MISSOURI BUREAU OF GEOLOGY AND MINES.
E. R. BUCKLEY, Ph. D., Director and State Geologist.

Vol. VIII, 2nd Series.

THE

Geology of Pike County

BY

R. R. ROWLEY.

THE HUGH STEPHENS PRINTING COMPANY,
JEFFERSON CITY, MO.

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BUREAU OF GEOLOGY OF MINES,
ROLLA, December 15, 1907.

To the President, Governor Joseph W. Folk, and the Members of the Board of Managers of the Bureau of Geology and Mines:

Gentlemen—It is my pleasure to transmit to you a report on "The Geology of Pike County," by Mr. R. R. Rowley. The report is Volume VIII, 2nd Series, and it is the fourth county geological report issued during the present administration of the Bureau.

Mr. Rowley has studied the Paleontology of this county for many years, whenever his duties as superintendent of the High school of Louisiana would permit. Several years ago, under the direction of the Bureau, he made an incomplete geological map of the county. During the past summer and fall he has completed this map and written the accompanying report.

The descriptions of fossils are the most complete of any that have yet been published for the formations occurring in this county. The horizons in which certain groups of fossils occur have been clearly established, although forms which were at one time believed to be restricted to a certain limited zone have been found to have a much wider vertical range.

The geological section for the county has been clearly established and the formations have been named and classified in a systematic manner.

The geological structure and physiography occupy subordinate places, but the Paleontological data herein contributed are of sufficient value to fully justify the publication of the volume. I am, very respectfully,

Your obedient Sir,
E. R. BUCKLEY,
Director and State Geologist.

ACKNOWLEDGMENTS.

To Mr. E. A. Dodge of Louisiana our thanks are due for the execution of two plates of drawings in the paleontological part of this report, also for photographs illustrating the geological formations.

To Mr. A. T. Hudelson as well as W. J. Howden for the use of river views, we wish to make acknowledgments.

INTRODUCTION.

There are very few counties in Missouri better situated for a study of strategraphic geology than Pike. The streams have cut channels through the so-called "Trenton backbone," exposing a continuous succession of formations, from the Trenton to the Des Moines. The strata consist of limestone, shale and sandstone alternating with one another several times. Shale, limestone and sandstone grade into each other both horizontally and vertically, exhibiting many of varying conditions of sedimentation, present in the ocean.

The ocean in which these sediments were laid down must have been, at times, teeming with life, as evidenced by the multitude of fossils with which some of the formations are crowded. The Louisiana limestone and the Hannibal formation are typically developed in this county and it is especially appropriate that there should be recorded in this volume a complete description of the fauna of these most interesting limestone and shale horizons. The author of this report has for years been making a careful study of the fossils occurring in these, as well as the other, formations of Pike county and it is believed that this contribution to the Paleontology of Missouri will be of very great scientific importance.

The streams, hills, valleys and prairies furnish a most interesting study in erosion. The Mississippi river with its broad expanse of water, sand bars, islands and shifting channel, if fully discussed, would require a chapter alone. The tributary streams have had histories which are equally as interesting as that of the great "father of waters." Over much of the eastern part of the county they are at base level, and instead of cuttng their channels deeper they are now engaged chiefly in carrying the loads of material handed them by their tributaries which finger out over the prairie to the west and the dividing ridges between.

The western part of the county is supposed to have been, during the Pleistocene, covered with the Glaciers. Mr. J. E. Todd, in

Vol. X, of the reports of this Bureau, has outlined the drift and described that which he observed in some parts of Pike county. The author of the present report does not agree with Mr. Todd, expressing it as his opinion that the erratics found in the valleys and along the streams were probably brought to their present position, by later agencies, from the drift sheet farther north. The absence of scratched and groved surfaces appeals to Professor Rowley as being rather conclusive evidence that the glacial ice sheet did not reach Pike county.

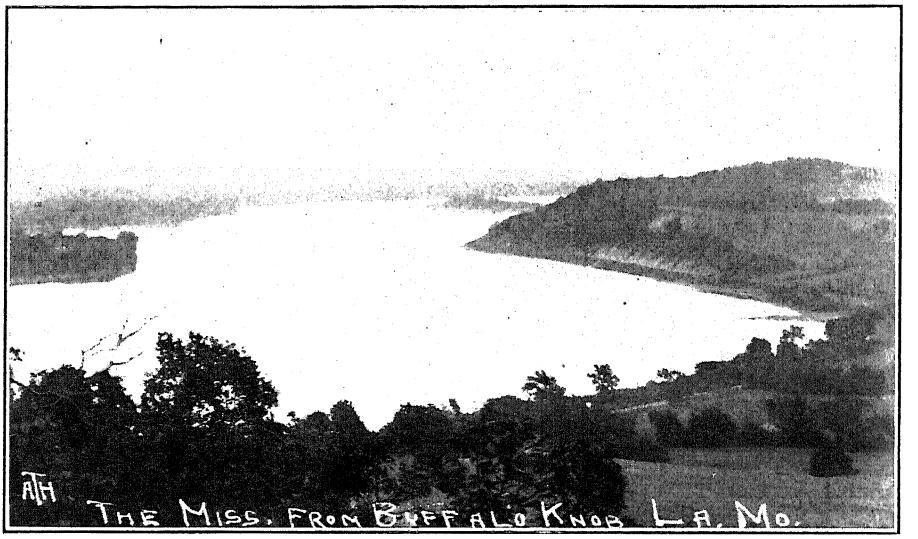
Although I have never given this area careful study, myself, I am inclined to agree with Mr. Todd in his conclusions relative to the extension of the ice sheet over the western part of Pike county. It is scarcely probable that the wide distribution of foreign boulders over that part of the county, especially along the stream channels, can be accounted for in any other way than through the former presence of an ice sheet. There is opportunity for additional study along this line.

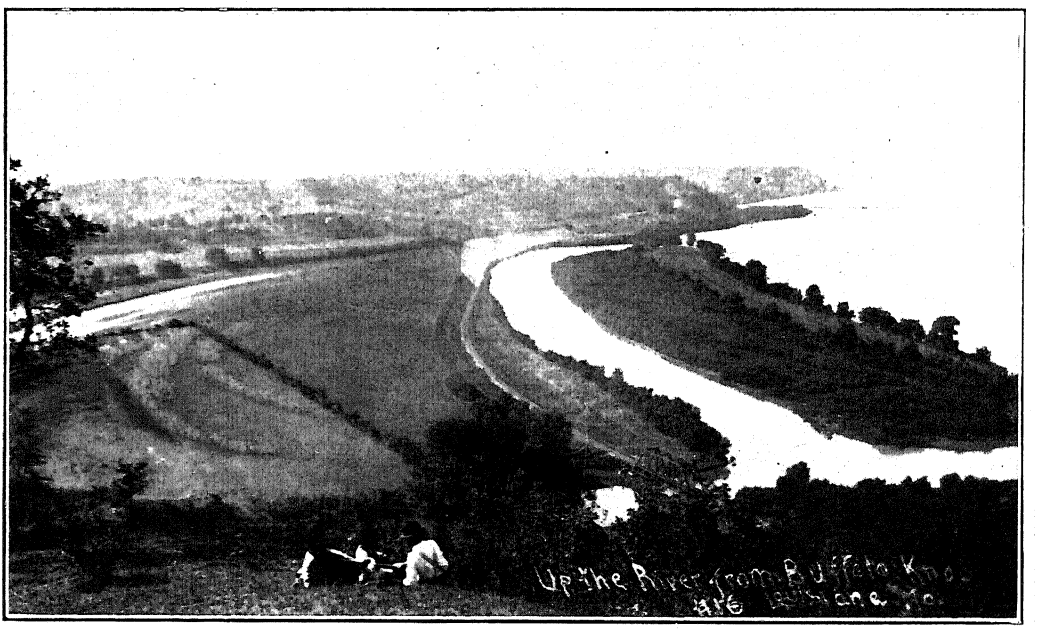
The structural features of the geology of the county have not been dwelt upon or discussed in any detail in this volume. The jointing, faulting and flexuring have been given the merest reference. These structures, however, have no special economic value and the omission of a full discussion of them may find some excuse in this fact.

The agricultural resources of this county are well understood by everyone and need not be dwelt upon in this report. The supply of water for every use is inexhaustible and of the finest quality. Mineral springs abound in some parts of the county providing opportunities for hotels and homes for invalids.

Although this county may never become a producer of coal, iron, lead or zinc, it has an almost inconceivable wealth of material for the development of manufacturing industries, in the deposits of limestone and shale. These are the materials from which most of the building materials of the future are to be manufactured. Clay products (brick, terra cotta and fire proofing), Portland cement and quicklime are the products which should be manufactured in Pike county. These are the products, through the manufacture of which the wealth of the county may be vastly increased. Combined with the agricultural resources, they will be the main source of the future wealth of the county.

E. R. BUCKLEY.





VIEWS OF THE MISSISSIPPI RIVER FROM BLUFFS OF PIKE COUNTY.

CHAPTER I.

PHYSIOGRAPHY.

LOCATION.

Pike county is located in the eastern part of Missouri, bordering on the Mississippi river, about fifty miles north of the middle of the eastern boundary of the State. It is bounded on the north by Ralls county and the Mississippi river, on the east by the Mississippi river, on the south by Lincoln and Montgomery counties and on the west by Ralls and Audrain counties.

DRAINAGE.

The county has an area of 620 square miles and has its greatest extent in an eastern and western direction, but with a diagonal river front of about forty miles. It is, essentially, a region of hills, streams, valleys and alluvial plains in the eastern part and more or less level prairie plateau in the western part.

The distance from the Mississippi river to the prairie edge varies from nine to twelve miles and embraces almost one half of the county. The plateau area in the southwestern and northern parts of the county is invaded by Cuivre and Salt rivers and their tributaries. The eastern hilly portion of the county is drained by the Mississippi river and its tributaries, Guinn's, Ramsay, Calumet, Buffalo and Noix creeks and Salt river and its tributaries, Grassy, Sugar, Haw, Peno and Spencer creeks. The southwestern and south central portions are drained chiefly by Cuivre river and its tributaries, Sulphur and Indian creeks.

ALLUVIAL PLAINS.

The Alluvial plains embrace the flood plain of the Mississippi river which varies in width from a few yards at Louisiana to about four miles at the southern boundary of the county; the short, nar-

row valleys of the tributary creeks; and the broad valley of Salt river and its tributaries. These valleys are covered with a deep rich soil of unsurpassed fertility.

At flood, the back water from the Mississippi and Salt rivers rarely covers the creek bottoms beyond a mile from their mouths.

THE HILLY REGION.

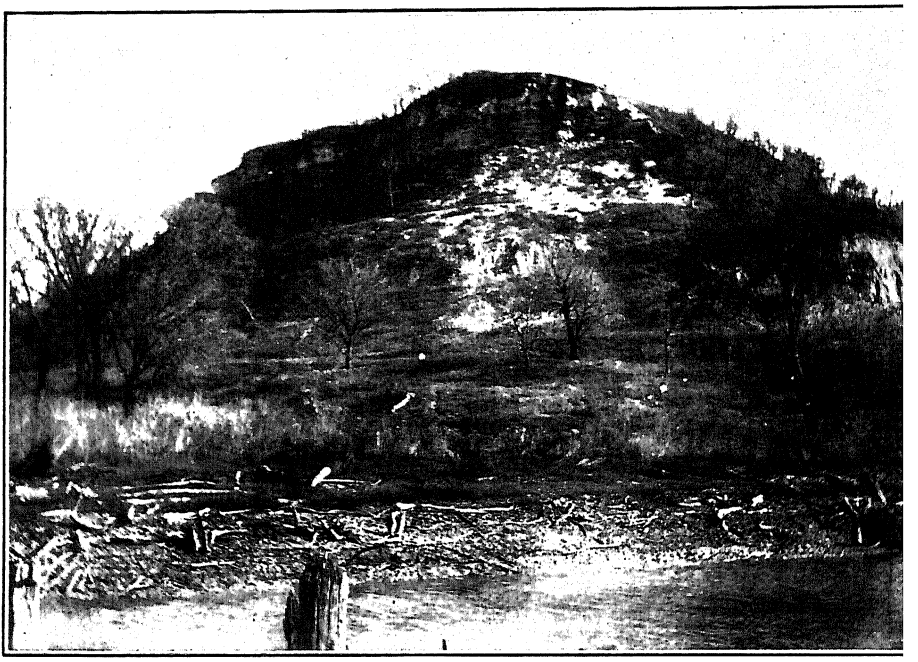
From the mouth of Salt river to Clarksville, and from Love's Station on the Burlington railroad to the northern boundary of the county, the Mississippi river flows along the western border of its flood plain. The highest hills in the county front the Mississippi, towering, in some cases, 250 feet above low water mark. From the tops of numbers of these hills magnificent views may be had of the surrounding country, especially of the alluvial plain lying between the Mississippi river and the bluffs on the Illinois side, five or six miles away, and marking the eastern edge of the flood plain of the great Mississippi river. Perhaps the most majestic of these hills are "the Pinnacle" at Clarksville, "Salt Peter Bluff" at Annada, "Buffalo Hill" at the mouth of Buffalo creek, "Matson Hill" at the mouth of Salt river, and "Marble Head" near Louisiana.

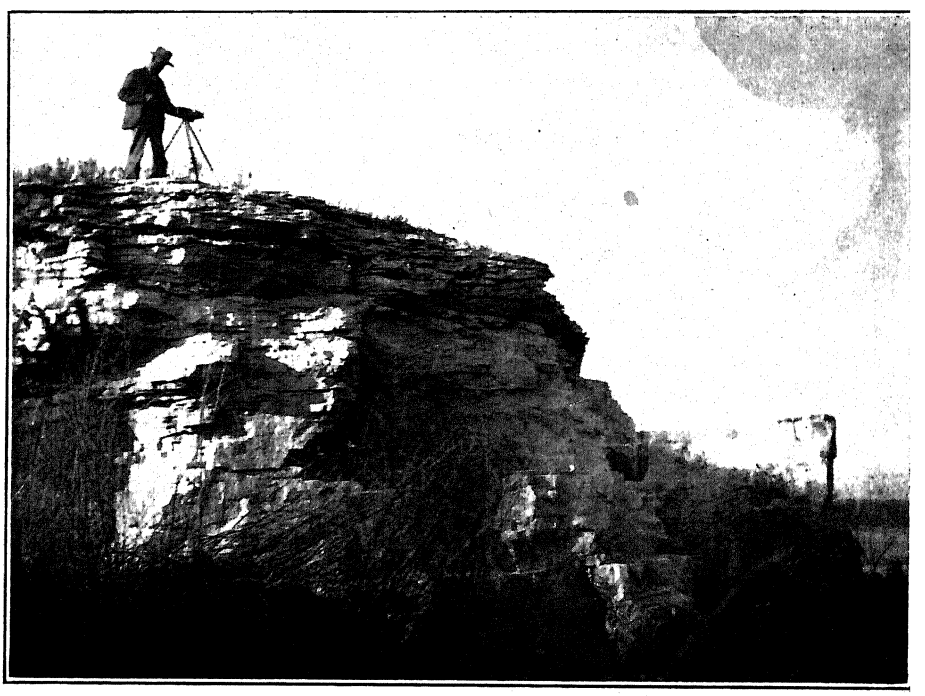
Back from the river, less than a mile, opposite the mouth of Salt river is the finest view of all, as standing on the gravel road on the backbone of "Dug Hill" one looks down a deep glen, across both Salt river and the Mississippi, six or more miles into the state of Illinois.

The hills on the north bank of Salt river are close to the river's edge, most of the flood plain being on the south side.

The best view of the Salt river bottom is had from the Louisiana and Frankford gravel road as it winds around "Arthur's Bend," about ten miles from Louisiana. Lines of high hills, having a general southwestward trend separate the different creek valleys. These hills decrease in height as the eastern edge of the prairie plateau area is approached. About ten miles southwest of Clarksville is the well known "Buffalo Knob." This hill is of moderate elevation but it constitutes a well known land mark, since it can be seen from long distances in almost every direction.

Where the streams impinge against the hills, steep, often perpendicular cliffs have formed even in the shale, as along the lower courses of Calumet, Noix and Grassy creeks, where the Hudson river shale is so excellently exposed.





BURLINGTON LIMESTONE.

Along the upper course of Buffalo and Peno creeks and along Salt river there are fine perpendicular exposures of Trenton limestone, while along upper Grassy creek, thirty to sixty foot exposures of Devonian shale are not uncommon.

Some of the finest exposures of Trenton limestone in the state occur along the Burlington railroad a mile or two west of the Mississippi river, between Elsberry and Foley in Lincoln county. The Trenton here constitutes a part of the anticline ridge that traverses Pike county.

The range of hills that separates the waters of Noix creek and its tributaries from Grassy creek and its tributaries is the most complex in the county. This range gives off numerous spurs and continues with almost no interruption from the Mississippi river north of Louisiana to McCune Station on the St. Louis and Hannibal railroad.

The range of hills separating the valley of Grassy creek from Salt river and its tributaries is much less imposing, though almost equally as rugged. The highest continuous range of hills, trending southwestward from the Mississippi river is that which lies between Noix creek and Little Buffalo creek. This range is less complex than the Grassy creek range, being an irregular finger like projection extending northwestward from the prairie region.

The highest point in the county is about two miles east of Curryville, on the divide near the headwaters of Peno, Spencer and Cuivre creeks.

The high hills and accompanying deep valleys with the broader flood plans of the rivers and larger creeks are excellent illustrations of land sculpture in a region having horizontally bedded sedimentary rocks of varying degrees of hardness and solubility.

THE PRAIRIE REGION.

Bowling Green, the county seat of Pike county, is located on the eastern edge of the table-land. From this point westward along the Chicago & Alton R. R. to the western boundary line of the county, a distance of thirteen and a half miles, the high prairie land is continuous.

Southeastward from Bowling Green, along the St. Louis and Hannibal railroad, the prairie land is also continuous almost to the Lincoln county line, fifteen or more miles.

Salt river with its tribuatries Peno, Spencer, Sugar and Haw creeks, has carved the northern and northwestern parts of the

county into low broad hills and shallow rocky valleys. Peno and Sugar creeks have cut into the Trenton anticlinal ridge.

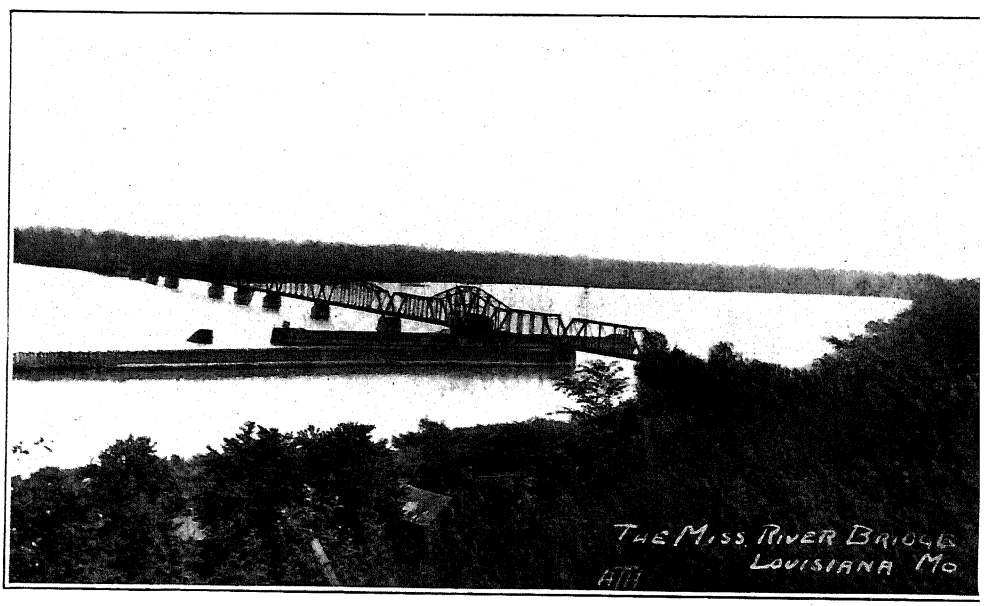
For miles along these streams, low exposures of Trenton limestone are continuous, excellent quarries of the stone having been opened near the town of Frankford. Two miles north of Curryville, the bed rock of Spencer creek is Upper Burlington limestone, while two or three miles northwest, down the stream, bluffs of Chouteau limestone appear. A mile or two further down, Hannibal shale is exposed. At Elk Lick the Hudson river beds appear and for much of the remainder of its journey through Ralls county the stream flows over the Trenton limestone.

Spencer creek from its source to its mouth, cuts through and exposes Burlington limestone, Chouteau limestone, Hannibal shale, Louisiana limestone (beds near Elk Lick but a few feet thick), Hamilton shale, Niagara limestone, Hudson River shale and Trenton limestone. Formations belonging to the Mississippian, Devonian, Silurian and Ordovician are exposed along its course of from fifteen to twenty miles, a section seldom found in such a short distance, in this state. The bluffs of Burlington and Chouteau limestone along this creek are among the highest in the county, frequently presenting vertical cliffs fifty or more feet in height. The bed of the stream is strewn with large oval to flat shaped boulders of chert.

In the limestone in the neighborhood of Spencerburg, along Spencer creek, are a number of caves, some of which have been explored for a distance of several hundred yards. from the mouth of one a strong spring of pure cold water rushes and falls several feet over the edge of the limestone below. One of the largest of these caves is just outside of the town and is said to have been the lair of panthers some decades ago.

In two or more of the caves there were, about twenty years ago, smooth, somewhat slick surfaced depressions in the floor clay, known as bear-wallows by the older residents. These were, doubtless, correctly named.

The streams that drain the southwestern part of the county have not cut deeply into the table-land and have scarcely carved elevations that could be dignified by the name of hills. The surface elevations do not compare with those of the eastern part of the county and the bluffs are not nearly so high as those along Spencer creek in the northwestern part of the county. Like Spencer creek, to the north, the creeks in the southern part of the county



SCENES ON THE MISSISSIPPI RIVER NEAR LOUISIANA.

cut through a series of geological formations. This is especially characteristic of Sulphur creek which, rising in a Chouteau limestone region south of Bowling Green, leaves the county over a bedrock of Trenton limestone, passing over all the intervening formations in the course of its journey in the county.

However, the streams in the southwestern part are different. They, as a rule, have their course in areas of Keokuk limestone and flow out of the county over areas of Burlington limestone.

This is absolutely true of Indian creek and probably so of the west fork of Cuivre river. The east fork of Cuivre river rises in Chouteau limestone, two miles southeast of Curryville and, as all of its lower course is in Burlington limestone, it is evident some movement of the earth's crust has either elevated the Chouteau or depressed the Burlington and Keokuk, movements that may have accompanied the faulting a few miles southwest of Ashley, to be further mentioned in a subsequent chapter of this report.

THE RIVER SYSTEMS.

The Mississippi river, flowing in a southeasterly direction, forms the eastern boundary of the county, a distance of about forty miles. This river with its tributaries drains the entire county. Its alluvial bottom in this county, as we have stated above, varies from a strip of land a few yards in width at Louisiana to about 3½ or 4 miles at the southern boundary. At Love's Station above the mouth of Salt river to the Ralls county line, the bottom land is only a few yards wide. Altogether the Mississippi river bottom land in this county, omitting the alluvial plains at the mouths of the larger creeks and Salt river, probably does not exceed an area of forty square miles.

The principal streams tributary to the Mississippi river, and flowing entirely or in part within this county, are as follows: Bryant's creek, Guinn's creek, Ramsay creek, Calumet creek, Little Calumet creek, Buffalo creek, Noix creek, Salt river and Cuivre river. Grassy, Sugar, Haw, Peno and Spencer creeks, tributaries of Salt river, and Indian and Sulphur creeks, tributaries of Cuivre river are sufficiently important, as a result of their location or size, to command our attention.

Bryant's creek, rises in Lincoln county, flows northeast into Pike, then east and southeast and re-enters Lincoln county, draining but three square miles in Secs. 32, 33, 34, T. 52, R. 2E.

Guinn's creek rises a mile or two southeast of Eolia and flows

in a general, but rather tortuous, northeastern direction and empties into the Mississippi river. The valley on the north side of this stream is nearly a mile wide.

Big Ramsay creek with its tributary *Little Ramsay*, drains a considerable territory between Eolia and the Chicago, Burlington and Quincy R. R., flowing about ten miles in a general easterly direction, then north about four miles and finally southeast three miles emptying into the Mississippi. Its course like that of Guinn's creek is rather tortuous. Its valley is rather wide.

Calumet creek rises in the northwest corner of T. 52, R. 1W., and flows in a relatively straight northeast course, emptying into the Mississippi, just north of Clarksville. This stream drains a wide, fertile valley.

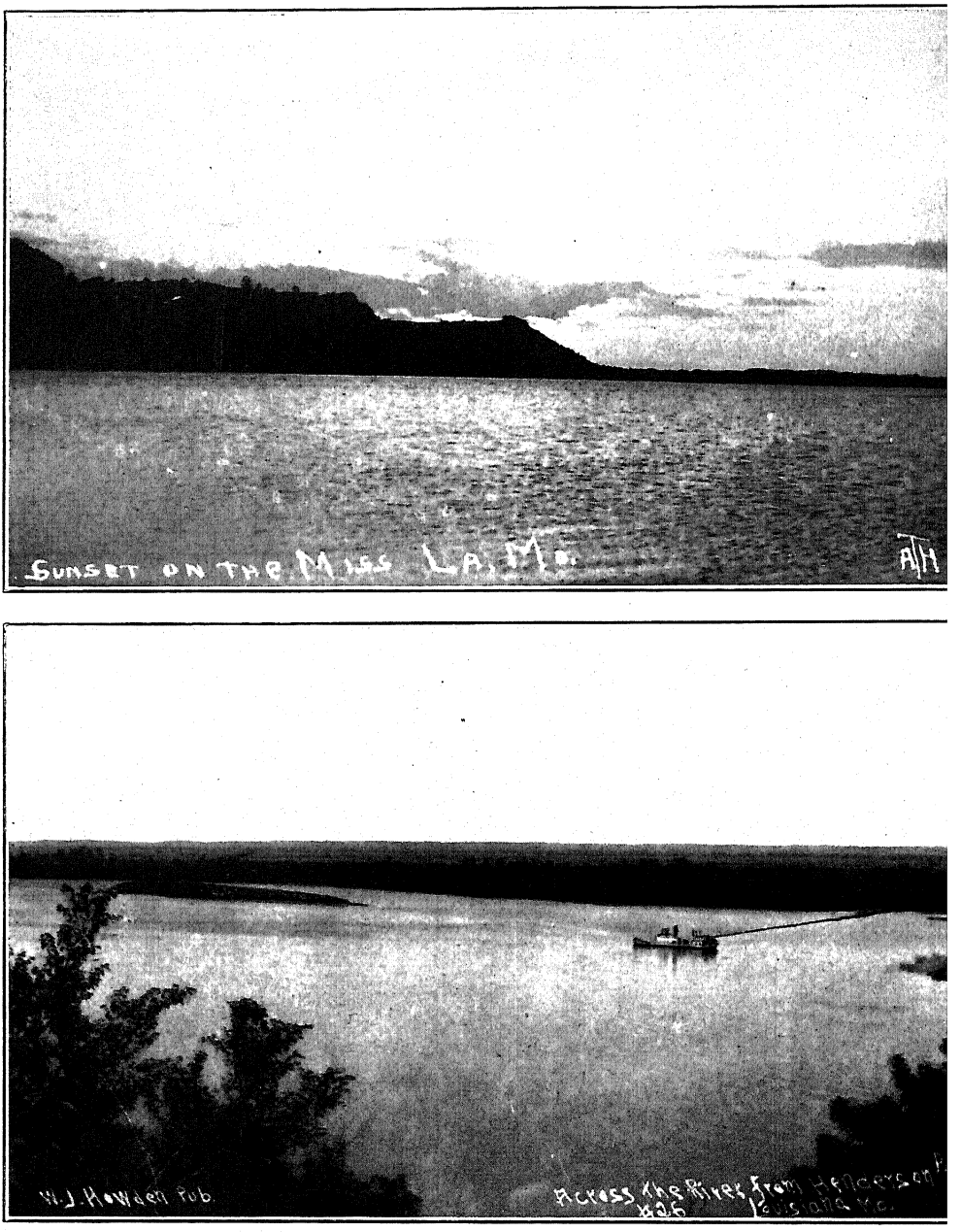
Little Calumet creek rises in Sec. 20, T. 53N., R. 1W., flows in a northeasterly direction emptying into the Mississippi river near the Fifth Principal Meridian. This stream drains an area of about eight square miles.

Buffalo creek with its numerous tributary streams drains an extensive area between the St. Louis and Hannibal railroad and the Mississippi river. The main stream is formed by several forks rising near Cyrene and Edgewood. It flows in a general direction a little east of north, emptying into the Mississippi, two miles below Louisiana. The tributary, known as Little Buffalo, rises in Sec. 21, T. 53N., R. 2W., flows in a general northeasterly direction and empties into Buffalo creek in Sec. 6, T. 53N., R. 1W. Big Buffalo creek derives its name from the fact that in the early settlement of the country, herds of Buffalo came to lick the salty soil formed by the salt springs along its lower course.

Noix creek rises near Bowling Green, flows in a general northeasterly direction and empties into the Mississippi river just south of Louisiana. This stream drains a broad fertile valley through which runs the Chicago and Alton railroad.

Grassy creek, with its tributaries, Cane creek, Dry Fork, South Fork and North Fork, drains a rather broad area but the stream itself is much shorter than either Noix or Buffalo creeks. It is made up of several forks, of nearly equal importance, which finger out over an area of considerable breadth. In general the stream flows a little north of east emptying into Salt river about a mile from the confluence of that stream with the Mississippi.

The bluffs and steep exposures of all the above described creeks follow the south side of the streams, especially along their



SCENES ON THE MISSISSIPPI RIVER NEAR LOUISIANA.

lower courses, the broad plains and gently sloping hills being to the north.

In the upper course where the branches are smaller and the slope greater there are some exceptions to this rule more especially along upper Buffalo.

Salt river flows in a sinuous course across the northwest corner of the county, being perhaps, twenty miles in length. With its tributaries, Spencer, Peno, Haw, Sugar and Grassy creeks and Tanyard Branch, it drains nearly 200 square miles in Pike county. It is the largest stream flowing through the county and the valley which it occupies is a broad alluvial plain of great fertility. This stream unlike the creeks before mentioned has its bordering hills and bluffs towards its mouth, on the north side.

Sugar creek is about six miles long and flows in a northeasterly direction emptying into Salt river after crossing the broad Salt river valley. Much of the lower course of Sugar creek is through a low plain. It drains an area of about twelve square miles.

Haw creek is a stream about five or six miles in length. It has a somewhat direct northeasterly course to the Salt river valley, whence it has an almost easterly course through the alluvial plain to Salt river. This stream drains an area of eight or nine square miles.

Peno creek is the longest stream wholly within the county. It rises near the Chicago & Alton R. R., about half way between Bowling Green and Curryville, flows in a northwesterly, northerly and northeasterly direction emptying into Salt river about two miles from where that stream enters the county. It has a number of small tributaries and together they drain an area of about seventy-two square miles.

Spencer creek rises on the east edge of the town of Curryville, flows north as a prairie slough, receiving a tributary from the east, then flows northwest as a small creek, receiving other and larger branches, until, finally, west of Spencerburg, it turns north and leaves the county less than two miles north of Elk Lick Springs. After leaving the county it traverses a part of Ralls county, finally emptying into Salt river. High bluffs of Burlington and Chouteau limestone occur along this stream, much of the country being broken and often quite rough.

Indian creek rises about a mile west of Curryville and flows in a general southeasterly direction, emptying into Cuivre river near the point where the latter leaves the county. It receives a consid-

erable number of tributaries and drains an area of about seventy square miles in the southwestern part of the county.

Cuivre river, like Indian, Spencer and Peno creeks, rises near Curryville on what might be denominated the "Height of Land" of the county.

Like Indian creek, it flows in a general southeasterly direction and leaves the county between Secs. 24 and 25, T. 52N., R. 3W. After traversing Lincoln county, it empties into the Mississippi just east of Old Monroe. In Pike county it is a mere creek. With its tributaries, Lick, Indian and Sulphur creeks, Cuivre river drains from 180 to 190 square miles in Pike county.

Sulphur creek rises two or three miles south of Bowling Green and flows south through the western half of T. 52N., R. 2W. and enters Lincoln county, joining Cuivre river.

DIVIDES.

The most conspicuous and important divide in this county is the table-land followed by the Chicago and Alton railroad from the western boundary of the county to Bowling Green, and known as the Curryville divide. This forks at Bowling Green one branch extending in a northwest direction about 7 miles and the other, followed by the St. Louis and Hannibal railroad, from Bowling Green to the Lincoln county line south of Eolia. This three pronged divide separates the county into three fairly well defined drainage basins,—one being occupied by the northeastward flowing streams that empty into the Mississippi; the second by Salt river and its tributaries; and the third by Cuivre river and its tributaries.

The minor divides are the lines of hills separating the drainage basins of the streams in the eastern part of the county, and the ridges separating the drainage basins of the main streams, tributary to Salt and Cuivre rivers. The most important of these is the northwestern spur of the Curryville divide which separates the waters of Peno and Spencer creeks.

SINK HOLES.

Sinks occur in a number of places in this county, especially where the Burlington limestone is the surface rock. There was at one time a fine example of a deep inverted funnel-shaped sink on the side of the hill, just west of the "Negro School House" at

Louisiana. This was for a long time a place of interest, displaying beautifully the manner in which the water finds its way beneath the surface to join streams which wind through unknown, mysterious, underground caverns.

