

GEOLOGY OF DECATUR COUNTY.

By *MOSES M. ELROD, M. D.*

Decatur county lies in the southeast central part of the State. Greensburg, the county seat, is forty-seven miles southeast from Indianapolis, and sixty-eight miles from Cincinnati, on the main stem of the Cincinnati, Indianapolis, St. Louis & Chicago railway. The county is of an irregular shape, measuring twenty-two miles in greatest length north and south, and twenty-one miles in greatest width east and west, and has an area of 231,671 acres. It is bounded on the north by Rush, on the east by Franklin, on the south by Ripley and Jennings, and on the west by Bartholomew and Shelby counties.

The territory of which the county is composed was purchased by the government from the Delaware Indians at the treaty of St. Mary's, January 15, 1819, but was not surveyed and offered for sale to settlers till 1820. The first land patent issued from the Brookville, Indiana, land office for lands in Decatur county, bears date of October 3, 1820, and was granted to John Shelhorn for what is still known as the Shelhorn homestead, between Little and Big Flat Rock creeks, in Adams township.

The county was organized pursuant to an act of the Legislature, passed at the session of 1821-1822; prior to this time it formed a part of Delaware county.

The Cincinnati, Indianapolis, St. Louis & Chicago railway crosses the county from the east to the northwest; the Vernon, Greensburg & Rushville railroad through the central part, from south to north, and the west by the Columbus, Hope & Greensburg road. The county is well supplied with good pikes; the county seat has six, radiating from that center. Many of the

township roads are graveled and in excellent repair, affording splendid drives through fine farms and beautiful pasture lands.

Greensburg, with a population of about 4,000 inhabitants, is one of the handsomest cities in the State, noted for its healthfulness, wealth, intelligence, and the literary taste of its citizens. Many of its streets are thickly bordered with the most beautiful of all our native forest trees, the white and sugar maple, trees that are beautiful in blossom, beautiful in full, dark summer leaf, and resplendent in russet and gold when touched by the icy finger of autumn.

St. Paul, Clarksburg, Adams, Westport, Millhousen, Sardinia and Milford are thriving and pretty towns of 600 to 200 inhabitants. Kingston, New Point, McCoy, Roszburg, Mechanicsburg, Pennington, Smyrna, Waynesburg and Alert are smaller but enterprising villages. Nearly all the towns of the county are noted for their excellent public school buildings, a sure index of the intelligence and morality of the people.

TOPOGRAPHY.

TABLE OF ALTITUDES, DECATUR COUNTY.

Vernon, Greensburg & Rushville Railroad, South of Greensburg.

Miles from Greensburg.	POINTS AT WHICH THE ELEVATIONS WERE TAKEN.	Feet Above Ocean.
	Greensburg depot, C., I., St. L. & C. R. R.	954.00
1.3	Junction of C., I., St. L. & C. R., R., and V., G. & R. R.	939.00
1.7	Muddy Fork of Sand Creek bridge	908.00
	Bottom of stream	894.00
7.2	Horace Station	868.05
8.9	Lett's Corner	891.05
13.14	Westport	801.05
15.14	Sardinia Crossing	770.05
19.74	Brewersville bridge, Big Sand creek	695.05
	Bottom of stream	643.05
25.8	North Vernon at O. & M. R. R. Crossing	721.08

Vernon, Greensburg & Rushville Railroad, North from Greensburg.

Miles from Greensburg.	POINTS AT WHICH THE ELEVATIONS WERE TAKEN.	Feet Above Ocean.
.50	Junction of C., I., St. L. & C. R. R., with V., G. R. R.	939.00
5.8	Sandusky Station.	939.00
7.0	Clifty Creek bridge.	934.00
	Bottom of stream	904.00
8.8	Williamstown, county line	954.05
11.7	Little Flat Rock Creek bridge.	958.00
	Bottom of stream	935.00
11.8	Milroy	963.00
15.3	Bennetts	982.07
19.0	Big Flat Rock bridge.	951.05
19.5	Rushville junction with Cambridge branch J., M. & I. R. R	955.06

Columbus, Hope & Greensburg Railroad.

.50	Junction of C., I., St. L. & C. R. R. and C., H. & G. R. R.	939.00
10.4	Clifty Creek bridge.	765.05
	Bottom of stream	720.05
12.7	Duck Creek bridge.	758.03
	Bottom of stream	723.03
15.2	Hope	737.04
26.6	Columbus, West end of Water street.	629.01

Points on C., I. St. L. & C. R. R., in Decatur County.

10.0	St. Paul.	864.00
	Flat Rock bed	792.00
	Clifty Creek bed	860.00
6.0	Adams	892.00
	Greensburg	954.00
	Sand Creek bed	939.00
3.0	McCoy's.	1,039.00
6.0	Smith's Crossing.	1,015.00
8.0	New Point.	993.00

Other Points in the County.

	Harris City, end of switch at quarry	854.00
	Summit between Sand creek and Salt creek—old survey of Lawrenceburg & Indianapolis Railroad, 1835	1,079.00
	Summit of divide at Clarksburg	1,034.00
	Top of Lower Silurian at Rosburg	953.00
	Top of Lower Silurian below Harris City	834.00
	Top of Lower Silurian at Douglas Hole, Clifty creek	884.00

The summit between Sand creek and Salt creek, on the line of the preliminary survey of the Lawrenceburg and Indianapolis railroad, made in 1835, as given above, 1,079 feet, is the highest point yet determined in Southeastern Indiana. McCoy's, on the present line of railroad, is the highest point on that road, and is thirty feet higher than Pierceville, on the O. & M. R. R. Through the county east of Greensburg, runs the divide that determines the natural drainage of the country to the east into White Water, and west into East White river. From the dividing ridge the lands fall away to a lower level, as they near the county lines; but in a much more marked degree on the southwest and west. Taking the summit above referred to as 1,079 feet above tide level, for comparison, Sardinia crossing is seen to be 301 feet lower; the Clifty creek bridge, on the C. H. & G. R. R., is 314 feet lower; St. Paul, 215 feet lower; and Williamstown, at the county line, 125 feet lower. Notwithstanding the great difference in the level of these points, the change from one to the other is so gradual as scarcely to be noticed by the casual observer, and taking the county as a whole it may be designated as "upland." The surface of the country is undulating, broken on the creek banks by bluffs that are usually covered with clay and gravel. The creek beds, first and second bottoms, are lower than the general level of the country, and their bluffs mark the limits of the ancient river beds. The bluffs are usually spoken of as hills, but, in the sense of an elevation above the general level, the use of the term hill is inapplicable. On Salt creek, Cobbs' Fork, Sand creek, Clifty creek, and tributary branches about Newburg and Flat Rock, near the boundary lines of the county, the creek bluffs are much higher than in the interior. The white clay lands of the east and southeast part of the county are "upland flats," in many places too level for efficient natural drainage. True hills, or rather, low elevations above the common level, are found in parts of Jackson township.

DRAINAGE.

As indicated above, the dividing ridge of the eastern part of the county determines its drainage, and the course of its creeks and the falling away of the general level of the country deter-

mines their velocity. From the bridge on the C., I., St. L. & C. R. R., over Sand creek to Brewersville, a distance of twenty-five miles, the creek has a fall of 296 feet, an average of about twelve feet to the mile. From Adams to the C., H. & G. R. R. bridge, Clifty creek has a fall of 140 feet in ten miles, fourteen feet to the mile. The "flat lands" north of New Point are drained by Salt creek and its branches, that flows south; thence northeast through Franklin county into White Water; those south of New Point, by Laughery creek, that joins the Ohio below Aurora, and the northern headwater branches of the Muscatatuck river. Through Sand creek and its branches, Rocky creek, Painter creek, Cobb's Fork, Muddy Fork, Millstone, Wyanouse, and others of less note, the drainage of the central and southwest part of the county is effected. Clifty creek and tributaries, North, South and Middle Forks, and Fall Fork, are the principal creeks of the west. From a study of the map it is seen that Decatur county is well supplied with creeks that have their origin within its limits, and owing to the topography of the country, flow to the east, south and west, and for the same reason is not traversed by any important stream that deserves the name of a river, except it be Flat Rock, that cuts through Adams township in the northwest corner of the county. As would naturally be expected, the streams of the central and northern part of the county have low banks that do not cut through the gravel and clay, but grow deeper and rocky as they cross the county lines. The bed of Flat Rock is seen by railroad elevations to be seventy-two feet below the level of St. Paul; Clifty creek, thirty-two feet below Adams, and forty-five feet below the bridge of C., H. & G. R. R. To the rule of the gradual increase of the height of the banks and bluffs of the creek, there is a marked exception in the case of Salt creek that reaches down to the Lower Silurian shales and soft limestones, cutting deep and abrupt gorges for its passage.

PALÆZOIC GEOLOGY.

DIP.

The junction of the Lower and Upper Silurian, Hudson River and Clinton groups, is a well-marked and easily recognized horizon, and advantage has been taken of this fact to determine the altitude of three points in the county for comparison. These determinations have been made with a reasonable degree of accuracy, by connecting the points selected with the adjoining railroad elevation. Especially may those at Rossburg and Harris City be relied on as correct. The junction of the two groups at Rossburg was found to be 953 feet above the ocean; Harris City, 834 feet, and that at Douglas Hole, on Clifty creek, near Sandusky, 884 feet. The average of the altitude is 890 feet, which gives a difference of twenty-five feet when compared with 915 feet, the average of thirteen determinations made by Prof. Orton,* in Montgomery, Preble, Miami, Clark, Greene and Warren counties, Ohio, low water in the Ohio river, at Cincinnati, being assumed at 410 feet above the sea level. Omitting the observation at Harris City, that is evidently shown to be below the general level of the Cincinnati Lower Silurian arch, by the dip of the overlying Niagara group limestone, the average of the two remaining points, Rossburg and Douglas Hole, is 908 feet, a difference of seven feet less than that of Ohio; and I have no doubt but the Douglas Hole should be also omitted, as not being an exposure of the top of the plain of the arch, but of the slope on the west side. The divide that runs northeast from McCoy's Station, through Kingston and Clarksburg, is probably the western crest of the Lower Silurian upheaval. This being the fact, Rossburg falls within the plain, and does not show any appreciable dip to the west of the top of the Hudson River group, from the vicinity of Dayton, Ohio, to the east side of Decatur county. On the contrary, it has a greater altitude than the average of those of Ohio, but not greater than the average of the six

* Geological Survey of Ohio. Geology, vol. 1, p. 411, *et seq.*

highest points. At Hollinsbe's quarry, just west of Rossburg, the exposed surface of the Niagara flags has a decided dip to the northeast, but this is probably local.

