GEOLOGICAL SURVEY OF KENTUCKY.

JOHN R. PROCTER, DIRECTOR.

REPORT

ON THE

GEOLOGY OF MARION COUNTY.

BY W. T. KNOTT.

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INTRODUCTORY LETTER.

LEBANON, KY., January 1, 1885.

HON. JOHN R. PROCTER, *Director of Kentucky Geological Survey:*

DEAR SIR: I herewith transmit to you my report on the Geology of Marion County. Other features are added, such as a list of fossils, some notes on the archæology, and notes on the curious fossil Beatricea which is found in large numbers in the county. Yours truly,

W. T. KNOTT.

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MARION COUNTY.

HISTORY, TOPOGRAPHY, ETC.

In the year 1834 Washington County was divided by a line running due east, from a point midway between Springfield and Lebanon, with its eastern terminus falling on the then Mercer, now Boyle, county line.

From this midway point the line west diverged north of a due east and west line, and falling on Hardin's Creek, followed that creek to its mouth, or to its confluence with the Beech Fork of Salt River, where is the Nelson County line. Since the original line there has been a slight modification of said line between the midway point and Hardin's Creek, but so slight as to be of no consequence as regards the history of the county, geologically or otherwise. The southern portion of Washington, so divided, is Marion County, which occupies a central position in the State, with Washington County on the north, Boyle on the east, Casey on the southeast, Taylor on the south, Larue southwest and Nelson County on the west.

The county has a superficial area of 400 square miles, or nearly so, with varied topography. In general terms its surface may be called broken or hilly, and especially so in the eastern and southern portions, yet in some instances, even in the more hilly parts, there occur quite large districts of practically level land, only with undulations sufficient to secure good drainage.

From the lowest valleys of the deepest drainage to the highest elevations are as much as 400 feet.

The most prominent and marked topographical features are occasioned by the existence of a series of "knobs" found

largely occupying the eastern, southern and western parts of the county.

The problems involved in the development of these topographical features are of special interest to the student of science. That all of these elevations, once constituted, or rather formed, a part of a regular continuous plateau seems not to admit of a doubt, and that the great plateau, of which they are now only "bench marks," once extended much further north than at present outlined by the "knobs" is alike evident.

Proofs are abundant showing that such a plateau did once exist, the many remains of elevations and "stumps" of knobs that are now to be seen, the many districts covered with the waste of superimposed geological formations under conditions not to be accounted for reasonably by any method of transportation, force the conclusion of this once existing, continuous, elevated table land. Its extreme original northern and northwestern limits may not as yet have been definitely determined, but in this county we find the northern boundary as it now exists forming the ragged edges of the escarpment of Muldrow's Hill.

The isolated knobs and knobby ridges of the county are mere fragments, detached from the Muldrow's Hill range, existing as monuments of the gradual but sure decadence of the once great "Cumberland Plateau."

Erosion has done the most of its mighty work here, subsequent to the building of the "Cincinnati Arch" and the elevation of the "Kentucky Anticlinal." Those great events left to erosion the *material*, no doubt in good condition and good shape for removal. By lines of fracture, crushing of strata of rocks, faults and fissures, the work of erosive carving was made much less difficult and indicated the sculpture resulting in the varied topography of this and other counties which front the range of Muldrow's Hill.

The "knob region" of the county is about one-fourth of its area, but in this region, in the valleys between the knobs and in the coves of the hills, are some of the best farms and most fertile soils, and on the north and northeast slopes and terraces of

the knobs the soil is productive, covered originally with fine timber.

The economic value of the knobs will be noticed more fully further on.

The public spirit and enterprise of the citizens have secured a system of railways and turnpike roads, with facilities not surpassed by any sister county in proportion to wealth. The Knoxville Branch of the Louisville and Nashville Railroad, now connecting Louisville and the North and Northwestern States with Knoxville, Tenn., and the South and Southeastern States of the Union, runs the entire length of the county from west to east, a distance of thirty miles, dividing it into somewhat equal parts.

The Cumberland and Ohio Branch of the Louisville and Nashville Railroad connects with the Knoxville Branch at Lebanon, running south to Greensburg, Green County, a distance of thirty miles.

Turnpike roads have been constructed from Lebanon radiating in every direction to the borders of the county, with others intersecting these at different points, making a network of McAdamized and gravel roads all over the county, which aggregate over one hundred miles.

The above railroad and turnpike facilities and advantages and conveniences are of great value to the county as regards its present and future prosperity, and such as can not well be overestimated.

There are several institutions of learning deserving notice. The oldest and best known at home and abroad are Loretto Academy, Calvary Academy, and St. Mary's College. Loretto and Calvary academies are both female institutions, the former located northwest from Lebanon ten miles, and near the Knoxville Branch Railroad, the latter south from Lebanon and four and a half miles distant, and near the Cumberland and Ohio Railroad. St. Mary's College, for males, is west and five miles from Lebanon, on the Knoxville Branch Railroad.

These institutions, ranking with any in the state, are under the auspices of the Catholic denomination, and were organized

long anterior to the organization of Marion county. There are good schools in Lebanon, both graded and common schools, where all have facilities for good English education.

The common school system throughout the county is a full average with other counties of the state.

DRAINAGE.

The general water flow has two systems of drainage from a dividing ridge running east and west. One system drains the waters of the northern part into the Beech Fork of Salt River, and includes Hardin's Creek, Cartwright's Creek, Pleasant Run and the Little Beech and their tributaries. All this drainage is northwest from the axis of the divide. None of these streams now are of any consequence as to water power, although in the early settlement of the county both Hardin's Creek and Cartwright's Creek supplied ample water to run grist mills for six or eight months in the year.

The southern and much the larger system of drainage is into the Rolling Fork of Salt River. (All the waters of this county flow into Salt River, thence by way of the Ohio and Mississippi rivers to the Gulf of Mexico.) The Rolling Fork runs the entire length of the county from Bradfordsville to its western border, and is formed by the junction of the "North" and "South" Forks at Bradfordsville. This stream has quite a number of good size creeks as tributaries. In the east, and flowing into the North and South forks before their junction, are Old Lick Creek, "Little South" and others of smaller dimensions. The system of drainage into the Rolling Fork from the *south*, bringing the water fall from Muldrow's Hill, includes (in regular order beginning east) Cabin Branch, Medlock's Creek, Arbuckle's Creek, Cloyd's Creek, Musson's Creek, Knob Creek, Clear Creek and Salt Lick Creek with their tributaries.

The waters flowing into the Rolling Fork from the *north* are in the same order, beginning east, Pope's Creek, Caney's Creek, Mattingly's Branch, Caney Run, Stewart's Creek, Cherry Run, Prather's Creek, Pound Run, Sulphur Lick and Pottinger's

Creek. The two last do not empty into Rolling Fork in the limits of the county, yet they drain a large district in the western portion of the county.

The Rolling Fork at one time, before the day of railroads and turnpikes, was in a limited sense a navigable stream for flatboats. Many such boats loaded with the products of the county bordering the river, such as whisky, bacon, etc., were carried by its flood tides into Salt River, thence into the Ohio and Mississippi rivers to Vicksburg, Natchez, New Orleans and other markets along the Lower Mississippi. Before the day of steam power, many of the streams in the county afforded water power for grist and saw mills, for from four to eight months in the year. Now this water power is of no value whatever, the streams afford much less flow and are soon dried up.

Springs and streams that once flowed the entire year last now but a few months, and this during the wet seasons. This great change, among other causes, may be attributed to the destruction and sweeping off our once dense forests from our lands, and the cultivation of our lands thus denuded.

In addition to the foregoing features of topography and drainage, below for reference is given a table of elevations above sea level of points on the Knoxville and Cumberland and Ohio branches of the Louisville and Nashville Railroad. Commencing at a point near the western border,

The elevation at	Feet.
New Hope (track at depot)	488
Chicago	673
Loretto	711
St. Mary's	733
Lebanon	754
Penick's	930
Riley's	914
Gravel Switch	896
North Fork	934
Elevations on Chesapeake and Ohio Branch at	
Lebanon (track at depot)	754
Calvary (track at depot)	625
Bed of Rolling Fork (at bridge)	595
Phillipsburg (track at depot)	712
Trestle, second at Muldrow's Hill	879
Summit of Muldrow's Hill	1160

GEOLOGY.

