonian of Missouri and their identification is not certain. Two median occipitals, one rostral, and two antero-dorso-laterals are all the specimens collected excepting fragments. The bones are smaller than those previously figured. The median occipital is narrower in front than in the type.

Occurrence—Mineola limestone of Ralls County.

Family Pterichthidae

Genus Glyptaspis Eastman

Glyptaspis

Plate 31, figure 3

Part of a large plate with the type of marking peculiar to the ventral plates of *Glyptaspis* was collected from the Snyder Creek shale of Callaway County. The figured part seems to represent not more than half of the original plate. The broken edge opposite the preserved margin is 1 cm. thick, and the broken ends are nearly as thick. Several times the writer has collected fragments of plates with ornamentation like that figured, but this is the only specimen which in any way indicates the shape. The preserved edge is thin and sharp.

Order Ctenodipterini

Family Ctenodontidae

Genus Dipterus Sedgewick and Murchison

Dipterus mordax Eastman

Plate 21, figure 11

1900. *Dipterus mordax* Eastman, Jour. of Geol., VIII, pp. 39-40, text-figs. 6, 8.
1908. *Dipterus mordax* Eastman, Rept. N. Y. State Mus., LX, pp. 161-162, pl. 4, figs. 5 and 6.
1908. *Dipterus mordax* Eastman, Iowa Geol. Surv., XVIII, pp. 220-221, pl. 2, figs. 4 and 5; pl. 7, figs. 5-9.

Eastman's description—"Lower dental plates attaining a length of over 3 cm. coronal surface gently convex, with six rows of very large, discrete, conical or rounded tubercles which extend from the outer margin for a variable distance toward the posterior angle; the two posterior rows often rudimentary. Some of the tubercles, when worn by use or by post-mortem abrasion, become elongated in the direction. The coarseness of tuberculation, in proportion to the size of the plates, is greater than in

any other described species. Apparently some diminution in number of tubercles, coincident with increase in size, takes place in the teeth of adult or old individuals.

Upper dental plates of the *D. flabelliformis* type do not differ materially from the lower as regards outline, or size and number of tuberculated ridges, but their substance is usually much thinner, the functional surface is nearly or quite plane or in some cases even concave, and in the effete condition it becomes worn down almost perfectly smooth. In well-preserved specimens the marginal contour is seen to be ovoid or subtriangular, like that of the lower dental plates, but the majority of examples have the external margin deficient, owing to wear, injury or poor preservation, and accordingly in that respect present deceptive appearances."

Remarks—Only one specimen from the Devonian of Missouri has been collected It is slightly broken on the thin margin and measures 11 mm. in length by 8 mm. in width. The specimen might with equal propriety be referred to *Dipterus pectinatus* Eastman, and the reference is made to *D. mordax* in the belief that the *D. pectinatus* Eastman is a synonym of *D. mordax*. As teeth of species of *Dipterus* show considerable variation the scarcity of specimens of *D. pectinatus* Eastman makes the species seem of doubtful value.

Occurrence—Callaway limestone of Montgomery County.

Unidentified fish remains

Plate 31, figures 4, 5, 6

From Mineola, Callaway and Snyder Creek formations the writer has collected fragments of plates belonging to Dinictithyids but too fragmentary to allow determination of the plates. Several species of armored fishes were present in each of the formations.

CHAPTER II

Fauna of the Middle Devonian of Southeastern Missouri

E. B. Branson and J. S. Williams

In order to make the volume on the Devonian of Missouri fairly complete the writers have figured and made comments on the species from the Middle Devonian of southeastern Missouri.

Most of the specimens studied were collected by Professor Stuart Weller and his students. Small collections have been made by Professor M. G. Mehl and the writers and by students from the University of Missouri. Most of the species were identified by Professor Weller's students before they were sent to the writers, and the writers merely verified the identifications.

The classification of the Southeastern Missouri Middle Devonian was furnished by Weller, and Tansey and Stewart discuss the stratigraphy on pages 166 and 213 of this volume.

The synonomy is not complete. The Brachiopod synonomy includes all of the descriptive articles since Schuchert's Bibliography was published and two or three of the references previous to the Bibliography. The synonomy for species of other phyla includes recent articles and some of the earlier articles which contained descriptions and figures.

The figures are of the best specimens from the area, but we have not intended to more than definitely indicate the species in any case excepting where the species is new. Copied figures are used for some well-known species.

Professor Weller has made extensive field studies of the Southeastern Missouri Middle Devonian, and it would be superfluous for us to make any comments on the stratigraphy or correlations. On page 2 of Chapter I, there is a correlation table that gives the relative positions of the strata.

The following are lists of fossils from the various formations as determined by the writers.

GRAND TOWER LIMESTONE

Blastoidea
Nucleocrinus verneuili (Troost)
Brachiopoda
Athyris fultonensis (Swallow)
Atrypa reticularis (Linnaeus)
Atrypa spinosa Hall
Camarotoechia sappho Hall
Camarotoechia welleri Branson and Williams
Chonetes mucronatus (Hall)
Craniella cf. hamiltoniae (Hall)
Pentamerella arata (Conrad)
Pholidostrophia iowaensis (Owen)
Productella spinulicosta Hall
Schizophoria striatula (Schlotheim)
Schuchertella chemungensis pectinacea (Hall)
Schuchertella pandora Hall
Spirifer grieri Hall
Spirifer varicosus Hall
Stropheodonta concava Hall
Stropheodonta demissa (Conrad)
Stropheodonta patersoni Hall
Pelecypoda
Actinopteria cf. boydi (Conrad)
Conocardium ohioense Meek
Leiopteria cf. dekayi Hall
Paracyclas elliptica Hall
Gastropoda
Diaphorostoma genevievensis Branson and Williams
Platyceras carinatum Hall
Platyceras nodosum Conrad
Cephalopoda
Gomphoceras grandtowerensis Branson and Williams
Gomphoceras hyatti Whitfield
Gomphoceras cf. impar Hall
Gomphoceras missouriensis Branson and Williams
Gomphoceras plenum? Hall
Nephriticeras sp.
Orthoceras cf. subulatum Hall
Trilobita
Dalmanites sp.
Phacops cristata Hall
Proetus crassimarginatus Hall and Clarke
Proetus haldimani Hall
Proetus sp.
Pisces
Onychodus sigmoides Newberry

BEAUVAIS SANDSTONE.

Brachiopoda
Atrypa reticularis (Linnaeus)
Chonetes vicinus (Castelnau)
Schizophoria striatula (Schlotheim)
Spirifer granulosus (Conrad)
Stropheodonta demissa (Conrad)
Gastropoda
Tentaculites sp.

ST. LAURENT FORMATION

Coelenterata
Cyathophyllum halli Edwards and Haime
Favosites limitaris Rominger
Bryozoa
Unidentified species.
Brachiopoda
Atrypa reticularis (Linnaeus)
Camarotoechia congregata (Conrad)
Camarotoechia prolifica (Hall)
Chonetes coronatus (Conrad)
Chonetes mucronatus (Hall)
Chonetes scitulus Hall
Cyrtina alpenensis Hall and Clarke
Cyrtina hamiltonensis Hall
Eunella linklaeni (Hall)
Leptostrophia perplana (Conrad)
Pholidops cf. oblata Hall
Spirifer audaculus (Conrad)
Spirifer pennatus (Atwater)
Strophalosia truncata (Hall)
Stropheodonta demissa (Conrad)
Tropidoleptus carinatus (Conrad)
Pelecypoda
Actinopteria cf. boydi (Conrad)
Glyptodesma cf. erectum (Conrad)
Leptodesma rogersi Hall
Limoptera macroptera? (Conrad)
Pterinea flabellum (Conrad)
Gastropoda
Tentaculites sp.
Trilobita
Cryphaeus boothi Green
Homalonotus sp.
Phacops rana (Green)

COELENTERATA

Class ANTHOZOA

Several species of corals are represented by fragmentary specimens.

Cyathophyllum halli Edwards and Haime is represented by one specimen from the sandstone member of the St. Laurent of Little Saline Creek

Favosites limitaris Rominger is represented by fragments from the St. Laurent limestone of Little Saline Creek.

Zaphrentis, *Cyathophyllum*, *Cystiphyllum*, *Dendropora* and *Heliophyllum* are other genera that are present.

In order to get materials for an adequate treatment of the corals a great deal of collecting would be necessary and a thorough study would require much more time than the writers have available.

ECHINODERMATA

Class BLASTOIDEA

Order Eublastoidea

Family Nucleocrinidae

Genus Nucleocrinus Conrad

Nucleocrinus verneuili (Troost)

Synonomy and description on pages 57-59

Figures on plate 8

Remarks—This species is abundant in one thin member of the Grand Tower on Little Saline Creek. Some of the specimens are very well preserved.

MOLLUSCOIDEA

Class BRYOZOA

Fragments of two or three bryozoans have been collected from the St. Laurent but they are too imperfect for determination.

Class BRACHIOPODA

Order Neotremata

Superfamily Craniacea

Family Craniidae

Genus Crania Retzius

Crania

Fragments of unidentified species of this genus have been found in the Beauvais sandstone of Little Saline Creek, Ste. Genevieve County.

Genus Craniella Oehlert

Craniella cf. hamiltoniae (Hall)

Plate 35, figure 5

1860. *Crania hamiltonia* Hall, Thirteenth Rep. New York State Cab. Nat. Hist., p. 77, figs. 4 and 5, on p. 76.
1867. *Crania hamiltoniae* Hall, Pal. New York, IV, pp. 27-28, pl. 3, figs. 17-23.
1892. *Craniella Hamiltoniae* Hall and Clarke, Pal. New York, VIII, pt. 1, pp. 148-153, pl. 4, figs. 3-16.
1897. *Craniella hamiltoniae* Schuchert, Bull. U. S. Geol. Surv., 87, p. 193.
1901. *Craniella hamiltoniae* Kindle, Indiana Dept. Geol. Nat. Res., 25th Ann. Rept., pp. 582-583, pl. 3, fig. 5.
1909. *Craniella hamiltoniae* Grabau and Shimer, North American Index Fossils, I, p. 208, fig. 244.
1911. *Craniella hamiltoniae* Cleland, Wisconsin Geol. Nat. Hist. Surv., Bull. 21, pp. 86-87, pl. 12, figs. 7 and 8.
1913. *Craniella hamiltoniae* Prosser and Kindle, Maryland Geol. Surv., Middle and Upper Devonia, pp. 131-132, pl. 9, figs. 1-7.
1913. *Craniella hamiltoniae* Clarke and Swartz, Maryland Geol. Surv., Middle and Upper Devonian, pp. 549-550, pl. 47, figs. 11-13.

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

Remarks—The identification is based on one imperfect specimen and is highly uncertain. Figure 5 of plate 35 shows all that the specimen shows.

Occurrence—Grand Tower limestone, Little Saline Creek, Ste. Genevieve County.

Genus Pholidops Hall

Pholidops cf. oblata Hall

Plate 35, figure 9

1867. *Pholidops oblata* Hall, Pal. New York, IV, p. 414, pl. 3, fig. 10.
1897. *Pholidops oblata* Schuchert, Bull. U. S. Geol. Surv. 87, p. 307.

Hall's description—"Shell suborbicular, somewhat flattened on the upper margin, discoid or depressed convex; the length and width about equal; muscular area of the interior small, circular, and divided through the middle by a longitudinal septum. External surface unknown."

Remarks—Only two specimens are in the collections of Walker Museum. The identification is made on the basis of general shape and the shape of the muscular area. One of the specimens shows part of the exterior part of the shell which is made up of concentric rings, but it may not belong to the same species as the internal mould.

Occurrence—Sandstone phase of the St. Laurent, 1½ miles west of Lithium, Perry County.

Order Protremata

Superfamily Orthacea

Family Rhipidomellidae

Genus Schizophoria King

Schizophoria striatula (Schlotheim)

For synonomy and description see p. 72. Specimens of this species are figured on plate 15.

Specimens of *S. striatula* (Schlotheim) from the Grand Tower are not as well preserved as those from the Snyder Creek shale but they are like the Snyder Creek specimens in every respect. Specimens are abundant on Little Saline Creek, Ste. Genevieve County. The species occurs, rarely, in the Beauvais sandstone.

Superfamily Strophomenacea

Family Strophomenidae

Genus Stropheodonta Hall

Stropheodonta concava Hall

Plate 32, figure 12

1857. *Strophomena* (*Stropheodonta*) *concava* Hall, Tenth Rep. N. Y. State Cab. Nat. Hist., pp. 115, 140, fig. 1.
1867. *Stropheodonta concava* Hall, Pal. New York, IV, pp. 96-98, pl. 16, figs. 1a-1h; pl. 14, figs. 2 a-d.
1897. *Stropheodonta concava* Schuchert, U. S. Geol. Survey, Bull. 87, p. 420.
1901. *Stropheodonta concava* Kindle, Indiana Dept. Geol. Nat Res., 25th Ann. Rep., pp. 619-620, pl. 5, figs. 1, 1a, 2; pl. 6, fig. 1.
1909. *Stropheodonta concava* Grabau and Shimer, North American Index Fossils, I, p. 216, fig. 261.
1913. *Stropheodonta concava* Prosser and Kindle, Maryland Geol. Surv., Middle and Upper Devonian, pp. 139-140, pl. 10, figs. 6, 7.

Hall's description—"Shell large, from two to three and a half inches wide on the hinge line, concavo-convex or subhemispheric, broadly semi-elliptical 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 are sometimes 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 towards 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, gently narrowing towards the extremities, vertically striated, with the margin crenulated for more than half the distance from the centre to the extremities. Area of the dorsal valve almost rectangular in that of the ventral valve, very narrow and nearly linear throughout. Sometimes narrower in the middle, striate and crenulate as 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."

Remarks—This species is rare. Only very imperfect specimens are in the Walker Museum and none in the University of Missouri collections.

Occurrence—Grand Tower limestone of Little Saline Creek.

Stropheodonta demissa (Conrad)

Described on p. 77. Figured on plates 5, 11, 14 and 61

Specimens from the Grand Tower are small, comparable in size to those from the Mineola. Some specimens from the Beauvais sandstone are of average size but for the most part they are small. Specimens from the St. Laurent are small and rare.

Stropheodonta patersoni Hall

Plate 32, figures 10 and 11

1857. *Strophomena (Strophodonta) patersoni* Hall, Tenth Rep. N. Y. State Cab. Nat. Hist., p. 114, figs. 1-5.
1867. *Strophodonta patersoni* Hall, Pal. New York, IV, pp. 89-90, pl. 12, figs. 9-12; pl. 13, figs. 1-5.
1897. *Stropheodonta patersoni* Schuchert, Bull. U. S. Geol. Surv. 87, p. 425.
1909. *Stropheodonta patersoni* Grabau and Shimer, North American Index Fossils, I pp. 215-216, fig. 258.
1912. *Stropheodonta patersoni* Kindle, Bull. U. S. Geol. Surv. 508, p. 75, pl. 3, figs. 5, 6.

Hall's description—"Shell semioval. Ventral valve convex, becoming gibbous in the middle, somewhat deeply deflected at the sides and front; sometimes marked by a few radiating undulations or folds, which affect both ventral and dorsal valves towards the front; hinge line straight; extremities often salient.

Surface marked by distant elevated radiating striae, and the intermediate spaces by undulating fine striae, and crossed by short abruptly arching wrinkles which are interrupted by the strong radiating striae. The finer radiating striae on the ventral valve are from three to ten or twelve between the stronger ones; while on the dorsal valve the spaces are wider, and there are from ten to twenty finer striae between the stronger ones. The finer striae are crossed by equally fine concentric striae, giving the entire surface a delicately cancellated appearance."

Remarks—This is a rare form which is represented in the University of Missouri and Walker Museum collections by fragments only. The peculiar markings near the hingeline give the main basis for identification.

Occurrence—Grant Tower limestone, Little Saline Creek.

Genus Leptostrophia Hall and Clarke

Leptostrophia perplana (Conrad)

Plate 35, figures 15 and 16

1842. *Strophomena perplana* Conrad, Jour, Acad. Nat. Sci., Philadelphia, p. 257, pl. 14, fig. 11.
1867. *Strophodonta perplana* Hall,Pal. New York, IV, pp. 92, 98-101, pl. 11, fig. 22; pl. 12, figs. 13-15; pl. 17, fig. 1.

1892. *Stropheodonta (Leptostrophia) perplana* Hall and Clarke, Pal. New York, VIII, pt. I, p. 288, pl. 15, figs. 2-13.
1897. *Stropheodonta perplana* Schuchert, Bull. U. S. Geol. Surv. 87, pp. 425-426.
1901. *Stropheodonta perplana* Kindle, Indiana Dept. Geol. Nat. Res., 25th Ann. Rep. pp. 618-619, pl. 5, figs. 3-7.
1909. *Stropheodonta (Leptostrophia) perplana* Grabau and Shimer, North American Index Fossils, I, pp. 217-218, fig. 264.
1911. *Stropheodonta perplana* Cleland, Wisconsin Geol. Nat. Hist. Surv., Bull. 21, p. 89, pl. 18, figs. 1-4.

Hall's description—"Shell semi-elliptical; 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 equalling or often a little greater than the width of the shell below; the extremities usually somewhat salient, except in extremely old shells. Margins of the shell often a little contracted just below the hinge-extremities, making the width less than 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 at an angle of 40 to 50 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 the 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 outwards, leaving an angle between the two or more than 90; the centre is marked by a narrow callosity or an impressed space.

Surface covered by fine subequal striae, those of the ventral valves 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 and regular intervals into minute granules, evidently the bases of minute spines, which have covered the surface of the ventral valve. The dorsal valve is marked by fine even rounded striae which are cancellated by close concentric striae, and the same obscure concentric undulations as are observed on the surface of the ventral valve. Very rarely there is some interruption to the regularity of the striae, apparently owing to an injury which has often caused the concentric striae to curve towards that point, and the radiating striae to converge making a kind of seam of cicatrix."

Remarks—The remains of this species from southeastern Missouri are all from a sandstone member of the St. Laurent. None of them is well preserved. The fineness of plications, flatness of valves, and shape of muscular area form the main basis for identification.

Genus Pholidostrophia Hall and Clarke

Pholidostrophia iowaensis (Owen)

Description and synonomy on pages 82 and 83

A specimen from the Mineola is figured on plate 11 at figure 9.

Remarks—Five specimens from the Grand Tower limestone of Little Saline Creek, Ste. Genevieve County, are in the collections of the Walker Museum. All of the specimens are imperfect. The species is rare in the fauna.

Genus Tropidoleptus Hall

Tropidoleptus carinatus (Conrad)

Plate 33, figures 11 and 12

1839. *Strophomena carinata* Conrad, Third Ann. Rep., N. Y. Geol. Survey, p. 64.
1867. *Tropidoleptus carinatus* Hall, Pal. New York, IV, pp. 407-408, pl. 62, figs. 2, 3.
1897. *Tropidoleptus carinatus* Schuchert, Bull. U. S. Geol. Surv. 87, pp. 457-458.
1903. *Tropidoleptus carinatus* Weller, Geol. Survey New Jersey, vol. 3, pp. 381-382, pl. 53, fig. 2.
1909. *Tropidoleptus carinatus* Grabau and Shimer, North American Index Fossils, I p. 305, fig. 382.
1913. *Tropidoleptus carinatus* Clarke and Swartz, Maryland Geol. Surv., Middle and Upper Devonian, pp. 585-586, pl. 55, figs. 1-5.

Hall's description—"Shell concavo-convex, semi-elliptical, the length sometimes nearly equalling the width; hinge line equalling, 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 encroachments of the foramen. Area from 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 eighteen to twenty 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 a few stronger imbricating lamellae mark the form of the shell in its stages of growth."

Remarks—No well preserved specimens of this species, from southeast Missouri, are in the collections of Walker Museum or the University of Missouri. Fragments are common and well enough preserved to make the identification positive.

Occurrence—St. Laurent limestone of Little Saline Creek, Ste. Genevieve County,

Genus Schuchertella Girty

Schuchertella chemungensis pectinacea (Hall)

Plate 32, figures 6 and 7

1687. *Streptorhynchus chemungensis pectinacea* Hall, Pal. New York, IV, pp. 73-75, pl. 10.
1897. *Orthothetes chemungensis* Schuchert, Bull. U. S. Geol. Surv., 87, pp. 295-296.

Hall's description—"Shells usually symmetrical, often unsymmetrical, semioval, with the hinge-extremities sometimes a little salient, often truncate and sometimes rounded.

The dorsal valve is moderately convex, or sometimes gibbous. The surface is marked by distant, very prominent striae, with two or three finer ones between them. The hinge, and other features of the shell, are the same as in other varieties of the species.

The well-marked specimens are usually small or of medium size."

Remarks—Four specimens from the Grand Tower limestone are referred to this variety; mainly on the basis of the distant striae with the finer striae between. One brachial valve is strongly convex with the greatest convexity near the middle.

Occurrence—Grand Tower limestone, Little Saline Creek, Ste. Genevieve County.

Schuchertella pandora Hall

Remarks—None of the specimens from southeastern Missouri has the area of the pedicle valve well preserved. Several specimens are in the Walker Museum collections, but this seems to be a rather rare form.

Occurrence—Grand Tower limestone, Little Saline Creek, Ste. Genevieve County.

Family Productidae

Genus Chonetes Fischer

Chonetes coronatus (Conrad)

Plate 32, figures 1, 2 and 3

1842. *Strophomena carinata* Conrad, Jour. Acad. Nat. Sci., Philadelphia, VIII, p. 257, pl. 14, fig. 13.
1854. *Chonetes littoni* Norwood and Pratten, Jour. Acad. Nat. Sci., Philadelphia, III, pl. 25, pl. 2, fig. 4.
1857. *Chonetes coronata* Hall, Tenth Rep. New York State Cab. Nat. Hist., p. 146, figs. 1, 2.
1867. *Chonetes coronata* Hall, Pal. New York, IV, pp. 133-137, pl. 21, figs. 9-12.
1897. *Chonetes coronatus* Schuchert, Bull. U. S. Geol. Surv., 87, p. 173.
1901. *Chonetes coronatus* Kindle, Indiana Dept. Geol. Nat. Res., 25th Ann. Rep., pp. 602-603, pl. 4, fig. 7.
1903. *Chonetes coronatus* Weller, New Jersey Geol. Surv., vol. 3, p. 380, pl. 53, fig. 6.
1909. *Chonetes coronatus* Grabau and Shimer, North American Index Fossils, I, p. 236, fig. 288.
1913. *Chonetes coronatus* Prosser and Kindle, Maryland Geol. Surv., Middle and Upper Devonian pp. 148-150, pl. 11, figs. 18-21.

Hall's description—"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 hingeline, the width being about once and a half as great as the length. The cardinal angles are sometimes produced in short acute auriculate 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 towards 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 intercalation, 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."

Remarks—This is one of the most abundant forms in the St. Laurent limestone. In the sandstone phase the specimens are preserved as internal moulds and in the limestone usually as exteriors. The specimens from the sandstone are larger than from the limestone. Spines along the hinge line are only rarely preserved.

Chonetes mucronatus (Hall)

Plate 35, figures 13 and 14

1843. *Strophomena mucronata* Hall, Geol. New York, Rep. Fourth Dist., p. 181, fig. 3, on page 180.
1857. *Chonetes laticosta* Hall, Tenth Rep. New York State Cab. Nat. Hist., p. 119.
1867. *Chonetes mucronata* Hall, Pal. New York, IV, pp. 124-126, pl. 20, figs. 1, 2; pl. 21, fig. 1.
1897. *Chonetes mucronatus* Schuchert, Bull. U. S. Geol. Surv,, 87, p. 176.
1901. *Chonetes mucronatus* Kindle, Indiana Dept. Geol. Nat. Res., 25th Ann. Rep., p. 606, pl. 4, fig. 11.
1909. *Chonetes mucronatus* Grabau and Shimer, North American Index Fossils, I, p. 235, fig. 286.
1912. *Chonetes mucronatus* Kindle, Bull. U. S. Geol. Surv., 508, p. 71, pl. 3, figs. 13, 14.
1913. *Chonetes mucronatus* Prosser and Kindle, Maryland Geol. Surv., Middle and Upper Devonian, pp. 146-148, pl. 11, figs. 11-17.

Hall's description—"Shell small, semioval, moderately convex, nearly flat (often flattened in the shale and gibbous in the limestone); cardinal line equalling or a little greater than the width of the shell below; the extremities sometimes salient.

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 towards 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 centre which are abruptly bent outwards 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."

Remarks—This species is abundant in the Grand Tower limestone of Little Saline Creek and common in the St. Laurent sandstone, 1½ miles west of Lithium, Perry County.

Chonetes scitulus Hall

Plate 32. figures 8 and 9

1857. *Chonetes scitula* Hall, Tenth Rep. New York State Cab. Nat. Hist., p. 147.
1867. *Chonetes scitula* Hall, Pal. New York, IV, pp. 130-131, pl. 21, fig. 4.
1897. *Chonetes scitulus* Schuchert, Bull. U. S. Geol. Surv., 87, p. 178.
1909. *Chonetes scitulus* Grabau and Shimer, North American Index Fossils, I, p. 237, fig. 289, a-b.
1912. *Chonetes scitulus* Prosser, Geol. Surv. Ohio, series 4, Bull. 15, pp. 541-542, pl. 32, fig. 6.
1913. *Chonetes scitulus* Prosser and Kindle, Maryland Geol. Surv., Middle and Upper Devonian, pp. 150-152, pl. 12, figs. 1-8; pl. 50, figs. 11-13.

Hall's description—"Shell transverse, semioval; hinge line often not quite equalling the greatest width of the shell; cardinal angles rarely a little salient.

Ventral valve moderately gibbous in the middle, and regularly curving to the front and basal margins; the gibbous portions narrowing towards the hinge line, and the umbo little elevated; abruptly depressed towards the cardinal angles, which are nearly flat and sometimes a little deflected at the extremities.

Dorsal valve with a concavity less than the convexity of the opposite valve; the cardinal angles flat.

Area of the ventral valve narrow and distinctly wider in the middle, the exterior margin gently curving; foramen partially closed by a convex deltidium, and the aperture filled by the cardinal process of the opposite valve. Dorsal area linear, half as wide as that of the opposite valve.

Surface marked by fine subequal striae, which are often alternated in size towards the margin. Of these, from 15 to 20 may be counted near the beak, while from bifurcation and intercalation there are from 50 to 60 on the margin, becoming obsolete towards the cardinal extremities. The striae are sometimes sharp and angular, and sometimes rounded; fine concentric striae are visible on well-preserved specimens. The cardinal margin of the ventral valve is furnished with two or three spines on each side towards the extremities, and as many more towards the beak, so that the bases of five can be readily counted, and sometimes six; while there is a minute point on each side of the apex, which may be another spine; and this, if preserved, would give twelve or fourteen spines on the cardinal line."

Remarks—The specimens from southeastern Missouri are too imperfect to make identification certain.

Occurrence—St. Laurent limestone of Little Saline Creek, Ste. Genevieve County.

Chonetes vicinus (Castelnau)

Plate 32, figures 4 and 5

1843. *Leptaena vicina* Castelnau, Systeme Sil. l'Amerique Septentrionale, p. 39, pl. 15, fig. 9.
1867. *Chonetes deflecta* Hall, Pal. New York, IV, pp. 126-128, pl. 21, figs. 7, 8.
1897. *Chonetes vicinus* Schuchert, Bull. U. S. Geol. Surv., 87, p. 180.
1909. *Chonetes vicinus* Grabau and Shimer, North American Index Fossils, I, p. 236, fig. 287.
1913. *Chonetes vicinus* Prosser and Kindle, Maryland Geol. Surv., Middle and Upper Devonian, pp. 155-157, pl. 12, figs. 14-21.

Prosser and Kindle's description—"Shell semi-elliptical; 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 about the middle of the length; abruptly depressed towards the cardinal angles, which are flattened, with the extremities deflected to the ventral side; the umbo is slightly elevated above the cardinal margin; cardinal area narrow; the interior shows strong dental lamellae, a somewhat angular median ridge terminates above the middle of the valve, and 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. Dorsal valve deeply concave, but not equaling the convexity of the ventral valve; cardinal area more than half as wide as that of the ventral valve; the interior surface beyond the vascular impressions is covered by elongate papillae, the marks of the striae being scarcely distinct. Surface marked by from twenty-six to thirty-four subangular or sometimes rounded striae which are often irregularly increased by bifurcation or intercalation towards the margin; in those with fewer striae, they are sharper and only half as wide as the interspaces, while in those with a larger number, the striae and interspaces are equal; there is a considerable space at the cardinal angles of each valve destitute of striae."

Remarks—The specimens from southeastern Missouri average larger than specimens *C. mucronatus* Hall and they have about twice as many plications, the common number being 30 to 40. The pedicle valve is more strongly convex than in *C. mucronatus* Hall. The character by which the species are differentiated at first sight is the much stronger and fewer plications in *C. mucronatus* Hall.

Occurrence—Common in the Beauvais sandstone of Little Saline Creek, Ste. Genevieve County.

Genus Productella Hall

Productella spinulicosta Hall

Plate 35, figures 10, 11 and 12

Description and synonomy on pages 86 and 87

Three specimens from the Grand Tower limestone of Little Saline Creek are in the collections of Walker Museum. The specimens are small and incomplete but the identification is fairly positive. Specimens of this species of about the same size have been collected from the Mineola of Callaway County.

Genus Strophalosia King

Strophalosia truncata (Hall)

Plate 35, figures 1, 2, 3 and 4

1843. *Strophomena pustulosa* Hall, Geol. New York, Rep. Fourth Dist., p. 181, fig. 4
1857. *Productus truncatus* Hall, Tenth Rep. N. Y. State Cab. Nat. Hist., p. 171.
1867. *Productella truncata* Hall, Pal. New York, IV, pp. 160-162, pl. 23, figs. 12-24.
1889. *Productella* (*Strophalosia?*) *truncata* Whiteaves, Cont. Canadian Pal. I, p. 112, pl. 16, figs. 1. 2.
1897. *Strophalosia truncata* Schuchert, Bull. U. S. Geol. Surv., 87, p. 419.
1909. *Strophalosia truncata* Grabau and Shimer, North American Index Fossils, I, p. 240, fig. 292.
1912. *Strophalosia truncata* Kindle, Bull. U. S. Geol. Surv., 508, p. 77, pl. 5, figs. 5-7.
1913. *Strophalosia truncata* Prosser and Kindle, Maryland Geol. Surv., Middle and Upper Devonian, pp. 160-162, pl. 13, figs. 14-16.

Hall's description—"Shell small, concavo-convex; hinge line equalling or less than the greatest width of the shell.

Ventral valve gibbous in the middle, broadly truncate on the umbo, regularly curving to the front, abruptly depressed at the sides, and forming narrow flattened ears at the cardinal extremity. A narrow linear area, and a perceptible foramen or callosity under the beak.

Dorsal valve moderately concave, minutely truncate at the apex, with a thickening of the hinge line in well-marked specimens.

Surface of ventral valve wrinkled at the hinge line, marked by a greater or less number of spiniferous ridges, supporting selnder spines of moderate length. There is usually a row of two or three spines on the ears just below the hinge-margin, and they are often closely arranged about the limits of the truncation on the umbo and more sparsely on the middle and lower part of the valve. The dorsal valve is wrinkled along the hinge line, and the surface covered by numerous elongate spiniferous pustules, bearing, when perfect, long slender spines. The entire surface of both valves is marked by fine closely arranged concentric striae. Interior of the dorsal valve wrinkled and pustulose, with a conspicuous depression at the umbo, and a short bifurcating cardinal process."

Remarks—Fragments of *S. truncata* are not uncommon in the St. Laurent limestone near St. Marys, Ste. Genevieve County. The parts preserved form a rather

insecure basis for identification. Many pedicle valves show the truncation. Prosser and Kindle state that the species is recognized by "its small size, gibbous and truncate ventral valve, flattened cardinal extremities, slightly concave dorsal valve which is wrinkled and pustulose on the interior, and the scattered surface spines on both valves."

Superfamily Pentameracea

Family Pentameridae

Genus Pentamerella Hall

Pentamerella arata (Conrad)

Synonomy and description on pages 87 and 88

Figure 16 on plate 16, and figures 17-23 on plate 17

Remarks—Only two specimens from the Grand Tower limestone are known to the writer. These specimens are rather massive and broad for the species. None of the Mineola specimens is as large as the ones from the Grand Tower.

Order Telotremata

Superfamily Rhynchonellacea

Family Rhynchonellidae

Genus Camarotoechia Hall and Clarke

Camarotoechia congregata (Conrad)

Plate 34, figures 7, 8, 9, 10, 11 and 12

1841. *Atrypa congregata* Conrad, Fifth Ann. Rep. New York Geol. Survey, p. 55.
1867. *Rhynchonella (Stenocisma) congregata* Hall, Pal. New York, IV, pp. 341-342, pl. 54, figs. 44-59.
1897. *Camarotoechia congregata* Schuchert, Bull. U. S. Geol. Surv., 87, p. 165.
1901. *Camarotoechia congregata* Kindle, Indiana Dept. Geol. Nat. Res., 25th Ann. Rep., p. 585.
1913. *Camarotoechia congregata* Prosser and Kindle, Maryland Geol. Surv., Middle and Upper Devonian, pp. 171-173, pl. 14, figs. 15-17.

Hall's description—"Shell robust, varying from short-ovate to subglobose; length and width nearly equal or a little wider than long; front rounded or straight in the middle; apex pointed.

Ventral valve convex at the sides, depressed in the middle; mesial sinus often beginning at about one-third the length from the apex, and becoming conspicuous towards the front; beak, in old shells, closely arcuate over the apex of the opposite valve; in young shells, nearly straight or slightly incurved.

Dorsal valve gibbous in old shells, regularly convex in young specimens; mesial fold scarcely conspicuous on the upper half of the shell, sometimes prominent near the margin; sides curving abruptly to the junction with the opposite valve.

Surface (in young shells) marked by only nine or ten distinct subangular or rounded plications; in older shells, by eighteen to twenty-two, of which three or four occupy the mesial sinus and four or five the mesial fold. In the two larger specimens observed, there are but three plications in the sinus, and this is the prevailing number. Slender concentric striae, sometimes a little imbricated in front, mark the surface of the shell."

Remarks—The species is abundant in the St. Laurent limestone. Many specimens are moulds of the interior. Average specimens are indistinguishable from average

specimens from New York. The specimens occur in the ordinary limestone but most abundantly in the sandstone phase of the formation. Those from the sandstone are considerably larger than those from the limestone.

Camarotoechia prolifica (Hall)

Plate 34, figures 1 and 2

1867. *Rhynchonella (Stenocisma) prolifica* Hall, Pal. New York, IV, p. 343, pl. 54a, figs. 1-10.
1894. *Camarotoechia prolifica* Hall and Clarke, Pal. New York, VIII, pt. 2, p. 192, pl, 57, figs. 42, 43.
1897. *Camarotoechia prolifica* Schuchert, Bull. U. S. Geol. Surv., 87, p. 168.
1913. *Camarotoechia prolifica* Prosser and Kindle, Maryland Geol. Surv., Middle and Upper Devonian, pp. 173-174, pl. 15, figs. 1-3.

Hall's description—"Shell subtriangular-ovate; length and width about equal; front rounded, with a shallow sinus and gentle elevation depressed in young shells and becoming gibbous in older ones.

Ventral valve depressed-convex in the middle, elevated or a little gibbous on the umbo, curving to the sides and gently depressed in a shallow sinus below the middle; apex slightly incurved.

Dorsal valve equally convex with the ventral, sometimes a little more convex, the difference increasing with age; regularly convex as far as the middle of the shell, below which the mesial fold becomes more or less elevated, but rarely rises conspicuously above the general outline.

Surface marked by about twenty to twenty-two, sometimes twenty-four, angular plications, of which three occupy the mesial sinus and four the mesial fold. Sometimes a few imbricating lines of growth are visible, but the finer surface markings are unknown.

Length usually less than half an inch, and few individuals exceed this. The casts of the interior show short and rather slender lamellae in the ventral valve, and a short septum in the dorsal valve."

Remarks—Specimens from the St. Laurent are small. The largest in the Walker Museum collection is 10 mm. wide by 9 mm. long. The number of plications ranges from 14 to 20. The number of plications in the sinus ranges from 3 to 5. The plications are not sharply angular.

Occurrence—St. Laurent limestone from 3 miles south of St. Marys, Perry County.

Camarotoechia sappho (Hall)

Plate 34, figures 15, 16 and 17

1860. *Rhynchonella sappho* Hall, 13th Rep. New York State Cab. Nat. Hist., p. 87.
1867. *Rhynchonella (Stenocisma) sappho* Hall, Pal. New York, IV, pp. 340-341; pl. 54, figs. 33-43; pl. 55, figs. 47-52.
1894. *Camarotoechia sappho* Hall and Clarke, Pal. New York, VIII, pt. 2, p. 192, pl, 57, figs. 10-14.
1897. *Camarotoechia sappho* Schuchert, Bull. U. S Geol. Surv., 87, p. 168.
1901. *Camarotoechia sappho* Kindle, Indiana Dept. Geol. Nat. Res., 25th Ann. Rep., p. 584, pl. 7, fig. 4.
1909. *Camarotoechia sappho* Grabau and Shimer, North American Index Fossils, I, p. 288, fig. 354, c. d.
1913. *Camarotoechia sappho* Prosser and Kindle, Maryland Geol. Surv., Middle and Upper Devonian, pp. 174-175, pl. 15, fig. 4.

Hall's description—"Shell, in full-grown individuals, transverse, gibbous, subelliptical. Young shells broadly subtrigonal becoming short-ovate; nearly straight in

the middle of the front, abruptly pointed at the beak; cardinal slopes concave; sides rounded to the mesial fold and sinus.

Ventral valve flabelliform, depressed-convex, rarely a little gibbous on the umbo, flattened and depressed in the middle towards the front; the sinus becoming perceptible about the middle of the length; sides nearly flat; apex abruptly acute, and more or less incurved according to age.

Dorsal valve gibbous, regularly arching transversely; the mesial fold becoming conspicuous only towards the front; in young shells only moderately convex.

Surface marked by twenty to twenty-two or twenty-four plications (fourteen or fifteen in the young shells), those towards the cardinal margin less elevated; about four to six mark the sinus and fold. In old shells, the plications are grooved towards the front; and those of the sides of the dorsal valve are very abruptly bent towards the ventral valve, with a shorter and wider groove, and all deeply bifid for the reception of the opposite plication. The shell is concentrically marked by fine thread-like elevated striae, which are more conspicuous and strongly undulating towards the front of the shell, their remains being often preserved in the casts.

Length and width, in full-grown shells, as seven to eight."

Remarks—One specimen of the species from Ste. Genevieve County is in the collection of the University of Missouri. It was sent in by a boy who lives in the valley of Little Saline Creek. With it were several *Nucleocrinus verneuili* (Troost). The specimen probably came from the Grand Tower limestone. It is well preserved save that the beaks of both valves are missing.

Camarotoechia welleri n. sp.

Plate 34, figures 3, 4, 5 and 6

Description—Shell small, longer than wide, length 7½ mm., width 7 mm.

Pedicle valve regularly convex from front to beak. Beak pointed, only slightly incurved. Sinus of moderate depth, originating behind the middle of the shell and projecting in front of the rest of the shell. Three rounded plications in the sinus. One or two large plications on either side of the sinus, the larger bounding the sinus. Total number of plications, about 7.

Brachial valve nearly straight from front to back. The fold originates near the beak and becomes prominent near the front. Two plications on the back half of the fold which bifurcate to form four at the front margin. One or two large rounded plications on either side of the fold. Other incipient plications make the margin irregular.

The species is based on one specimen which differs markedly from any other species known to the writers.

Occurrence—Grand Tower limestone, Little Saline Creek, Ste. Genevieve County.

Superfamily Terebratulacea

Family Terebratulidae

Genus Eunella Hall and Clarke

Eunella lincklaeni (Hall)

Description and synonomy on page 93

Figured on plate 20

Remarks—Only a few poor specimens of this species have been collected. They agree in every respect with specimens from the Mineola of Montgomery and Ralls Counties.

Occurrence—St. Laurent limestone of Little Saline Creek, Ste. Genevieve County.

Superfamily Spiriferacea

Family Atrypidae

Genus Atrypa Dalman

Atrypa reticularis (Linnaeus)

Description and synonomy on pages 97 and 98

Specimens are figured on plates 21 and 23

Remarks—This species occurs in the Grand Tower, Beauvais, and St. Laurent but is not abundant in any of the formations.

Atrypa spinosa Hall

Plate 34, figures 13 and 14

Description and synonomy on page 98

Figured on plate 20

Remarks—*Atrypa spinosa* Hall is a common form in the Grand Tower limestone. None of the specimens is as large as specimens from the Snyder Creek shale. The average size is 20 mm. wide, 19 mm. long, 11 mm. thick.

Family Spiriferidae

Genus Spirifer Sowerby

Spirifer audaculus (Conrad)

Plate 33, figures 3, 4 and 5

1842. *Delthyris audacula* Conrad, Jour. Acad. Nat. Sci., Philadelphia, VIII, p. 262
1857. *Spirifer eatoni* Hall, Tenth Rep. N. Y. State Cab. Nat. Hist., p. 157.
1867. *Spirifera medialis* Hall, Pal. New York, IV, pp. 227-229, pl. 38, figs. 1-25.
1882. *Spirifera audacula* Whitfield, Geol. Wisconsin, IV, p. 329, pl. 25, figs. 25, 26.
1894. *Spirifer audaculus* Hall and Clarke, Pal. New York, VIII, pt. 2, pp. 29-31, 39, pl. 24, figs. 1-13; pl. 29, fig. 5.
1897. *Spirifer audaculus* Schuchert, Bull. U. S. Geol. Surv., 87, p. 382.
1901. *Spirifer audaculus* Kindle, Indiana Dept. Geol. Nat. Res., 25th Ann. Rep., p. 646, pl. 8, fig. 4.
1903. *Spirifer audaculus* Weller, Geol. Surv. New Jersey, vol. 3, p. 382, pl. 53, fig. 1.
1909. *Spirifer audaculus* Grabau and Shimer, North American Index Fossils, I, p. 329, fig. 420 a.
1913. *Spirifer audaculus* Prosser and Kindle, Maryland Geol. Surv., Middle and Upper Devonian, pp. 192-193, pl. 18, figs. 7-9.

Description by Prosser and Kindle—"Shell medium size; valves moderately convex in young specimens, becoming ventricose in old shells; hinge line generally extended beyond the width of the shell below. Ventral valve usually more convex than the dorsal; incurved beak; cardinal area commonly of more than medium height; longitudinally striated and divided in the middle by the delthyrium which is about twice as high as wide; mesial sinus well defined, extending to the apex, of moderate width, rather deep and generally rounded at the bottom. Dorsal valve moderately convex; beak small and slightly incurved; cardinal area linear; mesial fold prominent, rising abruptly at the sides and rounded slightly or flattened on top; cardinal angles slightly reflected. Sur-

face marked by twenty or more simple plications on each side of the fold and sinus and the principal ones, especially of the ventral valve, are often marked along the center by a threadlike groove; toward the front are numerous, often imbricating, concentric lines."

Remarks—The Missouri specimens are poorly preserved. They are fairly abundant. Hall states that there are 20 to 30 plications on either side of the fold and sinus while the Missouri specimens have only sixteen. The Missouri specimens show no radiating striations and they lack the thread-like groove along the top of the larger plications. It may be that the preservation obscures this feature. The specimens intergrade with *S. pennatus* (Atwater) to such an extent that only the longer shells with high areas can be definitely distinguished

Occurrence—St. Laurent limestone, 3 miles south of St. Marys.

Spirifer granulosus (Conrad)

Plate 33, figures 1, 2 and 10

1839. *Delthyris granulosa* Conrad, Third Ann. Rep. Geol. Survey N. Y., p. 65.
1857. *Spirifer granulifera* Hall, Tenth Rep. N. Y. State Cab. Nat. Hist., p. 163.
1867. *Spirifera granulifera* Hall, Pal. New York, IV, pp. 223-225, pl. 36, figs. 1-13; pl. 37, figs. 1-4.
1897. *Spirifer granulosus* Schuchert, Bull. U. S. Geol. Surv., 87, p. 391.
1901. *Spirifer granulosus* Kindle, Indiana Dept. Geol. Nat. Res., 25th Ann. Rep., pp. 640-641, pl. 9, figs. 2, 2a, 2b.
1909. *Spirifer granulosus* Grabau and Shimer, North American Index Fossils, I, p. 328, fig. 417.
1913. *Spirifer granulosus* Prosser and Kindle, Maryland Geol. Surv., Middle and Upper Devonian, pp. 190-192, pl. 18, figs. 1-6.

Hall's description—"Shell more or less ventricose in its different stages of growth, somewhat transversely oval, semi-elliptical 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 or 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 plica-

tions 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."

Remarks—Only one specimen from southeastern Missouri has come to the writers' attention. It is from the Hamilton of Little Saline Creek, Ste. Genevieve County, probably Beauvais sandstone. The same specimen is preserved as internal and external moulds.

Spirifer grieri Hall

Plate 33, figures 6, 7 and 8

1857. *Spirifer grieri* Hall, Tenth Rep. N. Y. State Cab. Nat. Hist., p. 127.
1867. *Spirifera grieri* Hall, Pal. New York, IV, pp. 194-195, pl. 27, fig. 29; pl. 28, figs. 17-23.
1897. *Spirifer grieri* Schuchert, Bull. U. S. Geol. Surv., 87, p. 392.
1901. *Spirifer grieri* Kindle, Indiana Dept. Geol. Nat. Res., 25th Ann. Rept., pp. 638-639, pl. 8, fig. 6.
1909. *Spirifer grieri* Grabau and Shimer, North American Index Fossils, I, pp. 324-325, fig. 412, a-c.

Hall's description—"Shell gibbous, transversely oval or subquadrilateral, sometimes longitudinally ovate, the proportions of length and breadth being very 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 nearly 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 distinctly 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."

Remarks—This species is rare in southeastern Missouri. Five specimens are in Walker Museum. Some of the specimens have well-developed plications in the sinus but they extend only about half the length of the sinus. They are much smaller than the plications outside the sinus and they bifurcate near the middle of the length.

Occurrence—Grand Tower limestone of Little Saline Creek, Ste. Genevieve County.

Spirifer pennatus (Atwater)

Plate 33, figure 9

1820. *Terebratula pennata* Atwater, American Jour. Sci. Arts, II, p. 244, pl. 1, figs. 2, 3.
1841. *Delthyris mucronata* Conrad, Fifth Ann. Rep. Geol. Survey, New York, p. 54.
1856. *Spirifer mucronata* Billings, Canadian Nat. Geol., I, p. 474, pl. 7, figs. 9, 10.
1867. *Spirifer mucronata* Hall, Pal. New York, IV, pp. 216-218, pl. 34, figs. 1-23.
1897. *Spirifer pennatus* Schuchert, Bull. U. S. Geol. Surv., 87, p. 401.
1901. *Spirifer pennatus* Kindle, Indiana Dept. Geol. Nat. Res., 25th Ann. Rep., pp. 649-650, pl. 8, figs. 1, 2, 2a.

1909. *Spirifer mucronatus* Grabau and Shimer, North American Index Fossils, I, p. 330, fig. 421.
1909. *Spirifer pennatus* Stauffer, Geol. Surv. Ohio, series 4, Bull. 10, pp. 189-190.
1911. *Spirifer mucronatus* Cleland, Wisconsin Geol. Nat. Hist. Surv., Bull. 21, pp. 80-81, pl. 16, figs. 12-14.
1913. *Spirifer mucronatus* Prosser and Kindle, Maryland Geol. Surv., Middle and Upper Devonian, pp. 187-190, pl. 17, figs. 10-18.

Hall's description—"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 centre, and again it is angular.

Dorsal valve moderately convex, sometimes becoming gibbous. The sides are gently curving, and usually flattened towards the cardinal margin; the mesial fold 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, 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, sometimes presenting several interrupted lines of growth."

Remarks—The southeastern Missouri specimens are of the ordinary type of the species. Many of the specimens are well preserved. They are common in the St. Laurent limestone and in the sandstone phase of the St. Laurent. The specimens in Walker Museum from the limestone phase were collected 3 miles south of St. Marys and on Little Saline Creek and those from the sandstone phase from 1½ miles west of Lithium and from Little Saline Creek.

Spirifer varicosus Hall

Description and synonomy on page 102.

Figures on plates 19, 21, 24.

Remarks—This is a rare species in the Grand Tower of Ste. Genevieve County. Only four specimens are in the collections of Walker Museum and two of them are doubtful. It seems to be much less common than in the Mineola of central Missouri.

Family SUESSIIDAE

Genus Cyrtina Davidson

Cyrtina alpenensis Hall and Clarke

Plate 35, figures 6, 7 and 8.

1894. *Cyrtina umbonata* var. *Alpenensis* Hall and Clarke, Pal. New York, VIII, pt. 11, p. 362, pl. 28, figs. 16-20.
1897. *Cyrtina umbonata alpenaensis* Schuchert, Bull. U. S. Geol. Surv., 87, p. 199.
1909. *Cyrtina alpenaensis* Grabau and Shimer, North American Index Fossils, I, p. 313, fig. 393, d-e.

Description—Shell of medium size, hinge line usually slightly shorter than the greatest width of the shell. The dimensions of three specimens are: Width, 11.5 mm., 14 mm., 18 mm.; length of brachial valve, 7 mm., ——, ——; length of pedicle valve, 11 mm., 12 mm., 20 mm.; height of cardinal area, 4.5 mm., ——., 6.5 mm.

Pedicle valve with strongly curved cardinal area. Surface marked by six or seven rounded plications on either side of the sinus; no plications in the sinus; the plications extending only about half the length of the valve. The medium septum extends 8/11 of the length of the valve.

Brachial valve moderately convex, with a narrow well defined fold. No plications on the fold, six or seven plications on either side of the fold. The plications extend only about half the length of the shell. A median septum extends more than half the length of the valve.

All of the specimens examined are internal moulds.

Occurrence—Sandy phase of the St. Laurent limestone, Little Saline Creek, Ste. Genevieve County.

Cyrtina hamiltonensis Hall

Description and synonomy on pages 106 and 107.

Specimens are figured on plate 19.

Specimens of the ordinary kind occur in the St. Laurent limestone, 3 miles south of St. Marys.

Family Athyridae

Genus Athyris McCoy

Athyris fultonensis? (Swallow)

Description and synonomy on pages 109 and 110.

Figures on plate 17.

Remarks—The great variety in this species and the lack of diagnostic characters make it easy to find large numbers of varieties. Only two specimens from southeastern Missouri are in the Walker Museum collections. They are small and quite different from each other. They resemble *A. fultonensis* (Swallow) but the smaller specimen has more distinct fold and sinus than typical small *A. fultonensis*.

Occurrence—Grand Tower limestone of Little Saline Creek.

MOLLUSCA

Class PELECYPODA

Order Prionodesmacea

Superfamily Pteriacea

Family Pterineidae

Genus Pterinea Goldfuss

Pterinea flabellum (Conrad)

Plate 36, figure 2.

1842. *Avicula flabella* Conrad, Jour. Acad. Nat. Sci., Phila., vol. 8, pl. 238, pl. 12, fig. 8.

1884. *Pterinea flabella* Hall, Pal. New York, vol. V, pt. 1, Lamellibranchiata, I, pp. 93-96, pl. 14, figs. 1-21; pl. 15, figs. 1, 4-6, 8-10; pl. 83, figs. 11, 12.

1901. *Pterinea flabella* Kindle, Indiana Dept. Geol. Nat. Res., 25th Ann. Rep., p. 668.
1903. *Pterinea flabella* Weller, Geol. Surv. New Jersey, vol. 3, p. 378, pl. 52, fig. 12.
1909. *Pterinea (Cornellites) flabellum* Grabau and Shimer, North American Index Fossils, I, pl. 421, fig. 551.
1913. *Pterinea flabellum* Prosser and Kindle, Maryland Geol. Surv., Middle and Upper Devonian, pp. 250-251, pl. 29, figs. 1-4.

Hall's description—"Shell large; broad or narrow ovate, oblique rarely erect; length from two-thirds to nearly equal the height; and in some extravagant forms the height is about double the length; the greatest length below the middle; anterior and basal margins regularly curved; the posterior margin from a little above the base, follows a nearly straight line to the beak.

Left valve more or less convex, often gibbous and arcuate. Right valve flat or concave, with a little convexity on the umbo; arcuate, to correspond with the curvature of the opposite valve.

Hinge line straight, extended upon the posterior side; length greater than the length of the valve.

Beak of left valve acute, rounded, situated near the anterior extremity of the hinge, curving forwards over the hinge margin. In rare instances the beak does not extend quite as far as the margin of the hinge. Umbo of the left valve prominent, gibbous limited by the sulci of the cardinal expansions, and subtending an angle of from 30° to 60°. Beak of the right valve depressed, rounded, not rising above the hinge; umbonal region depressed-convex, gradually merging into the body of the valve, which is concave below.

Wing large, triangular, nearly flat, varying in proportions, defined (in the left valve) by the post-cardinal slope; margin concave; extremity acute, rounded. Ear of left valve a simple rounded convex lobe or auriculation, defined by a distinct, broad, rounded sulcus; margin rounded above, sinuate at its junction with the valve, forming the byssal sinus. The cardinal expansions of the right valve are similar in dimensions to those of the opposite valve; nearly in the same plane with the body of the shell, and defined only by the surface striae and the sinus.

Test strong, nacreous, often having a thickness of more than one millimetre. Left valve marked with from six to ten or twelve strong rounded rays, which originate at or near the beak and continue simple to the margin. The interspaces are marked by smaller, alternating costae, increasing by interstitial addition as the shell increases in size. The surface is also ornamented with strong, elevated, concentric lamellose striae of growth, which are more or less distinctly bent backwards over the stronger radii. The cardinal expansions are marked with rays; those on the ear in well-preserved specimens, are stronger than on the wing.

In the right valve the surface is marked with concentric lines which are more crowded on the cardinal expansions, and with a few strong radii on the wing, which are sometimes quite obsolete."

Remarks—This is a common form in the sandstone member of the St. Laurent on Little Saline Creek. Only one fragmentary specimen has been collected from the St. Laurent limestone. The specimens are all fragmentary.

Genus Glyptodesma Hall

Glyptodesma cf. erectum (Conrad)

Plate 36, figure 7

1842. *Aviculata erecta* Conrad, Jour. Acad. Nat. Sci., Phila., p. 238, pl. 12, fig. 5.
1884. *Glyptodesma erectum* Hall, Pal. New York, vol. V, pt. 1, Lamellibranchiata, I, pp. 153-155 pl. 11 figs. 1-10; pl. 12 figs. 1-9; pl. 13 figs. 1-4 12-15; pl. 25 figs. 14-17; pl. 86, figs. 1-8; pl. 87, figs. 1-3.
1909. *Actinodesma erectum* Grabau and Shimer, North American Index Fossils, I, p. 423, fig. 553, a, b.

Hall's description—"Shell large; body ovate, acute, erect or moderately oblique; wings more or less expanded, often greatly expanded; height frequently one-third greater than the length; basal margin more or less regularly rounded; anterior side broadly convex; posterior side nearly straight or slightly concave.

Valves very unequal. Left valve varying from moderately convex to gibbous and arcuate. Right valve depressed-convex in the umbonal region, flat or concave below; variable in convexity.

Hingeline straight, often greatly extended, equalling or usually greater than the length of the valve.

Beak of left valve prominent, acute, inclined forward, rising above the hingeline, and situated anterior to the middle of the body of the shell. Umbonal region somewhat prominent, often gibbous, limited anteriorly by a distinct rounded sulcus, and posteriorly by an interruption and change in the direction of the striae, which sometimes produces a defined line of separation. Umbonal angle acute.

Anterior wing auriform and small in young specimens, becoming expanded and variously extended in older specimens, limited by a distinct byssal depression; extremity rounded. Posterior wing large triangular; margin concave; extremity often extended beyond the margin of the shell.

Test thick, marked by fine, irregular, concentric striae of growth, which are sometimes raised into sharp lamellae, or crowded into prominent fascicles. These striae become more conspicuous upon the margins and upon the wings, where they are often highly lamellose. The distant lamellae which mark the body of the shell are sometimes continued upon the hinge, and becoming stronger, curve over the margin, giving it a sharply annulated aspect, which, when preserved in the impression of the hinge border, might be mistaken for a more important organic marking. Partially exfoliated shells show some obscure radiating lines which belong to the intimate shell-structure, and are not external.

Posterior muscular impression situated near the middle of the posterior slope, and marked by irregular vascular striae; from the lower anterior side of this impression the pallial line extends slightly downward, curving forward, and continuing in a line nearly parallel to the margin it terminates in a small muscular impression within the rostral cavity. The pallial line is frequently pitted or interrupted in its course, and from these pits radiating grooves extend toward the margin of the shell.

Ligamental area extending the entire length of the hinge, comparatively wide, grooved longitudinally with fine, continuous parallel lines. Hinge with one or two linear, slightly oblique, lateral teeth on the posterior side, and with numerous erect or oblique irregular folds along the cardinal line below the ligamental area, which terminate on the inner margin in distinct crenulations. The cardinal wrinkles are smaller and more regular anteriorly becoming large and irregular posterior to the beak."

Remarks—Only two specimens have been collected and they are too imperfect to warrant positive identification.

Occurrence—St. Laurent limestone, 3 miles south of St. Marys.

Genus Leptodesma Hall

Leptodesma rogersi Hall

Plate 36, figure 5

1884. *Leptodesma Rogersi* Hall, Pal. New York, vol. V, pt. 1, Lamellibranchiata, I, pp. 176-177, pl. 21, figs. 1-9.

1909. *Leptodesma rogersi* Grabau and Shimer, North American Index Fossils, I, p. 426, fig. 556 b.

1913. *Leptodesma rogersi* Prosser and Kindle, Maryland Geol. Surv., Middle and Upper Devonian, pp. 254-255, pl. 29, figs. 7-10.

1913. *Leptodesma rogersi* Clarke and Swartz, Maryland Geol. Surv., Middle and Upper Devonian, pp. 636-637, pl. 63, fig. 3.

Hall's description—"Shell of small or medium size, sub-rhomboidal; 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.

Beaks sub-anterior, obtuse, nearly erect, prominent. Umbonal region gibbous, oblique.

The anterior extremity is scarcely alate or auriculate, consisting of a rounded extension, straight above and slightly 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 actually 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 undulated 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, having several fine grooves parallel to the hinge."

Remarks—Fragments of this species are common in the St. Laurent limestone. With the specimens collected it is impossible to distinguish *L. rogeri* Hall from *L. spinigerum* Hall, and the reference is made to the former on the basis of the age of the rocks from which the specimens were collected.

Occurrence—St. Laurent limestone from three miles south of St. Marys.

Family Conocardiidae

Genus Conocardium Bronn

Conocardium ohioense Meek

Description and synonomy on pages 112 and 113.

Figured on plate 26

Remarks—Only two specimens from southeastern Missouri are in the Walker Museum collection. They are imperfect but are readily identifiable.

Occurrence—Grand Tower limestone of Little Saline Creek.

Family Pteriidae

Genus Actinopteria Hall

Actinopteria cf. boydi (Conrad)

Plate 36, figure 6

1842. *Avicula Boydii* Conrad, Jour. Acad. Nat. Sci., Phila., vol. 8, p. 237, pl. 12, fig. 4.
1884. *Actinopteria Boydi* Hall, Pal. New York, vol. V, pt. 1, Lamellibranchiata, I, pp. 113-116, pl. 19, figs. 2-24, 26-30; pl. 84, figs. 16, 17.
1889. *Actinopteria boydi* Nettleroth, Kentucky Fossil Shells, pp. 229-230, pl. 3, fig. 2.
1909. *Actinopteria boydi* Grabau and Shimer, North American Index Fossils, I, p. 449, fig. 592.

1911. *Actinopteria boydi* Cleland, Wisconsin Geol. Nat. Hist. Surv., Bull. 21, pp. 109-110, pl. 22, figs. 7, 8.

1913. *Actinopteria boydi* Clarke and Swartz, Maryland Geol. Surv., Middle and Upper Devonian, pp. 642-644, pl. 64, fig. 2.

Hall's description—"Shell of medium size, rhomboidal; body ovate, varying in proportions, the longitudinal axis at an angle with the hinge line of from 45° to 60°; 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 line 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 region 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 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 which (in good specimens) are produced into sub-tubular, spiniform extensions upon the rays. Lines of growth are seen between the 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 casts 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."

Remarks—The identification is based on one specimen on which the surface markings are obscure, which lacks a complete outline of the anterior alation, and which the umbonal part is somewhat crushed and broken, and on several fragmentary moulds from a sandstone.

Occurrence—Grand Tower limestone of Little Saline Creek; sandstone member of St. Laurent limestone of Little Saline Creek.

Genus Leiopteria Hall

Leiopteria cf. dekayi Hall

Plate 36, figures 8 and 9

1884. *Leiopteria dekayi* Hall, Pal. New York, vol. V, pt. 1, Lamellibranchiata I, pp. 164-165, pl. 19, fig. 1; pl. 20, figs. 16-18; pl. 88, figs. 5-10.

1909. *Leiopteria dekayi* Grabau and Shimer, North American Index Fossils, I, p. 425, fig. 555, d.

Hall's description—"Shell of medium size, sub-rhomboidal in general form; body narrowly ovate, oblique; length about equal to the height; anterior margin nearly vertical for one-third the length of the shell, thence broadly rounded over the basal margin and abruptly recurved at the post-basal extremity.

Left valve convex, gibbous on the umbo. Right valve smaller and less convex; the limitation of the wing not strongly defined.

Hinge line straight, length a little less than the length of the shell measured from the anterior side of the beak to the extremity of the wing.

Beaks anterior, acute, prominent, inclined forward. Umbonal region gibbous above, regularly convex below, subtending an acute angle.

Ear bending downward, with a strong fold in the upper part, limited by a broad undefined sulcus and shallow byssal sinus. Wing triangular, flat, defined by the abrupt retral bending of the striae and a depressed line along the post-cardinal slope; margin concave; extremity acute.

Test thin, marked by fine regular concentric striae, which at unequal intervals are crowded into fascicles, giving an undulated aspect to the surface of the cast; in old specimens, more crowded on the anterior side and ear, and on the wing usually regular, sometimes becoming a little fasciculate on the margin."

"Ligamental area narrow, marked by fine striae; below this area is a narrow oblique fold or lateral tooth."

Remarks—Only two identifiable specimens have been collected. The surface markings are not well preserved and the reference might, with equal propriety, be to *L. bigsbyi* Hall.

Occurrence—Grand Tower limestone of Little Saline Creek.

Genus Limoptera Hall

Limoptera macroptera? (Conrad)

Plate 36, figures 3 and 4.

1838. *Lima macroptera* Conrad, Ann. Report N. Y. Geol. Surv., p. 117.
1884. *Limoptera macroptera* Hall, Pal. New York, vol. V, pt. 1, Lamellibranchiata, I, pp. 246-248, pl. 24, fig. 14; pl. 26, figs. 6-9; pl. 27, figs. 1-10; pl. 28, figs. 4, 5; pl. 29, figs. 1-4; pl. 92, figs. 4-9.
1909. *Limoptera macroptera* Grabau and Shimer, North American Index Fossils, I, p. 422, fig. 553, d.

Hall's description—"Shell large; including the cardinal expansions, the form is subquadrate; body broadly ovate, erect or moderately oblique; wing more or less expanded; height one-fourth to one-third greater than the length; basal margin broadly rounded, with the anterior and posterior sides sub-parallel.

Valves very unequal. Left valve ranging from moderately convex to very gibbous, often somewhat regularly arcuate from beak to base. Right valve smaller than the opposite, in young specimens nearly flat below, depressed-convex in the middle, and more convex in the umbonal region; in specimens of medium size there is often a greater convexity in the upper part and in very old specimens the surface is depressed-convex and nearly flat in the lower part.

Hinge line straight, sometimes equalling but usually less than the length of the shell.

Beak of the left valve prominent, acute, inclined forward, rising above and arching over the cardinal line, situated anterior to the middle of the body of the shell. Umbonal region prominent, convex in young shells and gibbous in older ones, limited anteriorly by a distinct sulcus, and posteriorly by the abrupt umbonal slope. Beak of right valve acute, scarcely rising above the hinge line, defined anteriorly by the byssal sulcus, and posteriorly by the abrupt depression and distinct limitation of the wing. Umbonal angle acute.

Ear small, well-defined in young specimens, and scarcely increasing in size in proportion to the growth of the shells, limited by a distinct byssal depression; extremity rounded. Wing large, triangular; margin more or less concave in young shells, and often nearly straight in older shells; extremity produced or rectangular, often extending beyond the posterior margin of the valve.

Test thick, especially in the umbonal region; marked by distinct subequidistant, rounded radii, with slightly concave interspaces, in which are often finer, or obscurely developed rays; the right valve is usually more closely and less strongly marked by them than the left. The radii are crossed and crenulated by elevated, lamellose, concentric striae, which are more distant and conspicuous on the right valve. In the young shells, the radii are conspicuous on the wing; they are a little more distant on the body of the shell, and often obsolete along the line of the junction of the wing with the body, especially in the right valve. In both valves, the radii become obscure or obsolete below the centre, and the surface is marked by strong, irregular, concentric, lamellose undulations. The radii often become more or less obsolete upon the wing, while remaining conspicuous on the body of the shell.

Ligamental area extending the entire length of the hinge line, much wider in the left valve; marked by coarse parallel, undulating, longitudinal grooves or striae. There is a conspicuous oblique posterior lateral tooth, and two strong cardinal folds beneath or just anterior to the beak. Anterior muscular impression situated in the rostral cavity; the pallial line continues thence in a curve somewhat parallel to the margins of the shell, turning inward below the middle of the height and joining the large muscular impression."

Remarks—Remains of this species are rare and fragmentary. The characters of the ligament and teeth are not discernible. Concentric striae do not appear excepting as lines of growth near the outer margins. The largest specimen is more than 10 cm. long by more than 9 cm. from the tip of the posterior wing to the extreme front.

Occurrence—Sandstone member of the St. Laurent formation, Little Saline Creek.

Order TELEODESMACEA

Superfamily Lucinacea

Family Lucinidae

Genus Paracyclas Hall

Paracycles elliptica Hall

Plate 36, figure 1.

Description and synonomy on page 115.

Occurrence—This is a common form in the Grand Tower limestone of Little Saline Greek, Ste. Genevieve County.

Class GASTROPODA

Subclass Streptoneura

Order Aspidobranchia

Suborder Docoglossa

Family Bellerophontidae

Genus Bellerophon Montfort

One specimen of this genus is in the collection of Walker Museum, but it is too imperfect for identification.

Suborder Rhipidoglossa

Family Euomphalidae

Genus Euomphalus Sowerby

Fragments of specimens referable to this genus are rare in the St. Laurent limestone, 3 miles south of St. Marys.

Order CTENOBANCHIATA

Suborder Platypoda

Superfamily Taenioglossa

Family Capulidae

Genus Platyceras Conrad

Platyceras carinatum Hall

Plate 35, figures 17 and 18

Description and synonomy on page 121.

Figured on plate 26.

Remarks—Only one specimen complete enough for identification has been collected. It is unusual for the species but is remarkably like Hall's figures 20 and 21 of plate 2.

Occurrence—Grand Tower limestone of Little Saline Creek.

Platyceras nodosum Conrad

Plate 39, figure 11

Description and synonomy on page 122.

Figured on plate 28.

Remarks—Only one fragmentary specimen of this species has been collected but it is identified with a fair degree of certainty.

Occurrence—Grand Tower limestone of Little Saline Creek.

Genus Diaphorostoma Fisher

Diaphorostoma genevievensis n. sp.

Plate 39, figures 7, 8 and 9.

Description—Shell small. Spire elevated above the body whorl; one to two volutions above the body whorl. The body whorl expands rapidly. The aperture seems to be nearly circular though it is not well enough preserved in the specimen to determine its outline positively. Surface marked by fine concentric striae about 10 to the millimeter. The cotypes measure 8 mm. as greatest width of body whorl. and 6 mm. as greatest height of shell. The apical angle is 96 degrees.

The shell is remarkable for its small size and perfection of minute striae.

Occurrence—Grand Tower limestone of Little Saline Creek.

Subclass EUTHYNEURA

Order Opisthobranchia

Suborder Conulariida

Family Tentaculitidae

Genus Tentaculites Schlotheim

Tentaculites sp. undet.

Plate 39, figure 6.

Fragments of *Tentaculites* are common in the St. Laurent limestone and are present in the Beauvais sandstone. The fragments are too imperfect for specific reference. The specimen which shows best is an impression .9 of a millimeter in diameter with 3 annulations per millimeter. The annulations are closer together than in any described species and take up more of the space. This specimen is from the Beauvais sandstone. The same species is found in the St. Laurent but another species in that formation has much less prominent annulations.

Class CEPHALOPODA

Subclass Tetrabranchiata

Order Nautiloidea

Suborder Orthochoanites

Family Orthoceratidae

Genus Orthoceras Breynius

Orthoceras cf. subulatum Hall

Plate 37, figure 10.

1843. *Orthoceras subulatum* Hall, Geol. New York, Rept. Fourth Dist., p. 180, fig. 1.
1861. *Orthoceras subulatum* Hall, Descriptions of New Species of Fossils, etc., p. 49.
1862. *Orthoceras subulatum* Hall, 15th Rep. N. Y. State Cab. Nat. Hist., p. 77.
1879. *Orthoceras subulatum* Hall, Pal. New York, vol V, pt. 2, pp. 283-284, pl. 38, fig. 3; pl. 84, figs. 1, 2, 4, 6-10; pl. 86, figs. 1, 2.
1910. *Orthoceras (Geisonoceras) subulatum* Grabau and Shimer, North American Index Fossils, II, pp. 52-53, fig. 1252, b.
1912. *Orthoceras cf. subulatum* Kindle, Bull. U. S Geol. Surv., 508, p. 106.
1913. *Orthoceras subulatum* Prosser and Kindle, Maryland Geol. Surv., Middle and Upper Devonian, pp. 308-309. pl. 39, figs. 1, 2.

Hall's description—"Shell straight, regularly enlarging from the apex to near the aperture. Transverse section circular. Apical angle varying, in normal and compressed specimens, from six to nearly eight degrees. Initial extremity observed, but the characters are obscure.

Chamber of habitation well developed, having a length equal to about three times its diameter at the last septum, regularly expanding to a point near the aperture where it is slightly contracted. Air chambers numerous, increasing in depth from the apex to the outer chamber, where the depth is about three mm.

Septa smooth, thin, having a concavity equal to an arc of about 125 degrees. Sutures straight and horizontal, but little impressed on the internal mould.

Siphuncle small, subcentral, only observed at the septa, where its diameter is one mm., the tube having a diameter of fifteen mm. at the same point.

Test thin, usually showing a thickness of .2 mm.; sometimes it is considerably stronger over the anterior portion of the chamber of habitation. Surface marked by very fine, irregular, lamellose striae of growth. Some of the specimens show longitudinal striae, and more rarely very fine, filiform, longitudinal markings."

Remarks—Fragments from Missouri agree with *O. subulatum* Hall, but as the iving chamber is not present and a constriction in the living chamber is the main difference between this species and *O. constrictum* Vanuxemi the reference is uncertain. The location of the siphuncle has not been positively determined and the larger specimens may belong to *O. exile* Hall.

Occurrence—Grand Tower limestone of Little Saline Creek.

Family Rhadinoceratidae

Genus Nephriticeras Hyatt

Nephriticeras

Plate 37, figure 8, 9; plate 38, figure 4.

Fragmentary specimens of two species of this genus from the Grand Tower limestone are in the collections of Walker Museum.

Suborder CYRTOCHOANITES

Family Phragmoceratidae

Genus Gomphoceras Sowerby

Gomphoceras grandtowerensis n. sp.

Plate 37, figures 6 and 7.

Description—Shell of medium size, nearly straight; transverse section oval; place of greatest diameter the chamber adjoining the living chamber. Living chamber with the sides convex and contracting gradually to a place 22 mm. from the base. From this constricted band outward the sides are nearly straight. The aperture is narrowly oval. The average depth of the air chambers is 4 mm. 14 chambers are preserved in the type specimen and there is little difference in their depth. The septae are slightly curved backward on the less convex surfaces. Siphuncle not observed. The specimen is remarkable for its symmetry.

Occurrence—Grand Tower limestone of Little Saline Creek.

Gomphoceras hyatti Whitfield

Plate 38, figure 1.

1882. *Gomphoceras Hyatti* Whitfield, N. Y. Acad. Aci., 2nd Ann. Report, p. 206.
1893. *Gomphoceras Hyatti* Whitfield, Ohio Geol. Surv., vol. VII, pp. 427-428 pl. 4, fig. 1; pl .5, figs. 1-2.
1910. *Poterioceras hyatti* Grabau and Shimer North American Index Fossils, II, p. 128; fig. 1374 a, b.

Whitfield's description—"Shell large and robust, slightly arcuate throughout, but more strongly curved below than in the upper part; somewhat rapidly expanding from below upward to near the middle of the outer chamber, where it is suddenly contracted to the aperture, and on the lateral margins again slightly expanding. The rate of increase in diameter, as compared with the increased length is about as one and two, when meas-

ured on the inside curvature. Transverse section of the shell obtusely subtriangular, flattened or but slightly convex on the inner surface, rounded on the lateral surfaces, and obtusely rounded on the back; the dorso-ventral and lateral diameters are about as four and five, and the triangular form is more perceptible in the earlier stages of growth, owing to the greater convexity of the inner face in the upper portion and on the outer chamber. Outer chamber comparatively short, being about two-thirds as high as wide. Aperture large, irregularly tri-lobed, straight on the inner face and about four-fifths as wide as the entire width of the shell, and apparently about two-thirds as wide in a dorso-ventral direction as laterally. The exact form of the aperture on the outer side cannot be ascertained, owing to the imperfection of the specimen in this part. Septa moderately concave, very closely arranged in the lower part but more distinctly disposed above; the rate of increase in distance somewhat gradual to near the upper portion, where two or three of the septa are slightly more crowded. In the more distant portions three chambers occupy the space of one inch, but in the lower part of the specimen, where the transverse diameter is a little more than one and a half inches, they are less than one-twelfth of an inch apart. Siphuncle of moderate size and subcentrally situated. Surface of the shell unknown."

Remarks—A specimen from the Grand Tower limestone probably belongs to this species though the lack of diagnostic characters of the group makes positive identification impossible in most cases. The specimen is larger than the one figured by Whitfield and it does not show as much curvature as that specimen. More of the smaller end is missing than in the Ohio specimen. The aperture, shape, size, and living chamber are much alike in the specimens from Ohio and Missouri. The depth of the smaller chambers is not as small on the Missouri specimen, but the transverse diameter at the small end is 1½ inches in the Ohio specimen and more than two inches in the Missouri specimen.

Occurrence—Grand Tower limestone, 3 miles south of St. Marys.

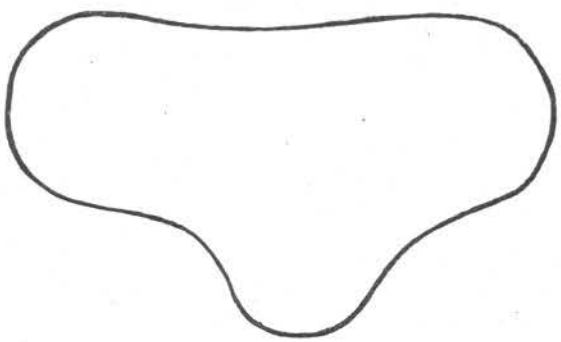

Fig. 10. Outline of the aperture of *Gomphoceras hyatti* Whitfield.

Gomphoceras cf. impar Hall

Plate 37, figure 1.

1879. *Gomphoceras impar* Hall, Pal. New York, vol. V, pt. 2, p. 332.

1888. *Gomphoceras impar* Hall, Pal. New York, supplement to vol. V, pt. 2, in vol. VII, pl. 120, fig. 4; pl. 121a, fig. 1.

Hall's description—"Shell straight, exogastric. Transverse section broadly oval. Point of greatest transverse section near the base of the chamber of habitation. Tube regularly enlarging to the last septum, where it is slightly constricted. Apical angle about 30°.

Chamber of habitation large, with a length equal to the greatest ventro-dorsal diameter. The dorsal side slopes somewhat more abruptly toward the aperture than the

ventral side. The tube gradually enlarges back of the aperture, and suddenly expands to the point of the greatest transverse section. The crenulated band in the cast forms a deep, narrow fossa at the base of the grand chamber, and is crossed by furrows, of which there are about four in the space of twelve mm.

Aperture sub-oval, having a length equal to the greatest ventro-dorsal diameter, or about twice its transverse diameter. The small aperture is indicated by a sinus in the margins of the large aperture.

Air-chambers numerous, regularly increasing in depth from the apex to near the base of the outer chamber, varying in depth from four to six mm. in the length of seventy mm. The last two air-chambers are shallower than the preceding. Septa not observed. Sutures straight and horizontal.

Siphuncle, test and surface-markings unknown."

Remarks—One Missouri specimen has many of the characters of *G. impar*. The shell is constricted at the base of the living chamber. The outer two air-chambers are much shallower than the others. The depth of the air-chambers ranges up to 7 mm. rather than to 6 mm. as in the type. The shapes of the living chamber and of the aperture are indistinct.

Occurrence—Grand Tower limestone of Little Saline Creek.

Gomphoceras missouriensis n. sp.

Plate 37, figures 2, 3, 4 and 5; plate 38, figure 2.

Description—The known specimens of this species are all moulds of living chambers. The living chambers are small. They range in size from 18 mm. in greatest diameter to 38 mm. As the outer ends are missing the length of the chamber cannot be determined. In a specimen 18 mm. in diameter 23 mm. of length is preserved, and in the specimen 38 mm. in diameter the length is 38 mm. The peculiarity of the chamber is in its almost straight sides of 12 to 14 mm.; abrupt narrowing from 18 to 13 mm.; and the much narrowed part proceeding outward at an angle of about 145 degrees from the outer part. The aperture of the only specimen that retains it nearly complete is subangular at the sides and has a diameter of 13 mm. in one direction by 10 mm. in the other with regularly curving sides from the subangular parts. The siphuncle is small and located subcentrally.

One specimen, which is referred to the same species, retains four air chambers. These slope apexward at an angle of 38 degrees. This specimen differs from the others in the restriction of the living chamber being much more pronounced. It narrows abruptly from a diameter of 31 mm. to 22 mm. In this specimen the shoulder forms almost a right angle while the others slope in much more gradually.

Occurrence—Grand Tower limestone of Little Saline Creek.

Gomphoceras plenum? Hall

Plate 38, figure 3.

1886. *Gomphoceras plenum* Hall, Fifth Ann. Rept. State Geologist, Expl. pl. (121a) 6, figs. 3, 4.

1888. *Gomphoceras plenum* Beecher, Pal. New York, supplement to vol. V, pt. 2, in vol. VII, pp. 33-34, pl. 121a, figs. 3, 4.

Beecher's description—"Shell large, stout, sub-fusiform. Transverse section circular; point of greatest gibbosity at about the tenth septum from the chamber of habitation. Axis nearly straight. Tube rapidly enlarging to the point of greatest transverse section, more gradually contracting to the outer third of the grand chamber, and abruptly constricted at the aperture.

Chamber of habitation as long as the diameter of the tube at the last septum. Aperture obscurely trilobate. Air-chambers from 6 to 7 mm. in depth over the larger portion of the shell; the last three being shallower. Sutures slightly curved.

Siphuncle situated near the ventral side of the tube; its elements in the interseptal spaces have not been observed.

Test not preserved. Internal mould smooth."

Remarks—The only specimen in the Missouri collections of Walker Museum is a fairly perfect living chamber 68 mm. by 56 mm. at the detached end; 75 mm. long. The center of the siphuncle is 7 mm. from the lower edge of the chamber. The aperture is subtriangular with its greatest diameter about 43 mm. The outline of the aperture is indistinct.

Occurrence—Grand Tower limestone of Little Saline Creek.

ARTHROPODA

Class CRUSTACEA

Subclass Trilobita

Order Opisthoparia

Family Proetidae

Genus Proetus Steininger

Proetus crassimarginatus Hall and Clarke

Plate 39, figure 4

Pl. 21, figs. 8-10; pl. 30, figs. 6-8

Description and synonomy on pages 125 and 126.

Remarks—A few fragmentary pygidia of this species are in the collections.

Occurrence—Grand Tower limestone of Little Saline Creek.

Proetus haldemani Hall

Plate 39, figure 12.

1861. *Proetus Haldemani* Hall, Descriptions New Species of Fossils, etc., p. 74.