Estimates of the dip of the Niagara group have been made by taking the junction of the top of the limestone with the calcareous Waldron shale as the horizon. Measurements show the base of the Waldron shale at the Clifty creek V., G. & R. R. R. bridge to be 20 feet above the bottom of the stream, which, reduced to the railroad level, is 924 feet above the ocean. The same process shows the shale under the St. Paul bridge over Flat Rock to be 819 feet; the difference in the level is 105 feet, the distance 8 miles due west, and the dip over 13 feet to the mile. From the V., G. & R. R. R. bridge, mentioned above, to the C., H. & G. R. R. bridge over Clifty creek is 13 miles southwest, the difference in elevation is 187 feet, and the dip over 14 feet to the mile. From these and other observations it is probable that the greatest dip is to the southwest, at about 15 feet to the mile.

CONNECTED SECTION.

The following general section shows the average thickness of the strata of clay, gravel and rock exposed in the county brought together in one ideal view.

General Section of Decatur County.

QUARTEINARY AGE.

Recent period.....	8 ft.
Drift period.....	40

DEVONIAN AGE.

CORNIFEROUS GROUP.

Blue crystalline, North Vernon quarry stone, wanting..	00 ft.
Gray limestone, Middle Corniferous.....	6
Magnesian limestone, Lower Corniferous.....	35

UPPER SILURIAN PERIOD.

NIAGARA GROUP.

Calcareous shale, Waldron fossil bed.....	6 ft.
Chert, rubble and flag	15
Drab quarry stone.....	25
Lower Niagara shale, flag and marl.....	10

CLINTON GROUP.

Calcareous sand-rock and flag.....	3 ft.
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LOWER SILURIAN PERIOD.

HUDSON RIVER GROUP.

Limestone, shale and marl.....	25 ft.
Total.....	<u>173 ft.</u>

LOWER SILURIAN DIVISION.

HUDSON RIVER GROUP.

The top members of this group outcrop in the bed of Sand creek, from Parker's mill, southeast of southeast, section 32, township 10, range 9 south, to the Jennings county line, except where covered by sand and gravel; on Painter creek, below the Boicourt Brothers' quarry, along the lower course of Rocky creek, in the bed of the North Fork of the Muscatatuck and Squaw creeks, near the Ripley county line, and on Salt creek and its branches. At no point in the county is the Hudson River group the surface stone of the general level of the country, but it is not buried very much below the common level on the boundary line east of Sand creek and on the Franklin county line. It is the outcropping fringe or border on the south and east of the more elevated and central parts of the county. Fossils found in the gravel and sand below the Douglas Hole, on Clifty creek, and below the Picayune mills, at Downeyville,

on Little Flat Rock, show that the water at these places reaches down to the Lower Silurian, and that the rocks of this age are not far below the surface on the north side of the county.

In lithological structure it is made up of buff, drab, blue or greenish shale or marl, intercalated with a few strata of semi-crystalline limestone, that seldom or never exceed six inches in thickness. In proportion, the limestone exceeds the shale and marl combined, but on account of frequent vertical fissures is of very little or no economic value. Where exposed, the marl and soft shales weather to sticky, unctuous clay, leaving the bands of limestone unsupported, that drop of their own weight, and hence undermine the overhanging cliff of the Niagara Group.

UPPER SILURIAN DIVISION.

CLINTON GROUP.

At the base of the Niagara Group, and underlying the Lower Niagara shale, marl or flags, at all the outcrops seen in the county where the Upper and Lower Silurian form a junction, there is found a bed of calcareous sand-rock, or shale, ranging in thickness from six inches to three feet. Where reduced to a single stratum of a few inches in thickness, as is frequently the case, to the unaided eye it has more the appearance of hard blue sandstone, slightly weathered on the outside to an ochrey color, than a limestone. Tested with mineral acids, the residue, from five to ten per cent. of the whole mass, is found to be siliceous. Examined with the microscope, the sand grains are found to be worn and irregular in outline, unlike quartz crystals. Where the beds are thicker and more shaly, as at Parker's mill, below Harris City, the formation has a much greater proportion of sand, and the color varies to yellow or drab throughout the whole stratum.

NIAGARA GROUP.

Underlying the building stone of this group are frequently seen thin strata of shale, flag, and thicker beds of marl that I

have designated as the Lower Niagara shale, to distinguish it from the Upper or Waldron shale. The intercalated flags of the lower shale are of the same general appearance, bedding and structure, as the overlying beds of Niagara stone. The shale is found in thin strata of thinner laminae. The marl, where seen in place or recently exposed, is blue; where weathered, it breaks down into a very friable, fine clay that, dry, much resembles an ash pile. These shales and marls, and, in fact, all the shales of the county, whether Lower or Upper Silurian, are generally called, by the quarrymen and others, soapstone; but as the latter term has been applied by mineralogists to a very different stone, its use to indicate shale should be dropped; and the same objection applies to the term slate. The Lower Niagara shale is seen in the outcrops on Salt creek and its tributaries, and on Sand creek. These beds are not exposed on Clifty creek or Flat Rock, except, perhaps, in the Lowe quarry at St. Paul.

The true Niagara building stone is not alone of interest as forming nearly the whole of the surface rock immediately underlying the clay and gravel of the east half of the county, but on account of its vast importance from an economic point. The quarry stone is exposed in the banks of Salt creek and branches, north fork of the Muscatatuck, Squaw creek, and Sand creek and all its tributaries, in the bed of Clifty creek and in the banks and bluffs of Flat Rock and Little Flat Rock creek. The best exposures of the main central beds are found on Sand creek, Cobb's Fork, Painter creek, and Rocky branch, embraced within a triangle formed by drawing a line from Greensburg to Millhousen; and from Greensburg to Westport. At the quarry of the Greensburg Limestone Company, Harris City, twenty-four feet nine inches of clear merchantable stone is taken out, and about the same extent of good stone is exposed at the quarry of Z. Boicourt on Sand creek, near Westport. The main central beds are free from the overlying chert and rubble of the west side of the county. The quarries of the east part of the county are opened at the base, and those of the west part at the top of the formation. The quarries of Fugit, Salt creek, Marion and Sand creek townships, are covered only by earth and gravel; those of Adams, Clay and Clinton townships, except in the bends of the

creek bottoms, by the base of the Corniferous group; the thickness of the overlying Corniferous varies from a few inches to more than thirty feet. Prof. Collett, in his report on Shelby county, 1881, makes the thickness of the Niagara limestone in Mr. Lowe's St. Paul quarry, twenty-nine feet ten inches, and my measurement just below the railroad bridge over Flat Rock, one mile below Mr. Lowe's, gives a thickness of twenty-seven feet. In these two sections the top beds are respectively fourteen and fifteen feet of chert and rubble.

I have estimated the thickness of the Niagara limestone at forty feet; twenty-five feet of this is clear quarry stone. It is probable that the total thickness of the group grows less to the northeast, near the top of the Lower Silurian Arch, and that the thinning out is at the expense of the top, cherty member.

In physical appearance, the Niagara limestone has been described as of a light blue, or light gray, drab and buff, or drab and gray color. The best quarry stone is of a uniform drab, or light blue. The drab colored stone weathers to a buff, and exposed specimens of more than two inches in thickness, when broken across, show a drab center. In chemical composition it is a magnesian limestone, in which the percentage of carbonate of lime exceeds the carbonate of magnesia. With the above is mixed a small per cent. of alumina, but not in proportion to detract from its value in making a strong "hot" quicklime, and about five per cent. of insoluble silicates. Mineralogically it is a dolomite, semi-crystalline in structure. The stratification is massive, the bedding even, thin to medium heavy, and at a few places very heavy. The middle beds are usually homogeneous, the top beds mixed with nodules, and bands of chert. In the stone south of Greensburg, about twelve feet above the Lower Niagara shale, is found a very persistent bed of stone, ranging from two to three feet in thickness, that has, scattered through it or aggregated in the horizontal seams, a few nodules of chert, but not in sufficient quantity to impair its value for bridge building; all the other ledges are free from flint. The thickest beds of massive stone are found on Clifty creek, and at St. Paul; the thinnest beds on Little Flat Rock, and the head waters of Clifty. Heavy beds are found at all points, but not in such large proportion to the whole number of strata. Where exposed and weathered, the outcrop presents

a rough perpendicular wall of "cliff rock," without any accumulation of fallen fragments at the foot. The beholder is impressed with the idea, and truly, that the rains and frosts of many winters have done but little to destroy these foundations of the everlasting hills.

The Upper Niagara shale bed, is the calcareous clay, shale and thin strata of limestone overlying the quarry stone, and closing the Niagara period and group. The greater per cent. of the mass is carbonate of lime. In Shelby county, they are known as the Waldron beds. In my report on Bartholomew county, I generally called this formation Calcareous shale, which is appropriate so far as chemical composition is concerned, but the presence of another calcareous shale at the base of the Niagara group in this county, not seen in Shelby and Bartholomew, necessitates the use of a more specific term. Following the rule of priority, Waldron being the place where the Upper Niagara bed fossils were first found and studied, I shall refer to it by the name of Waldron shale. In general it is made up of thin laminæ of shale, frequently erroneously called slate, with bands of limestone near bottom; and where constantly wet, the shale is replaced by clay. Where exposed to atmospheric influences it weathers to a buff or ochrey-colored friable clay, scarcely distinguishable from the surrounding yellow clay; where protected, the color is uniformly a drab or blue, with occasional streaks of green. The Waldron shale is not uniformly found at all the places where both the Niagara and Corniferous groups outcrop. It was seen only on Clifty creek and Flat Rock, in the west and northwest parts of the county. In thickness, it ranges from ten inches to six feet. At certain places the upper shale is highly fossiliferous, as at St. Paul, and at Hartsville, less than one mile west of the Decatur county line; at some points no fossils could be found, and very few at others.

DEVONIAN AGE.

CORNIFEROUS GROUP.

In my report on the geology of Bartholomew county, 1881, for convenience of study, and on account of the marked difference in general appearance and structure of the rocks of this group, they were divided into Upper, Middle and Lower Corniferous. The upper member, the equivalent of the North Vernon quarry stone, does not reach Decatur county, the nearest approach being four and one-half miles west of the county, on an air line from Greensburg to Columbus. The Middle Corniferous was only seen in one outcrop in the southwest corner of Clay township, on the farm of John Graham, southwest of southwest, section 30, township 10, range 7, where a knoll of highly fossiliferous, shelly, gray limestone is exposed to the surface, and has been quarried for light work. On Bear creek, just after it crosses the county line, and west of Alert, the same range of stone is found, and has been hauled into the county for macadamizing purposes.

The Lower Corniferous, but for the overlying drift, clay and gravel, is the surface stone of nearly the whole west half of the county. The Niagara and Corniferous groups are seen, either singly or together, at every outcrop or exposure. It is the only stone seen in Jackson township, except at the southeast corner. It is the surface stone of Clay, Adams, and the west parts of Washington, Clinton and Sand Creek townships, and is the only stone exposed in the beds of Fall Fork and Middle Fork creeks. It is the rock struck in sinking wells at Greensburg. The line on the map indicating the eastern limits of the Corniferous, is an average of the outcrops where it is drawn, and stone of this group is found to the east of it at many places, especially in Washington township.

