

## GEOLOGY OF JAY COUNTY.

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### LOCATION AND HISTORY.

Jay county was settled in 1833, and organized as a county in 1836, taking its name from John Jay, first Chief Justice of the United States.

Its eastern boundary is the State of Ohio, having Randolph county on the south, and adjoined to the westward by Delaware and Blackford counties, with Adams on the north.

In area it comprises about four hundred square miles, or nearly 260,000 acres of land.

The population in 1840 was but 3,863. The last census (1880) enumerates 19,281. The rapid increase of the last two years would probably raise the number considerably above 20,000.

In material development Jay county has been very much retarded, owing to no natural disadvantage, but mainly because of her isolation commercially. The intelligence and energy of the citizens has been constantly hampered by the absence of facilities for transportation.

Until within ten or twelve years they have had no connection with the railroad system of the West.

No less than three roads had been projected and partially built many years ago. Some of them were lines of importance, but all were abandoned after much work in grading had been done. It is probable that present enterprise will take possession of two of the old grades, as they are well preserved.

Three railroads now traverse the county. The P. C. St. L. (branch of the Pennsylvania Railroad), crosses the southwest corner of the county, passing through the thriving towns of Redkey and Dunkirk.

The Lake Erie & Western Railroad enters the county at the southwest corner, going northeast to Portland, thence eastward across the centre of the county.

The Grand Rapids and Indiana R. R., passes through the county from north to south, crossing the Lake Erie and Western at Portland.

Portland, the flourishing county seat, is rapidly becoming quite a business centre, having direct communication with Ft. Wayne, Richmond, Toledo and Indianapolis. All branches of trade are well represented, and on every side energy and enterprise manifest, in the erection of large business blocks, factories, elevators, mills and many beautiful residences.

One or two new railroads are now under projection, one being proposed, and the right of way granted, that will penetrate the county from the northwest to the southeast, entering Jay county at Camden, running from Bulffton to Union City. This will give the county a perfect net-work of railroads, and their number will atone for the isolation of the past, in which of necessity the vast resources of this county were but partially developed.

These are now opened up, and energy and enterprise are quickened and stimulated on every hand, giving promise of future prosperity that will make Jay the peer of any county in Indiana. It now possesses all the elements of commercial progress, an intelligent, hopeful citizenship, a soil of great fertility, and railroad connection with the great trade centers.

#### SURFACE FEATURES.

Generally speaking, Jay county is a portion of the north-western slope of the great water-shed lying between the Ohio river and the great lakes.

In surface configuration it is quite similar to the remainder of this great plateau region; especially is there a similarity of appearance with the localities eastward in Ohio, bearing the same relation to the great water-shed.

The Ohio counties adjoining to the east all have the gently rolling and undulating surface that characterizes Jay county.

The drainage of the county is mainly to the northwest, though the high ridge traversing the southern portion of the

county forms a water-shed, sending a number of small streams southward to the Mississinewa, and eastward to the headwaters of the Wabash in Ohio. The streams are all quite small, the Salamonie being the largest.

The Wabash barely touches the county at the northeast corner, flowing off to the northwest through Adams county. As a rule the streams have shallow channels, flowing with sluggish currents through level alluvial valleys. In certain localities, however, they have excavated deep channels through barriers of bowlder clay, presenting rocky bottoms flanked by bluffs with bold escarpment.

The whole central part of the county is a broad plain, of very level alluvial land, underlaid locally with unstratified blue clay, with occasional shallow deposits of sand and gravel. Fine sand exists locally in the clay, though the beds are irregular and not persistent.

Through this broad plain winds the Salamonie, with a general course from southeast to northwest, occupying the geographical centre of the county, comprising more than half of its area, embracing all of Noble, Wayne and Green townships, and including large portions of Penn, Knox and Pike townships. Its tributaries are all small brooks, finding their way from the elevated regions lying southward and northward. In Jackson, Bear Creek, and Wabash townships, the streams are all tributaries to the Wabash, the three largest being Wolf creek, Bear creek and Limber Lost.

The great central plain of the county is flanked on the south by an elevated ridge extending east and west across nearly the whole southern part of the county. It distinctly traverses Madison, Pike and Jefferson townships, gradually sloping off into a level plain in the western part of Jefferson township. It is locally known as the "Lost Mountain." It nowhere approximates to abruptness in appearance, but nevertheless the outline of highest elevation is very perceptible.

The Grand Rapids & Indiana Railroad crosses its summit below Hudson Station, at a grade of seventy-five feet to the mile, and that with a very deep cut into the crest of the ridge.

It is a mighty mass of glacial material, apparently heaped up against the Niagara rocks that crop out in force at Ridgeville.

This morainic material is, on an average, more than one hundred feet thick, reaching in certain localities a possible thickness of two hundred feet.

At New Mt. Pleasant, in Jefferson township, a well was dug to a depth of 108 feet without finding water or reaching the limestone. At other points eastward, deep wells have never passed through the clay, showing that this ridge is not caused by an elevation of the limestone, but that it is a mass of unstratified drift resting upon the Niagara rock.