The sink was well down the Hannibal shale slope and above a fine outcrop of Louisiana limestone at the locality we have designated as the "Town Branch" bluff. The surface of the funnel was at one time grassy, but in a few years the outlet below was stopped up and it began to hold water and fill with debris from above. Now there is scarcely a vestige of it left. Probably this is the fate of many a sink hole.

CAVES.

While caves occur in a number of places in the county, the largest and most interestng are in the bluffs of Burlington and Chouteau limestone along Spencer creek, near Spencerburg, as mentioned in connection with the physical features of that stream. In the Burlington limestone of Matson Hill, facing the river, at the mouth of Salt river, is a high narrow, one chambered cave with a hole in the top. In Buffalo Bluff there is a small cavern, and in the Trenton limestone further up Buffalo creek there is a cavern known as "Shy Cave." Since the formation of caverns is due to underground streams it is proper in this connection to mention the springs with which Pike county is generously supplied.

SPRINGS.

This county is abundantly supplied with both "fresh water" and "mineral" springs. The fresh water springs receive their supply chiefly from the limestone formations, while the mineral springs derive their supply from waters which have found their way through some of the shale horizons which contain salts readily soluble in oxygenated waters.

Fresh Water Springs. At Louisiana three fine springs issue from cracks in the Clinton limestone (oolite) just above the Hudson river shale, supplying many of the inhabitants with pure, clear, cool water.

At the foot of "Clinton Hill" is the well known Clinton spring, lately supplied with a fine, concrete, self draining basin, through the generosity of Miss Anna Draper and in whose honor this is herein called the "Draper Spring."

The *"Allen Spring"* at the corner of Jackson and Ninth streets

is, perhaps, stronger than the last and flows through several openings in the bottom of the oolite over a six foot depth of Hudson river shale. The volume of this spring fluctuates with the rainfall. A heavy fall of rain results in the outpouring of a strong volume of muddy water, within a few minutes after the rain.

A few hours after being flushed by a heavy rainfall it returns to its normal flow. The spring is thought to be so situated as to be free from contamination. The water is considered perfectly healthful.

The *Kingston Spring* and a number of others, less strong, flow out over the Hudson river shale along the river front near the pump house.

The *Isgrig Spring,* a mile below Louisiana on the gravel road, is another of the Hudson shale springs, although it comes up from the level plain or more properly a long gentle slope. This spring has considerable historical interest, since it furnished the pioneer settlers of the county with their supply of water, inside of a fort or stockade built at that place.

The *"Hudson Spring"* on Tanyard Branch, two miles west of Louisiana, flows out over the Hamilton shale just under the Louisiana limestone and furnishes cool water for a dairy. There is a small cave at this place.

The *"Norvel Spring"* near the road crossing on Grassy creek is another of the Hudson shale springs. There are other excellent fresh water springs above Louisiana on the Mississippi, at Clarksville, and along Spencer, Peno, Sugar, Grassy, Noix, Buffalo, Calumet, Ramsey, Sulphur, Cuivre and Indian creeks.

Mineral Springs and Wells. Of the natural mineral springs, the best known are the sulpho-saline (sulphur-salt) as the Upper and Lower Buffalo Licks, Mud Lick, and Elk Lick springs.

Elk Lick springs is somewhat of a health resort where accommodations are offered at a quiet rural inn to those "run down" in health and wishing to recuperate.

Of the artificial mineral springs and wells the county boasts of a number, differing much among themselves in mineral constituents.

The water of *"Thespian Springs"* on the corner of Kentucky and Fifth streets, in the very heart of Louisiana wells up from the bottom of a boring over a thousand feet deep and is of the sulpho-saline variety.

Over this spring a good structure has been built with bath-

rooms and other excellent sanitarium equipments. It is under the management of Dr. J. W. Crewdson.

The "B. B. Springs" at Bowling Green are of the bitter variety and are said to possess great health giving properties. A good hotel and bath house are connected with these springs.

The "Kalinat," a bitter water spring, and the "Ionian Lithia" springs, one mile northeast of Bowling Green on the Louisiana and Bowling Green gravel road, are owned and controlled by I. R. Stevens who has in connection a soda-water manufactory.

CHAPTER II.

ORDOVICIAN.

The Ordovician (Lower Silurian) is represented in this county by from thirty to forty feet of Trenton limestone and about one hundred feet of Hudson River shale. The Trenton limestone is probably the equivalent of the Kimmswick which occurs in and south of St. Louis county. It is that portion of the Trenton which carries the well known "sunflower coral," Receptaculites. The Hudson river shale is probably the equivalent of the Thebes of the southeastern part of the state.

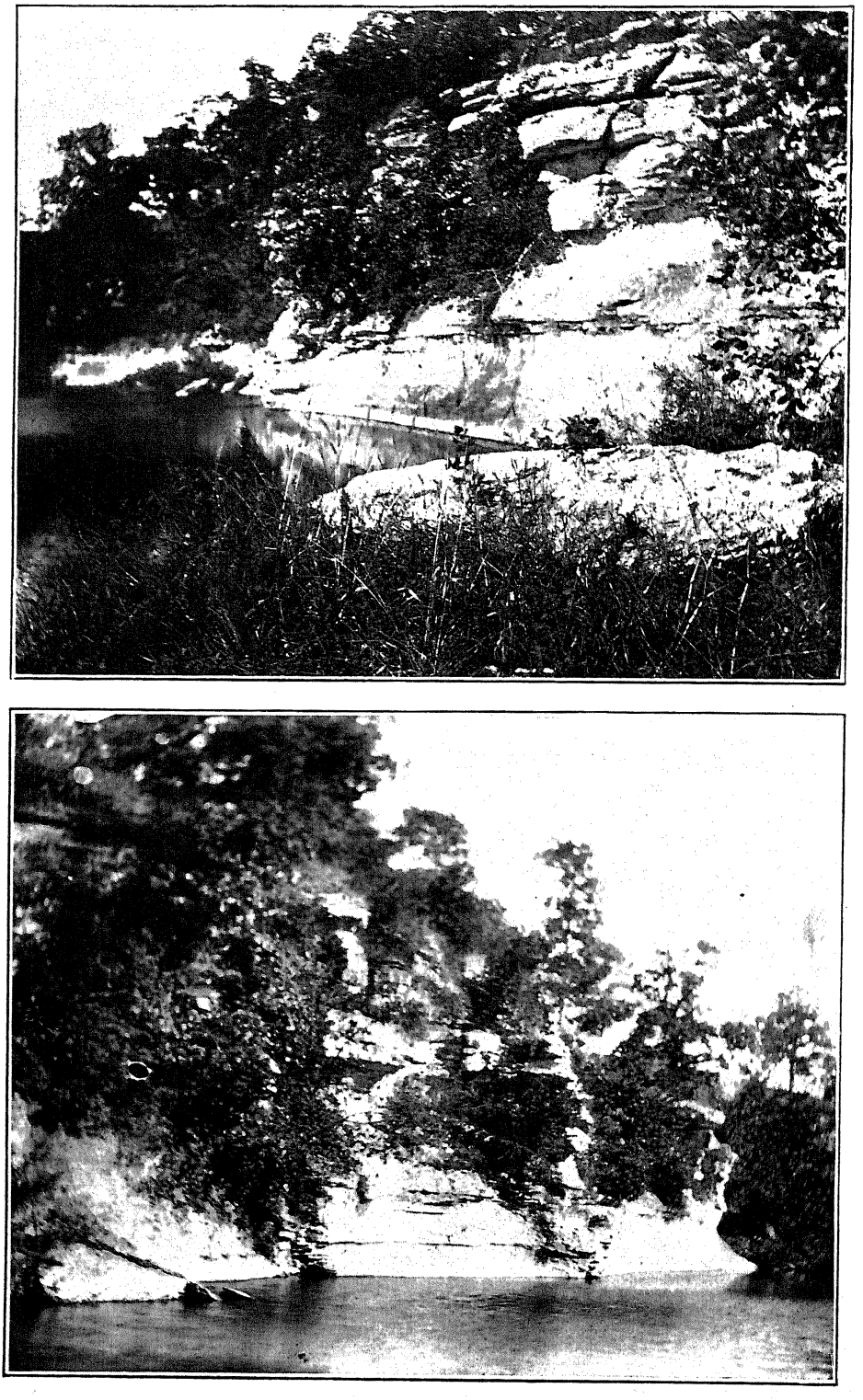
These formations are well exposed in the eastern part of the county along the streams tributary to the Mississippi river. They carry an abundant and characteristic fauna, as shown by the descriptions contained in the following pages.

TRENTON LIMESTONE FORMATION.

The lowest geological horizon in Pike county is the Trenton limestone, a formation exposed along many of the creek beds and forming bluffs from a few to thirty or forty feet in height. The stone varies in color from a creamy tint to a lead gray. It is a hard limestone but weathers readily and in a manner peculiar to itself.

Along the streams with Trenton exposures, flat fragments of this limestone perforated with large or small holes, are plentiful. These holes are presumably due to weathering by which the softer spots in the mass have been removed. Freshly quarried stone seems to show no evidence of these softer spots, however. The harder dove-colored rock usually shows small perforations while the cream colored or gray often has holes two or three inches in diameter. This stone can be readily indentified for some distance and with certainty from these peculiar markings without the aid of fossils.

Old bluffs, as along the Burlington railroad in Lincoln county and along Buffalo creek in Pike county, overhang their bases often



TRENTON LIMESTONE ALONG BUFFALO CREEK.

in an extravagant way as if the bottom layers were softer and yielded more radily to the weather than the mass above. In a bluff less than 25 feet in height the top may overhang the base sufficiently to protect wagons and farm machinery and is sometimes taken advantage of for that purpose. This weathering may take the form of coves or caves, as along Buffalo creek.

Along the smaller streams where frost and water have acted only upon the top layers, the weathering is in slabs or sheets diagonal to the bedding. I have noticed this same manner of sheeting in the Chouteau limestone.

The rock is apparently heavily bedded but the bedding planes are hardly noticeable except on the weathered surfaces. The bedding seldom shows in quarrying.

The stone has been used some for building and the great flag-like layers for walks and well tops. Its peculiar weathering, however, renders it less desirable than the Burlington limestone for these same purposes.

Despite the fact of its purity (98+% calcium carbonate) and the almost entire absence of chert, this stone, as I can learn, has not been used for lime in this county.

At Elsberry, Lincoln county, the Trenton limestone is being ground, barreled and shipped by a company who erected a plant there, several years ago. This plant appears to be doing a thriving business.

Perhaps the only quarries in the Trenton limestone in Pike county are at Frankford and, to the eye the fresh quarried stone presents an appearance equal to that of other limestones in the county.

The Pike county Trenton beds are of the age of the Galena division or the Receptaculites and underlying beds and would probably in part be classed with the Kimmswick of southeastern Missouri.

The top layer, a stratum of from four to twelve inches, is a veritable Cephalopod cemetery, Orthoceratites and other chambered shells crowding the beds. Moreover, this stratum is the hardest in the entire formation, and contains much iron pyrites. Exposures where the contact between the Hudson River shale and the Trenton limestone can be seen, are to be found a mile or more below Corinth Church in the bed of Calumet creek (T. 53, R. 1W., Sec. 24); on the farm of James Goodman near Dover Church, same Township, Sec. 32; on Buffalo creek in T. 53, R. 2W., Sec. 36; and

on a tributary of Sugar creek in T. 54, R. 3W., Sec. 10. At each of these places the topmost bed is well exhibited.

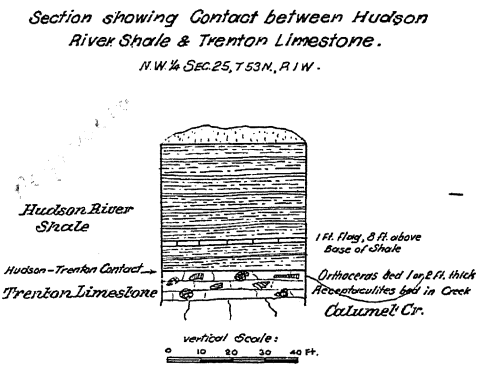


Fig. 1.

The three or four feet of stone underlying this Orthoceratite horizon might be appropriately called either the Receptaculites beds or Murchisonia division, as both of these classes of fossils occur abundantly at this horizon.

Immediately below the Receptaculites horizon are the Strophomenoid strata in which these concavo-convex brachiopods occur very abundantly.

The horizons below these beds have not been as satisfactorily studied.

The Auburn, Lincoln county, surface stone is an intensely hard bluish limestone with soft chert bands that yield a rich fauna of brachiopods, gasteropods, cephalopods, pelecypods and trilobites. This horizon which appears to be much lower than the Galena formation, extends up into Pike county and is exposed along Sulphur creek in S. E. ¼ Sec. 29, T. 52, R. 2W., where the writer saw the limestone and chert. The chert in this formation is almost light enough to float, and soft enough to be scratched by the thumbnail. Despite this fact its beautiful fossils can be readily and easily cut from the mass with a knife, the stone itself being siliceous. This horizon might be called the Auburn Chert Beds.

The best localities for collecting Trenton fossils in the county outside of the places already mentioned, are in a little branch bed, four miles south of Louisiana to the right of the Louisiana and Eolia gravel road in Sec. 5, T. 53, R. 1W., along Buffalo creek from the mouth of Little Buffalo to the northeast corner of T. 52, R. 2W.; and along Peno creek and the Salt river bluffs.

The following list of Trenton fossils found in this county, while not complete, embraces all of the commoner forms:

Protozoa:—
- Zittelella sp?
- Receptaculites globularis
- " oweni

Polypi:—
- Columnaria alveolata
- Halysites catenulatus
- Monticulipora (several unidentified species)
- Streptelasma corniculum
- Diphyphyllum? sp?

Crinoidea:—
- Dendrocrinus? (basal plates)
- Stems and plates of both crinoids and cystids.

Bryozoa:—
- Stictopora (several unidentified species)

Brachiopoda:—
- Camarella sp?
- Plectambonites sericea
- Platystrophia lynx (variety)
- Orthis tricenaria
- Dinorthis pectinella
- Dalmanella testudinaria
- " subaequata
- Orthis perveta
- " sp?
- Rhynchotrema increbescens
- Raphinesquina alternata
- Strophomena filitexta
- " sp?
- " deltoidea
- Zygospira recurvirostris
- " sp?

Gasteropoda:—
- Bellerophon bilobatus
- " sp?
- Fusispira ventricosa
- " sp?
- Helicotoma planulata
- " sp?
- Maclurea magna?
- Murchisonia gracilis
- bicincta
- major
- bellicincta
- two or more unidentified species.
- Raphistoma lenticulare
- Subulites elongatus
- " sp?
- Trochonema umbilicatum
- " sp?
- Cyrtolites sp?
- Bucania punctifrons
- " 2 or more unidentified species.

Cephalopoda:—
Colpoceras sp?
Cyrtoceras (2 or 3 unidentified species)
Endoceras (several unidentified species)
Oncoceras sp?
Ormoceras sp?
Orthoceras (several undertermined species)

Pelecypoda:—
Several unidentified genera and species.

Vermes:—
An undetermined form.

Crustacea:—
Acidaspis? sp?
Asaphus (two species)
Illaennus taurus
" sp?

The condition of preservation of the Trenton fossils renders identification of species often difficult. In exposed beds the Gasteropods, Cephalopods and Pelecypods are mere casts of the living cavity, the test having been destroyed. In a few cases the test has been eaten away and afterward replaced by an earthy sand that gives fairly well the shape of the fossil. The brachiopods and trilobites, however, preserve the test but are difficult to remove from the hard matrix, often "skinning off."

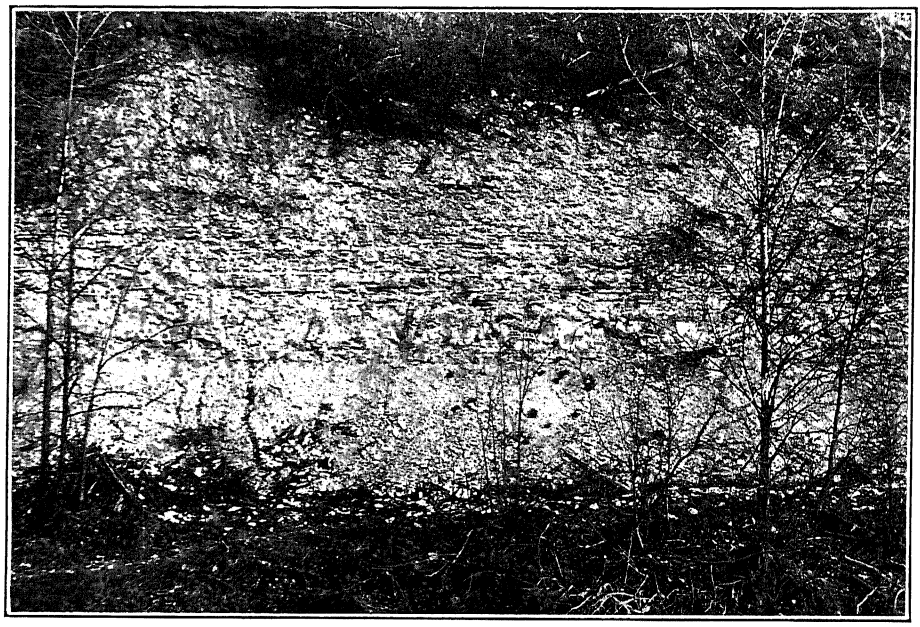
Unlike the limestone, the Auburn chert yields excellent fossils in a fine state of preservation, though the horizon is one of smaller forms and but few of the species are identical with those in the overlying beds.

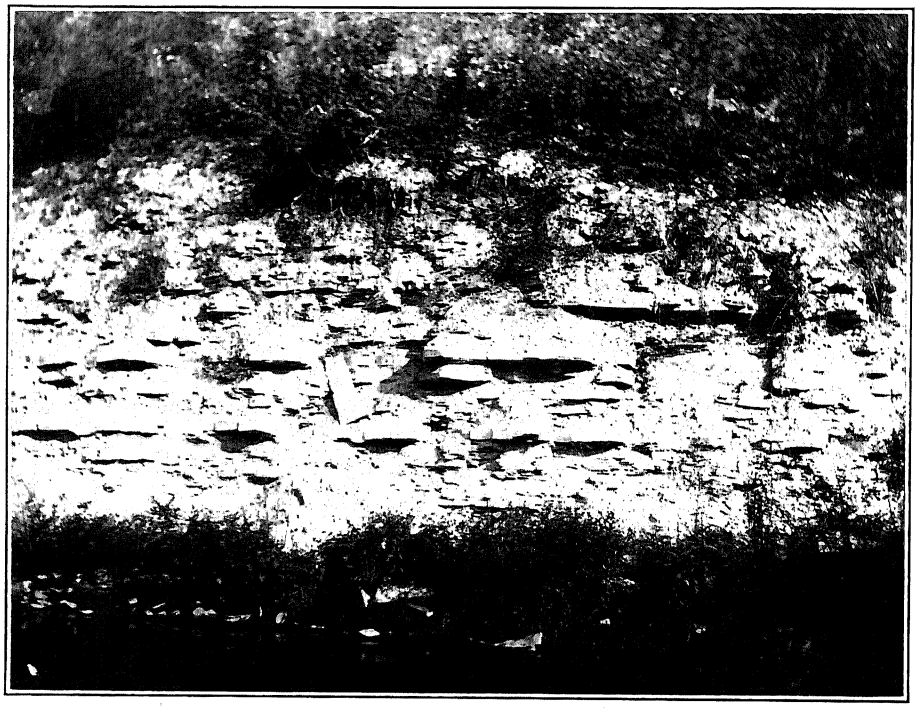
The fauna is a very extensive one and will compare favorably with the fauna of the same horizon in New York, Minnesota and Canada. Halysites catenulatus comes from the Receptaculites horizon and we believe this is its lowest recorded occurrence. The Diphyphyllum (?) is from the same bed.

THE HUDSON RIVER SHALE.

Overlying the Trenton limestone is a shale horizon of about one hundred feet. The shale is light blue in color and sandy in places as on Sulphur creek. It is usually rather argillaceous and composed of softer shales separated by hard beds from an inch to six inches in thickness.

In perpendicular bluffs, these alternate beds of softer and harder material look much like artificial walls. Of all the shales in the county, the Hudson River is the most durable, resisting

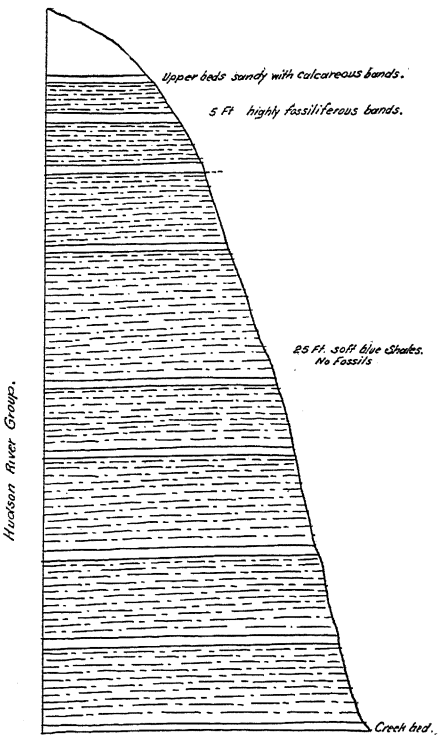




HUDSON RIVER SHALE.

1. Grassy creek.
2. Noix creek near Bethany Church.

longer the action of the weather. Wherever found in the county, the flags are persistent and are the chief characteristic of the formation.



Section on Sulphur Creek.
Sec. 18, T. 52 N., R. 3 W.
vertical Scale:
0 5 10 Ft.

Fig. 2.

The Atlas Portland Cement Company of Hannibal use this shale in the manufacture of Portland cement and quarry most of their supply a few miles above Bush Station in Pike county.

The Hudson River shale is exposed in the beds or banks of all the streams that empty into the Mississippi, in Pike county, and in many of the small brooks throughout the county.

There are very few fossils anywhere in this formation and it would be difficult to separate it into horizons on Paleontologic grounds. A quarter of a mile southwest of Watson station is a good exposure of the upper beds from which a few small fossils have been collected.

At the mouth of Buffalo creek, a number of years ago, the writer collected quite a number of large Monticuliporoid corals and a few other fossils but the exposure is now covered with silt. Along Noix creek, an occasional strophomenoid shell is found and fragments of Asaphus megistos, and perhaps a few other species of trilobites.

About four or five miles down the river bank from Louisiana, a number of good Asaphus have been picked up.

A fine A. megistos was found near the head waters of Calumet creek on the Cavin Wigginton place, a number of years ago, and is now in the Chicago University Museum as a part of the Van Horn collection. This specimen is entire and over eleven inches long. These trilobites are to be obtained by splitting the flags.

The best locality for collecting fossils from the Hudson River shale is on Sulphur creek near the southwest corner of T. 52, R. 2W.

At this locality the shales are sandy and give quite a little series of corals and brachiopods.

Other localities are three miles northeast of Edgewood, near McCune Station, four miles east of Frankford on the slope of the hill near the Louisiana and Frankford gravel road and on Spencer creek north of Elk Lick Springs.

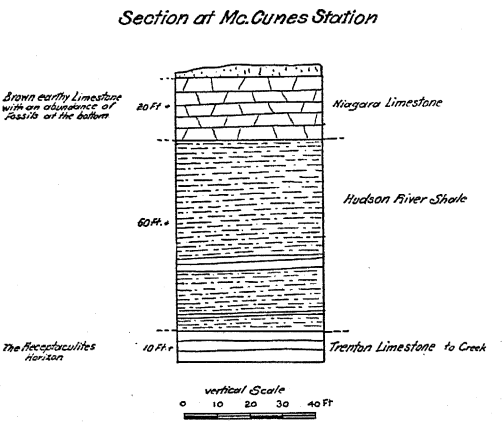


Fig. 3.

The formation at the last named locality is quite calcareous and has limestone bands, instead of argillaceous flags, filled with crinoid joints, and the writer was fortunate enough, some years ago, to find at this place the body of a Heterocrinus, or Ohiocrinus, with arms and a portion of the stem.

The following is a list of the fossils of this horizon:

Graptolites (undetermined genera and species)

Polypi:—
Monticulipora lycoperdon
" (3 or 4 undetermined species)

Crinoidea:—
Ohiocrinus sp?
Stems and plates of other genera

Bryozoa:—
One or two undetermined forms.

Brachiopoda:—
Plectambonites sericea
Lingula sp?
Platystrophia acutilirata
Dinorthis subquadrata?
Hebertella sinuata
" sp?
Dalmanella testudinaria
Rhynchotrema capax
Strophomena planumbona
" filitexta
Raphinesquina alternate
Zygospira recurvirostris

Pteropoda:—
Conularia sp?

Gasteropoda:—
Murchisonia bicincta
" gracilis?

Crustacea:—
Assaphus megistos
" gigas
Calymene callicephala?

The four largest springs, (the Isgrig, Clinton, Allen and Kingston springs) in and near Louisiana flow out over the Hudson River shales and furnish a supply of most excellent water but possessing no special medicinal properties.

It is probable that the Bebee Spring at Bowling Green and the Kalinat spring, two miles northeast of that place, flow through the Hudson and from it receive their supply of mineral ingredients. The Elk Lick, Mudlick and two Buffalo salt-sulphur springs flow from the Hudson River shales.

The sulpho-saline well at the Louisiana Sanitarium, coming to the surface from a distance of a thousand feet or more, receives its supply from Cambrian rocks, perhaps, as the outflow is over a Hudson surface.

CHAPTER III.

SILURIAN AND DEVONIAN.

The Silurian (Upper Silurian) is represented by a white oolitic and a brown limestone. The oolitic limestone attains a maximum thickness of about seven feet and from its fauna is thought to belong to the Clinton. The brown limestone overlies the white oolitic and attains a maximum thickness of twenty-five feet. This horizon is clearly Niagara. Both the white oolitic and the brown limestone vary greatly in thickness, being in places entirely absent.

The absence of and the thinning of the Niagara leads one to suppose that the Silurian and Devonian are unconformable. At least it is clear that only a part of the Silurian is represented. There may also be and probably is an unconformity between the Ordovician and Silurian.

The Devonian, which is represented by a variable thickness of from three to sixty feet of shale, is remarkably persistent throughout the county. This shale, which is known as the Hamilton, is believed to represent the Upper Devonian, the fossils passing upward into the Louisiana limestone without any special break. The persistence of certain species upward into the Louisiana limestone rather argues against an unconformity between the Devonian and Mississippian in this county.

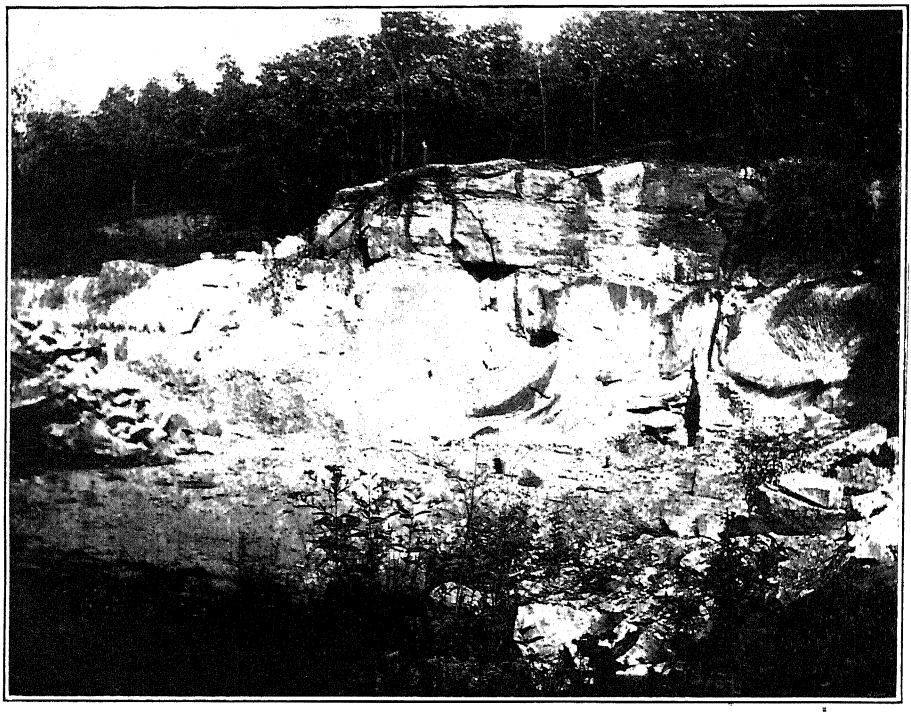
THE NIAGARA LIMESTONE.

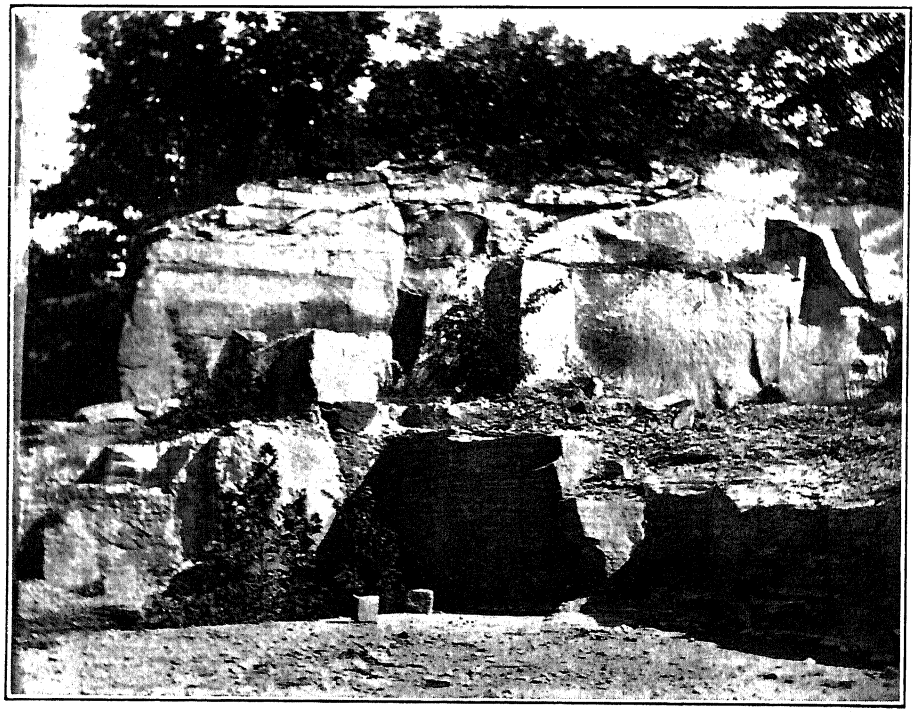
The rocks immediately overlying the Hudson River shale are of Niagara age, being the only representative of the Silurian in the county, as the Trenton and Hudson River represent the Ordovician.

On the river front at Louisiana is a double bed of white oolitic limestone, underlying a two foot bed of brown, earthy limestone, above the Hudson River shales. The thickness of the oolite is about seven feet. At the mouth of Buffalo creek, two miles southeast of Louisiana, the oolite is less than six feet, while the brown overlying limestone is quite nine feet in thickness.

The surface between the two layers of oolite is always crowded with cup corals and favosites, but owing to the intense hardness of the rock its fossils are rarely obtained in a satisfactory shape.

From a weathered outcrop, about three miles west of Louisi-





NIAGARA LIMESTONE.
Quarries near Bowling Green.

ana, near Grassy creek and the Henderson school house, the writer has collected an interesting suite of fossils from this horizon.

At Paynesville the oolite is persistent while westward it soon disappears, the brown limestone thickening. At the big Chicago and Alton R. R. bridge, two miles northeast of Bowling Green, the brown stone attains a thickness of 25 or more feet and is quarried for foundation purposes. On fresh blasted surfaces the color is a beautiful blue and its usual brown is doubtless due to weathering.

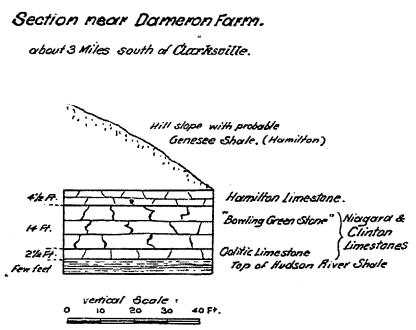


Fig. 4.

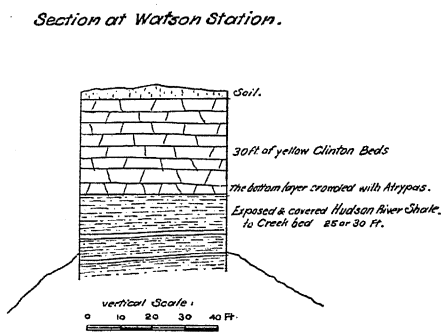


Fig. 5.

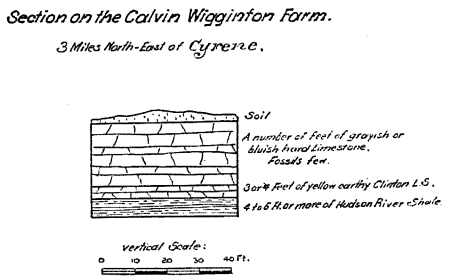


Fig. 6.

About half a mile, southwest of Watson station, the foot or more of the brown earthy limestone immediately above the contact with the Hudson River shale yields an abundance of small Atrypas, Orthids and Rhynchonelloids, in an excellent state of preservation.