1888. *Proetus Haldemani* Hall and Clarke, Pal. New York, VII, pp. 113-116, pl. 21, figs. 7-9; pl. 23, figs. 13-15.

Description abbreviated from Hall—"Outline sub-elliptical or elongate-ovate. Surface convex, distinctly and equally trilobate. Length to width as 1.7.

Cephalon semicircular or semi-lunate in outline; border broad, flat and rounded at the edge; widest in front and narrowing toward the genal angles, where it is very faintly produced. Surface evenly convex.

Facial sutures normal, rapidly approximating on the frontal margin.

Glabella broadly conate, constricted opposite the anterior angles of the eyes. Surface depressed-convex. Length and greatest width about equal; the anterior extremity scarcely reaching the marginal sulcus, the posterior margin ending abruptly at the occipital furrow. The anterior and lateral margins are bounded by shallow and inconspicuous furrows. Lateral furrows, as shown upon the cast of the lower surface, in four pairs, accompanied by the posterior accessory depressions. Of these furrows the first pair is very short and transverse, the other three pairs and the accessory pair inclined obliquely backward. The fourth pair is strong and reaches to the posterior margin, but does not open into the occipital furrow. Upon the surface of the test these lateral furrows would undoubtedly be less conspicuous, but no specimen has been observed in which the crust of the glabella is retained. Occipital lobes moderately strong; occipital furrow

narrow, impressed and scarcely widening upon the cheeks; occipital ring moderately broad, somewhat flattened and of about the same width along the posterior margin.

Eyes relatively large and somewhat elevated above the surface of the glabella.

Thorax composed of ten segments.

Pygidium rounded sub-triangular, slightly produced at the extremity; length to width as 1 to 1.5. Surface convex, sloping evenly to the lateral and posterior margins. Composed of eleven or twelve flattened, transverse annulations. Pleurae broad and evenly rounding to the margins; bearing from eight to eleven annulations, each being grooved by a faint impressed line, which is most distinct near the axis and toward the margins. The border is moderately broad and thickened, widening to the posterior extremity, the annulations, with the exception of the first three or four becoming extinct upon reaching its inner margin. Surface smooth or minutely granulose."

Remarks—Three imperfect cephala and several nearly perfect pygidia have been collected in Missouri. The pygidia differ slightly from Hall's figures in the glabella not narrowing so abruptly toward the front. The pygidium proportion is about 1 to 1.3 rather than 1 to 1.5 as in Hall's specimens.

Occurrence—Grand Tower limestone of Little Saline Creek, Ste. Genevieve County.

Proetus sp. undet.

Fragments of two other species of *Proetus* from the Grand Tower of southeastern Missouri are in the collections of Walker Museum, but it is impossible to make specific determinations from them.

Order PROPARIA

Family Calymenidae

Geuus Homalonotus Koenig

Homalonotus sp. undet.

A few fragments of this genus have been collected from 3 miles south of St. Marys, Perry County, St. Laurent limestone.

Family Phacopidae

Genus Dalmanites Barrande

Dalmanites sp. undet.

Fragments of this genus have been collected from the Grand Tower limestone on Little Saline Creek.

Genus Cryphaeus Green

Cryphaeus boothi Green

Plate 39, figure 10.

1837. *Cryphaeus Boothii* Green, Am. Jour. Sci., XXXII, p. 343 and figure.
1888. *Dalmanites* (*Cryphaeus*) *boothi* Hall and Clarke, Pal. New York, VII, pp. 42-45, pl. 16, figs. 1-4; pl. 16a, figs. 3-8.
1910. *Cryphaeus boothi* Grabau and Shimer, North American Index Fossils, II, p. 329, fig. 1648 a-b.
1913. *Dalmanites* (*Cryphaeus*) *boothi* Prosser and Kindle, Maryland Geol. Surv., Middle and Upper Devonian, pp. 333-334, pl. 44, figs. 1-4.

Prosser and Kindle's description—"General form suboval, laterally and posteriorly fimbriate; length about one-half greater than the width; surface depressed-convex,

distinctly trilobate; axis prominent, elevated. Cephalon relatively large; outline semi-elliptical, faintly produced on the frontal margin; length to width as 1 to 2; margin thickened by a broad doublure which is produced at the genal angles into broad, thin and blunt spines that normally reach to the sixth thoracic segment; glabella elongate subpentagonal, length and width equal and nearly equal to length of the cephalon; three pairs of transverse furrows conspicuous; eyes large, elevated, exceeding the height of the glabella; visual surface lunate with 206 lenses for each eye. Thorax length to width as 1 to 1.5; axis arched, widest at the fourth segment, tapering thence evenly to the pygidium; pleurae flattened, gently deflected along the fulcrum. Pygidium subtriangular, depressed convex; axis tapering with slightly incurved margins, and ending abruptly just within the posterior border, with from ten to fourteen annulations; the pleurae each bear five sulcate annulations, the anterior limbs of which are flattened, thickened and produced beyond the margin as short, flat and closely set spines; a similar spine, but shorter and relatively broader, is produced in the axial line, thus making eleven spines in the pygidial fimbria. In the normal forms the entire surface is covered with granulations which become quite strong on the axial region of the glabella and thorax, and the surface of the pygidial fimbria, where the granules become elongate and pustuliform, often crowded and more conspicuous than upon the surface of the shield itself."

Remarks—Three pygidia are in the Walker Museum, and the identification is based on these specimens.

Occurrence—Sandstone member of the St. Laurent, 1½ miles west of Lithium, Perry County.

Genus Phacops Emmrich

Phacops cristata Hall

Plate 39, figures 1 and 2.

1861. *Phacops cristata* Hall, Descriptions of New Species of Fossils, etc., p. 67.
1861. *Phacops bombifrons* Hall, Descriptions of New Species of Fossils, etc., p. 67.
1888. *Phacops cristata* Hall and Clarke, Pal. New York, VII, pp. 14-19, pl. 6, figs. 1-13, 16-29; pl. 8a, figs. 1-4.
1901. *Phacops cristata* Kindle, Indiana Dept. Geol. Nat. Res., 25th Ann. Rep. p. 744.
1910. *Phacops cristata* Grabau and Shimer, North American Index Fossils, II, pp. 322-323, fig. 1637.
1912. *Phacops cristata* Kindle, Bull. U. S. Geol. Surv., 508, pp. 107-108, pl. 10, figs. 6-8.
1913. *Phacops cristata* Kindle, Maryland Geol. Surv., Middle and Upper Devonian, pp. 331-332, pl. 43, figs. 13-15.

Hall gives the following brief characterization of the species: "The diagnostic characters of this species are very clearly defined, and may be summarized as follows: (a) the axial row of spines extending as far as the pygidium, (b) the short, stout spines on the genal angles, (c) the strongly protuberant glabella, (d) the comparative absence of tuberculations, except on the glabellar surface, (e) the ten or eleven crenulations upon each side of the sub-marginal furrow of the cephalon, (f) the dichotomous annulations of the pygidium."

Remarks—The specimens collected in Missouri are all imperfect cephala and pygidia. One cephalon has a spine preserved on the genal angle. The annulations on the pygidia are faintly to not at all dichotomous. The largest specimen is 22 mm. across the widest part of the cephalon, and the small size of the specimen suggests the variety *P. cristata pipa* Hall.

Occurrence—Grand Tower limestone of Little Saline Creek.

Phacops rana (Green)

Plate 39, figure 5.

1832. *Calymene bufo* var. *rana* Green, Monograph of the Trilobites of North America, p. 42.

1861. *Phacops rana* Hall, Descriptions of New Species of Fossils, etc., p. 55.
1868. *Phacops rana* Meek and Worthen, Geol. Surv. Illinois, III, pp. 447-449, pl. 11, figs. 1 a-e.
1910. *Phacops rana* Grabau and Shimer, North American Index Fossils, II, p. 323, fig. 1638.
1913. *Phacops rana* Prosser and Kindle, Maryland Geol. Surv., Middle and Upper Devonian, pp. 329-331, pl. 43, figs. 8-12.
1913. *Phacops rana* Clarke and Swartz, Maryland Geol. Surv., Middle and Upper Devonian, p. 699, pl. 72, figs. 8, 9.

Description by Prosser and Kindle—"General form elongate suboval; greatest width (measured at the posterior margin of the cephalon) to axial length as 1 to 2; the cephalon, thorax and pygidium are to one another in length as 1.5 to 2 to 1. Cephalon subsemicircular, the regularity of the outline interrupted by the slight protrusion of the glabella and the genal extremities, frontal margin obscure, concealed by the overhanging glabella; facial sutures rarely discernible; glabella large, gibbous outline subpentagonal, greatest width anteriorly, posterior furrow extending clear across the glabella; cheeks abruptly sloping to the margin, narrowing anteriorly and reflected ventrally to form the doublure; eyes prominent, scarce reaching the height of the glabella in uncompressed specimens, visual area lunate, separated from the cheek by a strong smooth sulcus, average number of lenses in normal adults is between forty and fifty for each eye. Thorax subquadrate, lateral margins slowly tapering, surface strongly trilobate; axis flattened at the margins, evenly convex in the middle, widest at the third or fourth segment, tapering very slowly to the ninth, and thence much more rapidly to the pygidium; pleurae flat for about one-third their width from the axis and thence abruptly deflected to the margin, each segment bears a furrow which becomes obsolete at the fulcrum. Pygidium relatively small, regularly and evenly rounded margin the posterior part of which forms the arc of a circle; axis composed of nine annulations, rapidly and evenly tapering from the last segment of the thorax, reaching an acute termination just within the posterior margin; pleurae seven in number, broad depressed-convex, and sloping evenly to the posterior margin. Surface of the test ornamented with tubercles, which are largest and most closely set upon the glabella."

Remarks—Fragments from the sandstone member of the St. Laurent have been referred to *P. rana* though no specimen is complete enough to make it possible to determine that it does not belong to *P. cristata* Hall. The reference is made to *P. rana* on account of the age of the rocks in which it occurs.

Occurrence—St. Laurent formation, 1½ miles west of Lithium, Perry County.

VERTEBRATA

Class PISCES

Subclass Teleostomi

Order Crossopterygii

Family Onychodontidae

Genus Onychodus Newberry

Onychodus sigmoides Newberry

Plate 39, figure 3.

1857. *Onychodus sigmoides* Newberry, Proc. National Institute, Washington, D. C., new series, 1, p. 124.
1889. *Onychodus sigmoides* Newberry, Monograph U. S. Geol. Surv., 16, pp. 56-57, pl. 36, figs. 1-4a; pl. 37, figs. 1-11.

1902. *Onychodus sigmoides* Hay, Bull. U. S. Geol. Surv., 179, p. 363.
1908. *Onychodus sigmoides* Eastman, Iowa Geol. Surv., 18, pl. 1, figs. 4, 11.
1908. *Onychodus sigmoides* Eastman, New York State Museum, Memoir 10, pl. 1, fig. 3; pl. 3, fig. 2.

Newberry's description—"Fishes of large size; head at least eighteen inches long, composed of numerous angular and rounded plates, supported on a cartilaginous brain-box, and so imperfectly united that in the fossil state they are usually disconnected and scattered. Of the head plates, the operculata are from three to five inches in diameter, nearly circular, but with a produced anterior angle. The maxillaries are triangular in outline, the anterior and posterior angles much produced, the lower margin nearly straight, and set with a large number of conical, pointed teeth. The dentary bone of the mandibles is often more than a foot in length, curved gently upward at its anterior extremity, which is rounded. Its posterior extremity is thin and flattened running off to a pointed edge, where it was overlain by the articular portion of the mandible.

The upper margin of the dentary bone is thickly set with conical, pointed teeth. Embraced within the anterior extremities of the mandibles is an arch of bone, which supports a series of large, conical, sigmoidally curved teeth seven or eight in number, set vertically, and projecting downward, forward and upward. These teeth show several prominent roots, which partially embrace the bases of the adjacent teeth. The exterior surfaces of the cephalic plates and the exposed portions of the maxillaries and mandibles are thickly set with small enameled tubercles, which have the form of appressed, striated, or sulcated cones. The body was covered with relatively thin, highly ornamented scales. These have a circular or elliptical outline; the under surface is smooth, or faintly marked with concentric lines, and often bears a central elevated tubercle or ridge. The exterior surface shows an anterior semi-lunar space, occupying about half its area, where adjacent scales were superimposed. This space is comparatively smooth, but is delicately ornamented with radiating lines of pits. The posterior and exposed portion of each scale is roughened with appressed, striated tubercles, similar to those on the cephalic plates, and with branching, somewhat foliated ridges of enamel."

Remarks—Two sigmoidal teeth have been collected from the Grand Tower limestone of southeastern Missouri, but they are complete enough to make the identification satisfactory. Two specimens have been collected from the Callaway limestone of Moniteau County.

Unidentified fish remains

Fragments of bone indicate the presence of other fishes besides *Onychodus sigmoides* Newberry, but the fragments are too imperfect for generic identification.

CHAPTER III

THE FAUNA AND THE CORRELATION OF THE BAILEY LIMESTONE IN THE LITTLE SALINE CREEK AREA OF STE. GENEVIEVE COUNTY, MISSOURI, BY V. O. TANSEY

The Bailey limestone was named by Ulrich from its exposure at the former Bailey's Landing on the Mississippi River, Perry County, Missouri. Fossils obtained from it at Bailey's Landing have been described by Meek and Worthen;[1] and its occurrence together with fossils collected from it along the Mississippi River in Jackson and Union Counties, Illinois, and at a point across the river in Perry County, Missouri, have been noted by Savage.[2] Its occurrence in Ste. Genevieve County, southeastern Missouri is described in a forthcoming report on that county by Stuart Weller.

Of the 64 or 65 species of fossils from the Bailey limestone in the Little Saline Creek area of Ste. Genevieve County, Missouri, 42 of the 49 accurately determined have been described from Lower Devonian strata of other localities.

That the Bailey limestone of this region is essentially of New Scotland age—based on the New York Helderberg; and that it is related essentially to the New Scotland of Maryland, and to the Coeymans-New Scotland of the Helderberg of New Jersey is evident from the following tables 1 and 2. Table 1 gives the fauna of the Bailey limestone in the Little Saline Creek area, and the occurrence of contained species in New York, New Jersey, Maryland, Tennessee, Oklahoma, Gaspe, Quebec, and Dalhousie, New Brunswick. Table 2 is a numerical summary, based on Table 1, of the species of the Bailey limestone as they occur in New York, New Jersey, and Maryland that brings out the relation of the Bailey limestone to the Helderberg of those states.

The description of the Bailey limestone in the Little Saline Creek region and of related strata outside of the New York-New Jersey-Maryland area are given in the following table 3 while the substantiating faunal data for such relationship is included in tables 1, 2, 4, and 5. Table 4 gives the occurrence in

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[1]Ill. Geol. Surv., vol. III, 1868.

[2]Ill. Geol. Surv., Bull. 8, pp. 112-113, 1907.

the New York-New Jersey-Maryland area of those species of the strata—related to the Bailey limestone—of Tennessee, Oklahoma, Gaspe, Quebec, and Dalhousie, New Brunwsick, that are not present in the fauna of the Bailey limestone in the Little Saline Creek area but are in the New York-New Jersey-Maryland region. Table 5 is a numerical summary of species, based on tables 1 and 4, that indicates the extent of equivalence between the Bailey limestone and the related strata of Tennessee, Oklahoma, Quebec, and New Brunswick through the species held in common and through the age indications as judged from the New York section of those species of the beds of Tennessee, Oklahoma, Quebec, and New Brunswick that do not occur in the Bailey limestone but are present in New York.

The Bailey limestone in the Little Saline Creek area of southeastern Missouri is practically equivalent to the Olive Hill formation plus the Birdsong shale plus the Decaturville chert of western Tennessee; it is partially equivalent to the Haragan shale plus the Bois D'Arc limestone of the Arbuckle mountain region of Oklahoma, to the St. Alban beds of Gaspe, Quebec, and to the Dalhousie formation of Dalhousie, New Brunswick.

TABLE NO. 2.

Area.	Number of species that occur in:				Number of species that are confined to:			Number of species that occur in and are confined to:		
	Coeymans, New Scotland, and Becraft.	Coeymans.	New Scotland.	Becraft.	Coeymans.	New Scotland.	Becraft.	Coeymans and New Scotland.	New Scotland and Becraft.	Coeymans, New Scotland and Becraft.
New York	36	13	33	11	2	18	0	5	5	1
New Jersey	22	13	14	10	6	3	0	1	4	3
Maryland	23	12	22	6	0	7	0	6	1	2

TABLE NO. 3.

Little Saline Creek Area, Ste. Genevieve Co., Missouri.[1]

Bailey limestone—about 200 feet thick.
- Upper member—about 100 feet thick.
  - Interbedded chert and limestone; lower portion highly fossiliferous.
  - Crystalline, highly fossiliferous, gray limestone about 5 feet thick.
- Lower member—about 100 feet thick.
  - Shaly zone with some chert; fossiliferous.
  - Thin-bedded dolomite with nodules of chert a few inches in diameter.

Western Tennessee.[2]

Decaturville chert—6 ± feet thick.
"Porous gray chert."
Break.
Birdsong shale—35-65 feet thick.
"Bluish shaly limestone and shale."
Break.
Olive Hill formation.
- Flat Gap member—0-53 feet thick.
  "Massive pure limestone."
- Bear Branch—Pyburn member—0-45 feet thick.
  "Massive limestone and oolitic hematite in north—impure cherty limestone in south."
- Ross member—0-60 ± feet thick.
  "Impure thin-bedded cherty limestone."

Arbuckle Mountains, Oklahoma.[3]

Bois d'Arc limestone—0-90 feet thick, average 60 feet.
"Thin-bedded crystalline and non-crystalline limestone with occasional chert lentils and thin beds of intercalated yellowish shale."
Hargan shale—0-166 feet thick, average 100 feet.
"Alternating blue to white shales and thin-bedded earthy limestones which weather into yellowish shales on long exposure."

Gaspe, Quebec.[4]

St. Alban beds—160 feet thick.
"Greenish calcareo-argillaceous shales, which are interstratified with less calcareous layers, of various shades of red."—90 feet.
"Gray limestones in layers of from six to eight inches thick, which are separated by bands of greenish calcareo-argillaceous shale, gradually increasing in amount towards the upper part."—70 feet.

Dalhousie, New Brunswick.[5]

Dalhousie formation.	Feet.
"From this point * * the section is concealed * * for a distance of 400 feet * * The total thickness of the sedimentary series * * is * * approximately 430 feet * *	
16. Coral reef limestone * * shaly in lower part	35
15. Thin white limestone	1.5
14. Barren shales	15
13. Ash bed with *Rensselaeria stewarti*	1
12. Blocky calcareous shale with gastropods (Coelidium)	2
11. Ash beds alternating with thin limestones and shales all highly fossiliferous * *	30
10. Soft shales with lamellibranchs	10

[1]Data from forthcoming report on Ste. Genevieve Co., Missouri, by Stuart Weller.
[2]Dunbar, C. O., Tenn. Geol. Surv., Bull. 21, p. 27, 1919.
[3]Reeds, C. A., Am. Jour. Sci., vol. 32, 4th ser., pp. 264, 265, 1911.
[4]Logan quoted by Clarke, J. M., N. Y. State Mus., Mem. 9, pt. 1, p. 26, 1908.
[5]Clarke, J. M . N. Y. State Mus., Mem. 9, pt. 2, pp. 11-12, 1909.

		Feet.
9.	Limestones and calcareo-argillaceous shales with profusion of corals and brachiopods	75
8.	Soft calcareous shales * * very rich in *Leptaena rhomboidalis*	20
7.	Compact limestone beds overlying the eruptive; contains corals and other fossils	7
	Volcanic boss * * near the middle of which lies a	
6.	detached mass of hardened and glazed calcareous shale * * 30 feet in transverse thickness, 15 feet in height * * This mass contains corals and brachiopods	30
5.	Compacted gray blocky limestone	10
4.	Coarse conglomeratic ash bed	12
3.	Hard blocky yellowish gray argillaceous limestone	40
2	Gray to yellowish hard calcareous shales with thin beds of limestone	125
1.	Calcareous shale with *Sieberella pseudogaleata, Leptaena rhomboidalis* and in the lowest stratum corals * * No contact metamorphism	30
	Volcanic boss * * overlain by''	

TABLE NO. 4.

Species not represented in the observed fauna of the Bailey limestone in the Little Saline Creek area, Mo., but that occur in the N. Y.-N. J.-Md. region.	N. Y.-N. J.-Md. area.					Tennessee.			Oklahoma.		Gaspe, Quebec.	Dalhousie, N. B.
	Below	Coeymans	New Scotland	Becraft	Above	Olive Hill formation	Birdsong shale	Decaturville chert	Haragan shale	Bois d'Arc limestone	St. Alban beds	Dalhousie formation
Aulopora schohariae Hall	Md.		x	Md.		*	*	*	*	*		*
Pleurodictyum lenticulare (Hall)		P.	x			*	*					
Duncanella rudis Girty			x				*		*	*		
Favosites shriveri (Herzer)					OR. Md. ON.							*
Favosites hemisphericus M.-E. & H.												
Halysites catenularius (Linne)	x											
Edriocrinus pocilliformis Hall			x			*	*					
Spirorbis laxus Hall	x						*					
Cornulites chrysalis Hall			x				*					
Ascodictyon siluriense Vine	Md.						*					
Phaenopora tenuis (Hall)			x				*					
Eridotrypa corticosa (Hall)			x				*					
Orthopora rhombifera (Hall)			x				*					
Lioclema ponderosum (Hall)			x				*					
Lioclema cellulosum (Hall)			x				*					
Callopora perelegans (Hall)			x				*		*			
Monotrypa tabulata (Hall)			x				*					
Crania pulchella H. & C.			x		OR.		*					*
Craniella agaricina (H. & C.)			x				*					
Pholidops ovatus Hall	Md.		x				*		*		*	
Orthostrophia strophomenoides (Hall)			x				*		*		*	
Dalmanella subcarinata (Hall)			x		OR. N. J.	*						
Dalmanella concinna (Hall)	Md.						*					

TABLE NO. 4—Continued.

Species not represented in the observed fauna of the Bailey limestone in the Little Saline Creek area, Mo., but that occur in the N. Y.-N. J.-Md. region.	N. Y.-N. J.-Md. area.					Tennessee.			Oklahoma.		Gaspe, Quebec.	Dalhousie, N. B.
	Below	Coeymans	New Scotland	Becraft	Above	Olive Hill formation	Birdsong shale	Decatur-ville chert	Haragan shale	Bois d'Arc limestone	St. Alban beds	Dalhousie formation
Dalmanella eminens (Hall)			x				*					
Rhipidomella emarginata (Hall)	Md.					*	*		*	*		
Schizophoria multistriata (Hall)			x	x								*
Stropheodonta varistriata (Conrad)	x	x				*	*		*			*
Stropheodonta crebristriata (Conrad)					S.G.				*			
Stropheodonta (Leptostrophia) beckei (Hall)			x	x	OR.	*	*	*		*	*	*
					Md.							
S. (Leptostrophia) magnifica (Hall)					OR.					*	*	
S. (Leptostrophia) oriskania Clarke					OR.					*		
S. (Brachyprion) schuchertana Clarke					OR.							*
S. (Brachyprion) major Clarke					OR.							*
Strophonella leavenworthana (Hall)		Md.	x								*	
Schuchertella woolworthana (Hall)		Md.	x	x		*	*	*	*	*	*	
Schuchertella radiatus (Vanuxem)			x									*
Plectambonites transversalis (Wahlenberg)	x								*			
Leptaenisca adnascens H. & C			x			*	*		*			
Anoplia helderbergiae Rowe			Md.				*		*			
Scenidium insigne (Hall)			x				*		*			
Chonostrophia jervensis Schuchert				x	OR.			*				
Gypidula (Sieberella) coeymanensis Schuchert		x	x			*	*				*	
G. (Sieberella) pseudogaleata (Hall)				x								*
Camarotoechia semiplicata (Conrad)		x									*	
Uncinulas vellicatus (Hall)			x	x							*	
Eatonia medialis (Vanuxem)			x	W.V.	OR.			*				

Rensselaeria marylandica Hall					OR.					*		
					Md.							
Atrypa nodostriata (Hall)	x								*			
Spirifer macropleurus (Conrad)		N.J.	x				*					
Spirifer concinnus Hall		N. J.	x	x						*		*
Cyrtina rostrata (Hall)				W.V.	OR.					*		
Rhynchospira globosa (Hall)	Md.		x			*	*		*		*	
Trematospira costata Hall			x				*		*			
Anoplotheca concava (Hall)			x	P.	OR.	*	*	*	*	*		
Meristella arcuata (Hall)			x	P.		*	*					
Meristella lentiformis Clarke					OR.					*		
Palaeopinna flabellum Hall					OR.						*	
Actinopteria textilis (Hall)			x		OR.		*				*	
					N. J.							
Actinopteria communis (Hall)	Md.	Md.	x		OR.			*				
Cypricardinia planulata (Conrad)					S.G.						*	
Pleurotomaria labrosa Hall			x	x							*	
Platyceras multisinuatum Hall			x			*	*					
Platyceras tenuiliratum Hall			x			*	*					
Platyceras spirale			x			*	*					
Platyceras lamellosum Hall			x						*			
Platyceras unguiforme Hall			x						*			
Diaphorostoma ventricosum (Conrad)			x	x	OR.				*			
Paltyostoma niagarense Hall	Md.								*	*		
Lophospira bilirata (Hall)			x								*	
Melissosoa compacta (Hall)		x										*
Euomphalus disjunctus Hall				x								*
Orthoceras pauciseptatum Hall			x				*					
Conularia huntiana Hall			x			*						
Conularia lata Hall					OR.						*	
Tentaculites aculus Hall			x		OR.		*					
Tentaculites gyracanthus (Eaton)	x								*			
Cordania cyclurus (H. & C.)			x								*	
Dicranurus hamatus Conrad		x	x						*			
Dalmanites pleuroptyx (Green)		x	x			*	*		*	*		
Dalmanites micrurus (Green)		x	x									*
Kloedenia manliusensis (Weller)	N. J.											*

TABLE NO. 4—Continued.

Species not represented in the observed fauna of the Bailey limestone in the Little Saline Creek area, Mo., but that occur in the N. Y.-N. J.-Md. region.	N. Y.-N. J.-Md. area.					Tennessee			Oklahoma.		Gaspe, Quebec.	Dalhousie, N. B.
	Below	Coeymans	New Scotland	Becraft	Above	Olive Hill formation	Birdsong shale	Decaturville chert	Haragan shale	Bois d'Arc limestone	St. Alban beds	Dalhousie formation
Kloedenia sussexensis (Weller)	Md.											*
Kloedenella halli (Jones)	Md.	Md.										*
Kloedenella pennsylvanica (Jones)	Md.											*
Totals						18	41	7	23	14	17	19

N. Y.-N. J.-Md. area =New York, New Jersey, Maryland, West Virginia and Pennsylvania.

x =Occurs in New York (occurrence given for New York only unless not present, in which case it is stated for Maryland; if not present in Maryland, it is given for New Jersey, Pennsylvania or West Virginia).

Md., N. J., P., W. V. =Occurs in Maryland, New Jersey, Pennsylvania, West Virginia.

OR. =Occurs in the Oriskany of New York.

SG. =Occurs in the Schoharie grit of New York.

On. =Occurs in the Onondaga of New York.

OR. Md., OR. N. J. =Occurs in the Oriskany of Maryland, of New Jersey.

* =Present in the fauna.

TABLE NO. 5.

Number of determined species.		Tennessee.			Oklahoma.		Gaspe, Quebec.	Dalhousie, N. B.
		Olive Hill formation	Birdsong shale	Decatur-ville chert	Haragan shale	Bois d'Arc limestone	St. Alban beds	Dalhousie formation
That are not restricted to the state or region		43	69	17	49	32	27	31
That occur in the N. Y.-N. J.-Md. area		39	65	17	45	30	27	27
That occur in New York		38	61	17	42	26	27	23
That occur in the Bailey limestone in the Little Saline Creek area, Mo.		25	28	10	24	17	10	8
Not in the Bailey limestone in the Little Saline Creek region, Mo., but that occur in the N. Y.-N. J.-Md. area		18	41	7	23	14	17	19
Not in the Bailey limestone in the Little Saline creek area, Mo., but that occur in New York.	Total	17	37	7	20	10	17	15
	Below the Coeymans	1	2	0	4	0	0	2
	In the Coeymans	3	3	0	3	1	2	3
	In the New Scotland	16	35	6	15	6	12	7
	In the Becraft	2	2	3	2	3	4	5
	Above the Becraft	1	3	4	3	5	4	3
	Not below the Oriskany	0	0	0	1	4	4	3
	Confined to the Coeymans	0	0	0	0	0	1	1
	Confined to the New Scotland	12	28	1	10	1	7	3
	Confined to the Becraft	0	0	0	0	0	0	2
	Confined to the Coeymans and New Scotland	2	2	0	2	1	1	1
	Confined to the New Scotland and Becraft	2	2	2	1	3	4	3

DESCRIPTION OF SPECIES.

Porifera

Class SPONGIAE

Order Lithistida, Suborder Eutaxicladina

Genus Hindia Duncan

Hindia fibrosa (Roemer)[1]

Plate 40, figures 1-4

Clamopora fibrosa F. Roemer (not Goldfuss), 1860, Sil. Fauna des Westl. Tenn., p. 20, pl. II, fig. 2.

Astylospongia inornata Hall, 1863, 16th Ann. Rept. N. Y. State Cab. Nat. Hist., p. 70.

Hindia sphaeroidalis Duncan, 1879, Ann. & Mag. Nat. Hist., ser. V, vol. IV, p. 84, pl. IX.

Hindia fibrosa Hinde, 1883, Cat. Foss. Sponges Brit. Mus., p. 57, pl. XIII, fig. 1.

Hindia sphaeroidalis Rauff, 1894, Palaeospongiologie, pt. 1, p. 335, pls. 15-17, figs. 1-4.[2]

Hindia sphaeroidalis Girty, 1899, U. S. Geol. Surv., 19th Ann. Rept., pt. III, p. 552.

Hindia fibrosa Weller, 1903, Pal. N. J., vol. III, p. 297, pl. XXXII, figs. 1, 2.

Hindia fibrosa Clarke, 1908, N. Y. State Mus., mem. 9, pt. 1, p. 116.

Hindia fibrosa Clarke, 1909, N. Y. State Mus., mem. 9, pt. 2, p. 50.

Hindia sphaeroidalis Swartz, 1913, Md. Geol. Surv., L. Dev., p. 195, pl. XVII, figs. 1-4.

Description—"Spherical, consisting of minute spicules uniting to form a series of delicate, straight canals which radiate from the center of the sponge and increase by bifurcation. The canals open upon the surface by polygonal orifices. The minute structure of this species was worked out by Rauff, and subsequently discussed critically by Hinde, Ulrich and Girty.

"Rauff showed that it consists of spicules, each of which bears 4 rays which diverge from a common center. Three of the rays are stout, slightly curved, concave on the inner side denticulate on the outer side and have expanded denticulate extremities. The fourth ray is small and directed towards the exterior. It is often abortive. The whole structure consists of superimposed series of these spicules. The manner in which they unite to form the cancals is illustrated diagrammatically in fig. 3 [p. 196]. Three spicules, whose centers form the angles of the cell, lie on one level while three alternating spicules, whose centers are dotted in the diagram, lie at a slightly higher level in the structure, their rays descending obliquely upon the rays of the first set, the third layer repeating the first, etc. In this manner walls are built up around the canals which are perforated by openings, placing the interior of the adjacent canals in communication. The form of an individual spicule and the manner in which it articulates with its neighbors is shown in fig. 4 [p. 196] while the manner in which they unite to form the walls of the canal is shown in fig. 5 [p. 197]. Excellently preserved specimens showing the inner structure are found at Keyser, West Virginia.

"Position of the genus has been much discussed. Steinmann regarded it as a form of Favosites. Rauff determined its true character, showing that it is a sponge and regarded it as one of the siliceous sponges.

"Diameter of spheres, 25 mm. or at times a little greater. They are frequently somewhat distorted by compression."—Swartz, 1913.

Dimensions—Mean diameter of sponges 7.8 to about 48 mm.

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[1] *See* Clarke, J. M., N. Y. State Mus., Mem. 9, pt. 2, pp 50-51, 1909.

[2] For additional references through 1895, *see* Md. Geol. Surv., L. Dev., p. 195.

COELENTERATA

Class ANTHOZOA

Subclass Tetracoralla

Family Zaphrentidae

Genus Streptelasma Hall

Streptelasma strictum Hall

Plate 40, figures 5-11

Streptelasma (Petraia) stricta Hall, 1874, 26th Ann. Rept. N. Y. State Mus. Nat. Hist., p. 114.
Streptelasma stricta Hall, 1879, 32nd Ann. Rept. N. Y. State Mus. Nat. Hist., p. 142.
Streptelasma strictum Hall, 1883, Rept. State Geol. N. Y. for 1882, pl. I, figs. 1-10.
Streptelasma strictum Hall, 1887, Pal. N. Y., vol. VI, p. 1, pl. I, figs. 1-10.
Streptelasma strictum Girty, 1895, 48th Ann. Rept. N. Y. State Mus. Nat. Hist., vol. II p. 300.
Enterolasma strictum Simpson, 1900, N. Y. State Mus., Bull. 39, p. 203, figs. 11, 12 (p. 204).
Streptelasma strictum Weller, 1903, Pal. N. J., vol. III, p. 298, pl. XXXIII, figs. 3, 4.
Enterolasma (Streptelasma) strictum Shimer, 1905, N. Y. State Mus., Bull. 80, p. 235.
Streptelasma strictum Swartz, 1913, Md. Geol. Surv., L. Dev., p. 198, pl. XVII, figs. 5-9.

Description—"Corallum simple, conical, very gradually and regularly enlarging; straight or very slightly curved, except at the apex, which is sometimes more abruptly bent. Exterior marked with strong undulations of growth and numerous fine concentric striae; external rays very prominent, from forty-five to fifty at a point where the diameter of the corallum is 15 mm.; the increase in number taking place usually at three distinct points, but sometimes at only two

"Calix deep, sides thin and nearly erect; a flat space at the bottom In one calix, having a diameter of 20 mm , there are fifty-four lamellae; alternate lamellae extending only a short distance from the walls at the base of the calix and frequently coalescing with the primary lamellae. For some distance below the calix-margin the lamellae are of the same size, their edges smooth and rounded, becoming sharp below, and their sides often distinctly granulose or spinulose. The primary lamellae unite and coalesce at the center of the calix, forming an indistinct plate or vesiculose core from 3 to 5 mm. in diameter. Fossette obscure or obsolete."—Hall, 1887.

Dimensions—Figured specimens indicate range in size of coralla.

Subclass Tabulata

Family Favositidae

Genus Favosites Lamarck

Favosites helderbergiae Hall

Plate 40, figures 12-17; plate 41, figure 1

Favosites helderbergiae Hall, 1874, 26th Ann. Rept. N. Y. State Mus. Nat. Hist., p. 111.
Favosites helderbergiae Hall, 1879, 32nd Ann. Rept. N. Y. State Mus. Nat. Hist., p. 145.
Favosites helderbergiae Hall, 1883, Rept. State Geol. N. Y. for 1882, pl. IV, figs. 1, 2; pl. V, figs. 1-3; pl. VI, figs. 1-8.
Favosites helderbergiae Hall, 1887, Pal. N. Y., vol. VI, p. 8, pl. IV, figs. 1, 2; pl. V, figs. 1-3; pl. VI, figs. 1-8.

Favosites helderbergiae Girty, 1895, 48th Ann: Rept. N. Y. State Mus. Nat. Hist., vol. II, pl. 302.
Favosites helderbergiae Weller, 1903, Pal. N. J., vol. III, p. 270.
Favosites helderbergiae Shimer, 1905, N. Y. State Mus., Bull. 80, p. 235.
Favosites helderbergiae Clarke, 1908, N. Y. State Mus., mem. 9, pt. 1, pp. 113, 218.
Favosites helderbergiae Clarke, 1909, N. Y. State Mus., mem. 9, pt. 2, p. 49.
Favosites helderbergiae Grabau and Shimer, 1909, N. Am. Index Foss., vol. I, p. 85, fig. 138.
Favosites helderbergiae Swartz, 1913, Md. Geol. Surv., L. Dev., p. 208, pl. XXII, fig. 1.

Description—"Corallum consisting of large, lenticular, depressed convex or hemispherical masses; base covered by a strongly wrinkled epitheca. Cell tubes polygonal; their inner surface showing evidence of a few strong longitudinal striae. Septa frequent, from ten to fifteen in the space of 10 mm.; thickness equal to that of the cell walls. Mural pores in one or two ranges, comparatively large, circular, with margins distinctly elevated. Cell walls thin, but frequently much thickened near the surface by silicification, and sometimes granulose or spinulose on the inner face. On some specimens the cells, at the surface, are nearly equal, having a diameter of about 1.5 mm.; on other specimens the diameter varies from .66 mm. to 1.5 mm.

"On many specimens some of the cell tubes are larger and less angular than those surrounding them, being a little more than 2 mm. in diameter. A single specimen from Coeymans Landing has slightly larger tubes on one portion, while on all the other parts the cells have the ordinary characters."—Hall, 1887.

Dimensions—Figured specimens indicate variation in size of coralla. Range in greatest internal diameter of corallites of the various specimens about 0.25 to 2.25 mm.; maximum range for any one specimen 0.7 to 2.25 mm.

Remarks—The specimens represent coralla of various shapes.

Hall figures a specimen of *F. helderbergiae* from New York "which differs from the prevailing specimens in having numerous and somewhat regularly distributed larger cells which are subcircular at their apertures."[1] This character prevails among the Missouri specimens.

The arrangement of the tabulae is accurately determinable only on portions of two of the specimens. The disposition of the mural pores is accurately determinable, and the septal spines are observable (to the unaided eye) on portions of all of the specimens. Two of the specimens show epitheca.

Favosites conicus Hall

Plate 41, figures 2-7

Favosites conica Hall, 1874, 26th Ann. Rept. N. Y. State Mus. Nat. Hist., p. 112.
Favosites conica Hall 1879, 32nd Ann. Rept. N. Y. State Mus. Nat. Hist., p. 146.
Favosites conicus Hall, 1883, Rept. State Geol. N. Y. for 1882, pl. III, figs. 4, 6-13
Favosites conicus Hall, 1887, Pal. N. Y., vol. VI, p. 9, pl. III, figs. 4, 6-13.
Favosites conicus Girty, 1895, 48th Ann. Rept. N. Y. State Mus. Nat. Hist., vol. II, p. 302.
Favosites conicus Girty, 1899, U. S. Geol. Surv., 19th Ann. Rept., pt. III, p. 560.
Favosites conicus Swartz, 1913, Md. Geol. Surv., L. Dev., p. 212, pl. XXIII, figs. 5-7.

Description—"Corallum forming conical masses; flattened at the base, which is covered by a strong epitheca, marked with concentric wrinkles and undulations and radiating undulations formed by the cell tubes. Cells arising from the center of the base and from an undefined central axis and quite abruptly curving to the surface, increasing by interstitial additions; polygonal, from four to eight-sided; diameter at the surface varying from 1.5 to 3.5 mm.; walls comparatively strong; interior with evidences of numerous spinules or small nodes. Tabulae of about the same strength as the walls,

[1]Pal. N. Y., vol. VI, pl. VI, fig. 1, 1887.

irregularly arranged, varying from eight to fifteen in the space of 10 mm. Mural pores comparatively large, circular, with distinctly elevated margins, disposed in one, two and sometimes three ranges. Where one or two ranges occur the pores are regularly arranged one above the other; where three ranges occur the disposition is more irregular."—Hall, 1887.

Dimensions—Variation in size of coralla indicated by specimens figured. Range in greatest internal diameter of corallites of the various specimens and maximum range for any one specimen 0.8 to 3.5 mm.

Remarks—The arrangement of the tabulae is accurately determinable on portions of part of the specimens. The disposition of the mural pores is accurately determinable, and the septal spines are observable (to the unaided eye) on portions of all of the specimens. Epitheca is shown on all of the specimens.

Genus Striatopora Hall

Striatopora missouriensis Meek and Worthen?

Plate 42, figures 1-4

Striatopora missouriensis Meek and Worthen, 1868, Ill. Geol. Surv., vol. III, pl. 369, pl. 7, fig. 4.

Striatopora missouriensis Keyes, 1894, Mo. Geol. Surv., vol. IV, pt. I, p. 121.

Description—"Corallum slender, ramose; branches cylindrical; cells obliquely ascending from an imaginary axis, rather distantly separated, slender and rounded within, but enlarging and curving outwards to the surface, where they terminate in comparatively large, transversely oval, or subrhombic mouths, alternately arranged, and directed more or less obliquely upwards, with a sharp, rather prominent lip below; striae distinct, ascending from each cell, and continued up the upper side of the enlarged opening, to the lower margins of the succeeding openings above.

"Length unknown; diameter of an imperfect branch, about 0.20 inch."—Meek and Worthen, 1868.

Remarks—Meek and Worthen's figure of *S. missouriensis* is too poor to permit more than doubtful reference of the material at hand to this species from the *Helderbergian* of Missouri. The specimens might be assigned to *S. issa* Hall[1].

A description of the material at hand follows: Corallum ramose, composed of closely united corallites (whose orifices are polygonal and unequal in diameter) which ascend obliquely from axis, rapidly increase in size, and end obliquely upon surface. Calyces funnel-shaped, sides marked by prominent longitidinal ridges that produce crenulation of thin calyx-edges, walls pierced by comparatively large mural pores.

Mean diameter of branches 6.5 to 15.0 mm. Range in greatest diameter of corallites of the various specimens, and maximum range for any one specimen 1.0 to 4.0 mm.

The specimens differ from *S. bella* Swartz in that the calyces narrow more rapidly downward and the calyx-ridges are more prominent.

Striatopora bella Swartz

Plate 42, figures 5-8

Striatopora bella Swartz, 1913, Md. Geol. Surv., L. Dev., p. 215, pl. XXV, figs. 1, 2.

Description—"Corallum branching, dendroid, consisting of closely united prismatic corallites which ascend along axis and then bend abruptly, terminating obliquely upon surface; corallites quite unequal in diameter, more or less irregular in cross-section. Calyx funnel-shaped, its base formed by a broad, flat tabula, its sides striated by twelve low ridges, its edges thin and slightly crenulated by the termination of the ridges. Walls of calyx perforated by large scattered pores. An occasional pore is seen to pierce the tabulae in the single specimen observed.

[1]26th Ann. Rept. N. Y. State Mus. Nat. Hist., p. 114, 1874.

"Diameter of corallum 5 to 10 mm. Diameter of orifices varying with maturity of corallite from 1 to 2.5 mm.

"This species differs from *S. issa* Hall in its less conical calyx with less prominent furrows. It differs from *S. cavernosa* Rom. which has more funnel-like calyces with obtuse edges."—Swartz, 1913.

Dimensions—Mean diameter of branches 6.5 to about 13.5 mm. Range in greatest diameter of corallites of the various specimens, and maximum range for any one specimen 0.8 to 3.5 mm.

Genus Pleurodictyum Goldfuss

Pleurodictyum lenticulare (Hall) ?

Plate 42, figure 9

Michelinia lenticularis Hall, 1874, 26th Ann. Rept. N. Y. State Mus. Nat. Hist. p. 113.
Michelinia lenticularis Hall, 1879, 32nd Ann. Rept. N. Y. State Mus. Nat. Hist. p. 145.
Michelinia lenticularis Hall, 1883, Rept. State Geol. N. Y. for 1882, pl. III, figs. 1-3, 5.
Michelinia lenticularis Hall, 1887, Pal. N. Y., vol. VI, p. 7, pl. III, figs. 1-3, 5.
Pleurodictyum lenticulare Beecher, 1891, Trans. Conn., Acad. vol. VIII, p. 207.
Pleurodictyum lenticulare Girty, 1895, 48th Ann. Rept. N. Y. State Mus. Nat. Hist., vol. II, p. 305.
Pleurodictyum lenticulare Swartz, 1913, Md. Geol. Surv., L. Dev., p. 218, pl. XXVI, fig. 1.

Description—"Corallum forming small lenticular bodies, the lower surface usually the less convex and covered with a strongly wrinkled epitheca. Cells large and few, usually from seven to twelve; broadly campanulate. Partition walls about 1 mm. thick; strongly marked longitudinally by nodose striations; denticulate on the margins. The number of striations and denticulations varies with the size of the cell.

"In a characteristic specimen 20 mm. in diameter, there are eight cells, the central one having a diameter of 11 mm., and the peripheral cells measuring from 6 to 8 mm. across. The entire height of this specimen is 9 mm.

"[*Remarks*]—This is a very small species, seldom attaining a diameter, of more than 25 mm., and is distinguished by its large cells and their strongly granulose-striate character. A small individual 10 mm. in diameter shows one large central cell and six smaller ones around the margin, also an incipient seventh cell. Occasionally there are two central cells in large individuals, and the number of peripheral cells in such specimens is from ten to twelve."—Hall, 1887.

Dimensions—Diameter of corallum undeterminable.

Remarks—On a fragment of rock are two detached groups of corallites which probably are parts of one corallum; one group shows portions of nine corallites, the other of four corallites. The nature of the base of the corallum represented is undeterminable.

ECHINODERMATA

Class CRINOIDEA

Order Camerata

Family Melocrinidae

Genus Scyphocrinus Zenker

Scyphocrinus sp.

Plate 42, figure 10; plate 43, figures 1-6

Description—This genus is represented by several parts of calyces and root-bulbs that are provisionally regarded as of a single species.[1]

[1]The "inflated or bulbous root" of *Scyphocrinus* was described as *Camarocrinus* by Hall and as *Lobolithus* by Barrande. *See* von Zittel's Text-book of Pal., vol. I, pp. 160 and 190, 1913.

Dimensions—Specimens figured indicate range in size of calyces. Greatest transverse diameter of root-bulbs about 35 to about 130 mm.

Order Inadunata

Suborder Fistulata

Family Poteriocrinidae

Genus Alsopocrinus n. g.

Description—Dorsal cup obconic. Infrabasals three, affected by disk-like depression for reception of column. Radials with straight facet and transverse ridge. Radianal rests upon one face of posterior basal and one face of right posterior basal. Anal unknown, in line with radials. Tegmen, arms and column unknown.

Remarks—This genus and the following species are founded upon a single, incomplete dorsal cup.

The character of the facet, and the transverse ridge is determinable only on the anterior, right anterior, and left posterior radials.

Alsopocrinus anna n. sp.

Plate 44, figures 4-6

Description—Dorsal cup obconic. Infrabasals three, affected by disk-like depression for reception of column, extend beyond periphery of column; two pentagonal, with truncate distal margins; one that lies in part below posterior basal and in part below right posterior basal smaller, quadrangular, with angular distal margin. Basals, posterior and right posterior ones hexagonal, others pentagonal. Radials with straight facet and transverse ridge,[1] four pentagonal, shape of right posterior one unknown. Radianal rests upon one face of posterior basal and one face of right posterior basal. Anal unknown, in line with radials. Tegmen, arms and column unknown.

Dimensions—Dorsal cup: Height 6.0 mm., proximal diameter 3.25 mm., distal diameter about 8.0 mm.

Remarks—The shape of the anal, radianal, and right posterior radial are undeterminable because the anal is missing, and the radianal and right posterior radial are incomplete.

Genus Edriocrinus Hall

Edriocrinus ? sp.

Plate 44, figures 1-3

Description—A portion of a calyx is doubtfully referred to this genus.

MOLLUSCOIDEA

Class BRYOZOA

Order Cyclostomata

Suborder Ceramoporoidea

Family Fistuliporidae

Genus Fistulipora M'Coy

Fistulipora ? sp.

Plate 44, figure 7

Description—A silicified portion of a zoarium is doubtfully referred to this genus.

[1]*See* remarks under *Alsopocrinus* n. g.

Order Cryptostomata

Family Fenestellidae

Genus Fenestella Lonsdale

Fenestella ? sp.

Plate 44, figure 8

Description—The specimen is a silicified fragment of a zoarium which shows only the non-celluliferous surface.

CLASS BRACHIOPODA[1]

Order Neotremata

Superfamily Craniacea

Family Craniidae

Genus Crania Betzius

Crania alsopi n. sp.

Plate 44, figures 9-11

Description—Dorsal valve prominently elevated; surface ornamented with radiating costae, that increase toward margin, crossed by concentric growth lines. One specimen with diameter of about 7 mm. has about 112 radiating costae at margin.

Remarks—The relation between the diameter of the dorsal valve and the number of radiating costae is determinable on but one of the two specimens (attached to a specimen of *Meristella atoka*) observed.

Order Protremata

Sub Orthacea

Family Orthidae

Genus Dalmanella Hall and Clarke

Dalmanella planoconvexa (Hall)

Plate 44, figures 12-17

Orthis planoconvexa Hall, 1859, Pal. N. Y., vol. III, p. 168, pl. XII, figs. 1-6, 1861.
Dalmanella planoconvexa Hall and Clarke, 1892, Pal. N. Y., vol. VIII, pt. I, pp. 207, 224.
Dalmanella planoconvexa Clarke, 1909, N. Y. State Mus., mem. 9, pt. 2, p. 145.
Dalmanella planiconvexa Schuchert, 1913, Md. Geol. Surv., L. Dev., p. 298, pl. LIV, figs. 1-6.

Description—"Shell plano-convex; outline somewhat circular or transversely oval; length and breadth about as ten to twelve. Dorsal valve nearly flat, slightly prominent near the beak on either side of the faint central depression, and quite flat towards the margins. Ventral valve convex, sometimes scarcely subangular towards the beak; greatest convexity a little above the middle of the shell, and thence sloping uniformly to the lateral and basal margins; beak small, acute, incurved. Area linear, its length

[1]For each species, the range in size of the shells is indicated by the figured specimens.

greater than half the width of the shell. Striae fasciculate, much curved upwards towards the cardinal and lateral margins.

"[*Remarks*] * * * * * *

" * In the dorsal valve the lamellae bordering the muscular areas which diverge abruptly, and then becoming almost obsolete, curve so as to enclose a broad oval space with a depressed line through the center * * In the ventral valve the lamellae are broadly divergent and, becoming gradually obsolete, are nearly lost and leave scarcely an impression in the cast. The imprint of the adductor muscles forms a small scar towards the upper part of the vascular area

* * * * * * * Hall 1859.

Dalmanella perelegans (Hall)

Plate 44, figures 18-26

Orthis perelegans Hall, 1857,10th Ann. Rept. N. Y. State Cab. Nat. Hist. p. 44, fig. 1.
Orthis perelegans Hall, 1859, Pal. N. Y., vol. III p. 171, pl. XIII, figs. 4-12, 1861.
Orthis perelegans Hall, 1883, Rept. State Geol. N. Y. for 1882, pl. XXXV figs. 32, 33.
Dalmanella perelegans Hall and Clarke, 1892, Pal. N. Y., vol. VIII, pt. I, pp. 207, 224, pl. VC, figs. 34, 35.
Dalmanella perelegans Clarke, 1900, N. Y. State Mus., mem. 3, p. 57.
Dalmanella perelegans Weller, 1903, Pal. N. J., vol. III, pp. 305, 327, pl. XXXV, figs. 5-8.
Dalmanella perelegans Shimer, 1905, N. Y. State Mus., Bull. 80, p. 243.
Dalmanella perelegans Schuchert, 1913, Md. Geol. Surv., L. Dev., p. 299, pl. LIV, figs. 14-23.
Dalmanella perelegans Dunbar, 1919, Tenn. Geol. Surv., Bull. 21, pl. 2, fig. 9.

Description—"Shell transversely oval; valves nearly equally convex. Dorsal valve subventricose, more or less depressed along the middle from near the beak to the front; beak small little elevated above the hinge line. Ventral valve elevated along the middle from the beak towards the front and sloping laterally; beak small, pointed, incurved, extending beyond that of the opposite valve. Cardinal margin generally sloping a little from the beaks, and rounding imperceptibly into the lateral margins. Area narrow, nearly half as long as the width of the shell. Foramen broad triangular, extending nearly to the apex of the beak. Surface marked by fine irregular bifurcating longitudinal striae, crossed by concentric lines of growth.

"[*Remarks*] * * . The ventral valve, although strongly elevated in the centre towards the beak, is not subcarinate * * and this gibbosity is lost before reaching the base. Along the middle of the dorsal valve there is a broad undefined depression, which is more conspicuous in the upper part, from the beak half way to the base; below which point, it becomes scarcely marked as a distinguishing character of the shell * * . The striae of this species are often fasciculate; the stronger ones separated by three, four, five or six smaller ones * *

* * * * * * * —Hall, 1859.

Dalmanella quadrans (Hall)

Plate 44, figures 27-31

Orthis quadrans Hall, 1859, Pal. N. Y., vol. III, p. 170, pl. XII, figs. 9-12, 1861.
Dalmanella quadrans Hall and Clarke, 1892, Pal. N. Y., vol. VIII, pt. I, p. 224.

Description—Shell subquadrangular, valves unequally convex, anterior border emarginate, anterior line of junction of valves sinuate. Ventral valve more convex than dorsal valve, most convex in middle, with prominent mesial elevation from beak nearly, or quite, to anterior margin; beak conspicuous, incurved. Cardinal area about $\frac{2}{3}$ width of shell, delthyrium comparatively large. Dorsal valve with pronounced mesial depression from beak to anterior margin; beak inconspicuous, incurved. Surface ornamented with radiating, bifurcating, fasciculate costae—4 to 5 in 1 mm. at anterior border—crossed by concentric growth lines.

Family Rhipidomellidae

Genus Rhipidomella Oehlert

Rhipidomella oblata (Hall)

Plate 44, figures 32, 33; plate 45, figures 1-8

Orthis oblata Hall, 1857, 10th Ann. Rept. N. Y. State Cab. Nat. Hist., p. 41, figs. 1-5
Orthis oblata Hall, 1859, Pal. N. Y., vol. III, p. 162, pl. X, figs. 1-17, 19-22, 1861.
Orthis oblata Whitfield, 1882, Geol. Wis., vol. IV, p. 320, pl. 25, figs. 1, 2.
Rhipidomella oblata Hall and Clarke, 1892, Pal. N. J., vol. VIII, pt. I, pp. 210, 225, pl. VIa, figs. 3, 4.
Rhipidomella oblata Girty, 1899, U. S. Geol. Surv., 19th Ann. Rept., pt. III, p. 562, pl. LXX, fig. 3a.
Rhipidomella oblata Clarke, 1900, N. Y. State Mus., mem. 3, p. 58, pl. 8, figs. 14, 15.
Rhipidomella oblata Weller, 1903, Pal. N. J., vol. III, pp. 304, 350, pl. XXXV, figs. 9-13; pl. XLVI, figs. 5-7.
Rhipidomella oblata Shimer, 1905, N. Y. State Mus., Bull. 80, p. 244.
Rhipidomella oblata Schuchert, 1913, Md. Geol. Surv., L. Dev., p. 303, pl. LV, figs. 9-16
Rhipidomella oblata Dunbar, 1919, Tenn. Geol. Surv., Bull. 21, pl. I, fig. 1.

Description—"Shell in the young state longitudinally subovate, and varying from circular to transversely oval in its stages of growth, resupinate. Ventral valve convex at the beak, flattened in the middle, and concave towards the front. Dorsal valve very convex in the middle and towards the beak; beaks of the two valves nearly equally elevated; that of the ventral valve pointed; area very small; foramen large. Surface finely striated; striae frequently bifurcating and curving towards the lateral and cardinal margins, concentrically marked by finer striae and stronger lines of growth, which are numerous in the older shells.

"Internally the ventral valve is marked by a large foliate vascular impression; impressions of the adductor muscles rarely well preserved, except in the casts. Teeth prominent, and, when entire, rounded and thickened at their extremities. Dorsal valve with a prominent cardinal process and divergent brachial lamellae; a central ridge, more or less prominent, extends from beneath the beak to near the base.

"[*Remarks*] * * The ventral valve is marked by a broad undefined depression down the centre, making the entire valve broadly concave from a little below the beak, and producing a sinuous outline in front. The dorsal valve maintains a generally uniform convexity, its greatest height being towards the beak.

"In young and half-grown shells the length and height are nearly equal, while in older specimens the proportions of length and breadth are often as three to four * * * * * * * * * * —Hall, 1859.

Remarks—In the case of the observed specimens, either the convexity of the dorsal valve is uninterrupted, or the valve is slightly flattened, medially, from the beak to the anterior margin.

Rhipidomella discus (Hall)

Plate 45, figures 9-16

Orthis discus Hall, 1859, Pal. N. Y., vol. III, p. 165, pl. Xa, figs. 7-12, 1861.
Rhipidomella discus Hall and Clarke, 1892, Pal. N. Y., vol. VIII, pt. I, pp. 210, 225.

Description—"Shell circular; valves moderately and nearly equally convex. Dorsal valve flattened or slightly depressed in the centre near the beak, the depression becoming broader and undefined below the middle of the shell. Ventral valve regularly convex, becoming flattened towards the lateral and basal margins, sometimes a little elevated in the middle. Area narrow; length equal to or greater than half the width of the shell.

Foramen large, usually filled with the trifid cardinal process. Surface finely striated; striae somewhat in fascicles, abruptly bending upwards towards the hinge line. Ventral valve with a small vascular impression."—Hall, 1859.

Rhipidomella ellsworthi n. sp.

Plate 45, figures 17-39,

Orthis hybrida? Meek and Worthen, 1868, Ill. Geol. Surv., vol. III, p. 371, pl. 7, figs. 7a-d.

Description—Shell subquadrangular to transversely suboval in outline, valves about equally convex, anterior border uninterrupted to emarginate, anterior line of junction of valves straight to sinuate. Dorsal valve marked, medially, from beak to front by a distinct, rounded depression flanked on each side by a distinct, rounded ridge; beak inconspicuous, incurved. Ventral valve most convex posterior to middle; either marked, medially, from beak toward, or to, anterior margin by an indistinct, rounded ridge bordered on each side by an indistinct, rounded depression—ridge corresponds in position with depression in dorsal valve, and depressions correspond with ridges on dorsal valve, or marked, medially, from anterior margin posteriorly by a shallow depression whose width at anterior margin approximates distance between apices of ridges of dorsal valve at anterior border; beak prominent, incurved. Length of cardinal area half to less than half width of shell, delthyrium comparatively large. Surface ornamented by radiating costae—3 to 4 in 1 mm. at anterior border—that increase by bifurcation, crossed by concentric growth lines.

Remarks—This species most closely resembles *R. discus* (Hall).

Meek and Worthen's material was obtained from the Bailey limestone at Bailey's Landing, Perry County, Missouri.

Rhipidomella melvillei n. sp.

Plate 46, figures 1-17

Description—Shell subpentagonal in outline, valves about equally convex, anterior line of junction of valves straight to sinuate. Ventral valve most convex posterior to middle; convexity of valve uninterrupted, or valve flattened, or shallowly depressed, medially, from anterior margin posteriorly; beak prominent, incurved over that of dorsal valve. Dorsal valve flattened, or shallowly depressed, medially, from beak toward, or to, anterior margin; beak inconspicuous, incurved. Cardinal area equal to or greater than half width of shell, delthyrium relatively large. Surface marked by radiating costae—4 in 1 mm. at anterior margin—that increase by bifurcation, crossed by concentric lines of growth.

Remarks—This species is quite distinct.

Genus Bilobites Linn

Bilobites varica (Conrad)

Plate 46, figures 18-25

Delthyris bilobata Conrad (not *Orthis bilobata* Sowerby), 1838, 2nd Ann. Rept. N. Y. Geol. Surv., pp. 112, 118.

Delthyris varica Conrad, 1842, Jour. Acad. Nat. Sci., Philadelphia, vol. VIII, p. 262, pl., 14 fig. 20.

Orthis varica, Hall 1859, Pal. N. Y., vol. III, p. 179, pl. XXIV, figs. 1a-i, k, 1861.

Orthis (Dicoelosia) varica Hall, 1883, Rept. State Geol. N. Y. for 1882, pl. XXXV, figs. 38-40.

Bilobites varicus Beecher, 1891, Am. Jour. Sci., 3rd ser., vol. XLII, p. 52, pl. I, figs. 3-27.

Bilobites varcius Hall and Clarke, 1892, Pal. N. Y., vol. VIII, pt. I, pp. 204, 205, 223, pl. Vb figs. 15-19.

Bilobites varica Weller 1903, Pal. N. J., vol. III, p. 306, pl. XXXV, figs. 14-18.

Bilobites varicus Dunbar, 1919, Tenn. Geol. Surv., Bull. 21, pl. 2, fig. 4.

Description—"Shell subcordiform ventricose, deeply bilobed at the base, with a deep sulcus upon each valve reaching to the beaks; hinge line short. Area common to both valves; that of the ventral valve higher. Foramen high and narrow. Ventral valve acuate, ventricose on each side of the sinus. Dorsal valve gibbous on each side the mesial sinus; each lobe becoming angular towards the beak, and compressed toward the cardinal extremities. Surface unequally striated; a few distant striae being visible to the naked eye, while under a lens the interspaces are seen to be distinctly striated. Fine concentric striae cross the radiating striae, and become conspicuous towards the base of the shell."—Hall, 1859.

Superfamily Strophomenacea

Family Strophomenidae

Genus Leptaena Dalman

Leptaena rhomboidalis (Wilckens)

Plate 46, figures 26-32

Conchita rhomboidalis Wilckens, 1769, Nachricht von selten Versteinerungen, p. 77 pl. VIII, figs. 43, 44.

Strophomena rugosa Hall, 1859, Pal. N. Y. vol. III, p. 195, pl. XIX, figs. 1a-y, 1861.

Leptaena rhomboidalis Hall and Clarke, 1892, Pal. N. Y., vol. VIII, pt. I p. 279, pl. VIII figs. 17-31; pl. XVa, figs. 40-42; pl. XX, figs. 21-24.

Plectambonites rhomboidalis Keyes, 1894, Mo. Geol. Surv., vol. V, p. 70, pl. XXXIX, fig. 6.[1]

Leptaena rhomboidalis Girty, 1899, U. S. Geol. Surv., 19th Ann. Rept., pt. III, p. 563.

Leptaena rhomboidalis Clarke, 1900, N. Y. State Mus., mem. 3, p. 57.

Leptaena rhomboidalis Weller, 1903, Pal. N. J., vol. III, pp. 278, 302, pl. XXVII, fig. 9 pl. XXXIII, fig. 10.

Leptaena rhomboidalis Shimer, 1905, N. Y. State Mus., Bull. 80, p. 240.

Leptaena rhomboidalis Clarke, 1908. N. Y. State Mus., mem. 9, pt. 1, pp. 111, 116, 183, pl. 34, figs. 1-3.

Leptaena rhomboidalis Clarke, 1909, N. Y. State Mus., mem. 9, pt. 2, pp. 45, 122, pl. 10, figs. 1-6.

Laptaena rhomboidalis Maynard, 1913, Md. Geol. Surv., L. Dev., p. 308, pl. LVI, figs. 13-17.

Laptaena rhomboidalis Dunbar, 1919, Tenn. Geol. Surv., Bull. 21, pl. 2, fig. 17.

Description—"Shell varying from semioval to semicircular. Hinge line equalling or greater than the width of the shell below; cardinal extremities often much extended. Dorsal valve flat or slightly concave in the upper part, and abruptly curving or inflated towards the front; beak prominent, perforate at its apex, and filling a deep sinus in the opposite valve. Ventral valve slightly convex or nearly flat in its upper part, and sometimes even concave; convex upon the umbo, often perforate near the beak; abruptly deflected or geniculate towards the front; cardinal area narrow, linear, partially occupying both valves. Foramen of the ventral valve a broad, shallow sinus, which is filled by the prominent cardinal process of the opposite valve, the latter being perforate or

[1]For complete bibliography to 1897, *see* Schuchert, C., U. S. Geol. Surv., Bull 87 p 240, 1897.

deeply grooved for the passage of a pedicle. Surface marked by regular, rounded, radiating striae, which increase by bifurcation and interstitial addition; the upper part of the valves marked by strong concentric wrinkles which do not extend below the abrupt bending of the valves.

"The interior of the shell is striato-punctate, or sometimes simply punctate. The muscular areas of the ventral valve are strong, more or less deeply bilobed, and limited by the extension of the dental lamellae. The interior of the dorsal valve is strongly marked by the muscular impressions; the dental process perforate near its outer surface, or deeply grooved; and there is often a deep cavity below this, extending towards the beak.

"[*Remarks*]—This shell exhibits much variety of form, being sometimes nearly flat or but slightly curved near the margin; and the corrugations are variable in number and strength. In very old shells they are often not as prominent as in younger ones, or those of medium size. The area, as usually exposed, is subject to much variation, and not unfrequently the valves are so closed as to leave no visible area. The beak of the dorsal valve, either at or just within its extremity, shows a rounded perforation or groove; and the beak of the opposite valve is marked by a rounded, shallow groove, which, extending downwards, often ends in a perforation both in young and old shells. Sometimes the groove only is visible, the perforation having doubtless once existed, but subsequently closed. In some specimens there is a simple indentation on the beak"—Hall 1859.

Genus Stropheodonta Hall

Stropheodonta arata (Hall)

Plate 46, figures 33-35

Strophodonta varistriata var. *arata* Hall, 1859, Pal. N. Y., vol. III, p. 183, pl. XVIII, figs. 1a-i, 1861.

Strophodonta varistriata var. *arata* Hall, 1883, Rept. State Geol. N. Y. for 1882, pl. XLIV, figs. 17, 18.

Stropheodonta varistriata var. *arata* Hall and Clarke, 1892, Pal. N. Y., vol. VIII, pt. I, pl. XIII, figs. 17, 18.

Stropheodonta varistriata var. *arata* Weller, 1903, Pal. N. J., vol. III, p. 275, pl. XXVII, fig. 3.

Stropheodonta varistriata var. *arata* Shimer, 1905, N. Y. State Mus., Bull. 80, p. 241.

Stropheodonta arata Schuchert, 1913, Md. Geol. Surv., L. Dev., p. 311, pl. LVII, figs. 7-10.

Description—"Shell semi-elliptical, with the cardinal extremities more or less salient; hinge crenulate. Dorsal valve more or less concave. Ventral valve varying from moderately convex to very gibbous, and sometimes geniculate towards the front. Area narrow. Foramen none, or a narrow elevation or callosity in place of it. Surface marked by very prominent sharp angular ridges and intermediate fine undulating striae, which cover also the slopes of the ridges. Sometimes a few short wrinkles mark the spaces between the ridges, along the cardinal margin towards the hinge extremities."—Hall, 1859.

Stropheodonta (*Leptostrophia*) *planulata* (Hall)

Plate 46, figures 36-38; plate 47, figures 1, 2

Strophodonta planulata Hall, 1859, Pal. N. Y., vol. III, p. 184, pl. XVI, figs. 9-12, 1861.

Stropheodonta planulata Schuchert, 1897, U. S. Geol. Surv., Bull. 87, p. 426.

Stropheodonta planulata Weller, 1903, Pal. N. J., vol. III, p. 276, pl. XXVII, figs. 1, 2.

Stropheodonta (*Leptostrophia*) *planulata* Schuchert, 1913, Md. Geol. Surv., L. Dev., p. 315, pl. LVII, figs. 14-16.

Description—"Shell semi-elliptical, width nearly one-half the length, plano-convex; hinge line greater than the width of the shell below; the cardinal extremities often salient. Dorsal valve flat. Ventral valve uniformly and very slightly convex, sometimes flattened towards the margins; beak scarcely elevated above the hinge line. Area linear. Foramen unknown. Surface finely and evenly striated; striae of the dorsal valve often flattened. Radiating striae crossed by fine closely arranged concentric striae, and sometimes with a few inconspicuous laminae of growth, and towards the cardinal extremities by a few wrinkles or undulations.

"*[Remarks]* * * * The striae are fine, equal or subequal, gently undulating, and increasing both by bifurcation and interstitial addition. A very slight exfoliation obliterates the concentric striae. The surface, when very slightly weathered, presents numerous punctures arranged in lines parallel with the striae; and these punctures are often visible upon the fresh unworn surface * * *

—Hall, 1859.

Genus Strophoneila Hall

Strophonella punctulifera (Conrad)

Plate 47, figures 3-6

Leaptaena punctulifera Conrad, 1838, 2nd Rept. N. Y. Geol. Surv., pp. 112, 117.
Strophomena punctulifera Vanuxem, 1842, Geol. N. Y., Rept. 3rd Dist., p. 122, fig. 5.
Strophomena (Strophodonta) punctulifera Hall, 1857, 10th Ann. Rept. N. Y. State Cab. Nat. Hist., p. 50, fig. 1.
Strophodonta cavumbona Hall, 1857, 10th Ann. Rept. N. Y. State Cab. Nat. Hist., p. 51.
Strophomena punctulifera Rogers, 1858, Geol. Penn., vol. II, pt. II, p. 825, fig. 648.
Strophodonta punctulifera Hall, 1859, Pal. N. Y., vol. III, p. 188, pl. XXI, figs. 4a, b;, pl. XXIII, figs. 4 a-c, 5c, 7e, 1861.
Strophodonta cavumboña Hall, 1859, Pal. N. Y., vol. III. pl. 187, pl. XXI, figs. 1-3, 1861.
Strophomena punctulifera Billings, 1863, Proc. Portland Soc. Nat. Hist., p. 108, pl. 3, fig. 2.
Strophomena punctulifera Billings, 1863, Geol. Canada, p. 957, fig. 448.
Strophomena punctulifera Billings, 1874, Pal. Fossils, vol. II, p. 31, pl. 3, fig. 2.
Strophonella punctulifera Hall, 1879, 28th Ann. Rept. N. Y. State Mus. Nat. Hist., p. 154.
Strophonella punctulifera Hall, 1883, Rept. State Geol. N. Y. for 1882, pl. XLIII, figs. 10-12.
Strophodonta punctulifera Walcott, 1884, U. S. Geol. Surv., Mon. VIII, p. 121, pl. 13, fig. 10.
Strophonella punctulifera Hall and Clarke, 1892, Pal. N. Y., vol. VIII, pt. I, p. 292, pl. XII, figs. 10-12.
Strophonella cavumbona Hall and Clarke, 1892, Pal. N. Y., vol. VIII, pt. I, pp. 291, 292.
Strophonella punctulifera Weller, 1903, Pal. N. J., vol. III, pp. 277, 301, pl. XXVII, figs. 6-8; pl. XXXIII, fig. 9.
Strophonella punctulifera Shimer, 1905, N. Y. State Mus., Bull. 80, p. 242.
Strophonella punctulifera Clarke, 1908, N. Y. State Mus., Mem. 9, pt. 1, p. 111, pl. 37, figs. 10, 11.
Strophonella punctulifera Clarke, 1909, N. Y. State Mus., Mem. 9, pt. 2, p. 45, pl. 9, figs. 16-18.
Strophonella punctulifera Schuchert, 1913, Md. Geol. Surv., L. Dev., p. 323, pl. LIX, figs. 8-10.

Description—"Shell subsemicircular, about four-fifths as long as wide. Ventral valve concave; beak not projecting beyond the hinge. Dorsal valve concave near the umbo, very convex near the middle; beak not elevated above the cardinal margin; sides somewhat contracted below the extremities of the hinge. Hinge line straight, nearly

or quite equalling the greatest width of the shell, finely crenulated. Area narrow, lineal, vertically striated. Foramen nearly closed, with a narrow prominent callosity along the centre. Surface marked by strong sharp striae, which increase by bifurcation and interstitial addition, becoming rapidly more numerous and finer towards the margins, and are distinctly punctate in the best preserved specimens.

"[*Remarks*] * * * * * * * *

" * * The striae, even in those scarcely exfoliated, are marked by one or two rows of elevated pustules, which are punctate at their extremities, and appear to be the bases of small tubular spines. This character, however, is very variable, and in some specimens obscure upon the surface of the shell, while it becomes conspicuous on the exfoliate specimens, and the casts are strongly punctate, while the interior of the shell is distinctly pustulose. * * * * * * *

* * * * * * * * * —Hall, 1859.

Genus Leptaenisca Beecher

Leptaenisca concava (Hall)

Plate 47, figures 7-16

Leptaena concava Hall, 1857, 10th Ann. Rept. N. Y. State Cab. Nat. Hist., p. 47.

Leptaena concava Hall, 1859, Pal. N. Y., vol. III, p. 197, pl. XVIII, figs. 2 a-f, 1861.

Leptaena? (subgenus?) concava Hall, 1883, Rept. State Geol. N. Y. for 1882, pl. XLVI, figs. 30, 31.

Leptaenisca concava Beecher, 1890, Am. Jour. Sci., 3rd ser., vol. XL, p. 238, pl. 9, figs. 1-5.

Leptaenisca concava Hall and Clarke, 1892, Pal. N. Y., vol. VIII, pt. I, p. 300, pl. XV, figs. 30, 31; pl. XVa, figs. 19-21.

Leptaenisca concava Clarke, 1909, N. Y. State Mus., Mem. 9, pt. 2, p. 46, pl. 10, figs. 7-11.

Leptaenisca concava Schuchert, 1913, Md. Geol. Surv., L. Dev., p. 310, pl. LVII, figs. 2-5.

Description—"Shell concavo-convex, hemispherical. Ventral valve regularly convex; umbonial region prominent; cardinal margin rounding from the beak towards the lateral extremities. Dorsal valve deeply concave. Hinge line less than the greatest width of the shell. Area of ventral valve broad, that of dorsal valve linear. Foramen triangular, nearly closed above by a thick callosity, the lower part occupied by the prominent cardinal process of the opposite valve. Surface marked by very fine close radiating striae, each fifth or sixth one a little more prominent than those between; crossed by fine regular concentric wrinkles, producing a beautiful subcancellate appearance."—Hall, 1859.

Remarks—The relative width of the hinge line is determinable on but three of the eleven specimens observed. These have their greatest width along the hinge line. The ventral valves of the observed specimens are either flattened or depressed, medially, from the cicatrix to the anterior margin. The radiating and concentric costae which ornament the shells are wavy.

Hall and Clarke figure two ventral valves of *L. concava* from New York whose greatest width is along the hinge line.[1]

Clarke says: "When Beecher described the genus Leptaenisca there was but one species known, the *L. concava* of the Helderbergian. We subsequently described as additional species from the same fauna two smaller forms, *L. adnascens* and *L. tangens* which then seemed to differ from the larger both in form, surface sculpture and degree of attachment or size of cicatrix. We have before us in the Dalhousie fauna shells which at maturity present the characters of *L. concava*; their deeply convex and concave shells, with a cicatrix well developed, the form arched but frequently distorted in growth and

[1]Pal. N. Y., vol. VIII, pt. I, pl. XV, figs. 30, 31, 1892.

some of these present a median flattening or sinus pretty well defined on the earlier portions of the ventral valves though this disappears in later growth. This median depression is one of the differentials of the smaller species *L. tangens* and *L. adnascens* and may indicate the possibility that the latter represent miniature conditions of *L. concava*. The presence of *Leptaenisca concava* in these beds is our first knowledge of the occurrence of the genus outside of the early Devonic of New York. The species are rare members of the Helderbergian fauna. At Dalhousie the shells are quite abundant."[1]

Schuchert figures a ventral valve from Maryland which is depressed medially, and whose hinge line is less than the greatest width of the valve.[2]

Superfamily Pentameracea

Family Porambonitidae

Genus Anastrophia Hall

Anastrophia verneuili (Hall)

Plate 47, figures 17-21; plate 48, figures 1-9

Atrypa lacunosa Vanuxem (not Sowerby), 1842, Geol. N. Y., Rept. 3rd Dist., p. 117, fig. 3 and p. 119.

Pentamerus verneuili Hall, 1857, 10th Ann. Rept. N. Y. State Cab. Nat. Hist., p. 104, figs. 1, 2.

Pentamerus verneuili Hall, 1859, Pal. N. Y., vol. III, p. 260, pl. XLVIII, figs. 1 a-i, k-p, r-v, x, y, 1861.

Pentamerus verneuili Billings, 1863, Geol. Canada, p. 957, fig. 453.

Anastrophia verneuili Miller, 1889, N. Am. Geol., Pal., p. 334.

Anastrophia verneuili Hall and Clarke, 1893, Pal. N. Y., vol. VIII, pt. II, pp. 224, 225, pl. LXIII, figs. 31-38; pl. LXXXIV, figs. 43, 44, 1894.

Anastrophia verneuili Girty, 1899, U. S. Geol. Surv., 19th Ann. Rept., pt. III, p. 565.

Anastrophia verneuili Dunbar, 1919, Tenn. Geol. Surv., Bull. 21, pl. 2, fig. 14.

Description—"Shell subglobose; transverse diameter generally greater than the height. Ventral valve nearly circular or transversely elliptical, more depressed than the opposite, having a distinct sinus, commencing near the beak and regularly widening and deepening to the front, where it terminates in a short truncated extension fitting into a corresponding depression in the front of the other valve; beak shorter than the opposite, perforated by a triangular or subcircular foramen, which is generally covered by the strongly gibbous incurved beak of the other valve. Dorsal valve very much elevated; beak extremely gibbous or ventricose, and strongly incurved. Surface marked by from twenty-four to thirty sharply angular elevated plications, which increase by interstitial addition and bifurcation; from four to six of the plications on the ventral valve usually occupy the sinus; while from five to eight of those on the dorsal valve are very slightly elevated, so as to form a flat rather indistinct mesial fold.

"*[Remarks]* * * The larger valve is the dorsal, and bears the two internal septa; while the smaller valve, or that with the sinus, is the ventral valve, having the triangular cavity beneath the beak, with a perforation at the extremity, and the dental lamellae are produced into the elongated cavity * * and which, from the thickening of the valve, is often affixed to the shell at its base without the intervention of the usual septum, which, when present, is a very subordinate feature. The dental lamellae are lobed on the outside * * leaving a space for the interlocking of the septa or brachial lamellae of the opposite valve. The dorsal valve is marked by two converging septa, which extend scarcely more than one-third of the length of the shell, and terminate in a thickened ridge in the deepest part of the valve. From these

[1]N. Y. State Mus., Mem. 9, pt. 2, p. 46, 1909.

[2]Md. Geol. Surv., L. Dev., pl. LVII, fig. 5, 1913.

laminae or septa, near their junction with the hinge line, originate two broad thin brachial plates * * * * * * * * * *

* * * * * * * * * *

"In the young shells of this species, the dorsal valve is abruptly incurved; the beak of the ventral valve is nearly as high as the opposite, and has beneath it a distinct triangular foramen and an apparent area * * As the shell grows older, the beak of the opposite valve fills the foramen; and the notch in the beak is carried farther inwards as the shell thickens, so that in old shells the beak presents a somewhat circular perforation, which communicates below with the triangular cavity.

"In extremely young shells, there is no appearance of mesial sinus or elevation."—Hall, 1859.

Family Pentameridae

Genus Gypidula Hall

Gypidula multicostata Dunbar

Plate 48, figures 10-19

Gypidula multicostata Dunbar, 1919, Tenn. Geol. Surv., Bull. 21, pl. 2, fig. 22.

Gypidula multicostata Dunbar, 1920, Trans. Conn. Acad. Arts and Sciences, vol. 23, p. 131, pl. III, figs. 12, 13.

Description—"Shell subtrigonal in outline. Ventral valve strongly convex and much larger than the dorsal. Its beak narrow and strongly arched, but not incurved over that of the opposite valve. The sides diverge regularly to their greatest width at about three-fourths to four-fifths the distance to the front of the shell, then round abruptly into the broad and very slightly emarginate anterior margin, so that the outline is almost an isosceles triangle. Dorsal valve transversely elliptical and gently convex. A broad but low flat fold occupies the median half of the ventral valve, becoming obsolete before reaching the beak, and a corresponding sinus is present on the dorsal valve. The fold and sinus bear each ten to twelve slender, sharp, angular plications separated by angular grooves of equal width, while the inner part of each lateral slope is marked by four or five obscure plications, of which the outer is the most indistinct. Beyond these, the lateral slopes are smooth. The spondylium in the ventral valve is similar to that of *G. coeymanensis*, but considerable variation may be noted in the development of the median septum which supports it. In some specimens the septum is strong and in a few entirely absent.

"*Dimensions*—Length, 40 mm.; width, 40 mm.; thickness, about 25 mm.

"*Discussion*—The species is readily distinguished from all other described ones by the large number and slenderness of its plications. It is most closely related to *G. coeymanensis*, but that species has fewer and much coarser plications and reaches its greatest width nearer its mid-length."—Dunbar, 1920.

