

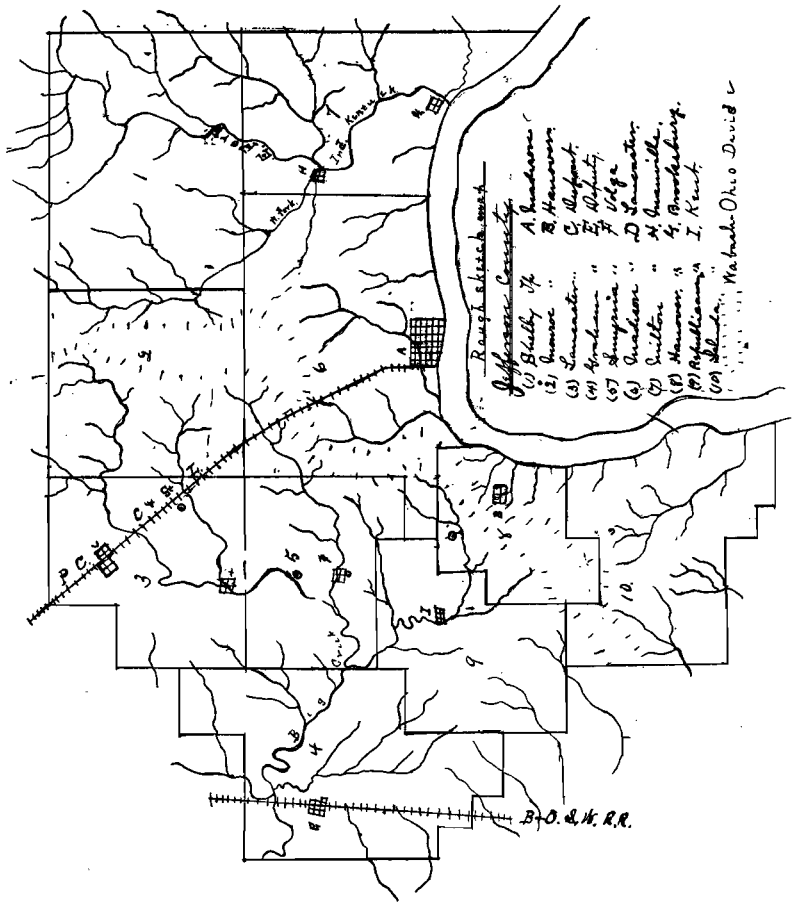
The Geology and Natural Resources of Jefferson County.

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The key to the topography and drainage of Jefferson County is in the location of the Wabash-Ohio Divide. This divide extends from Saluda Township in the south through Hanover, Madison, and Monroe to the Ripley County line. Its altitude is approximately 875 feet above sea level, and some 400 feet above the low water mark of the Ohio River. All the streams to the east of the divide flow directly into the Ohio. They are Indian Kentuck and its leading tributaries, Lost Fork, Doe Run, Dry, Brushy, East, Seal's, Wilson's, and West Forks, Toddy's Branch and Wolf Run, and Bee Camp, Crooked, Clifty, Saluda, and the headwaters of Fourteen Mile creeks. Since the divide, as at Hanover is only one and a half miles from the Ohio River, and at the farthest only twelve or fifteen miles, all of these streams have a high gradient. Those with the shorter courses have deep ravines and picturesque falls, as Clifty, Deadman, Crowe, Butler, Chain Mill, and Hearts, over which the water plunges to the depth of from forty to a hundred feet.

The sides of these ravines have slopes of from 25 to 35 degrees near the Ohio, and from that to the vertical, just below the falls. One of the interesting features of the slopes in the valleys and ravines, extending approximately east and west, is, that those facing the North are perceptibly steeper than those facing the South. The north slopes in almost every case, are from two to four degrees the more precipitous. The more rapid creep of the soils of the south slopes, because of the more frequent freezings and thawings during the winter season is probably sufficient to account for the difference in gradient of the two slopes.