At the Wigginton place, three miles east of Cyrene, the same basel layer gives quite a different fauna of beautiful shells, while two miles south of this latter locality the brook bed, as well as the stone itself, is full of favositoid and other corals with a few brachiopods more nearly like the Watson species, the Atrypas being fewer and larger.

At the Cyrene locality the Atrypas are very scarce while Orthids of four or five species are numerous. At Watson the Atrypas are very numerous while the Orthids are scarce.

When the oolite is present, it usually rests directly upon the

Hudson River shale but on Grassy creek and near Corinth church, a few feet of hard bluish, silicious limestone underlies the oolite, yielding much the same fossils.

The oolite at Louisiana was considered Devonian by Shumard and Swallow and fossils were credited to it that it does not contain, such as Acervularia Davidsoni, Zaphrentis corniculum and Favosites polymorpha. But one fossil has been found in the brown stone at Louisiana, a flat streptorhynchoid, and at the mouth of Buffalo creek, a few small imperfect, unidentified forms.

On the top of a hill between little and big Buffalo creeks is a brown limestone with fossils like those from the oolite.

The best localities for collecting fossils from the oolite are near Henderson school house on Grassy creek, on the Stark and McIlroy farms near Calumet P. O., along Little Calumet, Sugar and Grassy creeks and Upper Buffalo creek near Edgewood.

The brown stone localities have already been given.

Despite the puzzling character of these beds, there can be no doubt as to their horizon being Niagara even though Swallow called them Devonian and James Hall, Hudson River. They seem in fact to be transition beds between the Ordovician and Silurian with a Clinton facies.

On Tanyard Branch where a fine spring flows out over Hamilton shale, the oolite is entirely wanting while a mile and a half further west it reappears again. At Louisiana there are seven feet of oolite, on Tanyard Branch, 1½ miles due west, none; on Grassy creek, 1½ miles due west of the Tanyard branch locality, several feet of oolite. These are illustrations of the non-persistent character of this formation.

Economically, the oolite is of no importance. The brown stone is valuable for building and other purposes and has been quarried near Bowling Green for a number of years.

On the following page is a table of species from these beds, the best collecting localities, the range of the individual forms being indicated by stars. In the same manner, the localities where each species has been found are indicated.

It is possible that the streptorhynchoid shell found near Cyrene is specifically indentical with Dr. Shumard's Orthis missouriensis figured in the old Swallow report.

If so, it is very interesting since it would seem to make the Niagara bed the equivalent of the Cape Girardeau limestone, a formation whose horizon was determined by Swallow and Shumard to be Upper Silurian, but later by other writers and among them S. A. Miller, of the age of the upper Trenton.

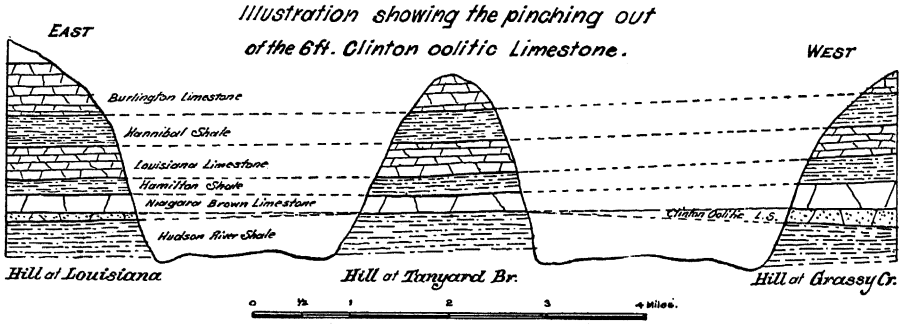


Illustration showing the pinching out
of the 6ft. Clinton oolitic Limestone.
EAST
WEST
Burlington Limestone
Hannibal Shale
Louisiana Limestone
Hamilton Shale
Niagara Brown Limestone
Hudson River Shale
Clinton Oolithic L.S.
Hill at Louisiana
Hill at Tonyard Br.
Hill at Grassy Cr.
0 ½ 1 2 3 Miles.

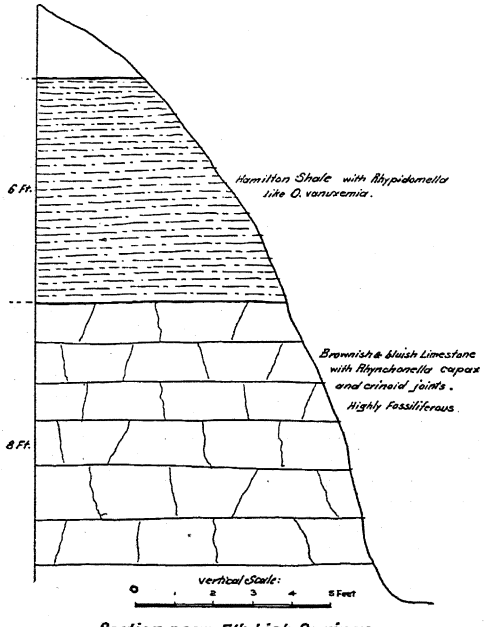
	Oolitic limestone.			Brown, earthy limestone.				
	Louisiana.....	McIlroy Farm..	Henderson School House.	Edgewood.....	Wigginton Farm.....	Watson Station	McCune Station	
Corals—								
Stromatopora? sp?.....	*	*	*	*				
Stromatopora? sp?.....	.....	.....	.....	*	*			
Zaphrentis sp?.....	*	*	*					
Cyathophyllum sp?.....	.....	.....	*	*	*			
Cystiphyllum sp?	.....	.....	.....	*				
Favosites sp?.....	*	*	*	*	*	*	*	
Favosites sp?.....	.....	.....	.....	*				
Favosites sp?.....	.....	.....	.....	*				
Lyellia? sp?.....	.....	.....	.....	*				
Columnaria sp?.....	.....	.....	.....	*				
Halysites catenulata.....	.....	.....	*	*	.....	*		
Crinoids—								
Calceocrinus alleni.....	.....	.....	.....	.....	.....	*		
Glyptocrinus.....	.....	.....	.....	.....	*			
Glyptocrinus.....	.....	.....	.....	.....	*			
Brachiopoda—								
Meristella? sp?.....	.....	*	*	.....	*	*	*	
Orthis testudinaria var.....	.....	.....	*	.....	*	*	*	
Orthis sp?.....	.....	.....	.....	.....	*	.....	*	
Orthis hybrida.....	.....	.....	.....	.....	*	*	*	
Orthis flabellulum.....	*	*	*					
Orthis sp?.....	.....	.....	.....	.....	*			
Retzia sp?.....	.....	.....	.....	.....	.....	*	*	
Rhynchonella? sp?.....	.....	.....	.....	*	*	*	*	
Rhynchonella? sp?.....	*	*	*					
Streptorhynchus? sp?.....	*	.....	.....	.....	*			
Streptorhynchus? sp?.....	.....	.....	*					
Storphomena rhomboidalis.....	.....	.....	.....	.....	*	*		
Zygospira putilla.....	.....	*	.....	.....	*	*	.....	.....
Rhynchotreta? sp?.....	.....	.....	.....	.....	*	.....	*	
Pteropoda—								
Conularia sp?.....	.....	.....	.....	.....	*			
Tentaculites? sp?.....	.....	.....	*					
Gasteropoda—								
Bellerophon sp?.....	.....	.....	.....	.....	*	.....	*	
Cyclonema sp?.....	.....	*	*	.....	*	*	*	
Crytolites sp?.....	.....	.....	.....	.....	*			
Holopea sp?.....	.....	.....	*	.....	*	.....		
Strophostylus sp?.....	.....	.....	.....	.....	*			
Euomphalus? sp?.....	.....	.....	.....	.....	*			
Murchisonia gracilis?.....	.....	.....	.....	.....	*	.....	?	h
Pleurotomaria sp?.....	.....	.....	.....	.....	*	.....	*	
Pleurotomaria sp?.....	.....	.....	.....	.....	*	.....	?	
Pleurotomaria sp?.....	.....	.....	.....	.....	*			
Cephalopods—								
Orthoceras annulatum.....	*	.....	.....	.....	*			
Pelecypods—								
Gen? sp?.....	.....	.....	*					
Gen? sp?.....	.....	.....	*					
Gen? sp?.....	.....	.....	.....	.....	*			
Vermes—								
Cornulites sp?.....	.....	.....	.....	.....	.....	*		
Cornulites sp?.....	.....	.....	.....	.....	*			
Crustacea—								
Calymene niagarensis.....	.....	.....	*	.....	.....	*		
Lichas? sp?.....	.....	.....	.....	.....	*			
Gen? sp?.....	.....	.....	.....	.....	*			
Gen? sp?.....	.....	.....	.....	.....	.....	*		

In small pockets in the brown stone, a thick, dark oil has been found in small quantities, a crude petroleum and in both this stone and the Hudson river shales, small pieces of zinc ore occur, rarely.

HAMILTON SHALE.

Overlying the Niagara brown stone at Louisiana are three or four feet of a black fissile shale, without fossil remains except in an inch layer of silicious sandstone at the very bottom. This sand layer is cemented into a hard mass by an oxide of iron and is very durable, being found in fragments along streams far from its outcrop. Embedded in this sand conglomerate are fish teeth, bones, coprolitic forms identical with remains from the blue shale just above, and a small linguloid shell of elongate shape.

On Grassy creek and several of its tributaries, five or six miles due west of Louisiana there are outcrops of these black and blue shales from 40 to 60 feet thick with quite a series of linguloid shells of several species. These shells are from one-tenth of an inch to one inch long and occur on the split surfaces of the black shale. The sandstone bands yield, as before, teeth, bones and coprolites and, at some localities, great numbers of the peculiar fossil, Ptychostylus subtumidus, described by W. F. E. Gurley as a



Section near Elk Lick Springs.

Fig. 7.

HAMILTON SHALE. GRASSY CREEK.

The man sits on the basal bed of Louisiana limestone and his feet rest on the top of the blue shale. The cross ink mark below him is the bottom of the blue and the top of the black shale. The black shale extends to the creek bed, 45 feet below the bottom of the blue shale or 63 feet below the base of the Louisiana.

sponge, but of vegetable origin, occur near the top of the shales. This fossil belongs in the blue shale. At one locality on Grassy creek, the writer found a single valve of a Stropheodonta, a genus of Devonian brachiopods, in the black shale. It would be easy to place this double fish bed in the same formation and call both the blue and black shales Genesee but the fossils of the Louisiana limestone pass into the blue shales above and a few have been found even in the upper fish bed, so upon the evidence of the brachiopods and other Louisiana limestone fossils the blue shales are part of the Louisiana limestone formation.

Upon the evidence of the Stropheodonta and the Lingulas, perhaps, the black shales should be recognized as upper Devonian.

Along the upper tributaries of Grassy and Noix creeks there are many exposures of these black shales of great thickness, and

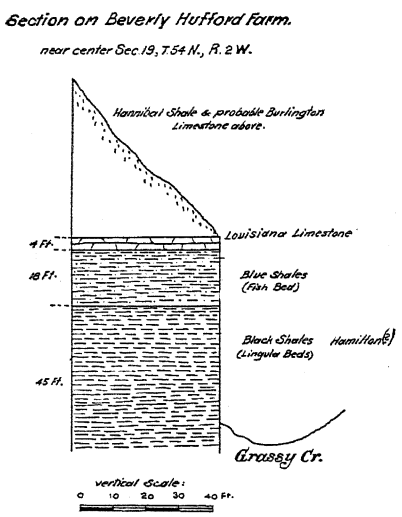


Fig. 8.

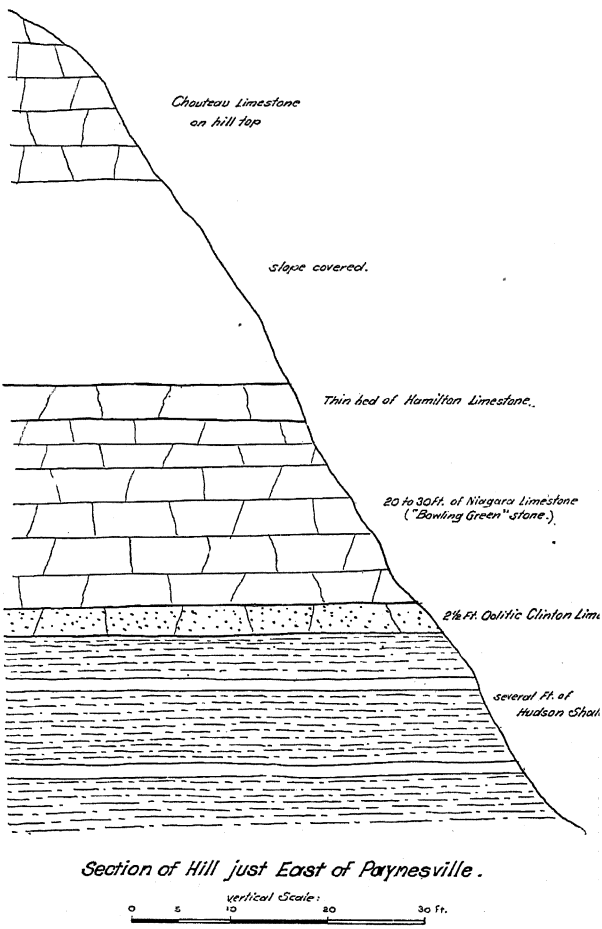


Fig. 9.

in places considerably sandy. Analyses of this shale give indications that it is much more suitable for use in the manufacture of Portland cement than the Hudson River shale.

All the fossils of this formation have been mentioned in the description of the localities where the shale occurs.

Near the Dameron Farm, between Clarksville and Paynesville along the gravel road is an outcrop of reddish limestone, overlying the Niagara brown stone, that yields well marked Hamilton fossils. Under the Niagara brown stone at this same place occurs the oolite overlying the Hudson River shale but the contact above could not be found, as the Hamilton limestone is the surface rock of the immediate region. So, the presence or absence of the black shales above is mere conjecture.

The presence here of well defined Hamilton beds above the brown stone and oolite throws much light upon the horizon of the latter. Near Clarksville on a hill top beside the gravel road in front of the Oglesby residence are four or five feet of this Hamilton limestone. A thin band of Hamilton limestone with characteristic fossils occurs just inside the town of Paynesville, as well as near the top of a hill, east of the town. The same succession of strata occurs here as at the Dameron Farm.

Occasional springs issue from the top of the black shales in this county.

It is more than probable that the black shales should be ranged along with the blue as a part of the Louisiana formation. The following list of fossils belongs to the Hamilton limestone and were collected at the two localities mentioned above.

Spirifer parryanus?
" annae?
Stropheondonta demissa
Atrypa reticularis
Zaphrentis? gigantea
Cyathophyllum? sp?
Cystiphyllum americanum
Favosites hamiltonensis
Striatopora rugosa
Crinoid columns.

CHAPTER IV.

MISSISSIPPIAN AND PENNSYLVANIAN.

The Mississippian is represented in this county by a thickness of about 250 feet, chiefly limestone. The lowest formation is the Louisiana (Lithographic) limestone, forty feet. Above this in

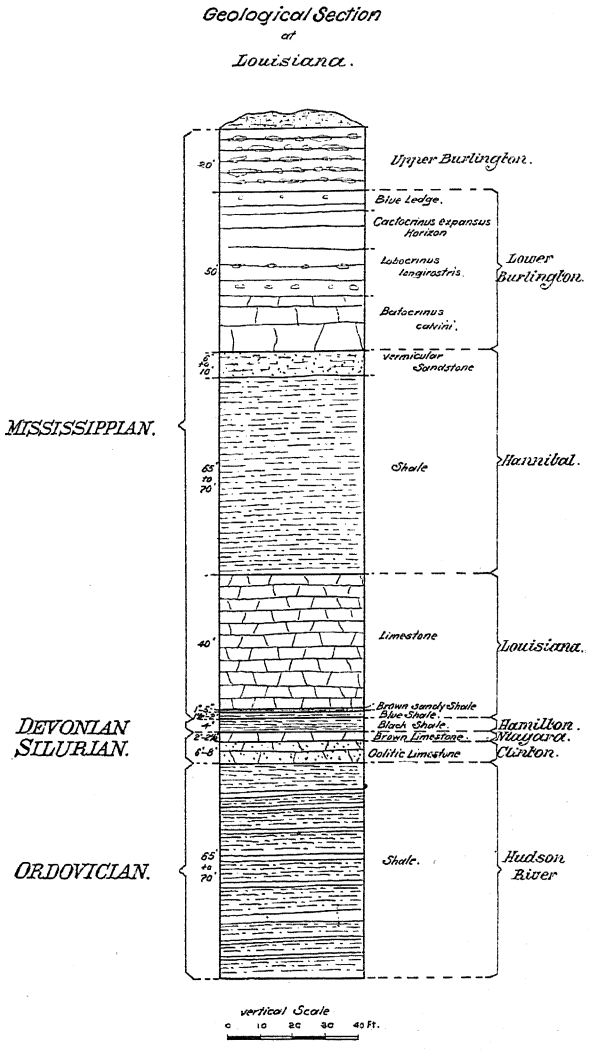


Fig. 10.

conformable succession are the Hannibal shale, 70 feet; the Chouteau limestone, 50 feet; the Burlington limestone, 80 feet; and the Keokuk limestone, 25 feet. This succession is beautifully exposed in the hills around Louisiana, where fresh exposures may be found in the quarries. It is interesting to observe that although the faunas of the Burlington and Chouteau are distinct in some localities, in others, for example at Louisiana, they are mingled making it impracticable to separate the formations. The separation of the Burlington into an Upper and a Lower member has been made upon paleontological data, although it is not clear that the faunas of these divisions do not migrate into lower and higher horizons in different localities.

On the following pages these formations are discussed in detail the descriptions being accompanied with full and complete lists of fossils.

The Pennsylvanian has been recognized in only one locality. Here it rests unconformably upon the Keokuk. This area is so small that it is not shown on the general geological map.

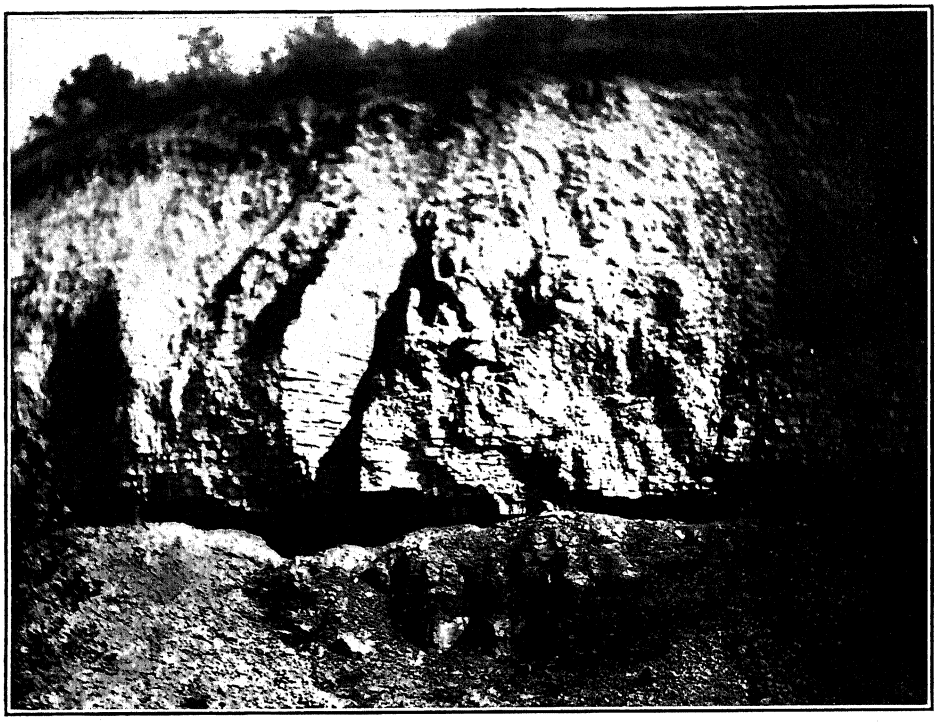
THE LOUISIANA LIMESTONE.

In the bluffs along the river front above the black shale and separated from the latter by about fifteen or sixteen inches of blue shale and from a half to two inches of soft yellow sandy shale, is the Louisiana limestone, a thinly bedded, close grained, light blue stone having a conchoidal fracture and giving a ringing sound to the hammer stroke. From the very nature of the rock it is hard although it breaks readily into angular fragments by the action of frost. In the early spring, it is dangerous to walk under an overhanging bluff lest the pieces, dislodged by the warming sun rays, fall and strike one.

Bluffs of this limestone are hardly possible except along streams by which the falling fragments may be removed and the base be kept clear of talus.

An outcrop on the Town Branch has been watched by the writer for a number of years, in fact, since boyhood. Each spring the shales below are covered by the fallen fragments and only after heavy rains and freshets (sometimes even until July) would the base be freed of the waste so that the shales below could be worked.

The top layers of the Louisiana limestone are hardly an inch thick and more or less yellow, thickening downward until quite



LOUISIANA LIMESTONE.

1. Mouth of Buffalo Creek, showing Hannibal above and Hamilton and Niagara below.
2. Eighth street quarry, Louisiana.

twelve inches is the depth of the bottom layer. The thin yellow clay-like bands that separate the layers, give to the whole bluff the appearance of a wall of mansonry, in the distance.

From the results of our studies it is quite clear that the Louisiana limestone belongs to the Mississipian and probably to that portion known as the Kinderhook. Of this division it is the lowest member. Professor Hall referred this formation first to the Hamilton division of the Devonian and later to the Chouteau; Professor

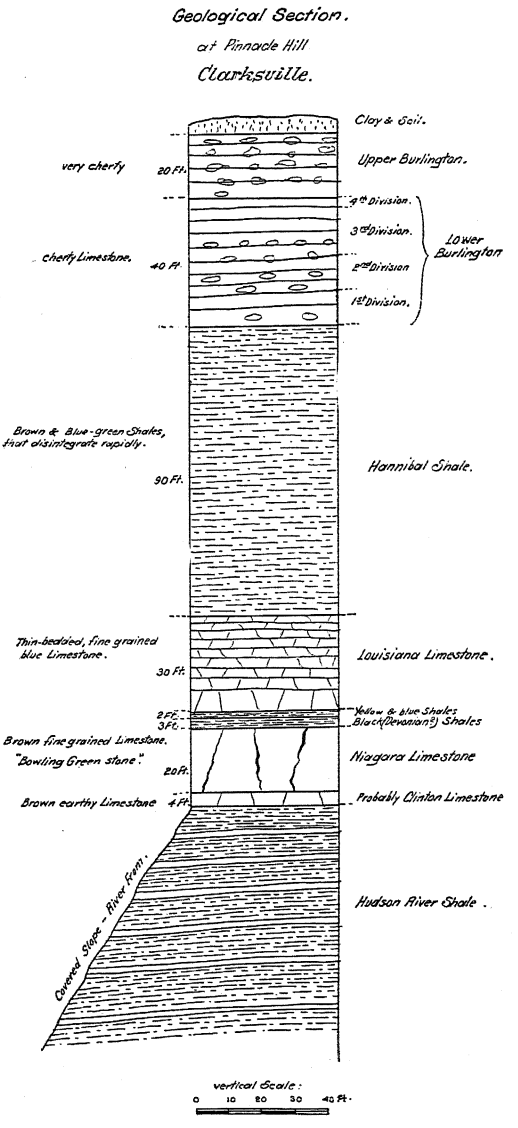


Fig. 11.

Swallow and Dr. Shumard to the Chemung; Professor Beecher to the Chouteau; and Gurley, Keyes and others to the Kinderhook.

There are few fossils above the bottom layers and these are to be obtained in good condition only from the softer clay partings. Shells from the body of the rock always "skin." Hollow geode-like masses of calcite occur in the layers and some iron is present, also heavy solid masses of calcite.

Immediately under the limestone, and in the soft yellow, sandy and blue shales, fossils in a good state of preservation are to be found, identical with the species from the limestone above. In the Swallow Survey this formation was called the "Lithographic" limestone from the fact that it was thought to be suitable for lithographic purposes.

It is the best limestone in the region for macadam when broken into small pieces and covered by some softer filling material like thoroughly pulverized or ground limestone.

The Louisiana limestone attains its greatest thickness along the Mississippi river from Hannibal to Clarksville, being 35 or 40 feet at the mouth of Buffalo creek. Westward it thins out and near Elk Lick is hardly two feet thick. Two miles northeast of Bowling Green it is less than eight feet thick.

The best localities for collecting fossils are on the Town Branch at the bottom of Allen's hill, along the river front north of Tennessee street, at Edison's avenue, Eighth and Kentucky streets, mouth of Buffalo creek and at Clarksville.

Most interesting series of young brachiopods and other fossils can be obtained by washing the soft yellow clay partings between the bottom two layers of the stone. There are probably in all, fully sixty distinct species of fossils from this horizon.

The list in full is given on the following pages.

	Louisiana limestone... [3]	Yellow sandy clay shale.. [2]	Blue shale... [1]	Hannibal shale ..... [4]	Chouteau limestone .. [5]
Crustacea—					
Phillipsia? stratton-porteri	*				
Cephalopoda—					
Orthoceras minimum	*	?	?		
Goniatites louisianensis	*	?			
Goniatites sp?	*	?	?	?	
Pelecypoda—					
Grammysia hannibalensis	*	*	*	*	
Aviculopecten? marbuti	*	?	?	?	
Gen? sp?		*	?		

	Louisiana limestone[3]	Yellow sandy clay shale[2]	Blue shale[1]	Hannibal limestone[4]	Chouteau limestone[5]
Pteropoda—					
Conularia marionensis?	.....	*	*	?	
Gasteropoda—					
Platyceras pulcherrimum	.....	*	*	?	
Platyceras anomalum	*				
Pleurotomaria? sp?	.....	.....	*	?	
Pleurotomaria minima	*				
Murchisonia? pygmaea	*				
Brachiopoda—					
Spirifer marionensis	*	* *	*		
Spirifer sp? (very small)	*				
Spiriferina clarksvillensis	*	*	?		
Spiriferina aciculifera	*	*			
Syringothyris hannibalensis	*	*	?	*	
Cyrtina acutirostris	*	*	*	?	*
Ambocoelia minuta	*	*			
Athyris hannibalensis	*	*	?	?	?
Nucleospira barrisi	*	*	?		
Trigeria? curriei	*	*			
Centronella? sp?	*	*			
Seminula buckleyi	*	*	.....	*	
Productella pyxidata	*	*	*	*	?
Chonotes ornata	*	*	*	?	?
Chonotes geniculata	*	*	?		
Strophalosia scintilla	*	*			
Strophalosia beecheri	.....	*			
Rhipidomella missouriensis	*	*	*	*	*
Orthothetes lens	*	*	?	?	
Crania rowleyi	*	*	?		
Crania dodgei	*	*	?		
Crania spiculata	*	?			
Orbiculoidea limata	.....	*	*		
Bryozoa—					
Streblotrypa sp?	*	*			
Lioclema sp?	*	*			
Stenopora sp?	*	*			
Stenopora sp?	*	*			
Polypi—					
Zaphrentis parasitica	*	*	*		
Zaphrentis palmeri	.....	*	*		
Zaphrentis acuta?	.....	*	*		
Protozoa—					
Palaeacis enorme	*	*	*		
Chonopterium effusum	*	*	*		
Sponge spicules?	*	?			
Plantae—					
Ptychostylus subtumidus	.....	.....	*		
Vermes—					
Cornulites carbonarius	*	*	?		
Spirorbis kinderhookensis	*	*	?		
Crinoidea—					
Allagecrinus americanus	*	?			
Poteriocrinus jeffriesi	*	?			
Platycrinus dodgei	*	*	?		
Crinoid plates and stems of unknown genera and species	*	*			
Of unknown affinities—					
Felicites gracilis	*				
Leptodiscus corrugatus	*	?			
Cyst-like bodies often rayed	*				
Minute link-like forms	*				
Like crinoid stumps, but small (attached)	*	*			

For the identification of the genera of the Bryozoa I am indebted to Mr. R. S. Bassler of the U. S. Geol. Survey.

THE HANNIBAL SHALE.

Immediately above the Louisiana limestone lies the Hannibal shale from sixty to seventy feet thick, the upper six to eight feet of which is quite sandy and heavily bedded, having been called the "Vermicular" sandstone by Swallow and Shumard.

The lower beds of shale are of a peculiar indigo blue color when freshly exposed but weather to a pale blue-green near the bottom and decidedly yellowish brown, just under the vermicular sandstone.

Fossils are almost entirely absent from the shales at most localities. On long weathered slopes, for this shale is usually nothing more than a clay when exposed, yielding rapidly to the weather, a few small pyritized shells may be collected by close search. At one point on Spencer creek, I collected several species of brachiopods and gasteropods a number of years ago, but all were internal casts and of the same species as are found in the same shales in the southern part of the state.

The Hannibal shale is evidently one of the most persistent members of the Mississippian in the state, stretching from Marion county to the southern and southwestern parts of the state and may be recognized by its rusty looking internal casts of fossils, from Hannibal to Cedar Gap. It passes even beyond the state and there is little doubt that the typical Kinderhook shales of Illinois and the Yellow sandstone of Burlington, Iowa, are equivalent beds.

The few feet of yellow sandstone above (vermicular sandstone) is often quite fossiliferous, yielding an interesting series of casts, containing branchiopods, gasteropods and lamellibranchs. These top beds are among the most durable of our rocks, the flags often lying along the hillsides and in the branch beds in company with the everlasting cherts of the Burlington.

In the cut of the Chicago and Alton R. R. near Bowling Green there is a good exposure of the shales where hard thin bands are present.

From the readiness with which the shales disintegrate, it is seldom that good exposures can be found and so, on the hillsides, they form long slopes.

It is probable that the shales are too sandy to be used in the

HANNIBAL SHALE.
Chicago and Alton R. R. cut, Bowling Green.

manufacture of Portland cement and the vermicular sandstone is of no economic value, whatever.

On Spencer creek the following fossils were obtained from the shale:

Spiriferina Sp? (Clarksvillensis?)
Rhipidomella sp? (Missouriensis)
Productella pyxidata
Zaphrentis acute?
At Louisiana on a clay slope:
Euomphalus sp? (small)
Murchisonia? sp? (small)
Zaphrentis sp?

The vermicular sandstone is filled with fossil worm borings and the split surfaces often show the peculiar fucoid, Taonurus.

The best exposures of this stone are about Louisiana and the following is a list of the fossil remains contained therein:

	Louisiana Limestone	Vermicular Sandstone	Burlington Limestone
Orthoceras sp?		*	
Goniatites sp?	*	*	*
Loxonema sp?		*	?
Pleurotomaria sp?	?	*	?
Bellerophon sp?		*	?
Euomphalus latus?		*	*
Grammysia hannibalensis	*	*	?
Aviculopecten sp?		*	?
Aviculopecten? sp?		*	?
Dexiobia sp?		*	
Macrodon sp?		*	
Prothyris sp?		*	
Sphenotus sp?		*	
Rhipidomella missouriensis	*	*	
Orthothetes lens	*	*	
Derbya? sp?		*	*
Productella pyxidata	*	*	?
Productella sp?		*	
Chonotes ornata	*	?	
Seminula sp?	*	*	
Spirifer marionensis?	*	*	*
Syringothyris hannibalensis	*	*	*
Taonurus crassus		*	
Vermes gen? sp?		*	

From the faunae of the Hannibal shale and Louisiana limestone, it is quite evident that the two formations could be and should be ranged in one group as the equivalent of the Kinderhook shales of Illinois. The Chouteau limestone, however, is nearer the Burlington than the Hannibal shale and while it is probably the

equivalent of the upper beds of the Waverly of Ohio and Marshall of Michigan as well as the LeGrand beds of Iowa, there is little relationship between it and the underlying shales.

The Louisiana limestone is a transition bed, the evidence of its fossils, being insufficient to place it, and while there will always be an element of doubt as to its horizon, there can be none with reference to the Chouteau limestone. It is clearly within the Mississippian.

The one strongest evidence of Carboniferous relationship in the Louisiana limestone is the presence of a species of Platycrinus but that is offset by its Crytina, Ambocoelia, Nucleospira, and Chonetes and yet each of these genera do occur in the Carboniferous and Platycrinus in the Devonian.

In the Chouteau, however, the Crinoids are all carboniferous, though the corals, sponges and some other forms may have a mixed aspect.

THE CHOUTEAU LIMESTONE.

This division, although not present at Louisiana, is well developed in the county. Its greatest thickness is about fifty feet as observed in "Salt Peter Bluff" near Annada. On Spencer creek, near Spencerburg is a great thickness of this stone.

