THE WABASH ARCH.

S. S. GORBY.

The northern half of Indiana consists of a generally level plain, broken slightly by occasional long, low and broad ridges that form the divides between the various water courses. Almost the whole of this region is covered by vast accumulations of transported material, consisting of sand, gravel, bowlders and clay. The general term applied to this accumulated material is "Drift," a term which well indicates its origin. Large volumes of flowing water, and immense masses of slowly-moving ice, are recognized as the agents that transported and deposited these vast accumulations of Drift. The uninterrupted flow of great volumes of water, and the continued movement of immense masses of ice through long periods of time, resulted in the wearing away of large portions of the original rocks. The whole extent of these ancient erosions is not yet known, but sufficient facts are at hand to show that in some localities the erosions have amounted to hundreds of feet. Whatever elevations occurred in the northern part of the State were leveled by advancing glaciers and flowing waters, and the sites of ancient hills and mountains are now covered by accumulations of the glacial period. But few exposures of rocks now occur throughout all that region, hence it will be seen that to accurately follow the line of upheaval, of which many evidences exist along the course of the Wabash River from the Ohio State line westward, is a work of great difficulty. However, prominent exposures occur at many points, and the distorted and tilted condition of the strata at these outcrops plainly indicates that strong movements or disturbances occurred in the strata at a period long before the deposition of the Drift. The influence of these ancient upheavals probably extended over the greater portion of Northern Indiana. The general line or axis of upheaval was from the north-west to the south-east, but the principal exposures in Indiana, from which the phenomena may be studied, are those which have been revealed by the denudations of the Wabash River; and the general direction of this river, until it reaches Delphi, in Carroll County, is westerly. The same evidences of upheaval are observed in Illinois, and may be seen to some extent at Momence, in Kankakee County, and also in the vicinity of Chicago. The line or axis may be followed north-westerly

from Chicago, until the volcanic regions of Lake Superior are reached. It is highly probable, as was suggested to me by Prof. S. A. Miller, the learned Paleontologist of Cincinnati, Ohio, that this line or axis of upheaval is a projection of ancient disturbances, which originated in the volcanic regions of Lake Superior. The tilted rocks showing the greatest evidence of disturbance are invariably those of the Upper Silurian formation. The Devonian rocks, where they are exposed contiguous to exposures of the tilted Niagara rocks, I think, almost uniformly occupy their normal or original position. The Keokuk rocks, also, which are exposed about three miles east of the great tilted mass of Niagara rocks near Kentland, Ind., seem to lie in their original position, as they show but little if any dip. The inference, then, is that the disturbances occurred at the close of the Upper Silurian formation, and before the beginning of the deposition of the Devonian rocks. In fact, it seems probable that the upheaval occurred while great masses of the Upper Silurian deposit were yet in a plastic condition, which is evidenced by frequent and large impressions termed *cone-in-cone*, caused probably by an upward pressure of the substrata. This *cone-in-cone* consists of a number of cone-shaped masses, having the appearance at times of one being within the other, hence the name. The apex of the cone is always vertical to the plane of the lines or seams of stratification; that is, where the stratum lies in a horizontal position the apex of the cone always points upward. These peculiar masses vary from a few inches across the base to eight or ten feet, and the hight generally equals or exceeds the diameter of the base. At Kentland, Ind., where the rocks lie in a horizontal position, the apex of the cone points upward, but where they dip to the east as much as 75° or 80°, as they do in Mr. John McKee's quarry, the apex of the cone points directly to the east. On another part of his farm, where the dip of the strata is 70° to 80° to the west, the cone-in-cone was observed to extend in the same direction.

EXPOSURES AT MARKLE.

At Markle, in Huntington County, which is situated immediately upon the line between Huntington and Wells County, the strata lie in positions varying from nearly horizontal in some places to an incline in others of from forty to forty-five degrees. At Beckwith's stone quarry, south of the Wabash River, the dip is to the north and west, varying from ten to thirty degrees. The stone is full of vertical seams, and is broken into small, angular fragments. The stone shows the peculiar markings of the water-lime rocks, as though various impurities were contained in the sediment deposited. When obtained in blocks of sufficient size it makes an excellent building stone. It is used mainly for foundations, but portions of it would dress readily, and it has been tested sufficiently to assure its durability.

At other points along the river west of the bridge the exposures show a dip of from forty to forty-five degrees, the direction varying from north to west.

