GEOLOGY OF MIAMI COUNTY.

BY S. S. GORBY.

Miami County, situated in north-central Indiana, is bounded on the north by Fulton and Wabash counties, on the east by Wabash and Grant, on the south by Howard and on the west by Carroll and Cass. It contains an area of 384 square miles, or 245,760 acres. The county is in the form of a parallelogram, being thirty miles in length, from north to south, and twelve miles wide, with one township forming an L-like projection on the east side, at the southeast corner. The following are the fourteen civil townships in the county: Allen, Perry, Union, Richland, Jefferson, Peru and Erie, on the north side of the Wabash River, and Pipe Creek, Washington, Butler, Deer Creek, Clay, Harrison and Jackson, on the south side of the river. The river runs in a westerly direction, dividing the county into two nearly equal parts.

Peru, the county seat of Miami County, is a thriving commercial and manufacturing city, situated in the central part of the county, upon the north side of the Wabash River, and in the midst of an agricultural region of unsurpassed fertility. The population of Peru in 1880 was 5,280; it is now estimated at fully 8,000. The following towns and villages are located in the northern part of the county: Wagoner, Lincoln and Birmingham, in Allen Township; Gilead and Stockdale, in Perry Township; Mexico, in Jefferson Township, and Denver, Chili and Pawpaw, in Richland Township. South of the Wabash River are Miami, in Deer Creek Township; Waupecong and McGrawsville, in Clay Township; North Grove, in Harrison Township; Amboy and Xenia, in Jackson Township; Bunker Hill, in Pipe Creek Township; South Peru, in Washington Township, and Peoria and Santa Fe, in Butler Township.

The distance from Peru to Amboy is	15 miles.
The distance from Peru to Bunker Hill is	8 "
The distance from Peru to Chili is	8 "
The distance from Peru to Deedsville is	13 "
The distance from Peru to Denver is	8 "
The distance from Peru to Gilead is	16 "
The distance from Peru to Lincoln is	16 "
The distance from Peru to Mexico is	6 "

The distance from Peru to Miami is . . . . . 12 miles
The distance from Peru to North Grove is . . . . . 13 "
The distance from Peru to Paw-paw is . . . . . 11 "
The distance from Peru to Peoria is . . . . . 9 "
The distance from Peru to Perrysburg is . . . . . 11 "
The distance from Peru to Santa Fe is . . . . . 9 "
The distance from Peru to Stockdale is . . . . . 15 "
The distance from Peru to Waupecong is . . . . . 13 "

RAILROADS.

The railroad facilities of the county are most excellent, there being but two out of the fourteen townships in the county that are not crossed by railroads. The Pittsburg, Chicago & St. Louis Railroad (the Pan-Handle) runs northwesterly across the southern part of the county; the Wabash, St. Louis & Pacific Railroad crosses the central part of the county from east to west, following the course of the Wabash River; the Lake Erie & Western, formerly I., P. & C. Railroad, runs a northerly and southerly direction through the central part of the county; and the Eel River Railroad, which follows the course of Eel River southwesterly, through the northern part of the county. The railroads throughout the county are most conveniently and happily located for the agricultural and commercial interests of the country.

SCHOOLS.

The total population of the county is near 30,000, and the school population a little less than 10,000. The total number of pupils attending school in 1886 was 6,244, and the average attendance was 4,412. The school terms throughout the county averaged 121 days in length—a period equal to a fraction more than six months. The teachers of the county have endeavored to raise their schools to the highest standard of excellence, and by a system of institutes and teachers' associations they have been able to keep in the van of progress. The schools are most efficiently managed, the principal object being to assist in the development of the minds of the youth, that they may acquire, without cramming, a knowledge of those branches best calculated to assist in the business of life, and to develop strength and integrity of character. The total value of all school property in the county is about $150,000, and the total tuition revenue about $75,000.

CHURCHES.

There are about thirty-five church organizations and the same number of church buildings in the county, representing Baptists, Catholics, Episcopalians, Friends, Disciples of Christ, Lutheran, Congregational, Methodist, Presbyterian and United Brethren. The church membership numbers about 6,000, and the value of church property is about $100,000. The average Sunday-school attendance is about 3,000.

Any locality that provides good schools and patronizes them liberally, that erects good church buildings and contains a church-going population, is always a desirable locality to live in. A locality of churches and good schools is a locality of sobriety, intelligence, industry and honesty—just such a locality as the intelligent, enterprising farmer, mechanic, lawyer, doctor or other man of intelligence will seek when hunting a new location. Any part of Miami County furnishes just such a locality.

AGRICULTURE.

Miami County is primarily an agricultural county. The county is generally level, with sufficient undulations, produced by the erosions of the streams, to give good natural drainage to a large portion of its area, which has been supplemented in the flat portions by surface ditches and underground tiles. The soils consist of sand or clay loams, and are of great fertility. The yield of wheat in 1886 from 41,988 acres was 777,107 bushels, an average of over 18½ bushels per acre; 42,258 acres of corn yielded 1,643,526 bushels, an average of nearly 39 bushels per acre; 6,081 acres of oats yielded 219,721 bushels, an average of more than 36 bushels per acre; 140 acres of barley yielded 3,342 bushels, an average of about 24 bushels per acre; 42 acres of buckwheat yielded 534 bushels, an average of about 13 bushels per acre; 120 acres of rye yielded 1,953 bushels, an average of over 16 bushels per acre; 633 acres of flax yielded 6,292 bushels of seed, an average of about 10 bushels per acre; 9,647 acres of timothy yielded 17,637 tons of hay, an average of 1⅘ tons per acre; 22,321 acres of clover produced 33,304 tons of hay, an average of 1½ tons per acre, besides 2,443 bushels of seed valued at $10,000; 932 acres of Irish potatoes yielded 70,219 bushels, an average of 75 bushels per acre; and 26 acres of sweet potatoes yielded 1,550 bushels, an average of 60 bushels per acre. These statistics of products during a year of average crops, in a general way illustrate the fertility of the soil. Improved methods of husbandry, with a gradual increase in the area artificially drained, are materially augmenting the average of the crops. There were 404,383 rods—nearly 1,300 miles—of drain tiles in use in the county in 1886.