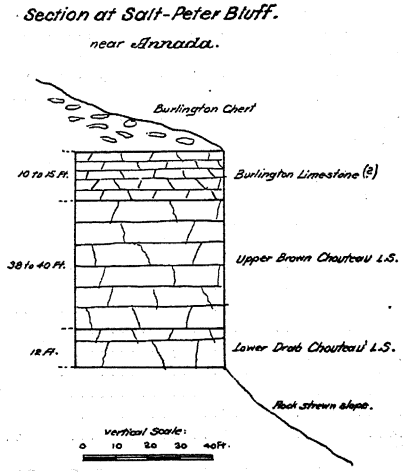
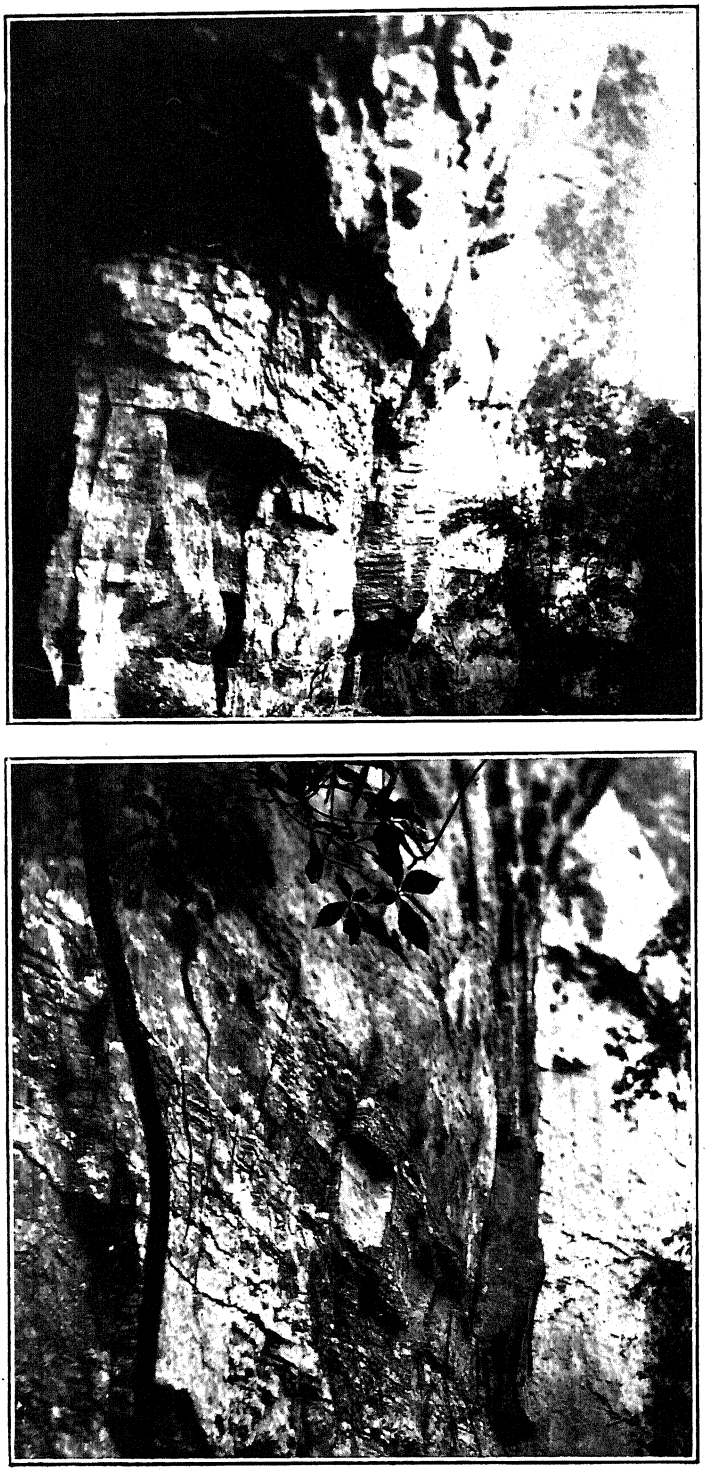


Fig. 12.

In a few feet of weathered outcrop of this limestone in a cut of the Chicago & Alton R. R., near Bowling Green, some interesting fossils have been collected.

Three and a half miles east of Curryville, on a branch, tributary to Peno creek, is a weathered exposure of fossiliferous Chou-



CHOUTEAU LIMESTONE.
St. Peters Bluff, Annada.

teau limestone only 5 or 6 feet thick, underlying the Burlington which it resembles much in appearance. In general color, the Chouteau is bluish at the bottom but brown and yellow above, scarcely distinguishable from the Burlington except by its fossils. It reminds one somewhat, in its method of weathering, of the Keokuk limestone but lacks the hardness and color of that formation. Where the Burlington overlies it, as at "Salt Peter Bluff," there is no apparent line of separation and it is almost impossible to determine where one ends and the other begins.

The stone is used for building purposes but is inferior to the Burlington limestone. It contains very little chert in Pike county though it is quite cherty in Lincoln county. Locally, it is quite fossiliferous but good specimens are only obtained from weathered exposures.

The following table includes all the fossils found in the county in this limestone:

Chouteau species of fossils and localities where found.	Near Edgewood.	2¼ miles S. E. Curryville.....	¾ mile E. Curryville.....	¼ mile N. E. Bowling Green.	Salt Peter Bluff.	On Short Line R. R.....	Ashley .....
Lophoblastus conoideus	.....	.....	*	*			
Lophoblastus pentagonus	.....	.....	*	*			
Amplexus sp?	.....	.....	*				
Amplexus sp?	.....	*	*	*	?		
Coleophyllum greenei	.....	.....	*				
Chonophyllum sp?	*	*	*	*	*	.....	*
Conostegites sp?	.....	*	*				
Cyathophyllum? glabrum	.....	*	*	.....	*		
Leptopora placenta	*	*	*	*	*	.....	*
Leptopora ramosa	.....	.....	.....	.....	*		
Leptopora procera	.....	*	*				
Syringopora harveyi?	.....	.....	*	*	*		
Zaphrentis calceola	.....	*	*	*	?	?	*
Zaphrentis sp?	.....	*	*	*	*		
Zaphrentis sp? (spiny)	.....	.....	*				
Batocrinus sp? (small)	.....	.....	*				
Gilbertsocrinus sp?	.....	.....	*				
Granatocrinus mutabilis	.....	*	*	*			
Platycrinus curryvillensis	.....	.....	*	*			
Platycrinus insolens	.....	*	*	?	.....	*	*
Platycrinus sp?	.....	.....	.....	*			
Steganocrinus? sp? (small)	.....	.....	.....	*			
Bryozoa (several forms)	*	*	*	*	*	*	*
Athyris sp?	.....	.....	*				
Athyris sp? (small)	.....	*	*				
Rhipidomella sp?	.....	.....	*	.....	*		
Productella sp?	.....	.....	*				
Productus sp?	.....	.....	*				
Spirifer marionensis	.....	.....	*				
Spirifer sp?	.....	.....	.....	.....	.....	*	
Leptaena rhomboidalis	.....	.....	*				
Euomphalus latus	*	.....	*	*	*		
Pleurotomaria? sp?	*						

At Louisiana there is an entire absence of Chouteau limestone but a mingling of Chouteau and Burlington fossils in the Lower Burlington beds.

The most characteristic fossil of the Chouteau is Leptopora placenta. Near Curryville, both east and south, the weathered exposures of Chouteau yield a great abundance of corals, many of which are externally like Devonian forms from the Falls of the Ohio. The best localities for collecting fossils are 2½ miles southeast of Curryville and 3½ miles east of the same place on the head waters of Peno creek; ½ mile west of Ashley; ½ mile northeast of Bowling Green on the Chicago and Alton R. R.; at Salt Peter Bluff near Annada; and about ¾ mile east of Edgewood.

THE BURLINGTON LIMESTONE.

The most important formation in the county from an economic standpoint is the Burlington limestone. This stone has been extensively quarried for years at Louisiana and furnishes the best building stone and the best material for quicklime in the county. It was crushed for a number of years and shipped to glass manufacturers and others at St. Louis and elsewhere. The Pratt company that built and operated the crusher plant at Louisiana, practically exhausted the ledge from which the rock for crushing was obtained, and it became necessary to move their machinery either to another hill or another place and it was moved to Elsberry, Lincoln county, Missouri.

The "White Ledge" furnishes beautiful stone for ornamental work and is hardly surpassed in excellence anywhere in the country. The hills at Louisiana are crowned with this limestone and bluffs of it follow the river from Clarksville to Marion county.

The line of separation between the Lower and Upper Burlington is well marked at Louisiana and it is convenient to separate the Lower Burlington into the following beds: Basal division from 5 to 8 feet, resting on the vermicular sandstone at Louisiana, rust brown, weathering soft. The stone is poor and seldom quarried. This division usually forms the floor of the various quarries in Louisiana. The fossils are peculiar and some of them as Batocrinus calvini, B. bulbosus, and Dorycrinus inflatus are characteristic of the division. It might be called the Batocrinus calvini horizon.

Above this division is a series of white and brown layers, quite cherty in some quarries and ranging from 15 to 20 feet in thickness. These beds are near the top of this division where Codo-

nites stelliformis occurs as also Cryptoblastus melo and Amphoracrinus divergens. Lobocrinus longirostris ranges through this entire division and it might be designated the Lobocrinus longirostris horizon.

The third division is the "White Ledge," from 10 to 14 feet thick and without seams and with little or no chert.

There are a great many brachiopods in this layer and but few crinoids, among the latter Agaricocrinus planoconvexus, Steganocrinus sculptus, Ichthyocrinus burlingtonensis and Cactocrinus expansus. For convenience we would designate this the Cactocrinus expansus horizon.

The "Blue Layer" of four feet overlies the "White Ledge" and is the top of the Lower Burlington limestone. This division contains mainly brachiopods and corals with but few blastoids and crinoids, the latter coming up from the division below. In this layer occur a few upper Burlington fossils such as a small variety of Schizoblastus sayi, Physetocrinus ventricosus, Actinocrinus scitulus. This might be called the Coral horizon.

There is no persistency in the character of the Upper Burlington and it is almost impossible to separate in into divisions. It is made up thin bands of brown and yellow limestone and chert. The stone is of little value.

The Burlington limestone outcrops on Spencer creek, Cuivre river and elsewhere throughout the western and southwestern parts of the county.

The following is a list of Burlington fossils found in this county with their range:

	Chouteau Limestone	First L. Burlington Division	Second L. Burlington Division	Third L. Burlington Division	Fourth L. Burlington Division	Upper Burlington	Keokuk Limestone
Amplexus bicostatus	*	*	*	*	*	*	*
Amplexus radigerus					*		
Amplexus vermicularis			*				
Amplexus archimediformis			*				
Aulopora gracilis		?	*	?	?		
Chaetetes? sp?			*				
Michelinia? sp?	*	*					
Michelinia sp?	?	?	*	*			
Stenopora sp?	*	*					
Striatopora carbonaria			*	*	*		
Syringopora sp?	*	?	?	*	*		
Cyathaxonia winchelli	*	?	*	?	?		
Aulopora longi			*	*	?	?	?
Aulopora amplexa			*	*	*	*	*
Zaphrentis calceola	*	*	*	?	?	?	

	Chouteau Limestone	First L. Burlington Division	Second L. Burlington Division	Third L. Burlington Division	Fourth L. Burlington Division	Upper Burlington	Kookuk Limestone
Zaphrentis centralis					*	*	*
Zaphrentis elliptica		*	*	*	*		
Zaphrentis radicula					*		
Zaphrentis capuliformis					*		
Zaphrentis sp?	?	*	*	*	?	?	
Actinocrinus scitulus				*	*	*	
Actinocrinus verrucosus				*			
Actinocrinus sp?				*	*		
Actinocrinus sp?			*				
Actinocrinus sp?			*				
Cactocrinus caelatus			?				
Cactocrinus clarus			*				
Cactocrinus eryx				?			
Cactocrinus expansus				*			
Cactocrinus glans						*	
Cactocrinus proboscidialis		*	*	*			
Cactocrinus obesus						*	
Cactocrinus puteatus		*					
Cactocrinus springeri				*	*		
Agaricocrinus brevis		*	*				
Agaricocrinus louisianensis		*					
Agaricocrinus decornis				*	*		
Agaricocrinus pyramidatus		*	*				
Agaricocrinus bellatrema						*	
Agaricocrinus americanus						*	
Agaricocrinus gracilis						*	
Agaricocrinus inflatus						*	
Agaricocrinus pentagonus			*	?			
Agaricocrinus planoconvexus				*	*	?	
Agaricocrinus stellatus						*	
Agaricocrinus bullatus						*	
Amphoracrinus divergens			*	?			
Amphoracrinus spino-brachiatus			*				
Barycrinus sp?						*	
Barycrinus sp?				*	*		
Batocrinus aequalis			*				
Batocrinus subaequalis			*				
Batocrinus calvini		*					
Batocrinus clypeatus			*				
Batocrinus lepidus			*				
Batocrinus quasillus			*				
Batocrinus turbinatus			*				
Batocrinus rotadentatus		?	*				
Lobocrinus aequibrachiatus						*	
Lobocrinus pyriformis						*	
Lobocrinus longirostris		?	*				
Lobocrinus bulbosus		*	?				
Lobocrinus inflatus		*					
Lobocrinus dubius			*				
Lobocrinus dubius var pustulosus			*				
Lobocrinus insolitus			*				
Belemnocrinus sp?			*				
Calceocrinus dactylus			*				
Calceocrinus ventricosus			*				
Calceocrinus wachsmuthi			*				
Catillocrinus wachsmuthi						*	
Cyathocrinus gilesi						*	
Cyathocrinus iowensis						*	
Cyathocrinus formosus					*		
Cyathocrinus sp?						*	

	Chouteau Limestone	First L. Burlington Division	Second L. Burlington Division	Third E. Burlington Division	Fourth L. Burlington Division	Upper Burlington	Keokuk Limestone.
Cyathocrinus sp?			*				
Dichocrinus lineatus			*				
Dichocrinus pisum						*	
Dichocrinus plicatus							
Dichocrinus striatus						*	
Dichocrinus sp?							
Dichocrinus sp							
Dorycrinus cornigerus						*	
Dorycrinus intermedius						*	
Dorycrinus roemeri						*	
Dorycrinus missouriensis						*	
Dorycrinus unicornis		?	*	*	*		
Dorycrinus inflatus		*					
Dorycrinus pentalobus						*	
Aorocrinus wachsmuthi				*	*		
Aorocrinus parvus					?	*	
Aorocrinus subaculeatus			*				
Eretmocrinus carica			*				
Eretmocrinus caliculoides						*	
Eretmocrinus leucosia			*				
Eretmocrinus parvus			*				
Eretmocrinus brevis						*	
Eretmocrinus nodosus			*				
Macrocrinus coronatus			*				
Macrocrinus konincki						*	
Macrocrinus verneuilianus						*	
Macrocrinus sp?				*	*		
Gilbertsocrinus obovatus						*	
Gilbertsocrinus tuberculosus						*	
Gilbertsocrinus reticulatus			*				
Gilbertsocrinus fiscellus			*	*	*		
Megistocrinus evansi			*	?	?	*	
Ichthyocrinus burlingtonensis		*	*	*	?		
Graphiocrinus sp?							
Physetocrinus ornatus		*	*				
Physetocrinus ventricosus				*	*	*	
Platycrinus asper						*	
Platycrinus Americanus			*				
Platycrinus burlingtonensis	*	?	*				
Platycrinus cavus						*	
Platycrinus corrugatus							
Platycrinus discoideus			*				
Platycrinus excavatus			*				
Platycrinus halli						*	
Platycrinus incomptus						*	
Platycrinus per-asper							
Platycrinus pileiformis			*				
Platycrinus planus		?	*				
Platycrinus pocilliformis			*				
Platycrinus regalis			*				
Platycrinus scobina			*				
Platycrinus subspinosus			*				
Platycrinus corbuliformis		*					
Platycrinus marginatus						*	
Platycrinus pisum			*				
Platycrinus planobasilis						*	
Platycrinus lautus		*					
Eucladocrinus pleurovimineus						*	
Eucladocrinus altidorsatus						*	
Eucladocrinus occidentalis						*	

	Chouteau Limestone	First L. Burlington Division	Second L. Burlington Division	Third L. Burlington Division	Fourth L. Burlington Division	Upper Burlington	Keokuk Limestone.
Eucladocrinus millebrachiatus						*	
Eucladocrinus praenuntius						* *	
Eucladocrinus tuberosus						*	
Poteriocrinus waltersi		*					
Poteriocrinus sp?			*				
Poteriocrinus sp?			*				
Poteriocrinus sp?			*				
Rhodocrinus barrisi						*	
Rhodocrinus whitei			?				
Rhodocrinus wortheni			*				
Saccocrinus amplus						*	
Steganocrinus araneolus			*				
Steganocrinus concinnus						*	
Steganocrinus pentagonus			*	*	*	*	
Steganocrinus sculptus			*				
Strotocrinus glyptus						*	
Strotocrinus regalis						*	
Symbathocrinus brevis			*				
Symbathocrinus dentatus						*	
Symbathocrinus papillatus			*				
Symbathocrinus wortheni			*				
Taxocrinus thiemi			*				
Teleiocrinus aegilops						*	
Teleiocrinus liratus						*	
Teleiocrinus umbrosus						*	
Zeacrinus elegans			*	*	?		
Zeacrinus troostanus			*?			*	
Zeacrinus faggi						*	
Zeacrinus sp??				*	*		
Archaeocidaris agassizi			*	*	*		
Archaeocidaris sp?		*					
Codaster gracillimus			*				
Codaster grandis						*	
Codaster superbus						*	
Codaster laeviculus						*	
Codonites stelliformis			*				
Codonites sp?			*				
Lophoblastus marginulus				*			
Lophoblastus inopinatus		*	*				
Lophoblastus aplatus				*	*		
Lophoblastus neglectus		?					
Carpenteroblastus magnibasis						*	
Carpenteroblastus stella						*	
Carpenteroblastus pentalobus				*	*		
Carpenteroblastus pyriformis						*	
Cryptoblastus melo		*	*	*			
Granatocrinus norwoodi					?	*	
Granatocrinus projectus			*				
Granatocrnus exiguus			*				
Granatocrinus concinnulus			*				
Granatocrinus calycinus						*	
Schizoblastus sayi					*	*	
Pentremites elongatus						*	
Metablastus lineatus			*	?	?	*	
Coscinium latum			*				
Evactinopora grandis			*				
Evactinopora radiata					*	*	
Evactinopora sex radiata			*				
Fenistella burlingtonensis			*				
Fenistella filistriata							

	Chouteau Limestone	First L. Burlington Division	Second L. Burlington Division	Third L. Burlington Division	Fourth L. Burlington Division	Upper Burlington	Keokuk Limestone
Layropor retrorsa			*				
Polypora burlingtonensis							
Rhombopora ramulosa			*				
Ambocoelia levicula							
Athyris incrassata			*				
Athyris lamellosa			*	*	*	?	
Athyris hannibalensis?			*	*	*	?	*
Athyris tenuilineata			*				
Camarophoria sp?			*				
Centronella rowleyi			*				
Centronella emaciata			*				
Chonetes logani			*	*	*		
Chonetes sp?			*				
Chonetes sp?			*				
Crania sp?			*				
Cyrtina burlingtonensis			*				
Seminula bisinuata			*				
Hustedia pygmaea			*				
Eumetria? perstrialis			*				
Acambona prima			*				
Lingula sp?			*				
Nucleospira obesa			*				
Rhipidomella burlingtonensis	*	*	*	*	?		
Rhipidomella diminutiva			*				
Schizophoria swallovi			*				
Retzia raricosta			*				
Camarotoechia elegantula			*				
Terebratula? fabulites			*				
Dielasma burlingtonensis			*	*	*		
Pugnax obtumwa			*	*			
Leiorhynchus boonensis			*				
Rhynchonella? sp?			*				
Rhynchonella? sp?			*				
Productus arcuatus?			*				
Productus cora?			*				
Productus burlingtonensis			*	*	*		
Productus punctatus?			*				
Productus semireticulatus	*	*	*	*	*	*	*
Productus viminalis?			*				
Productus sp?		*	*				
Productus sp?			*				
Productus sp?			*				
Spirifer forbesi			*				
Spirifer grimesi	*	*	*	*	*	*	?
Spirifer imbrex			*				
Spirifer incertus			*				
Spirifer marionensis?	*	*					
Spirifer meeki			*				
Spirifer nova-mexicana?			*				
Spirifer peculiaris?			*				
Spirifer striatiformis			*				
Spirifer temeraria				*			
Spirifer mundulus			*				
Spirifer insculptus				*			
Spirifer carinatus				*			
Spirifer schucherti			*				
Spirifer louisianensis			*				
Spirifer pikensis				*	*		
Spiriferina binacuta			*				
Spiriferina subtexta			*				

	Chouteau Limestone	First L. Burlington Division	Second L. Burlington Division	Third L. Burlington Division	Fourth L. Burlington Division	Upper Burlington	Keokuk Limestone
Spiriferina solidirostris			*	*	*		
Syringothyris typa?		*	*	*	?	?	?
Syringothyris plena				*	*	?	
Reticularia lineatoides			*	*	*		
Reticularia pseudolineata						*	*
Orthothetes? sp?			*				
Conularia sp?			*				
Bellerophon sp?			*	*			
Dentalium sp?			*				
Eccyliomphalus sp?			*	*	*		
Euomphalus latus	*	*	*	*	*	?	
Euomphalus ammon			*				
Euomphalus roberti			*				
Euomphalus springvalensis			*				
Loxonema sp?			*				
Loxonema sp?			*				
Macrochilina tantilla			*				
Macrochilina keyesi			*				
Capulus biseriale			?				
Capulus capax			?				
Igoceras capulus						*	
Capulus latus			*				
Capulus obliquus			*				
Igoceras quincyense						*	
Strophostylus reversus						?	
Capulus tribulosus						*	
Pleurotomaria subcarbonaria			*				
Pleurotomaria montezuma			?	*	?		
Pleurotomaria sp?			*				
Porcellia sp?			*				
Porcellia nodosa			*				
Cyrtolites bennetti			*				
Aviculopecten burlingtonensis			*				
Aviculopecten sp?			*				
Aviculopecten sp?			*				
Aviculopecten sp?			*				
Cardiomorpha sp?			*				
Cardiopsis sp?			*				
Conocardium spinalatum			*				
Crenipecten sp?			*				
Crenipecten sp?			*				
Cypricardella sp?			*				
Cypricardia sp?			*				
Edmondia nuptialis			*				
Edmondia burlingtonensis			*				
Nuculites sp?			*				
Pernopecten cooperensis			*				
Pernopecten sp?			*				
Prothyris meeki			*				
Sanguinolaria sp?			*				
Sanguinolites burlingtonensis			*				
Sphenotus sp?			*				
Grammysia imbricata			*				
Grammysia sp?			*				
Spirorbis? dubius			*				
Cyrtoceras sp?			*				
Goniatites sp?						*	
Goniatites sp?			*				
Goniatites sp?			*				
Nautilus sp?			*				
Orthoceras sp?			*				

THE KEOKUK LIMESTONE.

This formation is found only in the southwestern part of the county and the best exposures are on Indian creek where the rock consists of bands of limestone and chert, separated by thin shaly partings. The limestone bands are used in walling wells and rough masonry.

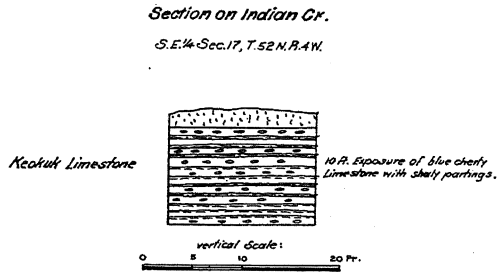


Fig. 13.

Locally, the Keokuk is quite fossiliferous. There are less than twenty-five feet of this rock at any outcrop in the county and it probably represents the base of the series although the contact with the Burlington has not been observed.

The following list of fossils is arranged from collections made along the East Fork of Indian creek in T. 52N., R. 4W., Sec. 16, S. W. quarter, about one and a half miles northeast of New Harmony:

Amplexus sp?
" sp? (spiny)
Aulopora sp?
Syringopora harveyi?
Zaphrentis dalei
" spinulifera
" centralis
Archaeocidaris sp?
Barycrinus stellatus
" sp?
" sp?
Batocrinus abscissus
" sweeti
" gurleyi
Dorycrinus gouldi
Granatocrinus granulosus
" excavatus

Oligoporus danae
Actinocriuus lowei
Tricoelocrinus wortheni
Archimedes owenanus
" grandis
" negligens
Coscinium asterium
" escharoides
" tuberculatum
Cystodictya sp?
Fenistella sp?
" sp?
Glauconome sp?
Hemitrypa sp?
" sp?
" sp?
Polypora sp?
Ptilopora sp?
Rhombopora sp?
Taeniodictya ramulosa
Athyris lamellosa?
Spirifer pseudolineata
Derbya robustum
Conularia sp?
Platyceras sp?
Fish spine. (Gen? sp?)
Productus semireticulatus
Spiriferina sp?

THE PENNSYLVANIAN.

We have noticed but one outcrop of Coal Measure rocks in the county and that is along a little brook, four miles northeast of Curryville, in the southern part of Sec. 1, T. 53N., R. 4W. Two feet of shaly limestone are here exposed and the fossils are scattered along the branch.

The following is a list of fossils collected:
Axophyllum rude
Archaeocidaris sp?
Seminula argentea
Athyris hirsuta

Chonetes mesoloba
" verneuiliana
" sp?
Productus longispinus
Productus punctatus
" semireticulatus
Spirifer cameratus
Spiriferina Kentuckiensis
Reticularia lineata
Derbya crassa
Crinoid stems (Gen? sp?)
" spines and plates. Gen? sp?

CHAPTER V.

RESUME OF STRATIGRAPHY. STRUCTURES.

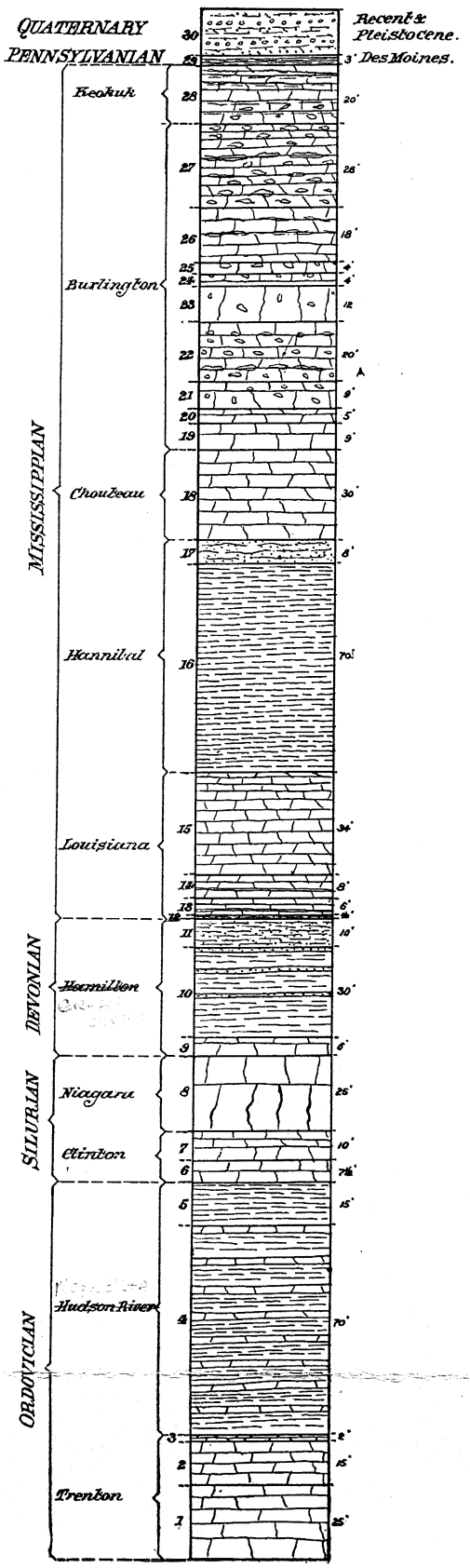
The distribution of the various geological formations is shown on the accompanying geological map. The mapping has been done without an accurate topographic base, dependence being placed upon land lines for the determination of locations. An attempt to transfer the geology of this map to the "Louisiana" topographic sheet of the U. S. Geological Survey would be futile, since the scale of the latter is too small to represent formations of less thickness than fifty feet.

In as much as there has always been more or less doubt as to the age of certain beds in the county, I give below a table of the various formations with the range of the various passage species of fossils with the hope that some light may be thrown on the subject.

These results are based upon my own research and study. Where I have been at all in doubt or upon the authority of others I have used an interrogation point in place of a star.

	Trenton	Hudson River.	Clinton	Hamilton	Louisiana	Hannibal	Chouteau	Burlington	Keokuk	Coal measures.
Halysites catenulatus	*		*							
Monticulipora (several species)	*	*								
Plectambonites sericea	*	*	?							
Platystrophia lynx (var)	*	*								
Dalmanella testudinaria	*	*	*							
Raphinesquina alternata	*	*								
Strophomena filitexta	*	*								
Bellerophon bilobatus	*	*	?							
Muchisonia gracilis	*	?	*							
Zygospira recurvirostris	*	*								
Murchisonia bicincta	*	*								
Asaphus megistos	*	*								
Strophomena rhomboidalis	?	?	*	?			*	*		
Fish teeth, Gen? sp?				*	*					
Goniatites sp?					*	*		?		
Grammysia hannibalensis					*	*		?		
Spirifer marionensis					*	*	*	*		

GENERAL GEOLOGICAL SECTION OF PIKE COUNTY.



	Trenton	Hudson River	Clinton	Hamilton	Louisiana	Hannibal	Chouteau	Burlington	Keokuk	Coal measures
Syringothyris hannibalensis					*	*		?		
Cyrtina acutirostris					*	?	*			
Athyris hannibalensis					*		*	*		
Productella pyxidata					*	?	?			
Rhipidomella missouriensis					*	?				
Orthothetes lens					*	?				
Ptychostylus subtumidus				?	*					
Spiriferina clarksvillensis					*					
Loxonema sp?						*	*	*		
Euomphalus latus						*	*	*		
Derbya sp?						*	*	*		
Amplexus bicostatus						?	*	*		
Leptopora expansa							*	*		
Syringopora harveyi							*	*	*	
Zaphrentis calceola							*	*		
Zaphrentis elliptica							*	*		
Cyathaxonia winchelli							*	*		
Aulopora amplexa							*	*	*	
Zaphrentis centralis								*	*	
Productus semireticulatus							*	*	*	*
Productus punctatus							?	?	?	*
Platycrinus burlingtonensis							*	*		
Spirifer grimesi							*	*	*	
Reticularia pseudolineata							?	*	*	
Porcellia nodosa							?	*		
Barycrinus stellatus								?	*	
Athyris lamellosa							?	*	*	

From this table will be seen the close relationship between the Trenton and Hudson River in their faunae; the nearer relationship of the Clinton and Niagara faunae to the Hudson River than to the beds above; the great likeness in the fauna of the Louisiana and the Hannibal and the wide gap between both and the Chouteau; the very close relation between the Chouteau and the Burlington.

STRUCTURES.

The chief geological structure of the county is the so-called Trenton "backbone," which appears to be an arch or anticlinal fold that crosses the southern boundary from Lincoln county and extends northwestward through Pike into Ralls county west of Salt river. It is nowhere nearer the Mississippi than two or three miles as shown by the occurrence of Hudson River shale in the beds of the creeks at their mouths.

The cutting into this uplift by the Mississippi and its tributary streams has made it possible to study and work out the formations lying above the Trenton limestone and the weathering

agencies have made more fascinating still the study of the faunas of these geological horizons.

This arch appears to be broken between the head waters of Peno creek, south of McCune Station and the head waters of Buffalo creek, east of Cyrene, since Grassy and Noix creeks having their sources in this intervening region, nowhere expose the Trenton limestone.

This arch extends into Ralls county beyond New London but has not been traced further than this by the writer.

It may have some connection with the Trenton arch of northwestern Illinois and eastern Iowa and is almost certainly connected with the Ozark uplift of southern Missouri.

Faults. Evidences of a somewhat extensive fault have been noticed near Cuivre river, about two and a quarter miles southwest of Ashley in Sec. 4, T. 51N., R. 3W. In the creek bed are a few feet of rather thin limestone bands standing edgewise like paving blocks with Burlington limestone in horizontal position adjacent while on the other side in the creek bank are a few feet of what appears to be Hannibal shale overlain by a yellow earthy limestone, possibly Chouteau.

The age of these rocks, except in the case of the Burlington limestone, could not be determined definitely at the time, from lithological characters and no fossils could be found. Near the south line of Sec. 3 in the same township, vertical strata were observed again but apparently with only Burlington limestone visible.

Following the strike of this apparent fault line, in company with Dr. C. R. Keyes, we observed a line of sinks and gaping vertical breaks, which in the writer's mind are evidences of a continuation of the great Cap au Gris fault which, a number of years ago, I had the pleasure of studying and tracing to the hill just north of Winfield. Later, piloted by Dr. Knox of Auburn, the writer again found this fault line a few miles southwest of Auburn, in Lincoln county.

Some years ago, a stock company was formed at Curryville, Missouri, to dig for coal which it was believed could be reached inside of a hundred feet, since a paying mine had been in operation at Vandalia, nine miles further west for some years. Curryville is on the high prairie with Burlington limestone in the creek bed, two miles north and Chouteau outcropping in the immediate vicinity, east and south.

The writer believed that Burlington limestone in place would

be reached inside of forty feet, being positive that the Coal Measures was absent. To the contrary no rock in place was struck till the shaft had reached a depth of one hundred feet when Hudson river shale with characteristic fossils was encountered. Within a few feet of the surface, chert fragments and a few small slabs of limestone were thrown out with the yellow sticky clay.

The Hudson river shale should have been from two hundred to two hundred and fifty feet below the surface at this place and the various formations between the Keokuk limestone and that horizon should have been passed through in sinking the shaft. The shaft may have been sunk in a filled up stream bed, or perhaps it was along the line of disturbance marked by the fault above referred to.

CHAPTER VI.

ECONOMIC CONSIDERATIONS.

FORESTRY.

Much of the best timber in the county was destroyed or worked into rails and building material during the original clearing up of the land. Despite the great destruction which was accomplished at that time and during the subsequent period, the hills and valleys still produce much desirable timber, especially the bottom lands along Salt and Mississippi rivers. Considerable of the upland is still covered with white and black oak, shell bark and white hickory, black walnut, ash, elm, linden and sugar tree, while in the bottom lands the sycamore, white walnut, soft maple, birch, pecan, hickory, elm, honey locust and burr oak still thrive.