The rocks of this county are all of the Paleozoic Era, and belong to the three ages of that era—the Silurian, Devonian and Carboniferous—and form a column nearly one thousand feet in height, beginning with the oldest and ending with the more recent rocks, as seen in the county. As the entire column can not be observed in any one place or section of rocks, it is constructed of sections of exposure in different parts. These, if all occurring at one exposure, would show as follows, commencing at the top of column:

Age.	Period.	Epoch.	Feet.	Feet.
Carboniferous.	Subcarboniferous.	Upper Subcarboniferous	50	. . 375
		Lower Subcarboniferous	325	
Devonian.	Hamilton.	Black Slate.	60	. . 75
	Corniferous.	Corniferous Limestone.	15	
Upper Silurian.	Niagara.	Crab Orchard Shale.	25	. . 45
		Medina.	20	
Lower Silurian.	Trenton.	Upper Hudson.	325	. . 500
		Middle Hudson.	150	
		Lower Hudson.	30	
Total	. . . . .	. . . . .	. . . . .	995

The oldest and bottom rocks of the county as discovered, and as shown in table above, are a part of the upper division of the Trenton Period—the upper or latest period of the Lower Silurian Age—and belong to an epoch known in New York ge-

ology as the Hudson River Epoch (Hall), in Ohio and Illinois as the Cincinnati Group (Meek and Worthen), and in the Geology of Tennessee as the Nashville Group (Safford).

This report will recognize the system and nomenclature of the New York reports, but will for better explanation and more accurate detail make the following divisions in the Hudson River Epoch. The *Upper Hudson River Beds*, the *Middle Hudson River Beds* and the *Lower Hudson River Beds*.

The Lower beds are found as surface rock only to a small extent, and in the northeastern part of the county, on Logan's Creek, and extending into Boyle and Washington counties. These rocks dip to the northwest and are seen no where else in the county. This exposure is nearly on a line east and west with the same rocks exposed in Boyle and Lincoln counties, and this line of exposure is its extreme southern limit in the State of Kentucky.

No Lower Hudson River rocks are seen in Kentucky south of this line. In fact the Lower Hudson River rocks are not truly surface rocks, as the section is seen only in the beds of the drainage and the slopes of the hills bordering on the creeks and branches, their greatest thickness only thirty feet. The strata in many places show large and well-defined *wave marks*, quite conspicuous and perfect, and to any one who would study the circumstances and environments of their formation are most interesting.

On account of the meager exposure of their beds, not being properly surface rocks, the conditions for soil making are entirely wanting, consequently distinct soils and any marked distribution of forest growth do not occur.

The sandstone shales are quite thin. The limestone rocks are heavier bedded, and with the limestone shales, bear fossils, and have the usual genera and species found in similar beds elsewhere. *Leptæna sericea*, *Orthis emacerata*, *Bellerophon bilobatus*, several species of *Chætetes*, *Berichea*, *Modiolopsis*, etc., are common.

SILICIOUS MUDSTONE OF OLD REPORTS.

Middle Hudson River Beds.—These rocks occur also only in the northeastern part of the county around Haysville. The farms for the most part on the highlands on Lander's Creek and Lick Run, north of Haysville, are all on these rocks. Near the Washington County line the depth of these beds is greater than at any other point and show a thickness of about one hundred and fifty feet, and slightly dipping a little north of west. This group, or rather division, of the Hudson River Epoch is made up largely of limestones and silicious mudstones, with shaly sandstones and clayey marls often intercallated.

The limestones in some beds are of great toughness and good thickness, adapted well for all kinds of building and masonry, but these beds are very rare. The most of the limestones are shaley and easily wasted.

The Silicious Mudstones when first opened have a bluish cast, and are rather soft, but exposure hardens them very much and turns them to a dingy yellow, with signs of rapid disintegration. They are of little value as building stones, as the rains and freezes and thaws, with other atmospheric influences, cause them to disintegrate rapidly into soils.

The rocks all contain some lime. Even the sandstone shales and soils made from them, as a general thing, are good, strong productive soils, especially for corn and the grasses, and small grain also does well in good seasons.

The soil is comparatively porous and light, and adapted to retain moisture, from which conditions of the soil small grain and clover are liable to be much injured by the late winter and early spring freezes. The soil is generally a deep soil, easily washed from the slopes, but not so apt to wash out deep gullies as some soils from other formations.

These middle beds produce as characteristic forest growth beech and large yellow poplars, with black walnut, white oak, and some few sugar maples. Red oak, swamp oak, dogwood, black gum, etc., are common. These rocks occupy so small

an area in this county that many of their characteristics found elsewhere may be entirely wanting here.

The silicious mudstones and sandstone shales bear no fossils except as occasional imperfect impressions or moulds in the layers of the rocks occur.

While the limestones are quite prolific of shells and coral., but few good specimens are found, fragments of *Ambonychia*, *Strophomena alternata*, *S. planoconvexus*, and an *Orthoceras* were found.

Upper Hudson River Beds.—By reference to the map it will be seen that these beds occupy a large area in the county, and embrace nearly one half of the cultivated lands within its limits.

This division, in its depth of rocks, measures about three hundred and twenty-five feet, composed of shaley sandstones and limestone, and beds of limestone, and beds of silicious mudstone holding a small proportion of lime. The lowest one hundred feet is made up of rather thin beds of limestone and shale alternating, the limestone layers from five to twelve inches thick. Upon this comes about one hundred and twenty-five feet of alternating limestones, sandstones and shales. The beds of limestones in some instances are in layers of twenty or more inches thick, of bluish tint, very tough and durable. Ascending again for about eighty feet, limestones of varied thickness occur, separated by thin layers of shale, and thick beds of clayey sandstone, and shelly limestone layers of from three to six inches in thickness.

The uppermost section of the upper beds for twenty feet is made up of the limestone, coral and beatricea beds, separated by thin shale or shelly limestone layers.

The limestones of this division are most wonderfully prolific in fossils. Many of the thin layers, with intercallated shales of clayey marl are simply *conglomerates* of shells and corals.

When these beds are exposed the conglomerated layers soon fall to pieces and leave thousands of perfect specimens of ancient life in their ruins. A noted feature of these rocks is the

coral and beatricea beds found at the top of the Hudson River Group. This bed is found in many places in the county where the Upper Hudson River Beds occur. Wagon loads of finely preserved specimens of columnaria corals, from the size of a marble to three feet in diameter appear, showing well the radiations and structure of the calices. The same may be said of the *columnopora corals*, except that the corallums are not so large as in *columnaria*. The *streptelasma* corals abound in unusual quantities also.

Beatricea nodulosa and *B. undulata* (Billings) are found in force in this bed, associated with the above and the tetradium corals, which also abound here. There has been great diversity of opinion among palæontologists as to where *beatricea* properly belongs. Some have placed it with the sponges, some with corals, and others have described it as a cephalopod, and others again, differing widely, have placed it in the plant kingdom, which last opinion appears to satisfy the mind more fully of its probable character than any other, because the features of its structure are more clearly accounted for to place it as a plant than as an animal. The entire county appears to be, with the exception of a small area in the northeastern part, on a coral reef, formed in the clear and comparatively shallow waters of the last ocean of the Lower Silurian Age. This reef is seen in the northern part of the county almost everywhere; in the western part it is exposed on the slopes of the hills, and in the eastern part it is seen in the deep drainage of the knobs. There are no extended tracts of level land on these rocks, though quite good size districts are only gently sloping, and many large farms are called level, because not cut up by deep drainage, but really a strictly level farm of any size can not be found.

The soils made from the rocks of this group or division of the Upper Hudson River Beds are locally known as "limestone lands," the soil and subsoil of a rather stiff yellow clay overlying the blue limestone. Its fertility is largely due to the fossiliferous shales and marls interstratafied with the limestone and silicious claystone beds upon which it rests. This soil lies over near

one fourth of the county, as can be seen from the map, and the thrifty and industrious farmer, with a propitious season, never has reason to complain of his crops. Subsoil plowing enhances its fertility greatly, and renders its cultivation much more thorough and less difficult, and prepares it for either wet seasons or dry seasons much better than ordinary shallow or surface plowing. All the grains and grasses do well when properly cultivated. If not attended to properly, the land is liable to wash on the steeper hillsides into deep gullies. These washes, when down to the rock, widen from year to year, until in time all the soil is gone, and recovery is impossible. But the wide awake farmer will never allow this, for the moment a wash is discovered he at once puts a stop to it by filling up with brush or rocks. Thus the incipient wash, and any damage done, is soon remedied, and the slope put down in grass.