It appears to be for the most part a mass of heavy boulder clay, with only local and irregular deposits of sand. On the outcrop at Ridgeville the elevation is 993 feet above the sea. Four miles north the railroad crosses the summit at an elevation of 1,053 feet, or 480 feet above Lake Erie. Six miles north of this summit, in the bed of the Salamonie, the limestone appears at an elevation of but 882 feet above the sea, being 111 feet below the level at Ridgeville, and 171 feet below the summit of the ridge. The general dip of the limestone at both points is northward, and the strata are apparently quite equivalent, thus giving the formation a descent of eleven feet to the mile to the north. There being no marked evidence of extensive erosion, we conclude that this extended elevated ridge is a morainic mass resting against the northern slope of the Niagara formation. Considering the position and arrangement of this ridge, the absence of gravel deposits in its mass, and its extension as a ridge of clay entirely across the county, we consider it one of a series of terminal moraines marking the path of the retreating glacier.

Eastward from Hudson Station it becomes gradually higher, and at a point observed in section 21, in Madison township, we judged it to be over 1,100 feet above the sea, and more than 500 feet above Lake Erie. Its surface, generally, is quite unbroken, though the southeast part of Madison township was quite hilly. Over portions of Pike township, large boulders are numerous distributed, most of them crystalline metamorphic rocks. In several places large masses of Devonian limestones were observed full of characteristic fossils.

To the northwest of the plain of the Salamonie lies another great barrier of boulder clay, not so marked in its outline as the southern ridge, yet clearly enough defined to exhibit a marked

parallelism. Its general course is from northwest to southeast, extending as a summit region along a line lying generally a little south of the line of the northern tier of townships, except in the western part, where the eroded valley of the Salamonie alters the outline of surface.

The elevation at no point is as great as that of Southern ridge. The Grand Rapids Railroad crosses it, five miles north of Portland, at an elevation of 955 feet above ocean level or 382 feet above Lake Erie. Localities westward in Penn township, are evidently somewhat higher.

The clays of this region are very thick and heavy. Where they have been undisturbed there is but little sand or gravel. The gravel beds are local deposits, lying invariably above the blue clay, and of later origin.

The great underlying mass in both ridges is an unstratified mass of blue clay, varying little in general characteristics.

The northern ridge gradually slopes off toward the Wabash, its gentle descent giving course to a number of small streams. In the northern part of Jackson township exists a marshy region, locally known as the "Loblolly." It is from one to two miles wide, and is about five miles long. It extends from the Adams county line, in a southwest direction, ending about section 17, Jackson township. Southwest of this point is a succession of ridges of sand and gravel, gradually thinning out toward Camden.

Continuous with the "Loblolly" basin, a broad channel passes through this region of ridges, along the line of "Haines' Ditch," passing southward into Blackford county, through the broad, low prairie lying northwest of Camden, comprising portions of several sections.

The northwest part of Penn township is high and rolling, as is observed in the region of Balbec, in section 15.

From this general survey, the whole surface configuration of Jay county is outlined by the deposition of glacial detritus forming a moraine in the southern part, and a similar, but smaller one in the northern part. The southern one has been subject to no rearrangement of its material, but the northern one has been altered by a subsequent modification in past glacial times, in which the later floods reassorted much of its mass,

covering the clays in places with deposits of sand and gravel, an arrangement not observed anywhere on the Southern ridge.

#### GEOLOGY OF THE DRIFT.

The surface features as just described indicate the characteristic phenomena of the Glacial and Fluvatile epochs. Their exhibition is very striking. The arrangement of the clays and gravel beds furnish favorable opportunity for the study of the dynamics of the Great Ice age.

The causes of the Glacial epoch have been discussed fully and ably in many preceding reports. But a few words for the better understanding of what follows by those who have not studied this subject.

The Glacial epoch is a part of the recent period of Geological history. It came on gradually at the close of the Tertiary, a mighty glacier forming in northern latitudes, and as its mass accumulated extended its foot southward, until it terminated finally in the latitude of Cincinnati, its average southern limit being about the 39th parallel of latitude. Various causes are assigned for the formation of such an ice mass. The probability is, that a number of agencies were conjoined in this great work, the most active being the gradual elevation of the region lying northward. Elevation occasions lowered temperature. The evidence for such elevation in this period is convincing.

Deep channels cut in glacial latitudes show such elevation, the depression at the close of the Glacial epoch causing them to fill up with glacial material. The striations on the surface of the rocks in many places show that the great ice mass moved southward with such great volume and depth that it was unhindered in its course by inequalities of surface.

Its weight and motion are the elements giving it great power. Such a mass passing over a rock surface would act as a great plane, tearing up masses of rock, taking them into its own mass, would transfer them to other localities, where its dissolution would deposit them. Our boulders are all these fragmental rocks, none of them being native. Softer material would be ground finer, and in the action of water would distribute itself

in sand bars and gravel beds. The melting of the glacier supplies another agent that acted powerfully in the distribution and arrangement of the drift, namely, great volumes of running water. These sluice-like torrents reassorted and modified many deposits of the glacial detritus, commingling often sand and alluvium preparing the way for future fertility.

In Jay county, the various results of the Glacial period may be satisfactorily studied.

The heavy deposits of unstratified blue clay, its wide belts strewn with bowlders, its ancient channels now filled up, sand and alluvium, all furnish data illustrative of its dynamics.