To the unaided eye the Lower Corniferous rock has the appearance of sandstone, and it is frequently so called by the quarrymen. Examined with a magnifier it is found to be made up of minute crystals of carbonate of lime and earthy matter; tested with strong acids, it is dissolved without any residue showing the presence of sand. The amount of earthy matter

or alumina in it varies, but not sufficiently to change the general appearance of the stone. Where found in thin, even laminae, or beds, the earthy constituent is increased. It breaks into irregular blocks, is with difficulty quarried in regular pieces, and when blasted, blows out or shells into small fragments. In structure it is not homogeneous; exposed in high walls and cliffs it weathers into small holes and pockets that afford nesting places for the wood pewee, or footholds for columbine and other plants. The cliffs at a distance have the appearance of a hard, gray rock, covered with lichen and moss; struck with the hammer it crumbles to powder; partially or wholly protected by a damp soil, it disintegrates to a fine rottenstone. In the vicinity of Greensburg, the lower beds are more crystalline than the average specimens of the whole group, are coarser in appearance, with a greater tendency to shell and break into fragments with thin edges. Typical specimens of the last variety may be seen in the banks of the Town Fork of Sand creek, in Greensburg, near the cemetery, and of the average stone at Milford. Chemically, it is a magnesian limestone. The general color is a sodden buff.

List of Fossils found in Decatur County.

LOWER SILURIAN.

HUDSON RIVER GROUP.

RADIATA.

POLYPI.

<i>Monticulipora approxematus</i>	Nicholson.
<i>Monticulipora briareus</i>	Nicholson.
<i>Monticulipora dalii</i>	Edwards & Haime.
<i>Monticulipora mammillata</i>	D'Orbigny.
<i>Monticulipora rugosa</i>	Edwards & Haime.
<i>Monticulipora pulchellus</i>	Edwards & Haime.
<i>Monticulipora sub-pulchellus</i>	Nicholson.
<i>Protarea vetusta</i>	Hall.
<i>Streptelasma corniculum</i>	Hall.

MOLLUSCA.

BRACHIOPODA.

<i>Orthis biforata</i> , var. <i>lynx</i>	Eichwald.
<i>Orthis occidentalis</i>	Hall.
<i>Orthis sinuata</i>	Hall.
<i>Orthis testudinaria</i>	Dalman.
<i>Rhynchonella capax</i>	Conrad.
<i>Rhynchonella ventricosa</i>	Hall.
<i>Strophomena alternata</i>	Conrad.
<i>Streptorhynchus</i> (<i>Strophomena</i>) <i>planoconvexus</i>	Hall.
<i>Streptorhynchus flitextus</i>	Hall.
<i>Zygospira modesta</i>	Say.

PTEROPODA.

<i>Tentaculites richmondensis</i>	Miller.
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GASTEROPODA.

<i>Murchisonia bellicincta</i>	Hall.
<i>Raphistoma</i> (<i>Pleurotomaria</i>) <i>lenticulare</i>	Emmons.
<i>Bellerophon bilobatus</i>	Sowerby.

LAMELLIBRANCHIATA.

<i>Ambonychia costata</i>	James.
<i>Orthodesma rectum</i>	H. & W.
<i>Modiolopsis pholadiformis</i>	Hall.

UPPER SILURIAN.

CLINTON GROUP.

BRACHIOPODA.

<i>Meristina intermedia</i>	Hall.
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NIAGARA GROUP.

PORIFERA.

<i>Astylospongia præmorsa</i>	Goldfuss.
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POLYPI.

<i>Favosites forbesi</i> var. <i>occidentalis</i>	Hall.
<i>Favosites niagarensis</i>	Hall.
<i>Favosites favosus</i>	Hall.
<i>Favosites spongilla</i>	Rominger.
<i>Stromatopora concentrica</i>	Goldfuss.
<i>Strombodes pentagonus</i>	Goldfuss.
<i>Cyathophyllum radricula</i>	Rominger.
<i>Eridophyllum rugosum</i>	Edwards & Haime.

CRINOIDEA.

<i>Eucalyptocrinus crassus</i>	Hall
<i>Eucalyptocrinus celatus</i>	Hall.

BRYOZOA.

<i>Lichenalia concentrica</i>	Hall.
<i>Fenestella parvulipora</i>	Hall.

BRACHIOPODA.

<i>Atrypa reticularis</i>	Linneus.
<i>Retzia evax</i>	Hall.
<i>Anastrophia vernuli</i>	Hall.
<i>Eichwaldia reticulata</i>	Hall.
<i>Orthis hybrida</i>	Sowerby.
<i>Orthis elegantula</i>	Dalman.
<i>Meristina maria</i>	Hall.
<i>Meristina nitida</i>	Hall.
<i>Rhynchonella indianensis</i>	Hall.
<i>Rhynchonella stricklandi</i>	Sowerby.
<i>Rhynchonella neglecta</i>	Hall.
<i>Rhynchonella whitii</i>	Hall.
<i>Rhynchonella acinus</i>	Hall.
<i>Rhynchotretra cuneata</i> var. <i>americana</i>	Dalman.
<i>Spirifera crispa</i>	Hall.
<i>Spirifera eudora</i>	Hall.
<i>Spirifera radiata</i>	Sowerby.
<i>Strophomena rhomboidalis</i>	Wahlenberg.
<i>Strophomena striata</i>	Hall.

PTEROPODA.

Tentaculites niagarensis.....Hall.

GASTEROPODA.

Platystoma niagarensis.....Hall.

Platystoma plebium.....Hall.

Strophostylus cyclostomus.....Hall.

CEPHALOPODA.

Gyroceras elrodi.....White.

Orthoceras annulatum.....Sowerby.

Orthoceras crebescens.....Hall.

Orthoceras.....Sp.?

DEVONIAN AGE.

CORNIFEROUS GROUP.

RADIATA.

POLYPI.

Acercularia davidsoni.....Edwards & Haime.

Amplexus yandelli.....Edwards & Haime.

Blothrophyllum decorticatedum.....Billings.

Cystiphyllum vesiculosum.....Goldfuss.

Cyathophyllum corniculum.....Rominger.

Cyathophyllum rugosum.....Edwards & Haime.

Favosites limitaris.....Rominger.

Favosites epidermatis.....Rominger.

Stromatopora tuberculata.....Nicholson.

Stromatopora nodulata.....Nicholson.

Zaphrentis gigantea.....Rafinesque.

MOLLUSCA.

BRACHIOPODA.

Atrypa reticularis.....Linneus.

Rhynchonella tethys.....Hall.

Spirifera oweni.....Hall.

Strophodonta demissa.....Hall.

GASTEROPODA.

<i>Bellerophon patulus</i>	Hall.
<i>Euomphalus decewi</i>	Billings.
<i>Loxonema nexile</i>	Phillips.

LAMELLIBRANCHIATA.

<i>Conocardium trigonale</i>	Hall.
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CRUSTACEA.

<i>Phacops bufo</i>	Green.
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The foregoing list is very incomplete in the number of species that might be found in the county. Doubtless many of the more rare forms will be picked up when careful search is made. Messrs. George Dunn, postmaster; Jo. Drake and Jas. Davidson, of Greensburg, have some nice native specimens from the Lower Silurian. Mr. Drake has a *Calymene senaria*, Conrad, said to have been found in the county, and I have some fragments of a trilobite, probably an *Asaphus gigas*, DeKay, from Sand creek, near Parker's mill. A fine specimen of an encrinite, from the Hudson river group, has been found on a branch of Salt creek, at Rossburg. Mr. Davidson has a stone containing hundreds of *Zygospira modesta*, Say, and Mr. Dunn a beautiful slab covered over with *Orthis testudinaria*, Dalman, that came from Little Flat Rock, near Downeyville, washed from the Lower Silurian shale, exposed in a deep hole below the mill, southeast of southeast, section 6, township 11, range 9.

LOCAL GEOLOGY.

Section at Wm. M. Hamilton's Quarry, Fugit Township.

Southeast of section 4, township 12 north, range 11 east.

Rubble and covered space, Niagara group.....	00 ft.	00 in.
Cherty limestone.....	00	4
Flag	00	4
Flag	00	4
Chert	00	2

Limestone and chert.....	00 ft.	4 in.
Dimension stone.....	00	6
Dimension stone.....	1	00
Flag.....	00	4
Flag.....	00	2
Dimension stone.....	00	6
Thin flag.....	1	00
Lower Niagara shale.....	1	00
Flag and shale.....	00	00
Total.....	6 ft.	00 in.

This quarry, if not the most northeasterly exposure of the Niagara stone in the county, is the only quarry in that vicinity that has been opened. Six feet does not represent the amount of available stone here buried in the bluff, and the higher ledges will probably be found to contain less chert-bands and nodules. Much of the stone here seen, from external appearance, seems to be an excellent building rock. The section was not continued down the creek to the Clinton beds and Lower Silurian, but I was told by Mr. James Holtsey, who has paid attention to the geology of that region, that it was not far down the creek to a point where Hudson River fossils are found. The overlying weathered gray boulder clay here has considerable thickness, judging from the height of the adjoining bluffs, and is covered by a growth of a better class of timber than that seen on a corresponding soil farther south.

Section at Larkin Waters' Quarry, Fugit Township.

Northeast of section 21, township 11, range 11 east.

Soil.....	00 ft.	00 in.
Thin bedded light flags, Niagara group.....	1	00
Chert.....	00	2
Thin flagging.....	1	6
Flag.....	00	3
Dimension stone.....	00	8
Dimension stone and flag.....	00	10
Dimension stone.....	00	10
Buff-weathered stone.....	00	2
Shaley marl, Lower Niagara shale.....	1	8
Total.....	5 ft.	5 in.

This section was taken a few feet west of the Franklin county line. Underlying the shaley marl are beds of hard stone, and down the creek a few yards was seen a buff-colored ledge, about eight inches thick, that probably belongs to the Clinton group. Underneath this ledge characteristic Lower Silurian fossils were seen. The marley shale weathers to a fine ashen powder where protected from moisture, at other places to a sticky clay. Considerable quantities of stone have been taken out, and it is quarried with facility with drills and crow-bars.

St. Maurice Quarry, Fugit Township.

Southeast of section 31, township 11, range 11.

Soil, thicker back in the bluff.....	3 ft.	00 in.
Flag and rubble, Niagara group	1	10
Dimension stone.....	00	8
Flag and chert.....	00	3
Flag	00	4
Ledges with chert band in middle.....	00	10
Dimension stone.....	1	6
Dimension stone.....	00	7
Dimension stone.....	00	10
Dimension stone.....	00	8
Total	10 ft.	6 in.

But little quarrying has been done at this place, scarcely enough to show the true quality of the stone. The bedding is not quite so regular as at some other quarries but once fully opened up will improve. The creek, a branch of Salt creek, runs over the bed, and, by erosion, has left the ledges exposed in descending order, and, might be worked with great facility. The stone for the St. Maurice Catholic church was obtained. The outcrop was not traced to the Lower Silurian that is known here, also that for some lighter buildings in the neighborhood. to come to the surface at a short distance southeast, in the bottom of the creek.