At Wheeler's limekiln, one hundred yards south of the Wabash bridge, the dip is to the north-west, at an angle of about forty degrees. The manner in which Mr. Wheeler removes the stone affords excellent facilities for examining the strata. The stone here is a nearly pure carbonate of lime, and shows none of the water marks peculiar to many of the magnesian limestones, whatever. In appearance it is a dirty gray stone, and is broken into small angular fragments, the largest scarcely more than a foot in diameter.

About a half-mile east of Markle, just over the line in Wells County, and on the north side of the river, is the limekiln of Mr. James Ratcliff. At this point the dip is east and south. The easterly dip is about ten degrees, and the southerly dip from ten to twenty degrees. The stone worked here is of about the same character as that exposed in Mr. Wheeler's quarry.

At an old quarry just east of the bridge on the north side of the river the strata dip to the south somewhat, but the full extent of the dip could not be ascertained, as there was but little of the rock exposed. The river through this region runs through a synclinal trough, but in the vicinity of Huntington it runs through a rift in the anticlinal. East of Markle, along the Wabash River, there are no exposures of the rocks sufficient to determine the extent or direction of the dip. The bluffs of the river are low, and composed wholly of Drift.

EXPOSURES AT HUNTINGTON.

At the first quarry, on the north side of Little Wabash River, two miles east of the depot at Huntington, and immediately south of the Wabash, St. Louis & Pacific Railroad, there is a dip in the strata of twenty-five degrees to the north, while a little further east at another quarry the rocks lie in a nearly horizontal position. At another point in the same vicinity the dip is to the north-west. For a distance of six or eight miles up the river, east of Huntington, the strata were observed to dip in various directions at angles varying from ten to sixty degrees. On the north side of the river the dip is east, west or north, while on the south side of the stream it is east, west or south. However, at many exposures the strata are nearly level, though they show more or less vertical seams that were caused, most likely, by the tilting up and settling back of the strata. At some of the localities where the rocks are lying in a nearly horizontal position faults occur at the vertical seams. These faults vary from a few inches to as much as four feet in one instance.

Where the rocks show least dip, long vertical seams occur at intervals of from six to twenty feet that are uniformly parallel with the line of strike. These seams are persistent, through a great many layers of the rocks, and it is at these seams that slight faults may sometimes be seen, as though the rocks on one side of the seam had settled to some extent.

In the exposures in the old quarries on the north side of the river, from one to two miles west of Huntington, the rocks dip to the north, east and west from ten to forty-five degrees.

The exposures on the south side of the river generally show an easterly, southerly and westerly dip. It appears, therefore, that the river throughout this region is running on an anticlinal, or at least through a rift in the anticlinal.

Clear Creek, three miles north-west of Huntington, runs through a synclinal trough. The creek runs south-westerly, and the rocks on each side dip toward the creek at angles of from twenty-five to sixty-five degrees.

Throughout all this region, wherever the rocks are exposed, they furnish distinct evidence of great disturbance. How far north or south the influence of the upheaval extended can not be determined, inasmuch as the rocks are overlaid by such a great depth of Drift. It is only where the rocks have been denuded by the torrents of the Wabash River, or its tributaries, that the phenomena can be studied at all.

EXPOSURES NEAR BELDEN.

In the vicinity of Belden, Wabash County, the limestones are tilted to a great degree, and they dip in every direction. The river at this point seems to be following the course of an anticlinal, as on the south side of the river the rocks dip east, south and west, while on the north the dip is generally north or north-west. The extent of the dip on the south side of the river is from twenty to sixty degrees, while on the north it varies from twenty to forty-five degrees. Occasional exposures are seen here, also, where the rocks lie in a nearly horizontal position. There is one point, however, on the north side of the stream, a mile or so west of Belden, where the dip is to the south to the extent of about twenty-five degrees.

Throughout this whole extent of territory, where the rocks have been exposed by the denudations of the Wabash, scarcely two closely connected points will show the strata in the same position. At one point they dip abruptly to the north, while at another, only two or three rods away, they dip strongly to the east or west. Cone-shaped masses are common. The quarries reveal them, semi-circular, with the strata dipping in every direction from the summit.

EXPOSURES AT WABASH.

In the vicinity of Wabash, Wabash County, the strata are distorted and tilted in every direction. Sometimes there is no apparent dip to be seen, while in the immediate vicinity the rocks are tilted forty to sixty degrees.

