
GEOLOGICAL SURVEY OF KENTUCKY.

JOHN R. PROCTER, DIRECTOR.

REPORT

ON THE

GEOLOGY OF MERCER COUNTY.

By W. M. LINNEY.

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INTRODUCTORY LETTER.

HARRODSBURG, KY., December, 1882.

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

DEAR SIR: I have the honor to present herewith a Report on the Geology and other natural features of Mercer county.

Owing to the fair exposure in this county of the lower rocks seen in the State, I have given more than usual space to the description of those which lie beneath the Hudson River Group.

Much work will yet have to be done in those rocks before all their physical and life-history will be thoroughly unveiled; yet I do not hesitate to express my judgment in regard to problems which have arisen. My only regret is, that the absence of other language has necessitated me to use more technical terms than I should desire.

Yours, very truly,

W. M. LINNEY

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GEOLOGY OF MERCER COUNTY.

TOPOGRAPHY, &C.

Mercer county was constituted from a part of Lincoln county in 1785. Its position is near the center of Kentucky; and, according to the Report of the Auditor of State made in 1878, contained one hundred and forty thousand acres of surface. More recent enactments of the Legislature have somewhat reduced this acreage by cutting off two small areas and adding them to Anderson county. The population in 1870 was thirteen thousand one hundred and forty-four, and in 1880, fourteen thousand one hundred and forty-two.

Harrodsburg, the county seat, has a population of twenty-two hundred, and is the oldest town in the State. Here is situated Daughters' College, one of the best female schools in the West, numbering among its graduates some of the best educated and most accomplished women of the country. With the above institution, a graded school in Harrodsburg, and the common schools of the county, Mercer enjoys more than the average facilities for the education of her youth.

The Cincinnati, New Orleans and Texas Pacific Railway traverses the county from north to south. Connecting this route with Harrodsburg is the Southwestern Railroad, four miles in length. Those two lines give all the needed facilities for travel and shipping. The Kentucky river flows along its northeastern boundary; when the proposed improvements on this stream are completed, steamboats will regularly visit a

number of landings in this county. Mercer has Anderson and Woodford on the north, Woodford, Jessamine, and Garrard on the east, Boyle on the south, and Washington and Anderson on the west.

The eastern and northeastern boundary line is a tortuous one, following the remarkable windings of Dix river to its mouth, and continuing with the Kentucky river to the Anderson county line. This boundary lies in a deep gorge hundreds of feet below the general surface; and the small streams which enter the rivers here run also in narrow channels. The general surface of the eastern half of the county, away from the cañon-like valleys, is either in level or in rolling tracts. Situated on these tracts are the finest lands in the county, where fields give their largest returns and pastures their richest herbage.

Salt river, here a small stream, winds its way through the middle of the county, nearly parallel with the flow of the rivers mentioned above. Its bed is not much depressed below the surface of the county, and the streams which enter it have no high bluffs and no rugged channels. The drainage is more gentle on the eastern than on the western side. Some very good bottom lands are situated in its valley; and its flow is sufficient to give power to a number of mills which are erected on its banks.

Chaplin river, here also a small stream, runs through the southwestern part of the county. It, like the branches which flow into it, winds in deep channeled lines among steep rounded hills. Several mills are favorably situated on this stream, and the water-power is sufficient to run them the larger part of the year.

Those rivers all have their flow toward the northwest, thus agreeing with the dip of the rocky floor of the county. Salt river falls nearly with the slope of the strata; the others do not conform to this feature. West of Salt river the county is usually much broken, hills succeeding hills everywhere.

As seen here, the varying features of cliff and hill, of level and gentle undulations, are ever pleasing to the eye. On

Dix river and on the Kentucky river are views which rival, if they do not surpass, those of many world-famed localities. Great walls of massive rocks reach high above the narrow valleys, rent apart by the forces which elevated them from an immense depth. They are marked by fractures, and fashioned by time into many imitative forms. Giant chimneys, castellated ruins, odd faces, and many other pictures grow into form, as fancy leads the eye among fractured stones, stained by ages and shaded with shrub and vine.

From the high escarpments one may look down upon the flowing river, shaded with hoary sycamores and drooping maples, or he may look across into small inaccessible caves, where swallows and vultures build their nests, and bats in slumber pass the day. From among those cliffs come forth the purest, sweetest waters, which bubble over strange moss-covered stones, and around which rare flowers shed their perfumes. Every succeeding year brings an increased number of visitors to High Bridge and to Pleasant Hill, the village of the Shakers. They come to see the picturesque views near those points; but up and down the river are many more which are hardly known save to the local fisherman who has an eye for beauty, or to the strolling naturalist, who accidentally falls upon them in his tramps.

PALÆOZOIC GEOLOGY.

The bedded rocks which are exposed to investigation in Mercer county are about eight hundred feet in thickness, and are the same that are seen across Dix river, in the lower part of Garrard county. They are not cut to such depth in the gorge of Dix river as those seen at Cooper's branch, on the Kentucky river, as mentioned in the Report on Garrard.

All the beds in the county belong to the Lower Silurian Age. Beginning at a depth of two hundred and twenty-five feet in the Chazy Group, they extend to and include half of the Middle Hudson River beds. The following section illustrates the divisions, with their position and thickness:

			Feet.	Feet.
<i>Lower Silurian—</i> Trenton Period . .	Hudson River Epoch . .	Middle Beds Lower Beds	75 } 200 }	275
	Trenton Epoch	Trenton Group . . . Birdseye Group . . .	175 } 130 }	
Canadian Period	Chazy Epoch		225
Total		805

CANADIAN PERIOD.