The timber growth peculiar to these rocks is white oak as the characteristic and most abundant growth, with hickory, black oak, and some sugar maple and ash on the more level lands, and these, with dogwood, hornbeam, elm, black haw, etc., on the hilly portions and along the valleys of the streams.

UPPER SILURIAN.

Niagara Period.—There is a series of rocks exposed in the eastern and western parts of the county, as well as at other points along the bluffs of the Rolling Fork and its tributaries, which is considered the equivalent of a part of the Niagara Period, as described in New York reports. It is true, however, that here the series is of much less thickness and wanting in some of the minor features of the period, and contains very few fossils, fucoids being the most abundant. The lower rocks are usually a dirty buff-colored, heavy-bedded argillaceous sandstone, hard and rough and uneven on the surface, apparently marked by remains of fucoids, some of large size, and when broken are of bluish tint, and disclose numerous small cavities, lined or filled with crystals of calcite. This bed lies in the western part of the county, as seen along the cuts of the railroad

near Coon Hollow and New Hope, immediately upon the tetradium beds of the Upper Hudson division, and consequently with those coral beds form the line of junction between the Lower and Upper Silurian ages.

The coral beds upon which these rocks are placed at Coon Hollow are about twelve feet thick, and are a perfect reef of *columnaria*, *columnopora*, *tetradium* and *streptelasma* corals, and several species of shells and both species of *beatricea* are also abundant in these beds.

Below is a section carefully taken near the Nelson County line, showing from the black slate at the top to the coral beds at the bottom:

	Ft.	In.
Black slate.		
Yellowish limestone without fossils	1	0
Gray subcrystalline limestone	2	4
Shale with pyrites	3	0
Shales containing chert in plates	1	6
Shales containing chert in nodules	1	2
Limestone containing chert in layers	1	2
Limestone containing chert in nodules	1	3
Silicious limestone with pyrites	5	0
Argillaceous sandstone with fucoids	14	0
Coral beds of Upper Hudson.		

A similar section has been discovered at no other point in the county. Near Holy Cross Church, in the western part of the county, are found twenty feet of greenish ash-colored shales, with *pyrites* and crystals of *selenite* and plant-like markings in the hard shales. These rocks have been described in the Garrard and Lincoln County reports and called "*Crab Orchard Shale*," because first found near Crab Orchard, Ky.

Until more study and closer examination of these series shall have been made their true place may not be certainly known, but probably enough is now known to place the heavy bedded argillaceous sandstone with its shales in the Medina Epoch, and the rocks and shales, superimposed and reaching to the Devonian age, known as *Crab Orchard Shales* in this report, in the Clinton Epoch of the New York reports.

Very few characteristic fossils of either epoch have as yet been found. A few *favosites*, *stromatopora*, *zaphrentes* and *Atrypa*

reticularis have been found in an imperfect condition. The series so far appears to be almost entirely destitute of fossils capable of being identified.

The soil over these rocks, where the waste of the corniferous limestone and shales have fallen upon them, is a good lively soil, and produces well. But the soil from the disintegration of the Crab Orchard shale is quite poor and responds very slowly to the toils of the farmer, while the forest growth is very much dwarfed, although similar in species to that of the tall, well shaped, large size timber trees of the epoch before it. The forests originally were well timbered.

DEVONIAN AGE.

Corniferous Period.—The Devonian, as well as the Upper Silurian, has but two of its representatives here, and these in rather small force.

This period has but the one epoch, and that the *Corniferous Limestone*, which lies immediately upon the Crab Orchard shales, and represented by only a few feet of limestone and shales, and is readily recognized. The change of formation and rocky material from the underlying beds is very sudden and well marked. From a thick, heavy-bedded argillaceous sandstone of bluish tint and somewhat banded with deeper blue, weathering rapidly when exposed, comes on about a foot, and sometimes two feet, of shales of pure limestone, almost a conglomerate of fossils. And upon this thin bed of shaly limestone arises a solid, compact gray limestone from four to six feet thick, sometimes with cherty nodules and bands of chert or hornstone, and often without either. Quarries in the beds without hornstone are worked in and around Lebanon, and this is one of the best building stones in the country.

This limestone is very variable in its structure within short distances. Only a few miles distant from a bed of pure limestone, the same is found full of cherty nodules and layers of chert or hornstone, so hard that it is impossible to use it as building material to any advantage. Then again the same bed

occurs in a shaly condition in a locality near by, and again it appears as a mottled brecciated rock. This phase of the bed is good stone for masonry. A greater portion of the piers of the bridge across the Rolling Fork, near Calvary, is of this kind of stone. This Corniferous limestone, in all of its phases, is rich in fossils. The cherty beds, when wasted, leave their fossils all thoroughly silicified, and specimens as nearly perfect as can be. From these beds are produced the *Phillipsastrea* in corallums from half a foot to eighteen inches in diameter, with epitheca and calices almost perfect, five or six species of favosites, several species of the horn-shaped corals, with numerous shells, etc. The same fossils are found at the falls of the Ohio at Louisville.

The soil from this bed and shales is one of the best in the county, and said by Professor Owen, in his Kentucky reports, to be the very best farming lands in the county. I give below the analysis of this soil by Dr. Peter, of "*Owen's Geological Survey of Kentucky*," Vol. III, pages 313, 314 and 315.

These analyses were made from specimens of soil taken from the farm then owned by Daniel Everhart, now owned by Mr. Joseph Phillips. The first column of figures shows analysis of *virgin soil*, the other two of soils that had been cultivated *sixty-five* years:

TABLE OF ANALYSIS.

	No. 673.	No. 674.	No. 675.
	Virgin soil.	Cultiv'td 65 years.	Cultiv'td 65 years.
Organic and volatile matter	4.786	4.748	3.679
Alumina	6.495	3.940	4.645
Oxide of iron	3.565	4.970	5.360
Carbonate of lime	.222	.222	.397
Magnesia	.339	.302	.372
Brown oxide of manganese	.271	.312	.172
Phosphoric acid	.262	.280	.279
Sulphuric acid	.042	.062	.042
Potash	.159	.181	.212
Soda	.011	.033	.019
Sand and silicates	85.040	84.720	84.720

Dr. Peter, after the above analysis, remarks: "In these soils

also the apparent anomaly is to be noticed of somewhat greater strength in the soil of the old field than in that analyzed as the virgin soil. From appearances, however, it is probable that some of the subsoil, which contains more potash than even the virgin surface soil, has been turned up by the plow and mixed with the upper soil in the cultivation of the field." These tables of analyses show the great importance of deep subsoil plowing in these soils at least, and there can be no doubt the same fact applies to all soils to a greater or less degree. The clays from the waste of this rock in different parts of the county are strong and lasting fertilizers when thrown on the washed and impoverished lands. Clays thus used are shown to have greatly enhanced the fertility of worn out soils, and are noticed in its having been taken from four to six feet from cellars. Clays thus used sixty years ago show to this day great strength and fertility.

HAMILTON PERIOD.

Black Slate.—But one epoch of this period is found here—the Genessee Shale, of New York reports, the Huron Shale, of Ohio reports,—known in these reports as Black Slate. This deposit is found in the eastern, western and southern parts of the county, sometimes as surface rock, but more commonly as outcrops from the bases of the knobs lying upon the Corniferous rocks. It has, where not eroded, a maximum thickness of about sixty feet, and is never found in full force except under the knobs.

Its bedding upon the lower group is quite variable. In some exposures the bottom is a tough, compact, black layer, with some lime; in other places the thin shaly structure reaches the bottom and extends to the top, and in others again the bottom is shaly with thin layers of dark calcareous sandstone for several feet, then a bed of very black slate, holding fossils. The fossils so far discovered are *Lingula melia* (Hall), *Lingula spatula* (Hall), *Discina minuta* (Hall), *Discina truncata* (Hall), and scales and spines of fishes and fucoids also occur. Iron pyrites in nodules and thin layers abound, so abundant in some places

that a pretty pure copperas, spontaneously formed, is gathered and used in coloring to good effect.