The whole ridge previously described, known as "Lost Mountain," is a portion of a vast terminal moraine. It is one of a series of such moraines marking the path of the retreating glacier.

The receding glacier as its dissolution went on probably made periodical advances. Each new terminus would make a new moraine. These successive accumulations of detritus would lie as ridges parallel with the southern limit of the glacier. The parallelism of these morainic ridges has been observed in the survey of the western counties of Ohio. They mark periodical resting places of the retreating glacier.

This great ridge is composed entirely of a heavy mass of unstratified boulder clay. There are no deposits of gravel in it.

The ridge forming the water-shed in the northern part of the county is similar in character, and the clays show the same arrangement. Wells have been sunk to a depth of 130 feet, as in section 13, Penn township; in section 32, Jackson township, 80 feet, and at the County Farm, 95 feet. None of these wells passed through the clay. All these points are on a line following the summit approximately. Being nearly centrally located on the water-shed, they all pass through the same heavy clay, and they mark a low morainic ridge quite parallel with the great moraine of "Lost Mountain." Between them lies the broad plain of the Salamonie and its tributaries. It is a depression which fluvial waters did not fill up, though currents of shallow water must have flowed over it in ancient times, partially filling up the great trough between the two morainic masses. It is covered deeply and in wide extent with

alluvial and fluviatile deposits, with local shallow deposits of fine sand and gravel, as seen south of Portland, and, again, in section 5, Noble township, and other points.

The filling up of this valley makes the outline of the moraines less distinct. The city of Portland stands upon a deposit of alluvium, passing through which the blue clay is met locally, but generally the limestone occurs at varying depths.

Over a large portion of Greene and Knox townships this condition prevails. Locally there are patches of white cold clay, probably of sedimentary origin.

Thus the character of the valley now occupied by the Salamonie shows that it was not formed by the excavation of the boulder clay, but that it originally existed as a valley between two great masses of morainic material, and has been partially filled by fluviatile and lacustrine deposits. In the whole plain of the Salamonie there are no evidences of swift currents, but only of gently flowing streams, leaving shoals of fine sand and shallow gravel beds.

The absence of boulders from the valley of the Salamonie throughout the eastern and central part of the county also suggests that this plane does not result from erosion, for where that occurs the eroded channel is left with its bed thickly strewn with boulders. The absence of these sustains the view that the Salamonie has simply chosen its course through a basin between two moraines, which gradually has been filled with fluviatile and organic deposits. These deposits are notable over portions of Noble and Wayne townships.

It is concluded, therefore, that the two heavy clay deposits of the county are two succeeding moraines, and that the present surface configuration of Jay county is outlined by them, though later influences have modified them, introducing new conditions.

These modifications came from surface and mass changes in the moraine itself. The matter composing it naturally solidified, its own weight promoting density, thus lowering its height; and, besides, the action of surface water would also assist in leveling down its summit. Under these influences the outline of a moraine would be modified, and in course of time it would assume the flattened, plateau-like appearance of the "Lost Mountain."



But the most marked changes in morainic material came with the period of greatest recession, when the dissolution of the ice was most rapid, and, consequently, the volume of water greatest and deepest. This produced a great inland fresh-water sea of mighty extent. There is evidence that the elevated water-shed of Ohio and Indiana was at least partially under water during this period. (*Vide* Ohio Survey, Vol. II, p. 47.) This time preceded the establishment of the present system of drainage for the lake region, the waters in that time finding outlets toward the Ohio and Mississippi. The abounding waters found passage-ways through the accumulated ridges of detritus and over the barriers of rock, making sluice-ways that are still distinctly outlined, though many are partially filled up with alluvial deposits.

These superfluous floods are found to have cut their way over summits ranging from 350 to 400 feet above Lake Erie. Newberry mentions five of these ancient channels passing over the present water-sheds, at an average elevation above Lake Erie of about 350 feet. The nearest one of these channels to Indiana is the one passing over the St. Mary's summit, at an elevation of 367 feet above the Lake. It connects the valleys of the Maumee and the Miami. As this same water-shed extended westward into Indiana, the same conditions were undoubtedly continued, and we may expect to find ancient channels in our Indiana summit region. The higher elevation of "Lost Mountain" did not offer as easy a passage-way as the lower moraine northward.

The summit between the Mississinewa and the Salamonie is nearly 100 feet higher, on an average, than that between the Salamonie and the Wabash, the latter being 383 feet, and the former 480. The receding waters in their decline, constantly close the lowest outlet. Their effect is naturally seen on the lowest ridges. The higher ridge shows no such results, being intact and unassorted.

The northern morainic ridge, on the contrary, was cut asunder by the superfluous waters of the Fluvatile epoch, and much of its mass reassorted and modified.

The ancient river entered the county from the northeast, coming in at section four, of Bear Creek township, passing in

a southwest direction, traversing the region known as the "Loblolly," then following the line of "Haines' Ditch," passing out of the county through the prairie northwest of Camden. It probably finds its continuation through Blackford county, with a deflection in its course to the southward. Such a channel is crossed by the railroad four miles southeast of Hartford City. It has been traced southward across Delaware, into Henry county, thence probably into the great valley of "The Collett Glacial river."