No attempt has been made to separate the rocks of the Canadian Period into the divisions that are made in the East and the North. It is probable that they will be found to include at least a portion of the Quebec Group, whenever they shall have been thoroughly studied. Till then, the whole series can be left in the Chazy Epoch.

Chazy Epoch.—The Chazy Limestones are the lowest rocks seen in Mercer county. They do not rise to the general surface, but constitute, in part, the walls of the deep gorges in and along the eastern border of the county. East of Harrodsburg, on Dix river, they are seen about two hundred and twenty-five feet thick; at High Bridge they are a little less than that above the water; at Munday's Landing one hundred and thirty, and at the Anderson county line about ninety feet above the river. The dip which carries them down is continued with the stream until, at Tyrone, in Anderson county, they are at the river's level. Along this whole distance they can be followed with ease, and their disappearance noted.

These rocks, wherever seen in Kentucky, present the same features—those of great bedded rocks marked with fractures and stained by time. At many exposed places they appear as if they had been bedded in twenty, thirty, or forty feet

layers, yet more often exhibiting layers of one to two feet, and sometimes even less. Never coming to the surface of the county, they can give to it no agricultural features.

Many of the layers are compact and tough; are capable of sustaining great weight without crushing, and are, therefore, well suited for massive foundations and solid superstructures. The old "Towers" and the heavy masonry for the support of High Bridge over the Kentucky river, were constructed, in great part, from the Chazy Limestones. Quarries could be opened in them, and the world supplied with building stones. A number of the beds are dark and fine-grained, but have yellow lines ramifying through them. Those lines are the impressions of plants which grew in the old ocean, where those rocks were formed. Those impressions or casts seem to be largely composed of silica; and if so, it must have resulted from the decomposition of plants which secreted that mineral. Some of these plant impressions are, in their compressed condition, over two inches broad, and have branches equal to the stems. There is often some carbonaceous matter around those impressions and between the layers of stone.

Some few of the beds are gray and are half crystallized; others are of light or of dark dove-color, occasionally having a partial birdseye structure. Some layers are coarse, but the most of them are fine-grained. In composition, they are mostly carbonate of lime, having in addition magnesia, silica, clay, &c. In a part of them, the planes of deposition are very regular; but in others, particularly those containing the large sea-weeds, the lamination is irregularly waved. The latter have a peculiar blotched appearance, on some angles of fracture, that is very interesting.

Those rocks have, in time, been fractured in lines which reached through every layer; and those fractures agree usually with angles and lines of the river bed, or extend across the country from one bend to another. Usually there is a dip away from the river. The fractures add much to the ease with which the rocks can be quarried for building purposes, or for the construction of roads to the river.

Some of those layers have their upper surfaces plated with chert, while, through a few of them, are thickly seen small crystals or flakes of iron pyrites. In two or three layers the rocks have been crushed, forming very pretty breccias. Good specimens of fossils are hard to obtain from these rocks. *Maclurea magna*, a large coiled shell, is not uncommon in the upper portion. They are seen only as casts in the tough heavy layers, and are hard to remove without shattering them to pieces. *Orthis costalis* is to be found quite frequently at one horizon on Dix river, near Spillman's Mill, but never in fine condition. These are characteristic fossils of the Chazy. With them are associated some other known forms, and quite a number which have not been identified.

TRENTON PERIOD.

The rocks of the Trenton Period in Kentucky have been a subject for some very unsatisfactory discussions; and if I shall be able to refer them to their appropriate places in the geological column, something will have been done toward settling some controverted points in the geology of the Ohio Valley. The divisions seem to me to be as well marked as could be expected at the same distance, in any direction, from the typical beds shown in New York. For the present they will be described under the Birdseye, Trenton, and Hudson River Groups.

Birdseye Group.—The Birdseye Group has two distinct characters here: first, it has some magnesian limestones at the base, and then some pure limestones above.

Magnesian Limestone.—The lower part of the Trenton Period in New York is represented as having *ten feet of buff limestones* in its lower part. At the base of the Birdseye in Kentucky are ten feet of rocks which, on exposed faces, are a dirty buff color; internally they are gray or a grayish-brown. Sometimes part of the layers are blotched with dark blue. They are true dolomites, containing from twenty-nine

to forty per cent. of magnesia, and fifty-one to fifty-six per cent. of carbonate of lime.

These rocks have been termed "Kentucky Marble," and have been used to some extent for building purposes; examples can be seen in the Clay Monument at Lexington, and in the columns of the State House at Frankfort. The character and the thickness of these beds are very uniform whenever seen. In Clark, Fayette, Jessamine, Garrard, Boyle, Mercer, Woodford, and Anderson counties, they occupy the same position, immediately on the Chazy, and disappear with the latter, when it becomes lost beneath the drainage of the rivers.

This stratum is quite regularly bedded, generally consisting of one four foot layer and several thinner ones. Often, in long continued exposures, the heavy layers are split into thinner ones. On exposure the blue spots first become of a reddish brown, and afterward fade into the common buff usual with the rock. This stone is easily quarried; its even-bedded layers, and its uniform thickness, make it desirable. It works fairly under the hammer, and the layers can be readily and evenly split. It does not usually wear as well in the cliffs as some of the rocks below or above it, but it must be quite a durable stone.

There are no fossils contained in this rock, unless those blue blotches seen on freshly fractured surfaces are due to the remains of sea-weeds, to which they have some faint resemblance at times. These layers have been used along the line of the Cincinnati, New Orleans and Texas Pacific Railway in the construction of heavy masonry as far south as Mississippi. Like the most of magnesian limestones, they sometimes exhibit stylolites.

Birdseye Limestones.—Resting on the Magnesian Limestones are about one hundred and twenty feet of mostly gray or dove-colored limestone. The exceptions are near the bottom, where there are a number of layers strongly resembling the tough, heavy beds of the Chazy. The gray

layers are partly crystallized, and are usually thin-bedded. The dove-colored are often heavy bedded and brittle, break with a conchoidal fracture, and are marked with strings or specks of calcite; the latter feature marking the former presence of fossils.