The oil supposed to exist in the black slate, (from its readiness to combustion), has caused some to believe that coal oil existed in reservoirs in this black slate deposit, but repeated efforts by boring into and through it in this county have failed to "*strike oil.*" Even if the theory of the production of coal oil from the spontaneous distillation of this black slate be true, the necessary environments to the proper collecting and holding in reservoirs the oil so produced do not exist here. Neither the impervious super-imposed clay beds, nor the lower porous rocks necessary to collect and hold the petroleum exist in the county. The thin layers of bituminous material found in the black slate have induced persons to dig for coal in its beds, who, not knowing that every stroke of the pick was carrying them *away* from the coal measures, grew wiser only after many bright dollars had been thrown away in the vain pursuit. Among the topmost beds of the black slate are found many fragments, and in some instances large sections, of petrified trees, from six inches to two and more feet in diameter, perfectly and thoroughly silicified, preserving well the original structure of the growth, even to the knots and curls and wavey growth of the layers. The largest specimens are *Dadoxylon newberryi* (Dawson), the smaller *Dadoxylon* (*?*) (N. S.).

The soil resulting from the black slate as a general thing is a cold, wet, whitish clay, of little value, but proper draining often causes the soil to part with its pauperizing acids and salts, retaining only its elements of fertility, and is comparatively a fertile soil, or can readily be made so by proper culture and with proper fertilizers.

SUBCARBONIFEROUS PERIOD.

Lower Beds.—It will be seen from the map that the Lower Subcarboniferous Epoch extends over quite a large portion of the county, all in the knobby regions, and lies upon the Black Slate. The bed rocks of the lower beds vary much in different

localities. In some instances beds of unworn cherty gravel are the lowest; in other places a soft ash-colored shale. Where this shale occurs its usual thickness is near a hundred feet, mixed with thin layers of silicious iron ore and beds of kidney ore, covered usually with beds of soft, muddy-colored argillaceous sandstones, in thin layers, easily decomposed. In many places the denuded exposures of these rocks afford quite picturesque and unique features of the natural scenery. Large areas of whitish-gray earth, utterly destitute of vegetation save here and there a lonely cedar or a scrubby oak, with diversified landscape, small and larger elevations, plateaus and plains, gentle slopes and escarpments—all in miniature—with fragments of dark brown silicious iron ore everywhere—truly weird looking places. These exposures are known as "*Licks*," noticed in this report under the head of "Mineral Waters." At the base of these shales a great many concretionary nodules, of sizes from a small marble to several inches in diameter, are found, each containing as nucleus a shell or fossil of some kind. While much the greater number are concretions, (from their concentric structure, shown in breaking them open, and the nucleus being just one fossil;) some few resemble, structurally, *coprolites*, representing no concentric structure or single fossil, but rather a spongy, porous mass of fragments of fossils inside of a compact surrounding of carbonate of lime. Analysis would show whether these are excrements of fishes or mere concretions. Associated with this bed are many fragments of petrified wood and fossils of porous, bony structure, with fish spines of the *Ctenecanthus* species. The crustaceans *Ceratiocaris elytroides* and *Ceratiocaris bradleyi* are also found.

This series of shales are perhaps equivalents of the Waverley in Ohio reports.

Above these come in a succession of hard, sandy shales, with limestones. The sandstones show a specie of fucoid, similar to *Canda-galli*, while the overlying shales are filled with fossils, as are also the limestones overlying these shales.

Fossils that in other States mark the Kinderhook and Keokuk divisions of the Subcarboniferous are quite numerous.

Palæacis obtusus, *Aulopora gigas*, *Zaphrentis dalli*, *Lophophyllum proliferum*, *Productus semireticulata*, *Athyris lamellosa*, *Athyris royissi*, *Conularia micronema*, *Orthis michelina*, and many other genera and species are found well preserved. The limestones and shales still higher in the beds have a great many fragments and specimens of crinoids, none in condition to identify with absolute certainty, yet enough can be seen to put them in the Keokuk group. There is a bed of "bowlders," or "geodes," quite conspicuous where exposed. The masses represent every size from one to ten inches in diameter; the center sometimes in quartz, and others calcite; sometimes in beautiful crystals, others with mamillated internal structure. That many of these geodes were once fossils is apparent from the fact that fossils are often found partly geodized, with marks of the fossil still retained in the structure of the geode.

A list of the fossils found will be given later in this report.

THE UPPER SUBCARBONIFEROUS.

This group is in small force, only seen in fragments and waste on the highest knobs. Perhaps twenty feet of gray compact limestone, and this only seen capping the greatest elevations, would represent the series, adding the waste and disintegrated material from rocks once covering them. The waste of the conglomerate, in some places, consisting of quartz pebbles, well worn, and masses still compacted is quite conspicuous. The limestone burns a rich white lime, and is used as masonry where needed, being a tough, hard and durable stone of heavy dimensions.

The waste of these rocks yields a few fossils—*Fish teeth*, *Fenestella*, *Valves of orthis dubia*, *Zaphrentis elliptica*, *Z. spinulosa*, *Palæacis cuneatus*, *Syringopora ramulosa*, *Lithostrotian canadense*, *etc.*, *etc.*

The soils of the Subcarboniferous Period are rather poor, but when fresh, from the decomposition of organic matter, a few inches only, however, they produce tobacco well, and wheat of a good grain but light yield is grown. All the grains and

grasses are cultivated, but the yield is not so great as on soils of other formations in the county.

On many of the ridges and terraces of the knobs quite a good soil is found for fruit culture, and their elevations make it more certain that the frosts will not hurt the fruit crops. While the lower grounds fail in fruit crops quite often, these elevated knob regions rarely do.

Quite large territories of this knob land susceptible of cultivation is yet untouched by the plow, and would no doubt be highly valuable for growing fruit of all kinds.

ECONOMICAL GEOLOGY.

Building Stone.—For all building purposes stone of an excellent quality, unsurpassed for toughness and durability, exists in easy reach in every part of the county, and can be had at little greater cost than that of quarrying and transportation. The blue limestone beds of the Hudson Group afford strata of almost any desirable dimensions from six to twenty inches in thickness, and may be quarried to any length and width required, works easily under the hammer and is susceptible of high polish.

The Corniferous limestone, not so abundant as the former, when free from hornstone, is a splendid stone for masonry, or when hammer-dressed is a handsome and valuable stone for pillars and columns, and sills and caps for stone fronts. Many of the large stores and business houses in Lebanon have their fronts of this stone. Columns twelve and fifteen inches square and fifteen feet long may be had from the Corniferous limestone.

The knob sandstone is a good building stone, used in foundations and masonry of every kind.

Lime.—No lime is superior to that made from the limestones of the county. Every epoch of the county has good material for lime, all easily accessible, easily burned, and producing a strong, rich lime, which works well for all purposes that lime is used for.

Sand.—The sandbanks of the Rolling Fork afford inexhaustible supplies of excellent, sharp, silicious sand for all purposes.

For making brick, and for cement for plastering, none can be preferable. The cost is only the transportation.

Clays.—The clays from every series of rocks in the county make good bricks. There is just enough iron in the clay to give the bricks when burned a handsome color and great toughness, hardness and durability. A good terra cotta and tile clay is derived from the decomposition of the shales of the lower Carboniferous, and a pottery clay from the "Crab Orchard" shales in the western part of the county.

Road Material.—Materials for turnpike roads of all kinds are more than sufficient for all demands. Stone for walls and capping culverts, for abutments and piers for bridges and all kinds of paving and curbing abound everywhere. The gravel beds of the Rolling Fork, and the different streams flowing into it abound in the finest hard cherty gravel.

MINERAL WATERS.

This county has several mineral springs within its borders, both of white sulphur and epsom. The white sulphur waters are supplied from the Black Slate, and found as a general thing at the bases of the knobs. These springs are frequent in the knobby parts, and in some instances afford splendid medicinal waters.