The soils of the county are generally a loose, black, sandy or gravelly loam, except in the flatter portions of the southern part of the county, where there is, as a rule, a considerable proportion of clay. There is but very little necessarily waste land in the county.

TIMBER.

Miami County was originally heavily timbered. The vast forests contained immense amounts of the finest walnut, poplar, oak, ash, hickory and other varieties of timber. The supply of walnut and poplar has been

almost wholly exhausted in recent years, though there yet remains in the wood lands a fair proportion of oak, ash, hickory, beech, elm and maple timber. There are yet remaining in the county about 55,000 acres of timber, or wood land, a considerable proportion of which has been largely culled. The following is nearly a complete list of the trees and shrubs indigenous to Miami County, although there are many other species and varieties of trees, shrubs and vines, now growing wild in the county, that have escaped from cultivation:

Acer dasycarpum, white maple.
Acer rubrum, swamp maple.
Acer saccharinum, sugar maple.

Aesculus glabra, buckeye.

Almus serrulata, water alder.

Ampelopsis quinquefolia, woodbine.

Asimia triloba, pawpaw.

Betula lenta, black birch.
Betula nigra, water birch.

Carya alba, shell-bark hickory.
Carya amara, pig nut.
Carya microcarpa, dwarf hickory.
Carya sulcatao, bottom lands, large hickory nut.
Carya tomentosa, black hickory.

Carpinus Americana, ironwood.

Cercis Canàdensis, red bud.

Celastrus Scandens, bitter-sweet.

Celtus occidentalis, hackberry.

Cornus ceircea, kinnikinick.
Cornus florida, dogwood.
Cornus paniculata, swamp dogwood.

Corylus Americana, hazelnut.

Cratægus coccinea, thorn apple.
Cratægus crus-galli, cockspur thorn.
Cratægus tomentosa, black thorn.
Cratægus tomentosa, var. punctata, sharp thorn.

Cupressus thyroides, white cedar.

Dianthua Americana, water willow.

Dispyrus Virginiana, persimmon.

Euonymus Americana, strawberry bush.
Euonymus atropurpurens, wahoo.

Fagus ferruginea, beech.

Fraxinus Americana, white ash.
Fraxinus quadrangulata, blue ash.
Fraxinus sambucifolia, water ash.
Fraxinus virides, green ash.

Gleditschia monosperma, water locust.
Gleditschia triacanthus, honey locust.

Gymnocladus Canadensis, coffee nut.

Juglans cineria, white walnut, butternut.
Juglans nigra, black walnut.

Juniperus Virginiana, red cedar.

Lindera benzoni, spice wood.

Liquidambar styraciflua, sweet gum.

Liriodendron tulipifera, yellow poplar.

Morus alba, white mulberry.
Morus rubra, red mulberry.

Negundo aceroides, box alder.

Planatus occidentalis, sycamore.

Populus alba, silver maple.
Populus heterophylla, cotton tree.
Populus monolifera, cotton wood.
Populus tremuloides, quaking aspen.

Pyrus coronaria, wild crab-apple.
Pyrus angustifolia, narrow-leaved crab-apple.

Prunus Americana, wild plum.
Prunus serotina, wild cherry.

Quercus alba, white oak.
Quercus bicolor, swamp white oak.
Quercus coccinea.
Quercus coccinea, var. tinctora.
Quercus imbricaria, shingle oak.
Quercus macrocarpa, burr oak.
Quercus nigra, black jack oak.
Quercus obtusiloba, post oak.
Quercus phellos, willow oak.

Quercus prinus, chestnut oak.
Quercus prinus, var. acuminata, chincapin oak.
Quercus palustris, swamp oak.
Quercus rubra, red oak.

Rhus glabra, smooth sumach.
Rhus toxicodendron, poison ivy.
Rhus typhina, stag-horn sumach.

Robinia pseudacacia, locust tree.

Rosa Carolina, swamp rose.
Rosa setigera, climbing rose.

Rubus Canadensis, dewberry.
Rubus occidentalis, black raspberry.
Rubus strigosus, red raspberry.
Rubus villosus, fall blackberry.
Rubus villosus var humifusus, low blackberry.

Salix humilis, prairie willow.
Salix lucida, shining willow.
Salix nigra, black willow.
Salix petiolaris, petiole willow.
Salix tristis, gray willow.

Sassafras officinale, sassafras.

Tilia Americana, linden, basswood.

Ulmus alata, winged elm.
Ulmus Americana, white elm.
Ulmus fulva, slippery elm, red elm.

Viburnum prunifolium, black haw.

Vitis æstivalis, summer grape.
Vitis cordifolia, winter grape.
Vitis indivisi.
Vitis labrusca, fox grape.
Vitis riparia.

TOPOGRAPHY AND DRAINAGE.

The surface of the county is generally level, or slightly undulating, except along the water courses, where the lands are considerably rolling or hilly. There is no land in the county so rough and broken as to make it necessarily waste land, nor are there any irreclaimable swamps. Originally there were many small swamps or bogs in the northern part of the

county, which were fruitful sources of malarial poisons and tormenting insects, but these have about all been reclaimed by draining, and are now among the most productive and profitable lands in the State.

The Wabash River crosses the county from east to west, and divides it into two nearly equal parts, there being seven civil townships, and about an equal number of acres, on either side of the river.

The principal streams south of the Wabash are the Mississinewa River, Little Pipe Creek, Big Pipe Creek and Deer Creek.

The Mississinewa River enters Miami from the southwest corner of Wabash County, flows northwesterly across Butler Township, and empties into the Wabash River about a mile above Peru.

Little Pipe Creek rises in the southern part of Butler Township, flows northwesterly across Butler and Washington townships, and empties into the Wabash about a mile below Peru.

Several branches of Big Pipe Creek rise in the western part of Grant and the northern part of Howard County, and unite in Jackson Township, Miami County. The stream then flows northwesterly, touching the southern part of Butler, the northern parts of Harrison and Clay, and the southern part of Washington Township, thence across Pipe Creek Township and into Cass County, finally emptying into the Wabash River about seven miles above Logansport.