The main tributaries of Indian Kentuck creek, meeting with less resistant rocks, in their development have extended their heads back some 30 miles from the Ohio into Ripley County. The lower portions of this stream, with its tributaries, drain the eastern part of the county, including Milton, Shelby, and the



eastern portions of Madison and Monroe Townships. Indian Kentuck has cut its bed to the temporary base level of the Ohio River. So much of it has reached this level, in fact, that in case of floods in the larger stream, the backwaters extend up the valley of the smaller to the distance of more than five miles. As the hill tops of the eastern portion of the county have approximately the same elevation as those of the central part, the valleys are very deep with decidedly precipitous slopes. In general, the crests of the higher hills and ridges on the Ohio side of the divide are from 350 to 425 feet above the level of the Ohio and the deeper valleys. The topography as a consequence, is extremely rough, and has a marked influence on the character of the agricultural pursuits. The southwestern portion of the county, including some of Saluda township, which is drained by the headwaters of Fourteen Mile creek, has a topography much less rough.

The streams of the Wabash side of the divide, largely tributaries of Big creek, whose waters flow into the Muscatatuck and thence to the east fork of the White River, have a course approximately of 250 or 300 miles before reaching the level of the Ohio River. The slopes therefore, of the westerly flowing streams are comparatively gentle. Big creek and some of its tributaries, especially where the direction of the flow is approximately parallel to the dip of the rocks through which the streams have cut, are noted for their numerous meanders or curves. These have in many cases almost vertical limestone cliffs, some of which reach to the height of 70 or 80 feet on the convex side, and long gentle slopes on the concave side.

The surface of the main divide is extremely flat. To the west, on the Wabash side of the divide, the topography is largely gently rolling. On the divides, between the streams, are some flat areas, the remnants of an old glacial peneplane. The highest hills in the west do not rise more than 100 feet above the stream beds.

The beds of the easterly flowing streams contain great quantities of thin, flat limestones, derived from the limestone layers of the Lorraine of the middle Ordovician. The westerly flowing streams are cutting out their valleys from the Niagara and Devonian limestones, consequently, their stream beds are largely in the solid rock. The slope of the stream beds in the west is very nearly that of the dip of the rocks. Not infrequently, large blocks of limestone fall from the cliffs to the bed of the stream below.

The outcropping formations which to a large extent, have

controlled in the formation of the topography, drainage, and the soils of Jefferson County are very interesting. In parts of the county, as in Hanover Township, where the Wabash-Ohio divide approaches more closely to the Ohio River, the outcropping rocks of the Lorraine and Madison beds of the Ordovician, the Clinton and the Niagara limestones and shales of the Silurian, and the Corniferous limestones and the New Albany Black shale of the Devonian formations, are all found within a distance of three miles.

The outcropping ledges of the Clinton and the Bluff or Laurel limestone of the Niagara, have largely controlled in the development of the topography of Jefferson County. These rocks may be seen along the crest of the river hills in the south, and along the hilltops to the west of the basin of Indian Kentuck creek, in the central and northern portions of the county. These outcropping ledges are everywhere, just to the east of the main divide. The formations in the central and eastern part of the county dip some twelve or fifteen feet to the mile towards the southwest; those in the western part probably dip slightly more in the same direction.

The hilltops in the east are capped with the dirty grey or yellowish argillaceous limestones of the Madison beds of the Ordovician. This limestone, which forms the upper part of the Richmond, and named the Madison beds by Foerste, is some 40 to 60 feet in thickness, and is usually quite soft below and very much more resistant above, within 15 feet of the Clinton layer. The streams of this eastern part of the county have cut to the depth of some 300 feet into the alternating and easily eroded blue shales and thin limestones of the Lorraine.

The rate of erosion in the valleys in the case of many of the easterly flowing streams, where the gradients are very steep, is very rapid. The downcutting in some of these valleys, during the last fifty years, since the practical disappearance of the forests, has probably exceeded that of any previous period, ten or twenty times as long.

The Clinton limestone, generally of a salmon yellow color, and abundantly fossiliferous, is a thin layer seldom more than three and a half or four feet in thickness. It outcrops near the tops of the river hills in Saluda, Hanover, and Madison Townships, and in a similar position along the crooked creek, Wolf Run and West Fork hills in east Madison and Monroe, and in many places near the hilltops in Shelby. It is probably the most

resistant rock of the whole series because of its close crystalline texture. It is one of the principal resistant strata in the development of the numerous falls. This formation is found capping the rocks in the stream beds above the larger falls, as at Butler, or else it outcrops in the stream bed a short distance above, in the valleys of the easterly flowing streams. In no case have the westerly flowing streams reached the Clinton formation in their downcutting. On the hill slopes the Clinton frequently projects as a small cliff or rock terrace.