A Stave and Heading Factory at Louisiana is engaged in working up native timber into useful products and as an enterprise that saves timber which would otherwise be wasted as stove wood, it should be encouraged.

The La Crosse Lumber Company, under the management of F. W. and C. G. Buffum, has long been one of the chief enterprises of the city of Louisiana.

BUILDING STONE.

The Burlington limestone is the best stone for building purposes to be found in the county. For many years it has been extensively quarried at Louisiana and to some extent at Clarksville and Bowling Green.

Next to the Burlington in importance is the Clinton brown and blue limestones quarried one mile northeast of Bowling Green and used for foundations and a variety of other purposes. Both of these stones are very durable and easily quarried.

The quarries at Louisiana, Bowling Green and Clarksville are described in detail in Vol. II, 2nd Series, of the reports of the Bureau. These descriptions include analyses and physical tests of the stone, demonstrating their suitability for building constructions.

PORTLAND CEMENT.

The hills in the vicinity of Louisiana, Clarksville and Ashburn contain practically inexhaustible quantities of limestones and shales well suited for use in the manufacture of Portland cement. Moreover the limestone and shale are so located on the hillsides that they can be handled by gravity, eliminating much of the expense of mining. This will be understood when it is recalled that the Burlington limestone caps the hills and is underlain with from 60 to 70 feet of Hannibal shale. Dr. Carpenter of Cornell University, once said in my presence that while the Hannibal shale contained a little more sand than he would like, yet a proper combination could be made with the Burlington limestone to give a good cement. Below the Hannibal shale is the Louisiana limestone, devoid of chert, forty feet thick and without magnesium. It has occurred to the writer that this limestone might be used after the Burlington limestone and Hannibal shale have been removed.

Rejecting the few feet of Genesee shale and Clinton limestone the second great shale, the Hudson river, is still 25 to 70 feet above the level of the valley.

This is the shale that is being used by the Atlas Portland Cement Company at their works south of Hannibal and much of that supply is quarried a few miles north of Busch in Pike county.

The Mississippi Valley Portland Cement Company after purchasing the range of hills along the south side of Noix creek beyond the Dodge place, in 1903, began the construction of a Portland cement plant, but for some unexplained reason work was suspended and has not yet been renewed.

A few months ago, the *Union City Portland Cement Company* of Michigan, bought the hills on both sides of the Louisiana and Frankford gravel road, at the Tanyard Branch crossing, two miles northwest of Louisiana, and have given notice that work on the construction of a Portland cement plant will begin very soon.*

Considerable capital has been invested in these plants and it is thought that it will be only a few years until this county will take her place among the leading producers of Portland cement.

CLAY.

While there are considerable beds of brown clay along some of the streams; blue clay from the decomposition of the Hudson

*The reader is referred to Vol. VI, 2nd Series of the reports of this Bureau for a detailed discussion of lime and cement resources of Missouri.

river shale; and red clay from the destruction of limestone, no use has ever been made of these except in the manufacture of ordinary red brick.

A bluff of brown clay of considerable thickness occurs on the right side of the Louisiana and Frankford gravel road just east of the Tanyard Branch. Higher bluffs and slopes of red and yellow clay, with bands of gravel, occur along the north bank of Noix creek west of the Igo Ford. The abundance of excellent shale in this county should serve as an attraction to a variety of clay working industries. The shales are of excellent quality and H. A. Wheeler in Vol XI of the reports of this Bureau states his belief that the Hannibal shale "would make a good quality of paving brick." It is our impression that there is stored in the shale deposits of this county materials for a variety of clay working industries.

COAL.

The writer has seen one small outcrop of Coal Measure rocks in this county. Although reports have been received of the finding of chunks of coal in several localities in the western and southwestern townships, I have never seen an outcrop of coal in this county. It is possible, however, that pockets of coal may be found in the Indian creek country.

METALS.

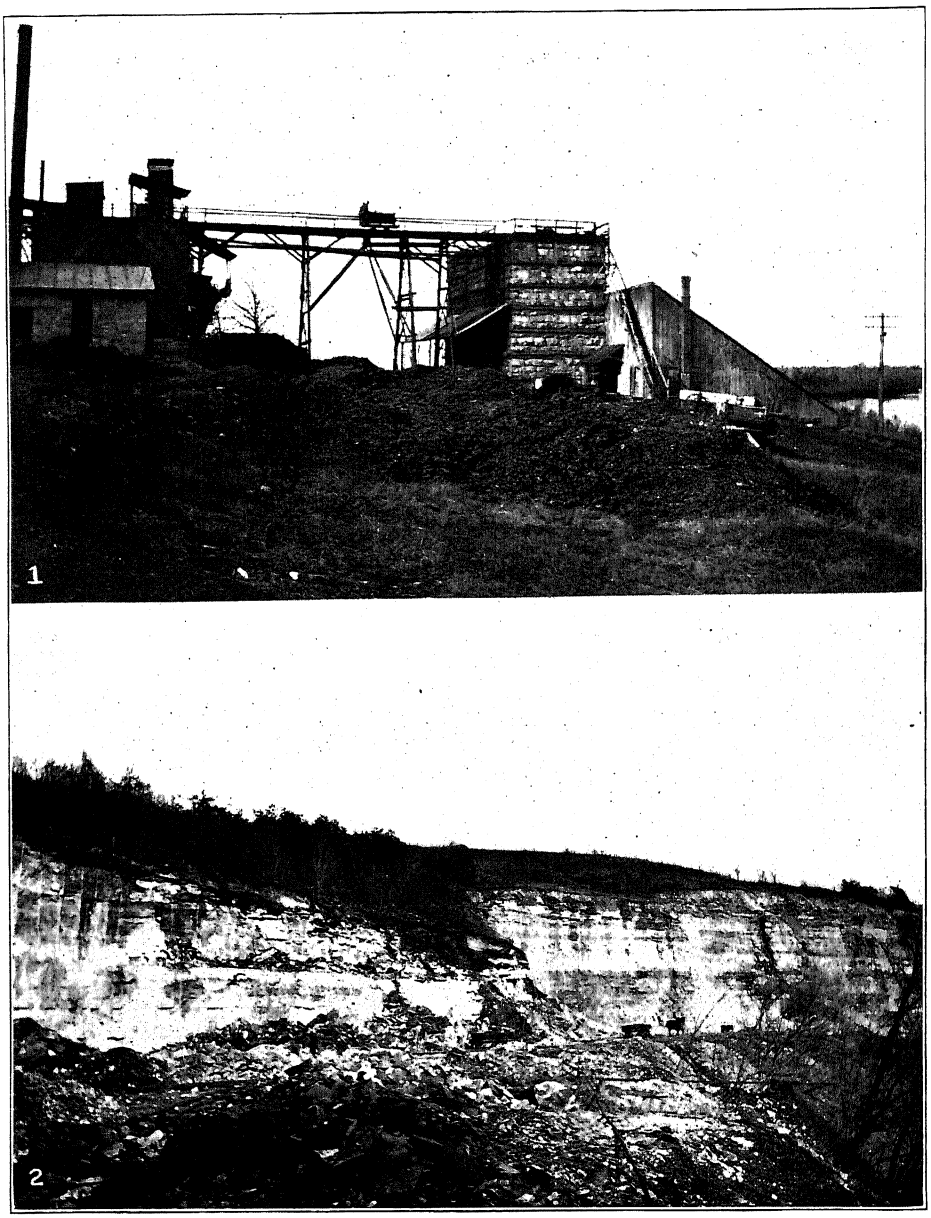
Probably the only metallic minerals of interest to be found in the county are iron pyrites and zinc blende. The former, as fool's gold is familiar to everybody as occurring in small quantities in most of the shales.

Zinc blende occurs in small pieces in the Hudson river shale and Clinton limestone, but not in paying quantities.

QUICKLIME.

Louisiana was once quite a lime manufacturing center and the remains of the old kilns are still to be seen on the hillsides. At present there is only one plant in operation. This is located at the mouth of Salt river and is owned and operated by the Marblehead Lime Company. The finest exposure of Burlington limestone in the county is located at this place and the company not only burns lime but crushes the stone for use in concrete.

The decline in the quicklime industry of this county is not due



1. Kilns, Marblehead Lime Co., Louisiana, Mo.
2. Quarry, Marblehead Lime Co., Louisiana, Mo.

to a want of suitable materials. There is sufficient limestone, close to transportation, for the production of unlimited quantities of lime. With proper enterprise and judicious encouragement this industry should develop into a source of great revenue.

ROAD MATERIALS.

Pike county is famous for her good roads, the principal towns being connected by graveled turnpikes. The creek bottoms furnish chert gravel and rounded bits of hard Hudson River shale, which from its excellence and abundance renders road making much less expensive than in many counties.

At Louisiana a substitute for the gravel is found in crushed Louisiana limestone and the waste of the quarries in the Burlington limestone. The quarry debris consists of limestone, clay and chert, and with this the streets are often repaired.

With the introduction of rock crushers, the matter of road making has been somewhat simplified, as any and all kinds of rock can be converted into road material.

The cheapness of the materials used in street paving should not control too far their use. The initial expense of macadamizing a street or road is frequently more than balanced by the cost of maintenance. The Burlington limestone, unless mixed with a goodly proportion of chert is too soft. The Louisiana limestone is much better, but this should not be used except when mixed with crushed chert or chert gravel. The reader, who is interested in road improvements is referred to Vol. V, 2nd Series of the reports of this Bureau for a much fuller discussion of this subject.

SAND.

All of the sand in Pike county has a yellowish or brownish color and is found along the creeks and in the bars of the Mississippi river. It is used only in mortar and as foundations for cement sidewalks.

SOILS.

The soils of this county comprise the (1) alluvial, (2) residual and (3) glacial. The alluvial soils are mainly of recent origin and are among the most fertile in the state. They are confined to the bottom lands of the rivers and larger streams and have the greatest expanse along the Mississippi and Salt rivers. Some of these bottom lands are subject to overflow and therein is one of the reasons for their perpetual fertility.

The residual soils occur chiefly in the eastern and southeastern portions of the county and are found along the slopes and tops of the ridges and hills in that part of the state. The soil at any particular place is dependent upon the composition of the formations which at one time overlay that place but have been removed through decomposition.

The glacial soils cover a greater part of the county. They consist of modified local residual soils to which have been added materials brought in by the ice sheet which at one time covered much of the area of the State.

WATER SUPPLY.

The city of Louisiana is supplied with water from the Mississippi river, the reservoir being on the top of a hill two hundred feet above low water in the river, so that the head is higher than that of most other city supplies. A good filter renders the water quite clear and wholesome.

Both in Louisiana and throughout much of the eastern part of the county are wells of living water and cisterns or wells lined with hydraulic cement and holding rainwater caught from the roofs.

On the prairie, the inhabitants either resort to borings for their supply of water or uncemented cisterns, since the under clay holds water like a "jug," as they express it. There are, however, some cemented cisterns.

Where springs abound a healthful supply of water is furnished those living near.

The supply of stock water is chiefly obtained from running streams, wells, springs and artificial ponds.

Many of our creeks have sufficient volume of water and enough fall to run corn mills and there are a number of these old mill sites still to be seen in the county, although none are now in operation, so far as the writer knows.

FARM PRODUCTS.

As mentioned before in connection with the natural divisions of the county, the soils of the alluvial areas of the Mississippi river and the valleys of the creeks are unsurpassed in fertility and yield immense crops of wheat, corn and hay while the prairie land produces corn, oats and hay in quantity.

Of the minor crops, potatoes and melons take the lead. The western part of the county adds to its agriculture, stock raising and Bowling Green and Curryville are the chief shipping points of cattle, hogs and horses. The mule, so inseparably connected with Missouri is not the least of our live stock products.

The grades of horses as well as of cattle are the best and claim the highest market prices. Sheep are raised in many parts of the county and thousands of pounds of poultry are shipped from the railroad towns.

The products of the orchard, while as varied as those of any other region in the same latitude, are chiefly apples.

Truck gardening and the raising of small fruits are carried on to some extent in the neighborhood of Louisiana and Bowling Green.

Two miles southwest of Louisiana on the Louisiana and Bowling Green gravel road and the Chicago and Alton R. R., is located the Stark Bros. Nurseries and Orchards Co., having a paid up capital stock of $1,000,000.

ROADS AND OTHER MEANS OF COMMUNICATION.

Three railroads cross the county, the Chicago, Burlington and Quincy which follows the west bank of the river; the Chicago and Alton which crosses the Mississippi river at Louisiana and running southwest and west, enters Audrain county just west of Curryville; and the St. Louis and Hannibal which passes through Frankford, McCune, Bowling Green, Cyrene, Edgewood and Eolia and on southeast through Lincoln county to St. Louis. The towns and stations on the Burlington Route are Busch, La Motte, Ashburn, Loves, Louisiana, Clarksville, Starkdale and Annada. On the Chicago and Alton the stations are Louisiana, Watson, Bowling Green and Curryville.

Fine gravel roads connect Louisiana with Frankford, Bowling Green, Clarksville and Eolia; Bowling Green with Ashley; and Clarksville with Turpin and Paynesville.

Good dirt roads traverse the county in various directions following the ridges or the streams across country in the hilly parts of the county and usually running north and south or east and west, sometimes along section lines, in the more level western plateau region.

The Mississippi river furnishes another means of transportation, a line of steamboats plying between Keokuk and St. Louis.

CHAPTER VII.

PALEONTOLOGY.

The formations of Pike county are rich in fossils, beautifully preserved and in most case easily identified. Scattered throughout the geological literature of the last half century one will find descriptions of fossils from the formations of this county.

In the following pages the writer has not attempted to supply descriptions of all the species of fossils which have been found in the formations of this county. To have done this would have made this volume too large to serve the purpose for which it is intended. Lists of all fossils found in the several formations are given on the preceding pages.

The fauna of the Louisiana limestone is given special prominence in this report since this formation, which is of very limited areal extent, is typically represented in this county.

The trilobites of the Ordovician also have sufficient interest to warrant the prominence given them in the following descriptions.

DESCRIPTION OF ORDOVICIAN TRILOBITES OF PIKE COUNTY, MISSOURI.

(See Plate XV.)

While the Ordovician rocks of Pike county are not prolific in Crustacean remains, fragments of a few species of Trilobites are not rare and, occasionally, an entire specimen is found.

A few of the most perfect individuals in the writer's collection are figured on the accompanying plate.

An entire specimen of Asaphus, eleven or twelve inches long, found on Calumet creek, many years ago, for a long time a part of the Van Horne collection is now in the collection of the University of Chicago.

Almost entire specimens of a beautiful species of Ceraurus have been obtained by the writer from the soft Trenton cherts of Lincoln county and it is almost certain that the same species oc-

curs at the same horizon on Sulphur creek near the Pike and Lincoln line but the material is too meager to determine.

There is no class of fossils more coveted by the amateur collector nor more admired by people in general than the tribolite.

For this reason we have introduced plate VI into this report.

ILLAENUS TAURUS, Hall.

(Pl., XV, Fig. 1.)

While our specimen differs somewhat from Hall's type, it comes nearer that species than any other with which we are acquainted.

The entire surface is perfectly smooth. The cephalic shield is very convex. Glabella hardly defined toward the front.

The eyes are rather large and at a distance from the glabella, in fact, they are located decidedly laterally but unfortunately both eye-stalks have been broken from our specimen. The thoracic segments are ten. The depression between the axis and lateral lobes is well defined, the axis being much wider than the lobes.

The pygidium is strongly convex and superficially resembles the head-shield.

This specimen was figured by Dr. C. R. Keyes in the IV Missouri Report as doubtfully *Illaenus insignis.*

The credit for collecting and loaning this fossil should have been given to Mr. Ralph Sweet by the State Geologist and at this late date we wish to call attention to that oversight.

The specimen was found by the above named person, now Dr. Ralph Sweet of Providence, R. I., in the upper part (*Receptaculites oweni* Horizon) of the Trenton limestone at McCune Station, Pike county, Missouri.

ASAPHUS GIGAS, Dekay.

(Pl. XV, Fig. 2.)

Pygidia and other fragments of this trilobite are not uncommon in the Hudson flags but entire specimens, even as young individuals, are seldom found.

The head is convex and somewhat semi-elliptical. The lateral cephalic angles not produced into spines as in the next species. Entire body apparently smooth. The number of segments in the thorax are eight.

The axis hardly distinguishable from the lateral lobes by any perceptible depression.

The eyes are large, apparently round, and close to an illy defined glabella.

The pygidium is almost semi-circular and somewhat like the head, with a broad illy defined margin.

The figured specimen is from the middle beds of the Hudson shale on the bank of the Mississippi river, about six miles below Louisiana.

It is mounted on the split surface of a flag and preserves, in part, the test.

On the figured specimen, the continuation of the axial lobe onto the pygidium is somewhat semi-circular and hardly defined.

ASAPHUS MEGISTOS, Locke.

(Pl. XV, Fig. 3.)

Like the preceding specimen, this one is from a split Hudson flag and preserves most of the test.

The head is apparently semi-circular, if our restoration of the front of he cephalic shield, somewhat injured in the specimen, is correct, as indicated by the dotted line. The convexity of the head shield is not great and the glabella poorly defined. The eyes are large and either side of the glabella at its posterior contraction. The lateral angles of the head shield are produced into spines that reach to the sixth thoracic segment. There are eight throacic segments.

The axis is scarcely wider than the lateral lobes and separated from them by shallow depressions.

The pygidium is almost semi-elliptical, smooth and with a wide depressed margin and a rapidly contracting continuation of the axis.

This specimen was found in a flag near the top of the Hudson shale on Calumet creek by Mr. Fred Crenshaw who very kindly traded it to the writer. Both this specimen and that of *A. gigas* are young individuals.

LICHAS TRENTONENSIS, Conrad.

(Pl. XV, Figs. 4 and 5.

We have figured a specimen, preserving the greater part of the head.

The glabella is composed of three strongly convex lobes and the surface beautifully ornamented by small pustules or large

granules. The lateral parts of the sephalic shield as well as the front margin are wanting in the figured specimen.

From the middle beds of the Trenton at Frankford, Missouri.

ILLAENUS SP?

The specimen is half rolled and somewhat injured at the front of the pygidium.

The surface is smooth. The head strongly convex and more or less circular at the front.

The glabella not defined. Peculiar lunate depressions and elliptical elevations, one on either side of the head, between the eyes, in line with the furrow separating the axis from the lateral body lobes, are strangely eye-like. The eyes, however, are located laterally and are rather large. There are ten thoracic segments, smooth and with no apparent furrow to separate the axis from the lateral lobes except where the test is removed, as on the left side of the drawing. The pygidium is convex, semi-circular but less than the head in size. The suture separating the cheek from the head shield is shown in Figure 8 and a small piece of the test partially surrounding the eye stalk.

On the cast of the pygidium, the extension of the axial lobe is rapidly contracted to a narrow spear-head-shaped depression.

A portion of the front of the pygidium and back of the thorax is injured as indicated in the picture.

The writer found this specimen in the upper part of the Trenton limestone (*Murchisonia major* Horizon) at McCune Station.

ILLAENUS SP?

(Pl. XV Figs. 9, 10 and 11.

It is possible that this species may be *I. taurus*.

The specimen is rolled and devoid of test.

The head shield is somewhat semi-circular with the glabella distinctly convex behind but not defined in front. The facial sutures are as illustrated. The eye-stalks strong and located at the lateral margin. The thoracic segments are ten and the body lobes well defined by strong furrows. The axial body lobe much wider than the lateral lobes.

The pygidium is much like the head in shape but smaller.

This fine specimen was found by a Mr. Vandervelt and sold to the writer.

The locality is Buffalo creek and horizon, above the middle beds of the Trenton limestone.

GEN.? SP?

(Pl. XV, Figs. 12, 13 and 14.)

The body of this small trilobite is almost flat, elliptical in outline, smooth except the glabella which is apparently ornamented by microscopic granules; at least, such ornamentation is apparently present on the inner surface of the test, as minute pits. The head is almost semi-circular and trilobed, the glebella being convex and almost circular in shape.

Two small elliptical lobes are at the rear of the glabella. The thorax has five or six segments. The axial lobe is considerably narrower than the lateral. The axial segments on the pygidium are six or more, the back ones more or less obsolete. The axis tapers little to the posterior end of the body. No sign of an eye can be seen on any of the specimens, either on the test or cast.

Specimens of this little trilobite are not rare in the lower beds of the Hudson shale four or five feet above the top of the Trenton limestone. The figured specimens are found by splitting into fine leaves the softer layers of the dark shale.

Specimens like our Figs. 12, 13, 14 were collected, some years ago, at the same locality as our material, by Mr. Ray S. Bassler of the U. S. National Museum and, if the species is a new one, doubtless Mr. Bassler has described it but if he has published anything, we are not aware of the fact. In the possession of six thoracic articulations and five or six pygidial furrows on the axis, our little trilobite agrees with Trinucleus but on no one of the many specimens yet found is there any appearance of the broad cephalic border of T. concentricus. Further, the axis on our specimens is wider than in the above species and the head much less convex. Our specimens, however, may be somewhat crushed as our Figure 13 seems to show.

THE INVERTEBRATE FAUNA OF THE LOUISIANA LIMESTONE.

In the present paper the writer has endeavored to illustrate and describe, sufficient for identification, the various fossil invertebrate forms that occur in the Louisiana limestone in Pike county, Missouri. Since this formation, as it is now known lithologically and paleontologically, represents a horizon which is confined to the boundaries of three counties in eastern Missouri, this monograph will be found to be practically complete as to the invertebrate fauna of the formation.

Since 1855, the various species, here brought together for the first time, have been described and figured in geological reports and bulletins in five or six different states and these publications, in many cases, are out of print or difficult to obtain.

It is mainly the Missouri student of paleontology, therefore, that this publication is intended to help and, incidentally, workers in other states.

Considerable collections have been made at different times by different collectors at Hannibal, Louisiana and Clarksville and such well known geologists as Hall, Swallow, Worthen, Gurley, Weller and Girty, have paid visits to these places carrying away fossil treasures.

Others as Prof. Winchell, Dr. White, Dr. Beecher, Prof. Clark and Dr. Schuchert have received and worked over supplies of fossils, while Mr. D. K. Greger of Fulton has been a frequent visitor to the various localities and has collected much material.

Small collections of late years have been made at Louisiana by Prof. Alonzo Jeffries and Mr. E. A. Dodge.

The writer, in a long series of years, has brought together by far the largest and finest of all these collections, and, in the present review of the subject, has found it necessary to add a few new species to the list.

The beds at Hannibal are practically covered up and have yielded nothing for many years. At present there is no collector at Clarksville and the exposures are few and collecting unsatisfactory.

A number of years ago, Dr. Reynolds, a dentist, made quite a collection of fossils at Clarksville but whether he or some other person supplied Professors Winchell and Hall and Dr. White with their material for description from that place is unknown to the writer.

PLANTAE?, PORIFERA, COELENTERATA, CRINOIDEA AND BRYOZOA.

ZAPHRENTIS PARASITICA, Worthen.

(Pl. XVI. Figures 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14.)

"Corallum small, truncated at the lower extremity, slightly expanded and compressed; breadth of the calice a little more than the length; surface marked with strong longitudinal striae; septal fossette comparatively large, central, extending laterally on the side of greatest curvature; about twenty strong lamellae, extend

from the border to the central fossette. Calice deep and irregularly ovate in form. Length 3-16 inch; greatest breadth of calice about ¼ inch.

The specimen figured is parasitic on the ventral valve of Productus pyxidatus.

Position and locality; Kinderhook group, Clarksville, Missouri."

The specimen from which Prof. Worthen made out his description was a young, attached coral, such as numbers 1 and 2 of our plate. Older specimens have more than twenty lamellae and are often strongly and peculiarly rugose from calicular budding and growth. The epithecal covering never extends to the top of the lamellae, giving the rim of the calice a naked appearance. On the side of Fig. 8, is a small incipient corallum, discoidal in shape and having less than twenty lamellae.

Figure 6 shows the depth of the calice. Figure 7 shows an expanding bud in the calice. Figure 11, is an extravagantly frilled specimen while Figure 13 has a peculiarly twisted appearance. It will be noticed that all the specimens figured have a flattened lower extremity showing that they were parasitic on other fossils throughout life, as parts of the shell or other objects to which each has been attached still adheres to the scar of attachment.

Dr. Charles R. Keyes in Vol. IV., Missouri Geological Survey, Paleontology, Part 1, has a short description of this coral under the name of Zaphrentis acuta. White and Whitfield, says "Usually pointed at the base" and yet Keyes' figure on Plate XIII is of a truncate specimen. In his reference of this form to Zaphrentis acuta, Dr. Keyes follows Winchell who doubtfully referred a specimen from Clarksville, Missouri, to the species.

We are not aware that Zaphrentic acuta was ever figured and it is safe to say the type specimen which, by the way, was from the Yellow sandstone of Burlington, Iowa, was a pointed form.

Dr. Stuart Weller in his Bibliographic Index of North American Carboniferous Invertebrates, follows Winchell and Keyes and refers this coral to White and Whitfield's species, Zaphrentis acuta. By collectors generally this coral has been identified as Zaphrentis ida, Winchell, a species originally described from the Goniatite beds of Rockford, Indiana. It is, however, distinct from either Zaphrentis acuta or Zaphrentis ida and must be known under Prof. Worthen's name Zaphrentis parasitica.

All of the specimens figured are from outcrops in and around Louisiana, Missouri.

ZAPHRENTIS PALMERI N. SP.

(Pl. XVI, Figs. 15, 16, 17, 18.)

Unlike Zaphrentis parasitica this coral, a much rarer form, is more expanded above, with deeper calice, thinner lamellae, indistinct longtitudinal striae and an epithecal covering to the top of the calice.

A small elliptical tabula occupies the bottom of the calice and the septa are thrown into groups by narrow false fossulae. Like Zaphrentis parasitica this fossil has a flattened scar of attachment. The number of lamellae at the outer rim of the calice is from forty-two to forty-six, of which but twenty to twenty-three reach the central tabula.

This rare form is from the inch or two inches of yellow sandy shales and top of the blue shales immediately below the Louisiana limestone, Louisiana, Missouri. Named for Mr. E. J. Palmer of Webb City, Missouri.

ZAPHRENTIS ACUTA? W. & W.

(Pl. XVI, Figs. 19, 20.)

This is a small, compressed form with an elliptical cross section, wrinkled, with indistinct longitudinal striae, with a base almost pointed but flattened on the inner side by a small scar of attachment. It has somewhat the appearance of Zaphrentis calceola. Like the other forms described above, this coral has a rather deep calice and in the characters mentioned in this description it agrees well with figures 15, 16 and 17, barring its elliptical cross section and almost pointed base.

This is the rarest cup coral from the Louisiana limestone series and comes from the thin band of yellow shale at the base.

We refer this form doubtfully to White and Whitfield's species, but are of the opinion that when the calice is known, it will either need a new specific designation or prove to be a variety of Zaphrentis palmeri. From the "Town Branch" locality, Louisiana.

GEN? SP?

(Pl. XVI, Fig. 21.)

The specimen figured is the only one of the kind, yet found. In external appearance it bears a strong resemblance to a cup coral but a break across just above the middle shows no lamellae. The outer surface is traversed longitudinally by numerous fine crowded striae and crossed by rounded folds or bands.

There is no appearance of a calice at the larger end, though the fossil has no appearance of being broken at either end. To the truncated smaller end is attached a specimen of Palaeacis enorme.

A cross section is somewhat elliptical and the internal appearance is that of quartzite.

The specimen may be a sponge or even of vegetable origin. It was obtained from the shales immediately below the Louisiana limestone, at Louisiana, Missouri.

PALAEACIS ENORMIS, M. & W.

(Pl. XVI, Figs. 22, 23, 24, 25, 26, 27, 28.

"Small, subglobose or obtusely subturbinate; irregularly rounded and apparently retaining remains of a scar of attachment at the base. Cells four or more, rounded, conical, of moderate depth, and rather irregularly disposed. Surface striae rather distinct and broken up into irregular granules. Length or height about 0.48 inch; greatest transverse diameter, about 0.43; breadth of cells nearly 0.18 inch. Locality and position; Rockford, Indiana, Goniatite bed of the Kinderhook Group. Subcarboniferous series. Also in same horizon at Clarksville, Missouri." Meek and Worthen.

The material of the distinguished authors must have been meagre, since they do not speak of any but old or adult specimens. Further they apparently had seen no attached forms, though fully half of the specimens found at Louisiana, old as well as young, are parasitic on other fossils. In washing and sifting the interstratified clay, specimens with one, two and three cells are not rare.

Instead of being the rule that the scar of attachment is apparently retained, it is quite well defined on all specimens.

This fossil occurs in the lower layers of the Louisiana limestone and the shale immedately below, at Louisiana and Clarksville.

The figured specimens are from Louisiana.

Palaeacis depressus, Meek and Worthen, described as a variety of *enormis*, is a good species, differing as much from *enormis* as *cuneiformis, compressus* or *obtusus*.

CONOPTERIUM EFFUSUM, Winchell.

(Pl. XVI, Figs. 29, 30, 31, 32, 33, 34.)

"Cells crowded, inseparable, rapidly enlarging, walls marked by vertical striae and a few pores communicate between the cells;

epitheca exterior." (Miller in North American Geology and Paleontology.)

I have illustrated a number of specimens that show all the characters of the species, the individual specimens varying in outline from hemispheric masses with flat, wrinkled bases to larger irregular shapes with the cells so crowded, that the epithecal surface and scar of attachment are enveloped.

Figures 29, 31, 32 are handsome specimens, 31 being attached to a broken Productus pyxidatus and 32 to a fine specimen of Cyrtina actuirostris. No. 33 is a peculiar specimen showing well the cone-cup growth of the fossil. Figure 34 is of an incipient corallum, looking much like worm cells.

Usually this fossil, like Palaeacis enormis, is attached to some shell or other object and even in the larger detached specimens, the scar of attachment is plainly visible.

Prof. Winchell's type specimens came from Clarksville, Missouri. Of my specimens figured, 31 is from Clarksville. All of the rest from Louisiana.

Found both in the Louisiana limestone and the sandy shales immediately below.

PTYCHOSTYLUS SUBTUMIDUS, Gurley.

(Pl. XVI, Figs. 35 and 36.)

"Body robust, thick, elevated, distinctly divided into five prominent, irregular lobes, which along the center, are subdivided into two smaller lobes; sides somewhat swollen and expanded along the middle; diameter of the base and top about the same; lobes extending to the summit, which is thereby quite deeply divided; top rounded and rather smooth, being irregularly and finely broken up or corrugated. The surface of the sides is also marked by rather deep grooves, which extend irregularly around the body and are more or less interrupted and broken up. From the Kinderhook shales, Pike county, Missouri. Collected by Mr. R. R. Rowley.

The above is Mr. Gurley's description of this fossil which he places under Protista. It is doubtless of vegetable origin, instead, but from its manner of preservation there is no indication of internal characters, being merely an aggregation of silicious sand or iron bisulphide or sand cemented together by an iron oxide. In the best preserved specimens, the exterior has the appearance of a thin dermal covering over the sand grains.

There is every indication that these organisms were of a soft consistency, at least internally, but from the fact so few of them are ever found in a crushed condition, it is probable the outside was strong enough to resist a pressure that was sufficient to crush and distort brachiopods.

At Louisiana this fossil is scarce, coming from the twelve inch bed of blue shale immediately below the inch and a half of yellow, sandy shale, upon which the Louisiana limestone rests.

Usually this fossil occurs in the fish-bone bed, a few inches below the range of the characteristic fossils of the Louisiana limestone; however, occasionally, Spirifer marionensis, Productella pyxidata and Cyrtina acutirostris occur sparingly associated with it.

There is considerable variation in the individuals and I hope in a future paper to figure some of these forms.

CORNULITES CARBONARIUS, Gurley.

(Pl. XVI, Fig. 37.

"Shell parasitic, tubular, conical, slender, tortuous, gradually enlarging towards the aperture, which is nearly circular and slightly flattened on the adhering side.

Surfaced marked by occasional lines of growth which are more or less distinct; in some places being quite obsolete, whilst at irregular intervals they thicken up or coalesce, irregularly enlarging and apparently changing the direction of growth of the shell.

Length 4 millimeters; diameter of aperture, 7 millimeters. The only example seen is attached to a ventral valve of Spirifer marionensis. It was discovered by Mr. R. R. Rowley.

Position and Locality. Kinderhook division of the sub-Carboniferous series, Pike county, Missouri."—Gurley.

It is not unusual to find specimens of this shell, attached to other fossils and sometimes in groups. The specimen figured is the largest I have yet found and hardly distorted.

In washing the soft clay that separates the lower layers of the Louisiana limestone, specimens of this shell are not uncommon and with little indication of ever having been attached.

It occurs both in the Louisiana limestone and the under yellow and blue shales, at Louisiana and Clarksville.

SPIRORBIS KINDERHOOKENSIS, Gurley.

(Pl. XVI, Fig. 38.)

"Shell discoidal, convolute, consisting of more than one volution (about two). The outer volution full and rounded, slightly flattened on the adhering side. Diameter of outer volution equal to one-third the diameter of the shell.

Surface smooth, with faint indications of fine lines of growth, which occasionally appear quite distinct. Diameter of an apparently adult specimen, two millimeters.

This species is comparatively common, being occasionally found attached to the separate valves of Spirifer, one valve containing three well developed examples. Discovered by Mr. R. R. Rowley.

Locality and Position—Pike county, Missouri, Kinderhook division of the Sub-Carboniferous series."—Gurley.