Deer Creek rises in the northern part of Howard County, flows northward into Harrison Township, Miami County, thence westerly across Clay and Deer Creek townships into Cass County, whence it pursues a westerly course across Cass County, and finally discharges its waters into the Wabash River at Delphi, in Carroll County.

The principal streams north of the Wabash River are Eel River, Flower's Creek, Washoni's Creek and Big and Little Wea-Saw's.

Eel River enters Miami County from Wabash County, on the east, flows southwesterly through Richland and Jefferson townships, crosses into Cass County, and discharges into the Wabash River at Logansport.

Flower's Creek rises in Perry Township, flows southerly through Richland Township, and discharges into Eel River just above Chili.

Washoni's Creek rises in the southwest corner of Perry Township, flows southerly through the western part of Richland Township, and discharges into Eel River a short distance below Chili.

Little Wea-Saw's Creek flows southwesterly through the eastern part of Union Township, and unites with Big Wea-Saw's about a mile above the junction of the latter with Eel River.

Big Wea-Saw's Creek flows southerly and southeasterly through Union Township, and discharges into Eel River near the town of Denver.

Besides these described, there are many other small creeks and brooks, in all parts of the county, that perfect the drainage and furnish an abundance of water for the use of the stock of the husbandman.

There are but few rock exposures in the county, the surface consisting almost wholly of glacial deposits—sand, gravel and clay. These materials, which were heterogeneously mixed during the glacial period and at its close, have been largely re-assorted and re-arranged during the lapse of the long ages since the close of the ice age. The entire drift-mass has been greatly modified by re-assortment and re-arrangement; but the surface, the portion subject to the direct action of the elements, has undergone a much greater change in this respect. Changes of topography have been synchronous with the modifications of the drift-mass. Water falling upon the surface, and percolating through the mass, has been the agent that produced the more noticeable changes. The close of the ice age left the surface of the whole of northern Indiana, the drift-area, in a broken, amorphous condition—hills or mountains and high ridges of mud, sand and bowlders, alternated with long, deep grooves and funnel-shaped hollows. Since the close of the glacial period the process of re-modeling the surface of the drift-area has continued uninterruptedly. By infinitely slow processes, the wash from higher portions has filled up the lower, until the whole of the vast area of northern Indiana, and much contiguous territory, has become one vast plain, broken only by the local erosions of the modern streams.

HISTORY.

Miami County derived its name from the Miami tribe of Indians, who, for a long time prior to its occupation by the whites, owned and occupied the land. The land was obtained from the Indians by treaty and purchase. The principal Indian villages in the county were Wea-Saws, at the mouth of Wea-Saws Creek, on Eel River, Squirrel's Village, on Eel River, near the east line of the county, and Flower's Village, on Eel River, near the center of Richland Township, on the north side of the Wabash River; and the Osage Village, on the south side of the river, situated upon the Mississinewa, about a mile above its junction with the Wabash River. The first white settlements in the county were made about the latter village, about the year 1822, or a little later. A number of Indians, who continue to occupy the original reserves, still reside about this place, and there are a number of others in other parts of the county. The Indians residing in the county are educated, intelligent citizens, and in good financial circumstances.

Miami County was organized by legislative enactment in January, 1834; the first session of the Commissioners' Court was held in June, and the first election was held in August, of the same year. The following is a list of the first officers elected to serve the county:

County Clerk: Benjamin H. Scott.
County Sheriff: Jacob Linzee.
County Treasurer: Abner Overman.

County Commissioners: John W. Miller, Alexander Jameson, John Cruidson.

Associate Judges: Jacob Wilkinson, Stephen Shanks.

Joseph Holman was Probate Judge and D. R. Bearss School Commissioner.

In 1827 the first house was erected within the limits of Peru. The town was regularly laid out in 1834. Miamisport, however, now included within the limits of the city of Peru, was platted in 1829.

The Wabash and Erie Canal was completed in 1837, and at once became an important route of transportation, adding very materially to the prosperity and development of the county. Since the great network of railroads has been completed in the county, affording more convenient and speedy methods of transportation, the canal has been abandoned.

The population of Miami County in 1840 was but 3,048; in 1850 it had increased to 11,304; the population in 1860 was 16,851, in 1870, 21,052, and in 1880, 24,083.

GEOLOGY.

The only rocks exposed in Miami County are those belonging to the Devonian and Upper Silurian formations. The Devonian is represented by from 30 to 35 feet of Corniferous limestones, and the Upper Silurian by the Waterlime and Niagara groups. Almost the entire county is covered by a broad sheet of drift, varying in depth from a few feet to 300 feet or more. The few rock exposures are due to the denudations by the streams.

THE DRIFT.

The drift, of course, is the superficial deposit, and is composed of sand, gravel, clay, chalk, or marl, and bowlders, in some places indiscriminately mixed, and in others assorted and re-arranged into beds of sand, gravel or other material.

By far the greater proportion of the vast drift-mass consists of immense beds of stiff, impermeable blue clay. These clay beds, or deposits of *till*, as they are sometimes termed, consist of massive deposits of blue or greenish-blue clay, which in places vary in color through all shades of green to gray and red. The larger part of it, however, is blue, which, upon exposure, weathers to a light gray.

This blue clay is persistent throughout Miami County, wherever there is a material depth of drift, except along the water-courses. As a rule, along the streams the clay was long ago carried away by the force of the running water, and sand or gravel re-deposited in its place. At Denver, on Eel River, in the northern part of the county, Mr. Charles bored a well for water through 125 feet of sand and gravel, without reaching the rock stratum beneath. The water, when obtained, however, was so

strongly impregnated with iron that it could not be used. This well was bored in the "bottom," or upon the river terrace Although a number of wells have been bored along this stream to a nearly equal depth, the rock strata have never yet been reached. The material passed through, however, is uniformly the same—sand and gravel. Though the bed rock has not been reached in any of the wells along Eel River, it is evidently true that the sand and gravel deposits extend to the solid rock, and that these materials have taken the place of the blue clay, or other glacial matter, removed by the currents of water.