Section at W. Hollensbe & Sons' Quarry, Salt Creek Township.

Southwest of southwest, section 8, township 10, range 11.

Earth and gravel, boulder clay.....	4 ft.	00 in.
Rubble or flag.....	00	3
Rubble or flag.....	00	4
Rubble or flag.....	00	4
Flag.....	00	3
Flag.....	00	6
Dimension stone.....	00	7
Flag.....	00	3
Dimension stone.....	00	8
Dimension stone, or heavy flag.....	00	6
Dimension stone.....	00	10
Dimension stone.....	00	4
Block bridge stone.....	00	10
Flag.....	00	2
Dimension stone, free from chert.....	00	9
Dimension stone.....	00	9
Dimension.....	00	7
Marley clay, Lower Niagara shale.....	00	2
Total.....	12 ft.	1 in.

This section, like the Hamilton, Water's and St. Maurice quarries, is on a branch of Salt creek, and on account of facility in working and shipping, is the most important and noted of any on the east side of the county. Besides what stone is sold in the yard to supply the local demand, large quantities are regularly hauled to the railroad, one mile south, at New Point, and shipped to Cincinnati, Indianapolis, and other cities. The various ledges are even in bedding, never tight, and free from vertical seams or faults. The stone is a uniform drab or blue, homogeneous in structure, and easily worked with the hammer, where further dressing is required. The mass of the quarry is about twenty feet below the level of the railroad track at New Point, and might be connected by a switch at a small expense; however, this want is but a small drawback in the summer, when the roads are solid. The natural drainage of the quarry is very good, and but little stripping required to

reach the stone. At the time of my visit, seven workmen, with a full outfit of drills, crowbars, hammers, etc., were at work taking out stone.

As may be seen by the section, the outcrop here is a part of the lower numbers of the Niagara group. The section is not continued down to include all the Lower Niagara shale and thin flags that probably have a thickness of six feet. Following the creek branch to the east, a stratum of hard, buff stone is passed that is referred to the Clinton, and lower down, near Rossburg, the Lower Silurian is exposed. Below Rossburg, opposite the farm of Mr. Topmiller, is an upper, buff-colored shale, and an under blue shale and limestone, both filled with well-preserved specimens of Hudson River (Cincinnati group) fossils.

Section on the North Fork of the Muscatatuck, Salt Creek Township.

Southwest of southwest, section 26, township 10, range 10.

Covered space and rubble, Niagara group.....	00 ft. 00 in.
Dimension stone.....	00 8
Dimension stone.....	00 4
Dimension stone.....	00 10
Dimension stone.....	00 10
Dimension stone or flag.....	00 3
Dimension stone.....	1 6
Total.....	4 ft. 4 in.

This section was taken on the road east of Layton's mill, and does not represent the full thickness of the Niagara group stone outcropping in the bed and banks of the creek before the Lower Silurian shale is reached, further south. A quarry of twelve feet of most excellent stone can be opened in this vicinity that can be worked with ease and very little labor in stripping, as the overlying white clay is thin and the creek banks low. On the road from Layton's mill to the creek quantities of gravel are seen, that from its physical appearance, and the absence of the fossils so common in the Corniferous group flint, I think must be derived from the eroded beds of the Niagara, that long years ago were much thicker than they now are; the limestone

has been dissolved out and the more persistent chert is left in irregular, angular fragments, to tell the tale of decay that has been going on for ages.

At Millhousen, Marion township, between the Catholic church and the town, are extensive outcrops of most excellent quarry stone, that has been worked to supply the local demand. South of Millhousen, in the bed of a branch of Squaw creek, was seen the surface exposure of a stratum of blue limestone that was without a vertical seam at fault in 200 feet, level as a threshing floor and clean as a polished doorstep.

Section on Squaw Creek, Marion Township.

Southeast of northeast, section 30, township 9, range 10 east.

Covered space, thin clay and gravel.....	00 ft.	00 in.
Niagara group limestone, in even beds from two to ten inches thick.....	12	00 in.
Lower Niagara shale and flag.....	6	00
Place of the Clinton group, covered.....	6	00
Lower Silurian shale and limestone.....	10	00
Total.....	34 ft.	00 in.

Accumulations of chert were seen here, and at other places near by, like that before described as occurring in Salt Creek township. These accumulations remind one of the masses of angular stone and gravel seen in the St. Louis limestone regions, and are probably due to the same causes. Those in Decatur county are always on the top of the bluff, above the influences of any currents of water that have flowed in the vicinity in recent times. This section was taken near the Ripley county line, and shows the junction of the Niagara period and Hudson River group. Large numbers of well-preserved crinoid stems in the limestone indicate that a careful search would likely result in finding good specimens of encrinurites.

In sections 2, 10, 11 and 12, township 9, range 9, and section 7, township 9, range 10, Marion township, are extensive outcrops of Niagara group building stone in the banks of Cobb's Fork of Sand creek and Rocky Branch of Cobb's Fork.

On the farm of William Magniss, section 12, some little

prospecting and quarrying has been done—enough to show that in the vicinity are inexhaustible beds of first-quality stone, ranging in thickness from two to eighteen and twenty-four inches; evenly bedded, uniform in structure, free from flint and easily quarried. In developing quarries on Cobb's Fork, the expense for stripping and drainage can be put at a minimum, nature having already done that part of the work.

Railroad facilities for shipping are all that is needed to develop this region into one of the greatest quarries in the county, and this want could be supplied, and will be, in the near future, at a comparatively small expense. In the construction of the coming houses that are to take the place of the present wooden structures, stone and brick will be the principal material.

The quarry business in Indiana is in its infancy; builders are just finding out the vast storehouses of material scattered over the country, and especially in Decatur county. In a few years at most, the *banks* of Cobb's Fork and branches will be paying dividends little dreamed of by the present owners.

Ducrow & Gleason's Quarry, Sand Creek Township.

Southwest of section 5, town 8, range 9.

Covered space.....	00 ft.	00 in.
Flag.....	00	4
Flag.....	00	3
Flag.....	00	4
Flag.....	00	6
Flag.....	00	2
Flag.....	00	2
Flag.....	00	3
Flag.....	00	3
Dimension stone.....	00	9
Dimension stone.....	00	6
Dimension stone.....	00	6
Dimension stone.....	00	6
Dimension stone.....	1	3
Marley clay, lower Niagara shale.....	1	2
Flagging, thin ledges, estimated at.....	3	00
Hard buff stone, Clinton group.....	00	8
Lower Silurian shale and limestone, about.....	20	00
Total.....	30 ft.	11 in.

This section was taken on the west side of Sand creek, near the top of the bluff, and does not represent the total thickness of the available stone that will be exposed as the work is carried back from the creek.

About thirty hands are worked during the busy season. The stone is handled with two derricks in the quarry, and one at the railroad yard, in Westport. Adjoining the quarry are the blacksmith shop, office and necessary sheds. The product is principally flagging and curb, together with building stone, that is shipped to the neighboring cities by rail from Westport. The stone is hauled to Westport on wagons.

In the lower Niagara flags, below the marley clay, a single specimen, each, of *Atrypa reticularis*, Linneus, and of *Orthoceras annulatum*, Sowerby, were found. Fossils are abundant in the Hudson River group shales that are seen below the Niagara and Clinton, and the same succession of buff and blue shale seen as at Rossburg.

Section at Boicourt Brothers' Quarry, Sand Creek Township.

Southeast of southeast, section 32, township 9, range 9.

Covered space	00 ft.	00 in.
Dimension and flag in the bluff, Niagara group....	12	00
Bridge stone with chert nodules.....	3	6
Dimension stone or flag.....	00	5
Dimension stone or flag.....	00	5
Dimension stone or flag.....	00	5
Dimension stone or flag.....	00	5
Dimension stone or flag.....	00	6
Flag.....	00	3
Dimension stone.....	00	8
Total.....	18 ft.	7 in.

This quarry is on, or rather in, Painter creek, as stone is taken out from the bottom of the stream, and on the lands of Hugh H. Hindman, of Greensburg. At the time of my visit, the firm was running with seven employes. The product is handled with two derricks and wagons to the railroad at Westport. During the past season they have shipped curbing and flag to Columbus, Indianapolis, Greensburg, and Edinburg.

Indiana. The stone is easily quarried, loose in bedding, and breaks have been made with drills and wedges, seventy-five feet long, and eight feet wide. The strata are very free from vertical seams.

About half a mile down the creek from Boicourt's, the Lower Silurian is seen in the bottom of the stream.

Section at Z. Boicourt's Quarry, Sand Creek Township.

Southwest of southeast, section 32, township 9, range 9.

Soil, thin.....	00 ft.	00 in.
Rubble or flag, Niagara group.....	00	4
Rubble or flag.....	00	6
Dimension stone.....	00	8
Dimension stone.....	00	8
Dimension stone.....	00	10
Dimension stone, massive.....	1	3
Dimension stone, irregular in bedding.....	2	00
Dimension stone.....	1	8
Dimension stone, darker blue than that above, and very even in texture.....	1	9
Dimension stone.....	00	9
Bridge stone with flint concretions, two or more heavy ledges, not worked.....	3	00
Dimension and flag, not worked.....	9	00
Total.....	22 ft.	5 in.

Four or five hands were at work with one derrick, blacksmith shop and a full line of drills, hammers, wedges and other tools. The local demand for foundation stone takes a part of the output, but the principal product is hauled to Westport and shipped by rail.

In connection with the quarry Mr. Boicourt runs a limekiln, in which the weathered top ledges are burned, making a lime that is in good repute with masons and plasterers.

As this quarry is worked back into the bluff the thickness of the available stone will reach more than twenty-five feet. On the south, near by, Mr. Geo. Boicourt has done some quarrying, sufficient to show that good stone can be had. At this

latter place the upper beds are a little more shelly and mixed with chert than the average, but this is probably local and would, in the main, disappear as the quarry is opened up.

Across Sand creek, at the foot of the mill dam above these quarries, a persistent stone, ten inches thick, outcrops, that is referred to the Clinton group. Overlying the Clinton is a bed of marl twelve inches thick, very much resembling that seen at the quarry of Larkin Waters', in Fugit township. Under the Clinton are found the dark-colored shales of the Hudson River group, Lower Silurian, filled with characteristic fossils, but not in a very good state of preservation. Good specimens of *Orthoceras annulatum*, Sowerby, *O. Crebescens*, Hall, and *Atrypa reticularis*, Linn., were found in the Niagara group limestone.

Mr. A. Layton, northwest of northwest section, 21, township 9, range 9, has opened a quarry in the west bluff of Sand creek, two and a half miles southeast of Letts' Corner. In quality the stone is equal to that of the sections already given. The product is sold in the quarry to supply the home demand.

Section at Greensburg Limestone Company's Quarry.

Harris City, Sand Creek township.