This species is found at both Louisiana and Clarksville and in both the Louisiana limestone and underlying shales.

ALLAGECRINUS AMERICANUS, Rowley.

(Pl. XVI, Figs. 39, and 41x4 and 40x5.)

The original description from the October, 1895, number of the Amerocan Geologist, follows:

"Crinoid minute, Calyx conical. Basals form a low rounded cup. Number unknown, as the suture lines are not visible under a hand glass. Radials five, elongate, each with one or two distinct articular facets above for the attachment of arms. The scars directed upward but not noticeably outward. Arms unknown. The dome or ventral surface composed apparently of three single pieces, though the depressions around the vault, suggest five."

"The left upper corner of one of the radials in several of the larger specimens meets the edge of the adjacent radial below the right upper corner of that plate and at first sight suggests an accidental break, but this may represent the anal area of other Palaeozoic crinoids. The larger specimens with this feature present, have scars for the attachment of nine arms, while the smaller examples have but five facets. A few thin round joints of a column have been observed attached to some of the specimens and small round stems are common in the clay. Plates apparently smooth. Most of the specimens are highly calcified so that features are made out with difficulty. The collection contains over three hundred specimens of all sizes, from those almost microscopic to those

one-sixteenth by one-thirtieth of an inch, all possessing the vault in place."

"Obtained from the clay partings between the two lower layers of the Lithographic or Louisiana limestone at the base of the Kinderhook Group, Louisiana, Missouri. The discovery of these little crinoids was made while washing clay for small brachiopods."

"All the specimens collected correspond very closely with those figured by Dr. Carpenter as the young of A. austini, but nothing like his mature form has come under my observation and I am convinced that my largest specimens are adults. This little crinoid is especially interesting, both because it is the second species of the genus from American rocks and also from its close relation to the only European species; moreover it is from a much lower horizon than Mr. Wachsmuth's A. carpenteri."

To specimen figure 41 are attached several joints of the column and one or two of the basal arm joints showing the arms to have been slender and, doubtless, short and immature.

The collection now contains several hundred more of these minute organisms, but as yet I have been unable to make out the basal sutures.

PLATYCRINUS DODGEI N. SP.

(Pl. XVI, Figs. 42, 43, 44, 45, 46, 47, 48.)

The basal disc is low but having an elevated ring about the stem pit. The suture lines are indicated by slender depressions between low double ridges as shown in Figure 42. The radials are about as high as the greatest breadth of the basal disc and but little broader at the top than below. The brachial scar is quite half the upper width.

There is a slight elevation of the central portions of the radial into an elongate, quadrangular figure, not noticeable on smaller plates.

The side of the restored calyx is almost perpendicular. Higher plates, vault and arms unknown. The column leaves the calyx as a round stem but becomes elliptical and most extraordinarily twisted and tuberculose or spiny. The axial canal is minute as usual with this genus. This species in the elevated basal ring about the column base and the sutural ridges recalls P. huntsvillae of the St. Louis group and P. truncatulus of the Lower Burlington limestone but outside of these features there are no resemblances.

The specific name is in honor of my valued friend and co-worker, Mr. E. A. Dodge of Louisiana, Missouri.

While stem joints of this species are not uncommon in the clay seams at the base of the limestone, the separate radials and basal discs are rare.

Locality—Louisiana, Missouri.

CRINOID PLATES AND STEMS.

(Pl. XVI, Figs. 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70.)

The plates here figured are of unknown species of crinoids and while rather scarce are nevertheless interesting, as forming a part of the fauna of the Louisiana limestone.

The stems, likewise, are of unknown species, the pentagonal ones bearing extravagantly long cirri, the joints of which are somewhat spinose on the inner side. (See Figures 68 and 69.)

POTERIOCRINUS JEFFRIESI, N. SP.

(Pl. XVI, Figs. 71, 72, 73.)

From the arrangement of the angles at the lower part of the basal plates, our little specimen had a low under basal cup of five plates. The basal plates are longer than wide, three of them being hexagonal, one (the largest) heptagonal of equal width and length and the fifth hexagonal without an angle below.

The radial plates a little wider than long, four of them being pentagonal and one quadrangular. The scars for the attachment of the first costals almost as wide as the upper edge of the radials. The radial opposite the anal area is much less in size than the other four radials and apparently without scar for costal attachment, the crinoid thus appearing to be four-armed. The two anal plates are pentagonal, the right being somewhat larger than the left and lying lower in the calyx. Smaller disconnected plates lie just above the anals and in the opening of the cup but their places in the calyx cannot be determined. Plates apparently smooth. Arms, under basals and column unknown.

Horizon: clay seams at the base of the Louisiana limestone.

Locality: Louisiana, Missouri.

The specific name of this unique little crinoid is in honor of a fellow teacher, Prof. Alonzo Jeffries of Ft. Smith Arkansas, with whom the writer spent many pleasant hours collecting fossils in the Eighth Street Cut.

LEPTODISCUS NOV. GEN.

Small discoidal or hemispheric masses; the underside flat or concave and with an epithecal covering, somewhat wrinkled concentrically.

The top side convex and ornamented by minute, sharp irregular ridges with deep, sharp depressions between; the surface appearing irregularly corrugate. On some specimens the ridges all leave the center of the top surface and radiate out toward the periphery but wholly unlike the lamellae of cup corals. On other specimens there is, apparently, no definite arrangement of the ridges.

On one specimen the elevations seems to start from the periphery and not only bifurcate but send off short branches that give a peculiar moss like appearance to the ridges. The thinness of these little bodies precludes the possibility of internal tabulae and it is likely they are sponges.

LEPTODISCUS CORRUGATUS N. SP.

(Pl. XVI, Figs. 74, 75, 76.)

The description of the genus above will serve as a description of this, the type species. Specimens of this little fossil are rather rare, having been obtained by washing the clay for young brachiopods.

From the clay seams at the base of the Louisiana limestone and the sandy shales immediately below the same limestone. Eighth street cut and the bluff at the mouth of Buffalo creek, Louisiana, Missouri.

GENUS? SP?

(Pl. XVI, Figs. 77, 78, Much Magnified.)

On the outside and inside of a brachial valve of Rhipidomella Missouriensis great numbers of these little cyst-like bodies occur singly and in groups, parasitic and smooth, very thin and some of them giving off very fine, long radiating tentacle-like ridges.

Their affinities, if fossils, are unknown to the writer. From the bottom layer of the Louisiana limestone, Louisiana, Missouri.

GENUS? SPECIES?

(Pl. XVI, Fig. 79 magnified. A colony attached to a valve of Syringothyris Hannibalensis.

This minute, parasitic organism has been found attached only to the above mentioned brachiopods, and but two colonies have

been observed. It has a chain-like or, more correctly speaking, sausage-link appearance.

As to where it belongs in the organic world is a matter of conjecture to the writer. The figured specimen is from the top of the bottom layer of the Louisiana limestone at the mouth of Buffalo creek.

GENUS? SPECIES?

(Pl. XVI, Figs, 14, 80, 81,)

This is a parasitic form, more or less disk-shaped or strongly rayed and has much the appearance of a crinoid stump and roots, the center having always a rounded depression such as would be the case if the column were detached at the stump. They are found attached to corals or brachiopods and I had at one time supposed them to be the stumps of Allagecrinus americanus but they are usually a little too large for that minute crinoid and, moreover there is no jointed character like crinoid columns possess, at least no visible sutures.

Lower layers and under shale of the Louisiana limestone at Louisiana, Missouri.

SPONGE SPICULES.

(Pl. XVI, Figs. 82, 83, 84, 85, 86.)

These are little free forms of from a single needle-like body to those with three or four rays and often with small tubercles and pits near the middle.

Obtained by sifting the clay between the bottom layers of the limestone at Louisiana and vicinity.

BASAL DISKS OF CRINOIDS.

(Pl. XVI, Figs. 87, 88, 89.)

Eighty-seven and Eighty-eight, are bottom and top views of the same specimen and is probably distinct from 89 which is cup shaped while the former is much shallower. It is possible that these disks belong to Poteriocrinus Jeffriesi but they are too large for the type specimen of that species.

Like the other small fossils figured on our plate these little cups are obtained from clay siftings, associated with the others and hardly rare.

Clay bands of the lower layers of the limestone at all the Louisiana localities.

STREBLOTRYRA SP?

(Pl. XVI, Fig. 90.)

These are small, simple or branching, rounded stems with elliptical apertures, arranged in spiral, longitudinal series. Stems solid.

STREBLOTRYPA SP?

(Pl. XVI, Fig. 91.)

This is an incrusting frond with apertures of no definite shape and thin separating walls. No definite arrangement into series of the apertures, recalling, under a magnifier, the Favositoids.

LIOCLEMA SP?

(Pl. XVI, Fig. 92.)

This is another incrusting form with elliptical apertures with more or less arrangement into series.

The walls about the apertures are thick and have smaller apertures or pits on the outer surface.

STENOPORA? SP?

(Pl. XVI, Fig. 93.)

This is a little, circular discoidal, incrusting form with irregular shaped apertures without arrangement into series. In places the surface of the inter-apertural wall is pitted.

All of the above Bryozoa were collected from the bottom layers of the limestone and under shale at Louisiana and Clarksville and no attempt has been made to do more than identify the genera and only so illustrate them as to call attention to their presence in the fauna.

To Mr. Ray S. Bassler of the U. S. Geological Survey we are indebted for the identification of the genera.

BRACHIOPODA.

ORBICULOIDEA LIMATA N. SP.

(Pl. XVII, Figs. 1, 2.)

Shell of medium size, circular. Dorsal valve, quite convex. Apex a little excentric. Shell thin, pale blue, shiny and the surface marked by numerous fine, concentric lines.

The specimen figured is attached to an Orthothetes lens. It is rather rare in the fauna of the Louisiana limestone and has only been found in the yellow and blue shales below. From an exposure on the Town Branch, Louisiana, Missouri.

CRANIA ROWLEYI, Gurley.

(Pl. XVII, Figs. 3, 4.)

"Shell circular, sub-conical, apex eccentric, small, distinct, pointed, elevated. Sides nearly straight, slightly convex."

"Surface of upper valve ornamented by fine, sharp, closely arranged radiating striae, a few of which extend quite to the apex, rapidly and regularly increasing by implantation as they approach the margin of the shell, being slightly interrupted by three well defined equidistant concentric lines of growth."

"Although conforming to the angular surface of the cardinal margin of a Spirifer, the shell preserves its regularity of outline. Breadth 10 millimeters; height 3 mm." Gurley.

The author of the species, evidently never saw but the one specimen and that was a small one.

A majority of the specimens found are attached to the valves of Spirifer marionensis and usually to one side or the other of the mesial fold or sinus. The number of concentric lines of growth are often more than three and may be less.

From the Louisiana limestone and thin underlying yellow, sandy shale. Louisiana and Clarksville.

CRANIA DODGEI N. SP?

(Pl. XVII, Figs. 5, 6.)

Shell, more or less circular, without ornamentation except the concentric lines of growth which are fine and numerous. Apex sharp, erect and somewhat eccentric.

Upper valve convex, color of the surface light-reddish brown. The three or four specimens in the collection are attached to as many different kinds of brachiopods. The one figured is on the convex valve of a Productella pyxidata. The shell is rare. Named for Mr. E. A. Dodge.

In Dr. Keyes' description of his species, Crania laevis, he gives as horizon and locality, the Burlington and Louisiana limestones, Louisiana, Missouri. From this description the type was evidently Burlington as it does not fit the species from the Louisiana limestone. Moreover, while there is a Crania from the Burlington at Louisiana, it is specifically different from the species here described.

From the Louisiana limestone and underlying yellow shale.

Localities—The Eighth street Cut, Mouth of Buffalo creek and on the Town Branch.

CRANIA SPICULATA, N. SP?

(Pl. XVII, Figs. 7, 8, 9, 10.)

Like the preceding species this shell is more or less circular where uninjured or attached to a more or less smooth surface as in figure 10. Unlike the other two species, it is roundly convex, the apex being inconspicuous.

In all of the specimens of this species, thus far found, the margin of the shell on one side is a more or less straight line for nearly a quadrant's distance.

The ornamentation is concentric lines of growth and crowded spicule bases. Not only the plications but the lines of growth of the Spirifer or Syringothyris to which our specimens are attached show on the surface of the Cranias.

The collecton contains 5 or 6 specimens and are all from the basal layers of the limestone. None have yet been found in the shale. Localities—Various quarries about Louisiana.

LINGULA SP?

(Pl. XVII, Figs. 11, 12.)

This shell is not uncommon in the black shales below the Louisiana limestone series, in beds that are usually considered Devonian. This and the two succeeding forms doubtless belong to species already named and described but the writer does not find it possible to place them specifically with any degree of certainty.

The specimens are obtained by splitting the black shale masses. The test is thinner than tissue paper, white or gray and with fine crowded lines of growth. Specimens flattened on the shale surface.

From the black so-called Genesse shale about five or six miles west of Louisiana on Grassy creek and its tributaries.

LINGULA SP?

(Pl. XVII, Fig. 13.)

While specimens figures 11 and 12, are more or less quadrilateral this shell is more oval and more actuely pointed in front. Test thin, light colored, flattened and covered with lines of growth.

Horizon and locality same as species above.

LINGULA SP?

(Pl. XVII, Fig. 14.)

This little shell differs much from either of the above, is almost a perfect oval and rarely flattened, either presenting a con-

cave or convex surface and is a bluish-transparent or brownish color and is often found in numbers together on the split surface of the shale.

In its pearly lustre it is like a fresh shell from the river bank.

Locality and horizon same as the last.

CHONETES GENICULATUS, White.

(Pl. XVII, Figs. 15, 16, 17, 18, 19.)

This shell has a length but little less than the width, a very convex pedicel valve and a correspondingly concave brachial valve. The plications are small, indistinct or wholly wanting except at the margin. The number of plications is about 40 to the valve.

The lines of growth are from one or two to six or eight and crowded at the margin in old shells. The cardinal spines are from six to eight, normally, and rather slender. The cardinal area of the pedical valve is a low, broad triangle with a central triangular foramen closed by a pseudodeltidium. The muscular scar and teeth of the brachial valve are shown in Figure 19.

In the clay partings between the bottom three layers of the limestone this little shell is very abundant and can be collected in quantity by washing the clay.

It is fairly plentiful also, in the yellow shale below.

CHONETES ORNATUS, Shumard.

(Pl. XVII, Figs. 20, 21, 22, 23.)

Shumard's descripton of this shell is as follows:

"Shell small, sub-semicircular, transverse, greatest width at the cardinal border. Dorsal valve moderately convex, hinge line prolonged into small acute ears, which are smooth, slightly deflected and convex; cardinal border with three or four minute spines on each side of the beak; surface with from thirty to forty rounded ribs, separated by sulci not quite as wide as the ribs; some of the latter bifurcate twice or thrice and others proceed from the beak to the border without division. They are crossed by fine concentric undulating lines of growth which are barely visible to the naked eye. Ventral valve, moderately concave with a shallow, transverse depression on the ears, corresponding to the convexity of the opposite valve."

While Dr. Shumard's description of this shell is lucid enough, his figure is very misleading, especially in the character of the cardinal spines, the artist making them extravagantly long and strong.

Our figure 23 shows the muscular scar of the brachial valve. While this is one of the most characteristic shells of the Louisiana limestone, it is by no means plentiful.

The best specimens come from the clay partings at the base of the limestone but it is also found in the yellow and blue shales below.

Localities, Louisiana and Clarksville.

STROPHALOSIA BEECHERI, Rowley.

(Pl. XVII, Figs. 24, 25.)

In all the years of collecting in the Louisiana limestone only one specimen of this species has ever been found and the chances are the type specimen, here figured for the second time, will remain unique for a much longer period.

The pedicel valve is convex but irregular in shape with a small attachment scar to the right of the beak. The hinge line is much longer on the right than on the left side and while the area is low, it is much more prominent than that of Productella pyxidata, the only shell with which this might be confounded.

A little pseudo-deltidium covers a triangular foramen much as in an Orthothetes. Lines of growth cross the shell and the surface is set with scattered spine bases.

Figure 25 shows the cardinal area.

From the yellow shales below the Louisiana limestone on the Town Branch, Louisiana, Missouri.

STROPHALOSIA SCINTILLA, Beecher.

(Pl. XVII, Figs. 26, 27, 28, 29.)

This is a small, parasitic form, attached to shells, corals and other fossils by the greater part of its convex valve which is thus flattened to the extent of attachment. The cardinal area is a low, elongate triangle with a closed delthyrium.

The concave valve is crossed by lines of growth and is without spines or other ornamentation while the attached valve has a few elongate spinose processes usually flattened against the shell to which the Strophalosia is attached.

The specimens we have figured are all attached to the same Productella.

Found at all the localities previously mentioned and in all three horizons (Louisiana limestone, yellow and blue shales).

PRODUCTELLA PYXIDATA, Hall.

(Pl. XVII, Figs. 5, 30, 31, 32, 33, 34, 35, 36.)

Hall's original description is as follows: "Shell semi-elliptical, breadth greater, than the height; cardinal extremeties somewhat rounded, the hinge line being shorter than the greatest width of the shell. Ventral valve broadly convex somewhat flattened and a little recurved at the cardinal extremities, gibbous on the umbo and beak recurved. Dorsal valve broadly concave, a little flattened at the cardinal extremities; concavity less than the convexity of the opposite valve."

"Surface marked by close concentric striae and more conspicuous imbricating lines of growth, the ventral valve sometimes having elongated spiniferous tubercles or ridges, which are arranged in alternating series; the dorsal valve sometimes with indistinct radiating ridges, which are not spiniferous."

"The prevailing character of the species, in its surface markings, is that of a concentric, imbricating or lamellose structure; while in some specimens we have, in addition to this, there are elongate spinferous tubercles towards the umbo and elongate ridges in the lower part of the shell."

"There is no visible area in several specimens examined, when the two valves and hinge line are entire, and the interior of the dorsal valve shows a strong, bilobed cardinal process, without sockets for the cardinal teeth of the opposite valve as in true Strophalosia."

Prof. Hall's specimens all show a paucity of spines since they were undoubtedly obtained from the underlying shales where they are usually smooth. (See Pl. XVII, figure 31.)

Our figure 30 is an apparently plicate specimen. The plications are, however, not continuous for any great distance and remind one of subtegminal spines.

Figure 36 is of a specimen partly imbedded in the hard limestone with some of its hair-like spines preserved full length.

Under his description of Productus Shumardianus Hall gives Clarksville, Missouri, as one of his type localities. As a matter of fact, so far as I can learn, no such shell has been found in the Louisiana limestone at Clarksville. His second reference to locality is doubtless correct as Productus Shumardianus probably comes from the yellow sandstone of Burlington, Iowa. Productella pyxidata is from the limestone and both shales below as well as the "Hannibal" shales above, perhaps.

It has been found plentifully at Clarksville, mouth of Buffalo creek, at Eighth street, on the Town Branch and along the river front.

ORTHOTHETES LENS, White.

(Pl. XVII, Figs. 37, 38, 39, 40, 41, 42.)

This species is somewhat variable in the number and size of its striae, proportional length of the cardinal margin, gibbosity of the shell and height of the cardinal area.

In a typical specimen the width is somewhat greater than the length and while the cardinal margin is a little produced, it is not the greatest width of the shell, that being well back toward the anterior margin. See illustrations. The thickness of the shell is less than half its length. There are from eighty to ninety crenulate striae to the valve. The implanted ones being less conspicuous than the original plications, throw the surface into groups of folds, showing strongly on some shells. This grouping is most noticeable at the front margin, of course, and consists of a strong bounding stria on each side with from two to five or six finer and lower striae between. The pedicel valve is little more convex than the brachial. The concentric lines are quite strong, giving good outlines of the shell at its various stages of growth. The cardinal area is more or less triangular and low with a closed deltidium.

While many of the shells are almost perfectly symmetrical, some few have the beak distorted in a manner strongly like Derbya.

Figure 39 is of a specimen with short cardinal margin, incurved pedicel beak and unusual thickness, giving an appearance not unlike that of Rhipidomella at a casual glance. Figure 40 is of an old specimen with a higher cardinal area than usual.

Figures 41 and 42 are views of the inner surfaces of the valves, showing cardinal processes and muscular scars.

Dr. White mentions Clarksville, Missouri, as one of the original localities from which his specimens for description were obtained.

Found in the limestone and the two lower shales at the various Louisiana exposures and Clarksville.

RHIPIDOMELLA MISSOURIENSIS, Swallow.

(Pl. XVII, Figs. 43, 44, 45, 46, 47.)

This shell is almost circular in outline and is very near to the Devonian forms Rhipidomella vanuxemi and Rhipidomella penelope, differing from the latter mainly in size. From Rhipidomella

Bulingtonensis this species varies mainly in its less prominent beak and greater width.

Of the two valves, the brachial is the more convex, especially so in older specimens. The concentric lines of growth are many on the larger shells and quite distinct, somewhat interrupting the continuity of the longitudinal striae. Of the latter there are from a hundred and thirty to a hundred and fifty to the valve.

Near or at the concentric lines the striae are often pierced horizontally by minute, round perforations that have the appearance of having at some time been connected with tubular spines and such spines or spine bases are to be seen under a glass, on the pedicel valve of a beautifully preserved specimen in our collection (Fig. 44).

Between the lines of growth the surface is beautifully ornamented by microscopic concentric lines. The cardinal area is triangular, rather low and much less than half the width of the shell, excavated and with a triangular foramen. While the beaks of both valves are distinct, neither is prominent.

On very large old shells, there is a broad illy defined sulcus, sometimes on the pedicel and sometimes on the brachial valve but rarely on both at the same time. The muscular scars, teeth and other internal features are illustrated in figures 46 and 47. One wrinkled old specimen in our cabinet has become so thickened anteriorly that it is quite wedge-shaped in appearance.

This fine shell occurs at all the Louisiana limestone exposures about Louisiana as well as at Clarksville, in the limestone and underlying yellow and blue shales.

SEMINULA BUCKLEYI N. SP?

(Pl. XVII, Figs. 48, 49, 50, 51, 52, 53.)

This is one of the rarities of the Louisiana limestone, the collection containing but eight specimens, good and bad. The width and length of the largest specimen are about equal while in the smaller specimens the length is usually the greater.

In outline the shell is strongly like S. argentea and S. subquadrata. The thickness of the shell is somewhat more than half its length. The pedicel valve has a rather, broad, central sulcus but no apparent, corresponding mesial fold on the brachial valve. On both our smaller specimens figured there is a narrow sinus traversing the pedicel valve, longitudinally.

The foramen piercing the beak of the pedicel valve is rather small and a little elliptical in the line of shell length. The pedicel

beak is moderately strong and somewhat incurved. Well defined lines of growth traverse both valves and much finer concentric lines, hardly visible to the unassisted eye.

We are glad to be able to dedicate this pretty species to Dr. E. R. Buckley, present State Geologist of Missouri.

Collected from the underlying shales at the outcrop on the Town Branch, from the limestone at Eighth street and at the mouth of Buffalo creek.

TRIGERIA? CURRIEI, Rowley.

(Pl. XVII, Figs. 54, 55, 56.)

This little brachiopod was figured and described in the American Geologist, June, 1901, and the original description follows: "Shell longer than wide, plicate but with the plications more or less obsolete, except near the front of the shell. Young indviduals, however, are plicate throughout. The beak of the pedicel valve is rather long and pointed with a triangular area beneath it and a delicate triangular foramen. Nothing is known of the inside of the shell. The shells vary from 1½ to 6 mm. in length and from 1 mm. to 6 mm. in width. The specimen figured is 5 mm. by 4 mm. (length and breadth). There is a slight sinus at the front margin of the brachial valve and sometimes one on the pedicel valve also. It is rather a rare form in the Louisiana (Lithographic) limestone at Louisiana, Missouri. It is obtained, among other small forms, by washing the clay between the limestone layers."

DIELASMA? PEDICULUS, Rowley.

(Pl. XVII, Figs. 57, 58, 59.)

This minute brachiopod was described in the same issue of the same journal as the last species and we quote that description: "Lenth of a large specimen 4½ mm., width 3½ mm."

"This little shell is smooth, rather flat, elongate with a rather long pedicel beak, the end of which is perforate. It occurs abundantly in the clay seams of the limestone and is obtained by washing the soft material. It is found associated with the above species, Ambocoelia minuta and Chonetes geniculatus in the Louisiana limestone at Louisana, Missouri."

If the specimen, figure 58, is of this species, and it seems to be, our description above is faulty in that there is a triangular foramen below the pedicel beak, instead of a perforation at the end. This fact would remove our species from Dielasma. The beak of this little shell is so delicate that it is often broken away and this gives the appearance of a perforation.

From an examination of a great number of specimens, we are now satisfied that the above description is faulty in the character of the pedicel opening and that our species will have to be removed to some other genus.

It is probably congeneric with Trigeria? curriei.

PUGNAX MISSOURIENSIS? Shumard.

(Pl. XVII, Figs. 60, 61, 62.)

Under the name of Rhynchonella missouriensis, Dr. Shumard, in the old geological report of Missouri, described a fossil from the Chouteau beds at Vandevers Falls, Cooper county, with which our Louisiana limestone specimen seems to agree specifically and we quote the author's description. "Shell gibbous, subtriangular; beaks sharp; greatest width usually near the front but very variable in different ages of the shell. Ventral valve much more elevated than the dorsal valve; degree of elevation varying according to the age of the shell; beak incurved, pointed; mesial ridge obscure, with from two to three obscure rounded folds, commencing a short distance in advance of the beak, and becoming more prominent toward the front, where the valve is emarginate and presents two or three deep indentations. Dorsal valve slightly convex near the beak, nearly plane anteriorly; sinus broad and shallow in young examples becoming deeper in the more advanced ages of the shell. It has two or three wide obscure plaits, sometimes reaching the beak. Tongue of sinus quadrangular, bent upwards at nearly right angles to the plane of the valve and in most specimens equal in length to one-third the length of the shell. The cardinal line is sinuous. The surface of the valves is covered with very fine concentric imbricating waved lines of growth."

Dr. Shumard's valves should be reversed, reading dorsal for ventral and vice versa. Our specimen differs widely from Dr. Shumard's in the number of folds on the pedicel valve, having six instead of three.

Only two specimens of this fine shell have been found in the Louisiana limestone at Louisiana.

SPIRIFER MARIONENSIS, Shumard.

(Pl. XVIII, Figs. 1, 2, 3, 4, 5.)

The original description is: "Shell transverse, sub-semi-circular, rather gibbous, hinge line extended into acute ears and equal to twice the length of the shell. Area narrow; borders sub-paral-

lel, marked with very fine transverse striae and more apparent longitudinal striae. Dorsal valve more gibbous than the ventral valve; aperture rather broadly triangular and not closed by a deltidium; beak pointed, incurved; sinus commencing at the apex of the beak, narrow, shallow, with three or four plications, which do not vary in size from those on the sides of the valve. Ventral valve regularly convex; mesial ridge scarcely elevated above the general convenity of the shell, being only a little prominent towards the front. The surface of the shell is marked with about fifty rounded ribs, mostly simple, except on the mesial fold and sinus, which are dichotomous; ribs crossed by fine, undulating lines of growth."

"This beautiful shell is easily recognized by its narrow area, and the slight elevation of its mesial fold, which, in young examples, is sometimes even concave. In young specimens the cardinal border is produced into long mucronate points."

For dorsal read ventral and for ventral read dorsal in the above description. The ratio of the width to the length in an extensive collection of these shells varies from 1 to 1, to 2 to 1.

This is one of the characteristic fossils of the Louisiana limestone and is found in the shales below as well as the limestone and at all the localities in the county where there are exposures of this formation.

The best specimens come from the clay layers of the limestone.

SYRINGOTHYRIS HANNIBALENSIS, Swallow.

(Pl. XVIII, Figs. 6, 7, 8, 9.)

This shell was originally described by Prof. Swallow in the Transactions of the St. Louis Academy of Science, Volume 1, page 647, as Spirifer (Cyrtia?) hannibalensis.

Prof. Weller in his Bibliographic Index of North American Carboniferous Invertebrates ranges Syringothyris hannibalensis under Syringothyris carteri as a synonym. We shall not attempt to unravel the tangle into which workers in brachiopods have gotten the species of this genus but retain the name given to the form from the Louisiana limestone.

Our shell has a moderately high triangular cardinal area with a long triangular foramen which is usually covered a third of the length down by the deltidial plate beneath which the point of the so-called syrinx may be seen when the foreign matter that fills the foramen can be removed. The great height of the cardinal area

makes the pedicel valve very convex and the beak is sharp and usually perpendicular, almost retrorse in some specimens.

One variety, a smaller form, probably Hall's Syringothyris missouriensis, has the cardinal area considerably shorter than the greatest width of the shell and the valves rounded at the hinge extremities with the area directed backward at a sharp angle.

The convexity of the brachial valve is moderate. There are twenty or more low (almost flat) or a little rounded plications either side of a strong, nonplicated mesial fold. On the pedicel valve the plications are almost obsolete; none whatever in the broad deep sinus.

Strong lines of growth cross the plications and rows of crowded, minute spine bases traverse the shell surface lengthwise, giving the appearance on weathered specimens of the "twilled cloth" look. A well preserved specimen is beautiful with its dense covering of hair-like spines.

The very thinness of this shell has made it difficult of preservation so the material is usually fragmentary or badly crushed. Plump specimens are some times broken from the hard rock but divested of the test. Found in the limestone and underlying shales at Louisiana and Clarksville.

SPIRIFERINA CLARKSVILLENSIS, Winchell.

(Pl. XVIII, Figs. 10, 11, 12.)

This is one of the rarest and, at the same time, one of the prettiest shells in the Louisiana limestone. Prof. Winchell's type specimen, of course, came from Clarksville but the writer has found the species only at Louisiana.

Its horizon seems to be about three and a half or four feet above the base of the Louisiana limestone, although it does occur downward even into the blue shale.

The cardinal area is quite high but the beak of the pedicel valve is a little incurved. The greatest width of the shell is along the hinge line. The foramen is quite large, triangular and uncovered in the specimens found.

The brachial valve is a little convex and has five or six strong plications either side of an unplicated mesial fold which is not much larger than the plications. The pedicel valve has six or seven strong plications either side of a well defined sinus. Strong imbricating concentric lines cross the plications, giving the shell a very handsome appearance. The collection contains four perfect specimens.

SPIRIFERINA ACICULIFERA, Rowley.

(Pl. XVIII, Figs. 13, 14, 15.)

We copy the description of this species from the November, 1903, number of the American Geologist. "Shell somewhat cyrtina form, small, width a little greater than the length. On the ventral valve, there are about seven small but distinct plications, either side of the sinus, which latter is well defined but without plications."

"On the dorsal valve there are six costae either side of the mesial fold but none on the fold itself, which is distinct and slightly flattened on top."

"Cardinal area less than the width of the shell, triangular and high like Cyrtina. Foramen high, triangular. Beak of the ventral valve slightly incurved. The outline of the shell is semicircular, the lateral extremities being rounded. Entire surface covered by the bases of small needle-like spines. Length of shell 5-32, width 7-32, height 4-32 of an inch."

This fossil is even rarer than Spiriferina Clarksvillensis. Obtained from the clay partings near the base of the Louisiana limestone, at the mouth of Buffalo creek and the Eighth street Cut.

This shell can be easily recognized from the young shells of Syringothyris that occur in the same clay seams by the plicated character of its valves, less height and smaller fold and sinus.

CYRTINA ACUTIROSTRIS, Shumard.

(Pl. XVIII, Figs. 16, 17, 18, 19, 20.)

Dr. Shumard's description of this shell in the "Geological Survey of Missouri, I and II Reports," 1855, is as follows: "Shell small; area very high, nearly an equilateral triangle; greatest width at the cardinal margin. Beak of ventral valve very slightly incurved in most specimens, sometimes straight; deltoid aperture narrow, becoming abruptly dilated near the base, lateral edges slightly elevated; the elevation most prominent at the dilated portion; mesial sinus commencing at the tip of the beak, rather deeply impressed and destitute of ribs. Dorsal valve semi-elliptical, flattened convex, mesial ridge elevated above the general convexity of the valve, and well defined by a wide, concave space on either side. Some specimens exhibit a faint longitudinal sinus running the whole length of the mesial fold. Valves with four or five simple rounded ribs on each side of the mesial fold and sinus, crossed by fine undulating, subimbricating lines of growth."

Dr. Shumard's types came from Hannibal and Louisiana. In very old shells the beak of the pedicel valve becomes so incurved that the resemblance to Spiriferina and even Spirifer is strong.

By washing the clay obtained between the lower layers of the limestone, young shells of this species are found almost microscopic in size and without plications except the mesial fold. In fact the fold and sinus enables the collector to separate such young material from Ambocoelia minuta. Often these young Cyrtinas are found attached to other fossils and, in many cases, by the cardinal area, suggesting a very short pedicel.

Cyrtina acutirostris is one of the characteristic fossils of the Louisiana limestone and rather common. It occurs in the limestone and shale below at all the outcrops around Louisiana and Clarksville.

AMBOCOELIA MINUTA, White.

(Pl. XVIII, Figs. 21, 22, 23, 24.)

As the name implies, this is a very small shell with a very convex pedicel valve and almost flat brachial valve. The cardinal area is high, illy defined and narrower than the greatest width of the shell. The beak of the pedicel valve is somewhat incurved. The cardinal foramen is quite a large triangular opening. There is a broad illy defined sinus on the brachial valve with a faint line of depression on the pedicel valve of old shells. The surface of well preserved specimens is thickly set with hair-like, appressed spines. The shell is found abundantly by washing the clay from the seams of the limestone, also in the shales below. Localities, Louisiana and Clarksville.