Near the middle of this group are a number of layers, which include some singular markings, which have been referred to a sea-plant, described by Prof. James Hall under the name of *Phytopsis tubulosa*. The long stems appear horizontal in the beds, and from them, at intervals, are vertical branches, one fourth to one half an inch in diameter. Those on the worn upper surface of the rock have a fancied resemblance to the eyes of birds; hence the name birdseye now including under it other structures, not only those marked by this plant, but all which have such specks and strings of calcite through them. The layers holding the typical birdseye structure are very fine-grained soft limestone, which, if it were not for crystals of calcite, and sometimes iron pyrites, might be used as lithographic stones; they are not all crystallized, are easy to dress down, and are very pretty when polished, though they have no glistening surface like marble. Near the mouth of Shawnee Run, on top of the cliff, are some of those layers on the surface in which the structure is finely marked.

In the Birdseye Group are a number of very smooth, uniformly bedded layers which quarry easily, work well, and appear well in structures. Some of the stone houses at Shakertown were erected of this material, and, although it has been exposed since 1809-1825, it has preserved its external qualities very well.

The lower portions of the Group, which are marked with plants so strongly, present some curious surfaces at times. Along some of the old fractures, where for ages decomposition has been going on, the walls have an honey-combed appearance. The old casts of plants have leached out, leaving their tortuous lines as holes extending into the rocky face, as if they had been made by the boring of worms.

At Shakertown there are several large kitchen table tops, made from the plant layers of the Birdseye Group, on whose polished surfaces the outlines of plants, with the bifurcation of the branches and their flexible characters, can be distinctly traced. The colors of the tracings are in contrast with the body of the stone, which gives to the whole a peculiar marble-like appearance.

Above the middle of those beds are some intercalated shales, containing thin plates of limestone filled largely with species of *retepora*, *ptilodictya*, *orthoceras*, *strophomena*, and often large masses of *Tetradium fibratum* are included in it. Individuals of a small bivalve crustacean, *Leperditia canadensis* (Jones), are very numerous.

The upper portion of the Birdseye contains much chert, and the top layer is everywhere plated with a two or three-inch layer of it. This chert is largely made up of fossils; but their condition in the matrix is such that it is very difficult to obtain more than fractured specimens. A *stromatopora*, *Columnaria alveolata*, and *Tetradium fibratum*, variety *apertum*, may be mentioned. The latter, however, is seen through more than half of the section.

Some of the fine-grained layers of this group show beautiful marks of lamination, and those sometimes split into good even flag-stones. No agricultural features of note are given by the decomposition of those rocks. The surface features formed from them are only fringing tracts along the river and creek bluffs on the eastern part of the county, and are more often, where the trees have not been destroyed, covered over with red cedar, growing into large trees where the soil is deep, or more shrubby where they are rooted in the fractures of the beds. The upper part of this group is the probable equivalent of Dr. Safford's Glade Limestone of Middle Tennessee.

Trenton Group.—The rocks which constitute the Trenton Group, in Mercer county, are not of uniform appearance or composition, and for convenience of description, may be divided into four divisions:

	Feet.
Upper Birdseye	30
Granular Limestone	25
Blue-grass Beds	90
Silicious Limestones	30

Silicious Limestones.—These beds lie at the base of the Trenton Group, and immediately on the Birdseye Limestone, and have the position of the Black River Group in New York, and the Carter's Creek Limestone in Tennessee. There is no place where a complete section can be seen of these rocks. They are quite silicious, very argillaceous, and generally heavy-bedded. They appear to decompose rapidly, and are usually overlaid with heavy beds of clay, containing a number of silicified fossils and very curiously-shaped nodules of chert, which have been liberated in their decomposition.

The rocks are coarse-grained and gray, often appearing as if more than half crystallized—rugged where exposed long to the atmosphere; and in exposures where they have been recently uncovered, appearing as if their surfaces were decomposed under the soil more rapidly than above it. Some of those layers exhibit a concretionary or wave-like structure, the laminæ being contorted.

The clay beds derived from these rocks are sandy, and where cultivated as soils, are disposed to cut rapidly into gullies. There are many farms on the bluffs of the Kentucky river which have many acres of land ruined from this cause. A number of fossils have been collected from this horizon. *Tetradium columnare*, *Columnaria alveolata*, *Receptaculites neptunii?* *Palaeophycus simplex*, *Streptelasma apertum* may be mentioned, and these are associated with a number of species of crinoids and forms of the orthoceratite family.

Blue-Grass Beds.—During the progress of the uncompleted Geological Survey of the State, made by Dr. Owen, Maj. S. S. Lyon suggested the above name for a part of the Lower Silurian area of Kentucky. Nothing could better represent the surface features as exhibited over a series of soils

seen in the central part of the State. For those soils are preëminently the soils where the blue-grass attains its most luxuriant character, and they have been derived from the destruction of the beds now to be considered.

About ninety feet of rocks are included in this division. Near the base are usually some layers of hydraulic limestones. Those are sometimes a dark gray on the surface, with a blue nucleus when broken, are composed of lime and clay, are often without fossils, yet are sometimes filled with a thin form of *Orthis testudinaria*. These layers are often absent, and usually few in Mercer.