Earth, gravel and clay.....	8 ft.	00 in.
Rough, eroded stone.....	4	2
Dimension stone.....	1	2
Dimension stone.....	1	00
Dimension stone.....	1	00
Dimension stone.....	1	4
Dimension stone.....	1	6
Dimension stone.....	1	2
Dimension stone.....	00	8
Dimension stone.....	2	00
Dimension stone.....	3	4
Dimension bridge stone, with small chert concretions.....	2	00
Dimension bridge stone, small chert concretions...	1	6
Dimension stone.....	00	10
Dimension stone.....	1	00
Dimension stone.....	1	00

Dimension stone.....	00 ft.	6 in.
Dimension stone.....	00	4
Dimension stone.....	00	7
Dimension stone.....	00	5
Dimension stone.....	1	9
Dimension stone.....	00	6
Dimension stone.....	1	2
<hr/>		
Total.....	36 ft.	11 in.

Deducting from the above section eight feet of earth and four feet two inches of rough stone, and there is left twenty-four feet and nine inches of good, merchantable dimension stone. Some of these strata are very heavy and massive in bedding, equaling those of any other outcrop seen in the county. All the ledges are very uniform in texture and color, and free from chert or flint concretions, except as indicated above. The chert in these ledges does not detract from the value of the stone for bridge building. The measurements above given were furnished by Mr. Harris, Superintendent of the quarry.

In order that all that is known, bearing on the value of the stone under discussion, may be presented in one connected history, the following is reproduced from Geological Survey of Indiana, 1878, page 90:

“According to General Gilmore, a cubic foot will weigh 169.98 pounds; crushing strength of a cubic inch, 16,875 pounds; ratio of absorption, 1 to 117.”

ANALYSIS.

	<i>Per Cent.</i>
Moisture, dried at 212° Fahr.....	0.85
Insoluble silicates.....	5.90
Ferric oxide.....	2.50
Alumina.....	3.70
Lime (equal 74.2 per cent. of carbonate of lime).....	41.55
Magnesia.....	4.93
Sulphuric acid.....	0.90
Carbonic acid.....	38.07
Chloride of alkalies.....	1.60
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Total.....	100.00

This stone showed the greatest resistance to a crushing force of any of the twenty-seven specimens tested by General Gilmore, and, according to the experiments of Mr. Thomas H. Johnson, M. A., C. E., reported in *Indiana Geology and Natural History*, 1881, page 34, *et seq.*, the modulus of elasticity of a sawed specimen is put at 6,800,000, which is higher than that of any other stone tested by Mr. Johnson. "In estimating the crushing weight of the stones tested for the State House Commissioners by General Q. A. Gilmore, they were all found greatly in excess of what is required, but it must be remembered that these results are for the ultimate crushing of the stone, while many will commence to yield to somewhat less than half the weight required for their total destruction"—(Cox, *id.*). From the above data the practical strength of Greensburg Limestone Company's stone may be estimated by taking one-half of 16,875 (say 8,000 pounds, in even numbers) in estimating the crushing strength of one cubic inch; this, multiplied by 144, gives 1,152,000 as the weight one cubic foot will successfully resist; or, estimated by another formula, 16,875 pounds, multiplied by 144, and the product reduced by dividing by eight, instead of two, the result is 178,750 pounds as the resisting power of a cubic foot. It is said that the piers that support the dome of St. Paul, London, and St. Peters, Rome, respectively sustain a weight of 39,000 and 33,000 pounds to the square foot. From this it is seen that, tested by the severest formula yet proposed for estimating the strength of stone, the Harris City limestone will safely resist four times the weight of the dome of St. Paul, and a column might be erected from it more than 1,050 feet high before the lower courses would be in danger of crushing—nearly twice the height of the famous pyramid of Cheops.

Harris City is a village of about 300 inhabitants, all of whom derive their support from the quarry. The town is located on the company's premises, and has a hotel, stores, large blacksmith shop, and neat residences, to which the company will soon add thirty more; for the accommodation of their employes.

The stone yards and quarry are under the efficient superintendence of Mr. Harris, who has arranged and erected a splendid system of derricks and cranes, and the machinery necessary

to operate them. Over 100 hands were at work, but this does not represent the company's capacity to quarry and handle stone, when supplemented, as it is, by machinery, steam, and horse power. Seven derricks and cranes were in use, and the machinery partly in place to operate two more cranes. The cranes in process of erection are to complete a circle of four, with a railroad track around the outside, and a central round house for the spools, where one man, with levers and breaks, can control and operate the hoisting and lowering of four cranes. At present, two mules furnish the necessary motive power, but, on completion of the works, are to be replaced by steam. Connected with the quarry is a steam engine and stone crusher, for preparing ballast, pikeing, and material for concrete foundations, and a steam pump, with a capacity to throw 3,000 gallons of water per minute. The crusher is operated only during the leisure season, to work up the broken stone that accumulates on the yard. Another season, it is the intention to increase the capacity to furnish cut stone by putting in three planers. Of course, in a quarry devoid of vertical seams, a channeler is necessary to start a break. The company is using a hand machine that has been improved by the superintendent, and, it is claimed, dollar for dollar expended in operating it, will do more work than any steam channeler.

During the first eight months of the year 1882, 2,500 car loads of stone, an average of over twelve a day, were shipped to the towns and cities of this and the four adjoining States. These shipments but imperfectly represent the value of the product of the quarry, as one car may be loaded with rubble at \$7.50, and another with cut stone worth over \$50. All branches of the trade, stripping, drilling, hoisting, draining, loading cars, cutting stone, and receiving orders by telephone, were in operation, altogether presenting the most active business prospect seen in the county.

The Lower Niagara group shale and flag underlies the section last given, and is known to the quarrymen as the "soapstone" beds. Its thickness I place at eight feet, which is a little more than the average, but not too high for this point. Eight feet added to the Harris City measurement, twenty-eight feet eleven inches, gives thirty-six feet eleven inches as the total thickness

of the Niagara. At the south end of the company's premises, in the east bank of Muddy Fork, is seen an outcrop of the lower flags, thin and of a greenish color. About one mile farther down the valley, in the bed of Sand creek, at Parker's mill, the Clinton group and Lower Silurian are the surface rocks. Both formations are fossiliferous, especially the latter.

Section at Hart & Bonner's Quarry, Washington Township.

Southwest of northeast, section 23, township 10, range 9.

Thin soil.....	00 ft.	00 in.
Rubble and flag, cherty in lower part.....	5	00
Dimension stone.....	00	8
Dimension stone.....	00	8
Dimension stone.....	00	7
Dimension stone.....	00	5
Dimension stone.....	00	6
Dimension stone.....	00	9
Dimension stone.....	00	7
Dimension stone.....	1	00
To the bed of the creek, not measured.....	00	00
Total.....	10 ft.	2 in.

Judging from the locality, about half way from the Greensburg cemetery, the top of the Niagara group and the Harris City quarry, where the base of the Niagara is reached, and the lithological appearance of the stone, the probability is that this quarry represents the top members of the formation. The outcrop showed irregularity in bedding. With more system in working the quarry, better results might be had.

Section at A. Forsyth's Quarry, Greensburg, Ind.

Town Fork of Sand creek.

Covered space.....	00 ft.	00 in.
Corniferous limestone, lower member, bedding thin, irregular and shelly.....	10	00
Place of the Upper Niagara, Waldron shale.....	00	00
Niagara limestone, irregular in bedding, thin and cherty.....	4	00
Total.....	14 ft.	00 in.

The Niagara limestone at this point is an outcrop of the extreme upper beds, and, as is the case elsewhere, is found in thin strata, mixed with more or less flint nodules and bands. It is quarried for light foundation and rubble. Just north of the Decatur county cemetery, Mr. Forsyth has a limekiln, in which the shelly, Corniferous stone is calcined. The stone used in making lime is intermediate in character, between the soft magnesian Corniferous, used in the Eck kiln, at Adams, and the hard Niagara limestone used in the Scanlan kiln, at St. Paul, and produces a lime intermediate in character, between the "cool" lime of the former and the "hot" lime of the latter. The product of the kiln is in repute with masons and plasterers, and finds a ready market.

At the bridge west of Greensburg, where the Greensburg and Columbus pike crosses the Muddy Fork of Sand creek, there is an outcrop of the Lower Corniferous group limestone, similar in character to that seen at the Forsyth quarry. The exposure has a thickness of about ten feet, and the top ledges are intermediate in hardness, and break into fragments with thin, feather edges; the lower ledges are softer, more even in bedding, and break into angular blocks. This stone was formerly burnt into lime, but the kilns are now abandoned.

Section on Clifty Creek, Clinton Township.

Bridge of the V., G. & R. Railroad.

Covered space	00 ft.	00 in.
Lower Corniferous limestone, one stratum.....	1	5
Calcareous shale, Waldron beds, Niagara group, weathered to a light buff clay.....	3	00
Niagara limestone, in ledges from four inches to fifteen inches thick, irregular in bedding, in places tight bedded.....	10	00
Covered to bottom of the creek.....	10	00
	24	5
Total.....	24 ft.	5 in.

The stone for the abutments of the V., G. & R. Railroad was quarried from this place, and as the quarrymen were looking only to getting an immediate supply of stone, the exposure

does not show to the best advantage. In the Waldron shale, or rather clay, fragments of *Eucalyptocrinus cœlatus*, Hall, and a few little brachiopods were found, sufficient to identify the formation as the Upper Niagara calcareous fossil bed. Just below the Douglas hole, southeast of northwest, section 12, township 11, range 10, is a bold outcrop of the Niagara in the Clifty creek bank, that has been quarried a little to supply the local demand for stone. The ledges are thin and mixed with chert; farther back, in the bluff, the character of the stone will doubtless improve. Fair specimens of quarry stone were seen in the creek bed above the Douglas hole. The outcrops at these points are about twelve feet thick.

Section at Mrs. Catherine Hays' Quarry, Adams Township.

Northwest of southeast, section 32, township 12, range 9.

Rubble, Niagara group.....	00 ft.	00 in.
Shelly limestone, with chert nodules.....	1	4
Dimension stone.....	00	8
Flag or fence base.....	00	3
Flag.....	00	2
Flag or fence base.....	00	4
Flag or fence base.....	00	4
Dimension stone.....	00	8
Dimension stone.....	00	8
Dimension stone.....	00	5
Dimension stone.....	00	5
To the bottom of Flat Rock.....	2	2
Total.....	7 ft.	3 in.

Here the outcrop, on the first bottom of the river, is exposed in mounds and beds, through and around which the river has, at some day, run and cut away a portion of the stone, the whole presenting an appearance not seen elsewhere. The quarry is worked to supply the home demand for foundation stone, and fence posts or bases. By fence bases, must be understood a triangular stone, about three feet long, and from three to four inches thick, that is sunk in the ground, and a wooden fence post fastened to it with an iron stirrup, or link. This arrange-

ment makes a fence in which all the wooden parts are above the ground, and protected from earth-rot. It makes a durable and popular fence; and, as the farmers are using it largely, the demand for bases is increasing yearly. By this invention a new industry is opened up to the quarrymen. The bases are sold, in the quarry, at from twelve to fourteen cents each. The stone at Mrs. Hays' quarry, and that of Mr. Wesley Garrett, just below, on the river, is well adapted, and largely used, for making fence bases.