Remarks—A description of the Missouri specimens follows:

Shell subtriangular in outline, anterior border emarginate, anterior line of junction of valves sinuate. Ventral valve more convex than dorsal valve, elevated medially from anterior margin posteriorly; beak prominent, incurved over that of dorsal valve. Dorsal valve depressed medially from anterior margin posteriorly; beak incurved, fills delthyrium. Surface ornamented with radiating plications that become less prominent on valves laterally, increase by bifurcation, and the more conspicuous of which extend almost, if not quite, to beaks, crossed by concentric growth lines. Medial elevation of ventral valve has 7 to 12 plications; medial sinus of dorsal valve has 7 to at least 9 plications.

Order Telotremata

Superfamily Rhynchonellacea

Family Rhynchonellidae

Genus Rhynchotrema Hall

Rhynchotrema formosa (Hall)

Plate 48, figures 20-22

Rhynchonella formosa Hall, 1857, 10th Ann. Rept. N. Y. State Cab. Nat. Hist., p. 76, figs. 1-5.

Rhynchonella formosa Hall, 1859, Pal. N. Y., vol. III, p. 236, pl. XXXV, figs. 6 a-i, k-p, r-u, x, y, 1861.

Stenocisma formosa Hall, 1867, Pal. N. Y., vol. IV, pt. I, p. 334.

Stenochisma formosa Hall and Clarke, 1893, Pal. N. Y., vol. VIII, pt. II, pp. 187-189; pl. LVI, figs. 41-45, 1894.

Rhynchotrema formosum Schuchert, 1897, U. S. Geol. Surv., Bull. 87, p. 369

Stenochisma formosa Shimer, 1905, N. Y. State Mus., Bull. 80, p. 245.

Stenochisma formosa Maynard, 1913, Md. Geol. Surv., L. Dev., p. 349, pl. LXII, figs. 25-29.

Description—"Shell subtriangular or transversely oval; lateral margins forming an angle at the beak of about 90 degrees to 110 degrees. Ventral valve somewhat more depressed than the opposite; beak prominent, arched, not strongly incurved. Dorsal valve larger, declining with a gentle curve towards the margins; beak incurved. Surface marked by twenty to twenty-four simple angular plications on each valve, from two to four of which in the middle are coarser and depressed in the ventral valve, having a corresponding number abruptly elevated upon the dorsal valve; concentrically marked by fine closely arranged striae."—Hall, 1859.

Remarks—But one specimen has been observed.

Genus Eatonia Hall

Eatonia singularis (Vanuxem)

Plate 49, figures 1, 2

Atrypa singularis Vanuxem, 1842, Geol. N. Y., Rept. 3rd Dist., p. 120, fig. 3.

Eatonia singularis Hall, 1859, Pal. N. Y. vol. III p. 243, pl. XXXVIII, figs. 14, 15 a, b, 16 a-c, 17 a-d, 18, 19 a, b, 20, 1861.

Eatonia singularis Hall and Clarke, 1893, Pal. N. Y., vol. VIII, pt. II, p. 206, pl. LXI, figs. 13-16, 1894.

Eatonis singularis Weller, 1903, Pal. N. J., vol. III, p. 311, pl. XXXVI, figs. 24-27.

Eatonia singularis Shimer, 1905, N. Y. State. Mus., Bull. 80, p. 245.

Eatonia singularis Schuchert, 1913, Md. Geol. Surv., L. Dev., p. 371, pl. LXV, figs. 21, 22.

Description—"Shell wider than long, varying in form from ovate to transversely elliptical or rhomboidal; hinge line very slightly declining from the beaks. Ventral valve depressed convex in the middle towards the beak, and concave between the centre and the deflected margins; and below the middle, extended into a deep broad sinus, which is prolonged and turned upwards in front at right angles to the longitudinal direction of the shell; beak small, closely incurved. Dorsal valve convex, sometimes gibbous, and sloping abruptly to the margins; having a strong mesial fold beginning above the centre, and produced in a broad flattened and greatly elevated extension. Surface marked by fine radiating striae, which, in well-preserved specimens, are

crossed by much finer concentric striae; a single central one, and sometimes two or three of the striae upon the mesial sinus, are much stronger than the others; and there is sometimes an impressed line down the centre of the dorsal valve.

"[*Remarks*]—The inner margins of the shell are denticulate, but this character is not shown in well-preserved specimens; it is seen in the casts, and upon the edges of the shell when worn from the exterior."—Hall, 1859.

Remarks—Only one specimen has been observed.

Genus Uncinulus Bayle

Uncinulus nucleolatus (Hall)

Plate 49, figures 3-16

Rhynchonella nucleolata Hall, 1857 (in part), 10th Ann. Rept. N. Y. State Cab. Nat. Hist., p. 68.

Rhynchonella nucleolata Hall, 1859 (in part), Pal. N. Y., vol. III, p. 227, pl. XXXI, figs. 2 f-i, k-p, r-u, x, y, (not figs. 1 a-c= *U. globulus*, 1 d-f and 2 a-e= *U. globulus*), 1861.

Rhynchonella nucleolata Billings, 1863, Proc. Portland Soc. Nat. Hist., p. 110, pl. 3, fig. 5.

Uncinulus nucleolata Hall and Clarke, 1893, Pal. N. Y., vol. VIII, pt. II, p. 199.

Uncinulus nucleolatus Girty, 1899, U. S. Geol. Surv., 19th Ann. Rept., pt. III, p. 564.

Uncinulus nucleolatus Weller, 1903, Pal. N. J., vol. III, p. 284, pl. XXIX, figs. 6-9.

Uncinulus nucleolatus Shimer, 1905, N. Y. State Mus., Bull. 80, p. 245.

Uncinulus nucleolatus Schuchert, 1913, Md. Geol. Surv., L. Dev., p. 365, pl. LXIV, figs. 16, 17.

Description—"Shell varying from spherical to spheroid-pentagonal ['this refers to the forms * * * * taken out and named *U. globulus*'[1]] or subpentagonal. Ventral valve convex or depressed convex, abruptly deflected towards the margins; beak small, depressed, closely incurved over that of the opposite valve, often subangular on its lateral margins. Dorsal valve larger, sometimes very gibbous, often a little depressed towards the beak; beak never prominent. Surface marked by fifteen to twenty-three simple rounded plications, about four or five of which are slightly elevated towards the front of the dorsal valve into a mesial prominence, and three to five depressed on the ventral valve, so as to form a more or less distinct sinus, which never extends beyond the middle of the shell. These depressions are prolonged in front into a more distinct linguiform extension fitting into a corresponding sinus in the front of the opposite valve, and sometimes curved inwards beyond the plane of a right angle with the back of the valve,"—Hall, 1859.

Remarks—The specimens at hand have from about 20 to about 34 plications on each valve, from 4 to 6 plications on the fold, and from 3 to 5 plications in the sinus,

Uncinulus mutabilis (Hall)

Plate 49, figures 17-22

Rhynchonella mutabilis Hall, 1857, 10th Ann. Rept. N. Y. State Cab. Nat. Hist., p. 66, figs. 1-7.

Rhynchonella mutabilis Hall, 1859, Pal. N. Y., vol. III, p. 225, pl. XXIX, figs. 4 a-p; pl. XXX, figs. 1 a-e, 2 a-i, k-p, r, s, 1861.

Uncinulus mutabilis Hall and Clarke, 1893, Pal. N. Y., vol. VIII, pt. II, p. 199, pl. LVIII, figs. 22-25, 1894.

Uncinulus mutabilis Weller, 1903, Pal. N. J., vol. III, p. 283, pl. XXIX, figs. 1-5.

[1]Schuchert, C., Md. Geol. Surv., L. Dev., p. 365, 1913.

Uncinulus mutabilis Clarke, 1908, N. Y. State Mus., Mem. 9, pt. I, p. 171, pl. 28, figs. 3-8.

Description—"Shell varying from ovate to spherical. Ventral valve sometimes depressed, generally most convex in the umbonial region; beak small, pointed, closely incurved over that of the opposite valve. Dorsal valve gibbous; beak incurved beyond the hinge line; cardinal border on each side of the beak, concave. Surface marked by twenty to twenty-six depressed rounded simple plications, of which about six or eight are slightly raised towards the front of the dorsal valve into an indistinct mesial elevation; and five or six depressed near the front of the ventral valve, and extended into a short linguiform prolongation; concentrically marked by fine undulating striae.

"[*Remarks*]—The plications on this shell are usually simple, though in a few specimens one or two of them are seen to bifurcate * * * the plications in front and at the sides are marked with a central impressed line towards the margins of the valves.

"In form and general aspect this species varies greatly, being sometimes longitudinally ovate or oblong, in others globose and subpentagonal. The extremes of these varieties, without the intermediate forms, would appear to present well-marked specific differences; but a careful study of the series shows such an imperceptible gradation of form as to leave no doubt of their identity.

"The cast of the ventral valve shows a strongly marked ovate muscular imprint, the details of which, and of the accessory parts, vary in individuals of different forms and proportions."—Hall, 1859.

Remarks—The observed specimens have from about 23 to about 38 plications on each valve, from 3 to 6 plications on the fold, and from 2 to 5 plications in the sinus. The surface of the valves is marked with concentric lines.

Uncinulus subpyramidatus n. sp.

Plate 49, figures 23-34

Description—Shell small, globose-subpyramidal in form, transversely subelliptical in outline. The dimensions of a complete example are: Length 9.7 mm., width 11.2 mm., thickness 8.9 mm., width of sinus 4.7 mm.

Pedicle valve depressed convex in the umbonal region, the surface a little inflected to the cardinal margin, curving to the antero-lateral margins with an increasing convexity as it approaches the margin; mesial sinus originating anterior to the beak, becoming moderately deep anteriorly and produced in front in a long lingual extension lying in nearly a right angle to the plane of the valve; the beak small, incurved over that of the brachial valve. Surface of the valve marked by simple, rounded plication, which become faint towards the beak, about three to about eight occupy each lateral slope of the valve, and one or two the mesial sinus, grooved longitudinally along their median line as they approach the anterior margin.

Brachial valve depressed convex in the umbonal region, the surface curving with a strong convexity as it approaches the antero-lateral margins, the mesial fold originating at, or anterior to, the beak, becoming moderately elevated in front, and curving rather abruptly to the anterior margin. Surface marked by plications similar to those of the pedicle valve, about three to about eight on each lateral slope, and two or three upon the mesial fold, grooved longitudinaly.

Surface of both valves marked by concentric lines of growth.

Remarks—This little shell is less globular and more coarsely plicated than *U. globulus*.

It differs externally from the associated *Wilsonia wadei* in its less angular and more globose form, the margins of the valves not being abruptly deflected.

Genus Wilsonia Kayser

Wilsonia wadei Dunbar

Plate 49, figures 35-48; plate 50, figures 1-4

Wilsonia wadei Dunbar, 1919, Tenn. Geol. Surv., Bull. 21, pl. 2, fig. 8.
Wilsonia wadei Dunbar, 1920, Trans. Conn. Acad. Arts and Sciences, vol. 23, p. 133, pl. III, figs. 3, 4.

Description—"Shell small, subglobular or subpentahedral in form; deepest and strongly truncate at the front margin; length, breadth and height about equal. Ventral valve depressed convex, but sharply deflected, almost angulated along the margins; beak short and small, neatly incurved. A mesial sinus begins about the middle of the valve and is produced anteriorly into a narrow linguiform extension that is sharply deflected at right angles to the plane of the valve. Dorsal valve about as deep as the ventral, also gently convex and steeply angulated at the margins. A fold on the anterior portion corresponds to the sinus of the opposite valve. The surface bears low rounded plications, of which one occupies the sinus, two the fold, and three each lateral slope. Rarely in large specimens there are two plications on the sinus and three on the fold. The plications become obsolescent near the beak.

"Internally the hinge plate in the dorsal valve bears a crural cavity as in *Camarotoechia*, and the cardinal process is wanting.

"*Dimensions*—Length, 9 mm.; width, 9 mm.; height, 8.5 mm. Of a large specimen: 11 mm., 10.5 mm. and 9.2 mm., respectively."—Dunbar, 1920.

Remarks—The Missouri representatives have from about 4 to about 7 plications on each lateral slope of each valve, 2 or 3 plications on the fold, and 1 or 2 in the sinus.

Genus Rhynchonella Fischer

Rhynchonella transversa Hall

Plate 50, figures 5-20

Rhynchonella transversa Hall, 1857, 10th Ann. Rept. N. Y. State Cab. Nat. Hist., p. 74, figs. 5, 6.
Rhynchonella transversa Hall, 1859, Pal. N. Y., vol. III, p. 234, pl. XXXIV, figs. 9-16, 1861.
Rhynchonella transversa Weller, 1903, Pal. N. J., vol. III, p. 283, pl. XXIX, figs. 28-31.

Description—"Shell subtriangular, wider than long, tapering abruptly to the beak. Ventral valve depressed convex, most prominent near the beak; beak arched. Dorsal valve a little larger, most elevated near the front; beak incurved; foramen narrow, continued up to the apex of the beak. Surface ornamented by about fourteen or fifteen sharply elevated plications on each valve, of which from three to four are elevated near the front into a rather faint mesial fold, and two or three depressed on the ventral valve so as to form a faint sinus in the front. Somewhat strong zigzag lines of growth mark the surface of the valves near the margin in front."—Hall, 1859.

Remarks—The specimens at hand have from 12 to 17 plications on each valve, from 3 to 4 on the fold, and from 2 to 3 in the sinus.

Rhynchonella (?) *bialveata* Hall

Plate 50, figures 21-24

Rhynchonella ? bialveata Hall, 1857, 10th Ann. Rept. N.Y. State Cab. Nat. Hist., p. 73.
Rhynchonella ? bialveata Hall, 1859, Pal. N. Y., vol. III, p. 233, pl. XXXIV, figs. 1-4, 1861.
Rhynchonella bialveata Schuchert, 1897, U. S. Geol. Surv., Bull. 87, p. 355.

Rhynchonella bialveata Weller, 1903, Pal. N. J., vol. III, p. 327, pl. XLII, figs. 9, 10.
Rhynchonella (?) *bialveata* Schuchert, 1913, Md. Geol. Surv., L. Dev., p. 377, pl. LXVI, fig. 4.
Camarotoechia bialveata Dunbar, 1919, Tenn. Geol. Surv., Bull. 21, pl. 2, fig. 6.

Description—"Shell small, triangular or triangular-ovate, sometimes compressed. Valves nearly equally convex; beak of dorsal valve incurved; beak of ventral valve almost straight and subangular; foramen narrow triangular, and continued to the apex of the beak. Surface ornamented by from twelve to fourteen simple angular plications on each valve; the two central of which, on the dorsal valve, die out a little before reaching the beak, near which they are somewhat depressed, but towards the front they become slightly elevated above the others, so as to form an indistinct mesial prominence. The middle plication on the ventral valve is smaller than the others, and depressed near the front so as to produce a faint sinus, which extends about two-thirds of the way to the beak, at which point the valve is most convex. The two plications bordering the sinus are larger and more prominent than those on each side of them, and become obsolete before reaching the beak. A few faint imbricating lines of growth are visible near the junction of the valves in front."—Hall, 1859.

Superfamily Terebratulacea

Family Centronellidae

Genus Rensselaerina Dunbar

Rensselaerina medioplicata Dunbar

Plate 50, figures 25, 26

Rensselaerina medioplicata Dunbar, 1917, Am. Jour. Sci., vol. XLIII, pp. 466, 469, pl. II, figs. 1-9, 12-18.
Rensselaerina medioplicata Dunbar, 1919, Tenn. Geol. Surv., Bull. 21, pl. 2, figs. 12, 13.

Description—"Shell decidedly elongate oval, often nearly cylindrical, but otherwise having the general form of the later Rensselaerias, though always less broad-shouldered. Shell substance very finely punctate. Of the exterior surface, the posterior half and the lateral slopes of the shell are entirely smooth; but anteriorly the median portion of both valves bears a few simple, rounded, conspicuous plications which become obsolete about half-way to the beaks. The plications are separated by well-defined concave interspaces that are at least as wide as the plications themselves. There is no cardinal area and the cardinal and lateral slopes are rounded. The sides of the shell are not incurved as in *Beachia*, nor steeply angulated as is commonly the case in *Rensselaeria*. The minute beak of the dorsal valve is concealed by that of the ventral valve, which is strongly incurved and closely appressed; the pedicle foramen is minute and neither resorbed nor abraded through the umbo.

"The ventral interior differs from that of *Rensselaeria* in having very small vertical dental plates that do not attain the bottom of the valve, while the pedicle or rostral cavity between them is very deep and narrow. The muscle scar is limited to the posterior half of the shell. The diductor scars are elongate and slender. Between their more deeply impressed posterior portions are embraced the narrow imprints of the adductor muscles. The dorsal interior has a thick and conspicuous trangular hinge plate, supported by two thickened crural lamellae. This plate is highly variable. Most commonly it is thickened medially into a slight triangular elevation, the actual cardinal process * * on which are the scars of the cardinal muscles; but all gradations occur from such an elevation to a decided triangular pit * * for the insertion of these muscles, or to the other extreme where a distinct median process arises * * at the sides of which lie the muscle scars. This tendency toward elevation of the center of the hinge plate is in marked contrast with *Rensselaeria*,

wherein the plate is primitively flat but in later forms always has a depressed cardinal pit. As in most lower Devonian terebratulids, the hinge plate is transversed by a well defined visceral foramen, which, beginning dorsal of the anterior edge of the plate, emerges on its surface just below the beak. The adductor muscle scars are narrow, separate and distinctly impressed. * * * * * *
* * * * * * * * * * *

"Shell with the characters of the genus; length of a mature individual 24 mm., width 14 mm., thickness 11 mm. Six to eight plications on the middle of the ventral valve and one more on the dorsal. About three of these plications in a width of 5 mm., on the anterior margin. Hinge plate extremely variable, being in some specimens excavate, in others raised into a median process."—Dunbar, 1917.

Remarks—A single specimen has been observed.

Rensselaerina medioplicata var. latior Dunbar?

Plate 53, figures 21-24; plate 54, figures 1-4

Rensselaerina medioplicata var. *latior* Dunbar, 1917, Am. Jour. Sci., vol. XLIII, p. 469, pl. II, figs. 10, 11.

Description—" * * a shell like *R. medioplicata* but proportionally much broader and shorter, and with the plications finer and somewhat more restricted to the anterior part of the shell. The length of a fully grown specimen is 20 mm., breadth 16 mm., thickness 11 mm. There are four plications in about the width of three in *R. medioplicata*."—Dunbar, 1917.

Remarks—The specimens—more or less of the anterior portion of the shell is missing—show no trace of plications.

Superfamily Spiriferacea

Family Atrypidae

Genus Atrypina Hall and Clarke

Atrypina imbricata (Hall)

Plate 50, figures 27-29

Leptocoelia imbricata Hall, 1857, 10th Ann. Rept. N. Y. State Cab. Nat. Hist., p. 108.
Leptocoelia imbricata Hall, 1859, Pal. N. Y., vol. III, p. 246, pl. XXXVIII, figs. 8-13, 1861.
Leptocoelia imbricata Billings, 1863, Geol. Canada, p. 957, fig. 452.
Trematospira imbricata Hall, 1863, Trans. Albany Inst., vol. IV, p. 146.
Trematospira imbricata Hall, 1863, 16th Ann. Rept. N. Y. State Cab. Nat. Hist., p. 60.
Trematospira ? imbricata Meek and Worthen, 1868, Ill. Geol. Surv., vol. III, p. 381, pl. 7, figs. 2 a-e.
Atrypina imbricata Hall and Clarke, 1893, Pal. N. Y., vol. VIII, pt. II, p. 162, pl. LIII, figs. 5, 6, 8-10, 1894.
Trematospira imbricata ? Keyes, 1894, Mo. Geol. Surv., vol. V, p. 96.
Atrypina imbricata Weller, 1903, Pal. N. J., vol. III, p. 312, pl. XXXVII, figs. 17-22.
Atrypina imbricata Shimer, 1905, N. Y. State Mus., bull. 80, p. 246.
Atrypina imbricata Clarke, 1908, N. Y. State Mus., Mem. 9, pt. 1, p. 109.
Atrypina imbricata Schuchert, 1913, Md. Geol. Surv., L. Dev., p. 394, pl. LXVIII, figs. 4-6.
Atrypina imbricata Dunbar, 1919, Tenn. Geol. Surv., Bull. 21, pl. 2, fig. 2.

Description—"Shell longitudinally semi-elliptical or suborbicular. Ventral valve convex, most prominent along the middle, and sloping laterally; beak small, incurved at the apex and perforated by a very small round aperture, one side of which is formed

by the deltidium. Dorsal valve flattened or depressed convex; beak scarcely elevated above the hinge; hinge line sloping from the beaks at an angle of about 150 degrees, rounded at the extremities, nearly equal to the greatest width of the shell; false area narrow, much shorter than the hinge. Surface marked by ten to twelve plications on each valve, of which two on the middle of the ventral valve are larger and more elevated than the others, and separated by a wider and deeper depression than between those on each side. The central plication on the dorsal valve is larger than the others—near the front, but usually dies out before reaching the beak. Shell marked by strong imbricating concentric lamellae of growth."—Hall, 1859.

Remarks—The observed specimen has 6 plications on each valve. The depression between the two central plications of the ventral valve is narrower than the depressions that bound them. The central plication of the dorsal valve is depressed, is narrower than the plication on each side of it, and does not attain the beak of the valve.

Genus Atrypa Dalman

Atrypa reticularis (Linne)

Plate 50, figures 30-40

Anomia reticularis Linne, 1767, Systema Naturea, ed. XII, I, p. 1132.
Atrypa reticularis Hall, 1852, Pal. N. Y., vol. II, p. 72, pl. XXIII, fig. 8; p. 270, pl. LV, fig. 5.
Atrypa reticularis Hall, 1859, Pal. N. Y., vol. III, p. 253, pl. XLII, figs. 1 a-r, 1861.
Atrypa reticularis Keyes, 1894, Mo. Geol. Surv., vol. V, p. 97, pl. XLI, figs. 13a, b.[1]
Atrypa reticularis Girty, 1899, U. S. Geol. Surv., 19th Ann. Rept., pt. III, p. 565.
Atrypa reticularis Weller, 1903, Pal. N. J., vol. III, pp. 236, 286, pl. XXI, figs. 35-37; pl. XXX, figs. 11-18.
Atrypa reticularis Shimer, 1905, N. Y. State Mus., Bull. 80, p. 246.
Atrypa reticularis Clarke, 1908, N. Y. State Mus., Mem. 9, pt. 1, p. 109.
Atrypa reticularis Clarke, 1909, N. Y. State Mus., Mem. 9, pt. 2, pp. 42, 81.
Atrypa reticularis Maynard, 1913, Md. Geol. Surv., L. Dev., p. 392, pl. LXVII, figs. 26-28.

Description—"Shell subrotund, more or less compressed, subtruncated above or on the hinge line; valves more or less equal, the beak of the dorsal [ventral] valve extending beyond the ventral [dorsal] valve, and the latter being deeper and more convex in older specimens; surface marked by dichotomous rounded striae, which are crossed by concentric elevated lamellae, giving a reticulated or decussated character to the surface.

"It is impossible to give a definite description of this very protean species, which commences its existence in the Clinton group, and continues under various modifications through the succeeding strata as far as the Chemung group. In each of its geological positions, however, it presents peculiar characters, and we are able to decide at once the geological position of specimens, by these peculiarities. * * * * * * * * * * * * * * —Hall, 1852.

Remarks—The variations exhibited by the representatives at hand from the Missouri Helderberg are shown by the specimens figured.

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[1]See Schuchert, C., U. S. Geol. Surv., Bull. 87, pp. 154-155, 1897, for complete bibliography to 1897.

Family Spiriferidae

Genus Delthyris Dalman

Delthyris perlamellosus (Hall)

Plate 50, figures 41-49.

Spirifer perlamellosa Hall, 1857, 10th Ann. Rept. N. Y. State Cab. Nat. Hist., p. 57, figs. 1-5.

Delthyris macropleura Rogers (not Conrad), 1858, Geol. Penn., vol. II, pt. II, p. 825, fig. 643.

Spirifer perlamellosus Hall, 1859, Pal. N. Y., vol. III, p. 201, pl. XXVI, figs. 1a-i, k-p, r-t, 2a-g, 1861.[1]

Description—"Shell trigonal or semi-circular, more or less extended on the hinge line, the extremities varying from obtuse or rounded to extremely mucronate. Ventral valve arcuate, the beak much extended beyond the opposite valve, and incurved at the apex; sinus deep, gradually expanding, and produced in front into a linguiform extension. Dorsal valve convex towards the middle, the mesial elevation very prominent, and the beak closely incurved against the area, or partially closing the foramen of the ventral valve. Area moderately wide, frequently much expanded, and becoming linear towards the extremities when the shell is much extended. Surface marked by four to six strong and abruptly elevated plications on each side of the mesial sinus and elevation, concentrically marked by strong imbricating lamellae, which are abruptly arched in passing over the plications, giving an extreme roughness to the surface. In well-preserved specimens, finer longitudinal striae mark the surface of these lamellae. In ordinary specimens, the concentric lamellae are more closely arranged and more distinctly imbricate towards the margin; while near the beaks they are more distant, and are scarcely imbricate."—Hall, 1859.

Remarks—The Missouri specimens have 3 or 4 plications on each side of the medial fold and sinus.

Delthyris missouriensis n. sp.

Plate 51, figures 1-11

Description—This species differs from *D. perlamellosus* in that the ventral cardinal area is perpendicular, or nearly so, to the plane of junction of the valves and is relatively broader, and the beaks of the valves are of about equal height.

The plications on each side of the medial fold and sinus vary from 3 to at least 6.

Delthyris octocostatus (Hall)?

Plate 51, figures 28, 29

Spirifer octocostatus Hall, 1857, 10th Ann. Rept. N. Y. State Cab. Nat. Hist., p. 62.

Spirifer octocostatus Hall, 1859, Pal. N. Y., vol. III, p. 205, pl. XXVIII, figs. 4a-e, 1861.

Spirifer octocostatus Weller, 1903, Pal. N. J., vol. III, pl. 288, pl. XXX, figs. 5-8.

Spirifer octocostatus Maynard, 1913, Md. Geol. Surv., L. Dev., p. 401, pl. LXVIII, figs. 25-29.

Description—"Shell subglobose; valves nearly equally convex. Ventral valve most elevated near the beak; sinus angular, extending to the apex; beak slightly incurved. Dorsal valve most convex in the middle; mesial elevation not prominent; beak rising little above the hinge line, slightly incurved; hinge line less than the width of the shell, rounded at the extremities. Area triangular, faintly defined, somewhat arcuate. Foramen narrow; a strong medium septum dividing the muscular area, and extending to the apex of the foramen. Surface having about four rounded moderately prominent

[1]Partial bibliography.

folds on each side of the mesial sinus and elevation, which become obsolete towards the beaks; concentrically marked by fine, regular, closely arranged, imbricating lamellose striae."—Hall, 1859.

Remarks—A small individual which has 3 plications on each side of the fold and sinus is doubtfully referred to this species.

Genus Spirifer Sowerby

Spirifer cyclopterus Hall

Plate 51, figures 12-27

Spirifer cycloptera Hall, 1857, 10th Ann. Rept. N. Y. State Cab. Nat. Hist., p. 58.
Spirifer cyclopterus Hall, 1859, Pal. N. Y., vol. III, p. 199, pl. XXV, figs. 1a-z, 1861.
Spirifera cycloptera Billings, 1863, Geol. Canada, p. 957, fig. 457.
Spirifera cycloptera Billings, 1874, Pal. Fossils, vol. II, p. 48, pl. 3a, fig. 4.
Spirifera cycloptera Hall, 1883, 2nd Ann. Rept. N. Y. State Geol., pl. LXI, figs. 12, 13.
Spirifer cyclopterus Hall and Clarke, 1893, Pal. N. Y., vol. VIII, pt. II, p. 36, pl. XXXVI, figs. 12, 15, 1894.
Spirifer cyclopterus Girty, 1899, U. S. Geol. Surv., 19th Ann. Rept., pt. III, p. 565.
Spirifer cyclopterus Weller, 1903, Pal. N. J., vol. III, pp. 287, 314, pl. XXX, fig. 2; pl. XXXVIII, figs. 1-6.
Spirifer cyclopterus Clarke, 1908, N. Y. State Mus., Mem. 9, pt. 1, p. 178, pl. 32, figs. 14-21.
Spirifer cyclopterus Clarke, 1909, N. Y. State Mus., Mem. 9, pt. 2, p. 84.
Spirifer cyclopterus Schuchert, 1913, Md. Geol. Surv., L. Dev., p. 406, pl. LXIX, figs. 8-10.

Description—"Shell semi-circular; extremities of the hinge line more or less symmetrically rounded. Ventral valve gibbous; beak elevated, more or less incurved; sinus moderately deep, curved on the sides and nearly flat in the middle. Dorsal valve very convex towards the middle, the mesial fold abruptly elevated and very prominent; beak little elevated above the hinge line, and scarcely incurved. Area moderate, scarcely extending to the extremity of the hinge line. Foramen large. Surface marked by five to seven rounded plications on each side of the mesial line, concentrically marked by fine close imbricating lamellose striae, which are more or less prominent, depending on the condition of preservation in the shell; surface of lamellae ornamented by short fine vertical striae or crenulations, which project in fimbriae on the edge of the lamellae.

"[*Remarks*]—This species presents comparatively little variety in form; though there are, rarely, to be found individuals with the cardinal extremities much extended * * and others where the extremities are subangular * * * The greater number, however, are rounded * * *

" * * * The muscular impressions of the ventral valve are very deep and strong, the margins of the foramen terminating in prominent teeth. * *

—Hall, 1859.

Remarks—The Missouri specimens have the medial fold of the dorsal valve shallowly depressed medially from the anterior margin posteriorly; and have from 5 to at least 8 plications on each side of the medial fold and sinus.

Family Suessiidae

Genus Cyrtina Davidson

Cyrtina dalmani (Hall)

Plate 51, figures 30, 31; plate 52, figures 1-4

Cyrtia dalmani Hall, 1857, 10th Ann. Rept. N. Y. State Cab. Nat. Hist., p. 64.
Cyrtia dalmani Hall, 1859, Pal. N. Y., vol. III, p. 206, pl. XXIV, figs. 2a-y, 1861.

Cyrtina dalmani Meek and Worthen, 1868, Ill. Geol. Surv., vol. III, p. 383, pl. 7, figs. 3a, b.

Cyrtina dalmani Hall and Clarke, 1893, Pal. N. Y., vol. VIII, pt. II, p. 46.

Description—"Shell trigonal; valves extremely unequal. Ventral valve triangularly pyramidal. Dorsal valve semi-circular; mesial lobe flat, or with a slightly depressed line; beak scarcely defined, or rising above the hinge line. Hinge line straight. Area triangular, flat or slightly arcuate. Foramen narrow, linear, usually closed in the lower part, with a semitubular opening above; concentric labellae strong, and often very conspicuous near the margin. Surface granulose-punctate."—Hall, 1859.

Remarks—The observed specimens have 3 or 4 plications on each side of the medial fold and sinus.

Family Rhynchospiridae

Genus Rhynchospira Hall

Rhynchospira formosa Hall

Plate 52, figures 5-18

Waldheimia formosa Hall, 1857, 10th Ann. Rept. N. Y. State Cab. Nat. Hist., p. 88.

Trematospira formosa Hall, 1859, Pal. N. Y., vol. III, p. 215, pl. XXXVI, figs. 2a-i, k-p, r-u, 1861.

Rhynchospira formosa Hall, 1859, Pal. N. Y., vol. III, p. 485, pl. XCVa, figs. 7-11, 1861.

Rhynchospira formosa Hall, 1867, Pal. N. Y., vol. IV, pt. I, p. 278, figs. 1-6.

Retzia formosa Miller, 1889, N. Am. Geol., Pal., p. 366.

Retzia formosa Whitfield, 1891, Ann. N. Y. Acad. Sci., vol. V, p. 512, pl. 5, figs. 15, 16.

Rhynchospira formosa Hall and Clarke, 1893, Pal. N. Y., vol. VIII, pt. II, p. 109, fig. 101; pl. L, figs. 21-25, 1894.

Retzia formosa Whitfield, 1895, Geol. Ohio, vol. VII, p. 413, pl. I, figs. 15, 16.

Rhynchospira formosa Girty, 1899, U. S. Geol. Surv., 19th Ann. Rept., pt. III, p. 566.

Rhynchospira formosa Weller, 1903, Pal. N. J., vol. III, p. 289, pl. XXXI, figs. 9-11.

Rhynchospira formosa Clarke, 1908, N. Y. State Mus., Mem. 9, pt. 1, p. 109.

Rhynchospira formosa Maynard, 1913, Md. Geol. Surv., L. Dev., p. 246, pl. LXXII, figs. 26-30.

Description—"Shell longitudinally ovate. Ventral valve tapering towards the beak; beak prominent rounded, arched or incurved, truncated at the apex by a round perforation, one side of which is formed by the deltidium. Dorsal valve gibbous, sometimes most prominent near the umbo; beak closely incurved beneath the opposite one. Surface marked by eighteen to twenty-two or twenty-three simple rounded or rarely subangular plications, two or three of which are much smaller and slightly depressed on the middle of each valve, so as to form a faint narrow sinus extending nearly or quite to the apex of the beaks, and giving a slight emarginate outline to the front. Surface marked by fine imbricating concentric lines of growth, which become strong lamellae towards the margins of the shell; shell granulose."—Hall, 1859.

Remarks—The specimens at hand have from 16 to 23 plications on each valve.

Genus Trematospira Hall

Trematospira equistriata Hall and Clarke

Plate 52, figures 19, 20

Trematospira equistriata Hall and Clarke, 1894, Pal. N. Y., vol. VIII, pt. II, pl. XLIX, fig. 47.

Trematospira equistriata Schuchert, 1913, Md. Geol. Surv., L. Dev., p. 430, pl. LXXIII, figs. 8, 9.

Description—This species is represented by an incomplete shell whose surface is marked with regular, simple plications of which there are 6 in the sinus, and about 23 on each side of the sinus which is well-defined—the fold on the dorsal valve is indistinct.

Family Meristellidae

Genus Nucleospira Hall

Nucleospira ventricosa Hall

Plate 52, figures 21-33

Spirifer ventricosa Hall, 1857, 10th Ann. Rept. N. Y. State Cab. Nat. Hist., p. 57.
Nucleospira ventricosa Hall, 1859, Pal. N. Y., vol. III, p. 220, pl. XIV, figs. 1a-h; pl. XXVIIIb, figs. 2-9, 14, 1861.
Nucleospira ventricosa Hall and Clarke, 1893, Pal. N. Y., vol. VIII, pt. II, p. 145, figs. 128-130; pl. XLVIII, figs. 2-6, 18; pl. LXXXIV, figs. 39, 40, 1894.
Nucleospira ventricosa Weller, 1903, Pal. N. J., vol. III, pp. 290, 316, pl. XXX, figs. 19-22; pl. XXXVII, fig. 16.
Nucleospira ventricosa Shimer, 1905, N. Y. State Mus., Bull. 80, p. 255.
Nucleospira ventricosa Clarke, 1908, N. Y. State Mus., Mem. 9, pt. 1, p. 110.
Nucleospira ventricosa Schuchert, 1913, Md. Geol. Surv., L. Dev., p. 430, pl. LXXIII, figs. 10-12.

Description—"Shell globose; valves almost equally convex. Ventral valve having a narrow sinus extending down the centre from beak to base; beak projecting above the other, strongly incurved and pointed (in many specimens the beaks are nearly equal). Dorsal valve having a central depressed line, which is less conspicuous than in the opposite valve; false area very small, concave Surface marked by concentric lines of growth; and, when perfect, covered with minute hair-like spines, which, when removed, leave a punctate surface

"[*Remarks*]—The interior of the dorsal valve shows a faintly defined muscular area, a longitudinal septum, and prominent recurved cardinal process, with an accessory process on each side for the attachment of the spires. The ventral valve shows a longitudinal septum similar to that of the opposite valve, with a more or less strongly defined muscular depression; area, or false area, a concave triangular space, over which the acute beak is arched In well-preserved specimens, the beak appears to be minutely perforate upon the under side. Internal spires * * * * showing ten or twelve turns on each side. * —Hall, 1859.

Genus Meristella Hall

Meristella laevis (Vanuxem)

Plate 52, figures 34-44; plate 53, figures 1, 2

Atrypa laevis Vanuxem, 1842, Geol. N. Y., Rept. 3rd Dist., p. 120, fig. 2.
Merista laevis Hall, 1857, 10th Ann. Rept. N. Y. State Cab. Nat. Hist., p. 94, figs. 1-6.
Atrypa laevis Rogers, 1858, Geol. Penn., vol. II, pt. II, p. 825, fig. 642.
Merista laevis Hall, 1859, Pal. N. Y., vol. III, p. 247, pl. XXXIX, figs. 3, 4, 1861.
Meristella laevis Whitfield, 1891, Ann. N. Y. Acad. Sci., vol. V, p. 510, pl. 5, figs. 6, 7.
Meristella laevis Hall and Clarke, 1893, Pal. N. Y., vol. VIII, pt. II, pp. 75-78, pl. XLIII, figs. 3-6; pl. XLIV, fig. 4, 1894.
Meristella laevis Keyes, 1894, Mo. Geol. Surv., vol. V, p. 104.
Meristella laevis Whitfield, 1895, Geol. Ohio, vol. VII, p. 411, pl. I, figs. 6, 7.
Meristella laevis Weller, 1903, Pal. N. J., vol. III, pp. 290, 317, pl. XXXI, figs. 1-8; pl. XXXVIII, figs. 11-18.

Meristella laevis Shimer, 1905, N. Y. State Mus., Bull. 80, p. 255.
Meristella laevis Clarke, 1908, N. Y. State Mus., Mem. 9, pt. 1, p. 110.

Description—"Shell ovate, thin, somewhat ventricose. Ventral valve the larger, most gibbous in the centre and umbonial region, having a shallow mesial sinus extending from the front more than half way to the umbo; beak prominent, ventricose, incurved, not perforate. Dorsal valve regularly convex, gibbous in the middle, but without a defined mesial fold; beak incurved. Surface smooth, or marked by obscure concentric lines and occasional stronger concentric wrinkles of growth, and, in the exfoliated shell, by obscure radiating striae."—Hall, 1859.

Meristella bella Hall

Plate 53, figures 3-6

Merista bella Hall, 1857, 10th Ann. Rept. N. Y. State Cab. Nat. Hist., p. 92, figs. 1, 3-7.
Merista bella Hall, 1859, Pal. N. Y., vol. III, p. 248, pl. XL, figs. 1a-i, k-p, *Merista* (=*Meristella*) *bella*, 1861.
Meristella bella Whitfield, 1891, Ann. N. Y. Acad. Sci., vol. V, p. 510, pl. V, figs. 8-10.
Meristella bella Hall and Clarke, 1894, Pal. N. Y., vol. VIII, pt. II, pl. XLIII, figs. 7-9; pl. XLIV, figs. 1-3.
Meristella bella Whitfield, 1895, Geol. Ohio, vol. VII, p. 412, pl. I, figs. 8-10.

Description—"Shell varying from suborbicular or subquadrilateral to transversely oval, usually somewhat broader than long, gibbous. Ventral valve a little the larger, most convex near the umbo; beak prominent and closely incurved. Dorsal valve convex, gibbous in the middle and towards the umbo; both valves marked with a small sublinear mesial sinus, that of the ventral valve stronger than the other, the two often giving a distinct emarginate outline to the front. Surface smooth, or marked by faint concentric lines of growth, with much fainter indications of radiating striae.

"[*Remarks*] * * * * The sinus on the front of the ventral valve is always broader and deeper than that on the other, giving a waved outline to the margins of the valves. * * * * * * * * *
* * * * * * * * * —Hall, 1859.

Remarks—But one specimen has been observed.

Meristella princeps Hall

Plate 44, figures 9-11

Merista princeps Hall, 1857, 10th Ann. Rept. N. Y. State Cab. Nat. Hist., p. 95, figs. 1-5.
Merista princeps Hall, 1859, Pal. N. Y., vol. III, p. 251, pl. XLIV, figs. 1a-b, 2a-b, 3a-c, 4a-h, 5 a-d, *Merista* (=*Meristella ?*) *princeps*, 1861.
Camarium princeps Hall, 1859, Pal. N. Y., vol. III, p. 486.
Meristella princeps Hall, 1860, 13th Ann. Rept. N. Y. State Cab. Nat. Hist., p. 93, figs. 5-7.
Meristella princeps Hall and Clarke, 1894, Pal. N. Y., vol. VIII, pt. II, pl. XLIII, figs. 10-13.
Meristella princeps Shimer, 1905, N. Y. State Mus., Bull. 80, p. 255.
Meristella princeps Clarke, 1909, N. Y. State Mus., Mem. 9, pt. 2, p. 41.

Description—"Shell ovate; sides sloping towards the beaks at an angle of about 60 degrees. Ventral valve more or less profoundly arcuate longitudinally, most ventricose near the central and umbonial region, depressed below and having a broad shallow flat or subangular mesial sinus in front, terminating (in old specimens) in a linguiform extension which is bent upwards at right angles to the longitudinal plane of the shell; beak strongly incurved. Dorsal valve gibbous and extremely elevated along the middle, which becomes in front a strong rounded mesial elevation; sides of the valve declining

very abruptly to the baso-lateral margins; beak closely incruved beneath that of the opposite valve. Surface marked by obscure fine radiating striae, which are crossed by indistinct concentric lines of growth; the latter often becoming conspicuous towards the margins.

"[*Remarks*]—This * * * * species differs considerably in the form and depth of the mesial sinus * * . In some of the specimens the sinus is very shallow and flattened within, while in other instances it is more impressed and angular in the middle; other specimens present intermediate grades of difference in this respect, the sinus being nearly flat within, and marked by a narrow, nearly linear, deeper depression along its middle * —Hall, 1859.

Remarks—This species is represented by a single, incomplete shell.

Meristella atoka Girty

Plate 53, figures 7-20

Meristella arcuata var. *atoka* Girty, 1899, U. S. Geol. Surv., 19th Ann. Rept., pt. III p. 567, pl. LXXI, figs. 1a-f.

Meristella atoka Dunbar, 1919, Tenn. Geol. Surv., Bull. 21, pl. 1, fig. 11; pl. 2, fig. 3.

Description—"Shell rather small, subtriangular; width slightly greater than the length.

"Umbo of the ventral valve full; beak small and strongly incruved; sinus strongly marked, beginning above the middle of the shell as a depressed line, deepening and broadening as growth advances, but never losing its angular character, the upturning of the sinus towards the front and the angularity so pronounced as often to make a distinct emargination in the anterior outline, which would otherwise be well rounded. Young examples are subcircular, but usually with a faint angular sinuation, noticeable in the two valves as seen from the front.

"From this type, by gradations, considerable variations are found. The fold varies both in strength and shape, and specimens occur in which this feature is high and rounded as well as high and angular, and others in which it is low and rounded and low and angular. But generally it is both angular and well marked. Similarly the shape varies from being wider than long to being longer than wide, the beak of the ventral valve in that case being higher and more projecting. Perhaps several specific names might be employed for the extremes of variation, but I do not believe that these distinctions would be justified * * * * * * * * * * * * * * * * * * * —Girty, 1899

Remarks—A description of the Missouri representatives follows:

Shell subtriangular to subpentagonal in outline, anterior border emarginate. Ventral valve longitudinally arcuate, medial anterior portion prolonged dorsally; marked, medially, from anterior margin posteriorly with prominent, subangular sinus; beak incurved over that of dorsal valve. Dorsal valve marked, medially, from anterior margin posteriorly with prominent, rounded fold; beak incurved. Surface ornamented with radiate costae—4 in 1 mm. near anterior border of shell—crossed by concentric growth lines.

MOLLUSCA

Class PELECYPODA

ORDER PRIONODESMACEA

Superfamily Pteriacea

Family Pteriidae

Genus Pteronitella Billings

Pteronitella sp.

Plate 54, figure 5

Description—An internal cast of a portion of a left valve—with extended posterior extremity, and marked at least with concentric lines and wrinkles—is doubtfully assigned to this genus.

Family Conocardiidae

Genus Conocardium Bronn

Conocardium sp.

Plate 54, figure 6

Description—This genus is represented by an internal cast of a part of a left valve

Superfamily Pectinacea

Family Pectinidae

Genus Aviculopecten M'Coy

Aviculopecten ? umbonata (Hall)?

Plate 54, figures 7, 8

Avicula umbonata Hall, 1859, Pal. N. Y., vol. III. p. 284, pl. LI, fig. 6, 1861.

Description—"Shell rhomboid, nearly once and a half as long as high; anterior margin broadly rounded; posterior side narrower and acutely rounded, very convex in the middle and upon the umbo; anterior wing small, acute, extending a little beyond the anterior margin of the shell, and separated from the body of the shell by a narrow well-marked sinus; posterior wing larger, separated from the body of the shell by a broad defined sinus. Surface marked by concentric lamellose striae, which are closely crowded on the wings.

"[*Remarks*]—The specimen has nearly all the shell exfoliated, and the small portion remaining is somewhat imperfect, the cast retaining the impressions of the lamellose striae "—Hall, 1859

Remarks—Doubtfully included here are two portions—the greater part of one is exfoliated—of left valves, and an internal cast of a part of a left valve

In addition to the concentric lines of Hall's specimen, they show concentric wrinkles; and the specimen that best exhibits the shell surface shows two faint, radial ribs.

Order Teleodesmacea

Superfamily Cypricardiacea

Family Pleurophoridae

Genus Cypricardinia Hall

Cypricardinia distincta Billings?

Plate 54, figure 9

Cypricardinia distincta Billings, 1874, Pal Fossils, vol. II, pt. I, p. 56, figs. 26, 27.

Cypricardinia distincta Clarke, 1908, N. Y. State Mus., Mem. 9, pt. I, p. 157, pl. 24, figs. 12-19.

Description—"Under this name the author cited and illustrated the two extremes of variation in this species, one elongate with broad and few growth bands and the umbonal ridge suppressed probably by compression, the other more rhomboidal in outline, with narrower, more numerous growth bands, sharper umbonal ridge and more sinuous postlateral margin. In the absence of intermediate forms these might be regarded so unlike as to be terms of parallel rather than continuous series.

" '*Original description*—Shell oblong or irregularly ovate; compressed or moderately convex; an oblique, obscure angulation extending from the umbones to the posterior angle; umbones sometimes slightly flattened by an obscure depression which descends, gradually widening, to the ventral margin; beak small, closely incurved. Dorsal margin straight, slightly concave or convex, parallel with the ventral margin or a little elevated posteriorly, usually about one-fourth shorter than the total length. Ventral margin usually gently concave, but sometimes straight or slightly convex. Anterior extremity usually with the lower half a little projecting and rounded, concave, at the mid-hight or obtusely rounded; posterior extremity, with the most projecting point at the mid-hight or a little below, narrowly rounded or angular; the upper half obliquely truncated with a straight or gently convex slope.

" 'The largest specimen collected is seventeen lines in length, eight lines in height at the umbones, and nine lines high at the posterior end of the hinge line. All the others are shorter and proportionally higher. In several specimens which have both valves in connection, the right valve is the most convex.'

"The surface of the broad growth rings is usually marked by very fine concentric lines and with good preservation the umbonal slope presents a series of fine radial and interesting surface lines which are sometimes exhibited from the hinge line as far as the middle of the basal margin. *Cypricardinia distincta* is one of the largest forms of the genus and is unlike the species known to us from the Oriskany fauna. It approaches more nearly the species *C. sublamellose* and *C. carassa* Hall of the New Scotland (Helderbergian) beds of New York. We find these shells to be quite common in the limestones [Grande Greve]."—Clarke, 1908.

Remarks—This form is possibly represented by an incomplete left valve.

MOLLUSCA

Class GASTROPODA

Subclass Streptoneura

Order Ctenobranchiata

Suborder Platypoda

Superfamily Taenioglossa

Family Capulidae

Genus Platyceras Conrad

Platyceras pentalobus Hall

Plate 54, figures 10-20

Platyceras pentalobus Hall, 1859, Pal. N. Y., vol. III, p. 319, pl. LVIII, figs. 7a-c, 1861.

Description—"Shell obliquely subconical; spiral with about two volutions; apex and upper volution smooth and rounded, becoming plicate on the last volution; plications four, five or more; peristome simple. Surface marked by fine transverse striae, which are strongly undulated in passing over the plications.

"[*Remarks*]—I have not been able to trace this species through its gradations of form; but it is so different from the other species observed, that I can have no doubt of its specific distinctness."—Hall, 1859.

Remarks—The Missouri specimens referred to *P. pentalobus* present a gradational variation as follows: Apex above to below upper surface of body whorl; whorls about 1½ to about 3, all contiguous to part of body whorl free; lower surface of body whorl flattened to rounded; upper surface of body whorl rounded to subangular to flattened.

Dimensions—Range in size of shells indicated by figured specimens.

Platyceras sp.

Plate 54, figures 21, 22

Description—Single specimen with about 2 contiguous whorls, apex below upper surface of body whorl, body whorl with median ridge; peristome incomplete, upper portion with shallow sinus, outer lip with deep sinus, character of lower portion undeterminable; surface marked with undulating growth lines.

Remarks—This shell resembles *P. tenuiliratum* Hall[1] but the apex is below the upper surface of the body whorl, and the outer lip is deeply sinuate.

Platyceras ? sp.

Plate 54, figures 23, 24

Description—A portion of a whorl is doubtfully referred to this genus.

Genus Diaphorostoma Fisher

Diaphorostoma sp.

Plate 54, figures 25, 26

Description—The specimen is an internal cast of a shell of about 2½ whorls which resembles *D. depressum* (Hall)[2] but is smaller.

[1]Pal. N. Y., vol. III, p. 317, pl. LVIII, figs. 1-5; pl. LIX, figs. 6a, b, 1859, 1861.
[2]Pal. N. Y., vol. III, p. 301, pl. LV, figs. 4a, b., 1859, 1861.

ARTHROPODA

Class CRUSTACEA

Subclass Trilobita

Order Opisthoparia

Family Goldiidae

Genus Goldius de Koninck

Goldius barrandii Hall[1]

Plate 54, figures 27

Bronteus barrandi Hall, 1859, Pal. N. Y., vol. III, p. 350, pl. LXXIII, figs. 1-4, 1861.
Bronteus canadensis Logan, 1863, Geol. Canada, p. 391.
Bronteus barrandii Clarke, 1908, N. Y. State Mus., Mem. 9, pt. 1, p. 104, pl. 9, figs. 12, 13.

Description—"Pygidium semi-elliptical; line of articulation straight; rudiment of the axis abruptly prominent, nearly twice as wide at its upper edge as the length, showing two articulations. Surface around the axis nearly plane, and thence sloping more abruptly, and again becoming nearly flat at the margin; marked by seven ribs on each side the median lobe, which is wider than the lateral ones and gradually narrowing from the base of the axis for one-fifth of its length, below which it gradually expands towards the border without bifurcating; its surface scarcely more prominent than the lateral ribs, and the furrows limiting it not more profound than the adjacent ones; lateral ribs narrow at their origin and gradually expanding towards the margin, the upper one wider at its wider extremity than either of the others. Surface marked by undulating lamellose striae, which are arched upward on the ribs; intermediate spaces covered by fine granulations."—Hall, 1859.

Remarks—Clarke notes:[2] "This species is one of the rarest in the fauna of the New Scotland beds (Helderbergian) in eastern New York and has not been elsewhere found save at the locality here considered. The description was based on a series of pygidia only but the writer has collected the other parts so that the species is pretty well understood. All New York specimens of the pygidia are of uniformly small size, bear an entire and spineless margin, a broad flat median rib with seven narrow and subequal ribs on each side. We have a single pygidium agreeing with these New York specimens in all details even to size, obtained by me in the St. Alban beds [which 'present a congeries of 51 species of which fully one-half occurs in the typical Helderbergian faunas (Coeymans of New Scotland) to the southwest.'[3]] in Cape Rosier Cove [Gaspe].

"The name used by Logan as above cited doubtless has reference to this species. We elsewhere note the presence of a large varietal expression of *B. barrandii* in the fauna of Stewart's Cove, Dalhousie."

Goldius barrandii is represented in the Missouri material at hand by a part of a pygidium.

The pygidium was about 15 mm. long, and about 24 mm. wide; that figured by Hall is 12.5 mm. long, and 17 mm. wide; and that figured by Clarke is 9 mm. long, and 12.3 mm. wide.

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[1] "The family name 'Bronteidae' cannot be retained, as de Koninck's term *Goldius* has priority over *Bronteus* Goldfuss, a term which was substituted for *Brontes* of the same author on finding that the latter appellation was preoccupied."—von Zittel's Text-book of Pal., vol. I, p. 720, 1913.

[2] N. Y. State Mus., Mem. 9, pt. I, p. 104, 1908.

[3] op. cit., p. 250.

Order Proparia

Family Phacopidae

Genus Dalmanites Barrande

Dalmanites cf. griffoni Clarke

Plate 55, figure 1

Description—A few portions of cephala, that present a considerable range in size, suggest that of *D. griffoni* described by Clarke from the St. Alban beds of Gaspe.

Clarke's description follows:[1] "There occurs in the Grande Cavee outcrops a Dalmanites having the characters of *D. micrurus* Green. In lobation of tail there is little to distinguish it from that species and the general outline of the head and of the glabellar lobes is similar, but in excavating these fossils from the compact residual clay into which the rock has altered, I observed and made sketch of a cephalon on the anterior limb of which was a very pronounced elongate and spatulate extension, as is represented in the outline in our figure. This was so fragile that I was unable to preserve it and no other specimen of the cephalon was complete in this frontal region. It is such a prolongation or snout as one sees in Salter's figure of *D. longicaudatus* (British Trilobites, 1864, pl. 3, fig. 19), from the Wenlock shale which one may regard as an incipient condition of the Probolium condition. It seems, hence, eminently appropriate to find this development accompanying a condition of complete glabellar lobation characteristic of true Odontochile, and likewise to find this expression of Dalmanites in earliest Devonic as well as in latest Siluric rocks."

In the case of the best preserved specimen, the width of the snout at its inception is 10 mm. and its probable length about 5 mm.; the one eye preserved has an elevation of about 8 ranges of lenses; the unexfoliated portion—practically all of the border and small portions of the cephalon contiguous to the border—appears granulose under the hand lens. The axial length of the cephalon—inclusive of the snout—was about 26 mm. and the width about 52 mm.

Dalmanites sp.

Plate 55, figures 2-7; plate 56, figure 1

Description—Several portions of pygidia and cephala are provisionally regarded as representatives of a single species—probably that of the specimens described above as suggestive of *D. griffoni* Clarke.

The specimen that represents the smallest cephalon, which had an axial length of about 10 mm. and a width of about 20 mm., retains one eye which has an elevation of 8 ranges of lenses.

The best preserved specimen, and the one that represents the smallest pygidium—length, inclusive of spine, 18 mm., width, 22 mm.—retains the impression of the spine which was about 1/12 of the total length of the pygidium, has 21 axial annulations, and 15 pleural ribs. Two of the remaining specimens have about 21 axial annulations and 14 or 15 pleural ribs, and the indications are that the others, which are more incomplete, originally had a like number.

The surface of the specimens appears granulose to the unaided eye or under the hand lens.

Dalmanites carlwegi n. sp.

Plate 56, figure 2

Description—Pygidium triangular, slopes rather abruptly at sides, length—inclusive of spine—about 3/4 of width; posterior extremity a short, slightly upturned,

[1]N. Y. State Mus., Mem. 9, pt. 1, p. 103, pl. 7, fig. 4; pl. 9, fig. 4, 1908.

claw-like spine that is about 1/12 of total length of pygidium; elevated axially from posterior extremity of axis into caudal spine. Axis consists of about 16 or 17 rounded annulations, tapers regularly; its length about 4/5 that of entire pygidium, its width at anterior end about 3/11 of width of pygidium, its width at posterior end about 1/3 that at anterior end. Each lateral lobe has 12 or 13 rounded ribs which are wider than intervening furrows and marked with narrow, shallow, longitudinal groove. Surface appears granulose under hand lens.

Dimensions—Two of the specimens are of equal size, more nearly complete, and slightly larger than the others. The two larger specimens: Length—inclusive of spine—25.5 mm., width 32 mm., length of axis 20 mm., anterior width of axis 9 mm., length of spine 2 mm., width of border 1.5 mm.

Remarks—This pygidium is distinguished by the short, slightly upturned, claw-like caudal spine.

A number of parts of pygidia that are in all probability of this species cannot be referred to it with certainty because in every case the posterior portion is broken off. The range in size is indicated by the specimens figured.

Genus Phacops Emmrich

Phacops hudsonicus Hall

Plate 56, figures 5-10

Phacops hudsonicus Hall, 1859, Pal. N. Y., vol. III, p. 355, pl. LXXIII, figs. 24a, 26-28 1861.

Phacops hudsonicus Girty, 1899, U. S. Geol. Surv., 19th Ann. Rept., pt. III, p. 571, pl. LXXI, figs. 4a-d.

Description—"Head semi-elliptical; length greater than half the width; posterior angles extended and abruptly rounded. Cheeks broad triangular, produced behind.[1] Glabella subpentagonal; length nearly one-third greater than the width. Frontal lobe very prominent, gibbous above; middle and anterior transverse furrows distinctly impressed in the cast; first annular furrow faintly defined; first annulation not prominent, with two pustules at the summit and a node at each extremity; occipital furrow and annulation strongly defined. Eyes small, extending backwards to the line of the first annular furrow, having an elevation of four ranges of lenses.

"[*Remarks*]—This species is founded on a single head (the test being removed from the glabella), which is more produced in front than the *P. logani*; the eyes are smaller, and not extending so far backwards."—Hall, 1859, 1861.

"It is interesting to note that this species * * is quite plentiful in Indian Territory, being more largely represented than the accompanying form, *P. logani*. * * The quantity of material examined makes it possible to add some details to Hall's description which may be amended as follows:

"Head semi-elliptical, varying somewhat in proportions but always transverse, the posterior angles extended and abruptly rounded. Cheeks triangular and produced behind.

"Glabella subpentagonal; transverse, usually having the width 1½ times as great as the length; tumid, produced, and covered with pustulose tubercles. The upper and middle furrows are faint, but the basal furrow is strong and deep. The basal lobe of the glabella strongly outlined by the basal furrow above, the occipital furrow below, and by the rapidly converging axial furrows. It is short, with a detached node at each extremity.

"The occipital ring is strongly elevated, usually rising to a pointed node in the center and with two less distinct nodes at the sides.

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[1]The description to this point is given by Hall on the explanatory page for plate LXXIII and is the correction for this part of his description on page 355.

"The cheeks are triangular, more or less produced and rather abruptly rounded behind.

"Eyes small, extending backward to the line of the basal furrow and with an elevation of four ranges of lenses.

"The axis of the thorax is prominent and narrower than the lateral lobes, the annulations being furnished with a node at each extremity. The lateral lobes are nearly plane and horizontal toward the axis, but are abruptly bent downward a little less than half their length from the axis. Each pleura is grooved, the groove extending beyond the point of curvature.

"The surface of the pygidium and thoracic segments is finely granulose, as is that of the cheeks of the cephalic shield, but the portions of the latter adjacent to the glabella, as well as the glabella itself, are raised into granulose pustules of several sizes.

"This species is extremely close to *P. logani*, with which it is associated, and the only character which, to my knowledge, can be relied upon to distinguish them is the comparative size and number of facets in their eyes. As pointed out by Hall, the eyes of *P. hudsonicus* are smaller and possess fewer lenses than *P. logani*. The occipital ring of the latter species has usually a pointed pustule in the center. This character is never found in *P. logani*, so far as my experience goes, but, on the other hand, it is variable in *P. hudsonicus*, and I believe sometimes inconspicuous. Otherwise the two species seem to be in perfect agreement. The character of the eyes is scarcely one in which we would expect to see a sexual difference manifested, but possibly the existing difference is of that character. However, apparent facts of distribution would seem to oppose such an interpretation."—Girty, 1899.

Remarks—Several parts of cephala are assigned to this species. The eyes of one have an elevation of 3 ranges of lenses; those of the others an elevation of 4 ranges. One exhibits a small spine at the genal angle. The surface is ornamented with granules which vary from those visible only under the hand lens to those visible to the unaided eye—most of the larger granules are confined to the glabella. The range in size of the cephala represented follows: Axial length about 7 to about 10 mm., width 13.5 to 19 mm. The cephalon described and figured by Hall has an axial length of 13 mm. and a width of 24.5 mm.

A few portions of cephala that resemble those mentioned above can be but doubtfully referred to *P. hudsonicus*.

The following is a description of a number of complete, or nearly complete, pygidia that are provisionally included here; pygidium semicircular, posterior and lateral slopes abrupt; axis prominent, composed of 9 or 10 rounded annulations; each lateral lobe has 7 to 9 rounded ribs that are wider than intervening furrows; each rib, except anterior one of each lobe, marked with narrow, shallow, longitudinal groove; surface ornamented with granules of unequal size—larger ones visible to naked eye. The range in size of the pygidia is: Length about 4.5 to 7 mm., width about 7 to 12 mm.

Phacops logani Hall

Plate 56, figures 16, 17

Phacops logani Hall, 1859, Pal. N. Y., vol. III, p. 353, pl. LXXIII, figs. 15-24 (not 24a) 25, 1861.
Phacops logani Girty, 1899, U. S. Geol. Surv., 19th Ann. Rept., pt. III, p. 571.
Phacops logani Clarke, 1900, N. Y. State Mus., Mem. 3, p. 21, pl. I, figs. 1-5.
Phacops logani Weller, 1903, Pal. N. J., vol. III, p. 321, pl. XL, figs. 3, 4.
Phacops logani Shimer, 1905, N. Y. State Mus., Bull. 80, p. 260.
Phacops logani Clarke, 1908, N. Y. State Mus., Mem. 9, pt. 1, pp. 103, 118, pl. 10, figs. 1-4, 7-9.
Phacops logani Clarke, 1909, N. Y. State Mus., Mem. 9, pt. 2, p. 138.
Phacops logani Ohern, 1913, Md. Geol. Surv., L. Dev., p. 497, pl. XCI, figs. 1-4.
Phacops logani Dunbar, 1919, Tenn. Geol. Surv., Bull. 21, pl. 2, fig. 18.

Description—"General form elliptical. Head semi-circular in outline, broadly concave above, with the posterior angles curved and declining more abruptly. Glabella somewhat pentagonal; length and greatest breadth nearly in the proportion of three to four; very prominent in front, projecting beyond the rudimentary frontal limb, which becomes more developed on each side, and below which is a defined groove, marking the limits of the lower side of the cephalic test. Upper surface convex, gibbous in front, having two pairs of transverse grooves, the middle and posterior ones of which are but faintly defined; while the third or anterior ones, extending from the inner angle of the eye backwards and a little inwards, are scarcely conspicuous, and, on many specimens, not observable. First annular furrow strongly defined, and sometimes with a small tubercle at the summit; first or intercalated annulation narrow and well defined, and terminated at each extremity by a strong oblong tubercle, which is wider than the annulation, and usually marked by two pustules at the summit, one on each side of the centre. Occipital furrow wider and more strongly defined than the intercalated one, slightly sinuous, and terminating in a deep cavity at each extremity; occipital annulation broad and strong, slightly sinuate at the extremities, and, when entire, marked by one larger central pustule and several smaller ones. Eyes of medium size, their summit less elevated than the glabella, extending backwards to the line of the occipital furrow, composed of seventeen vertical ranges of lenses; the entire number of lenses in full-grown specimens about one hundred, and varying in the specimens examined from ninety-three to one hundred and three. The axis of the thorax is prominent, and narrower than each of the lateral lobes; the annulations furnished with a prominent node at each extremity. The lateral lobes are flat or somewhat concave towards the axis, the articulations bending abruptly downward from the middle towards the extremities; each articulation strongly grooved, the groove extending beyond the curvature. Pygidium semi-circular; the axis prominent, with about nine annulations; the lateral lobes having about five or six ribs, each with a groove along the centre. Sufrace of the glabella pustulose, and of the articulations granulose, with some larger granules or pustules. The crust is thin, and the interior of the glabella shows distinct cavities corresponding to the external pustules. Hypostoma broad hastate; the buccal extremity obtuse, with a minute central point."—Hall, 1859.

Remarks—The incomplete cephalon observed departs from the foregoing description in that the eyes extend backward only to the line of the first annular furrow. As shown by the portions preserved, the eyes originally had at least 15 vertical ranges of lenses and an elevation of at least 6 ranges. The surface of the incomplete cephalon is marked with subequal granules—visible to the naked eye.

Dimensions—Axial length about 11 mm., width 23 mm.

CHAPTER IV

THE FAUNA OF THE LITTLE SALINE LIMESTONE IN STE. GENEVIEVE COUNTY

by

GRACE ANNE STEWART

INTRODUCTION.

The Little Saline limestone is named from the Little Saline Creek in Ste. Genevieve County, Missouri, along the course of which the beds outcrop to a limited extent. The formation consists of a pure white, or faintly pink, crystalline limestone, some beds of which are replete with finely preserved fossils. From a detailed study of the fauna it is obvious that the formation may be divided into two horizons or zones, a lower one in which upper Oriskany species predominate with a few Helderbergian holdovers, and an upper zone in which the upper Oriskany species are associated with some Onondagan forms.

The lower beds contain the larger portion of the fauna, for of the 102 species which have been identified, 77 occur here, with only 44 in the upper beds, 19 persisting through both horizons. Of the total number 26 species and 1 variety, or approximately 28 per cent of the entire fauna, belong to hitherto undescribed species.

The marked resemblance which exists between the Little Saline and the Oriskany fauna of the Appalachian trough, particularly in New York and Maryland, proves the contemporary age of the faunas, and the extension of the Oriskany sea into southeastern Missouri. The fauna was first discovered in 1913, and its presence in this region is of great interest, since its occurrence proves the westward extension of the typical Oriskany fauna for at least 500 miles further than was formerly supposed.

Typical upper Oriskany faunas have been recognized at a later date by C. O. Dunbar,[1] in western Tennessee, an occurrence which indicates a southward extension of the Oriskany sea for at least 200 miles.

The following correlation table shows the species which are present in the Little Saline limestone, and their occurrence elsewhere in the Appalachian trough and in Tennessee.

[1]Dunbar, C. O., Geol. Surv. Tenn., Bull. 21, p. 68, 1919.

One of the important facts which is established by these tables, is the close relationship which exists between the Little Saline fauna, and that of the upper Oriskany of New York state, although some of the Missouri specimens do not attain so large a size as do examples of the same species in New York. Of the 102 which have been identified, 51 are the same or show close affinity with New York species, 18 of these with Helderbergian, 31 with Oriskany, and 8 with Onondagan species, this latter group all being present in the upper beds. These are: *Cystodicya cf. rigida, Dalmanella lenticularis, Stropheodonata cf. inequiradiata, Centronella glansfagea, Spirifer cf. varicosa, Platyceras dumosum, Ceratolichas gryps* and *Phacops cristata.*

Of almost equal importance is the relationship existing between the Little Saline fauna, and that from the Lower Devonian of Maryland, 44 species in all being definitely recognized as identical or closely allied. Of these 21 are Helderbergian, and 31 are Oriskany species. Notwithstanding the greater distance separating the two regions, a surprisingly close resemblance is also recognized between Little Saline fauna and that of the Grand Greve limestone of Gaspe in far eastern Quebec, eighteen species are definitely identified with Grand Greve forms, while 6 show a close resemblance.

Less decided, but still quite marked, is the relationship existing between the Little Saline fauna and that from the Lower Devonian of Tennessee. Eight species are identified with, or show an affinity with Linden forms (Helderbergian), while 16 are identifiable, with forms from the Harriman chert and Quall limestone (Oriskanian). The fact that the Missouri fauna bears a closer resemblance to that of the more distant Appalachian trough than to the closer Tennesseean forms is surprising, since the entire trough seems to have served as a pathway for migration and environmental conditions within the limited southwestern part probably were similar.

FAUNAL TABLE.

x—denotes occurrence.

a—related species.

		Missouri.		Gaspe.	New York.			Maryland.		Tennessee.	
		L. Little Saline	U. Little Saline	Grand Greve	Helderberg	Oriskany	Onondagan	Helderberg	Oriskany	Linden	Harriman Quall
	Anthozoa										
1.	Zaphrentis cornuformis sp. nov.	x									
2.	Zaphrentis salinensis sp. nov.	x									
3.	Favosites cf. helderbergiae Hall	x		a	a			a		a	
4.	Favosites sp. undet.	x									
	Crinoidea										
5.	Edriocrinus cf. sacculus Hall	x				a			a		
	Bryozoa										
6.	Fistulipora acutula sp. nov.	x									
7.	Fistulipora variolata sp. nov.	x									
8.	Meekopora sp.		x								
9.	Heterotrypa undata sp. nov.	x									
10.	Monotrypa cf. tabulata Hall	x	x		a			a		a	
11.	Unitrypa cf. lata Hall		x	a							
12.	Unitrypa subcircularis sp. nov.		x								
13.	Polypora cg. hexagonalis Hall		x								
14.	Polypora media sp. nov		x								
15.	Polypora valida sp. nov.		x								
16.	Cystodictya cf. rigida Hall		x				a				
	Brachiopoda										
17.	Pholidops ovata Hall	x		x	x			x		x	
18.	Dalmanella lenticularis (Vanuxem)		x				x				
19.	Dalmanella oriskania sp. nov.	x	x								
20.	Rhipidomella emarginata (Hall)	x	x					x		x	

FAUNAL TABLE—Continued.

x—denotes occurrence.

a—related species.

		Missouri.		Gaspe.	New York.			Maryland.		Tennessee.	
		L. Little Saline	U. Little Saline	Grand Greve	Helderberg	Oriskany	Onondagan	Helderberg	Oriskany	Linden	Harriman Quall
21.	Rhipidomella musculosa Hall	x	x	x		x			x		
22.	Leptaena ventricosa (Hall)	x	x			x			x		
23.	Stropheodonta missouriensis sp. nov	x									
24.	Stropheodonta cf. demissa (Conrad)	x				a			a		
25.	Stropheodonta cf. inequiradiata Hall		x				a				
26.	Leptostrophia magnifica (Hall)	x	x	x		x			x		x
27.	Leptostrophia magniventra Hall	x	x	x		x			x		x
28.	Brachyprion cf. majus Clarke	x		a		a					
29.	Brachyprion sp	x									
30.	Schuchertella sp	x									
31.	Anoplia nucleata (Hall)		x	x	x	x			x		x
32.	Chonostrophia complanata (Hall)	x	x	x		x			x		x
33.	Eatonia peculiaris (Conrad)	x	x	x	x	x		x	x		x
34.	Eatonis plicata sp. nov	x									
35.	Uncinulus parvus sp. nov		x								
36.	Uncinulus salinensis sp. nov	x									
37.	Uncinulus welleri sp. nov	x									
38.	Plethoryncha barrandii (Hall)	x		x		x			x		a
39.	Plethoryncha principalis (Hall)	x	x			x					
40.	Centronella glansfagea (Hall)		x	x			x				
41.	Rensselaeria ovoides (Eaton)	x	x			x					x
42.	Rensselaeria cf. stewarti	x	x								
43.	Beachia suessana (Hall)	x				x			x		x
44.	Beachia ovalis (Hall)	x							x		
45.	Atrypa reticularis (Linne)		x		x			x	x	x	
46.	Spirifer arenosus (Conrad)	x	x	x		x			x		x
47.	Spirifer murchisoni Castelnau	x	x	x		x			x		x

48.	Spirifer cf. varicosa Hall		x				a					
49.	cf. Metaplasia pyxidata Hall		x			x			x		x	
50.	Cyrtina rostrata Hall	x				x		x	x		x	
51.	Rhynchospira attenuata sp. nov		x									
52.	Trematospira multistriata (Hall)		x		x	x		x				
53.	Nucleospira cf. ventricosa (Hall)	x		a	a			a		a	a	
54.	Meristella ampla sp. nov	x										
55.	Meristella carinata sp. nov	x										
56.	Meristella elliptica sp. nov	x										
57.	Meristella ovalis sp. nov	x										
58.	Anoplotheca dichotoma (Hall)	x				x			x		x	
59.	Anoplotheca flabellites (Conrad)	x		x		x		x	x		x	
	Pelecypoda											
60.	Actinopteria insignis Clarke	x				x						
61.	Actinopteria sp	x										
62.	Aviculopecten sp	x										
	Gastropoda											
63.	Strophostylus allani sp. nov	x										
64.	Orthonychia belli Clarke		x	x								
65.	Orthonychia praeconicum sp. nov		x									
66.	Orthonychia tortuosa Hall	x		x		x			x			
67.	Platyceras angulare Rowe	x							x			
68.	Platyceras depressum sp. nov	x										
69.	Platyceras dumosum Conrad		x				x					
70.	Platyceras elongatum v. parvum n. var	x										
71.	Platyceras gebhardi Conrad	x			x	x		x	x		x	
72.	Platyceras cf. gracile Ohern	x							a			
73.	Platyceras magnificum Hall	x							x			
74.	Platyceras cf. multisinuatum Hall	x			a			a		a		
75.	Platyceras cf. newberryi Hall	x			a				a			
76.	Platyceras nodosum Conrad	x	x	x		x			x			
77.	Platyceras peregrinus sp. nov	x										
78.	Platyceras planovolvis sp. nov	x	x									
79.	Platyceras reflexum Hall	x				x		x	x			
80.	Platyceras retrorsum Hall	x			x							
81.	Platyceras cf. subconicum Ohern	x							a			
82.	Platyceras trilobatum Hall	x			x			?				
83.	Diaphorostoma ventricosum (Conrad)	x	x	?	x	x		x	x		x	

FAUNAL TABLE—Continued.

x—denotes occurrence.

a—related species.

		Missouri.		Gaspe.	New York.			Maryland.		Tennessee.	
		L. Little Saline	U. Little Saline	Grand Greve	Helderberg	Oriskany	Onondagan	Helderberg	Oriskany	Linden	Harriman Quall
	Pteropoda										
84.	Hyolithes cf. oxys Clarke	x		a							
85.	Tentaculites elongatus Hall	x		x	x	x		x	x		
	Trilobita										
86.	Acidaspis sp. undet	x									
87.	Proetus conradi Hall	x		x		x					
88.	Proetus cf. pachydermatus Barrett	x						a			
89.	Proetus protuberans Hall	x	x		x			x			
90.	Lichas sp	x									
91.	Ceratolichas gryps Hall		x				x				
92.	Dalmanites cf. aspinosus Weller	x						a			
93.	Dalmanites cf. bisignatus Clarke	x				a					
94.	Dalmanites micrurus? (Green)		x	x	x			?	x		
95.	Dalmanites cf. pleuroptyx (Green)	x			a			a		a	
96.	Dalmanites slocomi sp. nov	x									
97.	Dalmanites cf. stemmatus var. convergens Clarke		x			x					
98.	Dalmanites sp. undet	x									
99.	Dalmanites praenuntia sp. nov	x									
100.	Cryphaeus sp		x								
101.	Phacops cristata Hall	x	x				x				
102.	Phacops sp		x								
	Totals	77	44	24	18	31	8	21	31	8	16

The corals observed from this geological horizon are few, and form a minor portion of the fauna. Only four species have been identified, all from the lower beds. Of these two species belong to new and undescribed forms: *Zaphrentis cornuformis*, and *Zaphrentis salinensis*, and they seem to exhibit little resemblance to any previously described lower Devonian forms.

Thus far but a single well preserved Crinoid base has been noticed, belonging to the genus Edriocrinus.

Most of the bryozoans occur in the upper beds, and the relative abundance of the fenestellids and fistuliporids point to an early Devonian age for the fauna. Of the 11 species identified, 4 are present in the lower beds, and 8 in the upper, only one species, *Monotrypa tabulata*, ranging through both horizons. They have for the most part been replaced by lime carbonate, and their condition of preservation is such that identification is difficult and more or less uncertain. From a careful study of thin sections it has been possible to identify at least six new species, the others showing affinities with described forms occurring either above or below the Oriskany.

The brachiopods are chief among the classes represented, and form a large portion of the fauna, 43 species have been identified, which is approximately 43 per cent of the whole. Of these, eleven species, or about twenty-five per cent belong to new and hitherto undescribed species. Of the remainder, two do not admit of certain determination, twenty-three occur in the Oriskany of New York and Maryland, and the remainder occur either above or below this horizon.

The age of the fauna is suggested by the large size of the brachiopods, although generally speaking, they do not attain so large a size as do the New York examples. *Rensselaeria ovoides* is considerably smaller, although many of the mature forms are larger than *Rensselaeria marylandica*, which is the southern representative of this species in Maryland. An exfoliated portion of the pedicle valve of an exceptionally large *Leptostrophia magnifica* has been observed, and many smaller examples. It is particularly noticeable that the brachiopods are for the most part represented by the separate valves only, and except in one or two species entire specimens occur but rarely. Entire specimens of *Eatonia peculiaris* are present in a splendid state of preservation, and are common both in the lower and in the upper beds.

The characteristic *Atrypa reticularis* is but meagerly represented, and only in the upper beds. The cosmopolitan *Anoplotheca flabellites* is rarely present, and so far as known is restricted to the lower beds. *Spirifer arenosus* and *Spirifer murchisoni* are present in greater abundance. The Meristellid brachipods show distinct differences from described forms, and are represented by at least four new species, which are restricted to the lower beds.

The following species of brachiopods range through both horizons: *Rhipidomella emarginata, Dalmanella oriskania, Rhipidomella musculosa, Leptaena ventricosa, Leptostrophia magnifica, Leptostrophia magniventra, Chonostrophia complanata, Eatonia peculiaris, Plethorhyncha principalis, Rensselaeria ovoides, Rensselaeria cf. stewarti, Spirifer arenosus* and *Spirifer murchisoni.*

A few fragments of Pelecypods occur in the lower beds but these present no diagnostic characters.

Quantitatively the gastropods come next in importance to the brachiopods. The assemblage is particularly characterized by the Platycerid type, and they present the characteristic lower Devonian aspect. They are for the most part restricted to the lower beds, 18 species occurring there, while only 6 occur in the upper. Only 3 species persist through both horizons. These are: *Platyceras nodosum, Platyceras planovolvis* and *Diaphorostoma ventricosa.* Of the 21 species which have been identified, five species and one variety are new, or approximately 28 per cent of the whole. Of the remainder, 10 occur in the Oriskany elsewhere, and 7 in the Helderbergian. One form, *Platyceras dumosum,* is an Onondagan species. Four of the species range through the Helderberg and the Oriskany. These are: *Platyceras gebhardi, Platyceras newberri, Platyceras reflexum* and *Diaphorostoma ventricosum.* One form, *Platyceras peregrinus,* belongs to that type of laterally compressed Platycerid shells, which is so common among the South American faunas.

The trilobites, although not represented by numerous individuals, belong to 17 different species. The specimens are all fragmentary, and not one entire example has been observed. Twelve species occur in the lower beds, and 7 in the upper, only 2 of these, *Proetus protuberans* and *Phacops cristata,* ranging through both horizons. Two new species have been described. Of the remainder, four occur in the Oriskany of New York and Maryland, seven in the Helderbergian of New York and Maryland, and two in the Onondagan of New York.

The material on which this study is based is preserved in the collections of Walker Museum of the University of Chicago. The writer wishes to acknowledge the helpful criticisms and suggestions of Professor Weller under whose constant supervision this paper has been prepared, and especially to acknowledge her indebtedness to him for the assistance given in the photographing of the specimens.

DESCRIPTIONS

COELENTERATA

Class ANTHOZOA

Subclass Tetracoralla

Family Zaphrentidae

Genus Zaphrentis Rafinesque

Zaphrentis cornuformis sp. nov.

Plate 57, figures 3-7.

Description—Corallite of medium size, simple, turbinate, commonly a little curved, rarely straight, the greatest curvature occurring near the apex; sides tapering gradually and uniformily, apex acute. The dimensions of the type specimen which is an average sized individual are: Length 85 mm., diameter of upper part of cup approximately 40 mm. Irregular wrinkled lines of growth give the shell an annulated appearance. Septa strongly marked on the exterior of the coral, about 85 in number where the diameter of the coral is 35 mm. A cross-section of the lower part of the cup shows the septa to be of equal length, almost reaching to the centre and not coalescing. A well-developed fossula occurs. Tabulae not observed, probably not well developed, or if present they have been poorly preserved. Character of cup obscure.

Remarks—This species may be distinguished easily from the other simple corals in the fauna, and likewise it is the most abundant. It differs from *Zaphrentis salinensis* in its more slender and tapering outline, in the distinct curvature of the sides, and it presents a less massive appearance. The septa are generally smaller.

Horizon—Lower beds.