The most noted sulphur spring is the one two and a half miles eastward from Lebanon, issuing from the black slate at the base of the knobs, which divide the drainage of the county at this point, and has the analysis below, as made by Dr. Peter, the chemist of *Owen's Geological Report of Kentucky*, and also chemist on the present survey. The analysis shows qualitatively:

Free sulphureted hydrogen.
Sulphate of soda.
Sulphate of magnesia.
Chloride of sodium.
Chloride of magnesia.
Bicarbonate of lime.
Bicarbonate of magnesia.

Has an alkaline reaction on georgina paper.

The same kind of water, of good strength, is found in the eastern part of the county, near the Boyle line, on the farm of A. Rollins, near "Buffalo Licks."

Epsom waters of well known medicinal properties, and from which a good article of epsom salts has been crystalized, are found in different localities, always supplied from the ash-colored shale resting upon the Black Slate. No analysis of this water has been made as yet, but no doubt it is the same or similar to the epsom at Crab Orchard, from which the famous "Crab Orchard Salts" are so abundantly manufactured. The most prominent and noted of the epsom springs are the "Plantation Licks," two or three miles from Raywick, and northwest; "Clay Licks," one or two miles south from Raywick, and the "Able Spring," about four miles south from Lebanon. These epsom springs, or "Licks" as they are called by the natives, were once great places of resort for buffalo, elk and deer for the purpose of drinking the seeping waters and eating the clays impregnated with the different mineral salts so abundant in the shales. This is evident from the fact that "traces," or "trails," exist to this day, cutting in many places ten or fifteen feet deep through the sharp backbones of the points or ridges near the bases of the knobs in order to shorten and improve the route to the terraces of the knobs, which are comparatively level. These "trails" extend from the extreme eastern to the western borders of the county, connecting a long line of "Licks" that exist for thirty or forty miles in the county, from five to eight miles apart, and all cattle and sheep on the range anywhere near these "Licks" are constant attendants, "sipping the waters and tasting the shale."

From the fact that so many "Licks" existed in this county, and the additional fact that originally this county was covered with cane and the rich wild peavine, this territory was to the buffalo, elk and deer, etc., a real paradise, and consequently to the Indian a "happy hunting ground."

DISTURBANCES.

The geological formations over the entire surface of the county show more or less disturbance. If the strata could be seen denuded of clays and soils which now cover them, great corrugations and unevenness of surface would appear, with a general and very decided dip toward the southeast. Anticlinals and synclinals, arches and troughs, are found everywhere of greater or less extent. Rocks within the space of one or two miles, and often less, dip in opposite directions, and it may be said in every direction almost.

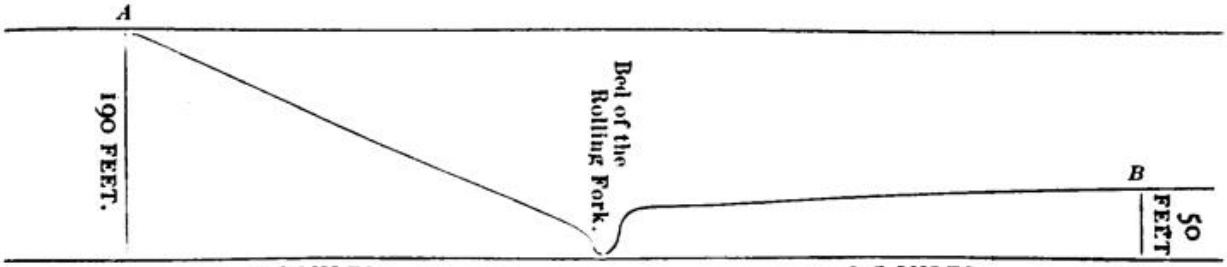
While these disturbances are but local and exist in a small way, they are noticeable everywhere almost in the county, resting upon the axis and slopes of a much more decided and extensive arch. As these smaller arches approximate the axis of the larger one the smaller and more frequent they become.

This larger arch extends quite through the county from the northeastern to the southwestern part, passing on the north of Lebanon, with its southern slope dipping slightly east of south, and finally disappears under the range of Muldrow's Hill Knobs.

This is possibly a section of the "Kentucky Anticlinal" of Linney.

The valley of the Rolling Fork occupies the most extensive synclinal in the county, and the bed of the river occupies the lowest part. Where the slopes of different angles met there was a lapping and crushing of the strata, and that is now the channel of the stream. The dip toward the river from the north is much greater than that from the south. The northern edge of the trough is thrown up higher by the "*Kentucky Anticlinal*" (Linney). At a distance of two and one half miles north of the deepest point in the synclinal, or the channel of the river, the margin is one hundred and fifty feet higher than at the same distance on the south side. Below is a section measured on the Chesapeake and Ohio Railroad, showing the Rolling Fork anticlinal. Two and one half miles north the dip is seventy-six feet per mile south. Three and and one half miles south the dip is only fourteen feet per mile north, showing, as

stated above, the difference in elevations of margins. Sections from Penick's Station, and also from St. Mary's Station, Louisville and Nashville Railroad, across the Rolling Fork Valley, show about the same results.



A—North edge of synclinal. *B*—South edge of synclinal.

ARCHÆOLOGY.

That this county was once a favorite hunting ground of the Indians is abundantly proven by the great number and variety of flint implements found.

In almost every part of the county great numbers of spear heads, arrow points, knives and scrapers of flint are found, and of all sizes, from the small arrow point of base one half an inch, with length one inch, to the largest, with base two inches and length six inches, adapted to the killing of every variety of game, from the bird to bear and buffalo. Many specimens perfect and handsomely wrought are found, as well as very many imperfect and broken ones. All colors of flint and chalcedony are represented. As no material is known to exist anywhere near from which they were made, is evidence that they were made elsewhere or the material brought here. One place in the southern part of the county, near the summit of Muldrow's Hill, on the farm of John Spurling, is a fine spring. At and around this spring are evidences of at least a temporary "workshop" and abiding place of the Indians. Although the land has been for a long time cultivated and plowed over, many broken and many unfinished implements and flakes and chips and chunks of "raw material" are to be found near the spring. No mounds or graves have been discovered near. This is at the head of, and overlooks the valley of Cloyd's Creek, a large

tributary of the Rolling Fork of Salt River. In this valley is found the only evidence of aboriginal agriculture, if indeed evidence at all, known in the county. There were found in this valley ten large implements, elliptical in shape, from three to five inches shortest diameter, in the alluvial bottom lands, and all together, and twelve to fifteen inches under the surface, supposed to have been used as hoes in the cultivation of a corn or bean patch in the rich loose bottom soil, and then laid away in that "*nest*" for future use. In the eastern part of the county, not far from Bradfordsville and east of it, under the shelving rocks, in the cliffs near the South Rolling Fork, have been found pottery and graves with skeletons and pottery and shells in them. Some teeth and under jawbone and a few fragments of other bones have been found.

In that vicinity axes, celts, pestles and discoidal stones were found, with many of the smaller and more common implements, a few of which are still being picked up over the plowed fields. In the early settling of this neighborhood many small mounds or graves were to be seen, but long continued cultivation of the lands has worn them down until all have been obliterated or nearly so.

The last Indian raid that ever occurred in this part of Kentucky took place near the junction of the North and South forks of the Rolling Fork, near these cliff dwellings and mounds just spoken of, in which one white man, Captain Jim Wilson, was killed and the Indians driven off never to return.

All the mounds that have been examined here are of one type, simply graves containing the remains of the dead, with a few implements buried with them, except one that was opened in May, 1882, and described at the time and published in our county paper, which description is given below:

"INTERESTING DISCOVERY."