Section at L. A. Shellhorn's Quarry, Adams Township.

Southwest, section 5, township 11, range 9.

Soil and covered space.....	00 ft.	3 in.
Flag or fence base, Niagara group.....	00	00
Flag or fence base.....	00	4
Flag or fence base.....	00	4
Flag or fence base.....	00	5
Flag or fence base.....	00	4
Flag or fence base.....	00	3
Flag.....	00	5
Flag or fence base.....	00	4
Flag or fence base.....	00	4
Flag or fence base.....	00	3
Flag or fence base.....	00	4
Flag or fence base.....	00	5
Dimension stone.....	00	6
Dimension stone, not measured to bottom of creek.	3	00
Total.....	7 ft.	4 in.

The flagging of Mr. Shellhorn's quarry is peculiarly adapted for making fence bases, and is extensively used for that purpose. A stone to work into bases, with but little waste, must be uniform in texture, so it may be broken to the required shape. Judging from the bases seen in the quarry, but little other stone is taken out. Good dimension stone can be had if wanted. If a shipping demand for bases should grow up, as seems probable, this quarry could furnish an unlimited supply. The stone here, on Little Flat Rock creek, and north, on Flat

Rock river, is exposed in the bed of the streams and bends where the superincumbent stone has been eroded away, and probably belongs to middle and lower division of the Niagara group. This supposition is strengthened by the finding of Lower Silurian fossils, at the foot of a hole near the Picayune Mills, that the creek has excavated, thirty feet deep, down to the Hudson River group.

The following extract, giving an account of Mr. W. W. Lowe's quarry, is taken from Prof. Collett's Report on the Geology of Shelby County, published in 1881, and is here inserted that persons interested in the geology of Decatur county may have a full history of what is known to date.

"The quarry of W. W. Lowe & Co., a short distance north-east of the village of St. Paul, is in Decatur county, but shipments are made from St. Paul. They employ, during the summer months, fifty to eighty men, have seven derricks and a full complement of drills and other tools. The opening shows a limestone face of 1,200 feet. They furnish dimension stone for foundations, piers, steps, lintels, sills, etc., and flags and curbs for sidewalks. The chief markets are at Indianapolis, Cincinnati, Terre Haute and Chicago, where it rivals the Joliet stone. The demand for flag and curb stone is extensive, and the supply inexhaustible. The dimension stones are very generally used in Ohio and Indiana for jails.

Section in Lowe's Quarry.

Chert and slope, Niagara.....	2 ft.	00 in.
Rubble, four to eight inch bed.....	12	00
"Milk Trough" ledge.....	1	8
Flag.....	00	4
White dimension stone.....	1	00
White dimension stone.....	00	9
White dimension stone.....	2	00
White dimension stone.....	1	00
White dimension stone.....	00	11
White dimension stone.....	1	2
Flag.....	00	5
Light gray dimension stone.....	1	6
Light gray dimension stone.....	3	4

Flag.....	00 ft.	7 in.
Dark blue limestone.....	1	8
Blue laminated—splits to flags; eight feet below bed of river.....	1	6
Total	29 ft.	10 in.

According to General Gilmore's experiments for the State House Commissioners, one cubic foot of the whitish gray, close-grained stone, will weigh 168.09 pounds; crushing strength of a cubic inch, 16,000; ratio of absorption, 1 to 336. The following is the analysis published in Geological Survey of Indiana, 1878, page 91:

ANALYSIS.

	<i>Per Cent.</i>
Water, dried at 212° F.....	0.60
Insoluble silicates.....	5.10
Ferric oxide.....	1.00
Alumina.....	2.40
Lime (equals carbonate of lime, 82.71).....	46.42
Magnesia.....	3.00
Carbonic acid.....	39.78
Sulphuric acid.....	0.80
Chloride of alkalies.....	0.50
Loss and undetermined.....	0.40
Total.....	100.00

This analysis shows a greater per cent. of carbonate of lime than the Harris City stone, otherwise the two are very much alike. The Lowe & Co. stone shows the lowest ratio of absorption—that is, it will absorb the least water.

Messrs. Lowe & Co. have erected a number of neat cottages on their premises for the accommodation of those employed in the quarry, and, with blacksmith shop, office and telephone, presents the appearance of a smart village. At the time of my visit the company were getting out stone to fill an order for jail flagging.

The following section is introduced to show the relation of the Niagara group to the overlying Corniferous stone of the Devonian age, in the northeast portion of the county.

*Section at Railroad Crossing Over Flat Rock River, East St. Paul,
Adams Township.*

Soil, Drift clay and gravel.....	00 ft.	00 in.
Corniferous limestone, lower division.....	2	00
Waldron shale fossil bed, Niagara group, weath- ered	6	00
Rubble and flag mixed with chert, some of the strata five and six inches thick.....	15	00
Dimension stone.....	2	6
Dimension stone.....	2	6
Dimension stone.....	2	6
Dimension stone.....	2	00
Dimension stone.....	3	00
Total	35 ft.	6 in.

It is an interesting question, how much lower the quarry-stone may reach on Flat Rock than is indicated by the sections given above. The "blue, laminated" (stone) that "splits to flags, eight feet below the bed of the river," of Prof. Collett's section, in the Lowe quarry, has all the characters of the Lower Niagara flags and shale, and I think this will be found to be the geological horizon of this bed. If my supposition is correct, no very valuable stone will be found below the "blue, laminated" stone, and six or eight feet lower, would reach the Lower Silurian.

The principal locality for Waldron shale fossils, is on Mill creek, east of Floyd's mill, and would be visited more than it is by collectors if other good localities were not close by, in Shelby county.

Section at Milford Bridge, Clifty Creek, Clay Township.

Corniferous limestone, lower division weathered to wedge-shaped pieces.....	7 ft.	00 in.
Calcareous, Waldron shale, fossiliferous, weath- ered to a light-buff, Niagara group.....	1	1
Rubble, irregular in bedding, Niagara group.....	00	5
Rubble, irregular in bedding, and cherty.....	00	3
Rubble, irregular in bedding.....	00	3
Rubble, irregular in bedding.....	00	4

Rubble, irregular in bedding.....	1 ft.	3 in.
Dimension stone, irregular in bedding.....	00	9
Dimension stone, irregular in bedding.....	1	2
Dimension stone, irregular in bedding.....	2	00
To bottom of Clifty creek.....	1	3
Total.....	15 ft.	9 in.

It is said that a very superior stone was taken from the bed of the creek near where the above section was made, several years ago, by Prof. R. T. Brown, who exhibited the specimen at the Indiana State Fair, where it attracted attention as the premium stone. If the same rule applies here that does at St. Paul, fifteen feet of the top members of the Niagara limestone, as seen above, will be found irregular in bedding and more or less mixed with chert, and the best stone at a lower level. A few yards below the Milford bridge the lower division of the Corniferous limestone is exposed in an abrupt bluff, more than thirty feet high, and bold escarpments of the stone are the rule in the creek bank below the town.

Section at C., H. & G. Railroad Bridge, Clifty Creek, Clay Township.

Slope covered, estimated.....	20 ft.	00 in.
Corniferous limestone, lower division, weathered to a rotten stone of sandy appearance, fossiliferous.....	4	00
Corniferous limestone, with calcite nodules.....	1	5
Corniferous limestone, no fossils, heavy bedded....	2	5
Calcareous, Niagara group, Waldron shale, no fossils.....	3	00
Bridge stone, cherty, Niagara group.....	1	8
Bridge stone, cherty.....	1	6
Bridge stone, cherty.....	0	10
Bridge stone, cherty.....	2	00
Bridge stone, cherty.....	1	10
Niagara limestone, cherty to bed of creek.....	7	6
Total.....	46 ft.	2 in.

The Corniferous group stone at this place presents a very characteristic appearance for all of the Clifty creek outcrops and the whole of Clay township. The quarrymen insisted that it was a sandstone. Not a fossil was found in the shale, nor could anything but fragments be found in the outcrop seen in the ravine east of the quarry. The Niagara stone is tolerably even bedded, but close and difficult to get out in regular blocks. Like all the top members of the group in this vicinity on Clifty creek, it is more or less cherty, but is a very good heavy stone for bridge and similar work. Better stone can be found under the bed of the creek.

Section at Mrs. Eva Eck's Lime Kiln, Adams, Clay Township.

Soil and covered space, thin.....	00 ft.	00 in.
Buff magnesian limestone, lower division of the Corniferous group, in ledges from four to fifteen inches thick, fossiliferous.....	10	00
Darker colored magnesian stone, in similar ledges.....	4	00
To bed of Clifty creek.....	4	00
Niagara group, in the creek.....	00	00
Total.....	18 ft.	00 in.

The stone from this quarry is burned to lime in a "perpetual kiln" of 300 bushels capacity, per day, and makes a white, "cool" lime that finds a very ready sale.

The Niagara group limestone has been quarried, some little, from the bed of Clifty, near the town of Adams, but not in quantities to show the quality of the stone.

In the northwest part of Jackson township, on Fall Fork and Middle Fork creeks, there is an outcrop, in considerable force, of massive, heavy bedded, magnesian stone, lower division of the Corniferous group. In places on Middle Fork, the Corniferous is cherty, and, just west of the county line, silicious masses of corals and bryozoa, a variety of "buhstone," are found. Heavy outcrops of Lower Corniferous were also seen in the bed and banks of Wyalosing creek, due west of Westport.

QUARTERNARY AGE.

DRIFT PERIOD.

From the close of the Corniferous to the Drift period, many pages of the geological record are wanting. What the condition of the country embraced in Decatur county was, during these long ages, is mere speculation, more than that it was dry land, subject to all the vicissitudes of climate that prevail at this day. It is reasonable to suppose that the rains, alternations of heat and cold, and other atmospheric influences, were slowly wearing away the rocky face of the land and cutting primitive valleys, that have grown, under more modern forces, to their present proportions, and it is not presuming too much to say that the valley of the Great Miami and the Collett Glacial River valley had a pre-glacial existence. Their extent was greatly increased during the Drift period, and is gradually increasing and changing shape at this day.

Except a little *recent* earth on the creeks and over the low lands, that were swamps until drained, all the complex material of loose stones, pebbles, gravel, sand and clay, found overlying the native bed rocks of the county, is of drift origin, and belongs to the Drift period. That the Drift material is not a confused mixture, like the dump of a quarry, but arranged in some sort of order, is manifest to the most careless observer. Every one who has passed over the county has noted the difference in the appearance and composition of the white clay lands of the "flat woods," and the yellow clay and gravel soil on the west, and the varying proportions in which these latter are combined, and their relations the one to the other. A typical section of the Drift, showing the general relations, was seen and measured in a well, near the county line, in the neighborhood of Hartsville. These actual measurements represent an ideal section of the various layers of clay and gravel considered in orderly succession.