This channel is one of very marked features, being in places so distinctly an ancient river bed, that it is known to the inhabitants as the "Lost River." The deposit of alluvium is very deep. The part of this channel known as the "Loblolly" is simply a portion of the old bed that was deeper than the rest, and was not so much filled up. A succession of small lakes, very narrow and deep, extend throughout its whole length. They are simply portions of the old bed that are gradually filling up with organic matter. Some of them are said to have sandy bottoms, with a shore of mucky material. The water has little or no current, moving sluggishly toward the Wabash.

The divide of the waters in this ancient channel is in a shallow pond in section 19, Jackson township. From this point "Haines' Ditch" follows the bed of the old stream, being raised above the ancient bed by alluvial deposits. The ditch has a gentle fall to the Salamonie, winding through this valley as a mere rill, where formerly poured a flood at times two or three miles wide, and perhaps two or three hundred feet deep.

Evidently the waters moved at times with the current of a rushing torrent. This deep channel passes through the barrier of blue clay, striking it in the western part of Jackson township, throwing up masses of sand and gravel into ridges that rise to a height of eighty feet above the *present surface* of the valley, as at "Tusey's Knob," section 24, of Penn township, and the ridges of similar appearance in the adjacent sections 25 and 26. These ridges stand directly in the line of the channel with their axes at right angles with its current. The first of these ridges are steep and abrupt. The succeeding ones to the southwest are gradually lower, and thin out towards Cam-

den, where the gravel and sand are found in deposits from six to ten feet thick, lying on the blue clay. All these deposits of sand and gravel have the usual "flow and plunge" structure, showing in their arrangement the action of water currents flowing at varying rates and depths.

In the higher ridges, as was observed in "Tusey's Knob," the stratification of the material is oblique and irregular; alternating layers of fine sand, and coarse gravel. These ridges are genuine "hog backs." The sides of "Tusey's Knob" are steep, and the summit is very narrow, coming up in places to a very sharp peak, from the top of which is a beautiful view, taking in at a glance the outline of this ancient valley.

North of this series of sand ridges undisturbed morainic material lies as a mighty barrier, having been penetrated to a great depth. In section 13, Penn township, a well was dug to a depth of 130 feet. South of this channel the general shore line is a barrier of unstratified bowlder clay, wells eighty and ninety feet deep not reaching the bottom. Previous to the Fluvial epoch, this morainic mass was continuous throughout the northwest part of the county. The sand ridges are the product of its reassortment. They exhibit the action of strong currents of water dashing over bars and shoals. The channel northeastward was deeper, and its flood striking this clay barrier excavated an outlet, reassorting the material, and mingling new ingredients, threw it up into the sand bars and shoals that now constitute the sand ridges and the gravel deposits in the vicinity of Camden. All the other gravel deposits of the county had this origin; but the beds elsewhere, as a rule, are much thinner in comparison, few of them exhibiting the assorting influence of deep and rapid currents.

The gravel found in the vicinity of West Liberty, section 13, Jackson township, is one of the broad sand bars of the southern shore of this ancient river. The shallow lateral deposits apparently alternate from side to side throughout the "Lob-lolly" region. They all rest upon beds of blue clay.

The conclusion is then made that the ancient inland sea had at this point an outlet identical and synchronous with those crossing the Summit region in Ohio. The earlier floods may have submerged much of this region, but their recession would gradually confine their volume to more specific limits, produc-

ing the broad outlets, with strong currents, reassorting the drift and depositing it in the ridges that are characteristic of this Summit region.

These ridges have a general parallelism of outline with the more recent shore lines of Lake Erie; namely, the lake ridges found in Western Ohio, the highest one extending into Indiana to Fort Wayne, where the waters of Lake Erie at that period had an outlet through the Valley of the Wabash. The "sand ridges" are older than the "lake ridges," the channels producing them being closed before the outlining of these ridges. Upon this distinction Professor Newberry says: "Careful observation will show that this belt of sand and gravel hills has little in common with the lake ridges, being composed of different materials, holding a higher level, and being far less continuous and uniform in altitude." (Vol. I, Ohio Survey, p. 43.)

Many inquiries in various parts of the county elicited no discovery of the so-called "Forest Beds," traces of which are found in many localities southward.

The deposits of drift, both glacial and fluvial, both the clays and the gravel, abound in fossils, many of them somewhat weathered. The most abundant are Devonian species; many fragments of limestone from the formations of that age being full of corals and shells. These are abundant in the gravel. The summit of "Tusey's Knob" is thickly strewn with them.

In the blue clays, and only in the blue clay, are frequently found fossils belonging to the Hudson river rocks of the Lower Silurian. A number of species have been identified. In a piece of shale found in the clay in section 16, Wayne township, resting on a large granite boulder, was found a Lower Silurian Lamellibranch *Ambonychia costata*. Trilobites are frequently found in the boulder clay, and all of Lower Silurian species, being *calymene blumenbachi*, curled up, just as found in the Lower Silurian shales at Richmond and Madison. It is not known that Lower Silurian fossils have been before found in the drift of Northern Indiana. Their presence here would indicate the existence of Lower Silurian formations to the northward or eastward. But the oldest exposures, so far as known, are the Upper Silurian. If the glaciers reached the Hudson River formation at any point it may have been in the deep erosion at some unknown point.