As frequently stated by writers in these reports, the glacial *debris*, as originally transported to this region, consisted of a heterogeneous mixture of particles, varying in size from the finest dust speck, invisible to the naked eye, to bowlders of gigantic dimensions. This vast mass of mixed material was shoved forward by the irresistible masses of slowly moving ice; and, as the process of tearing up stratum after stratum of solid rock, crushing it into pebbles and grinding it into powder, was continued for ages, in regions far north of the limits of this State, the great ice sheet, slowly moving southward, formed a great continental drag, which pulverized the fragments, and scattered the grist from this mighty mill over the vast areas that form the plains of Indiana.

Men can scarcely dare to conjecture the duration of the almost infinite period that elapsed, or the number of slowly plodding centuries that dragged their ice locked æon by, while the great continent remained fettered in adamantine ice. Men can not comprehend, they dare not attempt to comprehend, the infinite duration of eternity, the limitless region of space, nor the universal distribution and indestructibility of matter and force; and the long, almost interminable periods of geologic time are almost equally incomprehensible. To attempt to fix the limit, this way or that, or to attempt to fix in years the duration of a geologic period, is the visionary work of folly. By the brook one may pick up a pebble. It is composed of various elements and innumerable atoms of matter. Calcium, carbon, silica, iron and other elements enter into its compound. It is composed of simple, ultimate atoms. They were once all separate, but no one would dare to attempt to fix the period of time that has elapsed since the elements in the stone combined to produce the rock.

Calculations and conjectures and guesses are all equally valueless with respect to the duration of geologic periods, or the actual age of rocks. It is useless, then, to speculate upon the length of time that elapsed during the great Ice Age in America. The evidences that such a period did exist are abundant, and the changes wrought upon the surface of a large part of the continent are of such a character as to force the conclusion that in duration it was almost measureless. But to fix the limit one way or the other, to attempt to point to the beginning and the end, in fact, to attempt to measure its duration in years or centuries, is idle and useless.

Facts, however, are present that are important and convincing. There were long and well defined periods of time when almost continuously uniform conditions prevailed throughout the globe. This is true respecting the temperature and mechanical forces that were in operation during the Ice Age. Almost uniform conditions prevailed during the vast period of the Silurian Age. The same is true of the Devonian, Carboniferous and other periods of geologic time. The present period has been one of uniform conditions for ages that are measureless to man. The recurring seasons, spring and summer, fall and winter, with their periodic changes of temperature and atmospheric forces, with slight seismic and volcanic disturbances, have continued with uninterrupted regularity for countless ages. No one will dare to attempt to measure even the length of time that has elapsed since deciduous trees first appeared upon the earth. How futile, then, to attempt to measure the expanse of an age that begun countless centuries before the appearance of the most familiar works of organic nature.

It is absolutely impossible to measure accurately the duration of the present age, the Ice Age, or any other geologic period.

Men generally concede that the immense deposits of drift scattered over a very large part of North America, are of glacial origin. It is assumed that immense masses of ice accumulated in the elevated regions of British America, and that the force of gravity slowly carried them southward. The process is supposed to have continued for ages. The thickness of the vast ice-river was probably hundreds, and, in places, possibly thousands of feet. In its movement southward with resistless force, it tore up the strata and carried the loosened fragments along in imbedded ice. It formed an immense drag that planed off stratum after stratum of solid rock, and ground the fragments into atoms, scattering the particles over the vast plains of Ohio, Indiana, Illinois and other States. The entire body of the drift seems to be a vast body of morainic matter—the chips and shavings and dust of nature's workshop. The water from the melting ice assorted, carried forward and distributed vast quantities of this morainic matter over regions probably far south of the southern limits of the glacial ice; hence, we find bowlders and pebbles and other matter common to the drift as far south as the Ohio River. Igneous rocks of various kinds, such as are common in the drift, are found scattered all over the southern part of the State, but these should not be taken to indicate that the continental glacier ever reached the extreme limits at which they are found.

The modifying forces that have continued to operate since the close of the Ice Age have materially changed the character of the superficial portions of the drift deposits throughout their entire extent. This is especially true with respect to these deposits along their original southern limits in Indiana, where the residual matter resulting from the disintegra-

tion and decomposition of the local deposits has become mixed with the transported glacial matter. But the drift deposits of Miami County are far removed from the Southern limits of the morainic mass, and if the great drift beds are, indeed, of glacial origin, then the superficial deposits of this county have clearly been derived wholly from the same source.

With respect to the elements that go to make up the drift formation in Indiana, the principal are silica, alumina, lime and iron. The silica is found principally in the clays, sands and bowlders; the alumina in the clays and bowlders; the lime in the clays, marls, chalk, and the peat-like, swamp deposits, while the iron is abundant in the swamps in the form of bog ore, in gravel deposits, and in the clays and water. Other elements besides these, of course, enter into the composition of the drift, but from an economic point of view they possess little importance. Of the elements of the drift mentioned above, the silica and alumina are largely of foreign origin. They have been derived chiefly from the destruction of rocks belonging to other deposits than those found in this State. The iron, also, might have been derived from the same source, but the lime, which occurs in the drift in large quantities, in the form of chalk or marl, or other combinations, has evidently been chiefly derived from the deposits of limestone occurring in the State. The same forces that broke up the rocks in regions beyond the limits of the State, and ground the fragments into dust, continued their operations throughout Northern Indiana, tearing up the limestone strata and pulverizing the fragments of limestone as though they were between the stones of an enormous mill.

THE CLAYS.

The clay deposits extend over the greater part of Miami County. In some localities the clay beds appear at the surface, and in others layers of gravel or sand, or accumulations of lacustral matter, or peaty deposits lie over them.

There is considerable variation in the character of the clays exposed at different points throughout the county. Mr. John E. Milliron, of Denver, to whom I am especially indebted for valuable information and assistance, has given, for a number of years, great attention to the mineral resources of the county, and especially to the clays. He has collected many varieties of clay from the northern part of the county, and had careful analyses made of some of them by competent chemists, and other samples have been put to careful practical tests. Clay suitable for a good article of pottery occurs at several points near Denver, while tile and brick clays of most excellent quality may be found in almost any part of the county.