Section in James T. Galbraith's Well.

Soil, mixed with very little gravel.....	2 ft.	00 in.
Yellow clay, with gravel and small angular bowlders	15	00
Black carbonaceous soil, with timber.....	2	00
Blue bowlder clay, mixed with gravel near the top, and very tenacious and plastic at the bottom.....	5	00
Corniferous group limestone	4	00
Total.....	26	00

Of course, it is not to be expected that every well in the county, that even reaches down to the bed rock, will show all the four strata seen in Mr. Galbraith's well some one or more may be wanting, but the order in which they occur is never changed; blue bowlder clay never overlies yellow clay.

The blue bowlder clay is the most generally present of any member of the Drift series, and covers the bed rocks of the whole county, except where it has been removed by the action of forces that have operated since the close of the first chapter in the history of the Drift period. It is exposed in the bluff banks of Fall Fork, Middle Fork and Dry Fork creeks, where the overlying yellow clay and gravel are thin in the north part of Jackson and south part of Clay townships, and in the vicinity of Westport. The blue bowlder clay, weathered and altered in appearance by exposure to atmospheric influences, is the surface soil of the "flat woods." The western boundary of the white clay lands of the "flat woods," may be roughly indicated by a line drawn from the east of Clarksburg, to the head of Cobb's Fork of Sand creek, thence south with Cobb's Fork to the vicinity of Westport. All of the county east and south of this boundary line is blue bowlder clay changed to a grayish white and less retentive of moisture. I am aware that the white clay of Southeastern Indiana, especially of Jefferson and Jennings counties has been referred to another epoch than the Glacial, but, to my mind, the proof is satisfactory of the identity of the *blue clay*, found under the yellow clay and gravel all over the county, and the surface *white clay* of the "flat woods," so far as concern Decatur county; and I come to this conclusion without raising the question as to what may be the

case elsewhere. In riding from Kingston to Mechanicsburg, with Mr. T. L. Donnell, he said: "Between here and Mechanicsburg I will show you where you can stand with one foot on land as poor as Lazarus, and the other on land as good as any in the State." On reaching the place indicated, the sharp line of juncture was marked by a low ridge of yellow clay and gravel, that could be traced with the eye for nearly a mile in each direction. *This ridge rests on the so-called white clay;* and the language of Mr. Donnell is quoted to show that this, being the case, is a matter of common observation. West of Westport, in a shallow valley, the road has cut through fifteen inches of yellow clay and gravel, and three or more feet of blue clay; a short distance east the gravelly layer is wholly wanting. The blue and white clays are identical in physical make-up, except where gravel has been added by the same forces that covered it with yellow clay, and in chemical composition they are the same, under similar conditions. The boulder clay is of much more frequent occurrence in the east part of Bartholomew county, than is indicated by my report on that county, Indiana Geology and Natural History, 1881. It is made up of sand, gravel, pebbles and clay, mixed with bowlders of northern origin. In proportion to the whole mass, the clay largely exceeds all the other materials. Where protected by the yellow clay its color is blue or drab, where exposed, weathered to a grayish white. The difference in color is due to the action of the oxygen of the air on one of its constituents, the oxide of iron. In the "flat woods" the top is free from gravel. In Messrs. T. C. Doles & Brothers' tile pit, near Smith's Crossing, seven or eight feet down in a soft, blue clay, is seen a little gravel, and about twenty per cent. of sand, not enough, however, to prevent its making good tile; and water-washed and worn gravel is generally found in digging wells, from eight to thirty feet below the surface. When covered with yellow clay, and the top has been disturbed, the color is a little lighter blue, and the proportion of gravel increased near the line of juncture, but the true strata may be readily distinguished, the one from the other. The consistency is very different; the blue clay is a uniform, sticky, plastic, wet mass, nearly impervious to water, the equivalent of the "tile" of the English geologist, and when dry a veritable "hard-pan." The yellow clay is easily exca-

vated, wet or dry, and freed from moisture, is very friable. Boulders are seldom found, and never of large size. The only polished and striated stone that I have seen, found in either Decatur or Bartholomew counties, was taken from the blue clay bed of a well. Beds and lenticular masses of sand are not infrequent, and are the water-bearing strata.

The black soil bed is generally present where the boulder clay and the yellow clay form a junction. It has never been reported as occurring in or under the blue boulder clay, or its equivalent, the white clay of the "flat woods." * Mr. Frank Galbraith, an intelligent observer, who has dug eleven wells in the west part of Clay township, reports the succession to be: soil, yellow clay and gravel, black soil, frequently with buried timber, and blue clay. Mr. Enos Woodruff, in sinking two wells in the north part of Jackson township, reports the same strata. Mr. James Banister, of Alert, has dug four wells and found the black soil in all, and timber in a part of them. Buried timber is generally found in sinking wells about Newburg, on Sand creek, and in the vicinity of Clarksburg. The finding of buried timber several feet below the surface, is a phenomenon so striking to the average mind, that inquiry develops the fact, in all neighborhoods where the yellow clay is not replaced by sand or gravel; and frequent as the finding of timber may be, it is not nearly so often noted as the more frequent occurrence of the black soil. In thickness it ranges from two to eight feet, most usually about two feet. In physical appearance it more nearly resembles the blue boulder clay, and where it has apparently been disturbed, at some time in its history, is mixed with gravel. Its depth below the surface ranges from fifteen to thirty-six feet.

The yellow clay stratum is a heterogeneous mixture of clay, sand, gravel, pebbles and boulders, and forms the surface soil or subsoil of the central and western portions of the county. It is not uniform in composition; the relative proportion of its materials vary within a few feet. In general, the clay elements exceed all the others and is much less retentive of moisture than the blue boulder clay, but not so pervious as native clays. The proportion of sand is largely increased over Jackson and Sand Creek township, and locally over the south part of Clay township, where it occasionally replaces the clay down to the

bed rock, and when water bearing, is a quicksand. Beds and ridges of gravel mixed with clay are common, but beds of good road material are only found in the northwest part of Jackson township and in Clay, Adams and Clinton townships. A remarkable bed of gravel, is that on Big Flat Rock river. Commencing just below the confluence of Little Flat Rock creek with the river, it occupies an area one mile wide by three long, on the east bank of Big Flat. It lies in the fork of the streams, except at the lower end, where it is cut across by both the river and the creek. It is said that this bed of gravel, spread out and mixed with yellow clay, reaches into Rush county, and is known as a great wheat growing belt. In Decatur county, the bed in surface appearance and internal make up is identical with the Haw Patch gravel, of Bartholomew county, except that here it is known to rest on the bowlder clay, and occupies a higher level above the neighboring streams. The top of the bed is fifteen feet below the general level of the country, and forty-five feet above the bottom of the river. Where cut by the creek and river, it is bounded by bold steep bluffs. Another small bed of gravel of similar, if not identical, appearance is that seen between Middle Fork and Fall Fork creeks, near the county line. An excavation in the bank of one of these latter beds, shows gravel mixed with the soil at the top and finer gravel below until a quicksand is reached, all arranged in tolerably uniform, and nearly horizontal strata, as if deposited under running water. At the foot of the Flat Rock gravel, great quantities of pebbles, rounded and angular bowlders, with pieces of limestone derived from the Niagara and Corniferous groups, were seen piled up in a confused mass.

In the southeast quarter of section 8, township 10, range 8, commences an upland, "hogs-back," of gravel, that can be traced in a continuous ridge to the Clifty Creek valley. North of the creek it is continued in gravel hills and ridges beyond the Shelby county line. Its total length is near four miles, and fades into the yellow clay at each end. Its course is a little east of north. At the south end it has the width and much the appearance of a gravel road, and was used as such in the early history of the county. On each side of the ridge the soil is free from gravel, black and swampy. North of Clifty creek, on the farms of Mr. Ed. Marshal and Mr. John P. Elliott, the

ridge is cut into hills or mounds. Two of these mounds were examined where excavations had been made for road material. The stratification lacks the regularity of the Haw Patch or Adams township beds. No two sections, even when taken within a few feet, will represent the same succession of strata and materials. The sand sometimes lies in heavy deposits, several feet thick, the strata running in curved lines and vanishing layers at an angle of several degrees to the horizon. Sudden changes from sand to gravel occur, or the gravel may be replaced by pure sand without signs of stratification. Again, pockets of bowlders are found in such size and quantity as to spoil the gravel for use on the roads. These collections of bowlders are in confused piles, without stratification or other evidence of orderly arrangement. The whole mixture below the surface soil is free from clay, and shows the stratification most, if at all, where the gravel is of medium size. The layers are thin, ranging from one to five inches, and seldom reaching the last figure. The largest per cent. of the materials in the upland beds and mixed with the yellow clay is metamorphic sand, gravel and bowlders, derived from the Huronian and Laurentian hills north of the great lakes; the remainder is made up of chert and hard fragments weathered from the Niagara and Corniferous limestones. Especially are the Corniferous group corals common. It is very probable that a large per cent. of these corals are of Canadian origin.

The yellow clay bowlders are much more frequently found than those of the blue clay; they are of larger size, less worn and more angular. Representatives are found, of nearly all the primitive rocks; the most common are varieties of granite, gneiss, mica schist, greenstone, hornblende and diorite. They are most numerous along the west boundary line of the county, where they lie on the surface, or but partially buried in the soil. East and south of Clay and Adams townships, large bowlders are rare.

Yellow sand or moulders' sand in beds, have not been seen, but banks of washed sand on the creeks are common. Lenticular beds are found in digging wells in the yellow clay, and are frequently water-bearing.

In thickness the yellow clay is heaviest in Washington, Clinton and Adams townships, where the average is about twenty-

five feet; in the south part of Clay, and over the whole of Jackson townships it grows thinner, and the per cent. of gravel is gradually diminished and the sand increased.

The soil of Decatur county is mainly of foreign origin, that is not due to the disintegration of the native stones and shales, and is largely modified by the blue boulder or yellow clay on which it rests. The close of the Drift period left a barren waste of dry land, that time, "the avenger of all things," through the influence of climate, air, water and other forces, has brought to its present state of fertility. That plants and animals have been important factors in forming a soil over the clay beds, has been pointed out by Prof. Wm. Orton, and especially have the influences of earth-worms been studied and described by the late Mr. Charles Darwin. The work of the ant, crawfish and burrowing beetles, was supplemented and protected from the wash of the rains, as soon as the clay was covered by vegetation, however scanty it may have been; and in the case of the yellow clay, this must have been very soon, judging from what is seen when the subsoil is now exposed, and plants at once take root and grow. Doubtless these insignificant workers and the plants, brought to the surface clay and the soluble, chemical compounds, and left the pebbles and coarse sand below; hence, in time, a clay or loam soil, free from gravel. Taking this view of their work, the much despised earthworms and crawfish, as benefactors of the race, deserve more consideration at the hands of man, than to be ruthlessly murdered for fish bait. The low, black, burr oak soil of Clay and Jackson townships, and to a still more limited extent of other townships, was formed under swamps, and has been increased by the wash and sediment of the water that has flowed over it. Over the pure gravel beds, it is probable that the soil was mainly formed through the instrumentality of plants, and the result is a soil of the greatest fertility, with but a slight admixture of clay. The white clay soil of the "flat woods," the black, burr oak soil, and, in fact, all soils of the county, just in proportion as the clay exceeds the gravel, require underdrainage; except on the swampy lands, the amount of the subsoil mixed with the surface, determines the character and appearance of the soil.