Dr. Arthur, of Portland, has a number of these specimens in his cabinet, one being exhibited that was taken from the blue clay, twenty feet below the surface, in a well near Camden. They are frequently found in nearly every part of the county.

### PALÆOZOIC GEOLOGY.

The only rocks found in place in Jay county belong to the Niagara group of the Upper Silurian period. Of these there are only two outcrops, neither of them sectional exposures, but only surface showings in the beds of streams, the one being in the Salamonie, near Portland, and the other in the Wabash, at Jay City. Throughout the county the formation is heavily overlaid with drift. Over a good portion of Wayne and Greene townships the limestone is very near the surface. In the center of this region is the Salamonie outcrop, located in range 14 east, township 23, section 30. A quarry has been partially opened, but owing to high water at the time of my visit it was not seen in place. But an examination of a mass of stone that had been quarried showed it to be a shale of drab color, porous and argillaceous layers, stained in places with red oxide of iron, also abounding in fragments of chert. Some of the strata were full of fossils, the most numerous being *Pentameras oblongus*, with corals of the genus *Favosites*. One cast of *Pleurotomaria* was observed; the species could not be determined. Many of the fragments were full of crinoid stems. None of the stone exposed is adapted to building purposes. It has been used in making an excellent lime. The rock is easy of access, the alluvial deposit at this point being very shallow. The opening of a quarry will probably expose stone of a better quality.

Considering the fact that this is the only outcrop near Portland, there is promise of profit in opening and operating it. This, we are informed, the owner, Dr. Arthur, intends doing at an early day.

The second outcrop, and much the largest exposure, is in the extreme northeast part of the county, at Jay City, in the bed

of the Wabash. It is also a surface exposure, and no section could be taken, neither was the dip accurately distinguished, though the workmen state the general trend is northward.

The rock is near the surface for a long distance in the bed of the river, there being exposures in Adams county, westward, and near the Ohio line, eastward. North and south the rock is near the surface. A mile south of Jay City it appears in section 4, Wabash township, in the bed of a small branch, and in many wells in the vicinity, with an average depth of ten or twelve feet. The stone differs in appearance from that at Portland, being a porous, lenticular limestone of a light color, with very little of argillaceous and arenaceous ingredients. The surface layers only have been quarried. It makes an excellent lime, and is burned to meet the local demand.

The superior quality may be inferred from the character of the stone. These shales are full of fossils; many of them fragmental and imperfect, the crystalline purity of the rock preserving them generally as casts.

The following species were collected and identified. Further search will discover others:

*List of Fossils Found in the Niagara Shales at Jay City.*

<i>Stromatopora concentrica</i> .....	Goldfuss.
<i>Halysites catenulata</i> .....	Linneus.
<i>Favosites favosus</i> .....	Goldfuss.
<i>Favosites niagarensis</i> .....	Hall.
<i>Favosites venustus</i> .....	Hall.
<i>Zaphrentis stokesi</i> .....	Edwards & Haime.
<i>Spirifera eudora</i> .....	Hall.
<i>Spirifera stricklandi</i> .....	Sowerby.
<i>Strophodonta profunda</i> .....	Hall.
<i>Pentamerus oblongus</i> .....	Sowerby.
<i>Pleurotomaria</i> , two species too indistinct to determine.	
<i>Trochoceras</i> , species not determined.	
<i>Atrypa reticularis</i> .....	Linneus.
<i>Conularia niagarensis</i> .....	Hall.
<i>Eucalyptocrinus crassus</i> .....	Hall.

## ARCHÆOLOGY.

The antiquities of Jay county are full of interest. Though there are no extensive earth-works, the whole region abounds in relics of the aboriginal and pre-historic peoples. The characteristic implements, utensils and ornaments have been found in every township—such as grooved axes, hammers, pestles, fleshers, arrow-heads, totems, pipes and pottery. The only mounds observed were very small, and almost obliterated, being in two localities—one group of five small ones, located in section 35, Penn township; another of three similar mounds in section 13, Knox township. They are all obscurely oval, being from twenty-five to fifty feet in length, and from three to five feet high. Some have been almost obliterated by cultivation.

Dr. Arthur, of Portland, has thoroughly investigated their structure, but they have yielded no specimens, either in implements, pottery or bones. All of them contained ashes and alternating layers of clay, burned brick red, and beds of charcoal. They were probably habitation mounds, and possibly some of the outlying villages of that numerous people who have left monumental evidences in the great earth-works of Winchester and Anderson that this region was a center of their national power. While the mounds are thus unimportant, the relics gathered from various parts of the county are full of interest.

Their abundance and variety has attracted the attention of many collectors. Extensive collections have been made by Dr. C. S. Arthur, of Portland, Gen. J. P. C. Shanks, Mr. John Lalley. Dr. Porter, of Geneva, Adams county, also has a large number of fine specimens, many of them gathered in Jay county.

These various collections include a variety of articles not often equaled in a single county. Much of the workmanship is quite elaborate, showing in execution both taste and skill. The hardest rock has been fashioned and polished into symmetry and beauty. The excellence of the work is amazing as we remember it was wrought by men who had no knowledge of the harder metals.