The rest of this bed is made up mostly of gray limestones, though there are a number of dark blue ones to be seen. Many of the layers are heavy in some deep opened quarry or cut, yet appear as thin-bedded rocks on natural exposures. Between them are often interposed shales. The shales, and sometimes the rocks, are sandy. The sand is largely lime sand, though there is some silica in it. The decomposition of these rocks and shales seems to be rapid and uniform. They give the most level lands in the county, and the best soils in the county and in the State. They seem to contain every element in the best proportion to form the richest soils. These soils, in addition to their being the peculiar home of the blue-grass, are the same on which is grown nearly all of Kentucky's great staple—hemp. In the cereals, these soils outrank all others in the State in producing the largest returns. About one third of the county of Mercer contains soils derived from those rocks, and on them are some of the most beautiful and highly productive farms in the State.

The Blue-Grass beds are not seen west of Salt river in this county; they all lie between that stream and the eastern boundary of the county. Their general character can be seen along the cuts made for the Cincinnati Southern Railroad, north and south from Burgin. A great number of fossils are seen, many of which have not been determined. A list of a number of them is given in my REPORT ON THE ROCKS OF CENTRAL KENTUCKY. These beds are doubtless the equiv-

alents of Dr. Safford's ORTHIS BED, which forms the finest soils of Middle Tennessee. Some of the upper layers are covered with wave marks, showing a shallowing of the sea floor where they were laid down.

Granular Limestone.—On the real Blue-Grass beds there are usually to be seen, where it has not been eroded away, some heavy bedded gray granular limestones. They appear on the outside, and often internally, as sandstones. This peculiarity is doubtless due to some manner of crystallization, as the fossils which are included have undergone the same change. Besides, they can be traced to where this character is not so prominent, or is almost lost. Two miles east of Harrodsburg, one layer of this bed is seen three or four feet thick. Masses of this layer are often seen above the ground, appearing as boulders which have been transported from a distance. On the Munday's Landing road quarries were opened in this bed for material to construct a lock and dam on the Kentucky river. The lower layers are evenly bedded, and are often thin enough for flagging; they are often used for foundations and fences. At some localities some of the layers have a rose tint.

There are quite a number of caves and underground drains within those beds. Its granulated character makes it easily acted upon by carbonated waters. These acting along old fractures have destroyed the layers more readily decomposed, and produced the subterranean cavities.

A number of large bold springs are to be seen in the county, which have their origin in the peculiar character of this rock. The Boiling Spring in Harrodsburg, and Fountain Blue, northwest of that place, are locally well-known examples. Several large species of *lamellibranchs*, one or two forms of *orthoceras* and *Tetradium fibratum* are common in those layers, as are also large specimens of *Stromatopora rugosum*. All of them are largely destroyed by the granulation to which they have been subjected.

These limestones evidently occupy the place of the Capitol

Limestone, of which the State-house at Nashville was constructed. Here it is not so dark as it is in Tennessee; otherwise it is much like it.

These layers are often selected in Mercer county as the material for lining the backs of grates and fire-places, and are locally called fire-rocks. (Perhaps the mechanical arrangement may make it resist fire better than denser rocks.) I know of no other reason that would give it a preference over many others for the purpose.

Upper Birdseye Beds.—Those beds which must be referred to the Dove Limestone, which overlies the Capitol Limestone, in Dr. Safford's section at Nashville, are a local phase of the Trenton in Kentucky, as they are in Tennessee.

The greatest thickness of the Upper Birdseye, including several local features which overlies the typical layers, is about twenty-five feet. The following section, as exhibited in one of the quarries in Harrodsburg, will illustrate the particular layers. The Hudson River Group overlies the upper part:

No.		Feet.	Inches.
1	Layer containing large <i>stromatopora</i>	1	4
2	Lumpy layer with <i>Orthis borealis</i> and <i>Orthis lynx</i>	1	6
3	Uneven bedded blue limestone	1	0
4	Lumpy limestone with <i>Orthis borealis</i>		10
5	Grey limestone.		4
6	Lumpy limestone.		10
7	Partial birdseye limestone.		6
8	Dark birdseye limestone		2 to 4
9	Soft sandstone		2 to 4
10	Light dove limestone		6
11	Light dove limestone		6
12	Clay		2
13	Blue clouded birdseye limestone		8
14	Light dove birdseye limestone.		2
15	Light dove birdseye limestone.	1	10
16	Blue clouded birdseye limestone.	2	0
17	Carbonaceous shale.		1
18	Dark dove birdseye limestone, with green specks		10
19	Dark dove birdseye limestone, with green specks	1	6
20	Light birdseye limestone		10½
21	Blueish gray partial birdseye limestone.		7
22	Graptolite shale		1
23	Blueish dove birdseye limestone.		2½
24	Blueish dove birdseye limestone.		2½
	Total	17	½

The dove-colored layers are very much like the Birdseye layers one hundred and fifty feet below. They are fine-grained, brittle, pure, and take a fine polish. One familiar with both horizons would not always be able to refer selected specimens to their places. This uniformity of structure has led to a number of errors in noting the position of these beds, and those associated with them. They are rarely uniform for a mile together.

The heavy layers have been much used for masonry at Harrodsburg, and are very durable. At several points one or two layers have been crushed some time in the past, and cemented into beautiful breccias. Some of the layers are at times black, and not unfrequently contain small cavities filled with petroleum. One or two layers of shale contain graptolites, but they have not been submitted for determination.

The thin layer of sandstone is often seen in its horizon, and sometimes almost amounts to a conglomerate. Sometimes the presence of iron pyrites injures a layer for some distance in the quarry.

The lumpy layers do not seem to be concretionary; the fossils in them are usually crushed, showing more than ordinary compression among the materials; they break into very irregular lumps on exposure, or when an attempt is made to quarry them. At times, in this horizon, is a silicious layer, sometimes a foot thick, which has the character of a buhrstone. Species of *cyrtodonta*, *orthoceras*, *murchisonia*, and other shells seem to have been swept into depressions, and there cemented with silica, their cavities filled with the same mineral, and then the lime of the shells leached away.