Many of the springs in the river hills flow out just above the Clinton layer, as for instance, at the watering troughs on the Hanover, Graham, Canaan, Michigan, and Ryker's Ridge pikes. The location of so many of these springs at the outcropping edge of the Clinton layer is probably not so much due to the impervious character of the Clinton limestone as it is to a layer of soft shale one or two feet thick at the top of the Richmond, immediately below it.

The Clinton is separated from the Bluff limestone of the Niagara in many places by a layer of from ten to twenty feet of bluish shale, usually known as the Osgood shale, containing considerable chert and hornstone. The Bluff or Cliff limestone is the most noticeable formation of the whole series in Jefferson County. It is a hard, gray, resistant limestone, some 20 to 50 feet thick, capping many of the river and creek hills where it frequently forms a perpendicular cliff. Many of the hill slopes and stream beds in the same part of the county have great blocks of this stone scattered over them. These scattered blocks as well as the cliffs themselves covered as they frequently are, with lichens-mosses, ferns, and various flowering plants, add greatly to the beauty and attractiveness of the hills.

Above the cliff, limestone in parts of the county are outcroppings of the Waldron shale. The most important of these and the ones most abundantly filled with fossils, may be found along the banks of Little Graham creek, only a few feet above the water level, and within 15 or 20 yards of the B. & O. S. W. R. R. track, a short distance south of Paris Crossing or about one and one-fourth miles north of Deputy. Other outcrops occur along Big creek, some two miles east of Dupont, along the roadway near the bridge over Saluda creek, a short distance south of the High School building, and another near the Hanover School building.

The Corniferous limestone and the New Albany Black Shale

of the Devonian formations underlie the soil, and outcrop along the streams, of the greater portion of the county, west of the Wabash-Ohio divide. The thickness and character of the Corniferous limestone varies considerably in the different parts of the county. In thickness it runs from 30 to 50 feet. In places it has a dark blue color, but is usually a gray, varying from dark to light. The Black shale or Black slate as it is locally called, covers the higher lands west and in the midst of the Corniferous outcrops, but being easily weathered and eroded, it is not so frequently exposed as the limestone. E. R. Cumings, of Indiana University, in the thirty-second Annual Report of the Geology and Natural Resources of Indiana, in his discussion of the "Stratigraphy and Paleontology of the Cincinnati Series in Indiana," and August F. Foerste, of Dayton, Ohio, in the Twenty-first Annual Report, in his article on the Geology of the Middle and Upper Silurian Rocks", have given full descriptions and numerous sections of the rocks of this county from the lowest exposures of the Ordovician shales through the upper Ordovician, and Silurian.

The Mantle rock of the county is of three main types, depending on its origin. The flood plains of the Ohio, both first and second bottoms, or the flood plain proper and the first terrace, and the bottom lands of Indian Kentuck creek, are of alluvial origin. In these alluvial materials, however, there are in places great quantities of river worn glacial gravel and sand. The city of Madison is largely built on one of these glacial gravel deposits, and these deposits may be seen exposed in places in the lowlands in the upper part of the city, and along the banks of Crooked creek, both above and below the fill of the Pennsylvania Railroad. In many places the gravel and rounded pebbles of this fluvio-glacial deposit, have been converted into a conglomerate by the cementing actions of waters, strongly impregnated with calcium carbonate. In the valley of Indian Kentuck creek, at a distance of a half mile or more from the Ohio, are deposits of several feet in thickness, very closely approaching in character that of the loess. This deposit was very probably made in the backwaters of the Ohio, turbid with the very fine deposits of the Champlain period. The alluvio-glacial deposits of the Ohio and Indian Kentuck creeks, are probably in no place in Jefferson County more than 40 or 50 feet in depth, since the former stream in places, as at the Hanover landing, is eroding in original rock and not in alluvial formations.