Holotype and Paratypes No. 27552 *Walker Museum.*

Zaphrentis salinensis sp. nov.

Plate 57, figures 1, 2.

Description—Corallite simple, large, conical, sides straight, expanding gradually and uniformily. The dimensions of the type specimen are: Length about 80 mm., diameter of calyx approximately 55 mm. Tabulae not observed, possibly not strongly developed. Encircling lamellae are present on the part of the coral preserved. Septa about 90 where diameter of calyx is 45 mm. Length of septa, character of upper part of cup, and fossula not observed.

Remarks—One large incomplete example, and a smaller one, which appear to belong to this species, have come under observation.

Horizon—Lower beds.

Holotype and Paratype No 27553 *Walker Museum.*

Subclass Hexacoralla

Suborder Tabulata

Family Favositidae

Genus Favosites

Favosites cf. helderbergiae Hall

Plate 57, figure 8.

1874. *Favosites helderbergiae* Hall, N. Y. State Mus., 26th Ann. Rept., p. 111.
1887. *Favosites helderbergiae* Hall, Nat. Hist. N. Y. Pal., vol. 6, p. 8, pl. 4; figs. 1, 2; pl. 5, figs. 1-3; pl. 6, figs. 1-8.
1913. *Favosites helderbergiae* Swartz, Geol. Surv. Md. Low. Dev., p. 208, pl. 22, fig. 1,

Description—"Corallum consisting of large, lenticular, depressed, convex or hemispherical masses; base covered by a strongly wrinkled epitheca. Cell tubes polygonal; their inner surface showing evidence of a few strong longitudinal striae. Septa frequent, from 10 to 15 in the space of 10 mm.; thickness equal to that of the cell walls. Mural pores in one or two ranges, comparatively large, circular, with margins distinctly elevated. Cell walls thin, but frequently much thickened near the surface by silicification, and sometimes granulose or spinose on the inner face. On some specimens the cells, at the surface, are nearly equal, having a diameter of about 1.5 mm.; on other specimens the diameter varies from .66 to 1.5 mm. On many of the specimens some of the cell tubes are larger and less angular than those surrounding them, being a little more than 2 mm. in diameter.—"Hall, 1887.

Remarks—A few specimens have been observed in the Little Saline limestone which are doubtfully referred to this species. The specimens are fragmentary and in no case show the hemispherical outline which characterizes the corallum of the species. The corralites are prismatic, polygonal, more rarely hexagonal. The mural pores are irregularly disposed, at least two rows being present. Longitudinal striae not observed. The diameter of the cell tubes varies considerably, some of them being as large as 2.5 mm. in diameter.

Horizon.—Lower beds.

Figured specimen No. 27554 *Walker Museum.*

Favosites sp. undet.

Plate 57, figures 9, 10

There are present in the collection studied, several impressions of the epitheca of the concave bases of the Favosites. They do not exhibit any diagnostic characters, and are recorded only to show the presence of this type of coral in the Little Saline limestone A tentative comparison may be suggested with *Favosites foerstei* as figured by Dunbar. from the Tennessee beds, with this difference, that *Favosites foerstei* is characterized by convex bases, while the Little Saline form is concave.

Horizon—Lower beds.

Figured specimen No. 27551 *Walker Museum.*

ECHINODERMATA

Class CRINOIDEA

Order Indeterminate

Family Indeterminate

Genus Edriocrinus Hall

Edriocrinus cf. sacculus Hall

Plate 57, figure 11.

1859. *Edriocrinus sacculus* Hall, Nat. Hist. N. Y. Pal., vol. 3, p. 143, pl. 87, figs. 1-22, 1861.

1913. *Edriocrinus sacculus* Ohern, Geol. Surv., Md. Low. Dev. p. 256, pl. 40, figs. 7-12.

A single base of the Edriocrinus may be compared with this species. The concave depressions on the upper margin into which the radial plates fit are not clearly defined.

Horizon—Lower beds.

Figured specimen No. 27559 *Walker Museum.*

MULLUSCOIDEA

Class BRYOZOA

Order Cyclostomata

Family Fistuliporidae

Genus Fistulipora McCoy

Fistulipora acutula sp. nov.

Plate 58, figures 1, 2.

Description—Zoarium massive, under surface with a wrinkled epitheca; cells tubular, apertures somewhat irregular in outline, usually subcircular to oval; lunarium only slightly developed, and causing a slight angular protuberance of the peristome, the protuberances having the same general direction. Apertures fairly regularly and closely disposed, usually distant from one another from .25 to .75 mm. Cell walls thin. Vescicles angular, generally smaller than the cell apertures.

Cells tubular, cylindrical, characterized by numerous diaphragms which are oblique to the walls and convex upwards. Interstitial tissue abundantly developed, composed of vesicles irregularly disposed and not having the appearance of tubes divided by septa.

Surface characters not observed.

Remarks—This form may be distinguished from *Fistulipora variolata* by its less massive appearance, by the slighter development of the lunaria, and by the presence of diaphragms in the cell tubes.

Horizon—Lower beds.

Type specimen No. 27651 *Walker Museum.*

Fistulipora variolata sp. nov.

Plate 58, figures 3, 4.

Description—Zoarium massive, under surface with a concentrically wrinkled epitheca. Cells tubular, without diaphragms, apertures extremely irregular in outline, the

irregularity depending on the degree of development of the lunarium; disposition of the apertures also irregular, in some cases they are nearly touching, in others being as much as .75 mm. apart. Cell walls thin. Interspaces filled with vesicular tissue, vesicles angular, sometimes as large as the apertures but usually smaller.

A longitudinal section shows the abundant development of the interstitial tissue, and the irregularly shaped cell tubes. The vesicles are irregularly disposed in some places, but elsewhere are more regular and have the appearance of cylindrical tubes divided by septa.

Remarks—The distinguishing characteristics of this species are the extreme variation in the shape of the cell apertures caused by differences in the amount of development of the lunaria, and their irregular arrangement. This irregularity in disposition, and the large and numerous vesicles suggests a relationship with *Favosites parasitica* Hall, but that form is explanate or ramose, while the Little Saline forms are massive.

Horizon—Lower beds.

Type specimen No. 27650 *Walker Museum.*

Genus Meekopora Ulrich

Meekopora sp.

Plate 58, figures 5, 6.

Description—Zoarium lamellar, explanate, bifoliate; apertures obliquely inclined, apparently toward the distal margin of the branch, uniform in size, regularly spaced, about three occupying the space of one mm., margin of apertures slightly above the interspaces. Lunaria well developed, walls thin. A longitudinal section shows the bifoliate character of the zoarium, and the convex interspaces between the cell apertures; apertures broader than long. Diaphragms lacking.

Remarks—This form is especially characterized by the well developed lunaria. The fact that no diaphragms are present is peculiar since the presence of these structures is mentioned in the description of the genus.

Horizon—Upper beds.

Figured specimen No. 27652 *Walker Museum.*

Order Trepostomata

Suborder Amalgamata

Family Heterotrypidae

Genus Heterotrypa Nicholson

Heterotrypa undata sp. nov.

Plate 58, figures 7, 8.

Description—Zoarium ramose, branches bifurcating, their diameter about 20 mm. Zooecial apertures irregularly disposed, varying somewhat in size and shape, generally polygonal in outline, 3 to 4 occupying the space of 1 mm. Walls thick. Mesopores numerous, exhibiting considerable variety in size and shape and having no definite order of arrangement. A longitudinal section shows the mesopores to be well developed in the mature portion of the zoarium, but absent in the younger. The zooecial tubes grow upward from the base, then bend sharply outwards almost at right angles. Numerous diaphragms cross the zooecial tubes in the mature region, for the most part disposed irregularly, and in a few cases concave downward. Mesopore walls commonly undulating. Small, scattered, acanthopores are present.

Remarks—This species suggests some relationship to *Moticulipora* (*Heterotrypa*) *barrandii* Nicholson, of the Hamilton, but is characterized by thicker walls, more abundant mesopores, and undulating zooecial walls. Also there is a greater variation in the shape and size of the zooecia.

Horizon—Lower beds.

Holotype No. 27653 *Walker Museum.*

Suborder Integrata

Family Tematoporidae

Genus Monotrypa Nicholson

Monotrypa cf. tabulata Hall

Plate 59, figures 1-3.

1882. *Chaetetes? tabulatus* Hall, Rept. State. Geol. N. Y., pl. 9, figs. 12-15.
1887. *Chaetetes* (*Ptychonema*) *tabulatus* Hall and Simpson, Pal. N. Y., vol. 6, p. 14, pl. 9, figs. 12-15.
1913. *Monotrypa tabulata* Ulrich and Bassler, Geol. Surv., Md. Low. Dev., p. 278, pl. 50, figs. 1-4.

Description—Zoarium apparently in subspherical masses, having a diameter of from 40 to 45 mm. Zooecia closely crowded, irregularly polygonal in outline, sometimes hexagonal, usually about 3 in the space of 1 mm. Walls thin, in longitudinal section appearing extremely wavy, the undulations especially prominent in the mature region; diaphragms sparsely present. Mesopores and acanthopores absent.

Remarks—This is the most common bryozoa in the Little Saline limestone. The specimens exhibit the characteristic polygonal zooecia, and the corrugated walls of *Monotrypa tabulata* Hall, but differ in the presence of the diaphragms, and in having the undulations of the walls less persistent.

Horizon—Lower and upper beds.

Figured specimens No. 27658 *Walker Museum.*

Order Cryptostomata

Family Fenestellidae

Genus Unitrypa Hall

Unitrypa cf. lata Hall

Plate 59, figure 4

1883. *Fenestella* (*Hemitrypa*) *lata* Hall, Trans. Albany Institute, vol. 10, (abstract 1881, p. 34).
1885. *Unitrypa spatiosa* Hall (in error), Rept. of State Geol. N. Y. for 1884, pl. 2, fig. 12.
1887. *Fenestella* (*Unitrypa*) *lata* Hall and Simpson, Nat. Hist. N. Y. Pal., p. 136, pl. 52, figs. 1-10.

Description—Zoarium apparently infundibuliform, size unknown; branches of medium strength, width above a bifurcation .31 mm., increasing to .51 mm. below a bifurcation, straight, slightly rounded to flat on the reverse side, bifurcations infrequent. Interstices and branches of about equal width. Dissepiments slender, from one-half to the same width as the branches, more rounded, and frequently above the plane of the latter. Fenestrules oval, length from .60 to .75 mm., width from .25 to .30 mm., 11 to 12 occupy the space of 1 cm.

On the celluliferous side the branches are about the same strength as on the reverse side, 17 occurring in 1 cm. Fenestrules similar to those on the opposite face. Cell apertures in 2 ranges, sometimes 3 just before a bifurcation, slightly oblique to the axis of the branch, 16 in the space of 5 mm., separated by about half the diameter of an aperture, sub-circular in outline, sometimes crowded against fenestrules and indenting their borders.

A thin section reveals the superstructure, formed by the junction of the carinae and scalae. For a short distance the latter are oblique to the former, then gradually turn, until at the junction they are at right angles.

Remarks—This species resembles very closely *Unitrypa lata* Hall. In contrast the nodes common to that species have not been observed in any of the specimens studied, and the scalae are somewhat thicker, and the interstices wider than the scalae.

Horizon—Upper beds.

Figured specimen No. 27657 *Walker Museum.*

Unitrypa subcircularis sp. nov.

Plate 59, figures 5-7

Description—Zoarium infundibuliform, frond rapidly expanding, size unknown. Branches straight or slightly sinuous, flat, equal to or less than the width of the fenestrules, bifurcations frequent. Dissepiments strong, approximately the same width as the branches, slightly rounded on the reverse side, and on the same plane with them or a little depressed, expanded at their junction with the branches, 10 to 11 in the space of 1 cm. Fenestrules longitudinally oval, sometimes sub-circular.

On the celluliferous side the branches are straight to slightly sinuous, of equal strength with branches on the reverse side, 12 occupy the space of 1 cm., gradually expanding in width from .25 mm. above a bifurcation to .30 mm. below. Dissepiments about the same width as the branches or a little greater. Fenestrules elongate oval, length .75 to .90 mm., width about half as great, 11 occupy the space of 1 cm. Zooecial apertures in ranges of 2, 12 to 13 in 5 mm., oval in outline, separated by about half the diameter of an aperture.

Carinae connected by scalae form the superstructure. Interspaces sub-circular, greatest diameter .50 mm., scalae thick, carinated, 30 in the space of 1 cm., expanded considerably where they join the carinae.

Remarks—This species resembles *Unitrypa tegulata* Hall, but the apertures are more widely disposed than in that species.

Horizon—Upper beds.

Holotype No. 27655 *Walker Museum.*

Genus Polypora McCoy

Polypora cf. hexagonalis Hall

Plate 60, figures 1, 2

1883. *Fenestella hexagonalis* Hall, Trans. Albany Inst. 10, p. 169, (abstract 1881, p. 27).

1887. *Fenestella* (*Polypora*) *hexagonalis* Hall and Simpson, Pal. N. Y., vol. 6, p. 164, pl. 33, figs. 14-20.

Description—Zoarium apparently infundibuliform, size unknown. Surface essentially smooth on the reverse side. Branches of medium strength, sinuous, rounded, gradually enlarging from .40 mm. above a bifurcation to .90 before. Interstices wider than branches. Dissepiments rounded, about same strength as branches, and on the same plane, 3 present in the space of 5 mm. Fenestrules oval, outer rim hexagonal, length to width in proportion of 3 to 2.

On celluliferous side the branches are rounded, of uniform size near base of frond and enlarging gradually, reaching maximum width just before a bifurcation, rarely sinuous or anastomosing, bifurcation occurs regularly usually at intervals of 20 mm., width of branches just before a bifurcation .60 mm. Dissepiments strongly developed. Fenestrules elongate oval, width .45 mm., length approximately three times as great. Cell apertures in from two to four ranges, rarely five, 20 in the space of 5 mm. Shape not distinctly determined.

Remarks—This form has a greater number of apertures than *Polypora hexagonalis* Hall, and the dissepiments are not so distinctly carinated as in that species.

Horizon—Upper beds.

Figured specimen No. 27660 *Walker Museum.*

Polypora media sp. nov.

Plate 60, figure 3

Description—Zoarium infundibuliform, size unknown. Branches of medium strength on the obverse side, sinuous, rounded, sometimes slightly flattened, equal to about half the width of the interstices. Dissepiments about equalling the branches in strength, or slightly narrower, width from .60 to .70 mm., 4 in the space of 5 mm., flat to slightly rounded, on a plane with the branches. Surface granular. Fenestrules elliptical in outline, length usually about 1 mm., width from .50 to .60 mm.

On the celluliferous side the branches are less sinuous than on the reverse, gradually increasing in width from .40 to .80 mm. just before a bifurcation, 16 to 17 occupy the space of 1 cm. Dissepiments about the same strength as branches. Zooecial apertures in 2 to 4 ranges, 17 to 18 in 5 mm., separated by half the diameter of an aperture, sub-circular in outline, margins distinct.

Remarks—This species differs from *Polypora hexagonalis* Hall in having the apertures more widely disposed, in having a granular surface on the reverse side, and in showing no carinated dissepiments.

Horizon—Upper beds.

Holotype No 27659 *Walker Museum.*

Polypora valida sp. nov.

Plate 60, figures 4, 5

Description—Zoarium apparently infundibuliform, size unknown. Branches strong, straight, rounded slightly or sometimes almost flat, width above a bifurcation .50 mm., increasing to 1 mm. below a bifurcation. Dissepiments about one-half width of branches, on same plane as latter or a little depressed on the reverse side, 3 in the space of 5 mm. Fenestrules sub-triangular to oval, width .75 mm., length about twice as great, 6 occupy the space of 1 cm.

On the celluliferous side the fenestrules are elongate oval. Branches strong, 6 to 7 in 1 cm. Cell apertures in 4 to 5 ranges just below a bifurcation, and from 2 to 3 just above bifurcation, 20 present in 5 mm., circular to slightly oblong in outline, separated by less than half the width of an aperture. Both branches and dissepiments are covered with nodes, these being arranged regularly in parallel bands.

Remarks—This species may be differentiated from *Polypora hexagonalis* Hall, by the less sinuous branches, and by the greater number of branches. From the other associated species of this geological horizon it differs in having stronger branches, and in the presence of numerous nodes on the celluliferous side.

Horizon—Upper beds.

Holotype No. 27658 *Walker Museum.*

Family Cystodictyonidae

Genus Cystodictya Ulrich

Cystodictya cf. rigida (Hall)

Plate 60, figures 6, 7

1881. *Stictopora rigida* Hall, Trans. Albany Inst., vol. 10, abstract, p. 14.
1883. *Stictopora rigida* Hall, Report of State Geologist for 1882, Expl. 25, figs. 15, 16.
1887. *Stictopora rigida* Hall and Simpson, Nat. Hist. N. Y. Pal., vol. 6, p. 91, pl. 28, figs. 15, 16.

Description—Zoarium consisting of a flattened stipe, with straight, bifurcating branches; width of branches about 4 mm., just below bifurcation width increases to 5mm. Cell apertures oval, length about .30 mm., width about half as great. When split longitudinally and parallel to zoecial surface, the specimens show the mesathecal surface which is marked by sub-parallel, angular, and slightly undulating, longitudinal ridges.

Remarks—A single specimen showing the mesathecal surface has been observed, which resembles this Onondagan species. It differs in having somewhat wider branches, and in having transverse ridges not shown on specimens figured by Hall.

Horizon—Upper beds.

Figured specimen No. 27661 *Walker Museum.*

MOLLUSCOIDEA

Class BRACHIOPODA

Order Neotremata

Superfamily Craniacea

Family Craniidae

Genus Pholidops Hall

Pholidops ovata Hall

Plate 61, figures 1, 2

1859. *Pholidops ovatus* Hall, Nat. Hist. N. Y. Pal., vol. 3, p. 490, pl. 103, b, fig. 7.
1903. *Pholidops ovatus* Weller, Geol. Surv. N. J. Pal., vol. 3, pl. 226, pl. 20, figs. 27-29, p. 300.
1913. *Pholidops ovata* Schuchert, Geol. Surv. Md. Low. Dev., p. 294, pl. 53, figs. 10-12.

Description—Shell small, circular to ovate. The dimensions of a pedicle valve are: length 2.5 mm., width 2 mm. Apex excentric. The fine concentric lamellae common to this species have not been noticed in the specimens which have come under my observation. An impression of the pedicle valve shows the well defined anterior muscle markings which extend nearly to the middle of the shell.

Remarks—This little form of attached brachiopod is represented by three dorsal valves only, and there appears to be no essential variation from the New York specimens.

Horizon—Lower beds.

Figured specimens No. 27483 Walker Museum.

Order Protremata

Superfamily Orthacea

Family Orthidae

Genus Dalmanella Hall and Clarke

Dalmanella lenticularis (Vanuxem)

Plate 61, figures 9-11

1867. *Orthis lenticularis* Vanuxem, (non Wahlenberg), Geol. N. Y., Rept. Third Dist., 1842, p. 139, fig. 4. Hall, Nat. Hist. N. Y. Pal., 4, 1867, p. 35, pl. 5, figs. 1, 2.
1843. *Orthis lenticularis* and *O. lentiformis* Hall, Geol. New York, Rept. Fourth Dist., p. 17, fig. 4.
1889. *Orthis eboracensis* Miller, N. Amer. Geol. Pal., p. 357.
1892. *Dalmanella lenticularis* Hall and Clarke, Nat. Hist. N. Y. Pal., vol. 8, pt. 1, pp. 207, 224, pl. 5c, figs. 36-41.

Description—Shell of medium size, sub-elliptical to sub-ovate in outline, plano-convex, width greater than length or almost equal, the greatest width near the middle of the shell. The dimensions of a large pedicle valve are: Length 17 mm., width 19 mm. A small brachial valve measures 12 mm. in length, and 12.5 mm. in width. Cardinal extremities rounded.

Pedicle valve highly convex, the greatest convexity at or a little anterior to the umbonal region. Shell surface sloping gently to the lateral and anterior margins; beak small, blunt, incurved over the hinge line. Character of foramen not observed. A cast of the interior shows the long, narrow median septum extending from the beak almost to the anterior margin.

Brachial valve from depressed convex in the upper part to almost flat at the lateral margins; median portion marked by an ill-defined sinus which broadens out at the anterior margin forming a wide shallow depression Beak small, projecting slightly beyond the hinge line.

Surface of both valves marked by fine, radiating, bifurcating costae of uniform size, the bifurcations as many as four in passing from beak to anterior margin; 5 costae occupy the space of 1 mm. Coarser imbricating concentric growth lines cross the striae.

Remarks—This characteristic Onondagan species is represented here by the separate valves only. In the essential features the specimens observed agree closely with those figured by Hall in the New York reports, with this exception, that in the Little Saline forms the costae maintain a more uniform size.

Horizon—Upper beds.

Figured specimens No. 27481 *Walker Museum.*

Dalmanella oriskania sp. nov.

Plate 61, figures 12-14

Description—Shell of medium size, length usually slightly greater than width, although a number of the specimens have the length and width practically the same. The type specimen, a pedicle valve, measures 20 mm. in length and 19 mm. in width. The shape varies from semi-elliptical to semi-circular.

Pedicle valve highly convex, elevated or carinated along the median line, the greatest elevation at the umbonal region. The surface of the shell slopes rather steeply to the lateral and cardinal margins, but more gradually towards the anterior margin. Cardinal margins meet the beak at an obtuse angle, extremities rounded. Beak small and slightly incurved over the hinge line.

Brachial valve sub-convex to flat, characterized by a mesial sinus which is narrow and deep near the beak, and broad and shallow toward the anterior margin. Cardinal margins make a more obtuse angle with the beak than in the opposite valve. Beak small and inconspicuous. A cast of the interior shows two elongate and narrow muscle scars separated by a deep groove.

Surface of both valves marked by radiating costae of uniform size, which bifurcate frequently; 4 occur in the space of 1 mm at a point midway between the beak and anterior margin. These are crossed by coarser concentric lines of growth.

Remarks—This species resembles *Dalmanella subcarinata* Hall of the Lower Helderbergian beds, but is smaller, with the pedicle valve more highly convex and more elongated, and the cardinal margins meeting the beaks at a sharper angle.

Horizon—Lower and upper beds.

Holotype and Paratypes No. 27482 *Walker Museum.*

Family Rhipidomellidae

Genus Rhipidomella Oehlert

Rhipidomella emarginata (Hall)

Plate 61, figures 3-5

1859. *Orthis oblata var. emarginata* Hall, Nat. Hist. N. Y. Pal., vol. 3, p. 164, pl. 10a, figs. 4-6, 1861.

1913. *Rhipidomella emarginata* Maynard, Geol. Surv., Md. Low. Dev., p. 302, pl. 55, figs. 1-8.

Description—Shell small, a little broader than long, the hinge line less than the greatest width, from subtriangular to subcircular in outline. The dimensions of an average small individual are: Length 10 mm., width just below the middle of the shell 11 mm. The brachial valve of a larger form measures 13 mm. in length and 14 mm. in width.

Pedicle valve convex, the greatest convexity posterior to the middle, with a mesial sinus which is ill-defined near the beak, but becoming broad and more conspicuous toward the anterior margin. Hinge line straight, cardinal margins sloping abruptly from the beak, extremities rounded, giving the shell a circular outline.

Brachial valve more convex than the opposite, without well-defined fold; surface sloping uniformly from the middle to the anterior and lateral margins. Beak inconspicuous, slightly incurved below that of the opposite valve.

Surface of both valves covered with simple, radiating costae near the anterior margin, 3 occur in the space of 1 mm. These are crossed by coarser concentric growth lines, which are most prominent close to the anterior margin.

Remarks—This Helderbergian species is represented in the collection by one entire specimen, and a few separate valves. These are smaller than the forms figured from the Lower Helderbergian beds of New York, and the beak is less elevated.

Horizon—Lower and upper beds.

Figured specimens No. 27480 *Walker Museum.*

Rhipidomella musculosa Hall

Plate 61, figures 6-8.

1857. *Orthis musculosa* Hall, Tenth Ann. Rept. N. Y. State Cab. Nat. Hist., p. 46.

1859. *Orthis musculosa* Hall, Nat. Hist. N. Y. Pal., vol. 3, p. 409, pl. 91, figs. 1-3; pl. 95, figs. 1-7, 1861.

1892. *Rhipidomella musculosa* Hall and Clarke, *ibidem*, vol. 8, pt. I, pp. 190, 210, 225, pl. 6a, fig. 5.

1908. *Rhipidomella musculosa* Clarke, Mem. N. Y. State Mus., vol. 9, pt. 1, p. 201, pl. 42, figs. 1-5; pl. 43, figs. 14, 17, 19, 20, 22.

1913. *Rhipidomella musculosa* Schuchert, Geol. Surv., Md. Low. Dev., p. 305, pl. 55, fig. 20; pl. 56, figs. 1-4.

Description—Shell attaining a rather large size in mature examples, slightly broader than long. The dimensions of an average sized individual are: Length 35 to 36 mm., width 37 mm. Suborbicular in outline, hinge line short.

Pedicle valve depressed convex, flattened towards the anterior and lateral margins from the umbonal region. Beak small and slightly incurved above the hinge line. The muscular scars are strongly developed, large, fan-shaped, and extend well beyond the middle of the shell. Pallial region prominent.

Brachial valve much more convex than the pedicle, the surface sloping gently toward the lateral margins, and more abruptly toward the anterior margin.

Surface of both valves marked by fine radiating costae about 3 occupying the space of 1 mm. Concentric lines of growth also cross both valves, and appear to be more prominent on the pedicle valve, especially near the anterior margin.

Remarks—This is one of the less common species of the fauna, and all the specimens examined are separate valves.

Horizon—Lower and upper beds.

Figured specimens No. 27479 Walker Museum.

Superfamily Strophomenacea

Family Strophomenidae

Genus Leptaena Dalman

Leptaena ventricosa (Hall)

Plate 61, figures 15-17.

1857. *Strophomena depressa var. ventricosa* Hall, Tenth Ann. Rept. N. Y. State Cab. Nat. Hist., p. 55.

1859. *Strophomena rugosa var. ventricosa* Hall, Nat. Hist. N. Y. Pal., vol. 3, p. 417, pl. 94, figs. 2e, 2f, 3.

1892. *Leptaena rhomboidalis var. ventricosa* Hall and Clarke, *ibidem*, vol. 8, pt. 1, pl. 15a, fig. 43.

1908. *Leptaena rhomboidalis var. ventricosa* Clarke, N. Y. State Mus., Mem. 9, pt. 2, p. 87, pl. 21, fig. 87.

1913. *Leptaena rhomboidalis var. ventricosa* Schuchert, Geol. Surv., Md. Low. Dev., p. 309, pl. 56, fig. 18; pl. 57, fig. 1.

Description—Shell semi-circular to semi-oval in outline, sometimes attaining large size. Width commonly somewhat greater than the length, but in some examples the dimensions are nearly equal. The hinge line is equal to the greatest width of the shell, and the extremities are extended into conspicuous auricular projections in some cases. The dimensions of the pedicle valve of a large individual are: Length 39 mm., width 40 mm. A smaller shell measures 32 mm. in length and 34 mm. in width.

Pedicle valve extremely ventricose, the greatest convexity anterior to the middle of the shell, and from here the surface slopes abruptly toward the anterior margin, and less abruptly towards the lateral margins; above the maximum convexity the surface slopes uniformly to the hinge line. Surface marked by several large concentric wrinkles, which gradually decrease in size toward the beak, the last two or three being quite indistinct. Beak rounded and slightly incurved over the hinge line. A cast of the interior shows the strongly marked, fan-shaped muscular imprints, divided longitudinally by a median depression.

Brachial valve slopes gently from the hinge to the front, near which it becomes abruptly deflected causing a deep concavity. Concave area marked by concentric wrinkles which are less pronounced than those on the opposite valve. Beak small and inconspicuous. The interior casts show the strongly-marked, longitudinal muscular impressions.

Surface of both valves marked by fine, radiating costae, there being 2 or 3 present in the space of 1 mm.

Remarks—This characteristic Oriskany species occurs abundantly in the Little Saline beds, and is only represented by the separate valves in the collection studied. It differs from *Leptaena rhomboidalis* Hall, in the greater ventricosity of the pedicle valve, in its larger size, and in the more strongly marked muscular imprints. The same species occurs in the Oriskany sandstone of New York, and in the Oriskany beds of the Gaspe region, Canada.

Horizon—Lower and upper beds.

Figured specimens No. 27478 Walker museum.

Genus Stropheodonta Hall

Stropheodonta missouriensis sp. nov.

Plate 61, figures 21-22.

Description—Shell large, semi-circular in outline, width commonly greater than the length, the greatest width anterior to the middle of the shell. The dimensions of two brachial valves, the holotype and paratype, are: Length 38 mm., width 45 mm., and length 34 mm., width 40 mm.

Brachial valve gently concave to about 8 mm. from the anterior and lateral margins, where it becomes abruptly deflected upwards. This abrupt deflection is distinctly marked on the internal casts of the valves. Hinge line straight, finely crenulated, shorter than the greatest width of the shell. Cardinal extremities rounded. An impression of the interior shows part of the cardinal process, and the elongate septum extending more than half way to the anterior margin. Surface marked by fine, closely arranged, radiating striae.

Pedicle valve unknown.

Remarks—There are present in the collection studied only the interior and exterior impressions of the brachial valve. The form somewhat resembles *Strophoedonta linck-laeni* Hall, but is proportionately smaller, has a more pronounced semi-circular outline, more extended cardinal extremities, and with the hinge line shorter than the greatest width of the shell, and lacks the curvature of the lateral margins just below the cardinal angles.

Horizon—Lower beds.

Holotype and Paratype No. 27475 Walker Museum.

Stropheodonta cf. demissa (Conrad)

Plate 61, figure 18.

1842. *Strophomena demissa* Conrad, Jour. Acad. Nat. Sci., Phila., vol. 8, pl. 258, pl. 14, fig. 14.

1867. *Strophodonta demissa* Hall, Nat. Hist. N. Y. Pal., vol. 4, pp. 81, 101, pl. 11, figs. 14-17; pl. 12, figs. 1-5.

1913. *Stropheodonta demissa* Schuchert, Geol. Surv., Md. Low. Dev., p. 313, pl. 57, fig. 11.

Description—The only specimen referable to this species, a pedicle valve, is not entirely preserved and the identification is somewhat uncertain. Shell of medium size, sub-circular in outline, regularly and strongly concave. The dimensions are: Length

22 mm., width 26 mm. Hinge line long and straight, and equal to the greatest width of the shell. Surface marked with prominent, radiating, nodose costae, which increase by bifurcation and present a somewhat bunched and uneven appearance.

Remarks—This form has the general outline of *Stropheodonta demissa* Conrad, and the characteristic surface markings, but is more distinctly concave.

Horizon—Lower beds.

Figured specimens No. 27477 *Walker Museum.*

Stropheodonta cf. inequiradiata Hall

Plate 61, figures 19-20.

1887. *Strophomena* (*Strophodonta*) *inequiradiata* Hall, Tenth Rept. N. Y. State Cab. Nat. Hist., p. 113, figs. 1-3.
1861. *Strophomena inequistriata* Billings, Can. Jour. Sci. Arts, 6, p. 338, fig. 113.
Geol. of Canada, 1863, p. 367, fig. 375.
Pal. Fossils, 2, 1874, p. 24, fig. 13; pl. 2, fig. 4, p. 240.
1867. *Strophodonta inequiradiata* Hall, Pal. N. Y. vol. 4, p. 87, pl. 11, figs. 24-31; pl. 12, fig. 12; pl. 13, figs. 6-11.
Second Ann. Rept. N. Y. State Geol., 1883, pl. 45, figs. 13-14.
Walcott, Mon. U. S. G. S., vol. 8, 1884, p. 120, pl. 11, fig. 11.
1892. *Stropheodonta inequiradiata* Hall and Clarke, Nat. Hist. N. Y. Pal., vol. 8, pt. 1, pl. 14, figs. 13-14.

Two pedicle valves of a *Stropheodonta* have been observed which bear a marked resemblance to this Onondagan species. They are smaller than those figured in the New York reports, but exhibit the same semi-circular outline, high convexity, and the characteristic uneven and variable costae.

Horizon—Upper beds.

Figured specimens No. 27476 *Walker Museum.*

Genus Leptostrophia Hall and Clarke

Leptostrophia magnifica (Hall)

Plate 62, figures 1-3.

1857. *Strophodonta magnifica* Hall, Tenth Ann. Rept. N. Y. State Cab. Nat. Hist., pl 54.
1859. *Strophodonta magnifica* Hall, Nat. Hist. N. Y. Pal., vol. 3, pp. 414, 482, pl. 93, fig. 4; pl. 94, figs. 2a-2d; pl. 95, fig. 8; pl. 95a, figs. 15-19.
1859. *Strophodonta vascularia* Hall, *ibidem*, vol. 3, p. 412, pl. 92, fig. 4; pl. 95, fig. 10 (not pl. 93, figs. 2b, 2c=? *S. magniventra*), 1861.
1861. *Strophomena magnifica* Billings, Can. Jour. Sci. Arts, vol. 6, p. 348.
1863. *Strophomena magnifica* Billings, Geol. Canada, p. 961, fig. 468.
1883. *Strophodonta magnifica* Hall, Second Ann. Rept. N. Y. State Geol., pl. 44, figs. 27-28.
1892. *Stropheodonta* (*Leptostrophia*) *magnifica* Hall and Clarke, Nat. Hist. N. Y. Pal., vol. 8, pt. I, p. 288, pl. 13, figs. 27-28.
1900. *Leptostrophia magnifica* Clarke, Mem. N. Y. State Mus., vol. 3, No. 3, p. 53, p. 7, fig. 36.
1908. *Leptostrophia magnifica* Clarke, Mem. N. Y. State Mus., vol. 9, pt. 1, pp. 190-191, pl. 38, figs. 1-2; pl. 39, figs. 9-10.
1913. *Stropheodonta* (*Leptostrophia*) *magnifica* Schuchert, Geol. Surv., Md. Low. Dev., p. 318, pl. 58, figs. 2-5.

Description—Shell varying in size from medium to large, more or less semi-oval in shape, cardinal extremities usually well rounded, width a little greater than length,

or in some examples the length and width equal. The pedicle valve of an average sized individual measures 45 mm. from beak to anterior margin, and 50 mm. across the greatest width. The largest individual observed measures 75 mm. in length and 80 mm. in width.

Pedicle valve regularly convex, without median sinus. Beak flattened, inconspicuous, scarcely incurved over the hinge line. In the older individuals the surface of the shell in the pallial region is folded to form broad wrinkles. Large longitudinal muscle impressions are conspicuous in the casts of the interior, the divisions being marked off by distinct grooves, the whole scar fan-shape in outline.

Brachial valve from flat to slightly concave. The surface of the vascular area is characterized by numerous pustulose elevations, irregularly arranged, and which become faint towards the margins. The impressions of the two adductor muscle scars are sub-reniform in outline, and are separated by a low, rounded ridge.

The entire surface of both valves is marked by fine, radiating slightly flattened costae, with coarser concentric lines of growth crossing them. The costae vary considerably in size, and increase by bifucation and intercalation, the additions being most conspicuous a little below the beak. In exfoliated portions of the shell a distinct pitted structure is apparent, the pits arranged in longitudinal rows parallel to the striae.

Remarks—This species occurs abundantly in the Little Saline limestone, and is represented by separate valves only, pedicle valves and their casts being most frequent. The specimens agree closely with those from the Oriskany of New York and attain a similar size.

Horizon—Lower and upper beds.

Figured specimens No. 27474 *Walker Museum.*

Leptostrophia magniventra Hall

Plate 62, figures 4-5.

1857. *Strophodonta magniventra* Hall, Tenth Ann. Rept. N. Y. State Cab. Nat. Hist. p. 54.
1859. *Strophodonta magniventra* Hall, Nat. Hist. N. Y. Pal., vol. 3, p. 411, pl. 92, figs. 2a-2c, 3; pl. 95, fig. 9, 1861.
1859. *?Strophodonta lincklaeni* Hall, Nat. Hist. N. Y. Pal., vol. 3, pl. 93, fig. 2a (not figs. 3a, 3b=*S. lincklaeni*).
1859. *Strophodonta vascularia* Hall, Nat. Hist. N. Y. Pal., vol. 3, pl. 93, figs. 2b, 2c (not pl. 92, fig. 4; pl. 95, fig. 10=*S. magnifica*) 1861.
1861. *Strophomena magniventra* Billings, Can. Jour. Sci. Arts, vol. 6, p. 349.
1863. *Strophomena magniventra* Billings, Geol. Can., p. 961, fig. 469.
1874. *Strophomena magniventra* Billings, Pal. Fossils, vol. 2, p. 22, figs. 10-12, pl. 2, figs. 2-2a.
1892. *Stropheodonta* (*Leptostrophia*) *magniventra* Hall and Clarke, Nat. Hist. N. Y. Pal., vol. 8, pt. 1, p. 288, pl. 13, figs. 25-26.
1900. *Stropheodonta licklaeni* Clarke, Mem. N. Y. State Mus., vol. 3, No. 3, p. 52, pl. 7, fig. 37.
1913. *Stropheodonta* (*Leptostrophia*) *magniventra* Schuchert, Geol. Surv., Md. Low. Dev., p. 319, pl. 58, figs. 6-8.

Description—Shell elongate oval to semi-circular in outline, relative length and width variable. The dimensions of the only complete mature pedicle valve observed are: Length 41 mm., width 49 mm. The pedicle valve of a larger and probably older individual measures 50 mm. in length and approximately 60 mm. in width.

Pedicle valve of medium convexity, the surface sloping gradually and uniformly to the lateral and anterior margins with no fold or sinus. Hinge line slightly less than the greatest width of the shell, the greatest width a little posterior to the middle of the

shell. Beak broad, rounded, but little incurved. Crenulations on hinge line obscure. Cardinal extremities obtuse.

Surface marked with numerous, fine, rounded, radiating, bifurcating costae, which are separated by broader, flatter interspaces; in the middle of the shell 2 costae occupy the space of 1 mm. An exfoliated portion of the shell shows the elongate-oval adductor muscle impressions, and the large, plicated fan-shaped diductor muscular markings.

Hall describes the brachial valve as follows: "Dorsal valve (of this species) deeply concave, radiatingly striated, the striae finer than those of the ventral valve. The interior of the valve is marked by well-defined muscular areas; and outside of these the vascular and ovarian spaces occupy a large part of the shell, having a well-defined semi-elliptical area of a width little greater than the length, and somewhat contracted at the cardinal angles. The margin outside of the vascular area is striate-punctate."—Hall, 1859.

Remarks—One complete pedicle valve and three imperfect ones have come under my observation. None of the specimens show the elongated hinge line which characterizes some of the New York specimens. Swartz says: "*Stropheodonta magniventra* is easily distinguished from all associated Stropheodonta by its external ornamentation, i. e., by the few widely separated obscure striae on the ventral valve, and by the very delicate and exceedingly numerous striae of the dorsal valve. Another feature is the very high ventral cardinal area."—Swartz, 1913.

Horizon—Lower and upper beds.

Figured specimens No. 27473 *Walker Museum.*

Genus Brachyprion Shaler

Brachyprion cf. majus Clarke

Plate 62, figures 6. 7.

1874. *Strophomena inequiradiata* Billings, Pal. Fossils, vol. 2, pt. 1, p. 24 (not fig. 13), pl. 2, fig. 4.

1900. *Brachyprion majus* Clarke, Mem. N. Y. State Mus., vol. 3, p. 54, pl. 8, figs. 8-13.

1908. *Brachyprion majus* Clarke, Mem. N. Y. State Mus., vol. 9, pt. 1, p. 190, pl. 36, figs. 1-6.

Description—Shell of medium size, semi-circular to semi-elliptical in outline; length greater than width. The dimensions of the separate brachial and pedicle valves of different individuals are: Length 20 mm., width 28 mm., and length 16 mm., width 22 mm. The hinge line equals the greatest width of the shell, and is finely denticulate for about half its length.

Pedicle valve moderately convex, umbonal region broad and sloping abruptly to the posterior margin. Beak slightly elevated, flattened and incurved over the hinge line. Cardinal extremities sharply defined.

An interior of the brachial valve shows the valve to be moderately concave with a well defined mesial sinus which broadens a little toward the anterior margin. The surface exhibits a regularly marked pustulose character.

Surface of both valves marked by fine, radiating, irregular costae. These vary in size and increase by interstitial addition and by bifurcation, producing a fasciculate appearance. These are crossed by fine, concentric markings which have been poorly preserved in the specimens observed.

Remarks—The species is sparingly represented by one doubtful pedicle valve, and the internal casts of a few brachial valves. The form bears a stronger resemblance to *Brachyprion majus* Clarke of the Grand Greve limestone, Quebec, Canada, than to the same species in the Oriskany of Becraft mountain, New York. In the apparently mature forms the irregularity of the surface markings still persists giving the fasciculate appear-

ance, while in the New York specimens this is a feature of the immature forms only. The Little Saline specimens are considerably smaller than those from Quebec.

Horizon—Lower beds.

Figured specimens No. 27472 *Walker Museum.*

Brachyprion sp.

Plate 62, figures 8-10.

Description—Shell small, semi-circular to elongate oval. The dimensions of two brachial valves are: Length 12 mm., width 13 mm., and length 10 mm., width 11 mm.

Brachial valve deeply concave, hinge line straight, cardinal extremities rounded. The hinge line is finely crenulated, the crenulations extending over half the distance to the extremities. A cast of the interior shows the well-defined crural process, and the pustulose character of the surface. Exterior marked by numerous, irregular and unequal costae which are crossed by coarser concentric lines of growth.

Pedicle valve unknown.

Remarks—Impressions of the exterior of the brachial valve, and casts of the interior of the same valve have been observed. The species seems to be distinct from *Brachyprion schuchertanum* Clarke in that it is proportionately smaller and longer.

Horizon—Lower beds.

Figured specimens No. 27471 *Walker Museum.*

Genus Schuchertella Girty

Schuchertella sp.

Plate 62, figure 11.

Description—Shell of medium size, transversely elliptical, broader than long. The dimensions of a brachial valve are: Length approximately 31 mm., width 48 mm., the hinge line equal to the greatest width of the shell.

Pedicle valve moderately convex, the maximum convexity anterior to the umbonal region. From the middle, the surface the shell slopes toward the cardinal extremities in a manner to form a gently concave area upon each side. Surface marked by fine radiating costae, which increase by interstitial addition, there being about 20 in the space of 1 mm.

Remarks—One incomplete pedicle valve only occurs which is not certainly determinable.

Horizon—Lower beds.

Figured specimen No. 27470 *Walker Museum.*

Family Productidae

Genus Anoplia Hall and Clarke

Anoplia nucleata (Hall)

Plate 63, figure 5.

1857. *Leptaena nucleata* Hall, Tenth Ann. Rept. N. Y. State Cab. Nat. Hist., p. 47.
1859. *Leptaena nucleata* Hall, Nat. Hist. N. Y. Pal., vol. 3, p. 419, pl. 94, figs. 1a-1d, 1861.
1892. *Anoplia nucleata* Hall and Clarke, *ibidem*, vol. 8, pt. 1, p. 309, pl. 15a, figs. 17, 18; pl. 20, figs. 14-17.
1903. *Anoplia nucleata* Weller, Geol. Surv., N. J. Pal., vol. 3, p. 325, p. 41, fig. 9; p. 349, pl. 46, figs. 8-10.
1908. *Anoplia nucleata* Clarke, Mem. N. Y. State Mus., vol. 9, pt. 1, p. 211, pl. 41, figs. 15-17.

1913. *Anoplia nucleata* Schuchert, Geol. Surv. Md. Low. Dev., p. 340, pl. 61, figs. 22-24.

A single internal cast of a pedicle valve is the only specimen representative of this common Oriskany brachiopod. The dimensions are: Length 3 mm., width approximately 4 mm. The valve is extremely gibbous and exhibits the characteristic groove in the beak which extends almost to the middle of the shell. Surface features not preserved.

Horizon—Upper beds.

Figured specimen No. 27469 *Walker Museum.*

Genus Chonostrophia Hall and Clarke

Chonostrophia complanata (Hall)

Plate 63, figures 6-7.

1857. *Chonetes complanata* Hall, Tenth Ann. Rept. N. Y. State Cab. Nat. Hist., p. 56.
1859. *Chonetes complanata* Hall, Nat. Hist. N. Y. Pal., vol. 3, p. 418, pl. 93, fig. 1, 1861.
1892. *Chonostrophia complanata* Hall and Clarke, *ibidem*, vol. 8, pt. 1, p. 311, pl. 16, figs. 13-29.
1900. *Chonostrophia complanata* Clarke, Mem. N. Y. State Mus., vol. 3, No. 3, p. 50, pl. 7, figs. 1-13.
1908. *Chonostrophia complanata* Clarke, N. Y. State Mus., Mem. 9, pt. 1, p. 210, pl. 46, figs. 6-13.
1913. *Chonostrophia complanata* Schuchert, Geol. Surv., Md. Low. Dev., p. 341, pl. 62, figs. 1-2.

Description—Shell of medium size, broadly semi-circular in outline. The dimensions of an average sized pedicle valve are: Length 20 mm., width 24 mm. Another pedicle valve with a proportionately longer hinge line measures 17 mm. in length and 31 mm. in width. Hinge line equal to the greatest width of the shell; cardinal extremities acute.

Pedicle valve concave to nearly flat, slightly convex in the umbonal region, becoming gently concave toward the margins. Cardinal margin marked with a row of spines inclined towards the extremities on either side of the beak. Latter small, slightly incurved, scarcely elevated above the hinge line, apex pierced by a round foramen. The interior of the valve shows the strongly defined pustulose character of the surface.

On the exterior are fine, radiating, bifurcating costae, which are crossed by indistinct concentric lines of growth. In some cases minute concentric striae are preserved.

Remarks—This species is represented abundantly in the Little Saline beds by the exteriors and interiors of the pedicle valves, but in none of them are the cardinal spines well preserved. The specimens are generally smaller than in the New York Oriskany, resembling in this respect those from the Becraft mountain Oriskany, and those from the Grand Greve limestone, Gaspe, Quebec.

Horizon—Lower and upper beds.

Figured specimens No. 27468 *Walker Museum.*

Order Telotremata

Superfamily Rhynchonellacea

Family Rhynchonellidae

Genus Eatonia Hall

Eatonia peculiaris (Conrad)

Plate 62, figures 12-16.

1841. *Atrypa reticularis* Conrad, Geol. Surv., N. Y. Fifth Ann. Rept., p. 56.
1859. *Eatonia peculiaris* Hall, Nat. Hist. N. Y. Pal., vol. 3, p. 244, pl. 38, figs. 21-26; pl. 101, figs. 2a—g; pl. 101, fig. 2; pl. 101a, fig. 1.

1874. *Eatonia pecularis* Billings, Pal. Fossils, vol. 1, pt. 2, p. 40, pl. 3a, fig. 2, a-c.
1894. *Eatonis peculiaris* Hall and Clarke, Nat. Hist. N. Y. Pal., vol. 8. pt. 2, pl. 61, figs. 17-26.
1908. *Eatonia peculiaris* Clarke, Mem. N. Y. State Mus., vol. 9, pt. 1, p. 172, pl. 29, figs. 1-13.
1913. *Eatonis peculiaris* Schuchert, Geol. Surv., Md. Low. Dev., p. 372, pl. 65, figs. 23-28.

Description—Shell commonly small, and a little longer than wide, but in some specimens the length and breadth are the same. An average individual measures 17 mm. in length, and 15 mm in width. The dimensions of the largest specimen observed are: Length 25 mm., width 22 mm. Shell distinctly ovate in outline, the cardinal margins diverge from the beaks and form a flattened oval area on each side of the shell.

Pedicle valve depressed convex posteriorly from the middle of the shell toward the beak, but gently concave toward the margins of the cardinal slopes, where it becomes abruptly inflected. Anteriorly the valve is prolonged into a long linguiform extension.

Brachial valve convex, the surface sloping abruptly to the lateral margins. Toward the anterior margin the middle is elevated into a fold. Margins of both valves serrated, the serrations on the brachial more prominent than those on the opposite valve.

Surface of entire shell covered with fine, bifurcating striae, 5 to 6 of which occupy the space of 1 mm.

Remarks—This form, next to the Spirifers, is perhaps the most abundant fossil in the Little Saline beds, and it is the only species which occurs commonly with the two valves in articulation, complete specimens being found in a splendid state of preservation. Many of the shells are larger than those from the Oriskany beds of New York, and resemble rather in size those from the Grand Greve limestone of Gaspe, Canada, exhibiting a similar variation in shape and size.

This species is characterized by the linguiform projection of the anterior margin, the strong inflection of the pedicle valve along the cardinal slopes, and the serrated margins of the valves.

Horizon—Lower and upper beds.

Figured specimens No. 27467 Walker Museum.

Eatonia plicata sp. nov.

Plate 63, figures 1-4.

Description—Shell small, relative length and width variable, although the length is commonly greater than the width. The holotype which is an average-sized individual measures 13 mm. in length and 11 mm. across its greatest width which is slightly anterior to the middle of the shell. The form is elongate oval in outline, with the cardinal margins converging abruptly to the beak. Anterior margin serrated.

Pedicle valve depressed convex in the umbonal region, and flattening out towards the middle into a sinus which is prolonged into a long linguiform extension of the anterior margin. Toward the lateral margin the shell becomes inflected somewhat abruptly. Umbonal region scarcely differentiated; beak small, acute, incurved slightly, the apex pierced by a round foramen.

Brachial valve rather highly convex; near the anterior margin the middle becomes elevated into a fold. Umbonal region arched; the beak larger than in the opposite valve and more rounded.

Surface of both valves marked by simple radiating, coarse, angular plications, from 16 to 18 present on each valve, which are separated by deep narrow interspaces. The

plications increase rapidly in size toward the anterior margin. Near the postero-lateral margins the last two or three become obsolete.

Remarks—The exteriors of the separate valves occur. This species differs from *Eatonia peculiaris* Conrad, in its smaller size, in the presence of coarse angular plications, in the more broadly extended pedicle valve, and in the sharper mesial fold of the brachial valve.

Horizon—Lower beds.

Holotype and Paratypes No. 27466 *Walker Museum.*

Genus Uncinulus Bayle

Uncinulus parvus sp. nov.

Plate 63, figures 11-12.

Description—Shell small, sub-pentagonal in outline, length and width nearly equal, the postero-lateral margins meeting at the beak in an angle of 90 degrees or a little less. The dimensions of a perfect specimen, the hologype, are: Length 17 mm., width 17.5 mm., the greatest width midway between the beak and anterior margin. Cardinal extremities rounded.

Pedicle valve moderately convex, the most pronounced convexity in the region of the umbo; depressed anteriorly into a broad ill-defined sinus. Beak small, acute, elevated over the beak of the opposite valve.

Brachial valve a little more convex than the pedicle, elevated anteriorly into a scarcely perceptible mesial fold; beak incurved below that of the other valve.

Surface of each valve marked by about 18 simple, rounded plications, which become obsolete in the umbonal region, 6 of them included in the fold and sinus. Fine concentric striae and irregular lines of growth cross the plications. Lateral and anteriors margins of contact sharply serrated.

Remarks—Only one entire specimen of the above species, the holotype, has come under observation, but a separate pedicle valve is doubtfully referred to the same species. The species has been observed only in the upper beds, and is distinct from all the other Uncinulae present because of its small size, and the slight development of the fold and sinus. For these reasons one cannot be reasonably sure that it is a mature individual. The form resembles somewhat closely the figured specimen of *Uncinulus convexorus*[1] Maynard, fig. 14, but is entirely dissimilar to figs. 9-13 of the same species on which presumably the description is based.

Horizon—Upper beds.

Holotype No. 27463 *Walker Museum.*

[1]Maynard, T. P., Geol. Surv., Md. Low. Dev., pl. 65, figs. 9-14.

Uncinulus salinesis sp. nov.

Plate 63, figures 8-10

Description—Shell of medium size, sub-pentagonal in outline; width slightly greater than the length. The dimensions of the holotype are: Length 32 mm., width 35 mm., the maximum width anterior to the middle of the shell. The lateral margins conspicuously flattened and sharply serrated. The postero-lateral margins slope abruptly to the beaks, and are gently concave forming oval areas.

Pedicle valve depressed convex in the umbonal region, gradually flattening out to form a broad shallow sinus at the anterior margin, which projects in a linguiform extension, fitting into the mesial fold of the opposite valve. The surface slopes gradually to the lateral margins, where it turns abruptly forming a sharp angle, and meeting the brachial valve at right angles. Beak triangular, with acute apex, and apparently a

little elevated above the opposite. A cast of the interior shows a broad shallow depression extending half way to the anterior margin.

Brachial valve larger than the pedicle, and strongly convex to gibbous. Near the anterior margin it is elevated into a broad, sharply defined fold. At the lateral margins the shell becomes abruptly inflected, forming a flat area corresponding to a similar one on the other valve.

Surface of each valve marked with about 40 angular plications, the last two or three near the hinge becoming almost obsolete. Ten of the plications occupy the sinus. Indistinct concentric lines of growth are present.

Remarks—Two specimens referable to this species have been observed, one a nearly complete individual, the other a cast of the interior of the pedicle valve.

Horizon—Lower beds.

Holotype and Allotype No. 27464 *Walker Museum.*

Uncinulus welleri sp. nov.

Plate 63, figures 13-14.

Description—Shell of medium size, elongate oval, sub-pentagonal in outline. The dimensions of the holotype are: Length 30 mm., width 27 mm. Some specimens are larger, as much as 35 mm. in length, and 30 mm. in width. Shell characterized by flat and serrated lateral margins, and by gently concave postero-lateral margins which slope steeply to the beak.

Pedicle valve arched in the umbonal region, becoming strictly concave toward the anterior margin and forming a broad shallow sinus which becomes extended into a linguiform projection. Lateral margins inflected, forming flat lateral areas. Beak small, and incurved closely over that of the opposite valve.

Brachial valve highly convex, the anterior margin elevated into a scarcely perceptible fold. Toward the lateral margins the shell surface slopes abruptly, forming continuous flat areas with those produced by the inflection of the opposite valve. Beak sharply pointed, incurved below the other.

Surface of both valves marked with 40 to 50 simple angular plications, which are separated by deep, narrow furrows. Seven plications occupy the sinus.

Remarks—Only a few examples of this species have been observed. It may be distinguished from *Uncinulus salinensis* by its more elongate form, and by the less prominent fold and sinus. The species resembles *Uncinulus nobilis* Hall from the Helderbergian of New York, and may be a later development of that form, but it differs in being larger, in having a greater number of plications, and a flatter and less sharply marked mesial sinus.

Horizon—Lower beds.

Holotype and Paratype No. 27465 *Walker Museum.*

Name—This fossil has been named after Professor Stuart Weller, of the Department of Paleontology, University of Chicago.

Genus Plethorhyncha Hall and Clarke

Plethorhyncha barrandii (Hall)

Plate 63, figures 15-16.

1857. *Rhynchonella barrandii* Hall, Tenth Ann. Rept. N. Y. State Cab. Nat. Hist., p. 82, figs. 1-3; pl. 84, fig. 4.

1908. *Plethoryncha barrandii* Clarke, Mem. M. Y. State Mus., vol. 9, pt. 1, p. 171, pl. 28, figs. 16-17.

1913. *Camarotoechia* (*Plethoryncha*) *barrandii* Schuchert, Geol. Surv., Md. Low. Dev., p. 359, pl. 64, figs. 2-3.

Description—Shell large, sub-oval in outline, strongly convex, length usually greater than the width. A medium sized brachial valve measured 53 mm. in length and 40, mm. in width. The dimensions of the pedicle valve of another individual are: Length 45 mm., width 36 mm., the greatest width anterior to the middle of the shell. The lateral margins of both valves are conspicuously flattened.

Pedicle valve depressed convex, the greatest convexity just below the umbonal region. Near the anterior margin a broad shallow sinus is developed. Whether this is extended into a linguiform projection as described by Hall cannot be ascertained from the imperfect material at hand. The sides of the sinus curve upwards forming sharp lateral margins, the sides of which slope abruptly to meet the opposite valve. Beak pointed and only slightly incurved.

Brachial valve convex to gibbous. The shell surface slopes uniformly from the middle towards the lateral margins, then turns abruptly, meeting the other valve at right angles. Beak incurved more than that of the pedicle valve.

Surface of each valve marked with about 40 radiating, angular plications, and several indistinct ones near the postero-lateral margins. Intervening spaces narrow.

Remarks—A limited number of separate valves have come under observation. They are distinguished from the other species of *Plethorhyncha* with which they are associated by their larger size, and their coarser plications. With the exception of one fragment none of the specimens attain the proportions of the larger New York specimens.

Horizon—Lower beds.
Figured specimens No. 27461 *Walker Museum.*

Plethorhyncha principalis (Hall)

Plate 64, figures 1-3.

1856. *Rhynchonella principalis* Hall, Regents Rept., p. 84, Paleozoic Fossils, 1857, p. 44.
1859. *Rhynchonella principalis* Hall, Nat. Hist. N. Y. Pal., vol. 3, p. 443, pl. 106, fig. 4.

Description—Shell large, elongate oval, relative length and width variable. The dimensions of an average sized pedicle valve are: Length 45 mm., width 38 mm., the greatest width anterior to the middle of the shell.

Pedicle valve depressed convex, arched in the umbonal region, in some specimens forming a broad median ridge, the surface gradually flattening out toward the anterior margin to form a broad, shallow sinus. The shell surface slopes uniformly from the middle and forms sharp, lateral margins as it becomes abruptly inflected to produce flat, lateral areas. Beak flat, acute, slightly incurved.

Brachial valve convex to gibbous, flattening somewhat towards the anterior margin. Lateral margins abruptly incurved to meet the opposite valve at right angles. Beak arched and incurved more strongly than the beak of the pedicle valve.

Surface of each valve marked with from 60 to 80 radiating plications, which are exceedingly fine near the beak. These are crossed by faint, concentric growth lines.

Remarks—This species occurs abundantly in the Little Saline limestone, and is commonly represented by somewhat fragmental separate valves. This species is closely allied to *Plethoryncha barrandii* Hall, and in many cases it is almost impossible to draw a line of demarcation between the two species, one grading imperceptibly into the other. In general, however, this species may be distinguished by its smaller size, by the finer plications, and by the proportionately broader brachial valve.

Horizon—Lower and upper beds.
Figured specimens No. 27460 *Walker Museum.*

Superfamily Terebratulacea

Family Centronellidae

Genus Centronella Billings

Centronella glansfagea (Hall)

Plate 64, figures 4-7.

1857. *Rhynchonella glansfagea* Hall, N. Y. State Cab. Nat. Hist., Tenth Ann. Rept., p. 125, figs. 1-6.
1867. *Centronella glansfagea* Hall, Nat. Hist. N. Y. Pal., vol. 4, p. 399, pl. 61a, figs. 1-21, 25-26.
1908. *Centronella glansfagea* Clarke, Mem. N. Y. State Mus., vol. 9, pt. 1, p. 163, pl. 25, figs. 1-4.

Description—Size of shell variable, small to medium, sub-quadrate or spoon-shaped, the cardinal margins sloping abruptly to the beaks; length greater than the width, the maximum width about midway between the beak and anterior margin. The dimensions of two different individuals are: Length 20 mm., width 14 mm. and length 14 mm., width 10 mm.

Pedicle valve larger than the brachial, convex, usually sub-carinate along the middle, the surface sloping steeply to the lateral margins. Beak considerably elevated above that of the opposite valve, abruptly curved, and extended in a horizontal plane so that the apex lies well beyond the brachial valve.

Brachial valve smaller than the pedicle, depressed convex, towards the anterior margin becoming flatter and forming a faintly defined mesial sinus which includes the entire width of the shell. A small extremely carinated specimen shows a well defined sinus extending from beak to anterior margin. Beak small, incurved below the opposite.

Surface smooth, shell substance very finely punctate. The concentric lines of growth are especially prominent on the brachial valve.

Remarks—The few specimens studied seem to be fairly constant in their characters, and show no marked deviation from the New York examples.

Horizon—Upper beds.

Figured specimens No. 27507 *Walker Museum.*

Genus Rensselaria Hall

Rensselaeria ovoides (Eaton)

Plate 64, figures 8-12.

1832. *Terebratula ovoides* Eaton, Geological Textbook, p. 45.
1859. *Rensselaeria ovoides* Hall, Nat. Hist. N. Y. Pal., vol. 3, p. 456, pl. 104, figs. 1-4; pl. 105, figs. 1-6.
1900. *Rensselaeria ovoides* Clarke, Mem. N. Y. State Mus., vol. 3, No. 3, p. 39, pl. 5, figs. 17-19.

Description—Shells varying in size from medium to large, but in no case do they attain the large proportions of the New York examples. Some specimens are extremely gibbous, others less so. Both valves are incurved toward the lateral margins, and produce a conspicuous flattening of the shell. There is a distinct variation from elongate-oval or spatula-shaped gibbous forms to shorter and less gibbous ones. An average mature specimen is considerably longer than broad and measures about 62 mm. in length, and 40 mm. across its greatest width which is well above the middle of the shell. The dimensions of a smaller individual, and this size seems to be abundant, are: Length 35 mm., width 20 mm.

Pedicle valve commonly strongly convex transversely, the greatest convexity in the region of the greatest width. Shell surface sloping uniformly from the middle towards the lateral margins to near the edge where it becomes abruptly inflected, and bends almost at right angles toward the other valve. Beak fairly high, closely incurved over the umbo of the opposite valve.

Brachial valve less convex than the pedicle, the surface sloping more gently to the lateral margins, but near the edge being deflected in a similar manner. Beak less elevated than the beak of the pedicle valve.

Surface of both valves marked by fine, radiating costae, 3 occupying the space of 1 mm. These are crossed by conspicuous concentric growth lines, which show clearly the outline of the shell at various ages.

Remarks—This species which occurs abundantly in the Little Saline limestone, is represented by both entire specimens and by the separate valves. Due to the condition of preservation the punctate shell structure so characteristic of this genus has not been observed in any of the specimens studied. The species is distinguished by the distinct spatula-shaped shell, the high convexity of both valves particularly the pedicle, and the flattened character of the lateral margins in mature individuals.

Horizon—Lower and upper beds.

Figured specimens No. 27506, *Walker Museum.*

Rensselaeria cf. stewarti Clarke

Plate 64, figures 13-15

1907. *Rensselaeria stewarti* Clarke, Mem. N. Y. State Mus. No. 107, p. 239.
1908. *Rensselaeria stewarti* Clarke, Mem. N. Y. State Mus. No. 9, pt. 2, p. 38, pl. 7, figs. 10-20.

Description—Shell of medium size, usually broader than long, semi-circular in outline. An average individual measures 29 mm. in length and 31 mm. in width. Hinge line equal to the greatest width. Cardinal margins sloping abruptly from the beaks, and terminating in rounded extremities.

Pedicle valve convex, the maximum convexity in the umbonal region, from which the surface slopes uniformly, gradually flattening out toward the anterior and lateral margins. Beak high, triangular, incurved over the hinge line.

Surface marked with simple radiating plications, these gradually diminish in size toward the posterior margin until well above the middle of the shell they become obscure and apparently disappear. In some specimens the plications persist throughout the whole length of the shell. In general one plication occupies the space of 1 mm., at the anterior margin. Posterior to the middle, there are two and sometimes even three in 1 mm. The plications are crossed by coarser, concentric growth lines.

Remarks—This species is represented by the exteriors of the pedicle valve. It resembles *Rensselaeria stewarti* Clarke, from the Dalhousie beds of New Brunswick, Canada, but has a less convex pedicle valve, and a less prominent umbonal region. The species also resembles *Rensselaeria atlantica* Clarke, which occurs in the Chapman sandstone immediately above the Dalhousie beds and it may prove to be more closely allied to this form than to the former. Since many of the Little Saline species are identified with forms in the Grand Greve limestone which is a higher horizon than the Chapman, it would seem plausible that the present form may agree more closely with the form in the higher horizon.

Horizon—Lower and upper beds.

Figured specimens No. 27505, *Walker Museum.*

Genus Beachia Hall and Clarke

Beachia suessana (Hall)

Plate 64, figures 16, 17

1857. *Meganteris suessana* Hall, Tenth Ann. Rept. N. Y. State Cab. Nat. Hist., p. 100.

1859. *Rensselaeria suessana* Hall, Nat. Hist. N. Y. Pal., vol. 3, p. 459, pl. 107, figs. 1-15, 1861.

1913. *Rensselaeria (Beachia) suessana* Schuchert, Geol. Surv., Md. Low. Dev., p. 387, pl. 67, figs. 7-15.

Description—Shell of medium size, a little longer than wide, elongate oval in outline, both shape and size being somewhat variable. The dimensions of an average sized individual are: Length 27 mm., width 25 mm., the greatest width well below the hinge line. Posterior margins sloping somewhat abruptly from the beaks, and terminating in rounded cardinal extremities. Lateral margins of both valves abruptly inflected.

Pedicle valve moderately convex, the greater convexity across the middle of the shell. From the median line the shell slopes uniformly to the margins. Beak small, angular, and well elevated above the opposite valve; apex pierced by a round foramen.

Brachial valve about equally convex with the pedicle, the beak small, inconspicuous, and incurved slightly.

The radiating markings which characterize *Beachia suessana* Hall, from the New York Oriskany seem to be almost always absent in the specimens studied, probably due to the condition of preservation, but a few obscure ones have been noticed. Concentric growth lines mark the shells, these being most prominent near the anterior margin. Punctuate shell structure poorly preserved.

Remarks—Entire specimens and the separate valves occur. These correspond closely to *Beachia suessana* Hall, but differ in having more distinctly rounded anterior margins. There is also a close resemblance to *Beachia amplexa* Clarke, from the Grand Greve limestone of the Gaspe region, but all the specimens which have come under observation are considerably smaller than the former.

This species in characterized by the inflected lateral margins, and the depressed convex valves.

Horizon—Lower beds.

Figured specimens No. 27504, Walker Museum.

Beachia ovalis (Hall)

Plate 65, figure 1

1857. *Meganteris ovalis* Hall, Tenth Ann. Rept. N. Y. State Cab. Nat. Hist., p. 101.

1859. *Rensselaeria ovalis* Hall, Nat. Hist. N. Y. Pal., vol. 3, p. 458, pl. 106, figs. 2a-l, 1861.

1913. *Rensselaeria (Beachia) ovalis* Schuchert, Geol. Surv., Md. Low. Dev., p. 389, pl. 67, figs. 17-19.

Description—Shell longitudinally ovate, with a well-rounded anterior margin. The dimensions of an nearly perfect specimen are: Length 42 mm., width 36 mm., the greatest width anterior to the middle of the shell. Lateral margins of both valves strongly inflected.

Pedicle valve depressed convex, the most prominent depression along the middle. Beak well elevated above the hinge line and over the beak of the opposite valve.

Brachial valve about equally convex with the pedicle, but less prominent along the middle. Beak lower than that of the opposite valve and incurved below it.

The simple, radiating costae, which are characteristic of the New York specimens have not been observed. Due to the absence of the original shell surface and the punctate shell structure has also been destroyed.

Remarks—Only one imperfect specimen occurs in the collection. In contrast with the New York specimens it has a more broadly extended anterior margin, and more acute cardinal angles.

Horizon—Lower beds.

Figured specimen No. 27503, *Walker Museum.*

Superfamily Spiriferacea

Family Atrypidae

Genus Atrypa Dalman

Atrypa reticularis (Linne)

Plate 65, figure 2

1767. *Anomia reticularis* Linne, Systema Naturae, ed. 12, tome i, p. 1132.
1852. *Atrypa reticularis* Hall, Nat. Hist. N. Y. Pal., vol. 2, p. 72, pl. 23, fig. 8; pl. 270. pl. 55, fig. 5.
1913. *Atrypa reticularis* Maynard, Geol. Surv., Md. Low. Dev., p. 393, pl. 67, figs. 26-28.

This very common Silurian and Devonian brachiopod has not been found in the lower beds of the Little Saline limestone. It is represented in the upper beds by a few imperfectly preserved brachial valves. The dimensions of the largest valve observed are: Length 30 mm., width 29 mm. Other examples are considerably smaller. The valves are moderately convex, and the surface is marked by radiating costae which increase by intercalation. These are crossed by concentric lamellae, usually indistinctly preserved, and giving the characteristic reticulated or decussated appearance. The characters of the few specimens observed seem to be fairly constant.

Horizon—Upper beds.

Figured specimen No. 27502, *Walker Museum.*

Family Spiriferidae

Genus Spirifer Sowerby

Spirifer arenosus (Conrad)

Plate 65, figures 6-8

1839. *Dethyris arenosus* Conrad, Third Ann. Rept. N. Y. Geol. Surv., p. 65.
1859. *Spirifer arenosus* Hall, Nat. Hist. N. Y. Pal., vol. 3, p. 425, pl. 98, figs. 1-8; pl. 99, figs. 1-10; pl. c, figs. 1-8.
1908. *Spirifer arenosus* Clarke, Mem. N. Y. State Mus., vol. 9, pt. 1, p. 179, pl. 33, figs. 1-10.
1913. *Spirifer arenosus* Schuchert, Geol. Surv., Md. Low. Dev., p. 415, pl. 71, figs. 1-9; pl. 72, fig. 1.

Description—Shell attaining large size, usually broader than long. The dimensions of an average individual are: Length 50 mm., width 60 mm. Umbonal region wide, beak considerably elevated above the hinge line; in the younger forms this elevation is not so conspicuous. The cardinal extremities in the older individuals commonly well rounded.

Pedicle valve convex, with a wide shallow mesial sinus, which is almost obsolete, in some specimens being little more than a flattening of the surface along that part of the shell. At the apex it includes a single plication, which dichotomizes, until at the anterior margin it is occupied by 5 or 6 plications.

Brachial valve about equally convex with the pedicle. It is characterized by a mesial fold, which presents a more prominent feature than the sinus. The fold starts as a

single plication near the apex, which dichotomizes until at the margin it is represented by 5 or 6 plications.

Surface on each side of the fold and sinus marked by 15 to 20 broad, flattened, simple ribs, separated by flat interspaces. The ribs decrease in size as the cardinal margins are approached.

Remarks—This common Oriskany species occurs abundantly in the Little Saline limestone. The plicated fold and sinus are a distinguishing characteristic of the species. The shells do not display so great variability as does the associated *Spirifer murchisoni* and there seems to be no important differences from the New York examples.

Horizon—Lower and upper beds.

Figured specimens No. 27501, *Walker Museum.*

Spirifer murchisoni Castelnau

Plate 65, figures 9-11

1843. *Spirifer murchisoni* Castlenau, Essai Syst. Sil. l'Amer. Septent., p. 41, pl. 12, figs. 1-2.

1859. *Spirifer arrectus* Hall, Nat. Hist. N. Y. Pal., vol. 3, p. 422, pl. 97, figs. 1a-1h, 2a-ai, pl. 430, 1861.

1908. *Spirifer murchisoni* Clarke, Mem. N. Y. State Mus., vol. 9, pt. 1, pl. 177, pl.. 32, figs. 1-10.

1913. *Spirifer murchisoni* Schuchert, Geol. Surv., Md. Low. Dev., p. 411, pl. 70, figs. 1-5.

Description—Shell of medium size or larger, width greater than length, the greatest width along the hinge line. The most common type is a rather broadly extended shell, with regular curving sides. The dimensions of a complete individual are: length 25 mm., width 45 mm.

Pedicle valve convex, characterized by a fairly wide, shallow, mesial sinus, which flattens out toward the anterior margin.

Brachial valve equally convex with the pedicle, the middle portion elevated into an acute fold; beak incurved beyond the hinge line.

Eight or nine strong, regularly rounded plications, with two or three indistinct ones near the cardinal angles are present on each lateral slope of the valves. The intervening grooves are also rounded. Surface ornamented by fine, closely arranged, radiating striae, which are crossed by concentric striae.

Remarks—The separate valves usually occur, entire individuals are uncommon. The shells exhibit considerable variation in the size, width and depth of sinus, height of fold, angularity and strength of plications, but these differences do not seem to be constant enough to warrant a division into separate species. In general the Little Saline specimens correspond with the same species occurring in the Grand Greve limestone of the Gaspe region.

Horizon—Lower and upper beds.

Figured specimens No. 27500, *Walker Museum.*

Spirifer cf. varicosa Hall

Plate 65, figure 12

1857. *Spirifer varicosa* Hall, Tenth Rept. on the State Cab., p. 130.

1867. *Spirifer varicosa* Hall, Nat. Hist. N. Y. Pal., vol. 4, p. 205, pl. 31, figs. 1-4.

Description—Two fragmentary brachial valves have been observed which may be compared with this Onondagan species. The strongly elevated mesial fold with flattened summit, and the characteristic surface markings constitute the distinguishing marks of the species.

Horizon—Upper beds.

Figured specimens No. 27499, *Walker Museum.*

Genus Metaplasia Hall and Clarke

cf. Metaplasia pyxidata Hall

Plate 65, figure 14

1859. *Spirifer pyxidata* Hall, Nat. Hist. N. Y. Pal., vol. 3, p. 428, pl. 100, figs. 9-12, 1861.

1913. *Metaplasia pyxidata* Schuchert, Geol. Surv., Md. Low. Dev., p. 422, pl. 72, figs. 11-12.

Description—Shell small, length less than the width, the hinge line equal to the greatest width of the shell; sub-elliptical in outline. The dimensions of a pedicle valve are: Length 6 mm., width approximately 7 mm.

Pedicle valve highly convex, elevated along the middle line into a pronounced median fold with narrow sinus along the summit. Beak prominent, blunt and incurved. Surface essentially smooth.

Remarks—The pedicle valve of a small brachiopod resembles this species somewhat closely, but since there is nothing present in the collection to represent the brachial valve, and since the specimen is incomplete no certain identification can be made. This specimen studied differs from the figured specimens from New York and Maryland. (1) in being considerably smaller, (2) in having a more prominent beak, (3) in having steeply sloping postero-lateral margins, and (4) in having a total absence of surface striations.

Horizon—Upper beds.

Figured specimen No. 27498, *Walker Museum.*

Family Suessidae

Genus Cyrtina Davidson

Cyrtina rostrata Hall

Plate 65, figure 13

1857. *Cyrtia rostrata* Hall, Tenth Ann. Rept. N. Y. State Cab. Nat. Hist., p. 64.

1859. *Cyrtia rostrata* Hall, Nat. Hist. N. Y. Pal., vol. 3, p. 429, pl. 96, figs. 1-6; pl. 98, figs. 8a-8b, 1861

1908. *Cyrtina rostrata* Clarke, Mem. N. Y. State Mus., vol. 9, pt. 1, p. 183, pl. 31, figs. 25-28.

1913. *Cyrtina rostrata* Schuchert, Geol. Surv., Md. Low. Dev., p. 423, pl. 71, figs. 10-16.

Description—The only example at hand is an incomplete brachial valve which undoubtedly belongs to this species. Shell small, semi-circular in outline. The dimensions are: Length 10 mm., width approximately 17 mm., the hinge line being equal to the greatest width of the shell. Shell almost flat, or depressed convex, with a conspicuously marked, slightly flattened mesial fold, which increases in width from the beak to the anterior margin. Beak small and incurved a little over the hinge line. The surface on each side of the fold is marked with 6 or 8 radiating plications, which are crossed by finer, concentric, sharply zigzag lines.

Remarks—Sufficient portion of the brachial valve is present to demonstrate the outstanding features of this species—the semi-circular outline of the shell, the long, straight hinge line, and the coarse, radiating plications.

Horizon—Lower beds.

Figured specimen No. 27495, *Walker Museum.*

Family Rhynchospiridae

Genus Rhynchospira Hall

Rhynchospira attenuata sp. nov.

Plate 65, figure 3

Description—The collection contains a single nearly complete pedicle valve of a Rhynchospira, which belongs to an undescribed species. Shell of medium size, longitudinally subovate, postero-lateral margins converging gradually to the beak. The dimensions are: Length 14 mm., width 11 mm. Beak elongate, acute, apex perforated by a round foramen.

Surface marked by 10 to 12 simple, coarse, angular plications.

Brachial valve unknown.

Remarks—This form is unlike any described species of the genus in the extremely elongate and attenuate beak, and the more coarsely plicate surface.

Horizon—Upper beds.

Holotype No. 27497, *Walker Museum.*

Trematospira multistriata (Hall)

Plate 65, figures 4, 5

1857. *Spirifer multistriata* Hall, Tenth Ann. Rept. N. Y. State Cab. Nat. Hist., p. 59, figs. 1-6.

1859. *Trematospira multistriata* Hall, Nat. Hist. N. Y. Pal., vol. 3, p. 209, pl. 24, figs. 3a-3f; pl. 28a, figs. 5a-5f.

1900. *Trematospira multistriata* Clarke, Mem. N. Y. State Mus., vol. 3, No. 3, p. 43, pl. 6, figs. 1-4.

1913. *Trematospira multistriata* Schuchert, Geol. Surv., Md. Low. Dev., p. 428, pl. 73, figs. 3, 4.

Description—Shell of medium size, transversely oval in outline, cardinal extremities rounded. The dimensions of two separate valves are: Pedicle, length 19 mm., width 25 mm.; brachial, length 18 mm., width approximately 22 mm., the greatest width a little in front of the hinge line.

Pedicle valve moderately convex, with an ill-defined mesial sinus, which is broad and shallow at the anterior margin, but towards the beak becomes narrow and almost obsolete. Beak small, blunt, incurved over that of the opposite valve; apex pierced by a round foramen.

Brachial valve slightly more convex than the pedicle, the middle portion elevated into a scarcely perceptible fold which broadens anteriorly. Beak small, closely incurved below the other.

Surface of both valves marked by numerous prominent, angular, radiating plications; these bifurcate at regular intervals, each one usually twice in passing from the beak to the anterior margin, hence giving the surface a fasciculate appearance. Concentric lines of growth across the shell.

Remarks—This characteristic Helderbergian form is represented in the Little Saline fauna by a few separate valves but among the specimens studied none attain the large size of the full-grown New York examples as figured by Hall. In size, and in the number and coarseness of the plications, they seem to be more closely allied with the southern examples figured in the Maryland reports.

Horizon—Upper beds.

Figured specimens No. 27496, *Walker Museum.*

Family Meristellidae

Genus Nucleospira Hall

Nucleospira cf. ventricosa (Hall)

Plate 66, figures 1-3

1857. *Spirifer ventricosa* Hall, Tenth Ann. Rept. N. Y. State Cab. Nat. Hist., p. 57.
1859. *Nucleospira ventricosa* Hall, Nat. Hist. N. Y. Pal., vol. 3, p. 220, pl. 14, fig. 1; pl. 28b, figs. 2-9, 14, 1861.
1913. *Nucleospira ventricosa* Schuchert, Geol. Surv., Md. Low. Dev., p. 430, pl. 73, figs. 10-12.

Description—Shell small, transversely oval in outline. The dimensions of an imperfect brachial valve are: Length approximately 9 mm., width 11 mm. A smaller brachial valve measures 6 mm. in length and 8 mm. in width. The cardinal margins slope abruptly from the beaks, and terminate in well rounded extremities.

Brachial valve convex, median portion most elevated, and marked with a shallow sinus extending from the beak to the anterior margin. Beak pointed, moderately elevated. Surface marked by indistinct concentric growth lines.

Concerning the pedicle valve Hall says: "Ventral valve having a narrow sinus extending down the centre from beak to base; beak projecting above the other, strongly incurved and pointed (in many specimens the beaks are nearly equal)"—Hall, 1859.

Remarks—Three or four fragmentary brachial valves have been observed in the collection, which resemble *Nucleospira ventricosa* Hall, from the New Scotland beds of New York, and they are undoubtedly a later expression of that species. Except that the specimens observed possess more steeply sloping cardinal margins there seems to be no important variation from this New Scotland species.

Horizon—Lower beds.

Figured specimens No. 27494, *Walker Museum.*

Genus Meristella Hall

Meristella ampla sp. nov.

Plate 66, figures 9-11

Description—Shell from medium size to large, sub-quadrate in outline, relative length and width variable, but generally the width slightly greater than the length. The dimensions of the holotype, which is an average sized brachial valve are: length 36 mm., width 37 mm. Cardinal margins slope steeply to the beaks, extremities rounded.

Pedicle valve moderately convex, the greatest convexity in the umbonal region, apparently flattened anteriorly. Beak broad and flat, incurved slightly. A cast of the interior shows a large, strongly defined muscular area which is longitudinally striate. A long narrow process projects from the muscular platform to the beak. The region surrounding the muscular area is rugose.

Brachial valve more convex than the opposite, maximum convexity in the umbonal region, and a flattening occurs anteriorly similar to that of the opposite valve. Beak incurved slightly.