At the Main Street crossing, near the court-house, the strata dip to the north at an angle of forty-five degrees. A half mile west, at the quarries, they lie very nearly level, there being no dip in that neighborhood greater than about fifteen degrees, but at the latter point vertical seams occur, running parallel with the strike, but they are not so numerous as to injure the workable qualities of the stone. Cross seams also occur. The court-house is situated just at the top of the north bluff of the river, and the strata at that point dip strongly to the north, probably as much as forty-five degrees.

At the railroad cut, one-half mile east of Wabash, the strata dip north-east fifty degrees, and a little farther east they dip seventy degrees in the same direction.

At the railroad crossing, east of the city, the dip is fifty degrees north. At the quarries, one and one-half miles east of the city, the strata are nearly level again, the dip being not greater than six or eight degrees at any point. The little dip that was observed is to the north. Frequent vertical seams, or rents, occur here. Where the seams occur, in some instances, the rocks have been rent asunder as much as twelve or fifteen inches. Upheaval and the resettling of the strata would be likely to produce these rents. Slight faults, amounting to ten or twelve inches at most, frequently occur at the seams. At one point, near the railroad, the dip is about ten degrees north-east.

A good exposure is seen just on the east side of the city, at the northern end of the Cincinnati, Wabash & Michigan Railroad bridge. The river makes quite a bend here, and the rocks are exposed in the bluff, which has been cut into somewhat by the railroad company. There is here an easterly and southerly exposure of the bluff. At the easterly exposure the dip is east from sixty to sixty-five degrees, while at the south side the dip is to the south about seventy to eighty degrees. This gives the rounded bend of the bluff a cone-shaped appearance from the south-east. A little farther up the river the dip is to the north.

On the south side of the river, near the bridge, the strata dip to the south and south-west, at angles varying from twenty to fifty degrees. A short distance above the bridge is a grand exposure of the bluff. The rock here is quarried extensively for the manufacture of lime. On the west side of the exposure the dip is to the south-west, west and south. Farther east the dip is to the north. The workmen, in quarrying the

rock from the bluff, have left a great, cone-shaped mass, thirty or forty feet high, with three sides exposed, from the apex of which the rock dip in every direction at an angle of about sixty degrees. The dip is a little greater on the north side. Some of the exposures show the strata to be almost vertical. The cone-shaped mass of rock on the north side of the river is nearly opposite this; therefore, at this point the river seems to be running through a synclinal trough with almost vertical sides.

At the stone quarries near the south end of the bridge the strata dip to the south and south-west from ten to forty degrees. Faults occur here showing a displacement of the strata ranging from one to four feet. The stone quarried is used for flagging and building purposes. Water marks occur in the limestone. A little west of the quarry, in the cut of the road leading up the bluff, the stone dip slightly to the east.

At the large stone quarry on the south side of the river, about three-fourths of a mile west of the bridge, there is a slight dip to the south. The dip does not amout to more than five degrees. Vertical seams occur here that are persistent through all the layers of stone for many feet down. The principal seams runs parallel with the line of strike. The transverse seams are at various angles to the principal seams. The stone here is in layers from two to eight inches thick, and is used principally for flagging. It is quarried in blocks of any desired dimensions, as the seams are not so frequent as to injure the stone in any respect, which is first-class in every particular for flagging purposes.

EXPOSURES NEAR PERU.

East of Peru, Miami County, on the line of the Wabash, St. Louis & Pacific Railroad, the strata dip to the north-west at an angle of about 25 degrees. The accumulations of Drift cover the stone in this vicinity to such an extent that no satisfactory examinations of the strata could be made.

At the limekilns about two and one-half miles southwest of the city, on the line of the I., P. & C. R. R., the dip is to the east, at an angle of about 40 degrees. The stone, as it is exposed in the quarries, is a mass of fragments. This exposure is on the south side of the river.

On the north side of the river two or three slight exposures were seen, three or four miles west of the city, where the rocks dip slightly to the north.

EXPOSURES AT KOKOMO.

There is in the Niagara rocks at Kokomo a general westerly dip of about sixty feet to the mile, but at the first quarry south of the city on the Pan-handle Railroad the dip is slightly to the east. The stone is quarried principally for macadamizing purposes, and shows the water marks pecu-

liar to the water-lime, or hydraulic rocks of the Upper Silurian formation.

