REPORT OF THE GEOLOGY OF BUTLER COUNTY

Butler county is bounded on the north by Preble and Montgomery counties, on the east by Warren, and on the south by Hamilton county. It extends to the Indiana line upon the west.

It is divided into two unequal divisions by the Great Miami River, the division lying west of the river being about twice as large as that on the eastern side. The river now pursues a general south-westerly direction through the county, but an earlier formed channel diverges from the present valley opposite Hamilton and bears to the south-east. Within the limits of Hamilton county this older channel is known as Mill Creek valley, which divides at Cumminsville into two branches, one of which enters the Ohio on the western boundary of Cincinnati, and the other enters the little Miami valley at Red Bank station, on the Little Miami Railroad.

Part of another old channel is also found in the north-eastern corner of the county, adjacent to Middletown, which is connected with the Little Miami valley by way of Lebanon. Both of these ancient valleys have been turned to account within the last forty years for canal beds, the Miami Valley Canal from Cincinnati to Hamilton occupying the first channel, the second furnishing the route for the unsuccessful branch from Lebanon to Middletown. Very little lockage was found necessary in either.

The drainage of the eastern division of the county is mostly effected by streams of inconsiderable size. The tributaries of the Miami that enter upon the western side deliver the surface water of more than seven hundred square miles of territory. These streams have a remarkable agreement in direction, all of them flowing to the south-east. It is altogether probable that their channels owe much to glacial torsion, as this same south-easterly direction has been shown to be that in which the glaciers advanced in this portion of the State.

Some of these streams, as, for example, Seven Mile Creek and its tributaries, run largely on rocky beds, and thus show themselves to be of comparatively recent date. Others, again, as Twin Creek and Indian Creek, agree with the deeper valleys of the county in having the rock altogether concealed by heavy alluvial deposits, and thus lay claim to a longer history.

The highest land of the county is not more than 650 feet above the Ohio River at Cincinnatti. The highest land *measured* is two miles west of Jacksonburg, Wayne township, on the farm of Col. Phares. Its elevation by barometer is 642 feet above the base above named. Locke gives the elevation of a point of Cliff Limestone that barely enters the county on the north line of Milford township as 601 feet. Two miles due west of Oxford, on the Fairfield turnpike, an elevation, determined by the level, occurs of 610 feet above the Ohio River at Cincinnati. The elevations of a few prominent points in the county are appended, as obtained from canal and railroad and turnpike surveys. For several of the elevations here recorded, I am under obligations to Prof. R. W. McFarland, of the Ohio Agricultural and Mechanical College:

	Feet.
Hamilton Canal basin above low-water at Cincinnati	169
Low-water of the Miami at Hamilton	131
Middletown, canal level	211
Oxford, grade of railroad at depot	480
Oxford, highest ground within corporation	532
Somerville	334
Jacksonburg	543
Phare's farm two miles west of Jacksonburg	642
Sniveley's Hill, one mile south of Jacksonburg	563
Turnpike, two miles west of Oxford	610
North-east corner of Oxford township, on Darrtown Pike (formerly Riley's tavern) by Locke	601

The lowest ground in the county is to be found on its southern boundary, in the Miami valley. Its approximate elevation above the base already named is fifty feet.