The Mantle rock of the steep slopes of the hills east of the

Wabash-Ohio divide, is very thin. This is especially true of the cleared land. It is formed directly by the weathering of the soft Ordovician shale and limestone, and is composed of soil and sub-soil, rich in lime, and of thin limestones, derived from the Lorraine beds. The mantle rock of the very few small areas of level land, east of the divide, is derived from the formations above the Clinton beds. The rolling land of the western part of the county is covered with an mantle derived very largely from the Black shales, and of limestone and shale, derived from the Devonian and the Niagara. Where the Mantle rock has been derived from the limestones there is found much chert and other materials of silicious composition. This material makes up the larger proportion of the creek gravels of the westerly flowing streams.

The third main type of mantle rock is found on the flats of the Wabash-Ohio divide, and in part, extends over the higher ridges of approximately the same level on either side. In many places on the "flats" the mantle is 25 or 30 feet in depth, and is largely a glacial deposit. In gullies by the roadside or in old fields, striated, or glacially ground, pebbles and boulders may be obtained. Erratics weighing several hundreds of pounds, have, been taken from excavations, 15 and 20 feet in depth. As could be expected, however, the glacial material of this region is very largely derived from the sedimentary rocks nearby or to the north. The proportion of igneous rocks from the Canadian region is very small. In composition, therefore, this glacial mantle rock differs very little from those formed *in situ*, from different varieties of sedimentary rocks.

Several of the geological formations of Jefferson County are very rich in fossils. So marked is this fact, that geologists and others, frequently visit Madison and vicinity for the purpose of collecting the abundant and widely distributed fossil fauna of the Ordovician. Here are found several hundreds of species of many types of invertebrate fossils, the most abundant of which are the, corals, bryozoans, brachiopods, and gasteropods. The already mentioned recent article by E. R. Cumings, in which the Ordovician formations, both as to stratigraphy and paleontology, are so fully treated, makes it unnecessary to treat of these topics in this brief discussion.

In the article by A. F. Foerste in the Twenty-eighth Report, he treats rather fully the paleontology of the Clinton and the Niagara formation of the Silurian, in this and adjoining counties. The most interesting fossil beds of these formations are the cystidean

beds, which outcrop along the bed of Big creek in Monroe Township from the point where the Shun pike crosses that stream to a distance of some two miles above. These beds, discovered and worked by J. F. Hammell, of Madison, have furnished many rather rare and valuable species. Other interesting fossiliferous outcrops are those of the Waldron shales, above mentioned.

In the Twenty-sixth Annual Report, Edward M. Kindle treats in a similar manner the Devonian formations of this and adjoining counties, in his article on the "Devonian Fossils and Stratigraphy of Indiana." In passing, it may be added that the base of the Devonian in many parts of Jefferson County, but especially in the bed of Big Spring creek, some three miles southwest of Hanover, and along the roadside in the northwestern part of Hanover, and to the distance of several miles to the north of these localities, may be recognized by a coral reef formation, which is fully as interesting from the standpoint of numbers and size of species represented, and of structure, as that at the Falls of the Ohio. In addition to the fossil fish teeth mentioned by Kindle, as occurring in the Sellersburg beds, occurring just below the Black shale an almost perfect specimen of fossil fish head, some 8 or 9 inches long and 5 or 6 inches wide, has recently been obtained from a quarry in these beds at Big Springs. Several plant fossils have been obtained by the writer from the New Albany Black shale, which, so far as known, have not been mentioned by others.

In geological economic products, Jefferson County does not take a prominent place. The only important one, so far as known at present, is the soil, upon which the progress and prosperity of the county so much depends. Jefferson is essentially an agricultural county and upon agriculture its inhabitants must very largely rely. The most important topics to be discussed in the interests of its people, must be the soil, its origin, its composition and texture, and the methods by which it may be improved.

According to the Indiana soilsurvey (see Thirty-second Annual Report of Geology and Natural Resources), Jefferson County has five different types or general classes of soils. The writer of the present article, however, prefers to treat the subject of soils in a somewhat different manner.