The following is a section of Mr. George Defenbaugh's quarry, a little more than a mile south of the city:

SECTION OF GEORGE DEFENBAUGH'S QUARRY.

Gray limestone in thin layers	6 ft.
Black shale	3 ft.
Bituminous shale, showing evidences of petroleum	3 in.
Gray shale	3 ft.
Bituminous shale	3 in.
Blue limestone	6 ft.
Gray limestone	6 ft.
Total	24 ft. 6 in.

From this point, Mr. Defenbaugh informed me, that there is a general dip to the west of sixty feet to the mile.

Vertical seams occur in the strata here, but no faults were observed.

At Logansport the Devonian rocks are at the surface. They appear to lie in their original position, and show but little if any evidence of subsequent disturbance.

In the vicinity of Georgetown, about eight miles west of Logansport, a slight exposure of the Niagara rocks, on the south side of the river, shows a dip of about twenty-five degrees to the south. Two or three slight exposures on the north side of the river, in the same vicinity, show a slight dip to the east.

EXPOSURES AT DELPHI.

The Niagara limestones are exposed in the vicinity of Delphi, in Carroll County, and, as usual, where these rocks appear along the course of the Wabash River, the strata seem to have been greatly disturbed. The Devonian rocks in the immediate vicinity, Corniferous limestone and black slate, show but little if any evidence of disturbance. The Niagara rocks, however, are tilted in various directions. At the quarry of the Delphi Lime Company, one mile north of Delphi, the strata dip to the north at an angle of 45 degrees. Between the city and the quarry is an ancient water channel, once the Deer Creek bed. The ravine is probably 100 or 150 feet in width, and is partially filled with Drift material. The local name of this ravine is "Folly Slough," or "Grimes's Folly." The course of the slough is nearly east and west. On the north side of it the strata dip to the north at an angle of 45 degrees. On the south side of it the dip is to the south at the same angle. The depth of this ancient creek bed is not known, but it seems to be an ancient rift through which the waters of Deer Creek formerly ran. On the north side of the slough, near the creek, the strata in one place are in an almost vertical position. The slough is about three-fourths of a mile in length. At other localities in the neighborhood of Delphi, the strata dip in various directions.

EXPOSURES AT KENTLAND.

On the farms of Messrs. McKee and Means, three miles east of Kentland, Newton County, may be observed most remarkable evidences of disturbance. The rocks are exposed at the surface, upon probably the highest eminence in the county. The exposure is upon the open prairie, several miles away from any stream of water. The Iroquois River, several miles north, is the nearest stream. The elevation of rock forms a low, broad mound in the prairie. The surrounding country is covered with Drift to a great depth. A mile away from the quarries on the north it is 150 feet down to the rock. In the vicinity of Kentland the Drift is near 100 feet thick. At Mr. McKee's residence, 200 yards east of the quarry, it is 15 to 30 feet down to the rock. Two miles south, on the farm of Mr. Schlautenhofer, just on the edge of Benton County, the Drift is more than 100 feet thick. The simple presumption would be that this great mass of rock is merely a portion of greater masses that escaped the destroying influences of advancing glaciers, and the erosions and disintegrations of time. However, the glaciers have evidently enveloped it; they have passed round and over it, but the mass remains as a monument of greater forces that were in existence at a period long antedating the glacial period.

There are several places on Mr. John McKee's farm, and two on the farm of Mr. Means, where the rocks are exposed at the surface. The principal exposure is the most easterly, which Mr. McKee is now operating as a stone quarry. At this point there is an exposure sixty or seventy yards long, by fifty wide. The stone is nearly vertical in the quarry, dipping east at an angle of about eighty degrees. The strike at this quarry is due north and south. The following is nearly a complete section of the upheaved strata as they are exposed at the quarry, beginning at the east side.

SECTION OF M'KEE'S QUARRY.

Unworked layers gray limestone, 4 to 16 in. thick	20 ft.	
Gray limestone	1 ft.	8 in.
Gray limestone		6 in.
Gray limestone		8 in.
Gray limestone	1 ft.	8 in.
Gray limestone	1 ft.	
Gray limestone	1 ft.	2 in.
Gray limestone		8 in.
Gray limestone	2 ft.	2 in.
Gray limestone	1 ft.	2 in.
Gray limestone	1 ft.	4 in.
Gray limestone		6 in.
Gray limestone		6 in.
Gray limestone	1 ft.	2 in.
Gray limestone		6 in.