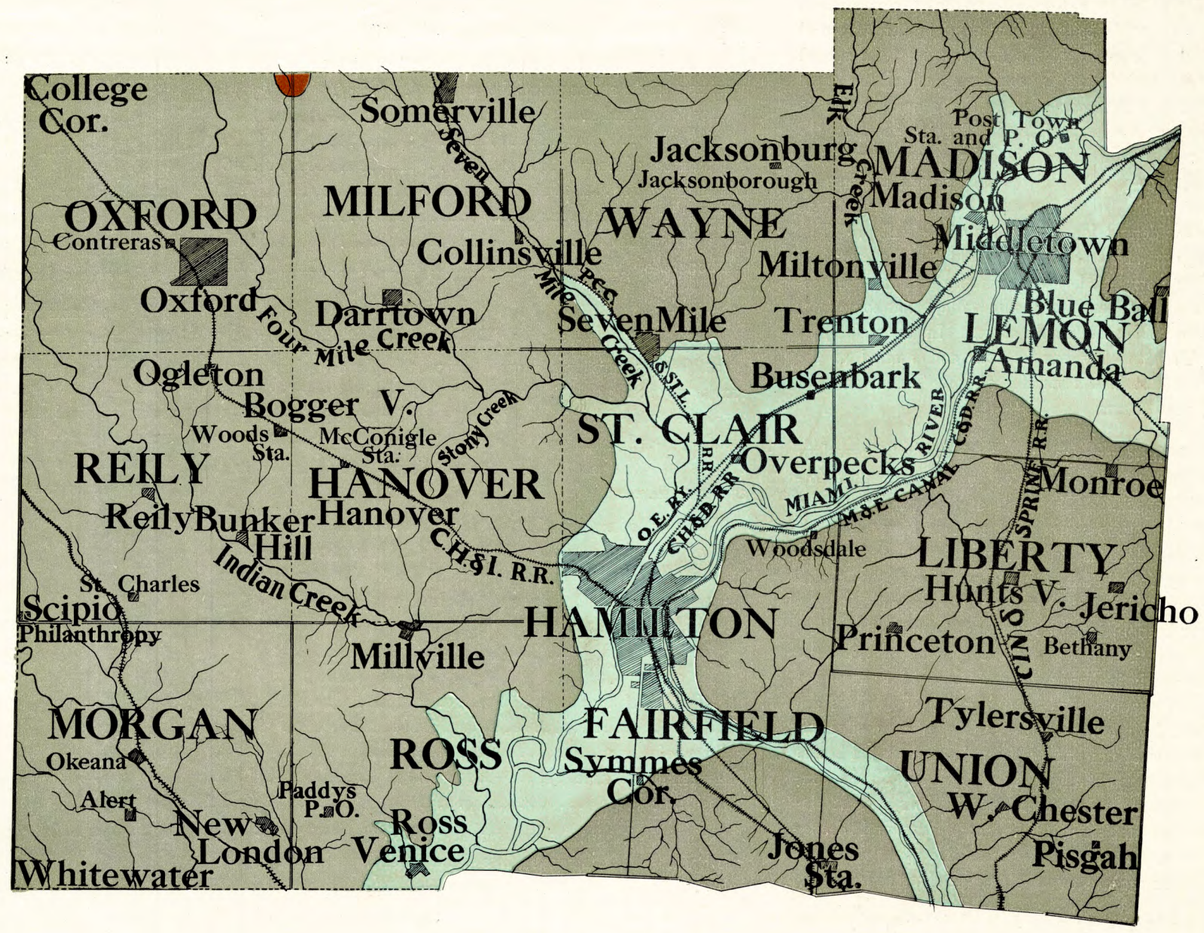
The principal areas of the alluvial lands and uplands of the county as they are distinguished from each other, are represented in the accompanying maps.

The former division embraces the valleys both ancient and modern—the eroded regions from which the rocks have been carried away to a depth at least below existing drainage courses. These areas could be approximately described as the portions of the country that have an elevation of not more than 250 feet above the Ohio River.

On the other hand, the uplands embrace the lands above this level. A large proportion of them, however, lie at an elevation between 400 and 600 feet above the Ohio. This division of the surface of the county is much less definite on the east side of the river than it is on the west, for the reason that the *drift* deposits are heavier in the first named district. In other words, the lines of the valley are here harder to be traced. There are areas of unmistakable uplands, but they are connected with the valleys by slopes of considerable extent, which completely obscure the true outlines of the rocky floor.

Explanation of Colors

3 Blue	Alluvial Lands,
2 Orange	Slinton Limestone.
1 Green	Cincinnati Group.



The uplands proper are remnants of the Blue Limestone plateau that once occupied all of south-western Ohio, but so much of which has already been removed by aqueous and glacial denudation. They are almost universally covered with shallow deposits of drift but over very large areas the character of the underlying rock shows through giving its peculiar features of the typography, to the agricultural capacity, and to the water-supply of the districts occupied. These upland drift deposits are in considerable part derived from the waste of blue limestone land to the northward, so that a closer bond of connection exists between the soil and the underlying rock than is usually found in drift-covered regions. A more detailed description of the drift deposits of the county can approximately find place here.

DRIFT BEDS.

The divisions of the drift that have been recognized in those portions of the Third Geological District already reported upon, are found here also. The lowest of these deposits or that which rests directly upon the bedded rocks, is the *bowlder clay*.

1. This formation is shown with great distinctness and in very numerous exposures in Butler County. Almost every stream in some portion of its course discloses it. Its general composition has been fully enough described in previous reports. A particular feature of the *bowlder clay* in Butler county is that of ancient vegetable growths, branches, trunks and roots of trees in large quantities. Examples can be seen in following almost any stream to its source, but one or two points may be named which especially are noteworthy in this respect. Collin's Run, near Oxford, a small tributary of Four Mile Creek, shows in its banks very numerous exposures of these pre-glacial and inter-glacial forest growths. The vegetation is imbedded in the clay very often, and part of it shows that it has been subjected to rough mechanical agencies. The frequent presence of leaves and roots in or upon the deposit serves to show, however, that the source of the vegetation was not very far removed. The north bank of Elk Creek, opposite the mill at Miltonville, also gives a fine exposure of clay. At this point a peculiar modification of the *bowlder clay* is found that deserves particular mention. It is a clay distinctly green in color, and, as shown by a single analysis of a specimen obtained at this point, is very rich in potash and soda. The analysis made by Prof. Wormley is here subjoined:

Water combined	4.50
Silicic acid	55.10
Iron sesquioxide	6.79
Alumina	19.41
Carbonate of lime	4.55
Silicate of lime	3.55
Magnesia	0.82
Potash of soda	4.95
	99.67

It will be seen that the elements here named viz., potash and soda are abundant enough here to make the clay a fertilizer of considerable value. Vivianite, or phosphate of iron, is of frequent, perhaps constant occurrence in it. Vegetable matter is also always present. This green clay has been more frequently met with in Warren and Butler counties than elsewhere.