An ochreous kind of clay, very fine in texture and highly colored with iron, which makes an excellent mineral paint, suitable for barns, out-

buildings, bridges and other similar work, is found in inexhaustible quantities. This paint has been used at Denver to some extent, and proves to have most durable properties. It only needs to be properly mixed with oil to be ready for use, and is applied with a brush as readily as any other kind of paint. A profitable industry might be built up in the manufacture of this paint for the purposes mentioned above. Mr. Milliron has given the matter careful attention, and his experiments with the paint have been highly satisfactory in every way.

There is a fine deposit of clay on the farm of Mr. Abram Alley, four miles northwest of Denver, on Wiesaw Creek, that may be profitably used in the manufacture of pottery, and is certainly valuable for the manufacture of tile and brick. It burns to a light cream color, stands the fire well, does not warp materially, and may be burned to any degree of hardness.

Mr. Milliron found on the same farm a vast quantity of a brownish-colored clay, which burns to bright red, and makes a most excellent paint. This same variety of clay occurs also on the farm of Louis Piper, two miles north of Denver, and on the farm of Wm. Zook, one mile north of Denver. It also occurs in the vicinity of Chili, in inexhaustible quantities.

THE SAND.

Sand in vast quantities occurs along the various streams throughout the county, and at other points where it occurs in the drift in lenticular beds. Much of it is valuable for the builders' use, and it is quite likely that considerable deposits of it occur that may be successfully used for the grinding of glass or for moulders' use. In view of the fact that there is an increasing demand for glass sand of good quality at the many large glass factories recently located throughout the gas fields, it is a matter of importance that careful search should be made for this valuable material throughout the entire State. At the present time by far the larger portion of all the sand used in the manufacture of glass is transported from points outside of the limits of Indiana. At a number of points in this State glass sand of good quality is found in large quantities, and it is quite probable that it occurs in many other places. Quite an item of expense might be saved to the manufacturers in the way of freight charges if sand of suitable quality could be procured in this State, and at the same time material benefits would accrue to those who might be able to supply the required material.

IRON ORE.

Bog iron ore in considerable quantities occurs throughout the northern part of the county. In the earlier days of the county furnaces were in operation along Eel River, and a considerable quantity of excellent iron was manufactured, but owing to the expense of collecting the ore the furnaces had to be abandoned.

WATER.

The many streams flowing through the county furnish an ample supply of excellent surface water for stock, while springs abound in many sections. Every sand stratum in the drift deposits contain more or less water, and by boring or digging until a good stratum of sand is found lying underneath a bed of impervious blue clay, an inexhaustible supply of excellent water is almost certainly obtained. In many instances the water rises to the surface and flows out, thus forming an artesian well.

In many localities the water is strongly impregnated with salts of lime, iron or other mineral matter, though, as a rule, these elements do not enter sufficiently into its composition as to render it unfit for domestic or manufacturing purposes.

DEPTH OF DRIFT.

South of the Wabash River the drift varies in depth from nothing to 100 feet or more, though it is only along the streams where it has been carried away by water that it is wholly wanting. At Bunker Hill, Gas Well No. 1, it is 58 feet thick; at Xenia it is 50 feet thick, while at Amboy, midway between the two points, it is 35 feet thick.

The alluvial matter in the Wabash River bottom varies from 5 to 50 feet in thickness. In Gas Well No. 2, at Peru, it is 10 feet thick; in Well No. 1, Northside, it is 36 feet thick, while at the Bearss Gas Well, No. 4, bored on the high lands two miles north of Peru, the drift is 324 feet thick. It is quite likely that the maximum thickness of drift north of the Wabash River in Miami County will approximate 400 feet in thickness, even if it does not exceed that depth.

DEVONIAN LIMESTONE.

The only rocks of the Devonian formation that are exposed in the county occur along Big Pipe Creek from the vicinity of Bunker Hill to the county line. Following Big Pipe Creek down towards its junction with the Wabash River, the Corniferous limestones are exposed at many points in Miami and Cass Counties. Near the mouth of the creek, in Cass County, the waterlime are the surface rocks. North of Bunker Hill, on Big Pipe Creek, and for a distance of about three-fourths of a mile along the creek, are almost continuous exposures of Corniferous limestone.

The larger proportion of the rock along the streams in this vicinity is a bluish gray limestone, somewhat crystalline in structure, and much of it is well adapted to rough masonry, such as bridge abutments, foundations and other similar work. A short distance below the railroad bridge there is an exposure of a light-gray, shaly limestone, remarkably full of fossils, many of which are in an excellent state of preservation, *Phillipsia bufo*

is quite common in these rocks, in which also occur several species of *Zaphrentis* and other cyathophylloid corals. Many species of *Spirifera* and other brachiopods are also present. I also found at this outcrop several fish teeth, fairly well preserved, and three or four vertebræ. This exposure of fossil-bearing rocks is very small, and lies immediately upon massive beds of sub-crystalline limestone.

At Wright's old limekilns, one-half mile below the Champion mills, on Pipe Creek, there is another exposure of Corniferous limestone. At this point the exposed strata are about 16 feet in thickness, of which the following is a section:

Gray, fossilliferous limestone	4 feet.
Bluish-gray silicious limestone (hornstone)	12 "
Total	16 feet.

The fossil-bearing rocks at this exposure contain the same species found in the fossil beds near Bunker Hill, but, as a rule, the fossils are not nearly so well preserved. The fossils serve to show, however, that the stratum containing them belongs to the same geological horizon as the Bunker Hill beds.

The silicious strata lying underneath the fossil beds vary in thickness from three or four inches to a foot or more. They are too cherty for the builder's use, except for rough masonry.

About a mile above the "falls" on Pipe Creek there is an old stone quarry, from which may be obtained building stone of fairly good quality. This stone is highly crystalline in structure, and has been quarried to some extent for local use under the name of "marble." Blocks of large dimensions may be obtained, and the quarry might be made fairly profitable if there were ready means for transporting the stone. Fossils are quite abundant here, characteristic of the Corniferous limestones, but they are usually so firmly imbedded in the matrix that they can not readily be obtained.

Further down the creek, at Stewart's Mills, in the edge of Cass County, there are high bluffs of Corniferous limestone, varying but little in general characteristics from the crystalline rocks mentioned above. At Costenborder's mill, a few hundred yards below Stewart's mill, there are 20 feet of Waterlime, or Lower Helderburg rocks exposed in the bluffs of the creek.