"*An Indian Mound Containing Rare Archæological Treasures—Copper Spools With Thread Upon Them—A Copper Breast-plate, Copper Celt, Lead Ore, etc.*"

"The North American Indian has no history known to us earlier than about three hundred and seventy years ago, except such as may have been from time to time disclosed to us in the dim pages gleaned from whatever has been left and still remains to us of that race, found in the sepulchers, mounds of ceremony or sacrifice, and earthworks and fortifications of stone. From these the archæologist has given to us a very interesting as well as a very plausible literature on the unwritten history of our aborigines, obtained from the study of the structure of those mounds, together with the various implements of their everyday life, consisting of implements of domestic use, weapons of war and the chase, objects of worship, etc. No one looks upon an Indian relic of any kind without some degree of interest, if nothing more than mere curiosity as to its material or shape, or the skill displayed in its structure, or all these points combined. The facts above are stated without any desire to enlarge upon them or to give a paper on prehistoric ages, but simply introducing a short description of the recent examination of a very interesting Indian mound in this county. There are several mounds in the county, some of which I examined years ago with great interest, but none so full of interest as this, because in this mound were found implements that I had never seen before, and that had only on one or two occasions ever been found at any other place so far as I know.

"This mound is located west of Raywick about five miles, and on the farm of Mr. L. H. Taylor, to whom I am indebted for the greater portion of the facts in this paper. The mound is about forty feet in diameter and ten feet high, located on the extreme eastern terminus of a plateau lying between the Rolling Fork and Salt Lick Creek, immediately above their

junction, about equidistant, say a quarter of a mile, from each, and about one hundred and fifty feet or more above the bed of the river. The location of the mound with reference to the surrounding country is simply sublime. Due east you look directly up the valley of the Rolling Fork, with a high range of knobs on each side, for miles away. At the base of the plateau when the mound was built, and for centuries after probably, there was a small lake, and the river was much nearer than now. Due west the eye follows the plateau descending, and gradually contracting until it is lost at the point of juncture of the creek and river. Due north there is a range of knobs elevated between three hundred and four hundred feet, running parallel with the river. Due south the view is directly up Salt Lick Creek Valley until obstructed by the higher elevation of the Muldrow's Hill Knobs. Viewing the *location* of this mound and its surroundings, we may not suppose it accidental. Being upon the spot we must believe that the ancient savage had a fine eye for the grand and beautiful in natural scenery, for from no other spot outside of a hundred feet in any direction would the landscape be so perfect and impressive.

"But the main interest was in the find in the mound and the structure of the mound. The excavation was made by Mr. Taylor, the details of which would be very creditable to a regular archæologist. The excavation was made from the top, twelve feet square and about nine or ten feet deep. At the bottom were found five piles of stone, in position exactly of the schoolboy's marble ring—one at each corner and one in the center. Each pile was composed of three stones—one on top of the other. The top stone on each showed evidences of fire. The pile in the center showed the same—that the top stone had been burned. From a compass I found that to stand over the center altar of stones the corner altars marked N. 45° E., N. 45° W., S. 45° E. and S. 45° W. In other words, the four altars, taken as the corners of a square, one way pointed exactly north and south, the other way east and west. Near the bottom of the mound was found a layer of fine sand like that found in the banks of the fine sand on the river. Above

this sand was clay a few inches thick, and then a stratum of charcoal three inches, then clay again. In the charcoal layer was found a pile of small, angular, jasper-colored pebbles, not water worn. About one and a half feet above the charcoal layer was a layer of ashes four or five inches thick, on which was found several pieces of galena or lead ore. One piece weighed seven pounds, the others less. One thin plate of copper, five and a half by three and a half inches, with two holes in it one and a half inches apart; one copper celt, or skin dresser, three and a half by one and three quarter inches, nicely shaped and of solid copper; eight copper spools, more or less corroded, two inches wide at the ends. Around some of these is twine or large thread, made of the inner fibers of bark, still remaining and stout enough to be unwound without falling to pieces. There were also three or four fragments of copper implements, shaped as the ends of the spools, but much larger, somewhat saucer-shaped, three inches in diameter. These show great skill in their construction, in being so exactly alike that when piled on each other they fit as nicely as a pile of breakfast plates. Pieces of burnt flint and sandstones were found also.

"This was perhaps either a sacrificial mound or the sepulcher of a tribe who cremated their dead, as no bones were found except some fragments of charred bones in very small pieces. The five piles of stone so exactly alike, with upper stone burned, may have been altars of sacrifice. The copper plate was no doubt the grand breastplate or ornament of some prominent man of his tribe. The copper spools were probably used in making matting cloth for domestic purposes, nets for fishing, etc. The copper celt is an implement admirably adapted to the skinning of animals as well as to dressing skins.

"This mound must be very old. When I first saw it years ago a beech tree two and a half or three feet in diameter was growing on the summit. W. T. KNOTT."

NOTES ON BEATRICEA.

Beatricea are long cone-like bodies, composed of three distinct layers. (1) A central chain of chambers. The divisions in this central pith-like structure are concavo-convex, and hence the center has cone-in-cone structure. (2) A succession of concentric layers of fine coniform structure. (3) External and sub-epidermal concentric layers, very plant-like. When not decorticated is covered with a nodulose, bark-like covering, with layers, as the concentric growth of the wood and bark of trees. After the external examination of a number of specimens it is found that the species *undulata* (Billings) is merely the specimen denuded of its original outer coating, and from all appearances there exists in the Beatricea of this county only the one species—the *B. nodulosa.* The following is about all the known bibliography on the subject:

Hyatt makes Beatricea a mollusk—(cephalopod allied to endoceras).—*American Journal of Science, Vol. xxxix., p. 262.*

Billings makes Beatricea a plant; has described two species, B. nodulosa and B. undulata.—*Canada Report, Second Series, Vol. ii., 1865.*

Verrill thinks that Beatricea *can not* be radiate.—*American Journal of Science, Vol. xxxix., p. 263.*

Dawson and Hooker, of England, and Chapman of Toronto, say the structure of Beatricea has none, or slight, appearance of wood fiber. They think they are corals allied to cystiphyllum.

James Hall and S. P. Woodward thought they might belong to *Rudistes.*

J. W. Salter has suggested that Beatricea are annelide tubes!

A. Hyatt, Jr., excludes Beatricea from the vegetable kingdom, and says they are molusca allied to orthoceras.—*American Journal of Science, Vol. xxxix., pp. 261–6.*

N. S. Shaler and Whitfield are of the opinion that Beatricea are sponges. Whitfield thinks they are allied to the Stromatopora group. Shaler thinks they are allied to the Hippursite group of Rudistes.—*American Naturalist, Vol. xi., p. 628.*

Hyatt changed his opinion and became satisfied that Beatricea were not cephalopods.—*Foot Note, American Naturalist, Vol. xi., p. 628.*

Dana thinks it probable that Beatricea are the internal bones of cephalopods, and founds his opinion upon the observations of Hyatt.—*Dana's Manual, Revised Edition, p. 228.*

As has already been stated in the report of this county, Beatricea is always found as companions of Tetradium, Columnaria and Columnopora corals, at the top of the Lower Silurian, and often specimens are found imbedded in the corallums of these corals.

Will not some scientist take hold of this *perplexity* and remove the embarrassing surroundings, and let the world know just what it is—whether plant, coral, cephalopod, or one of the sponges, or something else?

FOSSILS FOUND IN MARION COUNTY.

Subcarboniferous.

1. Palæacis obtusus (M. & W.).
2. Palæacis cuneatus (M. & W.).
3. Palæacis enormis (M. & W.).
4. Aulopora gigas (Rominger).
5. Aulopora sp. ined't.
6. Syringopora ramulosa (Goldfuss).
7. Zaphrentis elliptica (White).
8. Zaphrentis centralis (E. & H.).
9. Zaphrentis spinulosa (E. & H.).
10. Zaphrentis dalli (E. & H.).
11. Zaphrentis spinulifera (Hall).
12. Zaphrentis, 3 sp. ined't.
13. Archimedes oweniana (Hall).
14. Archimedes, 1 sp. ined't.
15. Lophophyllum proliferum? (Var.)
16. Lophophyllum, 1 sp. ined't.
17. Coscinium asterium (Prout).
18. Coscinium tuberculatum (Prout).
19. Coscinium wortheni (Prout).
20. Coscinium, 1 sp. ined't.
21. Fenestella delicata (Meek).
22. Fenestella multipora (Meek).
23. Fenestella banyana (Prout).
24. Fenestella plumosa (Prout).
25. Fenestella, 2 sp.?
26. Glauconome neriadis (White).
27. Cyathophyllum, 2 sp.?
28. Stictopora serrata (Meek).