Surface of both valves essentially smooth with faint lines of growth.

Remarks—This form is represented by the separate valves only. It resembles *Meristella sub-quadrata* Hall, but has a less distinctly quadrate outline, the pedicle valve is less convex, and the anterior margin more broadly rounded. It differs from associated species in the larger size of the full-grown examples, and in the greater tendency to quadrate outline.

Horizon—Lower beds.

Holotype and Paratypes No. 27487, *Walker Museum.*

Meristella carinata sp. nov.

Plate 66, figures 12-21

Description—Shell of medium size, sub-quadrate in outline, relative length and width variable, sometimes equal. The dimensions of a perfect individual, the holotype, are: Length 23 mm., width 24 mm. Hinge line less than the greatest width of the shell. Cardinal margins gently concave, forming depressed oval areas on both sides of the beak; extremities rounded.

Pedicle valve sub-quadrate in outline, arched from beak to base, depressed convex to about the middle, and then becoming somewhat concave to form a broad, shallow sinus, which at the anterior margin is projected into an acute linguiform extension. Beak elevated, rounded, and closely incurved over the brachial beak. An impression of the interior shows the large and strongly defined, fan-shaped muscular impressions.

Brachial valve strongly convex to gibbous, the median portion elevated into a sharply sub-carinated or rounded fold, which in some specimens is especially well defined at the anterior margin. From the fold the sides slope steeply to the lateral margins. Beak incurved below that of the opposite valve. The interior shows the impression of a narrow median septum extending over half way to the base.

Surface of both valves marked by concentric lines of growth, which are paralleled by numerous finer striations.

Remarks—This is a common species in the collection, and is represented by entire specimens and by individual valves. It approaches *Meristella lata* Hall, of the New York Oriskany, but differs in its smaller size, in the more sharply defined median portion of the brachial valve, in the more depressed pedicle valve, and in the projection of the sinus into linguiform extension. This form is especially characterized by the carinated brachial valve, and this feature distinguishes it from associated species.

Horizon—Lower beds.

Holotype and Paratypes No. 27492, *Walker Museum.*

Meristella elliptica sp. nov.

Plate 66, figures 4, 5

Description—Shell of medium size, elongate elliptical in outline, length considerably greater than the width. The dimensions of two perfect pedicle valves are: Length 28 mm., width 22 mm., and length 23 mm., width 19 mm., the maximum width midway between the beak and anterior margin.

Pedicle valve moderately convex, no indication of sinus, but a slight flattening of the shell is visible toward the rounded anterior margin. Beak prominent, incurved, apparently acute. Surface marked by fine concentric growth lines which are especially prominent near the base.

Brachial valve unknown.

Remarks—The species approaches *Meristella laevis* Hall, but differs in its more elongate form, and in the absence of a sinus.

Horizon—Lower beds.

Holotype and Paratypes No. 27490, *Walker Museum.*

Meristella ovalis sp. nov.

Plate 66, figures 6-8

Description—Shell of medium size, transversely oval in outline, usually broader than long. The dimensions of two separate valves are: Length 21 mm., width 25 mm., and length 14 mm., width 16 mm., the maximum width midway between the beak and anterior margin, or slightly anterior to the middle.

Brachial valve moderately convex, the greatest convexity in the umbonal region. Surface of the shell sloping uniformly to the lateral and broadly rounded anterior margins. Beak broad and incurved a little. Surface smooth except for the fine lines of growth which become more prominent near the base of the shell.

Pedicle valve unknown.

Remarks—The species of Meristella present a somewhat perplexing problem because the variation within each species is so great, and the gradation from one to another is so complete that a separation of the forms is difficult. The difficulty of separating the species is increased because so few entire specimens occur, the separate valves being most common, and no pedicle valve can at present be linked with the brachial valve here described with any degree of certainty.

These brachial valves bear a marked resemblance to those of *Meristella bella* Hall, but differ in being less gibbous, and in the absence of a mesial sinus which is a feature of that species, and which causes an emarginate outline of the front, not noticeable here.

Horizon—Lower beds.

Holotype and Paratypes No. 27489, *Walker Museum.*

Family Coelospiridae

Genus Anoplotheca Sandb.

Anoplotheca dichotoma (Hall)

Plate 66, figures 22-25

1859. *Leptocoelia dichotoma* Hall, Nat. Hist. N. Y. Pal., vol. 3, p. 452, pl. 103, b, figs. 3a-3c.

1913. *Anoplotheca dichotoma* Schuchert, Geol. Surv., Md. Low. Dev., p. 435, pl. 73, figs. 24-26.

Description—Shell small, concavo-convex, generally ovate. The dimensions of a somewhat imperfect pedicle valve are: Length 8 mm., width approximately 9 mm. The brachial valve of a different individual measures 7 mm. in length and 8 mm. in width.

Pedicle valve strongly convex, the middle elevated into a fold, from which the surface slopes abruptly to the lateral margins, and less steeply to the anterior margin. Greatest elevation in the umbonal region. Beak elevated above the hinge line, and notably incurved.

Brachial valve flattened at the postero-lateral margins, and near the beak depressed into a narrow sinus which becomes broad and shallow near the base of the shell.

Surface of both shells marked by radiating plications, which are imperfectly preserved. According to Hall "The surface is marked by dichotomizing plications, the central one of the dorsal valve becoming tripartite, and the three lateral, which are simple to their original, bifurcating and making 6 at the margin of the shell. On the central valve there are two smaller plications in the centre, and a dichotomizing one on each side; concentrically marked by a few imbricating lines of growth."—Hall, 1859.

Remarks—About half a dozen separate valves have been observed. They are smaller than the New York forms, and show the surface characters only indistinctly. The ovate outline, the highly convex to sub-carinate pedicle valve, and the plano-convex brachial valve with broad shallow sinus, are distinct features of the species which the specimens exhibit.

Horizon—Lower beds.

Figured specimens No. 27484, *Walker Museum.*

Anoplotheca flabellites (Conrad)

Plate 66, figures 26, 27

1841. *Atrypa flabellites* Conrad, Fifth Ann. Rept. N. Y. Geol. Surv., p. 55.

1859. *Leptocoelia flabellites* Hall, Nat. Hist. N. Y. Pal., vol. 3, p. 449, pl. 106, figs. 1a-1f; pl. 103b, figs. 1a-1f, 1861.

1913. *Anoplotheca (Leptocoelia) flabellites* Schuchert, Geol. Surv., Md. Low. Dev., p. 438, pl. 73, figs. 29-33.

Description—Shell of medium size, usually broader than long, from sub-oval to semi-circular in outline. The pedicle valve of an average sized individual measures 11 mm. from beak to anterior margin, and 13 mm. along the hinge line which is equal to the greatest width.

Pedicle valve convex, the maximum convexity along the middle. Beak slightly incurved above the hinge line, perforation in apex not observed. Cardinal extremities rounded. Surface marked with ten coarse, angular plications, the middle plication somewhat smaller than the two adjacent ones.

"Dorsal valve flat; beak straight; hinge line sloping from the beak at an angle of 110 to 160 degrees, rounded at the extremities. . . . . On the dorsal valve the two middle plications are a little closer together, and slightly more prominent near the front than the others; while the depressions separating them from these, each side, are a little wider and deeper than those between the other plications."—Hall, 1859.

Remarks—This characteristic lower Devonian species is represented in the Little Saline limestone by very few examples. There is a slight individual variation in the shape, the degree of slope of the cardinal margins, and the amount of rounding of the cardinal extremities, but on the whole the characters seem to be fairly constant. The specimens observed are smaller than those of this species figured from the Grand Greve limestone, and compare more closely in size with those from the Moose River sandstone, New Brunswick.

Horizon—Lower beds.

Figured specimens No. 27486, *Walker Museum.*

MOLLUSCA

Class PELECYPODA

Order Prionodesmacea

Superfamily Pteriacea

Family Pteriidae

Genus Actinopteria Hall

Actinopteria insignis Clarke

Plate 67, figures 1, 2

1900. *Actinopteria insignis* Clarke, Mem. N. Y. State. Mus., vol. 3, No. 3, pl. 35, pl. 4, figs. 10-13.

Description—Clarke discusses this species as follows: "In form and proportions this shell resembles a young *Actinopteria communis*, but its habit is always small, and its exterior profoundly cancellated. It is oblique, with large and much depressed posterior wing, and small but nasute anterior wing, separated from the body of the shell by a broad sulcus distinctly extending to the umbo. The principal radial striae are strong and rounded, each interspace bearing from one to three very much smaller ones, making a more marked contrast in the size of the radii than is exhibited by the species *Actinopteria communis*. These lines are crossed by close concentric lamellae cancellating the entire surface, though both series of lines are quite obscure on the posterior wing. To a certain degree this shell presents in miniature the characters of the species *Actinopteria textilis*, which is mainly distinguished from its associate, *Actinopteria communis*, in the stronger cancellation and interruption of the radii."—Clarke, 1900.

Remarks—A single well-preserved small specimen referable to this species has been observed and a larger one is doubtfully referred to the same species.

Horizon—Lower beds.

Figured specimens No. 27555, *Walker Museum.*

Actinopteria ?

Plate 67, figures 3, 4

The Little Saline limestone affords a few fragmentary examples which are tentatively referred to this genus. The pelecypods in general are represented by mere fragments, and constitute a subordinate part of the fauna.

Horizon—Lower beds.

Figured specimens Nos. 27556, 27557, *Walker Museum.*

Family Pectinidae

Genus Aviculopecten M'Coy

Aviculopecten sp. undet.

Plate 67, figure 5

A fragment of an Aviculopecten has been observed which is unsuitable for certain determination. The surface is characterized by the presence of coarse distinct ribs, with each intervening space divided by a lower less prominent rib, and the interspaces marked by fine, indistinct striae. Concentric, undulating markings cancellate the ribs; these are uniformly spaced at a distance of from 1.5 to 2 mm. apart.

Horizon—Lower beds.

Figured specimen No. 27558, *Walker Museum.*

Class GASTROPODA

Subclass Streptoneura

Order Aspidobranchia

Suborder Rhipidoglossa

Family Trochonematidae

Genus Strophostylus Hall

Strophostylus allani sp. nov.[1]

Plate 70, figures 9-15

Description—Shell of medium size to large. The dimensions of the holotype which is a large specimen are: Height 50 mm., width 40 mm. Shell consisting of three rapidly expanding whorls, the inner one rising considerably above the outer; spire of medium height; suture distinct; upper surface of volutions convex, sides obliquely rounded. Aperture entirely sub-circular to broadly oval, and slanting obliquely backward below. Character of inner lip cannot be determined from specimens observed. Surface marked by coarse, irregular lines of growth, and on the outer volution these are crossed at right angles by faintly defined striations.

Remarks—The species resembles *Strophostylus transversus* Hall, from the New York and Maryland Oriskany, but is distinguished by the higher spire, and the more distinctly irregular and imbricating lines of growth.

Horizon—Lower beds.

Holotype and Paratypes No. 27509, *Walker Museum.*

[1]This species has been named after Professor J. A. Allen, head of the Department of Geology, University of Alberta, Edmonton, Alberta, Canada.

Order Ctenobranchiata

Suborder Platypoda

Superfamily Ptenoglossa

Family Capulidae

Genus Orthonychia Hall

Orthonychia belli Clarke

Plate 67, figure 6

1908. *Platyceras (Orthonychia) belli* Clarke, Mem. N. Y. State Mus., vol. 9, pt. 1, p. 147, pl. 14, figs. 20, 21.

Description—Shell erect, of medium size. The dimensions are: Length about 45 mm., width of aperture 30 mm. Outline of shell conical, expanding very gradually but uniformly for about half its length. The expansion becoming more abrupt for the remainder of the distance. Apex missing. Aperture essentially circular, peristome undulating. Surface features obscure.

Remarks—An incomplete specimen only has come under observation. The apex of the shell is lacking, and its character unknown, but the remainder of the specimen seems to conform in all details with the form occurring in the Grand Grève beds at Gaspè.

Horizon—Upper beds.

Figured specimen No. 27512, *Walker Museum.*

Orthonychia praeconicum sp. nov.

Plate 68, figures 1, 2

Description—Shell of medium size, erect, conical to pyramidal, apex missing; height approximately 35 mm., maximum width of aperture 26 mm. Body volution entirely straight, expanding rapidly and becoming extremely ventricose, marked with four or five well-defined longitudinal ridges and depressions, which become obsolete about one-third of the distance from the apex. The depressions are broad and shallow in the middle of the shell, and become still broader and more conspicuous near the aperture; ridges round and prominent. Aperture having a sub-triangular outline; peristome apparently deeply sinuous.

Remarks—This species approaches *Platyceras (Orthonychia) conicum* Hall, but has a more pronounced pyramidal outline, and the aperture is more distinctly quadrangular. On the small patch of shell which remains attached to the casts, no trace of nodose striae such as characterize the above-mentioned species has been observed. It is of interest to note that the Little Saline specimens show a closer resemblance to the Hamilton examples that have been figured than to those from the Onondagan.

Horizon—Upper beds.

Holotype No. 27528, *Walker Museum.*

Orthonychia tortuosa (Hall)

Plate 67, figures 7-10

1859. *Platyceras tortuosum* Hall, Nat. Hist. N. Y. Pal., vol. 3, p. 472, pl. 113, figs. 1-5, 1861.

1908. *Platyceras tortuosum* Clarke, Mem. N. Y. State Mus., vol. 9, pt. 1, p. 146, pl. 14, figs. 22-25.

1913. *Orthonychia tortuosa* Ohern, Geol. Surv., Md. Low. Dev., p. 469, pl. 79, figs. 10-12.

Description—Shell erect, elongate, conical, ascending spirally and forming slightly more than one volution; whorls widely separated and expanding regularly to the aperture. Inner side of spire distinctly corrugated spirally. Aperture sub-circular, peristome undulated. Surface marked with fine concentric striae, which are closely crowded, wavy and parallel the undulations of the peristome.

Remarks—This species presents considerable variety in shape, rapidity of expansion of volutions, and in the distinctness of the corrugations. An average individual measures from 45 to 50 mm. from apex to peristome, while larger forms measure as much as 65 mm. in height, hence displaying a closer relationship in size to the Gaspe forms than to those of New York. Internal casts only occur, in a few cases with portions of the shell attached. The corrugations apparently are not a persistent feature, in some examples they are strongly marked, in others practically absent.

Horizon—Lower beds.

Figured specimen No. 27513, *Walker Museum.*

Genus Platyceras Conrad

Platyceras angulare Rowe

Plate 68, figures 3, 4

1913. *Platyceras angulare* Rowe, Geol. Surv., Md. Low. Dev., p. 476, pl. 85, fig. 3.

Description—Shell moderately elevated, sub-conical, sides sloping regularly from aperture to apex, one whorl. Apex incurved but free; aperture elongate oval in outline. The shell substance is missing, but the cast shows from 4 to 6 angular, longitudinal ridges occurring at irregular distances from each other, and separated by broad, shallow depressions, and extending from the aperture to very near the apex where they become obsolete. Indistinct elongate nodes mark the ridges. The dimensions are: Length from beak to outer edge of aperture 37 mm., length of aperture 27 mm., width of aperture 25 mm.

Remarks—One specimen, a cast of the interior has been observed. The general depressed appearance, and the sharp angular ridges separated by broad shallow grooves, suggest its affinity with the species described by Rowe. The specimen reveals in addition the character of the apex, and the general outline of the aperture.

Horizon—Lower beds.

Figured specimen No. 27514, *Walker Museum.*

Platyceras depressum sp. nov.

Plate 69, figures 15, 16

Description—Shell of medium size, depressed ovoid, consisting of three closely contiguous whorls; spire depressed below plane of body volution whose upper side is inclined toward the depressed spire. Lateral surface sloping obliquely downward, slightly concave, giving rise to a ridge-like lateral border. Whorls gradually expanding from apex to aperture, the aperture not well shown, but apparently vertical, and from triangular to sub-quadrilateral in outline. Suture lines deeply impressed.

Basal view showing a wide, deep umbilicus. Surface characters obscure; a small portion of shell adhering near the umbilicus exhibits indistinct transverse striae which have a tendency to sinuosity. Exterior surface rough, but not nodose as in *Platyceras nodosum* Conrad. Surface of the cast generally rough, possibly indicating a rough or somewhat nodose shell surface.

Remarks—There are present in the collection two entire casts and a fragmentary portion of a third. This species is distinguished from all the other Platycerids present

in the fauna by the depressed spire, the inclination of the upper side of the body whorl toward the spire, and the obliquely sloping lateral sides which make, with the upper side, a moderately sharp angle.

Horizon—Lower beds.

Holotype and Paratypes No. 27518, *Walker Museum.*

Platyceras dumosum Conrad

Plate 68, figure 5

1840. *Platyceras dumosum* Conrad, Third Ann. Rept. Pal. Dept. N. Y. Surv., p. 205.
1879. *Platyceras dumosum* Hall, Nat. Hist. N. Y. Pal., vol. 5, pt. 2, pl. 14, pl. 5, figs. 11-16 and pl. 6, fig. 1.

Description—Shell small, subovoid, consisting of about three whorls, the first two contiguous, and the third or body whorl becoming free and expanding rapidly; spire depressed below the plane of the body volution. Character of aperture obscure. Surface marked by closely spaced, concentric, sinuous striae. At irregular intervals on the longitudinal ridges there are projecting nodes which are extended into spines of uncertain length.

Remarks—One imperfect specimen may be referred to this Onondagan species. The form is smaller than those figured in the New York reports and may possibly be an immature individual. The spinose character of the surface is very distinctive of the species.

Horizon—Upper beds.

Figured specimen No. 27527, *Walker Museum.*

Platyceras elongatum var. *parvum* n. var.

Plate 68, figure 6

Description—Shell erect, elongate conical, slightly curved, curvature near the apex most pronounced. One or two curving undulations are present near the aperture; aperture not fully preserved, but presumably sub-circular to circular in outline. Surface essentially smooth.

Remarks—One specimen only has come under observation. It resembles the young specimen of *Platyceras elongatum* Hall, with the exception that the longitudinal and transverse striations are absent. The curving undulations give the shell a twisted appearance not noticeable in *Platyceras elongatum*, but such irregularities might be considered as an accidental feature in growth, rather than a diagnostic specific character, and it seems best to consider this form as a variety of the above species.

Horizon—Lower beds.

Holotype No. 27525, *Walker Museum.*

Platyceras gebhardi Conrad

Plate 68, figures 7-10

1859. *Platyceras gebhardi* Conrad, Nat. Hist. N. Y. Pal., vol. 3, p. 312, pl. 56, figs. 5a, 5b, 6, 7, 9; pl. 55, figs. 6a-b.

Description—Shell small, volutions expanding obliquely and rather rapidly. Spire composed of three or four contiguous volutions, apex in general plane of body whorl or slightly below. Suture line deeply marked; aperture rounded or subovate, in some specimens expanded. Surface finely striate transversely. The dimensions of an average sized individual are: Height 13 mm., height of aperture approximately 11 mm., width 10 mm.

Remarks—This form is represented chiefly by casts, and only fragments of the shell substance are preserved. The specimens are smaller than those from the Oriskany of New York, but in other respects agree with them.

Horizon—Lower beds.

Figured specimens No. 27522, Walker Museum.

Platyceras cf. gracile Ohern

Plate 68, figures 11-13

1913. *Platyceras gracile* Ohern, Geol. Surv., Md. Low. Dev., p. 478, pl. 85, figs. 10-13.

Description—Shell small, sub-conical, ascending spirally, whorls a little more than one, free; shell expanding regularly from apex to aperture; aperture circular to subcircular in outline; peristome not observed. The dimensions of a large specimen are: Height 30 mm., greatest diameter of aperture 16 mm. The proportionate height and breadth in individuals varies to a marked degree. A fragment of shell substance adhering to the cast shows the surface marked by irregular, transverse striations. Most of the specimens have distinct spiral corrugations extending from the aperture up to or almost to the apex. Apex missing in all specimens examined.

Remarks—This shell bears a close resemblance to *Platyceras gracile* Ohern, from the Maryland Oriskany, but it is considerably smaller, and does not have the apex so nearly in the plane of the right side of the aperture. Also some of the Little Saline forms are more nearly erect than those from Maryland.

Horizon—Lower beds.

Figured specimens No. 27523, Walker Museum.

Platyceras magnificum Hall

Plate 68, figures 14-17

1859. *Platyceras magnificum* Hall, Nat. Hist. N. Y. Pal., vol. 3, p. 476, pl. 119, figs. 1-6, 1861.

1913. *Platyceras magnificum* Ohern, Geol. Surv., Md. Low. Dev., p. 472, pl. 82, figs. 1-6.

Description—"Shell obliquely subovate. Spire depressed below the plane of the outer volution; volutions two or three, very rapidly expanding and becoming extremely ventricose below, usually free or with the first one contiguous, aperture expanded subcircular, campanulate, and often with the margin reflexed, particularly on the left side. Surface marked by distinct, transverse, lamellose, undulating striae."—Hall, 1859.

Remarks—The specimens in the collection are all casts of the interior, but patches of shell are attached and display sinuous lines of growth. The species differs from *Diaphorostoma ventricosum* Hall, in the more rapid expansion of the whorls, in the freedom of the volutions, and in the wider and more expanded aperture. Character of peristome obscure in all specimens observed.

Horizon—Lower beds.

Figured specimens No. 27529, Walker Museum.

Platyceras cf. multisinuatum Hall

Plate 69, figure 1

1859. *Platyceras multisinuatum* Hall, Nat. Hist. N. Y. Pal., vol. 3, p. 319, pl. 58, figs. 8a, b, c and 9a, b, 1861.

1913. *Platyceras multisinuatum* Ohern, Geol. Surv., Md. Low. Dev., p. 477, pl. 85. figs. 4-6.

Description—"Shell subdiscoid in the young state; apex nearly on a plane with the outer volution; volutions about three, the first one minute; outer one becoming

free, ventricose, rounded or scarcely angular below, somewhat flattened on the upper side, marked by several ridges and shallow depressions on the upper and dorsal sides; aperture somewhat longitudinally oval; peristome sinuate, with a deeper sinuosity on the anterior margin. Surface marked by fine, transverse striae, which are strongly undulated on the inequalities of the shell, and crossed by fine longitudinal or revolving striae."—Hall, 1859.

Remarks—Only a single fragmentary cast has come under observation. The general shape of the specimen corresponds closely to the above species, and the dorsal side exhibits the characteristic longitudinal ridges. Apex, surface striae, and character of peristome not observed. Aperture probably longitudinally oval or subcircular.

Horizon—Lower beds.

Figured specimen No. 27515, *Walker Museum.*

Platyceras cf. newberryi Hall

Plate 69, figure 2

1859. *Platyceras newberryi* Hall, Nat. Hist. N. Y. Pal., vol. 3, p. 333, pl. 63, figs. 14a-c, 1861.

1913. *Platyceras newberryi* Ohern, Geol. Surv., Md. Low. Dev., p. 479, pl. 86, fig. 4.

Description—Shell small, subdiscoidal, with about three volutions, the last one expanding rapidly and becoming almost ventricose, the first two small and closely coiled; aperture not well preserved, probably circular or transversely oval. Surface marked by widely and irregularly spaced, transverse, sinuous plications. These are crossed by closely packed, and regular longitudinal striations.

Remarks—The one specimen present in the collection is fragmentary, but near the apex a portion of the shell substance is preserved, which shows the surface markings in fine detail. In shape there is a close resemblance between this specimen and *P. newberryi*, but the surface ornamentation differs; the transverse plications being more widely spaced, more distinct, and more sinuous than in the specimens figured by Hall. The transverse ridges are lacking, although there is a suggestion of them in the plications, which on the lower part of the portion of shell adhering, become distinctly coarse and lamellose. There is no suggestion of flattening in the preserved part of the shell.

This specimen is evidently not identical with *P. newberryi*, although the general shape and strong development of the longitudinal striae suggest a close relationship.

Horizon—Lower beds.

Figured specimen No. 27519, *Walker Museum.*

Platyceras nodosum Conrad

Plate 69, figures 3-6

1841. *Platyceras nodosum* Conrad, Ann. Rept. Pal. N. Y., p. 56.

1859. *Platyceras nodosum* Hall, Nat. Hist. N. Y. Pal., vol. 3, p. 473, pl. 115, figs. 1-6; pl. 116, figs. 1-4, 1861.

1913. *Platyceras nodosum* Ohern, Geol. Surv., Md. Low. Dev., p. 469, pl. 79, figs. 13, 14.

Description—Shell of medium size. The dimensions of an average individual are: Height 45 mm., diameter 25 mm. Spire depressed, consisting of three or four rapidly expanding volutions. In cross-section the whorls present an oval outline, the upper side convex, the lateral side also convex and obliquely inclined to the upper. Surface marked with spinose nodes, having no definite arrangement. Original shell present in one small patch shows transverse, strongly marked, sinuous lamellae. Character of aperture and peristome obscure.

Remarks—This species is represented sparsely in the lower beds, but somewhat more abundant in the upper. In general the specimens are smaller than those from the

New York Oriskany, but very similar in size to the ones occurring at Cumberland, Maryland.

Horizon—Lower and upper beds.

Figured specimens No. 27521, *Walker Museum.*

Platyceras peregrinus sp. nov.

Plate 69, figures 13, 14

Description—Only a fragmentary portion of one shell has been observed. Shell depressed, discoidal, whorls probably not more than one; apex of spire incomplete, but apparently obtuse; younger portion of the shell less compressed than later stages, the more pronounced compression beginning rather suddenly about one-third the distance from the apex. Suggestions of parallel transverse undulations are present in the older part of the shell. Character of aperture not observed.

Remarks—This form may be distinguished from all the other Platycerids present in the fauna because of the strong lateral compression. In general shape the specimen agrees best with *Platyceras compressum* Clarke and Swartz, from the Chemung of Maryland, but expansion of the whorl is more rapid in that form, and compression begins closer to the apex. Some resemblance to *Platyceras whitii* Clarke, from the Devonian of Para, is also suggested, but the dorsal ridge of that form is absent here.

Horizon—Lower beds.

Holotype No. 27517, *Walker Museum.*

Platyceras planovolvis sp. nov.

Plate 70, figures 1-5

Description—Shell medium to large, discoidal, consisting of 3 or 4 gradually but rapidly expanding whorls, which in the majority of the specimens are closely coiled in one plane; whorls contiguous with the exception of one or two specimens and in these the outer volution is free; spire in same plane or very slightly depressed below body volution. In cross section the whorls present a circular to an oval outline.

Aperture entire, shape varying from sub-circular or transversely oval to longitudinally oval, expanded, almost campanulate; outer lip of peristome extended, inner contiguous with body volution. Upper side of body whorl slightly flattened to gently and evenly convex.

Surface marked by transverse striae, closely packed, and undulating. A few of the specimens show traces of transverse ridges.

Remarks—This is the most abundant species of the genus in the Little Saline limestone and is distinct from all the associated species by reason of the character of coiling in one plane. It is represented by the internal casts only; rarely these have portions of the shell attached which reveal the surface features. The specimens present a distinct variation in size, in outline of aperture, in rapidity of expansion of whorls, and in amount of depression of spire, but all exhibit the same even manner of coiling in one plane, and the expanded aperture.

Horizon—Lower and upper beds.

Holotype and Paratype No. 27526, *Walker Museum.*

Platyceras reflexum Hall

Plate 69, figures 7-9

1859. *Platyceras reflexum* Hall, Nat. Hist. N. Y. Pal., vol. 3, p. 477, pl. 120, figs. 1-7, 1861.

1913. *Platyceras reflexum* Ohern, Geol. Surv., Md. Low. Dev., p. 473, pl. 83, figs. 5, 6; pl. 84, figs. 1, 2.

Description—Shell of medium size, spirally ascending, sub-conical in outline; apex consisting of two or three closely coiled but free volutions. Body whorl expanding regularly, and towards the aperture somewhat rapidly; aperture almost circular and rather broadly expanded; character of peristome obscure. Fine, undulating, and closely crowded transverse striae mark the surface.

Remarks—This species is represented by some small specimens which are apparently young individuals, and by several incomplete large forms which are doubtfully referred to the same species. They display a considerable variation in the rapidity of expansion of the body whorl, and in the amount of expansion of the aperture, but in general they closely approximate the above species.

Horizon—Lower beds.

Figured specimens No. 27530, *Walker Museum.*

Platyceras retrorsum Hall

Plate 69, figure 10

1859. *Platyceras retrorsum* Hall, Nat. Hist. N. Y. Pal., p. 320, pl. 58, figs. 10a, b, 6c; pl. 59, figs. 9a, b.

Description—Shell of medium size, depressed, ascending spirally, whorls about two, free; the first whorl nearly smooth, while the second or body whorl is marked with widely spaced, spiral ridges or corrugations, which are absent on the ventral side of the shell. Dorsal side flattened, the apex a little elevated above the outer volution of the shell. Surface marked transversely by fine, closely spaced, sinuous striae. Aperture not definitely known, probably subcircular with undulating peristome.

Remarks—One exfoliated individual occurs which has portions of the shell attached. Apart from its smaller size, there seems to be no essential difference from the specimens in the Lower Helderberg of New York.

Horizon—Lower beds.

Figured specimens No. 27524, *Walker Museum.*

Platyceras cf. subconicum Ohern

Plate 69, figure 11

1913. *Platyceras subconicum* Ohern, Geol. Surv., Low. Dev., p. 479, pl. 86, figs. 1-3.

Description—Shell small, obliquely conical, whorls probably one; shell expanding fairly rapidly from apex to aperture; apex broken but it appears to have been blunt and twisted slightly to the right. Aperture and peristome obscure; surface features not preserved.

Remarks—The specimens are entirely too fragmentary for certain determination, and the reason for referring the specimen to this species is because of the evident correspondence in shape with authentic specimens in the collection of Walker Museum.

Horizon—Lower beds.

Figured specimen No. 27520, *Walker Museum.*

Platyceras trilobatum Hall

Plate 69, figure 12

1859. *Platyceras trilobatum* Hall, Nat. Hist. N. Y. Pal., vol. 3, p. 316, pl. 57, figs. 5a, b, c, 1861.

1913. *Platyceras trilobatum* Ohern, Geol. Surv., Md. Low. Dev., p. 475, pl. 84, figs. 7, 8.

Description—"Body of shell obliquely or arcuately ovoid, trilobate; volutions three or four, the last one (or more) becoming free, gradually expanding to the aperture; the apex closely involved and rising above the plane of the outer volution, or sometimes

on the same plane, concave toward the suture; aperture subangularly ovate, sinuate on the right and left sides, and the shell extended in front. Surface marked by two strong, spiral depressions corresponding to the sinuosities of the aperture, and crossed by lamellose striae which are strongly undulated on the sinuosities of the last volution, and are marked by other undulations on the earlier volutions, indicating former sinuosities in the margin of the aperture."—Hall, 1859.

Remarks—An incomplete and exfoliated specimen is the only example representing this species. The apex is missing, hence the character of the complete specimen cannot be definitely determined. The distinctly trilobate form, and the clearly defined spiral depressions are the characters used to identify the species. Surface is irregular, lumpy, or nodose in character. Shell surface unknown.

Horizon—Lower beds.

Figured specimen No. 27516, *Walker Museum.*

Genus Diaphorostoma Fisher

Diaphorostoma ventricosum (Conrad)

Plate 70, figures 6-8

1859. *Platyostoma ventricosa* Hall, Nat. Hist. N. Y. Pal., vol. 3, p. 300, pl. 55, fig. 9a, b, c; p. 469, pl. 112, figs. 1-10; pl. 113, figs. 7, 8; pl. 115, fig. 8, 1861.

1892. *Platyostoma ventricosa* Conrad, Jour. Acad. Nat. Sci., Phila., vol. 8, p. 275, pl. 17, fig. 5.

1900. *Diaphorostoma ventricosum* Clarke, Mem. N. Y. State Mus., vol. 3, No. 3, p. 30, pl. 3, figs. 25-28.

1913. *Diaphorostoma ventricosum* Ohern, Geol. Surv., Md. Low. Dev., p. 482, pl. 87, figs. 1, 2.

Description—Shell globose, spire slightly elevated, in a few cases depressed; whorls three, closely coiled, expanding rapidly until the last one or body whorl becomes highly ventricose; volutions flattened on upper side, curving obliquely on the lower, giving the shell a twisted appearance. Aperture subcircular, greatest diameter 40 mm., inner lip of peristome reflexed. Surface of shell marked by indistinct transverse striae, which parallel the lines of growth.

Remarks—This species is fairly abundant in the collection, both mature and immature individuals being present. The flattened upper surface, and the pronounced ventricosity of the body volution characterize all the specimens. Some of the smaller ones may be readily confused with *Diaphorostoma depressum* Conrad, and the only apparent distinction is the greater tendency to ventricosity in the outer volution.

Horizon—Lower and upper beds.

Figured specimens No. 27508, *Walker Museum.*

Order Opisthobranchia

Suborder Pteropoda

Family Hyolithidae

Genus Hyolithes Eichwald

Hyolithes cf. oxys Clarke

Plate 69, figure 17

1908. *Hyolithes oxys* Clarke, Mem. N. Y. State Mus., vol. 9, pt. 1, p. 143, pl. 12, figs. 10-13.

Description—Shell large, conical, sides tapering gradually, length approximately 42 mm., diameter of aperture 16 mm. Dorsal face strongly convex; ventral face not

observed. Surface marked by concentric striae which bend slightly upwards towards the aperture. At irregular, but wide intervals there are shallow depressions paralleling the striae; these are especially noticeable near the aperture.

Remarks—The interior of the dorsal side has been observed. The form bears a close resemblance to the large specimen of *Hyolithes oxys* Clarke, with this difference, that the longitudinal grooves present in that form are lacking here, and the concentric striae bend towards the aperture instead of towards the apex.

Horizon—Lower beds.

Figured specimen No. 27510, *Walker Museum.*

Suborder Conulariida

Family Tentaculitidae

Genus Tentaculites Schloth

Tentaculites elongatus Hall

Plate 69, figure 18

1859. *Tentaculites elongatus* Hall, Nat. Hist. N. Y. Pal., vol. 3, p. 136, pl. 6, figs. 16-21, 1861.

1908. *Tentaculites elongatus* Clarke, Mem. N. Y. State Mus., vol. 9, pt. 1, p. 118, pl. 12, figs. 8, 9.

1913. *Tentaculites elongatus* Ohern, Geol. Surv. Low. Dev., p. 485, pl. 87, figs. 8-10.

Description—A few fragmentary specimens belonging to this species occur. The elongate and tapering form, and the strongly marked annulations are unmistakable evidence of their identity with this common Oriskany species. The absence of the fine, closely arranged annular striae which are characteristic of this species, is doubtless due to the condition of preservation.

Horizon—Lower beds.

Figured specimen No. 27511, *Walker Museum.*

ARTHROPODA

Class CRUSTACEA

Subclass Trilobita

Order Opisthoparia

Family Odontopleuridae

Genus Acidaspis Murchison

Acidaspis sp. undet.

Plate 71, fig. 1.

Description—This species is represented by a single fragmentary cranidium, apparently semi-circular in outline, glabella convex, elongate and narrow, sides straight, separated from lateral lobes by distinct longitudinal furrows. Posterior lateral lobes well defined, small, suboval, anterior pair obsolete or missing entirely. Occipital furrow broad and shallow, but behind the posterior lateral lobes depressed into deep, circular pits. Occipital segment well defined, covered with pustules. Surface of glabella and lateral lobes also marked with pustules which vary considerably in size.

Cheeks, thorax and pygidium unknown.

Remarks—The material present in the collection is entirely too fragmentary for certain determination, but the form corresponds fairly closely with *Acidaspis tubercalatus* Hall. It differs in the obsolescence of the anterior lobes, and the better definition of the occipital segment.

Horizon—Lower beds.

Figured specimen No. 27548, *Walker Museum.*

Family Proetidae

Genus Proteus Steininger

Proetus conradi Hall

Plate 71, figure 2

1900. *Proetus conradi* Clarke, N. Y. State Mus., Mem. vol. 3, No. 3, p. 25, pl. 2, figs. 11-16.

1908. *Proetus phocion* Clarke, Mem. N. Y. State Mus., vol. 9, pt. 1, p. 135, pl. 9, figs. 14-16.

Description—An incomplete cephalon is the only example representing this species. The specimen possesses a subtriangular, strongly convex glabella with both extremities well rounded, the anterior portion forming the apex of the triangle. Length slightly greater than the width. The species is characterized by a flat marginal border which is separated from the rest of the cephalon by a shallow groove. Cheeks gently convex, borders flattened.

Remarks—The strongly convex subtriangular glabella, together with the flattened marginal border, are the characters used for the determination of this specimen.

Horizon—Lower beds.

Figured specimen No. 27550, *Walker Museum.*

Proetus cf. pachydermatus Barrett

Plate 71, figure 3

1903. *Proetus pachydermatus* Weller, Pal. N. J., vol. 3, p. 248, pl. 22, figs. 16-21.

1913. *Proetus pachydermatus* Maynard, Geol. Surv., Md. Low. Dev., p. 489, pl. 89. fig. 1.

Description—This species is represented by several fragmentary, exfoliated cephala. Cephalon small, semi-circular, with a broad, depressed convex, marginal border. Glabella elongate oval, or subtriangular, moderately convex, anterior margin rounded, posterior margin straight, the whole set off from the rest of the cephalon by a distinct bordering furrow, or sulcus. The two anterior pairs of glabellar furrows are obsolete, the third pair is pronounced, and curving to connect with the occipital furrow, thus forming two distinct lobes at the base of the glabella.

Cheeks poorly preserved, free cheeks entirely lacking. Facial sutures and other characteristics not shown in the incomplete specimens.

Remarks—The form resembles *Proetus pachydermatus* Maynard from the Helderberg of Maryland, but lacks the small basal lobes situated posterior to the glabella basal lobes.

Horizon—Lower beds.

Figured specimen No. 27549, *Walker Museum.*

Proetus protuberans Hall

Plate 71, figures 4-7

1859. *Proetus protuberans* Hall, Nat. Hist. N. Y. Pal., vol. 3, p. 351, pl. 73, figs. 5-8, 1861.

1902. *Proetus protuberans* Weller, Geol. Surv. N. J., vol. 3, p. 296, pl. 32, fig. 2.
1913. *Proetus cf. protuberans* Ohern, Geol. Surv., Md. Low. Dev., p. 490 pl. 89, figs. 2-4.

Description—Pygidium small, semi-circular, axis conical, conspicuously elevated, having 7 or 8 annulations. Lateral lobes with 4 or 5 depressed pleura. Distinct, flattened marginal border present.

Two glabellae occurring in the upper beds apparently belong to this species. These are prominent, broadly rounded in front, with indistinct lobing, tapering gradually to frontal margin, only a slight portion of which is preserved.

Remarks—With the exception of the smaller size, the specimens do not show any essential differences from those figured from the New York Oriskany.

Horizon—Lower and upper beds.

Figured specimens No. 27546 *Walker Museum.*

Proetus sp.

A number of pygidia of Proetus are present in the upper beds too imperfectly preserved to be identified.

Family Lichadidae

Genus Lichas Dalman

Lichas sp.

Plate 71, figures 8, 9

A few fragments of the cephalon of a large Lichad occur which are not determinable. The surface is covered with prominent pustulae of variable size, and might suggest such a species as *Lichas pustulosus* Hall.

Horizon—Lower beds.

Figured specimens No. 27544, *Walker Museum.*

Genus Ceratolichas Hall and Clarke

Ceratolichas gryps Hall

Plate 71, figures 13-15

1876. *Acidaspis* n. sp? Illustrations of Devonian Fossils, pl. 19, fig. 1 (not figs. 2 and 3).
1888. *Lichas* (*Ceratolichas*) *gryps* Hall, Pal. of New York, vol. 7, p. 84, pl. 19b, figs. 7-13.

Description—Glabella large, embracing nearly the entire cephalon. Frontal lobe elliptical, convex or tumid, elevated behind, sloping abruptly to the sides and the posterior margin, and becoming obsolete at or just behind the centre of the shield. It bears at its summit two strong, diverging, recurved spines, which nearly equal the glabella in length. Longitudinal furrows subparallel, diverging near the frontal margin. Lateral lobes depressed, becoming obsolete; the members of the first and second pairs have coalesced, and the third pair can be detected only as low, obsolescent nodes bearing a faint tubercle. Near the outer edge of the lateral lobes, and just within the eye lobes, are slender erect pines, usually represented by the broken bases.

The anterior slope of the glabella is broad and nearly vertical, the occipital furrow narrow, and the occipital ring broad upon the axis, arched and bearing at its centre two long, divergent spines which are curved downward and slightly inward toward their tips. In the single specimen observed which retains one spine apparently entire, its length is nearly equal to the length of the cephalon. Eye lobes small, inconspicuous.

Surface bearing tubercles which are closely disposed over the frontal lobes, but are scattered or obsolescent on the lateral lobes. On the posterior slope of the frontal lobe these tubercles appear to be arranged in two longitudinal rows of three or four each. The spines of the head shield are covered with acute pustules and granules. . . . . " Hall, 1888.

Remarks—A fragmentary glabella corresponds with the descriptions and illustrations of this species as shown in the New York Palaeontology.

Horizon—Upper beds.

Figured specimen No. 27543, *Walker Museum.*

Order Proparia

Family Phacopidae

Genus Dalmanites Barrande

Dalmanites cf. aspinosus Weller

Plate 71, figures 10, 11

1903. *Dalmanites aspinosus* Weller, Pal. N. J., vol. 3, p. 252, pl. 22, fig. 15.
1913. *Dalmanites aspinosus* Maynard, Geol. Surv., Md. Low. Dev., p. 499, pl. 91, fig. 16.

Description—Three incomplete pygidia comprise the only material available for study. The dimensions of the largest specimen are approximately: Length 18 mm., width 26 to 27 mm. Semi-elliptical in outline, posterior pointed. Axis only partly preserved, tapering uniformily, and reaching to within 2 mm. from the posterior margin; the portion preserved divided into 10 annulations which posteriorly become obscure. Lateral lobes with 8 curved pleural, angular and prominent, oblique to the lateral margins; shallow grooves separate the pleura.

Remarks—With such inadequate material the identification of these specimens with *Dalmanites aspinosus* Weller, is uncertain, but the sharp angular pleural ribs extending to the lateral margins of the pygidium, and the absence of any marginal border, strongly suggest this species. From the incomplete pygidia neither the number of pleural ribs, nor the axial annulations can be certainly determined. In size the specimens are comparable to those from the Maryland Oriskany. Those from New Jersey as figured by Weller are considerably larger.

Horizon—Lower beds.

Figured specimens No. 27541, *Walker Museum.*

Dalmanites cf. bisignatus Clarke

Plate 71, figure 12

1903. *Dalmanites bisignatus* Clarke, Mem. N. Y. State Mus., vol. 3, No. 3, p. 19, pl. 2, figs. 6-8.

Description—Pygidium distinctly triangular, length greater than width, pleural lobes sloping steeply to the lateral margins; posterior margin apparently extended into a flattened spine. Axis convex, tapering, sides straight or slightly concave; portion preserved divided into 12 segments. Lateral lobes strongly convex, with 14 segments, separated by broad, flat grooves. Ribs flat, well defined to lateral margin and divided longitudinally by fine median depressions. No marginal border present. Surface ornamentation indistinct, consisting of a few, nearly obsolete pustules on the axial portion.

Remarks—This form is represented by a single imperfect pygidium which hardly merits specific determination. It resembles *Dalmanites bisignatus* as figured by Clarke

from the Becraft Mountain Oriskany, New York, State, and may be compared with that species. In contrast it has a greater number of axial annulations, and lacks the characteristic surface ornamentation of that species.

Horizon—Lower beds.

Figured specimen No. 27538, *Walker Museum.*

Dalmanites micrurus ? (Green)

Plate 71, figure 22

1832. *Asaphus micrurus* Green, Monograph, Trilobites, N. Amer., p. 56, fig. 3.
1859. *Dalmania micrurus* Hall, Nat. Hist. N. Y. Pal., vol. 3, p. 359, pl. 74, figs. 13-20.
1908. *Dalmanites micrurus* Clarke, Mem. N. Y. State Mus., vol. 9, pt. 1, p. 120, pl. 9, figs. 1-3.
1913. *Dalmanites micrurus* Ohern, Geol. Surv., Md. Low. Dev., p. 507, pl. 91, figs. 10-11.

Description—A few incomplete cephala exhibit certain definite characters of this species. Frontal lobe large, showing transverse subrhombohedral outline, three pairs of lateral lobes sharply defined; eyes prominent, large; cheeks separated from glabella by deep, strongly marked dorsal furrows. Entire surface finely pustulose. Because of the absence of the frontal border which is a feature of the species, one cannot be reasonably sure of the correctness of the identification, but the general shape, and complete separation of the lateral lobes together with the pustulose surface strongly suggest *D. micrurus.*

Horizon—Upper beds.

Figured specimen No. 27542, *Walker Museum.*

Dalmanites cf. pleuroptyx (Green)

Plate 71, figure 16

1832. *Asaphus pleuroptyx* Green, Mon. of Trilobites of North Amer., p. 55.
1888. *Dalmanites* (*Hausmania*) *pleuroptyx* Hall and Clarke, Nat. Hist. N. Y. Pal., vol. 7, p. 28, pl. 11a, figs. 1-3.
1913. *Dalmania* (*Hausmania*) *pleuroptyx* Ohern, Geol. Surv., Md. Low. Dev., p. 510, pl. 93, figs. 6-10.

Description—One incomplete pygidium may be compared with this species. It is depressed convex, triangular in outline with the axis depressed in the posterior region, 8 annulations present in part preserved; the intermediate furrows are deep and narrow, obsolete down the center of the axis. Pleural lobes with broad segments, total number unknown, divided longitudinally by faint median depressions, intermediate furrows narrow and shallow. Ribs strongly oblique posteriorly; lateral margins flattened, indistinct.

Remarks—The specimens observed are too fragmentary to permit certain determination, but the characters preserved strongly suggest *D. pleuroptyx.*

Horizon—Lower beds.

Figured specimen No. 27540, *Walker Museum.*

Dalmanites slocomi sp. nov.

Plate 71, figure 20

Description—Pygidium broadly triangular, moderately convex, ending posteriorly in a caudal spine. The dimensions of the type specimen are: Length 35 mm., width 45 mm. Axis depressed, conical, margins tapering uniformly, apex rounded, extending to within 5 mm. from the posterior margin, marked by 15 or 16 low, somewhat flat

annulations, which are separated by broad, shallow grooves. Surface ornamentation consisting of two rows of tubercles which become obseolete on the last three or four posterior annulations. Lateral lobes with 12 pleura which slope obliquely to the lateral margins, the 7 or 8 anterior ones divided by distinct longitudinal furrows which persist to the end of each rib; extremities of ribs flattened to form a marginal border having a uniform width of 2 mm., intervening furrows broad. Surface marked by indistinct pustules.

Cephalon and thorax unknown.

Remarks—The form resembles *Dalmanites multiannulatus* Ohern, from the Maryland Oriskany, but is smaller, has fewer axial and pleural segments, less distinct surface ornamentation, and it is especially characterized by the presence of a caudal spine.

Horizon—Lower beds.

Holotype No. 27535, *Walker Museum.*

Name—This fossil is named after Mr. A. W. Slocom, of Walker Museum, Univeristy of Chicago.

Dalmanites cf. stemmatus var. convergens Clarke

Plate 71, figure 17

1892. *Dalmanites* sp. nov. A. var., Amer. Jour. Sci. 1892, p. 412.

1900. *Dalmanites* (*Synphoria*) *stemmatus var. convergens* Clarke, Mem. N. Y. State, Mus., vol. 3, No. 3, p. 19, pl. 2, figs. 3-5.

Description—Pygidium triangular, slender and tapering, width greater than length. Axial region with 12 flattened annulations, the posterior two scarcely discernible; intervening grooves narrow; pleural segments 10, each one divided by a narrow, faintly defined median furrow. Lateral margins gradually converging posteriorly, apparently terminating in a short caudal spine.

Remarks—A single incomplete pygidium resembles the above species. The only difference observed is the presence of the faint median grooves on the pleural segments.

Horizon—Upper beds.

Figured specimen No. 27539, *Walker Museum.*

Dalmanites sp. undet.

Plate 71, figure 18

There is present in the collection a single specimen of the frontal margin of an unknown species of Dalmanites. The outer edge is coarsely denticulate, with 7 or 8 serrations, the two central ones being larger than the others. A resemblance is noted with the frontal margin of *Dalmanites multiannulatus* Ohern, but the Little Saline form is smaller, more evenly dentated, and the bifurcating process is less conspicuous.

Horizon—Lower beds.

Figured specimen No. 27537, *Walker Museum.*

Dalmanites praenuntia sp. nov.

Plate 71, figure 19

Description—Pygidium of medium size, broadly triangular in outline. The dimensions of the holotype are: Length 14 mm., width 20 mm. Axis attenuate, depressed convex, marked by 12 to 14 annulations; intermediate furrows narrow and shallow. Lateral lobes with a corresponding number of ribs also separated by shallow furrows, each rib divided longitudinally by a fine median groove which bends posteriorly as it approaches the dorsal furrow. At the lateral margins the ribs are slightly flattened

forming a faint border. Posterior margin of pygidium terminating bluntly, and showing the beginning of two rudimentary spines.

Cephalon and thorax unknown.

Remarks—This species is represented by a single complete pygidium. It may be differentiated from all other associated Dalmanites by the character of the posterior margin of the pygidium. In this feature it seems to be a forerunner of such species as *Dalmanites (Odontocephalus) aegeria* Hall, *Dalmanites (Odontocephalus) coronatus* Hall, or *Dalmanites (Odontccephalus) selenurus* Hall, of the New York and Ohio Onondagan fauna, which have the two posterior spines developed in a conspicuous manner.

Horizon—Lower beds.

Holotype No. 27536, *Walker Museum.*

Genus Cryphaeus Green

Cryphaeus sp.

Plate 71, figure 21

Description—Pygidium small, sub-oval, wider than long; the dimensions are: Length 9 mm., width 11 mm. The axial region is characterized by 7 well defined annulations, broad and rounded, each one bearing in the middle a faintly defined node; intervening grooves narrow and shallow. Pleural lobes moderately broad, sloping gradually toward the lateral margin to near the edge where they turn and bend dorsally; each lobe bears 5 annulations which terminate in spines, the character of which cannot be determined from the specimen. Each pleural segment is marked at the abrupt turn by a circular depression which probably represents the base of a short node. Two additional ones are present at the posterior of the pygidium, and from the base of each extends a short spine.

Remarks—A single incomplete pygidium in the collection apparently represents an undescribed species of this genus. In general shape, character of pleura and spines, it resembles *Dalmanites (Cryphaeus) comis*, but differs in the larger size, in having an additional axial annulation, and in the presence of nodes at the ends of the pleural segments.

Horizon—Upper beds.

Figured specimen No. 27547, *Walker Museum.*

Genus Phacops Emmrich

Phacops cristata Hall

Plate 71, figures 23-25

1888. *Phacops cristata* Hall and Clarke, Nat. Hist. N. Y. Pal., vol. 7, p. 14, pl. 6, figs. 1-31, 16-29; pl. 8a, figs. 1-4.

1913. *Phacops cristata* Kindle, Geol. Surv., Md. Mid. Dev., p. 331, pl. 43, figs. 13-15.

Description—Cephalon of medium size, semi-circular in outline, genal angles rounded. The dimensions of a nearly perfect head are: Length 16 mm., width 26 mm. Glabella large, width greater than length, moderately convex, narrow posteriorly, and rapidly expanding anteriorly, giving a subpentagonal outline. Anterior margin prominent and projecting beyond the frontal margin. Laterally the glabella is separated from the cheeks by deep, narrow furrows. The surface is marked by three pairs of glabellar furrows, the anterior and middle two scarcely perceptible, the posterior pair strongly marked, extending about half way across the glabella, and almost cutting off a narrow segment at the base of the head. Cheeks small, confined to the posterior portion of the cephalon, and bounded by a convex margin. Occipital furrow distinct, extending to, and merging in the marginal border.

Eyes large, less elevated than the glabella, and not extending back to the line of the occipital furrow; composed of numerous rows of vertical lenses with hexagonal outline. Surface of glabella coarsely and strongly pustulose.

Thorax not observed.

A few fragmentary pygidia occur in the upper beds which are doubtfully referred to this species. They are semi-circular in outline, moderately convex, with axial lobe elevated and marked with 7 or 8 annulations. Pleural lobes with from 5 to 6 coarse ribs.

Remarks—This species occurs more abundantly in the upper than in the lower beds, and is represented by numerous cephala, and by a few exfoliated pygidia. The characteristic stout spines of the genal angles have not been observed in the specimens examined. Their absence is probably due to the condition of preservation.

Horizon—Lower and upper beds.

Figured specimens Nos. 27541 *and* 27532, *Walker Museum.*

Phacops sp.

Plate 71, figure 26

Description—Pygidium small, semi-circular in outline. The dimensions are: Length 8 mm., width 13 mm. Axis prominent, narrow and tapering, with 7 rounded annulations, the two posterior ones indistinct; intermediate depressions shallow. Pleural lobes with 6 rounded segments also separated by shallow grooves.

Horizon—Upper beds.

Figured specimen No. 27533, *Walker Museum.*

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DEVONIAN OUTLIER NEAR ROLLA, PHELPS COUNTY.

The recent discovery of an outlier of Devonian near the crest of the Ozark uplift has added new and important data on the geologic history of the Ozark region. It indicates that the Devonian seas extended to a much greater distance over the uplift than has formerly been suspected. The following condensed description is taken from the Journal of Geology.[1]

Location and General Description.—The Devonian outlier lies about 1½ miles northwest of Rolla, in the N. E. ¼ N. W. ¼ Sec. 3, T. 37 N., R. 8 W. It is on the east side of the road and lies fifty feet below the crest of the ridge. It occupies a little knoll between two gullies, and when first found consisted of a number of knobs of quartzite projecting from the hill and having a rough alignment. The base was concealed, but just above the top of the outlier were a number of Mississippian boulders, and on the north, west and south at higher and lower levels are outcrops of the Jefferson City formation.

The summit of the ridge is capped by a thin stratum of Pennsylvanian sandstone, and boulders of Pennsylvanian float are found in abundance at lower levels. The Pennsylvanian rests unconformably upon the Jefferson City formation on the east side of the hill. On the west side there appears to be a thin stratum of Mississippian between them, but the exposures are very poor, and the exact relationships are difficult to determine.

An excavation was made along the side of these quartzite masses in an attempt to expose the lower contact. This was not entirely successful, but the excavation showed that there was a continuous ledge of quartzite at least thirty feet long and from three to six feet in thickness, increasing in thickness toward the east. Beyond the limits of the excavation there are a few other knobs of quartzite, probably continuous with the part just described. This makes the total length of the outlier about fifty feet, and its greatest width slightly less.

Lithologic Characteristics.—Lithologically the Devonian rock is a hard, dense quartzite breaking with a splintery fracture. In color it ranges from white through gray to bluish and almost black. The lighter shades predominate. Thin sections show

[1]Bridge, Josiah, and Charles, B. E. A Devonian outlier near the crest of the Ozark uplift. Jnl. Geol. XXX, p. 450-458

great numbers of well-rounded quartz nuclei with strong evidences of secondary growth. In some sections the grains show as angular interlocking crystals because of this secondary growth; in other sections, large secondarily enlarged grains are separated from each other by a finely crystalline ground mass of the same material. The rock contains numerous cavities, most of which have been formed by the leaching out of large fossils, and on the surfaces of these cavities are to be found many small but perfect crystals of quartz and of limonite pseudomorphous after pyrite. The quartzite is somewhat fractured, and these fractures are filled with a soft, yellow, non-fossiliferous, somewhat conglomeratic sandstone.

From the structure and secondary growth it seems evident that the rock was originally a calcareous sandstone, laid down by an advancing sea against an old land mass. The calcareous matter has been completely leached out, and much of it replaced by silica. The soft, yellow sandstone is of later age, either basal Mississippian or Pennsylvanian.

Paleontology.—Fossils are abundant in the quartzite. They are not evenly distributed, but are most abundant at the base. At the first glance, parts of the stratum appear to be barren, but careful search of almost any fragment will reveal fossils. The fossils all occur as external and internal molds, and in most cases the preservation is excellent. Corals and Mollusca dominate the fauna. Other forms are not common, though individuals of a given species may be very abundant.

The following table gives a list of the species which have been obtained from this quartzite, and also their occurrence at other localities. Column 1 shows species occurring in the Grand Tower formation in southern Illinois; column 2, species occurring in the Jeffersonville beds at Louisville, Kentucky; column 3, species occurring in Michigan; column 4, species occurring in Ohio; and column 5, species occurring in New York.

List of Species identified from the Devonian Quartzite at Rolla, Missouri

	1 Illinois	2 Kentucky	3 Michigan	4 Ohio	5 New York
Coelenterata:					
Zaphrentis gigantea, Lesueur		x	x	x	x
Zaphrentis prolifica, Billings		x	x	x	
Zaphrentis sp					
Acervularia rugosa (E. and H.)	x	x	x		
Amplexus yandelli (E. and H.)	x	x	x		
Favosites winchelli, Rominger		x	x		x
Favosites emmonsi, Rominger	x	x	x		
Favosites basalticus, Goldfuss				x	x
Favosites turbinatus (?) Billings		x	x	x	x
Favosites limitaris, Rominger		x	x		x
Favosites clausus, Rominger		x	x		x
Cladopora labiosa (Billings)		x	x		x
Molluscoidea:					
Cystodictya gilberti (?) Meek	x	H*		x	
Stropheodonta demissa (Conrad)	x	x	?		x
Rhipidomella vanuxemi, Hall	x	x	x	x	x
Centronella glansfagea, Hall	x	x	x	x	x
Eunella (?) sp					
Spirifer divaricatus, Hall		x		x	x
Spirifer grieri (?), Hall	x	x		x	x
Martinia maia (?) (Billings)				x	
Nucleospira concinna, Hall	x	x		x	x
Mollusca:					
Acinodesma occidentale (?), Hall	x	x			
Conocardium cuneus (Conrad)	x	var.		x	x
Conocardium ohioense, Meek		x		x	
Bellerophon pelops, Hall	x	x		x	x
Bellerophon newberryi, Meek				x	?
Hormotoma maia, Hall					
Igoceras conicum (Hall)	x	x		x	x
Loxonema robustum (?), Hall				x	
Cyclonema crenulata, Meek		x		x	
Callonema bellatula, Hall		x	x	x	
Callonema humile, Meek		x		x	
Callonema conus, Kindle		x			
Tentaculites scalariformis, Hall	x	x		x	x
Coleolus tenuicinctum, Hall	x			H	H
Orthoceras sp					
Gomphoceras sp (2)					
Zittleoceras nereus, Hall					x
Arthropoda:					
Phacops cristata, Hall	x	x			x
Proetus clarus, Hall	x	x			
Dalmanites calypso, Hall	x	x		x	x

*H indicates that species occurs in the Hamilton at that particular locality.

Correlation.—From the foregoing table it is evident that this fauna is of Onondaga age, and that it is the partial equivalent of the Grand Tower formation of southern Illinois and southeastern Missouri. Its affinities are entirely with the eastern Devonian and have no resemblance to the later Devonian faunas of Iowa and north central Missouri. Of the thirty-seven identified forms, seventeen occur in the Grand Tower formation of southern Illinois, thirty in the Jeffersonville beds of southern Indiana, thirteen in the Onondaga group of Michigan, twenty-two in the Onondaga of Ohio and eighteen in the Onondaga of New York. These figures are not exact and are probably too low, for the faunal lists from the various regions are incomplete and represent compilations in most cases. The most complete lists are those from the Grand Tower formation and from the Jeffersonville beds. Weller and Savage have shown the relationship of the Grand Tower fauna to the Onondaga of the eastern United States.

Savage has also shown that the Jeffersonville beds are the equivalent of the upper portion of the Grand Tower of Illinois. Since more than 80 per cent of the forms occurring at Rolla are also found in the Jeffersonville beds, it seems certain that this outlier belongs to the upper portion of the Grand Tower formation. Certain horizons in this formation are reported to be full of corals, but until the faunal lists for this formation are completed, a closer correlation cannot be made.

Conclusions.—The presence of a Grand Tower outlier at Rolla indicates a much greater submergence of the Ozark uplift during Onondaga time than has commonly been supposed. The nearest outcrops of the Grand Tower formation are at least 100 miles to the east. The St. Francois Mountains, the structural center of the uplift, are directly between the two exposures, and it is not believed that these were covered in Devonian time. In view of the thinning out of the Devonian to the north, it may be assumed that the Onondaga sea extended westward along the southern border of the St. Francois Mountains, and that it may have covered much of the southern portion of the uplift. Further field work may reveal other outliers, which will enable the boundaries of this sea to be traced more definitely.

PLATE NO. 1

PLATE 1.

Cyathophyllum halli (Edwards and Haime)
Page 49.

Fig. 1. A much-weathered specimen. About two-thirds natural size. (Callaway limestone of Boone County.)

Chonophyllum ellipticum Hall and Whitfield
Page 51.

Fig. 2. A large specimen from the Snyder Creek shale.
Figs. 3 and 5. Other specimens from the Snyder Creek about ¾ natural size.
Fig. 4. An average specimen from the Callaway limestone. (X 4/5.)

Streptelasma cooperensis Branson
Page 48.

Figs. 6 and 7. Specimens from the Cooper limestone near Lupus. About ¾ natural size.

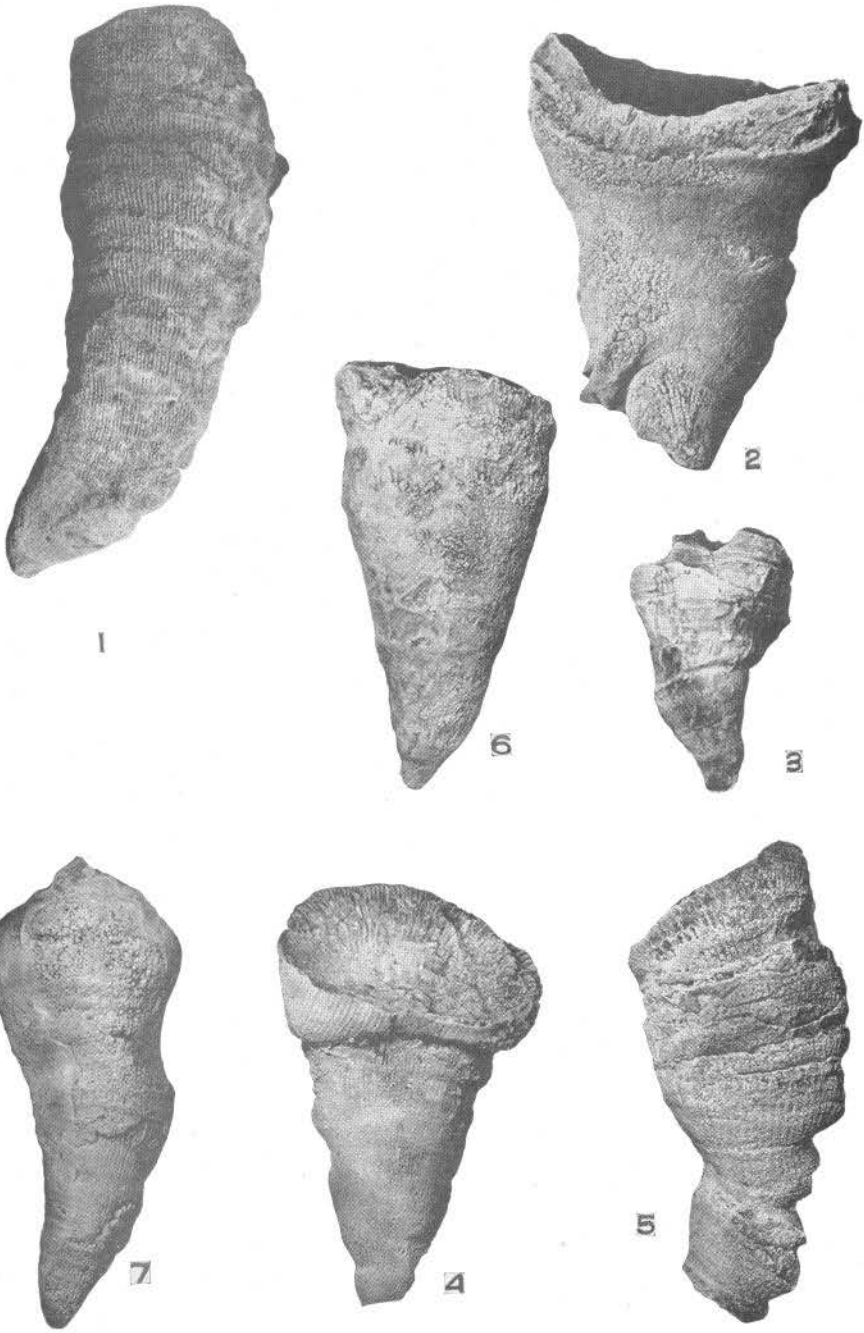
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PLATE NO. 2

PLATE 2.

Favosites alpenensis Winchell
Page 53.

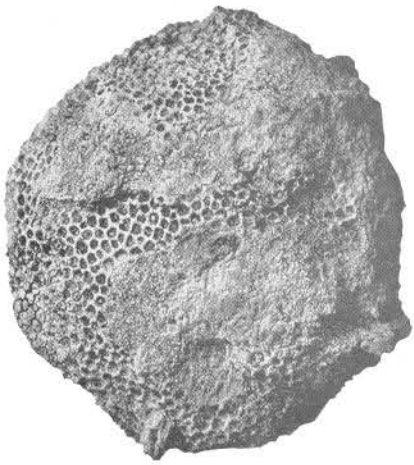
Fig. 1. Almost spherical corallum from the Mineola of Ralls County.
Fig. 2. An elongate corallum from the Mineola of Ralls County.
Fig. 3. A corallum from the Mineola of Ralls County. About $\frac{2}{3}$ natural size.

Favosites sp. undet.

Figs 4 and 5. Top and side views of a corallum. (Devonian of Callaway County, formation uncertain.) (X 2/3.)

Chonophyllum ellipticum Hall and Whitfield
Page 51.

Fig. 6. Inside of the cup of the specimen shown in figure 2, of plate 1.



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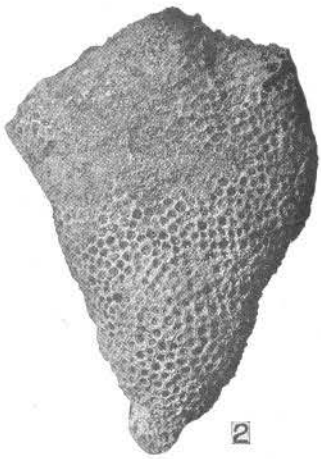

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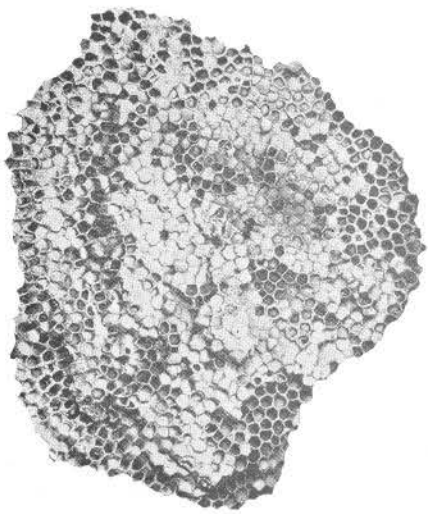

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PLATE NO. 3

PLATE 3

Favosites limitaris Rominger
Page 54.

Fig. 1. A mass of rock containing several branches.
(Callaway limestone of Boone County.)

Ceratopora snyderensis Branson
Page 56.

Fig. 2. An average specimen (X 4/5).
(Snyder Creek shale of Callaway County.)

Fig. 3. Gen. and sp. undet. (See plate 4, figs. 5 and 6.)
(Snyder Creek shale of Callaway County.)

Diplophyllum callawayensis Branson
Page 50.

Fig. 4. An exfoliated colony about 4/5 natural size.
(Callaway limestone of Boone County.)

Ceratopora grabaui Branson
Page 56.

Fig. 5. The usual occurrence of the species.
(Mineola limestone of Montgomery County.)

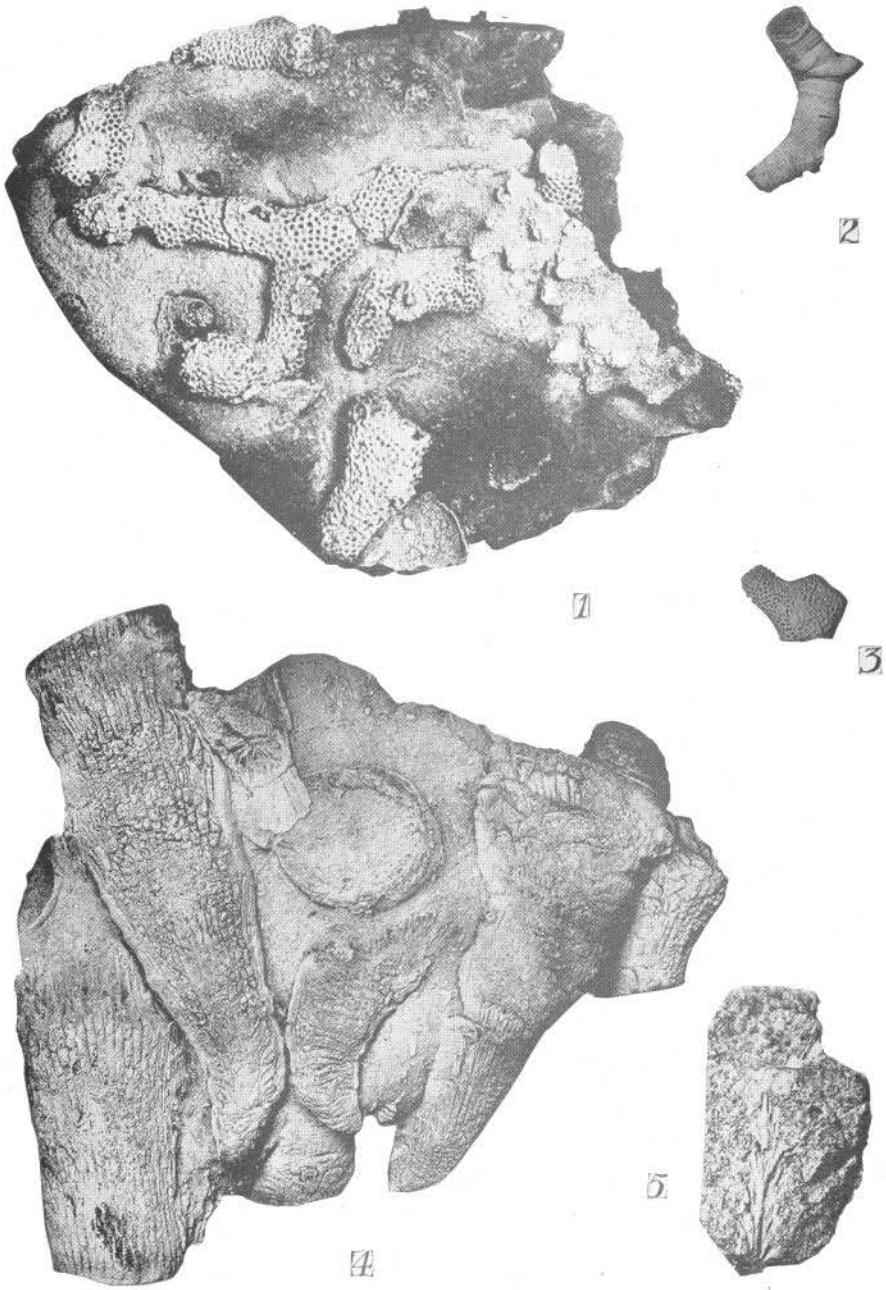
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PLATE NO. 4

PLATE 4

Stromatopora solidula Hall and Whitfield
Page 56.

Fig. 1. A small part of a surface about 10 times natural size. (Snyder Creek shale of Callaway County.)

Ceratopora grabaui Branson
Page 56.

Fig. 2. A specimen from which most of the branches are missing. About twice natural size. (Mineola limestone of Montgomery County.)

Fig. 3. A vertical section about twice natural size.

Aulopora repens Knorr and Walch
Page 55.

Fig. 4. A fragment on *Stropheodonta demissa* (Conrad). (Snyder Creek shale of Callaway County.)

Gen. and sp. undet.

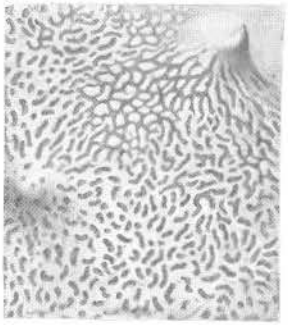
Figs. 5 and 6. Vertical and cross-section of fragment from the Snyder Creek shale. (X6.)

Lioclema occidens (Hall and Whitfield)
Page 69.

Figs. 7 and 8. Vertical and cross-sections of zooecia. (X 30.) (Snyder Creek shale of Callaway County.)

Acervularia davidsoni Edwards and Haime
Page 52.

Figs. 9 and 10. Small areas enlarged about 6 times. (Callaway limestone of Boone County.)



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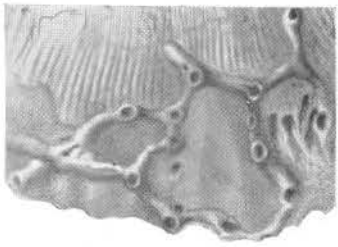

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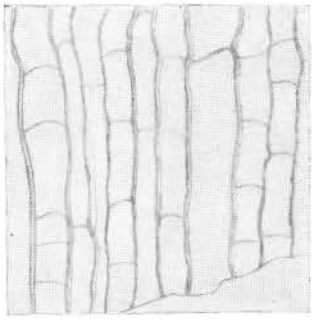

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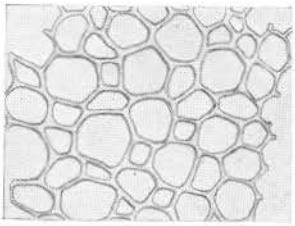

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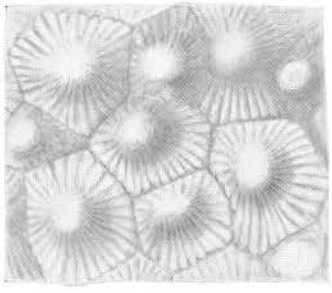

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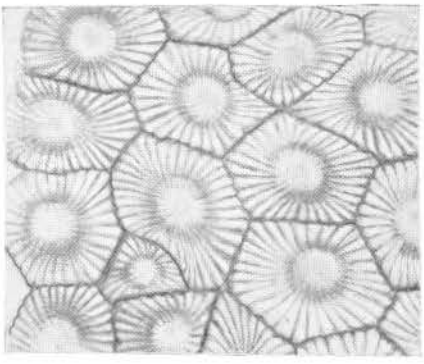

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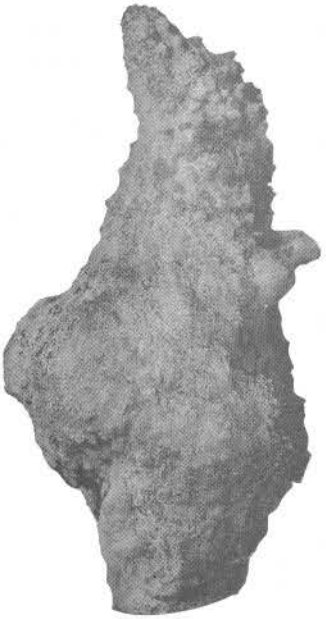
PLATE NO. 5

PLATE 5

Stromatopora solidula Hall and Whitfield
Page 56.

Figs. 1, 2, 4, 5. Colonies of various shapes. (X ⅙.)
Fig. 3. The base of a colony that formed on a gastropod.
Fig. 6. Base of a colony with wrinkled epitheca.
(Snyder Creek shale of Callaway County.)



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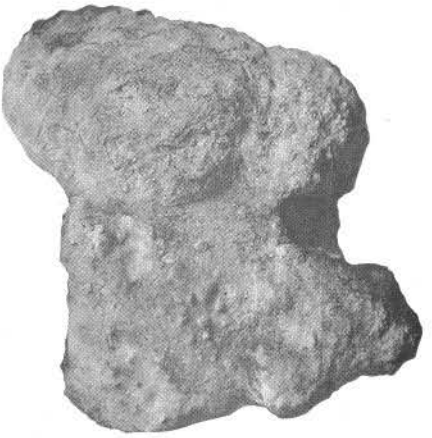

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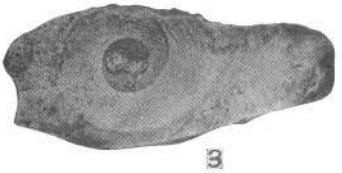

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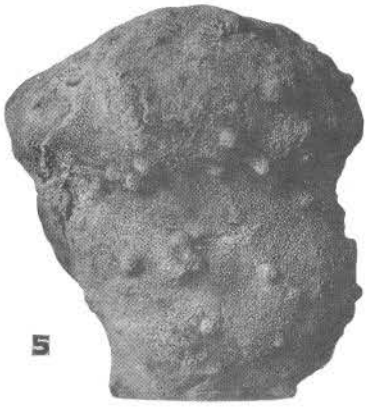

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PLATE NO. 6

PLATE 6

Megistocrinus missouriensis Branson and Wilson
Page 66.

Fig. 1. Basal view of the holotype.
(Mineola limestone of Montgomery County.)

Megistocrinus mineolaensis Branson and Wilson
Page 66.

Figs. 2-4. Top, side, and basal views of the holotype.
(Mineola limestone of Ralls County.)

Stereocrinus moori Branson and Wilson
Page 62.

Fig. 5. Basal view of one of the cotypes.
Fig. 6. Top view of a cotype which has clear sutures. About one-third broken away.
(Mineola limestone of Ralls County.)

Melocrinus lylii Rowley
Page 59.

Figs. 7 and 8. Side and top views of the holotype. (Collection of R. R. Rowley. Snyder Creek shale of Callaway County.)

Spirorbis omphaloides (Goldfuss)
Page 57.

Figs. 9 and 10. Views of two average specimens. (X5.)
(Snyder Creek shale of Callaway County.)

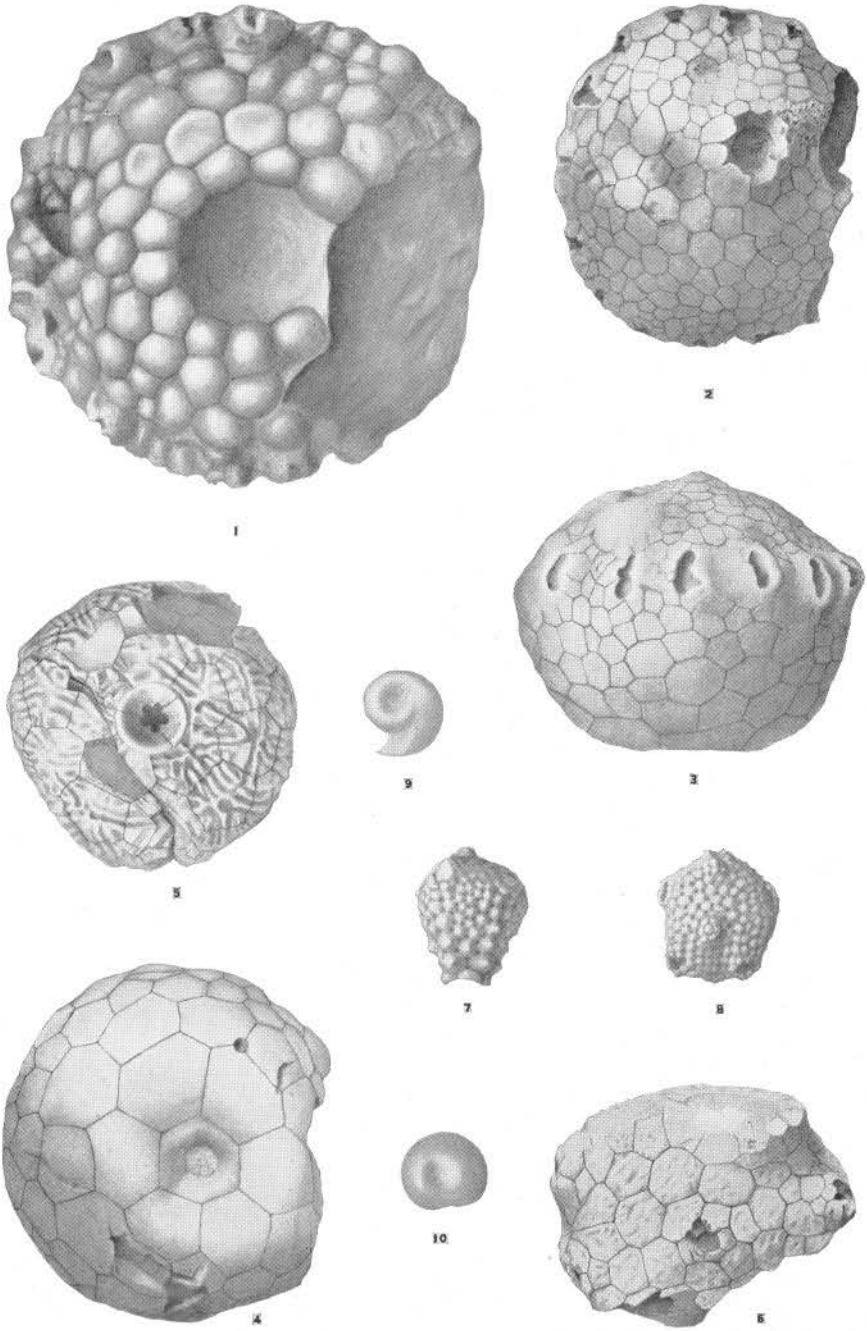
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PLATE NO. 7

PLATE 7

Stereocrinus springeri Branson and Wilson
Page 63.