Along the Ohio River and Indian Kentuck and Big creeks, there are what are locally known as bottoms or bottom soils. These may be further classified as first and second bottom soils. There is no distinct line of demarcation between the two, yet there is a difference in texture and subsoil. The real second bottom, or

first terrace, is not overflowed and was not even, by the great flood of 1884. The first bottoms are very largely overflowed, year by year. While the second bottoms are not extensive in Jefferson County because of the great curve of the Ohio to the west, leaving but small areas of lowlands on the convex side, yet there are very valuable areas. Above Brooksburg, in the eastern part of the county, these bottoms are, in places, very sandy, and in all places where they occur the soils contain more sand and gravel than is found in the ordinary first bottoms. Watermelons are grown, more or less, extensively and with considerable profit, on the sandy second bottom soils. The first bottoms are of a darker color and have a greater percentage of clay. It is a question whether the deposits left by the Ohio River floods of today are of any considerable benefit in adding fertility. So much of the material of these recent deposits come from worn out and gullied clay soils, that on the whole, not nearly so much fertility is left as in the past, when only the black loams of extended woodlands were eroded and deposited. The soil of the Ohio, and Indian Kentuck bottoms are largely alluvial, while those of the other streams are in many cases, largely colluvial, that is, their origin is largely from the hill slopes nearby. With the clearing of the steep slopes along the streams on the Ohio side of the divide, and with the resultant large increase in the volume of floods, the value of the narrower bottoms is rapidly deteriorating, because of the loss of soil and its replacement by gravel and small stones. All the bottom lands of the county are still largely planted in corn, although, in recent years, a considerable area has been sown to alfalfa. This has proven a profitable crop.

The soils classified on the soil map as Limestone Upland, extending over the greater part of the east half of the county, may well be classified under two heads. The first of these comprise the soils of the slopes of the more or less rugged hill lands. These soils are colluvial, but are composed almost entirely of the decomposed Ordovician shales and limestones, and in the most easterly part of the Lorraine, shales alone. These well drained, loose, fertile, and easily cultivated soils, black with humus, proved very attractive to the early settlers in this part of the state. These rugged hill slopes were cleared and cropped, year after year, while the flat soils of the uplands were untouched. The result was an almost complete loss of soils from these hills, and in the case of hundreds of acres, a complete abandonment. As man gave up the attempt to earn a living on them, nature again began

her work and is clothing the hills with shrubs and trees, among which are the valuable Black Locust. A decade or so ago, some one wiser than this neighbors, sowed a few acres of these steep, and rocky limestone soils in sweet clover, and the effect has been far-reaching. The seeds of the sweet clover have been carried by the streams, and borne by animals, including man, to thousands of acres of this land. Large areas of what, a few years ago was considered worthless soil, has been redeemed and made fertile. The growth of the sweet clover with its deeply penetrating root system holds the soil and at the same time adds nitrogen and humus. It prepares the soil for blue grass and alfalfa. It furnishes excellent pasture for cattle, and is valued very highly by the apiarist, as the abundant source of a high quality of honey. With the increased growth of alfalfa for winter feed, and of sweet clover and blue grass for summer pasture, there is a bright future for the erstwhile worthless limestone hill lands of much of southeastern Indiana.

The soils of the uplands, or comparatively level portions of the Ohio side of the divide, are in the main good, and on them are some of the best farms of the county. The great need of these soils, as they are farmed, as well as of 90 per cent of all the farms of Jefferson County, is humus. Too continuous cultivation of corn, wheat, hay or other crop, without barnyard manure, clover, or other humus adding material, has reduced productiveness to one half what it should be. Commercial fertilizer, to the neglect of the humus supply has impoverished many a farm in Jefferson County, and tens of thousands in southeastern Indiana.

The area included in the soil map of the Thirty-second Report, as Volusia silt loam, and which covers the greater part of the county, west of the divides, varies considerably in texture and fertility. This in the writer's opinion, seems to depend on the depth of the soil above the limestone substratum. The quality of the soil, and the value of the farming lands in much of the northeastern and eastern part of the Volusia silt loam area greatly exceeds much of that in the southerly and southwesterly part. The former are, in part, formed from the decomposition of limestones, or have had much calcareous material brought to the surface through capillary action. The broad valleys, even in the western part of the county, where the soil rests on a substratum of limestone, as along Big Spring creek and other streams farther west, are much more fertile. In much of the region in the west, as in parts of Republican Township, where almost all of the soil