As a rule, the Corniferous limestones along Big Pipe Creek are too cherty and silicious to make good lime, but there are two or three localities where fairly good lime has been made of the gray, fossiliferous limestones that overlie the cherty deposits.

There is but little, if any, evidence of disturbance in the Corniferous limestones exposed along Pipe Creek. The rocks, as a rule, lie almost

horizontally, although in places there is quite a perceptible dip to the west or southwest, and occasionally the rocks are slightly inclined to the north.

The Corniferous limestones were reached in the gas well at Bunker Hill at a depth of fifty-eight feet, but as the Waterlime and Niagara limestones lie immediately under them, it was found impossible to determine from the drillings brought up the exact thickness of the Devonian rocks, on account of the fact that the particles collected were too small to afford fossils or other distinguishable features of either formation.

WATERLIME.

These rocks are exposed along the Wabash River for a distance of about a half mile above the Lake Erie & Western R. R. bridge, and about one mile west of Peru. There are three quarries in operation here—the Kazell quarry, Brownlee's quarry, and the O'Donnell quarry. O'Donnell's is the upper and Kazell's the lower quarry. The position of the rocks in all these quarries is nearly horizontal, there being but a slight dip, and that toward the south. The ledges or layers are from three to sixteen inches in thickness, and slabs may be quarried of any desired dimensions. The stone is a hydraulic limestone, bluish in color, of fine, even texture, with occasional dark veins that run parallel with the plane of stratification. It is well adapted to foundation work, bridge abutments and all similar work, and, indeed, would make a fair building stone. The thin layers make a most excellent flagging stone, admirably suited for sidewalks, for which it is extensively used. The thickness of the exposed strata is fourteen feet, but the total thickness of the Waterlime at this point has not yet been ascertained.

The Waterlime, like the Carboniferous limestone, shows very little evidence of disturbance. Wherever these rocks are exposed they appear to lie just as they were originally deposited. They were evidently deposited at the close of the period of disturbance that tilted and distorted the Niagara limestones in the immediate vicinity.

NIAGARA LIMESTONE.

Exposures of Niagara limestone occur along Little Pipe Creek near its junction with the Wabash River, and at several points along the Wabash River in the vicinity of Peru. The same limestones are exposed at many points along the Mississinewa River.

At Wallick's Mill, on Little Pipe Creek, about a mile south of the Wabash River, and near the Lake Erie & Western R. R. track, there is an extensive exposure of Niagara limestone. The rocks are tilted and greatly distorted. The dip varies from 30° to 50°, and the general direction of the incline is to the north or northeast. The rapid dip of the Niagara here carries it below the level-lying Waterlime at the river near

a mile north. The total thickness of strata exposed, measured across the upturned edges, is about 150 feet. The altitude of the highest Niagara rocks exposed here is probably 125 feet greater than that of the top of the Waterlime rocks exposed in the banks of the river. The dip of the Niagara rocks, as stated, varies from 30 to 50 degrees, while the Waterlime rocks lie in an almost horizontal position. What dip there is to the Waterlime is to the South. It is probably at the rate of one foot in twenty-five. In view of the fact that Niagara rocks are more than 100 feet higher than the Waterlime, and of the rapid dip of the former toward the north, while the Waterline lies nearly horizontal, can any one question the fact of the upheaval of the Niagara limestones, and the subsequent deposition of the Waterlime? The exposure here is no isolated example of the disturbance of the Niagara strata. At other points in Miami County, in Wabash, Huntington, Wells, Adams, Blackford, Carroll and Newton counties, the same phenomena are exposed. At every point, almost, throughout all this region, where the Niagara limestones are exposed, they show more or less evidence of disturbance. The strata are more or less tilted, and broken to a greater or less extent at every point. In some places the layers of stone are almost vertical, and in others but little dip is perceptible. In some places the rocks have been so broken by some crushing destructive force that scarcely a piece can be found large enough for the builders' use, while in other localities a slight dip, and long, frequent vertical seams, with occasional cross seams, are about the only evidence of disturbance; but throughout the whole extent of the Niagara exposures in all this wide reach of territory, the evidence of a marked disturbance, most general in its character, is everywhere present.

The stone exposed in the vicinity of Wallick's mill is a grayish colored limestone, sub-crystalline in structure, and contains many casts of characteristic fossils, the most common of which are *Calymene niagarensis*, *Favosites niagarensis* and several species of brachiopods. It makes a very good quality of lime, and limekilns have been in operation here for many years.

For building purposes this stone is not desirable, although fair foundation stones might be obtained here; but the rough, amorphous condition of the rocks, coupled with the fact that they are most difficult and expensive to work, makes quarrying at this point almost wholly unprofitable.

The Niagara limestones are exposed at Trippier's limekilns, on the south side of the Wabash River, about one-fourth of a mile east of Peru. The exposures occur in the bluffs of the stream, and are of considerable extent. The stone quarried here is used almost wholly in the manufacture of lime. The kilns are owned by Mr. Charles Trippier, and the lime he manufactures is of excellent quality. The rocks contain quite a number of fossils, and I succeeded in procuring specimens of *Eucalyptocrinus crassus*, *Caryocrinus ornatus*, *Spirifera radiata*, *Spirifera eudora*, *Calymene niagarensis* and several other species there.

There is the same distorted condition of the strata here that has been noted as occurring wherever the Niagara rocks are exposed along the Wabash River. The rocks are tilted to the extent of about twenty-five degrees, the dip being west by southwest.

One-fourth of a mile east of Trippier's, on the south side of the highway, occurs another exposure of Niagara limestones. The rocks here are easily identified by the fossils they contain, the same species occurring as are found at Trippier's. The rocks at this place are strongly inclined to the west, probably to the extent of 40 or 45 degrees.

The Niagara limestones are again exposed at the highway bridge over the Mississinewa River, about one-fourth of a mile east of the exposure last mentioned. At the bridge, however, the direction of the dip has changed to the east, showing that there is arch or anticline in the strata between the bridge and the exposure further west. The dip of the strata at the bridge is just 25 degrees, the incline having been accurately measured by Mr. Ed. Hiller, of Peru, with a clinometer. Mr. Hiller is a very competent gentleman, who has given considerable time to the study of the geology of Miami County, and especially to the structural features of the exposed strata. He has examined every outcrop of rocks, and given particular attention to the tilted and broken strata of the Niagara group.