The variety of material used is astonishing. We have observed Indian arrow-heads of all descriptions, flints of every color, even to green. One arrow-head, in possession of Gen. Shanks, is made from crystalline quartz. Most of the stone axes are made of granite, in its various forms of syenite, diorite, or greenstone. The pipes are usually steatite, or soapstone. Some of these are of curious form, and exhibit considerable skill in copying natural objects. Dr. Arthur's collection contains one that is a fair representation of an otter, and another a good imitation of a rattlesnake's head.

Tubular pipes are met with. One in the possession of Dr. Porter, at Geneva, is about ten inches long, made of steatite. The bowl is funnel-shaped and horizontal, not turned up in ordinary pipe form. A shorter one in Dr. Arthur's cabinet shows the marks of the teeth of some energetic smoker.

Occasionally throughout this county rounded masses of a flinty silicious stone are found, having a sharp angular fracture, quite spheroidal in form, and varying in size from a hen's egg to the fist of a man. They have evidently been used as implements. They are not the ordinary hammer stones, having neither grooves or polished surface. All of them have the sharp angular pointed appearance on the sides where the laminations of the material end. They all have this characteristic. Only a few of them have been found.

Dr. Arthur suggests their use in the manufacture of implements from the granitic rocks. It was found upon trial that the burned edges of these stones would readily disintegrate the hardest green stone, when applied with continued yet gentle blows. The sharp points granulated the granite very rapidly, and a few hours only would suffice to form a battle-axe or pestle from any syenitic boulder.

We have not learned whether implements of this description have been observed in other localities. We offer this as a suggestion of their probable use.

Near the Salamonie, south of Portland, on the land of Mr. Jonas Votaw, in section 28, Wayne township, is a deposit of sand and gravel, in which were found at one time seventeen human skeletons, lying at a position below the present level of the Salamonie, apparently an ancient sepulcher. The bones and relics were all in an advanced stage of decay, so that many



crumbled on exposure. The only relics preserved were a tubular pipe of steatite, and what is evidently the *osselet* of a squid or calamary, the internal bone or shell of a cephalopod, called the "pen," from its pointed, pencil-like form. The specimen is a perfect one, with the conical cavity at the lower end, showing distinctly its nature. It must have been transported from the sea coast as an ornament. Other relics of similar nature and origin have been discovered, indicating tribal communications among the ancient people, and interchange of commodities.

In a gravel pit just south of Portland, in section 20, one of those broad, shoal-like deposits of gravel and sand, overlaid by a few feet of yellow sedimentary sandy soil, was found a locality, about three feet below the surface, where ashes and charcoal were found mingled with the gravel, some of the boulders showing the action of heat. Associated with them were fragments of pottery, of rather a rude character, yet exhibiting some symmetry of outline, with traces of ornamentation, being decorated by marks made with the finger-nail before the baking of the pottery. There were no indications on the surface of any disturbance of the soil; no irregularity of outline either in elevation or depression. It is probable that a small habitation mound had once occupied this spot, that in such yielding, sandy soil had, in the lapse of ages, been wholly obliterated.

#### THE MASTODON.

The gigantic mammals of the early quaternary have left their remains in various portions of the county, its heavy alluvium and muck deposits being very favorable for their preservation. Bones of the mastodon and the post-glacial deer or elk have been frequently met with. The gigantic antlers of the latter have been found, in size indicating an animal eight or nine feet high and ten or eleven feet in length. These antlers have been picked up in a bog north of Camden, in Penn township.

Fragments of the skeleton of the mastodon have been met with in various places, vertebrae, ribs and teeth usually quite well preserved. In a locality in the western part of Penn township numerous fragments have been gathered, indicating the presence of an entire skeleton, that will be exhumed at an

early day. One of the shoulder-blades now in the possession of Dr. Arthur indicates a monster of immense proportions.

It is probable that the proposed draining of the "Loblolly" region will discover well preserved skeletons of the mastodon, which it is hoped will be carefully preserved in the interest of science.

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## ECONOMIC GEOLOGY.

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### SOIL AND WATER.

What has been said previously of the surface configuration of Jay county is suggestive of the general condition and character of the soil.

It is mainly of drift origin, and the commingling of sand and clay with organic material of vegetable origin, has produced a very fertile soil.

Much of the surface is covered with several feet of rich, black loam, showing a soil of inexhaustible fertility. Some of the land is low, but all of it is capable of perfect drainage. Clays for drain tiles are abundant, and of excellent quality. Factories are being rapidly multiplied and the production of tile is really a great industry. Everywhere the benefits of drainage are apparent. Land formerly deemed worthless is waving with magnificent crops of wheat and corn.

The benefits of drainage are not confined to increased fertility in the soil by carrying off superfluous water, but thorough drainage has enhanced the healthfulness of the whole county. The work is not completed yet, but the introduction of drainage has been attended by a marked decrease in all malarial diseases, formerly the terror of this locality.

One reason for this result is that drainage improves the quality of the drinking water.

Surface water is swiftly carried off, and the shallow wells supplied by it become dry, and are replaced by deeper ones, which penetrate to the purer waters of the lower sand strata. Shallow wells full of swamp water are mere pools of pestilence, in which the germs of disease are generated.

Certain localities in the county have experienced great difficulty in procuring good water. This, as far as we observed, is limited for the most part to the higher clay ridges. The water is locally known as "bitter water." To the taste it is rather nauseating, being sweetish rather than bitter. It acts as a cathartic, and is generally considered unhealthful.