has come from the weathering of the Black shale, and where it is underlain by considerable depths of the same rock, the soil is heavy and very soon loses its fertility by continuous cropping. On these soils the principal plants, growing in old wornout fields, are the sassafras, greenbriar, dewbriar, and low scraggly growths of the blackberry. The greater part of the uplands in the Volusia area, as well as those included in the Miami and Scottsburg Silt loams, are not only greatly in need of humus, but especially of lime. Those limited areas of soils that are immediately below, or that are above but within a few feet of the outcropping limestones, probably do not need lime. The secret of successful farming over the rolling lands of the western part of the county, lies in the addition of lime in some form, and the periodic growing of crops or other treatment to keep up an abundant supply of humus. The addition of fertilizers should have double the effect, when these soils are properly amended so that their texture shall be greatly improved.

The soils of the "Flats", "Slashes", "Buttermilk", or "Crawfish" lands, as they are variously called, comprise the remaining portion of the county. They are largely the Miami and Scottsburg silt loams, of the soil map, but are more widely distributed in smaller areas, especially in Madison, Smyrna, Hanover, and Republican Townships. These flat areas are probably the remnants of a much more extensive glacial penoplane, which has since the disappearance of the glacier, been dissected by the erosive work of streams. The soil proper, of all these areas of flats, is extremely fine grained, and of light color. The grayish or bluish-white color, is probably due to the long continued action of swamp waters, containing carbon dioxide, and humous acids, on the iron oxide, and hence causing in large part, the removal of the coloring matter. The decaying vegetation in the woodlands of these flats, not infrequently after heavy rains, color the streams draining them to a chocolate brown. The difference in fertility between the soils of the flats in the western part of the county, or the Scottsburg silt loams, and those in the central part or the Miami silt loams, where this is at all marked in favor of the latter, is probably due to the sources of the materials transported by the glaciers in their formation. Those of the westerly area had their source from the outcrops of the Black shale, while those of the central part, largely from outcropping limestones, and of soils of limestone origin.

Viewed from the farmer standpoint, these flat soils upon which

the Sweet Gum, Black Gum, Beech, and Black Jack oak grow, are difficult to work. They are very heavy and cold, and during wet seasons, crops are frequently a total failure. Where handled wisely, however, these soils are proving more and more valuable. In dealing with them the first important point is thorough drainage. For surface drainage the fields are plowed in narrow strips 25 or 30 feet between the dead furrows, which are deep and kept open at the ends that the drainage may be unobstructed.

Because of a hardpan, or a very close textured impervious layer, which is often found a few feet below the surface, and which does not permit the ready escape of the water downward, many farmers cultivating these soils are of the opinion that tile drainage would prove to be useless. Others, however, do not concur in that belief. What is needed, above everything else in connection with the flat lands of this and adjoining counties, is a thoroughly reliable tile drainage test on some ten or fifteen acres of the worst hard pan soil. With successful drainage, deeper plowing, lime and the ever needed humus, these soils should prove among the best.

Stone, although so abundant in the greater part of Jefferson County, is rarely found of high quality, for construction work. A few feet of the Laurel limestone of the Silurian, as at Hanover and along Big and Middlefork creeks in the northern part of the county, is a rather valuable building stone, and has been used by the Pennsylvania Railroad for bridge and culvert construction, and rather extensively for foundation work. Portland cement has largely superseded the use of such stone for construction purposes. The chief value of stone in this county today, is for agricultural, road building, and concrete purposes. In the Thirtieth Annual Report of Geology and Natural Resources, is given a discussion of the quality, and distribution of the road materials of this county. In this connection, however, it may be said that in the building and repairing of macadam roads in this county and probably in many others, very little attention is given to the quality of the stone. The specifications for new roads call for crushed stone so many feet wide, and so many inches deep and of a certain size, but a special examination, and testing of materials to be used, a point of very great importance in building a first class, and lasting road, is seldom, if ever, made by an expert. Soft rocks, long exposed to weathering, and already crumbling, together with much soft shale and clay, are hauled out for repair work or for the making of new roads. The life

of such materials is at the longest, but a year or so. The cost would be but little more were good materials specified and demanded in all road contracts. The taxpayers are paying for good materials and those in authority should see to it that such materials and only such materials are used.