In Mercer county the fossils in the heavy layers have not become silicified; yet in Boyle county, ten miles away, and near where the KENTUCKY ANTICLINAL crosses the county, they have all been replaced with silica.

Two or three of those dove limestones contain vast numbers of valves of *leperditia*. There are two species, and are probably those described by Dr. Safford as *Leperditia capax* and *Leperditia morgani*,

The presence of those *leperditia*, of several species of *cyrtodonta* and *murchisonias*, with *Rhynchonella increbescens*, *Tetradium fibratum*, *Bellerophon troosti*, *Orthoceras capitulinum*, *Lichas trentonensis*, here in close association, evidently marks in part Dr. Safford's Middle Nashville Beds.

These beds are certainly lower than any exposed at Cincinnati; and the presence of such undoubted Trenton forms as *Orthis borealis*, *Arthraria antiquata*, *Stromatopora rugosa*, &c., in and near this horizon, would seem to be sufficient, without the close relation existing in lithological characters, to place them in the Trenton.

The top layers in the Birdseye here contain a large *Stromatopora*. It has been crystallized, and thus the structure largely destroyed. In some cases it is seen to be covered with pimples, and probably should be referred to *Stromatopora pustulosa* (Saff.)

There were certainly a number of changes which took place over this region about the time of the completion of the Trenton Group. The patch-like character of some of the beds, the formation of breccias, the invasion of sand, the opening of veins and their injection with barytes, lead, and zinc, all testify to changing conditions and local disturbances. When examined, the *Stromatopora* bed seems to have begun as a reef, but ended in being buried in silt.

The soils made from the Upper Birdseye are not extensive ones; they lie in narrow lines and patches immediately around the Blue-grass Beds, and may be ranked as fair. The resisting character of the heavy dove layers often leaves them exposed, the soils having washed from over them.

Hudson River Epoch.—The rocks which have been so far described are seen only in quite a limited portion of Central Kentucky, and mark, by their outlines, the most deeply-eroded portions. While seen in a number of counties, there is not a single one of them but exhibits, somewhere within its limits, higher rocks. Those rocks which, in the blue limestone region, overlie the Trenton Group, are of the HUDSON

RIVER EPOCH, equivalent here, in part, to the HUDSON RIVER and UTICA GROUPS. It is probable that the UPPER BIRDSEYE, with its graptolite shale and bituminous matter, may, in part, represent the Utica Group, but here the division cannot be accurately determined.

The rocks of the Hudson River Group aggregate a thickness of six hundred and fifty feet in this part of the State, and are naturally and conveniently separated into three divisions—the lower, the middle, and the upper beds. The lower beds are in full force in Mercer county, and the middle beds show only about one half their thickness. The upper part of the middle beds and the upper beds, with many feet of other and higher beds, once were spread over the county. Those have been removed during a vast period of time by the causes which are now carrying away the rocks from the Ohio Valley.

Lower Beds.—The lower beds of the Hudson River Group have usually at their base a single layer of limestone, which often contains rolled pebbles of limestone, some iron, and crystals of fluor-spar. This layer disintegrates rapidly when it is exposed, so that the pebbles and spar are common in the débris. This layer is sometimes overlaid with several feet of thin hydraulic limestones, which are disposed to break into squares from four to five inches in diameter. Resting on the above is a series of limestones, ranging from six to twenty feet thick. The mass is composed almost entirely of branching corals, and largely of one species only.—*Chaetetes fibrosus*. The exception is in a few layers of hard, firm limestones, composed of the broken stems and buttons of one or two species of crinoids.

On the top of these coral beds is often an olive-colored mud shale, in which are sometimes included large concretionary masses, which appear as if they had accumulated like balls of snow by rolling. Above those shale beds are other layers of coral limestone, and then for a hundred feet a succession of limestones and shales; the former thin and the

latter thick-bedded. These all decompose rapidly and deeply, so that a section through them is rarely to be seen. They give rise to a very fair clay soil, and very desirable farms are situated on them. Some of these rocks are to be seen east of Salt river, but the larger part lie to the west of that stream.

Above these mostly shale beds there are some seventy-five feet of heavier limestones, in which the proportion of shales have largely decreased. Some of these stones are good, durable building material, and make a fair article of lime. They are usually semi-crystallized, and blue or gray in color, but on exposure attain to a reddish or brownish exterior. Among them, and near the top, are several layers, the toughest, hardest in the series, which exhibit on the surface peculiar characters like wave marks.

These layers cannot be better described than by quoting from Prof. Edward Orton (Geology of Ohio, vol. 1, page 377):

“The bottom of the waved layer is generally even, and beneath it is often found an even bed of shale. Its upper surface is diversified, as its name suggests, with ridges and furrows. The interval between the ridges varies, but in many instances it is about four feet. The greatest thickness of the ridge is six or seven inches, while the stone is reduced to one or two inches at the bottom of the furrow, and sometimes it entirely disappears.”

Layers with those characters exist in the lower beds of the Hudson River Group in the seven counties which I have examined, and occupy horizons from one hundred and forty to one hundred and seventy feet above the base. Sometimes the ridges are fifteen or sixteen inches in diameter, and I have seen them in single blocks placed over narrow culverts with the rounded surface up. Nothing could be more desirable for the purpose. In scores of places I have taken the directions of these curves, but as they continually change their courses, the notes made were worthless.

The shales between all those heavy beds waste away, and the beds break down, and are left usually on the surface. To such an extent does this occur that many fields seem to have

at least half of the soil covered with loose stones. Sometimes they are gathered and piled in the fields by the farmers until they appear like so many isolated chimneys. Occasionally they are left to cumber the ground until their number becomes so great that the ground beneath them cannot be cultivated, and the land is left to *run wild*.