Figs. 1-3. Side, basal, and top views of the holotype. (Mineola limestone of Ralls County.)

Dactylocrinus concavus (Rowley)
Page 67.

Figs 4 and 5. Basal and side views of the type specimen. (Collection of R. R. Rowley. Snyder Creek shale of Callaway County.)

Stereocrinus vandiveri Branson and Wilson
Page 63.

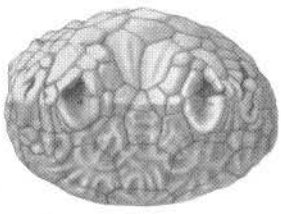
Figs. 6-8. Anal side, top, and basal views of a cotype. The top is somewhat weathered. Some sutures near the margin are indistinct and others cannot be made out. (Mineola limestone of Ralls County.)

Melocrinus tersus Rowley
Page 60.

Figs. 9 and 10. Side and top views. (Collection of R. R. Rowley. Snyder Creek shale of Callaway County.)

Melocrinus gregeri Rowley
Page 59.

Figs. 11 and 12. Side and top views of a specimen from the type locality. (Snyder Creek shale of Callaway County.)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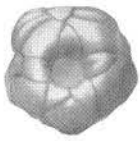
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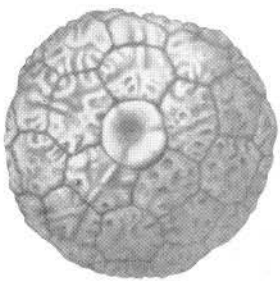
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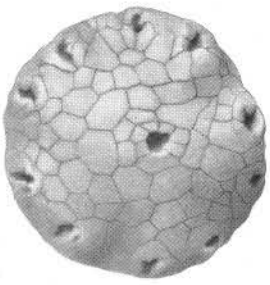
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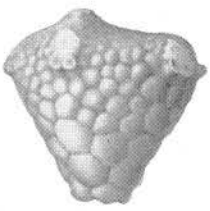
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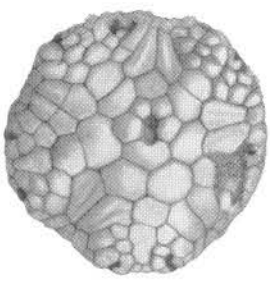
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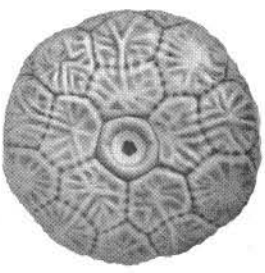
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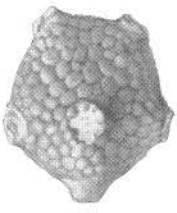
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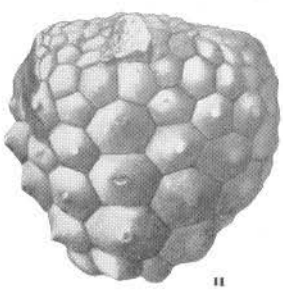
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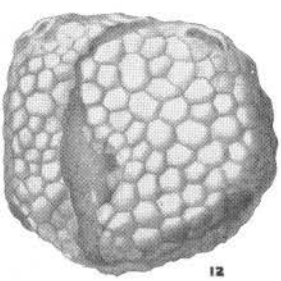
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PLATE NO. 8

PLATE 8

Megistocrinus missouriensis Branson and Wilson
Page 66.

Fig. 1. Top view of the holotype.
Fig. 2. Side view of the holotype. The margin is somewhat distorted, but the decided upturning in the anal area seems to be normal.
(Mineola limestone of Montgomery County.)

Nucleocrinus verneuili (Troost)
Page 57.

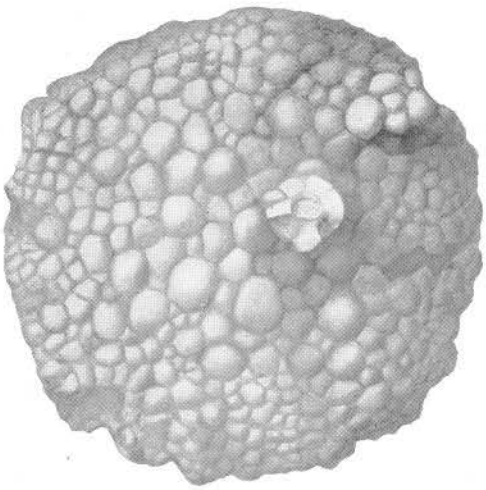
Fig. 3. Top view of an interior mould. (X2.)
Fig. 4. Side view of an interior mould.
(Mineola limestone of Montgomery County.)

Megistocrinus broadheadi Branson and Wilson
Page 65.

Fig. 5. Top view of the holotype.
Fig. 6 Basal view of the holotype.
Fig. 7. Side view of the holotype.
(Mineola limestone of Montgomery County.)

Stereocrinus moori Branson
Page 62.

Fig. 8. View of the anal area turned slightly to the right of center. Specimen slightly broken. (Mineola limestone of Ralls County.)



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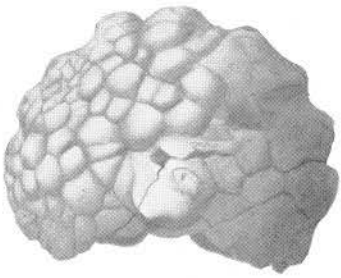

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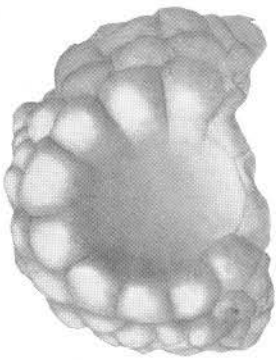

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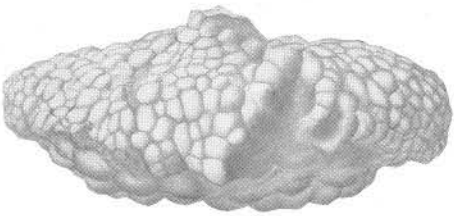

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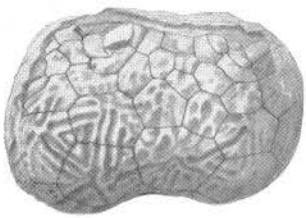

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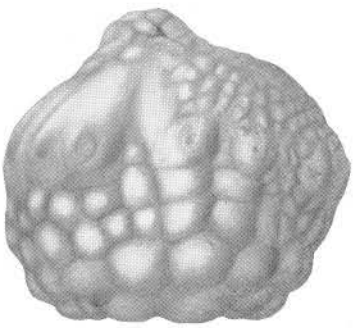

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PLATE NO. 9

PLATE 9

Cystodictya mineolaensis Branson
Page 71.

Fig. 1. A form with frequent branching. (X3.)
Fig. 3. A form with few branches. (X3.)
(Mineola limestone near Mineola, Missouri.)

Coscinium missouriensis Branson
Page 71.

Fig. 2. Surface of a zoarium (X7). (Mineola limestone near Mineola, Missouri.)

Rhombopora missouriensis Branson
Page 70.

Fig. 6. Part of a branch (X7). (Snyder Creek shale of Callaway County.)

Cyclotrypa communis Ulrich
Page 68.

Fig. 7. Surface of a small part of a zoarium. (X7).
Fig. 8. Vertical section. (X5).
Fig. 9. Tangential section, not passing through a macula. (X5).
(Mineola limestone near Mineola, Missouri.)

Hemitrypa mineolaensis Branson
Page 70.

Fig. 10. The superficial network with a portion of the zoarium. (X15).
Fig. 11. Non-celluliferous face of a portion of a frond. (X5).
Fig. 12. Celluliferous face of a portion of a frond. (X5).
(Mineola limestone near Mineola, Missouri.)

Fenestella missouriensis Branson
Page 69.

Fig. 13. Non-celluliferous face. (X5).
Fig. 14. Celluliferous face. (X5).
(Mineola limestone near Mineola, Missouri.)

Lioclema occidens (Hall and Whitfield)
Page 69.

Fig. 15. A small part of a zoarium, including one of the large pores. (X8).
(Snyder Creek shale of Callaway County.)

Cyclotrypa magna-monticulata Branson
Page 68.

Fig. 16. Surface of a zoarium, including a macula. (X3).
Fig. 4. Vertical section. (X7).
Fig. 5. Tangential section. (X7).
(Mineola limestone near Mineola, Missouri.)

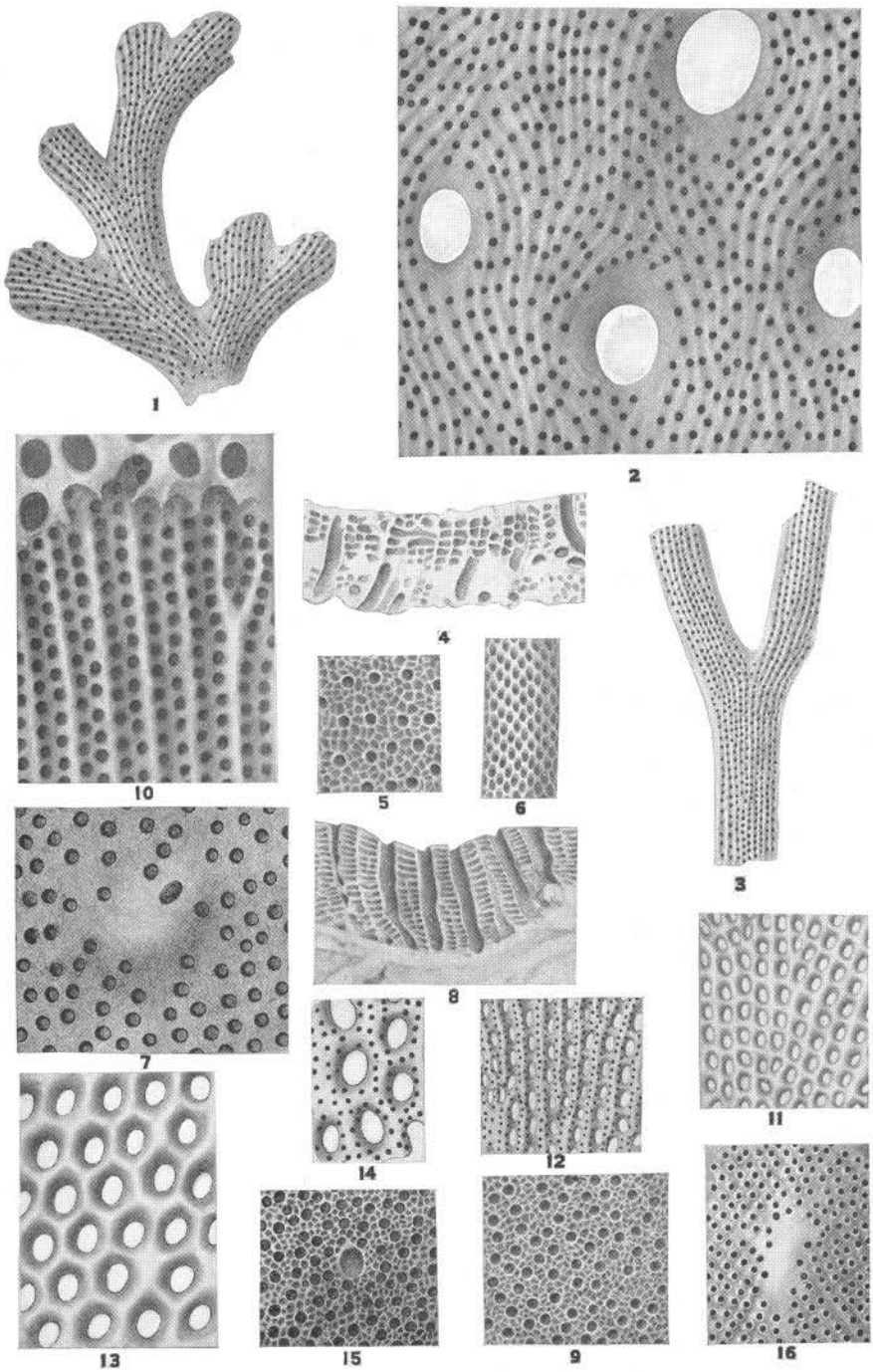
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PLATE NO. 10

PLATE 10

Cyclotrypa magna-monticulata Branson
Page 68.

Fig. 1. A fragment showing wrinkled epitheca.
Fig. 3. A fragment showing projecting monticules.
Fig. 6. An impression showing monticules as depressions.
(Mineola of Montgomery County.)

Rhombopora missouriensis Branson
Page 70.

Fig. 2. A fragment of the *Rhombopora* bed of rock.
(Snyder Creek shale from Craghead Creek, Callaway County.)

Hemitrypa mineolaensis Branson
Page 70.

Fig. 5. An impression of a zoarium.
(Mineola of Montgomery County.)

Lioclema occidens (Hall and Whitfield)
Page 69.

Figs. 4 and 7. Two common types of zoaria.
(Snyder Creek shale of Callaway County.)

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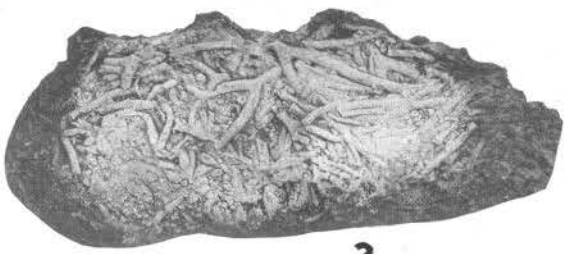

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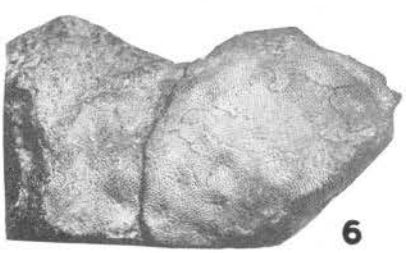

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PLATE NO. 11

PLATE 11

Crania famelica H. and W.
Page 72.

Figs. 1 and 2. Top and side views of an average specimen. (X1½).
(Snyder Creek shale from Callaway County.)

Stropheodonta demissa (Conrad)
Page 77.

Fig. 3. An interior of a pedicle valve. (Snyder Creek shale of Callaway County.)
Fig. 8. A small specimen with the beginning of the arrangement of plications in bundles which culminated in *S. mineolaensis* Branson (X2).
(Mineola limestone of Montgomery County.)

Schizophoria propinqua (Hall)
Page 74.

Fig. 4. A small specimen of pedicle valve. (X2.)
(Mineola limestone of Montgomery County.)

Schuchertella cf. pandora (Billings)
Page 84.

Fig. 5. A small pedicle valve.
Fig. 14. Posterior view of an imperfect pedicle valve.
(Mineola limestone of Montgomery County.)

Stropheodonta navalis Swallow
Page 82.

Fig. 7. Plications and punctation of an average specimen. (X5).
(Snyder Creek shale of Callaway County.)

Stropheodonta equicostata Swallow
Page 79.

Fig. 6. Plications and punctation of an average specimen. (X5).
(Snyder Creek shale of Callaway County.)

Pholidostrophia iowaensis (Owen)
Page 82.

Fig. 9. Interior of a small brachial valve.
(Mineola limestone of Montgomery County.)

Productella callawayensis (Swallow)
Page 85.

Fig. 10. A small pedicle valve.
Fig. 16. A pedicle valve of medium size with spines unusually preserved.
(Snyder Creek shale of Callaway County.)

Stropheodonta boonensis (Swallow)
Page 75.

Fig. 11. Plications and punctation of an average specimen. (X5.)
(Snyder Creek shale of Callaway County.)

Strophonella crassa (Rowley)
Page 83.

Fig. 12. Side view of type.
Fig. 13. Brachial view of type.
Fig. 14. Posterior view of type.
(Snyder Creek shale of Callaway County.)

Stropheodonta inequiradiata Hall
Page 80.

Fig. 15. Details of plications and striations.
(Mineola limestone of Montgomery County.)

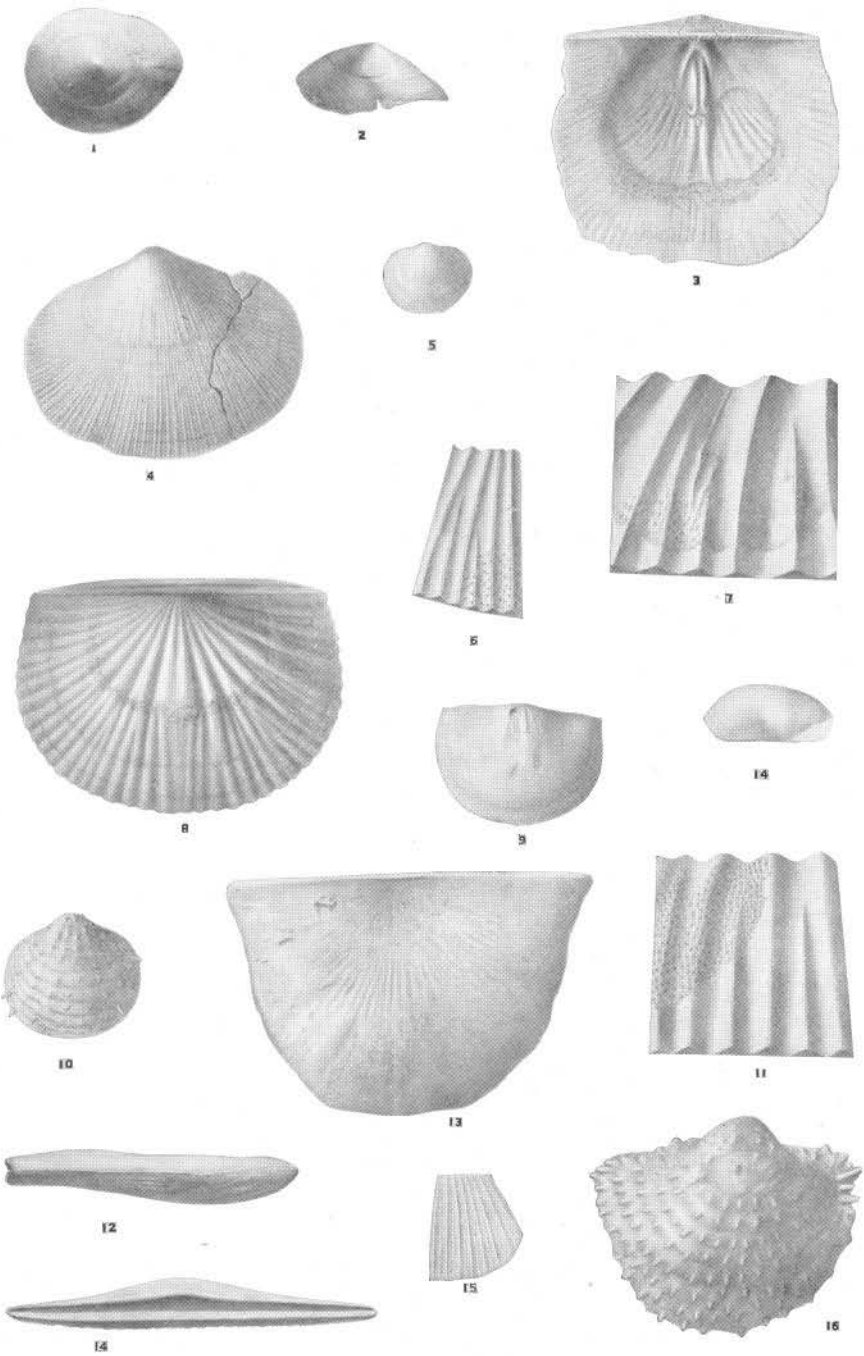
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PLATE NO. 12

PLATE 12

Stropheodonta cymbiformis Swallow
Page 76.

Fig. 1. Brachial view of an average specimen.
(Snyder Creek shale, Craghead Creek, Callaway County.)
Fig. 2. Pedicle view of the same specimen.
Fig. 3. Side view of the same specimen.

Stropheodonta navalis Swallow
Page 82.

Figs. 4 and 8. Pedicle and brachial views of an average specimen with both ends of hinge broken away. (X¾.)
Figs. 5 and 7. Pedicle and brachial views of a small specimen with hinge of right side nearly complete.
Fig. 6. Back view of a large specimen.
(All specimens from the Snyder Creek shale, Craghead Creek, Callaway County.)

Stropheodonta equicostata Swallow
Page 79.

Fig. 9. Pedicle view of a small specimen with average plications.
Fig. 10. Pedicle view of a specimen with unusually short hinge and large plications.
Figs. 11 and 14. Pedicle and lateral views of a small specimen.
Figs. 12 and 15. Side views of average specimens taken from slightly different angles.
Fig. 13. Pedicle view of an average specimen.
Fig. 16. Pedicle view of an average specimen.
Fig. 17. Brachial view of an average specimen.
(All specimens from the Snyder Creek shale of Callaway County.)

Stropheodonta mineolaensis Branson
Page 81.

Figs. 18, 20, and 21. Side, pedicle, and brachial views of a convex specimen.
Fig. 19. Pedicle view of a flat specimen. (X¾.)
(All from the Mineola of Ralls County.)

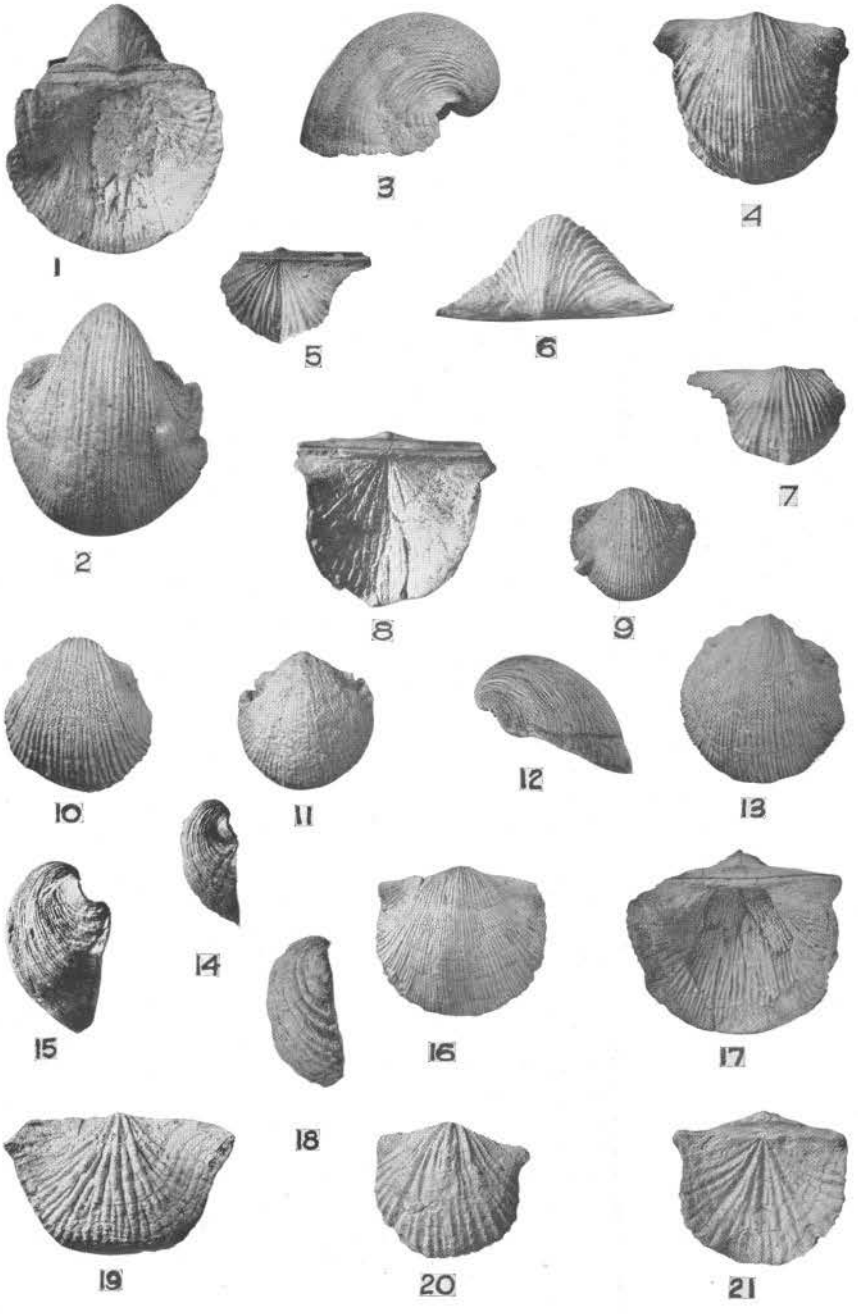
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PLATE NO. 13

PLATE 13

Stropheodonta callawayensis Swallow
Page 75.

Fig. 1. Brachial view of a large specimen.
(Collection of D. K. Greger. Photo by Greger.)
Fig. 2. Pedicle view of a large specimen with left end of hinge broken away.
Fig. 3. Pedicle view of a small specimen grading toward *S. demissa* (Conrad).
Fig. 4. Pedicle view of a specimen with unusually small sharp plications.
Fig. 5. Back view of an unusually thick-shelled specimen. Both ends of hinge missing.
(All specimens from the Snyder Creek shale of Callaway County.)

Stropheodonta boonensis Swallow
Page 75.

Fig. 6. Pedicle view of an immature specimen.
Figs. 7 and 8. Pedicle views of average specimens.
Fig. 9. Side view of an average specimen.
Figs. 10 and 11. Side and pedicle views of a small specimen.
Fig. 12. Brachial view showing concavity of brachial valve.
(All specimens from the Snyder Creek shale of Callaway County.)

Stropheodonta inflexa Swallow
Page 81.

Figs. 13, 16, and 17. Pedicle, side, and brachial views of an average specimen.
Figs. 14 and 15. Brachial and side views of an average specimen.
(All specimens from the Snyder Creek shale of Callaway County.)

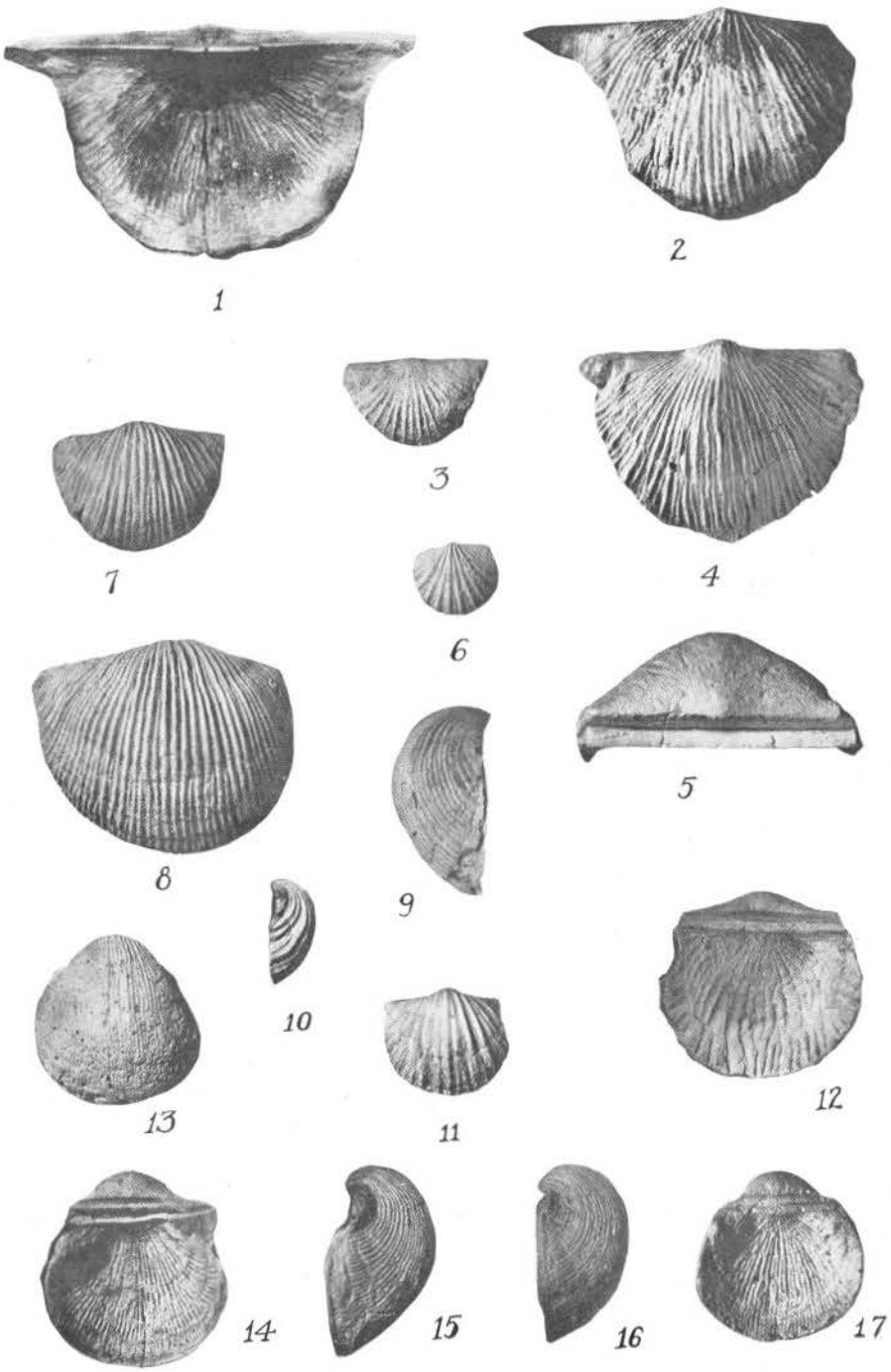
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PLATE NO. 14

PLATE 14

Stropheodonta demissa (Conrad)
Page 77.

Figs. 1 and 3. Pedicle and back views of an average specimen.
(Callaway limestone of Callaway County.)
Figs. 2 and 4. Immature specimens, pedicle views.
(Snyder Creek shale of Callaway County.)
Fig. 5. Interior mould of brachial valve of an immature specimen.
(Snyder Creek shale of Callaway County.)
Fig. 6. A small specimen from the Mineola limestone.
Fig. 7. A specimen of average size with coarse plications.
(Snyder Creek shale of Callaway County.)
Fig. 8. A large specimen with fine plications.
(Snyder Creek shale of Callaway County.)

Stropheodonta inequiradiata Hall
Page 80.

Figs. 10 and 11. Side and pedicle views of an imperfect specimen.
(Mineola of Montgomery County.)

Stropheodonta boonensis Swallow
Page 75.

Fig. 9. An unusually convex specimen.
(Snyder Creek shale of Callaway County.)

Stropheodonta navalis Swallow
Page 82.

Fig. 12. Side view of an average specimen.
(Snyder Creek shale of Callaway County.)

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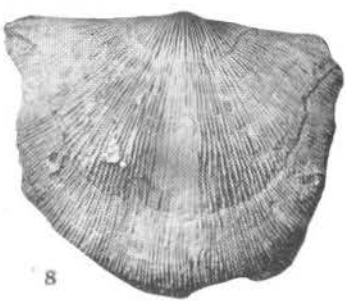

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PLATE NO. 15

PLATE 15

Schizophoria striatula (Schlotheim)
Page 72.

Fig. 1. Internal mould of a brachial valve of an average specimen.
Fig. 3. Internal mould of an average pedicle valve.
(Callaway limestone of Callaway County.)
Fig. 2. Brachial view of a large specimen.
Fig. 4. Pedicle view of a small specimen.
Figs. 5 and 6. Pedicle and side views of an average specimen.
Fig. 7. Pedicle valve of a specimen with the front margin slightly more sinuate than average. (Snyder Creek shale of Callaway County.)

Schuchertella arctostriata (Hall)
Page 83.

Figs. 8 and 12. Exteriors of pedicle and brachial valves.
(Snyder Creek shale of Callaway County.)
Fig. 9. Brachial valve of a specimen from the Lime Creek of Iowa.

Productella callawayensis Swallow)
Page 85.

Figs. 10 and 13. Pedicle and brachial views of a large specimen.
Fig. 11. Pedicle valve of a large specimen.
Fig. 14. Brachial view of a small specimen.
(Snyder Creek shale of Callaway County.)

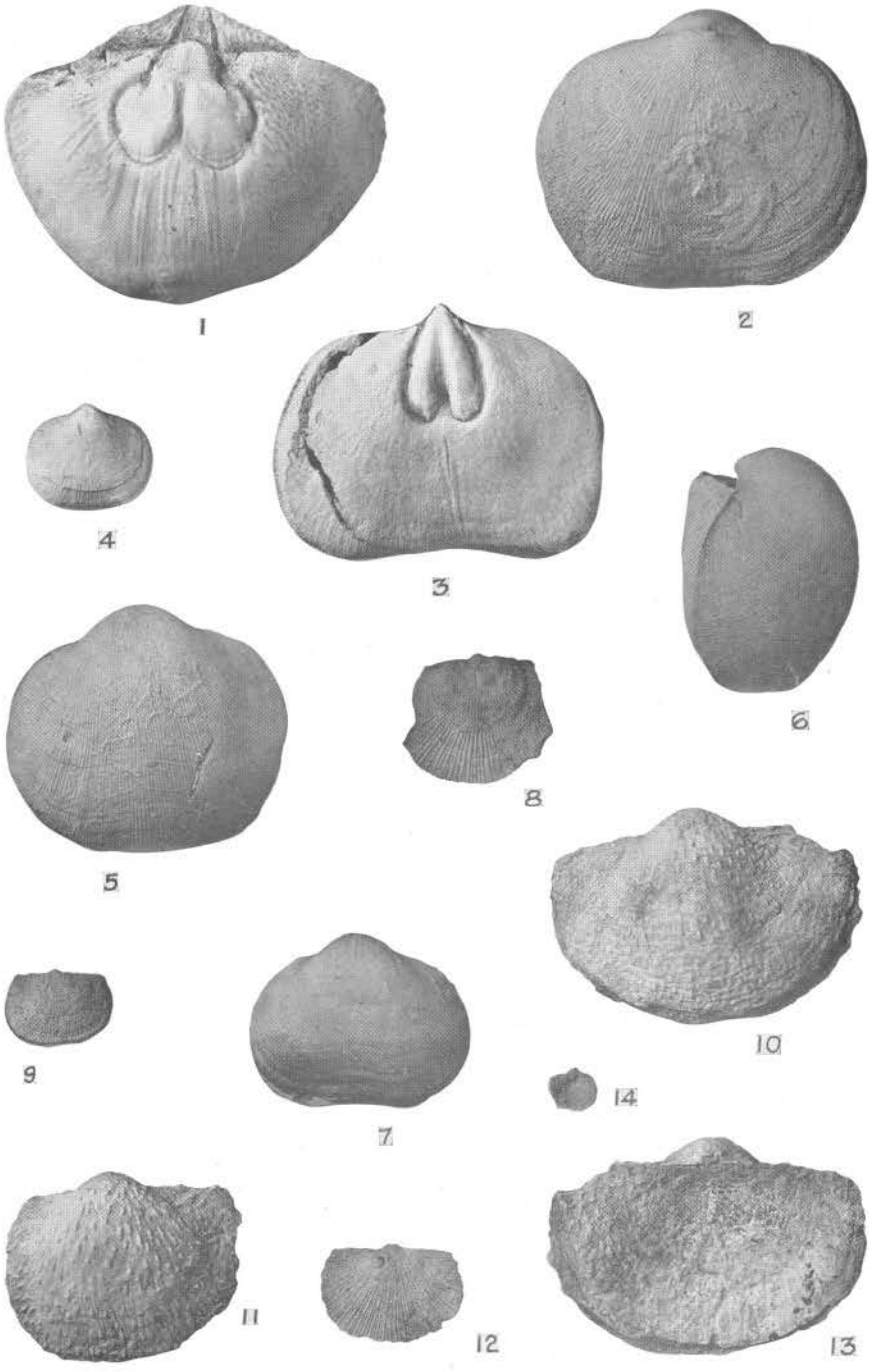
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PLATE NO. 16

PLATE 16

Reticularia fimbriata (Conrad)
Page 105.

Figs. 1 and 2. Two views of a pedicle valve.
(Mineola of Montgomery County.)

Cranaena calvini (Hall and Whitfield)
Page 94.

Fig. 3. Brachial view of a small specimen with an unusually straight hinge line.
(Snyder Creek shale of Callaway County.)

Figs. 4 and 5. Brachial and side views of a small specimen.
(Snyder Creek shale of Callaway County.)

Martinia halli Branson
Page 106.

Figs. 6-8. Brachial, pedicle, and side views of an average specimen. (X2).
(Callaway limestone of Moniteau County.)

Cyrtina missouriensis (Swallow)
Page 108.

Fig. 9. Cardinal area of an average specimen. (X2).
(Callaway limestone of Callaway County.)

Pugnoides altus (Calvin)
Page 92.

Figs. 10-12. Brachial, pedicle, and side views of an average specimen. (X2).
(Snyder Creek shale of Callaway County.)

Pugnoides swallovi Branson
Page 92.

Figs. 13 and 14. Brachial and side views of an unusually gibbous specimen. (X2).
(Mineola of Montgomery County.)

Fig. 15. Brachial view of a small specimen from the same locality as Figs. 14 and 15. (X2).

Pentamerella arata (Conrad)
Page 87.

Fig. 16. A view of the cardinal area and beak of the pedicle valve of an imperfect specimen. (X2). (Mineola of Ralls County.)

Gypidula marionensis Greger
Page 89.

Figs. 17-19. Side, brachial, and pedicle views of an average specimen. (X2).
(Cooper limestone of Marion County).

Fig. 20. Beak and area of pedicle valve of an imperfect specimen. (X2).
(Cooper limestone of Marion County.)

Pentamerella fultonensis Branson
Page 88.

Figs. 21-23. Pedicle, brachial, and side views of an average specimen. (X2).
(Callaway limestone of Callaway County.)

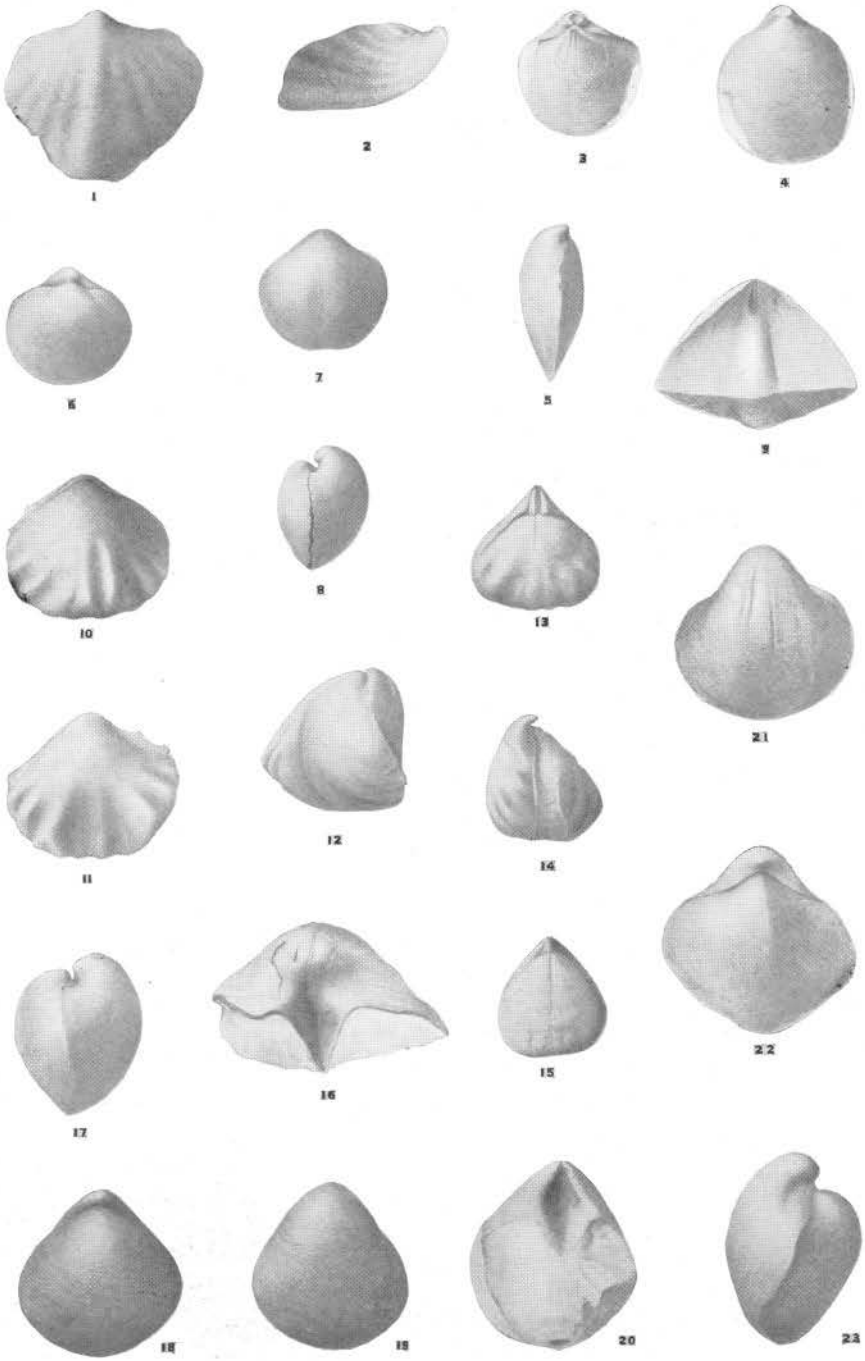
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PLATE NO. 17

PLATE 17

Athyris fultonensis (Swallow)
Page 109.

Figs. 1-3. Brachial, lateral and pedicle views of an immature specimen.
(Snyder Creek shale of Callaway County.)
Fig. 4. Pedicle valve of an immature specimen.
(Callaway limestone of Callaway County.)

Athyus vittata (Hall)
Page 110.

Figs. 8 and 9. Pedicle and lateral views of a small gibbous specimen.
(Mineola limestone of Montgomery County.)
Figs. 10 and 15-16. Pedicle, brachial, and lateral views of a small specimen.
(Mineola limestone of Montgomery County.)

Hypothyris gregeri Branson
Page 91.

Figs. 5-7. Brachial, lateral, and pedicle views of a small specimen.
(Callaway limestone of Callaway County. X2.)
Figs. 11-14. Brachial, front, lateral, and pedicle views of a large specimen.
(Callaway limestone of Callaway County. X2.)

Pentamerella arata (Conrad)
Page 87.

Fig. 17. Brachial valve of a broad, smooth specimen.
Fig. 18. Pedicle valve of a small specimen with few large plications.
Fig. 19. Mould of a pedicle valve of a large specimen with few plications.
Fig. 20. Brachial view of a small specimen with indistinct plications.
Fig. 21. Mould of pedicle valve with numerous sharp plications.
Fig. 22. Pedicle view of specimen shown in fig. 20.
Fig. 23. Side view of the specimen shown in figs. 20 and 22.
(All specimens from the Mineola limestone of Montgomery County. X2.)

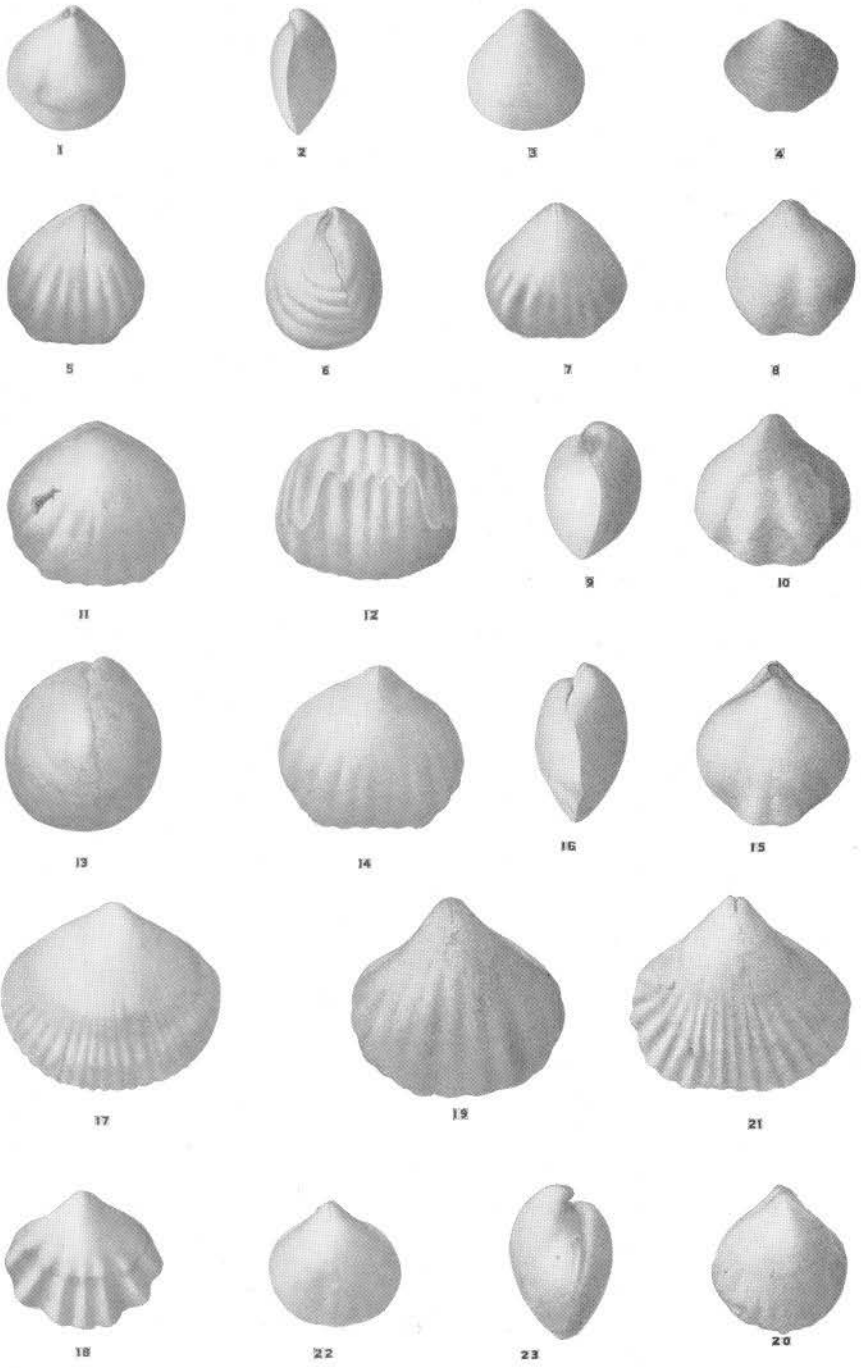
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PLATE NO. 18

PLATE 18

Newberria missouriensis Swallow
Page 93.

Fig. 1. Internal mould of an imperfect pedicle valve.
Figs. 2 and 3. Two views of an internal mould of a brachial valve.
Fig. 4. Side view of a specimen with pedicle valve slightly more convex than average. (Callaway limestone of Boone County.)

Cranaena calvini Hall
Page 94.

Fig. 5. Pedicle valve of a small specimen retaining color pattern. (X2). (Snyder Creek shale of Callaway County.)

Genus and species not determined

Fig. 6. Internal mould of a brachial valve. (X4). (Mineola limestone of Montgomery County.)

Atrypa gregeri Rowley
Page 97.

Figs. 7-9. Three views of a cotype (X2). (Snyder Creek shale of Callaway County. Collection of R. R. Rowley.)

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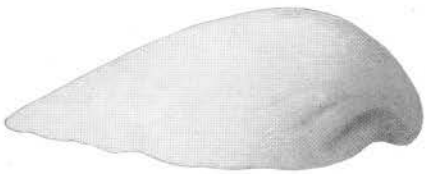

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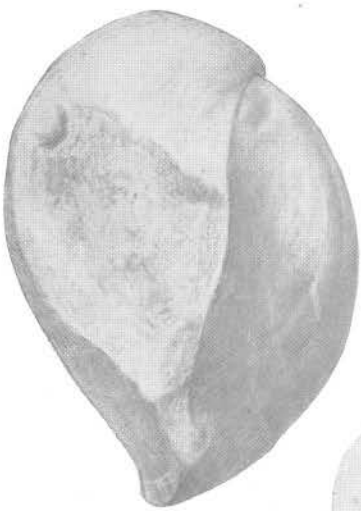

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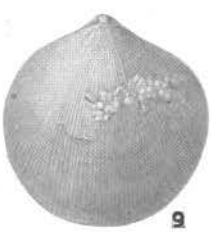

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PLATE NO. 19

PLATE 19

Cyrtina missouriensis (Swallow)
Page 108.

Figs. 1-4. Pedicle, brachial, cardinal, and side views of a perfect specimen. (X2). (Callaway limestone of Callaway County.)

Cyrtina hamiltonensis Hall
Page 106.

Figs. 5-8. Pedicle, brachial, side, and cardinal views of a perfect specimen. (X2). (Mineola limestone of Montgomery County.)

Cyrtina triquetra Hall
Page 108.

Figs. 9-12. Pedicle, brachial, side, and cardinal views of a perfect specimen. (X2). (Snyder Creek shale of Callaway County.)

Spirifer annae Swallow
Page 99.

Figs. 13 and 15-17. Pedicle, brachial, cardinal and side views of a perfect specimen. (X2). (Snyder Creek shale of Callaway County.)
Fig. 14. Surface magnified to show striations.

Spirifer varicosus Hall
Page 102.

Fig. 18. Brachial valve of a small specimen. (X2). (Mineola limestone of Montgomery County.)

Spirifer asper Hall
Page 100.

Fig. 19. Magnified surface.
Figs. 20-23. Brachial, pedicle, side, and cardinal views. (Callaway limestone of Callaway County.)

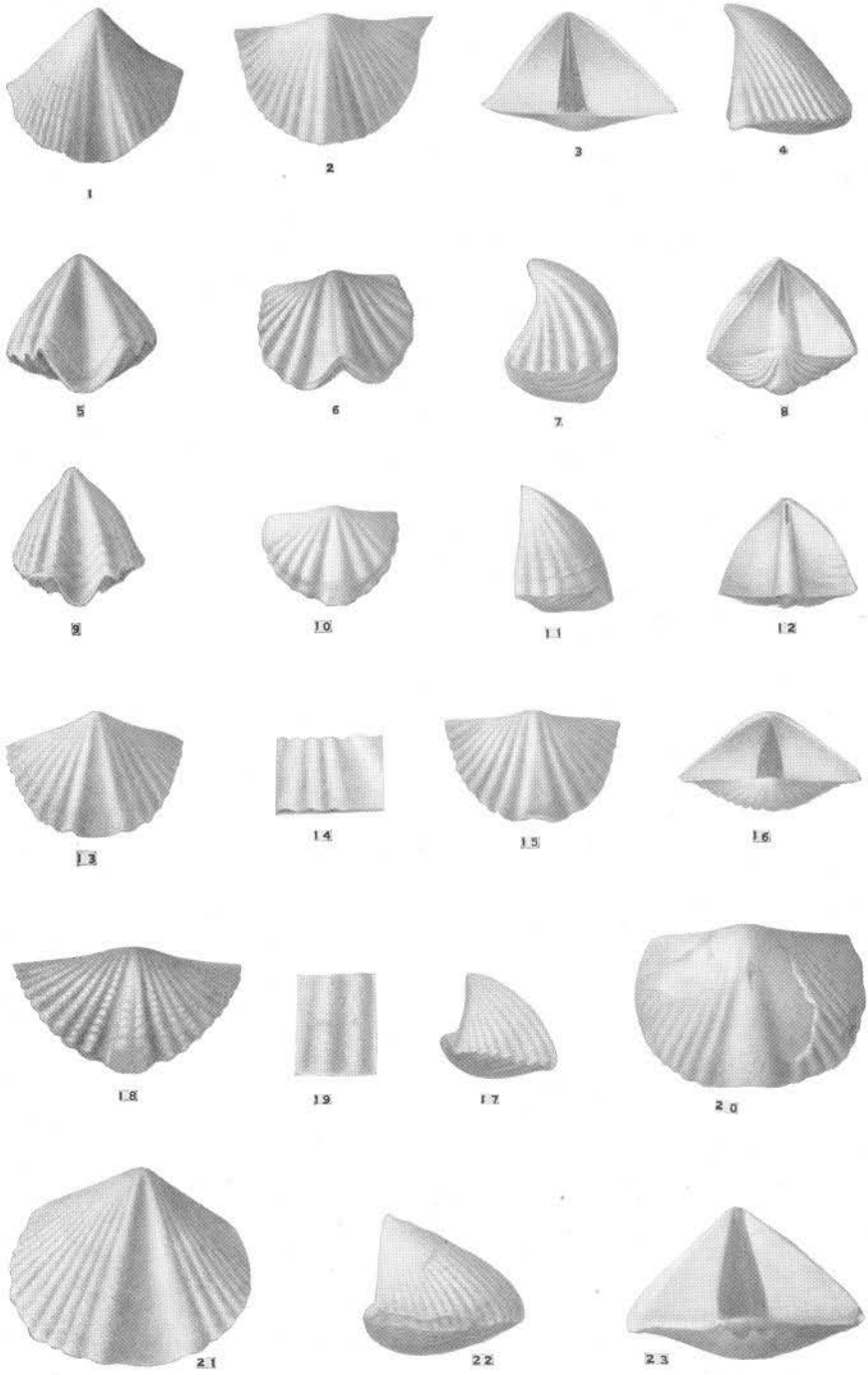
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PLATE NO. 20

PLATE 20

Syringothyris n. sp.
Page 104.

Figs. 1 and 2. Side and posterior views of an imperfect mould.
(Mineola of Montgomery County.)

Syringothyris occidentalis (Swallow)
Page 103.

Figs. 3-5. Posterior, anterior, and lateral views of a perfect interior mould of a small specimen. (Callaway limestone of Callaway County.)

Spirifer subvaricosus H. & W.
Page 101.

Figs. 6 and 7. Front and side views of an imperfect pedicle valve.
(Mineola of Ralls County.)

Atrypa spinosa Hall.
Page 98.

Fig. 8. Brachial valve of an average specimen.
Figs. 9, 10, 11. Lateral, pedicle, and brachial views of an average specimen.
(Snyder Creek shale of Callaway County.)

Eunella lincklæni (Hall)
Page 93.

Figs. 12, 14 and 16. Brachial, lateral, and pedicle views of an average specimen.
Fig. 13. Lateral view of an average specimen.
Fig. 15. Lateral view of a gibbous specimen. (Mineola of Montgomery County.)

Cranaena romingeri (Hall)
Page 96.

Figs. 17, 18, 19. Lateral, pedicle, and brachial views of an average specimen.
(Mineola of Ralls County.)

Cranaena iowaensis (Calvin)
Page 95.

Figs. 20, 21, 22. Brachial, lateral, and pedicle views of a large specimen.
(Callaway limestone of Callaway County.)

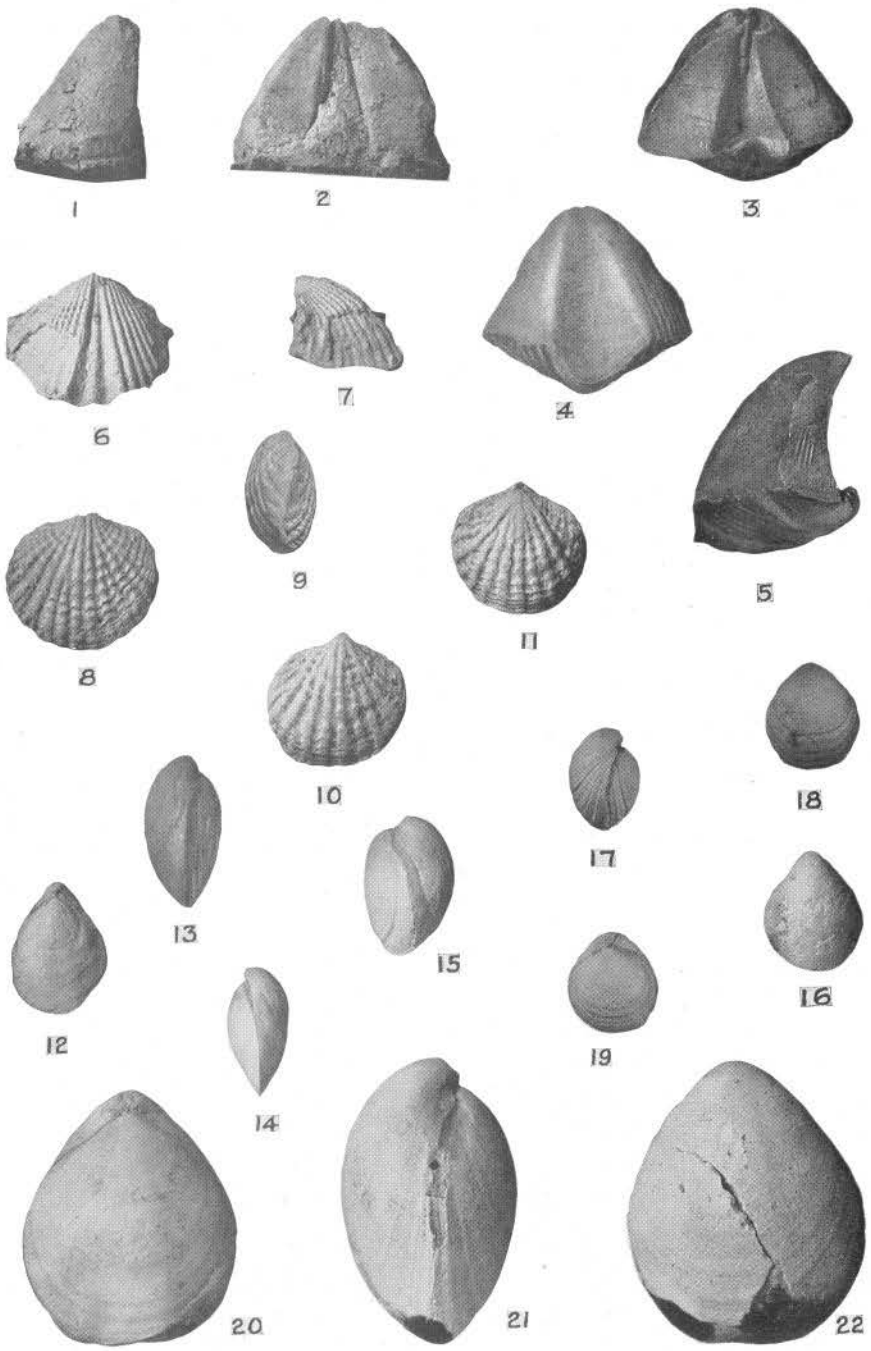
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PLATE NO. 21

PLATE 21

Syringothyris occidentalis (Swallow)
Page 103.

Figs. 1, 2, 3. Cardinal area, brachial, and pedicle views of well-preserved moulds of interiors. (Collection of D. K. Greger. Photos by D. K. Greger.)

Spirifer varicosus Hall
Page 102.

Figs. 4 and 5. Small pedicle valves. (X2).
(Mineola of Ralls County.)

Atrypa reticularis (Linnæus)
Page 97.

Fig. 6. A specimen with well-preserved spines. (X2/3.)
(Callaway limestone of Callaway County.)
Fig. 7. Brachial view of a large old specimen. (X2/3.)
(Snyder Creek shale of Callaway County.)

Proetus crassimarginatus Hall and Clark
Page 125.

Fig. 8. Front of a fragmentary cephalon. (X2).
Fig. 9. A small pygidium (X2).
Fig. 10. Front of a cephalon of average size.
(Mineola of Montgomery County.)

Dipterus mordax Eastman
Page 128.

Fig. 11. The only specimen known from the Callaway limestone. (X4).

Ptyctodus ferox Eastman
Page 127.

Fig. 12. Top of the best specimen collected from the Missouri Devonian.
(Snyder Creek shale of Callaway County.)

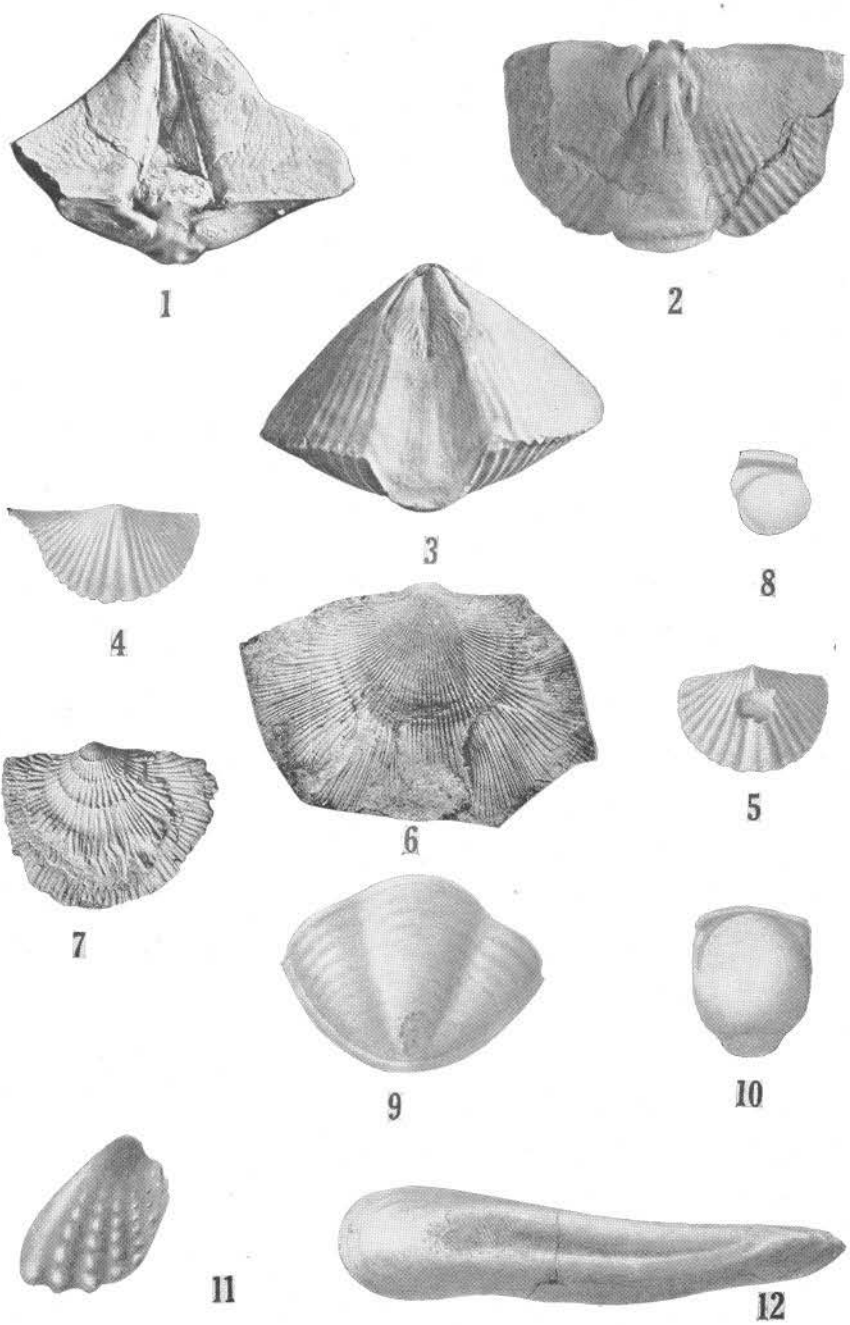
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PLATE NO. 22

PLATE 22

Spirifer euryteines Owen
Page 100.

Fig. 1. Pedicle valve of a large specimen. (Snyder Creek shale of Callaway County.)
Fig. 2. Cardinal view of a specimen with low area. (Snyder Creek shale of Callaway County.)
Fig. 3. Pedicle valve of a large silicified specimen. (Mineola limestone of Ralls County.)
Fig. 4. Cardinal view of the same specimen.
Fig. 5. Cardinal view of a small specimen. (Snyder Creek shale of Callaway County.)
Figs. 6 and 7. Portions of silicified spires. (Mineola limestone of Ralls County.)
Fig. 8. Side view of an exfoliated specimen. (Mineola limestone of Montgomery County.)
Fig. 9. Brachial valve. (Snyder Creek shale of Callaway County.)
Fig. 10. Surface enlarged to show ornamentation. (X4). (Snyder Creek shale of Callaway County.)
Fig. 11. Brachial valve of specimen figured in 1 and 2.
Fig. 12. Brachial valve of specimen figured in 3 and 4.

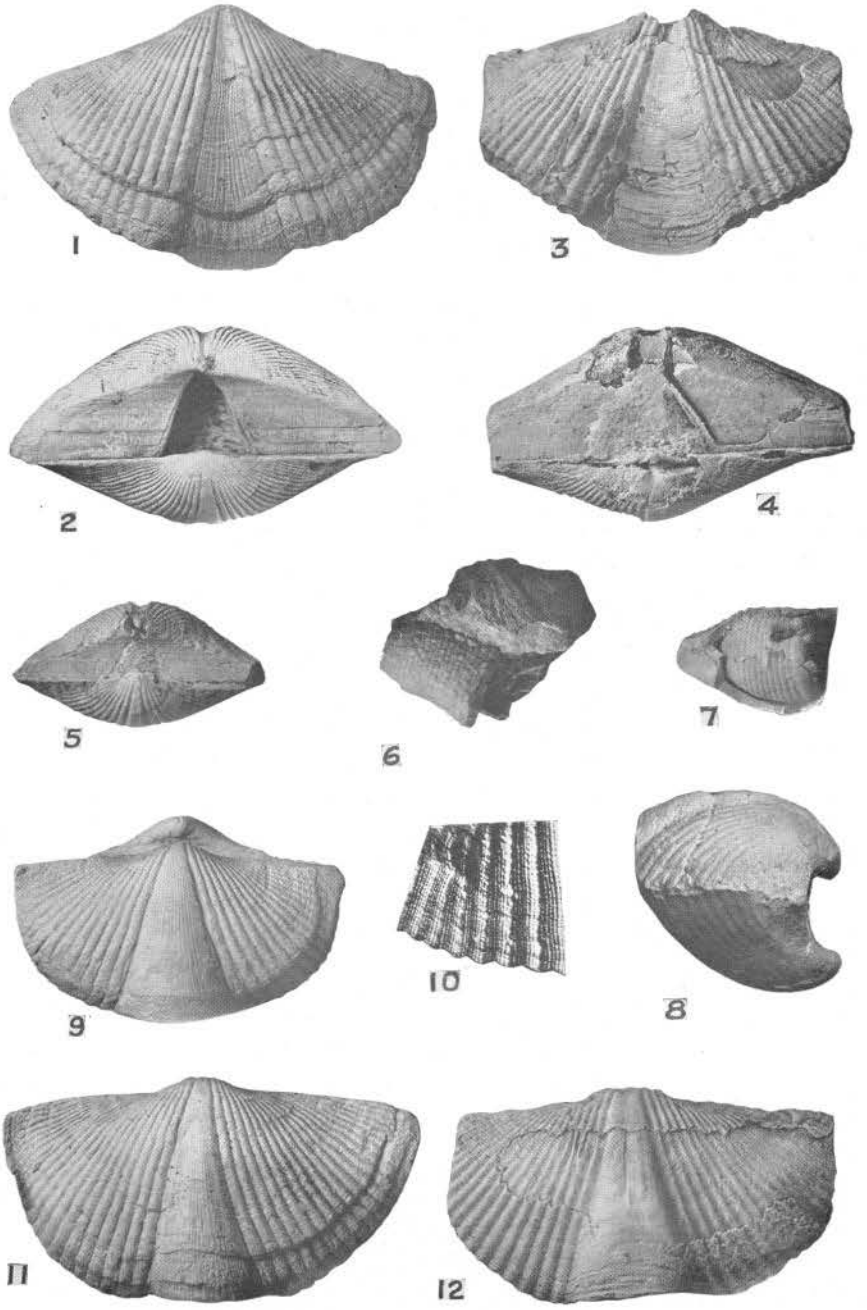
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PLATE NO. 23

PLATE 23

Syringothyris occidentalis (Swallow)
Page 103.

Fig. 1. Mould of pedicle valve. (Collection of D. K. Greger. Photo by Greger.) (Callaway limestone of Callaway County.)

Spirifer euryteines Owen
Page 100.

Fig. 2. An unusually flat cardinal area. (Snyder Creek shale of Callaway County.)
Fig. 3. An exfoliated pedicle valve. (Mineola of Montgomery County.)

Spirifer asper Hall
Page 100.

Fig. 4. An enlargement to show details of the sinus. (Photo by Greger.) (Callaway limestone of Callaway County.)

Pentamerella missouriensis Branson
Page 88.

Fig. 5. The holotype. (X3½). (Snyder Creek shale of Callaway County.)

Gypidula mineolaensis Branson
Page 90.

Fig. 6. Pedicle valve of an imperfect specimen.
Figs. 10 and 11. Side and pedicle views of an imperfect specimen.
(Specimens from the Mineola of Ralls County.)

Atrypa hystrix Hall
Page 99.

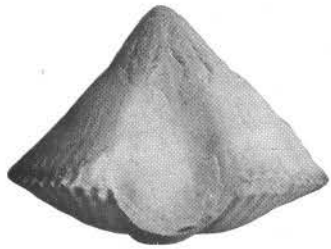
Fig. 7. A specimen from the Lime Creek of Iowa to compare with *Atrypas* from the Snyder Creek shale

Atrypa spinosa Hall
Page 98.

Figs. 8 and 9. Pedicle views of average specimens.
(Snyder Creek shale of Callaway County.)

Atrypa reticularis (Linnaeus)
Page 97.

Fig. 12. A small smooth specimen, pedicle view.
Fig. 13. A large rough specimen, pedicle view.
(Snyder Creek shale of Callaway County.)



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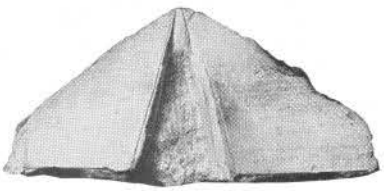

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PLATE NO. 24

PLATE 24

Pentamerella missouriensis Branson
Page 88.

Figs. 1-4. Brachial side, front and pedicle views of the holotype.
(Snyder Creek shale of Callaway County.)

Camarotoechia gregeri Branson
Page 91.

Figs. 5, 6 and 8. Side, pedicle and brachial views of an average specimen.
Figs. 7 and 9. Side and brachial views of a small specimen.
(Snyder Creek shale of Callaway County.)

Pentamerella fultonensis Branson
Page 88.

Figs. 10, 11, 12. Pedicle, side and brachial views of one of the cotypes.
(Callaway limestone of Callaway County.)

Spirifer subvaricosus Hall and Whitfield
Page 101.

Fig. 13. Back view of a specimen with an unusually high cardinal area.
(Mineola of Ralls County.)

Spirifer varicosus Hall
Page 102.

Figs. 14 and 15. Side and pedicle views of a small specimen.
(Mineola of Ralls County.)

Camarotoechia depressa Kindle
Page 90.

Fig. 16. Brachial view of the only specimen collected.
(Snyder Creek shale of Callaway County.)

Spirifer annae Swallow
Page 99.

Fig. 17. Pedicle view of an average specimen.
(Snyder Creek shale of Callaway County.)

Schuchertella arctostriata (Hall)
Page 83.

Figs. 18, 19, 20. Brachial, pedicle and side views of an average specimen.
Fig. 21. Cardinal area of an unusually well-preserved specimen.
Figs. 22 and 23. Brachial and pedicle views of a flattened specimen.
(Snyder Creek shale of Callaway County.)

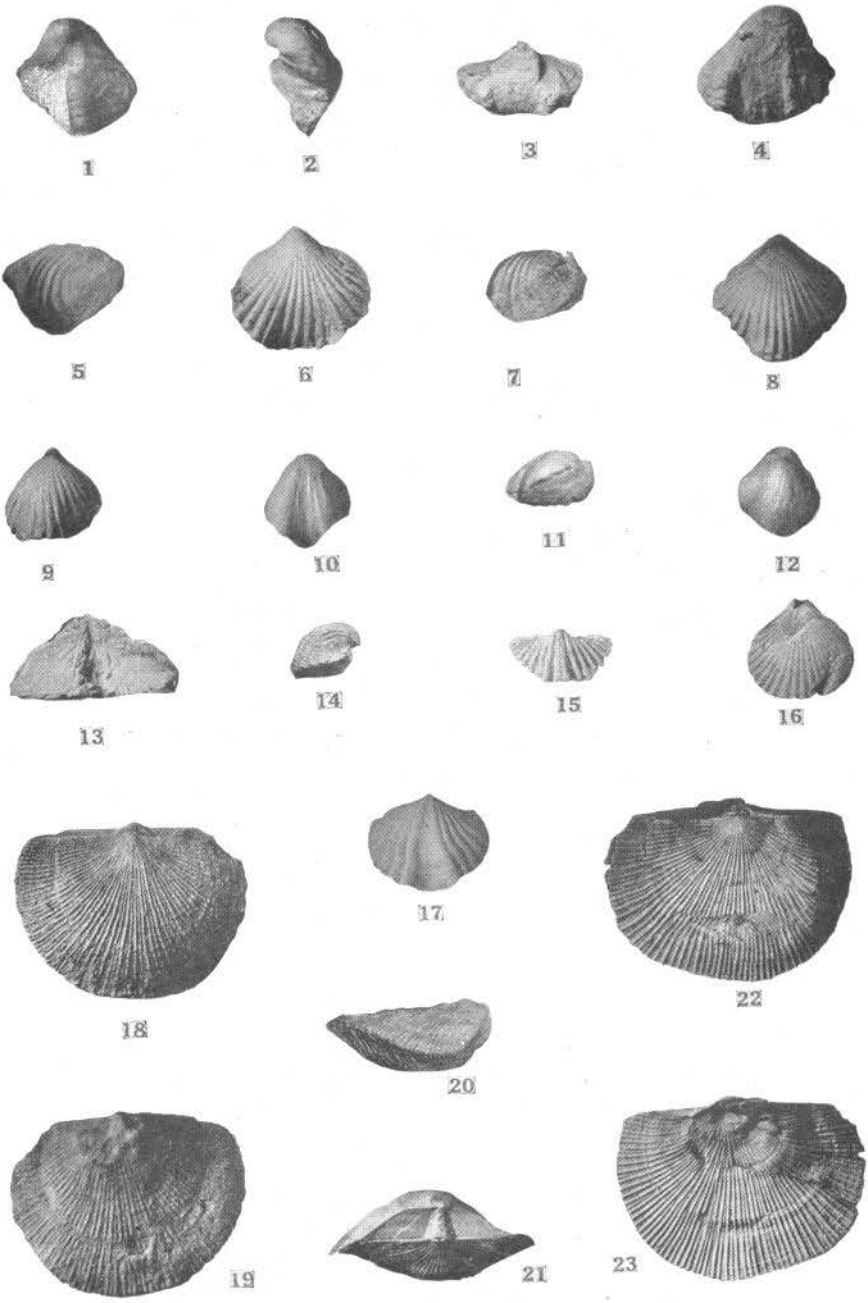
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PLATE NO. 25

PLATE 25

Goniophora hamiltonensis (Hall)
Page 114.

Figs. 1 and 2. Cardinal view and left valve of an imperfect specimen.
(Snyder Creek shale of Callaway County.)

Modiomorpha missouriensis Branson
Page 114.

Fig. 3. Left valve of an average specimen.
Fig. 4. Cardinal view of the same specimen.
Fig. 5. Left valve of a specimen with strongly projecting umbones.
Fig. 6. Cardinal view of a small specimen.
Figs. 10 and 11. Side and cardinal views of an interior mould.
(All specimens from the Snyder Creek shale of Callaway County.)

Clinopistha rowleyi Branson
Page 111.

Figs. 7 and 8. Cardinal and side views of an average specimen.
(Snyder Creek shale of Callaway County.)

Paracyclas lirata (Conrad)
Page 116.

Fig. 9. Left valve of a large specimen resembling *P. elliptica*.
Fig. 12. Right valve of an average specimen slightly broken in front.
(Both specimens from the Snyder Creek shale of Callaway County.)

Nucula cf. lirata (Conrad)
Page 112.

Figs. 13 and 14. Side and cardinal views.
(Snyder Creek shale of Callaway County.)

Grammysia elliptica Hall
Page 111.

Fig. 15. A left valve slightly tilted from a cardinal view.
(Snyder Creek shale of Callaway County.)
Fig. 16. Another view of the same valve.

Nucula snyderensis Branson
Page 112.

Fig. 17. Cardinal view of an average specimen.
(Snyder Creek shale of Callaway County.)
Fig. 18. Right valve of the same specimen.

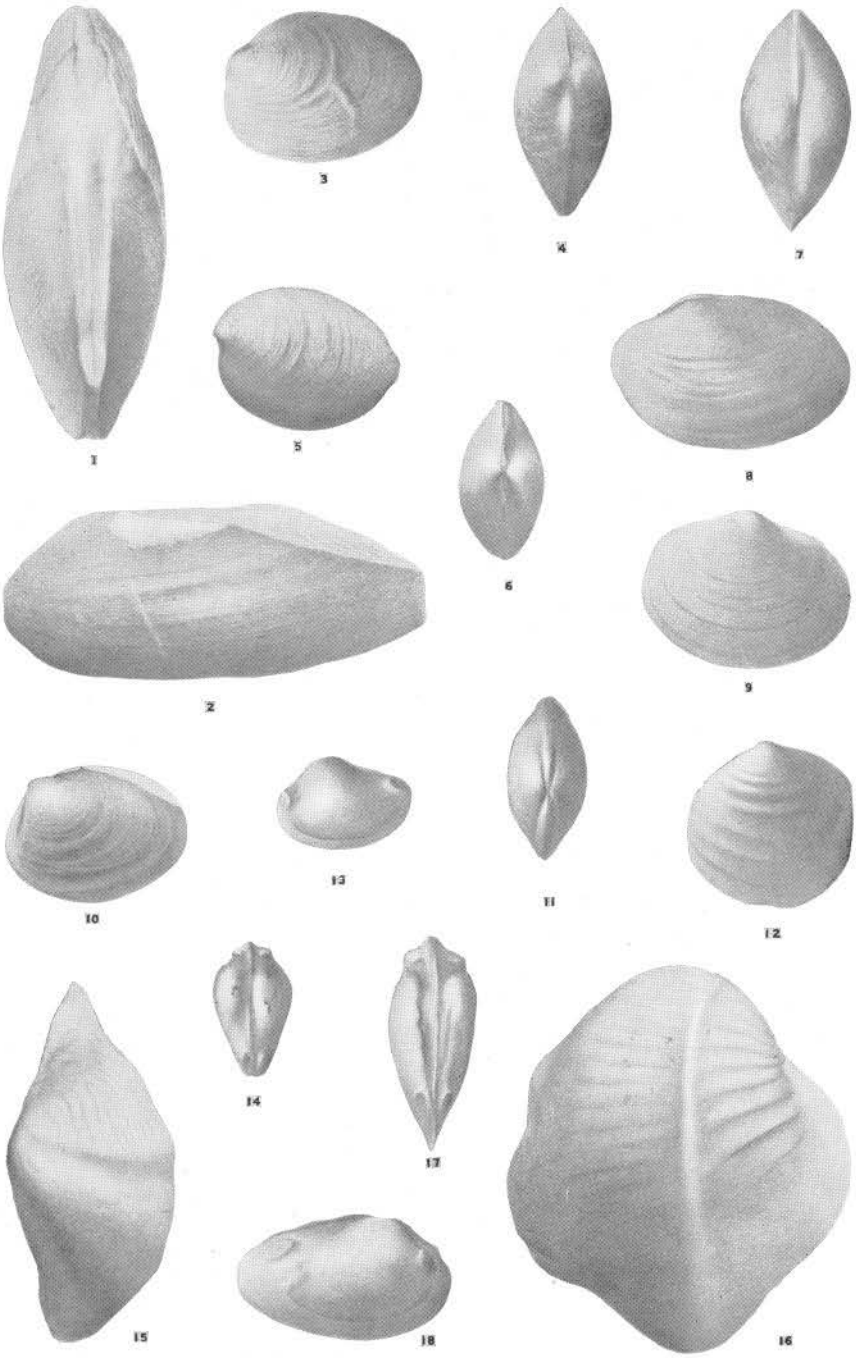
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PLATE NO. 26

PLATE 26

Conocardium ohioense Meek
Page 112.