Recently, several plants have purchased and erected for the purpose of pulverizing limestone for use on farms for amending the soil. Such plants have been pulverizing limestones in Hanover, Graham, Madison, and Monroe Townships. The stone used in the first two localities is a high grade Devonian limestone analyzing above 95 per cent lime. The Niagara limestone, outcropping in Saluda, Hanover, Madison, Monroe, Lancaster, and Symrna Townships, is used in other places, and the better grades are probably equally as good as the Devonian, of the western part of the county. The clay limestones of the lower Madison beds, and the Lorraine, of the eastern part of the county, are not usually of a quality to be of value for pulverizing.

Another economic product of Jefferson County, while not of great importance at present, is yet of considerable popular and scientific interest. This is the natural gas obtained during the last half dozen years, from three wells driven for water. The first of these was driven in March, 1908, on the farm of Mr. William Rowison, two miles north of Volga, in Symrna Township. The writer visited this well soon after gas was found, and quite a flow of gas was escaping through the water in the bottom of the well. Owing to the inability of the owner to have the well properly packed at that time the correct gas pressure could not be obtained. Later the well was packed and the gas piped to the owners residence nearby, where it has been used for fuel, for cooking and heating, and lighting purposes for the last 6 years, with small reduction of pressure. The second well was bored near the residence of Mr. Theodore Schneider, one and one half miles northwest of the town of Hanover. Gas was struck at a depth of 85 feet, and the pressure, on packing the well several weeks afterwards, was found to be approximately 70 lbs. to the inch. This gas was used for household purposes for some four years and a smaller flow still continues. Gas was obtained at about the same time in a driven well at Volga, but no use was made of it. The last well drilled in which gas was obtained, was on the farm of Mr. W. R. Dryden, a few hundred yards south of Middlefork station of the Madison branch of the Pennsylvania Railroad. Gas was struck here at a depth of 168 feet, and the

pressure on packing the well a few days later was between 90 and 100 lbs. This gas was piped to the residence a few hundred of feet away, and has been used for heating and lighting purposes for the last two years. The pressure is still almost as strong as when the gas was first obtained.

In the case of the Schneider well, no record was kept of the thickness or character of the strata, passed through in drilling, but so far as may be judged from the prevailing thickness of the strata in the vicinity, the gas in this well was struck near the horizon of the upper Madison beds of the Ordovician. At the Dryden well, farthest north, gas was obtained at a depth of about 150 feet below the coral reef layer of the lower Devonian. This would probably be some 60 to 75 feet below the Clinton layer, and would reach the lower Richmond beds. The depth of the Rowlison well is reported as 167 feet, and if that be correct, the gas here was obtained at approximately the same horizon. These wells are found within an area, nine miles long and two miles wide. Whether other wells would strike gas within the same area is an open question.

It is the popular opinion through this region, that this gas originated in, or has some connection with the Trenton limestone. This, in all probability, is an erroneous conclusion, since it is not at all likely that gas from the Trenton limestone could pass through the hundreds of feet of the Ordovician shales and be obtained in these upper rocks. Mr. Frank Oliver, of Dupont, owner of a well-boring outfit, during the season of 1915, sank a well to the depth of 1,000 feet, on a farm only one-third of a mile north of the Dryden well with the expectation of obtaining gas from the Trenton limestone. He was disappointed, as no gas was obtained from any source. Other borings in Jefferson County in the past have penetrated the Trenton limestone but without obtaining gas. It is not at all likely that any great quantity of gas will ever be obtained from the rocks underlying this county, yet enough may be obtained to make it profitable to use for household purposes over a limited area.

With a good market for an electric current, water power plants in such streams as Clifty, and perhaps others, may be profitably located. With the building at Clifty of a series of large reservoirs at a distance above the falls for the purpose of impounding the waters of excessive rains, and then piping it for some distance along the bluffs below the falls, a drop of 175 or 200 feet

could be obtained. Such a plant on this, and similar plants on other streams, are among the possibilities of the future.

From the stream beds of the southwestern portion of the county, some gold has been obtained. One man with shovel and pan is said to have earned from a dollar to a dollar and a half a day for several weeks in washing the sands in the crevices of the rocky creek beds. The very small quantity of gold found in these streams is of glacial origin, and has been brought in from regions far to the north. Black sand, the usual accompaniment of placer gold, may be seen along almost any road side gully of the county, but gold in paying quantities will not be obtained in this region of sedimentary rocks.