The limestones in the vicinity of the Mississinewa bridge are dolomitic, occur in thin layers, and are considerably broken. They are hard, rough and difficult to work. They are suitable only for foundation work in masonry, but the thin layers are to some extent adapted to flagging purposes. But few fossils have been found in them, and those were Niagara brachiopods.

The Niagara limestones are exposed in the banks of the Mississinewa River at "The Cliffs," four and a half miles southeast of Peru. Here the strata are thin and lie in an almost horizontal position. The strata are broken by numerous irregular vertical seams. I found no fossils here myself, but Prof. Hooper, formerly City Librarian at Indianapolis, at one time collected a considerable number of fairly well preserved Niagara fossils at the foot of the principal ledge of rocks. By the fossils, which, as stated, were fairly well preserved, Prof. Hooper was able to readily identify the rocks.

The rocks at the Cliffs are Dolomitic limestones, hard and sub-crystalline in structure. They are only fit for foundation work or flagging, and have never been quarried to any great extent for any purpose. The total thickness of the strata exposed here is about twenty-five feet.

About a mile below the town of Peoria, and a short distance above the second bridge across the Mississinewa River, occurs another exposure of Niagara limestone. The rocks exposed at this point form the north bluff of the stream. The thickness of the exposure is about forty feet, and

extends for a fourth of a mile or more along the stream. The bottom layers are cherty limestone about twenty feet in all, with about twenty feet of heavy bedded stone above. The exposed rocks lie in the form of an arch, with the strata dipping east and west from the center.

At Peoria there are limited exposures of Niagara limestone, containing much chert, along the west bluff of the stream. The total thickness of the strata exposed here is about thirty-five feet, but the points of exposure are small, the rocks being covered by accumulations of clay and soil—the debris forming a steep slope.

The next exposure of rocks along the Mississinewa occurs about one mile above Peoria, and one-eighth of a mile east of the Miami County line, in Grant County. The rocks are exposed on the north side of the stream, the thickness of the strata being about forty-five feet. There is a southeasterly dip at this place of about ten degrees.

The Niagara limestones of Miami County do not possess the properties of valuable building stone, although they may be profitably used for foundations, or other rough work. The Waterlime rocks near Peru, however, are much better even for the roughest work, consequently there have been no special efforts made to develop a quarrying industry along the Mississinewa River.

For the manufacture of lime the Niagara limestones furnish excellent material at many points along the Wabash and Mississinewa Rivers, and several parties have made profitable use of the advantages afforded.

NATURAL GAS.

The citizens of Miami County were among the first in the State to begin an active search for natural gas. When the fact became known that gas was to be found in paying quantities in this State, by drilling down to the Trenton limestones, the citizens of Peru promptly organized a stock company with sufficient capital, and at once began to prospect for the valuable fuel.

As no one was able to determine beforehand just where gas was to be found in commercial quantities, the rule over the state was to locate the first well at a spot most convenient for piping. If gas was not found in the first attempt a second effort would be made and the next well located at some little distance from the first. With the knowledge obtained by drilling the first well, the second was usually completed in less time, and at a reduced expense. Advantage was taken of every fact bearing upon the conditions under which gas was found in localities that produced it abundantly, and a second, third or fourth well was usually located with reference to the structural features of the surface.

The first well drilled for gas in Miami County was located in the northern part of the city of Peru. The altitude of the surface at this well is 657 feet above sea level. The following is a record of the strata passed through in drilling:

SECTION OF WELL No. 1, PERU.

Alluvium—River drift	36 feet.
Niagara limestone	385 "
Hudson River and Utica	454 "
Trenton limestone	30 "
Total depth	905 "
Top of Trenton below sea level	218 "

In this well a small quantity of petroleum was found at a depth of 880 feet, five feet below the top of the Trenton limestone. Salt water in large quantity was struck at 900 feet—25 feet in Trenton. It failed to produce gas.

Well No. 2 was located just south of the city, and about one and one-fourth miles from No. 1. The altitude of the surface at well No. 2 is 700 feet above sea level. The following is a record of the strata passed through in this well:

SECTION OF STRATA IN GAS WELL No. 2, PERU.

Soil and gravel	10 feet.
Waterlime and Niagara limestone	410 "
Niagara (?) Shale	45 "
Clinton (?) limestone	15 "
Hudson River and Utica	449 "
Trenton limestone	27 "
Total depth	956 "
Top of Trenton below sea level	229 "

Failing to get gas in well No. 2, the prospectors concluded that it was not to be found in large quantities in the immediate vicinity of the city.

The next point selected was on the Yonce farm, about seven miles south-east, and in the direction of the Amboy and Xenia gas fields. The following is a section of the Yonce well, No. 3:

SECTION OF GAS WELL, No. 3.

Drift	70 feet.
Limestone—Waterlime and Niagara	490 "
Hudson River limestone and shale	250 "
Utica shale	150 "
Trenton limestone	42 "
Total depth	1,002 "

The altitude of the surface at this well was never accurately measured, so that the depth of the top of Trenton below sea level could not be determined. Gas was obtained in quantity sufficient to make a flame four or five feet high. Salt water was struck at a depth of 1,000 feet, 40 feet in Trenton, and raised to the surface, but did not flow out.

By comparing the sections given of wells Nos. 1 and 2 at Peru, it will be observed that the top of Trenton limestone is 11 feet lower in well No. 2 than it is in No. 1, as compared with sea level. Wherever the rocks are exposed along the Wabash river, near Peru, there is a west by southwest dip, and in some places the tip is very rapid, showing facts of remarkable disturbance. As well No. 2 is south of No. 1, this west by southwest dip carries the Trenton of well No. 2 to a lower geographical horizon than that of its occurrence in No. 1. Investigations of the prospectors in the vicinity of Peru led them to conclude that owing to the tilted and broken condition of the strata in the neighborhood of the city, the probabilities were that if gas ever had been confined in the strata of the Trenton limestones in that vicinity, it had virtually all escaped through the cracks and fissures of the upturned strata. The results of the drilling of wells Nos. 1 and 2 showed a considerable dip of the rocks toward the south. It was thought, therefore, that the summit of an arch in the strata might be found by going some distance north, consequently well No. 4 was located upon the Bearss farm, about three miles north of the city. At this well an extraordinary thickness of drift was found over the stratified rocks.