The soils derived from these rocks and shales are very fertile; they are warm and quick, and perhaps none in the country are more easy to restore. An indolent treatment has, however, ruined many acres of good land. The steep sloping character of those lands has had much to do with the injury done the soils, nearly all of them being what is commonly termed "ridges" or "hills."

Good springs from those rocks are few; and the best water can be obtained only from cisterns.

The rocks, and sometimes the shales, are literally made up of shells, corals, and other remains of a former life. They are such as are usually found in those beds in other near counties. A list of them is given in another report.

Middle Beds.—The rocks of the Middle Beds of the Hudson River Group have but a small superficial extent in the county. In the southwestern part they are seen between Chaplin river and the Washington county line, and in a few instances are left on the highest hills between Chaplin river and Salt river. Their thickness is about seventy-five feet, or one half of what they usually attain.

Those beds are composed of sandy shales and sandstones, which give a yellowish-brown soil, easy to work, and generally fertile. They are not so warm and quick as the soils from the Lower Beds; but in dry seasons they produce the best crops. The deep soils are of that character which holds much moisture, and furnishes it longer than do the limestones and shales of the other beds.

These beds are deeply and frequently cut by the drainage lines, and consequently present very steep slopes everywhere. There is often seen in them a heavy sandy concretionary layer,

which, when broken, sometimes exhibits a structure as if a number of bowls had been set one within another.

The county map shows where the different rocks appear at the surface, and consequently exhibits the distribution of the soils.

MINERALS, &c.

Barytes.—In Mercer county a number of veins traverse the Trenton and Chazy rocks, which are filled with barytes or heavy spar. These deposits are from a fraction of an inch to several feet in width. The smaller ones are generally simple—the larger ones are compound. The latter are sometimes a breccia, composed of fragments of the inclosing rocks cemented with the spar. I have not been able to see them extending into the Hudson River Group. Sometimes it appears as if some of the veins had been opened a second time, and calcite deposited on one side of the spar.

At a number of places in the county attempts have been made to find silver in the deposits, and much material has been thrown out from them. Several times parties have taken out several tons of the spar and shipped it away. It seems not to have proven a paying business. It is useless to say that there is no prospect that these veins will ever yield any precious metals. As for the barytes, that mineral is rarely used for legitimate purposes; but, on the other hand, only serves the base purpose of adulteration.

Galena.—Some little galena, or lead ore, is seen in the veins of heavy spar. The quantity is quite small, and no efforts made in mining for it would be remunerative.

Zinc Blende.—Small quantities of this mineral are occasionally met with, associated with the lead in the deposits mentioned above.

Other Minerals.—Quartz crystals are met with sometimes, forming the interior of shells, &c., where those have become silicified. Calcite is common in many of the lime-

stones of the county, and is often seen filling fractures through the different beds over the country. The presence of fluor-spar has been mentioned. Small quantities of iron, usually in the form of pyrites, is frequently seen in some of the rocks.

Mineral Springs.—Around Harrodsburg there are a number of springs impregnated with minerals, such as iron, sulphur, magnesia, &c. They make their appearance about the junction of the Trenton and Hudson River Groups. Formerly, several of these were included in what was termed the "Harrodsburg and Greenville Springs," then the best known and most fashionable watering-place in the South. There are several other points in the county where there are sufficient quantities of iron sulphides in the beds to give by their decomposition good mineral springs.

Caves.—A number of small caves exist in the county east of Salt river. They are small, and usually wet, and have little that is interesting about them, except their being reservoirs for springs. Most of them are situated in the heavy layers of granular limestone which lies near the top of the Trenton Group.

Mammoth Remains.—Some years since, on some property belonging to the Shakers, and situated two miles north of Harrodsburg, a ditch was excavated in order to drain a small swamp. During the progress of the work the greater portion of the remains of a mammoth (*Elephas Americanus*) was exhumed. It now forms a prominent feature in the museum of Daughters' College.

Some years since Capt. Bissett, in making an excavation for a lock and dam on the Kentucky river, threw out from a deposit of gravel a mammoth tooth, which was given to Col. J. Stoddard Johnston, of Frankfort. A year or two afterward another fine tooth was picked up on a shoal a mile or two below the place where the first was found, and, as it had been imbedded in gravel, it is probable that it came from the same bed. The latter one is in the writer's possession, and measures thirteen inches in length.

WASTE BEDS.

Over many of the farms in Mercer county are to be seen deposits of rocks which have never been a part of any of the beds seen now in place in the county. Those have been derived from groups of rocks which once existed here. The masses have been removed, and these fragments remain as an evidence of their former existence.

These remnants are composed of fragments which belonged, in some instances, as high in the formations as the coal measures, and may be particularized as corals from the Carboniferous Limestones; geodes from the Keokuk Shales and Sandstones; corals from the St. Louis Limestones; pebbles and sandstones from the Carboniferous.

They are often isolated here and there, but in some places are in large beds. On Dr. A. T. Stephenson's farm, several miles from Dix river, they are several feet thick. On other farms in that portion of the county fields are cultivated, and the plough seems to turn up nothing but sand and mill-stone pebbles. None of those beds are assorted. The sand and the large blocks of sandstone, the gravel and the geodes, are all in the same accumulations. This is an evidence that they were not transported by water, which always assort and distributes material in proportion to its size and density.

The disturbance which gave most of the features to the present topography of the State passed through Boyle county to the south of those beds. This disturbance rent and shattered the upper rocks to pieces, and threw them off to the southeast and to the northwest, and left such conditions that those rocks could not have been moved over the arch. Besides, Dix river flows in a channel which was an open fracture transverse to this uplift, and it has never flowed where those rocks are now seen.