In scenes of great natural beauty, Jefferson County is unexcelled in the state, if indeed in the Mississippi valley. The gorge of the Ohio, reaching its greatest depth, where this stream cuts through the resistant Silurian strata in the vicinity of Hanover and Madison, presents views of unusual interest and attractiveness. These river views, as beheld from the top of precipitous bluffs, as Cedar Cliff and Cragment on the east, and College and Logans Points on the south are without superiors of their kind in any region. At the heads of half a score of deep wooded ravines in the same locality are picturesque falls and rapids. The principal ones of these, beginning with that of Clifty creek on the north, are Clifty, two miles northwest of Madison; Deadman and several others at the head of Happy Valley, one-half mile northeast of Hanover; Crowe, within the town of Hanover; the two at the head of Butler Ravine and Chain Mill, one-half and one mile south of Hanover, respectively; with heart's and the rapids and falls of Saluda creek, three and five miles south of the same point. Over precipices, varying in height up to 100 feet, and through gorges of much greater vertical dimensions, the waters of these streams plunge in their brief course from the Wabash-Ohio divide to the valley of Ohio, 400 feet below.

The ever invigorating atmosphere of these hills, and the great natural beauty of the whole region, attracts many, and should attract many more visitors, for health and pleasure. No part of our esteemed commonwealth furnishes a better opportunity for the student, whether of rocks and their contents, of plants, of birds, and insect life, and of nature in all its varied forms, than do the valleys of the Ohio and its tributaries in Jefferson County. The outcropping ledges and abundant fossils of many formations,

the hills and valleys, the deep ravines, the cataracts and rapids make geology a study of ever increasing interest and pleasure. The varied flora and fauna of the deep Ohio valley and wooded ravines, of the hill slopes, and of the level and more or less swampy lands of the "Flats", give abundant material for the botanist, entomologist, and bird lover.

Among objects of archaeological interest, very little remains. Of the series of watch towers, or signal stations along the bluffs of the Ohio River used by prehistoric peoples, nothing is left. Of the very interesting old fort on the triangular point of land between the cliffs and precipitous slopes of Big creek on one side and of the former course of Little Graham creek on the other, lying just west of the water tank on the B. & O. S. W. Railroad, a mile north of Deputy, a few scattered stones, marking the site of the wall of defense on the land side, and the topography of the site, alone remain. A few years ago, under the auspices of Miss D. L. Cravens of Madison, the writer examined a number of supposed and real prehistoric mounds, and superintended the opening of some that had not at that time been fully excavated. The supposed mound within the town of Lancaster, and the one a short distance north of Middlefork station were found to be elevations, due to natural causes. The Lawson mound, about one mile east of Manville, on the high narrow ridge between Indian Kentuck and its tributary, Brushy Fork creek, was in part excavated, and in addition to a few flint implements, a very interesting bit of old pottery, and a few of the larger bones of two badly decomposed skeletons were obtained. The earthenware vessel is of about five or six quarts capacity, and contained, when found, the remains of two or three mussel shells. The articles found in this mound are now in the museum of Hanover College. The Walker mound, located in the valley of the Ohio, near Hanover, was thoroughly examined. This mound had been excavated by parties many years ago, when a number of large copper beads were found. The later opening disclosed nothing further except another bead, now changed largely to the green copper carbonate, and a few implements.

At a point about one and one-half miles southeast of the Lawson mound, Mr. Fred Wolfe, a few years ago, inadvertently opened a burial ground, while grading and excavating a site near his residence for a farm building. He reports the finding of many badly decayed human bones together with their crude rock cover-

ings. A skull or two and some others of these relics of prehistoric peoples were preserved for a time by neighbors, it is said, but now probably nothing is now left. The old gravel bar, below the Hanover landing on the Ohio River, which is composed of rounded glacial pebbles, gravel and sand, was a site where the ancient inhabitants of this part of the Ohio valley, manufactured many stone implements, such as arrow and spear heads, axes, etc. Many of these interesting objects have been collected from this place in the past, and a few are still obtained.