The vegetable matter that is intermingled with *bowlder clay* is to be distinguished from that which is borne upon its surface. The presence of a buried soil of inter-glacial age has been repeatedly mentioned in the reports of this Geological District. Examples of this ancient soil are not wanting in Butler county. An interesting case of this sort is recorded by David Christy, Esq., in his "Letters on Geology," published in 1848. In the last letter of the series, page 5, he says:

"Beneath the Diluvium are occasional bits of 'hard-pan or very tough blue clay, with imbedded pebbles.' I had my attention directed to this new and interesting feature of our Geology last summer by Robert Beckett, Esq., eight miles east of Oxford. He called upon me to examine the stump of a tree standing erect in this deposit at a point where a small stream is encroaching upon a bluff. The roots penetrated the hard-pan in all directions. Twenty feet of Diluvium overlies it. We dug out the stump and a part of the roots. Some years since, Mr. B., in digging a well twenty or thirty rods distant from this point, at a depth of ten feet in the Diluvium, struck upon another small tree, standing erect, with the trunk and some of the branches almost entire. This tree continued down to a depth of thirty feet, where he found its roots, in the natural position of growth, penetrating the hard-pan."

The remarkable example noted in the second edition of the Report of the Ohio Geological Survey for 1869, in the chapter on Montgomery county, will be recalled. (See also Silliman's Journal for July, 1870.) A peat bed, fourteen feet in thickness, was found buried under one hundred feet of drift deposits, itself overlying gravel and clay.

2. The yellow, gravelly clay that makes the main element of the Drift in all of this region is also very abundant in Butler county. It is not formed from the weathering of the upper portions of the *bowlder clay* in situ. The action of the atmosphere upon an exposed bed of blue clay changes its color and also its texture, it is true, but much more than this is required to account for the surface clays of Southern Ohio. They have worn away from their old places of deposit by water, and have been re-deposited. The bowlder clay is always unstratified; the yellow clays are generally distinctly stratified. The uplands of the county, especially of its northern and central portions, are almost universally covered with deposits of this kind. There are no elevations in the county that escape the deposits of the modified drift.

The sand and gravel that make a third element in the drift of this region do not deserve a place by themselves. They form a phase only of the second order of deposits, and must be referred not only to the same general line of agencies, but also approximately to the same time. As has just been stated, the highest elevations in the county give clear proof of having been involved in the submergence, by which alone these facts can be explained. Bowlders are found at all altitudes, and some of the largest size are found at the greatest elevation. One lying on the highest land of the west side of Ross township measured one hundred and thirty cubic feet above ground.

In concluding this description of the Drift formations of the county, the opportunity may be taken to say that the history involved is a long and complicated one. There can be no doubt that the general order of events has been correctly determined in the best statements that have thus far been made in regard to North American Drift; but the details of the history are yet to be worked out. Oscillations of temperature and level will doubtless be found to have taken part in the history, and the time occupied in these changes will stretch into long cycles.

In description of the Drift of the county, the deposits of the Great Miami valley require a place by themselves.

The map accompanying this report shows two groups of areas in the county, as has been already stated, viz., the uplands and the alluvial lands. This latter division demands a brief description at this point. The valley in which the Great Miami now flows, and the two south-eastern branches of this valley that were occupied by the river in some earlier period of its history, together contain not less than seventy-five square miles. This area constitutes one of the finest agricultural districts in the State. Land embracing a greater number of advantages, in fact, is scarcely to be found anywhere. The following points are to be observed:

1. The bedded rock has been cut out to a greater depth than existing agencies can account for throughout most of this area. The rocky floor is very seldom laid bare by the river, and it is as seldom struck in any excavations or borings that are made in the valley.

2. The valley is filled with immense accumulations of gravel and bowlders. These gravel-beds undoubtedly overlie deposits of *bowlder clay* in many parts of the valley. Indeed these deposits are occasionally, though rarely, struck in wells and similar excavations; and sometimes they even approach very near the surface. The gravel is of various sorts and sizes and indicates various degrees of strength in the currents that have transported it. Large quantities of sand are distributed through it. In composition, it is principally limestone, thus agreeing with the pebbles and bowlders that fill the *Drift* clays of the county, but, unlike the true *Drift* pebbles, it has lost the marks of the previous stage in its history, viz., the shaping which it received under the glacial sheet. Its pebbles no longer show the polish and striation due to this stage, but, on the other hand, bear unmistakable marks of having been fashioned in running water.