Animals acquire a taste for it and thrive on it. When accustomed to its use they prefer it to any other water. The largest region with water of this character is a belt of land from two to three miles wide, coincident in extent with the outline of the summit of the southern ridge of the county. It exists in patches along the line of the northern ridge, and usually lacking the marked characteristics, being less bitter and nauseating. It appears to be limited to the clay formations—never found in alluvial or gravel deposits. It is evidently a surface water, the deeper waters being usually pure and potable. In one or two instances we saw two wells near each other—even within a few feet—one being "bitter" and the other good water, the good water coming from the lower level below the hard pan. The remedy, therefore, is a tubed well, carefully sunk to the lower water, otherwise the "bitter water" will be intermingled.

Samples of this water from a well at Mount Pleasant were submitted to Professor Elwood Haynes, of Portland, for examination. The following is his report:

*Qualitative Analysis of "Bitter Water" from Mt. Pleasant, Jay County, Ind.*

Free carbonic acid.

Carbonate of calcium.

Carbonate of iron.

Carbonate of magnesium (trace).

Sulphate of magnesium (epsom salts).

Sulphate of aluminum (trace).

Chlorides (trace).

The sulphate of magnesium existed in quite large quantities, and is, undoubtedly, the cause of the bitter taste of the water. The well-known cathartic, "epsom salts," is sulphate of magnesium. To a sample of water similar in composition to the above, except that it contained no epsom salts, was added a small quantity of that substance (obtained from a druggist),

and the result was a bitter water which could not be distinguished from the sample analyzed. Moreover, after all the other constituents of the water, save that of the sulphate of magnesium, were removed, the water still retained its bitter taste. The carbonates of iron and calcium existed in considerable quantities, and were held in solution by the free carbonic acid contained in the water. No test was made for phosphoric acid, as the necessary requisites could not be obtained in this place.

For the benefit of those using bitter water of the above description, I would say that the bitterness of the water may be almost entirely removed by adding a requisite quantity of lime. The quantity of lime to be added depends entirely upon the amount of salts contained in a given quantity of the water, and can only be determined by trial."

This suggestion of the Professor ought to be practically tested by those who have wells of this water—where it is not convenient to put down tubed wells to the pure water below.

The continued use of water containing such ingredients can not fail to be detrimental to physical welfare. A little lime thus used might avert much sickness.

The analysis indicates that all the causes of the bitterness of the water are present in the soils of these localities. The heavy clays retain the chemical agents that characterized the rock from which they were made. The limestones dissolved by glacial and chemical action were largely composed of the carbonates and sulphates that are held in solution in these waters.

The undisturbed portion of this mass of material, its compact, close-grained structure, produce conditions favorable to the preservation of these elements in the soil. The surface-water sinks down through the clay and takes up these ingredients, becoming especially charged with the sulphate of magnesium, giving its bitterness. If the surface waters could sink to the lower strata, the deeper waters would also be bitter, but the hard-pan prevents such impregnation, the deeper waters having an artesian flow, with a fountain head where the soil is not charged with epsom salts. It is probable that there are places where the hard pan is penetrated by the bitter surface waters. At such points the deeper waters will also be bitter, and may give some the impression that the waters of both strata are alike bitter. But such exceptions need not disturb the general rule that the lower waters are quite uniformly

pure and potable. The construction of cisterns would answer the purpose where tubed wells are not desirable or practicable, and would always furnish the purest water.

At various points strong springs were observed, some of them quite heavily charged with iron and sulphur. In a low, marshy region in Greene township, section 17, a strong "sulphur" spring was observed; another in section 35, in Noble township. The numerous springs of never failing water are a compensation for the absence of flowing streams, that renders this county very favorable for grazing purposes. While in dry seasons the small streams become stagnant or wholly dry, these fountains are always accessible, and are invaluable to the stock raiser.

For this reason the whole county is well adapted to the raising of cattle and sheep. Numerous flocks and herds of fine live stock indicate that the capacities of this county in this direction are beginning to be properly appreciated.

#### THE TIMBER AND FLORA.

The county was originally an almost unbroken forest. It still contains a vast amount of most excellent timber. At present there is a large local and foreign trade in the hard woods, for building and manufacturing purposes. Oak, ash and hickory are found abundantly in every township. Oak is especially abundant along Bear creek. The sandy land of Jackson and Penn townships abounds in walnut, wild cherry, hard maple and butternut. The alluvial valleys are full of lofty sycamores and gigantic burr-oaks. The whole "Loblolly" region is stocked with a dense growth of majestic elms, oaks, ash and maples.

The following is a list of the more important trees, shrubs and vines found growing in the county:

#### LIST.

<i>Acer saccharinum</i> .....	Sugar maple.
<i>Acer rubrum</i> .....	Red maple.
<i>Acer dyascarpum</i> .....	Soft maple.
<i>Amelanchier canadensis</i> .....	Serviceberry (rare).
<i>Asimina triloba</i> .....	Paw-paw.
<i>Aesculus glabra</i> .....	Ohio buckeye.