RECENT PERIOD.

This period includes all the various sediments of running water, earth, sand and gravel, that are known as alluvial deposits, and forming at the present day. In consequence of the absence of important water courses the deposit forms but a moiety of the clay or earth of Decatur county, and is here referred to only to complete the history. Attention is invited to the fact that the increased facilities for the drainage of the country renders the streams more liable to overflows, and consequently greater modification of existing deposits than was formerly the case.

ECONOMIC GEOLOGY.

AGRICULTURE.

The yellow clay soils have in them untold possibilities. I was shown a productive field on Little Flat Rock creek that had been planted to corn for fifty years, without change or rest, until last year. The crop reports for 1882 show that Decatur is one of the three largest corn-growing counties south of Central Indiana, and well up in all the other farm products. An exhausted yellow clay soil can be readily brought back to fertility, and fertilizers yield a big profit on the investment. The sub-soil contains all the chemical elements of fertility, and once brought to the surface is within itself productive, hence this kind of a soil never can be wholly exhausted.

The white clay soil of the weathered boulder clay, is too close and compact to be a very certain soil in all seasons, wet or dry, without extensive artificial drainage. These lands have been occupied principally by thrifty Germans, and it is astonishing what they already have accomplished in the way of farming. Once thoroughly drained, this soil produces excellent crops of wheat, corn and grass.

BUILDING STONE.

The vast importance of the quarry interest, and its bearing on the present and future wealth of Decatur county, can not be overestimated. I have already attempted to show its magnitude at this day, and its potentialities for the future. No county in the State can compare in the amount of Niagara limestone exposed, the ease with which it can be quarried, its strength and uniformity of texture. The supply is inexhaustible; thousands of acres of merchantable stone twenty-five feet thick, covered only with a thin soil, await development against the eighteen or twenty acres that have been removed. The demand is for all kinds of stone for architectural use, from the foundation to the coping, and for heavy masonry can not be superceded. At present the supply and demand are equal, and no stone is left over in the yards. Orders that can not be filled with available stone, without much stripping, are sent to other firms, and the ledges in sight disposed of first. The stone comes from the quarry with the top and bed ready for use, and in consequence of the absence of vertical seams or faults, can be had in length and width far beyond the possibilities of transportation.

LIME.

The buff magnesian limestone of the lower division of the Corniferous group, within the last few years, has attracted attention as a lime rock. Its very appearance was against it, and caused it to be passed by until tested, when it was found to make a beautiful white lime, that is rapidly growing in favor with masons and plasterers. At Greensburg, the locally harder portion of the bed is burned; at Adams, the softer, spongy stone. All the members of the Corniferous group below the North Vernon stone, make what is known as "lean," or "cool," lime. This is due to the stone containing a greater per cent. of magnesia and alumina than the Niagara limestone, that produces a "fat," or "hot," lime, that slacks quickly. The "cool" lime slacks slowly, runs smoothly under the trowel, and does not "chip-crack," like most of the "hot" lime plastering. When used in mortar it partakes more of the character of a hydraulic cement than the "hot" lime, and in time becomes

harder than brick. The Niagara limestone makes a first-class, strong lime, and for certain purposes, as purifying gas, can not be superceded. Decatur county has an abundance of stone, easy of access for the manufacturer, of either variety.

BRICK AND TILE.

The weathered white clay of the "flat woods," is a first-class brick or tile clay. The principal tile factories that came to my notice were those of Mr. Wm. M. Hamilton, at Clarksburg; Isaac Deilkes, Glidewell & Martin, and J. T. Doles & Brothers, near Smith's Crossing. The Messrs. Doles have the largest factory in the county. They use steam as the motive power, employ eight men, and have a kiln capacity of 18,000 tile. The capacity of the other kilns is about 10,000 at a burn. The product of the factories is sold in the yard. The other surface clays of the county, where free from gravel, and not too calcareous, make the best of tile and brick. In short, the rule is to burn the brick near where wanted, out of the clay found in the vicinity.

SAND.

The washed river and creek sand, especially of the west part of the county, is in high repute with builders for all kinds of work. It is said that the clean white sand of Sand creek, east of Greensburg, has been used for making glass in the New Albany factory. With its inexhaustible beds of the very best building stone, unrivaled brick clay, superior limerock and sand, Decatur county is destined in a near day to take rank as the stone, brick and lime "Newcastle" of the Ohio valley.

FRUIT.

All the orchard and small fruits are grown. The apple does well on the yellow clay soil for a few years; but seems to be short lived. This trouble might be remedied by more care in selecting varieties that have proved hardy, not only in this latitude, but on *this* soil. It is a well known fact to any person who has paid attention to botany, that certain forest trees are found on a peculiar soil, adapted to their growth. The sugar

maple does best, and is common on a limestone soil or ledge, the sweet gum and persimmon flourish on the compact, impervious clays; and it is reasonable to suppose that the same may be true of the different varieties of the apple. An apple is an apple, but a wild crab is not a Rome beauty. Peaches are too uncertain a crop, except for domestic use. Pears, plums and cherries do well. Grapes have not been tested beyond a home supply; but as the northern fox grape, *Vitis labrusca*, L., grows wild, luxuriantly, on the white clay lands in the neighborhood of Millhousen and Westport, it is more than probable that its cultivated varieties, the Isabella, Catawba, Concord and others could be very successfully grown.

WATER SUPPLY.

In sinking wells an uncertain supply of water may be struck in the sand seams of any of the clays. The veins found in the blue clay are the stronger, but are liable to fail in seasons of drought. A certain supply is found a few feet below the surface of the stone in about one-half the wells dug. Springs are not common, and driven wells infrequent. The Niagara shales are generally water-bearing. It is not all water which is "clear as a crystal" and cold that is free from pollution. The greatest safety is in deep wells, sunk where there is no possibility of contamination from surface drainage, or soakage from the barn yard, or other outbuildings. Recent investigations in sanitary science have rendered it very probable, to say the least, that typhoid and the so-called typho-malarial fever have their origin in contaminated drinking water. This being true, typhoid is essentially a preventable disease, and can be prevented by using only potable water for all purposes. No well is safe that does not go into, or rather below, the blue clay.

ARCHÆOLOGY.

Mr. Geo. H. Dunn, postmaster, Mr. Jos. Davidson and Prof. L. H. Marshall, of Greensburg, have paid special attention to the antiquities of the county, and have made fine collections. Some of their specimens are very rare and can not be duplicated. Professor Marshall, at my request, has prepared the following account of the Indian relics, etc.:

The archæology or antiquities of Decatur county furnish the archæologist or collector of relics a prolific and very interesting field of observation. The earthworks, in the form of mounds, are neither numerous or large, but the surface relics or antiquities, such as stone and flint implements, are abundant.

To locate and describe the most important mounds of this county, time and space prevent, and no correct or adequate conception of the rare antiquities, implements or emblems, can be formed without the aid of cuts or plates. The mounds, so far as my observation extends, are found chiefly along the water-courses which flow through the county, of which Flat Rock and Clifty are the principal ones, evidently showing that such streams were the favorite and necessary places of resort of the pre-historic people. The mounds are principally burial mounds, as skeletons or bones are found in most of them, which crumble readily upon exposure to the atmosphere. And I regret to say, that in the excavation of some of these mounds by our worthy and esteemed fellow-townsmen, Messrs. Geo. H. Dunn and Jas. Davidson, with myself, disclosed the fact that these mounds had been previously disturbed, by unskilled and ignorant curiosity seekers, other than ourselves, as the bones were usually found by us thrown back together in a promiscuous mass, without observing the surroundings or developments made, or even preserving the few relics found therein. That these mounds are artificial, we have abundant and conclusive evidence, as a diversity of soil, stone vaults, shells, coals, ashes, beads, wristlets, also pottery, and fragments of the same, have been found in them, but unfortunately, these last mentioned came into the possession of non-residents of the county.

From a mound on a high, plateau-like tract of land, on the farm of the Shellhorn estate, near the junction of Little with Big Flat Rock, was found by Messrs. Dunn, Davidson and myself, a large and remarkable sea shell (*Busacon peruersum*), thirteen inches or more in length, capable of holding probably a half gallon of liquid. The whorl or volutions, running the unusual way, to the left, two small holes, one at each end, are perforated, probably serving the purpose of carrying it, by means of a cord, suspended from the opposite shoulder. This rare specimen forms a part of Mr. Dunn's collection. Of the surface relics, stone axes, chisels, pestles, fleshers, gouges, flint arrows and spear points, have been found rather plentifully; rare slate specimens, such as pipes, emblems, medicine tubes, shuttles, etc., have been found, also one slate axe. All of which no written history has been transmitted to us, to enlighten us as to the use of these mysterious emblems and implements by the people who have long since passed away. Highly polished chisels, a very peculiar gouge, sharp, concave on one side, and convex on the other, and the most perfect canoe-shaped shuttle, with a number of other peculiar and interesting relics, constitute a part of Decatur county antiquities. The arrow and spear points, embracing all the unique forms of flint, quartz and carnelian, are found throughout the county in abundance.

The pestles, axes, fleshers, chisels, gouges, etc., are principally of gray-stone, green-stone and granite. The emblems are chiefly of blue or striped slate (diorite?), very highly polished. In the locality of New Point, I am informed, was found earth-works, evidently once a well-planned town or village, evincing a civilization and intelligence far superior to the modern Indian. Of the more modern Indian antiquities we have but few; perhaps my own cabinet will comprehend nearly all of any importance.

L. H. MARSHALL.

December, 1882.

THANKS.

I am under obligations, and hereby return thanks to all with whom I came in contact in the prosecution of my work. I am under especial obligations for favors and information to Messrs. Geo. H. Dunn, Jo. Davidson, Jos. Drake, S. S. Anderson,

civil engineer, and Prof. L. H. Marshall, of Greensburg. I am indebted to Mr. Anderson for railroad and other elevations, and to Professor Marshall for the foregoing account of the antiquities of the county, which have been kindly furnished "without money and without price." To Mr. T. L. Donnell, of Kingston, whose hospitality I enjoyed for three days, who kindly furnished the conveyance and went with me to places that otherwise I would have been unable to reach; to Mr. C. A. Hamilton and Prof. E. A. Allen, of Kingston; Mr. T. C. Doles, of Smith's Crossing; Mr. John Shellhorn, of Adams township; Mr. Jenkins, druggist, of St. Paul; Mr. Isaac Vansickle, of Hartsville, and to Mr. Geo. K. Greene, of the State Geological Rooms, for identifying and naming the Lower Silurian and Clinton group fossils.