Figs. 1 and 2. Two views of a ventricose specimen. (X2.)
Figs. 3 and 4. Two views of a specimen with the posterior end missing. (X2.)
Figs. 5-7. A large ventricose specimen with both ends missing.
(Mineola limestone of Ralls and Montgomery Counties. X2.)

Platyceras cf. erectum Hall
Page 122.

Fig. 8. Side view of a small specimen. (X2.)
(Mineola limestone of Montgomery County.)

Platyceras carinatum Hall
Page 121.

Figs. 10-11. Two views of an average specimen.
(Mineola limestone of Montgomery County.)

Platyceras cf. calantica Hall
Page 120.

Figs. 9 and 17. Side and top views of an average specimen.
(Mineola limestone of Montgomery County.)

Platyceras annulatum Branson
Page 122.

Figs. 12 and 13. Side and top views of the holotype.
(Mineola limestone of Montgomery County.)

Euryzone lucina (Hall)
Page 119.

Fig. 14. Side view of a nearly perfect specimen so incrusted as to conceal a slit band if one is present. (Mineola limestone of Ralls County.)

Platyceras conicum Hall
Page 121.

Figs. 15 and 16. Side and top views of an imperfect specimen.
(Mineola limestone of Montgomery County.)

Euryzone mineolaensis Branson
Page 118.

Fig. 18. A portion of a shell showing the slit band.
(Mineola limestone of Ralls County.)

Pleurotomaria providencis Broadhead
Page 118.

Fig. 19. Part of the shell showing ornamentation and slit band.
Fig. 20. A composite drawing. The shells in the collection of the University of Missouri are all imperfect or covered with hard rock. Broadhead's cotypes are in the collection.
(Cooper limestone of Providence, Missouri.)

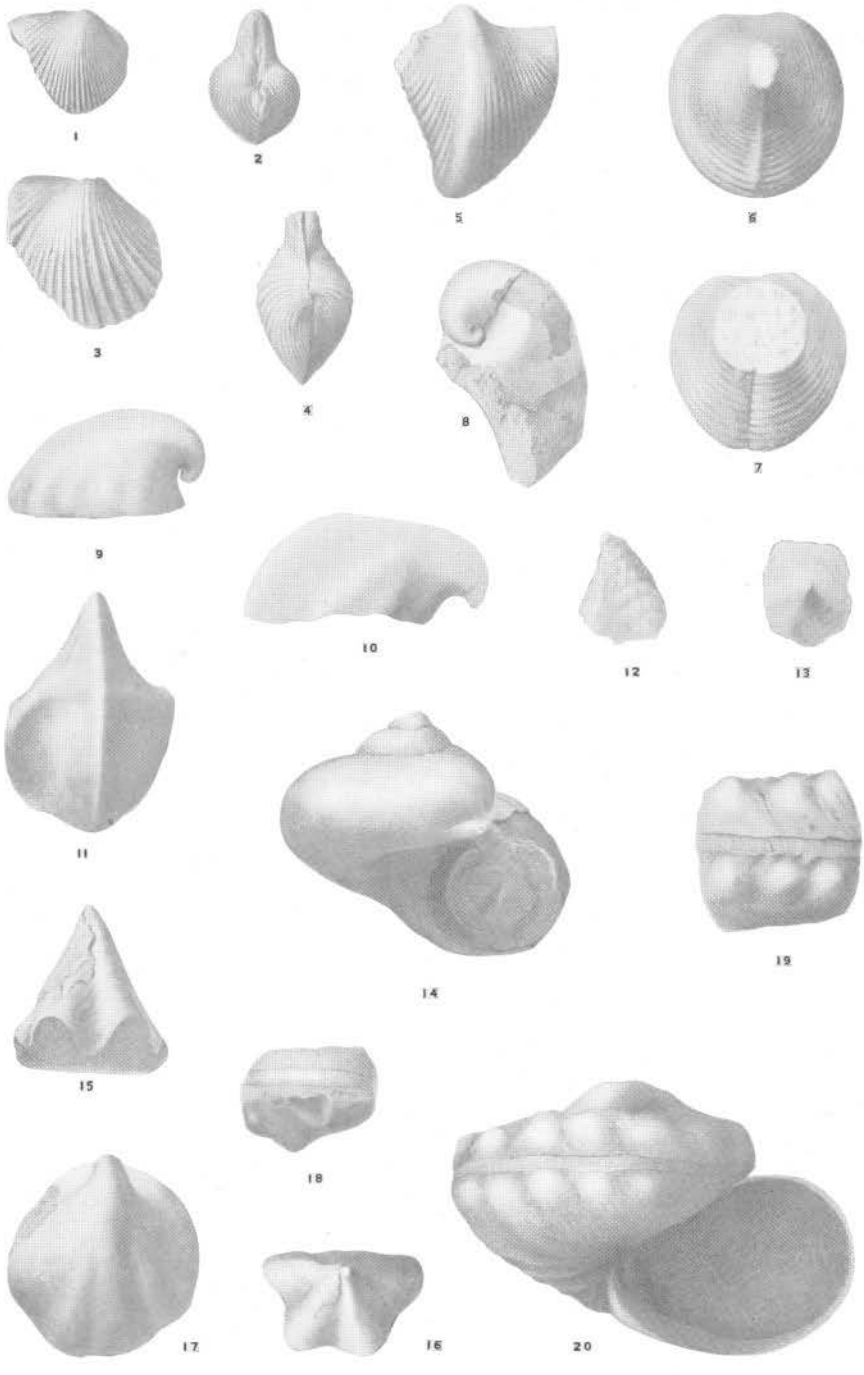
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PLATE NO. 27

PLATE 27

Diaphorostoma snyderensis Branson
Page 123.

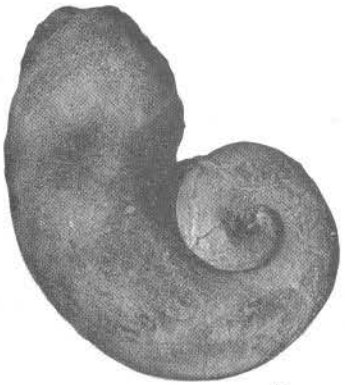
Figs. 1, 8, 9. Three views of average specimens.
(Snyder Creek shale of Callaway County.)

Belerophon sp.
Page 117.

Figs. 2, 3. Front and side views of the only specimen collected.
(Snyder Creek shale of Callaway County.)

Schizodus chemungensis (Conrad)
Page 113.

Figs. 4, 5, 6, 7. Left, right, and top views of average specimens.
(Snyder Creek shale of Callaway County.)



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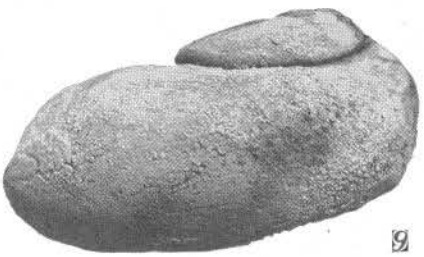

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PLATE NO. 28

PLATE 28

Pleurotomaria isaachii H. and W.
Page 117.

Fig. 1. Side view of a large specimen. (Snyder Creek shale of Callaway County.)
Fig. 10. Side view of an average specimen with low spire (Snyder Creek shale of Callaway County.)
Fig. 11. Top view of a slightly deformed specimen. (Snyder Creek shale of Callaway County.)

Pleurotomaria sp. undet.
Page 117.

Fig. 2. An imperfect mould. (Mineola limestone of Ralls County.)

Platyceras cf. erectum Hall
Page 122.

Fig. 3. Side view of a large specimen. (Mineola limestone of Montgomery County.)

Platyceras nodosum Conrad
Page 122.

Fig. 4. Side view of an imperfect specimen. (Mineola limestone of Montgomery County.)
Fig. 5. Another view of the same specimen.

Euomphalus cf. *hecale* Hall
Page 120.

Fig. 6. Side view of an average specimen. (Snyder Creek shale of Callaway County.)
Fig. 7. Top view of the same specimen.

Euryzone mineolaensis Branson
Page 118.

Fig. 8. An imperfect specimen. (Mineola limestone of Ralls County.)
Fig. 9. A nearly complete specimen. (Mineola limestone of Ralls County.)

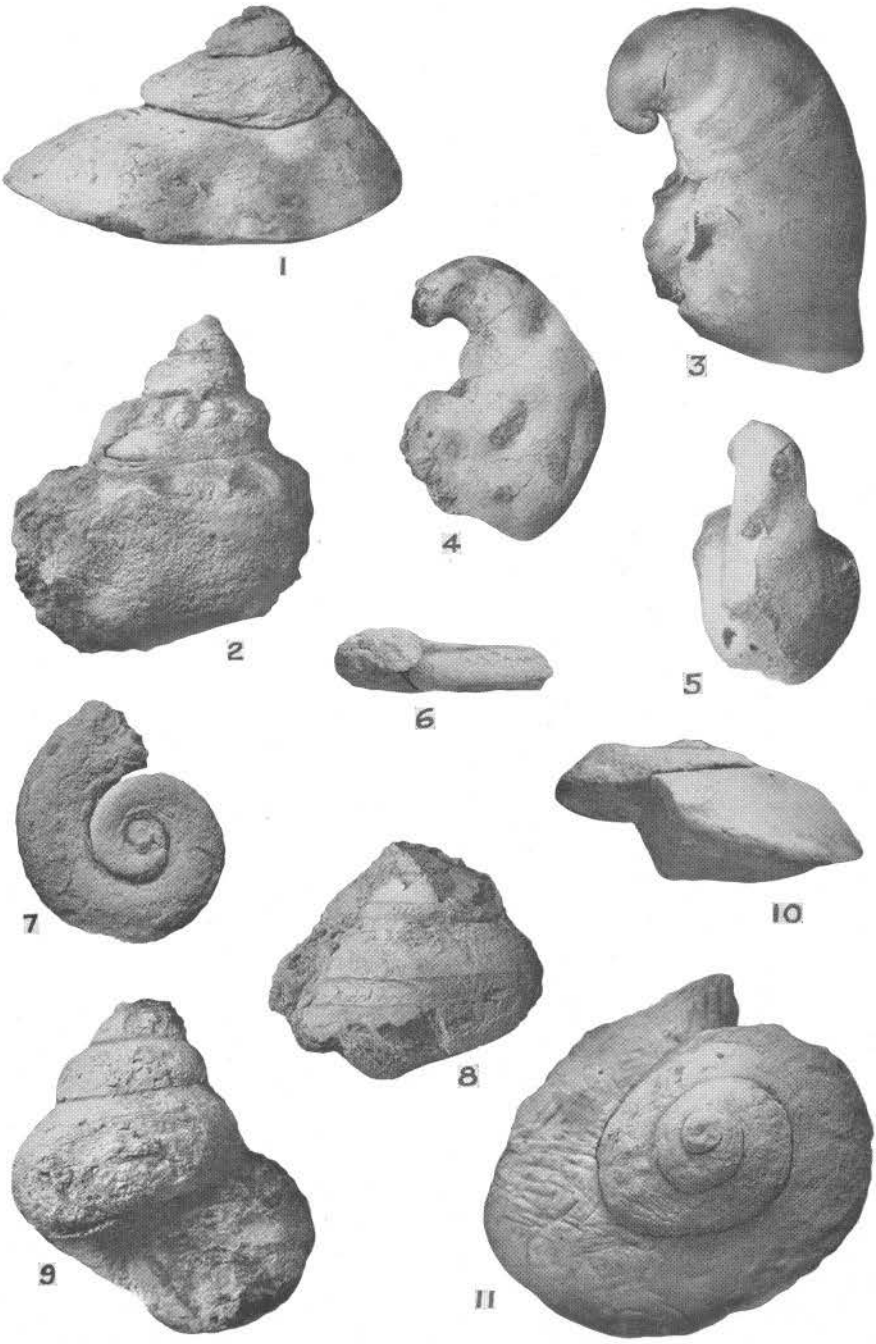
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PLATE NO. 29

PLATE 29

Orthoceras sp. undet.
Page 123.

Fig. 1. End of septum showing siphuncle.
Fig. 2. Side view of four segments.
(Snyder Creek shale of Callaway County.)
Figs. 3, 5, 6. Fragments of two undeterminable species.
(Snyder Creek shale of Callaway County.)

Cyrtoceras sp. undet.
Page 124.

Fig. 4. An imperfect and much-weathered specimen. (X2).
(Snyder Creek shale of Callaway County.)

Gomphoceras sp. undet.
Page 125.

Fig. 7. The only specimen collected from the Mineola. (X 4/5). (Ralls County.)

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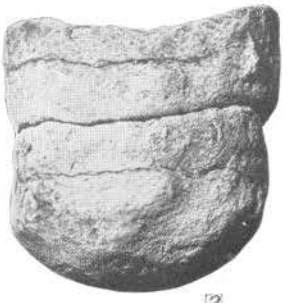

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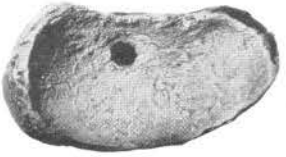

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PLATE NO. 30

PLATE 30

Spiroraphe arata (Hall)
Page 119.

Figs. 1 and 2. Top and side views of an average specimen.
(Callaway limestone of Callaway County.)

Orthoceras cf. atreus Hall
Page 124.

Fig. 3. An imperfect specimen about 2/5 natural size.
(Snyder Creek shale of Callaway County.)

Orthoceras sp. undet.
Page 123.

Fig. 4. Fragment of unidentified specimen. Five more chambers were collected.
(X2/5). (Snyder Creek shale of Callaway County.)
Fig. 5. Part of living chamber and four segments of another species. (X 2/5).
(Snyder Creek shale of Callaway County.)

Proetus crassimarginatus Hall and Clarke
Page 125.

Figs. 6 and 7. Pygidia from the Mineola limestone of Montgomery County.
Fig. 8. Pygidium from the Snyder Creek shale of Callaway County.

Bellerophon sp. undet.
Page 117.

Fig. 9. Small specimen from the Mineola limestone of Montgomery County.

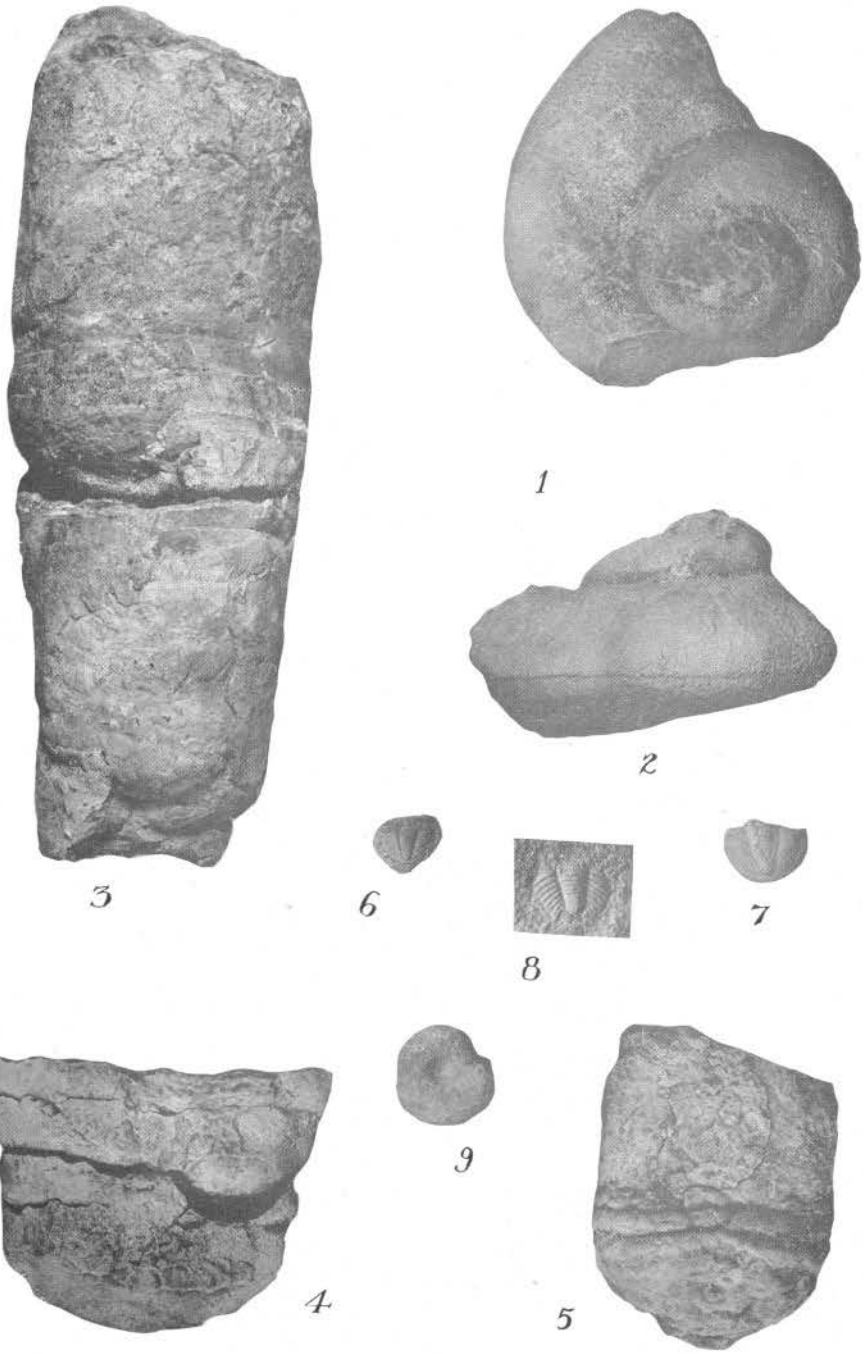
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PLATE NO. 31

PLATE 31

Ptyctodus calceolus (Newberry and Worthen)
Page 126.

Figs. 1 and 2. Top and side views of a large specimen. (X 8/7).
(Mineola limestone of Ralls County.)

Glyptaspis
Page 128.

Fig. 3. *Glyptaspis* plate (X 1/2). (Snyder Creek shale of Callaway County.)

Dinichthyids
Page 129.

Figs. 4 and 5. Outer view of a postero-supero-gnathal of a dinichthyid. (Mineola of Ralls County.)
Fig. 6. Fragment of a dinichthyid bone. (Mineola of Ralla County.)

Dinichthys pustulosus Eastman
Page 127.

Fig. 7. Median occipital, showing pustules.
Fig. 8. Rostral. The reference to *D. pustulosus* is uncertain.
(Mineola limestone of Ralls County.)

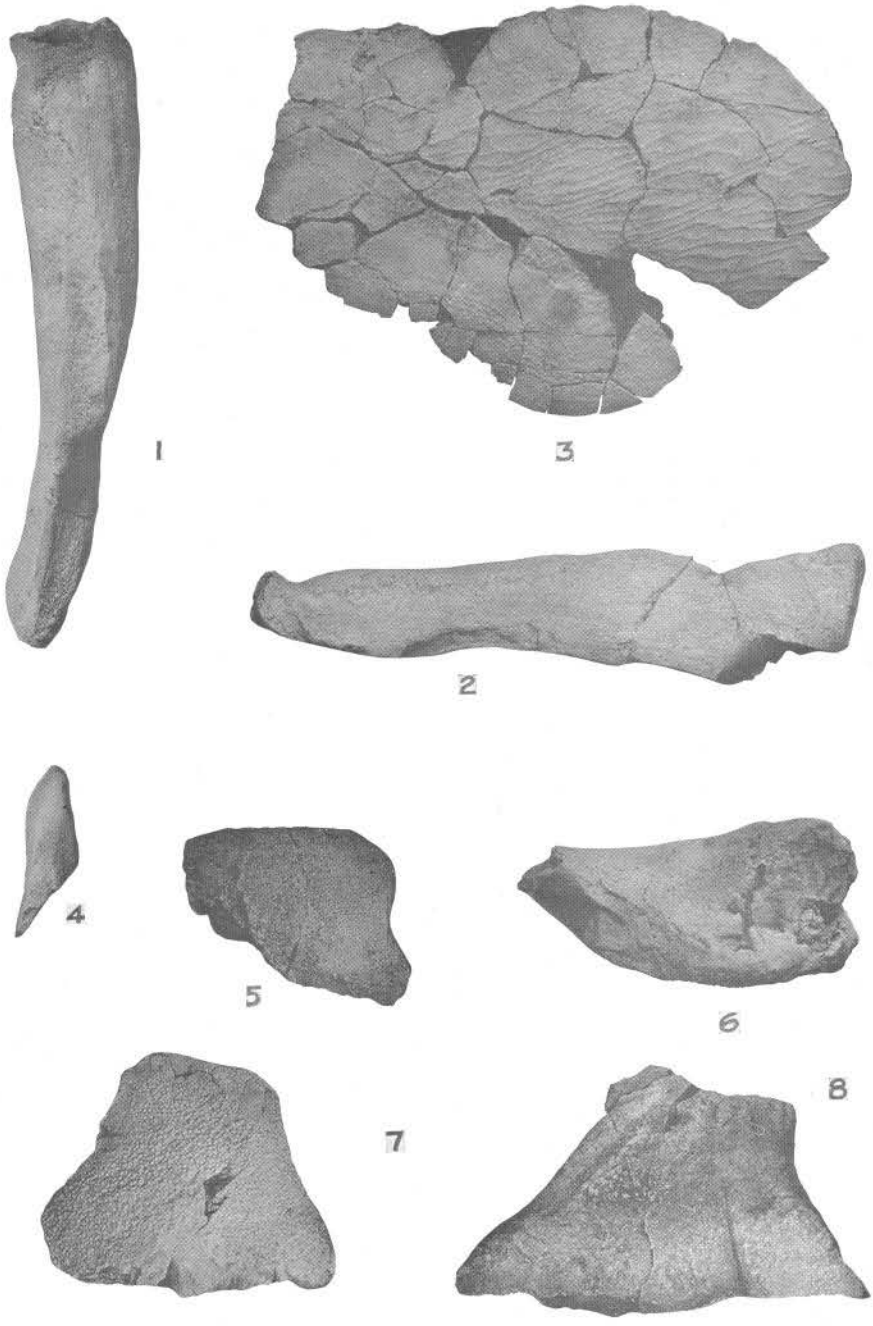
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PLATE NO. 32

PLATE 32

Chonetes coronatus (Conrad)
Page 138.

Fig. 1. Brachial valve of an ordinary specimen.
Figs. 2 and 3. Pedicle valves of large specimens.
(St. Laurent limestone) (W. M.* 23996 and 23976).

Chonetes vicinus (Castelnau)
Page 140.

Fig. 4. An imperfect interior mould of the pedicle valve.
Fig. 5. An average brachial valve.
(Beauvais sandstone) (W. M. 23995).

Schuchertella chemungensis pectinacea (Hall)
Page 137.

Fig. 6. Internal mould of a brachial valve.
Fig. 7. Exterior of a brachial valve.
(Grand Tower limestone) (W. M. 23879).

Chonetes scitulus Hall
Page 139.

Figs. 8 and 9. Pedicle and brachial views. (After Hall.)

Stropheodonta patersoni Hall
Page 135.

Fig. 10. A small area near an umbone to show peculiar ornamentation. (X2).
(Grand Tower limestone) (University of Missouri collection).
Fig. 11. A pedicle valve. (After Hall.)

Stropheodonta concava Hall
Page 134.

Fig. 12. A pedicle valve. (After Hall.)

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*W. M. indicates Walker Museum.

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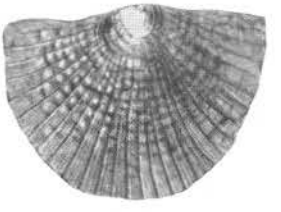

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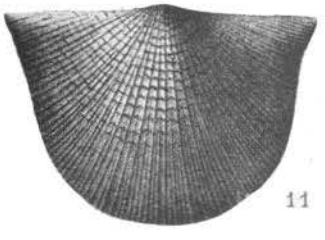

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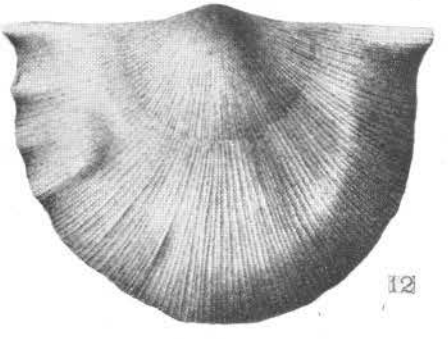

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PLATE NO. 33

PLATE 33

Spirifer granulosus (Conrad)
Page 146.

Figs. 1, 2, 10. Brachial, pedicle, and side views. (After Hall.)

Spirifer audaculus (Conrad)
Page 145.

Figs. 3 and 4. Brachial valves.
Fig. 5. An imperfect pedicle valve.
(St. Laurent limestone) (W. M. 23987).

Spirifer grieri Hall
Page 147.

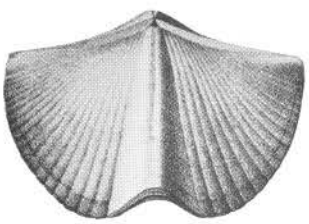
Figs. 6-8. Brachial and front views. (After Hall.)

Spirifer pennatus (Atwater)
Page 147.

Fig. 9. An imperfect pedicle valve.
(St. Laurent formation) (W. M. 23979).

Tropidoleptus carinatus (Conrad)
Page 137.

Figs. 11 and 12. Pedicle and brachial views. (After Hall.)



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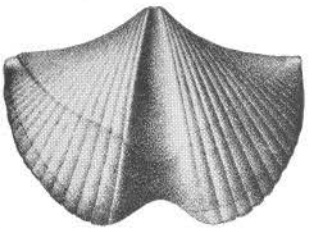

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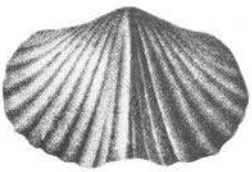

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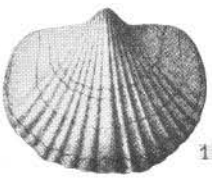

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PLATE NO. 34

PLATE 34

Camarotoechia prolifica (Hall)
Page 143.

Figs. 1 and 2. Pedicle and front views. (After Hall.)

Camarotoechia welleri Branson and Williams
Page 144.

Figs. 3, 4, 5, 6. Brachial, pedicle, side, and front views of the holotype.
(Grand Tower limestone) (W. M. 23885).

Camarotoechia congregata (Conrad)
Page 142.

Figs. 7, 9. 10. Front, pedicle, and brachial views.
(The specimen is probably from the Grand Tower. It was sent to the University of Missouri by a resident of the district.) (University of Missouri collection.)

Figs. 8, 11. Front and brachial views. (After Hall.)

Fig. 12. Interior mould of brachial valve.
(St. Laurent formation) (W. M. 23963).

Atrypa spinosa Hall
Page 145.

Figs. 13 and 14. Pedicle and brachial views.
(Grand Tower limestone) (W. M. 23871).

Camarotoechia sappho Hall
Page 143.

Figs. 15, 16, 17. Brachial, front, and pedicle views.
(Probably from the Grand Tower limestone. The specimen was sent in with the specimen of *C. congregata* (Conrad) and specimens of *Nucleocrinus verneuili* (Troost).) (University of Missouri collection.)

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PLATE NO. 35

PLATE 35

Strophalosia truncata (Hall)
Page 141.

Figs. 1 and 2. Exteriors of pedicle valves. (After Hall.)
Fig. 3. Exterior of a brachial valve.
Fig. 4. Exterior of a pedicle valve.
(St. Laurent limestone.) (W. M. 23977.)

Craniella cf. hamiltoniae (Hall.)
Page 133.

Fig. 5. An imperfect valve.
(Grand Tower limestone.) (W. M. 23881.)

Cyrtina alpenensis Hall and Clarke
Page 148.

Fig. 6. A side view. (After Hall and Clarke.)
Fig. 7. Side view of a pedicle valve.
Fig. 8. Front view of a pedicle valve.
(St. Laurent limestone.) (W. M. 23961.)

Pholidops cf. oblata Hall
Page 133.

Fig. 9. An impression of a brachial valve.
(St. Laurent limestone.) (W. M. 23969.)

Productella spinulicosta Hall
Page 141.

Figs. 10 and 12. Two views of pedicle valves. (After Hall.)
Fig. 11. A pedicle valve.
(Grand Tower limestone.) (W. M. 23882.)

Chonetes mucronatus (Hall)
Page 141.

Fig. 13. A pedicle valve. (After Hall.)
Fig. 14. A pedicle valve from the St. Laurent formation.
(W. M. 23875.)

Leptostrophia perplana (Conrad)
Page 135.

Fig. 15. A pedicle valve. (After Hall.)
Fig. 16. An imperfect brachial valve.
(St. Laurent formation.) (W. M. 23965.)

Platyceras carinatum Hall
Page 156.

Figs. 17 and 18. Two views of the best specimens in the collections.
(Grand Tower limestone.) (W. M. 23891.)

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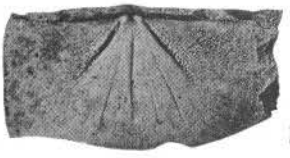

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PLATE NO. 36

PLATE 36

Paracyclas elliptica Hall
Page 115.

Fig. 1. An average specimen.
(Grand Tower limestone.)

Pterinea flabellum (Conrad)
Page 149.

Fig. 2. Left valve of a well-preserved specimen. (After Hall.)

Limoptera macroptera ? (Conrad)
Page 154.

Fig. 3. A left valve. (After Hall.)
Fig. 4. An imperfect left valve. (X½).
(St. Laurent limestone.) (W. M. 23846.)

Leptodesma rogersi Hall
Page 151.

Fig. 5. A nearly perfect left valve. (X 5/2). Restoration of the end of the alation slightly incorrect.
(St. Laurent limestone.) (W. M. 23971.)

Actinopteria cf. *boydi* (Conrad)
Page 152.

Fig. 6. A left valve. (After Hall.)

Glyptodesma cf. *erectum* (Conrad)
Page 150.

Fig. 7. An imperfect left valve with hinge line somewhat uncertain.
(St. Laurent limestone.) (W. M. 23981.)

Leiopteria dekayi Hall
Page 153.

Fig. 8. An imperfect left valve. Umbonal part uncertain.
(Grand Tower limestone.) (W. M. 23889.)
Fig. 9. A left valve. (After Hall.)

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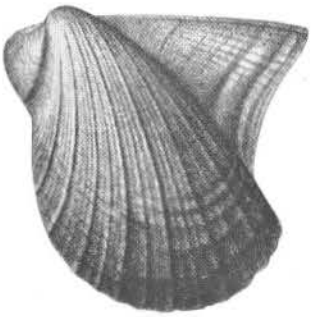

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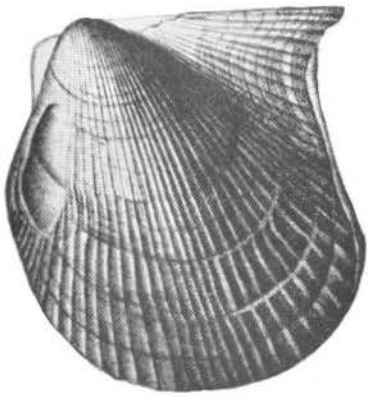

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PLATE NO. 37

PLATE 37

Gomphoceras cf. *impar* Hall
Page 159.

Fig. 1. The best preserved specimen. (X 3/5).
(Grand Tower limestone.) (W. M. 23895.)

Gomphoceras missouriensis Branson and Williams
Page 160.

Figs. 2 and 3. Side views of two living chambers.
Fig. 4. Dorsal view of a living chamber.
Fig. 5. Outline of aperture.
(Grand Tower limestone.) (W. M. 23900.)

Gomphoceras grandtowerensis Branson and Williams
Page 158.

Figs. 6 and 7. Two views of the holotype. (X½).
(Grand Tower limestone.) (W. M. 23897.)

Nephriticeras sp. undet.
Page 158.

Fig. 8. Side view of a fragment.
(Grand Tower limestone.) (W. M. 23902.)
Fig. 9. Unidentified specimen.
(Grand Tower limestone.) (W. M. 23903.)

Orthoceras cf. *subulatum* Hall
Page 157.

Fig. 10. The largest specimen collected. The air chambers are better preserved in other specimens.
(Grand Tower limestone.) (W. M. 23898.)

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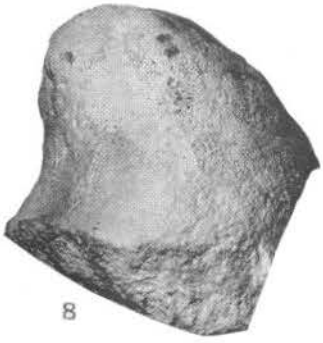

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PLATE NO. 38

PLATE 38

Gomphoceras hyatti Whitfield
Page 158.

Fig. 1. Side view of a large specimen. (X½).
(Grand Tower limestone.) (W. M. 23896.)

Gomphoceras missouriensis Branson and Williams
Page 160.

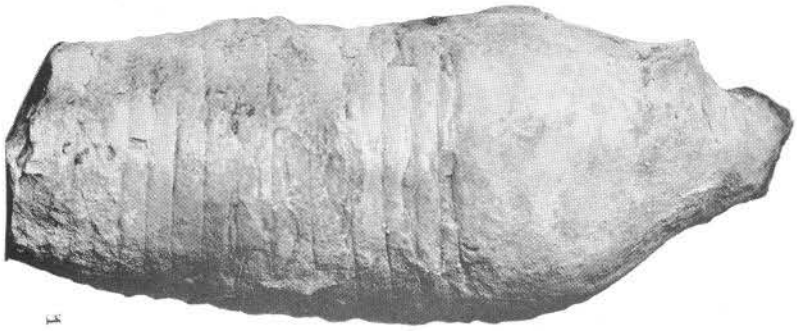
Fig. 2. Side view of the largest specimen collected.
(Grand Tower limestone.) (W. M. 23900.)

Gomphoceras plenum Hall?
Page 160.

Fig. 3. Side view of the living chamber of the only specimen collected. (X½).
(Grand Tower limestone.) (W. M. 23984.)

Nephriticeras n. sp.
Page 158.

Fig. 4. The only specimen in the collections. (X½).
(Grand Tower limestone.) (W. M. 1878.)



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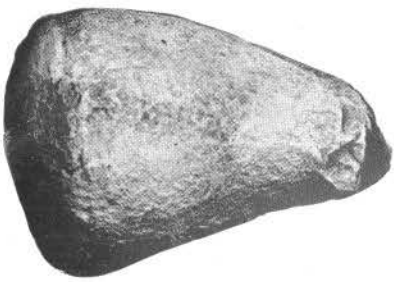

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PLATE NO. 39

PLATE 39

Phacops cristata Hall
Page 163.

Fig. 1. An imperfect cephalon.
(Grand Tower formation.) (W. M. 23909.)

Fig. 2. Pygidium and some pleural segments. (After Hall.)

Onychodus sigmoides Newberry
Page 164.

Fig. 3. A fragmentary specimen, slightly retouched.
(Grand Tower limestone.) (W. M. 23912.)

Proetus crassimarginatus Hall and Clarke
Page 161.

Fig. 4. An ordinary pygidium.
(Grand Tower limestone.) (W. M. 23905.)

Phacops rana (Green)
Page 163.

Fig. 5. Figure after Hall.

Tentaculites sp. undet.
Page 157.

Fig. 6. A cast of an impression. (X6.)
(Beauvais sandstone.) (W. M. 23992.)

Diaphorostoma genevievensis Branson and Williams.
Page 156.

Figs. 7 and 8. Side and top views of one of the cotypes.

Fig. 9. The same specimen as in fig. 8. (X5).
(Grand Tower limestone.) (W. M. 23893.)

Cryphaeus boothi Green
Page 162.

Fig. 10. The best pygidium in the collections.
(St. Laurent limestone.) (W. M. 23967.)

Platyceras nodosum Conrad
Page 156.

Fig. 11. The only specimen in the collections.
(Grand Tower limestone.) (University of Missouri collection.)

Proetus haldemani Hall
Page 161.

Fig. 12. One of the most complete cephala in the collections.
(Grand Tower limestone.) (W. M. 23908.)

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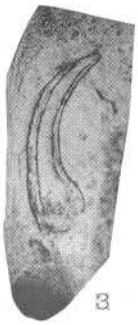

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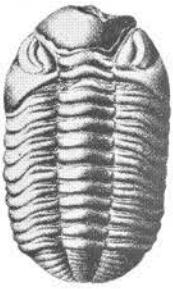

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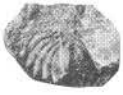

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PLATE NO. 40

PLATE 40

Hindia fibrosa (Roemer)
Page 176.

Fig. 1. An incomplete sponge.
Figs. 2, 3. Complete individuals.
Fig. 4. A specimen that shows the radial canals and spicules. (X2).

Streptelasma strictum Hall
Page 177.

Figs. 5-8. Side views of incomplete coralla.
Fig. 9. Top view.
Fig. 10. Side view.
Fig. 11. Top view.

Favosites helderbergiæ Hall
Page 177.

Fig. 12. Top view of a portion of a corallum.
Figs. 13-16. Side views of specimens.
Fig. 17. Top view of a fragment of a corallum.

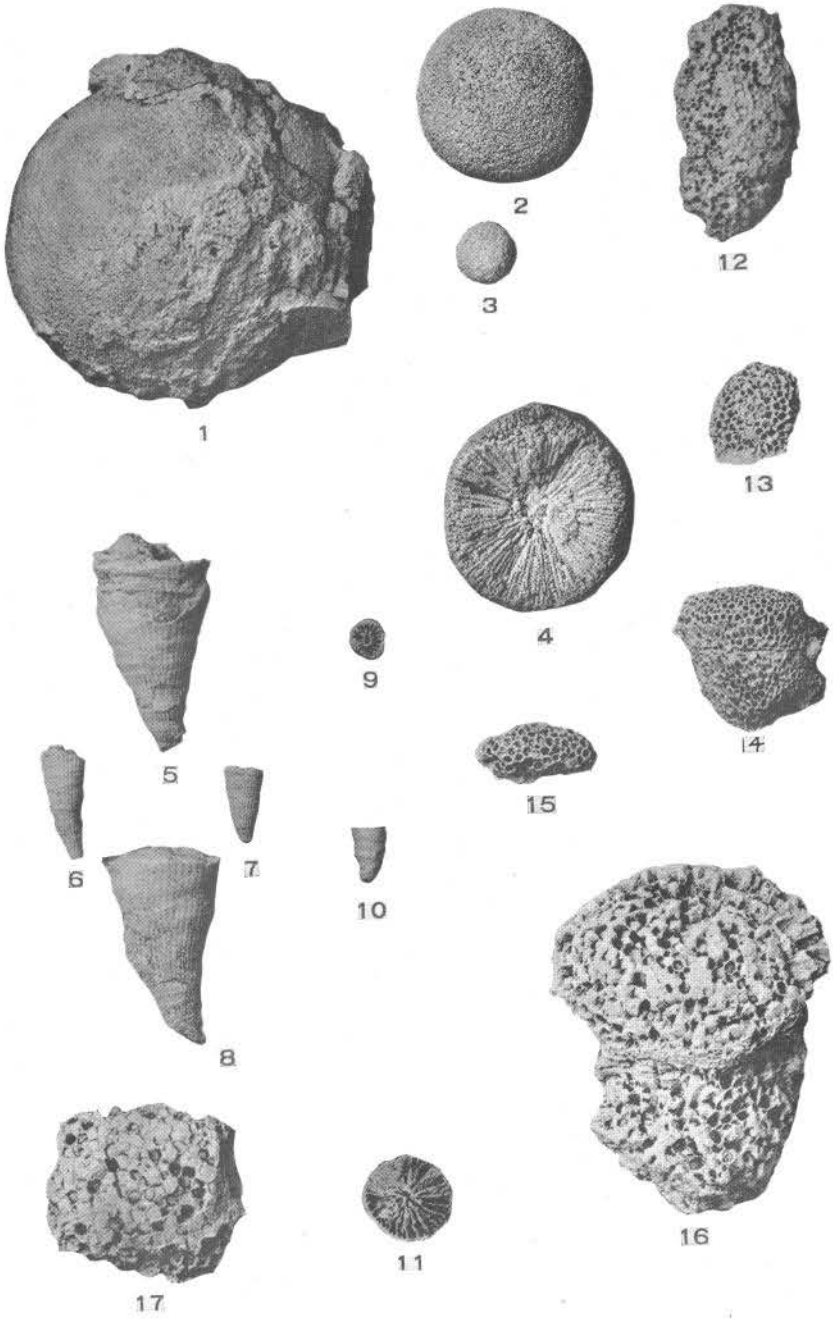
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PLATE NO. 41

PLATE 41

Favosites helderbergiæ Hall
Page 177.

Fig. 1. Side view of a portion of a corallum.

Favosites conicus Hall
Page 178.

Fig. 2. Basal view of an incomplete individual.
Figs. 3, 4. Side and basal views of a portion of a corallum.
Fig. 5. Side view of an incomplete corallum.
Fig. 6. Basal view of a specimen.
Fig. 7. Side view of a specimen.

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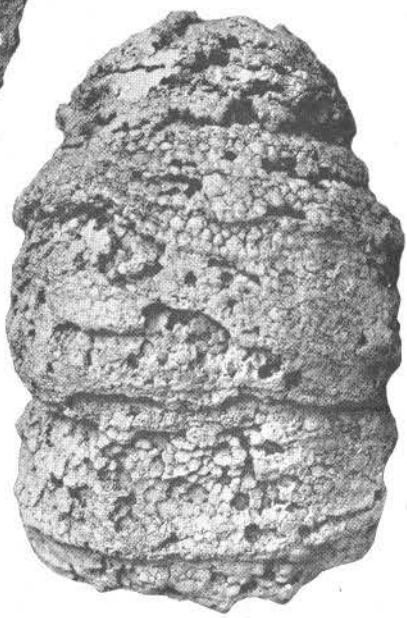

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PLATE NO. 42

PLATE 42

Striatopora missouriensis Meek and Worthen?
Page 179.

Figs. 1-3. Portions of coralla.
Fig. 4. Portion (fig. 1). (X2).

Striatopora bella Swartz
Page 179.

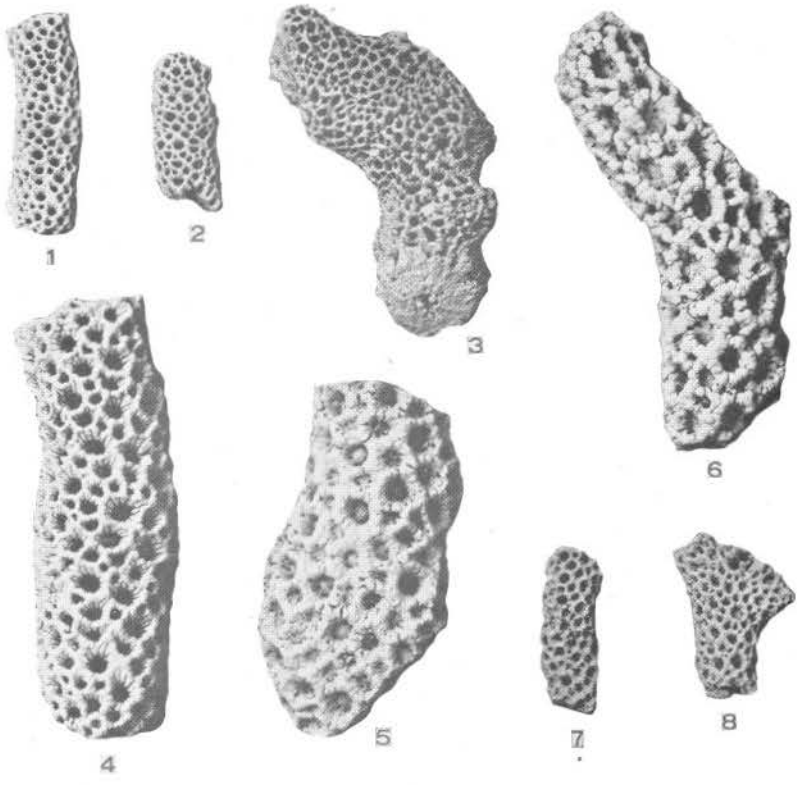
Figs. 5, 6. Parts of coralla. (X2).
Figs. 7, 8. Portions of coralla.

Pleurodictyum lenticulare (Hall)?
Page 180.

Fig. 9. Top view of a portion of the corallum. (X2).

Scyphocrinus sp.
Page 180.

Fig. 10. Top view of an incomplete root-bulb.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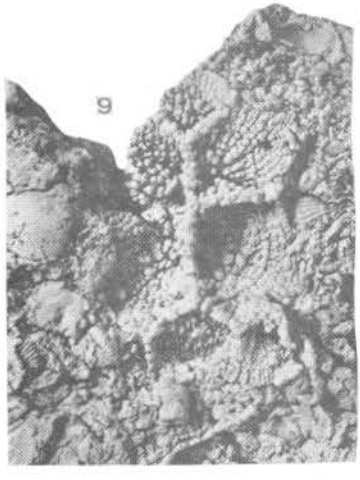
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PLATE NO. 43

PLATE 43

Scyphocrinus sp.
Page 180.

Fig. 1. Side view of an incomplete root-bulb that retains part of the collar.
Fig. 2. Top view of an incomplete root-bulb.
Figs. 3, 4. A portion of the unweathered surface of a root-bulb to show the polygonal character of the plates, and a portion of the weathered surface of the same bulb to show the stellate character.
Fig. 5. Side view of an incomplete calyx.
Fig. 6. Basal view of a portion of a calyx.

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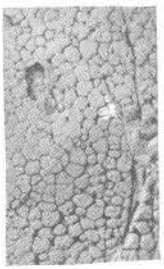

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PLATE NO. 44

PLATE 44

Edriocrinus ? sp.
Page 181.

Figs. 1-3. Side, top and basal views of the portion of a calyx.

Alsopocrinus anna n. sp.
Page 181.

Figs. 4-6. Side views and basal view of the incomplete dorsal cup.

Fistulipora ? sp.
Page 181.

Fig. 7. Portion of a zoarium. (X2).

Fenestella ? sp.
Page 182.

Fig. 8. The fragment shows the non-celluliferous face of a zoarium. (X2).

Crania alsopi n. sp.
Page 182.

Meristella princeps Hall
Page 203.

Figs. 9-11. Dorsal and side views of the uncrushed specimen, and dorsal view of the crushed specimen attached to the representative of *Meristella princeps.*

Dalmanella planoconvexa (Hall)
Page 182.

Figs. 12, 13. Ventral and posterior views.
Figs. 14-16. Ventral, dorsal, and posterior views.
Fig. 17. An incomplete dorsal valve.

Dalmanella perelegans (Hall)
Page 183.

Fig. 18. Dorsal view.
Fig. 19. Interior of a fragment of a dorsal valve.
Figs. 20-24. Ventral, dorsal, posterior, anterior and side views.
Figs. 25, 26. Ventral and dorsal views.

Dalmanella quadrans (Hall)
Page 183.

Fig. 27. An incomplete dorsal valve.
Fig. 29. An incomplete dorsal valve.
Fig. 28. An incomplete ventral valve.
Figs. 30, 31. Dorsal and ventral views.

Rhipidomella oblata (Hall)
Page 184.

Figs. 32, 33. Side and posterior views.

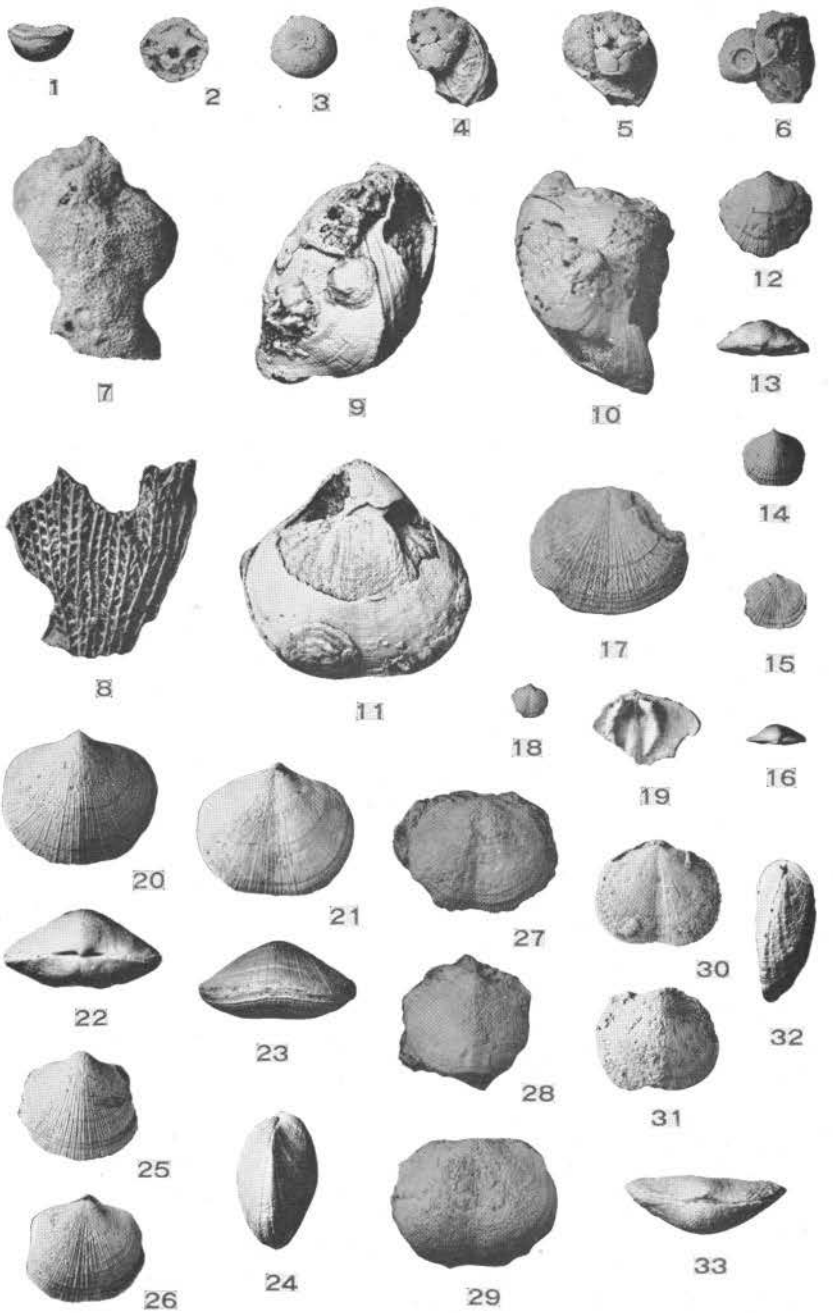
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PLATE NO. 45

PLATE 45

Rhipidomella oblata (Hall)
Page 184.

Figs. 1, 2. Dorsal and ventral views.
Figs. 3, 4. Dorsal and ventral views.
Fig. 5. An incomplete ventral valve.
Fig. 6. A ventral valve.
Figs. 7, 8. Incomplete dorsal valves.

Rhipidomella discus (Hall)
Page 184.

Figs. 9-12. Dorsal, ventral, side and posterior views.
Fig. 13. Dorsal view.
Fig. 14. An incomplete dorsal valve.
Figs. 15, 16. Ventral and dorsal views.

Rhipidomella ellsworthi n. sp.
Page 185.

Figs. 17-31. Ventral, dorsal, side, anterior and posterior views of three shells.
Figs. 32, 33. Ventral and anterior views.
Fig. 34. Dorsal view.
Fig. 35. Ventral view.
Fig. 36. Ventral view.
Fig. 37. Ventral view.
Fig. 38. An incomplete ventral valve.
Fig. 39. An incomplete dorsal valve.

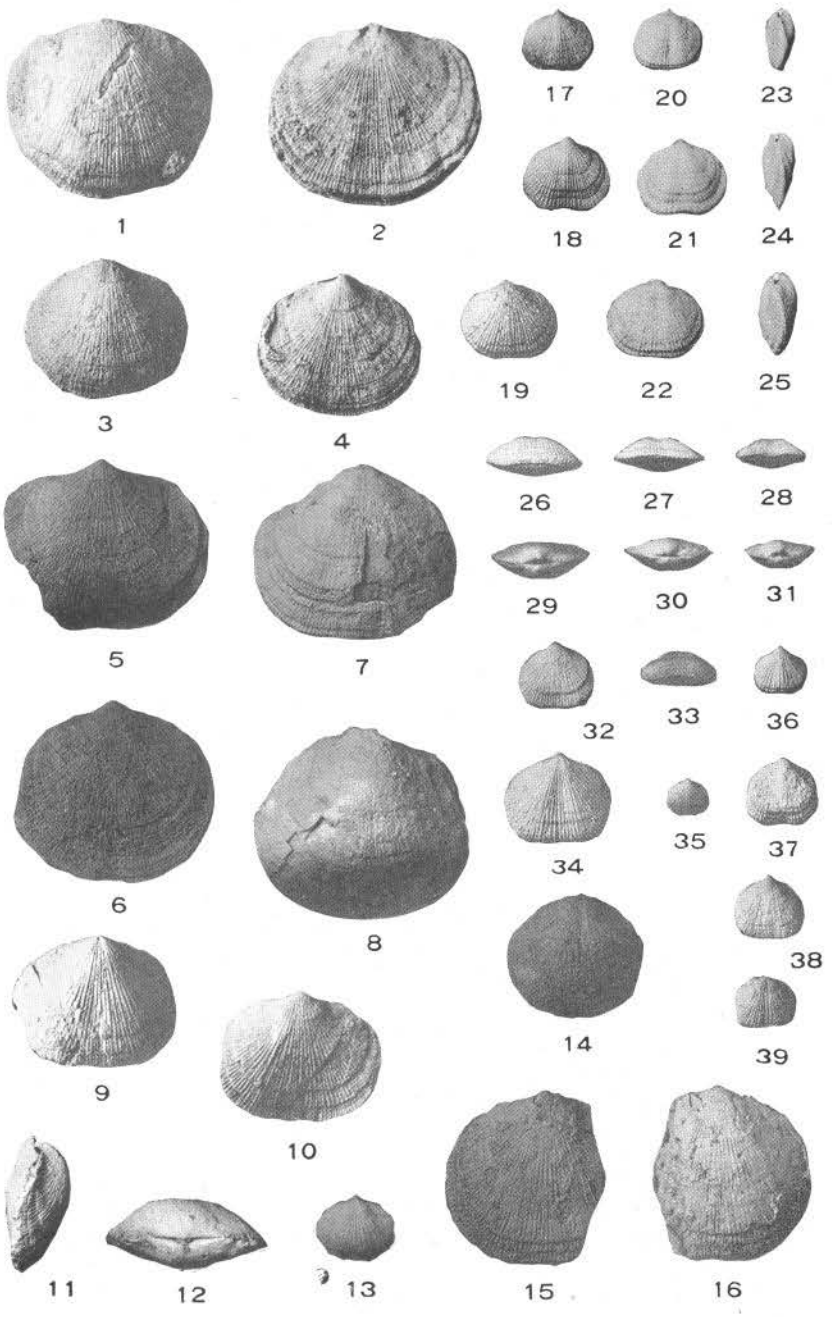
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PLATE NO. 46

PLATE 46

Rhipidomella melvillei n. sp.
Page 185.

Figs. 1-10. Ventral, dorsal, posterior, anterior, and side views of two specimens.
Figs. 11-13. Ventral, dorsal, and anterior views.
Figs. 14, 15. Ventral and dorsal views.
Fig. 16. Ventral view.
Fig. 17. An incomplete ventral valve.

Bilobites varica (Conrad)
Page 185.

Figs. 18-20. Ventral, dorsal, and anterior views.
Figs. 21-23. Ventral, dorsal, and posterior views.
Fig. 24. Ventral view.
Fig. 25. Dorsal view.

Leptaena rhomboidalis (Wilckens)
Page 186.

Fig. 26. A partially exfoliated, incomplete ventral valve.
Fig. 27. Interior of an incomplete dorsal valve.
Fig. 28. A partially exfoliated, incomplete ventral valve.
Fig. 29. Internal cast of an incomplete ventral valve.
Fig. 30. External cast of a part of a dorsal valve.
Fig. 31. Dorsal view.
Fig. 32. Ventral view.

Stropheodonta arata (Hall)
Page 187.

Fig. 33. Almost complete external cast of an incomplete dorsal valve.
Figs. 34, 35. Ventral and side views of a partially exfoliated, incomplete ventral valve.

Stropheodonta (*Leptostrophia*) *planulata* (Hall)
Page 187.

Fig. 36. An incomplete ventral valve.
Fig. 37. Interior of a portion of a ventral valve.
Fig. 38. A partially exfoliated, incomplete ventral valve.

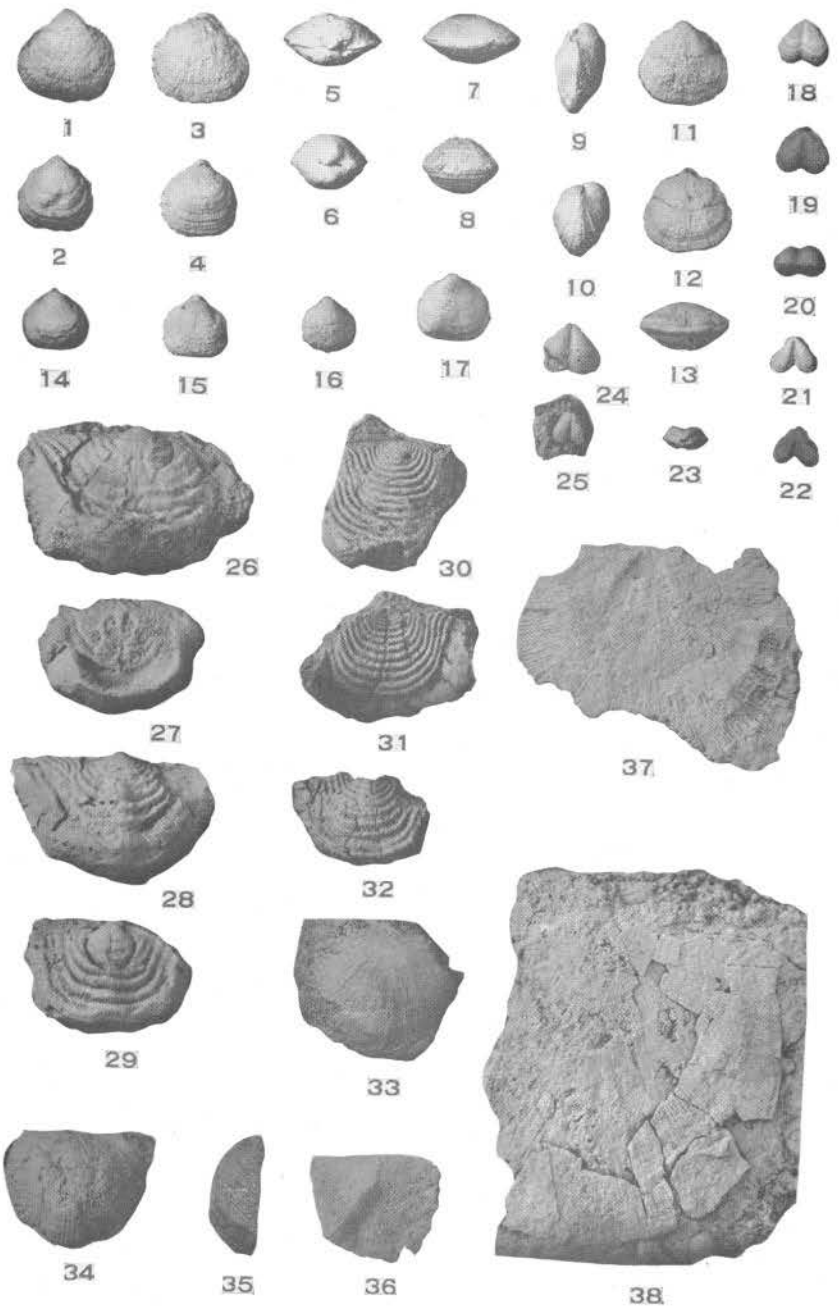
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PLATE NO. 47

PLATE 47

Stropheodonta (*Leptostrophia*) *planulata* (Hall)
Page 187.

Figs. 1, 2. Partially exfoliated, incomplete ventral valves.

Strophonella punctulifera (Conrad)
Page 188.

Figs. 3, 4. A partial cast of the interior of an incomplete ventral valve, and the corresponding partial interior of the valve
Fig. 5. Interior of a portion of a ventral valve.
Fig. 6. Interior of an incomplete ventral valve.

Leptaenisca concava (Hall)
Page 189.

Figs. 7-12. Ventral and posterior views of three incomplete shells.
Figs. 13, 14. Incomplete ventral valves.
Fig. 15. Dorsal view.
Fig. 16. Interior of a portion of a ventral valve.

Anastrophia verneuili (Hall)
Page 190.

Figs. 17, 18. Interior of parts of dorsal valves.
Fig. 19. Interior of a portion of a ventral valve.
Fig. 20. Dorsal view of an incomplete shell with unusually fine plications.
Fig. 21. Dorsal view of a specimen with relatively coarse plications.


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PLATE NO. 48

PLATE 48

Anastrophia verneuili (Hall)
Page 190.

Figs. 1-3. Ventral, dorsal, and anterior views.
Figs. 4-6. Ventral, dorsal, and side views.
Figs. 7-9. Ventral, dorsal, and anterior views.

Gypidula multicostata Dunbar
Page 191.

Fig. 10. A portion of a ventral valve with 12 plications on the fold.
Figs. 11, 12. Anterior and ventral views.
Fig. 13. Interior of an incomplete ventral valve.
Fig. 14. Interior of an incomplete ventral valve.
Figs. 15-17. Ventral, dorsal, and side views.
Fig. 18. An incomplete ventral valve.
Fig. 19. Anterior view.

Rhynchotrema formosa (Hall)
Page 192.

Figs. 20-22. Side, ventral, and dorsal views of the one specimen.

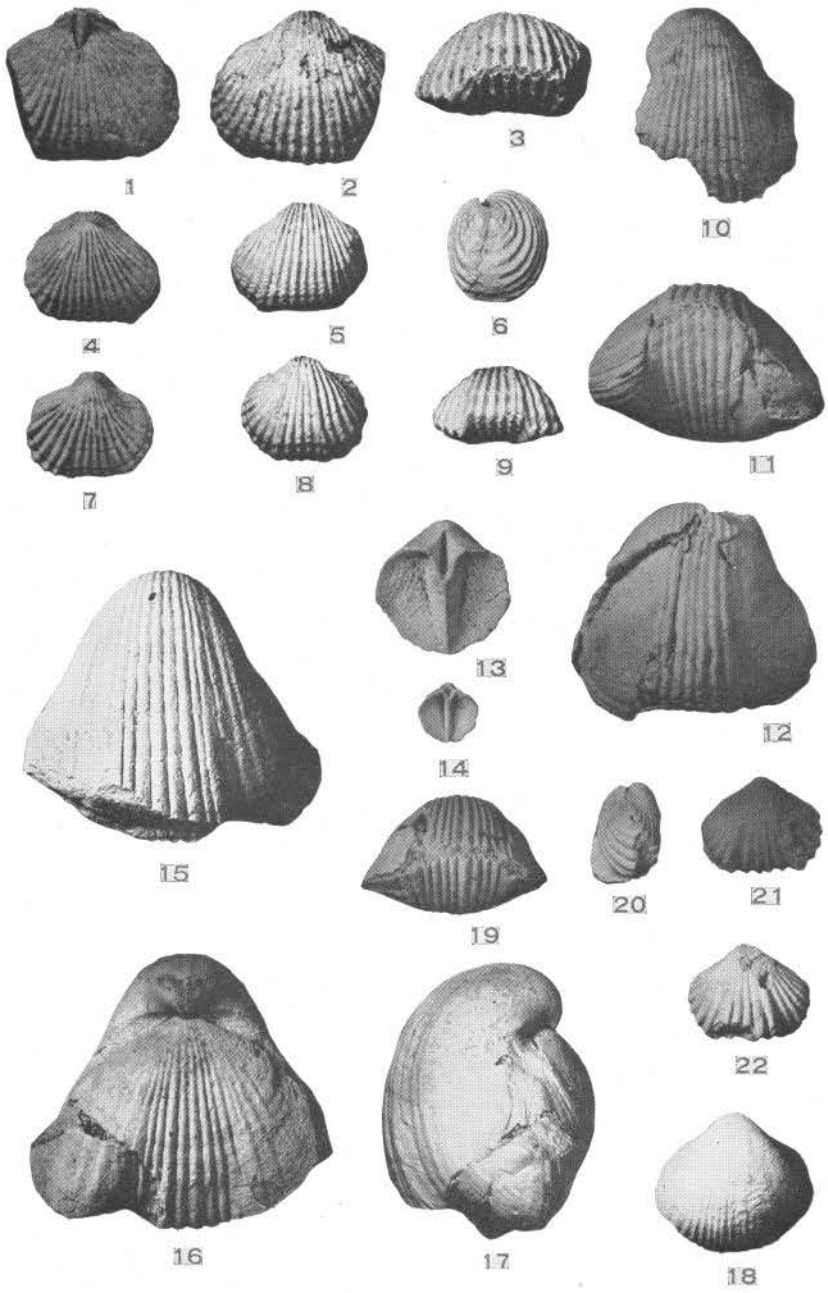
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PLATE NO. 49

PLATE 49

Eatonia singularis (Vanuxem)
Page 192.

Figs. 1, 2. Ventral and anterior views of the single specimen.

Uncinulus nucleolatus (Hall)
Page 193.

Figs, 3, 4. Anterior and dorsal views.
Fig. 5. Dorsal view of a specimen with 5 plications on the fold.
Figs. 6-11. Side and anterior views of three specimens.
Figs. 12-14. Anterior, dorsal, and side views.
Fig. 15. Posterior view.
Fig. 16. Posterior view of a portion of a shell.

Uncinulus mutabilis (Hall)
Page 193.

Figs. 17-19. Dorsal, side, and anterior views.
Fig. 20. An incomplete ventral valve.
Fig. 21. Side view.
Fig. 22. Dorsal view.

Uncinulus subpyramidatus n. sp.
Page 194.

Figs. 23-30. Dorsal, anterior, side, and ventral views of two incomplete shells.
Figs. 31, 32. Dorsal and anterior views.
Fig. 33. Anterior view.
Fig. 34. Dorsal view.

Wilsonia wadei Dunbar
Page 195.

Figs. 35-46. Ventral, dorsal, side, and anterior views of three specimens.
Figs. 47-48. Interior of incomplete ventral valves.

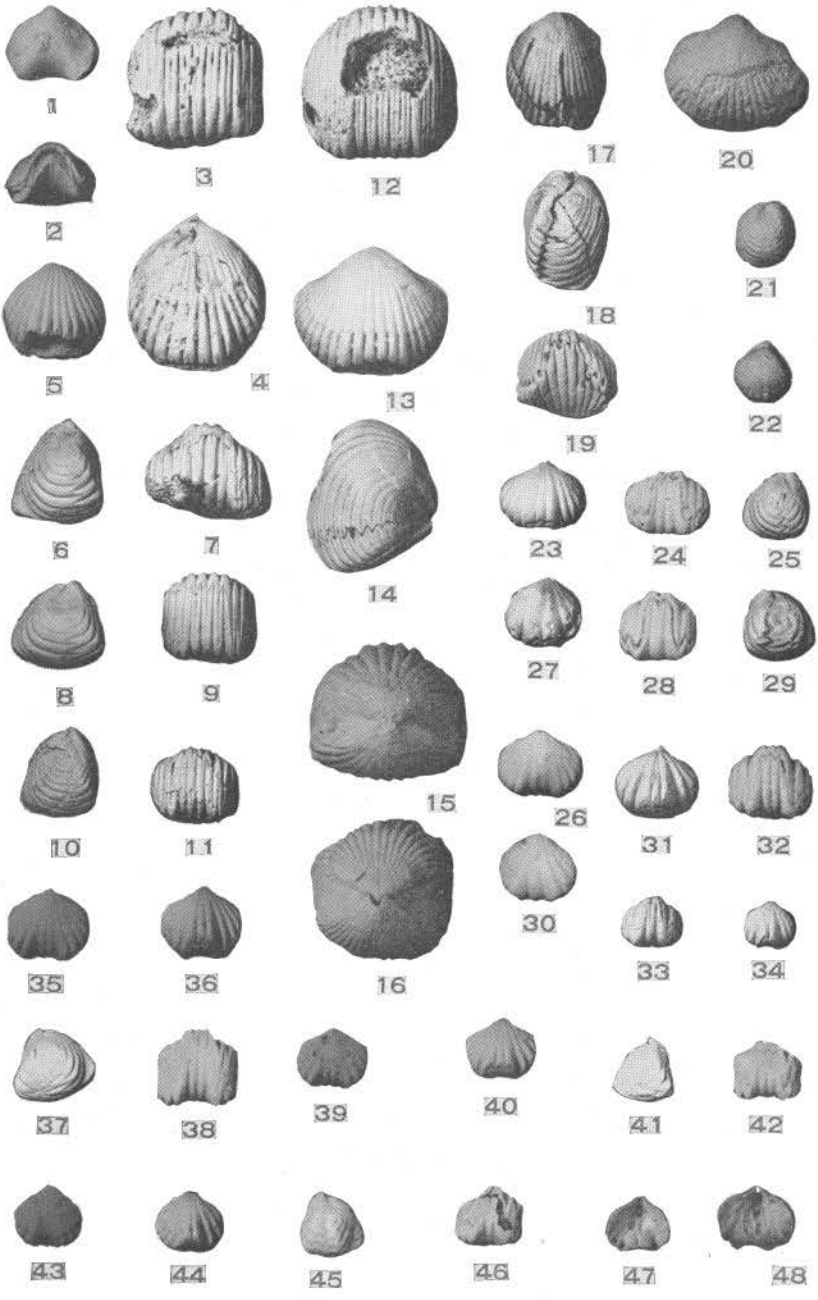
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PLATE NO. 50

PLATE 50

Wilsonia wadei Dunbar
Page 195.

Figs. 1, 2. Ventral and side views.
Figs. 3, 4. Dorsal and anterior views.

Rhynchonella transversa Hall
Page 195.

Figs. 5-12. Dorsal, side, ventral, and anterior views of two specimens.
Figs. 13-15. Dorsal, side, and ventral views.
Fig. 16. Dorsal view.
Fig. 17. Side view.
Fig. 18. Posterior view.
Fig. 19. Ventral view.
Fig. 20. Side view.

Rhynchonella (?) *bialveata* Hall
Page 195.

Figs. 21-23. Ventral, dorsal, and side views of one specimen.
Fig. 24. Dorsal view of the other observed specimen.

Rensselaerina medioplicata Dunbar
Page 196.

Figs. 25, 26. Dorsal and anterior views of the one specimen.

Atrypina imbricata (Hall)
Page 197.

Figs. 27-29. Side, ventral, and dorsal views of the single specimen.

Atrypa reticularis (Linne)
Page 198.

Fig. 30. An incomplete, elongate ventral valve.
Fig. 31. Internal cast of a ventral valve.
Fig. 32. Posterior view.
Figs. 33, 34. Ventral and anterior views.
Fig. 35. Side view of an incomplete shell with numerous growth lines.
Fig. 36. Anterior view of a specimen that shows the remains of fringes.
Fig. 37. A dorsal valve that shows the remains of fringes.
Fig. 38. An incomplete ventral valve that retains the remnants of fringes.
Fig. 39. Anterior view of a specimen with a prominent dorsal fold.
Fig. 40. Anterior view of a variety.

Delthyris perlamellosus (Hall)
Page 199.

Fig. 41. Ventral view.
Figs. 42, 43. Dorsal and side views.
Figs. 44-49. Dorsal, side, and anterior views of two specimens.

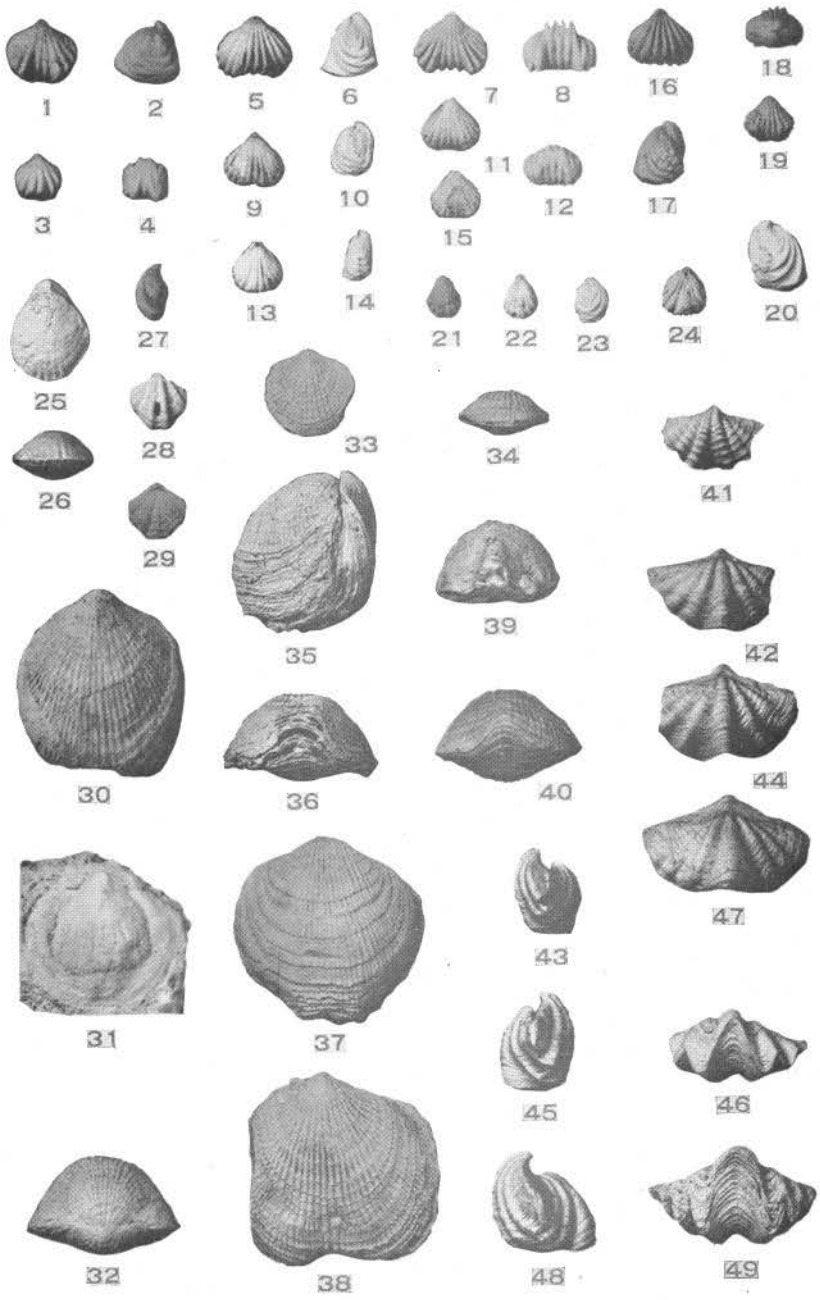
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PLATE NO. 51

PLATE 51

Delthyris missouriensis n. sp.
Page 199.

Figs, 1-6. Posterior, side, and ventral views of two specimens.
Figs. 7, 8. Posterior and side views.
Fig. 9. A portion of a ventral valve.
Fig. 10. Interior of a fragment of a ventral valve.
Fig. 11. Dorsal view.

Spirifer cyclopterus Hall
Page 200.

Figs. 12, 13. Ventral and dorsal views.
Figs. 14-16. Dorsal, ventral, and posterior views.
Figs. 17-19. Dorsal, ventral, and anterior views.
Figs. 20, 21. Incomplete dorsal valves.
Figs. 22, 23. Interior of fragments of ventral valves.
Fig. 24. Side view.
Fig. 25. Ventral view.
Fig. 26. Dorsal view of an incomplete shell on which the medial depression of the fold is well-marked, and which has a bifurcated plication.
Fig. 27. A portion of a ventral valve.

Delthyris octocostatus (Hall) ?
Page 199.

Figs. 28, 29. Ventral and dorsal views of the single specimen.

Cyrtina dalmani (Hall)
Page 201.

Fig. 30. Posterior view.
Fig. 31. Dorsal view.

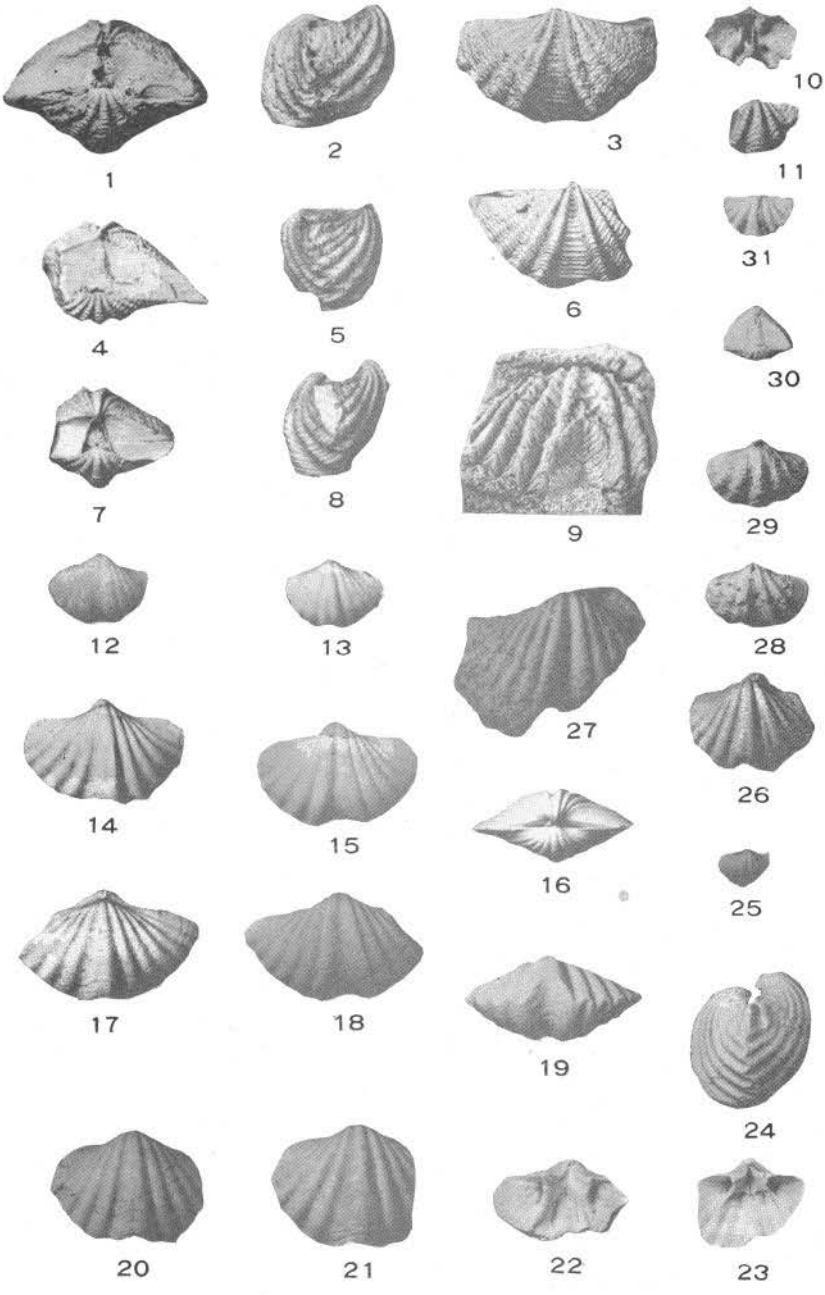
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PLATE NO. 52

PLATE 52

Cyrtina dalmani (Hall)
Page 201.