<i>Aesculus flava</i> .....	Sweet buckeye.
<i>Crataegus coccinea</i> .....	Red hawthorn.
<i>Cornus florida</i> .....	Dogwood.
<i>Cornus canadensis</i> .....	Bunchberry.
<i>Carya alba</i> .....	Shell-bark hickory.
<i>Carya glabra</i> .....	Pig nut.
<i>Carya tomentosa</i> .....	White heart hickory.
<i>Corylus americana</i> .....	Hazel nut.
<i>Celastrus scandens</i> .....	Bitter sweet.
<i>Carpinus americana</i> .....	Iron wood.
<i>Cercis canadensis</i> .....	Red bud.
<i>Cephalanthus occidentalis</i> .....	Fever bush.
<i>Celtis occidentalis</i> .....	Hackberry.
<i>Euonymus atropurpureus</i> .....	Waahoo.
<i>Fagus ferruginea</i> .....	Beech.
<i>Fraxinus americana</i> .....	White ash.
<i>Fraxinus sambucifolia</i> .....	Black ash.
<i>Fraxinus quadrangulata</i> .....	Blue ash.
<i>Gleditschia triacanthus</i> .....	Honey locust.
<i>Hamamelis virginica</i> .....	Witch hazel (rare).
<i>Juglans nigra</i> .....	Black walnut.
<i>Juglans cinerea</i> .....	Butternut.
<i>Morus rubra</i> .....	Red mulberry.
<i>Morus nigra</i> .....	Black mulberry.
<i>Nyssa multiflora</i> .....	Black gum.
<i>Negundo aceroides</i> .....	Box elder.
<i>Populus tremuloides</i> .....	American aspen.
<i>Populus heterophylla</i> .....	Downy-leaved poplar.
<i>Populus monilifera</i> .....	Cotton wood.
<i>Prunus serotina</i> .....	Wild cherry.
<i>Platanus occidentalis</i> .....	Sycamore.
<i>Quercus macrocarpa</i> .....	Burr oak.
<i>Quercus alba</i> .....	White oak.
<i>Quercus nigra</i> .....	Black oak.
<i>Quercus rubra</i> .....	Red oak.
<i>Quercus prinoides</i> .....	Chinquapin.
<i>Sassafras officinale</i> .....	Sassafras.
<i>Salix nigra</i> .....	Black willow.
<i>Salix humilis</i> .....	Low bush willow.
<i>Salix discolor</i> .....	Glaucous willow.

<i>Staphylea trifolia</i> .....	Bladder nut.
<i>Tilia americana</i> .....	Linn, or basswood.
<i>Tecoma radicans</i> .....	Trumpet creeper.
<i>Ulmus americana</i> .....	Elm.
<i>Ulmus fulva</i> .....	Slippery elm.
<i>Viburnum prunifolium</i> .....	Black haw.
<i>Vaccinium macrocarpa</i> .....	Cranberry.
<i>Zanthoxylum americana</i> .....	Prickly ash.

It is noticeable in this list that White Poplar (*Liriodendron tulipifera*) is wanting. It was not observed anywhere in the county, and if it exists at all it is very rare. It is stated that the "leather-wood" (*Dirca palustris*) existed, but careful search failed to find it. In one locality we noticed the *ailanthus*, an Asiatic tree (Tree of Heaven), growing as a forest tree. Witch Hazel is found in but two localities—near Antioch, in Pike township, and near Camden, in Penn. The "Loblolly" marsh abounds in rare plants, and its beautiful orchids, gigantic grasses, sedges and ferns, make it a botanist's paradise. Vegetation grows very rank and dense, with almost a tropical luxuriance. Some of the ferns were four and five feet high. The aquatic reeds were very tall. One species, *Phragmites communis*, being twelve feet high.

#### ROADS.

One of the conditions of prosperity is a net-work of good, solid roads. These are beginning to be appreciated, and numerous well-constructed gravel roads exist. But much needs yet to be done in this direction before the facilities for transportation will be proportionate to the production. The difficulty heretofore has been a lack of material, but careful search has shown that in almost every locality a supply of gravel can be found, though in some instances it must be carried quite a distance. The shallow beds of gravel in the level land will furnish, ordinarily, an adequate supply for local demands.

The great sand ridges of Penn township are an inexhaustible store-house of road material, that will some day be utilized. The gravel is clean and sharp, and of the very best quality.

## EDUCATION.

One of the pioneer colleges of Indiana was formerly located near Portland, and known as Liber College. It has passed away as an institution, but the present intelligence of the people owes much to its early influence.

The present public schools are well equipped, and doing a work under the efficient superintendency of Prof. Houk.

The Portland city schools are well managed, and are fully up with the educational progress of the times.

Funds have just been subscribed for the establishment of a Normal School, which will soon be built, and promises to be a flourishing educational institution, that will find ample room for service in equipping the young teachers of Eastern Indiana for the great work of training children for the duties of citizenship.

## THANKS.

In this survey we have been aided materially by the hearty co-operation of the generous and public spirited citizens of Jay county. We are especially indebted to Dr. C. S. Arthur and Gen. J. P. C. Shanks, for many courtesies and acts of kindness. Also, to Mr. Culver, Mr. John Y. Miller, Rev. T. C. White, D. D., Prof. Elwood Haynes, Prof. Houk, Dr. Wiest, of Jay City; Dr. Muncy, of West Mt. Pleasant, and especially to Mr. Geo. K. Greene, of New Albany, for the identification of fossils.