The following is a section of the strata encountered in the Bearss well:

SECTION OF THE BEARRS WELL, No. 4.

Drift	324	feet.
Niagara	379	"
Hudson River and Utica	307	"
Trenton	31	"
Total depth	1,041	"
Depth to Trenton	1,010	feet.
Altitude of surface	757	"
Top of Trenton below sea level	253	"

No gas nor oil was found in this well.

Wells Nos. 1 and 4 were the only ones bored north of the river in Miami county. The experiments so far made demonstrated the fact fully that gas was not to be found in paying quantities in the immediate vicinity of Peru. The citizens, therefore, concluding that gas was a necessity, promptly proceeded to organize a company with sufficient capital to drill wells in the developed gas area in the extreme southern part of the county and pipe it to the city. This line was projected to the vicinity of Xenia and completed some months ago, and the city is now as well supplied with gas for all purposes as any city in the State.

The company was organized with a capital stock of $100,000, but the total amount required to drill the wells, lay mains and distribute the gas exceeded $200,000. More than forty miles of pipe are used in principal

and distributing mains. The company has facilities for extending their mains to the center of the gas area, and Peru is assured of natural gas in abundance as long as the great reservoir of Indiana continues to supply it.

BUNKER HILL GAS WELL.

The Bunker Hill well was drilled in 1887. There was a careful record kept of the strata encountered in drilling the well, by Professor Neff, superintendent of schools at Bunker Hill.

The altitude of the railroad track near the well is 837 feet above sea level. The surface at the well is about six feet lower, or 831 feet below sea level.

The following, by Prof. Neff, is a record of the strata encountered in drilling the Bunker Hill well:

SECTION BUNKER HILL GAS WELL.

Drift—soil, clay, sand, etc.	58 feet.
Limestone, Corniferous, Waterlime, Niagara	503 "
Hudson River limestone and shale	389 "
Utica shale	42 "
Trenton limestone	12 "
Total depth	1,004 "
Top of Trenton below sea level	161 "

This well produced no gas nor oil, but salt water was struck in the Trenton, which raised to within 20 feet of the surface, or to an altitude of 811 feet above sea level.

GAS AT AMBOY.

There are several strong natural gas wells at Amboy and vicinity. The first well drilled there produced near 2,500,000 cubic feet of gas every twenty-four hours. The gas was perfectly dry and free from oil. This well was drilled in the fall of 1887. As there is but little difference in the thickness and character of the strata encountered in the several wells drilled in that vicinity, the "log" of well No. 1, at Amboy, will be given as an example of all:

SECTION OF GAS WELL No. 1, AMBOY.

Drift	35 feet.
Waterlime and Niagara limestone and shale	350 "
Hudson River and Utica	522 "
Trenton limestone	33 "
Total depth	940 "

In this well the drill passed through about 85 feet of shale near the bottom of the Niagara. This was followed by 12 feet of limestone, possibly Clinton, which contained a large amount of salt water. This salt water was cased off, after which the drillers had no further trouble on account of water. At the time this report goes to press there are some five or six productive gas wells in the vicinity of Amboy. The depth of Trenton limestone below sea level is 100 feet in Well No. 1.

GAS AT XENIA.

Xenia was the first point in Miami County to secure natural gas. The first well was drilled there in the summer of 1887. The following record of Well No. 1, at Xenia, fairly illustrates the character of the strata in that locality:

SECTION OF GAS WELL No. 1, XENIA.

Soil	4 feet.
Gravel	46 "
Waterlime	31 "
Niagara	238 "
Hudson River and Utica	587 "
Trenton limestone	31 "
Total depth	937 "
Altitude of surface at well	815 "
Trenton below sea level	91 "

The flow of gas from this well was rather weak. Water was reached in the Trenton limestone soon after gas was found, and, rising in the bore above the gas-bearing stratum, materially checked the flow of gas.

Water was found in the Niagara limestone, but this was cased off, and, rising outside of the casing, flowed out in a strong stream.

The second well drilled at Xenia was a strong one, yielding dry gas in sufficient quantity to supply the entire town.

The Peru Company has drilled several wells in the vicinity of Xenia, some of which are very powerful. As a rule the wells drilled in this locality are dry, that is, there is not much, if any, water found in the Trenton rocks.

The experiments of the citizens of Peru, and of the towns in the southern part of the county, were valuable to science, in that they demonstrated, or defined, rather, the northern limits of the gas area in that region. They most clearly demonstrate the fact that gas is not to be found in paying quantities along the Wabash River, nor near it.

On the farm of Mr. Al. Morris, two and a half miles south of Peru, a well was bored for water to the depth of 100 feet. Solid rock was not penetrated, but a strong flow of gas was found at the depth of 100 feet.

When lighted the flame was three or four feet high, and burned continually. The gas was probably generated in one of the so-called buried swamps, common in the drift of Indiana.

ARCHÆOLOGY.

The Aborigines of Miami County left but few monuments to perpetuate their memory. Occasional mounds are about the only earthworks, and these, or the greater part of them, are in the southern part of the county. As a rule the mounds observed are merely small, conical hillocks, varying in height from two to five feet, and in diameter from twenty to fifty feet.

Implements of stone are not rare, but they are by no means so plentiful as they are in some other parts of the State. Stone axes of the grooved pattern are sometimes plowed up in the fields, or picked up in other places, and the smooth form of axe, or scraper, peeler or flesher, as it is sometimes termed, are frequently found. Flint arrow and spear heads of various patterns, including the barbed, stemmed, rotary, serrated, triangular and leaf-shaped forms, are common, though not plentiful.

Pottery has only been found in fragments, and pipes are very rarely found. Perforated and polished pieces are rare. The Indian or Mound Builder of Miami County was an economical kind of a citizen, and did not throw his implements of war or the chase away recklessly.