Gray limestone		5 in.
Gray limestone		6 in.
Gray limestone		6 in.
Gray limestone		10 in.
Gray limestone	1 ft.	
Gray limestone	1 ft.	2 in.
Gray limestone, shaly, fragmentary	1 ft.	2 in.
Gray limestone, somewhat shaly.	1 ft.	6 in.
Gray, shaly limestone	2 ft.	2 in.
Gray limestone in fragments		7 in.
Gray, shaly limestone	2 ft.	10 in.
Gray, shaly limestone		10 in.
Gray, shaly limestone	1 ft.	2 in.
Gray limestone	1 ft.	4 in.
Gray limestone	2 ft.	4 in.
Gray limestone		3 in.
Gray limestone		7 in.
Gray limestone		10 in.
Gray limestone		2 in.
Gray limestone	1 ft.	6 in.
Gray limestone	1 ft.	4 in.
Gray limestone	1 ft.	
Total	59 ft.	4 in.

The vertical depth to which the quarry has been worked is about twenty feet. Work was commenced on the east side, and it was a task of great difficulty to get down any depth. The seams between the layers of stone being almost vertical, a blast of powder had but little effect. The work is carried westward in the quarry by merely prying off the huge blocks of stone that are standing on edge. Seams or fractures occur in the strata at right-angles to the plane of stratification. Shells of Cephalopods occur in the strata, such as *Orthoceras simulator*, *O. annulatum*, etc. A short time ago Mr. McKee found a large shell in a perfect condition, which, from his description, was a *Gyroceras*, or *Lituite*, but unfortuuately it had been laid away, and at the time of my visit could not be found. There are also several species of Lower Silurian fossils found in this quarry, consisting of delicate bryozoans, or the thin single values of *Orthis testudinaria*. These are invariably found in the seams between the layers of stone, attached slightly to the sides of the strata by a calcareo-argillaceous cement. They are never found imbedded in the stone. They have evidently been carried up through crevices in the rocks by the force of escaping steam or gas from below.

Frequent impressions termed *cone-in-cone* occur in the rocks here. They vary in size from a few inches across the base to six or eight feet.

About 200 yards north-west of the quarry is an exposure of the rocks where the dip is to the north-east, at an angle of seventy-five or eighty degrees. Fifty yards farther in the same direction the strata are vertical, with the strike north-west and south-east.

About one-fourth of a mile north of the last is another exposure of stone, formerly worked extensively as a quarry. At this point the dip is due west, at an angle of seventy-five or eighty degrees. The exposure is about fifty yards long, by thirty wide.

One-fourth of a mile west from the last on the farm of Mr. Means is another exposure of considerable extent, where the dip is to the north about seventy-five degrees. And on the line between the farms of Mr. Means and Mr. Van Nata is another exposure, where the dip is to the north to about the same extent.

While but few fossils have been found in the rocks here, and those that have been found conflict in their testimony in regard to the formation, some being Upper and others Lower Silurian, the general tendency of the evidence is such as to establish the belief that the formation is Upper Silurian. All those fossils that are imbedded in the rocks, whose characters are well enough preserved to admit of identification, are readily recognized as fossils common in the Niagara rocks. It would be difficult to account for the presence of these firmly imbedded in the rocks of the Hudson River or Trenton period. On the other hand, the Lower Silurian fossils found are of the most delicate forms and lightest character, such as would readily be carried upward through rents or crevices by the force of escaping steam or gas, such as would accompany an upheaval of the character indicated by the evidence all along the Wabash Valley.

EXPOSURES AT MONON.

In the vicinity of Monon, White County, the Niagara rocks are exposed to a limited extent along Monon Creek. The Drift in that neighborhood possesses no great depth at any point. The depth of Drift varies from six to thirty feet. Owing to the fragmentary character of the rocks, it is difficult at most points to determine the direction or extent of the dip. In the vicinity of Mr. Robert Gray's limekiln the rocks are broken into small angular fragments, as though they had been subjected to the influence of some powerful explosive. In selecting stone for the manufacture of lime the workmen select the localities where the fragments are the largest, and at those places the largest pieces are not more than ten to twelve inches in diameter. At some points it is difficult to find a piece of stone larger than a half brick.