The only way to account for their presence here, at this time, is, that all those rocky groups once covered this part of Kentucky; and while the soft shales, the decomposable limestones, and the crumbling sandstones have been dissolved and carried off by suspension in water, or washed away as soils are

now washed, those hard silicious rocks, which are nearly indestructible, have been left behind.

Another fact has assisted in this preservation. The disturbance which has been mentioned, and to which the name KENTUCKY ANTICLINAL has been given, not only broke through the crust along its line south of Mercer county, but it affected the rocks in every part of the county. Parallel fractures and uplifts left a slight wave-like structure in the rocks; and in the troughs and pockets the debris from the higher groups has been protected and preserved.

Along some of those lines of disturbance, heavy layers of the Upper Birdseye have been so fractured that as many as twelve or fifteen lines are seen in the space of a single inch. Had those rocks been covered only with a few hundred feet of strata, such profound shattering could hardly have taken place, for a few open fractures would have given the necessary relief. But at a depth of several thousand feet, some parts of an anticlinal or a synclinal would require a multiplication of relief lines like those mentioned.

The most prominent disturbance in the county is the one which is to be seen in connection with the gorge of Shawnee Run. This passes through the county, and can thence be traced through Washington county to the uplift seen on Wheatley's branch.

These and other facts demonstrate that some time in the geological past the coal measures, with their vast accumulations of conglomerates, sandstones, and shales, holding rich stores of carbon, covered this part of Kentucky. They have gone to feed the insatiate sea, that gorges upon the wreck of continents. But they have left uncovered some of the richest soils and some of the fairest counties in the State.

ARCHÆOLOGY.

The origin of man, and the length of time he has existed upon the earth, are questions of much interest. His first condition; the food he ate and the clothing he wore; the arms he

wielded and the tools he used; the ornaments he put on and the Deity he worshiped; the dwellings he inhabited and the temples where he sacrificed; the habits of his life and the mode of his burial—all these subjects and many more are thought worthy of close investigation in every country.

In the United States there are many evidences which go to prove that, before the later Indian nations had peopled America, one or more other nations of men had inhabited a large portion of what is now the States of the Union. The stone walls and fortifications, the earthen mounds and their contents, and the relics found over the country, are the evidences of a former occupation of those regions.

To the archæologist, therefore, every mound or grave, every tool of bone, horn, flint, or other material, becomes interesting as part of the records of the past. It is only to the close investigation of these, when hereafter brought together into a single record, that we may look for all that we shall ever learn of those prehistoric men.

Mercer county is not without some records which prove that over its area once lived a people whose history lies buried in the dust of ages. That they had cultivated tastes and a knowledge of soils is attested by the fact that they chose the beautiful and fertile valley of Salt river for their homes.

That they lived here permanently is evidenced by the fact that they here buried in graves and mounds many of their dead. That they were somewhat skilled workmen is shown in their delicately chiseled arrow-points, their perfectly shaped axes, and the carved images on their pipes.

That they understood the properties of clay is certain from the broken fragments of pottery which have been unearthed in several places; and that they lived on mixed food is not left to conjecture, for remains of bears, elks, deer, buffaloes, coons, squirrels, fish, turtles, and mussels are still to be found near where their habitations were.

Those people were not ignorant of travel or trade, for among the materials used in their devices were copper and

catlinite from Lake Superior, greenstone from the boulders seen north of the Ohio; slates from the coal regions; steatite and mica from some metamorphic locality, and shells from the gulf coast.

The mounds and graves over the county have all been destroyed, and in the majority of cases the information they held has been lost. A few notes were prepared describing some of them, which will appear in a forthcoming volume of the Smithsonian Reports. Many of the relics found have been lost or destroyed. Others are preserved in the various collections of the county.

ACKNOWLEDGMENTS.

I wish here to acknowledge my thanks to a number of ladies and gentlemen in Mercer and other counties for the many acts of kindness and hospitality I have received from their hands. To Jno. Aug. Williams, President of Daughters' College, I am especially indebted for generous encouragement in my work, and his assistance in many things. To Mr. W. T. Knott, of Lebanon, and Prof. J. C. Fales, of Danville, co-laborers in geological investigations, I am under many obligations for favors conferred.

APPENDIX A.

STATISTICS OF MERCER COUNTY, COMPILED FROM THE REPORTS OF THE 10TH CENSUS OF THE UNITED STATES, 1880.

<p>1880. Total population 14,142 1870. Total " 13,144 1860. Total " 13,701 1880. White " 10,994 1870. White " 9,834 1860. White " 10,149 1880. Colored " 3,148 1870. Colored " 3,310 1860. Colored " 3,552 1880. Native " 14,028 1870. Native " 12,938 1860. Native " 13,527 1880. Foreign " 114 1870. Foreign " 206 1860. Foreign " 174 1880. Harrodsburg, population 2,202 1880. Bergin, population 150 1880. Nevada, population 131 Number of farms 1,406 Acres of improved land 122,475 Value of farms, including build- ings and fences \$4,337,240 Value of farming implements and machinery \$96,185 Value of live stock \$643,806 Cost of building and repairing fences, 1879 \$25,861 Cost of fertilizers, 1879 \$135 Estimated value of all farm pro- ducts, 1879 \$692,982 Assessed valuation, real estate, \$2 844,610 Assessed valuation, per'l prop'ty, \$696,360 Assessed valuation, total \$3,540,970 Taxation, State \$16,111 Taxation, county \$11 921 Taxation, town and school dist. \$1,580 Taxation, total \$29,615 *Miles of railroad 12.88</p>	<p>*Valuation of railroads in the county \$281,900 *Miles of turnpikes 130 *Average cost of turn'kes per mile, \$2,500 *Total cost of turnpikes \$325,000 Number of horses 4,765 Number of mules and asses 889 Number of working oxen 41 Number of milch cows 2,962 Number of other cattle 5,112 Number of sheep (excluding spring lambs) 16,258 Number of swine 18,941 Pounds of wool 104,133 Pounds of butter 193,295 Pounds of cheese 658 Gallons of milk 11,787 Bushels of Indian corn 856,933 Bushels of wheat 168,936 Bushels of oats 28,481 Bushels of Irish potatoes 10,612 Bushels of rye 9,205 Bushels of sweet potatoes 1,394 Bushels of barley 400 Bushels of buckwheat 140 Pounds of tobacco 14,360 Value of orchard products \$7,926 Tons of hay 3,406 Manufact'ing establishments, No., 80 Capital invested in \$205,400 Average number of hands 129 Wages paid in the year \$41,425 Cost of materials \$243,197 Value of products \$389,608 Bonded debt \$16,000 Total No. of acres of land, 1881 144,379 Average value per acre, 1881 \$16.20</p>
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* Derived from other sources.