29. Stictopora carbonaria (Meek).
30. Amplexus, 2 sp. ?
31. Discina newberryi (Hall).
32. Discina pleuritis (Meek).
33. Athyris lamellosa (L'Eveille).
34. Athyris sublamellosa (Hall).
35. Athyris subtilita (Hall)
36. Athyris royissii (L'Eveille).
37. Athyris, 2 sp.?
38. Chonetes millipuncta (M. & W.).
39. Chonetes planumbona (M. & W.).
40. Chonetes shumardiana (D. Koninck).
41. Chonetes logani (Norwood & P.).
42. Chonetes, 1 sp.?
43. Lingula melia (Hall).
44. Lingula membranacea (Winchell).
45. Orthis michelini (L'Eveille).
46. Orthis swallovi (Hall).
47. Orthis dubia (Hall).
48. Orthis, 1 sp.?
49. Streptorhynchus crenistriatus (Phillips).
50. Streptorhynchus keokuk (Hall).
51. Productus semireticulatus (Martin).
52. Productus flemingi (Sowerby).
53. Productus punctatus (Sowerby).
54. Productus magnus (M. & W.).
55. Productus, 2 sp.?
56. Nucula shumardana (Hall).
57. Nucula, 1 sp.?
58. Conocardium carinatum (Hall).
59. Conocardium, 1 sp.?
60. Evactinopora radiata (M. & W.).
61. Spirifer striatus (Miller).
62. Spirifer cameratus (Morton).
63. Spirifer keokuk (Hall).
64. Spirifer kentuckiensis (Shumard).
65. Spirifer suborbicularis (M. & W.).

66. Spirifer, 3 sp.?
67. Cyrtolites, 1 sp.?
68. Conularia micronema (M. & W.).
69. Conularia newberryi (Winchell).
70. Conularia subcarbonaria (M. & W.).
71. Conularia crawfordsvillensis (R. Owen).
72. Platyceras equilateralis (Hall).
73. Platyceras fissurella (Hall).
74. Platyceras uncum (M. & W.).
75. Platyceras acutirostris (Whitfield).
76. Platyceras infundibulum (M. & W.).
77. Platyceras, 2 sp.?
78. Pleurotomaria wortheni (Hall).
79. Pleurotomaria shumardi (M. & W.).
80. Pleurotomaria, 1 sp.?
81. Goniotites, sp.?
82. Gyroceras, 1 sp.?
83. Aviculopecten amplus (M. & W.).
84. Aviculopecten, 1 sp.?
85. Orthoceras baculum (Meek).
86. Orthoceras expansum (M. & W.).
87. Orthoceras, 1 sp.?
88. Ceratiocaris elytroides (Meek).
89. Ceratiocaris bradleyi (Meek).
90. Phillipsia bufo (M. & W.).
91. Phillipsia lodiensis (M. & W.).
92. Phillipsia, 1 sp.?
93. Alecto, 2 sp.?
94. Athyris obmaximus (McChesny).
95. Rhombopora lepidodendroides (Meek).
96. Polypora stragula (White).
97. Lithostrotian canadense (Castleman).
98. Lithostrotian proliferum (Hall).
99. Cyathoxonia cynodon.
100. Dichocrinus lineatus (M. & W.).
101. Dichocrinus simplex (Shumard).
102. Dichocrinus ficus (Casseday & Lyon).

103. Dichocrinus expansus (M. & W.).
104. Agaricocrinus tuberosus (Troost).
105. Agaricocrinus wortheni (Hall).
106. Synbathocrinus robustus? (M. & W.).
107. Synbathocrinus, 1 sp.?
108. Forbesiocrinus meeki (Hall).
109. Forbesiocrinus, 1 sp.?
110. Poteriocrinus indianensis (M. & W.)
111. Batocrinus, 3 sp.?
112. Scaphiocrinus, 1 sp.?
113. Platycrinus, 3 sp.?
114. Pentremites wortheni (Hall).
115. Pentremites conoideus (Hall).
116. Pentremites pyriformis (Hall).
117. Pentremites, 1 sp.?
118. Archæocidaris wortheni (Hall).
119. Rhynchonella mutata (Hall).
120. Rhynchonella, 1 sp.?
121. Terebratula hastata (Sowerby).
122. Terebratula inornata (McChesny).
123. Granatocrinus granulosis (Hall).
124. Granatocrinus, 1 sp.?
125. Euomphalus planorbiformis (Hall).
126. Euomphalus, 1 sp.?
127. Cyclonema, 1 sp.?
128. Ctenecanthus spectabilis (St. John & Wor.).
129. Ctenecanthus keokuk (St. J. & Worthen).
130. Palæoniscus, sp.?
131. Fish teeth, many genera and species.
132. Teeth of crustaceans?
133. Ceramopora, 2 sp.?

Fossils of Devonian Age.

1. Favosites rotundituba (Davis).
2. Favosites hemisphericus (Y. & S.).
3. Favosites emmonsi (Rominger).

4. Favosites placenta (Rominger).
5. Favosites canadensis (Billings).
6. Favosites amplissimus (Davis).
7. Favosites tuberosus (Rominger).
8. Favosites eximius (Davis).
9. Favosites limitaris (Rominger).
10. Favosites turbinatus (Billings).
11. Favosites epidermatis (Rominger).
12. Michelinia hispida (Davis).
13. Michelinia cylindrica (E. & H.).
14. Michelinia insignis (Rominger).
15. Michelinia plana (Davis).
16. Cystiphyllum vesiculosum (Goldfuss).
17. Cystiphyllum americanum (M-E.).
18. Cystiphyllum sulcatum (Billings).
19. Cystiphyllum squamosum (Nicholson).
20. Cystiphyllum ohioense (Davis).
21. Phillipsastrea gigas (Owen).
22. Phillipsastrea yandelli (Rominger).
23. Phillipsastrea verneuillei(M-E.).
24. Zaphrentis gigantea (Raffinesque).
25. Zaphrentis prolifica (Billings).
26. Zaphrentis ungula (Rominger).
27. Zaphrentis exigua (Davis).
28. Zaphrentis colletti (Hall).
29. Zaphrentis cyathiformis (Hall).
30. Zaphrentis rafinesqui (M-E.).
31. Strombodes knotti (Davis).
32. Strombodes, 1 sp.?
33. Alveolites mordax (Davis).
34. Alveolites confertus (Nicholson).
35. Alveolites squamosus (Billings).
36. Cyathophyllum fimbriatum (Davis).
37. Cyathophyllum juvenis (Rominger).
38. Cyathophyllum corniculum (M-E.).
39. Amplexus yandelli (E. & H.).
40. Aulacophyllum sulcatum (Hall).

41. Aulacophyllum princeps (Hall).
42. Blothrophyllum decorticatum (Billings).
43. Blothrophyllum cinctutum (Davis).
44. Blothrophyllum louisvillense (Davis).
45. Blothrophyllum promissum (Hall).
46. Dendropora neglecta (Rominger).
47. Syringopora straminium (Davis).
48. Syringopora per elegans (Billings).
49. Ptychophyllum tropæum (Davis).
50. Ptychophyllum knappi (Hall).
51. Striatopora cavernosa (Rominger).
52. Dalmanites, 1 sp.?
53. Platystoma bucculentum (Davis).
54. Platystoma strophium (Hall).
55. Platystoma ventricosum (Conrad).
56. Platystoma, 1 sp.?
57. Heliophyllum colligatum (Billings).
58. Heliophyllum halli (E. & H.).
59. Heliophyllum exiguum (Billings).
60. Heliophyllum infundibulum (Hall).
61. Heliophyllum denticulatum (Hall).
62. Platyceras carinatum (Hall).
63. Platyceras curvirostrum (Hall).
64. Platyceras dumosum (Conrad).
65. Spirifer grieri (Hall).
66. Spirifer divaricata (Hall).
67. Spirifer cuspidata (Sowerby).
68. Spirifer fimbriata (Conrad).
69. Spirifer manni (Hall).
70. Spirifer varicosa (Hall).
71. Terebratula harmonia (Hall).
72. Pentamerella dubia (Hall).
73. Atrypa reticularis (Linneaus).
74. Aulopora erecta (Rominger).
75. Aulopora aperta (Winchell).
76. Cladopora labiosa (Billings).
77. Cladopora imbricata (Rominger).