On the north side of the Monon east of the railroad bridge there is a dip of probably twenty degrees to the north. West of the bridge on the south side of the creek there is an apparent dip of about twenty degrees to the north-west.

There are numerous wide rents in the strata extending down many feet, sometimes a foot or more wide, that are filled with clay. A great many specimens of Drift copper have been taken out of the clay in these crevices.

EXPOSURES AT MOMENCE.

At Momence, Kankakee County, Illinois, which is situated five or six miles west of the State line, there is a considerable exposure of Niagara limestone along the Kankakee River. The stone is fragmentary, the pieces angular, and varying in size from the smallest pieces to occasional slabs six or eight feet long. There is a general south-westerly dip in the strata of about six feet in one hundred yards. The stream follows the course of the general dip of the strata.

The country surrounding Momence is underlaid with limestone at a very shallow depth. It is generally found at from six to thirty feet below the surface in digging wells. Wherever found in wells it presents the same fragmentary appearance as the rock exposed along the river.

While at Momence, Mr. J. L. Clark, Civil Engineer and County Surveyor of Kankakee County, kindly promised to send me a correct survey of the rapids of the Kankakee River, which he did in two letters dated respectively July 16, 1886, and August 2, 1886. As the only feasible plan yet suggested for draining the lands in Indiana, submerged by the waters of the Kankakee River through a large portion of the year, is to blast out the rock forming the great natural dam at Momence, I have thought it well to append the two letters from Mr. Clark giving the facts in this connection. The second letter was written in answer to questions in regard to the distances between the points at which elevations were taken, and Mr. Clark kindly had the distances chained in order to be perfectly accurate. The following are the letters:

MOMENCE, ILL., July 16, 1886.

S. S. Gorby, Indianapolis, Ind.:

DEAR SIR—I ran the levels from the mouth of Trim Creek to the mouth of Tower Creek last Saturday. Tower Creek empties into the river about 1,400 feet below the head of Miller's Island.

The difference in altitudes of the terminal points will change with different stages of water, getting less as the water gets higher, owing to the fact that the high banks at and below Momence confine the water in the channel, while the low banks above allow overflow. When I took the levels the river was very low, and both dams closed. The following is a list of altitudes, the surface of the water at the mouth of Tower Creek being datum plane:

Surface of water at the mouth of Tower Creek	.00 ft.
Surface of water at the head of Miller's Island	.44 ft.
Surface of water below lower dam	6.76 ft.
Top of stone abutment, north branch wagon bridge	16.25 ft.
Top of stone abutment, railroad bridge	17.33 ft.
Top of lower dam.	12.29 ft.
Top of upper dam.	13.06 ft.
Surface of water in mill pond	12.42 ft.
Surface of water below upper dam	9.65 ft.
Surface of water at mouth of Trim Creek	12.70 ft.
South bank of river opposite Trim Creek	13.98 ft.

J. L. CLARK.

MOMENCE, ILL., August 2, 1886.

S. S. Gorby, Indianapolis, Ind.:

DEAR SIR—Your letter of the 30th was received this morning. Chained the distance to-day, and find it as follows:

From Trim Creek to rock in river	2,250 ft.
From Trim Creek to railroad bridge	8,477 ft.
From Trim Creek to lower dam	10,224 ft.
From Trim Creek to wagon bridge	11,088 ft.
From Trim Creek to head of Miller's Island	18,870 ft.
From Trim Creek to mouth of Tower Creek	20,286 ft.

Yours truly,

J. L. CLARK.

The opinion has prevailed in the minds of many that the fall of water at Momence is much greater than that given in the letters of Mr. Clark. The facts show that there is a fall of only a few feet to the mile. The fall is actually less at Momence Rapids than the fall of Eel River at Logansport.

At Kankakee the Niagara limestones show a slight dip to the south-west, amounting to probably four or five feet in one hundred yards. Long, vertical seams occur, running parallel with the line of strike. Long, low ridges, or wavy elevations, frequently occur, running at right angles to the line of strike.

In Cook County, Illinois, the Niagara limestones are the only rocks that appear at the surface. In the vicinity of Chicago the strata are tilted in various directions, and at angles varying from ten to forty-five degrees. In the south-eastern part of the city, at the Bridgeport quarries, the strata dip in various directions, the strongest dip being to the north-east.