Figs. 1, 3. Ventral, dorsal, and posterior views.
Fig. 4. Central view of a portion of a shell.

Rhynchospira formosa Hall
Page 201.

Figs. 5-7. Ventral, dorsal, and side views.
Figs. 8-11. Ventral and dorsal views of two specimens.
Figs. 12-14. Ventral, dorsal, and side views.
Fig. 15. Side view.
Fig. 16. Anterior view of a perfect individual.
Fig. 17. Ventral view of a variety.
Fig. 18. Dorsal view.

Trematospira equistriata Hall and Clarke
Page 201.

Figs. 19, 20. Ventral and posterior views of the one specimen.

Nucleospira ventricosa Hall
Page 202.

Fig. 21. Ventral view.
Fig. 22. Ventral view.
Figs. 23, 24. Ventral and anterior views.
Figs. 25, 26. Dorsal and anterior views.
Figs. 27-30. Anterior, dorsal, ventral, and side views.
Figs. 31-33. Dorsal, ventral, and posterior views.

Meristella laevis (Vanuxem)
Page 202.

Figs. 34-36. Ventral, dorsal, and side views.
Figs. 37-44. Ventral, dorsal, side, and anterior views of two specimens.

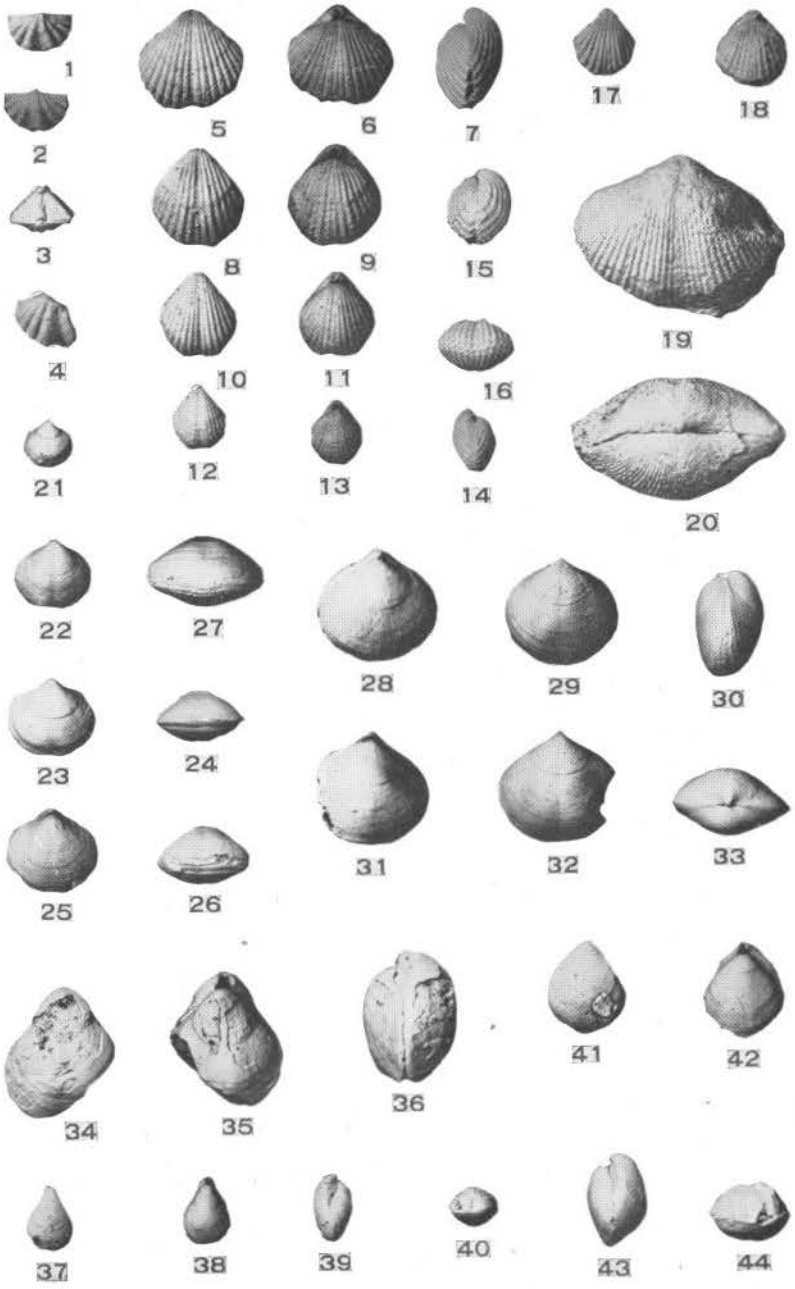
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PLATE NO. 53

PLATE 53

Meristella laevis (Vanuxem)
Page 202.

Figs. 1, 2. Dorsal and side views.

Meristella bella Hall
Page 203.

Figs. 3-6. Ventral, dorsal, side, and anterior views of the single specimen.

Meristella atoka Girty
Page 204.

Figs. 7-10. Dorsal and side views of two specimens.
Figs. 11, 12. Dorsal and anterior views.
Figs. 13-15. Side, dorsal, and anterior views of a partially restored shell.
Fig. 16. Dorsal view of an almost completely exfoliated individual.
Fig. 17. An incomplete ventral valve.
Fig. 18. Internal cast of a ventral valve.
Fig. 19. A partially exfoliated ventral valve.
Fig. 20. Anterior view of an almost wholly exfoliated individual.

Rensselaerina medioplicata var. latior Dunbar (?)
Page 197.

Figs. 21, 22. Dorsal and side views of a portion of a shell.
Fig. 23. A portion of a ventral valve.
Fig. 24. Side view; the marked projection of the ventral above the dorsal beak is due to distortion.

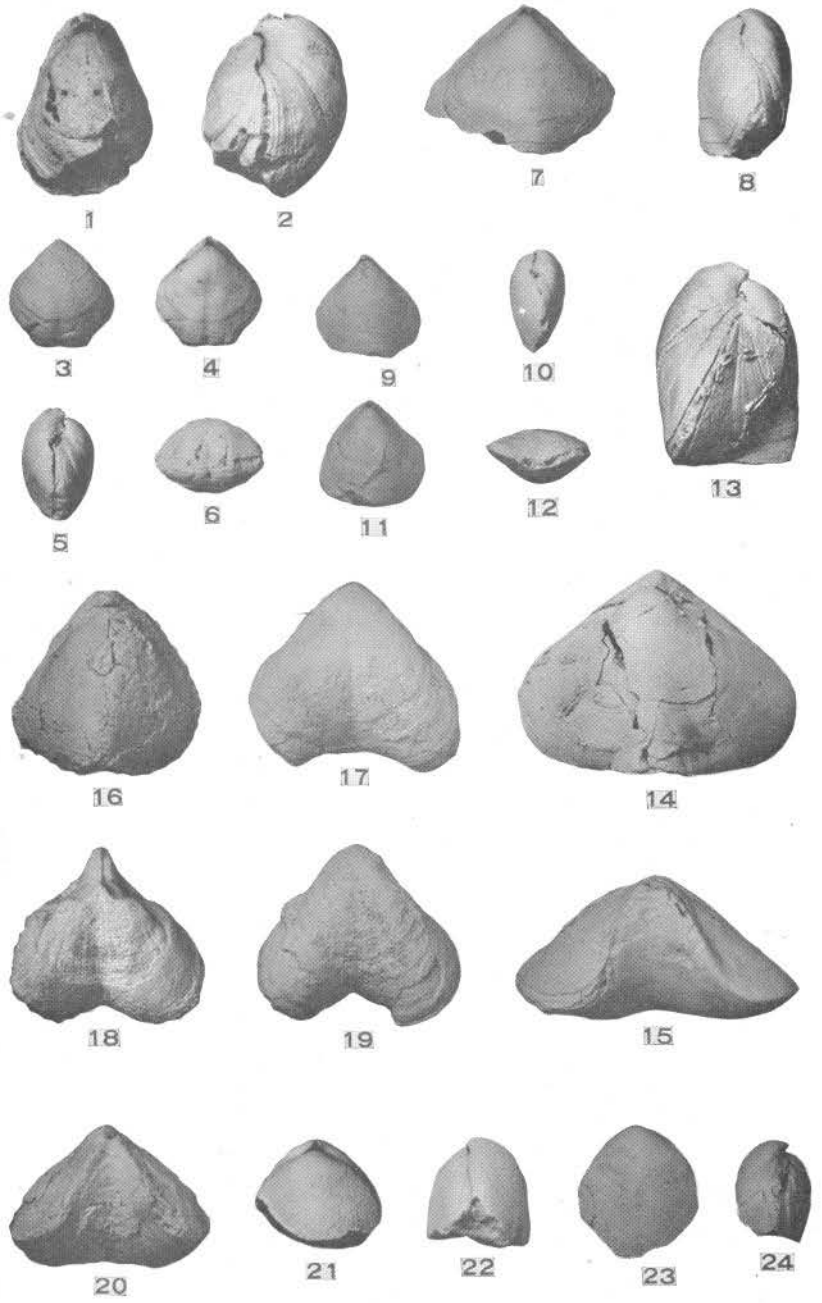
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PLATE NO. 54

PLATE 54.

Rensselaerina medioplicata var. latior Dunbar (?)
Page 197.

Fig. 1. Ventral view of a portion of a shell.
Fig. 2. A portion of a ventral valve.
Fig. 3. Interior of a fragment of a dorsal valve.
Fig. 4. Interior of a part of a ventral valve.

Pteronitella (?) sp.
Page 205.

Fig. 5. Internal cast of a portion of a left valve—the only specimen observed.

Conocardium sp.
Page 205.

Fig. 6. The one specimen—an internal cast of a part of a left valve.

Aviculopecten (?) *umbonata* (Hall) (?)
Page 205.

Fig. 7. An incomplete left valve that retains portions of the shell.
Fig. 8. A portion of a left valve.

Cypricardinia distincta Billings (?)
Page 206.

Fig. 9. The single specimen—an imcomplete left valve.

Platyceras pentalobus Hall.
Page 207.

Fig. 10. Ventral view.
Fig. 11. Upper view.
Fig. 12. Upper view.
Figs. 13-15. Upper, lower, and ventral views.
Figs. 16, 17. Upper and lower views.
Figs. 18-20. Upper, lower, and ventral views.

Platyceras sp.
Page 207.

Figs. 21, 22. Upper and dorsal views of the partially exfoliated individual.

Platyceras (?) sp.
Page 207.

Figs. 23, 24. Dorsal and ventral views of the specimen.

Diaphorostoma sp.
Page 207.

Figs. 25, 26. Upper and ventral views of the single representative—an internal cast.

Goldius barrandii Hall
Page 208.

Fig. 27. The sole specimen—a portion of a pygidium.

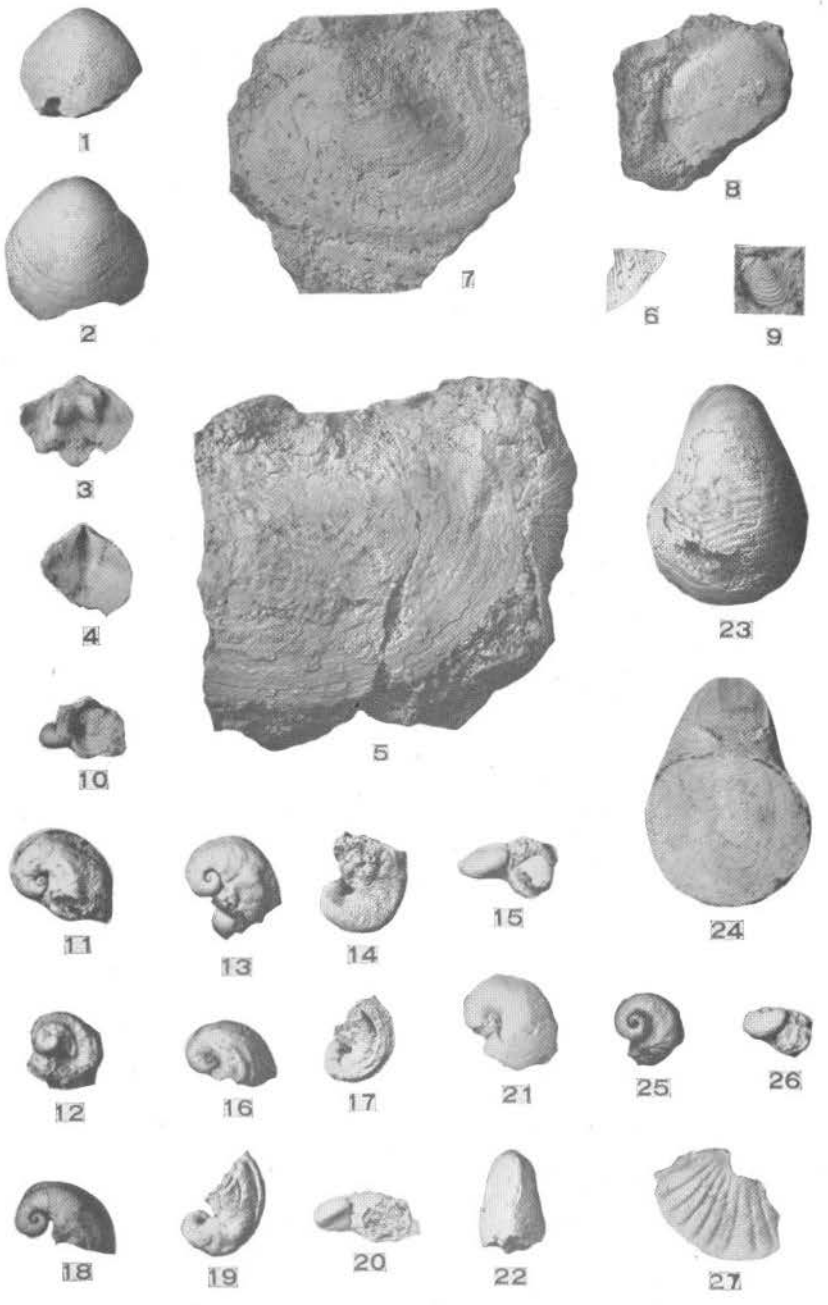
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PLATE NO. 55

PLATE 55

Dalmanites cf. griffoni Clarke
Page 209.

Fig. 1. An almost wholly exfoliated, incomplete cephalon.

Dalmanites sp.
Page 209.

Fig. 2. A partially exfoliated portion of a glabella.
Fig. 3. Interior of a part of a cephalon.
Fig. 4. A fragment of a cephalon with the impression of the genal spine.
Fig. 5. A part of a pygidium.
Fig. 6. A nearly complete pygidium.
Fig. 7. A part of a pygidium that retains portions of the test.

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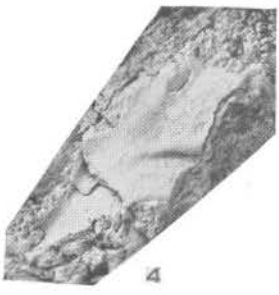

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PLATE NO. 56

PLATE 56

Dalmanites sp.
Page 209.

Fig. 1. A portion of a pygidium—partially exfoliated.

Dalmanites carlwegi n. sp.
Page 209.

Fig. 2. An incomplete pygidium.

Dalmanites carlwegi n. sp. (?)
Page 209.

Fig. 3. A part of a pygidium.
Fig. 4. An incomplete pygidium.

Phacops hudsonicus Hall
Page 210.

Figs. 5, 6. Top and side views of a partially exfoliated portion of a cephalon.
Fig. 7. A part of a cephalon—the eye has an elevation of 3 ranges of lenses.
Figs. 8, 9. Top and side views of a portion of a cephalon.
Fig 10. An almost wholly exfoliated, incomplete cephalon.

Phacops hudsonicus Hall (?)
Page 210.

Fig. 11. An incomplete pygidium.
Figs. 12, 13. Pygidia.
Figs. 14, 15. Parts of cephala.

Phacops logani Hall
Page 211.

Figs. 16, 17. Top and side views of the single, partially exfoliated, incomplete cephalon.

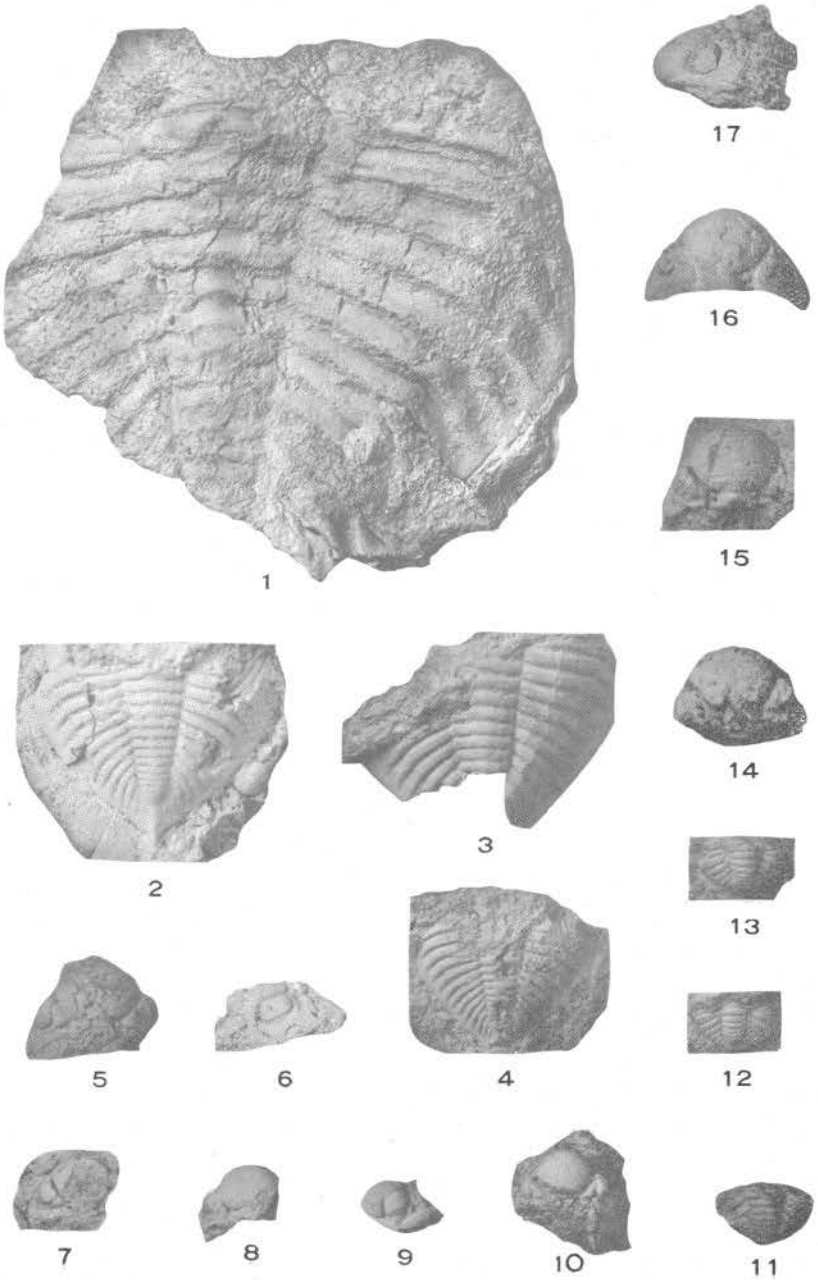
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PLATE NO. 57

PLATE 57

Zaphrentis salinensis sp. nov.
Page 221.

Fig. 1. Side view of almost complete corallum.
Fig. 2. Side view of small individual.

Zaphrentis cornuformis sp. nov.
Page 221.

Fig. 3. Side view of a large specimen.
Fig. 4. Lateral view of small individual, slight curvature of specimen not apparent from this view.
Figs. 5-7. Side views of three individuals of different sizes.

Favosites cf. helderbergiæ Hall
Page 222.

Fig. 8. Portion of corallum showing mural pores.

Favosites sp.
Page 222.

Figs. 9, 10. Impressions of the epitheca of the concave bases.

Edriocrinus cf. sacculus Hall
Page 223.

Fig. 11. Lateral view of the calyx.

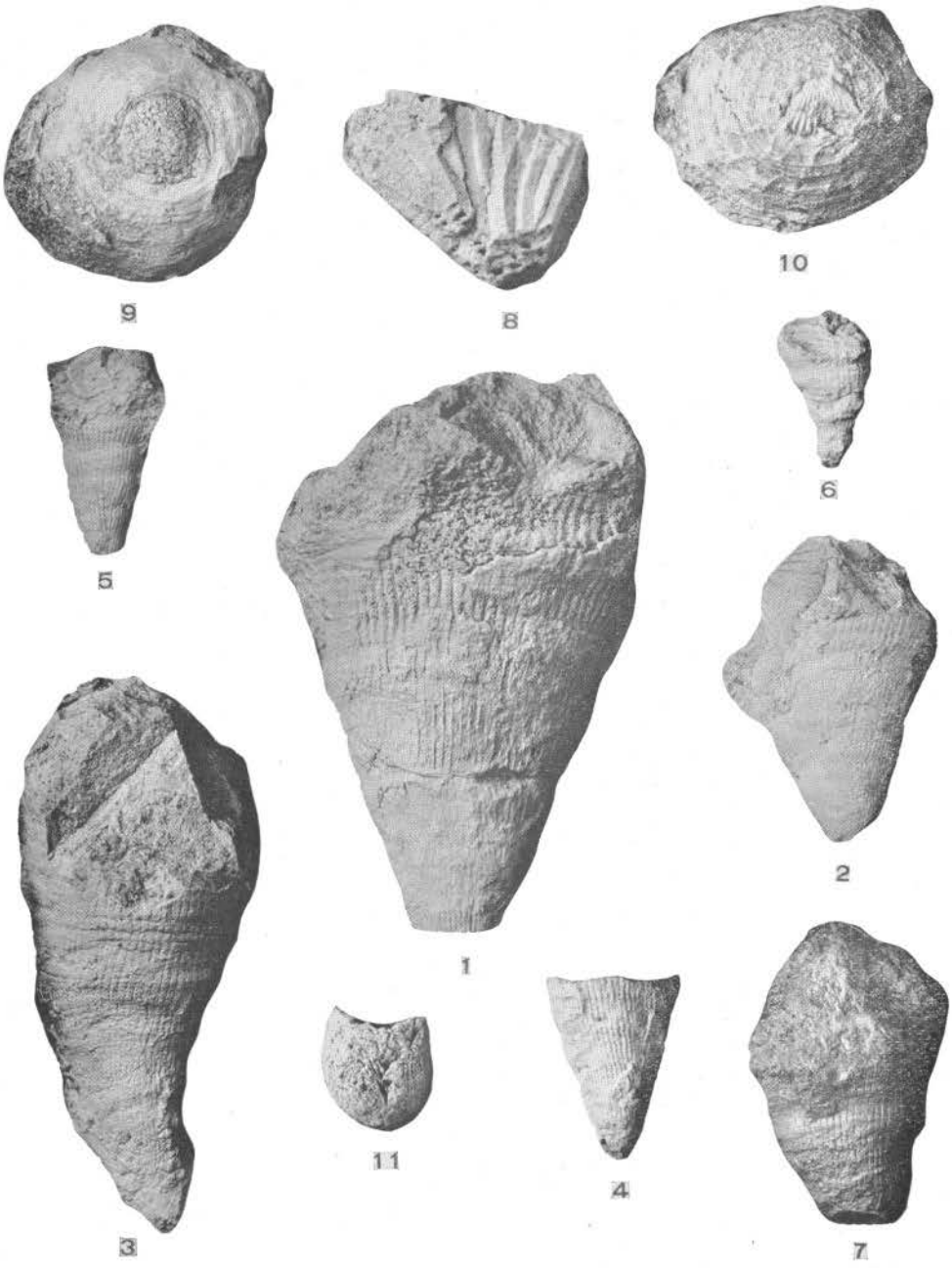
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PLATE NO. 58

PLATE 58

Fistulipora acutula sp. nov.
Page 223.

Fig. 1. An enlargement of a vertical section showing zooecial tubes, diaphragms, and interstitial tissue. (X20.)
Fig. 2. Enlargement of transverse section showing outline of the zooecia. (X20.)

Fistulipora variolata sp. nov.
Page 223.

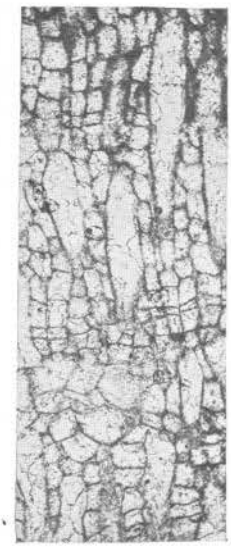
Fig. 3. Enlargement of vertical section showing character of zooecial tubes and vesicles. (X15.)
Fig. 4. Enlargement of transverse section showing zooecia with well-developed lunaria, and abundant angular interstitial cells. (X15.)

Meekopora sp.
Page 224.

Fig. 5. Enlargement showing character of zooecial apertures. (X20.)
Fig. 6. Portion of zoarium, natural size, showing mesathecal surface.

Heterotrypa undata sp. nov.
Page 224.

Fig. 7. Enlargement of vertical section showing abundant diaphragms and undulating cell walls. (X15.)
Fig. 8. Enlargement of transverse section. (X15.)



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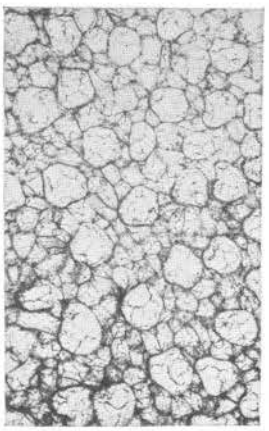

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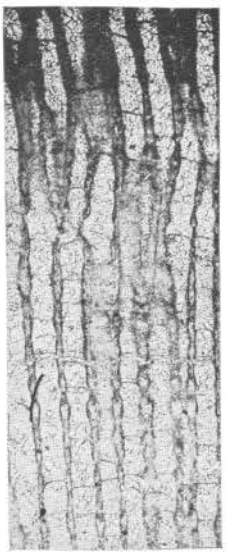

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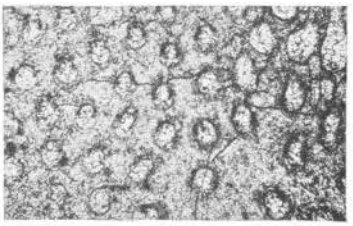

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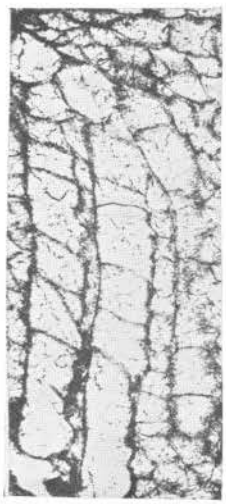

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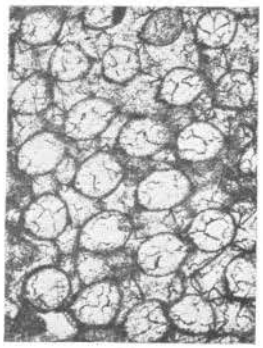

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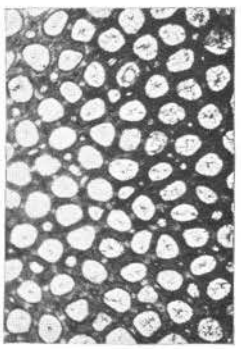

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PLATE NO. 59

PLATE 59

Monotrypa cf. tabulata Hall
Page 225.

Fig. 1. Enlargement of vertical section showing undulating character of cell walls. (X 20.)
Fig. 2. Enlargement showing angular zooecia without mesapores. (X 20.)
Fig. 3. Transversely fractured zoarium, natural size.

Unitrypa cf. lata Hall.
Page 225.

Fig. 4. Enlargement of horizontal section showing characters of superstructure, fenestrules, and zooecia. (X 5.)

Unitrypa subcircularis sp. nov.
Page 226.

Fig. 5. Portion of frond, showing impression of superstructure. (X 5.)
Figs. 6, 7. Enlargements of horizontal sections, showing characters of the superstructures. (X 15, 20.)

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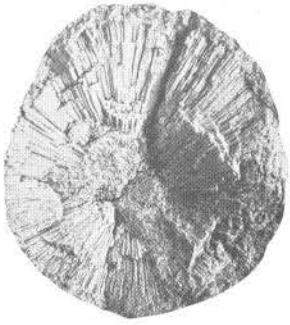

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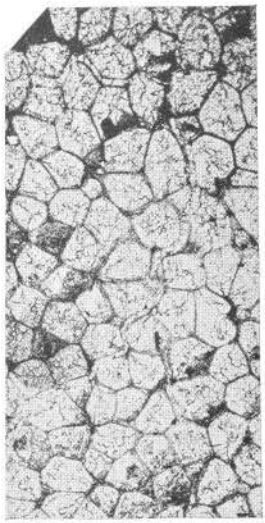

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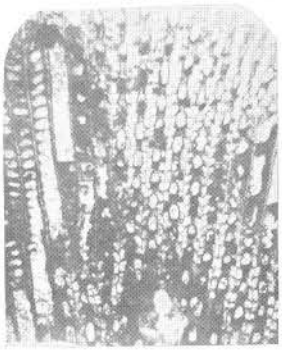

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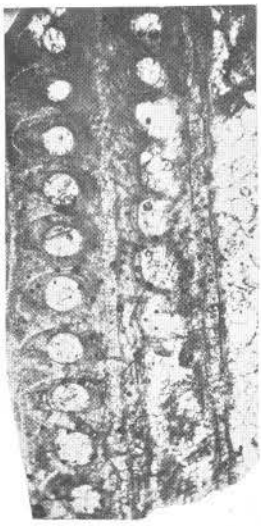

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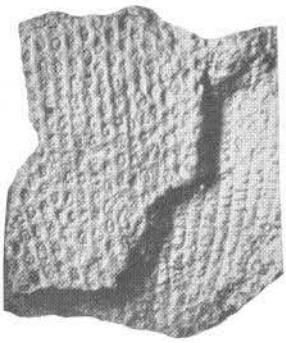

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PLATE NO. 60

PLATE 60

Polypora cf. hexagonalis Hall
Page 226.

Fig. 1. Enlargement of portion of frond, reverse side. (X 3.)
Fig. 2. Enlargement of portion of frond, obverse side. (X 3.)

Polypora media sp. nov.
Page 227.

Fig. 3. Enlargement of horizontal section, showing characters of fenestrules, zooecia, and the slightly sinuous branches. (X 5)

Polypora valida sp. nov.
Page 227.

Fig. 4. Enlargement of portion of the frond, reverse side, showing strong branches. (X 3.)
Fig. 5. Enlargement of horizontal section. (X 5.)

Cystodictya cf. rigida Hall
Page 228.

Fig. 6. Portion of zoarium showing mesathecal surface, natural size.
Fig. 7. Enlargement of horizontal section showing character of zooecia. (X 15.)

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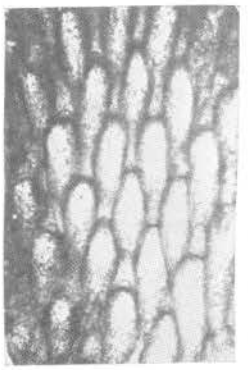

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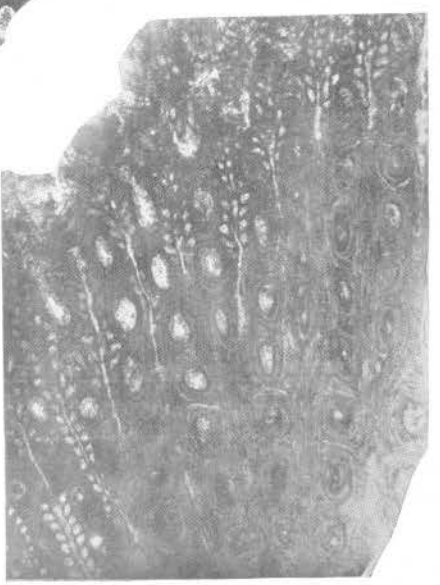

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PLATE NO. 61

PLATE 61

Pholidops ovata Hall
Page 228.

Figs. 1, 2. Interior moulds of two dorsal valves.

Rhipidomella emarginata Hall
Page 230.

Fig. 3. Exterior view of pedicle valve.
Figs. 4, 5. Exterior views of two brachial valves.

Rhipidomella musculosa Hall
Page 230.

Fig. 6. Exterior view of pedicle valve.
Fig. 7. Exterior view of a pedicle valve showing the large, fan-shaped muscular impressions.
Fig. 8. Brachial valve of larger individual.

Dalmanella lenticularis (Vanuxem)
Page 229.

Fig. 9. Partly exfoliated brachial valve.
Figs. 10, 11. Exterior views of two pedicle valves.

Dalmanella oriskania sp. nov.
Page 229.

Fig. 12. Exterior view of brachial valve.
Fig. 13. Mould of the interior of a brachial valve, showing the form of the muscular impressions.
Fig. 14. Exterior view of a pedicle valve.

Leptaena ventricosa (Hall)
Page 231.

Fig. 15. Partly exfoliated pedicle valve, showing muscular imprints.
Fig. 16. Exterior view of pedicle valve.
Fig. 17. Exterior view of brachial valve.

Stropheodonta cf. demissa (Conrad)
Page 232.

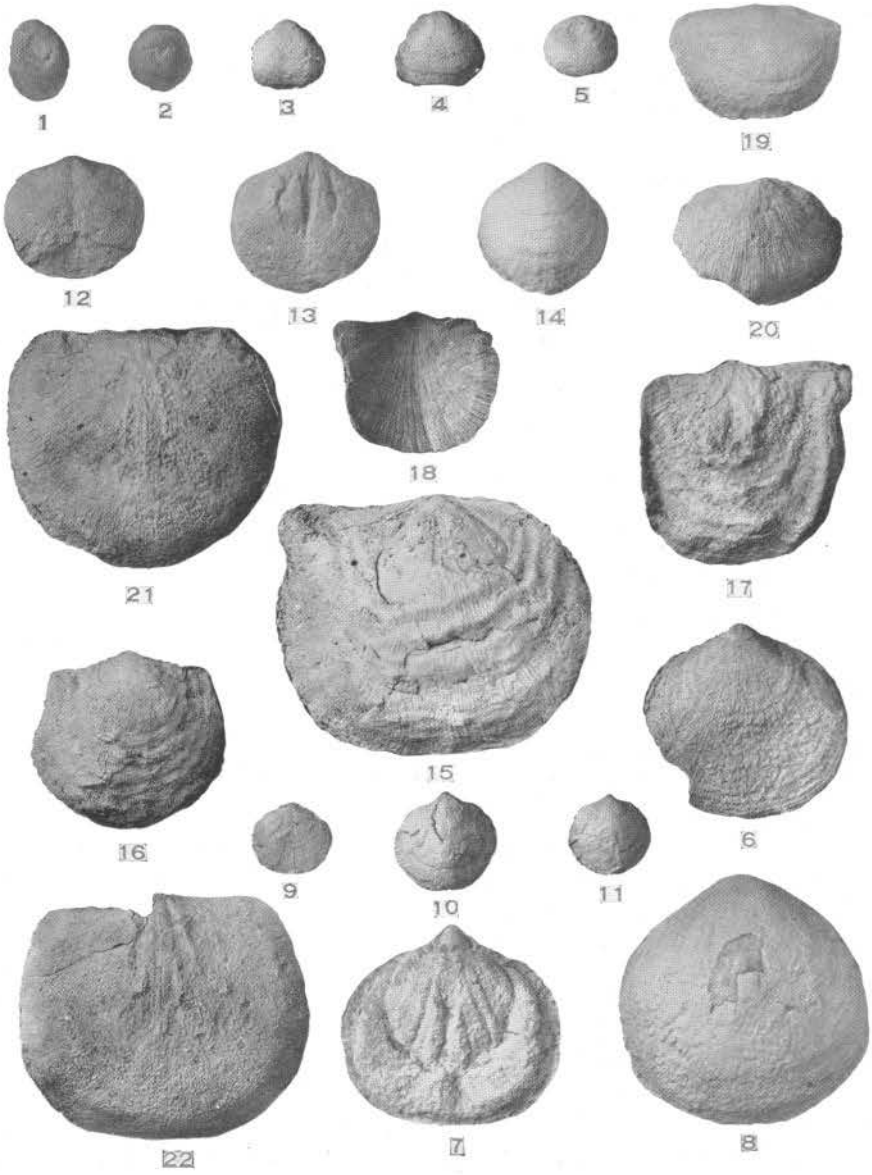
Fig. 18. Exterior view of a brachial valve.

Stropheodonta cf. inequiradiata Hall
Page 233.

Figs. 19, 20. Views of two pedicle valves.

Stropheodonta missouriensis sp. nov.
Page 232.

Fig. 21. Interior view of a brachial valve.
Fig. 22. Interior view of an incomplete brachial valve, showing muscular impressions.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22
7
8

PLATE NO. 62

PLATE 62.

Leptostrophia magnifica (Hall)
Page 233.

Fig. 1. Exfoliated portion of large pedicle valve.
Fig. 2. Interior view of an incomplete brachial valve showing muscular impressions and pustulose aspect of the vascular area, and crenulations of the hinge line.
Fig. 3. Exterior view of the pedicle valve.

Leptostrophia magniventra Hall
Page 234.

Fig. 4. Exterior view of an exfoliated pedicle valve.
Fig. 5. Exfoliated pedicle valve showing form of muscle scars.

Brachyprion cf. majus Clarke
Page 235.

Fig. 6. Exterior view of a pedicle valve.
Fig. 7. Interior view of a pedicle valve.

Brachyprion sp.
Page 236.

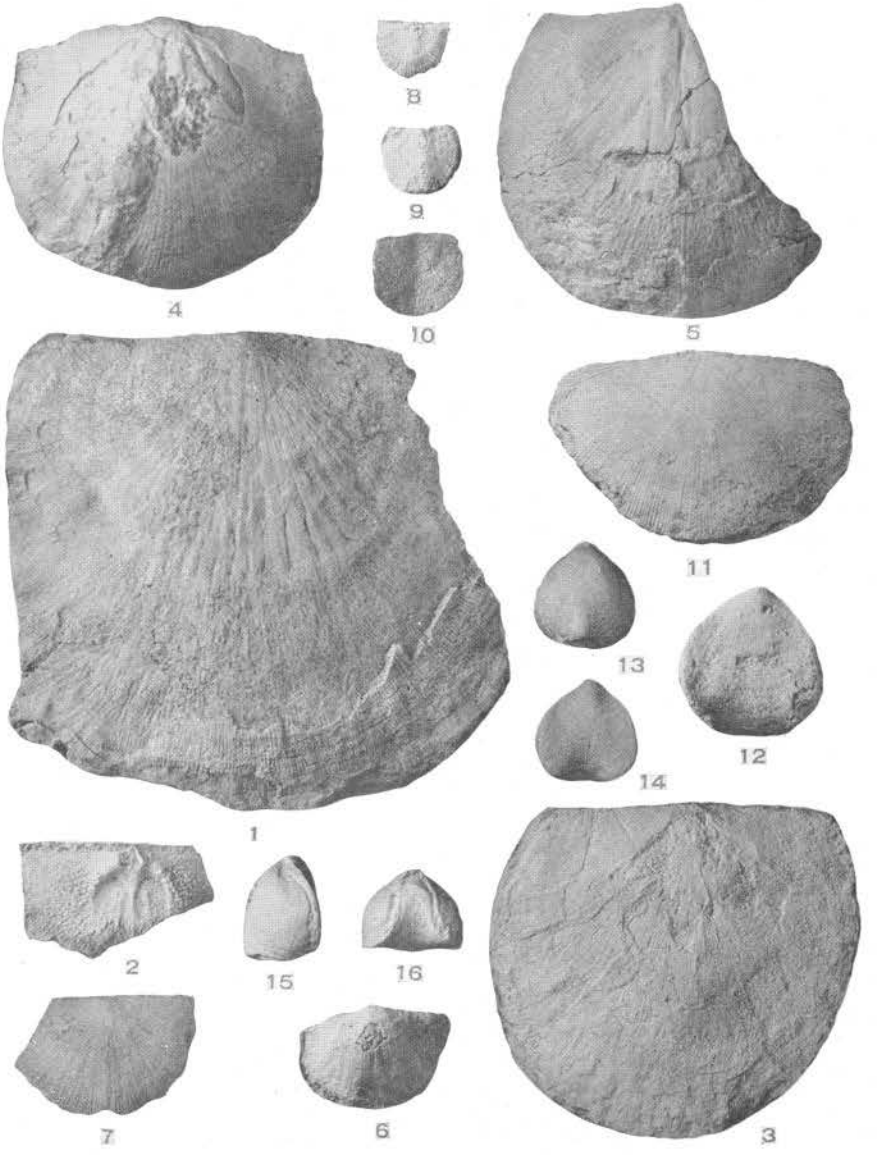
Fig. 8, 9. Interior views of two brachial valves.
Fig. 10. Exterior view of a brachial valve.

Schuchertella sp.
Page 236.

Fig. 11. View of an incomplete pedicle valve.

Eatonia peculiaris Conrad
Page 237.

Fig. 12. Pedicle view of a large individual.
Figs. 13-16. Brachial, pedicle, lateral and anterior views of a nearly perfect specimen of average size.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7
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3

PLATE NO. 63

PLATE 63.

Eatonia plicata sp. nov.
Page 238.

Figs. 1-3. Pedicle views of three individuals.
Fig. 4. Brachial view of an imperfect valve.

Anoplia nucleata (Hall)
Page 236.

Fig. 5. Internal mould of a pedicle valve. (X 1.5)

Chonostrophia complanata (Hall)
Page 237.

Fig. 6. Exterior view of a pedicle valve.
Fig. 7. Interior view of a pedicle valve showing muscle scars and pustulose character of the surface.

Uncinulus salinensis sp. nov.
Page 239.

Figs. 8-9. Pedicle and brachial views of a nearly complete specimen, the holotype.
Fig. 10. Cast of the interior of a pedicle valve.

Uncinulus parvus sp. nov.
Page 239.

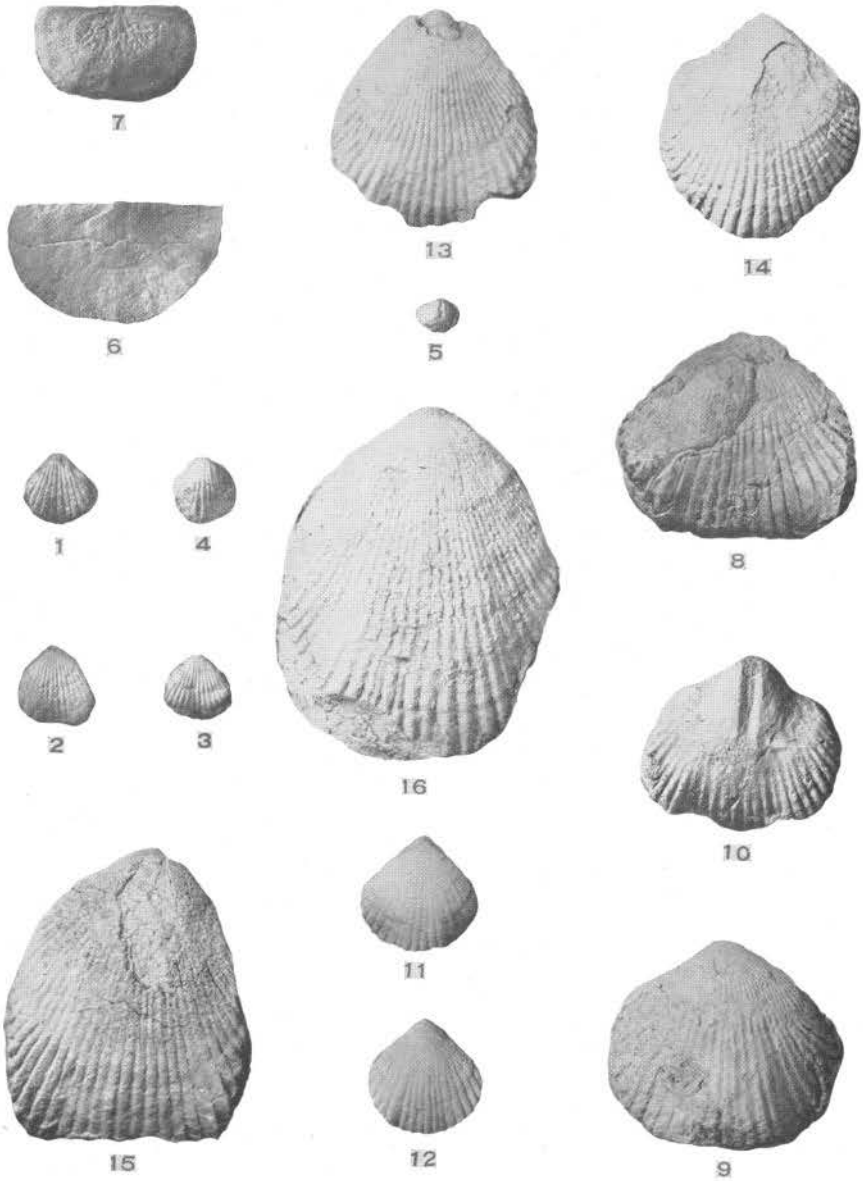
Figs. 11-12. Brachial and pedicle views of the holotype.

Uncinulus welleri sp. nov.
Page 240.

Fig. 13. Exterior view of a pedicle valve.
Fig. 14. Exterior view of a brachial valve.

Plethorhyncha barrandii (Hall)
Page 240.

Fig. 15. View of the exterior of a pedicle valve.
Fig. 16. Exterior view of a brachial valve.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9

PLATE NO. 64

PLATE 64.

Plethorhyncha principalis (Hall)
Page 241.

Fig. 1. View of a nearly complete brachial valve.
Fig. 2. View of an incomplete brachial valve.
Fig. 3. View of a small, rotund, brachial valve.

Centronella glansfagea (Hall)
Page 242.

Figs. 4, 5. Pedicle and brachial views of a nearly complete specimen.
Fig. 6. Brachial view of broader individual.
Fig. 7. Pedicle view of large individual.

Rensselaeria ovoides (Eaton)
Page 242.

Figs. 8, 9. Pedicle views of two small specimens.
Figs. 10-12. Pedicle, brachial and lateral views of a large, nearly complete specimen.

Rensselaeria cf. stewarti Clarke
Page 243.

Figs. 13-15. Views of three pedicle valves.

Beachia suessana (Hall)
Page 244.

Fig. 16. Brachial view of a nearly complete specimen.
Fig. 17. Pedicle view of a second nearly complete specimen.

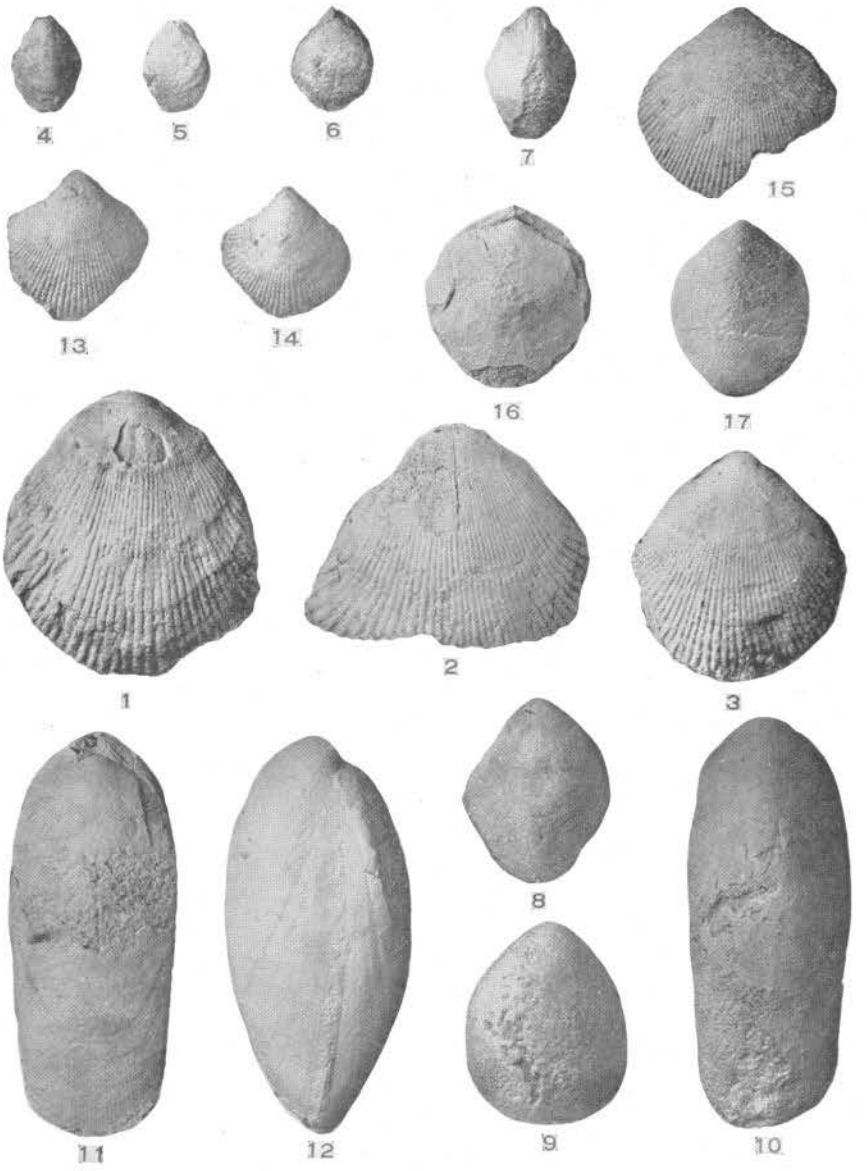
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PLATE NO. 65

PLATE 65.

Beachia ovalis (Hall)
Page 244.

Fig. 1. Pedicle view of a nearly complete but exfoliated specimen.

Atrypa reticularis (Linnè)
Page 245.

Fig. 2. Brachial view of large specimen.

Rhynchospira attenuata sp. nov.
Page 248.

Fig. 3. Pedicle view of the holotype.

Trematospira multistriata (Hall)
Page 248.

Fig. 4. Pedicle view of a nearly complete valve.
Fig. 5. Brachial view of an incomplete valve.

Spirifer arenosus (Conrad)
Page 245.

Fig. 6. Pedicle view of a nearly complete valve.
Fig. 7. Pedicle view of larger specimen.
Fig. 8. Brachial view of a nearly complete valve.

Spirifer murchisoni Castelnau
Page 246.

Figs. 9, 10. Pedicle views of two nearly complete valves.
Fig. 11. Brachial view of a nearly complete valve.

Spirifer cf. varicosa Hall
Page 246.

Fig. 12. View of an incomplete brachial valve.

Cyrtina rostrata Hall
Page 247.

Fig. 13. View of an incomplete brachial valve.

cf. Metaplasia pyxidata Hall
Page 247.

Fig. 14. View of a pedicle valve. (x 1.5)

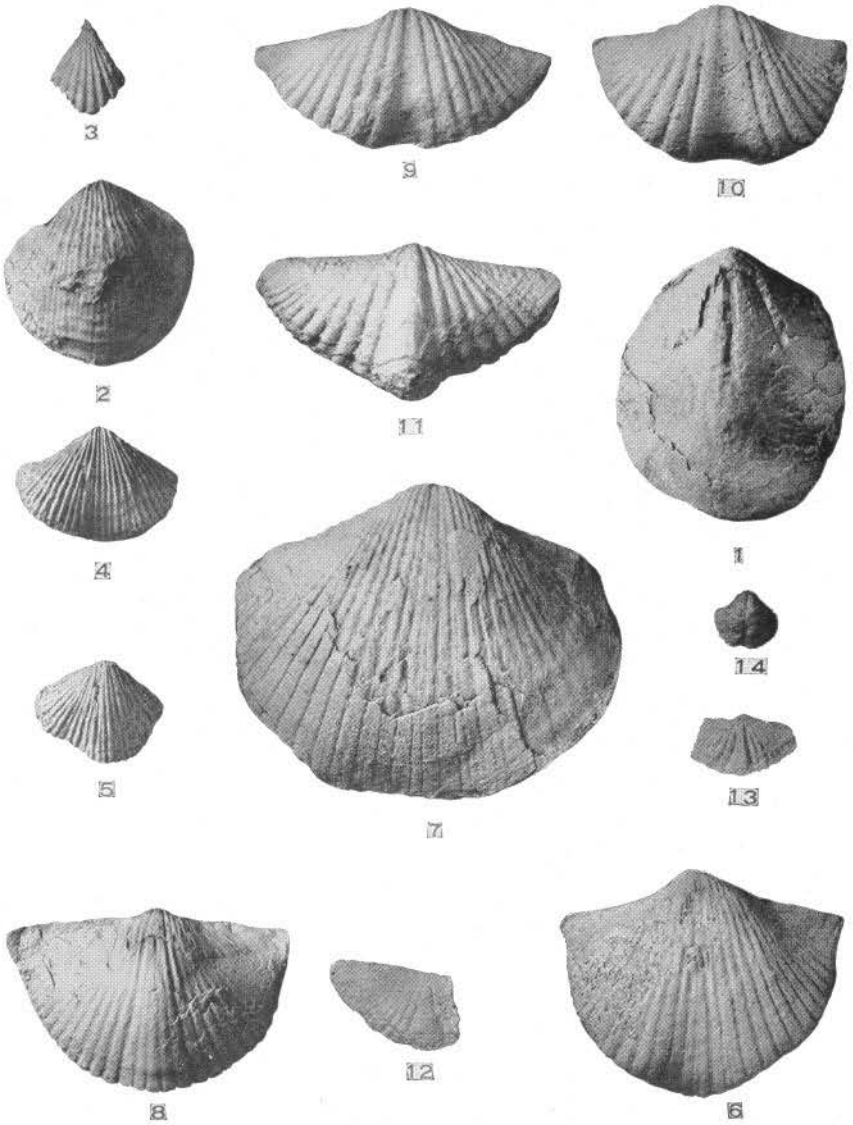
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PLATE NO. 66

PLATE 66.

Nucleospira cf. ventricosa (Hall)
Page 249.

Figs. 1, 2. Views of two brachial valves showing the narrow sinus.
Fig. 3. View of an incomplete brachial valve.

Meristella elliptica sp. nov.
Page 250.

Figs. 4, 5. Views of two pedicle valves.

Meristella ovalis sp. nov.
Page 250.

Figs. 6-8. Views of three brachial valves.

Meristella ampla sp. nov.
Page 249.

Figs. 9, 10. Views of two pedicle valves.
Fig. 11. View of the internal mould of a pedicle valve showing the muscular scars.

Meristella carinata sp. nov.
Page 250.

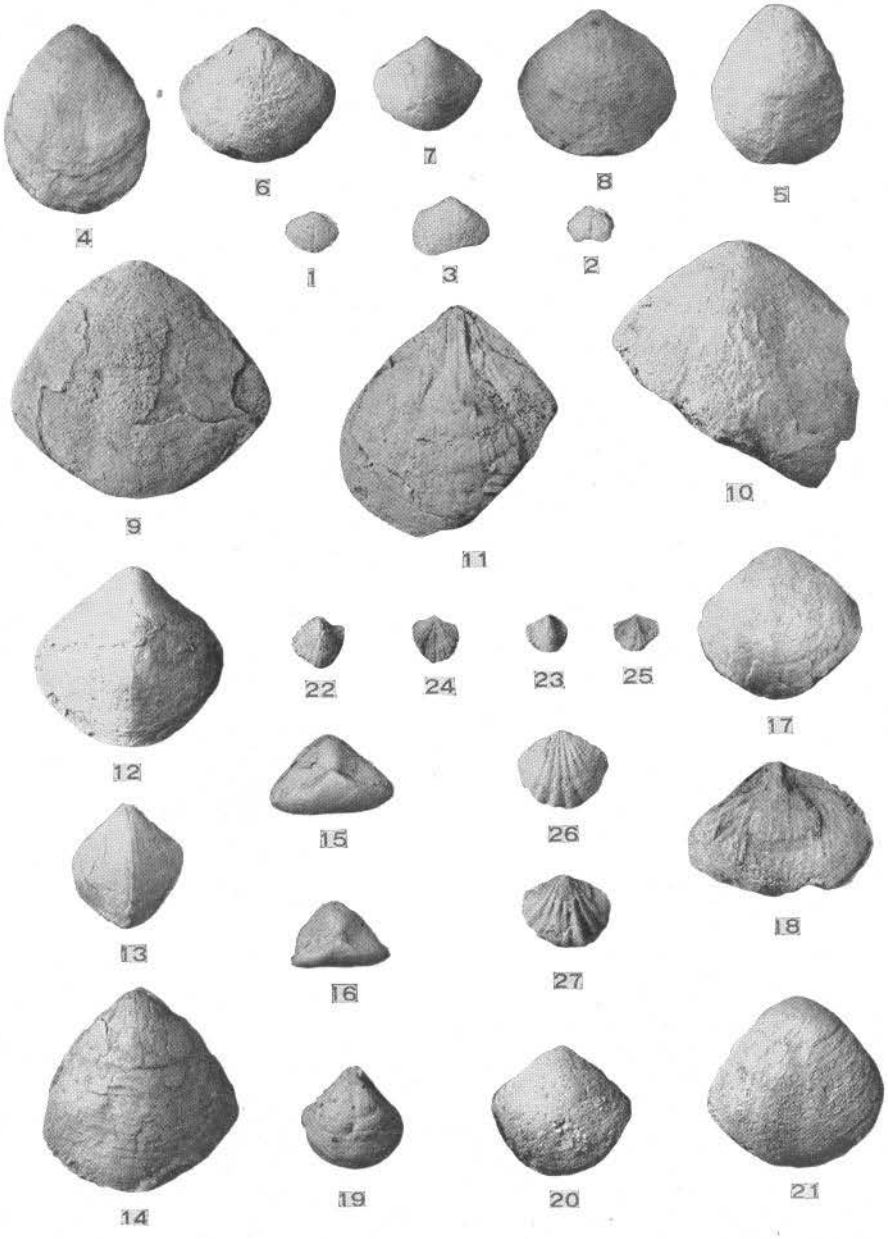
Figs. 12-14. Brachial views of three individuals.
Figs. 15-16. Posterior views of two nearly complete specimens.
Fig. 17. View of a pedicle valve.
Fig. 18. View of the internal mould of a pedicle valve showing the muscle scars.
Fig. 19. Brachial view of a young specimen doubtfully referred to this species. (X 4).
Figs. 20, 21. Pedicle valves doubtfully referred to this species

Anoplotheca dichotoma (Hall)
Page 251.

Figs. 22, 23. Views of two pedicle valves.
Figs. 24, 25. Views of two brachial valves.

Anoplotheca flabellites (Conrad)
Page 251.

Fig. 26. View of a brachial valve.
Fig. 27. View of a pedicle valve.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16
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14
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20
21

PLATE NO. 67

PLATE 67.

Actinopteria insignis Clarke
Page 252.

Fig. 1. Left valve showing the outline and external characters of the shell
Fig. 2. Left valve of larger example doubtfully referred to this species.

Actinopteria?
Page 253.

Figs. 3, 4. Incomplete specimens of two left valves.

Aviculopecten sp. undet.

Fig. 5. Incomplete ventral portion of a left valve.

Orthonychia belli Clarke
Page 254.

Fig. 6. Lateral view.

Orthonychia tortuosa Hall
Page 254.

Figs. 7-10. Lateral views of four individuals showing variation in size.

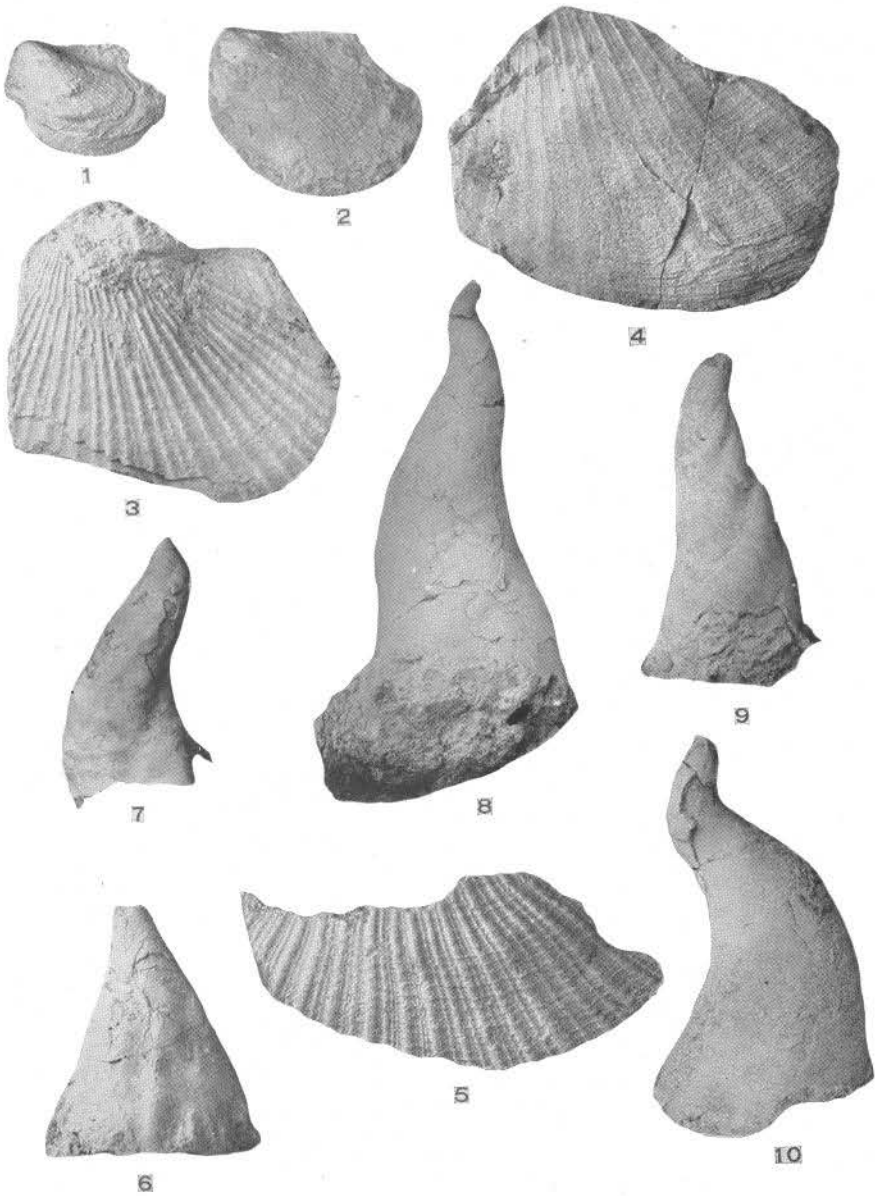
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PLATE NO. 68

PLATE 68.

Orthonychia praeconicum sp. nov.
Page 254.

Figs. 1, 2. Lateral views of two specimens.

Platyceras angulare Rowe
Page 255.

Figs. 3, 4. View of the spire and the lateral aspect of a nearly complete specimen.

Platyceras dumosum Conrad
Page 256.

Fig. 5. Lateral view showing spine bases.

Platyceras elongatum var. *parvum*. n. var.
Page 256.

Fig. 6. Lateral view of a nearly complete example.

Platyceras gebhardi Conrad
Page 256.

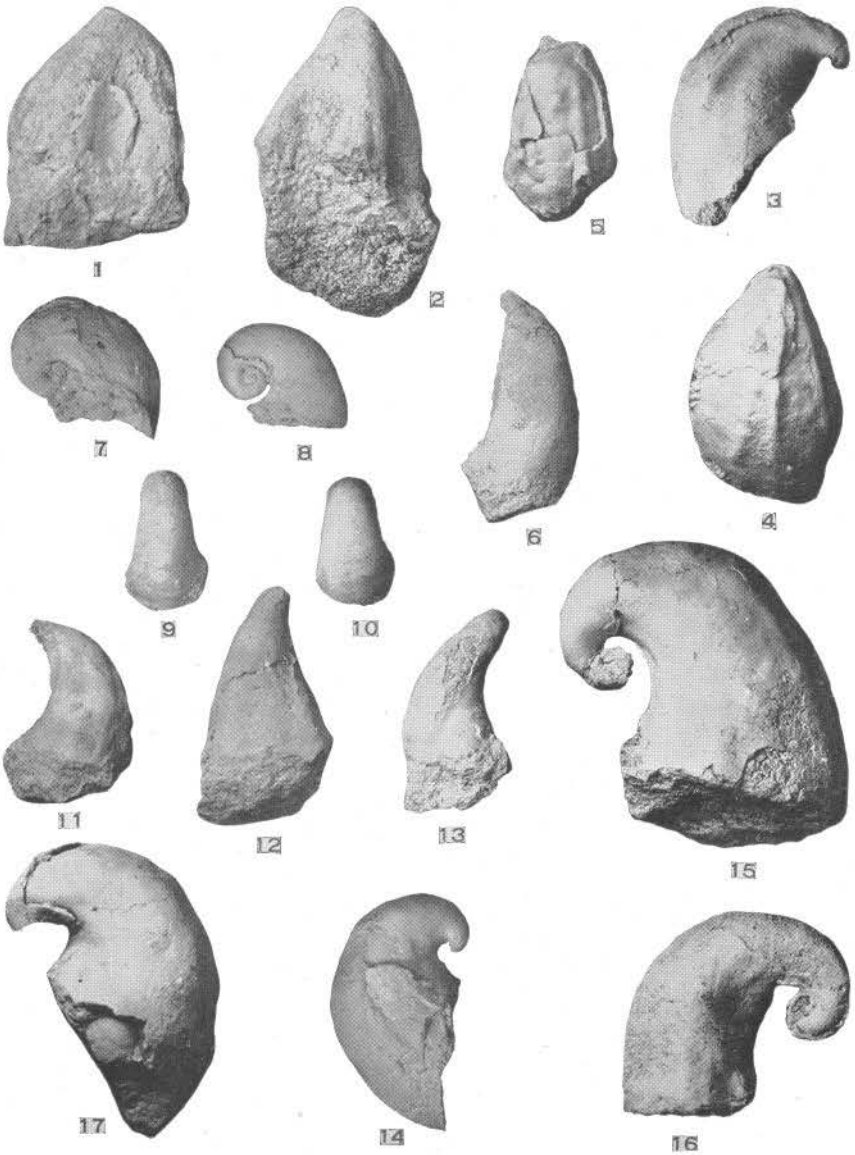
Figs. 7, 8. Spiral views of two small individuals.
Figs. 9, 10. Lateral views of the same specimens.

Platyceras cf. gracile Ohern
Page 257.

Figs. 11-13. Lateral views of three individuals.

Platyceras magnificum Hall
Page 257.

Figs. 14-15. Spiral views of two normal specimens.
Fig. 16. Spiral view of a less ventricose specimen.
Fig. 17. Spiral view of a specimen with the apex of the shell incomplete.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16

PLATE NO. 69

PLATE 69.

Platyceras cf. multisinuatum Hall
Page 257.

Fig. 1. Spiral view of an incomplete specimen.

Platyceras cf. newberryi Hall
Page 258.

Fig. 2. Lateral view showing character of the surface markings.

Platyceras nodosum Conrad
Page 258.

Fig. 3. Lateral view of a small individual showing nodes.
Figs. 4, 5. Spiral and lateral views of a mature specimen.
Fig. 6. Umbilical view of an incomplete specimen.

Platyceras reflexum Hall
Page 259.

Figs. 7-9. Spiral views of three specimens showing variation in size.

Platyceras retrorsum Hall
Page 260.

Fig. 10. Spiral view of a nearly complete specimen.

Platyceras cf. subconicum Ohern
Page 260.

Fig. 11. Lateral view of an incomplete specimen.

Platyceras trilobatum Hall
Page 260.

Fig. 12. Spiral view of a specimen incomplete in the apical part.

Platyceras peregrinus sp. nov.
Page 259.

Figs. 13, 14. Spiral and lateral views of an incomplete specimen, showing the much compressed form.

Platyceras depressum sp. nov.
Page 255.

Figs. 15, 16. Spiral and lateral views showing the compressed and subangular outline of the shell.

Hyolithes cf. oxys Clarke
Page 261.

Fig. 17. View of the convex face of an incomplete specimen.

Tentaculites elongatus Hall
Page 262.

Fig. 18. Lateral view of the internal cast of a specimen. Natural size.

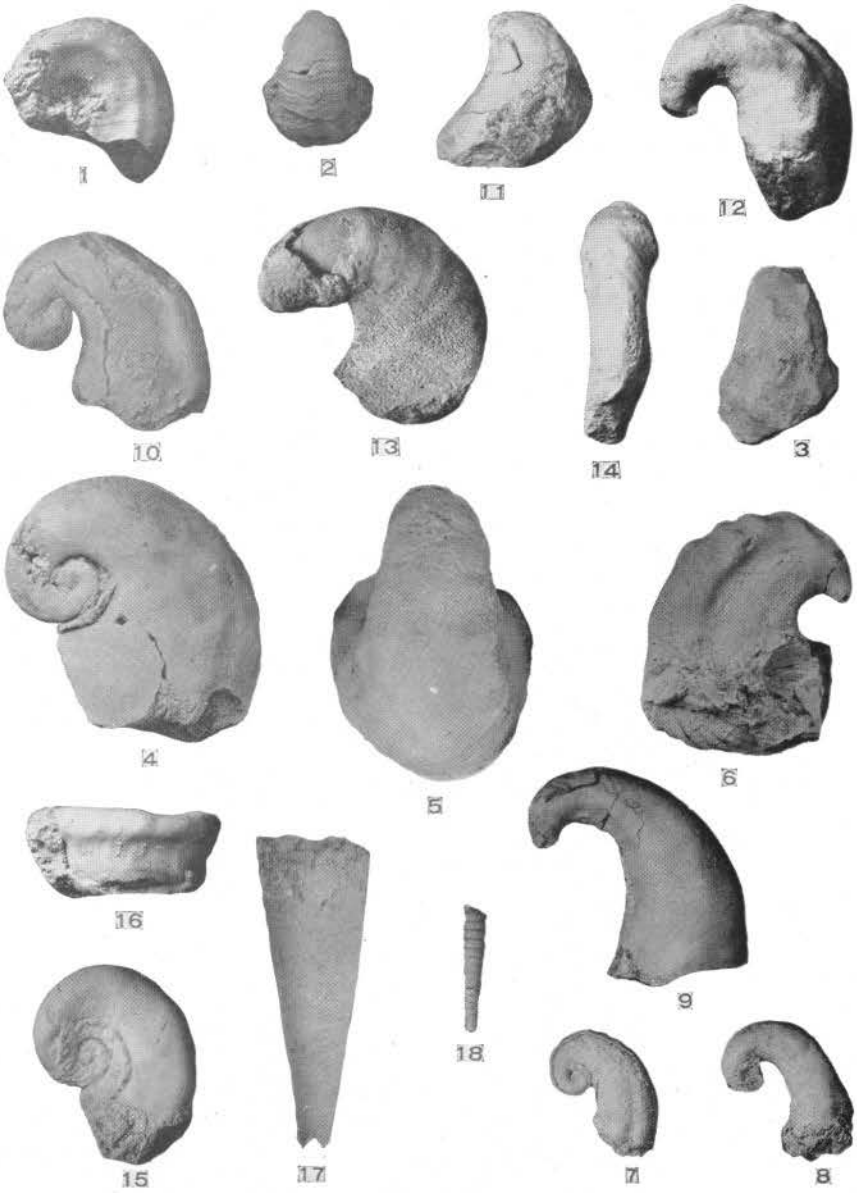
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PLATE NO. 70

PLATE 70.

Platyceras planovolvis sp. nov.
Page 259.

Figs. 1-3. Spiral views three specimens showing variation in size.
Fig. 4. Umbilical view of a sinistrally coiled specimen.
Fig. 5. Umbilical view of a larger, dextrally coiled specimen.

Diaphorostoma ventricosum (Conrad)
Page 261.

Fig. 6. Lateral view of small specimen.
Figs. 7, 8. Lateral and spiral views of a large specimen.

Strophostylus allani sp. nov.
Page 253.

Figs. 9-15. Spiral views of two small specimens.
Figs. 11, 12. Lateral views of the same specimens.
Figs. 13, 14. Lateral and spiral views of a large specimen.
Fig. 15. Lateral view of a smaller specimen.

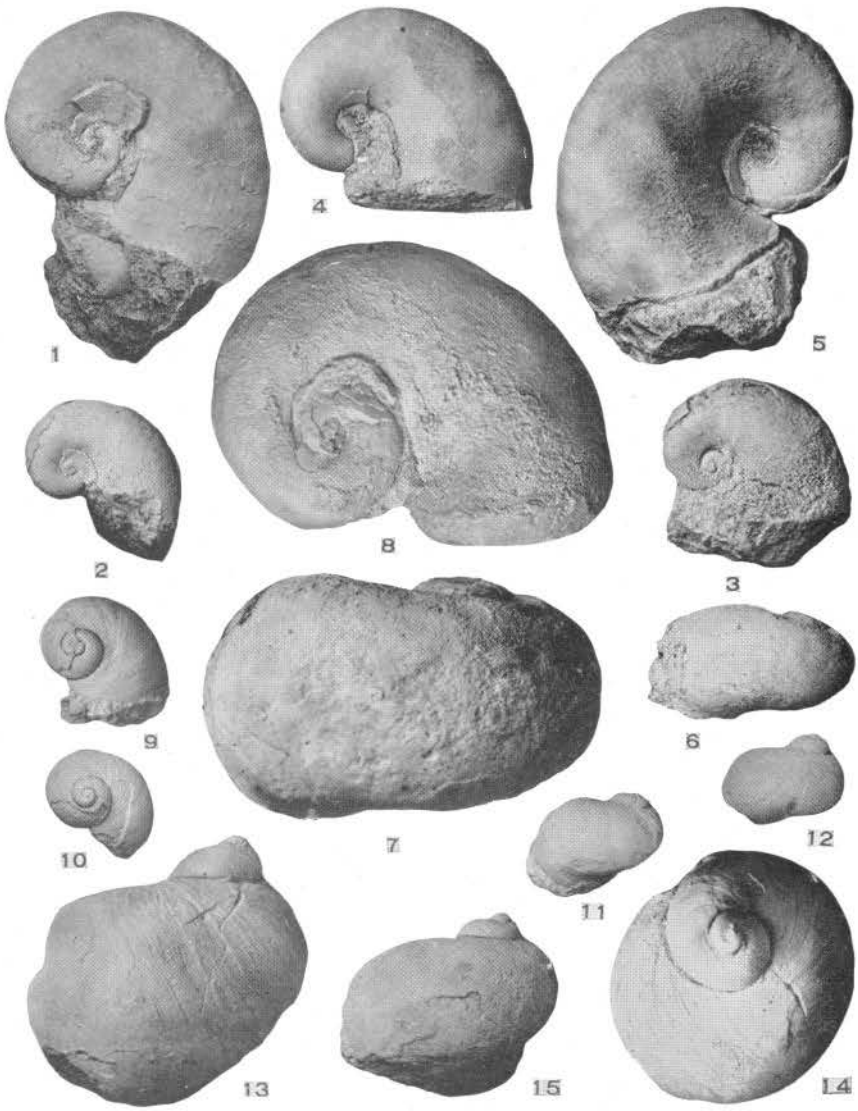
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PLATE NO. 71

PLATE 71.

Acidaspis sp. undet.

Page 262.

Fig. 1. View of an incomplete cephalon.

Proetus conradi Hall

Page 263.

Fig. 2. View showing the glabella and the marginal border.

Proetus cf. pachydermatus Barrett

Page 263.

Fig. 3. View of an incomplete cephalon.

Proetus protuberans Hall

Page 263.

Figs. 4-6. Three pygidia of different sizes.

Fig. 7. View of a glabella with portions of the cheeks.

Lichas sp.

Page 264.

Figs. 8, 9. Two fragments of the test of a large lichad.

Dalmanites cf. aspinosus Weller

Page 265.

Figs. 10, 11. Two incomplete pygidia.

Dalmanites cf. bisignatus Clarke

Page 265.

Fig. 12. View of an incomplete pygidium.

Ceratolichas gryps Hall

Page 264.

Figs. 13, 14. Front and dorsal views of a nearly complete cranidium from the Grand Tower limestone of Illinois.

Fig. 15. Glabella of larger specimen from the Little Saline limestone.

Dalmanites cf. pleuroptyx (Green)

Page 266.

Fig. 16. View of an incomplete pygidium.

Dalmanites cf. stemmatus var. convergens Clarke

Page 267.

Fig. 17. View of a nearly complete pygidium.

Dalmanites sp.

Page 267.

Fig. 18. Anterior margin of the cephalon.

Dalmanites praenuntia sp. nov.

Page 267.

Fig. 19. View of pygidium showing the slightly bilobed posterior margin.

Dalmanites slocomi sp. nov.

Page 266.

Fig. 20. View of a nearly complete pygidium.

Cryphaeus sp.

Page 268.

Fig. 21. View of a nearly complete pygidium with the spines broken off.

Dalmanites micrurus? (Green)

Page 266.

Fig. 22. Incomplete cephalon showing the tuberculate surface.

Phacops cristata Hall

Page 268.

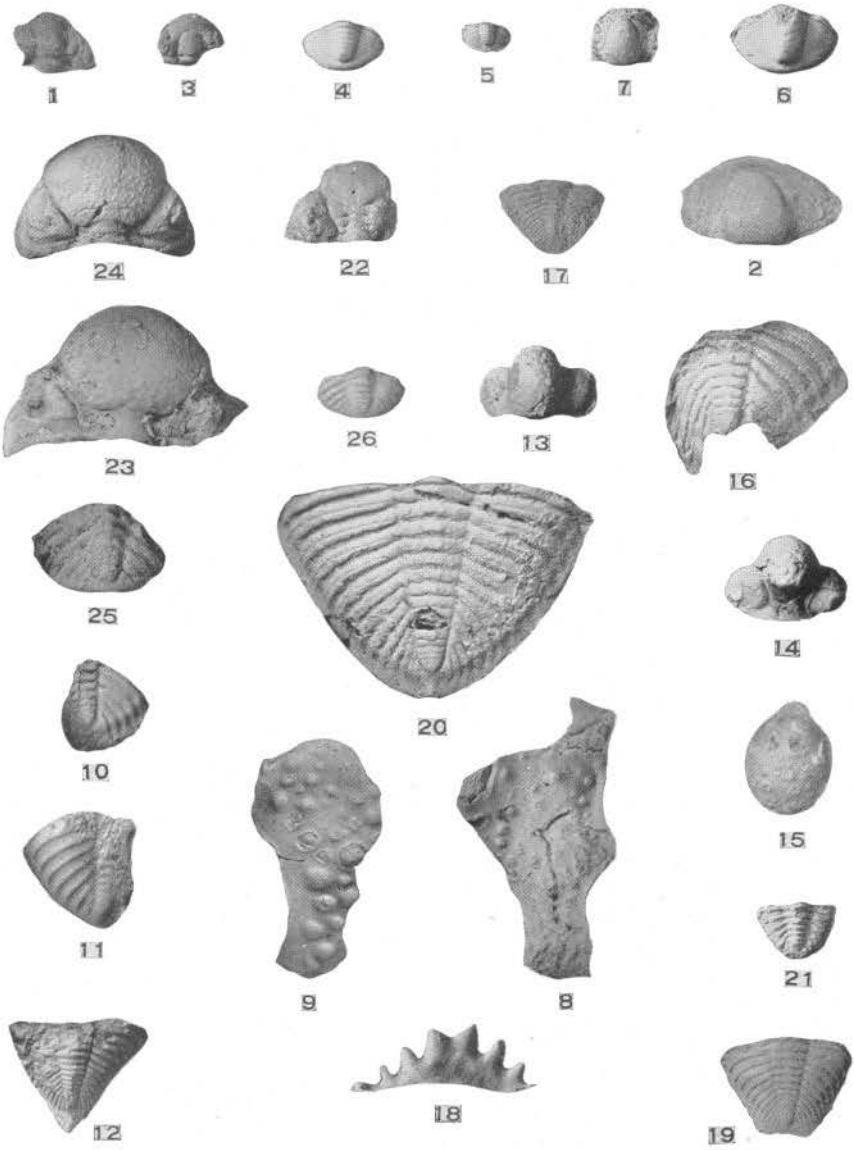
Fig. 23. Dorsal view of a large cephalon.

Figs. 24, 25. Dorsal view of a cephalon and an incomplete pygidium.

Phacops sp.

Page 269.

Fig. 26. A nearly complete pygidium.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2
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26
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16
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11
9
8
21
12
18
19

INDEX

D

G

M

N

T

U

V

W

Z