**GEOLOGICAL SURVEY
of
KENTUCKY**

JNO. B. PROCTER DIRECTOR.

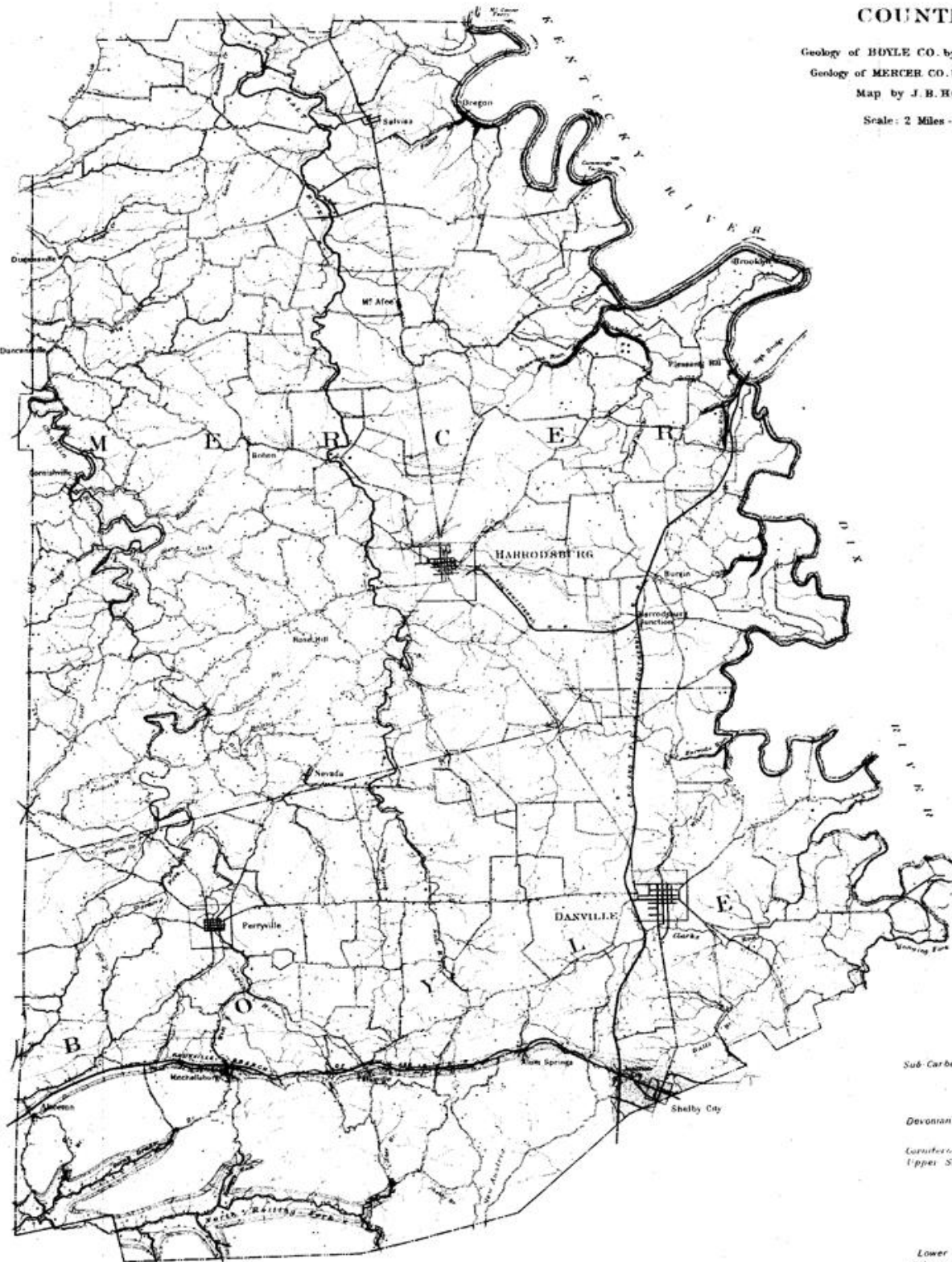
**BOYLE AND MERCER
COUNTIES**

Geology of BOYLE CO. by J. C. FALES

Geology of MERCER CO. by W. M. LINSEY

Map by J. B. HOEING

Scale: 2 Miles = 1 Inch.



CONVENTION OF SIGNS

	Streams
	Roads
	Rail Roads
	Indian Mounds
	Mines
	County Lines

SCHEME OF COLORS.

		Upper
Sub-Carboniferous		Lower
Devonian		Black Slate
Carboniferous and Upper Silurian		
		Upper
		Middle
Lower Silurian		Lower
		Trenton
		Birdseye
Cambrian		Chazy L.S.