A letter at hand from Mr. W. C. Egan, of Chicago, an intelligent geologist and paleontologist, contains some interesting facts in this connection which are here quoted:

"Directly west some four miles from the lake, nearly in a direct line from our court-house, is the 'Artesian Well Quarry.' There is but little dip shown there. The rock is strongly impregnated with bituminous matter, similar to the outcrops of Bloom, Illinois. About three miles south-east there is another exposure where the dip is in several directions. About two miles south-east of the court-house are the Bridgeport quarries, where again the dip varies. Still following in a circle south-easterly, you come to the Stony Island Quarries."

At the Stony Island Quarries the tilted rocks arise in cone-shaped masses, which dip at angles of from twenty-five to sixty degrees in every direction from the apices. In this respect the exposures exhibit very nearly the same phenomena as shown by the exposures in the vicinity of Wabash and Huntington, Ind.

Mr. Egan continues: "Directly west of the Bridgeport Quarries about four miles, is an outcrop at Hawthorne station—C., B. & O. R. R.—where the dip is similar to that at Stony Island.

"At the Bridgeport exposure the upper portion is of a pale color, and somewhat magnesian. The same can be said of the Hawthorne exposure, and is, as Winchell expresses it, ' to a considerable extent in a broken and amorphous condition.' The lower portion is of a bluish cast, and more compact and hard. There is no line of demarkation, but the one runs into the other almost imperceptibly. The lower portion is somewhat ' diversified' with patches of an argillaceous character. The stratum of rocks is entirely different from those at Joliet and Lemont, there being but little if any evidence of stratification. Stratification undoubtedly existed at one time, and volcanic heat must have been the means of change, which at the same time uplifted and distorted the beds."

In the Geology of Cook County, Third Geological Report of Illinois, page 245, is the following statement in regard to the rocks at Bloom village, referred to in Mr. Egan's letter:

"About a mile east of Bloom village, near the line of the Joliet cut-off of the Michigan Central Railroad, in the south-west quarter of section 22, township 35, north, range 14, east, there occurs an outcrop of these strata in the bottom and sides of a small stream. The exposure is only of about six feet, of a light-gray, fossiliferous limestone, weathering to a yellow or buff color, of a decidedly concretionary structure, and showing stratification very imperfectly. The rock is in many places stained with bitumen, and contains cavities filled with the substance in a liquid condition, though in the rock itself the more volatile part appears to have evaporated, leaving only a black stain, or in some instances particles of dark, coaly-appearing matter. The outcrop appears to be on a ledge or upheaval, which extends for nearly two miles in a general north-east and south-west direction, having a breadth of from a quarter to a half mile."

On page 246 of the same report is the following statement concerning the dip at the Old Thorntown Quarries:

"In the quarries at Old Thorntown, the strata have a strong dip, varying from ten to twenty degrees to the south-east, and by this a considerable thickess of strata is exposed."

At various points throughout Cook County the strata were observed to dip strongly to the south-east or north-east. Most of the points described above I visited myself during July, 1886, and found the strata occupying the same phenomenal position observed throughout the Wabash Valley, in Indiana.

There is certainly absolute evidence of an upheaval extending from the northern part of Indiana, near the Ohio line, north-westerly by Chicago, to the regions of Lake Superior. That the position of the rocks at Chicago, Momence, Kentland, Delphi, Wabash, Huntington, and other points is due to the same cause, I have no doubt whatever. They all belong to the same geological formation, and the fact that none of the newer rocks show the same phenomena is clear evidence that the

upheaval occurred prior to the deposition of the sediment that formed the later rocks. That this anticlinal formed a great barrier, or rock dam, extending entirely across the State, is quite clear. To what altitude the summit of this ancient barrier extended can not even be conjectured. The hand of time, operating through ages of the past, has leveled the hills and filled up the valleys. How long and to what extent this ancient barrier resisted the attacks of advancing glaciers can never be known, but it is evidently true that the great rock dam had a wonderful influence in modifying the surface of Indiana, and probably that of Illinois also.

The gas and oil fields of Western Ohio are in the area influenced by the disturbances which tilted and distorted the strata along the Wabash River. To what extent these disturbances have influenced the accumulation of oil and gas in these areas is unknown, but in view of the fact that these vast accumulations are known to exist in Ohio, it seems that efforts might be made with confidence to find similar reservoirs in Indiana.