NUCLEOSPIRA BARRISI, White.

(Pl. XVIII, Figs. 25, 26,27.)

This is a plump, almost circular shell with length and width about equal. The beaks are so incurved as to quite hide the cardinal area. The valves are almost equally convex and crossed by lines of growth. A slight furrow crosses each valve from the beak to the front of the shell in larger specimens. Surface covered thickly with appressed hair-like setae.

Found rather sparingly in the limestone seams and the shales below, both at Clarksville and Louisiana.

ATHYRIS HANNIBALENSIS, Swallow.

(Pl. XVIII, Figs. 28, 29, 30.)

The width of this shell varies from a little greater than the length to nearly twice that dimension. The valves are almost equally convex. The beak of the pedicel valve incurved and perforated at the end by a small round hole.

The hinge line is straight but less than the width of the shell. An indistinctly outlined sinus crosses the pedicel valve with a corresponding, almost obsolete fold, on the brachial valve. The concentric lines of growth are extended into thin lamellar expansions, often extravagant and toothed along the edge. At the front of the shell in well preserved specimens the lamellar expansions are often quite as broad as the length of the shell itself.

This is another characteristic shell of the Louisiana limestone but not plentiful.

Found in the shales and limestone alike at both Louisiana and Clarksville.

FILICITES GRACILIS, Shumard.

(Pl. XIX, Fig. 34.)

"This curious fossil, in its general appearance, bears considerable resemblance to the fimbriated tentaculae of some of the crinoids. As it appears on the surface of the rock it consists of a central bifurcating axis, very slender, from which proceeds at nearly right angles on either side, a series of very thin leaf-like plates, about four lines in length; these laminae rise directly opposite each other, and they appear to be directed obliquely backwards and downward. It has a more slender and delicate appearance than the species figured by Prof. Hall.

Found by Prof. Swallow in the Lithographic limestone at Louisana and Elk Lick Spring, Pike county, and on North river in Marion county," Shumard.

A number of years ago, the writer found on fresh broken surfaces of the hard limestone what then appeared to be this fossil but mislaid the specimens and has been unable to find them, so is forced to copy Mr. Meek's figure.

Our supposed specimens of this species came from the Town Branch Bluff.

S. A. Miller in his "North American Geology and Palaentology" refers this fossil to the Coelenterata under the name Plumalina gracilis.

LINGULA MISSOURIENSIS, N. SP.

(Pl. XIX, Fig. 1.)

This fine lingula is much larger than the other species we have already figured from the Black shale and is elongate and elliptical in outline. It is flattened convex but never so flat as the other species and with a thicker test of a light brown or amber color instead of white or pearly.

Concentric lines of growth cross the shell. The figured specimen is of a natural cast and quite perfect except near the beak. In fact it is the most perfect outline the writer has yet seen of this species.

From the Black shale usually referred to the Genesee division of the Hamilton Group. Grassy creek, Pike county. The figured specimen is the property of Mr. E. A. Dodge.

LINGULA LINEOLATA N. SP.

(Pl. XIX, Figs. 35, 36.)

This species is small, subquadrate, or elliptical, flattened convex and crossed by well defined lines of growth between which the surface is ornamented by fine, crowded, microscopic cross striations. Where the test is removed the lines of growth appear lamellate and jagged or dentate.

One of the two types has both valves in place and has a thickness of 1-5 or 1-6 of the length of the shell. The smaller specimen is from the hard limestone of the bottom layer at the mouth of Buffalo creek while the larger one is from the clay seam above the bottom layer of the Louisiana limestone at the Grassy creek locality.

CYRTINA ACUTIROSTRIS, Shumard.

(Pl. XIX, Fig. 2.)

The specimen figured on this plate shows the foramen covered by a convex integument nearly to the top. This covering is thin and usually removed, probably after the death of the brachiopod. Of the shells preserving this covering, the greater number are of medium size and only rarely an old shell and probably never a very young one. Many of the specimens, as in the present case, have the beak of the ventral valve more or less distorted. A small proportion have the cardinal area extended into acute points. Very old shells have the ventral beak so incurved that the cardinal area is Spirifer-like. The young shells are often attached to other shells by the area as if they had been parasitic.

The very smallest of the young shells are distinguishable from young Ambocoelias by the sinus and mesial fold, other distinct plications being wanting.

The figured specimen is from the yellow under shale on the Town Branch.

SPIRIFER MARIONENSIS, Shumard.

(Pl. XIX, Figs. 3 and 6.)

The specimen figured is from the yellow sandy under shales on the Town Branch and has two specimens of Crania rowleyi attached, one of which is seen in the picture.

Figure six is of the shell enlarged to show the beautiful surface ornamentation, consisting of fine, crowded concentric lines between two growth lines. The variation of this shell in length of hinge line and the character of the mesial fold has been mentioned under the general description of the species.

SYRINGOTHYRIS HANNIBALENSIS, Swallow.

(Pl. XIX, Figs. 4 and 5.)

Our figure on this plate is of a somewhat crushed ventral valve, showing the covering plate over the foramen and the point of the inner tube beneath. The lines of growth would indicate a very old shell. The surface ornamentation is shown in figure 5 and consists of minute setae bases where the surface is well preserved and the "twilled-cloth" appearance where the spine bases have been removed by weathering.

The specmen figure 4 is from the clay seam between the bottom two layers of limestone and from the Eighth street exposure.

CONULARIA SP?

(Pl. XIX, Fig. 20.)

Shell under medium size. Test thin and fossil usually flattened by pressure. Angles furrowed by a sharp line-like depression. An indistinct line traverses the middle of each side. The costae or transverse plications are fine and crowded with a downward curve to the middle of the side and then upward to the furrow at the corner (angle) opposite.

The specimens of this shell are so poorly preserved and so fragmentary that it seems impossible to refer them to the proper species, especially since Swallow's species apparently from this horizon, were never figured. Dr. Keyes in locating Swallow's

Conularias (Conularia marionensis and Conularia triplicata) makes his "Upper Hamilton shale" read Hannibal shale. It is doubtful if Swallow ever found any such fossil in the Hannibal shale.

We have in our possession a specimen of this Conularia embedded in a black coprolitic form, the end of the conularia only visible outside the coprolite. That recalls the fact that so many of the specimens of Conularia crustula, collected from the Upper Coal Measures at Kansas City are half embedded in a hard, smooth bluish or blue black pebble.

This Conularia comes from the yellow shale under the Louisiana limestone at the Town Branch Bluff.

PLATYCERAS PULCHERRIMUM, N. SP.

(Pl. XIX, Figs. 11, 12, 13, 14.)

Shell of medium size and composed of two or three rapidly enlarging, almost contiguous volutions, the outer one of which makes up almost the entire bulk of the fossil. The point of the spire is almost acute, slender and quite free from the neighboring volutions. The point of the spire is on a plane with the top side of the body of the shell or depressed below it.

Aperture almost circular, large and with little sinuosity even when attached to an object. Surface with strong lines of growth and crowded striae between, distinct and beautiful.

On one of the attached specimens, the lip of the shell is contracted, looking like a secondary growth.

The sinuous character of the lines of growth and striae on some specimens merely follow indistinct elevations and depressions of the surface which usually become obsolete before the lip is reached. The dorsal line is a beautiful curve.

Two of the figured specimens are attached to valves of Spirifer marionensis conforming well to the surface. As the host in each case is a detached valve, it is probable the Platyceras attached itself after the death of the Spirifer. This beautiful shell is from the yellow shales directly under the limestone and all the figured specimens were collected from the Town Branch locality.

Other speimens in the collection are from Eighth street and the mouth of Buffalo creek.

Two or three very small specimens of Platyceras have been found in the clay seams of the limestone, doubtless, the young of this species.

GASTEROPODA.

PLATYCERAS? ANOMALUM N. SP.

(Pl. XIX, Figs. 15, 16, 17, 18, 19.)

The larger of these two peculiar shells is quadrangular but with a broadly rounded front (?) edge and a narrower rounded back (?) edge, the lateral (?) edges being almost straight. Extending from the angles made by the lateral (?) edges with the circular front (?) to the apex are shallow but distinct narrowing furrows. Similar furrows extend from the apex to the angles made by the back (?) circular edge and the lateral edges making a rather strong medium, rounded ridge. The four furrows throw the sides and posterior (?) surface into three rounded ridges.

The elevation of the shell is quite as great as half the length (?) Apex sharp and directed toward the front (?) but not coiled. A few concentric lines of growth and a microscopically granular surface is the ornamentation.

The front surface is thrown into indistinct, minute (seen under a magnifier) plications or ridges, hardly reaching the apex. The front (?) edge, seen from the lower side, is minutely crenate. The other edges smooth. An indistinct transverse depression on the inside, below the front (?) margin, may be a muscular scar.

The smaller specimen has the outer surface thrown into more numerous furrows and ridges and more distinctly visible under a lens. Otherwise the shells agree well and are beyond doubt of the same species.

These fossils might be easily mistaken for brachiopods, related to Crania, but they never occur attached to other objects neither do their edges show that they ever could have been attached. They are, doubtless, gasteropods and related to Platyceras.

They are among the rare shells in the Louisiana limestone and come from washings of the clay seams.

The locality is the mouth of Buffalo creek, two miles southeast of Louisiana.

MURCHISONIA? PYGMAEA, Rowley.

(Pl. XIX, Fig. 7.)

The original description of this and of the next species were published in the October, 1895, number of the American Geologist and we repeat those descriptions.

"Shell minute, elongate, slender, tapering very gradually. Volutions rounded, the lowest being quite as long as the two whorls above. Suture well defined. No surface ornamentation visible, probably on account of the pyritized condition of the specimens which, after all, may be but casts. Natural size of the figured specimens one-sixteenth by one-fortieth of an inch. A rare species."

"Collected from the clay parting between the lower two layers of the Louisiana or Lithographic limestone at Louisiana, Missouri. These shells were obtained while washing the clay for young brachiopods and were found associated with Allagecrinus americanus, Pleurotomaria minima, Cyrtina acutirostris, Orthothetes lens, Chonetes geniculata, C. ornata, Spirifer marionensis, Spiriferina aciculifera, Productella pyxidata, Nucleospira barrisi; and other well known Kinderhook species."

After examining a number of these minute forms, we are convinced that we were in error in stating that they are casts, since they occur associated with Pleurotomaria minima, a shell, preserving the most delicate markings.

PLEUROTOMARIA MINIMA, Rowley.

(Pl. XIX, Fig. 8.)

We copy the original description. "Outline of shell low trochiform, minute. Volutions preserved rarely more than three, increasing rapidly in size. A narrow spiral band, quite noticeable around the middle of the first volution. Suture well defined. Umbilicus small surface apparently ornamented by transverse lines, visible only on a single specimen. Aperture sub-circular. Length and breadth of specimens about equal. One-seventeenth of an inch in diameter. Collected from the clay parting between the lower two layers of the Louisiana or Lithographic limestone at Louisiana, Missouri."

An examination of a larger number of specimens has added little to the original description except that we have become better acquainted with the surface markings, well shown in our figure and have been able to see the spiral band to the top and even the transverse lines on that.

PLEUROTOMARIA? SP?

(Pl. XIX, Fig. 9.)

The only specimen we have of this shell is an imperfect cast from the blue shales and we figure it to complete the fauna. It shows two volutions but no surface features except indications of a spiral band.

Found at the Town Branch locality a little above the fish bed.

PLEUROTOMARIA SP?

(Pl. XIX, Fig. 10.)

The only specimen we have seen of this shell seems to be a mould, of coprolitic origin, though perfect in outline and in the banded character of the genus.

Outside of the bands, no other surface features are observable. The specimen is black and smooth as if polished and firmly attached to what appears to be part of a coprolite, black and smooth like itself. Found in the fish bed horizon of the blue shale, associated with coprolitic forms and fish teeth. Town Branch locality, Louisiana, Missouri.

CEPHALOPODA.

ORTHOCERAS SP?

(Pl. XIX, Fig. 24.)

Our figure is of the open chamber of an Orthoceras whose specific characters can not be made out.

The writer has seen but two specimens of this Orthoceras and has misplaced the one with chamber walls. From the bottom layer of the Louisiana limestone at the Town Branch locality.

ORTHOCERAS MINIMUM N. SP.

(Pl. XIX, Fig. 25. (x5).

This shell is one among the smallest of the Louisiana limestone fossils and one of the very rarest. The type consists of an outer or living chamber, somewhat crushed and a few simple closed chambers with their partition walls. The shell is round and the closed chambers of moderate width. The siphuncle is so small that it defies a pocket magnifier to locate it.

Obtained by washing the clay over the bottom layer of the Louisiana limestone at the mouth of Buffalo creek.

GONIATITES LOUISIANENSIS, Rowley.

(Pl. XIX, Figs. 26, 27.)

The original description from the October, 1895, number of the American Geologist is as follows: "Shell compressed, very small. Umbilicus large and rather deep, but the condition of the specimens is such that the inner whorls are not visible. Volutions rather slender and rounded on the dorsal side. Septa distinct only in a few specimens, probably on account of the pyritized condition of the shells."

"Dorsal lobe long, tongue-shaped and rounded at the end. Dorsal saddle hardly as long as the dorsal lobe, but wider, and rounded at the extremity. Upper lateral lobe shallow and rounded at the end. Lateral saddle shallow, broad and rounded. Lower lateral lobe broad, obtuse. From the umbilicus to the dorsal side of a volution, three well-defined, equi-distant furrows extend. Body chamber not present in the specimen figured. The average size of the twelve or more specimens in the collection is little more than half that of the example figured."

"Obtained from the clay partings between the lower layers of the Louisiana or lithographic limestone at the mouth of Buffalo creek, Louisiana, Missouri. Compare with Dr. A. Winchell's G. pygmaeus from the Marshall Group."

LAMELLIBRANCHIATA.

PERNOPECTEN? MARBUTI N. SP.

(Pl. XIX, Fig. 23.)

This fine shell, "double sided" as it is, is exfoliated and injured about the edge, having been broken from the hard limestone. The patch of test remaining shows it to have had very fine longitudinal striations and rather strong concentric, cross lines of growth. The length is greater than the width and the shape is broadly ovate.

Hinge line rather short. Beak distinct. The shape of the wing-like extremities of the hinge area are probably as indicated by the dotted lines but the specimen is so injured that we cannot be certain of this. The shell is low convex in both valves and the test rather thick. This may be, after all, an Aviculopecten. The cross lines of growth are lamellate and with a wavy appearance as they cross the longitudinal striations.

It is very rare, a single specimen being all the writer has ever found.

The specific name is for Prof. C. F. Marbut, professor of geology in the Missouri State University.

The type is from the bottom layer of the limestone at the mouth of Buffalo creek.

GRAMMYSIA HANNIBALENSIS, Shumard.

(Pl. XIX, Figs. 21, 22.)

We quote Dr. Shumard's description: "Shell transverse, subovate, rather depressed; anterior extremity rounded, posterior extremity obliquely truncated and obtusely angulated; basal margin gently rounded; hinge margin slightly concave; beaks obtuse, situated at about one-third the distance from the anterior to the posterior extremity; surface marked with about eighteen concentric ribs, the lower ones broad and angulated, those near the beak rounded and very close together."

Our specimen came from the basal layer of the Louisiana limestone and is partly embedded in the hard stone. While this shell is not uncommon in the Hannibal shales above the Louisiana limestone, it is quite rare below, the specimen figured being the best one yet collected at Louisiana.

Fragments of this shell occur in both the yellow and blue shales below and all the specimens collected by the writer are from the Town Branch locality.

CRUSTACEANS.

PHILLIPSIA STRATTON-PORTERI N. SP.

(Pl. XIX, Figs. 28, 29.)

A rather small species. Cephalic shield semicircular, about twice as broad as long and with the postero-lateral angles produced into slender elongate spines that extend back, probably to the middle of the thoracic margin. A poorly defined rim with little upward deflection, borders the front and sides of the head shield.

The glabella has but little convexity and a length but half that of the head shield and a width one-fifth as great. The length of the glabella is once and a half as great as the width. Neck segment narrow, depressed. Only the posterior lateral lobes of the glabella observable. Eyes round, more than one-third as long as the glabella and quite as prominent. Reticulations not visible under a hand glass.

Facial sutures traceable with difficulty, meeting the anterior

margin of the Cephalic shield almost in front of the eye. Thorax not known. Pygidium almost semicircular, a little wider than long and fully as long as the head shield. Mesial lobe convex, much less wide anteriorly than the lateral lobes, tapering backward to a blunt point at the broad posterior margin of the pygidium and having thirteen segments. Lateral lobes somewhat convex and with a broad flattened margin, ten segments each ending with a marginal blunt spine giving the outline a toothed appearance.

There are five or six other rows of nodes on the lateral lobe, the central row being much the strongest. Seven rows of nodes cross the middle lobe, longitudinally, the middle row being very much the strongest. Less distinct nodes cover the cephalic shield including the glabella.

The spinose or toothed character of the outer ends of the pygidial segments, unusually small glabella and prominent rounded eyes readily separate this trilobite from other species of the genus.

The three specimens figured are all that are known of this little crustacean and all three were found on the top surface of the bottom layer of the limestone, the two associated as indicated and the third an inch or two away. Locality, mouth of Buffalo creek.

Named specifically for the author and ardent lover of nature, Mrs. Gene Stratton-Porter of Limberlost Cabin, Geneva, Indiana.

PHILLIPSIA MISSOURIENSIS, Shumard.

(Pl. XIX, Figs. 30, 31.)

Shumard's description of this trilobite from the "Geological Survey of Missouri," 1855, is: "Glabella tumid, greatest height about the center, ovoid, obtusely rounded in front, truncated posteriorly, length a little greater than the width, widest behind, three furrows on either side, posterior pair strongly marked; these commence at the dorsal sinus, about one-third the distance from base to front, pass in a curve backwards, and bifurcate about midway between the center and sides of the glabella; one branch, very shallow, is continued for a short distance almost transversely; the other bends backwards nearly to the occipital sinus, and with the main branch partially encloses a large oval lobe on each side, the lobes separated by a space about half the width of the glabella, middle pair of furrows, shallow, curving backwards in a direction nearly parallel with the posterior ones, but considerably shorter; anterior pair feebly impressed, a little oblique; occipital sinus a

little convex towards the front, shallowest in the middle, occipital ring wide, flattened, much lower than the plane of the glabella. Pygdium semicircular, flattened convex, width double the length, margin broad and slightly concave; axial lobe almost as wide as the lateral lobes, rounded at the extremity, segments ten, separated by strongly marked furrows; lateral lobes flattened, with six or seven segments, separated by shallow, but well-marked furrows; surface thickly studded with granules, which are rather smaller than those of the glabella. Cheeks and thorax unknown. The test is of a light chestnut brown color."

"Obtained by Prof. Swallow from the lithographic limestone at Hannibal, Louisiana and Chouteau Springs."

We have a few fragments apparently of this species.

GEN? SP?

(Pl. XIX, Figs. 32, 33.)

These very minute shells are bivalve crustaceans and doubtless belong to the Ostracoid family.

They are hardly visible without a glass, long, elliptical and elliptical in cross-section. Edgwise a line may be seen, the closed valve edges.

Specimens of this little organism are in the hands of Mr. Ray S. Bassler of the National Museum for description. Obtained in the clay washings of the limestone seams, at the mouth of Buffalo creek.

MISCELLANEOUS INTERESTING FOSSILS FROM THE PALAEZOIC ROCKS OF PIKE COUNTY.

On plate five we have illustrated by a series of drawings, the growth characteristics of the finest of the Burlington Blastoids, Codonties stelliformis and have described a new variety of the same.

The Batocrinus is interesting as a transitional form, and suggestive of the relationship between that genus and Macrocrinus and Eretmocrinus.

The brachiopod from the Clinton limestone is somewhat of a puzzle, generically, and doubtfully identified but the pictures of the Lingulae are to further illustrate a species described under Plate IV.

The rest of the figures are parts of a rare sea urchin of the old Burlington Seas.

So many beautiful fossils have been collected from the rocks of Pike county that one does not know when to stop illustrating them, the crinoids and blastoids alone from the Burlington, numbering scores.

The fauna of the Louisiana limestone, illustrated in this report is one of the smallest in the county and with the Trenton limestone, Hudson shales, Niagara limestone, Burlington limestone, Keokuk beds and Coal Measures to draw from, a cumbrous volume might be written.

CODONITES STELLIFORMIS, M. & W.

(Pl. XX, Figs. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11.)

We have figured a series of specimens of this fine blastoid to show variations in form, surface ornamentation and for comparison with a form described below.

It will be observed that the younger specimens are more elongate and much less lobed than adult individuals. In some specimens the anal opening is at the base of a prominent wart-like tubercle.

One specimen, Fig. 11, is a four sided individual and the only one the writer has ever seen, though he has collected nearly a hundred normal specimens of the species. The chief charactristics of Codonites stelliformis are the thick test, star shaped body, long spiracular clefts and linear ornamentation.

The range of this fossil is limited to the Cryptoblastus melo horizon and while it occurs very sparingly through seven or eight feet of limestone, it is not often found beyond the twelve to fourteen inches of rock that yields *melo* so abundantly. Handsome specimens are occasionally found in the soft white chert.

At Cedar Gap, Missouri, this or a kindred species has been found as a pyritized cast in the Hannibal shales. This would make the range of considerable extent if the formation and the fossil have been correctly identified but a loose fossil on a clay slope is not a safe index to range. The specimens figured are from the Lower Burlington quarries around Louisiana.

CODONITES STELLIFORMIS VAR. CATACTUS N. VAR.

(Pl. XX, Fig. 12.)

The length of the body is equal to the width. The flattened or concave areas adjacent to the ambulacra in stelliformis are

wanting in this form, thus giving to the ambulacra a ridge like appearance, much attenuate at the extremity.

The interradial sinuses are rather deep and give a rather strong stellate ventral aspect.

The interradial or deltoid plates are somewhat smaller than in stelliformis but visible on a side view from the greater convexity of the ventral surface.

The anal side of the type specimen is so injured that the character of the anal opening is unknown but probably similar to that of stelliformis. The respiratory slits are much as in stelliformis. The test is thin, differing much in this respect from Codonites stelliformis. The ornamentation is lines parallel with the plate sutures.

The attenuated character of the ambulacral lobes, height in proportion to width, greater convexity of ventral surface and thinness of the test are the distinguishing characteristics of this variety.

It may prove to be a new species when other material is collected. From the Cryptoblastus melo horizon of the Lower Burlington at Louisiana.

BATOCRINUS CURIOSUS, N. SP.

(Pl. XX, Figs. 13, 14.)

The three basal plates form a broad flat surface and are entirely hidden on a side view by the extravagantly protuberant radials. The first costals are narrow, small and without convexity. The second costals are much larger and strongly wart-like. The second plate of the second series is axillary. All of the upper radial plates are tuberculose. There are probably from twenty-two to twenty-four arm bases in a continuous rim. The first intercostal plate is large and strongly tuberculose with one or two small flat plates above.

The vault plates are all wart-like and the base of the anal tube is of medium size and almost central. The stem was round and of medium size, with a small central perforation.

In the extravagantly enlarged radials the specimen bears a strong resemblance to an overgrown Macrocrinus. The expanded basal plates recall Eretmocrinus but in general the fossil is much like Batocrinus subaequalis differing from that species in the features mentioned above.

The type was obtained from the top of the Cryptoblastus melo horizon in Pratt's Quarry, Louisiana, Missouri.

EOCIDARIS (LEPIDOCIDARIS) SQUAMOSUS M. & W.

(Pl. XX, Figs. 15, 16, 17, 18.)

Plates hexagonal with thin margins sloping up half way to the plate center and there forming a circular elevation surrounding a basin shaped depression from the center of which arises the tubercle for the attachment of the spine. The top of the encircling ridge is set with nodules, more or less irregularly arranged. Surface of the plate otherwise apparently smooth. Central tubercle elevated above the annulation between which latter and the tubercle is but a slight depression. The annulation itself is elevated above the outer nodular rim. Spines small, elongate, slender, apparently straight. Surface finely striate.

Articulating extremity expanded into a sharp annular crenulate rim contracted below scarcely more than above. The portion of a jaw figured shows that organ to have been strong.

From the Batocrinus calvini horizon of the Lower Burlington limestone (very base of the Lower Burlington).

Marble Head quarry, two miles above Louisiana on the Mississippi river.

PHOLIDOSTROPHIA?? PARKSI N. SP.

(Pl. XX, Figs. 22, 23, 24.)

Shell subcircular in outline, concavo-convex, the amount of convexity recalling Productus or Productella.

One-third of the convex length of the ventral valve forms a more or less flattened region not unlike that of Leptaena rhomboidalis but of much less extent and hardly so flat. The ends of the cardinal area are slightly produced into blunt ears. The beak of the ventral valve is distinct but not incurved.

The shell is covered by strong cross lines of growth. About the beak, fine indistinct, longitudinal striae or plications are visible but not noticeable beyond the flattened area.

The cardinal area is unusually high for a concavo-convex shell, recalling that of Orthothetes or Derbya. A convex deltidial plate covers the top of a rather broad foramen. There is a minute perforation in the ventral beak which may be due to wear.

The adhering limestone has not been removed from the dorsal side of the specimen but it is doubtful if the dorsal valve is preserved. The type is unique. From the Clinton brown limestone near Watson Station. The specific name is for Prof. W. A. Parks of the University of Toronto. This shell is certainly not a Pholidostrophia in the great height of its cardinal area.

We would probably be justified in creating a genus for the reception of this species but as only one specimen of the shell has come under the observation of the writer, he does not think it expedient at least until the brachial valve is seen.

Associated with this shell at Watson Station is quite an interesting fauna of small brachipods corals, pelecypods, gasteropods and a few other less plentiful forms, and while the beds are, beyond doubt of the Niagara age, they are low in that formation and are probably the equivalent of the Clinton beds of New York. Leptaena rhomboidalis occurs sparingly at the same locality and horizon and were it not for the high cardinal area and strong deltidium of our species it might, at a hasty glance, be taken for that species. However its lack of plications together with other features mentioned above remove it not only from Leptaena but from all other Niagara genera with which the writer is familiar.

It also bears a superficial resemblance to Rafinesquina, barring its greater convexity, higher cardinal area and nonplicate surface.

If the slightly flattened unbonal region were once a surface of attachment our shell might be compared with the European Devonian genus Davidsonia.

LINGULA LINEOLATA, Rowley.

(Pl. XX, Figs. 19, 20, 21.)

This species was figured on Plate XIX. of this report and the types are refigured here to show further details.

* * * * * * * * *

We have returned to Meek and Worthen's generic term Codonites, being satisfied that it should hold, despite the priority of Orophocrinus, arraying Meek and Worthen's excellent description and more excellent figure against a meagre diagnosis of a fossil known only as a picture.

Our variety Codonites stelliformis var catactus should doubtless be ranked as a good species, bearing a stronger resemblance to the Belgian species of the genus than to stelliformis.

There is a much more elongate form in the basal layer of the Burlington limestone but only detached radial (fork) pieces and a single badly crushed body have yet been found and the latter in no condition to be studied or figured to show specific characters.

It agrees with the form we have pictured in Fig. 12 in the thinness of the test and the narrow ambulacral ridges but differs

in being much longer and narrower and with comparatively short ambulacra.

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The specimens numbered 3, 4, 13, 14 on Plate XX have been misplaced and thus rendered our descriptions of them less fully than we had wished.

EXPLANATION OF PLATE XV.

ILLAENUS TAURUS, Hall.

Fig. 1. Top view of the body, much of the head being turned in.

ASAPHUS GIGAS, Dekay.

Fig. 2. Dorsal view of an entire specimen—a young individual.

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ASAPHUS MEGISTOS, Locke.

Fig. 3. Dorsal view of an almost perfect young specimen.

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LICHAS TRENTONENSIS, Conrad.

Figs. 4, 5. Dorsal and side views of an imperfect head.

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ILLAENUS SP?

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Fig. 6. Dorsal view of the head shield.
Fig. 7. Dorsal view of thorax and pygidium. Same specimen.
Fig. 8. Lateral view of the entire body. Same specimen.

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ILLAENUS TAURUS? Hall.

Fig. 9. Lateral view of a fine specimen (rolled).
Fig. 10. Front view of the head. Same specimen.
Fig. 11. Dorsal view of the thorax and pygidium. Same specimen.

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GEN? SP?

Fig. 12. Dorsal view of a perfect body.
Fig. 13. View of the inner or concave surface of a specimen.
Fig. 14. Dorsal view of a cephalic shield.

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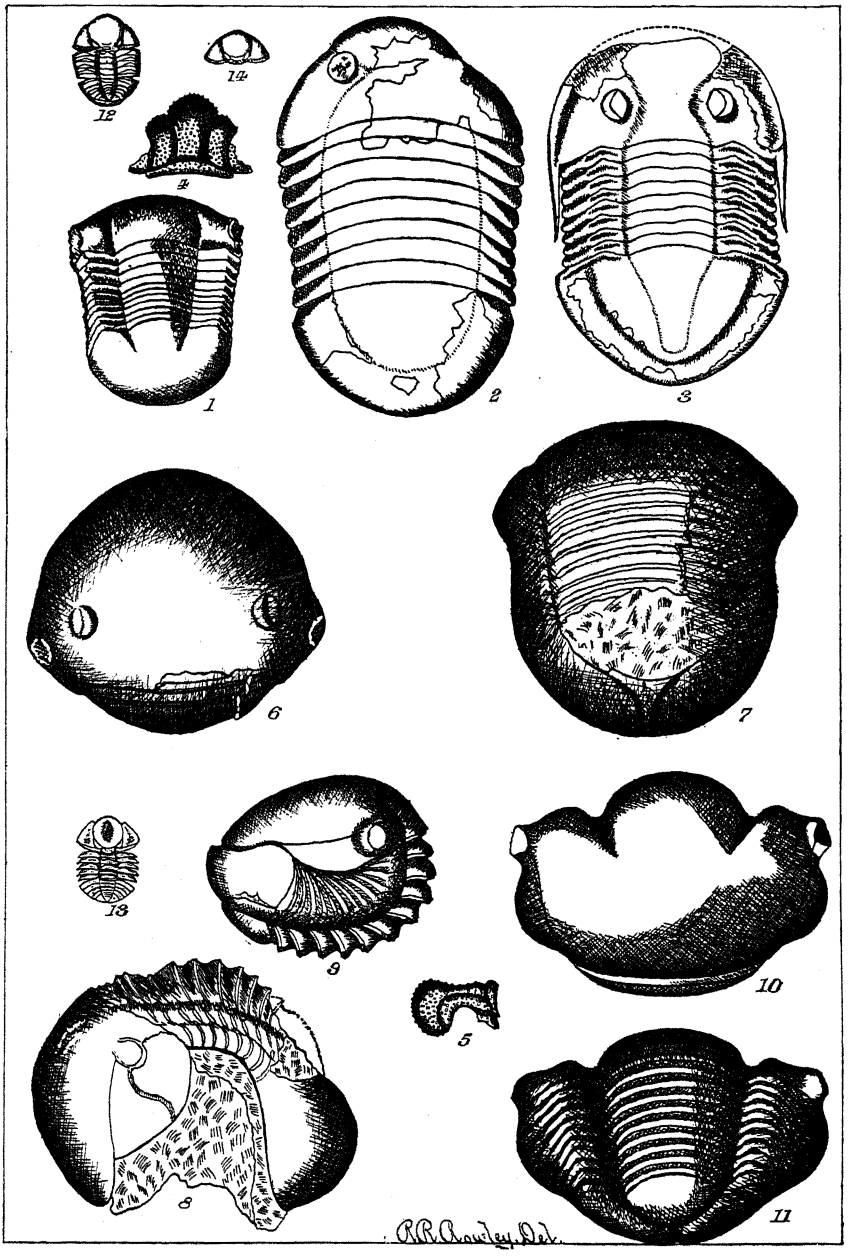

ORDOVICIAN TRILOBITES.

INVERTEBRATE FAUNA OF THE LOUISIANA LIMESTONE.

EXPLANATION OF PLATE XVI.

ZAPHRENTIS PARASITICA, Worthen.

Figs. 1 and 2, side views of two attached forms, the first to the brachial valve of Rhipidomella missouriensis and the other to Syringothyris hannibalensis.

Figs. 3 and 4, are side and basal views of a young detached specimen.

Figs. 5 and 6, are side and calice views of a medium-sized individual.

Fig. 7, side view of a curved specimen showing the calice with a central bud expanded.

Fig. 8, side view of a large specimen with a discoidal young specimen attached to the side.

Figs. 9 and 11, side views of two very wrinkled old corallums.

Fig. 10. View of an old specimen, showing well calicular gemmation.

Fig. 12. Side view of a worn specimen, showing the cup.

Fig. 13. Views of a peculiarly twisted specimen.

Fig. 14. View of an old specimen to which are attached some parasitic organisms. Page 61

ZAPHRENTIS PALMERI N. SP.

Figs. 15, 16. Side views of two different specimens.

Figs. 17, 18. Side and calice views of the same specimen.

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ZAPHRENTIS ACUTA? W. & W.

Figs. 19, 20. Two different side views of the same specimen.

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GEN? SP?

Fig. 21. View of the only specimen in the collection.

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PALAEACIS ENORMIS, M. & W.

Fig. 22. View of an adult specimen.

Figs. 23, 24. Views of two old specimens.

Fig. 25. A three-celled specimen attached to Spirifer marionensis.

Fig. 26. A small detached three-celled specimen.

Figs. 27, 28. Two small, attached, single-celled specimens.

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CONOPTERIUM EFFUSUM, Winchell.