78. Cladipora, 1 sp.?
79. Stromatopora tuberculata (Nicholson).
80. Quenstedtia cornuta (Billings).
81. Dolatocrinus lacus (Lyon).
82. Dolatocrinus, 1 sp.?
83. Actinocrinus abnormis (Lyon).
84. Actinocrinus, 1 sp.?
85. Macropetalichthys sullivanti (Newberry).
86. Macropetalichthys, 1 sp.?
87. Fish teeth of several species.

Fossils of Hudson River Beds.

1. Crania dyeri (S. A. Miller).
2. Crania scabiosa (Hall).
3. Crania mullipunctata (S. A. Miller).
4. Leptæna sericea (Sowerby).
5. Orthis bellula (James).
6. Orthis emacerata (Hall).
7. Orthis fissicosta (Hall).
8. Orthis laticosta (James).
9. Orthis lynx (Eichwald).
10. Orthis occidentalis (Hall).
11. Orthis sinuata (Hall).
12. Orthis dentata (Pander).
13. Strophomena alternata (Conrad).
14. Strophomena rhomboidalis (Sowerby).
15. Strophomena nasuta (Conrad).
16. Strophomena alternistriata (Hall).
17. Zygospira headi (Billings).
18. Zygospira modesta (Say).
19. Tentaculites tenuistriatus (M. & W.).
20. Bellerophon canadensis (Billings).
21. Bellerophon bilobatus (Sowerby).
22. Bellerophon, sp.?
23. Cyclonema bilix (Conrad).
24. Cyclonema, sp.?
25. Cyrtolites carinatus (S. A. Miller).

26. Murchisonia bellicincta (Hall).
27. Murchisonia bicincta (Hall).
28. Pleurotomania subconica (Hall).
29. Pleurotomania, 1 sp.?
30. Beatricea nodulosa (Billings).
31. Beatricea undulata (Billings).
32. Orthoceras anticostiensis (Billings).
33. Orthoceras byrnsi (S. A. Miller).
34. Orthoceras halli (S. A. Miller).
35. Orthoceras, 1 sp.?
36. Ambonychia radiata (Hall).
37. Ambonychia alata (Meek).
38. Modiolopsis modiolaris (Conrad).
39. Modiolopsis pholadifornsis (Hall).
40. Orthonota contracta (Hall).
41. Orthonota parallela (Hall).
42. Asaphus gigas (DeKay).
43. Acidaspis, sp.?
44. Columnaria alveolata (Goldfuss).
45. Favistella stellata (Hall).
46. Columnopora cribriformis (Nicholson).
47. Chætetes briareus (Nicholson).
48. Chætetes dalli (E. & H.).
49. Chætetes fletcheri (E. & H.).
50. Chætetes gracilis (Nicholson).
51. Chætetes jamesi (Nicholson).
52. Chætetes lycoperdon (Say).
53. Chætetes mammulatus (D'Orbigny).
54. Chætetes nodulosus (Nicholson).
55. Chætetes rugosus (Hall).
56. Chætetes tuberculatus (E. & H.).
57. Stellipora antheloidea (Hall).
58. Streptelasma corniculum (Hall).
59. Tetradium fibratum (Safford.)
60. Tetradium minus (Safford).
61. Buthrotrephis subnodosa (Hall).
62. Buthrotrephis ramulosa (S. A. Miller).

63. Agelacrinites cincinnatiensis (Roemer).
64. Palæophyllum divaricans (Nicholson).
65. Megambonia jamesi (Meek).
66. Serpulites jamesi (Nicholson).
67. Ptilodictya hilli (James)
68. Ptilodictya falciformis (Nicholson).
69. Pterinea demissa (Hall).
70. Alecto confusa (Nicholson).
71. Alecto arachnoida (Hall).
72. Beyrichia chambersi (S. A. Miller).
73. Rhychonella capax (Conrad).
74. Rhychonella dentata (Hall).

APPENDIX A.

STATISTICS OF MARION COUNTY, COMPILED FROM THE REPORTS OF THE TENTH UNITED STATES CENSUS, 1880.

1880. Total population	14,693
Males over 21 years of age	3,328
Total males	7,327
Females	7,366
1870. Total population	12,838
1860. Total population	12,593
1880. White population	11,189
1870. White population	9,495
1860. White population	9,004
1880. Colored population	3,504
1870. Colored population	3,343
1860. Colored population	3,589
1880. Native population	14,494
1870. Native population	12,600
1860. Native population	12,379
1880. Foreign population	199
1870. Foreign population	238
1860. Foreign population	214
Township population—	
1880. Lebanon	2,054
1880. Bradfordsville	150
1880. Loretto	129
. . Raywich	146
. . Newmarket	74
*Total acreage	196,858
*Average value per acre	$9.05
Number of farms	1,443
Acres of improved land	115,274
Value of farms, buildings, fences	$3,497,555
Value of farm implements and machinery	107,693
Value of live stock	583,270
Cost of building and repairing fences, 1879	46,490
Cost of fertilizers, 1879	1,886
Estimated value of all farm products, 1879	522,603
Assessed valuation, real estate	2,215,019
Assessed val'n, personal propt'y	1,013,304
Assessed valuation, total	3,228,323
Taxation, State	14,689
Taxation, county	35,000
Taxation, town and school dist.	3,653
Taxation, total	53,342
Miles of railroad	41.80
†Value of railroad in county	$587,700
†Miles turnpike (now over 100)	84
†Av. cost per mile of turnpike	$2,650
†Total cost of turnpikes	322,600
Number of horses	4,693
Number of mules and asses	1,046
Number of working oxen	92
Number of milch cows	3,076
Number of other cattle	5,485
Number of sheep	9,140
Number of swine	21,500
Pounds of wool	48,451
Pounds of butter	181,991
Pounds of cheese	100
Gallons of milk	3,270
Bushels of Indian corn	745,464
Bushels of wheat	77,852
Bushels of oats	56,920
Bushels of rye	12,851
Bushels of Irish potatoes	8,554
Bushels of sweet potatoes	3,474
Bushels of buckwheat	225
Pounds of tobacco	101,980
Tons of hay	2,888
Value of orchard products	$20,888
Manufacturing establishments	50
Capital invested in	$298,337
Hands employed in	174
Wages paid in year	$58,735
Cost of materials	551,596
Value of productions	747,292
Bonded debt	234,500
Floating debt	2,300
Total debt	236,800
1880. Capital in flouring and grist mills	99,000
Value of products	291,156
Capital and distilleries	139,427
Value of products	305,000
Capital in lumber	15,600
Value of products	39,625

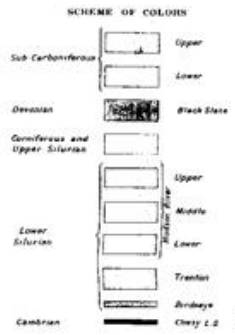
*From the Auditor's Report, 1881. †From other sources.

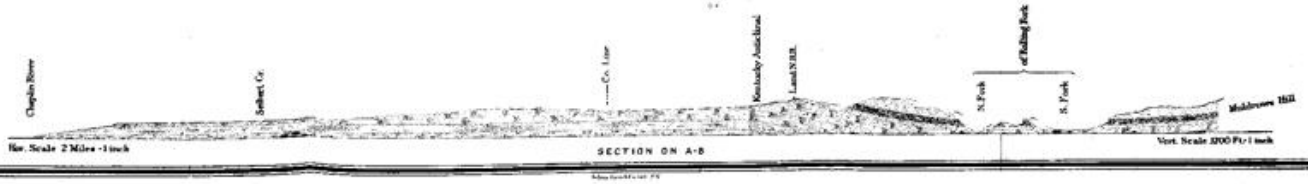
GEOLOGICAL SURVEY
OF
KENTUCKY

JNO R PROCTER, DIRECTOR.

WASHINGTON AND MARION COUNTIES.

Geology of WASHINGTON CO. by W M LINNEY.
Geology of MARION CO. by W T KNOTT
Map by J R MOEING
Scale: 2 Miles = 1 Inch.





Hor. Scale 2 Miles = 1 inch
SECTION ON A-B
Vert. Scale 1000 Ft = 1 inch