Fig. 29. Top view of a fine specimen, showing the irregularities in the cells.
Fig. 30. Basal view of a hemispheric specimen, showing the epitheca and scar of attachment.
Fig. 31. View of a fine specimen attached to the cardinal area of Productella pyxidata.
Fig. 32. A fine individual attached to Cyrtina acutirostris.
Fig. 33. Under view of a peculiar specimen, showing the cone-cups well.
Fig. 34. An incipient colony attached to Spirifer marionensis.

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PTYCHOSTYLUS SUBTUMIDUS, Gurley.

Figs. 35 and 36. Side and top views of a medium-sized specimen.

Page 65.

CORNULITES CARBONARIUS, Gurley.

Fig. 37. Top view of a specimen attached to Spirifer marionensis.

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SPIRORBIS KINDERHOOKENSIS, Gurley.

Fig. 38. Top view of a specimen attached to the brachial valve of Spirifer marionensis. Page 67.

ALLAGECRINUS AMERICANUS, Rowley.

Fig. 39. Side view of a large specimen x 4.
Fig. 40. Ventral view of a smaller specimen x 5.
Fig. 41. Side view of a large specimen preserving a few of the upper stem joints and the bases of the slender arms x 4.

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PLATYCRINUS DODGEI, N. SP.

Fig. 42. A very large basal disc.
Fig. 43. A large radial. Fig. 44. Side view of a basal disc.
Fig. 45. Lower surface of a small basal cup.
Fig. 46. A short column. Figs. 47, 48, separate stem joints.

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CRINOID PLATES AND STEMS.

Figs. 49, 50. Two views of a warty radial plate.
Figs. 52, 55. Views of two radial plates. Fig 59. An arm plate.
Figs. 51, 52, 54, 56, 57. Interradial plates. Fig. 58. On elongated, slender third radial.
Fig. 60. A flat discoidal body, stem joint or basal plates of a crinoid.
Fig. 61. A stem joint with cirri attached. Fig. 62. A strongly stellate stem joint.
Figs. 63, 64. Side and end views of a round column with alternate larger and smaller joints.
Figs. 65, 66. Side and end views of a pentagonal stem with very long cirri.
Fig. 67. Another pentagonal stem with cirri.
Figs. 68, 69. Side and end views of a cirrus enlarged, showing spiny projections on the joints.
Fig. 70. A coiled round-stem.

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POTERIOCRINUS JEFFRIESI, N. SP.

Figs. 71, 72, 73. Two side views and top view of the type specimen.

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LEPTODISCUS CORRUGATUS, N. SP.

Fig. 74. Top side of a large specimen discoidal in outline.
Figs. 75, 76. Side and basal views of a hemispheric specimen.

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GENUS? SP?

Figs. 77, 78. Views of two groups of these minute organisms greatly magnified.

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GEN? SP?

Fig. 79. Magnified view of a group of these minute parasitic forms, attached to a valve of Syringothyris hannibalensis.

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CRINOID? STUMP?

Fig. 14. Several of these parasitic forms attached to Zaphrentis parasitica.
Fig. 80. Specimen attached to Productella pyxidata.

Fig. 81. A less branched specimen attached to Spirifer marionensis. Page 71.

SPONGE? SPICULES?

Figs. 82, 83, 84, 85, 86. Examples of specimens of different shapes. Page 71.

CRINOID BASES.

Figs. 87, 88. Under and upper views of a basal disc of five plates x 2.

Fig. 89. Side views of a basal cup with several stem joints attached. Page 71.

STREBLOTRYPA SP.

Fig. 90. A ramose stem of the bryozoa. Page 72.

STENOPORA? SP.

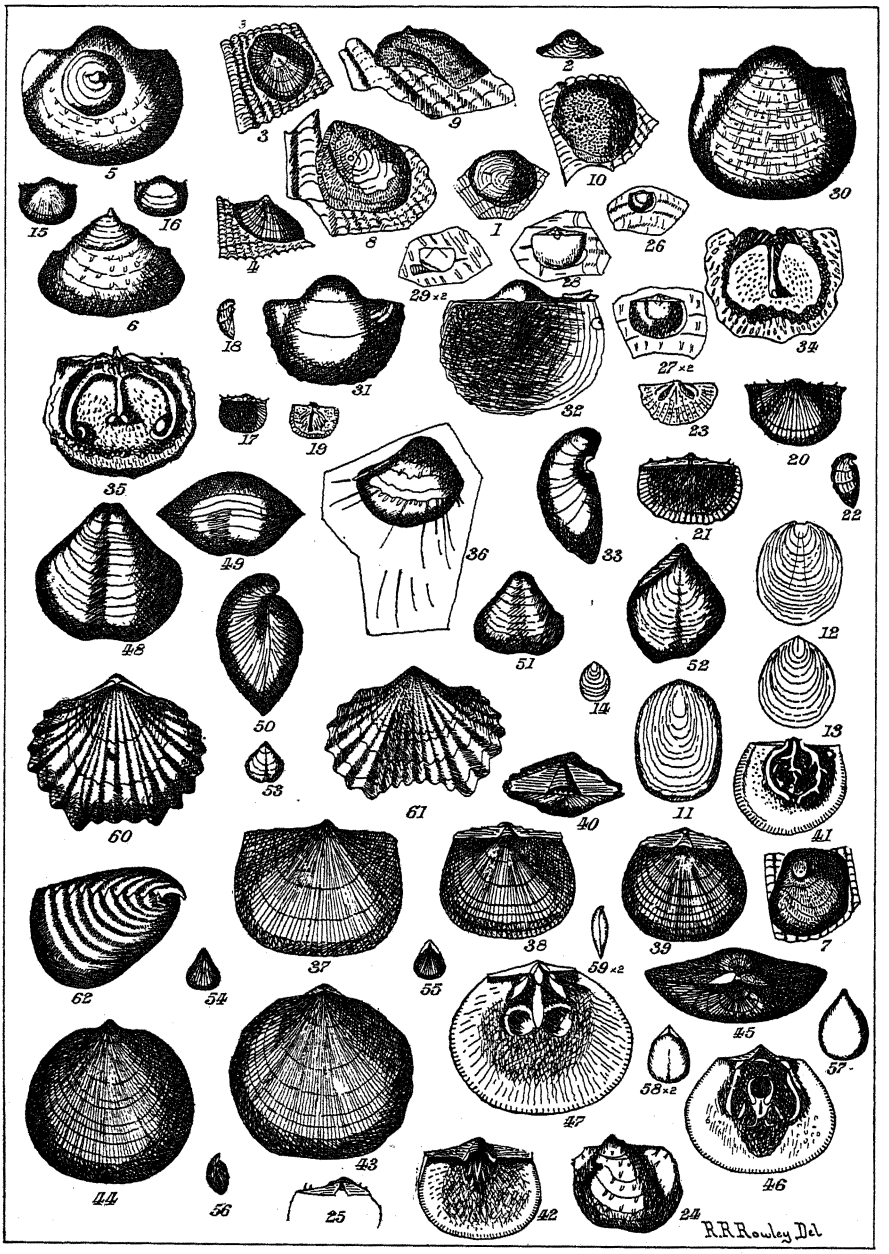
Fig. 91. An incrusting colony on a brachiopod. Page 72.

LIOCLEMA SP?

Fig. 92. An incrusting frond on a brachiopod. Page 27.

STENOPORA? SP?

Fig. 93. A circular, discoidal, incrusting colony on a shell. Page 72.



INVERTEBRATE FAUNA OF THE LOUISIANA LIMESTONE.

EXPLANATION OF PLATE XVII.

ORBICULOIDEA LIMATA, N. SP.

Figs. 1 and 2. Top and side views of the type, attached to a valve of Orthothetes lens. From the yellow under shale on the Town Branch.

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CRANIA ROWLEYI, Gurley.

Figs. 3, 4. Top and side views of a medium-sized specimen, attached to the ventral valve of Spirifer marionensis. From a clay seam in the limestone at the mouth of Buffalo creek.

Page 73.

CRANIA DODGEI, N. SP.

Figs. 5, 6. Top and side views of the type specimen, attached to the convex valve of Productella pyxidata. From the underside of the basal layer of the limestone at the mouth of Buffalo creek.

Page 73.

CRANIA SPICULATA, N. SP.

Fig. 7. Top view of a finely preserved specimen attached to the dorsal valve of a Spirifer marionensis. From a clay seam in the limestone at the mouth of Buffalo creek.

Figs. 8, 9. Top and side views of a distorted specimen attached to the dorsal valve of Syringothyris hannibalensis. Horizon and locality same as Fig. 7.

Fig. 10. Top view of a specimen attached to the dorsal valve of Spirifer marionensis and nearly entirely covered by a Bryozoan frond.

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LINGULA SP?

Fig. 11. An elongate specimen as it appears on the surface of the black shale. Grassy creek locality.

Fig. 12. A more rounded specimen probably of the same species. Same locality and horizon.

Page 74.

LINGULA SP?

Fig. 13. This shell is probably specifically distinct from Figs. 11 & 12. Same locality and horizon.

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LINGULA SP?

Fig. 14. This little shell is quite distinct from the above species and is never so flat as the others. Same horizon and locality.

Page 74.

CHONETES GENICULATUS, White.

Fig. 15. View of the convex valve of a plicated specimen.
Fig. 16. Similar view of a smooth specimen.
Fig. 17. View of the concave valve of a specimen.
Fig. 18. Edge view to show thickness.
Fig. 19. Inner surface of a brachial valve, showing muscular scar & c. All from the clay seams of the limestone at Eighth street.

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CHONETES ORNATUS, Shumard.

Fig. 20. View of the pedicel valve of a full sized specimen.
Fig. 21. View of the brachial valve of a specimen.
Fig. 22. Edge view of a specimen.
Fig. 23. Inner surface of a brachial valve, showing muscular scar & c. Specimens from Eighth street and the mouth of Buffalo creek.

Page 75.

STROPHALOSIA BEECHERI, Rowley.

Figs. 24, 25. Ventral and cardinal views of the type specimen. From the yellow sandy shale immediately below the limestone on the Town Branch.

Page 76.

STROPHALOSIA SCINTILLA, Beecher.

Fig. 26. A specimen attached to the concave valve of Productella pyxidata.
Fig. 27. The same specimen (Fig. 26) two diameters.
Fig. 28. A specimen, two diameters, with two spines in place.
Fig. 29. A smaller specimen, two diameters.
All of these are attached to the same Productella.

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PRODUCTELLA PYXIDATA, Hall.

Fig. 5. A more or less spinose brachial valve to which a Crania is attached.

Fig. 30. Ventral view of a large specimen with a more or less plicate appearance. From the yellow shales under the limestone on the Town Branch.

Fig. 31. A specimen almost smooth, from the limestone seams at the mouth of Buffalo creek.

Fig. 32. Dorsal view of a large specimen from a clay seam of the limestone. Same locality as Fig. 31.

Fig. 33. View of the edge of a specimen from the yellow shale on the Town Branch.

Figs. 34, 35. Inner surface of two brachial valves, showing muscular scar and other features.

Fig. 36. A specimen partly embedded on limestone showing the great length of the spines.

Page 77.

ORTHOTHETES LENS, White.

Fig. 37. Pedicel valve of a large, fine specimen from the clay seams of the limestone at the mouth of Buffalo creek.

Fig. 38. Brachial valve of a somewhat smaller specimen from the same horizon and locality as the last.

Fig. 39. Brachial valve of a specimen with a short hinge line. From the yellow shales below the limestone on the Town Branch.

Fig. 40. Cardinal view of an old specimen with an unusually wide area. From the same horizon and locality at 37 and 38.

Fig. 41. Brachial valve. Inner surface to show muscular scar and other features.

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RHIPIDOMELLA MISSOURIENSIS, Swallow.

Fig. 43. Dorsal valve of a large specimen from the yellow shale on the Town Branch.

Fig. 44. Ventral view of a splendidly preserved specimen from a clay seam at the mouth of Buffalo creek.

Fig. 45. Cardinal view of a large specimen from the yellow shale under the Louisiana limestone on the Town Branch.

Fig. 46. Pedicel valve showing hinge line, teeth and muscular scar.

Fig. 47. Brachial valve, showing hinge features, muscular scar, &c.

Both 46 & 47 are from the clay seams at Eighth street.

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SEMINULA BUCKLEYI, N. SP.

Fig. 48. Pedicel valve of the type specimen.
Fig. 49. Front view of both valves, same specimen.
Fig. 50. Side view of same specimen to show thickness.
Fig. 51. Pedicel valve of a smaller specimen.
Fig. 52. Brachial valve of another specimen.
Fig. 53. Pedicel valve of a young specimen.

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TRIGERIA? CURRIEI, Rowley.

Fig. 54. Pedicel valve of a large plicate specimen.
Fig. 55. Brachial valve of another specimen showing open foramen.
Fig. 56. Side view of a specimen to show thickness.
All of these from the clay seams of the limestone and obtained by washing and sifting. Mouth of Buffalo creek.

Page 80.

TRIGERIA? PEDICULUS, Rowley.

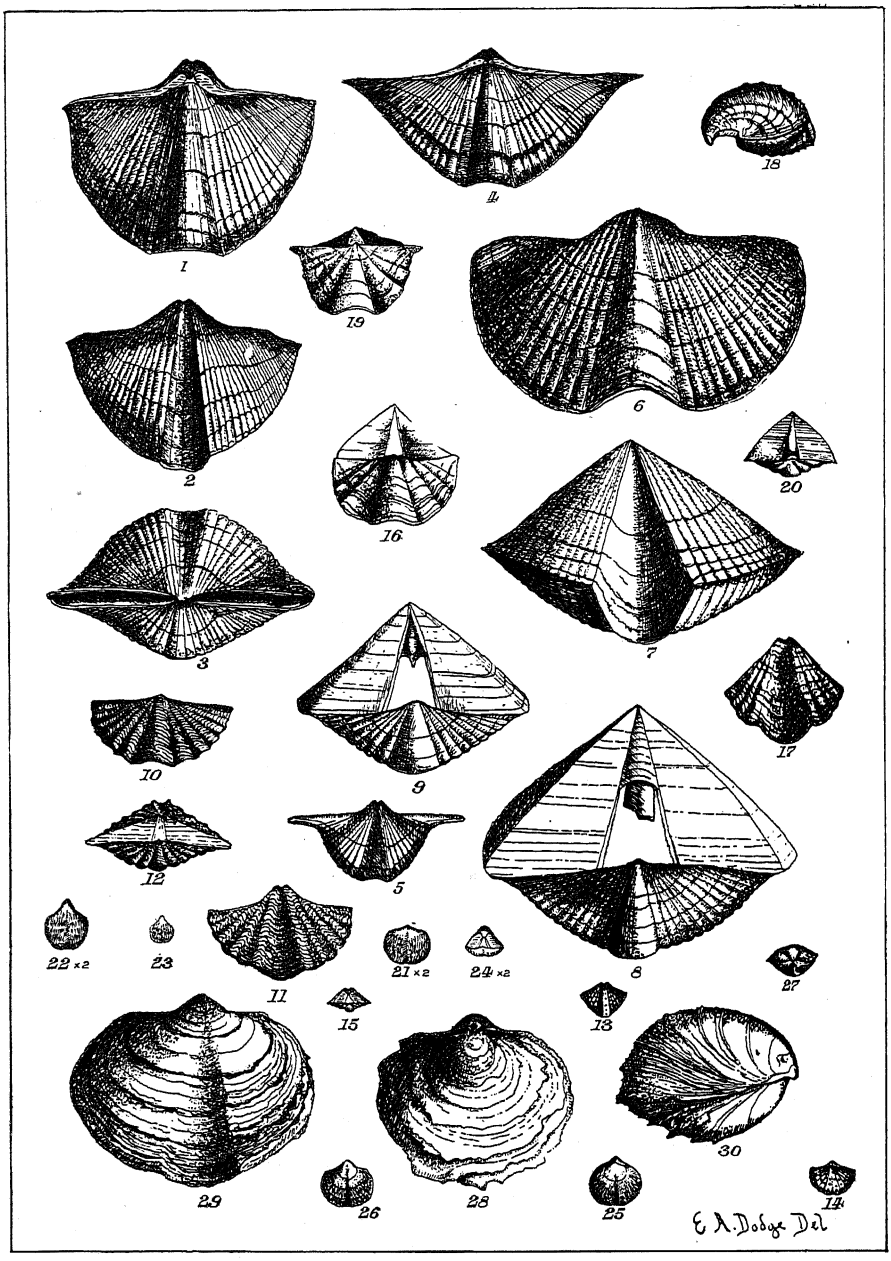
Originally described as Dielasma? pediculus.
Figs. 57, 58, 59. Ventral, dorsal and side views of three large specimens. Obtained from the same horizon, locality and by the same means as Trigeria curriei.

Page 80.

PUGNAX MISSOURIENSIS? Shumard.

Figs. 60, 61, 62. Dorsal, ventral and side views of the only perfect ("skinned") specimen in the collection. Page 80.
From the limestone band at the base, on the Town Branch.

The type specimen of Seminula buckleyi came from a clay seam in the limestone at the Eighth street bluff.
Figs. 51 and 52 from the yellow shales below the limestone on the Town Branch.



INVERTEBRATE FAUNA OF THE LOUISIANA LIMESTONE.

EXPLANATION OF PLATE XVIII.

SPIRIFER MARIONENSIS, Shumard.

Fig. 1. Dorsal view of a fine specimen from a clay seam of the limestone at the Eighth street Bluff. The mesial fold is stronger on this specimen than usual and the plications almost obsolete on the fold.

Fig. 2. Ventral view of a somewhat smaller specimen from the one inch band of yellow, sandy shale immediately under the limestone, at the Town Branch locality.

Fig. 3. Cardinal view of a fine, plump specimen from the same locality as figure 2. On this specimen, while the mesial fold is well outlined by lateral furrows, it has scarcely any elevation above the general surface of the valve.

Fig. 4. Dorsal view of a younger specimen greatly extended along the cardinal line. The mesial fold is practically flat on this specimen and the cardinal area has little width, the beak of the ventral valve incurving over the foramen. From the Town Branch locality.

Fig. 5. Ventral view of a young specimen with extended and very acute cardinal extremities. From the Eighth street Bluff.

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SYRINGOTHYRIS HANNIBALENSIS, Swallow.

Fig. 6. Dorsal view of an exfoliated specimen, medium size, from the mouth of Buffalo creek.

Fig. 7. Front, ventral view of a "skinned" specimen from the same locality as the last (Fig. 6).

Fig. 8. Back view, showing the extravagantly elevated cardinal area, with a pseudo-deltidium covering a part of the high triangular foramen. A part of the syrinx is seen as it lies below and under the foramen covering. This specimen preserves the test but is not perfect at the front. From the Eighth street Bluff.

Fig. 9. Cardinal view of an under-sized specimen, perfect and probably the form called Syringothyris missouriensis by Prof. Hall.

The greatest width of the shell is not on the cardinal line. A part of the pseudodeltidium covers half the length of the syrinx.

This fine specimen is from a clay seam in the limestone on the Town Branch.

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SPIRIFERINA CLARKSVILLENSIS, Winchell.

Fig. 10. Dorsal view of a separate valve. Mouth of Buffalo creek.
Figs. 11 and 12. Ventral and Cardinal views of a perfect specimen from the same locality as Fig. 10.

One perfect specimen has been found in the under blue shales on the Town Branch and two small ones in the clay seams of the limestone at Eighth street.

Page 83.

SPIRIFERINA ACICULIFERA, Rowley.

Figs. 13, 14, 15. Ventral, dorsal and cardinal views of the original type specimen, natural size.

From the mouth of Buffalo creek. Clay seam in the limestone.

Page 84.

CYRTINA ACUTIROSTRIS, Shumard.

Fig. 16. Cardinal view of a rather large specimen with an uncovered foramen. From the clay seam in the limestone at the mouth of Buffalo creek.
Fig. 17. View of the ventral valve from the front of a full sized specimen from the same locality as the last and from a clay seam of the limestone.
Fig. 18. Side view of an old specimen with greatly incurved break and wrinkled surface. From the same horizon and locality as Figs. 16 and 17.
Fig. 19. Dorsal view of a fine specimen with acute cardinal extremities. From a clay seam in the limestone. Mouth of Buffalo creek.
Fig. 20. Cardinal view of a smaller specimen with a perpendicular area. From a clay seam in the limestone at the mouth of Buffalo creek.

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AMBOCOELIA MINUTA, White.

Fig. 21. Dorsal valve of a large specimen, enlarged to two diameters, showing a slight median depression and the closely arranged hair-like spines, lying flat on the surface.

Fis. 22 and 23. Ventral views of a large specimen enlarged to two diameters and natural size with a shallow central depression and appressed spines.

Fig. 24. Cardinal view of a large specimen, two diameters.

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NUCLEOSPIRA BARRISI, White.

Figs. 25, 26. Dorsal and ventral views of a large, well preserved specimen, showing the appressed spines.

Fig. 27. Front view, showing the thickness of the shell.

Both specimens from the clay seams of the limestone at the mouth of Buffalo creek.

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ATHYRIS HANNIBALENSIS, Swallow.

Fig. 28. Dorsal view of an old specimen.

Fig. 29. Ventral view of a very large and fine specimen.

Fig. 30. Side view of an old specimen.

The first two of these are from the clay seams of the limestone at the mouth of Buffalo creek and the last one from the yellow, sandy shale below the limestone at the Town Branch locality.

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EXPLANATION OF PLATE XIX.

LINGULA MISSOURIENSIS, N. SP.

Fig. 1. Cast of the inner side of the valve, showing lines of growth.

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LINGULA LINEOLATA, N. SP.

Fig. 35. View of the pedicel valve. Fig. 36. Similar view of a larger specimen.

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CYRTINA ACUTIROSTRIS, Shumard.

Fig. 2. Cardinal view of a specimen with the foramen closed, except near the apex, by a roof-like plate.

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SPIRIFER MARIONENSIS, Shumard.

Fig. 3. Ventral view of a fine specimen with a Crania rowleyi attached.

Fig. 6. Surface enlarged to show the fine lines crossing the plications.

Page 88.

SYRINGOTHYRIS HANNIBALENSIS, Swallow.

Fig. 4. Cardinal view of a large injured specimen showing well the foramen covering and the syrinx lying beneath.

Fig. 5. Surface enlargement to show the bases of the fine hair-like spines or setae and the "twilled cloth" appearance where the setae are removed. These features show beautifully on Louisiana specimens.

Page 88.

MURCHISONIA? PYGMAEA, Rowley.

Fig. 7. Side view of a specimen showing five volutions. x5.

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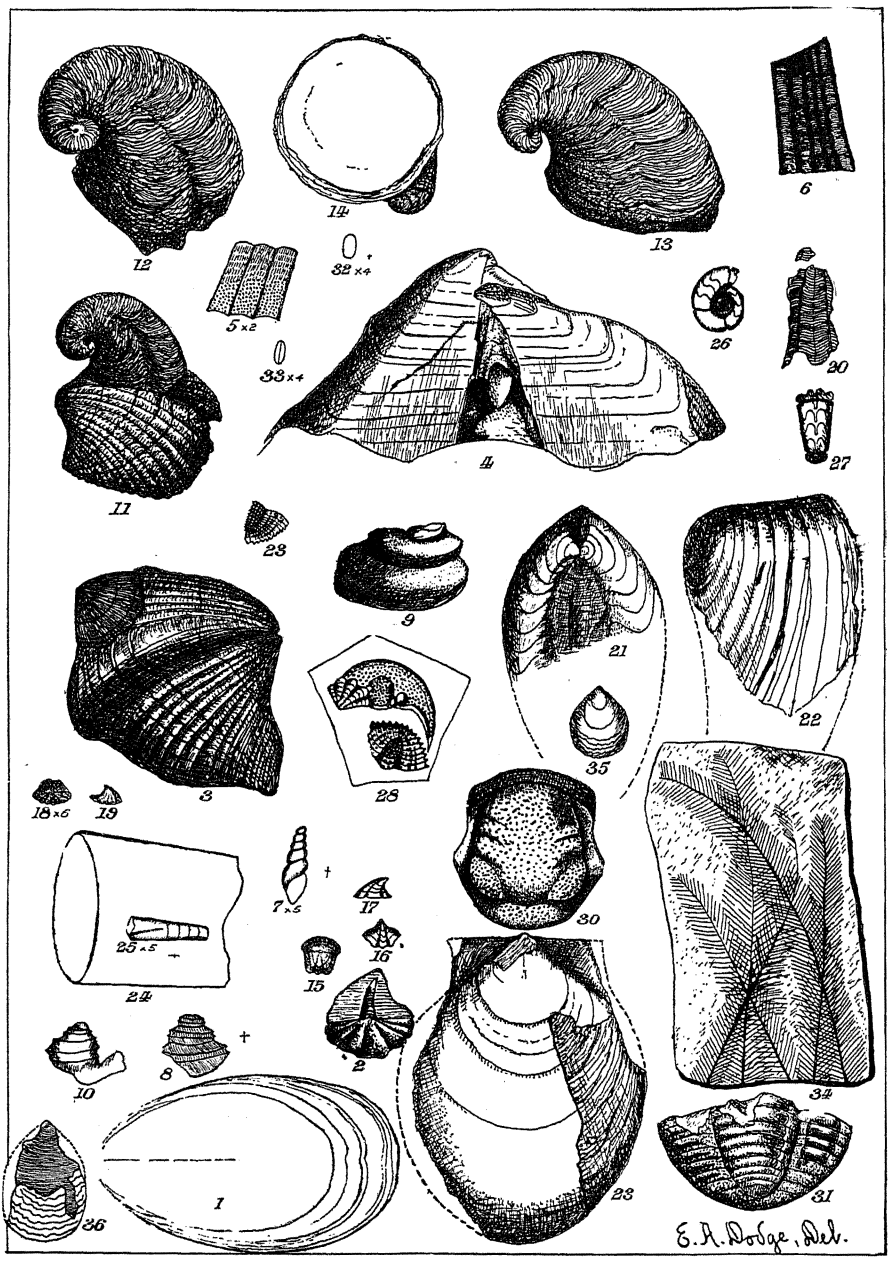
PLEUROTOMARIA MINIMA, Rowley.

Fig. 8. Side view of a large specimen enlarged to six diameters, showing the beautiful surface markings.

Page 91.



INVERTEBRATE FAUNA OF THE LOUISIANA LIMESTONE.

PLEUROTOMARIA SP?

Fig. 9. A specimen from the blue shale, being a mere cast of the inside.

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PLEUROTOMARIA SP?

Fig. 10. A specimen of coprolitic origin, showing a good outline but no surface ornamentation.

Page 92.

PLATYCERAS PULCHERRIMUM, N. SP.

Figs. 11, 13. Two beautifully preserved specimens attached to Spirifer marionensis.

Figs. 12, 14. Two other fine specimens, one showing a nearly round aperture.

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PLATYCERAS? ANOMALUM, N. SP.

Figs. 15, 16, 17. Various side and apical views of the largest specimen found, to show shape and plications.

Figs. 18, 19. Apical and side views of a much smaller specimen with a greater number of plications.

Page 90.

CONULARIA SP?

Fig. 20. Side view of an imperfect specimen from the yellow shale.

Page 88.

GRAMMYSIA HANNIBALENSIS, Shumard.

Figs. 21, 22. Hinge and side views of a large specimen embedded in the hard limestone.

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PERNOPECTEN? MARBUTI, N. SP.

Fig. 23. Side view of a specimen embedded in the limestone, restored where the edge is broken. This fossil has both valves in place.

Page 93.

ORTHOCERAS SP?

Fig. 24. View of the open outer chamber of a large specimen.

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ORTHOCERAS MINIMUM, N. SP.

Fig. 25. The open and four closed chambers of a specimen x5.

Page 92.

GONIATITES LOUISIANENSIS, Rowley.

Figs. 26, 27. Side and dorsal views of the type specimen.

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PHILLIPSIA STRATTON-PORTERI, N. SP.

Fig. 28. Head and pygidium as they lie together on the surface of a slab.

Fig. 29. Pygidium of another specimen found near the other two.

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PHILLIPSIA MISSOURIENSIS, Shumard.

Figs. 30, 31. After Meek's figures in the old Missouri report.

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OSTRACOID SHELL, GEN? SP?

Figs. 32, 33. Side and edge views of a large specimen x4.

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FILICITES GRACILIS, Shumard.

Fig. 34. After Meek's figure in the old Missouri report. The drawings on this plate are original as in the three previous plates, except figures 30, 31, 34. All figures on the four plates, except 30, 31, 34 and 1 are of specimens in the writers collection. The last is the property of the draftsman, Mr. E. A. Dodge.

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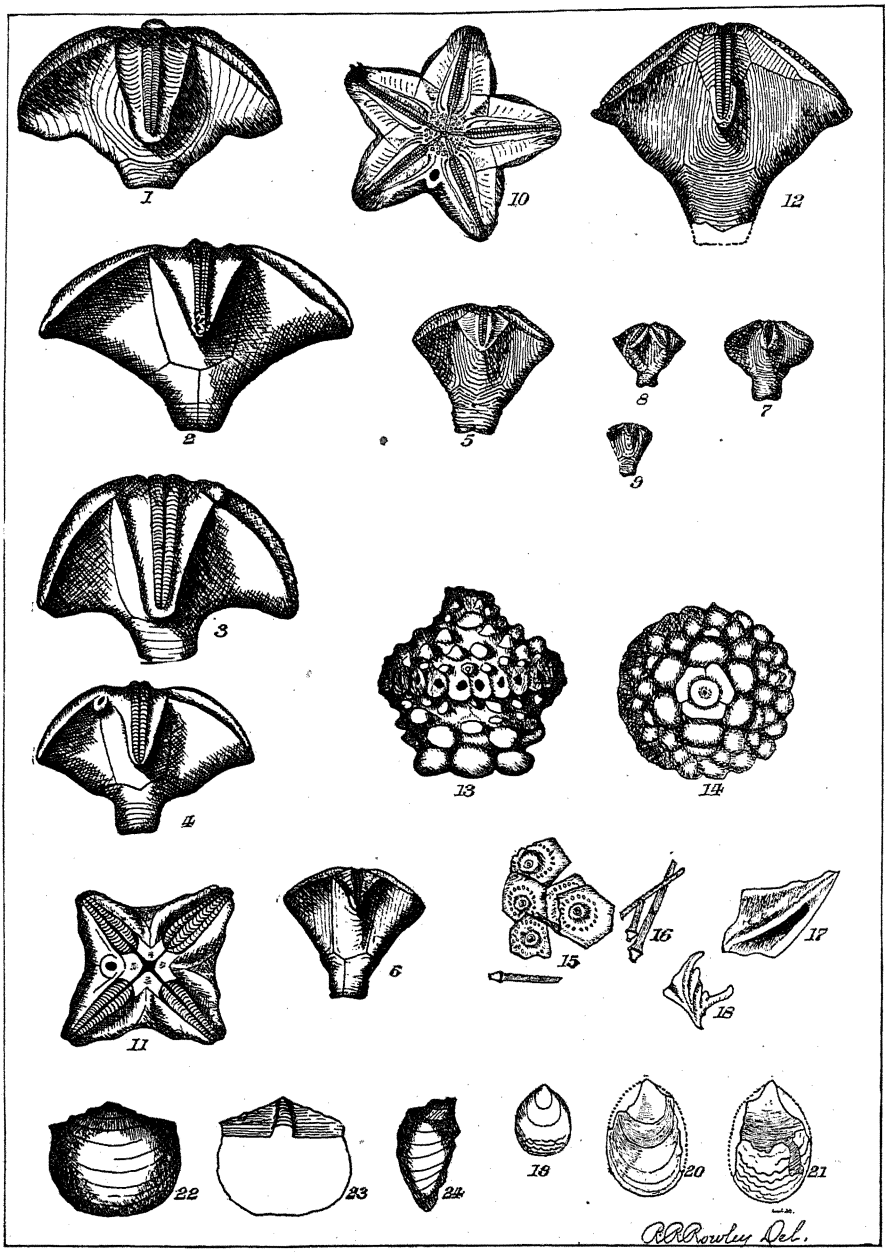

MISCELLANEOUS PALEOZOIC FOSSILS FROM PIKE COUNTY.

EXPLANATION OF PLATE XX.

CODONITES STELLIFORMIS, M. & W.

Fig. 1. Side view of a fine old specimen, much flattened.
Fig. 2. Side view of a very large individual, preserving three rays.
Fig. 3. Similar view of a large heavy specimen.
Fig. 4. Side view of a fine specimen, above medium size.
Figs. 5, 6. Side views of the same specimen, somewhat below medium.
Fig. 7. A small specimen showing rounded ambulacral tips.
Figs. 8, 9. Side views of small specimens, the latter approaching the Codaster outline.
Fig. 10. Ventral view of a fine specimen to show features.
Fig. 11. Ventral view of a four-rayed specimen, one ray having apparently a double ambulacrum.

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CODONITES STELLIFORMIS VAR. CATACTUS, N. VAR.

Fig. 12. Side view of the type specimen, showing the sharply pinched character of the ambulacra.

Page 97.

BATOCRINUS CURIOSUS, N. SP.

Figs. 13, 14. Side and basal views of the type specimen, showing the strong warty character of the plates.

Page 98.

EOCIDARIS (LEPIDOCIDARIS SQUAMOSUS), M. & W.

Figs. 15, 16. Showing the plates and spines.
Figs. 17, 18. Views of a jaw piece.

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PHOLIDOSTROPHIA?? PARKSI N. SP.

Figs. 22, 23, 24. Exterior, cardinal and side views of a pedicel valve.

Page 99.

LINGULA LINEOLATA, Rowley.

Fig. 19. Ventral view of one of the types.
Figs. 20, 21. Ventral and dorsal views of the other type.

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